GEOTECHNICAL INVESTIGATION REPORT
PROPOSED COMMERCIAL DEVELOPMENT
3850 CAMBRIAN ROAD
NEPEAN, OTTAWA, ONTARIO

PREPARED FOR

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation that was completed by GeoTerre Limited (GeoTerre) in relation to a proposed commercial development located at 3850 Cambrian Road, Nepean, Ottawa, Ontario as located as shown on attached Figure 1 to the general development details of attached Appendix G. The purpose of the investigation was to establish the prevalent soil and groundwater conditions within the limits of the site and, based on that information provide geotechnical design recommendations for the proposed development, especially site grading and foundation support.

This report is subject is subject to the *Limitations and Information Regarding Use of Report* of attached Appendix A.

2.0 SITE AND PROJECT DESCRIPTION

The site of the proposed commercial development is located at 3850 Cambrian Road, Nepean, Ottawa as shown on attached Figure 1. The proposed site is almost square with an overall area of approximately 1.36 hectares and while not shown on attached Figure 1, will be located on the northwest corner of the future intersection of Cambrian Road and the proposed realigned Greenbank Road. This site forms part of the overall Half Moon Bay development, and as such, is generally known to be underlain by 15 m to 20 m thick deposits of weak, compressible Leda Clay. As indicated on the site plan of attached Appendix E, a total of four (4) low rise (maximum of two stories), CRU's (commercial retail units) are proposed, i.e., two (2) within the north limits of the site, two (2) within the south limits of site with development access roads and parking areas located in between.

Based on review of historical area photos for the site, a series of various activities have taken place within the site boundaries, including the apparent removal and partial replacement of up to as much as 3 m of organic materials that was once present and infilling of a former south flowing open ditch as originally located along the approximate alignment shown on attached Figure 2. Apart from a 10 to 15 m wide strip along the east limit of the site with existing grades that vary from approximate elevation 93.5 m at the south end of site to 94.5 m at the north end of the site, elevations within the remaining westerly portions of the site vary from approximate elevation 92.2 m at the south end of the site to 93.0 m at the north end of the site. Based on preliminary site grading information provided by SLR (Canada) Ltd. (SLR), anticipated site top of pavement grades are as follows:

Northwest Corner: 93.2 m	Northeast Corner: 93.9 m
Southwest Corner: 93.2 m	Southeast Corner: 94.0 m

3.0 INVESTIGATION METHODOLOGY AND RESULTS

Based on review of available site surficial geology information and borehole information presented in various geotechnical summary reports prepared by Paterson Group for the overall proposed Half Moon Bay development as available through the City of Ottawa database, soil conditions within the general site area are known to consist of between 15 and 20 m of weak silty clay "Leda Clay" deposits overlying competent glacial till materials at depth. Hence, by way of confirming actual conditions within the site, GeoTerre undertook a project specific borehole investigation program consisting of the completion of fourteen (14) boreholes to depths of between 5.9 m and 21.3 m at the approximate locations shown on attached Figure 2. More specifically, the project specific borehole investigation program consisted of drilling the following boreholes at the approximate locations shown on attached Figure 2:

- Deep boreholes BH22-3 and 11 to respective total investigated depths of 18.7 m and 21.3 m to confirm total depth of weak silty clay soils and nature of underlying competent soils.
- Shallow boreholes BH22-1, 2, 4 to 10 and 12 to 14 to depths of between 5.8 m (BH22-7) and 7.5 m (BH22-13 and 14) to better confirm the near surface soil conditions.

The as drilled location of each borehole shown on attached Figure 2 was established by GeoTerre relative to available site features and as such, are considered accurate to about plus/minus 1 m. The geodetic ground surface elevations of each as-drilled borehole location as presented in attached Table 1 and the borehole logs of attached Appendix B, were established by SLR relative to a reported Geodetic elevation of 93.55 m for the top of an existing circular sanitary sewer manhole located in the southeast corner of the site by Annis, O'Sullivan, Vollebekk Ltd., Ontario Land Surveyors, Ottawa.

Boreholes were drilled between November 21 and 25, 2022 using a track mounted drill rig supplied and operated by CCC Drilling, Ottawa, Ontario turning 200 mm diameter hollow stem augers, with all field drilling investigation works completed under the supervision of a GeoTerre supervisor. During drilling of each borehole, Standard Penetration Tests (SPT) and associated split spoon soil sampling as advanced using an automatic drop hammer near surface and generally by hand below depths of approximately 3 m were completed at 0.76 m intervals to 3 m. Thereafter, and in anticipation of significant depths of weak silty clay, each borehole was advanced using the following generic approach over each successive 1.5 m (5 feet) interval:

1. Complete SPT through upper 0.46 m (18 inches).
2. Advance MTO sized Field Vane to a tip depth of 0.92 m (3 feet) prior to completing a field vane test in accordance with ASTM D2573/D2573M-18, including remoulded strength assessment.
3. Advance MTO sized Field Vane to a tip depth of 1.22 m (4 feet) prior to completing a field vane test to similar details noted above.

In addition to the foregoing SPT and insitu field vane testing, 0.6 m long, 70 mm diameter thin-wall steel Shelby tube samples were retrieved from with boreholes BH22-3 and 11 at top depths of 4.6 m, 6.0 m and 9.1 m (total of 6 samples) with a view to undertaking soil consolidation tests to the details provided later. Upon retrieval, each Shelby tube sample was sealed in such a fashion that the sample was both airtight and restrained from moving and delivered to the testing laboratory the same day they were retrieved.

Upon reaching competent materials at an approximate depth of 16.2 m in deep borehole BH22-3, the nature of the competent soils was confirmed by completing two (2) SPT's at 1.5 m intervals for a final investigated total depth of 18.7 m. In comparison, after confirming that weak silty clay materials extended beyond a depth of 16.5 m at the location of BH22-11, the nature of the underlying soils were investigated by undertaking a Dynamic Cone Penetration Test (DCPT)[1] from 18.5 m until refusal to further DCPT advance was encountered at a depth of 21.3 m.

The SPT 'N' values and DCPT values were completed using an automatic drop hammer that is generally considered to have an 80% energy efficiency rating and hence, field SPT 'N' values are referred to as SPT 'N_{80}' values or DCPT 'N_{80}' values. The SPT hammer type is important because most empirical geotechnical relationships between SPT 'N' values and strength and/or expected soil performance were based primarily on SPT 'N_{60}' values obtained before the year 2000, i.e., those obtained using what was referred to as the Rope and Cathead SPT hammer system.

Groundwater conditions were noted during and upon completion of drilling of each borehole with five (5) 50 mm diameter monitoring wells being installed as per the following to permit monitoring of longer term water levels:

- 50 mm diameter Monitoring Well in deep borehole BH22-3 to a tip depth of 18.3 m with the primary objective of confirming water pressures within the deep soils below the surface silty clay layer.
- 50 mm diameter Monitoring Wells in boreholes BH22-1, 4, 12 & 14 to tip depths of 4.6 m with primary objective of confirming the near surface water levels.

Available water levels within the various installed monitoring wells up to December 6, 2022 are summarized in attached Table 2.

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[1] DCPT consists of advancing a 60 degree, 50 mm diameter inverted cone using blows from the SPT hammer with number of blows for each 0.3 m of advance being recorded as the DCPT value for that depth interval. DCPT values are generally taken as being 150 % greater than the equivalent SPT N values.

Boreholes with monitoring well installations were backfilled with low permeability bentonite from just above the top of the well screen to ground surface whereas boreholes with no installations were backfilled with a combination of drill cuttings and low permeability bentonite.

Soil samples retrieved from the boreholes were returned to the GeoTerre CCIL (Canadian Council of Independent Laboratories) certified soil testing laboratory for review by a senior engineer and completion of the following geotechnical laboratory soil index testing on select borehole samples:

- Water content on each retrieved intact sample
- Twelve (12) sieve and hydrometer grain size analyses on fine grained samples
- Four (4) Atterberg Limit Soil Plasticity test determinations
- Three (3) Soluble Sulphate Content Tests

A log of encountered soil conditions within each borehole as determined by GeoTerre based on the above noted senior engineer sample review and associated geotechnical soil index tests are presented on the borehole logs of attached Appendix B that also include the results and locations of all in-situ tests, groundwater observations and borehole backfill details. The results of the water content and Atterberg Limit Soil Plasticity tests and a summary of the grain size data are also presented on the borehole logs of attached Appendix B, with complete grain size distribution data presented in attached Appendix C. The Atterberg Limits soil plasticity data is also presented on the soil plasticity charts of attached Appendix D.

In addition to the laboratory soil index testing, a total of three (3) samples were submitted to AGAT Laboratories Ltd., Mississauga, Ontario for soluble sulphate content testing the results of which were as follows:

• BH22-4-Sample 4 (silty clay crust materials at depth of 2.6 m)	0.05 %
• BH22-5-Sample 2 (silty clay crust materials at depth of 1.1 m)	0.03 %
• BH22-13-Sample 3 (near surface sandy silt at depth of 1.8 m)	0.03 %

Pursuant to the retrieval of the aforementioned Shelby Tube samples from within the silty clay materials at depths of between 4.6 and 9.1 m during drilling of boreholes BH22-3 and 11, they were submitted to the Golder Associates (Golder), Ottawa soil testing laboratory for the completion of a total four (4) Oedometer Soil Compression tests. These tests consist of loading an approximately 20 mm thick, 63 mm diameter circular test sample as obtained from a location that was deemed by Golder to be representative of the overall thin wall Shelby tube sample and thereafter, subsequently loaded in a series of small increasing loads (5 kPa to 317 kPa) as deemed appropriate based on the past experience of Golder for samples obtained from locations with field measured undrained shear strengths of between 20 and 40 kPa. The results of these four (4) tests as reported by Golder Associates are presented in attached Appendix F, which includes the results of a grain size analysis and Atterberg Limit Soil Plasticity test for each test sample. The soil index test data obtained on the Oedometer test samples are also presented on the borehole logs of attached Appendix B and within the summary grain size figures of Appendix C and summary soil plasticity test result figures of the attached Appendix D.

In addition to the foregoing borehole investigation and soil testing works, the field investigation works also included the completion of a Shear Wave Velocity Sounding investigation to determine the applicable Seismic Site Class as per the requirements of the 2012 version of the Ontario Building Code and, to satisfy a City of Ottawa design requirement for the approval of proposed developments underlain by weak "Leda Clay" materials. The results of this study as completed on December 8, 2022 by the Montreal office of Geophysics GPR International Inc., using MASW (Multi-channel Analysis of Surface Waves) and SPAC (Spatial Auto Correlation) seismic refraction methods are presented in attached Appendix C. In summary, the MASW/SPAC report concludes that the site can be classified as Seismic Class D under the 2012 Ontario Building Code.

4.0 SUBSURFACE CONDITIONS

4.1 Summary

Based on information obtained at the borehole locations as detailed on the logs of attached Appendix B and summarized in attached Table 1, the soil conditions within the limits of the site appear to consist primarily of the following:

- Somewhat discontinuous layer of peat or topsoil that is either at surface or buried under a thin layer of surface fill with total combined thickness of these materials that varies from 0.2 m (BH22-12) to 2.2 m (BH22-14) with typically thicknesses in the order of just less than 1 m except along the easterly 10 to 15 m of the site where fill thicknesses are greater. These materials are believed to be a result of various general work activities undertaken on this site since 2004, including preparation of a construction access road along the easterly 10 to 15 m of the site.
- Extensive layer of intermediate plasticity Silty Clay materials from immediately below the surface fill and/or organic materials to confirmed total depths of 16.2 m (underside elevation of 76.7 m) at the location of BH22-3 and 18.3 m (underside elevation of 74.9 m) at the location of BH22-11. This layer has a near surface upper crust that is comprised of interbedded cohesionless fine grained sandy silt materials and silty clay materials with estimated average undrained shear strengths in the order of 50 kPa.
- Deep layer of underlying cohesionless glacial till materials of unconfirmed total thickness.

Available water levels within the various installed groundwater monitoring wells as summarized in attached Table 2, indicate that on December 6, 2022, i.e., 11 days after the completion of all drilling works, water levels in the four shallow wells of BH22-1, 4, 12 and 14 varied from elevation 92.314 m (BH22-1) and 91.649 m (BH22.4). In comparison the water level within the deep well of BH22-3 on December 6, 2022 was 92.100 m. The data suggests that the water levels within the surface silty clay materials are more or less consistent with the water level of underlying deep soils. The data also suggests that on an overall basis, groundwater flows seem to be predominantly northwest to southeast. However, please note that the attached summary water level data of attached Table 2 represent measurements over a quite limited period of time and as such, may not represent fully stabilized values, especially in the near surface silty clay materials. In addition, some seasonal variation should be expected.

A more detailed assessment of the foregoing conditions is presented in the following sections. However, for specific information, the reader should consult the attached factual data presented in attached Appendix B to F. In addition, it should be noted that the following summary is based on soil and groundwater conditions that were only confirmed at the borehole locations and variations between and beyond those locations should be expected.

4.2 Stratigraphic Units

4.2.1 Surface Materials

As detailed in attached Table 1, these materials refer to a somewhat discontinuous layer of peat or topsoil that is either at surface or buried under a thin layer of surface fill with total combined thickness of these materials varying from 0.2 m (BH22-12) to 2.2 m (BH22-14) with typically thicknesses in the order of just less than 1 m except along the east side of the site where fill thicknesses of between 1.8 m and 3.0 m were confirmed at the locations of BH22-4, 10 and 14. Underside elevations of the foregoing materials as detailed in attached Table 1 vary from 91.3 m at the location of BH22-10 to 92.4 m at the location of BH22-7 with most underside elevations being in the order of 92.2 to 92.3 m except for BH22-10. While the peat and possibly the surface topsoil materials are presumed native to the site, in general these materials are believed to be a result of the various general work activities undertaken on this site since 2004. Review of available air photographs for the site indicate the following general works have occurred within the site limits since it was positively confirmed to be a green field site in 2004:

- Removal and/or partial removal of surface peat materials from the site in 2008 in conjunction with placement of a layer of surface sand materials.
- Establishment of a construction access road in 2013 along the easterly 10 to 15 m of the site and various minor widening and/or realignment upgrades through to 2018.
- Preservation of a former south flowing drainage drain noted on attached Figure 2 through to its total backfill in 2020.

In general, the foregoing activities are believed to be the primary reason why most of the fill materials that form part of this layer have a trace of organic materials present. In particular, the fine grained near surface fill materials of BH22-4, 10 and 14 are specifically believed to be related to the above noted east side construction access road. While attempts were made through the completion of BH22-6, 9, 12 and 13 to assess the materials of the backfilled former drainage ditch, localized deeper pockets of fill than indicated in the aforementioned boreholes should be expected along this feature.

In keeping with the variable nature of how these various materials were generated, SPT ‘N_{80}’ values are also highly variable and as such, no conclusion on the apparent degree of compactness and/or consistency of these fill materials is presented.

4.2.2 Silty Clay

Silty Clay of the Ottawa Valley Clay Plain as commonly referred to as "Leda Clay" was encountered below the surface topsoil/organics/fill materials and thereafter to the maximum depth of each borehole except BH22-3 and 11 where the silty clay was confirmed to have respective underside depths of 16.2 m (elevation 76.7 m) and 18.3 m (elevation 74.9 m). In keeping with other deep silty clay deposits not exposed to major post-deposition loading through other geological processes, they are considered normally consolidated and as such, exhibit a stronger upper crust overlying lying weaker materials at depth as detailed in attached Table 1. More specifically, the upper crust materials as comprised of a combination of fine grained cohesionless and low plasticity silty clay materials have combined total thicknesses of between 2.1 m (BH22-12) and 1.1 m (BH22-1 and 8) and associated underside elevations that vary from a high of 91.1 m (BH22-1) and a low of 90.1 m (BH22-10) for an overall average of 90.7 m. The summary undrained shear strength data of attached Figure 3 however suggest that the underside of this layer is at or just slightly below elevation 90.0 m. The results of three (3) grain size distribution analysis on samples of the fine grained cohesionless "crust" materials are presented on Figure C1 of attached Appendix C with similar data from one (1) grain size distribution analysis obtained on a sample of the silty clay "crust" materials presented on Figure C2 of attached Appendix C.

SPT 'N_{80}' data obtained within the fine grained cohesionless materials varied from 15 to zero, i.e., SPT advance using manual push, with most values being less than 10. Hence, based on this data, the fine grained cohesionless materials are considered to have a very loose to loose degree of compactness with a strength profile that reduces with depth. SPT 'N_{80}' data obtained fully within the silty clay crust materials varied from 4 to zero as defined above. Hence, based on this data and the results of in-situ field vane undrained shear strength determinations within the lower reaches of the upper crust silty clay materials, the silty clay portions of the crust are adjudged to have a firm to marginally stiff consistency, i.e., undrained shear strengths of between 25 and 50 kPa between approximate elevation 90 to 91 m and presumed slightly higher values above elevation 91 m.

As noted above, and detailed in the attached Table 1, significant depths of weaker silty clay materials are present below the upper crust, i.e., confirmed total depth of 16.2 m (underside elevation of 76.7 m) at the location of BH22-3 and estimated total depth of 18.3 m (underside elevation of 74.9 m) at the location of BH22-11. The results of ten (10) grain size distribution analyses and six (6) Atterberg Limit soil plasticity determinations are presented respectively on Figure C3 and D1 of attached Appendices C and D. Hence, based on this data these materials are described as silty clay of intermediate plasticity.

In terms of strength, attached Figure 3 presents a summary compilation of undrained shear strength determinations obtained within each borehole using an MTO Field Vane. The compiled field vane undrained shear strength data exhibits a trend of decreasing shear strength from just below the underside of the surface crust at approximate elevation 90 m to achieve minimum values in the order of 22 kPa at or about approximate elevation 89.5 m. Hence, based on this data, the silty clay materials below the surface crust are described as having a soft consistency between approximate elevation 89.5 and 82 m, before becoming firm below this depth, i.e., undrained shear strengths of between 25 and 50 kPa. In terms of sensitivity, i.e., ratio of peak to remolded undrained shear strengths, this ratio for this set of borehole test data varied from 4 to 38 with most values being in the 5 to 25 range and as such, these materials are described as having a low to medium sensitivity.

With respect to compression characteristics of the silty clay materials, the results of four (4) soil consolidation (Oedometer) tests completed on test samples from within deep boreholes BH22-3 and 11, are presented in attached Appendix E. Summary Oedometer test parameters derived by GeoTerre are presented in attached Table 3, including estimates of the maximum previous Pre-Consolidation (loading) pressures experienced by the test samples using methods proposed by Casagrande (1936), Okiwawa, 1987, Becker et al, (1987) and Boone, (2010). Based on this summary data, the following conclusions are deemed appropriate:

- Materials immediately below the upper crust appear to typically have an OCR (defined in attached Table 3) values in the order of 2.2 within the upper reaches of the soft silty clay zone, i.e., BH22-3: Test Sample 6 and BH22-11: Test Sample 9, reducing to approximately 1.3 (range 1.3 to 1.4) within the lower reaches of the soft silty clay zone. i.e., BH22-3: Test Sample 6 and BH22-11: Test Sample 9.
- Virgin Consolidation Compression Index (C_c) values 0.85 and 0.87 obtained respectively for BH22-3: Test Samples 6 and 9, whereas respective values of 1.31 and 1.16 were obtained for BH22-11: Test Samples 6 and 9.
- Coefficient of Reloading (C_r) values as determined from the first unload/reload test cycle undertaken at 40 kPa were respectively 0.007 and 0.005 for BH22-3: Test Samples 6 and 9 whereas respective values of 0.008 and 0.009 were obtained for BH22-11: Test Samples 6 and 9.
- Coefficients of consolidation up to an approximate stress of 60 kPa that are typically equal to 0.01 cm^2/cm reducing considerably to about 0.00005 cm^2/sec at stress levels greater than 60 kPa.

4.2.3 Deep Cohesionless Glacial Till Materials

This layer refers to deposits of cohesionless glacial till materials with a trace of clay that were confirmed within BH22-3 to be present between a depth of 16.2 m (Elevation 76.7 m) and the terminal depth of this borehole of 18.7 m (Elevation 74.2 m) and suspected of being present within BH22-11 between a depth of 18.3 m (Elevation 74.9 m) and the terminal investigation depth of BH22-11 of 21.3 m (Elevation 71.8 m). The results of two (2) grain size distribution analyses obtained on samples of these materials are presented on Figure E3 of attached Appendix E.

Field SPT 'N_{80}' values of 6 and 39 were obtained within these materials at BH22-3 whereas DCPT values within the same layer within BH22-1 varied from a low of 8 to 86, with both boreholes displaying increasing values with depth. Hence, based on the foregoing data, these materials described as being as having a loose degree of compactness becoming dense to very dense at depth.

4.3 Groundwater

Available water levels within the various installed groundwater monitoring wells as summarized in attached Table 2, indicate that on December 6, 2022, i.e., 11 days after the completion of all drilling works, water levels in the four shallow wells of BH22-1, 4, 12 and 14 varied from elevation 92.314 m (BH22-1) and 91.649 m (BH22.4). In comparison the water level within the deep well of BH22-3 on December 6, 2022 was 92.100 m. The data suggests that the water levels within the surface silty clay materials are more or less consistent with the water level within the underlying deep soils. The data also suggests that on an overall basis, groundwater flows seem to be predominantly northwest to southeast. However, please note that the attached summary water level data of attached Table 2 represent measurements over a quite limited period of time and as such, may not represent fully stabilized values, especially in the near surface silty clay materials. In addition, some seasonal variation should be expected.

5.0 ENGINEERING ASSESSMENT AND RECOMMENDATIONS

5.1 General

As indicated on the site plan of attached Appendix E, a total of four (4) low rise (maximum of two stories) CRU's (commercial retail units) without basements are proposed, i.e., two (2) within the north limits of the site, two (2) within the south limits of site with development access roads and parking areas located between and around. Apart from a 10 to 15 m wide strip along the east limit of the site with existing grades that vary from approximate elevation 93.5 m at the south end of site to 94.5 m at the north end of the site, elevations within the remaining westerly portions of the site vary from approximate elevation 92.2 m at the south end of the site to 93.0 m at the north end of the site. Based on SLR preliminary grading information, top of pavement and retail unit finished floor elevations (FFE) are anticipated to be as follows, with approximate existing site grades provided for comparison:

Northwest Corner Pavement: 93.2 m Proposed Building B FFE: 93.9 m (Existing Approx Grade: 92.6 m)	Northeast Corner Pavement: 93.9 m Proposed Building A FFE: 93.9 m (Existing Approx Grade: 94.5 m)
Southwest Corner Pavement: 93.2 m Proposed Building C FFE: 94.0 m (Existing Approx Grade: 93.5 m)	Southeast Corner Pavement: 94.0 m Proposed Building D FFE: 94.2 m (Existing Approx Grade: 93.6 m)

As detailed within, achieving the above noted site grades are estimated to result in settlements in the order of 75 mm and more importantly, the required site grading works detailed in Section 5.2 will result in the underlying weak silty clay soils reaching a point where additional surface loadings, including in particular those related to the proposed buildings, will result in unacceptably high settlements, i.e., in the order of 80 to 100 mm even at very modest SLS (Serviceability Limit State) foundation bearing pressures of 60 kPa. Hence, and subject to actual site settlement monitoring results in response to the site grading works and minimum viable SLS foundation loadings, there appears to no obvious solution to address the unacceptably high estimated building settlements as discussed in more detail in Section 5.3. In addition to the foregoing site grading and foundation design assessments of Section 5.2 and 5.3, Sections 5.4 and 5.5 respectively address buried site services and pavement design works with Section 5.6 addressing some general design and construction considerations.

Please note that the engineering assessment and design recommendations provided in the following sections are intended for guidance and sole use of the designers and planners associated with the proposed development. In addition, it should be further noted that the soil and groundwater conditions were only confirmed at the borehole locations and will vary between these locations.

5.2 Site Preparation and Grading

As noted in Sections 2 and 4.2.1 of this report, various construction activities were undertaken within the site limits between 2004 and 2018, the net result of which is a somewhat discontinuous layer of peat or topsoil that is either at surface or buried under a thin layer of surface fill. The total combined thickness of these materials varies from 0.2 m (BH22-12) to 2.2 m (BH22-14) with typically thicknesses in the order of just less than 1 m except along the east side of the site where fill thicknesses of between 1.8 m and 3.0 m were confirmed at the locations of BH22-4, 10 and 14. Underside elevation of the foregoing materials as detailed in attached Table 1 vary from 91.3 m at the location of BH22-10 to 92.4 m at the location of BH22-7 with most underside elevations being in the order of 92.2 to 92.3 m except for BH22-10. However, some of the upper reaches of the underlying native materials have random organic contents and, locally deeper buried organic materials are expected along the alignment of the former drainage ditch shown on attached Figure 2.

The foregoing fill and otherwise organic impacted materials are unsuitable for support of building foundations and paved areas, and as such, these materials need to be removed and replaced with suitable inorganic materials, with the most obvious materials in this case being OPSS.MUNI 1010 Granular A materials given that almost all of the site will be developed or paved. For design purposes, an approximate underside elevation of 92.0 m should be anticipated for the required removal and replacement works that should be undertaken as per the following:

1) All existing topsoil and other obviously weak or deleterious materials are removed from the entire footprint area of the proposed site to expose the top surface of the underlying inorganic native soils as expected to consist of a combination of fine grained cohesionless materials and low plasticity silty clay at elevations no deeper than approximate elevation 92.0 m.
2) Exposed top surface from 1) is nominally compacted with at least 5 passes of a large ride-on compactor, preferably in vibration mode although it is very possible that it will be required to adopt a zero vibrations mode within areas that are occupied by fine grained cohesionless materials at or a short distance above the ambient water table. During this work, particular emphasis should be given to the identification and remediation of any soft/weak spots that may be present, i.e., sub-excavate and replace with inorganic fill compacted to at least 95 % of its Standard Proctor Maximum Dry Density (SPMDD) or, 98 % if practical.
3) Regrade entire site to a constant general elevation in the order of 92.0 m to accommodate the placement of continuous layer of Geo-Grid (Terrafix Geogrid Product TBX3000) on the native subgrade under the footprint area of each proposed building and at least 5 m beyond and a similar layer at elevation 92.3 m in anticipation of an approximate building foundation underside not lower than elevation 92.5 m.
4) Raise the grade of the entire site from approximate elevation 92.0 m up to proposed final top of pavement grades using OPSS.MUNI 1010 Granular A materials compacted in lifts not exceeding 0.3 m thick to achieve at least 98 % of their SPMDD, including placement of proposed Geo-Grid layers noted in 3) above.

At variance to the above general site grading approach, fine grained, low permeability local native materials is preferred for backfill of the former drainage ditch up to approximate elevation 92.0 m, which may require continuous sump and pump operations along the length of the former drainage ditch to achieve. However, if required, Granular A materials can used for backfill of the entire former drainage ditch.

It is recommended that all site preparation works outlined in the foregoing page be undertaken while temperatures, including those overnight, are above zero and under the full-time direction of suitably qualified geotechnical personnel.

The objective of the proposed Geo-Grid layers is to enhance the load distribution below each proposed strip or pad foundation and also assist with modulating differential building settlements. By way of planning for the design and construction of the proposed commercial retail units, servicing requirements for each proposed commercial unit must be located above the proposed Geo-Grid layers in order to better preserve the above noted Geo-Grid design objectives.

Based on the summary consolidation test data presented in attached Table 3, total settlements in response to the foregoing site preparation and grading works are estimated by GeoTerre to be somewhere in the order of 75 mm for an assumed average final site grade of approximate elevation 94.0 m. It is however recommended that a suitable settlement monitoring plan be instigated during completion of the foregoing site grading works by way of developing a better understanding of how the soils of the site respond under full scale loadings. In the interim however, it should be assumed that no site servicing works can be undertaken until all soil settlements related to general site grading works have taken place or, until the rate of settlement and/or projected final settlements are deemed acceptable.

5.3 Building Foundation Considerations

5.3.1 Building Foundations

Based on the summary grading information of Section 5.2, the "typical" design stratigraphy for the building foundations is estimated to be as follows:

- Elevation 94.0 to 92.0 m: Compacted OPSS.MUNI Granular A Materials
- Elevation 92.0 to 90.0 m: Upper Soil Crust (Silty Clay and Fine Grained Cohesionless Materials)
- Elevation 90.0 to 81.0 m: Soft Silty Clay (average undrained shear strength of 22 kPa)
- Elevation 81.0 to 75.0 m: Firm Silty Clay (average undrained shear strength of 40 kPa)

Based on the above noted soil design stratigraphy and assumed foundation underside of elevation 92.5 m, a design bearing capacity at the ULS (Ultimate Limit State) of 100 kPa is deemed appropriate for strip foundations up to 2 m wide and pad footings up to 4 m by 4 m in size. However, in terms of estimating settlement to assess a suitable SLS (Serviceability Limit State) allowable bearing capacity, analyses completing by GeoTerre indicate that 2 m wide strip foundation with 60 kPa uniform load will generate some 80 to 100 mm of settlement which is unacceptable. This high settlement estimate for a relative small applied foundation load is largely a result of the 44 kPa of additional surface loads generated as a result of the required site grading works detailed in Section 5.2, i.e., the site grading additional surface loads has resulted in a significant portion of the deep silty clay layer being loaded close to, or very slightly beyond the maximum load the soil has previously experienced which in geotechnical terms is known as the maximum past pre-consolidation effective pressure (σ'_p). The maximum past pre-consolidation represents the transition between relatively flat portion of the Oedometer Voids Ratio (e) versus Log_{10} Applied Stress (e-Log P) plots of attached Appendix E, at pressures less than the σ'_p values of attached Table 3 versus the steep portion of the e-Log P plots lot at pressures greater than σ'_p.

In terms of potential solutions, the conventional approach to limit post construction settlements is to apply a pre-load, i.e., place materials (usually granular) over the surface of the site with the objective of increasing the σ'_p value and thereby reduce building settlements by removing the pre-load and replacing it with a building of lighter total loads than the pre-load. For this site, the following pre-load values are estimated to result in the following total maximum settlements below the center of the pre-loaded area.

Height of Grade Raise Granular Fill	Estimated Maximum Settlement (approx.)
1 m (22 kPa)	225
2 m (44 kPa)	425
3 m (66 kPa)	650

The major downside of the foregoing approach is the amount of time required for the settlements to occur, i.e., outrageously long times (> 100 years) based on the coefficient of consolidation test data of attached Appendix E. However, settlement monitoring reports from quite a number of pre-load test piles that have been undertaken within the overall Half Moon Bay development tend to suggest that the overall "bulk" rate of settlement may be considerably shorter even though no general recommendations arising out of the test pile settlement data is known by GeoTerre to have been developed. Another possible approach is the use of pre-fabricated vertical wick drains installed in a regular grid pattern that speeds up the development of the problematic settlements by shortening the drainage path for excess pore-water pressures within the silty clay matrix. However, cost implications as well as the applicability of this approach to the Leda Clays of the Ottawa area will have to be researched although as a general comment, it is known to GeoTerre that vertical wick drains have issues with maintaining drainage integrity in situations where large settlements are expected.

Another possible approach to determine how best to develop this site would include the possible use of lightweight materials for site grading and building construction and thereby hopefully limit final applied surface foundation loads resulting from the proposed development. To this end, settlement analyses completed by GeoTerre for site grading works completed using materials with a density of 18 kN/m^3 indicate that while it considerably reduces settlements related to site grading, it does not appreciable reduce the settlements in response to building foundations with SLS loads of 60 kPa.

In consideration of the foregoing, GeoTerre is not in a position to provide immediate recommendation on how best to proceed with the development of this site, although we look forward to interfacing with SLR and other interested parties to hopefully reach consensus on how best to move forward.

On the more general design front, please note that all exterior footings or interior footings of unheated buildings should be provided with soil or equivalent soil cover as per the recommendations of Section 5.6.1 for the purposes of frost protection. Please also note that the shallower foundations can be placed will result in lower "average" loads being transferred to the compressible soil below elevation 90 m, even though the maximum depth change of 1 m above the underside elevation of 92.5 m assumed within, are not expected to change the overall conclusions regarding estimated building settlements.

Finally, please note that excavations for footings must be completed in accordance with the Occupational Health and Safety Act (and Regulations for Construction Projects).

5.3.2 Seismic Design

As noted in Section 3.0, a Shear Wave Velocity Sounding to determine the applicable Seismic Site Class as per the requirements of the 2012 version of the Ontario Building Code and, to satisfy a City of Ottawa design requirement for the approval of proposed development known to be underlain by weak "Leda Silty Clay" materials was undertaken. The results of this study as completed on December 8, 2022 by the Montreal office of Geophysics GPR International Inc., using MASW (Multi-channel Analysis of Surface Waves) and SPAC (Spatial Auto Correlation) seismic refraction methods are presented in attached Appendix F. In summary, the MASW/SPAC report concludes that the site can be classified as Seismic Class D under the 2012 Ontario Building Code.

Additional analyses completed by GeoTerre indicate that the soils at the site are not susceptible to liquefaction.

5.4 Buried Site Services

It is understood that the depth of required site services has not yet been determined, although it is generally expected that they will not exceed 3 m in depth below final grades given that primary storm and sanitary sewer connection have been established in the southeast corner of the site and, the design frost penetration depth for the site as detailed in Section 5.6.1 is 1.8 m. As previously recommended in Section 5.2, no buried service installations should be undertaken until site settlements related to general site grading have been deemed to be essentially complete. A similar delay should also be enacted until any building footprint pre-loading works have reached a similar status.

Subsequent to the effective completion of site settlements related to grading and the like, it is anticipated that required site service trenching works within areas scheduled for paving will be undertaken through approximately 2 m of OPSS-MUNI 1010 Granular A into the underlying native soils located below the estimated approximate water table level of 92.0 m. Trench excavations to these depths are expected to remain largely stable if excavated with side slopes that are inclined no steeper than 1 Vertical to 1 Horizontal (1V:1H). However, some water seepage from within the native fine grained cohesionless materials below approximate elevation 92 m should be expected and as such, will likely lead to lead to sidewall instability below elevation 92 m and associated ravelling of the overlying Granular A materials. However, it should be possible to accommodate the water inflow issues using appropriately spaced and properly functioning sump and pump installations along the length of the required trenches in advance of excavating below elevation 92 m.

Notwithstanding the foregoing trench stability assessments, where workmen must enter any excavation deeper than 1.2 m, the sidewalls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act (and Regulations for Construction Projects) in Ontario. Specifically, as of April 8, 2013, sub-section 226 of the Occupational Health and Safety Act recognize four (4) broad classifications of soils, which are summarized as follows:

TYPE 1 SOIL
a) is hard, very dense and only able to be penetrated with difficulty by a small sharp object;
b) has a low natural moisture content and a high degree of internal strength;
c) has no signs of water seepage; and
d) can be excavated only by mechanical equipment

TYPE 2 SOIL
a) is very stiff, dense and can be penetrated with moderate difficulty by a small sharp object;
b) has a low to medium natural moisture content and a medium degree of internal strength; and
c) has a damp appearance after it is excavated

TYPE 3 SOIL
a) is stiff to firm and compact to loose in consistency or is previously-excavated soil;
b) exhibits signs of surface cracking;
c) exhibits signs of water seepage;
d) if it is dry, may run easily into a well-defined conical pile; and
e) has a low degree of internal strength

TYPE 4 SOIL
a) is soft to very soft and very loose in consistency, very sensitive and upon disturbance is significantly reduced in natural strength;
b) runs easily or flows, unless it is completely supported before excavating procedures;
c) has almost no internal strength;
d) is wet or muddy; and
e) exerts substantial fluid pressure on its supporting system

The expected near surface Granular A materials are expected to behave as Type 2 soil whereas the native soils over the 91 to 92 m horizon are expected to behave as Type 3 soil. While excavations below elevation 91 m are not expected, please note that soils below elevation 90 m will behave as Type 4 soil.

Based on the foregoing anticipated trench conditions above approximate elevation 91 m, the design of the various site services may be completed in accordance with their various applicable OPSD's. Bedding material and backfill within the various pipe zones should consist of OPSS.MUNI Granular 'A' compacted to at least 95 % of its SPMDD. Trench backfill should consist of locally excavated "clean" OPSS.MUNI 1010 Granular A material compacted in lifts not exceeding 300 mm in thickness to achieve at least 95 % of its SPMDD throughout and 98 % in the upper 300 mm under paved areas. All site servicing elements prone to freezing should be provided with soil (or equivalent) cover for frost protection purposes in accordance with the recommendations of Section 5.6.1.

In addition to foregoing general buried services installation requirements within a trench, the following additional requirements should be enacted to help avoid lowering of the groundwater table and related potential negative hydrogeological impacts and possible ground settlements, especially for services installed below the estimated "average" groundwater table level for the site of elevation 92.0 m:

- Watertight pipes and related joints.
- Provision of clay seals around the pipes up to at least elevation 93 m to prevent lateral flow within/along the pipe bedding. At a minimum, clay seals should be placed as close as possible to the property line for all services that exit the site and at least every 20 m within the site.

Finally, the invert of elevation of proposed stormwater infiltration chambers should be carefully assessed with the project hydrogeological scientist to help avoid potential negative hydrogeological impacts.

5.5 Pavement Considerations

In anticipation of the site paving works being completing on a subgrade that consists of at least 1.5 m of well compacted OPSS.MUNI Granular A materials as per the site preparation works outlined in Section 5.2, the following pavement structures are recommended which assumes that all granular materials related to site grading are removed to a minimum depth of at least 300 mm below required final grades or as required to make sure that no contaminated granular materials are present within the total recommended pavement depths provided below:

Entranceways/Fire Routes/Main Throughways

Asphalt	Surface Course (HL3)	40 mm	
	Basecourse (HL8)	60 mm	
		100 mm	100 mm
New Granular Base (OPSS.MUNI 1010 Granular A)			200 mm (minimum)
Existing "Site Grading" Granular Base			350 mm (minimum)
			650 mm

Car Parking Areas

Asphalt	Surface Course (HL3)	40 mm	
	Basecourse (HL8)	40 mm	
		80 mm	80 mm
New Granular Base (OPSS.MUNI 1010 Granular A)			200 mm (minimum)
Existing "Site Grading" Granular Base			350 mm (minimum)
			630 mm

Asphalt materials to be in accordance with the appropriate OPSS and similarly, compacted in accordance with the requirements of OPSS 310. Granular base materials are to be compacted to at least 100 % of their SPMDD. Given the expected presence of quite deep Granular A base materials below all expected paved areas, an extensive system of sub-drains to promote drainage of water from with the underlying granular materials is not considered necessary.

5.6 General Design and Construction Considerations

5.6.1 Frost Penetration

The estimated depth of frost penetration for the site is 1.8 m and the underside of all exterior footings and/or elements that are prone to freezing should be provided with this amount of soil or equivalent cover.

5.6.2 Concrete Sulphate Requirements

Based on the results of the soluble sulphate content testing presented in Section 3.0, the soils at the site pose no risk of soluble sulphate attack on buried concrete. Accordingly, no special sulphate protection provisions for buried concrete are required for the site and therefore regular "general use" Portland cement may be used.

5.6.3 Import and Export of Site Soil

Environmental issues related to the proposed works were beyond the scope of this GeoTerre report and the intent of this section is to highlight that the disposal of excess soils from the site and/or the import of required grade raise fill materials must be undertaken in accordance with applicable environmental legislation.

5.6.4 Borehole Abandonment

It is recommended that prior to the damage of any existing boreholes with installed piezometers that the installed piezometer pipes be abandoned in accordance with MOE Regulation 903.

5.6.5 Construction Supervision

It is recommended that the works outlined within be completed under the under the direct observation of GeoTerre who have the best familiarity with the soil conditions within the site boundaries and the rationale behind the development of the various geotechnical design recommendations presented within. In addition, and as detailed in the "*Limitations and Information Regarding Use of Report*" of attached Appendix A, retaining GeoTerre to undertake the foregoing observations during construction is considered to be an integral and vital part of the implementation of the various recommendations, opinions and suggestions contained in this report.

6.0 CLOSURE

We trust that this report sufficient details the conditions that exist at this site and the significant challenges that still need to be addressed before an appropriate geotechnical design strategy can be developed for the site. To that end, please do not hesitate to contact GeoTerre should you have any questions or require clarification on any matter.

As previously noted, we wish to highlight that the contents of this report are subject to the attached Statement of Limitations of Appendix A.

GEOTERRE LIMITED

LICENSED PROFESSIONAL ENGINEER
I. CORBETT
Apr 6'23
PROVINCE OF ONTARIO

Ivan Corbett, M.Sc., P.Eng.
President

REFERENCES

Becker, D.B., Crooks, J.H.A., Been, K., and Jefferies, M.G. 1987. "Work as a criterion for determining in situ and yield stresses in clays". Canadian Geotechnical Journal, 24(4): 549-564.

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Oikawa, H. 1987. "Compression curve of soft soils." Journal of the Japanese Geotechnical Society, Soils and Foundations, 27(3): 99-104.

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TABLES

TABLE 1
PROPOSED COMMERCIAL DEVELOPMENT
3850 CAMBRIAN ROAD, NEPEAN, OTTAWA
GEOTECHNICAL INVESTIGATION REPORT - REVISION 1 - FINAL

SUMMARY OF BOREHOLE INFORMATION

Borehole No.	Borehole Depth (m)	Ground Surface Elevation(1) (m)	Stratigraphic Summary (m) Layer Thickness/**Investigated Depth** (Underside Elevation)				
			Surface Peat/ Topsoil/Fill	Fine Grained Cohesionless Materials	Silty Clay Layer		Deep Soils (Cohesionless Till Materials)
					Upper Crust (2)	Below Crust	
BH22-1	5.9	92.506	0.3 (92.2)	1.1 (91.1)	None	**4.5** (86.6)	Not Reached
BH22-2	7.3	92.582	0.4 (92.2)	1.7 (90.4)	None	**5.2** (85.3)	Not Reached
BH22-3	18.7	92.952	0.8 (92.1)	None	1.3 (90.8)	14.1 (76.7)	**2.5** (74.2)
BH22-4	5.9	93.682	1.8 (91.9)	None	1.4 (90.5)	**2.7** (87.7)	Not Reached
BH22-5	5.9	92.456	None	None	1.8 (90.6)	**4.1** (86.5)	Not Reached
BH22-6	7.5	93.015	0.8 (92.2)	1.4 (90.8)	None	**5.3** (85.5)	Not Reached
BH22-7	5.8	93.115	0.7 (92.4)	1.4 (91.0)	None	**3.7** (87.3)	Not Reached
BH22-8	7.3	93.154	1.0 (92.2)	1.1 (91.0)	None	**5.2** (85.8)	Not Reached
BH22-9	5.9	93.215	0.9 (92.3)	1.3 (91.0)	None	**5.7** (87.3)	Not Reached
BH22-10	7.5	94.233	3.0 (91.3)	1.1 (90.1)	None	**3.4** (86.8)	Not Reached
BH22-11	21.3	93.164	0.9 (92.2)	1.2 (91.0) (3)	0.8 (90.3)	?? (74.9)	**3.0** (71.8)
BH22-12	5.9	92.547	0.2 (92.3)	2.1 (90.3)(3)	None	**3.6** (86.6)	Not Reached
BH22-13	7.5	92.949	0.7 (92.3)	1.5 (90.7)	None	**5.3** (85.5)	Not Reached
BH22-14	7.5	94.394	2.2 (92.2)	0.7 (91.5)	0.8 (90.7)	**3.8** (86.9)	Not Reached

Notes: (1) Borehole survey data obtained by SLR (Canada) Ltd. relative to the top of an existing Round Sanitary Sewer manhole located in the south east corner of the site with a Geodetic Elevation of 93.55 m as confimed by a Registered Ontario Land Surveyor.

(2) Based on Midpoint of SPT Values of greater than 1 and 0 (Manual Push)

(3) Includes overlying thin layer of silty clay.

TABLE 2
PROPOSED COMMERCIAL DEVELOPMENT
3850 CAMBRIAN ROAD, NEPEAN, OTTAWA
GEOTECHNICAL INVESTIGATION REPORT - REVISION 1 - FINAL

Borehole Monitoring Well Details & Groundwater Level Measurements up to December 6, 2022

Borehole No.	Borehole Depth (m)	Ground Elevation (m)(1)	Monitoring Well Details					Measured Groundwater Levels in metres(2)					
			Type	Tip Depth (m)	Screen Length (m)	Tip Formation	Installation Date	28-Nov-22		06-Dec-22			
								Depth(2)	Elevation	Depth	Elevation	Depth	Elevation
BH22-1	5.9	92.506	50 mm PVC Pipe	4.6	3.0	Silty Clay	24-Nov-22	0.589	91.917	0.192	92.314		
BH22-2	7.3	92.582	No Monitoring Well Installed										
BH22-3	18.7	92.952	50 mm PVC Pipe	18.3	1.5	Cohesionless Glacial Till	22-Nov-22	1.232	91.720	0.852	92.100		
BH22-4	5.9	93.682	50 mm PVC Pipe	4.6	3.0	Silty Clay	23-Nov-22	2.539	91.143	2.033	91.649		
BH22-5	5.9	92.456	No Monitoring Well Installed										
BH22-6	7.5	93.015	No Monitoring Well Installed										
BH22-7	5.8	93.115	No Monitoring Well Installed										
BH22-8	7.3	93.154	No Monitoring Well Installed										
BH22-9	5.9	93.215	No Monitoring Well Installed										
BH22-10	7.5	94.233	No Monitoring Well Installed										
BH22-11	21.3	93.164	No Monitoring Well Installed										
BH22-12	5.9	92.547	50 mm PVC Pipe	4.6	3.0	Silty Clay	24-Nov-22	0.535	92.012	0.274	92.273		
BH22-13	7.5	92.949	No Monitoring Well Installed										
BH22-14	7.5	94.394	50 mm PVC Pipe	4.6	3.0	Silty Clay	23-Nov-22	2.846	91.458	2.396	91.998		

Notes: (1) Borehole survey data obtained by SLR (Canada) Ltd. relative to the top of an existing Round Sanitary Sewer manhole located in the south east corner of the site with a Geodetic Elevation of 93.55 m as confimed by a Registered Ontario Land Surveyor.
(2) Water depth relative to ground surface.

🟨	Wells Believed to be Sensing Near Surface Silty Clay Water Table Pressures/Levels
🟩	Wells Believed to be Sensing Underlying Cohesionless Glacial Till Water Table Pressures/Levels

TABLE 3
PROPOSED COMMERCIAL DEVELOPMENT - 3850 CAMBRIAN ROAD, NEPEAN, OTTAWA
GEOTECHNICAL INVESTIGATION REPORT -REVISION 1 - FINAL
SUMMARY OF OEDOMETER SOIL COMPRESSION TEST DATA

Test Sample Information								Estimated Test Key Parameters									
Borehole	Ground Elevation	Water Table Elevation[1]	Sample# &(Type)[2]	Borehole Strength Data [3]	Depth	Elevation	Unit Weight	Insitu Effective Stress [4]	Estimated Preconsolidation Pressure[5]					OCR [6]	Settlement Key Parameters [7]		
									Method A	Method B	Method C	Method D	Average		e_o	C_c	C_r
	(m)	(m)			(m)	(m)	(kN/m^3)	(kPa)	(kPa)								
BH22-3	92.952	92.100	6 (Type B)	29	5.05	87.902	17.51	48.1	105	98	104	103	104	2.2	1.204	0.850	0.007
			9 (Type C)	27	9.70	83.252	17.39	83.6	115	112	118	115	116	1.4	1.237	0.870	0.005
BH22-11	93.164	92.273	6 (Type B)	28	5.13	88.034	16.85	48.1	108	98	103	100	104	2.2	1.428	1.310	0.008
			9 (Type C)	22	9.65	83.514	16.80	79.8	105	98	105	102	104	1.3	1.454	1.160	0.009

NOTES

1) BH22-3 Water Levels based on that recorded on December 6, 2022, whereas BH22-11 Water Level is based on that recorded in BH22-12 on December 6, 2022

2) Type A: Upper Crust Sample; Type B: Sample from Weak Silty Clay just below Upper Crust; Type C: Sample from lower reaches of Weak Silty Clay

3) Value quoted is Average Field Vane Undrained Shear Strength (C_u) Measured above and below test sample in kPa

4) Based on Assumed Unit Weight of 18.0 kN/m^3 above Elevation 90.8 m in BH22-3 and 90.3 m in BH22-11 and Average of Oedometer Test Samples below the foregoing Elevations

5) Method A (Casagrande, 1936); Method B (Oikawa, 1987); Method C (Becker et al, 1987); Method D (Boone, 2010). Average excludes Method C values.

6) OCR - Over Consolidation Ratio (ratio of average past-preconsolidation pressure/existing insitu effective stress)

7) e_o - initial void ratio as estimated at existing vertical effective stress of test sample; Cc - Coefficient of Virgin Compresion;

Cr - Coefficient of Reloading values obtained over the first increment of unloading after achieving appied maximum test load

FIGURES

PROPOSED COMMERCIAL DEVELOPMENT
3850 CAMBRIAN ROAD, NEPEAN, OTTAWA
GEOTECHNICAL INVESTIGATION REPORT

SITE LOCATION PLAN

GEOTERRE

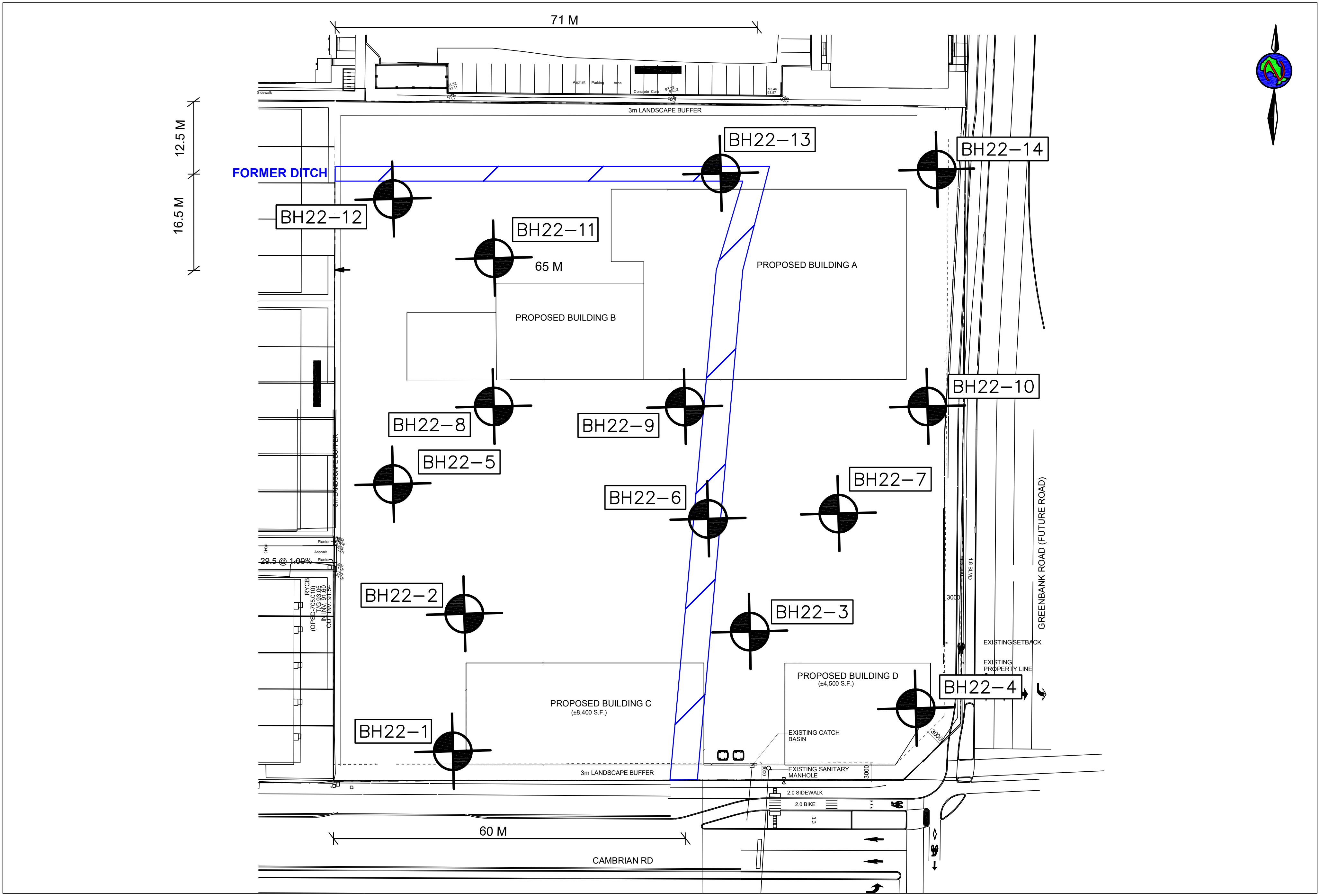
215 ADVANCE BLVD. - UNIT 5/6
BRAMPTON, ONTARIO, L6T 4V9
TEL (905) 455-5666
FAX (905) 455-5639

Date: April 6, 2023

Project No: TG22-045

Scale: AS SHOWN

FIGURE 1



PROPOSED COMMERCIAL DEVELOPMENT
3850 CAMBRIAN ROAD, NEPEAN, OTTAWA
GEOTECHNICAL INVESTIGATION REPORT

BOREHOLE LOCATION PLAN

GEOTERRE

215 ADVANCE BLVD. - UNIT 5/6
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TEL (905) 455-5666
FAX (905) 455-5639

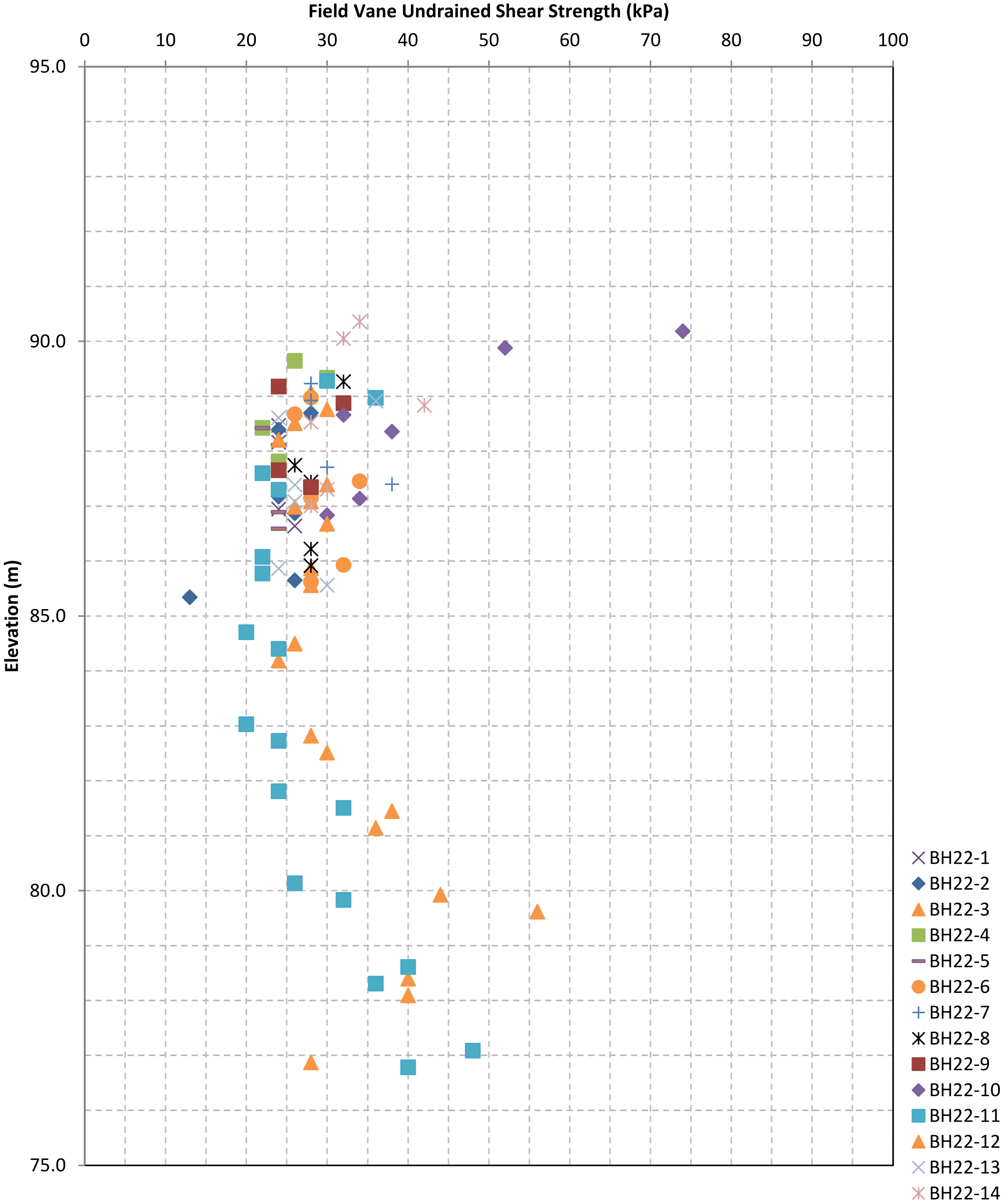
Date: April 6, 2023

Project No: TG22-045

Scale: AS SHOWN

FIGURE 2

FIGURE 3
PROPOSED 3850 CAMBRIAN ROAD DEVELOPMENT
2022 GEOTECHNICAL INVESTIGATION
FIELD VANE DATA VERSUS ELEVATION



APPENDIX A

LIMITATIONS AND INFORMATION REGARDING USE OF REPORT

LIMITATIONS AND INFORMATION REGARDING USE OF REPORT

This report was prepared by GeoTerre Limited (GeoTerre) in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently working under similar conditions in the jurisdiction in which the services were provided. No other warranty, expressed or implied is made

This report was prepared by GeoTerre Limited (GeoTerre) for the sole use of the named client and for review and use by its designated consultants and government agencies during realization of the project. Any use by a third party of this report other than those named in the preceding sentence, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. GeoTerre accepts no responsibility for damages, if any, suffered by any third party as of a result of decisions made or actions based on this report.

The conclusions and recommendations presented in this report are based on information determined at the borehole locations. Subsurface and groundwater conditions between and beyond the boreholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

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 details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

During construction, we recommend that GeoTerre be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those considered by GeoTerre in the preparation of this report and to confirm and document that construction activities do not adversely affect the recommendations, opinions and suggestions contained in the GeoTerre report. Adequate field review, observation and testing during construction are necessary for GeoTerre to be able to provide letters of assurance in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, the GeoTerre responsibility is limited to the accurate interpretation of the information encountered at the borehole locations at the time of their initial measurement, determination or estimation during the preparation of this report.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs, e.g. the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. 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.

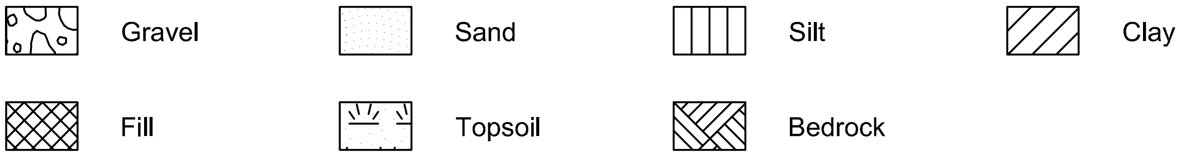
APPENDIX B

GEOTERRE
2022 BOREHOLE LOGS

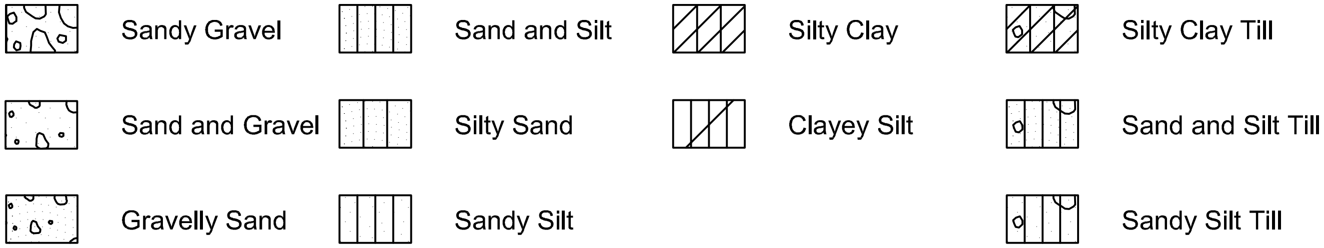
GEOTERRE

SYMBOLS AND TERMS FOR BOREHOLE LOG SOIL DESCRIPTION

BASIC SOIL SYMBOLS



EXAMPLE SOIL REPRESENTATIONS



CLASIFICATION BY PARTICLE SIZE (UNIFIED SOIL CLASSIFICATION SYSTEM)

NAME		PARTICLE SIZE RANGE		
		MM	U. S. STANDARD SIEVE SIZE	
			RETAINED	PASSING
Boulders		>200	8 inch	-
Cobbles		75 to 200	3 inch	8 inch
Gravel	**coarse**	19 to 75	0.75 inch	3 inch
	fine	4.75 to 19	No. 4	0.75 inch
Sand	**coarse**	2 to 4.75	No. 10	No. 4
	medium	0.425 to 2	No. 40	No. 10
	fine	0.075 to 0.425	No. 200	No. 40
Fines (Silt and Clay Particles)		<0.075	-	No. 200

PROPORTION OF MINOR COMPONENTS BY WEIGHT

noun	gravel, sand, silt, clay	>35 % and main fraction
"and"	and gravel, and silt, etc.	35 to 50 %
adjective	gravelly, sandy, silty, clayey, etc.	20 to 35 %
"some"	some sand, some silt, etc.	10 to 20 %
"trace"	trace sand, trace silt, etc.	0 to 10%

DEGREE OF PLASTICITY

DEFINITION	CATEGORY
$W_L<30$	Low
$30<W_L<50$	Medium
$W_L>50$	High

COMPACTNESS OF GRANULAR SOILS BASE ON SPT

COMPACTNESS CONDITION	UNCORRECTED FIELD SPT N-VALUES (BLOWS/300 MM)
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

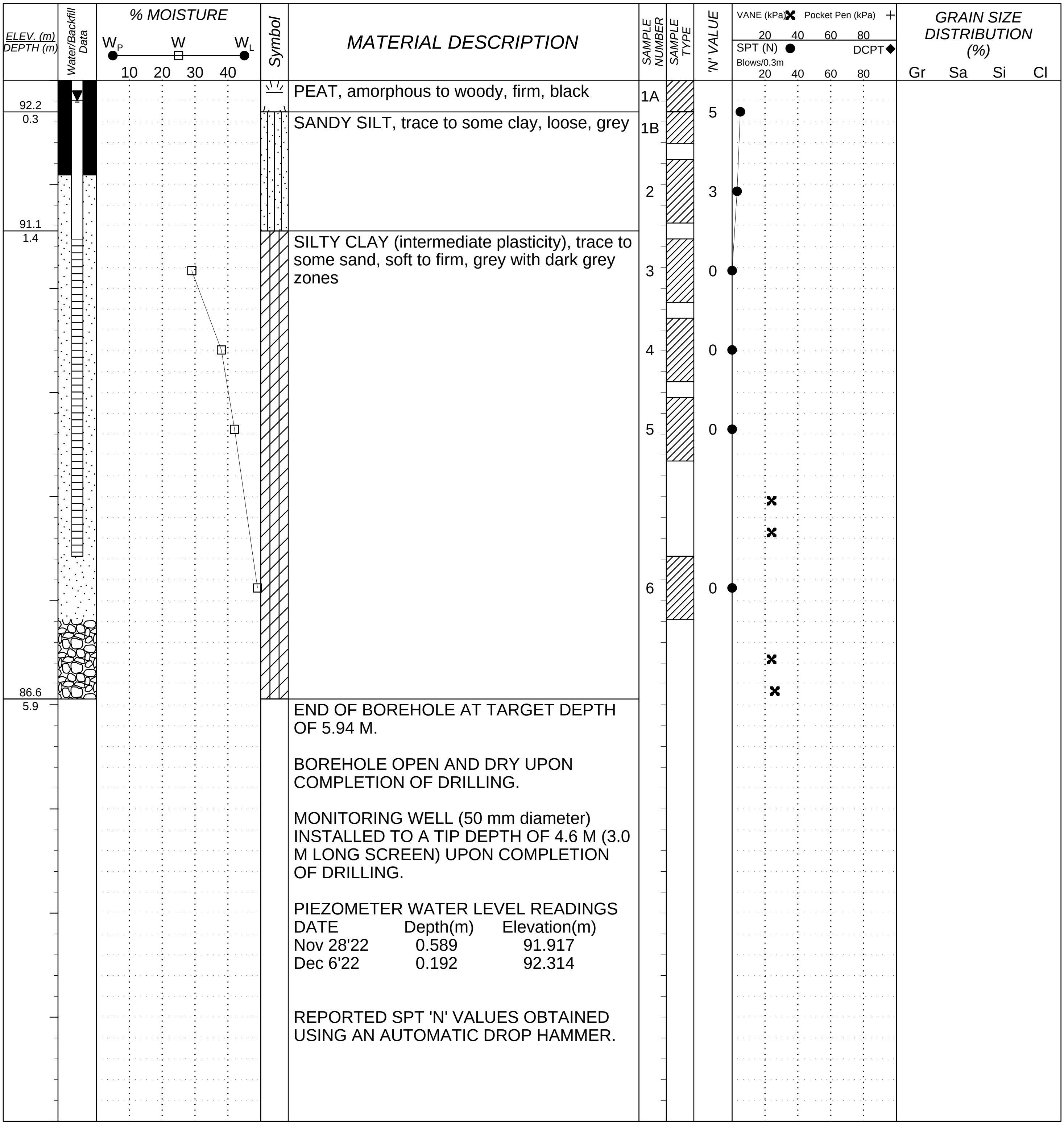
CONSISTENCY AND UNDRAINED SHEAR STRENGTH OF COHESIVE SOILS

CONSISTENCY OF COHESIVE SOILS	UNDRAINED SHEAR STRENGTH (KPA)	UNCORRECTED FIELD SPT N-VALUES (BLOWS/300 MM)
Very Soft	<12	<2
Soft	12 to 25	2 to 4
Firm	25 to 50	5 to 8
Stiff	50 to 100	9 to 15
Very Stiff	100 to 200	16 to 30
Hard	>200	>30

LOG OF BOREHOLE BH22-1

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.506 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 24 2022**



PEAT, amorphous to woody, firm, black

SANDY SILT, trace to some clay, loose, grey

SILTY CLAY (intermediate plasticity), trace to some sand, soft to firm, grey with dark grey zones

END OF BOREHOLE AT TARGET DEPTH OF 5.94 M.

BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING.

MONITORING WELL (50 mm diameter) INSTALLED TO A TIP DEPTH OF 4.6 M (3.0 M LONG SCREEN) UPON COMPLETION OF DRILLING.

PIEZOMETER WATER LEVEL READINGS

DATE	Depth(m)	Elevation(m)
Nov 28'22	0.589	91.917
Dec 6'22	0.192	92.314

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

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SAMPLE TYPE

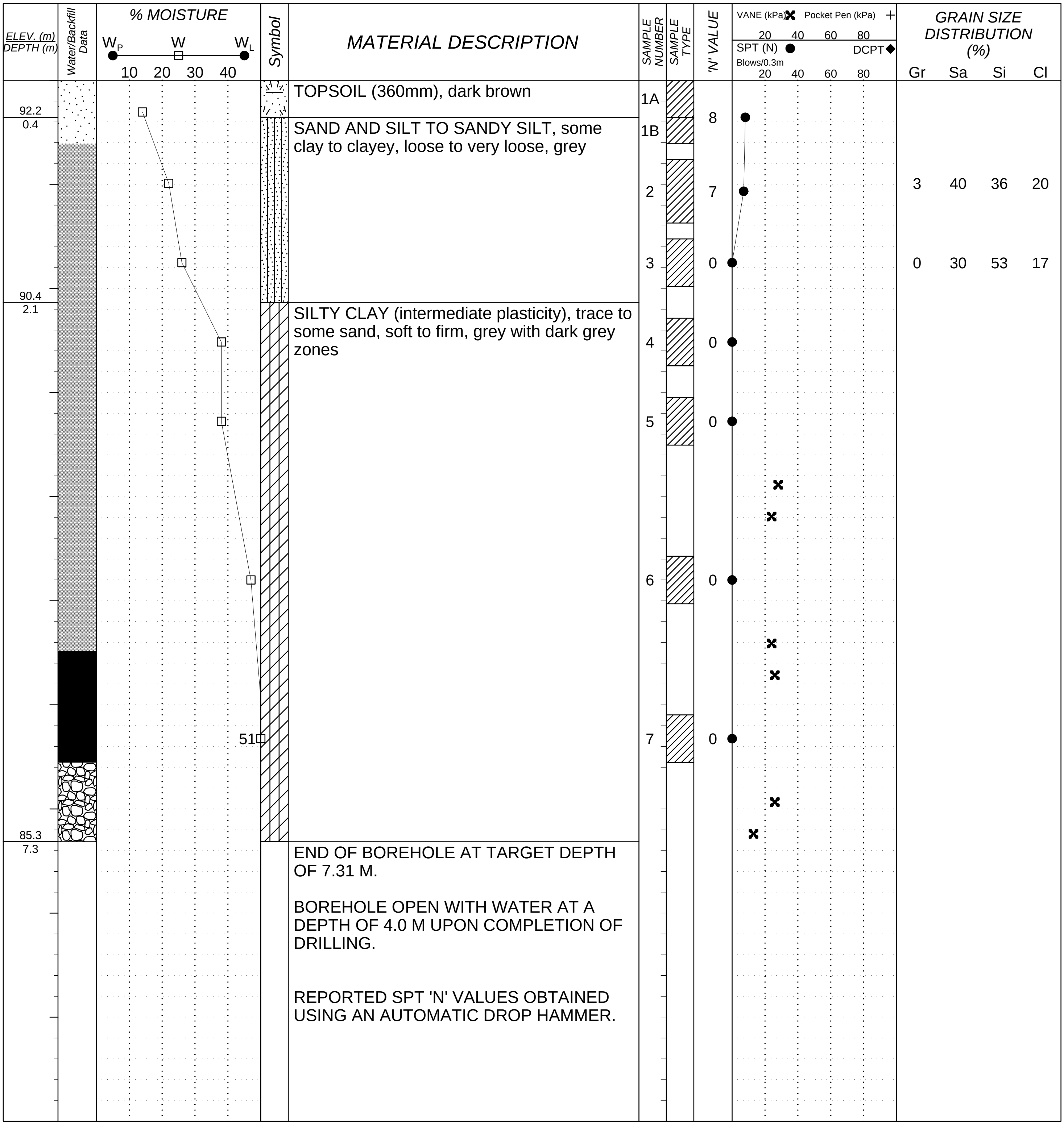
▤	Auger Sample	☐	Thin Wall Tube Sampler
▨	Split Spoon Sample	▥	Pionjar Sample
░	Bulk Sample	☒	Soil Core (PQ)

BACKFILL LEGEND

░	Concrete	■	Bentonite	▧	Grout
▒	Drill Cuttings	⁘	Filter Sand	▩	Slough
▓	Asphalt	▦	Slotted Pipe		

LOG OF BOREHOLE BH22-2

PROJECT No.: **TG22-045**	Drilling Data
CLIENT: **SLR**	METHOD: **Hollow Stem Augers**
PROJECT: **3850 Cambrian Road**	DIAMETER: **200 mm**
LOCATION: **Nepean, Ontario**	PREP. BY: **VTM** APPR. BY: **IC**
SURFACE ELEV.: **92.582 metres (Geodetic)**	DATE: **November 25 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE	GRAIN SIZE DISTRIBUTION (%) Gr	Sa	Si	Cl
	TOPSOIL (360mm), dark brown	1A					
92.2 0.4	SAND AND SILT TO SANDY SILT, some clay to clayey, loose to very loose, grey	1B	8				
		2	7	3	40	36	20
		3	0	0	30	53	17
90.4 2.1	SILTY CLAY (intermediate plasticity), trace to some sand, soft to firm, grey with dark grey zones	4	0				
		5	0				
		6	0				
		7	0				
85.3 7.3	END OF BOREHOLE AT TARGET DEPTH OF 7.31 M.						

BOREHOLE OPEN WITH WATER AT A DEPTH OF 4.0 M UPON COMPLETION OF DRILLING.

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

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SAMPLE TYPE

- ☰ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ⊞ Pionjar Sample
- ☒ Soil Core (PQ)

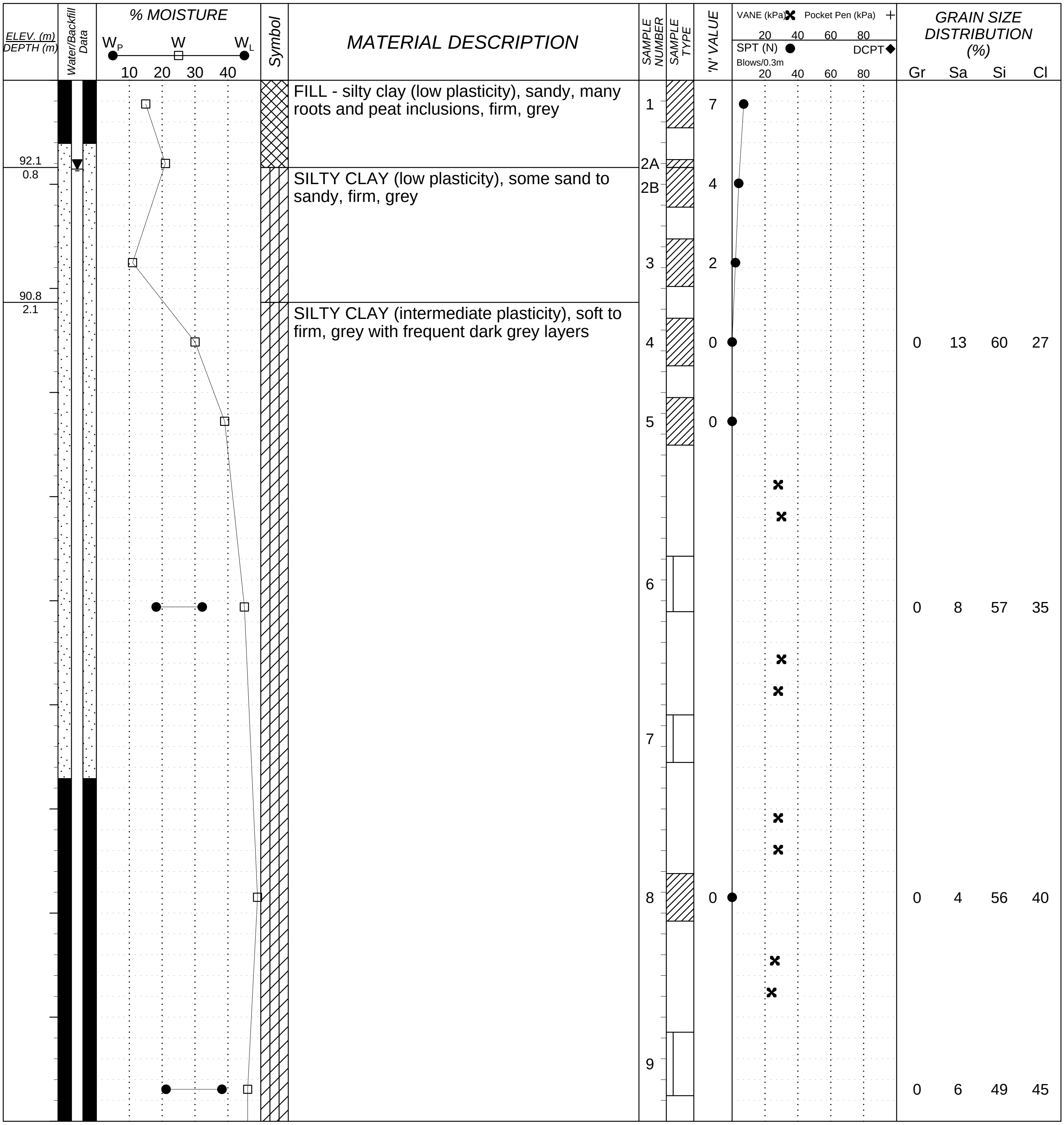
BACKFILL LEGEND

- ▩ Concrete
- ░ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁘ Filter Sand
- ⊞ Slotted Pipe
- ▧ Grout
- ▦ Slough

LOG OF BOREHOLE BH22-3

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.952 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 22 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE	Gr	Sa	Si	Cl
	FILL - silty clay (low plasticity), sandy, many roots and peat inclusions, firm, grey	1	7				
		2A					
92.1 0.8	SILTY CLAY (low plasticity), some sand to sandy, firm, grey	2B	4				
		3	2				
90.8 2.1	SILTY CLAY (intermediate plasticity), soft to firm, grey with frequent dark grey layers	4	0	0	13	60	27
		5	0				
		6		0	8	57	35
		7					
		8	0	0	4	56	40
		9		0	6	49	45

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

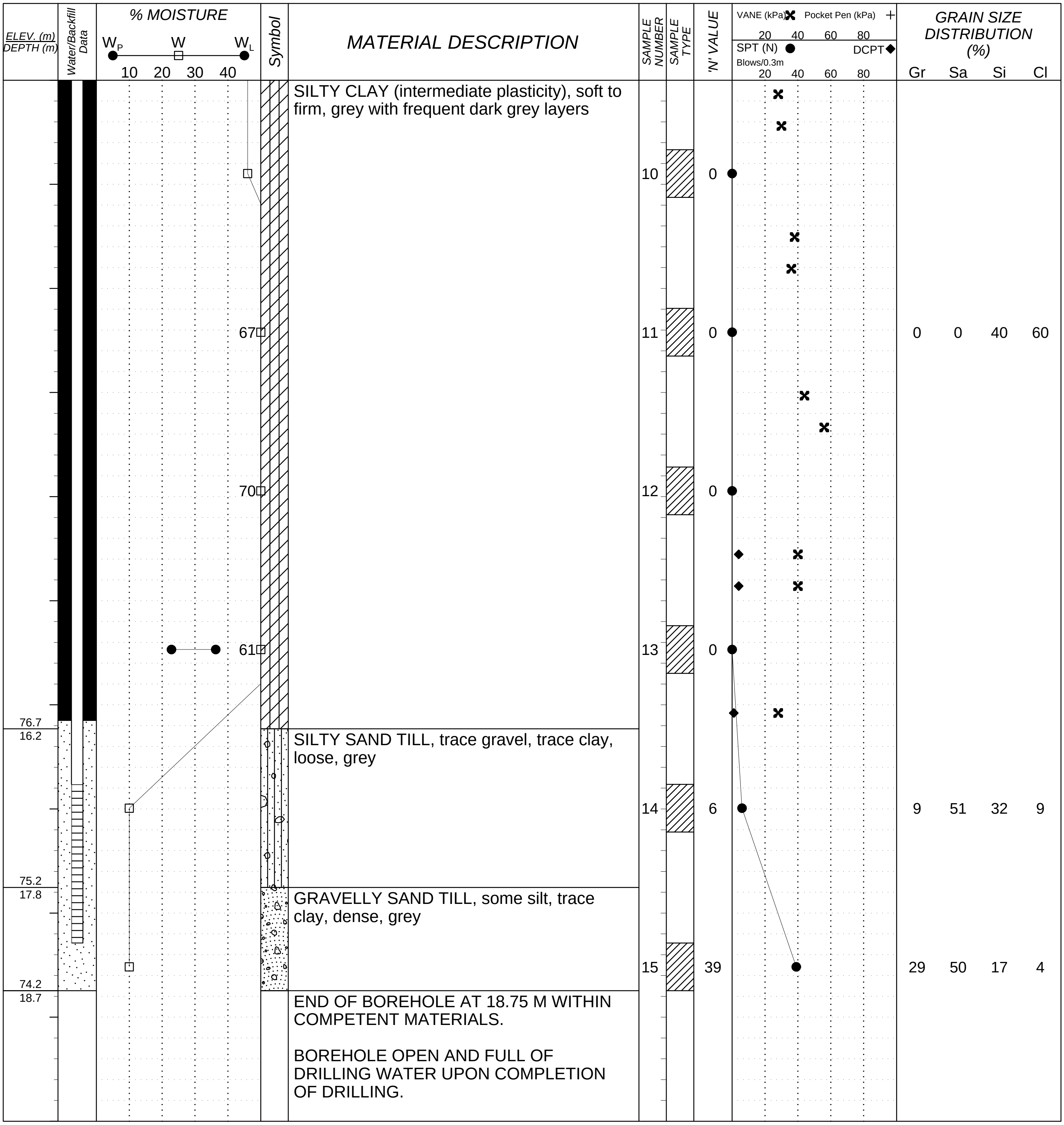
BACKFILL LEGEND

- ░ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁘ Filter Sand
- ▥ Slotted Pipe
- ▧ Grout
- ▩ Slough

LOG OF BOREHOLE BH22-3

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.952 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 22 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION
	SILTY CLAY (intermediate plasticity), soft to firm, grey with frequent dark grey layers
76.7 16.2	SILTY SAND TILL, trace gravel, trace clay, loose, grey
75.2 17.8	GRAVELLY SAND TILL, some silt, trace clay, dense, grey
74.2 18.7	END OF BOREHOLE AT 18.75 M WITHIN COMPETENT MATERIALS. BOREHOLE OPEN AND FULL OF DRILLING WATER UPON COMPLETION OF DRILLING.

SAMPLE NUMBER	% MOISTURE	'N' VALUE	Gr	Sa	Si	Cl
10		0				
11	67	0	0	0	40	60
12	70	0				
13	61	0				
14		6	9	51	32	9
15		39	29	50	17	4

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SAMPLE TYPE
- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

BACKFILL LEGEND
- Concrete
- Drill Cuttings
- Asphalt
- ■ Bentonite
- Filter Sand
- Slotted Pipe
- ☒ Grout
- Slough

LOG OF BOREHOLE BH22-3

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.952 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 22 2022**

ELEV. (m) DEPTH (m)	Water/Backfill Data	% MOISTURE W_P ● W □ W_L ● 10 20 30 40	Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ Pocket Pen (kPa) + 20 40 60 80 SPT (N) ● DCPT ◆ Blows/0.3m 20 40 60 80	GRAIN SIZE DISTRIBUTION (%)			
									Gr	Sa	Si	Cl
				MONITORING WELL (50 mm diameter) INSTALLED TO A TIP DEPTH OF 18.3 M (1.5 M LONG SCREEN) UPON COMPLETION OF DRILLING. PIEZOMETER WATER LEVEL READINGS DATE Depth(m) Elevation(m) Nov 28'22 1.232 91.720 Dec 6'22 0.852 92.100 REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.								

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ▯ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

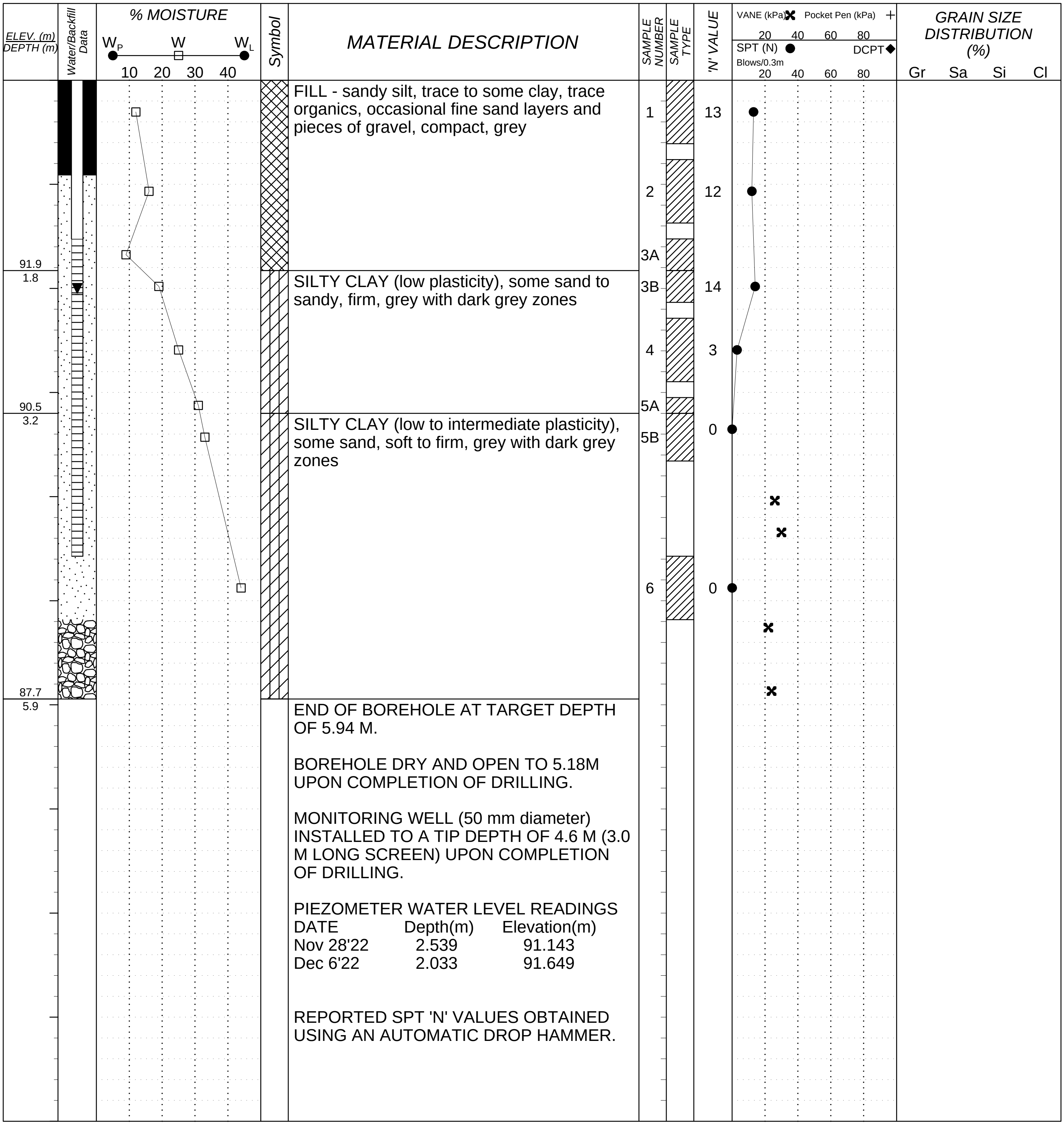
BACKFILL LEGEND

- ▩ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁚ Filter Sand
- ⊞ Slotted Pipe
- ⊠ Grout
- ▦ Slough

LOG OF BOREHOLE BH22-4

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.682 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 23 2022**



FILL - sandy silt, trace to some clay, trace organics, occasional fine sand layers and pieces of gravel, compact, grey

SILTY CLAY (low plasticity), some sand to sandy, firm, grey with dark grey zones

SILTY CLAY (low to intermediate plasticity), some sand, soft to firm, grey with dark grey zones

END OF BOREHOLE AT TARGET DEPTH OF 5.94 M.

BOREHOLE DRY AND OPEN TO 5.18M UPON COMPLETION OF DRILLING.

MONITORING WELL (50 mm diameter) INSTALLED TO A TIP DEPTH OF 4.6 M (3.0 M LONG SCREEN) UPON COMPLETION OF DRILLING.

PIEZOMETER WATER LEVEL READINGS

DATE	Depth(m)	Elevation(m)
Nov 28'22	2.539	91.143
Dec 6'22	2.033	91.649

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

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SAMPLE TYPE

☰ Auger Sample	☐ Thin Wall Tube Sampler
▨ Split Spoon Sample	▥ Pionjar Sample
░ Bulk Sample	⊠ Soil Core (PQ)

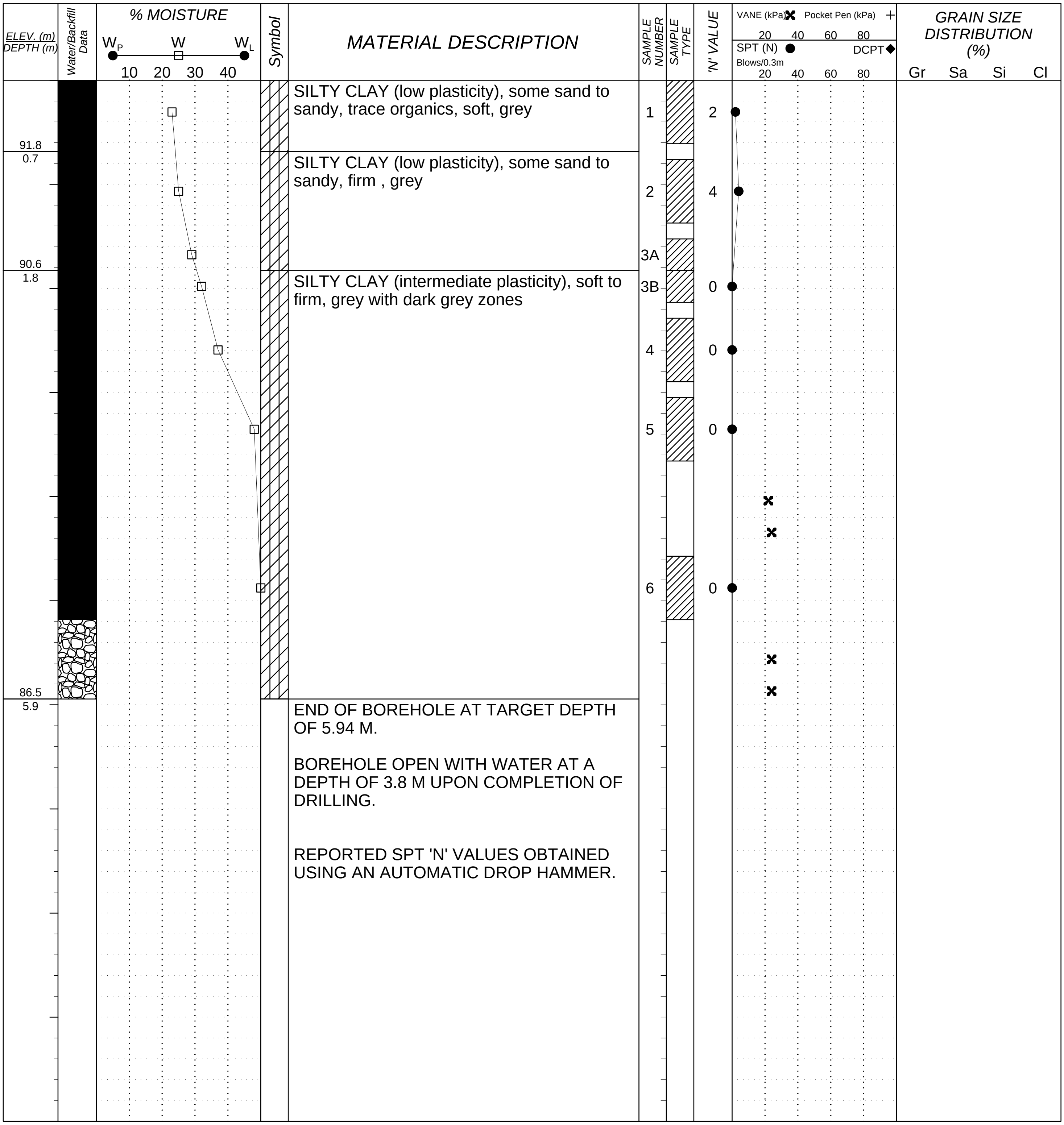
BACKFILL LEGEND

▒ Concrete	■ Bentonite	⧅ Grout
▒ Drill Cuttings	⁘ Filter Sand	▦ Slough
▓ Asphalt	▥ Slotted Pipe	

LOG OF BOREHOLE BH22-5

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.456 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 24 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
	SILTY CLAY (low plasticity), some sand to sandy, trace organics, soft, grey	1	2
91.8 0.7	SILTY CLAY (low plasticity), some sand to sandy, firm , grey	2 3A	4
90.6 1.8	SILTY CLAY (intermediate plasticity), soft to firm, grey with dark grey zones	3B 4 5 6	0 0 0 0
86.5 5.9	END OF BOREHOLE AT TARGET DEPTH OF 5.94 M. BOREHOLE OPEN WITH WATER AT A DEPTH OF 3.8 M UPON COMPLETION OF DRILLING. REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.		

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ▒ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

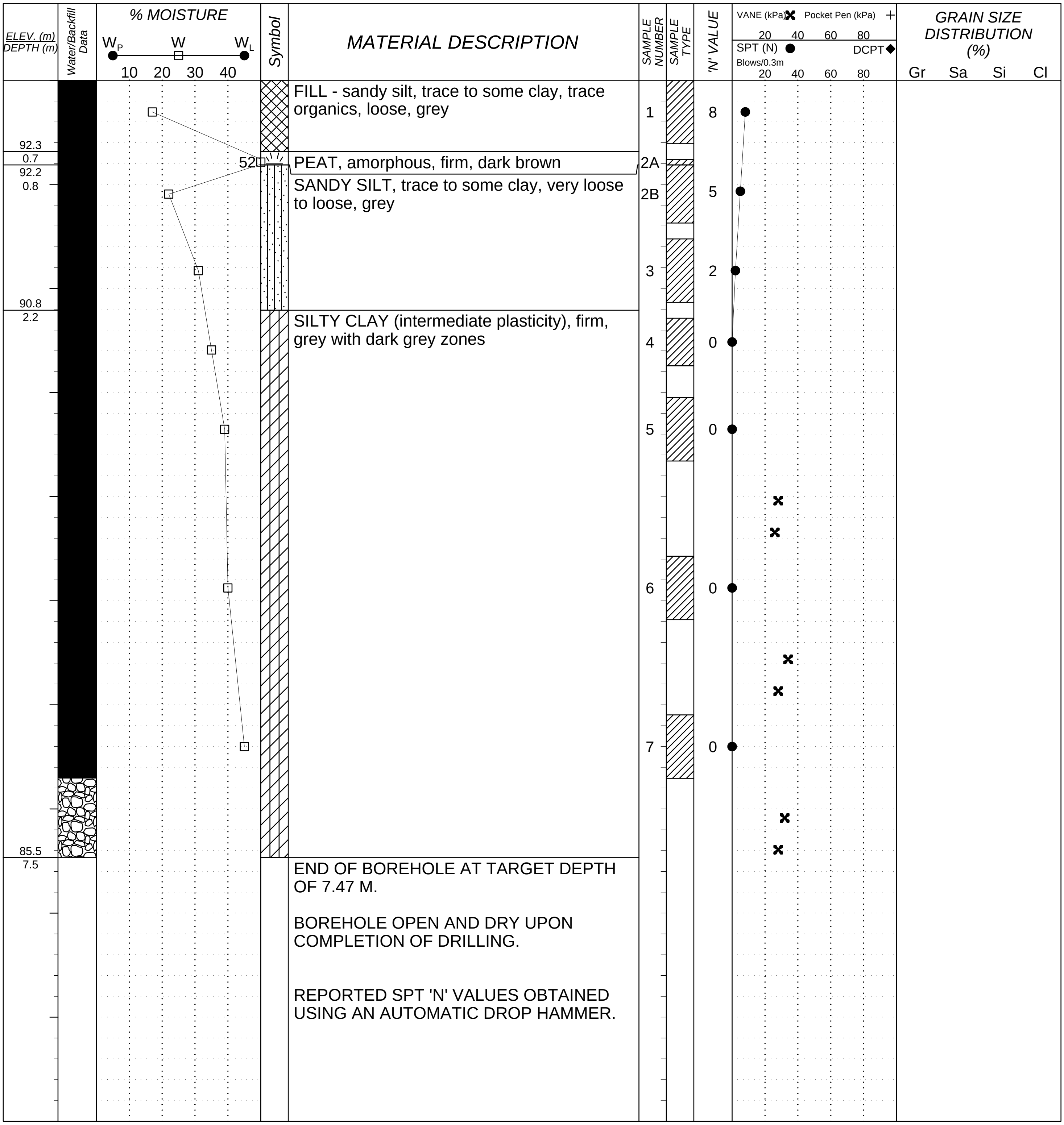
BACKFILL LEGEND

- ▒ Concrete
- ▒ Drill Cuttings
- ■ Asphalt
- ■ Bentonite
- ⁘ Filter Sand
- ▥ Slotted Pipe
- ▧ Grout
- ▨ Slough

LOG OF BOREHOLE BH22-6

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.015 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 24 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION
	FILL - sandy silt, trace to some clay, trace organics, loose, grey
92.3 0.7	PEAT, amorphous, firm, dark brown
92.2 0.8	SANDY SILT, trace to some clay, very loose to loose, grey
90.8 2.2	SILTY CLAY (intermediate plasticity), firm, grey with dark grey zones
85.5 7.5	END OF BOREHOLE AT TARGET DEPTH OF 7.47 M. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

SAMPLE NUMBER	'N' VALUE
1	8
2A	
2B	5
3	2
4	0
5	0
6	0
7	0

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ▒ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

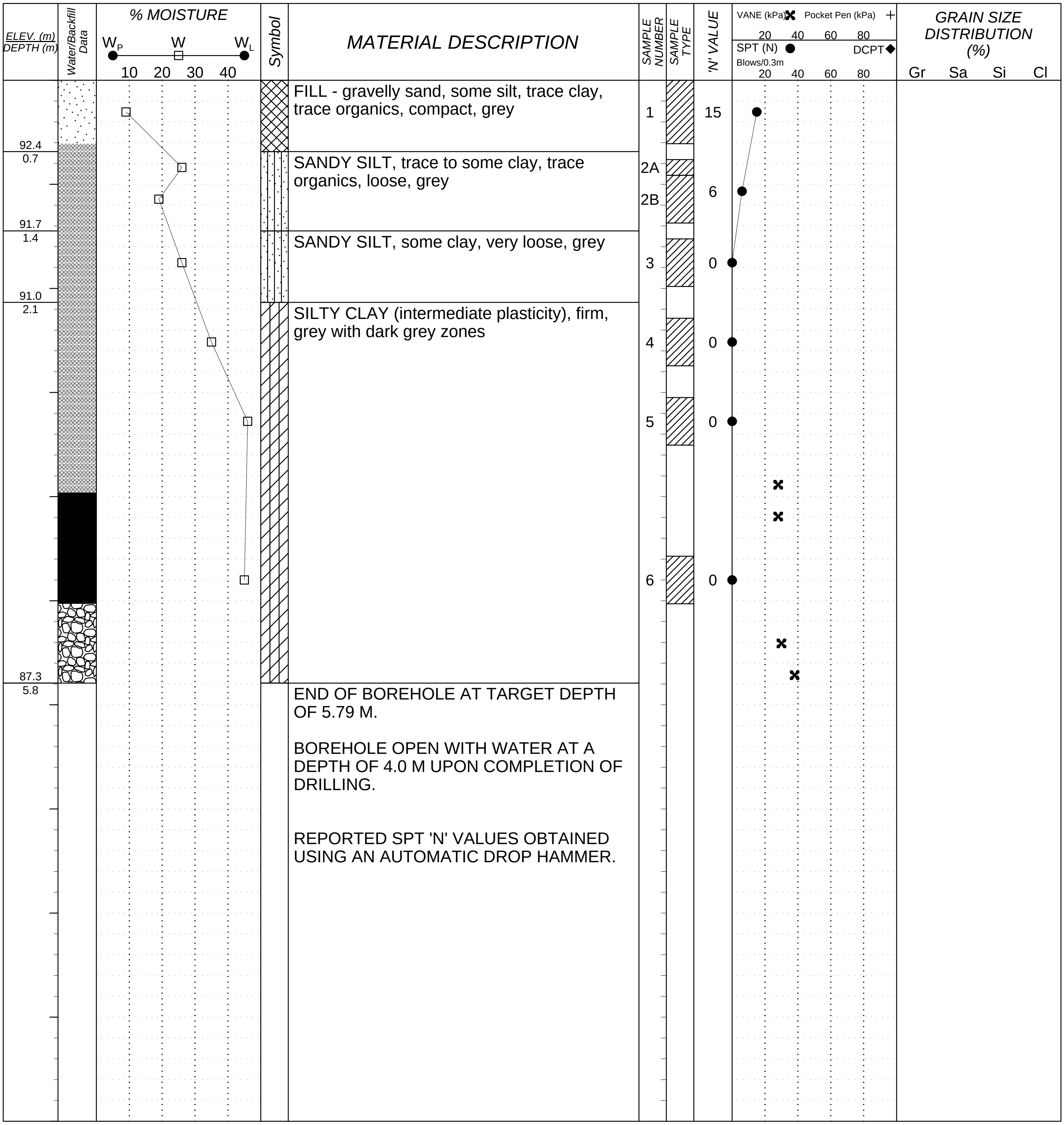
BACKFILL LEGEND

- ▒ Concrete
- ▒ Drill Cuttings
- ■ Asphalt
- ■ Bentonite
- ⁚ Filter Sand
- ▥ Slotted Pipe
- ▧ Grout
- ▩ Slough

LOG OF BOREHOLE BH22-7

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.115 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 25 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
	FILL - gravelly sand, some silt, trace clay, trace organics, compact, grey	1	15
92.4 0.7	SANDY SILT, trace to some clay, trace organics, loose, grey	2A 2B	6
91.7 1.4	SANDY SILT, some clay, very loose, grey	3	0
91.0 2.1	SILTY CLAY (intermediate plasticity), firm, grey with dark grey zones	4 5 6	0 0 0
87.3 5.8	END OF BOREHOLE AT TARGET DEPTH OF 5.79 M. BOREHOLE OPEN WITH WATER AT A DEPTH OF 4.0 M UPON COMPLETION OF DRILLING. REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.		

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SAMPLE TYPE

☰	Auger Sample	☐	Thin Wall Tube Sampler
▨	Split Spoon Sample	▥	Pionjar Sample
░	Bulk Sample	☒	Soil Core (PQ)

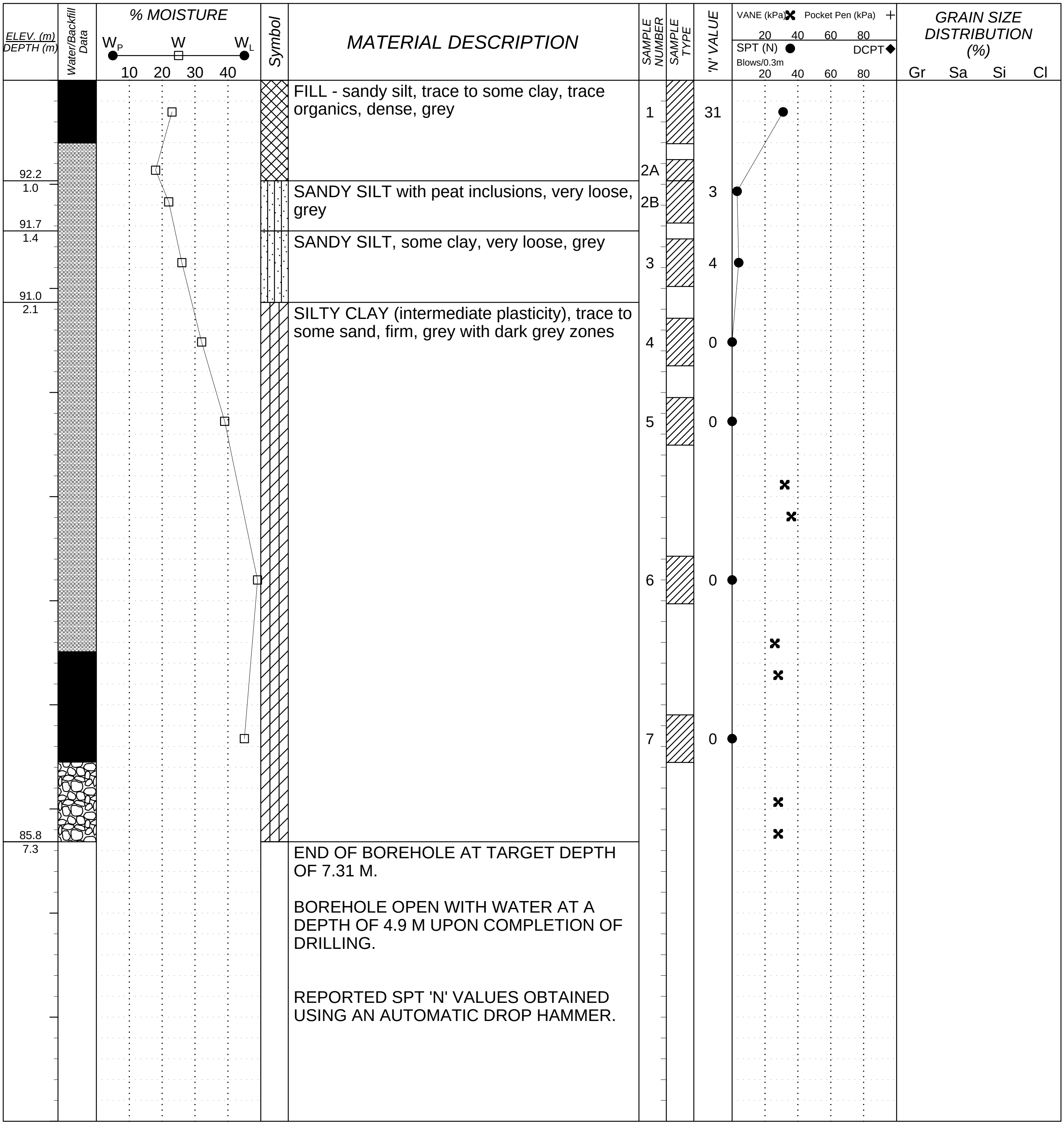
BACKFILL LEGEND

▩	Concrete	■	Bentonite	▧	Grout
░	Drill Cuttings	⁚	Filter Sand	▦	Slough
▓	Asphalt	▥	Slotted Pipe		

LOG OF BOREHOLE BH22-8

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.154 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 25 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
	FILL - sandy silt, trace to some clay, trace organics, dense, grey	1	31
		2A	
92.2 1.0	SANDY SILT with peat inclusions, very loose, grey	2B	3
91.7 1.4	SANDY SILT, some clay, very loose, grey	3	4
91.0 2.1	SILTY CLAY (intermediate plasticity), trace to some sand, firm, grey with dark grey zones	4	0
		5	0
		6	0
		7	0
85.8 7.3	END OF BOREHOLE AT TARGET DEPTH OF 7.31 M. BOREHOLE OPEN WITH WATER AT A DEPTH OF 4.9 M UPON COMPLETION OF DRILLING. REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.		

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SAMPLE TYPE

- ⊟ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

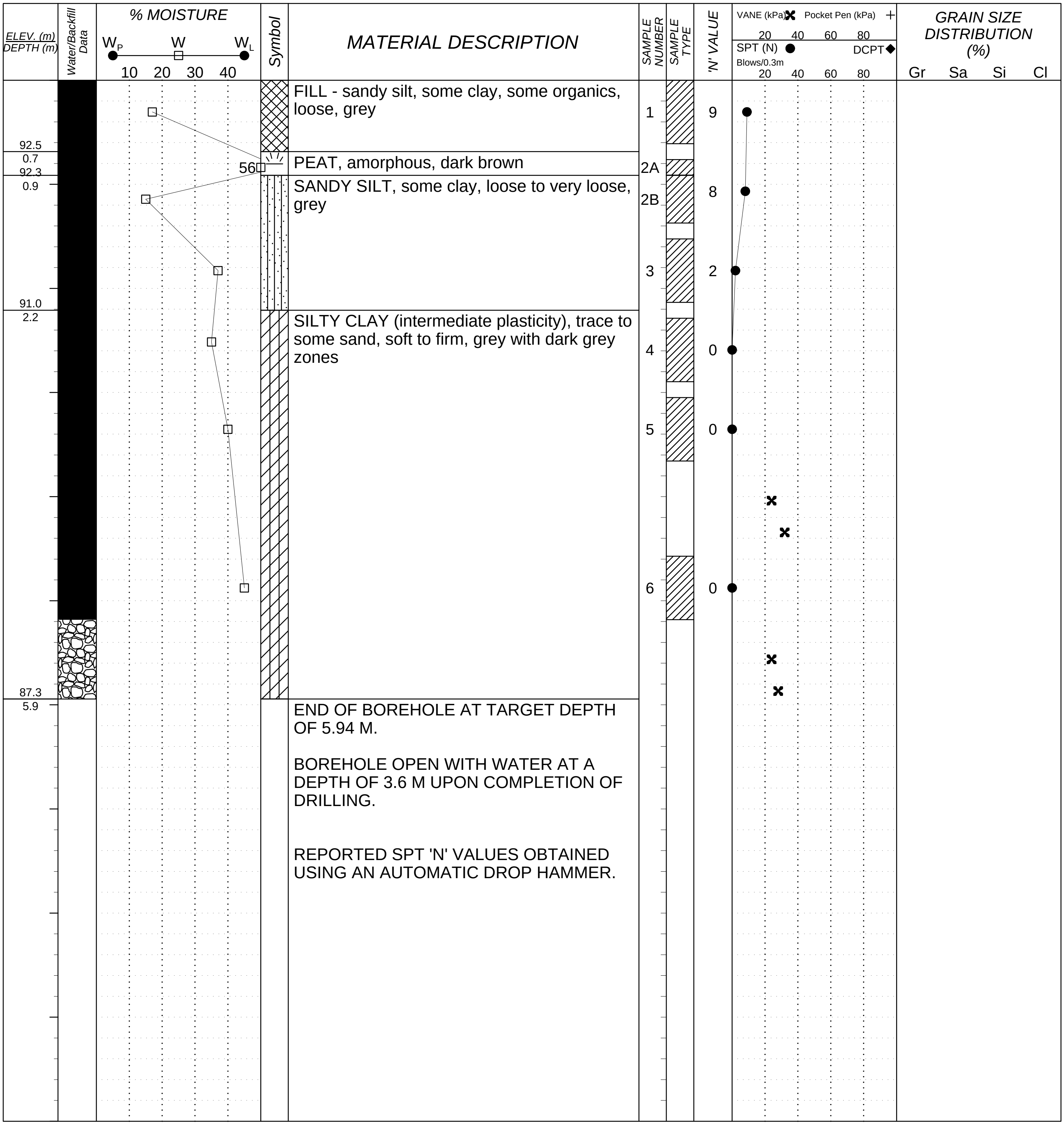
BACKFILL LEGEND

- ▩ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁘ Filter Sand
- ▦ Slotted Pipe
- ▧ Grout
- ▩ Slough

LOG OF BOREHOLE BH22-9

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.215 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 24 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
	FILL - sandy silt, some clay, some organics, loose, grey	1	9
92.5 0.7	PEAT, amorphous, dark brown	2A	
92.3 0.9	SANDY SILT, some clay, loose to very loose, grey	2B 3	8 2
91.0 2.2	SILTY CLAY (intermediate plasticity), trace to some sand, soft to firm, grey with dark grey zones	4 5 6	0 0 0
87.3 5.9	END OF BOREHOLE AT TARGET DEPTH OF 5.94 M.		

BOREHOLE OPEN WITH WATER AT A DEPTH OF 3.6 M UPON COMPLETION OF DRILLING.

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

LOG OF BOREHOLE SLR-3850CAMBRIANDRIVE-NEPEAN-NOVANEREMOULD.GPJ GEOTERRE.GDT 2/18/23

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SAMPLE TYPE

- ☰ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

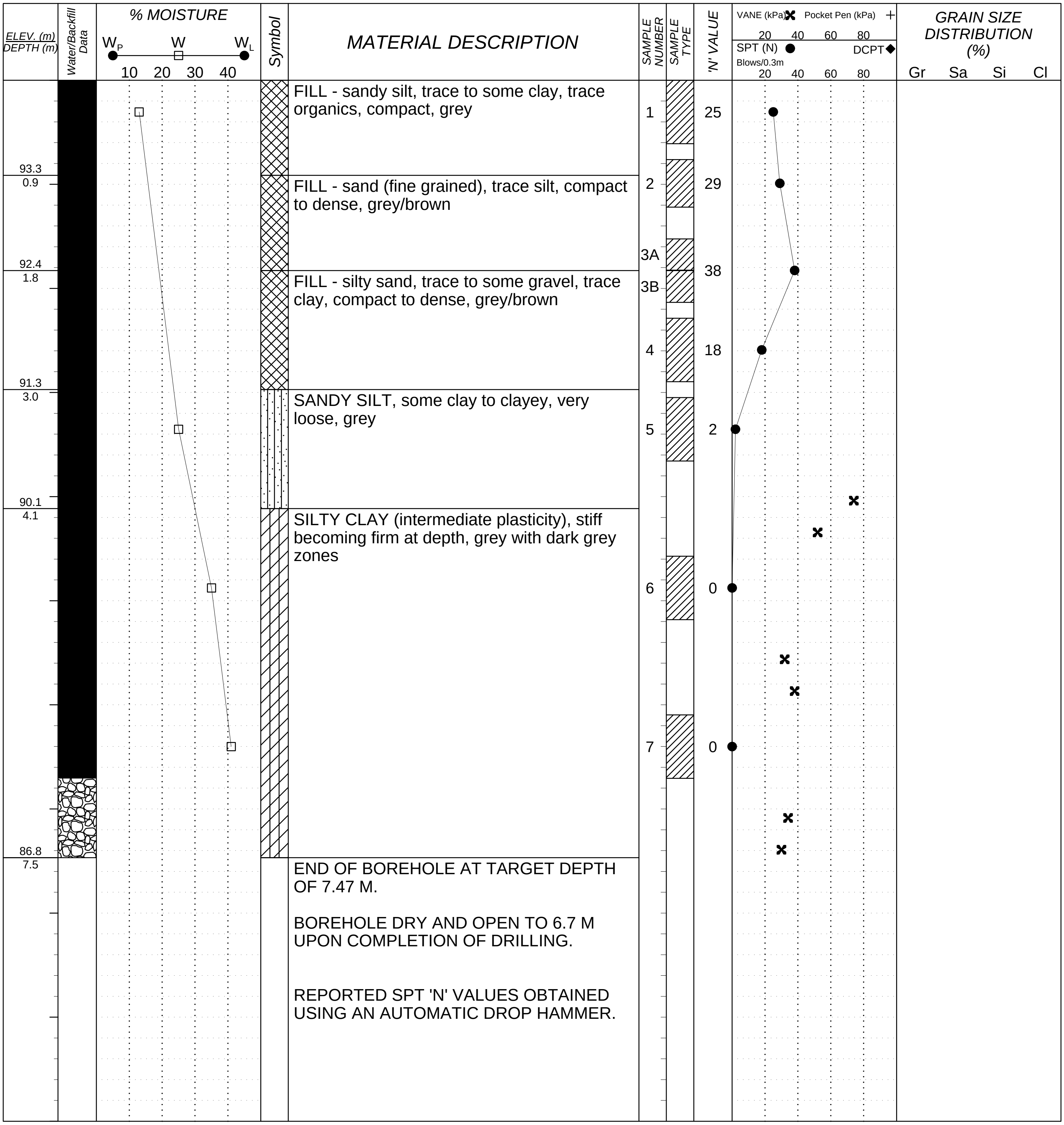
BACKFILL LEGEND

- ▓ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁘ Filter Sand
- ▥ Slotted Pipe
- ☒ Grout
- ▩ Slough

LOG OF BOREHOLE BH22-10

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **94.223 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 23 2022**



ELEV. (m) / DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
	FILL - sandy silt, trace to some clay, trace organics, compact, grey	1	25
93.3 0.9	FILL - sand (fine grained), trace silt, compact to dense, grey/brown	2	29
		3A	
92.4 1.8	FILL - silty sand, trace to some gravel, trace clay, compact to dense, grey/brown	3B	38
		4	18
91.3 3.0	SANDY SILT, some clay to clayey, very loose, grey	5	2
90.1 4.1	SILTY CLAY (intermediate plasticity), stiff becoming firm at depth, grey with dark grey zones	6	0
		7	0
86.8 7.5	END OF BOREHOLE AT TARGET DEPTH OF 7.47 M. BOREHOLE DRY AND OPEN TO 6.7 M UPON COMPLETION OF DRILLING. REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.		

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

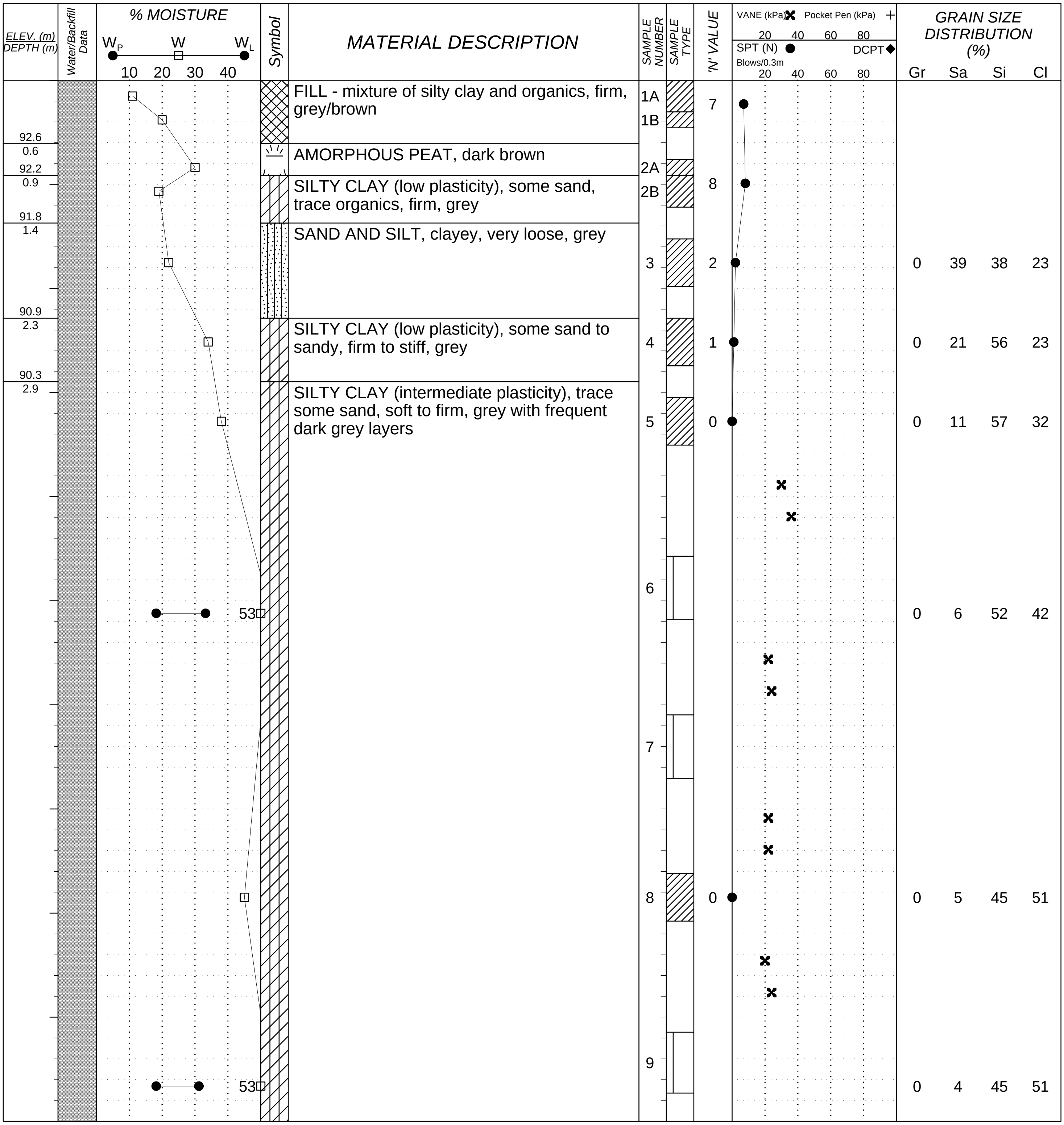
BACKFILL LEGEND

- ░ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁚ Filter Sand
- ▥ Slotted Pipe
- ▧ Grout
- ▦ Slough

LOG OF BOREHOLE BH22-11

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.164 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 21 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION
	FILL - mixture of silty clay and organics, firm, grey/brown
92.6 0.6	AMORPHOUS PEAT, dark brown
92.2 0.9	SILTY CLAY (low plasticity), some sand, trace organics, firm, grey
91.8 1.4	SAND AND SILT, clayey, very loose, grey
90.9 2.3	SILTY CLAY (low plasticity), some sand to sandy, firm to stiff, grey
90.3 2.9	SILTY CLAY (intermediate plasticity), trace some sand, soft to firm, grey with frequent dark grey layers

SAMPLE NUMBER	'N' VALUE	Gr	Sa	Si	Cl
1A	7				
1B					
2A	8				
2B					
3	2	0	39	38	23
4	1	0	21	56	23
5	0	0	11	57	32
6		0	6	52	42
7					
8	0	0	5	45	51
9		0	4	45	51

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SAMPLE TYPE

▤ Auger Sample	☐ Thin Wall Tube Sampler
▨ Split Spoon Sample	▥ Pionjar Sample
░ Bulk Sample	☒ Soil Core (PQ)

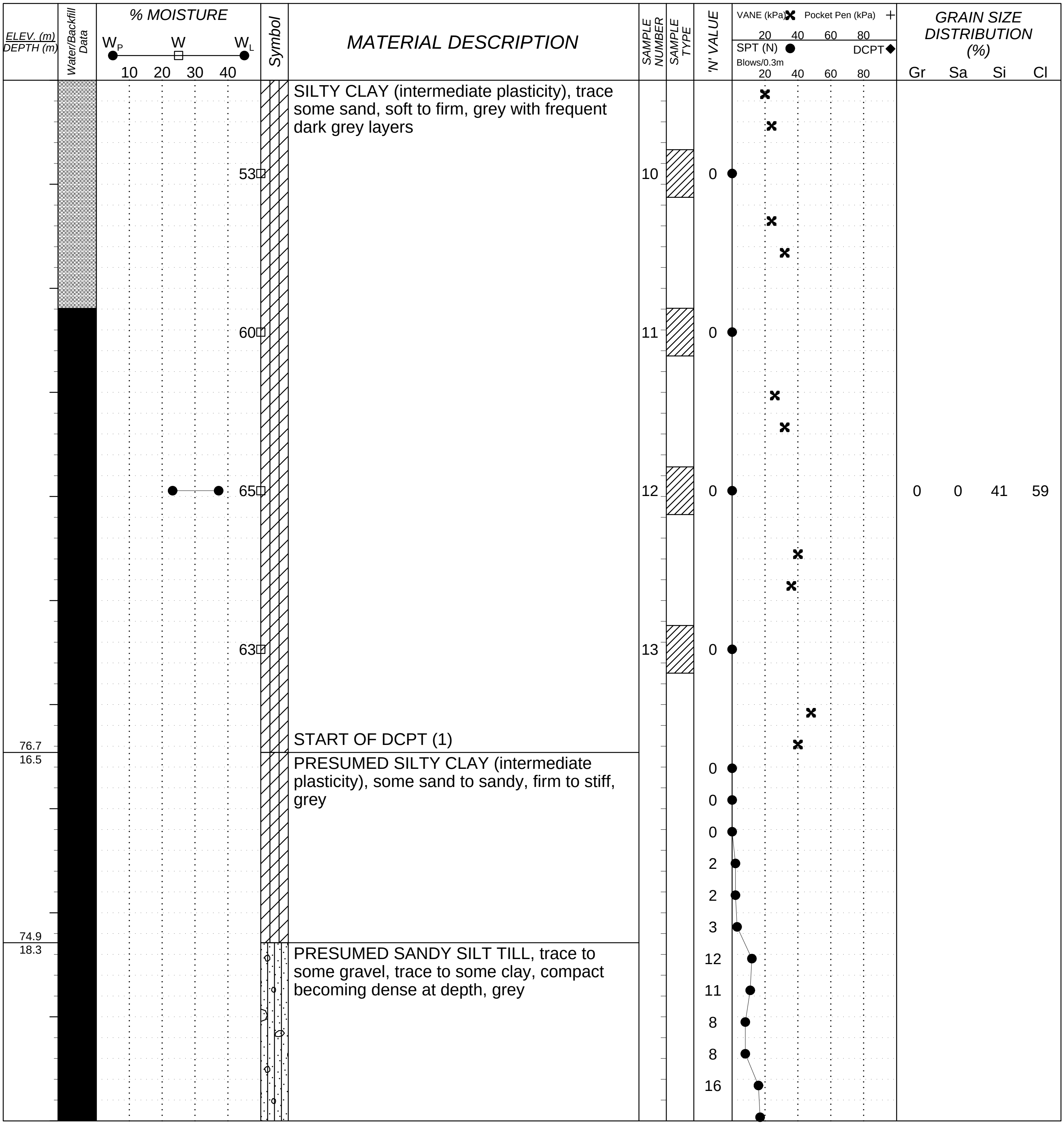
BACKFILL LEGEND

▩ Concrete	■ Bentonite	▧ Grout
░ Drill Cuttings	⁘ Filter Sand	▦ Slough
▓ Asphalt	▥ Slotted Pipe	

LOG OF BOREHOLE BH22-11

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.164 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 21 2022**



ELEV. (m) DEPTH (m)	% MOISTURE	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	Gr	Sa	Si	Cl
		SILTY CLAY (intermediate plasticity), trace some sand, soft to firm, grey with frequent dark grey layers							
	53		10	▨	0				
	60		11	▨	0				
	65		12	▨	0	0	0	41	59
	63		13	▨	0				
		START OF DCPT (1)							
76.7 16.5		PRESUMED SILTY CLAY (intermediate plasticity), some sand to sandy, firm to stiff, grey			0 0 0 2 2 3				
74.9 18.3		PRESUMED SANDY SILT TILL, trace to some gravel, trace to some clay, compact becoming dense at depth, grey			12 11 8 8 16				

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SAMPLE TYPE

▤	Auger Sample	☐	Thin Wall Tube Sampler
▨	Split Spoon Sample	▥	Pionjar Sample
░	Bulk Sample	☒	Soil Core (PQ)

BACKFILL LEGEND

▒	Concrete	■	Bentonite	▧	Grout
░	Drill Cuttings	⁘	Filter Sand	▩	Slough
▓	Asphalt	▥	Slotted Pipe		

LOG OF BOREHOLE BH22-11

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **93.164 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 21 2022**

ELEV. (m) DEPTH (m)	Water/Backfill Data	% MOISTURE W	Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	SPT (N) ● Blows/0.3m	GRAIN SIZE DISTRIBUTION (%) Gr Sa Si Cl
	■			PRESUMED SANDY SILT TILL, trace to some gravel, trace to some clay, compact becoming dense at depth, grey			17 20 86 41 >99	121	
71.8 21.3				END OF DCPT (1) AT 21.33 M DUE TO REFUSAL. BOREHOLE REMAIN OPEN AND AND FULL OF DRILLING WATER UPTO 7 M UPON COMPLETION OF DRILLING. DCPT - Dynamic Cone Penetration Test					

% MOISTURE: W_P ● W □ W_L ●; 10 20 30 40

VANE (kPa) ✖ Pocket Pen (kPa) + 20 40 60 80; SPT (N) ● DCPT ◆ Blows/0.3m 20 40 60 80

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

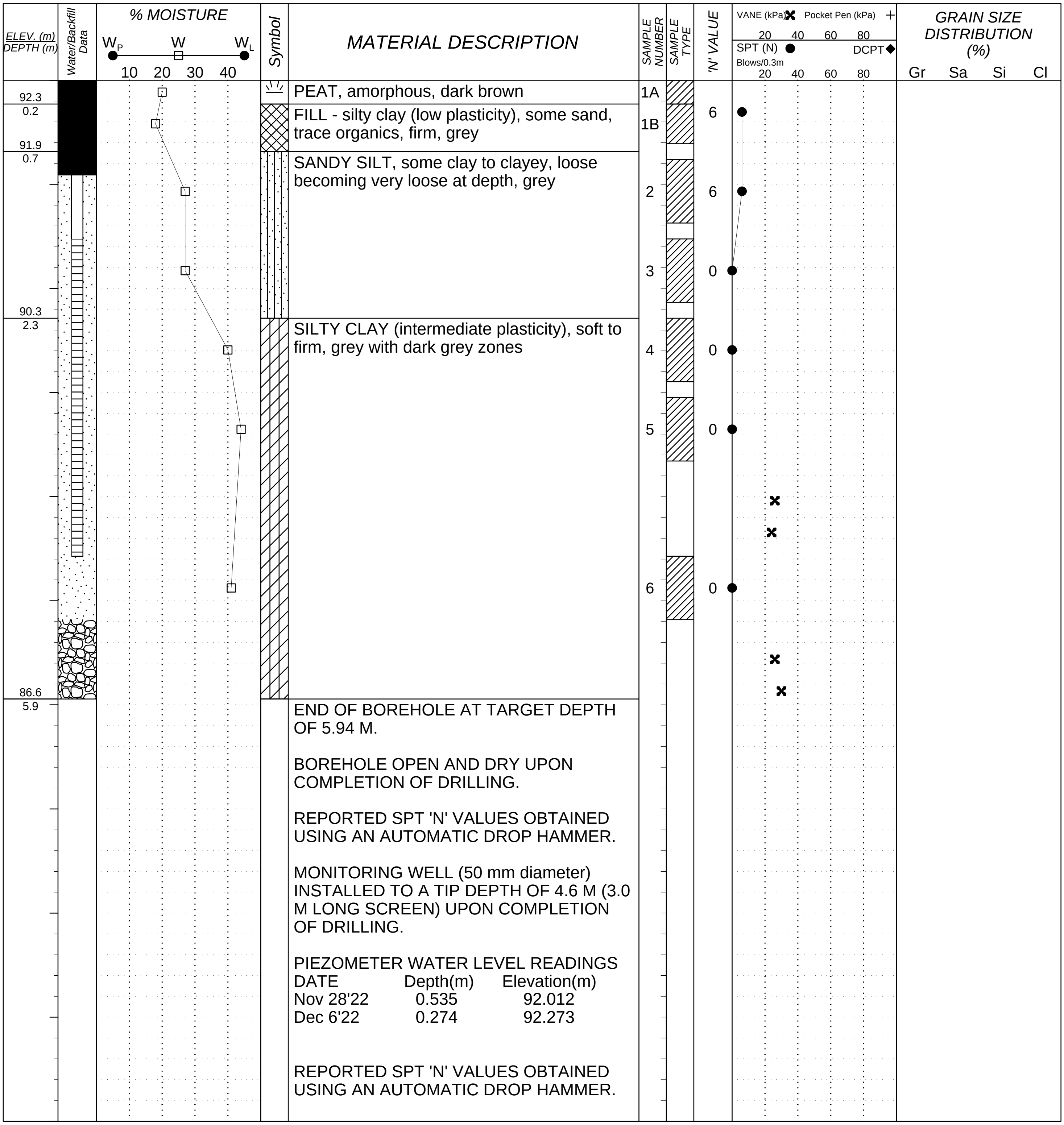
BACKFILL LEGEND

- ▒ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁘ Filter Sand
- ▥ Slotted Pipe
- ▧ Grout
- ▒ Slough

LOG OF BOREHOLE BH22-12

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.547 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 24 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
92.3 0.2	PEAT, amorphous, dark brown	1A	
91.9 0.7	FILL - silty clay (low plasticity), some sand, trace organics, firm, grey	1B	6
90.3 2.3	SANDY SILT, some clay to clayey, loose becoming very loose at depth, grey	2 3	6 0
86.6 5.9	SILTY CLAY (intermediate plasticity), soft to firm, grey with dark grey zones	4 5 6	0 0 0

END OF BOREHOLE AT TARGET DEPTH OF 5.94 M.

BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING.

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

MONITORING WELL (50 mm diameter) INSTALLED TO A TIP DEPTH OF 4.6 M (3.0 M LONG SCREEN) UPON COMPLETION OF DRILLING.

PIEZOMETER WATER LEVEL READINGS

DATE	Depth(m)	Elevation(m)
Nov 28'22	0.535	92.012
Dec 6'22	0.274	92.273

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

LOG OF BOREHOLE SLR-3850CAMBRIANDRIVE-NEPEAN-NOVANEREMOULD.GPJ GEOTERRE.GDT 2/18/23

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SAMPLE TYPE

▤ Auger Sample	☐ Thin Wall Tube Sampler
▨ Split Spoon Sample	▥ Pionjar Sample
░ Bulk Sample	☒ Soil Core (PQ)

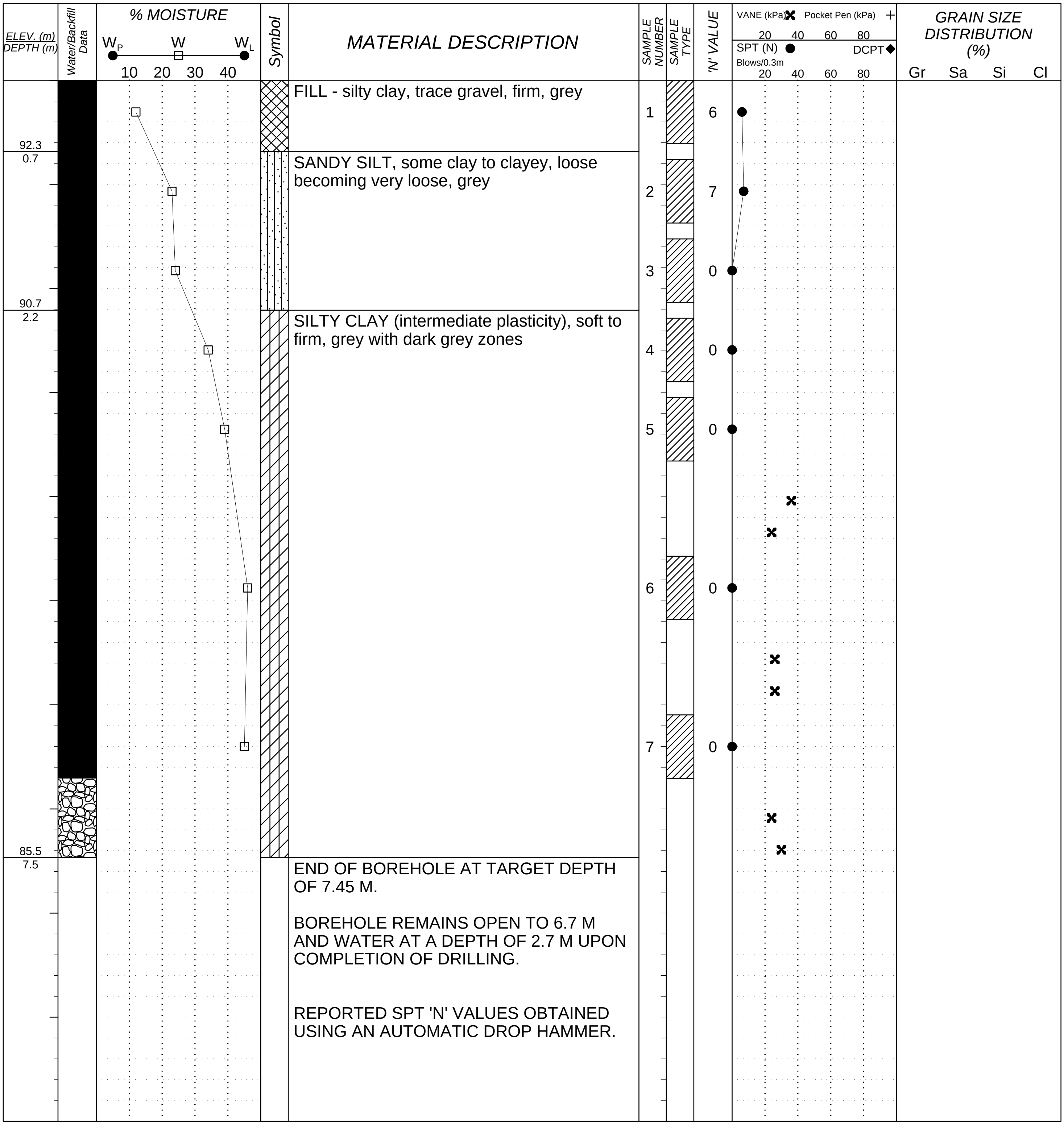
BACKFILL LEGEND

▩ Concrete	■ Bentonite	▧ Grout
▒ Drill Cuttings	⁘ Filter Sand	▦ Slough
▓ Asphalt	▥ Slotted Pipe	

LOG OF BOREHOLE BH22-13

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **92.949 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 23 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION
	FILL - silty clay, trace gravel, firm, grey
92.3 0.7	SANDY SILT, some clay to clayey, loose becoming very loose, grey
90.7 2.2	SILTY CLAY (intermediate plasticity), soft to firm, grey with dark grey zones
85.5 7.5	END OF BOREHOLE AT TARGET DEPTH OF 7.45 M.

BOREHOLE REMAINS OPEN TO 6.7 M AND WATER AT A DEPTH OF 2.7 M UPON COMPLETION OF DRILLING.

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

SAMPLE NUMBER	'N' VALUE
1	6
2	7
3	0
4	0
5	0
6	0
7	0

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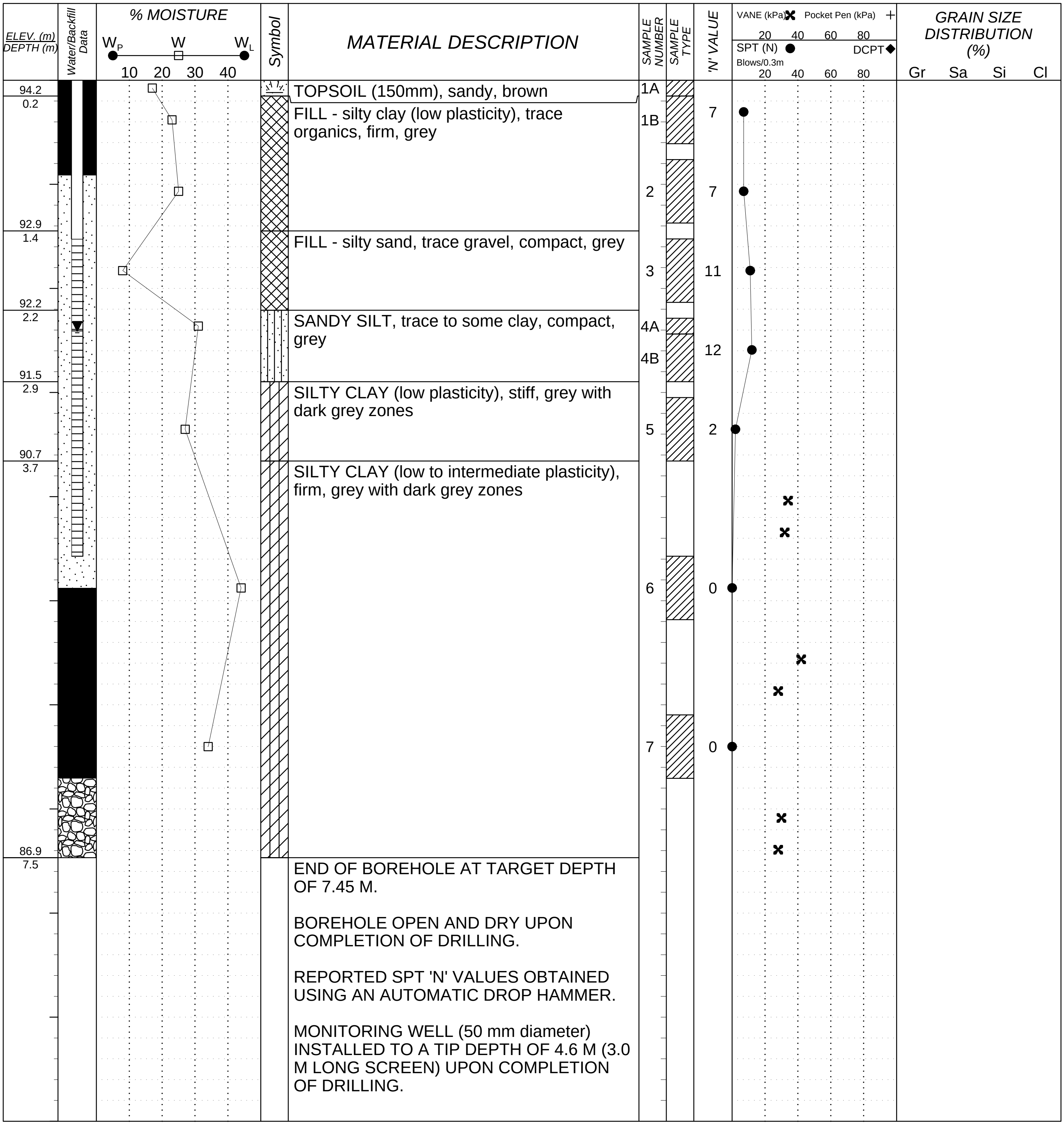
SAMPLE TYPE
- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

BACKFILL LEGEND
- ▒ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁚ Filter Sand
- ▥ Slotted Pipe
- ▧ Grout
- ▩ Slough

LOG OF BOREHOLE BH22-14

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **94.394 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 23 2022**



ELEV. (m) DEPTH (m)	MATERIAL DESCRIPTION	SAMPLE NUMBER	'N' VALUE
	TOPSOIL (150mm), sandy, brown	1A	
94.2 0.2	FILL - silty clay (low plasticity), trace organics, firm, grey	1B 2	7 7
92.9 1.4	FILL - silty sand, trace gravel, compact, grey	3	11
92.2 2.2	SANDY SILT, trace to some clay, compact, grey	4A 4B	12
91.5 2.9	SILTY CLAY (low plasticity), stiff, grey with dark grey zones	5	2
90.7 3.7	SILTY CLAY (low to intermediate plasticity), firm, grey with dark grey zones	6 7	0 0
86.9 7.5	END OF BOREHOLE AT TARGET DEPTH OF 7.45 M.		

BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING.

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

MONITORING WELL (50 mm diameter) INSTALLED TO A TIP DEPTH OF 4.6 M (3.0 M LONG SCREEN) UPON COMPLETION OF DRILLING.

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SAMPLE TYPE

- ▤ Auger Sample
- ▨ Split Spoon Sample
- ░ Bulk Sample
- ☐ Thin Wall Tube Sampler
- ▥ Pionjar Sample
- ☒ Soil Core (PQ)

BACKFILL LEGEND

- ▩ Concrete
- ▒ Drill Cuttings
- ▓ Asphalt
- ■ Bentonite
- ⁚ Filter Sand
- ▤ Slotted Pipe
- ▧ Grout
- ▦ Slough

LOG OF BOREHOLE BH22-14

PROJECT No.: **TG22-045**
CLIENT: **SLR**
PROJECT: **3850 Cambrian Road**
LOCATION: **Nepean, Ontario**
SURFACE ELEV.: **94.394 metres (Geodetic)**

Drilling Data
METHOD: **Hollow Stem Augers**
DIAMETER: **200 mm**
PREP. BY: **VTM** APPR. BY: **IC**
DATE: **November 23 2022**

ELEV. (m) DEPTH (m)	Water/Backfill Data	% MOISTURE W_P ● W □ W_L ● 10 20 30 40	Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ Pocket Pen (kPa) + 20 40 60 80 SPT (N) ● DCPT ◆ Blows/0.3m 20 40 60 80	GRAIN SIZE DISTRIBUTION (%) Gr Sa Si Cl
				PIEZOMETER WATER LEVEL READINGS					

DATE	Depth(m)	Elevation(m)
Nov 28'22	2.846	91.548
Dec 6'22	2.396	91.998

REPORTED SPT 'N' VALUES OBTAINED USING AN AUTOMATIC DROP HAMMER.

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SAMPLE TYPE

▤	Auger Sample	☐	Thin Wall Tube Sampler
▨	Split Spoon Sample	▥	Pionjar Sample
░	Bulk Sample	☒	Soil Core (PQ)

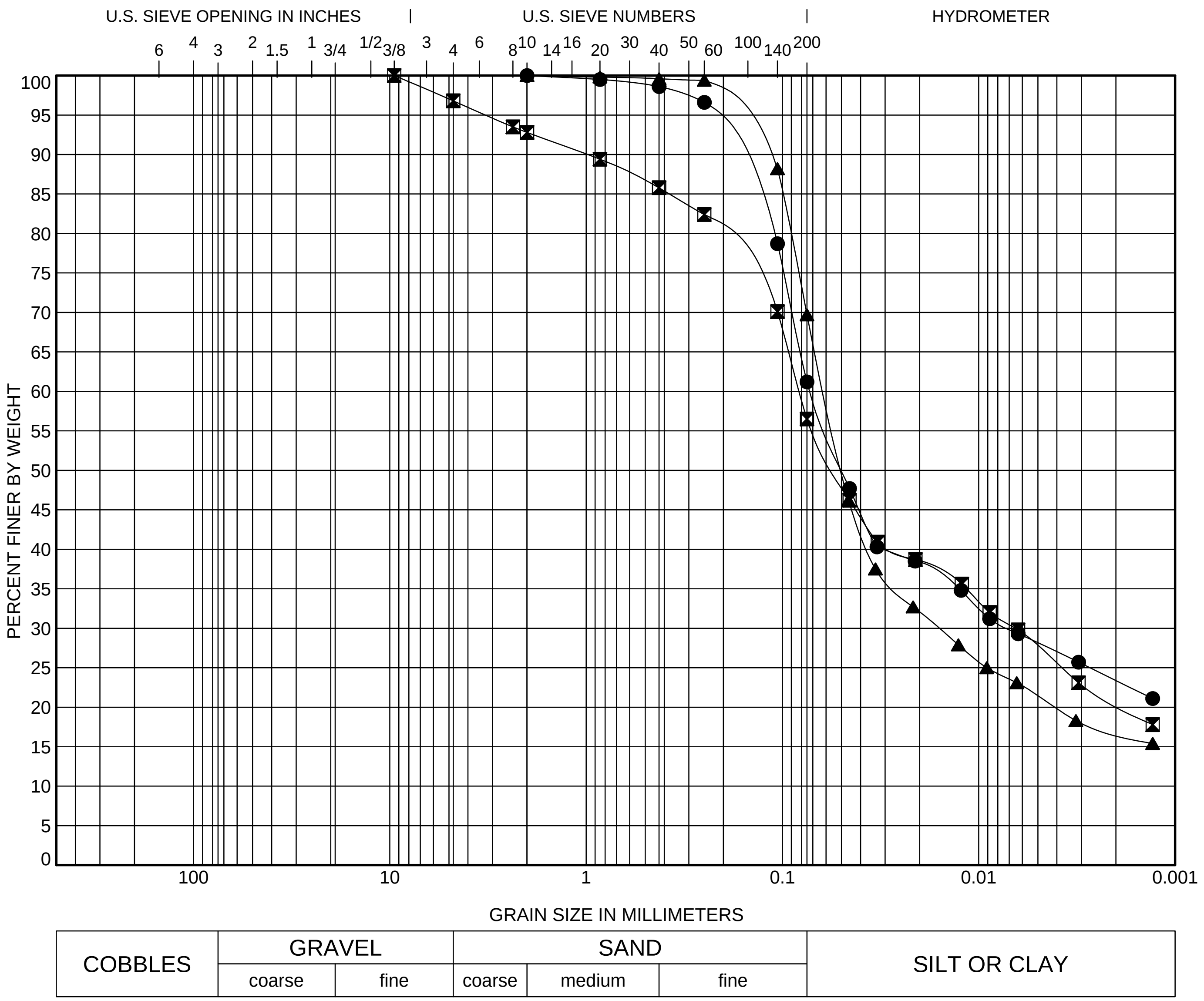
BACKFILL LEGEND

▩	Concrete	■	Bentonite	▧	Grout
▒	Drill Cuttings	⬚	Filter Sand	▦	Slough
▓	Asphalt	▥	Slotted Pipe		

APPENDIX C

GEOTERRE 2020
LABORATORY GRAIN SIZE DATA

GRAIN SIZE ANALYSIS
SURFACE SAND AND SILT "CRUST" MATERIALS



	Specimen Identification and Depth (m)		Classification	LL	PL	PI	Cc	Cu
●	BH22-11	1.75						
☒	BH22-2	0.99						
▲	BH22-2	1.75		**NP**	**NP**	**NP**		

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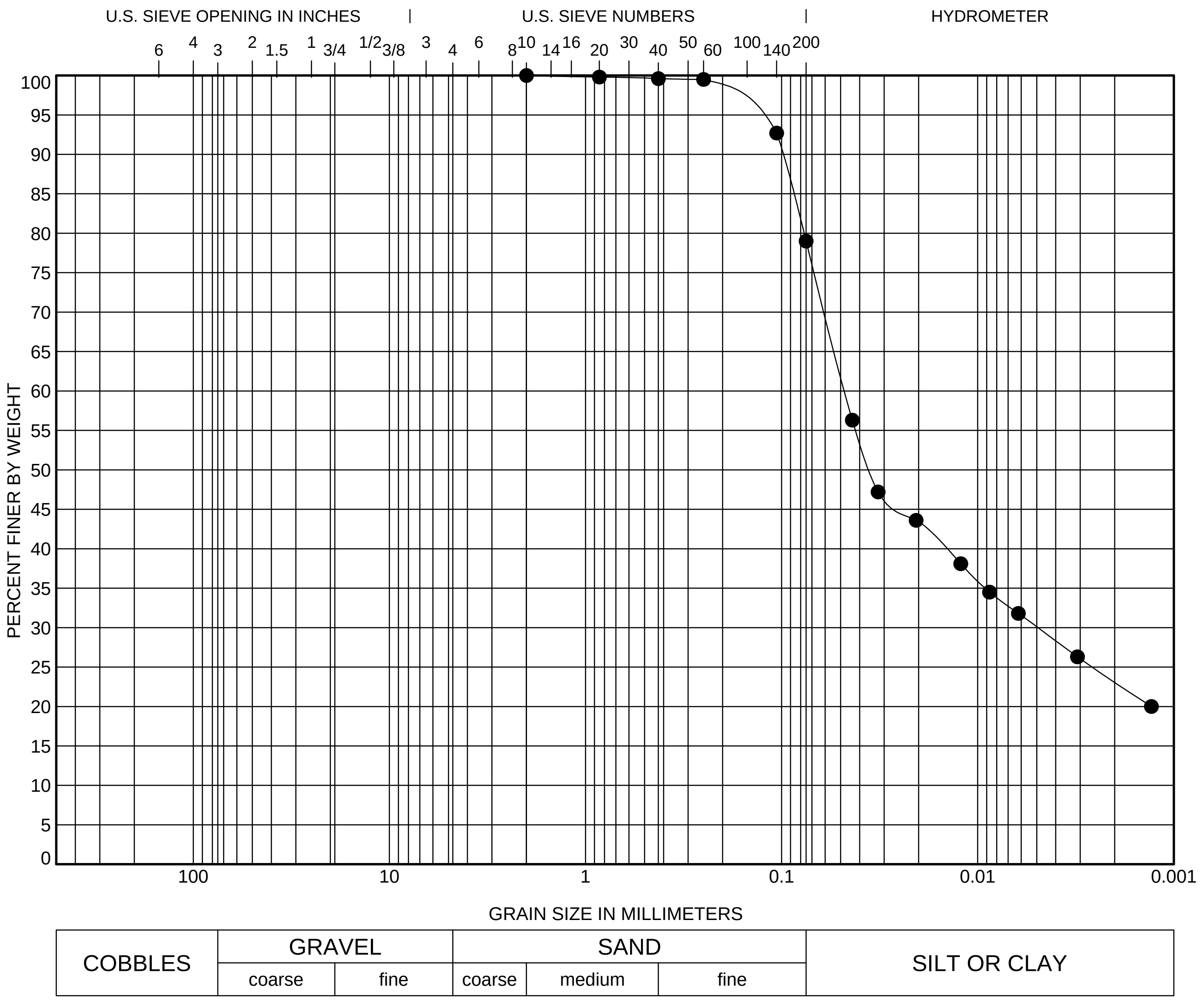
FIGURE C1

Project No.: TG22-045
Client: SLR
Project: 3850 Cambrian Road
Location: Nepean, Ontario

GRAINSIZE - GEOTERRE SLR-3850CAMBRIANDRIVE-NEPEAN.GPJ GEOTERRE.GDT 2/11/23

GRAIN SIZE ANALYSIS
SURFACE SILTY CLAY "CRUST" MATERIALS



	Specimen Identification and Depth (m)		Classification	LL	PL	PI	Cc	Cu
●	BH22-11	2.51						

GRAINSIZE - GEOTERRE SLR-3850CAMBRIANDRIVE-NEPEAN.GPJ GEOTERRE.GDT 2/11/23

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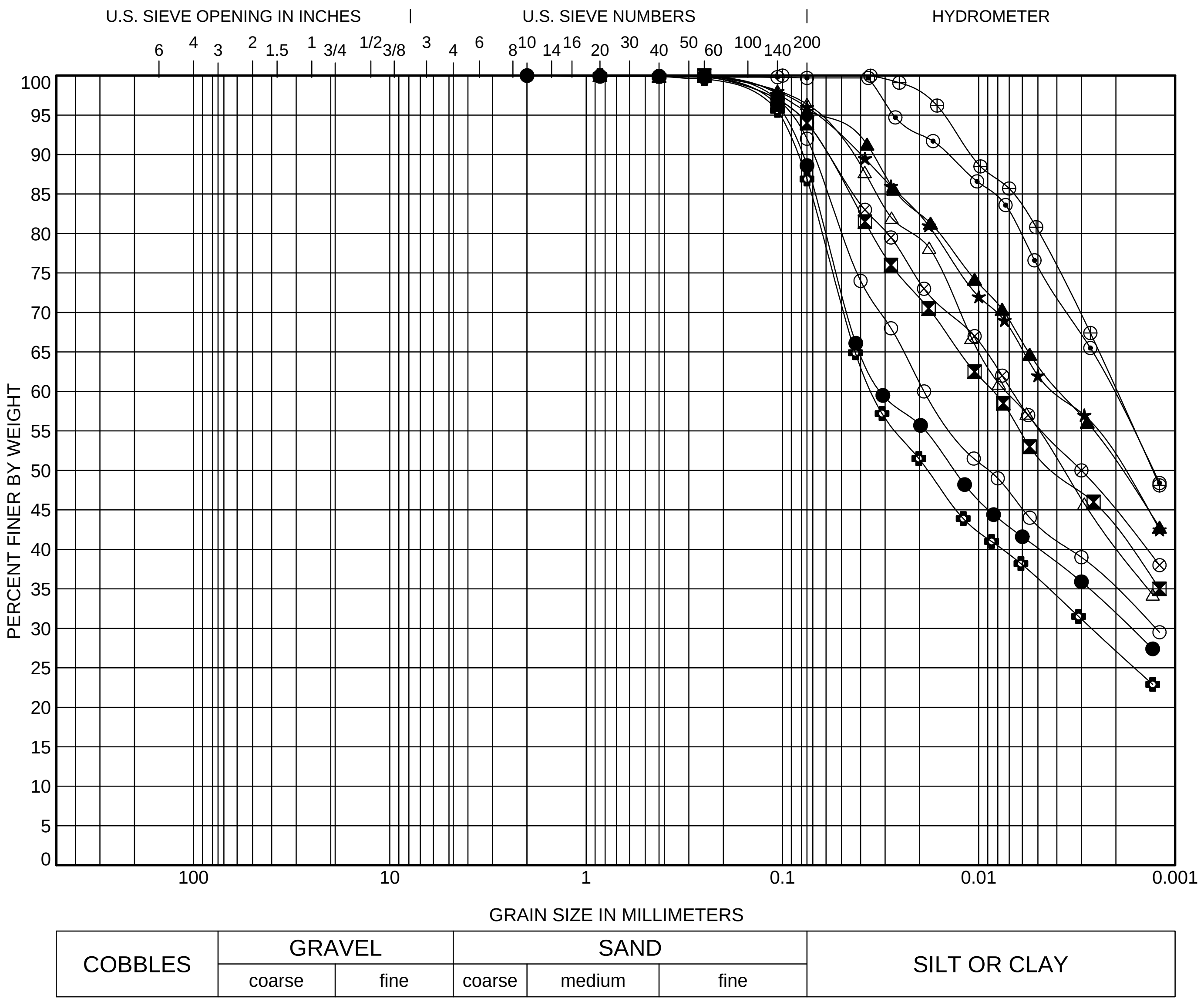
FIGURE C2

Project No.: TG22-045
Client: SLR
Project: 3850 Cambrian Road
Location: Nepean, Ontario

GRAIN SIZE ANALYSIS
SILTY CLAY MATERIALS BELOW THE "CRUST"



Specimen Identification and Depth (m)			Classification	LL	PL	PI	Cc	Cu
●	BH22-11	3.28						
⧗	BH22-11	5.12		33	18	15		
▲	BH22-11	7.85						
★	BH22-11	9.66		31	18	13		
⊙	BH22-11	13.94		37	23	14		
✤	BH22-3	2.51						
○	BH22-3	5.06		32	18	14		
△	BH22-3	7.85						
⊗	BH22-3	9.69		38	21	17		
⊕	BH22-3	12.42						

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FIGURE C3

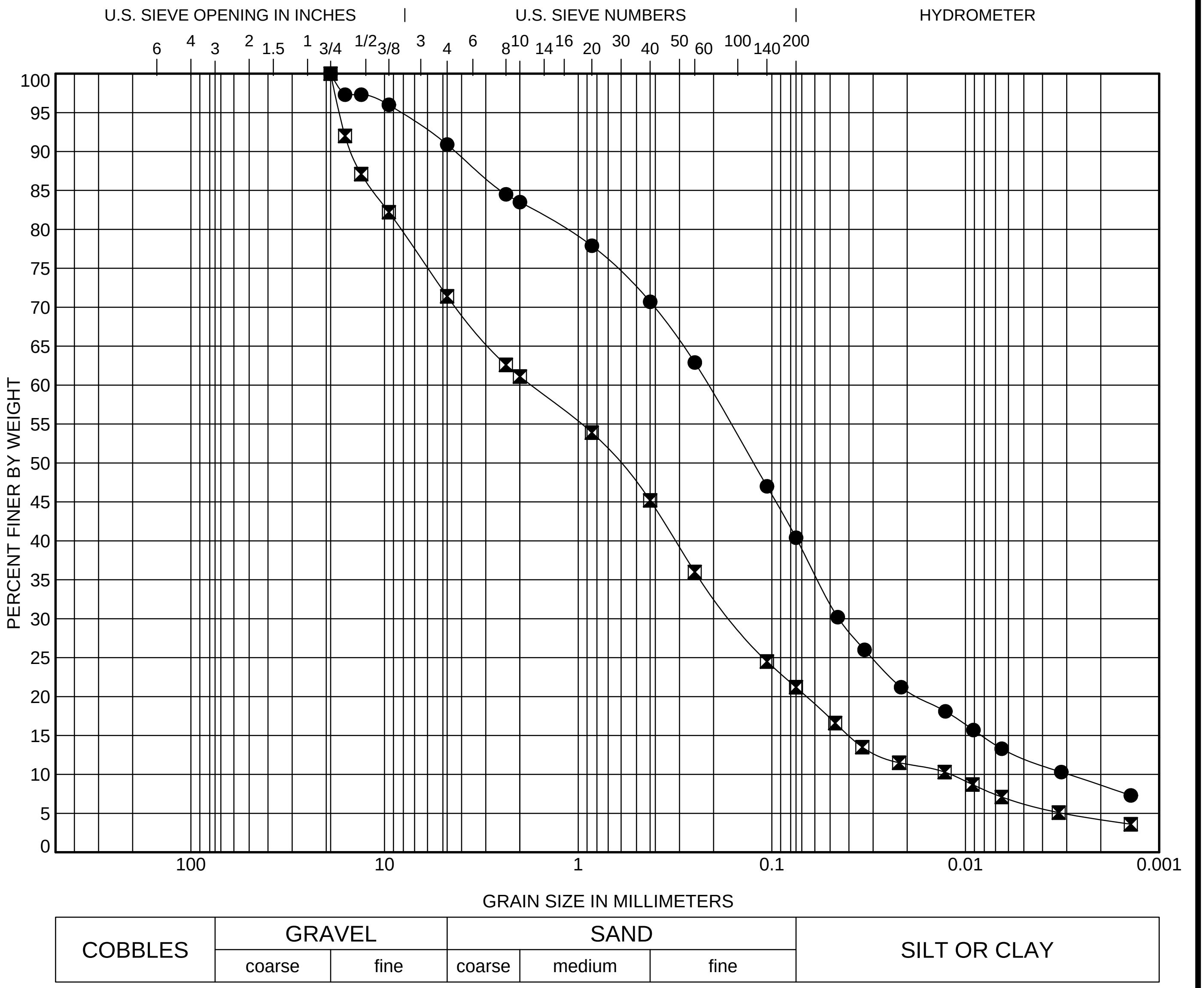
Project No.: TG22-045

Client: SLR

Project: 3850 Cambrian Road

Location: Nepean, Ontario

GRAIN SIZE ANALYSIS
DEEP COHESIONLESS GLACIAL TILL



	Specimen Identification and Depth (m)		Classification	LL	PL	PI	Cc	Cu
●	BH22-3	16.99					**3.22**	**72.57**
☒	BH22-3	18.52					**1.21**	**145.86**

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FIGURE C4

Project No.: TG22-045

Client: SLR

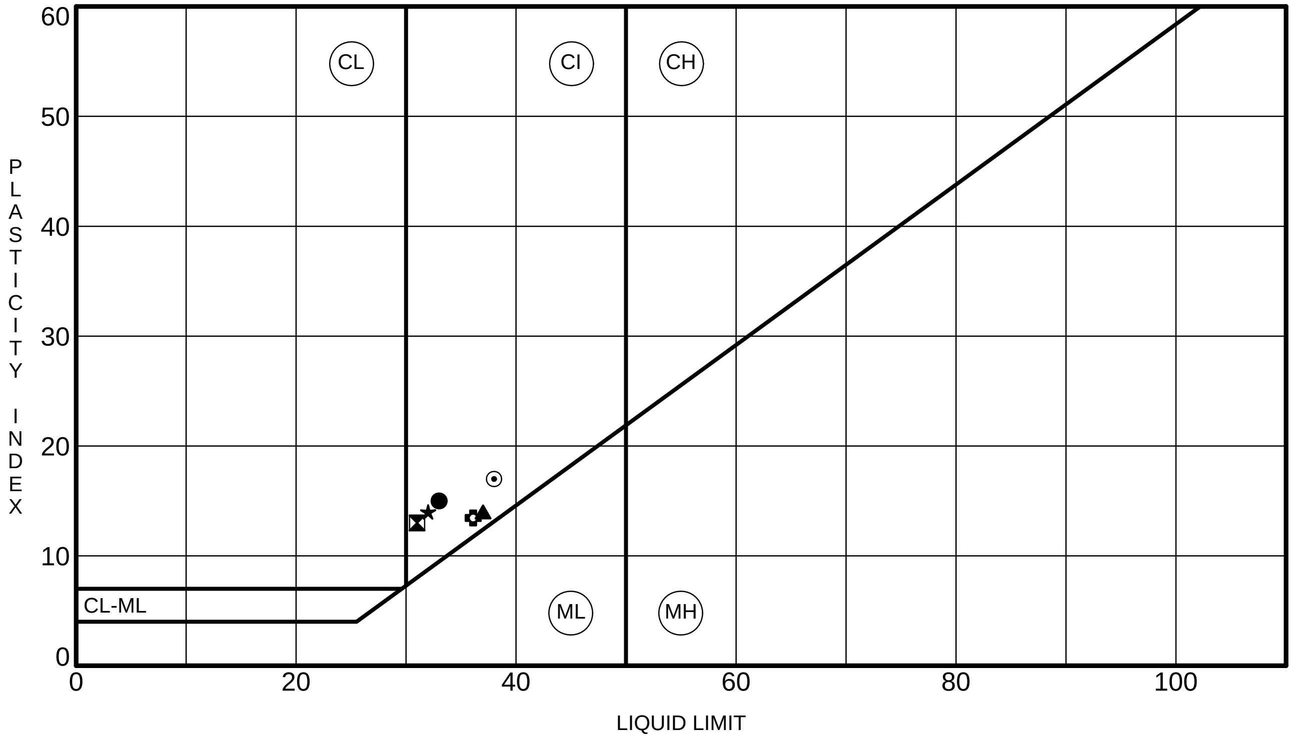
Project: 3850 Cambrian Road

Location: Nepean, Ontario

APPENDIX D

GEOTERRE 2020
SOIL PLASTICITY DATA

ATTERBERG LIMIT TEST RESULTS
SILTY CLAY MATERIALS BELOW THE "CRUST"



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BH22-11	5.12	**33**	**18**	**15**	**94**	**LEAN CLAY(CI)**
⧗	BH22-11	9.66	**31**	**18**	**13**	**96**	**LEAN CLAY(CI)**
▲	BH22-11	13.94	**37**	**23**	**14**	**100**	**LEAN CLAY(CI)**
★	BH22-3	5.06	**32**	**18**	**14**	**92**	**LEAN CLAY(CI)**
⊙	BH22-3	9.69	**38**	**21**	**17**	**94**	**LEAN CLAY(CI)**
✿	BH22-3	15.47	**36**	**23**	**13**		

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FIGURE D1

Project No.: TG22-045
Client: SLR
Project: 3850 Cambrian Road
Location: Nepean, Ontario

GEOTERRE ATTERBERG LIMITS SLR-3850CAMBRIANDRIVE-NEPEAN.GPJ GEOTERRE.GDT 2/11/23

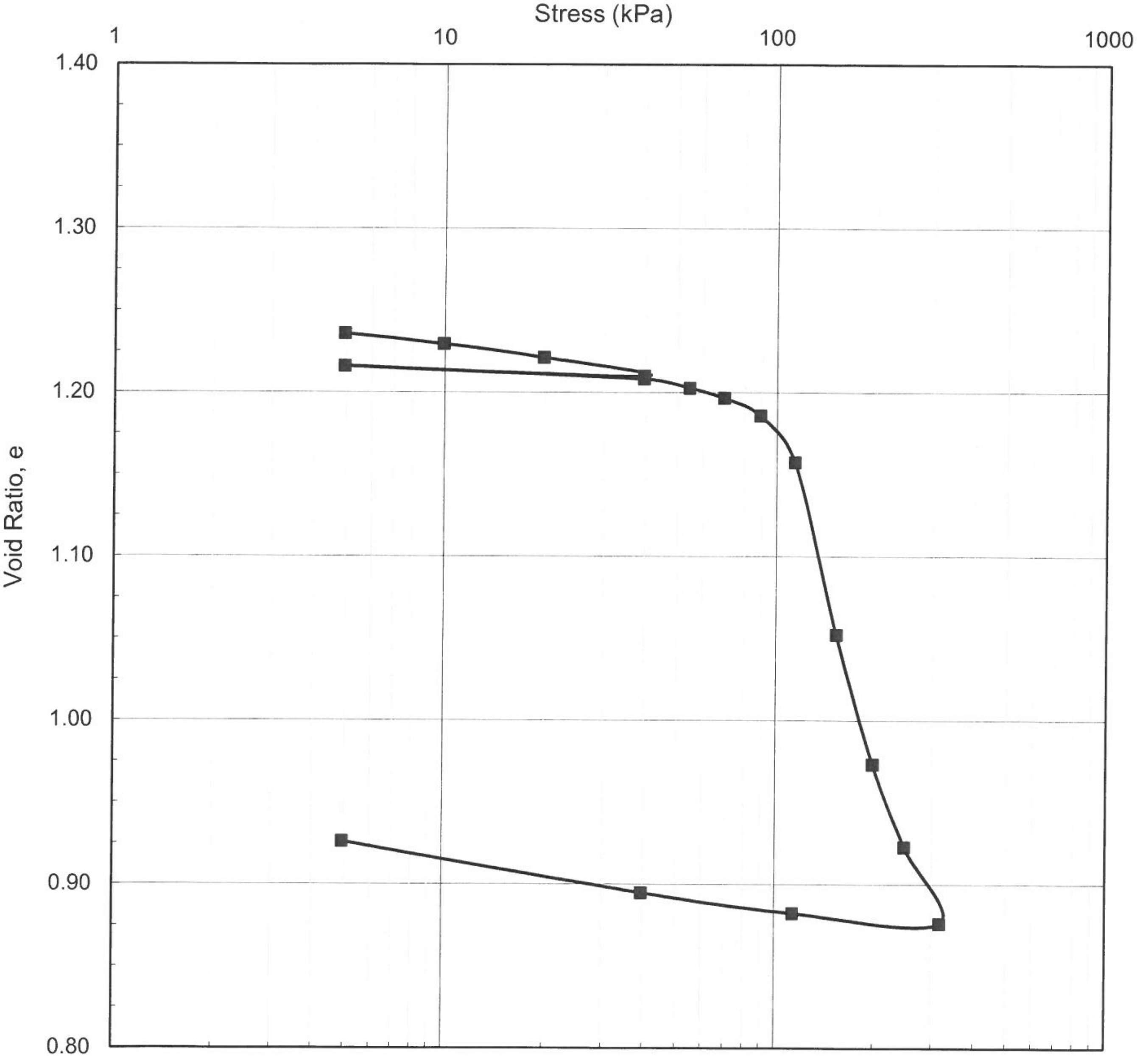
APPENDIX E

2022 ODOMETER CONSOLIDATION TEST DATA

BOREHOLE BH22-3
SAMPLE 6
DEPTH OF 5.05 M

σ'_{vo}= ** kPa
CALCULATED EXISTING EFFECTIVE
OVERBURDEN PRESSURE

σ'_p = ** kPa
MOST PROBABLE APPARENT
PRECONSOLIDATION PRESSURE



LEGEND

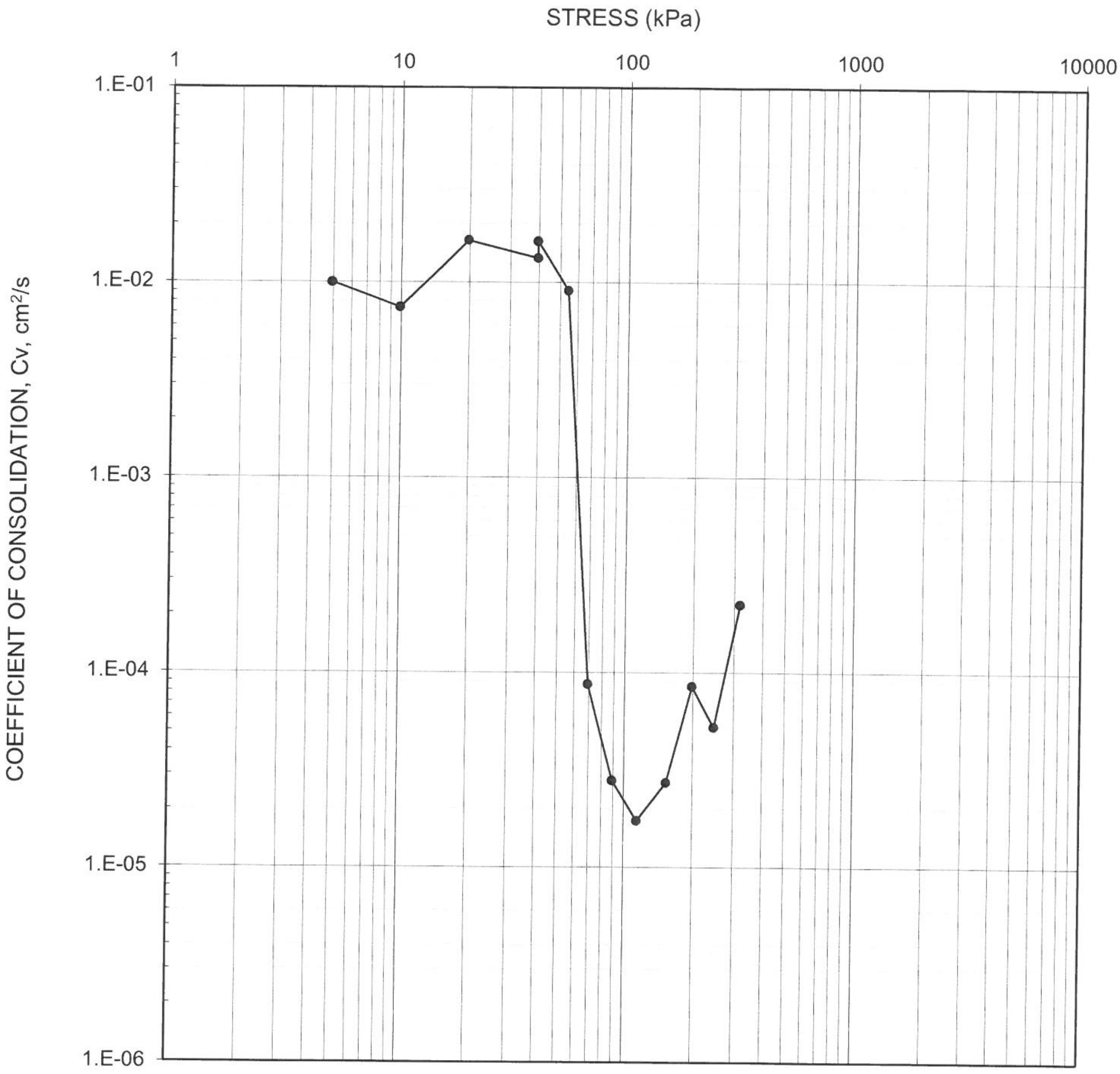
Borehole:	22-03	w_i =	45%	S_o =	100%	γ =	17.5 kN/m^3
Sample:	6	w_f =	34%	e_o =	1.24	G_s =	2.77
Depth (m):	5.05	w_l =	32%	C_c =			
Elevation (m):	TB Supplied	w_p =	18%	C_r =			

GOLDER
MEMBER OF WSP

Consolidation Test Results

Void Ratio vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI



LEGEND

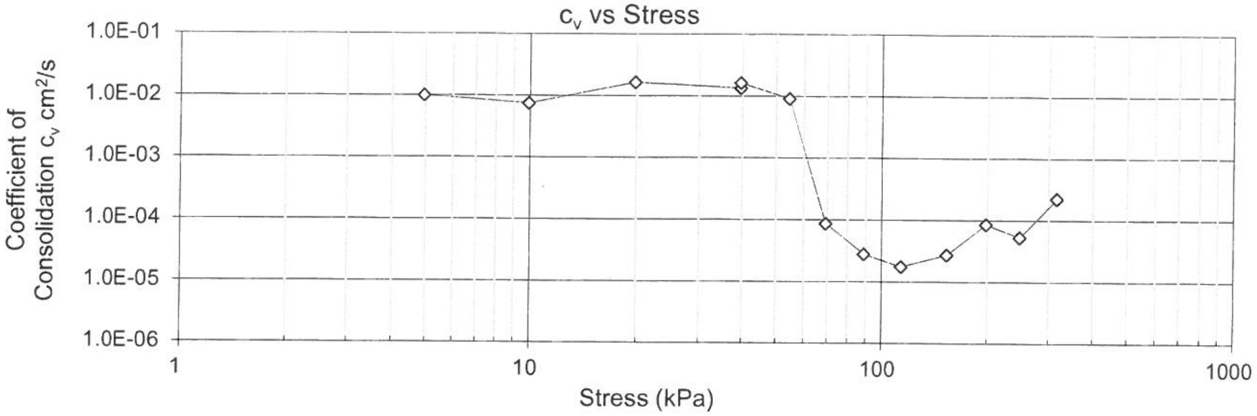
Borehole: 22-03 Sample: 6 Depth (m): 5.05

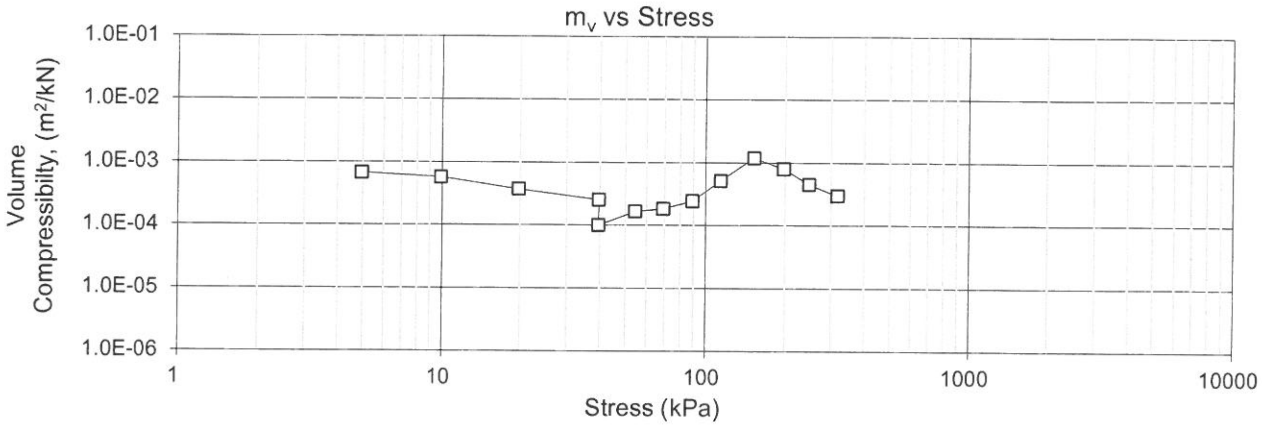
GOLDER
MEMBER OF WSP

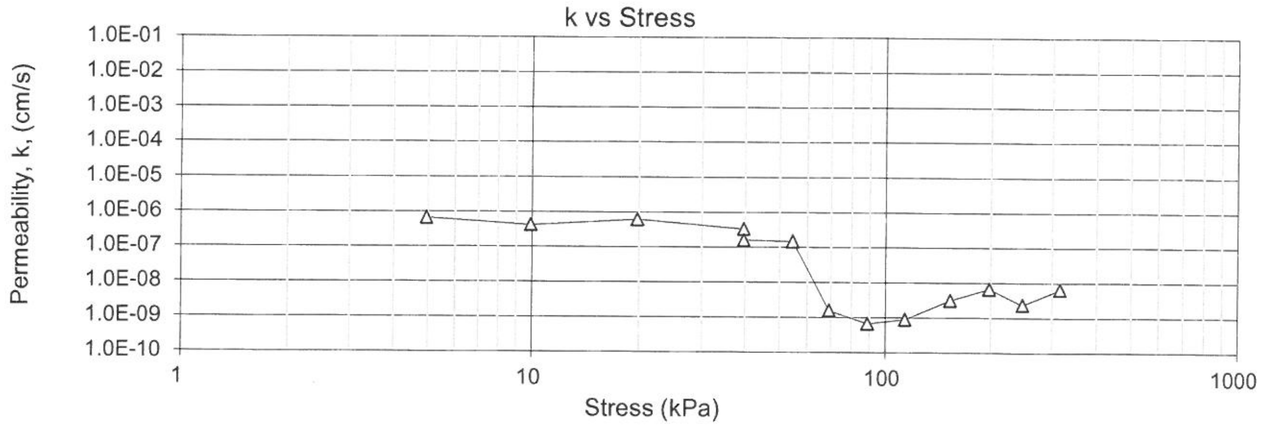
Consolidation Test Results

Cv vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI







LEGEND

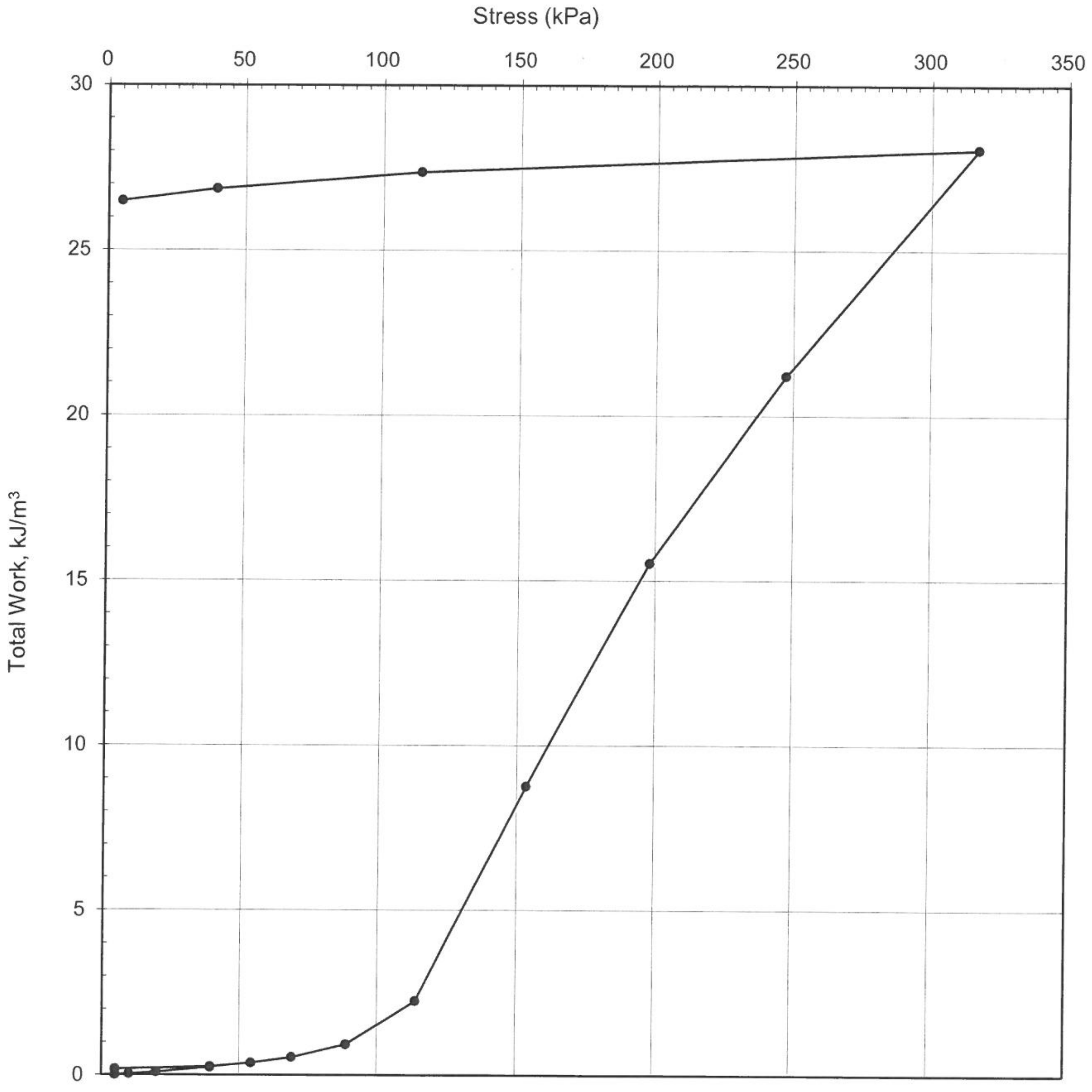
Borehole: 22-03 Sample: 6 Depth (m): 5.05

Note : LIR not = 1, use Cv's with caution

GOLDER
MEMBER OF WSP

Consolidation Test Results

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI



LEGEND

Borehole: 22-03 Sample: 6 Depth (m): 5.05

GOLDER
MEMBER OF WSP

Consolidation Test Results

Total Work vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI

WATER CONTENT DATA		WHOLE SAMPLE BEFORE TEST	WHOLE SAMPLE AFTER TEST	TOP TRIMMINGS	BOTTOM TRIMMINGS	SIDE TRIMMINGS	THEORETICAL
TARE NUMBER		3	3	168	175	461	
WEIGHT OF WET SOIL & TARE, g		198.07	262.66	47.77	48.36	49.81	198.07
WEIGHT OF DRY SOIL & TARE, g		161.97	235.25	39.11	40.00	41.70	
WEIGHT OF TARE, g		81.26	154.54	21.25	21.20	21.95	81.26
WEIGHT OF WATER, g		36.1	27.41	8.66	8.36	8.11	
WEIGHT OF DRY SOIL, g		80.71	80.71	17.86	18.80	19.75	80.74
WATER CONTENT, %		44.73	33.96	48.5	44.5	41.1	44.7

Dial Reading = 0.0001 inch = 0.00254 mm

STEP	STRESS kPa	TEST TYPE	INITIAL DIAL READING D_o 10^{-4} in	FINAL DIAL READING D_{100} 10^{-4} in	EQUIPEMENT DEFORMATION DHe (see note 1) 10^{-4} in	DEFORMATION ΔD $(D_{100}-D_o\text{-}\Delta He)$ mm	FINAL HEIGHT H (H0 - DD) mm	VOID RATIO e	AVERAGE SAMPLE HEIGHT mm	t_{90} sec	COEFFICIENT OF CONSOLIDATION Cv cm^2/sec	mv m^2/kN	PERMEABILITY k cm/s	TOTAL WORK kJ/m^3	AVERAGE STRESS kPa
1	5	Consolidation	5546	5518	1.0	0.0686	20.541	1.2359	20.576	90	9.97E-03	6.71E-04	6.56E-07	0.01	2.5
2	10	Consolidation	5518	5490	5.0	0.0584	20.483	1.2295	20.512	120	7.43E-03	5.72E-04	4.17E-07	0.03	7.4
3	20	Consolidation	5490	5447	13.0	0.0762	20.407	1.2212	20.445	54	1.64E-02	3.74E-04	6.02E-07	0.08	14.9
4	40	Consolidation	5447	5390	16.0	0.1041	20.303	1.2099	20.355	66	1.33E-02	2.55E-04	3.32E-07	0.24	29.7
5	5	Rebound	5390	5436	-24.0	-0.0559	20.359	1.2159	20.331					0.17	22.3
6	40	Consolidation	5436	5383	25.0	0.0711	20.287	1.2082	20.323	54	1.62E-02	9.96E-05	1.58E-07	0.25	22.3
7	54	Consolidation	5383	5358	5.0	0.0508	20.237	1.2027	20.262	96	9.07E-03	1.66E-04	1.48E-07	0.37	47.0
8	69	Consolidation	5358	5328	8.0	0.0559	20.181	1.1966	20.209	9942	8.71E-05	1.83E-04	1.56E-09	0.54	61.9
9	89	Consolidation	5328	5282	7.0	0.0991	20.082	1.1858	20.131	30840	2.79E-05	2.43E-04	6.63E-10	0.93	79.2
10	114	Consolidation	5282	5171	8.0	0.2616	19.820	1.1573	19.951	48588	1.74E-05	5.13E-04	8.73E-10	2.25	101.4
11	153	Consolidation	5171	4776	15.0	0.9652	18.855	1.0523	19.337	29154	2.72E-05	1.18E-03	3.15E-09	8.76	133.6
12	198	Consolidation	4776	4486	4.0	0.7264	18.128	0.9732	18.492	8544	8.48E-05	7.91E-04	6.58E-09	15.53	175.7
13	247	Consolidation	4486	4298	6.0	0.4623	17.666	0.9229	17.897	12960	5.24E-05	4.53E-04	2.33E-09	21.20	222.7
14	317	Consolidation	4298	4115	14.0	0.4293	17.237	0.8762	17.452	2898	2.23E-04	2.99E-04	6.53E-09	28.06	282.2
15	114	Rebound	4115	4154	-17.0	-0.0559	17.293	0.8822	17.265					27.36	215.4
16	40	Rebound	4154	4215	-16.0	-0.1143	17.407	0.8947	17.350					26.86	76.7
17	5	Rebound	4215	4361	-33.0	-0.2870	17.694	0.9259	17.551					26.49	22.3

	ACTUAL	HEORETICAL	
INITIAL SAMPLE HEIGT H_0, mm	20.61	20.61	
SPECIFIC GRAVITY, Gs	2.767	2.767	
INITIAL SOLIDS HEIGHT, mm	9.19	9.19	
INITIAL VOID RATIO, e_0	1.243	1.243	
INITIAL DEGREE OF SATURATION,	99.5	99.5	(100)
INITIAL WET DENSITY, kN/m³	17.51		

FINAL SAMPLE HEIGT H_0, mm =	17.694
SPECIFIC GRAVITY, Gs =	2.767
FINAL SOLIDS HEIGHT =	9.187
FINAL VOID RATIO =	0.9259
FINAL DEGREE OF SATURATION	101.5
COMPUTED EXISITNG EFFECTIVE OVERBURDEN PRESSURE, σ'_{vo} kPa	100000
MOST PROBABLE APPARENT PRECONSOLIDATION PRESSURE, σ'_p kPa	100000

CONSOLIDATION TEST SUMMARY

MACHINE NUMBER	3	CALCULATED BY	CW	PROJECT NUMBER	22513712/6000
RING NUMBER	3	CHECKED BY	MI	BOREHOLE NUMBER	22-03
RING HEIGHT, mm	20.61	DATE STARTED	23-Nov-22	SAMPLE NUMBER	6
RING DIAMETER, mm	63.58	DATE FINISHED	08-Dec-22	SAMPLE DEPTH (m)	5.05
RING AREA, cm²	31.75	REMARKS			

V2020

GRAIN SIZE DISTRIBUTION

FIGURE

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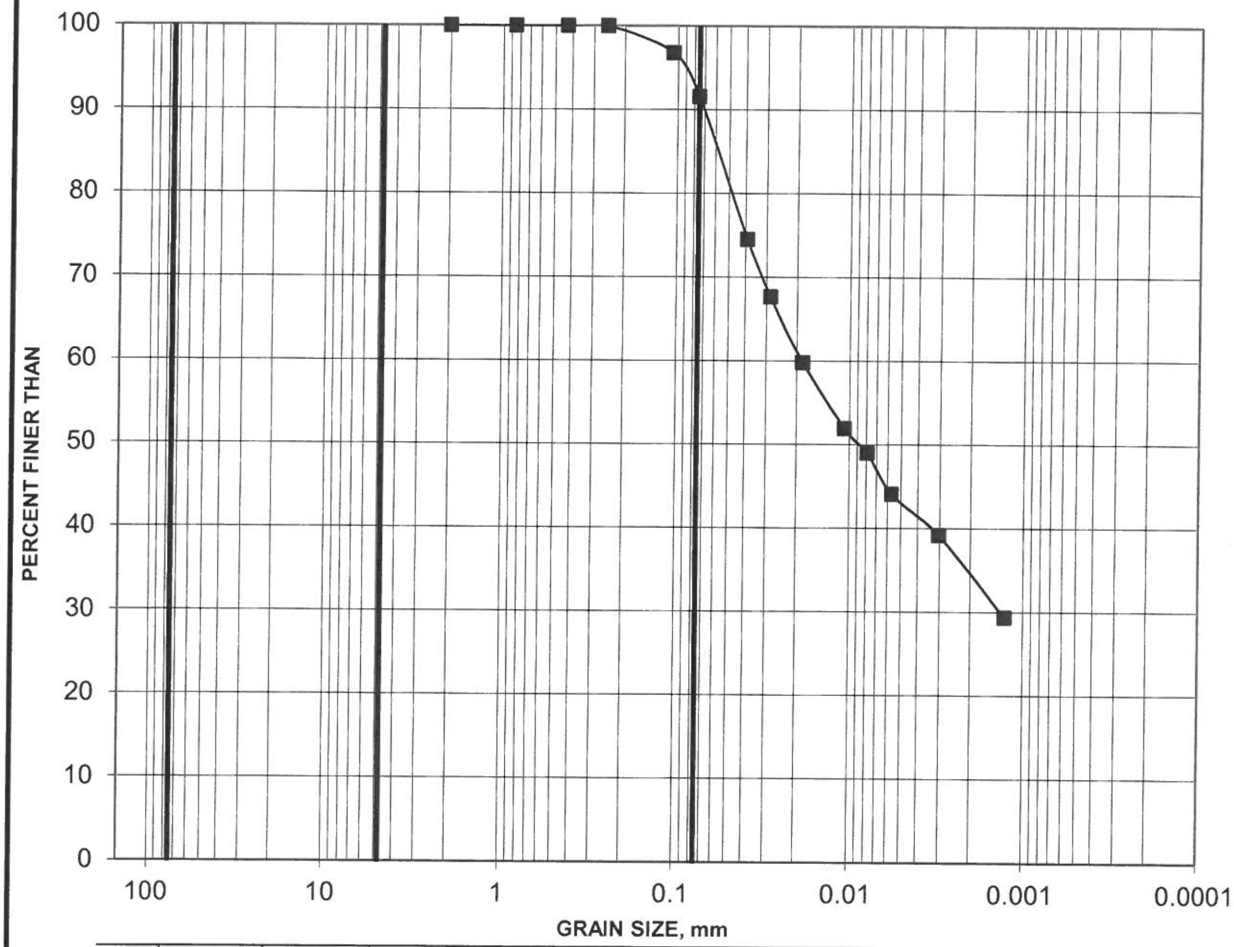


COBBLE SIZE	COARSE	FINE	COARSE	MEDIU	FINE	SILT AND CLAY
	GRAVEL SIZE		SAND SIZE			

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
-■-	22-03	6	4.57-5.11	0	8	57	35

Project: 22513712/6000

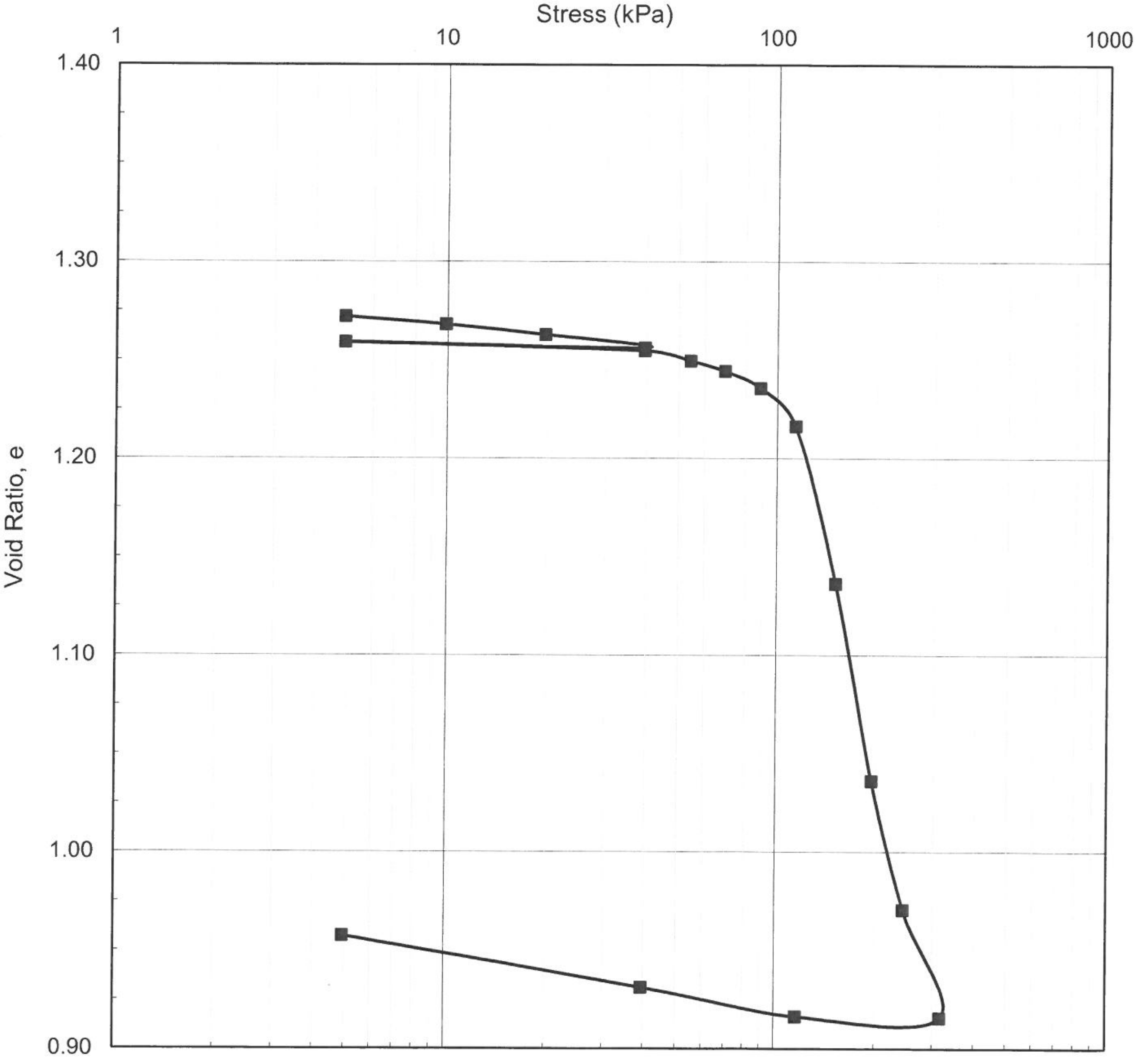
GOLDER
MEMBER OF WSP

Created by:	CW
Checked by:	MI

BOREHOLE BH22-3
SAMPLE 9
DEPTH OF 9.70 M

σ'_{vo}= ** kPa
CALCULATED EXISTING EFFECTIVE OVERBURDEN PRESSURE

σ'_{p} = ** kPa
MOST PROBABLE APPARENT PRECONSOLIDATION PRESSURE



LEGEND

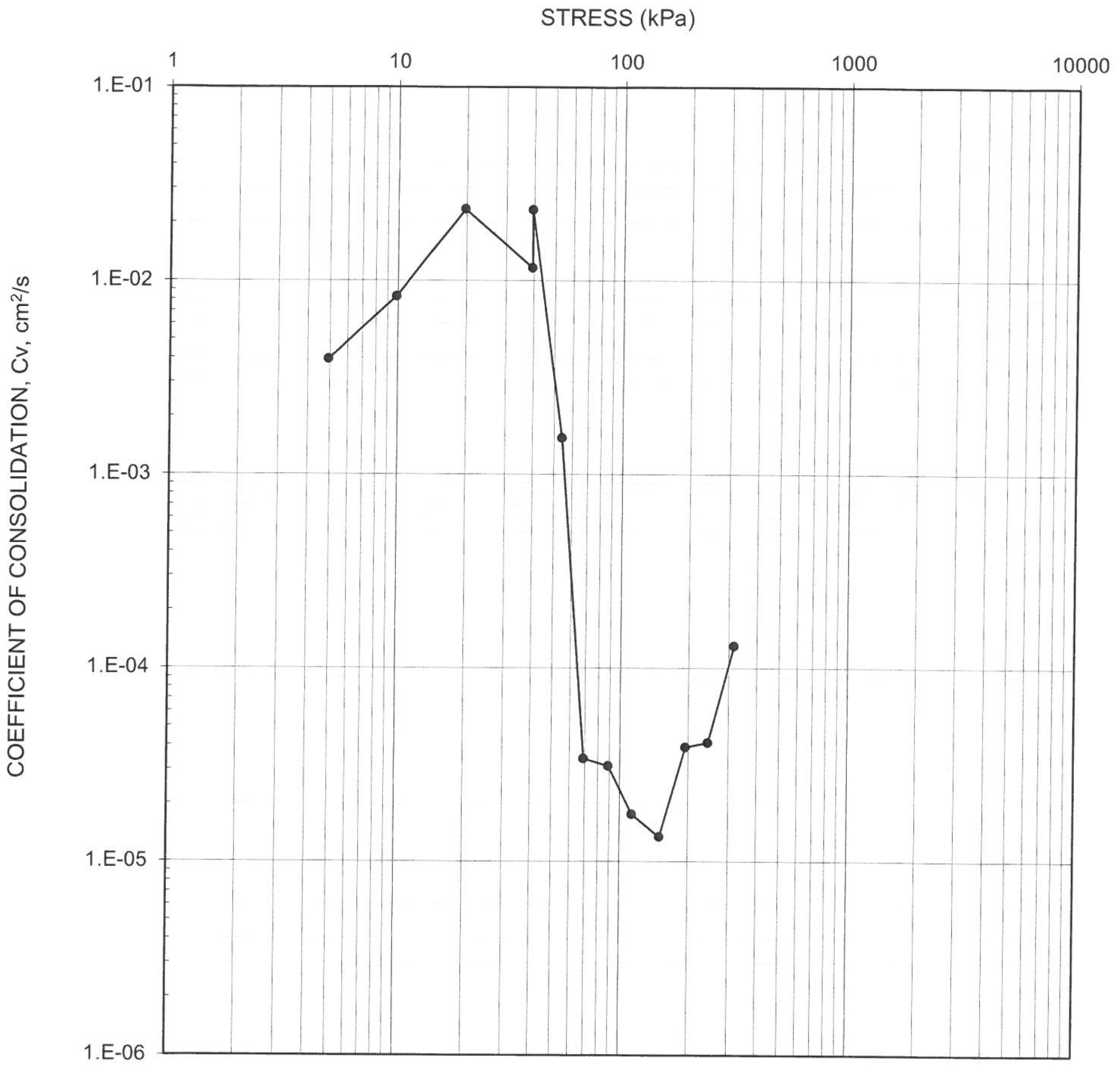
Borehole:	22-03	w_i =	46%	S_o =	100%	γ =	17.4 kN/m³
Sample:	9	w_f =	35%	e_o =	1.28	G_s =	2.76
Depth (m):	9.7	w_l =	38%	C_c =			
Elevation (m):	TB Supplied	w_p =	21%	C_r =			

GOLDER
MEMBER OF WSP

Consolidation Test Results

Void Ratio vs Stress

Figure No.
Revision
Project No. 22513712/6000
Created By cw
Checked By MI



LEGEND

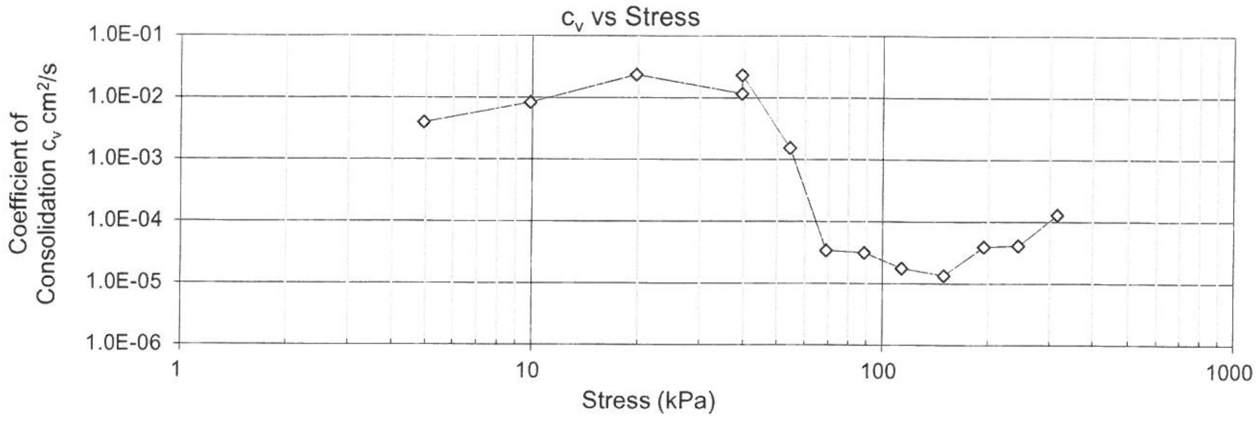
Borehole: 22-03 Sample: 9 Depth (m): 9.70

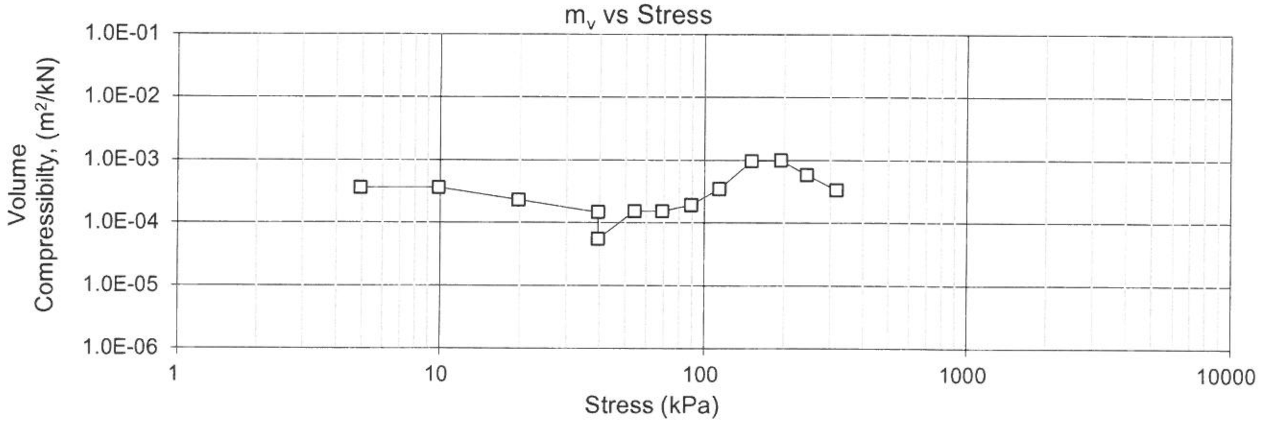
GOLDER
MEMBER OF WSP

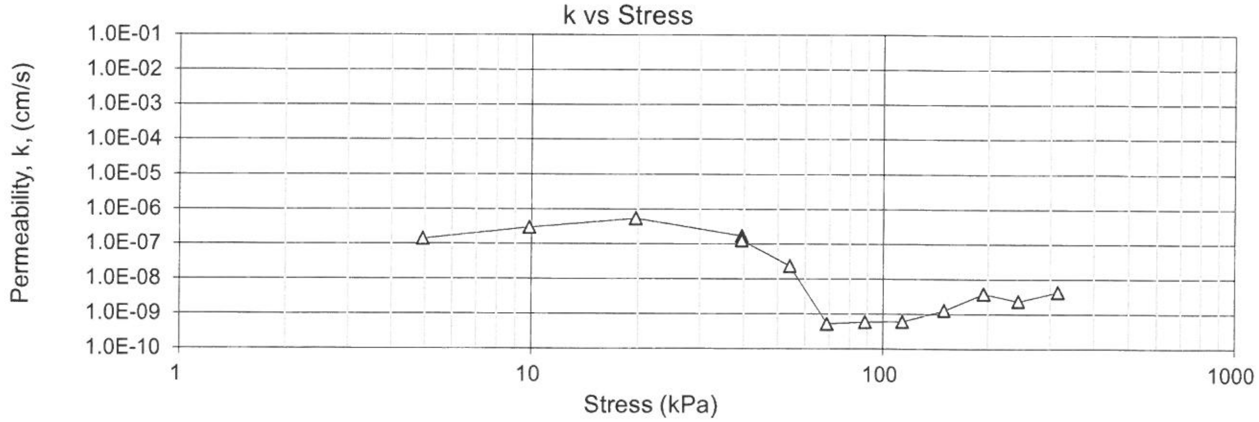
Consolidation Test Results

Cv vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	cw
Checked By	MI







LEGEND

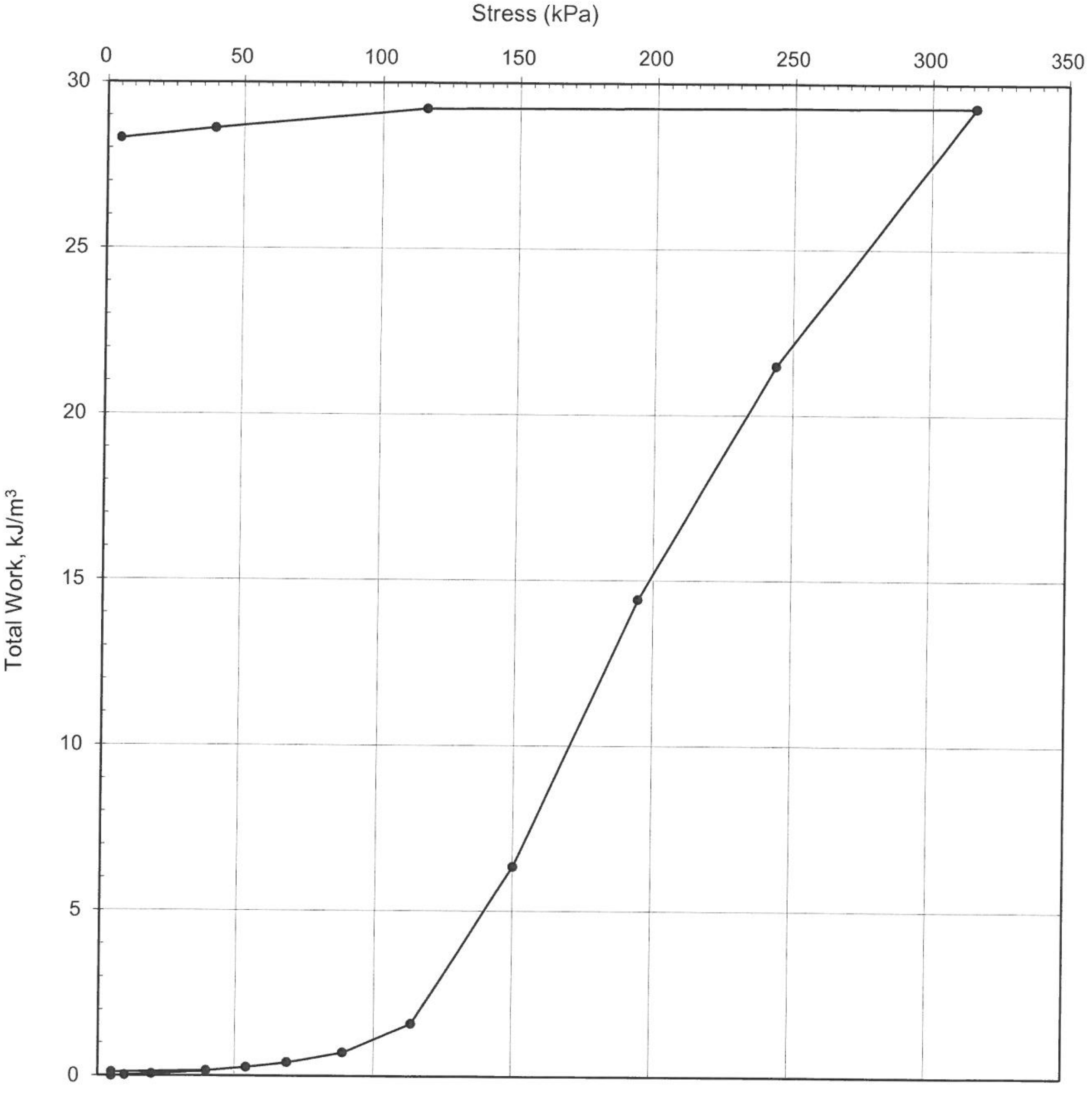
Borehole: 22-03 Sample: 9 Depth (m): 9.70

Note : LIR not = 1, use Cv's with caution

GOLDER
MEMBER OF WSP

Consolidation Test Results

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI



LEGEND

Borehole: 22-03 Sample: 9 Depth (m): 9.70

GOLDER
MEMBER OF WSP

Consolidation Test Results

Total Work vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI

GRAIN SIZE DISTRIBUTION	FIGURE

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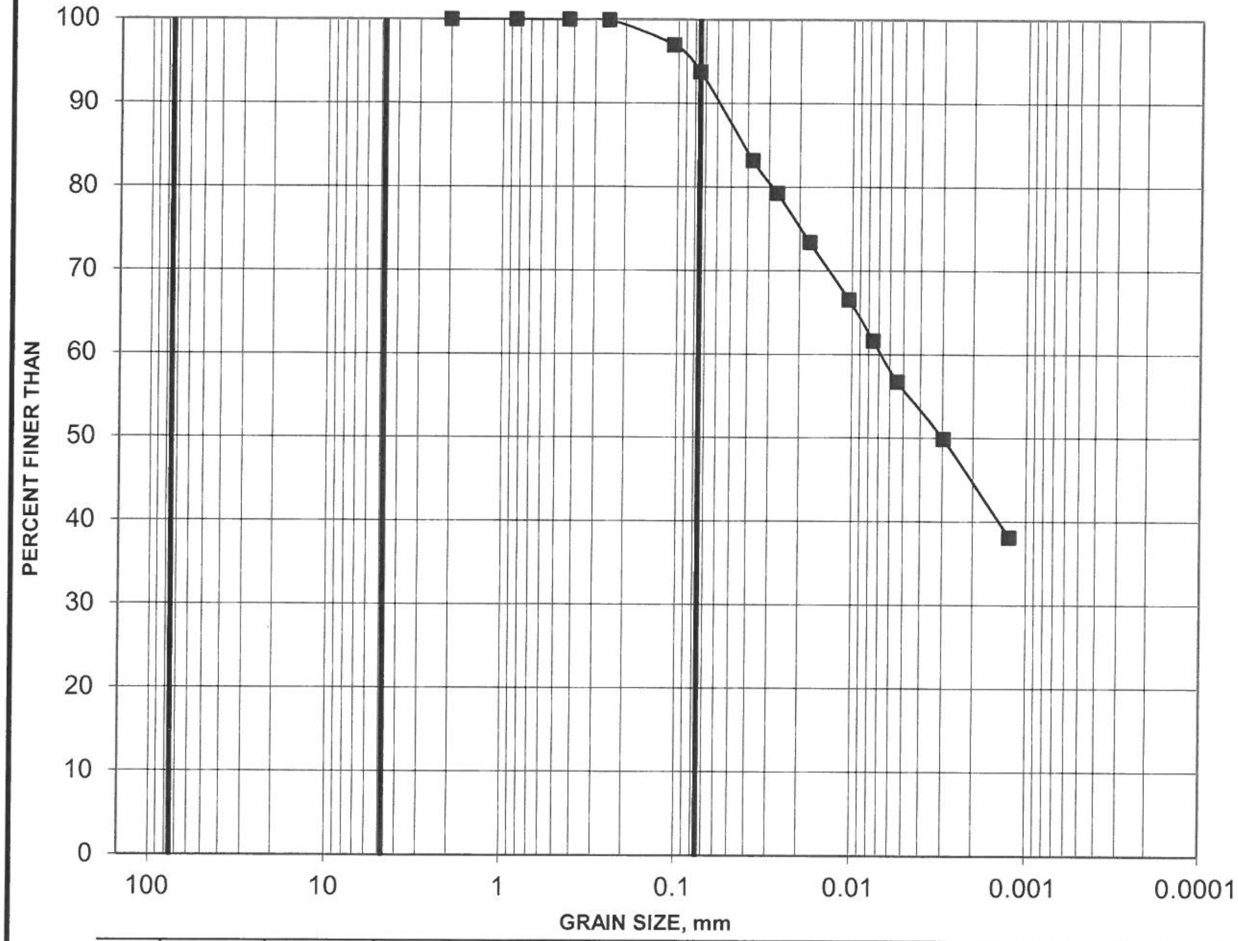


COBBLE SIZE	COARSE	FINE	COARSE	MEDIU	FINE	SILT AND CLAY
	GRAVEL SIZE		SAND SIZE			

	Borehole	Sample	Depth (m)	Constituents (%) Gravel	Sand	Silt	Clay
■	22-03	9	9.17-9.75	0	6	49	45

Project: 22513712/6000

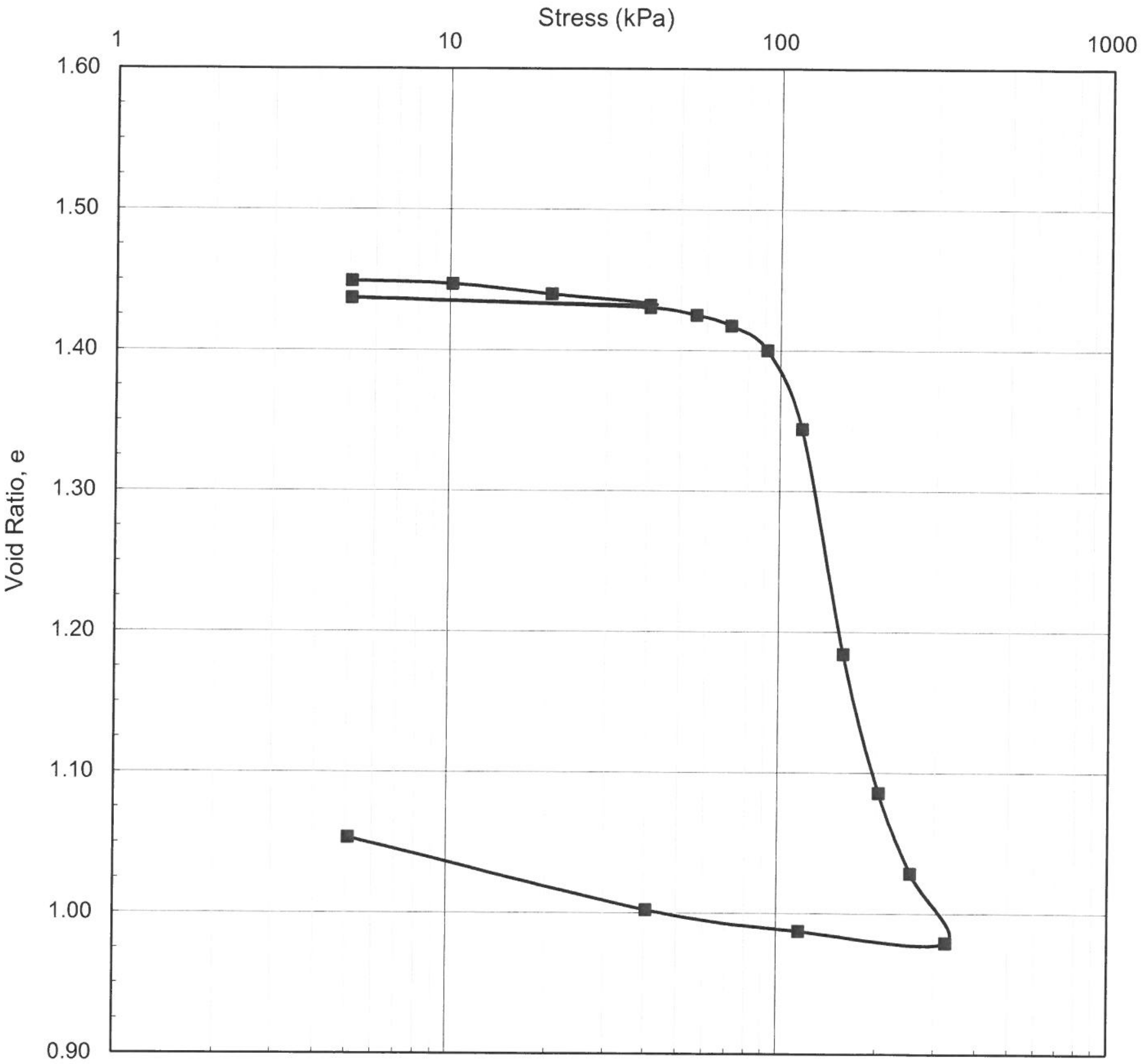
GOLDER
MEMBER OF WSP

Created by:	CW
Checked by:	MI

BOREHOLE BH22-11
SAMPLE 6
DEPTH OF 5.13 M

σ'_{vo}= ** kPa
CALCULATED EXISTING EFFECTIVE
OVERBURDEN PRESSURE

σ'_p = ** kPa
MOST PROBABLE APPARENT
PRECONSOLIDATION PRESSURE



LEGEND

Borehole:	22-11	w_i =	53%	S_o =	100%	γ =	16.8 kN/m³
Sample:	6	w_f =	38%	e_o =	1.45	G_s =	2.76
Depth (m):	5.13	w_l =	33%	C_c =			
Elevation (m):	TB Supplied	w_p =	18%	C_r =			

GOLDER
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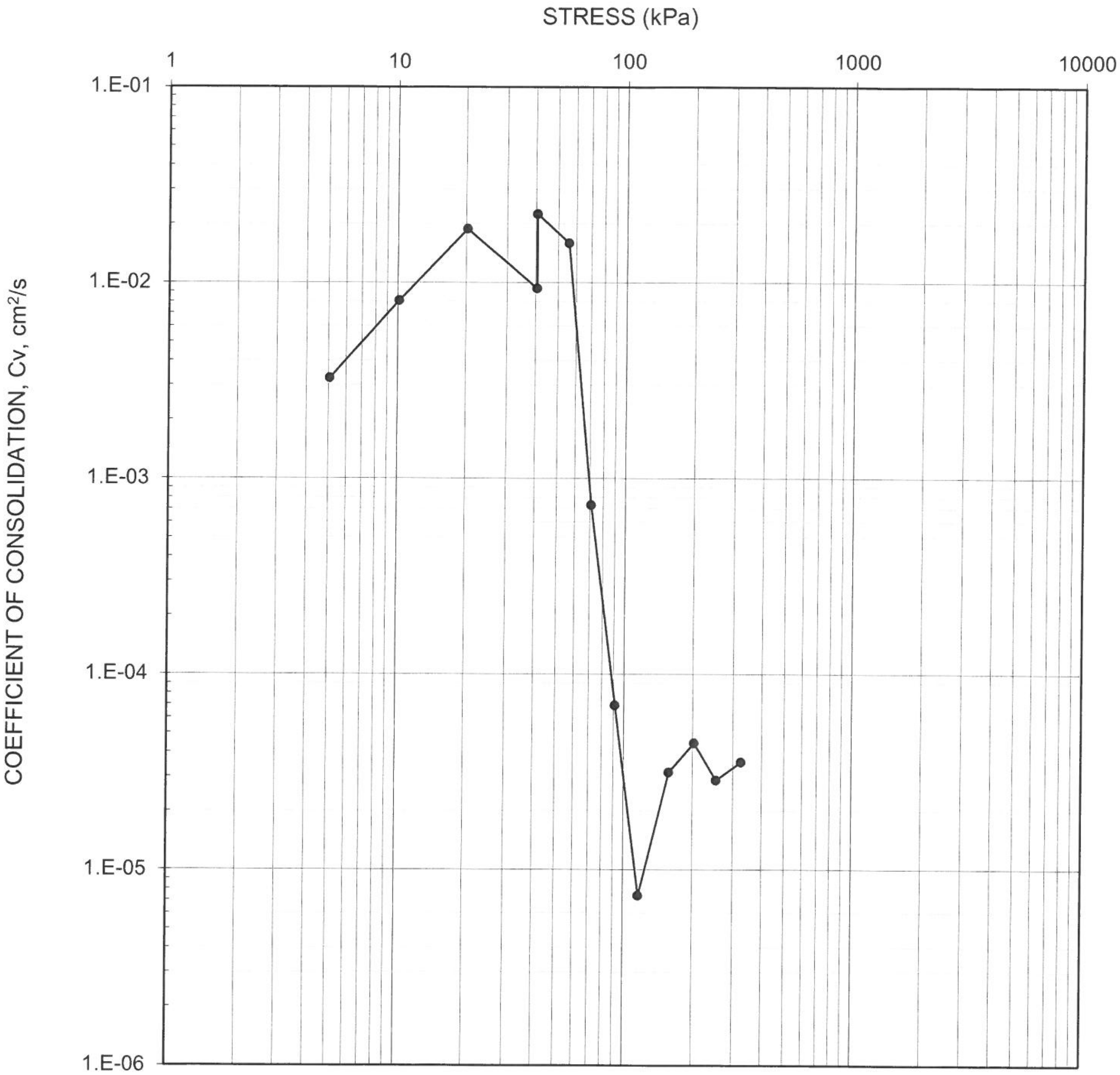
Consolidation Test Results

Void Ratio vs Stress

Figure No.
Revision
Project No. 22513712/6000
Created By cw
Checked By MI



LEGEND

Borehole: 22-11 Sample: 6 Depth (m): 5.13

GOLDER
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Consolidation Test Results

Cv vs Stress

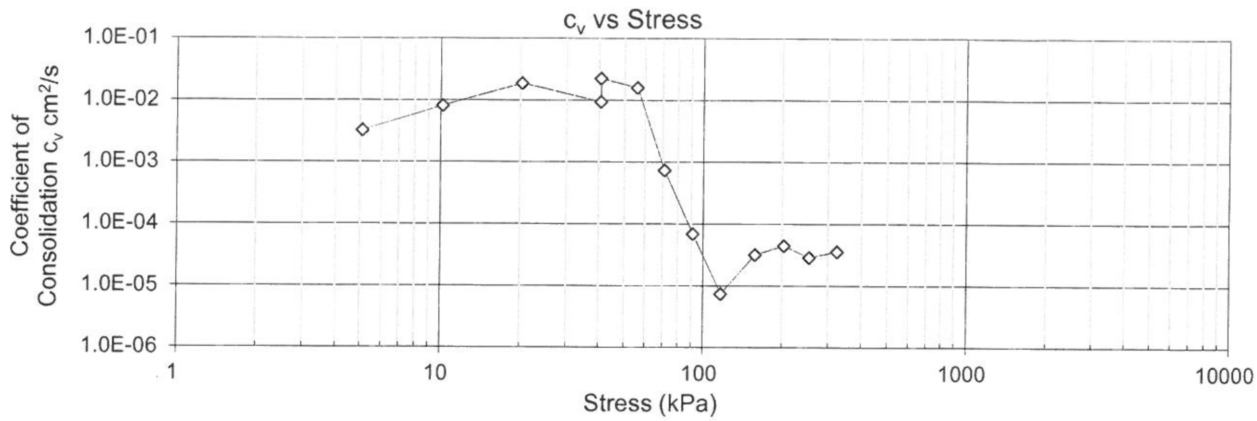
Figure No.

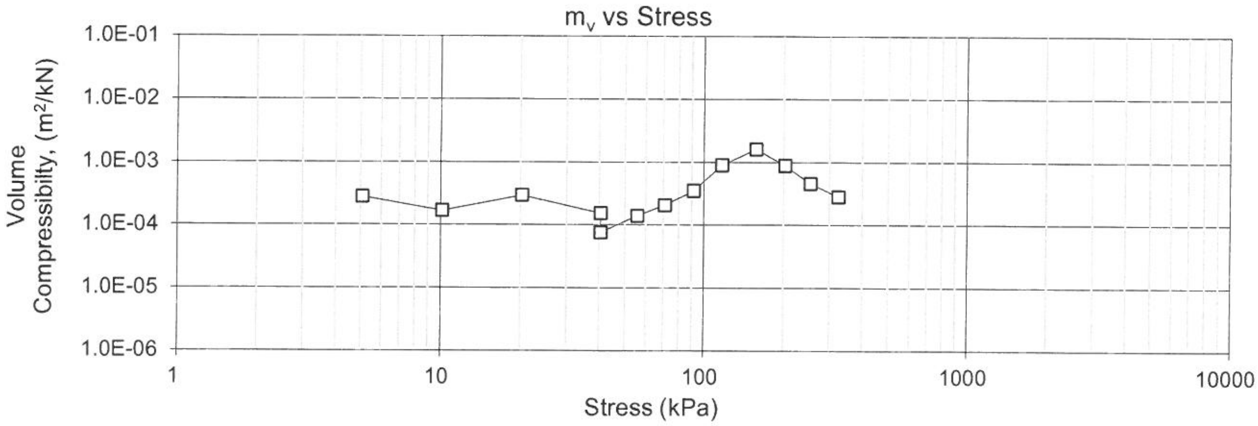
Revision

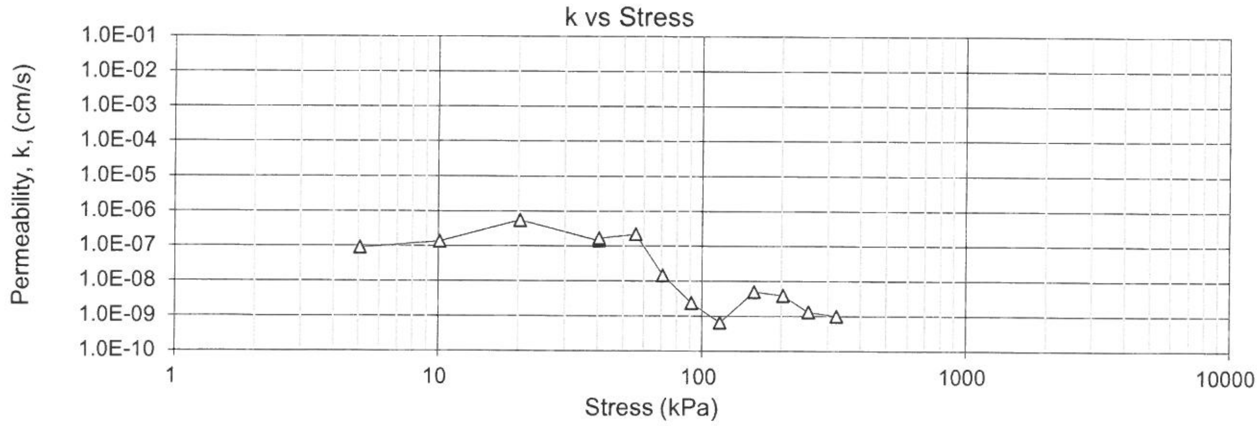
Project No. 22513712/6000

Created By cw

Checked By MI







LEGEND

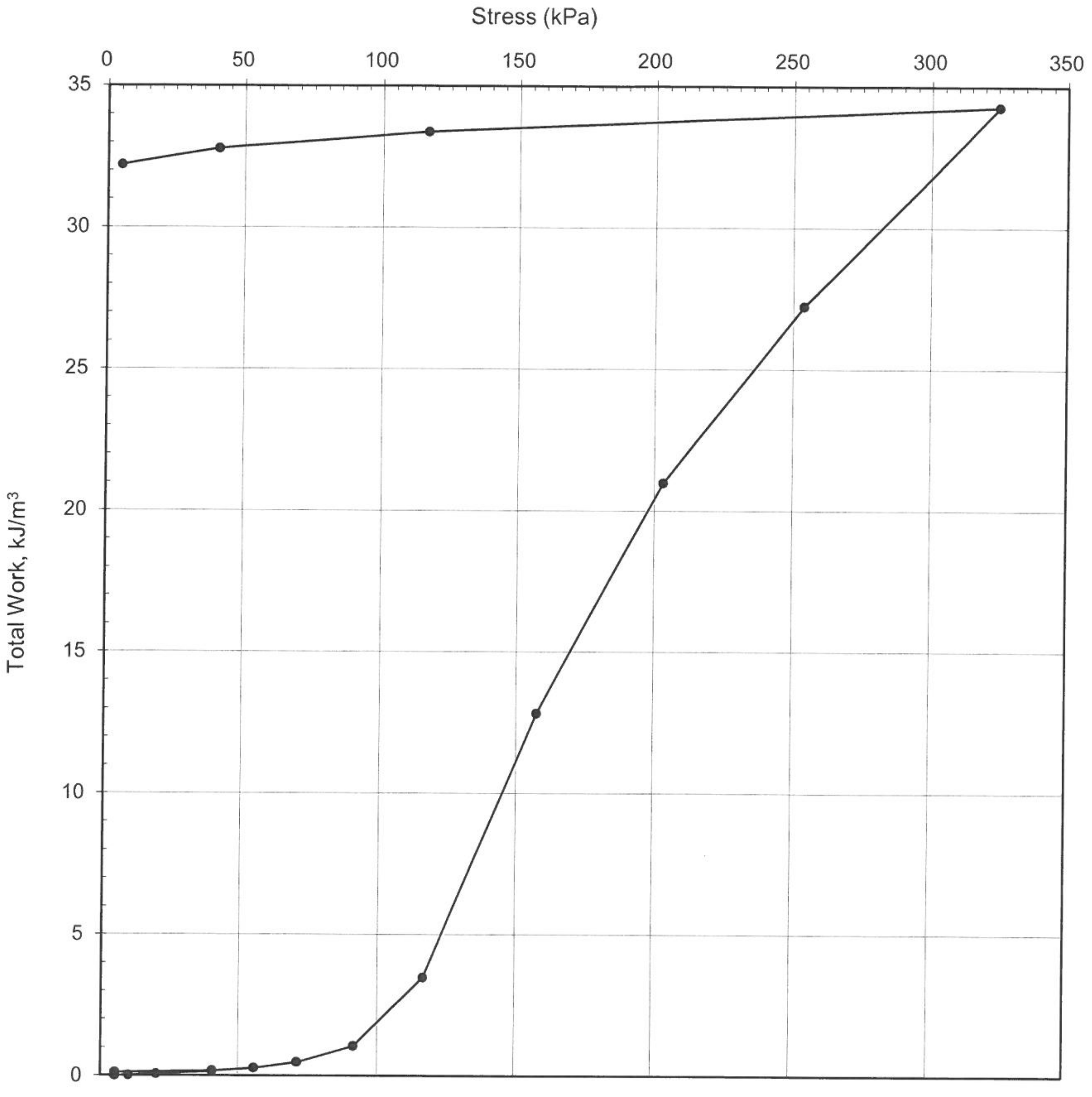
Borehole: 22-11 Sample: 6 Depth (m): 5.13

Note : LIR not = 1, use Cv's with caution

GOLDER
MEMBER OF WSP

Consolidation Test Results

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI



LEGEND

Borehole: 22-11 Sample: 6 Depth (m): 5.13

GOLDER
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Consolidation Test Results

Total Work vs Stress

Figure No.
Revision
Project No. 22513712/6000
Created By CW
Checked By MI

WATER CONTENT DATA		WHOLE SAMPLE BEFORE TEST	WHOLE SAMPLE AFTER TEST	TOP TRIMMINGS	BOTTOM TRIMMINGS	SIDE TRIMMINGS	THEORETICAL
TARE NUMBER		ring 1	ring 1	127	453	206	
WEIGHT OF WET SOIL & TARE, g		169.9	227.48	61.17	42.29	49.33	169.9
WEIGHT OF DRY SOIL & TARE, g		136.29	203.02	48.65	35.14	40.38	
WEIGHT OF TARE, g		72.3	139.03	21.86	21.91	21.45	72.3
WEIGHT OF WATER, g		33.61	24.46	12.52	7.15	8.95	
WEIGHT OF DRY SOIL, g		63.99	63.99	26.79	13.23	18.93	65.35
WATER CONTENT, %		52.52	38.22	46.7	54.0	47.3	49.4

Dial Reading = 0.0001 inch = 0.00254 mm

STEP	STRESS kPa	TEST TYPE	INITIAL DIAL READING D_o 10^{-4} in	FINAL DIAL READING D_{100} 10^{-4} in	EQUIPEMENT DEFORMATION DHe (see note 1) 10^{-4} in	DEFORMATION ΔD $(D_{100}-D_o.\Delta He)$ mm	FINAL HEIGHT H (H0 - DD) mm	VOID RATIO e	AVERAGE SAMPLE HEIGHT mm	t_{90} sec	COEFFICIENT OF CONSOLIDATION Cv cm^2/sec	mv m^2/kN	PERMEABILITY k cm/s	TOTAL WORK kJ/m^3	AVERAGE STRESS kPa
1	5	Consolidation	5546	5535	1.0	0.0254	17.905	1.4491	17.917	210	3.24E-03	2.79E-04	8.86E-08	0.00	2.5
2	10	Consolidation	5535	5521	8.0	0.0152	17.889	1.4470	17.897	84	8.08E-03	1.68E-04	1.33E-07	0.01	7.6
3	20	Consolidation	5521	5490	10.0	0.0533	17.836	1.4397	17.863	36	1.88E-02	2.93E-04	5.40E-07	0.06	15.2
4	41	Consolidation	5490	5451	17.0	0.0559	17.780	1.4321	17.808	72	9.34E-03	1.54E-04	1.41E-07	0.15	30.4
5	5	Rebound	5451	5484	-19.0	-0.0356	17.816	1.4369	17.798					0.11	22.8
6	41	Consolidation	5484	5446	19.0	0.0483	17.767	1.4303	17.792	30	2.24E-02	7.58E-05	1.66E-07	0.17	22.8
7	56	Consolidation	5446	5424	7.0	0.0381	17.729	1.4251	17.748	42	1.59E-02	1.40E-04	2.17E-07	0.27	48.2
8	71	Consolidation	5424	5396	6.0	0.0559	17.673	1.4175	17.701	912	7.28E-04	2.05E-04	1.46E-08	0.47	63.4
9	91	Consolidation	5396	5339	7.0	0.1270	17.546	1.4001	17.610	9522	6.90E-05	3.49E-04	2.36E-09	1.05	81.2
10	117	Consolidation	5339	5170	8.0	0.4089	17.138	1.3442	17.342	86400	7.38E-06	8.99E-04	6.50E-10	3.48	104.0
11	158	Consolidation	5170	4692	18.0	1.1684	15.969	1.1844	16.553	18456	3.15E-05	1.60E-03	4.93E-09	12.83	137.1
12	203	Consolidation	4692	4404	4.0	0.7214	15.248	1.0857	15.608	11634	4.44E-05	8.81E-04	3.83E-09	20.97	180.4
13	254	Consolidation	4404	4234	6.0	0.4166	14.831	1.0287	15.039	16758	2.86E-05	4.58E-04	1.28E-09	27.22	228.6
14	325	Consolidation	4234	4074	18.0	0.3607	14.471	0.9794	14.651	12828	3.55E-05	2.82E-04	9.81E-10	34.26	289.6
15	117	Rebound	4074	4114	-17.0	-0.0584	14.529	0.9874	14.500					33.37	221.0
16	41	Rebound	4114	4173	-16.0	-0.1092	14.638	1.0023	14.584					32.78	78.7
17	5	Rebound	4173	4344	-24.0	-0.3734	15.012	1.0534	14.825					32.20	22.8

	ACTUAL	HEORETICAL	
INITIAL SAMPLE HEIGT H_0, mm	17.93	17.93	
SPECIFIC GRAVITY, Gs	2.763	2.7	
INITIAL SOLIDS HEIGHT, mm	7.31	7.64	
INITIAL VOID RATIO, e_0	1.453	1.347	
INITIAL DEGREE OF SATURATION,	99.9	98.9	(100)
INITIAL WET DENSITY, kN/m^3	16.85		

FINAL SAMPLE HEIGT H_0, mm =	15.012
SPECIFIC GRAVITY, Gs =	2.763
FINAL SOLIDS HEIGHT =	7.311
FINAL VOID RATIO =	1.0534
FINAL DEGREE OF SATURATION	100.3
COMPUTED EXISITNG EFFECTIVE OVERBURDEN PRESSURE, σ'_{vo} kPa	100000
MOST PROBABLE APPARENT PRECONSOLIDATION PRESSURE, σ'_p kPa	100000

CONSOLIDATION TEST SUMMARY

MACHINE NUMBER 1
RING NUMBER 1
RING HEIGHT, mm 17.93
RING DIAMETER, mm 63.51
RING AREA, cm^2 31.68

CALCULATED BY cw
CHECKED BY MI
DATE STARTED 22-Nov-22
DATE FINISHED 08-Dec-22
REMARKS

PROJECT NUMBER 22513712/6000
BOREHOLE NUMBER 22-11
SAMPLE NUMBER 6
SAMPLE DEPTH (m) 5.13

V2020

GRAIN SIZE DISTRIBUTION	FIGURE

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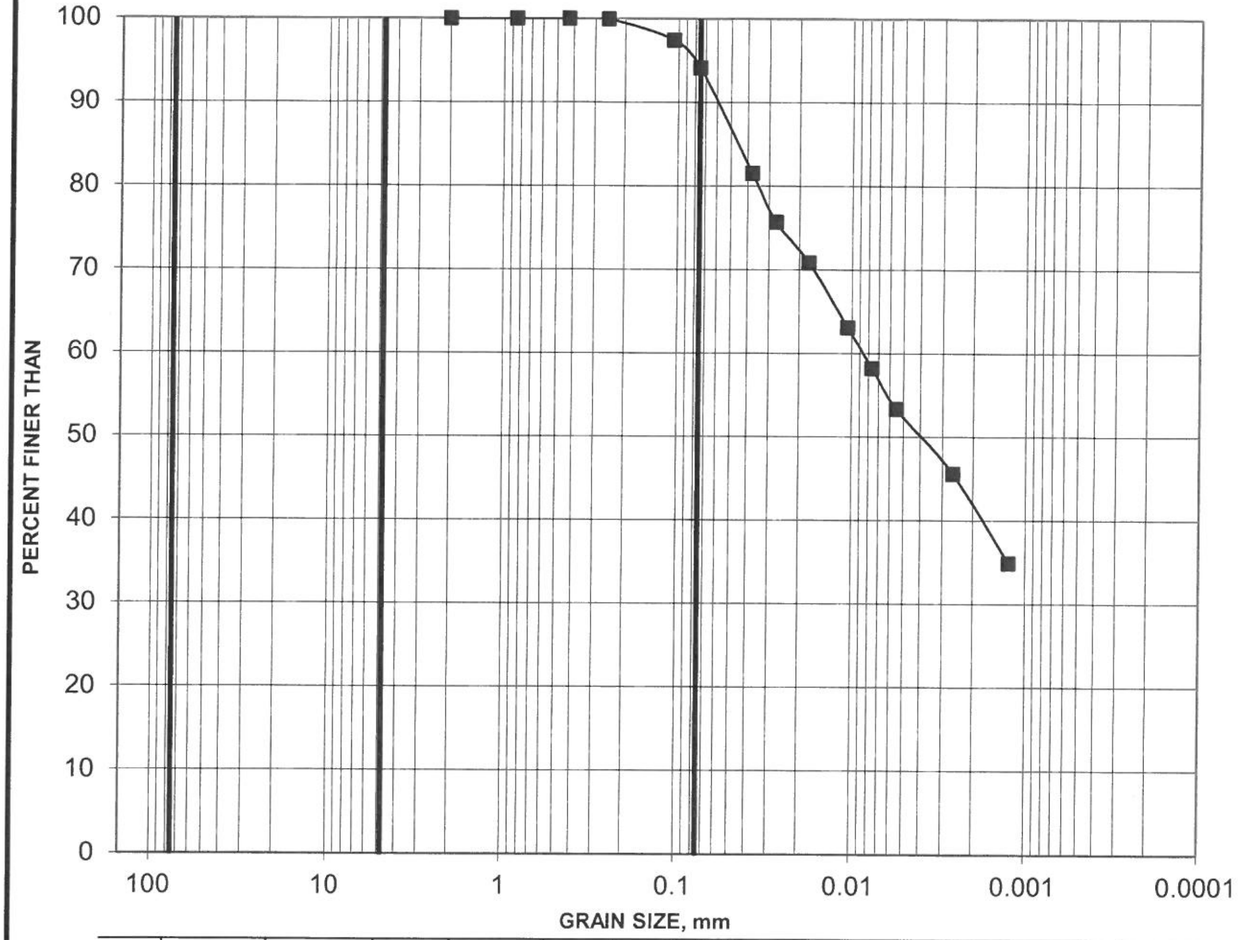


COBBLE SIZE	COARSE	FINE	COARSE	MEDIU	FINE	SILT AND CLAY
	GRAVEL SIZE		SAND SIZE			

				Constituents (%)			
	Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
—■—	22-11	6	4.57-5.18	0	6	52	42

Project: 22513712/6000

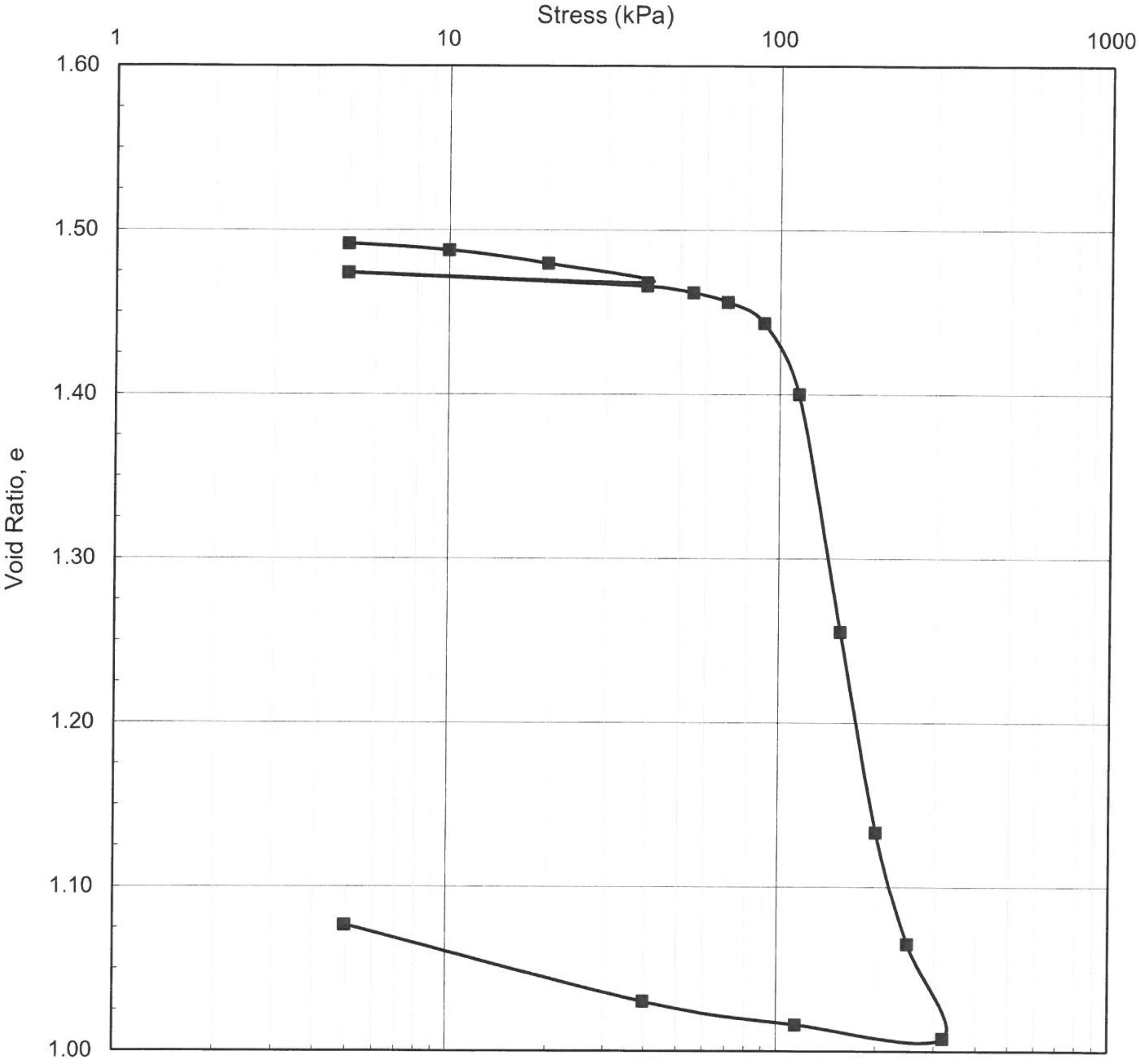
GOLDER
MEMBER OF WSP

Created by:	CW
Checked by:	MI

BOREHOLE BH22-11
SAMPLE 9
DEPTH OF 9.65 M

σ'vo= ** kPa
CALCULATED EXISTING EFFECTIVE
OVERBURDEN PRESSURE

σ'p = ** kPa
MOST PROBABLE APPARENT
PRECONSOLIDATION PRESSURE



LEGEND

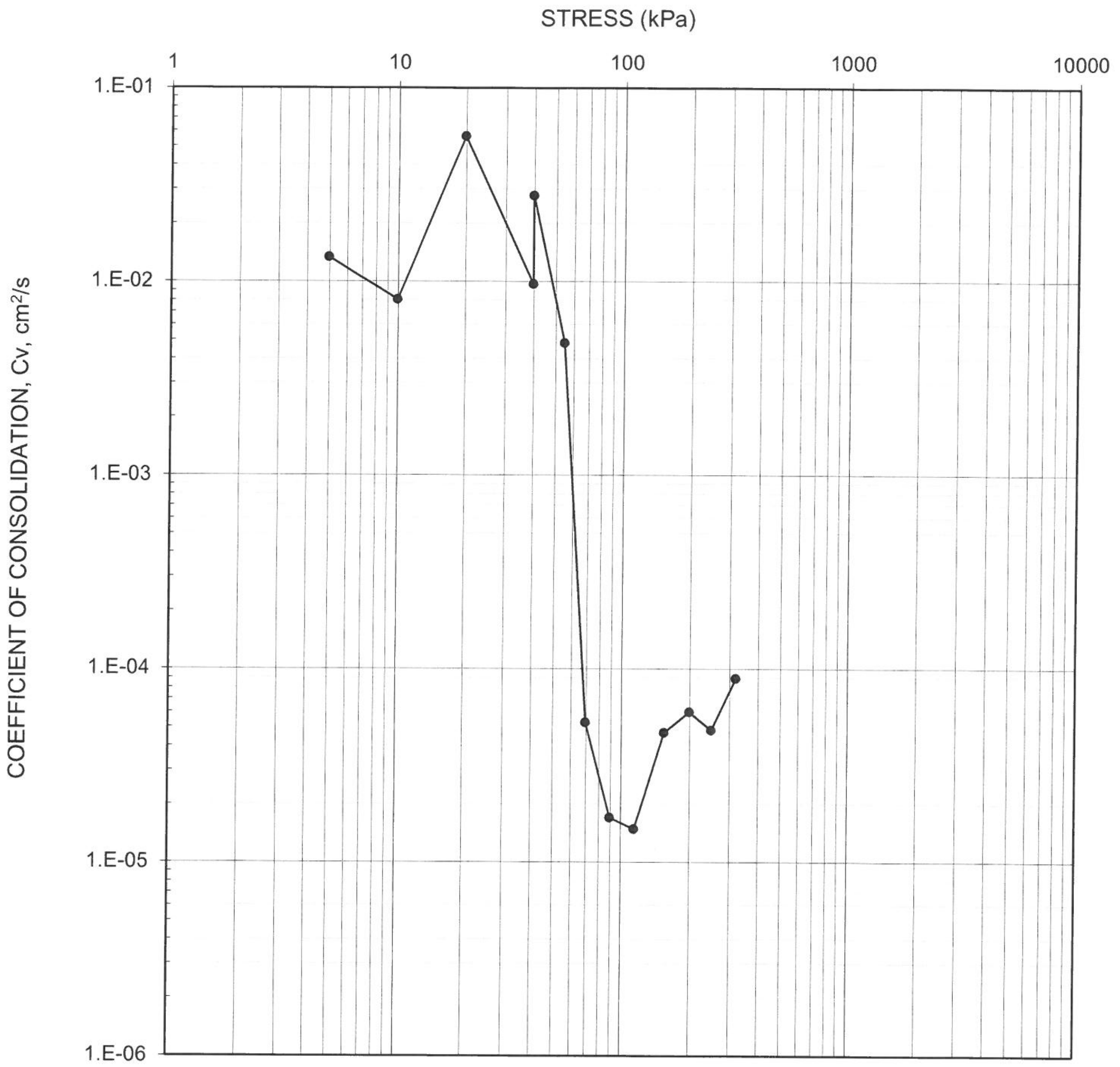
Borehole:	22-11	w_i =	53%	S_o =	100%	γ =	16.8 kN/m³
Sample:	9	w_f =	38%	e_o =	1.50	G_s =	2.79
Depth (m):	9.65	w_l =	31%	C_c =			
Elevation (m):	TB Supplied	w_p =	18%	C_r =			

GOLDER
MEMBER OF WSP

Consolidation Test Results

Void Ratio vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	cw
Checked By	MI



LEGEND

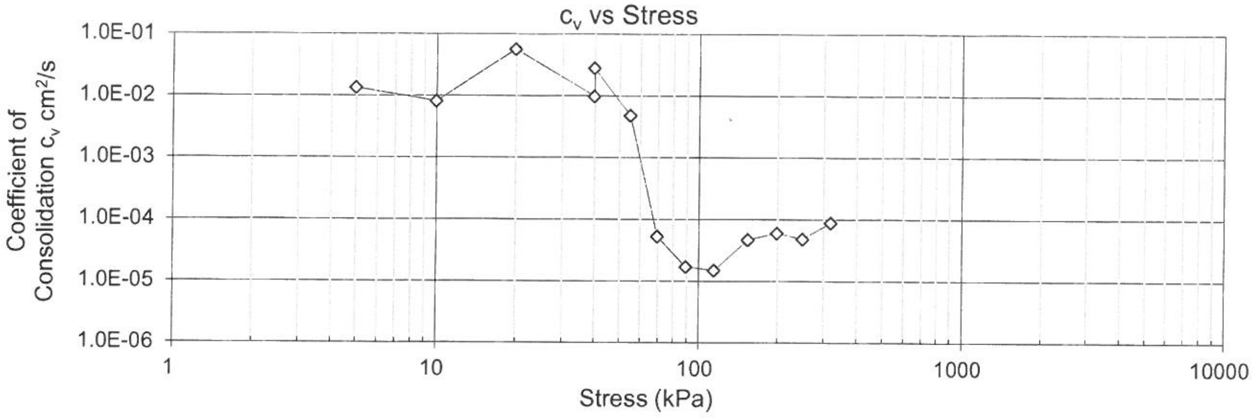
Borehole:	22-11	Sample:	9	Depth (m):	9.65

GOLDER
MEMBER OF WSP

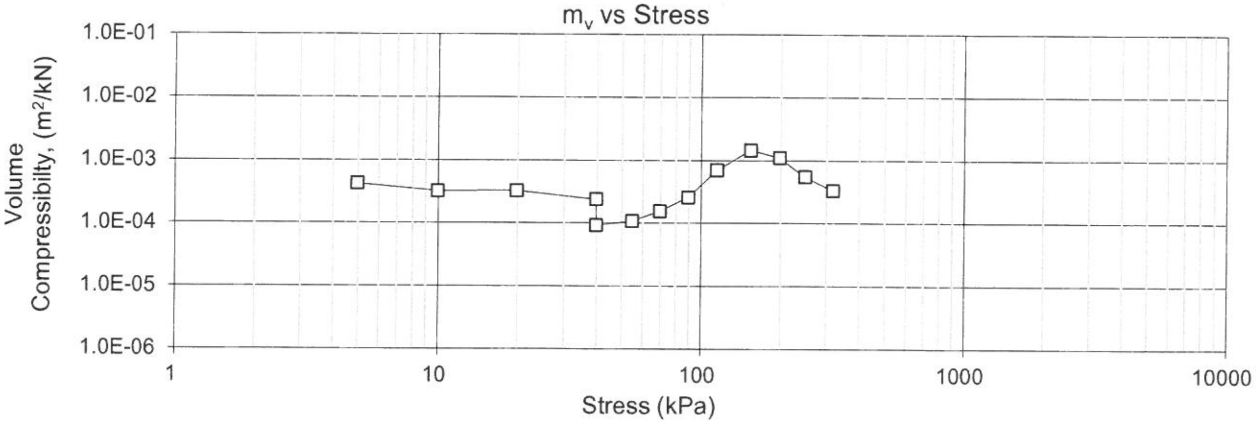
Consolidation Test Results

Cv vs Stress

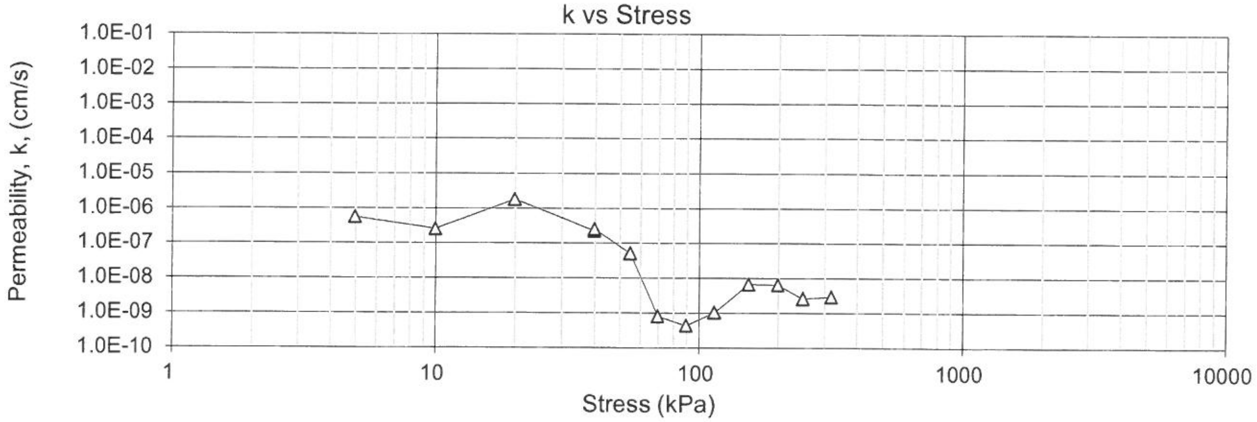
Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI



c_v vs Stress



m_v vs Stress



k vs Stress

LEGEND

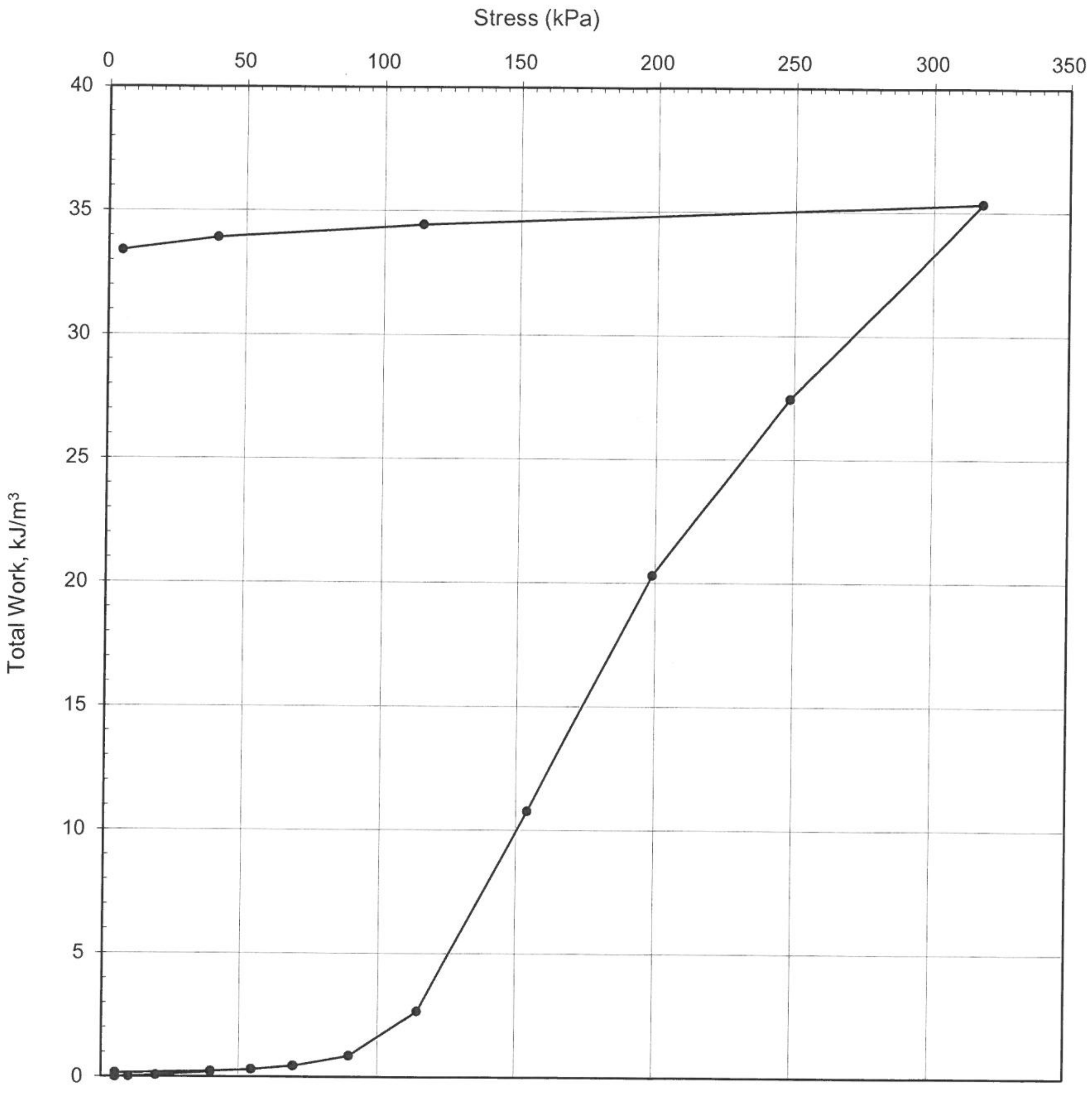
Borehole:	22-11	Sample:	9	Depth (m):	9.65

Note : LIR not = 1, use Cv's with caution

GOLDER
MEMBER OF WSP

Consolidation Test Results

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI



LEGEND

Borehole: 22-11 Sample: 9 Depth (m): 9.65

GOLDER
MEMBER OF WSP

Consolidation Test Results

Total Work vs Stress

Figure No.	
Revision	
Project No.	22513712/6000
Created By	CW
Checked By	MI

WATER CONTENT DATA	WHOLE SAMPLE BEFORE TEST	WHOLE SAMPLE AFTER TEST	TOP TRIMMINGS	BOTTOM TRIMMINGS	SIDE TRIMMINGS	THEORETICAL
TARE NUMBER	Ring 2	Ring 2	285	121	283	
WEIGHT OF WET SOIL & TARE, g	242.65	300.3	45.74	57.93	57.94	242.65
WEIGHT OF DRY SOIL & TARE, g	194.68	265.82	37.33	44.92	45.64	
WEIGHT OF TARE, g	104.89	176.03	21.83	22.07	21.36	104.89
WEIGHT OF WATER, g	47.97	34.48	8.41	13.01	12.30	
WEIGHT OF DRY SOIL, g	89.79	89.79	15.50	22.85	24.28	89.48
WATER CONTENT, %	53.42	38.40	54.3	56.9	50.7	54.0

Dial Reading = 0.0001 inch = 0.00254 mm

STEP	STRESS kPa	TEST TYPE	INITIAL DIAL READING D_o 10^{-4} in	FINAL DIAL READING D_{100} 10^{-4} in	EQUIPEMENT DEFORMATION DHe (see note 1) 10^{-4} in	DEFORMATION ΔD (D_{100}-D_o-ΔHe) mm	FINAL HEIGHT H (H0 - DD) mm	VOID RATIO e	AVERAGE SAMPLE HEIGHT mm	t_{90} sec	COEFFICIENT OF CONSOLIDATION Cv cm^2/sec	mv m^2/kN	PERMEABILITY k cm/s	TOTAL WORK kJ/m^3	AVERAGE STRESS kPa
1	5	Consolidation	5524	5502	1.0	0.0533	25.307	1.4917	25.333	102	1.33E-02	4.23E-04	5.53E-07	0.01	2.5
2	10	Consolidation	5502	5478	8.0	0.0406	25.266	1.4877	25.286	168	8.07E-03	3.22E-04	2.54E-07	0.02	7.5
3	20	Consolidation	5478	5432	14.0	0.0813	25.185	1.4797	25.225	24	5.62E-02	3.24E-04	1.78E-06	0.07	14.9
4	40	Consolidation	5432	5368	17.0	0.1194	25.065	1.4680	25.125	138	9.70E-03	2.37E-04	2.25E-07	0.21	29.8
5	5	Rebound	5368	5411	-19.0	-0.0610	25.126	1.4740	25.096					0.15	22.3
6	40	Consolidation	5411	5360	19.0	0.0813	25.045	1.4660	25.086	48	2.78E-02	9.22E-05	2.51E-07	0.22	22.4
7	55	Consolidation	5360	5336	8.0	0.0406	25.004	1.4620	25.025	276	4.81E-03	1.08E-04	5.07E-08	0.30	47.2
8	70	Consolidation	5336	5306	7.0	0.0584	24.946	1.4562	24.975	25080	5.27E-05	1.55E-04	7.99E-10	0.45	62.1
9	89	Consolidation	5306	5247	8.0	0.1295	24.816	1.4435	24.881	77214	1.70E-05	2.57E-04	4.28E-10	0.86	79.5
10	114	Consolidation	5247	5066	8.0	0.4394	24.377	1.4002	24.597	86400	1.48E-05	6.98E-04	1.02E-09	2.66	101.8
11	154	Consolidation	5066	4470	17.0	1.4707	22.906	1.2554	23.642	25392	4.67E-05	1.45E-03	6.65E-09	10.76	134.2
12	199	Consolidation	4470	3977	5.0	1.2395	21.667	1.1334	22.287	17634	5.97E-05	1.09E-03	6.40E-09	20.31	176.5
13	249	Consolidation	3977	3697	8.0	0.6909	20.976	1.0653	21.321	19998	4.82E-05	5.48E-04	2.59E-09	27.44	223.7
14	318	Consolidation	3697	3451	16.0	0.5842	20.392	1.0078	20.684	10170	8.92E-05	3.30E-04	2.88E-09	35.34	283.4
15	114	Rebound	3451	3505	-21.0	-0.0838	20.476	1.0161	20.434					34.45	216.3
16	40	Rebound	3505	3578	-17.0	-0.1422	20.618	1.0301	20.547					33.91	77.0
17	5	Rebound	3578	3790	-26.0	-0.4724	21.090	1.0766	20.854					33.40	22.4

	ACTUAL	HEORETICAL	
INITIAL SAMPLE HEIGT H_0, mm	25.36	25.36	
SPECIFIC GRAVITY, Gs	2.789	2.7	
INITIAL SOLIDS HEIGHT, mm	10.16	10.46	
INITIAL VOID RATIO, e_0	1.497	1.424	
INITIAL DEGREE OF SATURATION,	99.5	102.3	(100)
INITIAL WET DENSITY, kN/m^3	16.80		

FINAL SAMPLE HEIGT H_0, mm =	21.090
SPECIFIC GRAVITY, Gs =	2.789
FINAL SOLIDS HEIGHT =	10.156
FINAL VOID RATIO =	1.0766
FINAL DEGREE OF SATURATION	99.5
COMPUTED EXISITNG EFFECTIVE OVERBURDEN PRESSURE, σ'_{vo} kPa	100000
MOST PROBABLE APPARENT PRECONSOLIDATION PRESSURE, σ'_p kPa	100000

CONSOLIDATION TEST SUMMARY

MACHINE NUMBER	2
RING NUMBER	2
RING HEIGHT, mm	25.36
RING DIAMETER, mm	63.53
RING AREA, cm^2	31.70

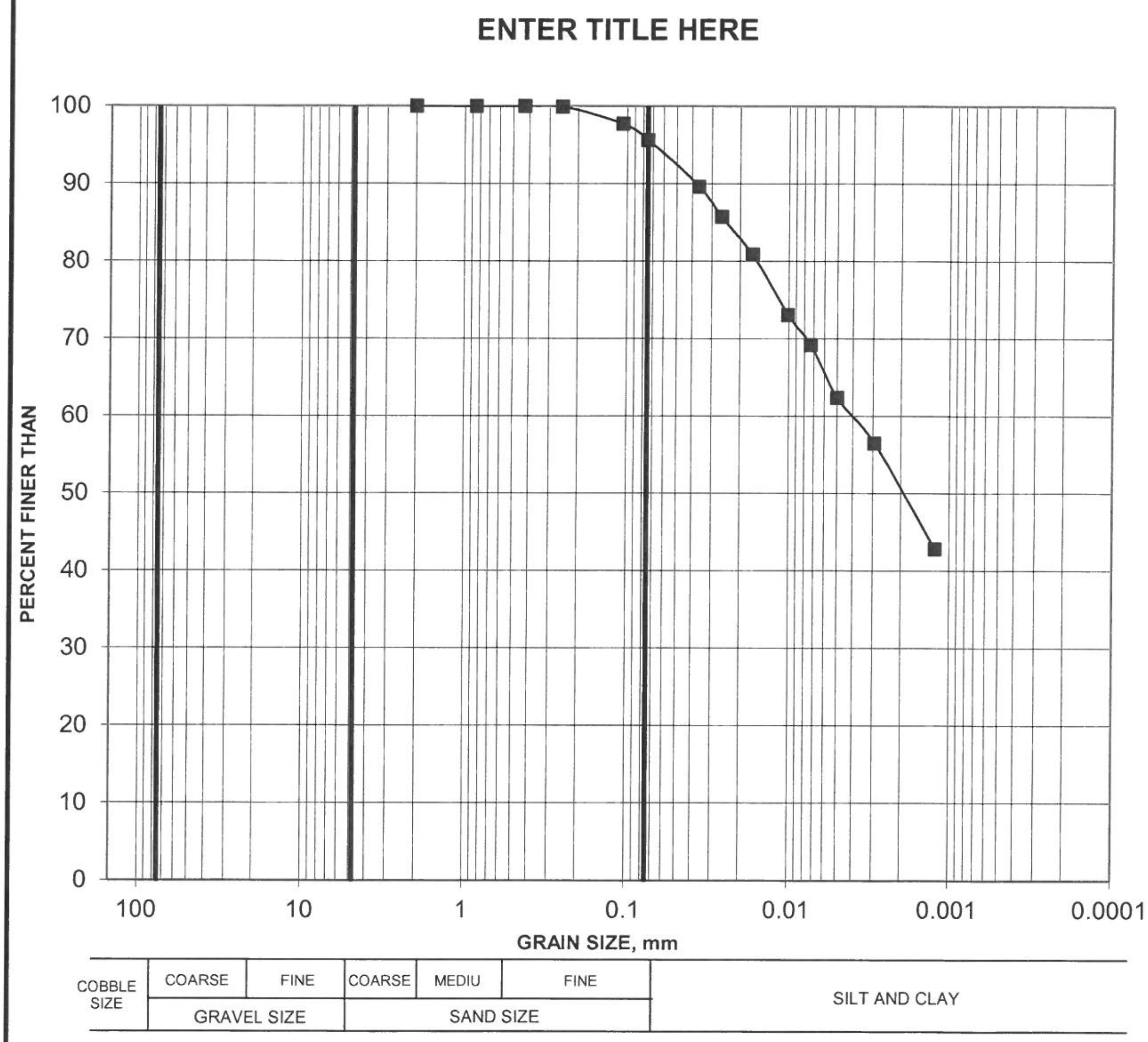
CALCULATED BY	cw
CHECKED BY	MI
DATE STARTED	22-Nov-22
DATE FINISHED	08-Dec-22
REMARKS	

PROJECT NUMBER	22513712/6000
BOREHOLE NUMBER	22-11
SAMPLE NUMBER	9
SAMPLE DEPTH (m)	9.65

V2020

GRAIN SIZE DISTRIBUTION

FIGURE



				Constituents (%)		
Borehole	Sample	Depth (m)	Gravel	Sand	Silt	Clay
—■— 22-11	9	9.14-9.73	0	4	45	51

GOLDER
MEMBER OF WSP

Project: 22513712/6000

Created by:	CW
Checked by:	MI

APPENDIX F

MASW
SITE EVALUATION REPORT

GEOPHYSICS GPR INTERNATIONAL INC.

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December 23rd, 2022

Transmitted by email: icorbett@geoterre.ca
Our Ref.: GPR-22-04020

Mr. Ivan Corbett, P.Eng.
GeoTerre Limited
215 Advance Blvd., Unit 5/6
Brampton ON L6T 4V9

Subject: **Shear Wave Velocity Sounding for the Site Class Determination**
3850 Cambrian Road, Nepean, Ottawa (ON)

Dear Sir,

Geophysics GPR International inc. has been mandated by GeoTerre Limited to carry out seismic shear wave surveys at 3850 Cambrian Road, Nepean, in Ottawa (ON). The geophysical investigation used the Multi-channel Analysis of Surface Waves (MASW), the Spatial AutoCorrelation (SPAC), and the seismic refraction methods. From the subsequent results, the seismic shear wave velocity values were calculated for the soil and the rock, to determine the Site Class.

The surveys were carried out on December 8th, 2022, by Mr. Louis-Emmanuel Warnock, B.Sc. and Ewen Pasdeloup, trainee. Figure 1 shows the regional location of the site and Figure 2 illustrates the location of the seismic spreads. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the testing methods, and the results presented in table and graph.

MASW PRINCIPLE

The *Multi-channel Analysis of Surface Waves* (MASW) and the *SPatial AutoCorrelation* (SPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface wave. The MASW is considered an "active" method, as the seismic signal is induced at known location and time in the geophones' spread axis. Conversely, the SPAC is considered a "passive" method, using the low frequency "signals" produced far away. The method can also be used with "active" seismic source records. The SPAC method generally allows deeper Vs soundings. Its dispersion curve can then be merged with the one of higher frequency from the MASW to calculate a more complete inversion. The dispersion properties are expressed as a change of velocities with respect to frequencies. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. The inversion of the Rayleigh wave dispersion curve yields a shear wave (V_S) velocity depth profile (sounding).

Figure 3 schematically outlines the basic operating procedure for the MASW method. Figure 4 illustrates an example of one of the MASW/SPAC records, the corresponding spectrogram analysis and resulting 1D V_S model.

INTERPRETATION

The main processing sequence involved data inspection and edition when required; spectral analysis ("phase shift" for MASW, and "cross-correlation" for SPAC); picking the fundamental mode; and 1D inversion of the MASW and SPAC shot records using the SeisImagerSW™ software. The data inversions used a nonlinear least squares algorithm.

In theory, all the shot records for a given seismic spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation, local surface seismic velocities variations, and/or dipping of overburden layers or rock. In general, the precision of the calculated seismic shear wave velocities (V_S) is around 15% or better.

More detailed descriptions of these methods are presented in *Shear Wave Velocity Measurement Guidelines for Canadian Seismic Site Characterization in Soil and Rock*, Hunter, J.A., Crow, H.L., et al., Geological Surveys of Canada, General Information Product 110, 2015.

SURVEY DESIGN

The seismic acquisition spreads were located on a vacant lot (Figure 2). The geophone spacing was of 3.0 metres for the main spread, using 24 geophones. A shorter seismic spread, with geophone spacing of 1.0 metre, was dedicated to the near surface materials. The seismic records were produced with a seismograph Terraloc Pro 2 (from ABEM Instrument), and the geophones were 4.5 Hz. The seismic records counted 4096 data, sampled at 1000 µs for the MASW surveys, and 40 µs for the seismic refraction. The records included a pre-trigged portion of 10 ms. An 8 kg sledgehammer was used as the energy source, with impacts being recorded off both ends of the seismic spreads. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

The shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length.

RESULTS

The MASW calculated V_S results are illustrated in Figure 5. Some low seismic velocities were calculated from the surface to 7 metres deep.

The $\overline{V}_{S30}$ value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (30 metres) by the sum of the time spent in each velocity layer from the surface down to 30 metres, as:

$$\bar{V}_{S30} = \frac{\sum_{i=1}^{N} H_i}{\sum_{i=1}^{N} H_i/V_i} \quad | \quad \sum_{i=1}^{N} H_i = 30\ \mathrm{m}$$

(N: number of layers; H_i : thickness of layer "i" ; V_i : V_S of layer "i")

Thus, the $\overline{V}_{S30}$ value represents the seismic shear wave velocity of an equivalent homogeneous single layer response, between the surface and 30 metres deep.

The calculated $\overline{V}_{S30}$ value of the actual site is 302.2 m/s (Table 1), corresponding to the Site Class "D".

CONCLUSION

Geophysical surveys were carried out to identify the Site Class at 3850 Cambrian Road, Nepean, in Ottawa (ON). The seismic surveys used the MASW and the SPAC analysis, and the seismic refraction to calculate the $\overline{V}_{S30}$ value. Its calculation is presented at Table 1.

The $\overline{V}_{S30}$ value of the actual site is 302 m/s, corresponding to the Site Class "D" ($180 < \overline{V}_{S30} \leq 360$ m/s), as determined through the MASW and SPAC methods, Table 4.1.8.4.-A of the NBC, and the Building Code, O. Reg. 332/12. It must be noted that some low seismic velocities were calculated from the surface to 7 metres deep. A geotechnical assessment could be required for the potential of liquefaction, the clay sensitivity, and other critical parameters.

It must also be noted that other geotechnical information gleaned on site; including the presence of liquefiable soils, very soft clays, high moisture content etc. (cf. Table 4.1.8.4.-A of the NBC) can supersede the Site classification provided in this report based on the $\overline{V}_{S30}$ value.

The V_S values calculated are representative of the in situ materials and are not corrected for the total and effective stresses.

Hoping the whole to your satisfaction, we remain yours truly,

Jean-Luc Arsenault, M.A.Sc., P.Eng.
Senior Project Manager

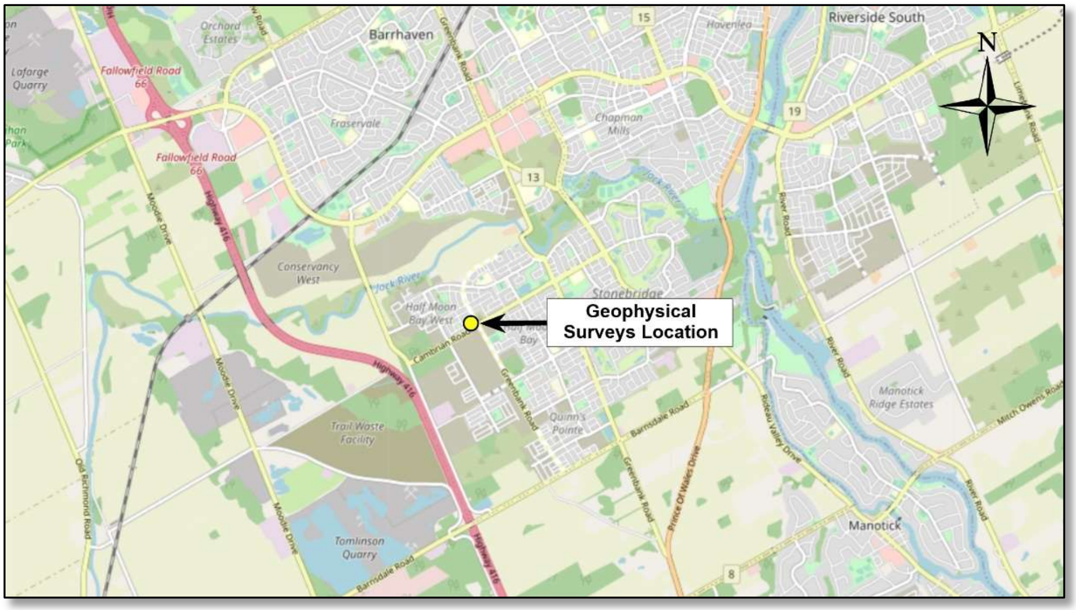


Figure 1: Regional location of the Site
(source: *OpenStreetMap©*)

Figure 2: Location of the seismic spreads
(source: *geoOttawa*)

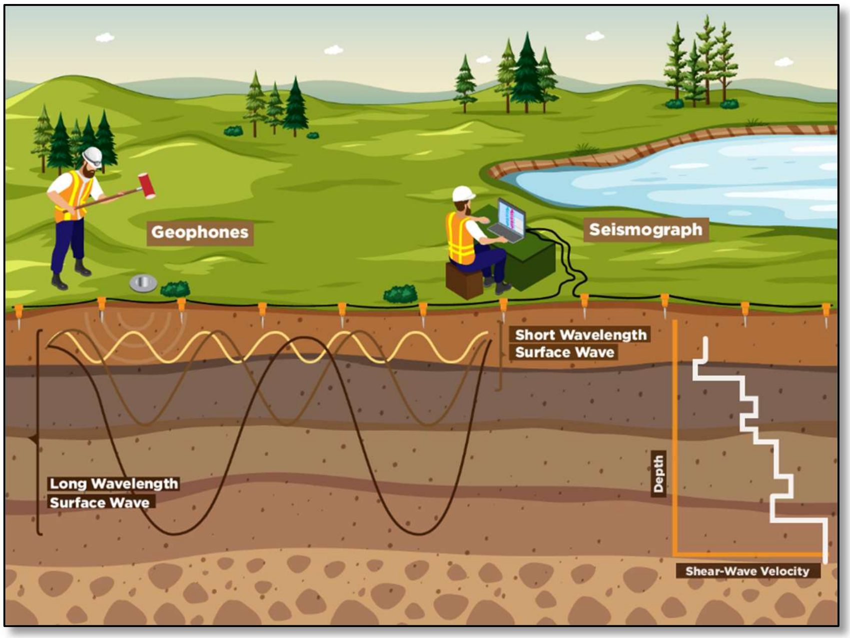
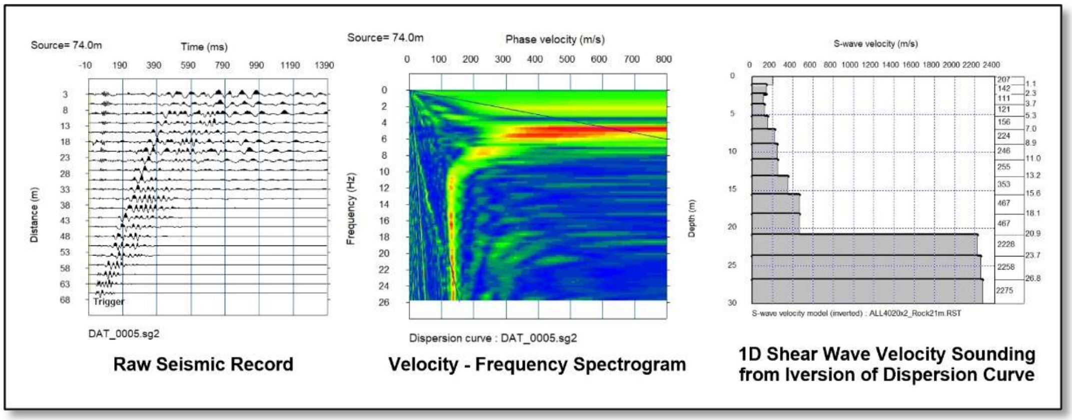


Figure 3: MASW Operating Principle



Raw Seismic Record

Velocity - Frequency Spectrogram

1D Shear Wave Velocity Sounding from Iversion of Dispersion Curve

Figure 4: Example of a MASW/SPAC record, Phase Velocity - Frequency curve of the Rayleigh wave and resulting 1D Shear Wave Velocity Model

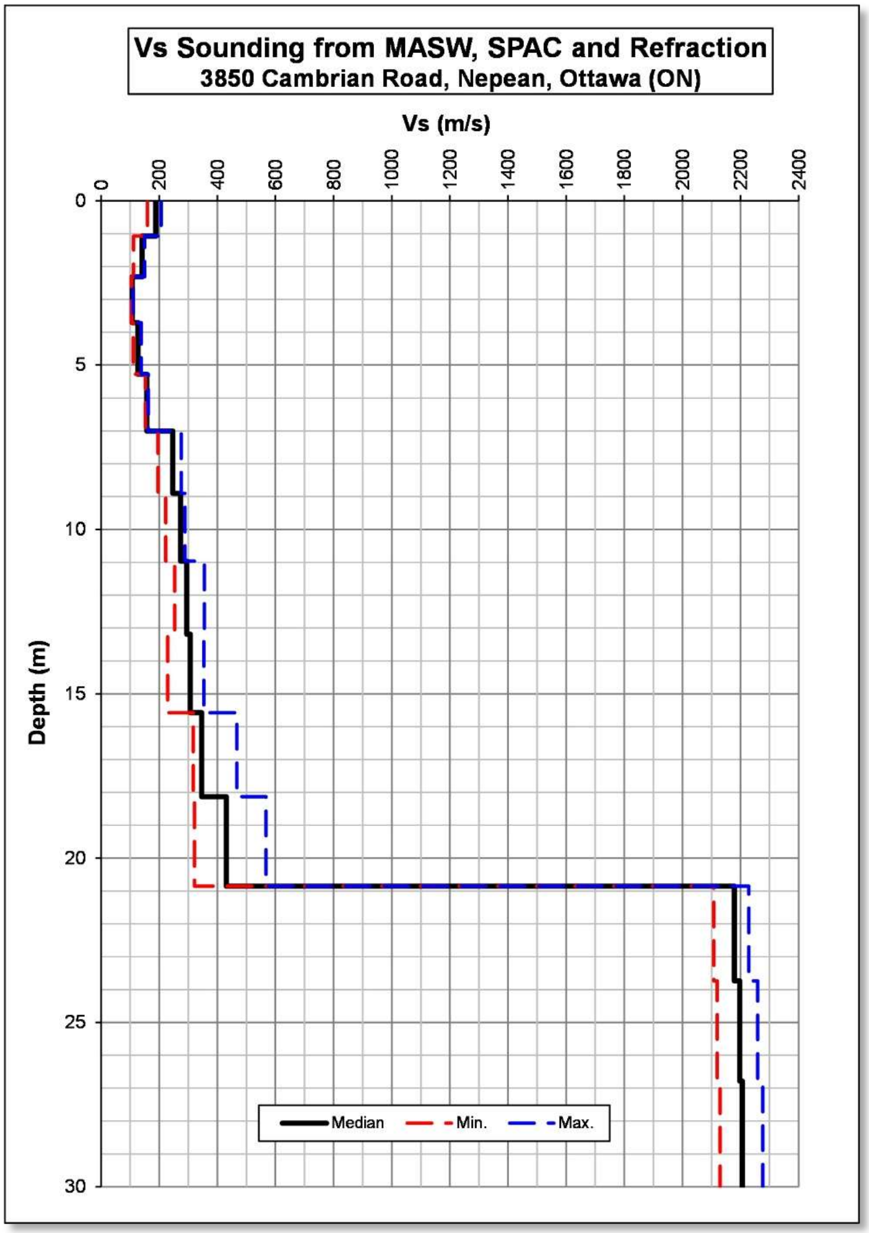


Figure 5: MASW Shear-Wave Velocity Sounding

TABLE 1

V_{S30} Calculation for the Site Class (actual site)

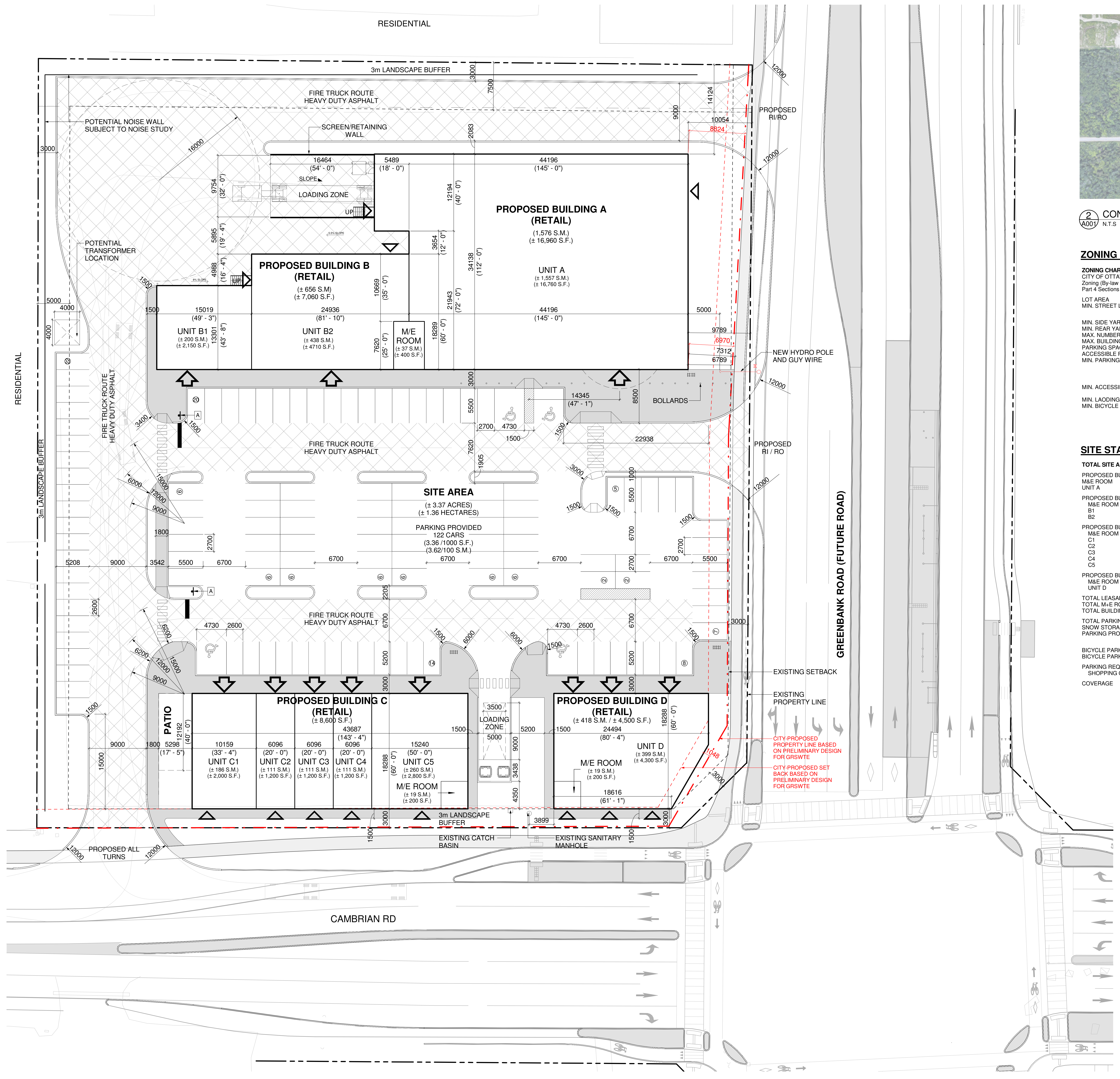
Depth	Vs			Thickness	Cumulative Thickness	Delay for med. Vs	Cumulative Delay	Vs at given Depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	**159.5**	187.6	206.6	**Grade Level (December 8th, 2022)**				
1.07	**111.6**	**141.5**	**150.2**	1.07	1.07	0.005711	0.005711	187.6
2.31	**105.2**	**107.4**	**110.7**	1.24	2.31	0.008739	0.014451	159.7
3.71	**110.7**	**126.8**	**138.7**	1.40	3.71	0.013047	0.027497	134.9
5.27	**152.3**	**157.4**	**162.6**	1.57	5.27	0.012348	0.039845	132.4
7.01	195.7	246.5	275.4	1.73	7.01	0.010995	0.050841	137.8
8.90	222.4	273.8	289.0	1.90	8.90	0.007689	0.058530	152.1
10.96	252.9	294.8	355.1	2.06	10.96	0.007526	0.066056	165.9
13.19	229.0	307.0	353.5	2.23	13.19	0.007549	0.073605	179.2
15.58	317.1	346.0	467.4	2.39	15.58	0.007786	0.081390	191.4
18.13	321.7	430.9	567.2	2.55	18.13	0.007385	0.088775	204.2
20.85	2107.8	2178.1	2228.7	2.72	20.85	0.006311	0.095087	219.3
23.74	2119.6	2197.2	2258.7	2.88	23.74	0.001324	0.096411	246.2
26.79	2130.0	2206.1	2276.0	3.05	26.79	0.001388	0.097799	273.9
30				3.21	30.00	0.001457	0.099256	302.2

V_{S30} (m/s)	**302.2**
Class	**D** (1)

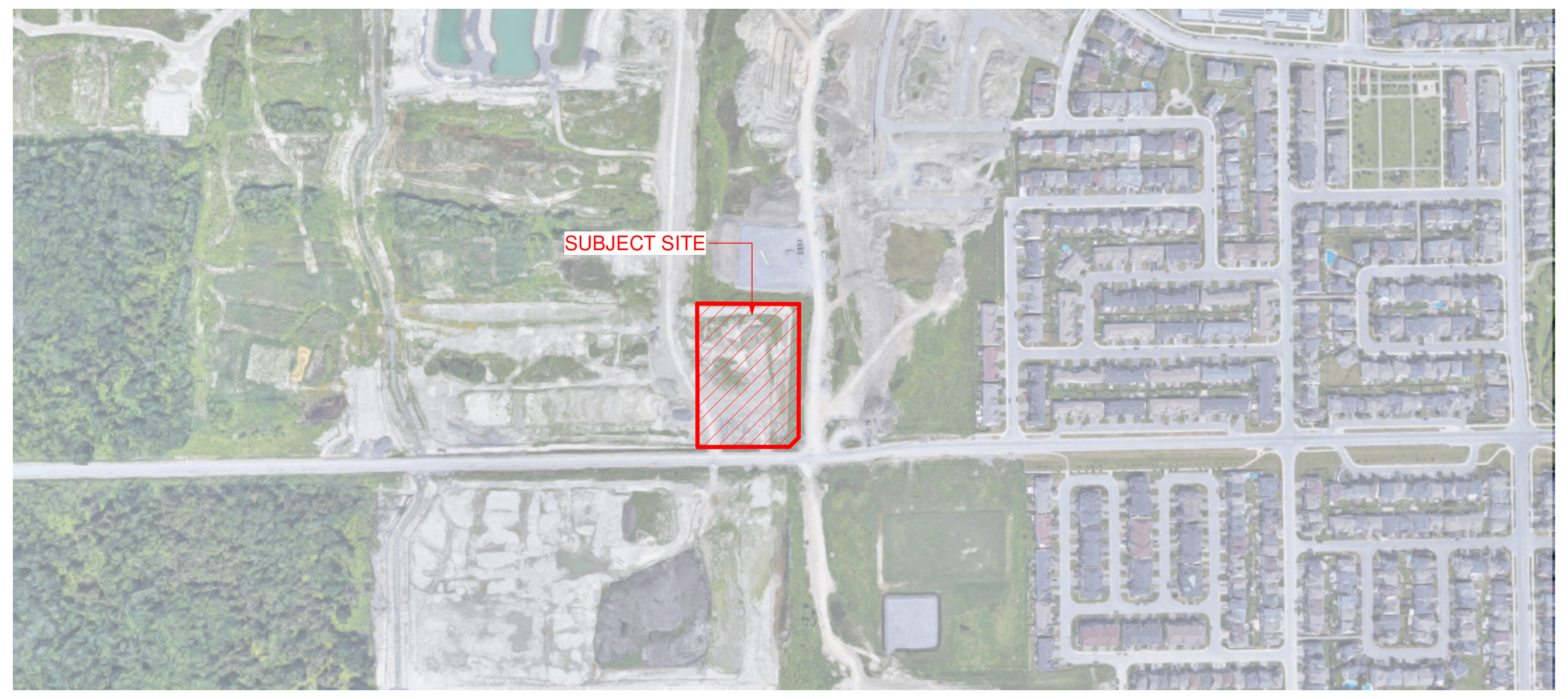
(1) Some low seismic velocities were calculated from the surface to 7 metres deep. A geotechnical assessment could be required for the potential of liquefaction, the clay sensitivity, and other critical parameters.

APPENDIX G

PROPOSED
SITE DEVELOPMENT PLAN



1 SITE PLAN
A001 1 : 300



2 CONTEXT PLAN
A001 N.T.S

ZONING CHART

ZONING CHART CITY OF OTTAWA Zoning (By-law No. 2008-250) Part 4 Sections 100-114	REQUIRED	PROPOSED * indicates non-compliance
LOT AREA	N/A	13,637.9 S.M.
MIN. STREET LINE SETBACK	3.0M	3.0M (ALONG CAMBRIAN ROAD) 0.7* (ALONG RE-ALIGNED GREENBANK ROAD)
MIN. SIDE YARD SETBACK	3.0M	9.0M (NORTHERLY SIDE)
MIN. REAR YARD SETBACK	7.5M	7.5M
MAX. NUMBER OF BUILDINGS ON A LOT	MORE THAN ONE (1) MAIN BUILDING PERMITTED	3 BUILDINGS
MAX. BUILDING HEIGHT	12.5M AND XX STOREYS	6.7M
PARKING SPACE DIMENSIONS	2.6M (MIN) 3.1M (MAX) WIDE x 5.2M LONG	2.7M x 5.5M
ACCESSIBLE PARKING DIMENSIONS	3.66M	
MIN. PARKING SPACES		122 CARS
	SHOPPING CENTRE: 122 CARS 3.6 CARS (PER) 100 S.M. OF TOTAL LEASABLE FLOOR AREA	
MIN. ACCESSIBLE PARKING SPACE	2 CARS RANGING FROM 100-199 AS PER PART C TABLE SECTION 111	4 SPACES
MIN. LAODING SPACES	1 (3.5M X 9M)	2
MIN. BICYCLE PARKING SPACES	13 SPACES	16 SPACES

SITE STATISTICS

TOTAL SITE AREA	±3.37 ACRES	±1.36 HA.
PROPOSED BUILDING A AREA	±16,960 S.F.	±1,576 S.M.
M&E ROOM	±200 S.F.	±19 S.M.
UNIT A	±16,760 S.F.	±1,557 S.M.
PROPOSED BUILDING B AREA	±7,060 S.F.	±656 S.M.
M&E ROOM	±200 S.F.	±19 S.M.
B1	±2,150 S.F.	±200 S.M.
B2	±4,710 S.F.	±438 S.M.
PROPOSED BUILDING C AREA	±8,600 S.F.	±799 S.M.
M&E ROOM	±200 S.F.	±19 S.M.
C1	±2,000 S.F.	±186 S.M.
C2	±1,200 S.F.	±111 S.M.
C3	±1,200 S.F.	±111 S.M.
C4	±1,200 S.F.	±111 S.M.
C5	±2,800 S.F.	±260 S.M.
PROPOSED BUILDING D AREA	±4,500 S.F.	±418 S.M.
M&E ROOM	±200 S.F.	±19 S.M.
UNIT D	±4,300 S.F.	±399 S.M.
TOTAL LEASABLE FLOOR AREA	±36,320 S.F.	±3,374 S.M.
TOTAL M+E ROOM AREA	±800 S.F.	±74 S.M.
TOTAL BUILDING FLOOR AREA	±37,920 S.F.	±3,523 S.M.
TOTAL PARKING		122 CARS
SNOW STORAGE SPACES		0 CARS
PARKING PROVIDED (N.I.C SNOW STORAGE)		122 CARS
	3.36/1,000 S.F	3.62/100 S.M
BICYCLE PARKING REQUIRED		13 BIKES
BICYCLE PARKING PROVIDED		18 BIKES
PARKING REQUIRED		
SHOPPING CENTRE 3.6/100 S.M.		122 CARS
COVERAGE		25.8%

TURNER
FLEISCHER

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LEGEND

⇦	PROPOSED ENTRANCE ARROW
◁	PROPOSED EXIT ARROW
¤	PROPOSED FIRE HYDRANT
	PROPOSED SIAMESE CONNECTION
⊥	PROPOSED SIGN
▨	PROPOSED FIRE & TRUCK ROUTE (HEAVY DUTY ASPHALT)
■	PROPOSED CONCRETE SIDEWALK

#	DATE	DESCRIPTION	BY
4	2023-03-09	ISSUED FOR COORDINATION	DEM
3	2023-03-07	ISSUED FOR COORDINATION	BSH
2	2022-12-21	ISSUED FOR COORDINATION	NFP
1	2022-10-26	ISSUED FOR REVIEW	NFP

Choice Properties REIT

PROJECT
CAMBRIAN RD (N. PARCEL)
BARRHAVEN, ONTARIO

DRAWING
SITE PLAN

PROJECT NO.
21.327SD
PROJECT DATE
2022-08-19
DRAWN BY
BSH
CHECKED BY
DEM
SCALE
As indicated

N

DRAWING NO.
A001
REV.
4