REVISED REPORT ON
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
336 KING STREET EAST, CALEDON, ONTARIO

PREPARED FOR:

336 KINGS RIDGE INC.

PREPARED BY:

DS CONSULTANTS LTD.

DS Project No : 18-566-10-R1
Date : June 6, 2018

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DRAWINGS

1. INTRODUCTION

DS Consultants Limited (DSCL) was retained by 336 Kings Ridge Inc. to undertake a geotechnical investigation for the proposed development located at 336 King Street East in Caledon, Ontario.

It is understood that the proposed development will consists of construction of fifteen (15) town-houses. The lots will therefore be serviced by a road, storm and sanitary sewers and watermains.

The finish floor elevation of the proposed construction, and the invert of the site services is not known to us at the time of writing this report.

This report is revised and supersedes our previously issued report on May 28, 2018 (DS Project No. 18-566-10).

The purpose of this geotechnical investigation was to obtain information about the subsurface conditions at boreholes locations and from the findings in the boreholes to make recommendations pertaining to the geotechnical design of underground utilities, roads and to comment on the foundation conditions for the building construction.

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 the 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 has been prepared for 336 Kings Ridge Inc. and its architect and designers. Third party use of this report without DSCL consent is prohibited.

2. FIELD AND LABORATORY WORK

Four boreholes (BH18-1 through BH18-4, see Drawing 1 for borehole locations) were drilled on May 10, 2018 to a depth of 8.2m. Boreholes were drilled with solid stem continuous flight augers equipment by a drilling sub-contractor under the direction and supervision of DSCL personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the DSCL laboratory for detailed examination by the project engineer and for laboratory testing.

As well as visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture contents. Grain size analyses of two (2) selected soil samples were conducted and the results are presented in Drawing 7.

Water level observations were made during and upon completion of drilling. Three (3) monitoring wells of 50mm diameter were installed in boreholes BH18-1, BH18-3 and BH18-4 for the long-term groundwater monitoring and environmental testing.

The surface elevations at the borehole locations were surveyed by DSCL, using differential GPS system, leased from Sokkia Canada Inc.

3. SUBSURFACE CONDITIONS

The subject site is currently occupied by a single storey structure and associated driveway and landscape areas. Topography of the site is generally flat, with mild slope towards south. A ravine slope is located south of the subject property. It is understood that the existing structure will be demolished prior to the re-development of the site.

The borehole location plans are shown on **Drawing 1**. General notes on sample description are provided on **Drawing 1A**. The subsurface conditions in the boreholes are presented in the individual borehole logs presented on **Drawings 2 to 5**. A generalized sub-surface profile is presented on **Drawing 6**.

3.1 Soil Conditions

Pavement Structure/Topsoil:

Two boreholes (BH18-1 and BH18-2) were drilled on the driveway and encountered pavement structure consisting of 50mm, overlying 450 to 500mm of granular fill. Other two boreholes encountered **s**urficial topsoil layer of about 400mm in thickness. 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.

Silty Clay:

Below the topsoil/pavement structure, native soil consisting of silty clay was found in BH18-1 to BH18-3, extending to depths of 4.6 to 6.1m and overlying silt deposit. Silty clay was present in a firm to hard consistency, with measured SPT ‘N’ values ranging from 8 to over 50 blows per 300mm penetration. Moisture contents in the tested samples of silty clay ranged between 18 to 22 percent.

Grain size analysis of one sample from silty clay deposit (BH18-1/SS3) was carried out and gradation curve for the results is provided on **Drawing 7**, with following fractions:

Clay: 43%

Silt: 54%

Sand: 3%

Atterberg Limits testing was carried out on same sample of silty clay deposit (BH18-1/SS3), results are provided on the respective borehole log and summarized below:

Liquid Limit: 35%

Plastic Limit: 19%

Plasticity Index: 16%

Silt/Silty Sand:

Below the surficial topsoil in BH18-4 and below silty clay in all other boreholes, a silt deposit was encountered extending to the maximum explored depth of 8.2m. Silt was interbedded with a silty sand layer below a depth of 7.6m. Silt was present in a compact to very dense state, with measured SPT 'N' values of 20 to over 50 blows per 300 mm of penetration.

Grain size analysis of one sample from silt deposit (BH18-4/SS4) was carried out and gradation curve for the results is provided on Drawing 7, with following fractions:

Clay: 12%

Silt: 73%

Sand: 12%

Gravel: 3%

3.2 Groundwater Conditions

Short term groundwater levels were found to be in the range of 2.3 to 7.6m below ground surface during drilling. Groundwater levels measured in the monitoring wells on May 21 and 28, 2018 were at depths ranging from 1.0 to 5.6m, corresponding to Elev. 219.5 to 224.7m. **Table 1** summarizes the depth and elevation of water level readings in monitoring wells.

Table 1: Groundwater Levels Observed in Monitoring Wells

BH No.	Ground Surface Elev. (m)	Date of Drilling	Date of Observation	Depth of Groundwater (m)	Elevation of Groundwater (m)
BH18-1	225.8	May 10, 2018	May 21, 2018	5.6	220.1
BH18-3	224.1	May 10, 2018	May 28, 2018	4.6	219.5
BH18-4	225.7	May 10, 2018	May 28, 2018	1.0	224.7

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

4. DISCUSSION AND RECOMMENDATIONS

It is proposed to develop the site as a residential subdivision. The lots will therefore be serviced by a network of road, storm and sanitary sewers and watermains.

4.1 ROADS

The investigation has shown that the predominant subgrade soil, after stripping the topsoil and any other organic and otherwise unsuitable subsoil, will generally consist of silty clay and silt.

Based on the above and assuming that traffic usage will be residential/commercial collector road, the following minimum pavement thickness is recommended for roads to be constructed within the development:

40 mm HL3 Asphaltic Concrete

65 mm HL8 Asphaltic Concrete

150 mm Granular 'A'

300 mm Granular 'B'

These values may need to be adjusted according to the Town of Caledon Standards. The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer in order to facilitate the construction. Furthermore, heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the weak subgrade by heavy truck traffic.

4.1.1 STRIPPING, SUB-EXCAVATION AND GRADING

The site should be stripped of all topsoil and any organic, weathered or otherwise unsuitable soils to the full depth of the roads, both in cut and fill areas. Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 8 tonnes. Any soft spots thus exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer. The subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Owing to the clayey (i.e. impervious) nature of some subsoils at the site, proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, or as per Town Standards. The compaction of the new fill should be checked by frequent field density tests.

4.1.2 CONSTRUCTION

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.1.3 DRAINAGE

The Town of Caledon may require the installation of full-length subdrains on all roads. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines.

All paved surfaces should be sloped to provide satisfactory drainage towards catch-basins. As discussed in Section 4.1.1, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.2 SEWERS

As a part of the site development, new watermain, storm and sanitary sewers is to be constructed. It is assumed that the trenches are generally within 4 to 5 m below the existing grade.

4.2.1 TRENCHING

Based on the boreholes, the trenches in most of the boreholes will be dug mainly through in silty clay and silt with some clay. No major problems with groundwater are anticipated in the area of BH18-1 to BH18-3 for excavation to a depth of about 4.5m. In BH18-4, water level was recorded at a depth of 1m below the existing grade. Due to low permeability of silt, it is expected that water seepage can be handled with conventional methods of pumping from sumps/ gravity drainage. However, contractor should be prepared to employ more elaborate dewatering procedures, should flow from sand seams or silt becomes severe. Any excavation below a depth of 5m will require positive dewatering, otherwise it will result in an unstable base and flowing sides.

The sides of excavations in the natural strata can be expected to be temporarily stable at relatively steep side slopes for short periods of time but they should be cut back at slopes no steeper than 1:1 in order to comply with the safety regulations. Where wet sand layers are encountered, flattened slopes will be required.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the very stiff to hard clayey soils can be classified as Type 2 Soil above groundwater and Type 3 Soil below groundwater. The silt deposit with layers of silty sand can be classified as Type 3 Soil above groundwater and Type 4 Soil below the water table.

4.2.2 BEDDING

The undisturbed native stiff to hard or compact to very dense soils encountered in the boreholes will provide adequate support for the pipes and allow the use of normal Class B type bedding.

The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt.

The bedding material should consist of well graded granular material such as Granular ‘A’ or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.2.3 BACKFILLING OF TRENCHES

Based on visual and tactile examination, the on-site excavated inorganic native soils are considered to be suitable for re-use as backfill in the service trenches provided their moisture contents at the time of construction are within 2 percent of their optimum moisture content. Significant aeration of the wet silty sand and silt excavated from below the water table will be required prior to their use as backfill material.

The clayey soils especially when its consistency is hard is likely to be excavated in cohesive chunks or blocks and will be difficult to compact in confined areas. For use as backfill, the clayey material will have to pulverized and placed in thin layers. The clayey soils will have to be compacted using heavy equipment suitable for these soils which may be difficult to operate in the narrow confines of the trenches. Unless the clayey materials are properly pulverized and compacted in sufficiently thin lifts post-construction settlements could occur. Their use in narrow trenches such as laterals (where heavy compaction equipment cannot be operated) may not be feasible.

Imported granular fill, which can be compacted with hand held equipment, should be used in confined areas.

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.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content and each layer should be compacted to at least 95% SPMDD. In the upper 1.0 m, underneath the road base, the compaction should be increased to 98% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

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.

The topsoil encountered at the site can be used for landscaping fill to raise the grades. Topsoil cannot be reused as foundation and trench backfill material.

4.3 ENGINEERED FILL

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below house foundations, roads, boulevards, etc.

Prior to the construction of engineered fill, all of the existing topsoil, asphalt and surficially weathered/disturbed soils must be removed. The base must be thoroughly proof-rolled. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix A**. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS can be used on engineered fill, provided that all requirements on **Appendix A** are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

The following is a recommended procedure for an engineered fill:

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make

known where all fill material will be obtained, and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DSCL. Without this confirmation no responsibility for the performance of the structure can be accepted by DSCL. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur.

6. Full-time geotechnical inspection by DSCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the DSCL representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings should be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by DSCL to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DSCL.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

The inorganic clayey silt (till), sandy silt and silt are considered suitable for use as engineered fill, provided that their moisture contents at the time of construction are at or near optimum. As mentioned before in Section 4.2.3 of this report, the clayey tills are likely to be excavated in cohesive chunks or blocks and will be difficult to compact. They should be pulverized and placed in thin layers not exceeding 150 to 200 mm and compacted using heavy equipment suitable for these types of soils (e.g. heavy sheepsfoot compactors).

4.4 FOUNDATION CONDITIONS

The proposed houses can be supported by spread and strip footings founded on the undisturbed native soils or engineered fill material.

Based on the borehole information, footings founded on native soils can be designed for design for bearing capacity values of 250kPa at SLS and 375kPa at ULS. The bearing values and the corresponding founding elevations at the borehole locations are summarized on Table 2.

Table 2: Bearing Values and Founding Levels of Spread Footings

BH No.	Material	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth Below Existing Ground (m)	Founding Level at or Below Elevation (m)
BH18-1	Silty Clay	250	375	1.5	224.3
BH18-2	Silty Clay	250	375	1.2	224.7
BH18-3	Silty Clay	250	375	1.2	222.9
BH18-4	Silt	250	375	1.1	224.6

Footings founded on engineered fill can be designed for a bearing capacity of 150 kPa at SLS (Serviceability Limit State), and for a factored geotechnical resistance of 225 kPa at ULS (Ultimate Limit State).

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

All footings bases must be inspected by this office to confirm the bearing capacity values, prior to pouring concrete.

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 capacities have been calculated by DSCL 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 provided by DSCL to validate the information for use during the construction stage.

4.5 EARTH PRESSURES

The lateral earth pressures acting on foundation and basement walls may be calculated from the following expression:

$$p = k(\gamma h + q)$$

where, p = Lateral earth pressure in kPa acting at depth h

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

γ = Unit weight of backfill, a value of 21 kN/m3 may be assumed

h = Depth to point of interest in metres

q = Equivalent value of surcharge on the ground surface in kPa

The above expression assumes that the perimeter drainage system prevents the build up of any hydrostatic pressure behind the wall.

4.6 FLOOR SLAB AND PERMANENT DRAINAGE

The floor slab can be supported on grade provided all topsoil, fill, and surficially softened soils are removed and the base thoroughly proof rolled. The fill required to raise the grade can consist of inorganic soil, placed in shallow lifts and compacted to 98 percent 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.

A perimeter drainage system will be required around the exterior basement walls. Underfloor drainage is recommended. The perimeter drainage system shown on **Drawing 8** is recommended for the basement walls where open cut procedures are used.

4.7 EXCAVATION AND GROUNDWATER CONTROL

Excavations can be carried out with heavy hydraulic backhoe. No major problems with groundwater are anticipated in the area of BH18-1 to BH18-3 for excavation to a depth of about 4.5m. Positive dewatering/groundwater control will be required prior to any excavation in water bearing silts below the groundwater table; otherwise it will result in an unstable base and flowing sides. Water must be lowered to 1m below the lowest excavation base.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the overburden soil can be classified as Type 3 soil above groundwater table and Type 4 below the groundwater table.

The select inorganic fill and native soils free from topsoil and organics can be used as general construction backfill where it can be compacted with sheep's foot type compactors. 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.

Imported granular fill, which can be compacted with hand held equipment, should be used in confined areas. Underfloor fill should be compacted to at least 98 percent 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.

5. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Limited (DSCL) 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, DSCL will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DSCL at the time of preparation. Unless otherwise agreed in writing by DSCL, 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 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.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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. DSCL 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.

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

DS CONSULTANTS LIMITED

LICENSED PROFESSIONAL ENGINEER
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Sangar

Alka Sangar, M.Eng., P.Eng.

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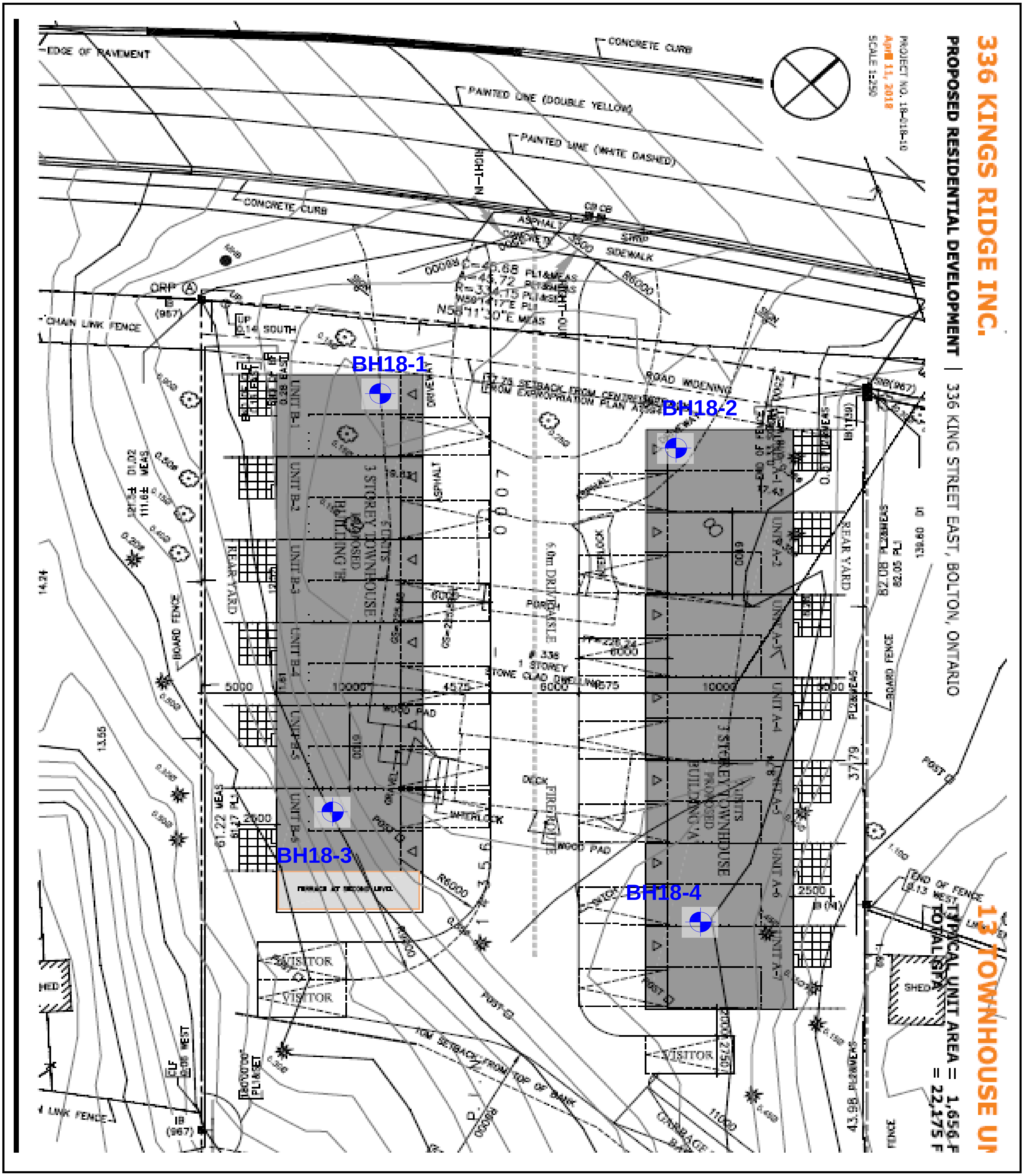
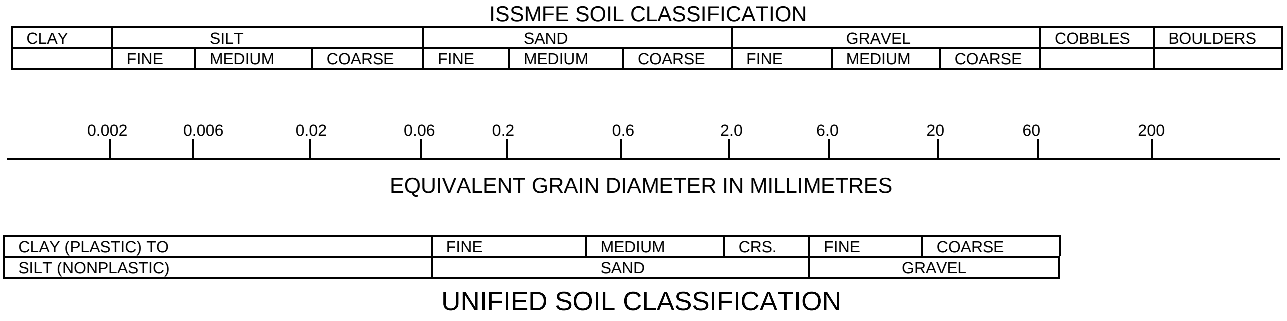
Drawings



Client:	336 Kings Ridge Inc.			Project No:	18-566-10	Drawing No:	1
Drawn:	SG	Approved:	AS	Title:	BOREHOLE LOCATION PLAN		
Date:	May, 2018	Scale:	N.T.S	Project:	Proposed Residential Development, 336 King St. E, Caledon, ON		
Original Size:	Letter	Rev:	N/A		DS CONSULTANTS LTD.		

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DSCL 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.



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.

DS CONSULTANTS LTD.

LOG OF BOREHOLE BH18-1

1 OF 1

PROJECT: Geotechnical Investigation - Proposed Townhouses
CLIENT: 336 Kings Ridge Inc.
PROJECT LOCATION: 336 King Street E, Caledon, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: May-10-2018

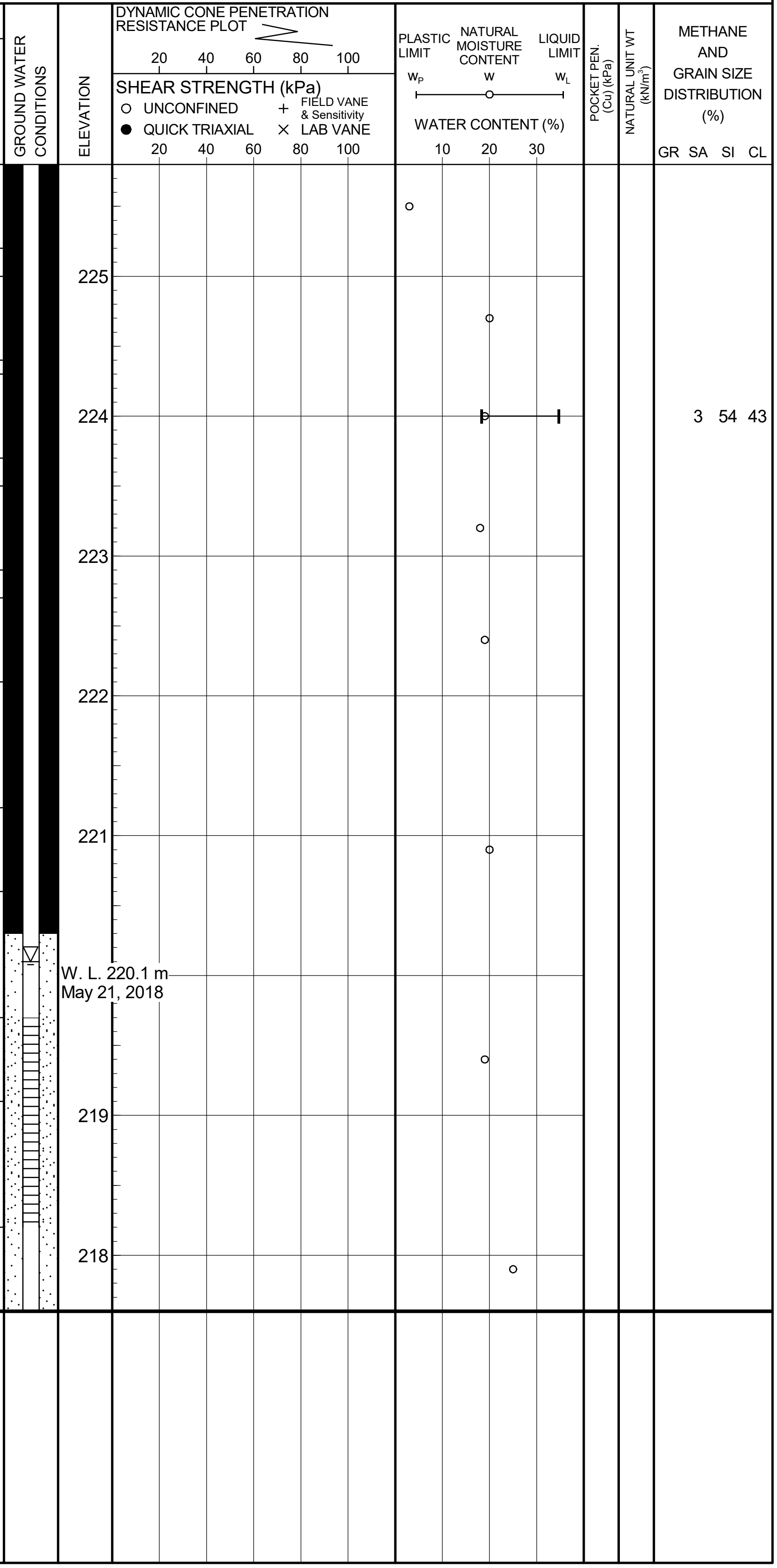
REF. NO.: 18-566-10
ENCL NO.: 2

SOIL PROFILE

(m) ELEV / DEPTH	DESCRIPTION
225.8	
225.8 0.0 0.1	**ASPHALTIC CONCRETE:**50mm **GRANULAR BASE:**450mm
225.3 0.5	**SILTY CLAY:** trace sand, occasional gravel & sand seams, brown to grey, moist, very stiff to hard
219.7 6.1	**SILT:** some clay, trace sand, grey, moist, very dense
218.2 7.6	**SILTY SAND:** trace clay, grey, wet, dense
218.0 7.8	**SILT:** some clay, trace sand, grey, moist, dense
217.6 8.2	**END OF BOREHOLE** Notes: 1) Water level at 7 mbgs upon completion. 2) Water Level Readings: Date Water Depth (mbgs) May 21, 2018 5.6

SAMPLES

NUMBER	TYPE	"N" BLOWS/0.3 m	GR	SA	SI	CL
1	AS					
2	SS	8				
3	SS	28		3	54	43
4	SS	42				
5	SS	36				
6	SS	69				
7	SS	68				
8	SS	40				



GROUNDWATER ELEVATIONS

Measurement 1st ∇ 2nd ▼ 3rd ▼ 4th ▼

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

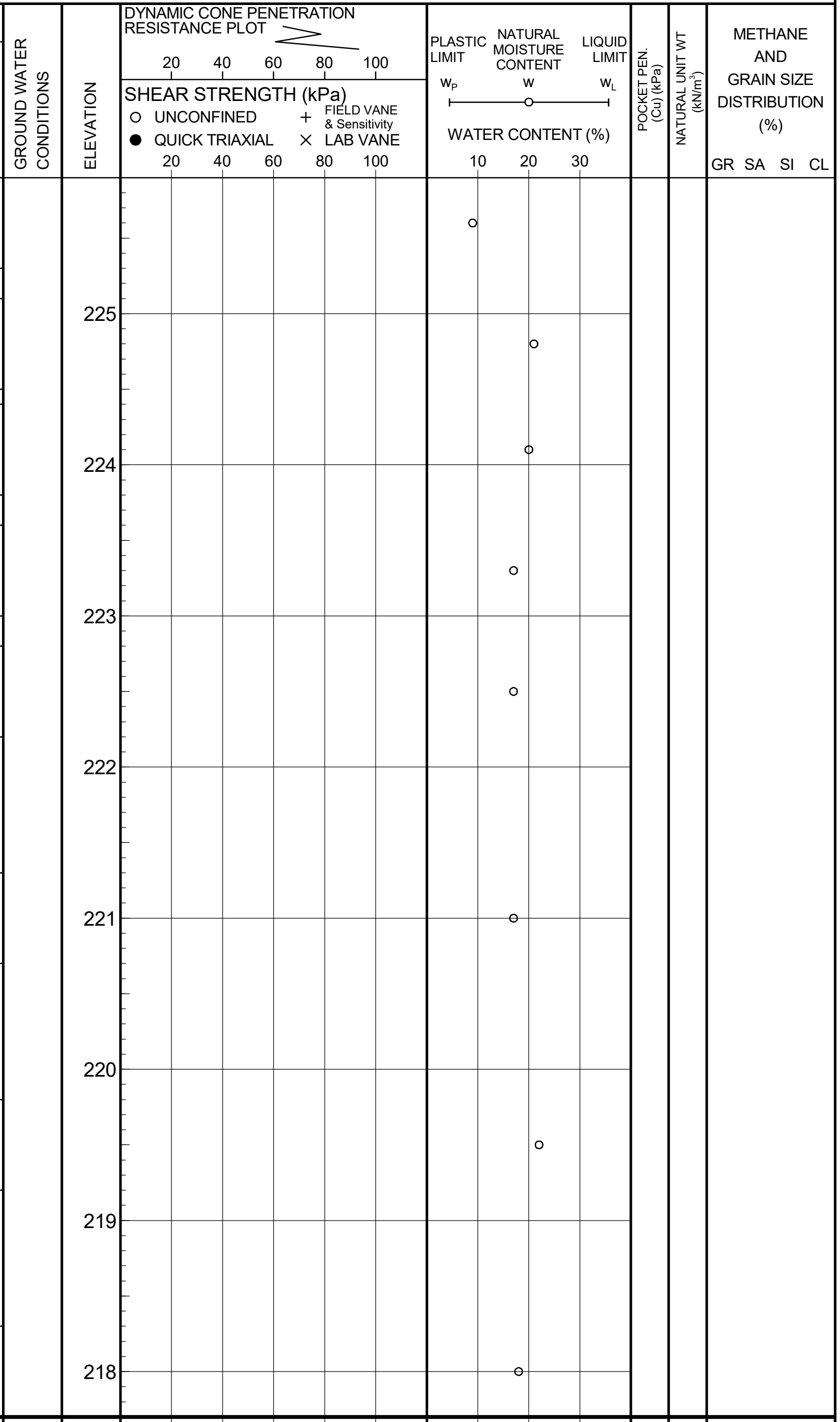
LOG OF BOREHOLE BH18-2

PROJECT: Geotechnical Investigation - Proposed Townhouses
CLIENT: 336 Kings Ridge Inc.
PROJECT LOCATION: 336 King Street E, Caledon, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: May-10-2018

REF. NO.: 18-566-10
ENCL NO.: 3

SOIL PROFILE		SAMPLES		
(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
225.9 0.0	**ASPHALTIC CONCRETE:**50mm			
225.9 0.1	**GRANULAR BASE:**500mm	1	AS	
225.4 0.6	**SILTY CLAY:** trace sand, occasional gravel & sand seams, brown to grey, moist, very stiff to hard	2	SS	14
		3	SS	32
		4	SS	45
		5	SS	33
		6	SS	58
219.8 6.1	**SILT:** some clay, trace sand, grey, moist, dense	7	SS	48
218.3 7.6	**SILTY SAND:** trace clay, grey, wet, dense			
218.1 7.8	**SILT:** some clay, trace sand, grey, moist, dense	8	SS	42
217.7 8.2	**END OF BOREHOLE** Notes: 1) Water level at 7.6m during drilling.			



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

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

DS CONSULTANTS LTD.

LOG OF BOREHOLE BH18-3

1 OF 1

PROJECT: Geotechnical Investigation - Proposed Townhouses
CLIENT: 336 Kings Ridge Inc.
PROJECT LOCATION: 336 King Street E, Caledon, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: May-10-2018

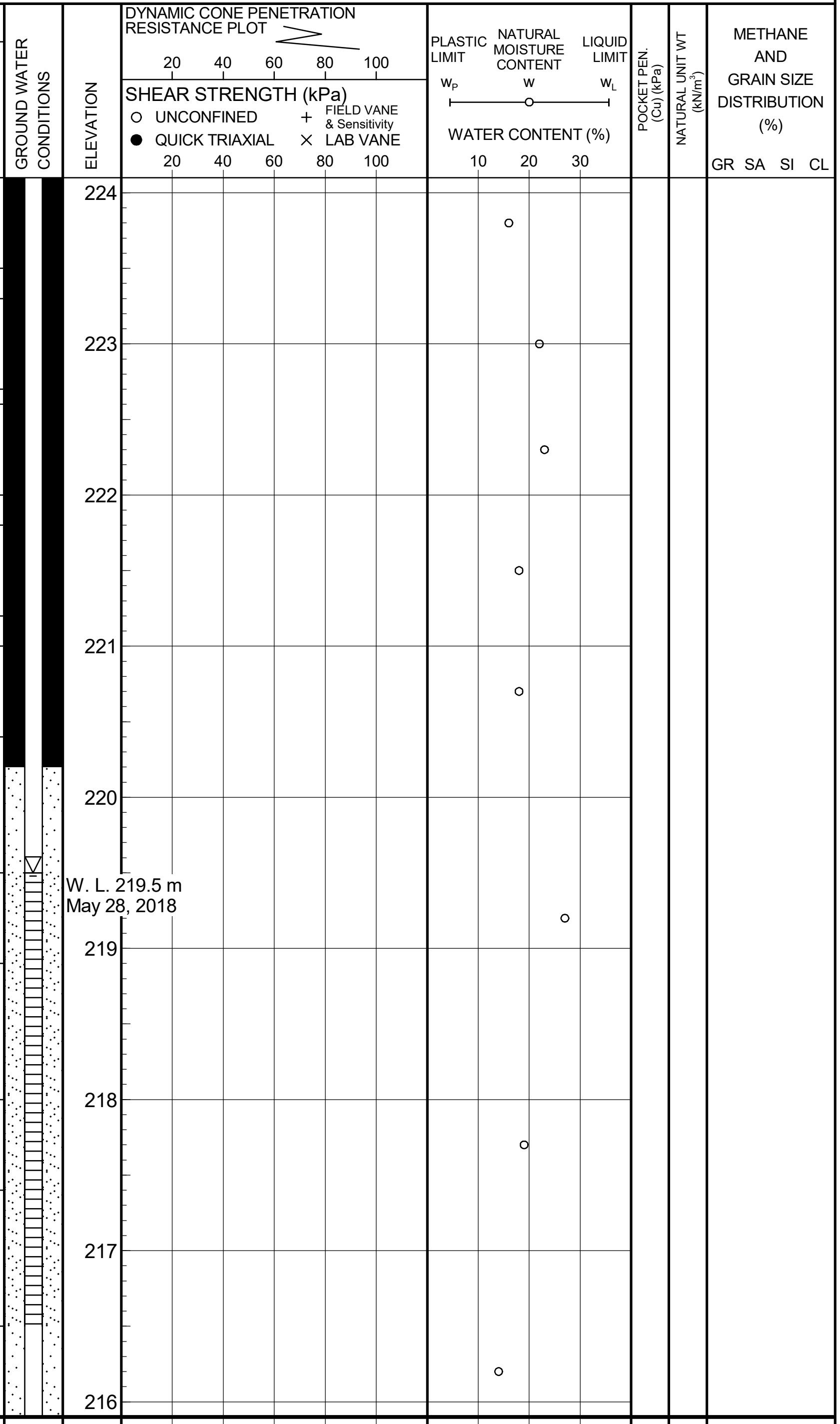
REF. NO.: 18-566-10
ENCL NO.: 4

SOIL PROFILE

(m) ELEV DEPTH	DESCRIPTION
224.1	
0.0	**TOPSOIL:**400mm
223.7 0.4	**SILTY CLAY:** trace sand, brown, moist, stiff to hard
219.5 4.6	**SILT:** some clay, trace sand, grey, wet, very dense
218.0 6.1	**SILTY SAND:** trace clay, grey, wet, very dense
217.8 6.3	**SILT:** trace to some clay, trace sand, grey, moist to very moist, very dense
215.9 8.2	**END OF BOREHOLE**

SAMPLES

NUMBER	TYPE	"N" BLOWS/0.3 m
1	SS	6
2	SS	11
3	SS	17
4	SS	33
5	SS	49
6	SS	54
7	SS	60
8	SS	56



Notes:
1) 50mm dia. monitoring well installed in the borehole upon completion.
2) Water Level Readings:

Date	Water Depth (mbgs)
May 28, 2018	4.6

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

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

DS CONSULTANTS LTD.

LOG OF BOREHOLE BH18-4

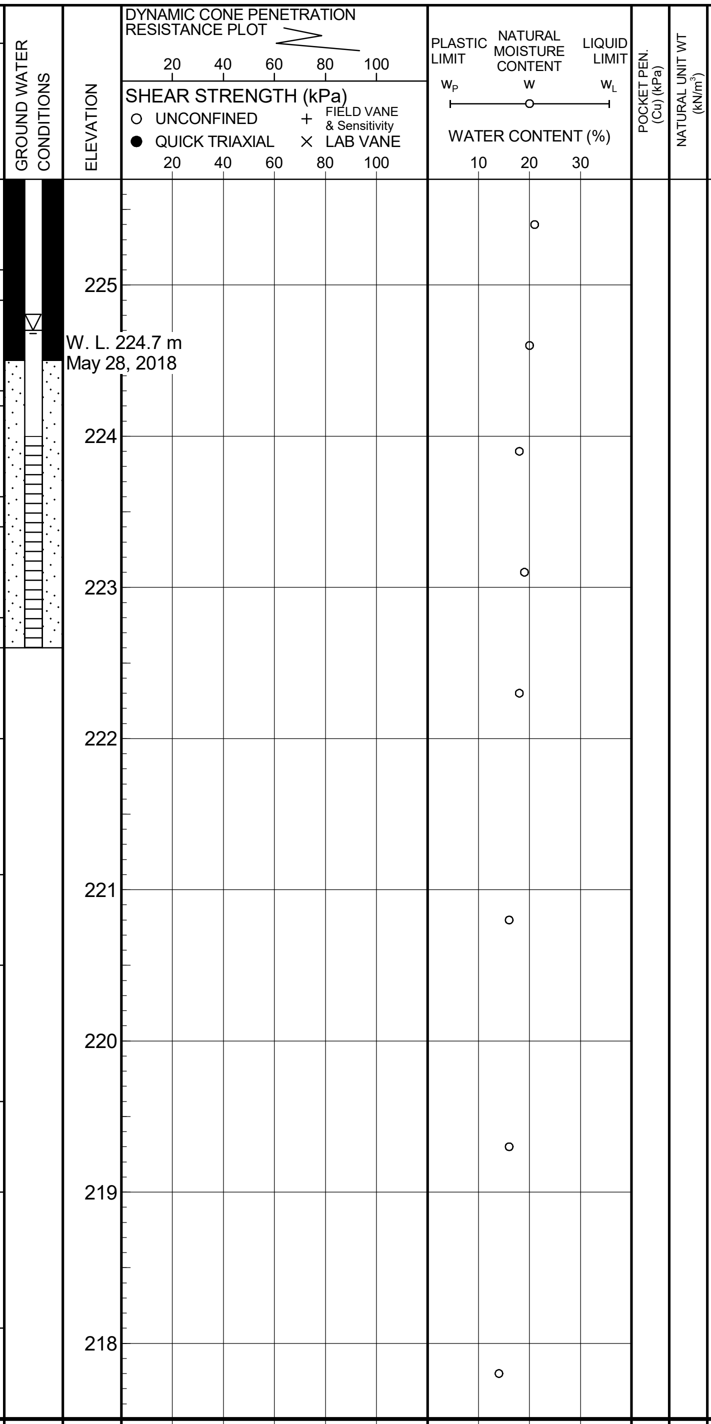
1 OF 1

PROJECT: Geotechnical Investigation - Proposed Townhouses
CLIENT: 336 Kings Ridge Inc.
PROJECT LOCATION: 336 King Street E, Caledon, ON
DATUM: Geodetic
BOREHOLE LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Auger
Diameter: 150mm
Date: May-10-2018

REF. NO.: 18-566-10
ENCL NO.: 5

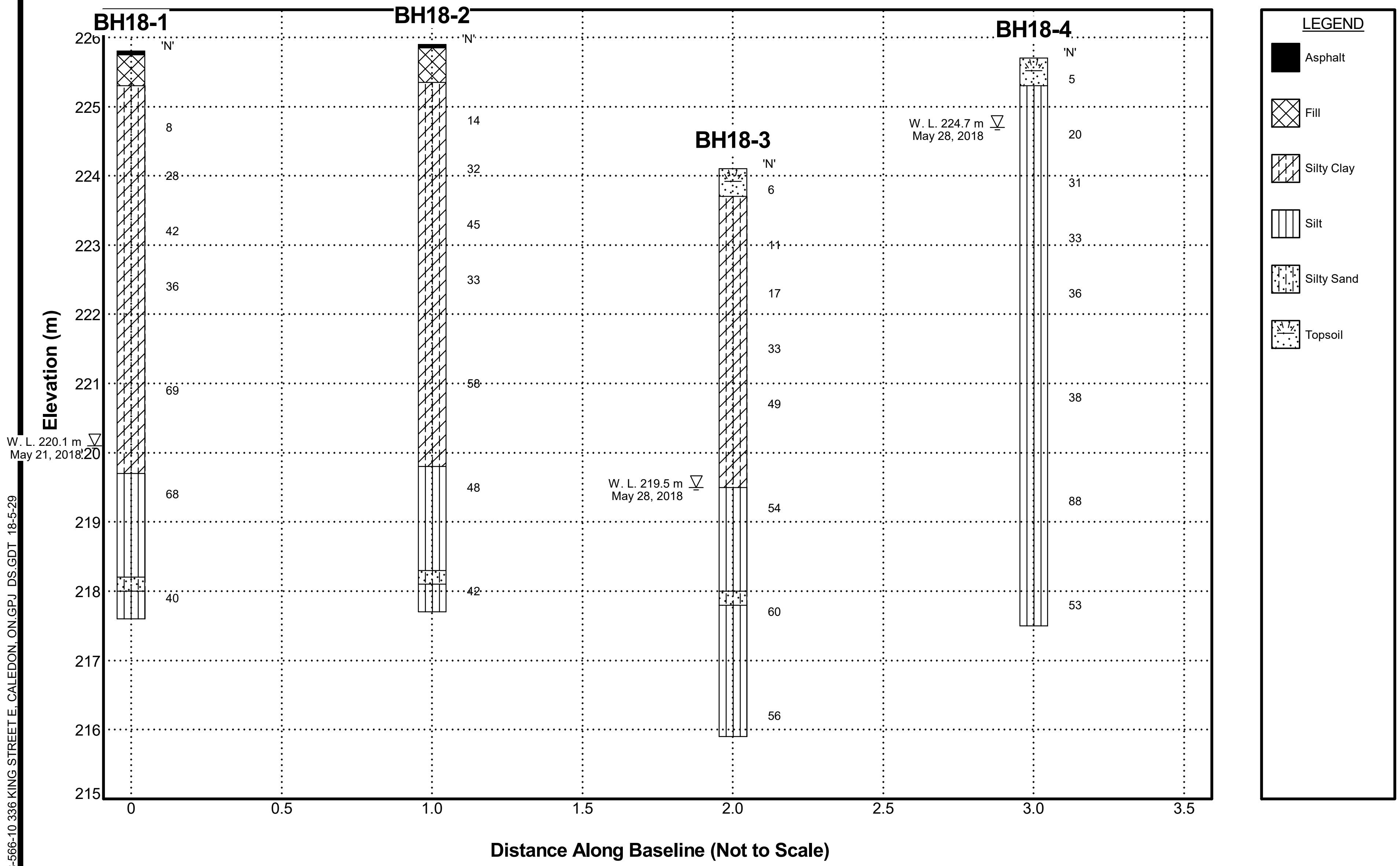
SOIL PROFILE		SAMPLES			METHANE AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m	GR	SA	SI	CL
225.7								
0.0	**TOPSOIL:**400mm	1	SS	5				
225.3 0.4	**SILT:** some clay, trace to some sand, brown to grey, moist, compact to very dense	2	SS	20				
		3	SS	31				
	grey, wet below 2.3 m	4	SS	33	3	12	73	12
		5	SS	36				
	some clay to clayey below 4.6 m	6	SS	38				
		7	SS	88				
		8	SS	53				
217.5 8.2	**END OF BOREHOLE** Notes: 1) 50mm dia. monitoring well installed in the borehole upon completion. 2) Water Level Readings: Date Water Depth (mbgs) May 28, 2018 1.0							



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

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

DS SOIL LOG 18-566-10 336 KING STREET E, CALEDON, ON.GPJ DS.GDT 18-6-7



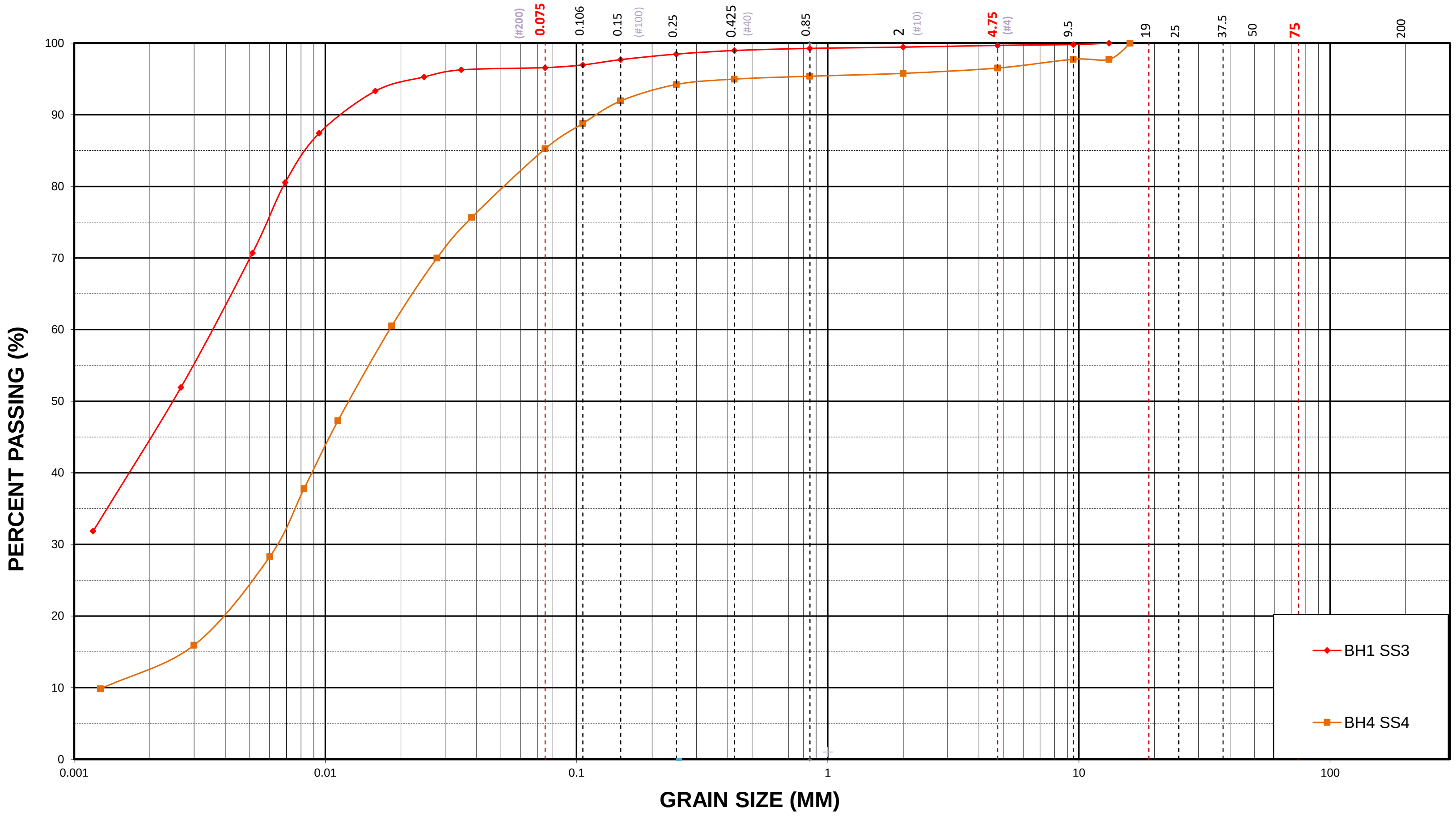
DS FENCE (M) 18-566-10 336 KING STREET E, CALEDON, ON.GPJ DS.GDT 18-5-29

DS CONSULTANTS LTD.

Generalized Sub-surface Profile

DRAWING NO.	6
JOB NO.	18-566-10
DATE	May 2018

Particle Size Distribution (ASTM-D421/D422)

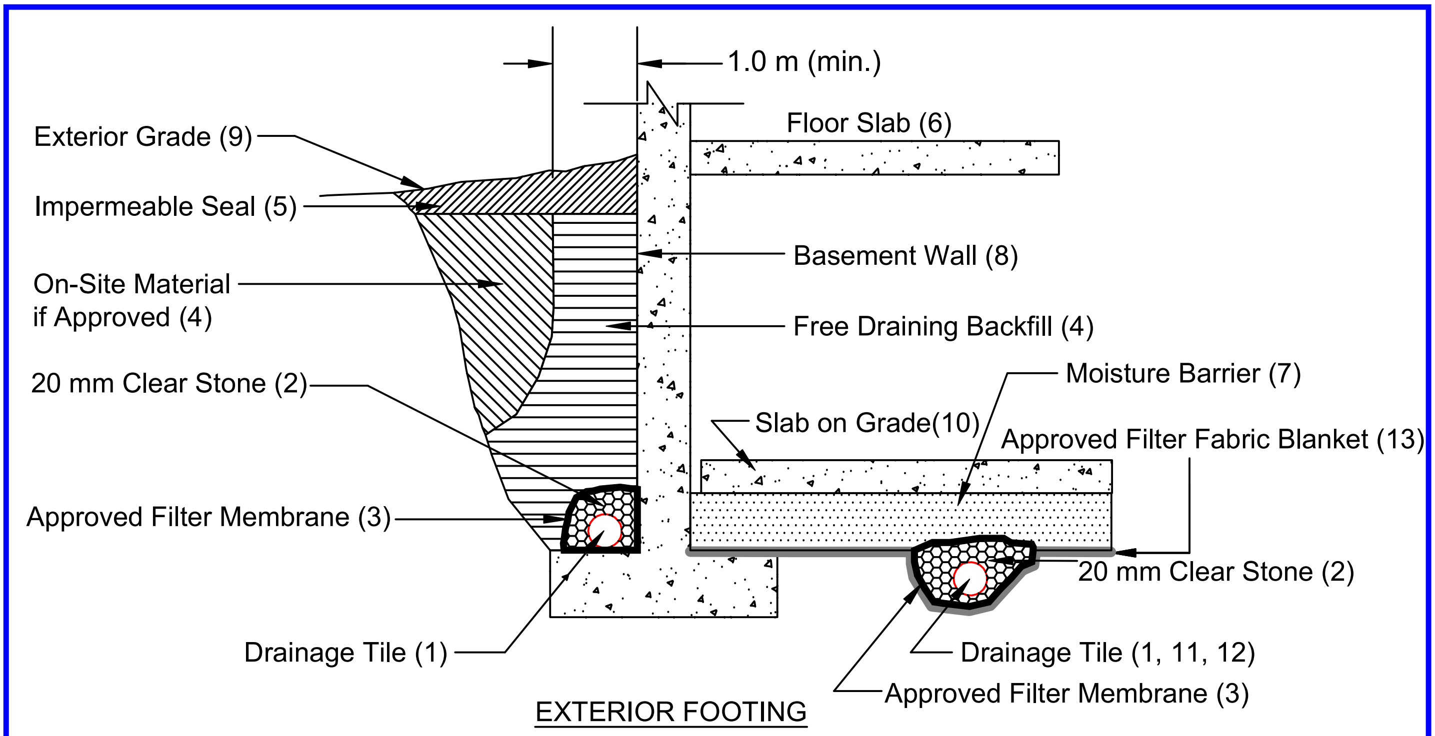


Silt and Clay		Sand			Gravel		Cobble +
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	

Specification and Comments:

DS CONSULTANTS LTD.
6221 Highway 7, Unit 16
Vaughan, Ontario, L4H 0K8
Telephone: (905) 264-9393
www.dsconsultants.ca

Project:	**Proposed Residential Development**	Project No.:	**18-566-10**
Client:	**Georgian Group**	Date:	**May-25-2018**
Location:	**336 King Street E, Caledon,ON.**	Figure No.:	7



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)

Appendix A

Engineered Fill Guidelines

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows; however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and DS Consultants Ltd (DSCL). Without this confirmation no responsibility for the performance of the structure can be accepted by DSCL. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by DSCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the DSCL representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

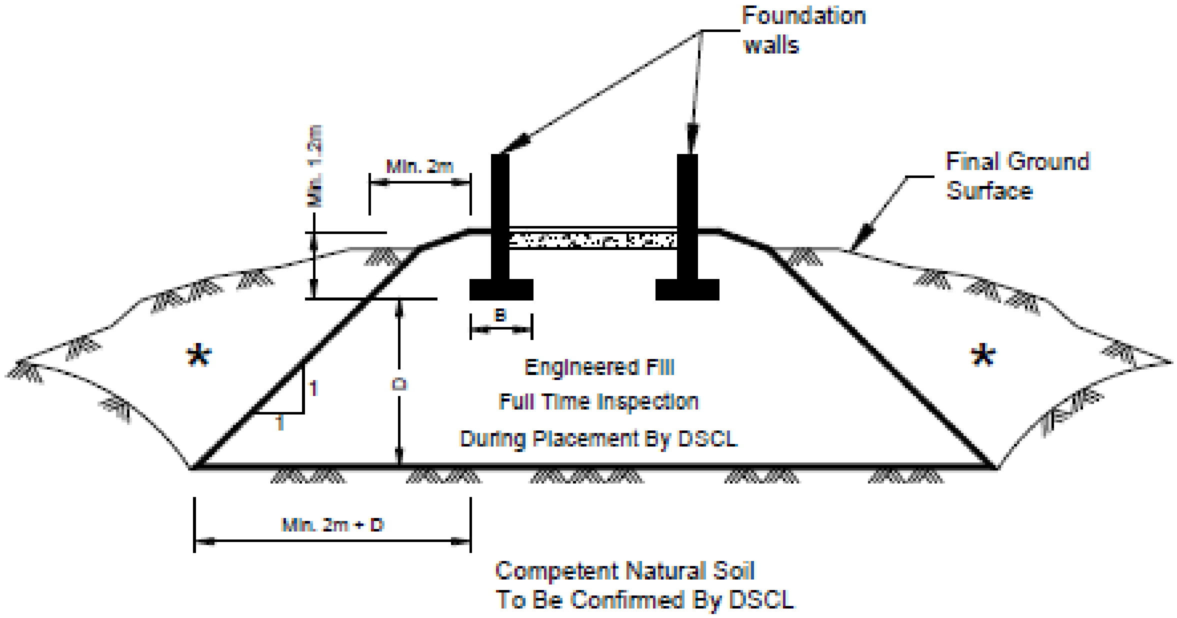
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from DSCL prior to footing concrete placements. All excavations must be backfilled under full time supervision by DSCL to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of DSCL.

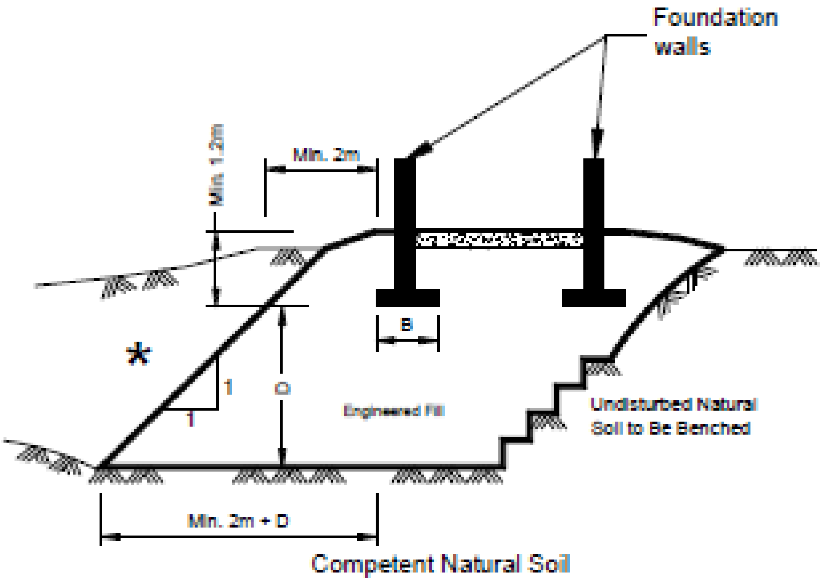
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with DS Consultants Ltd report attached.





* Backfill in this area to be as per the DSCL report.