



Proposed Building Addition

Geotechnical Investigation Report

Project Location:

45 Innovation Drive
Dundas, ON

Prepared for:

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1.0 INTRODUCTION

MTE Consultants Inc. (MTE) was retained by Kalos Engineering Inc. to conduct a geotechnical investigation for a proposed addition to the existing industrial building located at 45 Innovation Drive in Dundas, Ontario.

It is understood that an approximately 3,940 m² (42,320 ft²) slab-on-grade addition will be constructed at the southwest corner of the existing building. Drive aisles and loading areas will be constructed along the north side of the addition and the northwest parking lot will be expanded. It is anticipated that the existing services will be updated for the proposed addition. The design details are referenced from Kalos Engineering Inc.'s Site plan Drawing No. AO, dated October 2019.

The ground surface in the area of the proposed addition is generally level with elevations ranging from 215.4 to 215.9 m between the borehole locations.

The purpose of this geotechnical investigation is to determine the soil and groundwater conditions in the area of the proposed building addition and provide geotechnical engineering recommendations for site preparation, excavations and dewatering, foundations, slab-on-grade construction, site servicing, pavement design and subdrainage requirements, and preliminary infiltration rates.

2.0 FIELD AND LABORATORY PROGRAM

The fieldwork for this investigation was carried out on May 18, 2023, and involved the drilling of six (6) boreholes (Boreholes BH101-23 to BH106-23) to depths ranging from approximately 2.4 to 4.1 m. It is noted that auger refusal was encountered in all of the boreholes on suspected bedrock. The locations of the boreholes are shown on the Site Plan, **Figure 1 in Appendix A**.

Private and public utility companies were contacted prior to the start of drilling activities in order to isolate underground utilities near the boring locations.

The boreholes were advanced with a Diedrich D50T track mounted drill rig equipped with continuous flight hollow stem augers, supplied and operated by London Soil Test Ltd.

Representative soil samples were recovered throughout the depths explored. Standard Penetration Tests (SPT) were carried out during sampling operations in the boreholes using conventional split spoon equipment. The SPT N-values recorded are plotted on the borehole logs in **Appendix B**.

Upon completion of drilling, the boreholes were backfilled with soil cuttings and bentonite in accordance with Ontario Regulation 468/10 (formerly O. Reg. 903) under the provinces Water Resources Act.

The fieldwork was monitored throughout by a member of our geotechnical engineering staff, who directed the drilling procedures; recorded SPT values; documented the soil stratigraphies; monitored the groundwater conditions; and transported the recovered soil samples to our office for further classification.

The geodetic ground surface elevations at the borehole locations were surveyed by MTE's Geomatics Division.

All of the soil samples collected were submitted for moisture content testing with the results provided on the borehole logs in **Appendix B**. Additionally, two soil samples were submitted for particle size distribution analyses and the results are provided in **Appendix C**. The remaining soil samples will be stored for a period of 1 month and will be discarded of at that time without prior request from the client to extend storage time.

3.0 SOIL CONDITIONS

Reference is provided to the appended borehole logs for soil stratigraphy details, SPT N-values, approximate shear strengths, moisture content profiles, and groundwater observations and measurements. Soil conditions encountered in the boreholes typically include fill overlying native glacial till deposits and bedrock.

3.1 Fill

Surficial topsoil fill was encountered in all of the boreholes and ranged in thickness from 80 to 150 mm (average thickness of 120 mm). The composition of the topsoil fill was typically dark brown sandy silt and was very moist at the time of the fieldwork.

Fill was encountered beneath the topsoil fill in all of the boreholes and extended to depths ranging from 1.5 to 3.0 m (average depth of 2.2 m). The fill was light brown to brown/grey in colour and typically ranges in composition from sand and gravel to silt with trace to some clay, sand, and gravel. Topsoil and organics were observed throughout the fill.

SPT N-values measured in the fill range from 5 to 33 blows per 300 mm penetration of the split spoon sampler indicating loose to dense conditions.

Insitu moisture contents in the fill range from about 1 to 23% indicating damp to wet conditions.

3.2 Glacial Till

Glacial till was encountered beneath the fill in all of the boreholes and extends to the termination depth of each borehole. The till was light brown to brown in colour and typically ranges in composition from sandy silt to clayey silt. Occasional cobbles and bedrock fragments were noted within the till. The results of particle size distribution analyses conducted on samples of the glacial till are provided in **Appendix C** and summarized in the following table;

Table 1 - Results of Glacial Till Particle Size Distribution Analyses

Borehole Number	Sample Depth (mbgs)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH104-23	2.3 - 2.7	4	22	40	34
BH106-23	1.5 - 2.0	5	18	44	33

SPT N-values measured in the glacial till range from 6 to 28 blows per 300 mm penetration of the split spoon sampler indicating loose to compact conditions in the non-cohesive portions and stiff to very stiff conditions in the cohesive portions.

Insitu moisture contents in the till range from about 13 to 26%. The non-cohesive portions of till appeared to range from very moist to saturated conditions. The cohesive portions of till appeared to range from drier than the plastic limit to wetter than the plastic limit.

3.3 Bedrock

All of the boreholes were terminated on auger refusal on suspected bedrock. The bedrock was not proven by coring; however, it is noted that based on geological mapping, the site is located in the vicinity of the transition point between the Amabel Group, the Clinton-Cataract Group, and the Queenston formation bedrock. Based on the type and colour of the recovered rock fragments, and the inability of the augers to penetrate the bedrock surface, the suspected bedrock is expected to consist of dolostone of the Amabel/Clinton-Cataract Groups rather than the softer Queenston shale, the upper portions of which can be drilled with a conventional auger rig. The termination depth on the suspected bedrock is summarized in the following table;

Table 2 - Depth of Suspected Bedrock

Borehole Number	Borehole Ground Surface Elevation (masl)	Depth of Suspected Bedrock (mbgs)	Elevation of Suspected Bedrock (masl)
BH101-23	215.9	4.0	211.9
BH102-23	215.9	2.4	213.5
BH103-23	215.4	3.7	211.7
BH104-23	215.6	4.1	211.5
BH105-23	216.7	2.4	214.3
BH106-23	217.1	2.7	214.4

4.0 GROUNDWATER CONDITIONS

Groundwater observations and measurements were carried out in the open boreholes at the time of drilling and are summarized on the borehole logs. Saturated soil conditions encountered at the time of drilling are summarized in the following table;

Table 3 - Saturated Soil Conditions

Borehole Number	Saturated Soil Type	Depth of Saturated Soil (mbgs)	Elevation of Saturated Soil (masl)
BH101-23	Sandy Silt Till	3.8	212.1
BH102-23	Dry		
BH103-23	Dry		
BH104-23	Clayey Sandy Silt Till	3.0	212.6
BH105-23	Dry		
BH106-23	Dry		

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations and local variations.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

The project will involve the design and construction of a proposed slab-on-grade addition to the southwest corner of the existing industrial building located at 45 Innovation Drive in Dundas, Ontario. Drive aisles and loading areas will be constructed along the north side of the addition and the northwest parking lot will be expanded. It is anticipated that the existing services will be updated for the proposed addition.

The subsurface stratigraphy at the site comprises fill overlying native glacial till deposits and bedrock. Saturated glacial till deposits were encountered in Boreholes BH101-23 and BH104-23 at depths of 3.8 m and 3.0 m (Elevation 212.1 m and 212.6 m), respectively. Auger refusal was encountered in all of the boreholes on suspected bedrock at depths ranging from 2.4 to 4.1 m (Elevation 211.5 to 214.4 m).

Based on the results of this geotechnical investigation construction of the proposed building addition will be challenging due to the depth of fill soils at the site.

The following subsections of this report contain geotechnical recommendations pertaining to development of the property including site preparation, excavations and dewatering, foundations, slab-on-grade construction, site servicing, pavement design and subdrainage requirements, and preliminary infiltration rates.

5.2 Site Preparation

Given the extensive fill deposits in the area of the proposed building addition, it is anticipated that full removal of the fill and compaction of imported structural fill may not be the most economical option for development. In consideration of this, we have provided site development options for removal and replacement of the fill as well as development options that would allow for leaving the material in place.

Prior to carrying out any cutting and filling operations, the surficial topsoil fill, asphaltic concrete, and any fill materials containing organic content or debris must be removed. Asphaltic concrete is present within the northeast portion of the proposed addition; however, boreholes were not advanced in this area. The average topsoil fill thickness measured in the boreholes was about 120 mm thick. It is recommended that the average thickness across the site be increased by 50 mm for removal/stripping calculations to account for variations at the site.

5.2.1 Site Preparation - Structural Fill

If it is proposed to construct the building addition on a structural fill pad, the existing fill must be removed from the building footprint. It is understood that the proposed addition will be constructed in the vicinity of Boreholes BH101-23 to BH104-23. The fill thicknesses generally ranged from 2.3 to 3.0 m in these boreholes (average depth of 2.5 m).

The fill soils at the site generally comprise silt soils and organic content was observed throughout the fill. The majority of the fill materials are not considered geotechnically suitable for reuse.

During fill removal, care should be taken to prevent undermining the existing building foundations. If the encountered fill materials adjacent to the existing footings extend below the footing levels, underpinning of the existing footings may be required. If an excavation may affect the stability of the adjacent structure, the contractor shall take precautions to prevent damage to the adjacent building as per O.Reg 213/91, s. 229.

It is noted that the movement of excess soil from a project site is regulated under O.Reg. 406/19 and the associated Rules for Soil Management and Excess Soil Quality Standards. The Regulation and Rules have been enacted with various phase in dates between January 2021 and 2025. Depending on the proposed timing and final design of the project, excess soil management may be captured under the Regulation and associated Rules.

Following removal of the fill materials, the native subgrade soils must be verified by geotechnical personnel.

Any fill materials required to be imported to the site should be granular in nature (sand or sand and gravel) and must be tested and verified by a geotechnical engineer prior to placement. All fill should be placed in maximum 300 mm thick lifts and compacted to the following percentages;

Table 4 - Engineered Fill Requirements

Fill Use	Minimum Compaction Required
Structural fill to support buildings	100% SPMDD
Subgrade fill beneath pavements or services	98% SPMDD
Bulk fill in landscape areas	90% SPMDD

The native subgrade soils are very susceptible to disturbance due to the silt content, and it is recommended that construction traffic on the subgrade be minimized.

Where a structural fill pad is constructed, it must extend a minimum 1.0 m beyond the edge of the footing envelope of any building and down to native subgrade at an angle of 45 degrees to the horizontal. Full time testing by geotechnical personnel is required during fill placement and compaction to monitor material quality, lift thickness, and verify the compaction by insitu density testing.

In order to minimize the effects of weather and groundwater, fill operations onsite should be carried out in the dry summer months.

5.2.2 Site Preparation - Ground Improvement

As an alternative to removal of the existing fill and construction of a structural fill pad, the use of ground improvement measures for the site could be explored. Ground improvement measures are specialized techniques that would allow the fill materials to remain in place and permit the construction of buildings with conventional spread and strip foundations and slab-on-grade floors. Potential ground improvement measures include dynamic/rapid impact compaction, rammed aggregate piers, or controlled modulus columns.

Dynamic or rapid impact compaction methods involve densifying the fill soils using surficial compaction. Typically, the ground surface is surveyed before and after compaction to measure the grade change and corresponding level of densification. It is recommended that certification testing (i.e. plate load and/or dynamic cone penetrometer [DCP] testing) of the densified fill be completed following compaction.

Rammed aggregate piers methods involve construction of compacted coarse aggregate piers within the fill to stiffen the fill materials and transfer loading to the underlying native soils. The piers are installed by either augering through the fill and removing the spoils or by driving through the fill and displacing the fill laterally. As the equipment is removed from the hole, the voids are filled with coarse aggregate and compacted in layers using heavy ramming forces. Controlled modulus columns are another ground improvement method that involves installing concrete or grout columns into the soil.

The selection of the ground improvement technique should be the responsibility of the specialized contractor. The specialized contractor is also required to provide certification for the improved ground upon completion.

5.3 Excavations and Dewatering

All excavations at the site should be carried out in conformance with the Ontario Occupational Health and Safety Act and Regulations for Construction Projects. The fill soils encountered at the site are classified as Type 3 soils, and temporary side slopes through this material must be cut at an inclination of 1.0 horizontal to 1.0 vertical or less from the base of the excavation. The native glacial till soils encountered at the site are classified as Type 2 soils and the bedrock at the site is classified as Type 1 soils. The temporary side slopes for Type 1 and 2 soils can be cut near vertical up to 1.2 m above the base of excavation and at an inclination of 1 horizontal to 1 vertical or less above this level, exclusive of groundwater effects. Where wet to saturated conditions are encountered, excavation side slopes should be expected to slough to flatter inclinations, potentially 3.0 horizontal to 1.0 vertical or flatter.

Trench side slopes must be continuously inspected especially after periods of heavy rainfall or snow melt to identify areas of instability. Surface water should be directed away from entering the trench.

Minor groundwater inflow should be expected from saturated glacial till deposits overlying the bedrock. It is envisioned that conventional sump pump techniques will be adequate to control the inflow.

It will be necessary to flatten or support the excavation side slopes where groundwater seepage is occurring to ensure stability. Every excavation that a worker may be required to enter shall be kept reasonably free of water (O. Reg. 213/91, s. 230).

5.4 Conventional Building Design

If the fill is removed and replaced with structural fill or the ground is improved, then the building addition can be constructed with conventional spread or strip footings and slab-on-grade floors. Recommendations for these design methods are provided hereinafter.

5.4.1 Foundation Design

Conventional spread footings founded on the approved structural fill may be designed for a factored geotechnical bearing resistance at Ultimate Limit States (ULS) of 225 kPa, and soil bearing resistance for 25 mm of settlement at Serviceability Limit States (SLS) of 150 kPa.

It is anticipated that the above geotechnical bearing resistance would be obtainable through ground improvement at the site; however, further consultation with specialized contractors would be required.

The founding native soils are very susceptible to disturbance by construction activity, especially during wet weather and care should be taken to preserve the integrity of the material as bearing strata.

The soil in trenches beneath footings for sewer and watermain services, if applicable, shall be compacted by tamping up to the level of the footing base, or shall be filled with concrete having a strength not less than 10 MPa, to support the footing.

The footing areas must be inspected by qualified geotechnical personnel to ensure that the soil conditions encountered at the time of construction are suitable to support the design resistances prior to pouring concrete. Any loose, disturbed, organic and deleterious material identified during the inspection should be removed from the footing areas and replaced with structural fill or concrete.

All exterior floor slabs and footings in unheated areas must be provided with a minimum 1.2 m of earth cover or equivalent insulation after final grading in order to minimize the potential of damage due to frost action, as per Ontario Provincial Standard Drawing, OPSP 3090.101, dated November 2010. If construction is undertaken during the winter, the subgrade soil and concrete should be protected from freezing.

Where the footings of the proposed addition abut the footings of the existing building, the footing levels should match to avoid uneven stress distribution and undermining.

Where spread footings are constructed at different elevations, the difference in elevation in the individual footing should not be greater than one half of the clear distance between the footings. The lower footing should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with OBC Section 9.15.3.9.

A Site Classification 'D' should be used for earthquake load and effects in accordance with Table 4.1.8.4.A. of the 2012 Ontario Building Code.

In general, the majority of the structural fill and/or ground improved soils excavated from the foundation trench areas will be suitable for reuse as foundation wall backfill. Wet to saturated soils are not considered suitable for reuse as foundation wall backfill and imported OPSS 1010 Granular 'B' material should be used.

The backfill should be placed in maximum 300 mm thick lifts and compacted to at least 95% Standard Proctor Maximum Dry Density (SPMDD) on the outside of the building addition; and 100% SPMDD on the inside of the building addition. The backfill must be brought up evenly on both sides of walls not designed to resist lateral earth pressure.

5.4.2 Concrete Slab-on-Grade Floors

Any additional material required to raise grades below the floor slab should be comprised of granular soil and compacted to 98% SPMDD. A minimum 150 mm thick layer of Granular 'A' material uniformly compacted to 100% SPMDD should be provided directly beneath the slab for leveling and support purposes.

If the building is constructed on structural fill, a modulus of subgrade reaction of 25 to 30 MPa/m should be used in the design of the floor slabs. If a ground improvement approach is used, the ground improvement design-build contractor should supply an appropriate modulus for slab design.

No special underfloor drains are required, provided the exterior grades are lower than the floor slabs and positively sloped away from the building.

If a moisture-sensitive floor finish is to be applied to the slab, then we recommend that a 15 mil polyethylene moisture vapour barrier be installed directly beneath the slab as per Article 9.13.2.7 of the Ontario Building Code. The purpose of the vapour barrier is to reduce moisture transfer by diffusion as per Article 5.5.1.2 of the Ontario Building Code. Joints in the vapour barrier should be lapped not less than 100 mm.

The water to cement ratio and slump of the concrete utilized in the floor slab should be strictly controlled to minimize shrinkage of the slab. Control joints should be sawed into the slabs at regular intervals within 12 hours of initial concrete placement in order to prelocate shrinkage cracks.

Concrete testing should be performed onsite to determine the slump, temperature, and air entrainment; and concrete cylinders should be cast for compressive strength testing.

5.5 Deep Foundation Building Design

If the existing fill is to remain in place and ground improvement measures are not undertaken, the building would need to be constructed utilizing a deep foundation method. It is envisioned that helical piers or micropiles extending into the native soils and/or bedrock would be feasible options for the site. With these alternatives, the building loading would be transferred through the fill to the underlying compact native soils and/or bedrock.

Helical piers and micropiles are specialized foundation solutions provided by select contractors. The native soils or bedrock would provide a competent bearing stratum for deep foundations. The founding depths of the deep foundations should be embedded a minimum of 1.0 m into the compact native soil deposits at the site and/or 1.0 m into the bedrock at the site.

If it is proposed to explore these options, MTE would be pleased to provide further geotechnical recommendations.

5.6 Site Servicing

5.6.1 Pipe Bedding

It is understood that the proposed building addition will be provided with full municipal services. It is anticipated invert elevation of the pipes will be at conventional 2.0 to 3.0 m depths below ground surface. No bearing problems are anticipated for pipes set on native inorganic subsoil or imported structural fill. The existing fill materials are generally considered suitable for support of buried pipes; however, this should be confirmed by geotechnical inspection at the time of construction. The bedding material may need to be thickened if excavations encounter soft or spongy soil at the base of the service trench.

Pipe bedding for water and sewer services should be conventional Class 'B' pipe bedding comprising a minimum 150 mm thick layer of OPSS 1010 Granular 'A' aggregate below the pipe invert. Granular 'A' type aggregate should be provided around the pipe to at least 300 mm above the pipe and the bedding aggregate should be compacted to a minimum 100% SPMD.

A well-graded clear stone such as Coarse Aggregate for HL4 Asphaltic Concrete (OPSS 1003) could be used in the sewer trenches as bedding below the spring line of the pipe to facilitate sump pump dewatering, if necessary. The clear stone should be compacted with a plate tamper and fully wrapped with a non-woven filter cloth to prevent the migration of fine particles from the saturated soils.

5.6.2 Trench Backfilling

The trenches above the specified pipe bedding should be backfilled with inorganic onsite soils placed in 300 mm thick lifts and compacted to at least 95% SPMDD. Where trenches enter the proposed building addition the backfill should be compacted to 100% SPMDD or 5 MPa lean-mix concrete may be used. Wet or saturated native soils are not considered suitable for reuse as trench backfill. Any additional material required to be imported at the site should meet OPSS Select Subgrade Material specifications.

To minimize potential problems, backfilling operations should follow closely after excavation so that only a minimal length of trench is exposed. Care should be taken to protect side slopes of excavations by diverting surface run-off away from the excavations. If construction extends into the winter, then additional steps should be taken to minimize frost and ensure that frozen material is not used as backfill.

All materials and construction services required for the work should be in accordance with the relevant sections of the Ontario Provincial Standard Specifications.

5.7 Pavement Structure

It is understood that pavements will be constructed for new drive aisles and loading areas along the north side of the proposed building addition. It is also understood that the northwest parking lot will be expanded.

The existing topsoil, asphaltic concrete, and deleterious material in the vicinity of the drive aisles, parking areas, and loading docks should be removed. Depending on finished grades at the site, the subgrade soils will consist of existing fill, or approved engineered fill.

The pavement component thicknesses in the following table are recommended based on the proposed pavement usage and the frost-susceptibility and strength of the subgrade soils;

Table 5 - Pavement Design

Pavement Component	Light Duty Drive Aisles and Car Parking Areas	Heavy Duty Truck Traffic Areas	Loading Docks
Asphalt Hot Mix	90 mm	120 mm	-
Portland Cement Concrete	-	-	200 mm
OPSS 1010 Granular 'A' Base	150 mm	150 mm	150 mm
OPSS 1010 Granular 'B' Subbase	450 mm	450 mm	300 mm

Concrete testing should be performed onsite to determine the slump, temperature, and air entrainment of the concrete pavement structure; and concrete cylinders should be cast for compressive strength testing.

Samples of aggregates should be checked for conformance to OPSS 1010 prior to utilization on site and during construction. The Granular 'B' subbase and Granular 'A' base courses must be compacted to 100% SPMDD, as verified by insitu density testing.

The asphaltic concrete paving materials should conform to the requirements of OPSS 1150. The asphalt should be placed and compacted in accordance with OPSS 310. The Performance Graded Asphalt Cement (PG-AC) designation for the asphaltic concrete is 58-28.

The asphaltic concrete should comprise 40 mm of the HL3 surface over 50 mm of HL4 or HL8 binder for light duty drive aisles and car parking areas and 40 mm of HL3 surface over 80 mm of HL4 or HL8 binder for heavy duty truck traffic areas.

The pavement design is based on the assumption that construction will be carried out during the drier time of the year and that the subgrade soil is stable as determined by proof-rolling inspected by qualified geotechnical personnel. If the subgrade is wet and unstable, additional granular subbase will be required.

All materials and construction services required for the work should be in accordance with the relevant sections of the Ontario Provincial Standard Specifications.

It is recommended to install subdrains beneath the low lying areas of the pavement structure and connected to catchbasins. The purpose of the subdrains is to remove excess subsurface water in order to improve overall pavement serviceability and increase the pavement life.

The work of subdrain installation shall be in accordance with OPSS 405 and OPSD 216.021. The subdrain shall be 100 or 150 mm diameter perforated pipe conforming to OPSS 1801 or 1840, and wrapped with geotextile conforming to OPSS 1860.

5.8 Curbs and Gutter and Sidewalks

The concrete for curbs, gutters and sidewalks should be proportioned, mixed, placed and cured in accordance with the requirements of OPSS 353, and OPSS 1350 and shall meet the following specific requirements (OPSS 353.05.01):

- Minimum compressive strength = 32 MPa at 28 days
- Coarse aggregate = 20.0 mm nominal max. size
- Maximum slump = 60 mm for curbs and gutter, 70 mm for sidewalks
- Air entrainment = $6.5 \pm 1.5\%$

During cold weather any freshly placed concrete must be covered with insulating blankets to protect against freezing as per OPSS 904. Three cylinders from each day's pour should be taken for compressive strength testing. Air entrainment, temperature and slump tests should be conducted on the same batch of concrete from the test cylinders made.

5.9 Preliminary Infiltration Rates

For the design of potential onsite infiltration galleries, infiltration rates were assessed based on the soil types determined from the particle size distribution results. Two (2) particle size distribution analyses were completed on the native glacial till soils encountered at the site. The results are plotted on **Table 101 in Appendix C**.

The estimated vertical hydraulic conductivity (k) is derived from empirical formula by Kaubisch. The estimated infiltration rate is based on recommendations from the Sustainable Technologies Evaluation Program (STEP) produced by the Toronto and Region (TRCA), Lake Simcoe Region (LSRCA), and the Credit Valley (CVC) Conservation Authorities. A Factor of Safety has not been applied and should be selected by the designer of the infiltration facility.

Table 6 - Preliminary Infiltration Rates of Native Glacial Till Soil

Location	Sample Depth (mbgs)	Sample Elevation (masl)	K-Value (m/sec)	Unfactored Infiltration Rate (mm/hr)	Soil Description
BH104-23	2.3 – 2.7	213.3 – 212.9	2.3E-10	<1	Clayey Sandy SILT, trace Gravel
BH106-23	1.5 – 2.0	215.6 – 215.1	1.4E-10	<1	Clayey SILT, some Sand, trace Gravel

Any imported material to be placed below any infiltration gallery will need to be tested and approved prior to placement.

5.10 Construction Inspection and Testing

MTE recommends that geotechnical inspection and testing procedures be conducted throughout the various phases of the potential project.

Engineer site visits should be conducted to confirm geotechnical bearing resistances for footings. Soil compaction testing should be carried out on structural fill beneath the proposed building addition, engineered fill to raise grades in pavement areas, foundation wall backfill, subslab granular fill, and trench backfill. Laboratory and field testing of the pavement structure components (granulars and asphaltic concrete) should be conducted, as well as concrete testing for foundations, curbs and sidewalks.

MTE offers soil compaction, concrete, and asphalt testing, as well as soil inspection services through our Stratford, Kitchener, and London offices.

6.0 LIMITATIONS OF REPORT

Services performed by MTE Consultants Inc. (MTE) were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the Geotechnical Engineering & Consulting profession practicing under similar conditions in the same geographic area where the services are provided. No other warranty or representation expressed or implied as to the accuracy of the information, conclusions or recommendations is included or intended in this report.

This report was completed for the sole use of the Client. This report is not intended to be exhaustive in scope or to imply a risk-free site. As such, this report may not deal with all issues potentially applicable to the site and may omit aspects which are or may be of interest to the reader.

In addition, it should be recognized that a soil sample result represents one distinct portion of a site at the time it is collected, and that the findings of this report are based on conditions as they existed during the time period of the investigation. The material in the report reflects our best judgment using the information available at the time the report was written. The soil and groundwater conditions between and beyond the test holes may differ from those encountered in the test holes. Should subsurface conditions arise that are different from those in the test holes MTE should be notified to determine whether or not changes should be made as a result of these conditions.

It should be recognized that the passage of time may affect the views, conclusions and recommendations (if any) provided in this report because groundwater conditions of a property can change, along with regulatory requirements. All design details were not known at the time of submission of this report and it is recommended MTE should be retained to review the final design documents prior to construction to confirm they are consistent with our report recommendations. Should additional or new information become available, MTE recommends that it be brought to our attention in order that we may determine whether it affects the contents of this report.

Any use which another party makes of this report, or any reliance on, or decisions to be made based upon it, are the responsibility of such parties. MTE accepts no responsibility for liabilities incurred by or damages, if any, suffered by another party as a result of decisions made or actions taken, based upon this report. Others with interest in the site should undertake their own investigations and studies to determine how or if the condition affects them or their plans. The contractors bidding on this project or undertaking the construction should make their own interpretation of the factual information and draw their own conclusions as to how subsurface conditions may affect their work.

The benchmark and elevations provided in this report are primarily established to identify differences between the test hole locations and should not be used for other purposes such as, planning, development, grading, and excavation.

All of which is respectfully submitted,
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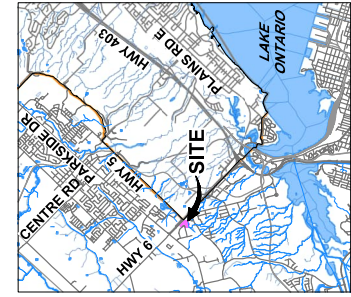
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Appendix A

Figures

Figure 1 - Site Plan



KEY PLAN (NIS)

LEGEND

- SITE BOUNDARY
- BOREHOLE
- (215.9m) ELEVATION (m AMSL)

REFERENCES

CITY OF BURLINGTON, ROAD NETWORK, OPEN DATA SET;
LAND INFORMATION ONTARIO, AERIAL IMAGE AND WATER NETWORK, © QUEEN'S PRINTER FOR ONTARIO, 2023; AND
KALOS ENGINEERING, SITE PLAN, PROJECT No. 18188, DRAWING No. AO, OCTOBER 2019.

NOTES

THIS FIGURE IS SCHEMATIC ONLY AND TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.
ALL LOCATIONS ARE APPROXIMATE.



 Engineers, Scientists, Surveyors	
PROJECT GEOTECHNICAL INVESTIGATION 45 INNOVATION DRIVE DUNDAS, ONTARIO	
TITLE SITE PLAN	
Drawn Scale AS SHOWN	AS SHOWN
Checked Project #7815300	Project
Date June 05/23	Rev. No. 0

FIGURE 1

Appendix B

Borehole Logs

Abbreviations and Symbols

MTE Boreholes BH101-23 to BH106-23





The following are abbreviations and symbols commonly used on borehole logs, figures and reports.

Sample Types

AS	Auger Sample
CS	Chunk Sample
BS	Bulk Sample
GS	Grab Sample
WS	Wash Sample
SS	Split Spoon
RC	Rock Core
SC	Soil Core
TW	Thinwall, Open
TP	Thinwall, Piston

Soil Tests

PP	Pocket Penetrometer
FV	Field Vane
SPT	Standard Penetration Test
CPT	Cone Penetration Test
WC	Water Content
WL	Water Level

Penetration Resistance

Standard Penetration Test, N (ASTM D1586)	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.) open spilt spoon sampler for a distance of 300 mm (12 in.).
Dynamic Cone Penetration Resistance	The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive an uncased 50 mm (2 in.) diameter, 60o cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

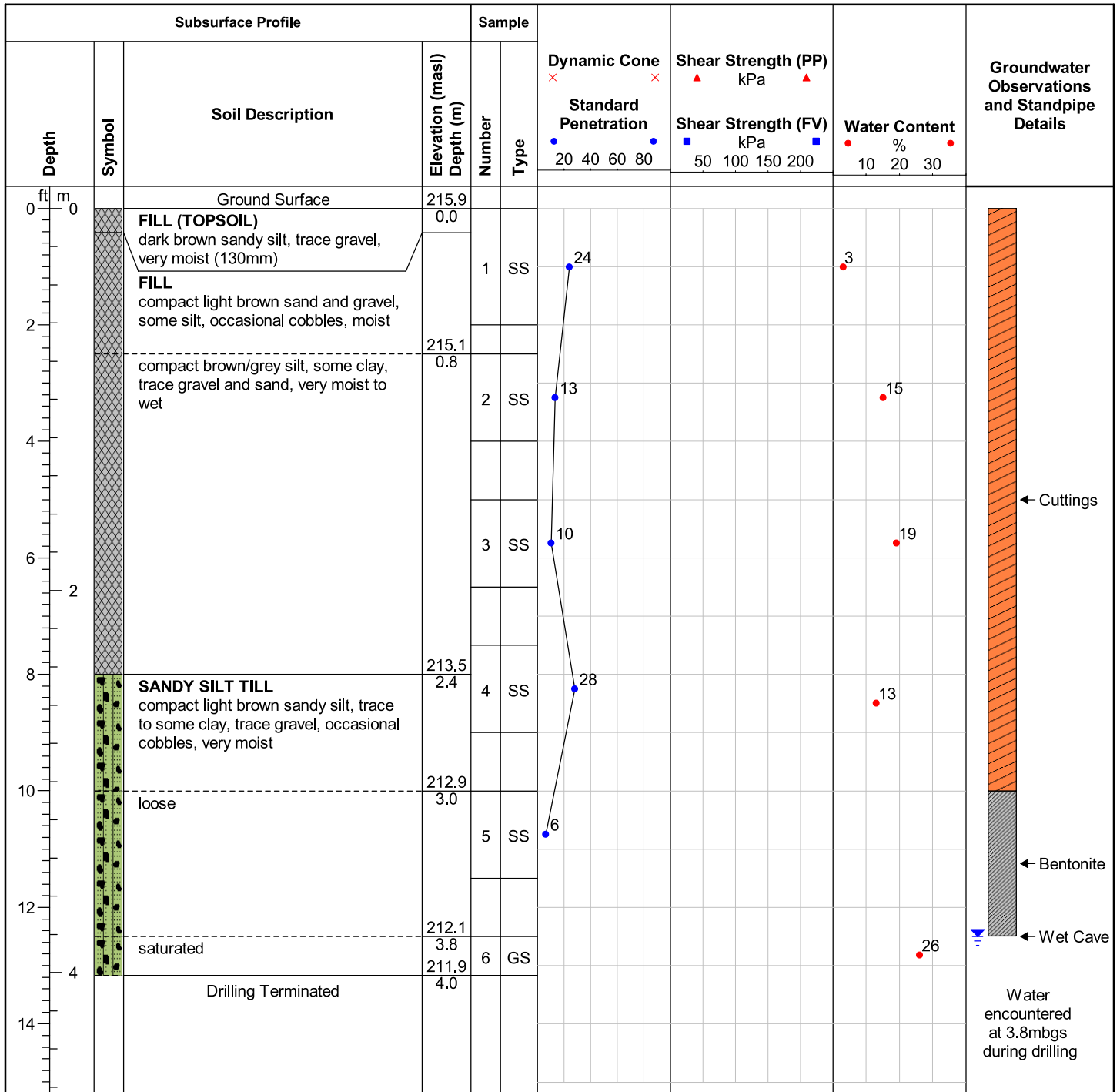
Soil Description

Cohesive Soils	Undrained Shear Strength (Cu)	
Consistency	kPa	psf
Very Soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very Stiff	100 to 200	2,000 to 4,000
Hard	Above 200	Above 4,000

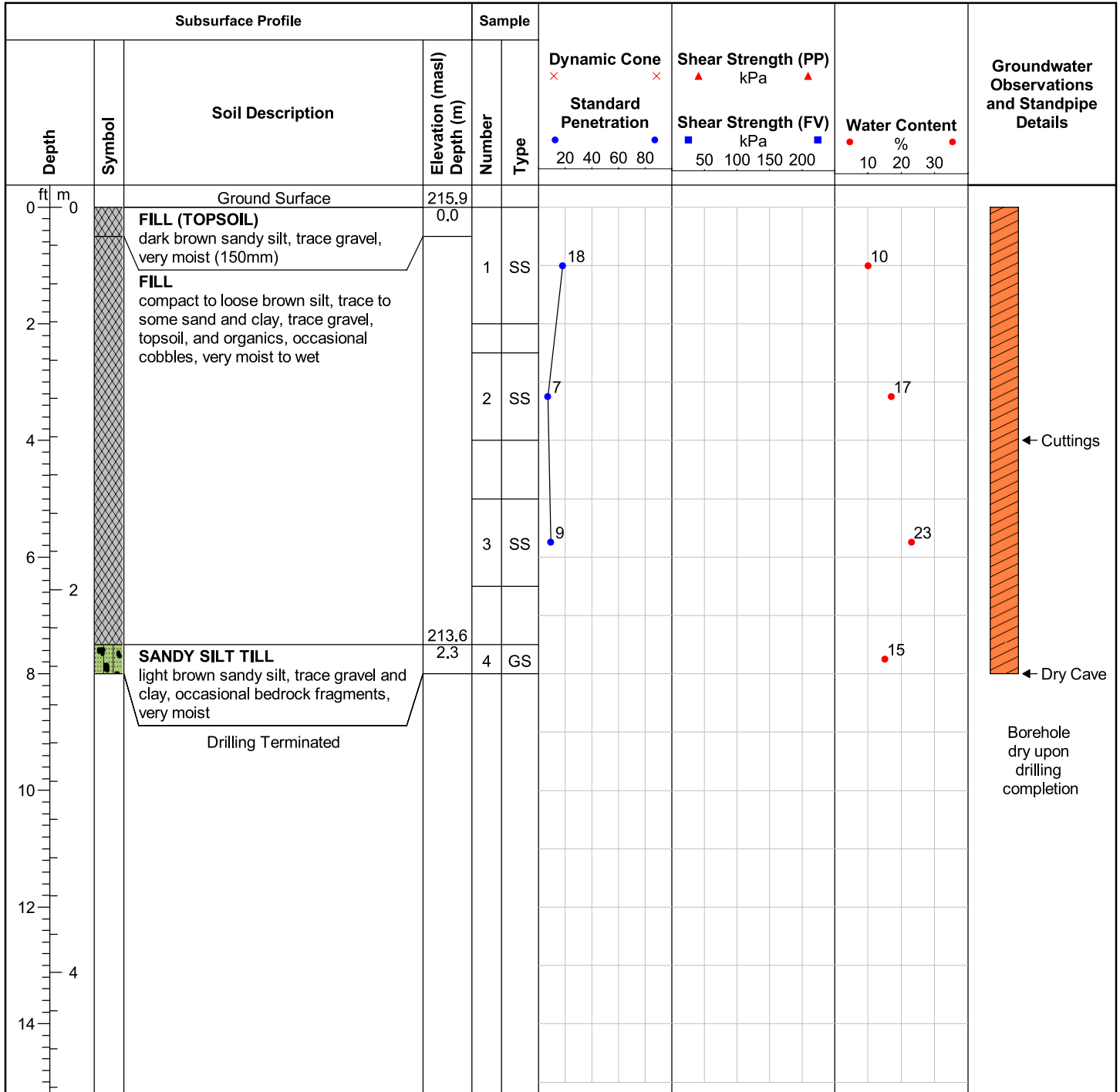
Cohesionless Soils	
Relative Density	SPT N Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Above 50

WH	Sampler advanced by static weight of hammer
WR	Sampler advanced by static weight of drilling rods
PH	Sampler advanced by hydraulic force
PM	Sampler advanced by manual force

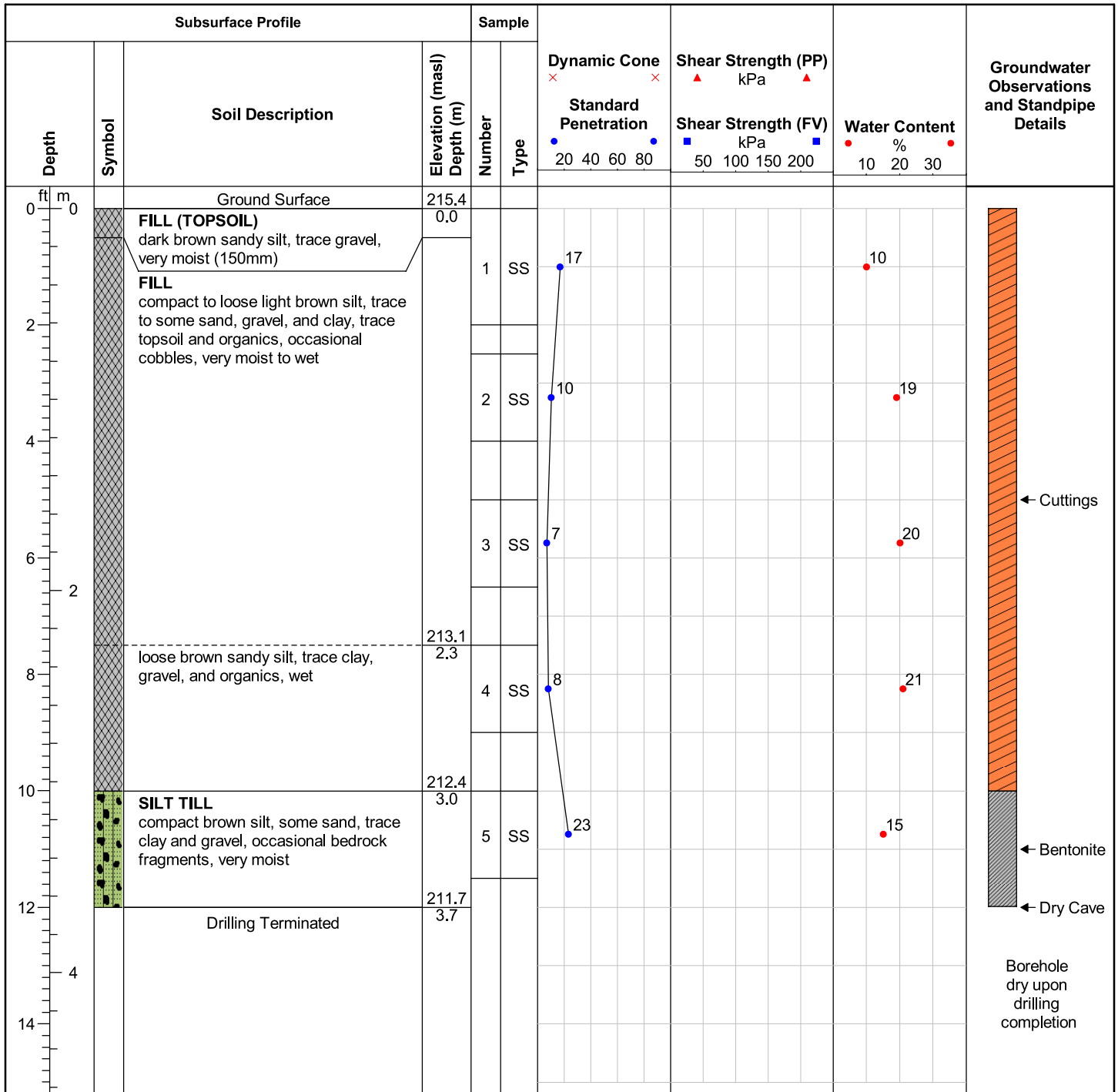
DTPL	Drier than Plastic Limit
APL	About Plastic Limit
WTPL	Wetter than Plastic Limit
mbgs	Metres below Ground Surface

ID No.: BH101-23**Project Name:** Proposed Building Addition**MTE File No.:** 47612-300**Client:** Kalos Engineering Inc.**Site Location:** 45 Innovation Drive, Dundas, ON**Date Completed:** 5/18/2023**Drilling Contractor:** London Soil Test Ltd.**Drill Rig:** D50T Track Mounted**Drill Method:** Hollow Stem Augers**Protective Cover:** N/A**Field Technician:** A. Challis**Drafted by:** B. Heinbuch**Reviewed by:** D. Gonser**Notes:**

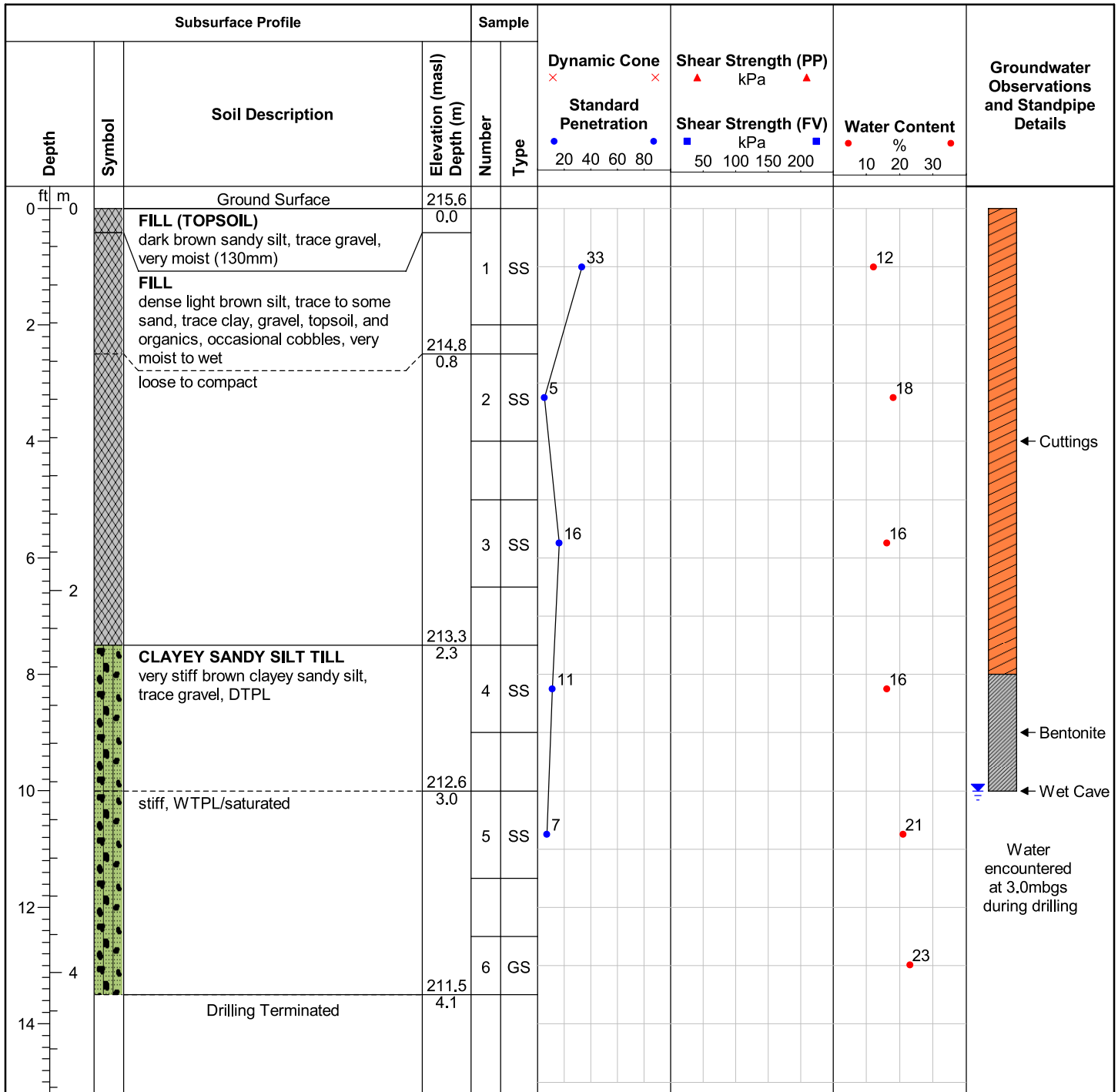
Auger refusal encountered at 4.0mbgs on suspected bedrock.

ID No.: BH102-23**Project Name:** Proposed Building Addition**MTE File No.:** 47612-300**Client:** Kalos Engineering Inc.**Site Location:** 45 Innovation Drive, Dundas, ON**Date Completed:** 5/18/2023**Drilling Contractor:** London Soil Test Ltd.**Drill Rig:** D50T Track Mounted**Drill Method:** Hollow Stem Augers**Protective Cover:** N/A**Field Technician:** A. Challis**Drafted by:** B. Heinbuch**Reviewed by:** D. Gonser**Notes:**

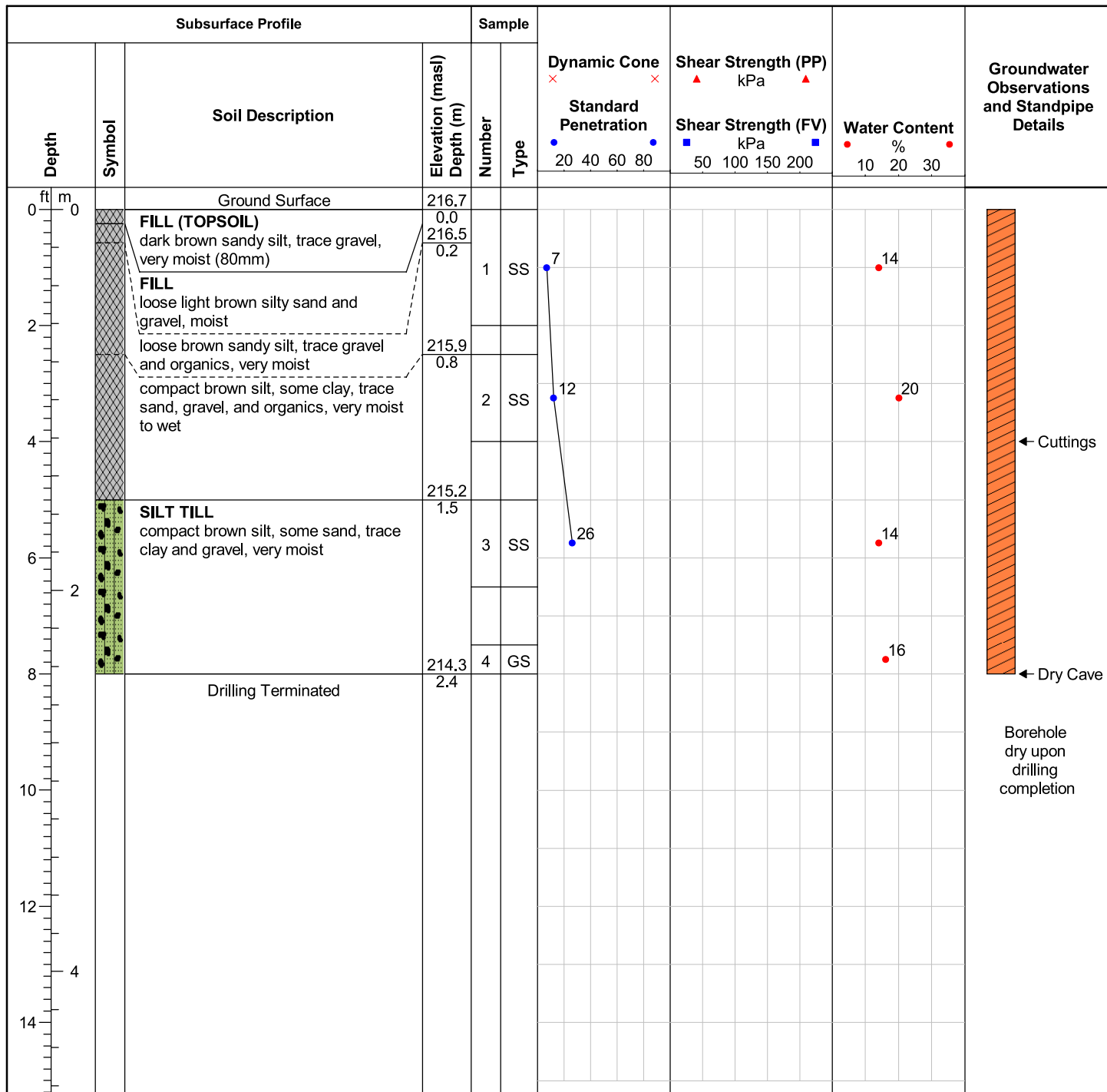
Auger refusal encountered at 2.4mbgs on suspected bedrock.

ID No.: BH103-23**Project Name:** Proposed Building Addition**MTE File No.:** 47612-300**Client:** Kalos Engineering Inc.**Site Location:** 45 Innovation Drive, Dundas, ON**Date Completed:** 5/18/2023**Drilling Contractor:** London Soil Test Ltd.**Drill Rig:** D50T Track Mounted**Drill Method:** Hollow Stem Augers**Protective Cover:** N/A**Field Technician:** A. Challis**Drafted by:** B. Heinbuch**Reviewed by:** D. Gonser**Notes:**

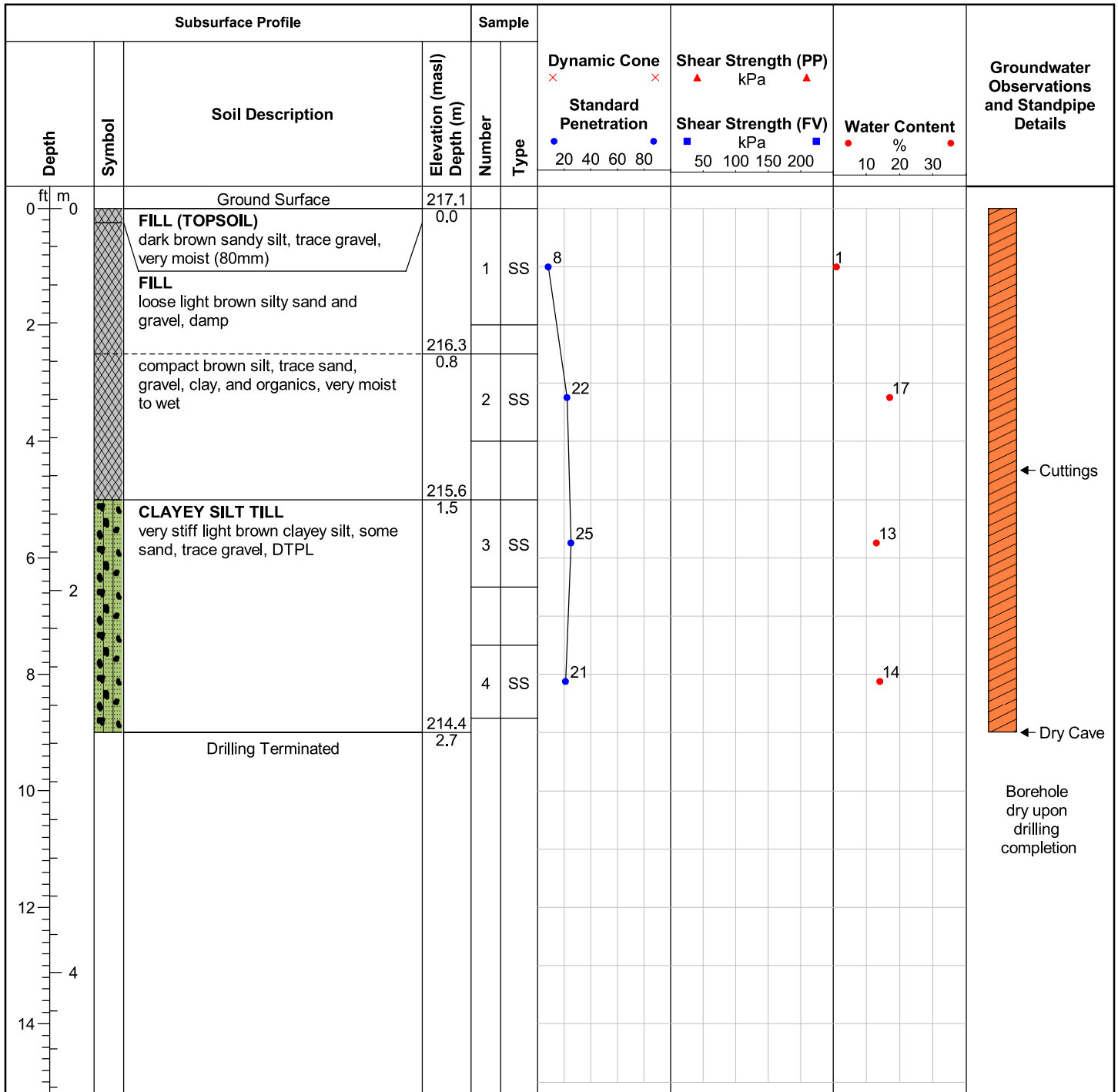
Auger refusal encountered at 3.7mbgs on suspected bedrock.

ID No.: BH104-23**Project Name:** Proposed Building Addition**MTE File No.:** 47612-300**Client:** Kalos Engineering Inc.**Site Location:** 45 Innovation Drive, Dundas, ON**Date Completed:** 5/18/2023**Drilling Contractor:** London Soil Test Ltd.**Drill Rig:** D50T Track Mounted**Drill Method:** Hollow Stem Augers**Protective Cover:** N/A**Field Technician:** A. Challis**Drafted by:** B. Heinbuch**Reviewed by:** D. Gonser**Notes:**

Auger refusal encountered at 4.1mbgs on suspected bedrock.

ID No.: BH105-23**Project Name:** Proposed Building Addition**MTE File No.:** 47612-300**Client:** Kalos Engineering Inc.**Site Location:** 45 Innovation Drive, Dundas, ON**Date Completed:** 5/18/2023**Drilling Contractor:** London Soil Test Ltd.**Drill Rig:** D50T Track Mounted**Drill Method:** Hollow Stem Augers**Protective Cover:** N/A**Field Technician:** A. Challis**Drafted by:** B. Heinbush**Reviewed by:** D. Gonser**Notes:**

Auger refusal encountered at 2.4mbgs on suspected bedrock.

ID No.: BH106-23**Project Name:** Proposed Building Addition**MTE File No.:** 47612-300**Client:** Kalos Engineering Inc.**Site Location:** 45 Innovation Drive, Dundas, ON**Date Completed:** 5/18/2023**Drilling Contractor:** London Soil Test Ltd.**Drill Rig:** D50T Track Mounted**Drill Method:** Hollow Stem Augers**Protective Cover:** N/A**Field Technician:** A. Challis**Drafted by:** B. Heinbuch**Reviewed by:** D. Gonser**Notes:**

Auger refusal encountered at 2.7mbgs on suspected bedrock.

Appendix C

Laboratory Test Results

Table 101

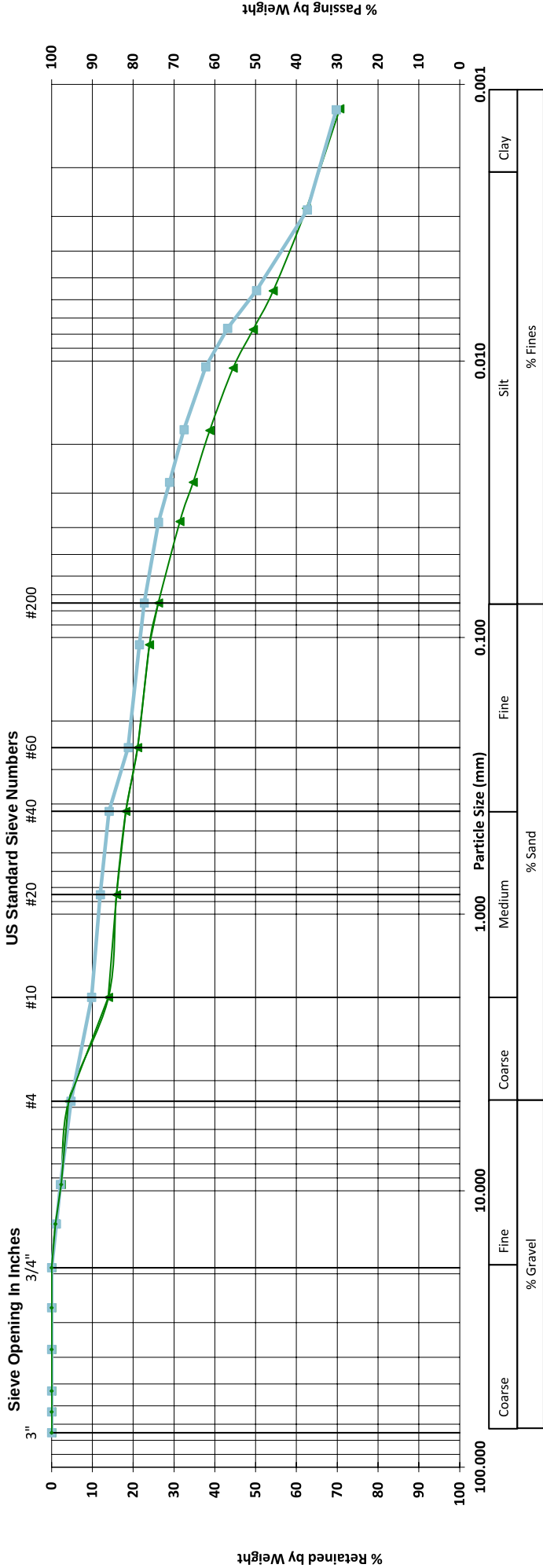


Particle Size Distribution Analysis Test Results

Project Name: Proposed Building Addition
Client: Kalos Engineering Inc.
Project Location: 45 Innovation Drive, Dundas, ON

Date Sampled: May 18, 2023
Date Tested: May 29-31, 2023
MTE File No.: 47612-300
Table No: 101

Unified Soil Classification



Symbol	Borehole ID	Sample #	Sample Depth	Description
▲	BH104-23	SS-4	2.3-2.7 mbgs	Clayey Sandy SILT, trace Gravel
■	BH106-23	SS-3	1.5-2.0 mbgs	Clayey SILT, some Sand, trace Gravel



NOTES: