APPENDIX D

GEOTEHNICAL INVESTIGATION REPORT

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REPORT ON

GEOTECHNICAL INVESTIGATION
SPADINA SUBWAY EXTENSION ENVIRONMENTAL ASSESSMENT
CITY OF TORONTO

Submitted to:

Toronto Transit Commission
1138 Bathurst Street
Toronto, Ontario M5R 3H2
Canada

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by URS on behalf of the Toronto Transit Commision (TTC) to assist in the completion of an Environmental Assessment for the proposed extension to the Spadina Subway in Toronto, Ontario.

The purpose of this report is to provide preliminary geotechnical information on the subsurface physical conditions (soil and groundwater) along the proposed subway route and recommendations and comments on the geotechnical aspects of design and construction of the works. Preliminary soil design parameters are provided, together with discussion and comments on relevant aspects such as excavations, method of ground support, backfilling and soil and groundwater disposal options.

General design recommendations for soil parameters, ground water conditions and environmental aspects are provided on the assumption that the existing borehole are representative of the full subway alignment.

2.0 PROJECT AND SITE DESCRIPTION

The location of the project is illustrated in Drawing 1. The existing Spadina Subway line is proposed to extend from the present Downsview Station terminus north-westward, crossing the northern side of Downsview Park, then moving north along Keele Street and through the campus of York University, before terminating at Steeles Avenue. Initial work on an extension to the Spadina Subway was completed in the early 1990's when the line was to extend north-westward to Steeles Avenue, and then east to connect with the northern end of the existing Yonge Line (this became known as the Yonge-Spadina Loop). As of 1994, a first phase extension to York University was being designed, but due to funding changes, work on extending the Spadina Line was halted in 1994.

The proposed route will extend over a distance of approximately 6 km and will include four stations to be located in the following areas (from south to north):

- GO/Sheppard Avenue
- Keele Street and Finch Avenue
- York University (at York Boulevard and Ian McDonald Boulevard)
- Steeles Avenue, west of Keele Street (at Northwest Gate)

2.1 Site Description

The natural ground surface along the proposed alignment varies from about Elevation 196 m in the south to Elevation 201 m in the north, and is between the Black Creek and West Don River.

The proposed subway alignment will be running mainly under public road boundaries along Allen Road and Keele Street, Downsview Park, several industrial land parcels in the Sheppard/Keele area, and the York University campus.

3.0 INVESTIGATION PROCEDURES

The field work for the Spadina Subway Extension was carried out between 21 October and 27 November, 2005 at which time twelve boreholes (Boreholes Y-121 to Y-132) were advanced to depths of between 13.56 m to 25.54 m along the proposed route. A plan illustrating the location of the boreholes is shown on Drawing 1.

The borehole investigation was carried out using a truck-mounted Diedrich drilling rig and a track-mounted Bombadier drilling rig, supplied and operated by DBW Drilling Limited of Ajax, Ontario. The boreholes were advanced using 108 mm internal diameter continuous flight hollow stem augers. Soil samples were obtained at intervals of 0.76 m for depths up to 4.6 m, and at intervals of 1.5 m for the remainder depth of the borehole, using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure in the current version of the TTC document “Geotechnical Standards - Direction for Conducting Site Investigation”.

The groundwater conditions in the open boreholes were observed during and after the drilling operations. Each borehole included an observation well, consisting of a 1.5 m long, 50 mm diameter slotted screen within a 3.7 m long sand pack in the lower granular deposit; and a 19 mm diameter piezometer with a 0.3 m long, 50 mm diameter slotted screen within a 3.7 m long sand pack in an upper granular deposit, with the exception at Borehole Y-128 where only one piezometer was installed. Bentonite pellets were used to seal off the depth between the two sand packs to prevent cross contamination of water bodies, in accordance with Regulation 903 of the Ontario Water Resources Act. All boreholes were then backfilled to the ground surface with bentonite pellets and flush-mounted protective casing was installed, except at Boreholes Y-123 and Y-124, where the well casing extended to approximately 1 m above ground. The installation details are shown on the Record of Borehole sheets for Boreholes Y-121 to Y-132.

To determine the hydraulic conductivity of the overburden sediments, a rising head test (“slug test”) was performed on all the monitoring wells. For each test, 1.0 x 10^{-3} m^3 of groundwater was removed rapidly from the monitoring well and well casings and water level recovery was monitored manually using an electronic water level meter over a period of time.

The field work was supervised throughout by a member of Golder's technical staff, who located the boreholes in the field, arranged for the clearance of underground services, supervised the drilling, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil samples obtained. The samples were identified in the field, placed in appropriate containers, labelled and transported separately to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to ASTM Standards as appropriate. Classification tests (water content determinations, Atterberg limit tests and grain size distribution analyses) were carried out on selected soil samples.

Composite samples from the boreholes were collected and sent to AGAT Laboratories Limited of Mississauga for Toxic Characteristic Leaching Procedure (TCLP) testing in accordance to MOE Regulation 347, prior to soil disposal by Provincial Environmental Services Inc. at PSE Taro Landfill site in Stoney Creek, Ontario.

The northings, eastings and elevations of the as-drilled borehole locations were surveyed by J&R Surveys Ltd of Mississauga and are summarized below. The borehole locations are recorded based on the MTM NAD27 (Zone 10) coordinate system, and the ground surface elevation at the borehole locations referenced to the geodetic datum.

Borehole Number	*Locations*	*MTM NAD83 Northing (m)*	*MTM NAD83 Easting (m)*	*Ground Surface Elevation (m)*
Y-121	Allen Road	4,845,794.1	307,649.5	197.92
Y-122	Whitehorse Rd / Kodiak Crescent	4,845,857.7	307,292.2	198.01
Y-123	Downsview Park	4,845,858.1	306,632.9	195.28
Y-124	Downsview Park	4,845,793.3	306,429.3	195.20
Y-125	St.Regis Road	4,845,857.2	305,771.6	194.66
Y-126	Keele St / LePage Street	4,846,199.8	305,637.1	194.96
Y-127	Keele St / Finch Street	4,846,780.0	305,532.6	197.77
Y-128	Keele St / Murray Ross Road	4,847,321.6	305,430.1	197.27
Y-129	Pond Road	4,847,758.1	305,229.2	198.07
Y-130	York Blvd / Ian MacDonald	4,847,995.2	304,846.2	199.80
Y-131	Ottawa Road	4,848,143.9	304,428.4	201.37
Y-132	South of Steeles Avenue	4,848,345.5	303,905.8	200.71

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The Quaternary deposits of the Toronto region consist predominantly of glacial till, glaciolacustrine and glaciofluvial sand, silt, and clay deposits and beach sands and gravels. These deposits were laid down by glaciers and associated glacial rivers and lakes. Recent deposits of alluvium are found in river and stream valleys and their flood plains.

The Quarternary soil deposits overlie the Ordovician age bedrock of the Georgian Bay Formation which consists predominantly of shale with interbeds of limestone and siltstone. This bedrock formation is about 250 m thick and has a regional dip to the southeast of about 5 m/km. A deep valley trending northwest-southeast is inferred east and outside the study area. This deep valley would have been eroded in the past by ancient rivers. The overburden thickness is in excess of 60 m in the study area.

The Quaternary soil deposits overlying the bedrock are believed to have been deposited over the course of at least two glaciations and one interglacial (i.e. warmer) stage. The oldest soil deposits identified in the area are the Illinoian tills which immediately overlie the bedrock. These tills are overlain by lacustrine sands, silts and clays of the Don Formation which were deposited during the Sangamonian interglacial period.

The majority of the surficial deposits in the study area are believed to have been deposited during the Wisconsinian glacial period. This period saw several glacier advances and retreats. During the glacial advances, till deposits were set down and during retreats, glaciofluvial and glaciolacustrine deposits formed in meltwater streams and lakes. The Scarborough, Pottery Road and Thorncliffe Formations were formed during the glacial retreat while the Sunnybrook Till and the younger Leaside and Wildfield Tills were formed during ice advances. Numerous small pockets of lake or pond deposits are to be found scattered throughout the till plain in depressions at the till surface. These deposits tend to be concentrated along the edges of the major stream valleys.

Sand and silt deposits are present in most parts of the area under the youngest till sheet. It is believed that these soils are glaciofluvial or meltwater sediments deposited during an interval of significant ice retreat. It is thought that there were several intervals of sand and silt deposition.

The most recent natural deposits of sand, silt and gravel are found within the flood plains of the existing rivers.

Apart from the naturally deposited soils within the study area, fills such as old waste, engineered fills and landscape fills are to be expected with in the study area.

4.2 Site Geology

The soil deposits in the Toronto region consist predominantly of glacial till, glaciolacustrine, and glaciofluvial sand, silt, and clay deposits. These deposits were laid down by glaciers and associated glacial rivers and lakes. The soil deposits overlie the Georgian Bay Formation bedrock which consists primarily of shale with interbeds of limestone and siltstone. This bedrock formation is generally found about 50 to 75 m below the ground surface in the region of the proposed subway alignment.

The soil deposits are believed to have been deposited over the course of at least two glaciations and one interglacial (i.e., warmer) stage. The majority of the soil deposits in the study area are believed to have been deposited during the Wisconsinian glacial period which saw several glacial advances and retreats. During the glacial advances till deposits were formed at the base of the glacial ice (i.e., basal or lodgement till). During glacial retreats glaciofluvial (river-deposited) and glaciolacustrine (lake deposited) sediments were formed adjacent to and on top of the glacial till.

The study area is located within the physiographic region known as the Peel Plain. Most of the tableland area consists of till partly modified by the former presence of shallow glacial lakes or post-glacial erosion features (locally existing streams and rivers).

4.3 Subsurface Conditions Along Proposed Alignment

As part of the subsurface investigation for the proposed subway alignment, twelve boreholes (Boreholes Y-121 to Y-132) were advanced along the proposed alignment of the Spadina Subway Extension. The borehole locations are shown on Drawing 1.

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of laboratory tests carried out on selected soil samples, are included in the Record of Borehole sheets, Figures 1 to 7. The laboratory test results for the individual borehole are included in Appendix A. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and results of Standard Penetration Tests and, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

In general, the area is underlain by two till sheets, considered to be a part of substages of the Wisconsin glaciation. The till sheets are underlain and/or separated by variable thicknesses of interstadial deposits of sand, silt and silty clay of glaciofluvial and glaciolucustrine origin. Bedrock was not encountered in any of the boreholes.

The native deposits encountered at the site are grouped as follows:

- Sand to Silty Sand (Types 5 and 6)
- Sand and Silt to Silt (Types 7 and 8)
- Clayey Silt to Silty Clay (Types 9 and 10)
- Clayey Silt to Silty Clay Till (Type 11)
- Sandy Silt to Sand and Silt Till (Type 12)

The soil types described on the Record of Borehole sheets and on the figures included in this report are given twelve different classifications and graphic symbols (Types 1 through 12). The graphical representations of these material types are supplemented by colour on the figures included with this report to facilitate visualization of the geologic and material characteristics of the soil deposits. It is to be noted that Deposit Type 11 and 12 are interpreted as a till deposit on the basis of the heterogeneous structure, the relatively broad grain size distribution and the documented local geology.

Within this report, the naming convention includes “Upper”, “Middle”, and “Lower”, depending on the relative elevations and grain size characteristics of the deposits. This convention has been adopted to be consistent with work completed for the Sheppard Subway and is used to avoid geologic unit classifications based on geologic age or stage of glacial advance. In some instances, geologic nomenclature, although correct in defining the geologic origin and age of a particular deposit, does not necessarily convey indications of material type or potential engineering behaviour. Precedence in this report has therefore been given to naming the different soil units based on relative elevation and grain size composition.

In general, the stratigraphy at the site is defined by a sheet of predominantly cohesive glacial till (Upper Till) encountered from near the surface to depths typically on the order of 5 to 15 m thick. In some areas, however, this glacial till layer may be found to depths of 20 to 25 m. Below the Upper Till deposits of relatively uniform glaciolacustrine or glaciofluvial sand and silt (Upper Sand/Silt) are commonly encountered with thicknesses on the order of 5 to 10 m. The Upper Sand/Silt Deposit is notably thicker near the GO/Sheppard Station, between the Finch Avenue and York University stations, and between the York University and Steeles Stations. Cohesive deposits were encountered below the Upper Sand/Silt in many of the boreholes that penetrated this deposit. In some cases, the samples included coarse sand and fine gravel and were interpreted as indicative of glacial till. It is unclear as of this report and investigation results whether or not these materials represent a geologic glacial till unit or highly consolidated glaciolacustrine deposits. For the purposes of this report, these soils have been interpreted as glaciolacustrine soils and given the designation of Upper Clay.

Within all of the soil deposits there are smaller zones of compositionally different materials. For example, within the Upper Till, there can be found zones of uniform sand and silt, and within the Upper Sand/Silt, there can be found zones or layers of silty clay or clayey silt. During deposition, the base of the glacial ice sheets in this area overrode relatively weak glaciolacustrine and deltaic deposits of sand, silt, and clay. Thus, materials from these interstadial deposits became incorporated into the basal glacial till. This condition is exhibited by the boreholes near York University where the Upper Till includes relatively large and apparently discontinuous zones of granular till as well as sand and silt. For final design, it will be necessary to complete more boreholes in the areas where such variation may be important for determining aquifer continuity characteristics for dewatering or groundwater cut off.

It should be noted that the interpreted stratigraphy illustrated on Drawing 2 is a simplification of the subsurface conditions based on widely spaced boreholes. Variation in the stratigraphic boundaries between boreholes will exist and are to be expected. The interpreted stratigraphy is also does not necessarily represent a direct borehole-to-borehole linking of similar soil types. In some areas, borehole off-set distances (away from the centre-line interpretation), descriptions of soil types on the original boreholes, and overall geologic considerations suggest that continuity between deposits or larger deposits within which described soil samples likely should be included depart from individual sample descriptions on the borehole logs. In particular, those boreholes from past projects or wells that were not classified in the field following the TTC Standards are more subject to interpretation based on consideration of the geology and information from more recent investigations.

4.3.1 Asphalt

Approximately 180 mm of asphalt underlain by about 600 mm of granular material was encountered in Borehole Y-125, where the borehole was carried out on the road pavement.

4.3.2 Topsoil

Between 70 mm to 244 mm of topsoil was encountered at ground surface in all boreholes, except in Borehole Y-125.

4.3.3 Fill

A layer of fill was encountered underlying the topsoil in Boreholes Y-123, Y-124, and Y-128, with thickness between 1.37 m and 2.98 m. The sampled fill material consist mainly of clayey silt to silty sand and sand, trace gravel, trace topsoil and organics. Oxidizing stains, brick and concrete fragments were also noted within the fill material. For Boreholes Y-123 and Y-124, the sampled fill material includes traces of reworked till material which was encountered just below the fill layer. Measured Standard Penetration Test (SPT) “N” values in the cohesive fill material

are between 8 and 13 blows per 0.3 m of penetration, indicating a stiff consistency; and between 3 and 10 blows per 0.3 m of penetration within the granular fill material, indicating a very loose to loose relative density. The measured natural water content of the three selected samples within the cohesive fill material are between 9.0 and 13.0 per cent. It should be noted that, although these general characteristics are described for the sampled materials, fills placed in urban environments are typically highly variable in composition, density/consistency, and moisture content.

4.3.4 Sand to Silty Sand (Type 5 and 6)

An interstadial granular deposit was encountered underlying the glacial till (clayey silt to silty clay till) in most of the boreholes (Boreholes Y-122, Y-123, Y-125, Y-126, Y-129, Y-131 and Y-132). The surface of which was encountered between Elevation 182.77 m and Elevation 196.80 m, with thickness between 0.25 m and 6.1 m. The granular deposit consists mainly of fine to medium coarse grey sand to silty sand, trace to some gravel and trace clay.

Grain size analysis was carried out on three selected samples of the sand to silty sand deposit and an envelope of the grain size distribution results is shown in Figure 1. The uniformity coefficient (Uc) is estimated to be between 33 and 93, with an average value of 72.

The measured natural water contents of twenty-one samples are between 6.9 per cent and 19.4 per cent.

Measured SPT “N” values ranged from 25 to more than 100 blows per 0.3 m of penetration, indicating a compact to very dense relative density. However the SPT “N” values are typically more than 50 blows per 0.3 m of penetration in most boreholes, except at Boreholes Y-122, Y-125 and Y-132, where SPT “N” values between 22 and 36 blows per 0.3 m of penetration were recorded. The lower SPT “N” values were measured at either the upper portion of the deposit and/or at the sand/till interface.

4.3.5 Sandy Silt to Silt (Type 7 and 8)

Another interstadial granular deposit was encountered within the glacial till in all the boreholes, except Boreholes Y-121, Y-125 and Y-127, between Elevation 176.67 m and Elevation 191.15 m, with thickness between 1.22 m and 6.1 m. This deposit consists primarily of grey sandy silt, trace to some clay and trace gravel to fine silt, trace to some sand, trace gravel. Gravel seams and sand partings were noted in Boreholes Y-123 and Y-124 respectively. Grain size analyses were carried out on fifteen selected samples of the sandy silt to silt deposit and an envelope of the test results is shown in Figures 2A and 2B. The uniformity coefficient (Uc) is estimated to be between 8 and 85 with an average of 38. An Atterberg limit test was carried out on one selected sample and plotted on Figure 3; measuring a plastic limit of 11.3, a liquid limit of 14.6, and a plastic index of 3.3, exhibiting a low plasticity.

The measured natural water contents of twenty-six samples are between 7.2 per cent and 17.0 per cent.

Measured SPT “N” values ranged from 15 to more than 100 blows per 0.3 m of penetration, indicating compact to very dense relative density; however typical “N” values were between 30 to 86 blows per 0.3 m of penetration, indicating a dense to very dense relative density.

4.3.6 Clayey Silt to Silty Clay (Type 9 and 10)

An interstadial cohesive deposit was encountered within the glacial till and granular deposits at all the boreholes, except Boreholes Y-121, Y-122, Y-126, Y-127 and Y-131; the surface of which was encountered between Elevation 173.94 m and Elevation 188 m, and has thickness ranging from 1.51 m to 7.25 m. The deposit was notably thicker, between 3.35 m and 7.25 m at the south portion of the alignment (Downsview and along Keele Street). The cohesive deposit encountered within York University area is typically thinner, about 1.75 m, except at Borehole Y-130 where it was 4.57 m thick.

These soils, classified as clayey silt to silty clay are differentiated from the cohesive glacial till materials on account of apparent layered structure. It is considered that these soils are glaciolacustrine in origin, although it is also interpreted that they have in some cases been incorporated into glacial till deposits as a result of glacial disturbance, remoulding, and redeposition.

This cohesive deposit consists mainly of grey clayey silt, trace sand and gravel, with silt seams to silty clay, trace sand and gravel, with fine sand partings. Grain size analyses were carried out on five selected samples of the clayey silt to silty clay deposit. The grain size distribution envelope is shown in Figure 4. Atterberg limit tests were carried out on five selected samples, typically measuring plastic limits between 15.1 and 16.9 per cent, liquid limits between 19.6 and 33.7 per cent, and corresponding plastic indices between 4.5 and 16.8 per cent. A higher plastic limit of 29.9 per cent and liquid limit of 49.8 per cent was tested on the sample obtained in base of Borehole Y-125 at Elevation 176.07 m. The results are plotted on Figure 5.

The measured natural water contents of the eighteen samples within the cohesive deposit are typically between 13.6 per cent and 20.8 per cent; with the exception of the sample obtained at the base of Borehole Y-125, where a water content of 30.6 per cent was measured.

Measured SPT “N” values within the cohesive deposit ranged from 22 to more than 100 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. However the SPT “N” values are found to be lower in Boreholes Y-125, Y-128, Y-130 and Y-132, ranging between 22 to 71 blows per 0.3 m of penetration; where the base of the deposit was typically encountered above Elevation 177 m, except at Borehole Y-129.

4.3.7 Clayey Silt to Silty Clay Till (Type 11)

A deposit of glacial till was encountered underlying the topsoil in all boreholes, except at Borehole Y-124 (Downsview Park), where the surface of this till deposit was between Elevation 192.23 m and Elevation 201.13 m, and thickness between 1.52 m and 6.86 m. This cohesive deposit is differentiated from those materials classified as clayey silt to silty clay (Types 9 and 10) on account of a more massive structure and embedded angular coarse sand and fine gravel.

The glacial till deposit consists mainly of brown to grey clayey silt to silty clay, trace to some sand and gravel; seams of brown fine sand and sand partings were noted in Boreholes Y-122 and Y-123. Oxidizing stains were observed within this deposit.

Atterberg limit tests were carried out on seventeen samples of this till deposit, measured plastic limits between 9.9 and 22.5 per cent, liquid limits between 15.5 and 37.7 per cent, and corresponding plasticity indices between 5.6 and 15.2 per cent, exhibiting a low to medium plasticity. The average plastic limit is about 15.0 per cent, average liquid limit about 24.9 per cent and an average plastic index of 9.6. The test results are plotted on Figure 6. The measured natural water content were between 6.8 and 27.6 per cent, with an average at about 13.6 per cent.

Measured Standard Penetration Test (SPT) “N” values were typically between 5 and 85 blows per 0.3 m of penetration, indicating a firm to hard consistency. The SPT “N” values were typically lower when measured in the till nearer to the ground surface, and greater than 100 blows per 0.3 m of penetration (Boreholes Y-121, Y-122 and Y-123) below Elevation 185 m or at interface with the granular interstadial deposits.

4.3.8 Sandy Silt to Sand and Silt Till (Type 12)

Another glacial till deposit was found underlying the clayey silt to silty clay till deposit near to ground surface (Boreholes Y-124, Y-126, Y-127, Y-129 and Y-130) or within the clayey silt to silty clay till deposit (Borehole Y-121), where the surface of the till deposit was between Elevation 187.25 m and Elevation 198.45 m, and the thickness from 0.91 m to 6.1 m.

This till deposit consists mainly of sandy silt to silty sand, trace to some clay and gravel, trace cobbles. Grain size analyses were carried out on seven samples of the sandy silt to sand and silt till deposit and grain size distribution envelope is shown on Figure 7. The uniformity coefficient (Uc) is estimated to be between 24 and 700, with an average of 187. The measured natural water content of fourteen selected samples are between 3.3 per cent and 14.2 per cent.

Measured Standard Penetration Test (SPT) "N" values were typically between 14 and 57 blows per 0.3 m of penetration, indicate that these soils are compact to very dense.

5.0 HYDROGEOLOGY

The proposed alignment is located between the valleys of the West Don River and Black Creek and their tributaries. General drainage of the study area is probably toward the West Don River and Black Creek via tributary streams. The hydrogeology within the glacial deposits of the area can be relatively complex. The lower permeability glacial till layers tend to impede groundwater flow whereas the interstadial deposits of silt and sand serve as local shallow aquifers. Details of the monitoring wells and piezometer installations and water level measurements are shown on the Record of Borehole sheets and are summarized on the stratigraphic profile shown in Drawing 2. It should be expected that the groundwater level in the area will be subject to seasonal fluctuations, particularly during spring flows and precipitation events.

The results of the single well response tests are presented in Appendix B and the calculated hydraulic conductivity values are summarized below. It should be noted that the calculated hydraulic conductivity values are only representative of the general soil mass between the top and bottom elevations of the sand-pack around the well screen or piezometer and for a limited distance within the soil deposit. The calculated hydraulic conductivity values should only be considered an indicator of the formation hydraulic properties and not a definitive measure of the overall formation behaviour. Layers of coarse material within this zone may unduly influence such test and for final design and prior to construction, field pumping tests should be conducted in any areas in which dewatering or groundwater flow issues may be critical.

Summary of Rising Head Test Results ("Slug Tests")

Test Well	Depth of Well (m)	Elevation of Well (m)	Calculated Hydraulic Conductivity (cm/s)
Y-121	18.29	179.63	2.82E-05
Y-122	24.38	173.63	1.78E-03
Y-123	24.38	170.90	1.78E-05
Y-124	18.29	176.91	1.51E-06
Y-125	18.29	176.37	1.55E-06
Y-126	12.95	176.37	2.56E-05
Y-127	13.56	184.21	1.36E-05
Y-128	18.29	178.98	3.78E-08
Y-129	18.29	179.78	8.54E-05
Y-130	13.87	185.93	1.61E-05
Y-131	13.11	188.26	5.70E-05
Y-132	12.19	188.52	6.86E-04

The results suggest an average hydraulic conductivity of 4.3E-04 cm/s within the interstadial granular deposits; an average hydraulic conductivity of 1.4E-05 to 3.0E-05 cm/s within the cohesive and glacial till deposits.

Where the granular soils underlie a glacial till unit, it is common that either downward or upward hydraulic gradients exist with downward hydraulic gradients generally prevalent in the tableland areas between river valleys. Downward hydraulic gradients are indicated by progressively lower groundwater levels measured in piezometers with their measuring tips sealed at progressively lower elevations. For example, in the York University area, piezometers that are installed and sealed into the ground about 7 to 10 m below the ground surface indicate a groundwater level at approximately Elevation 194 to 200 m (about 2 to 3 m below the ground surface). Deeper wells, installed and sealed in the interstadial deposits exhibit lower groundwater levels in the range of about Elevations 182 to 189 m.

In some areas along the route options, the glacial till (Upper Till) and silt and clay (Upper Clay) layers meet, pinching out the Upper Sand/Silt deposit, and inhibit subsurface drainage and relief of groundwater pressures. Where multiple glacial till layers occur separated by interstadial or granular deposits, groundwater conditions will need to be carefully examined to provide adequate guidelines for design. Because of regional groundwater flow and variations in topography (e.g. watercourse valleys), groundwater trapped in granular layers overlain by low permeability silt and clay soils can be under pressures such that any wells or excavations that puncture the granular layers will exhibit a pressure head elevation above the interface of the granular and low-permeability units and, in some cases, this pressure head may be higher than the ground surface resulting in “artesian” conditions (wells under such conditions will flow at the ground surface). Hydrostatic conditions (i.e., a single groundwater table) should not be assumed for any location within the study area.

Available subsurface data in conjunction with mapping of groundwater discharge areas suggests that the Upper Sand/Silt Deposits are more extensive and potentially “daylight”, or intersect the ground surface, in the western limits of the study area and toward the valley of Black Creek. The Upper Sand/Silt Deposit is notably thicker near the GO/Sheppard Station, between the Finch Avenue and York University stations, and between the York University and Steeles Stations. Both the detailed subsurface exploration work completed in the 1990’s for the planned subway extension and the YPDT subsurface model suggest that within the broad study area the granular deposits are on the order of 5 to 10 m thick. The detailed subsurface information and experience with other projects in the area suggests that, although the Upper Sand/Silt deposits may be hydraulically connected, they may also be interrupted by the overlying Upper Till deposit or lenses of cohesive materials within the Upper Sand/Silt deposits.

6.0 MAN-MADE FEATURES SIGNIFICANT TO DESIGN AND CONSTRUCTION

6.1 Adjacent Properties and Structures

Between the existing Downsview Station and Finch Avenue, the proposed alignment will cross several residential, commercial, and light industrial areas. North of Finch Avenue, the proposed alignment will be running adjacent to an existing petroleum products storage facility, and then through open fields before entering the main York University campus and terminating at Steeles Avenue.

Based on the prevailing soil conditions and our knowledge of typical construction practices, it is anticipated that the majority of one to three storey residential structures or light commercial structures in the area are supported by shallow spread foundations. Where the structures do not have basements or below-grade levels, it is expected that such foundations would bear about 1.2m to 2 m below the immediately adjacent ground surface for frost-protection considerations and to be founded below any relatively poor fill soils. Typical residential foundations for homes with basements have foundations seated approximately 1.5 m below the lowest adjacent ground surface. Foundations for light commercial buildings without basements are anticipated to consist of either shallow spread footings, seated approximately 1.2 to 1.5 m below the lowest adjacent ground surface, or in some cases, may consist of relatively short drilled shafts extending 2 to 3 m below the finished floor or adjacent grade level, whichever is lower. It is understood that foundation conditions for larger structures will be reviewed separately based on municipal building records and are therefore not discussed further in this report.

Based on a review of the available mapping, it is anticipated that the number of structures within the “zone of influence” of the proposed construction will be 24, and the proposed alignment would be passing directly under the Schulich School of Business building in York University. Additional discussion of the “zone of influence” and issues related to construction near existing structures is provided in a subsequent section of this report

6.2 Soil and Groundwater Chemistry

An evaluation of soil and groundwater chemistry is not part of this report.

6.3 Boreholes and Wells

The locations of boreholes and wells reviewed during this study, to the date of this memorandum, are illustrated on Drawing 2. In most cases, boreholes or wells completed during the investigations carried out by the TTC in the 1990s have surveyed coordinates such that field locations may be identified. The conditions and precise locations of older boreholes and wells completed by other owners are unknown. Requirements for monitoring and groundwater supply well decommissioning have changed since most of these holes were drilled. Thus, it should be assumed that open standpipes exist at the borehole or well locations and these could affect construction. Such conditions should be addressed during final design to help assure that old exploratory boreholes do not negatively affect construction.

7.0 RECOMMENDATIONS FOR DESIGN

This section of the report includes an interpretation of the geotechnical data obtained with respect to design, and provides comments and recommendations on geotechnical aspects of design of the works. It should be noted that the subsurface data is available at isolated borehole locations along the design section. Conditions will vary between and beyond the boreholes and the design and construction must allow for reasonable variations.

Construction of the proposed subway will influence the existing site features depending on the construction methods used, workmanship, the proximity of construction to the features, and the condition of the nearby structures or utilities.

7.1 Cut and Cover Construction

7.1.1 Subway Structure Design Aspects

7.1.1.1 Foundations

From the stratigraphic profile, it can be seen that the typical founding soils for the four proposed subway station base slabs are summarized with the elevations as shown.

Station	*Estimated Elevation of Base Slab (m)*	*Founding Soil*	*Soil Type*
GO/Sheppard Avenue	180	Silt; Clayey Silt (Interstadial)	8; 9
Keele/Finch	178	Clayey Silt to Silty Clay Till; Clayey Silt (Interstadial)	11; 9
York University	175	Sandy Silt to Sand and Silt Till	12
Steeles Avenue	180	Clayey Silt to Silty Clay Till	11

Note: 1) Elevation of base slab is estimated from the subway vertical alignment profile provided by URS; to be reviewed as needed with the final EA alignment.

7.1.1.2 Flotation/Uplift

Potential uplift pressures acting on base slabs and hydrostatic pressures on walls is expected for permanent structures of the subway along this alignment. The measured water levels from ground surface in the twelve boreholes drilled along the alignment typically ranged from 7 m to 14 m at the south (Allen/Sheppard and south on Keele Street); 5 m to 7 m near the north (within York University); and 2 m to 3 m between Keele/Finch station and York University station. The expected water head difference using the latest measured water levels and the expected elevation of station base slab are summarized below.

Station	*Base Slab Elevation (m)*	*Nearest Borehole*	*Head Difference to Base Slab (Piezometer) (m)*
GO/Sheppard Avenue	180	Y-124	+9
Keele/Finch	178	Y-127	+15
York University	175	Y-130	+24
Steeles Avenue	180	Y-132	+16

Note:
1) Elevation of base slab is estimated from the subway vertical alignment profile provided by URS; to be reviewed as needed with the final EA alignment.
2) The head difference is obtained using the latest water level measurements in piezometers.
3) (+) refers to water head (in metres) above the elevation of base slab at each proposed station.

7.1.1.3 Lateral Earth Pressures

There is some indication that in situ horizontal stresses, often described in terms of the ratio of in situ horizontal to vertical stress (K_o), within the glacial tills may be high with K_o values on the order of 1 or more. Because of excavation processes, this high lateral stress will likely be relieved to some degree. Although active stresses may be developed during excavation, relieving the in situ stresses, the permanent structures will likely be restrained against displacement and there may be some long-term reestablishment of in situ stresses that are closer to the initial conditions. Therefore, for preliminary design of underground structures, lateral pressures may be assumed to be approximately half of the vertical stress. For preliminary design, the horizontal stresses, σ'_h, can be assumed to be equivalent to:

σ'_h = 0.5(z)21 kPa, where z is the depth from the ground surface to a maximum of the depth to the groundwater level

σ'_h = 0.5(z)21 + 0.5(z_w)11 kPa, where z_w is the depth below the groundwater level

For preliminary design, groundwater pressure may be assumed to be equivalent to $9.81z_w$.

Lateral stresses for final design must be refined from these estimates and based on additional exploration and testing. It is considered, however, that the stresses given above should be sufficient for preliminary proportioning of structure sizes for initial planning or costing purposes.

7.1.1.4 Backfill to Structure

Backfill to the station walls should consist of well compacted fill, which is compatible with the hydrogeologic conditions of the surrounding ground, pertaining to each station site. It is

generally recommended that the in situ permeability of mass backfill be similar to that of the surrounding ground, and therefore careful consideration should be given prior to backfilling work. It is particularly of concern where granular backfill is used over large areas of excavation for the station construction through cohesive ground. The pore space within the granular backfill will become saturated with time, and may exacerbate undesirable leakage in the permanent structure or undesirable groundwater flow patterns. Furthermore, if the surrounding ground is suspected to or shown to be affected by contamination, it will then be necessary to use low permeability backfill materials to limit the potential for aquifer cross-contamination.

7.1.2 Excavations

Cut and cover construction may be carried out by either creating a wide open cut with sloped sides or, if space is restricted, by providing structural support to excavations with vertical walls. Based on the prevailing ground conditions, temporary cuts for open-cut construction may be made with side slopes in the range of 1:1 to 1.5:1 (horizontal : vertical). It is expected, however, that in most instances, vertical excavation sides will be required and that these excavations will require some form of temporary shoring. The shoring may take the form of soldier-piles and wood lagging walls, drilled secant pile (caisson) walls, or soil-nail ground support. Horizontal support may be provided by internal braces or drilled anchors that extend into the ground behind the supporting walls. Where temporary or permanent easements can be obtained from neighbouring property owners, it may be assumed that ground anchors or soil nails will extend horizontally (or at some shallow angle) into the ground a distance of up to twice the depth of the excavation. For soil nail supported excavations, this distance may be less (on the order of equal to the excavation depth) but for planning purposes, the greater extent should be used since the actual or likely support systems are unknown at this time.

7.1.2.1 Shored Excavations

7.1.2.1.1 Temporary Ground Support Systems

For temporary ground support at deep excavations, soldier piles and lagging wall is typically used where groundwater conditions (or where dewatering is carried out) and wall and ground displacement is permitted to some degree. Where displacement is limited or not well-tolerated and the ground support system closely controlled, contiguous bored and cast-in-place concrete pile (secant pile) walls are often used. In some instances, depending on cost and ground/groundwater condition considerations, soil nail walls or concrete diaphragm walls may also be appropriate. It is anticipated that sheet pile walls may have limited application, if any, for this project since the ground may be too dense for driven sheet pile installation. Concrete diaphragm walls are also seldom used in the Greater Toronto Area since continuous concrete walls can be constructed in situ using the secant pile wall technique often more economically. Lateral pressures for design of the temporary structures will depend on the temporary structure design. For flexible walls, such as soldier piles and lagging or sheet piles, the distribution of lateral pressure may take on a trapezoidal shape, whereas for stiffer walls, such as secant pile or concrete diaphragm walls, the lateral pressure distribution may be similar to a more common triangular active earth pressure distribution with magnitudes similar to those given above for design of the permanent structures. For final design and construction, recommended lateral pressure distributions for temporary should be developed for each particular construction situation.

7.1.2.1.2 Soil Anchors and Soil Nails

Soil anchors may be used for support of temporary or permanent earth retaining structures. In general, where these are to be used for support, temporary or permanent subsurface easements will be required from adjacent property owners since the anchors or nails will extend into the ground beyond the limits of the excavation. For preliminary planning purposes, it can be assumed that soil anchors may extend into the ground a distance equal to the depth of the excavation. If soil nails are to be used, this distance may be less, but until further design studies are undertaken, the assumed easement requirements should be as for the soil anchors.

7.1.2.1.3 Groundwater Control

Use of cut and cover construction methods may necessitate groundwater control by active dewatering. The water-bearing granular soils, if exposed, will flow into excavations unless the water is removed. If active dewatering is not permitted, other measures may be necessary to facilitate construction. Continuous excavation support walls that fully penetrate the water-bearing soils around the excavation may be used to cut off groundwater flow (typically contiguous caissons, sometimes referred to as tangent or secant pile walls. Alternatively, ground improvement using grouts to effectively plug the pore space in the soil may be used to limit flows of water through the ground and into the excavation. Other groundwater control measures may be feasible depending on the details of the design and local subsurface conditions. Additional design and subsurface investigations will be required, however, prior to further assessment of groundwater control needs. Further discussion on dewatering is presented in Section 7.3.

7.1.2.2 Evaluation of Settlement due to Shored Excavations

During construction, the ground surrounding excavations supported by soldier piles and lagging walls may deform up to about 0.2% of the excavation depth in both the horizontal and vertical directions. Ground displacements for secant pile walls or well-constructed soil-nail supported walls can be about half of this value, depending on design and workmanship. In general, the maximum displacements occur very near the edge of the excavation and dissipate to nominal values at distances ranging from approximately equal to the excavation depth or up to twice this distance for relatively poor ground conditions. Displacements on the order of 0.2% of the

excavation depth, or about 30 mm for a 15 m deep excavation, can be damaging to buildings or utilities that are within the “zone of influence”. A detailed examination of the geometry of the site, ground conditions, and nearby structures should be completed if any buildings are within a distance of about 1.5 to 2.0 times the depth to the base of the excavation as per the requirements of the TTC Design Manual.

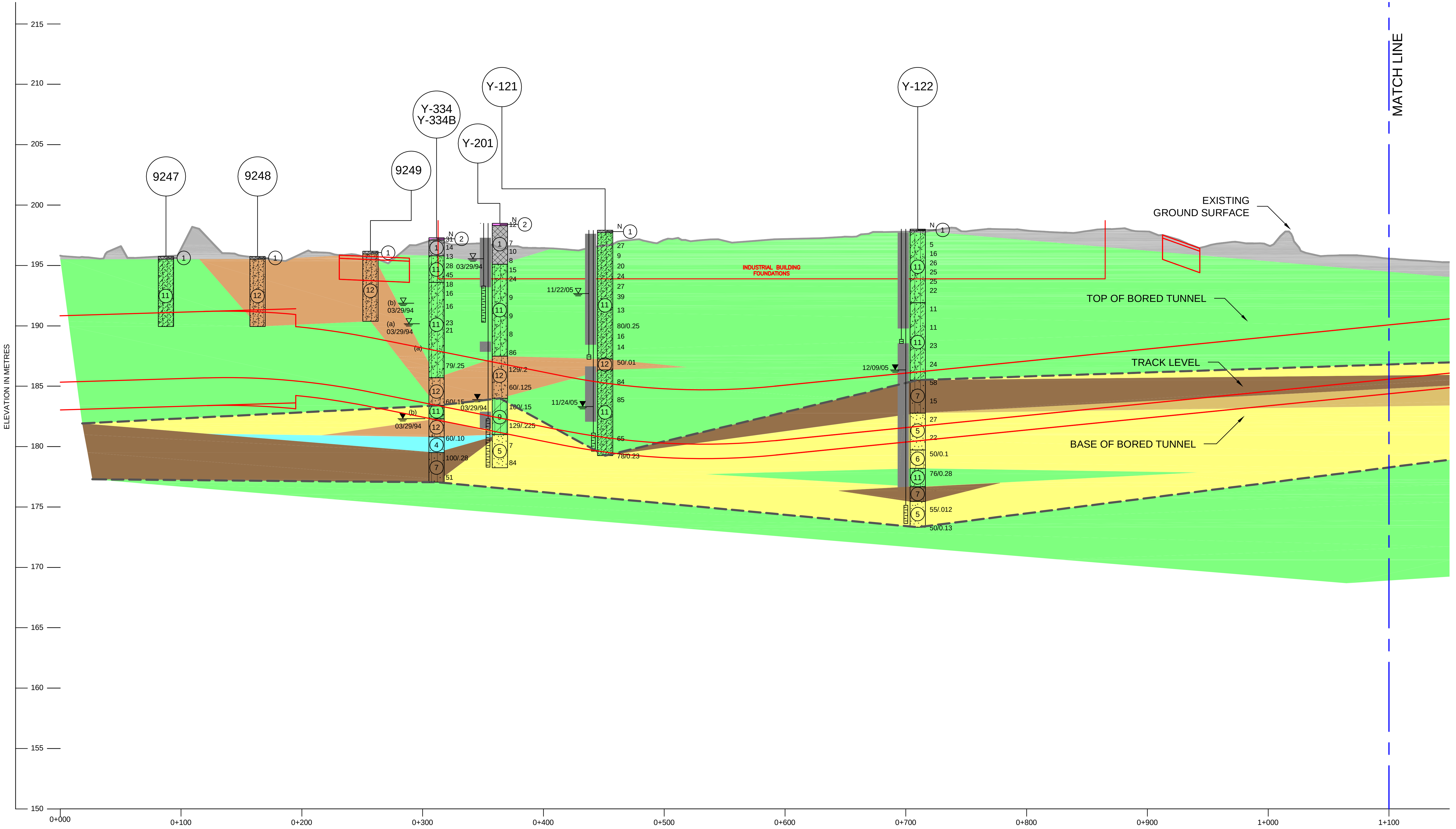
7.2 Tunnelling Methods

In general, the anticipated ground conditions along the proposed subway route options should be favourable to tunnel or mined station construction. A brief summary of possible techniques is provided below.

- Tunnel Boring Machine (TBM): for relatively long lengths of tunnel, generally greater than about 600 m, or multiple lengths of tunnel greater than 300 m, it may be both feasible and economically suitable to use a tunnel boring machine. Tunnel boring machines are generally not suited to construction of underground transit stations. The recently-built Sheppard Subway was constructed using TBMs specifically designed for and purchased by the TTC. The TBMs were designed as earth-pressure-balance (EPB) machines so as to assist in controlling ground displacements in potentially difficult ground conditions below groundwater levels. Boulders may present difficulties for machine tunnelling, but the TBMs designed and used for the Sheppard Subway performed well with a head configured with both rock and soil cutting tools.

- Sequential Excavation Method (SEM): The sequential excavation method (sometimes called NATM), in which a number of short-length stages of mechanically-assisted and unsupported excavation are followed immediately by steel ribs and shot-crete lining construction, may also be a suitable technique for relatively short sections of tunnel or stations. Although soft-ground SEM/NATM has not been used frequently in the Toronto area, it is becoming a more common technique and may prove economically and technically suitable for portions of the Spadina Subway extension. Ground conditions should be generally favourable for such construction provided that groundwater is adequately controlled and that the tunnel has a depth of cover at least equal to the diameter of the tunnel.

- In addition to the use of TBMs and the SEM, tunnels or mined stations (if such might be considered) could be completed with a number of other techniques, depending on the required tunnel or station geometry. Such techniques could include use of large or irregularly-shaped tunnelling shields (as used for University Station in Toronto), jacked pipe arches, and hand-mining with steel plates for temporary liner construction. As with the SEM techniques, groundwater control may be critical for successful construction. Additional information and recommendations on alternative methods should be further developed as the project progresses through preliminary design.



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PROJECT No. 04-1111-054 REV. B

TITLE
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ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE 2B

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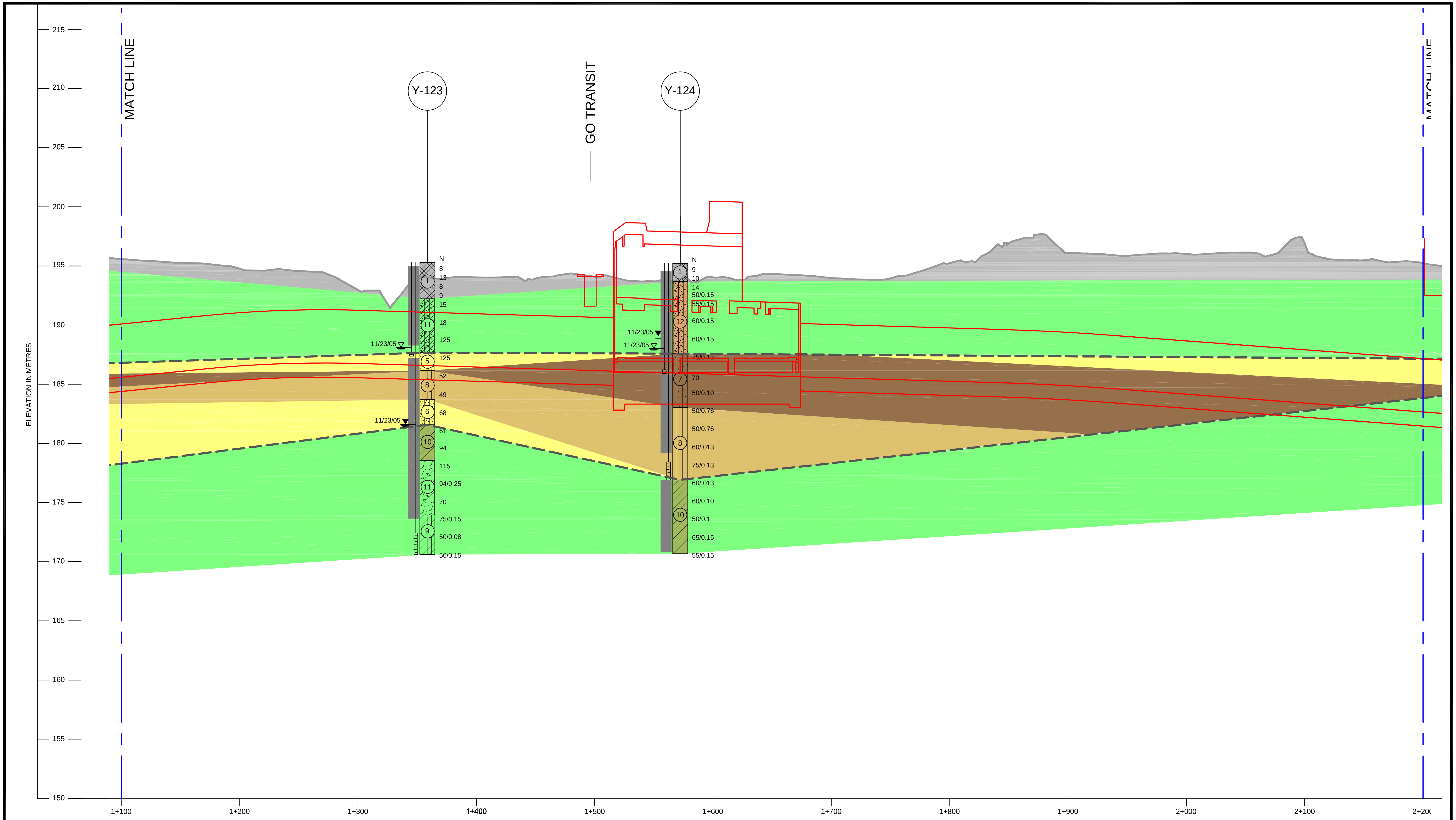

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TITLE

STRATIGRAPHIC PROFILE CHAINAGE 1+100 - 2+200 ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE 2C

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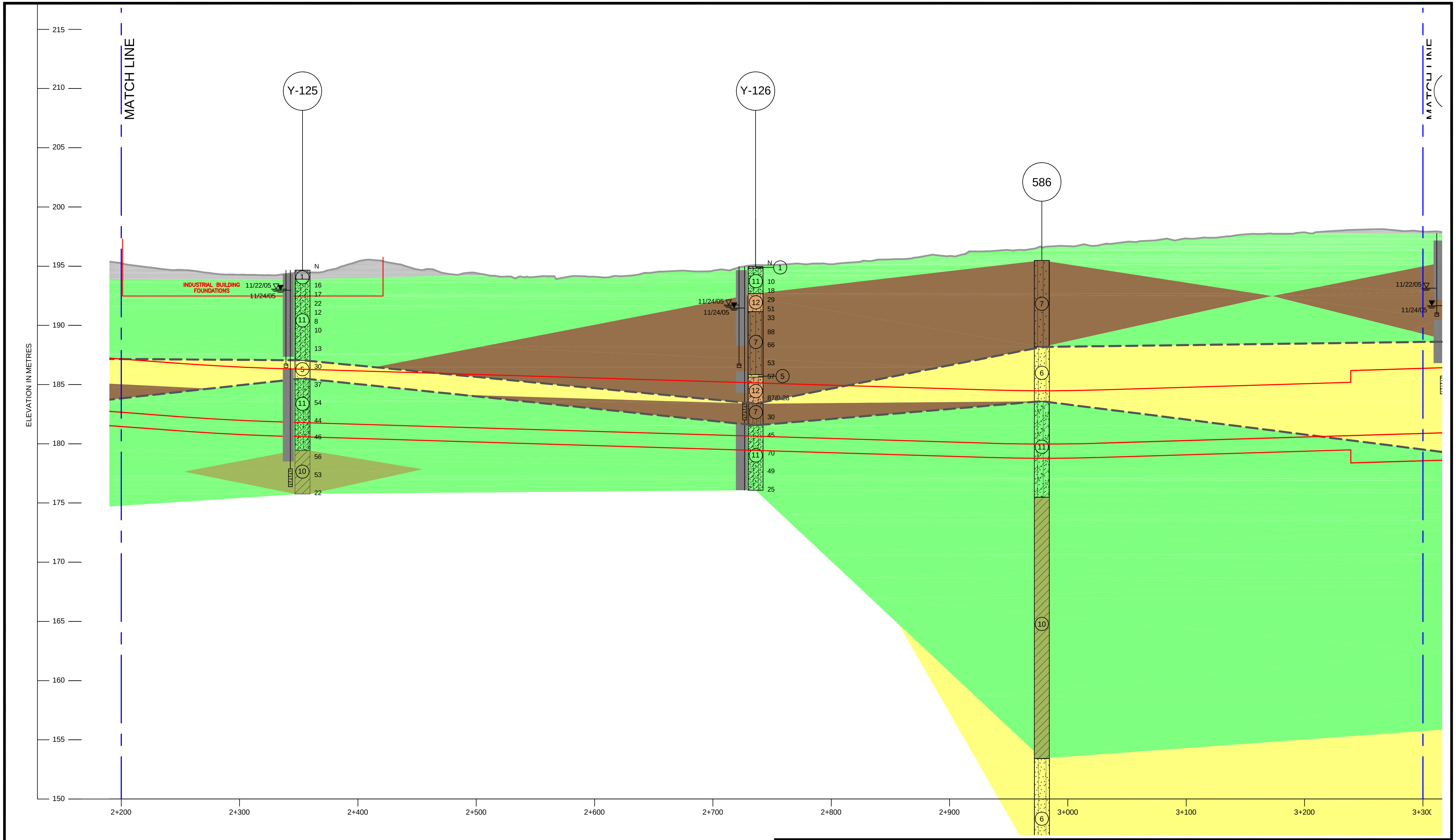

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STRATIGRAPHIC PROFILE CHAINAGE 2+200 - 3+300 ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE **2D**

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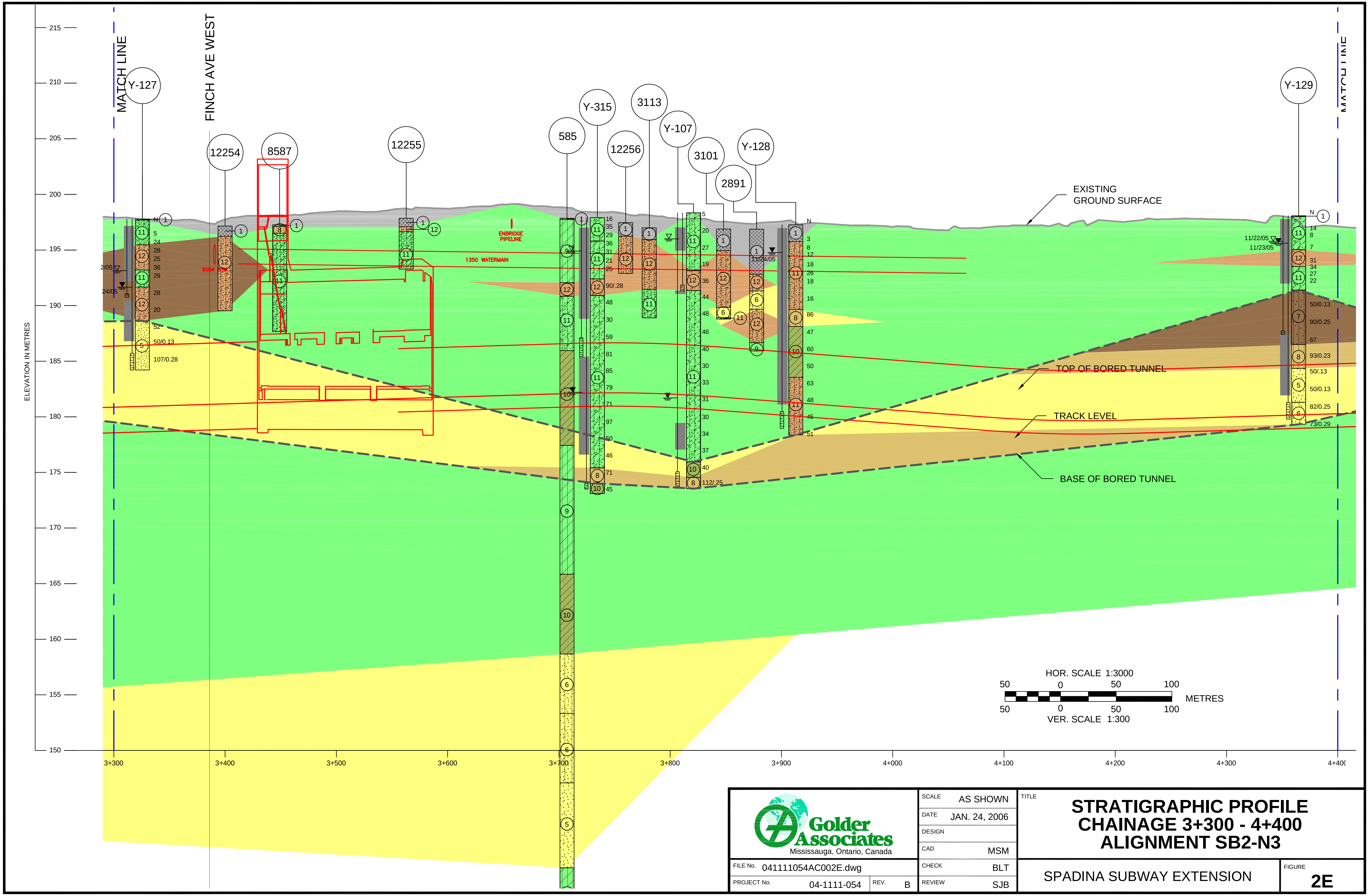

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PROJECT No. 04-1111-054 REV. B

TITLE
STRATIGRAPHIC PROFILE
CHAINAGE 3+300 - 4+400
ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE 2E

PLOT DATE: February 09, 2006
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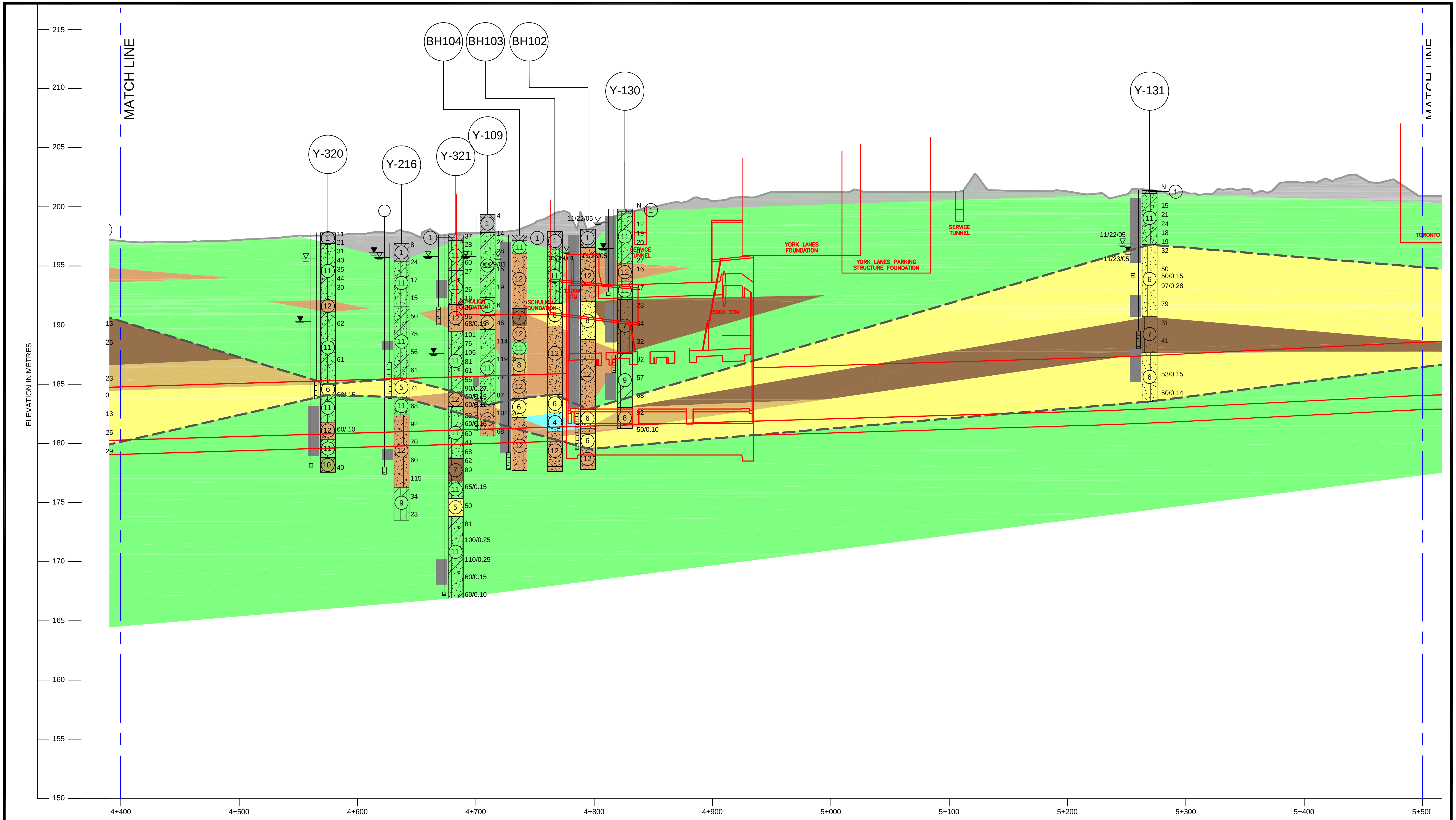

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REVIEW SJB

TITLE
STRATIGRAPHIC PROFILE CHAINAGE 4+400 - 5+500 ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE 2F

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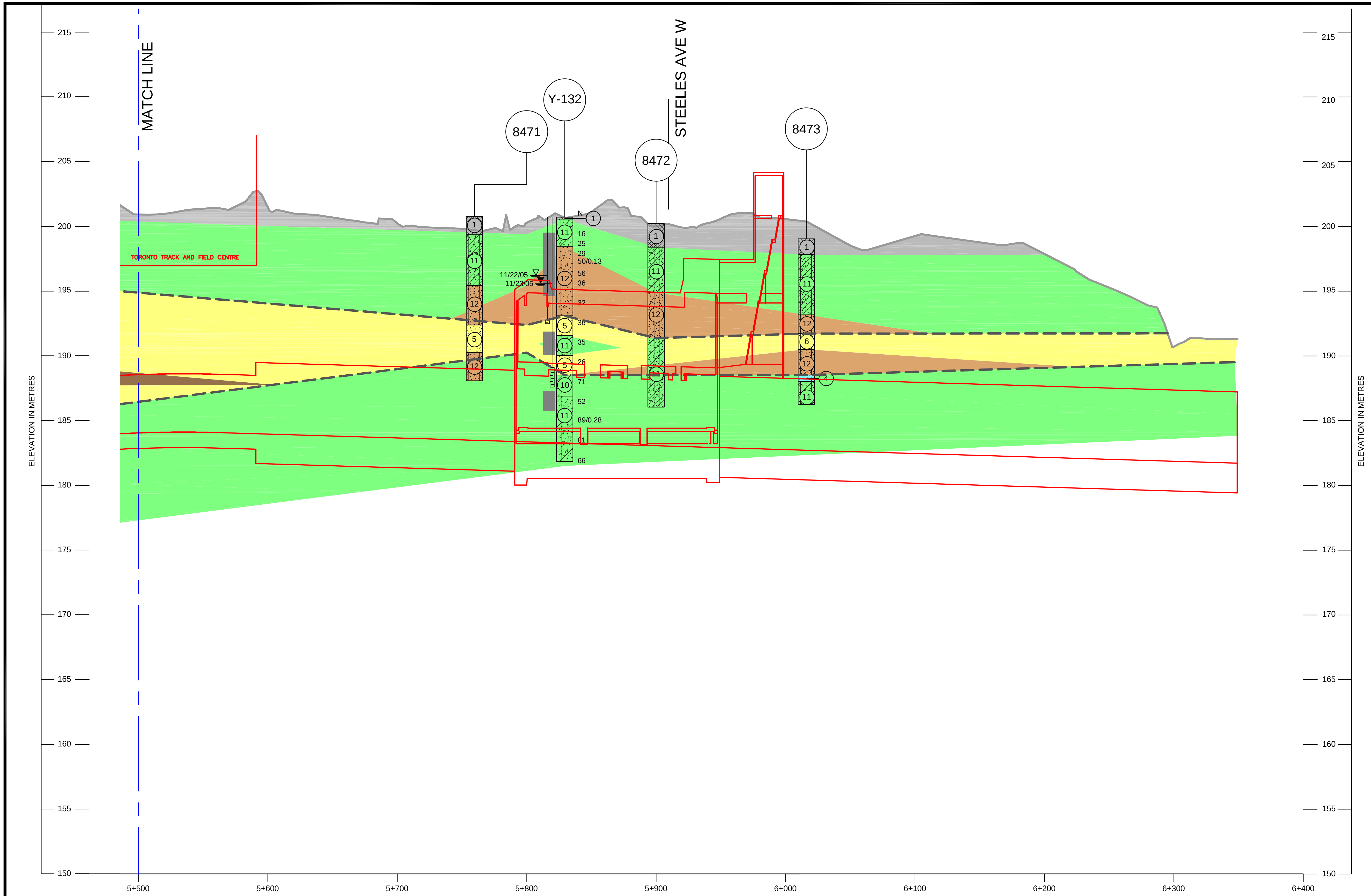

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STRATIGRAPHIC PROFILE
CHAINAGE 5+500 - 6+349
ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE **2G**

Construction of running tunnels or mined stations using tunnelling techniques will also induce ground displacements. Typically, during construction of the Sheppard Subway (using a tunnel boring machine), displacements in ground similar to that which may be encountered along the Spadina Subwayextension was limited to about 30 mm or less, though instances of greater settlement should be expected depending on the depth to the tunnel, workmanship, and local conditions. Where the ground conditions consisted of hard cohesive soils in the bottom of the tunnel and saturated granular soils in or near the top of the tunnel, larger settlements and ground losses occurred. An instrumentation program carried out in conjunction with tunnel construction should assist in identifying locations of higher than acceptable ground loss allowing remedial grouting to be completed to minimize the effects of tunnelling on surface features or foundations.

Where the tunnels pass directly beneath existing structures, additional ground control measures may be necessary. Such measures could include underpinning or various forms of grouting. It is generally recommended that any tunnelling that is to be carried out beneath buildings be at a depth that leaves a distance of at least twice the tunnel diameter between the crown of the tunnel and the underside of any building foundations. Tunnelling beneath buildings is feasible and has been accomplished successfully on many projects throughout Canada and world-wide, though special construction measures may be needed to limit potential risks and consequent costs. Detailed settlement and building damage potential evaluations should be completed for any areas where it is contemplated that tunnelling will be completed beneath buildings that are to remain in place during construction. Typically, ground displacements often occur at a maximum over the centreline of the tunnel and dissipate to nominal values over a distance perpendicular (in each direction) to the centreline approximately equal to the depth to the tunnel. A detailed examination of the geometry of the site, ground conditions, and nearby structures should also be completed if any buildings are within a horizontal distance of about 2 times the depth to the base of the tunnel (the “zone of influence”), as per the requirements of the TTC Design Manual.

Use of some tunnel construction methods may necessitate groundwater control by active dewatering. The water-bearing granular soils, if exposed, will flow into tunnel faces unless the water is removed. If active dewatering is not permitted, other measures may be necessary to facilitate construction. If earth pressure balance or slurry machines are used for tunnel excavation, dewatering may not be necessary except, perhaps, for shafts or isolated construction incidents or locations. The selection of the primary tunnel lining will have an influence on whether or not dewatering is required or groundwater is drawn down. Use of a precast, segmented, and gasketed concrete liner may avoid influencing local groundwater conditions whereas use of a ribs and lagging liner may act as a large horizontal drain. Alternatively, if tunnels are constructed by other methods (e.g. SEM/NATM) ground improvement using grouting techniques (permeation or jet grouting) to effectively plug the pore space in the soil or replace the soil may be used to limit flows of water through the ground and into the tunnels. Other groundwater control measures may be feasible depending on the details of the design and local subsurface conditions. Additional design and subsurface investigations will be required, however, prior to further assessment of groundwater control needs. Further discussion on dewatering is presented below.

7.3 Dewatering

Dewatering of the interstadial granular soils may be necessary for open-cut stations, cut and cover stations or tunnels, or open-face tunnel construction. In addition, it is anticipated that dewatering may be required for the start and end shafts for tunnels constructed with tunnel boring machines, emergency exits. Based on previous construction for Toronto subway projects, such dewatering may be accomplished using deep wells or eductor well systems. It is anticipated that active dewatering for lengths of tunnel constructed using tunnel boring machines may not be required.

For the purposes of the Environmental Assessment, an outline assessment of potential dewatering conditions was conducted. This dewatering assessment, limited in its scope, considered the following:

- construction of a station near the intersection of Keele Street and Finch Avenue with the subsurface conditions consisting of water-bearing granular deposits (Upper Sand/Silt), on the order of 5 m to 10 m thick, between two cohesive deposits (Upper Till and Upper Clay);
- construction of a station at Steeles Avenue, near the westerly limit of the proposed alignment with the subsurface conditions consisting of water-bearing granular deposits with a thickness on the order of about 5 m to 10 m;
- construction of a station at York University with subsurface conditions consisting of water-bearing granular deposits with a thickness on the order of up to about 10 m;
- construction was assumed to be completed using conventional cut and cover methods without implementation of any groundwater control mitigating measures except for dewatering using wells or well points; and
- the permeability (hydraulic conductivity) of the granular deposits was assumed to range between $5x10^{-3}$ and $5x10^{-6}$ cm/s.

Based on these assumptions, it is anticipated that the lateral extent of the groundwater drawdown could be on the order of 500 to 1,500 m from the dewatering system to where the drawdown is on the order of about 1 m. Typical flows extracted from a dewatering system installed for construction of the hypothetical station conditions assumed above are estimated to range between 1,000 and 5,000 litres per minute. These values are consistent with the magnitudes of dewatering discharge from station construction work on the Sheppard and Eglinton Subway projects. Given that the granular soils are typically very dense and the cohesive soils range between firm to hard, the influence of dewatering on settlement of the surrounding ground should be relatively minimal. Further investigations and analyses will be required to better define estimated dewatering quantities and drawdown radius values for design and final permitting. In some cases it may be necessary to adopt construction methods that minimize groundwater taking to minimize the costs of groundwater treatment and the risks arising from movement of contaminants across property boundaries. At each of the station areas noted above, the available information suggests that continuous excavation support walls (e.g. secant pile or concrete diaphragm walls) may be constructed to pass through and cut off the aquifers since the aquifers appear to be confined with the base of the granular soils above the bottom of the excavation with relatively thick cohesive (aquitard) deposits below. Where groundwater taking is carried out near potentially contaminated sites, the groundwater extracted during dewatering may require treatment prior to disposal. In addition, it may be necessary to seal potential vertical pathways for groundwater seepage that could develop along the boundaries between the ground, temporary shoring, and permanent structure. During construction of the Sheppard Subway, such measures were necessary at some locations. Groundwater was treated for the reduction of petroleum hydrocarbons via activated carbon filters prior to disposal and, during construction and backfilling of the box structures, bentonite seals were placed along these boundaries to minimize the potential for aquifer cross-contamination.

8.0 SOIL AND GROUNDWATER MANAGEMENT

During construction large volumes of earth, on the order of 1 million cubic metres, will be excavated and will require disposal. During the recent Sheppard Subway project, selection of disposal sites was left to the contractors. However, clear pre-construction and field-sorting criteria, consistent with current regulations, will need to be developed to identify soils that will require disposal at licensed landfill sites.

Based on the available subsurface information, groundwater aquifers will be intercepted by construction and it appears that groundwater conditions may present an issue for the Finch Avenue/Keele Street, York University, and Steeles Avenue stations. In the area of the proposed options, the aquifers (saturated granular deposits) typically consist primarily of fine sand and silt. The combined permeability, limited vertical thickness of the aquifers, and water pressures that may be encountered during construction may not result in the need to draw large quantities of groundwater from these aquifers (though MOE Permits to Take Water are still likely to be required). Where tunnelling may be completed by closed-face tunnel boring machines, the need for dewatering may also be minimized. If it becomes necessary to further limit the flows required from dewatering and their influence on the shallow aquifers at the site, the available information suggests that groundwater cut-off or minimization methods may be a practicable solution as relatively thick cohesive (aquitard) layers are likely to be present at and below the base of the excavations. The influence of construction dewatering on the local aquifers and surface water environments will be affected by the combination of design details, local geology, and any mitigation designs, and for these reasons additional subsurface information will be critical for design-level evaluations of dewatering issues and to develop documentation to complete the analyses and assessments for permits to take water. Management of extracted groundwater may include discharging to storm or sanitary sewers or to water courses. The potential volumes, environmental chemistry, and temperature of such discharges must be carefully assessed prior to construction to define the environmentally, technically, and economically suitable management method.

9.0 CLOSURE

This report was prepared to provide preliminary information related to geology, hydrogeology, and tunnel design engineering for assisting with selection of a preferred route for the proposed extension of the Spadina Subway. This report was based on data and project plan available at the time of its preparation. Consequently, additional information that may be found or developed in the future may have an influence on the conclusions presented herein. It is expected that this work will be updated periodically throughout the planning and design process as successively more detailed information becomes available.

GOLDER ASSOCIATES LTD.

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John Westland, P.Eng.
Principal

NK/BLT/SJB/ JW/blt
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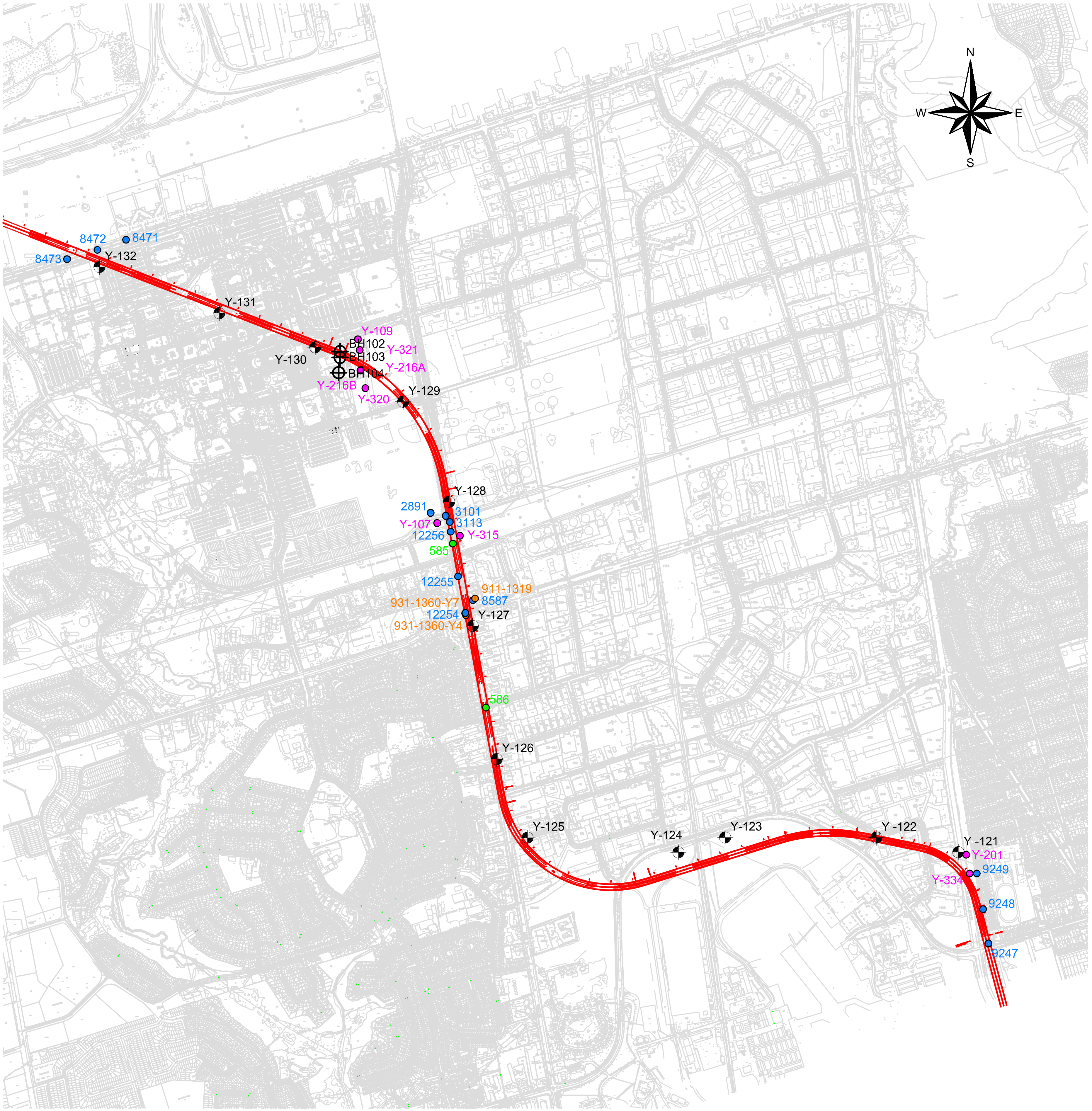

LEGEND:

- ⌖ BOREHOLE (GOLDER, 2005)
- ⊕ BOREHOLE (YORK UNIVERSITY) (SHAHEEN & PEAKER LIMITED)
- 🟢 BOREHOLE (GOLDER)
- 🔵 BOREHOLE (OTHERS)
- 🟣 BOREHOLE (TTC, 1993)

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SCALE 1:25000 METRES

NOTES:

1. PROJECTION IS MTM NAD27, ZONE 10

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PROJECT No. 04-1111-054
REV. B

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DATE DEC. 9, 2005
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TITLE

BOREHOLE LOCATION PLAN

SPADINA SUBWAY EXTENSION

DRAWING 1

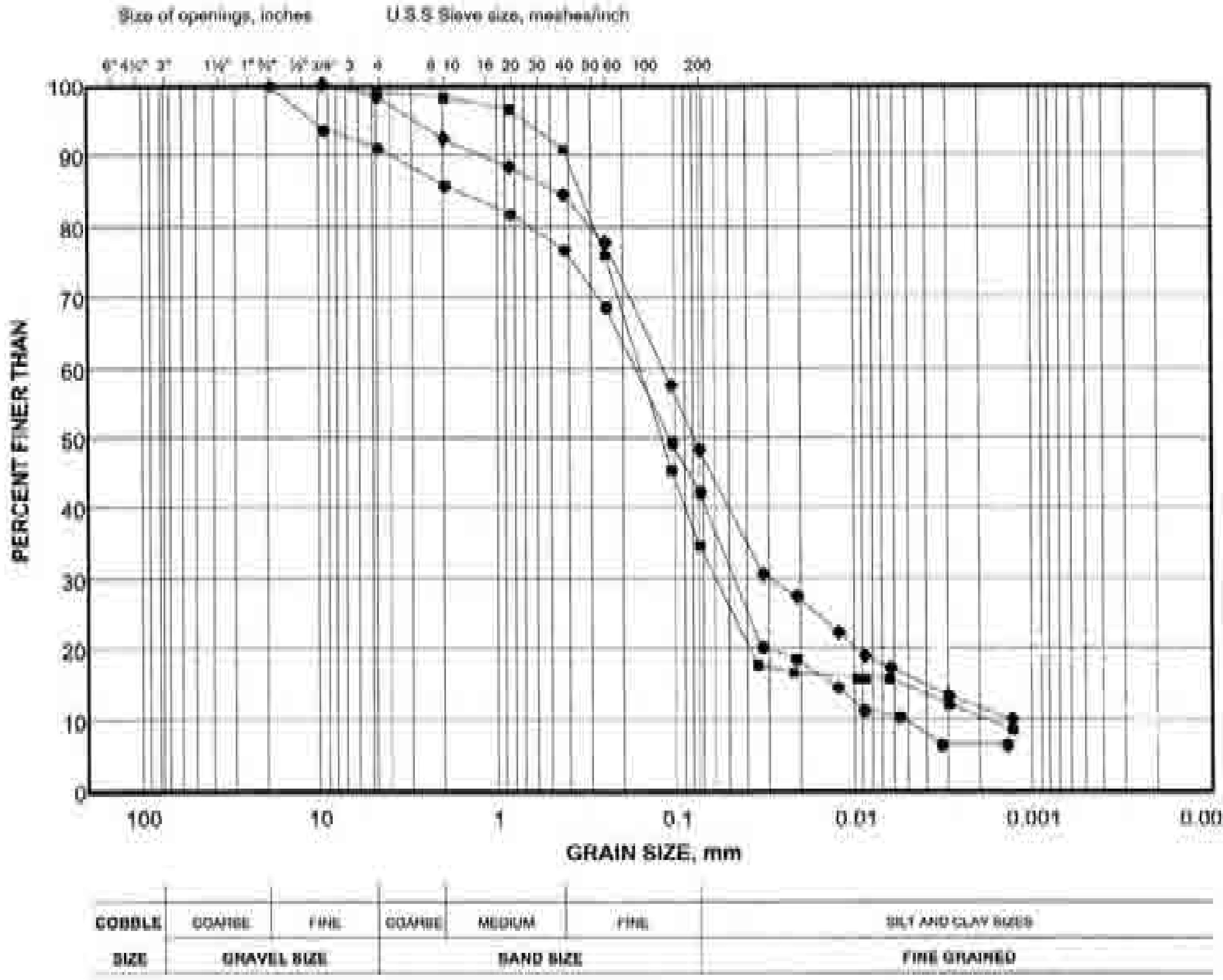
PLOT DATE: February 08, 2006
FILENAME: T:\Projects\2004\04-1111-054 (URS, North York)\-AB-Geotech Report\041111054AB001.dwg

Toronto Transit Commission

GRAIN SIZE DISTRIBUTION ENVELOPE

Sand to Silty Sand
(Type 5 and 6)

FIGURE 1



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-125	8	186.8
■	Y-132	8	192.8
◆	Y-131	8	193.6

Project Number: 04-1111-084

Checked By:

Golder Associates

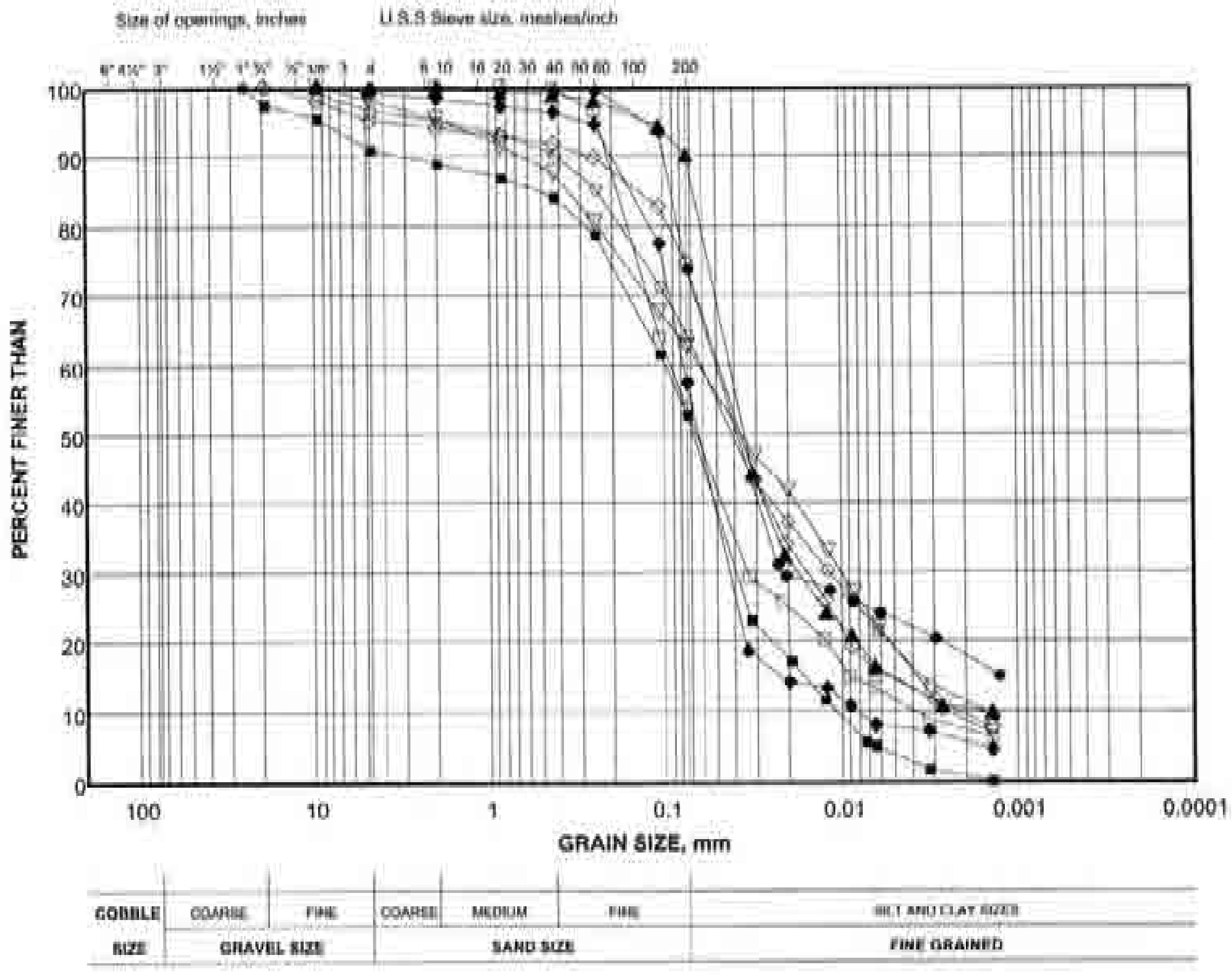
Date: 08-Dec-05

Toronto Transit Commission

GRAIN SIZE DISTRIBUTION ENVELOPE

Sandy Silt to Silt
(Type 7 and 8)

FIGURE 2A



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-121	13B	182.3
■	Y-126	6	190.2
◆	Y-126	11	182.5
▲	Y-123	10	184.3
▽	Y-124	9	185.7
○	Y-122	12	184.0
□	Y-122	17	176.4
◇	Y-124	12	181.5

Project Number: 04-1111-054

Checked By:

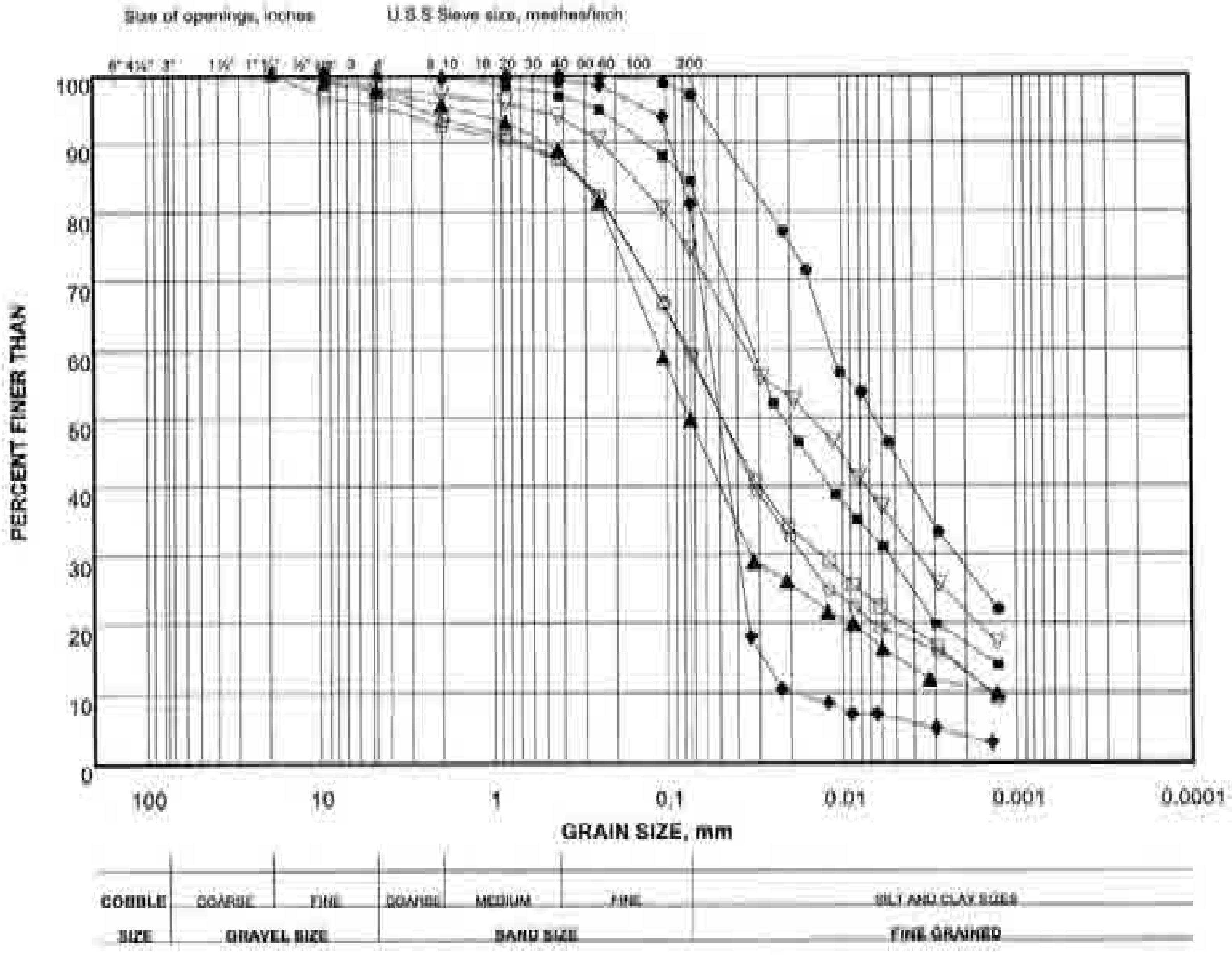
Golder Associates

Date: 09-Dec-05

Toronto Transit Commission

GRAIN SIZE DISTRIBUTION ENVELOPE
Sandy Silt to Silt
(Type 7 and 8)

FIGURE 2B



LEGEND

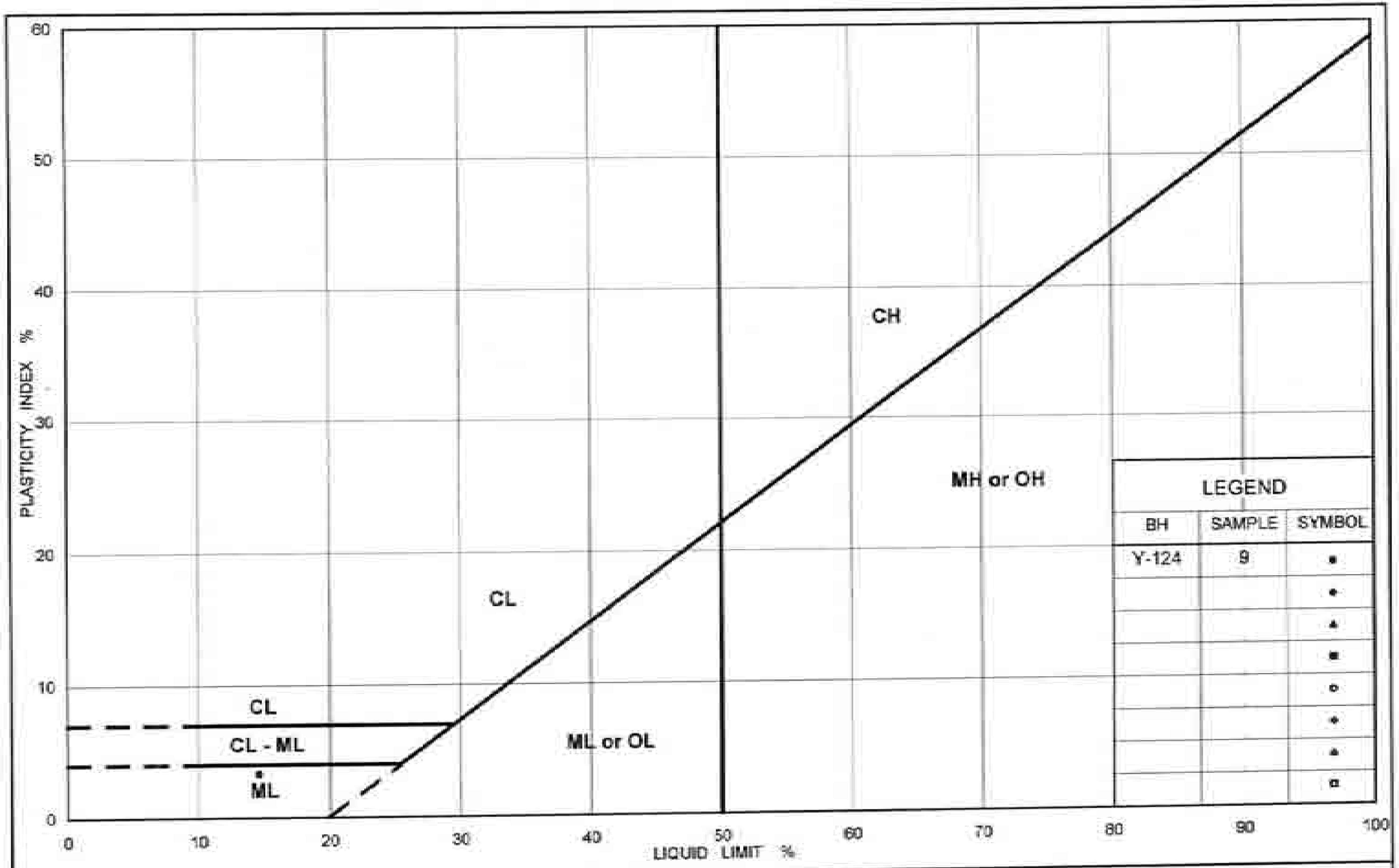
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-128	8	189.5
■	Y-129	11	185.7
◆	Y-130	14	182.8
▲	Y-131	13	186.1
▽	Y-129	8	190.3
○	Y-131	11	188.9
□	Y-130	9	190.3

Project Number: 04-1111-054

Checked By:

Golder Associates

Date: 08-Dec-05



Golder Associates

Toronto Transit Commission

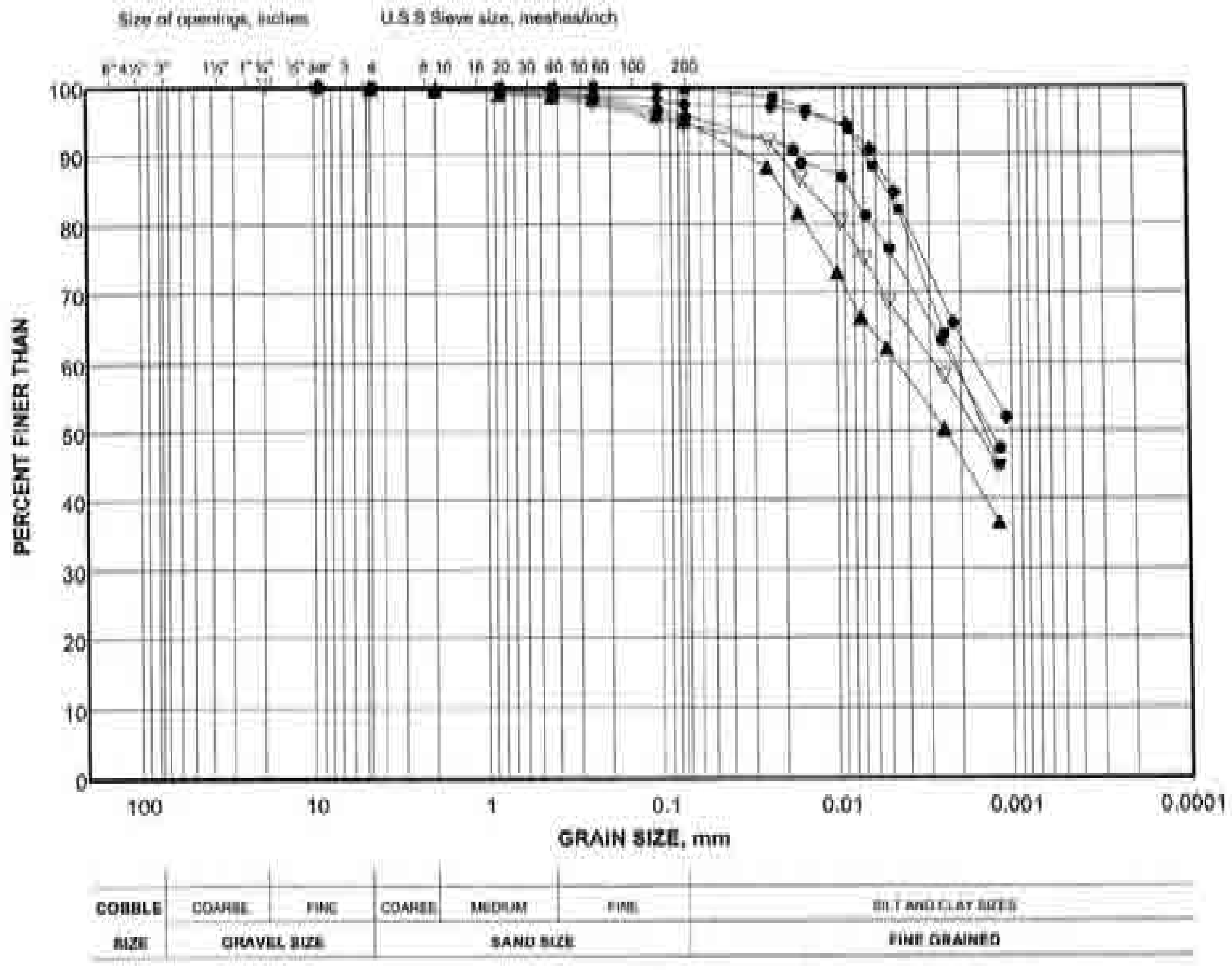
PLASTICITY CHART
Sandy Silt to Silt
(Type 7 and 8)

FIG No. 3
Project No. 04-1111-054

Toronto Transit Commission

GRAIN SIZE DISTRIBUTION ENVELOPE
Clayey Silt to Silty Clay
(Type 9 and 10)

FIGURE 4



LEGEND

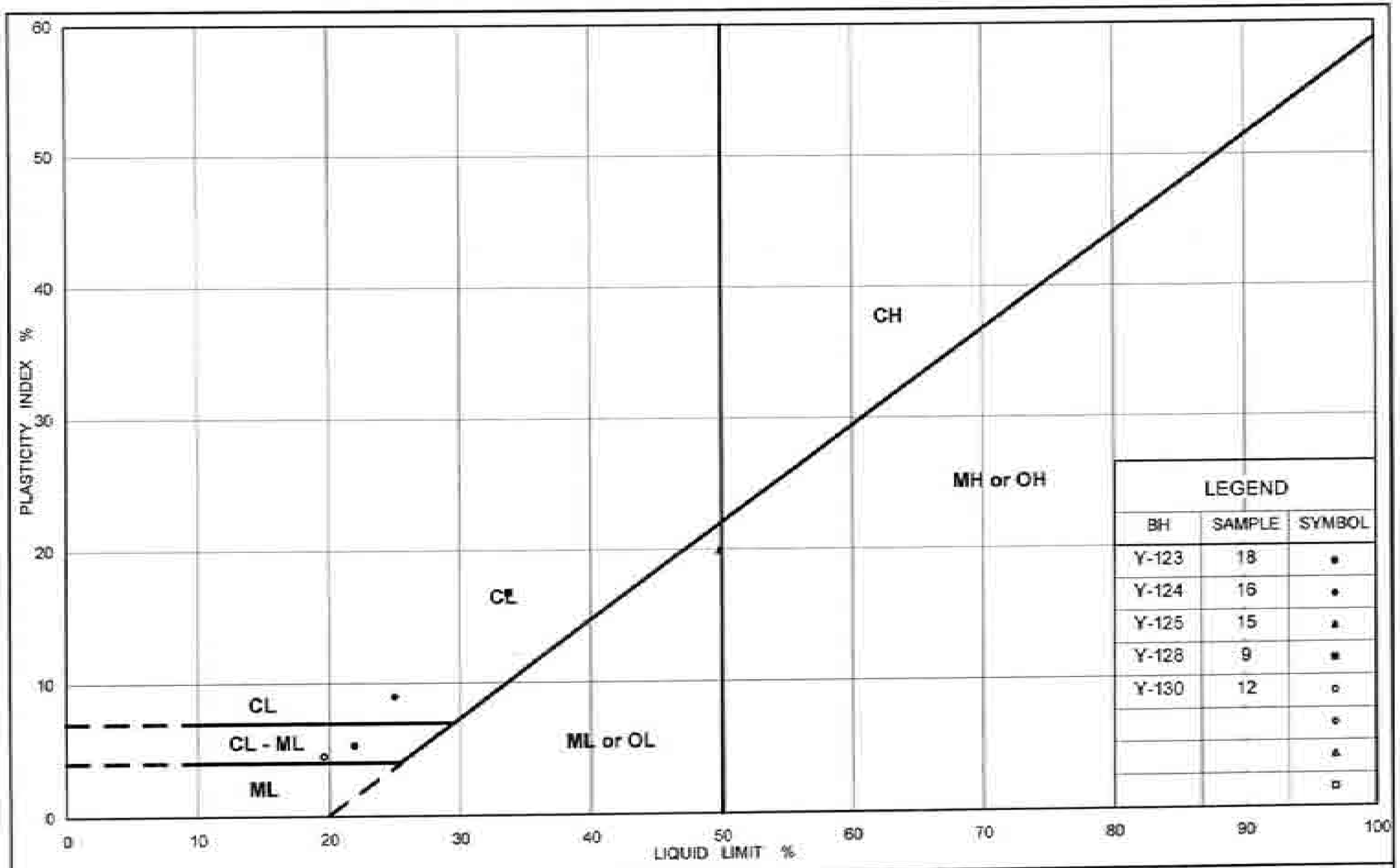
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-125	14	177.6
■	Y-129	14	181.1
◆	Y-123	13	179.8
▲	Y-132	11	188.2
▽	Y-128	11	184.8

Project Number: 04-1111-054

Checked By: ______________

Golder Associates

Date: 08-Dec-06



Golder Associates

Toronto Transit Commission

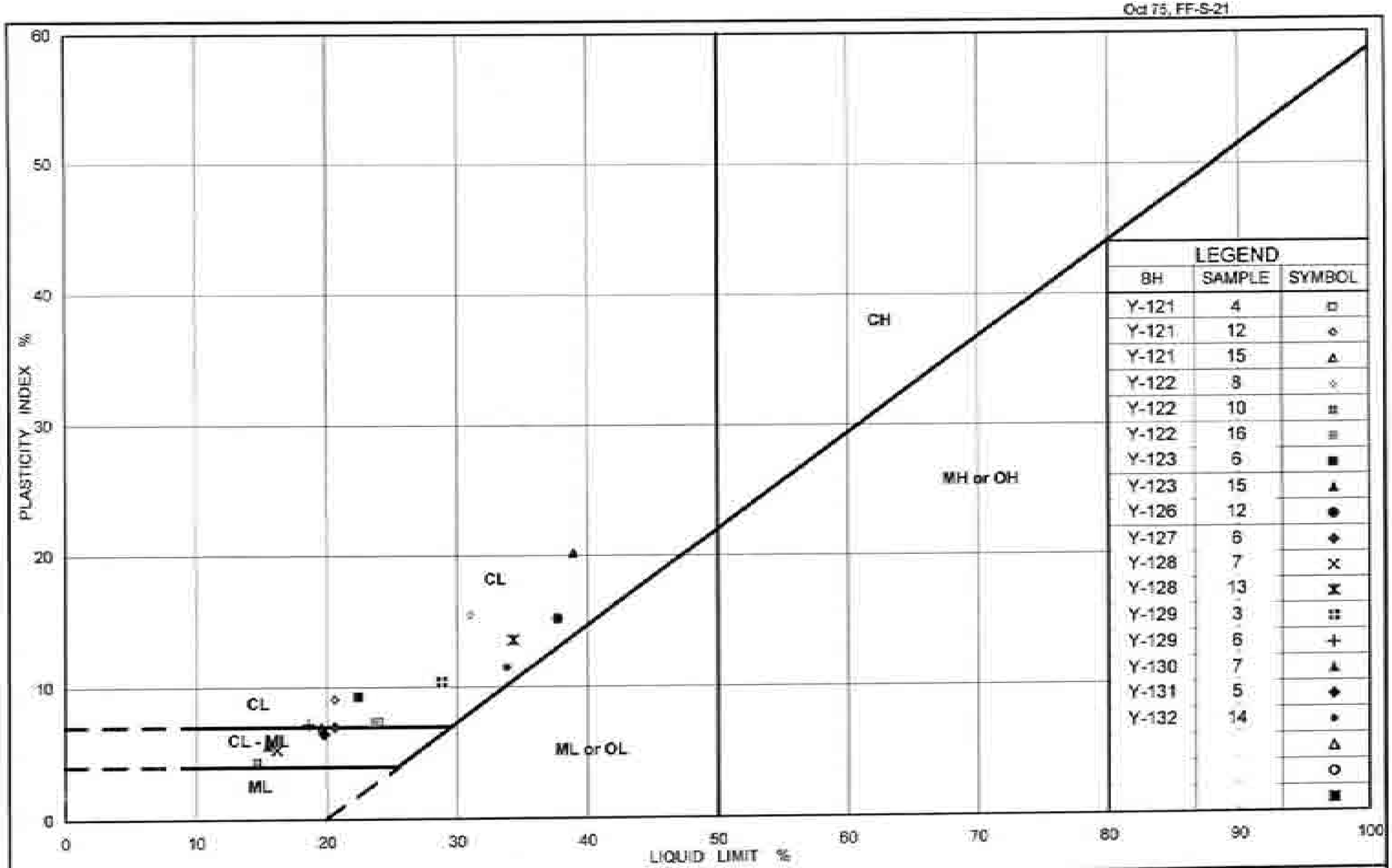
PLASTICITY CHART

Clayey Silt to Silty Clay
(Type 9 and 10)

FIG No. 5

Project No. 04-1111-054

Oct 75, FF-S-21



Golder Associates

Toronto Transit Commission

PLASTICITY CHART

Silty Clay to Clayey Silt Till
(Type 11)

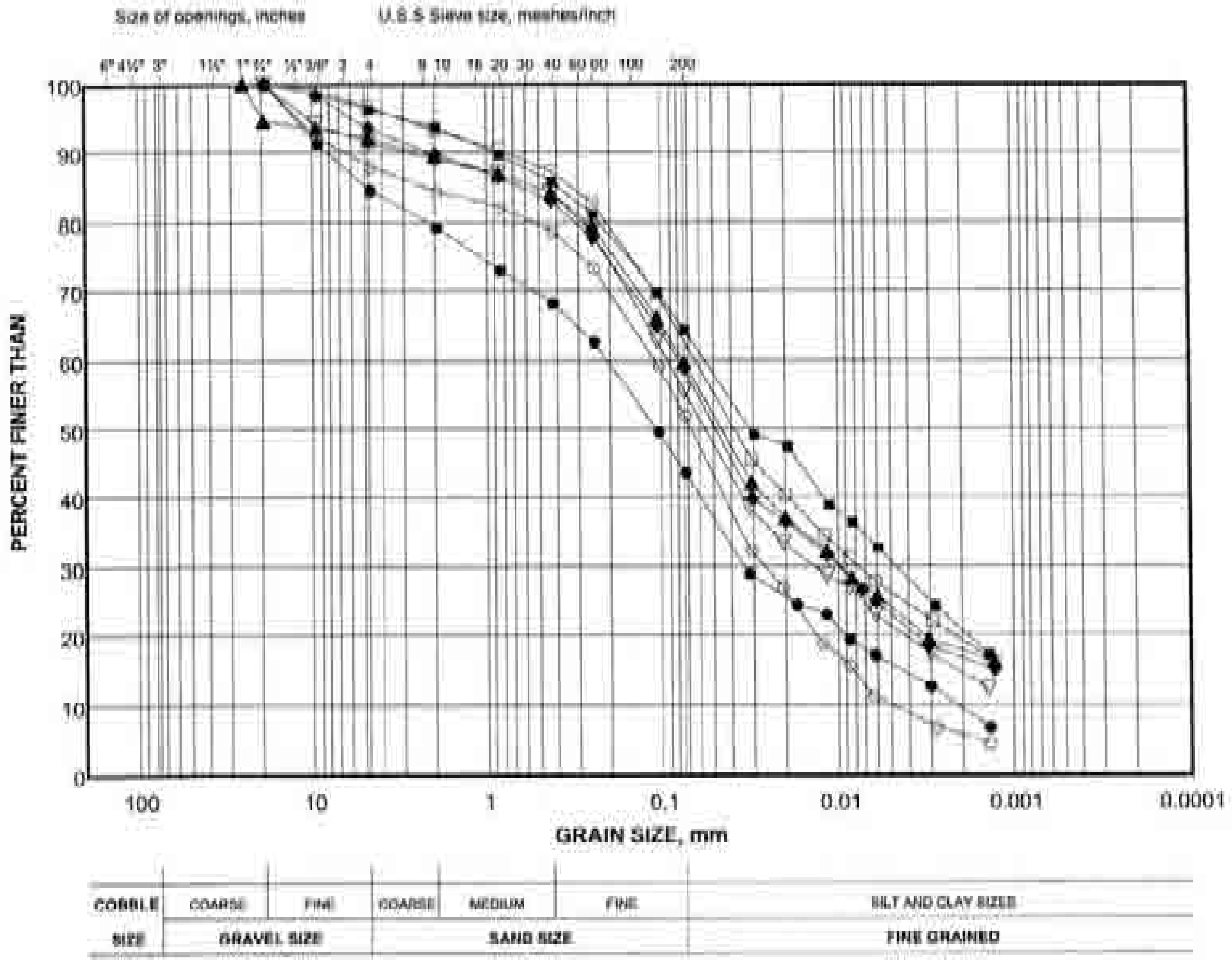
FIG No. 6

Project No. 04-1111-054

Toronto Transit Commission

GRAIN SIZE DISTRIBUTION ENVELOPE
Sandy Silt to Sand and Silt Till
(Type 12)

FIGURE 7



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-121	10	187.2
■	Y-127	4	194.4
◆	Y-127	8	189.9
▲	Y-130	6	194.9
▽	Y-132	5	196.6
○	Y-124	6	190.5
□	Y-129	5	194.0

Project Number: 04-1111-054

Checked By: ____

Golder Associates

Date: 09-Dec-05

BOREHOLE MATERIAL SYMBOLS (AS PER TTC STANDARDS):

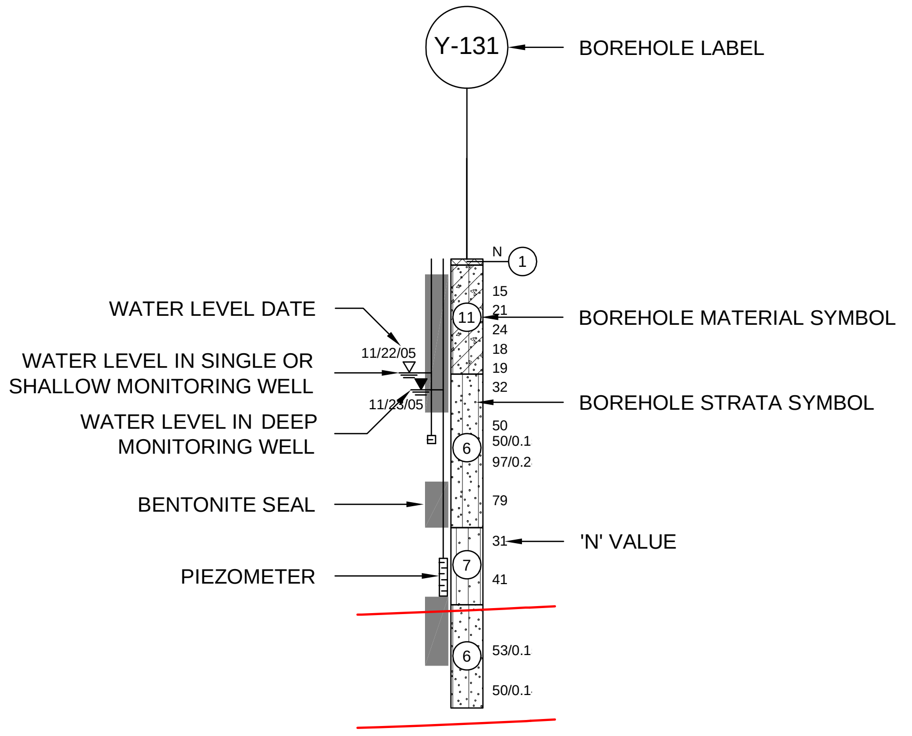
- ① FILL
- ② ORGANICS
- ③ GRAVEL
- ④ SAND & GRAVEL AND GRAVELLY SAND
- ⑤ SAND
- ⑥ SILTY SAND
- ⑦ SANDY SILT/ SAND AND SILT
- ⑧ SILT
- ⑨ CLAYEY SILT
- ⑩ CLAY/SILTY CLAY
- ⑪ SILTY CLAY TILL / CLAYEY SILT TILL
- ⑫ SANDY SILT/SILTY SAND/ SAND AND SILT TILL

GENERAL LEGEND:

- – – – – INTERPRETED MAJOR DEPOSIT BOUNDARY
- – – – – INTERPRETED PIEZOMETRIC LEVEL
- Y-13 Y-SERIES BOREHOLE BY TTC
- BH10 BH-SERIES BOREHOLE BY SHAHEEN & PEAKER (YORK UNIVERSITY)
- 8473 ALL OTHERS FROM CITY OF TORONTO DATABASE

NOTES:

1. CONTINUITY AND CONSISTENCY OF STRATIGRAPHIC BOUNDARIES ARE A FUNCTION OF LIMITED SITE SPECIFIC DATA AND SIMPLIFICATIONS ARISING FROM GEOLOGIC MODELLING.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE ENVIRONMENTAL ASSESSMENT TITLED, "SPADINA SUBWAY EXTENSION", PROJECT 04-1111-054, DATED DECEMBER 2005.
3. BOREHOLE DIAMETERS IN PLAN AND PROFILE ARE NOT TO SCALE.



REFERENCES:

1. ALIGNMENT PROFILE PROVIDED BY URS. THE PROFILES ARE APPROXIMATE AND ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY.

Golder Associates
Mississauga, Ontario, Canada

SCALE	AS SHOWN
DATE	JAN. 24, 2006
DESIGN	
CAD	MSM
CHECK	BLT
REVIEW	SJB

FILE No. 041111054AB002A.dwg
PROJECT No. 04-1111-054 REV. B

TITLE
STRATIGRAPHIC PROFILE CHAINAGE 0+000 - 6+349 ALIGNMENT SB2-N3

SPADINA SUBWAY EXTENSION

FIGURE 2A

PLOT DATE: February 09, 2006
FILENAME: T:\Projects\2004\04-1111-054 (URS, North York)\-AC-Geotech Report\041111054AB002A.dwg

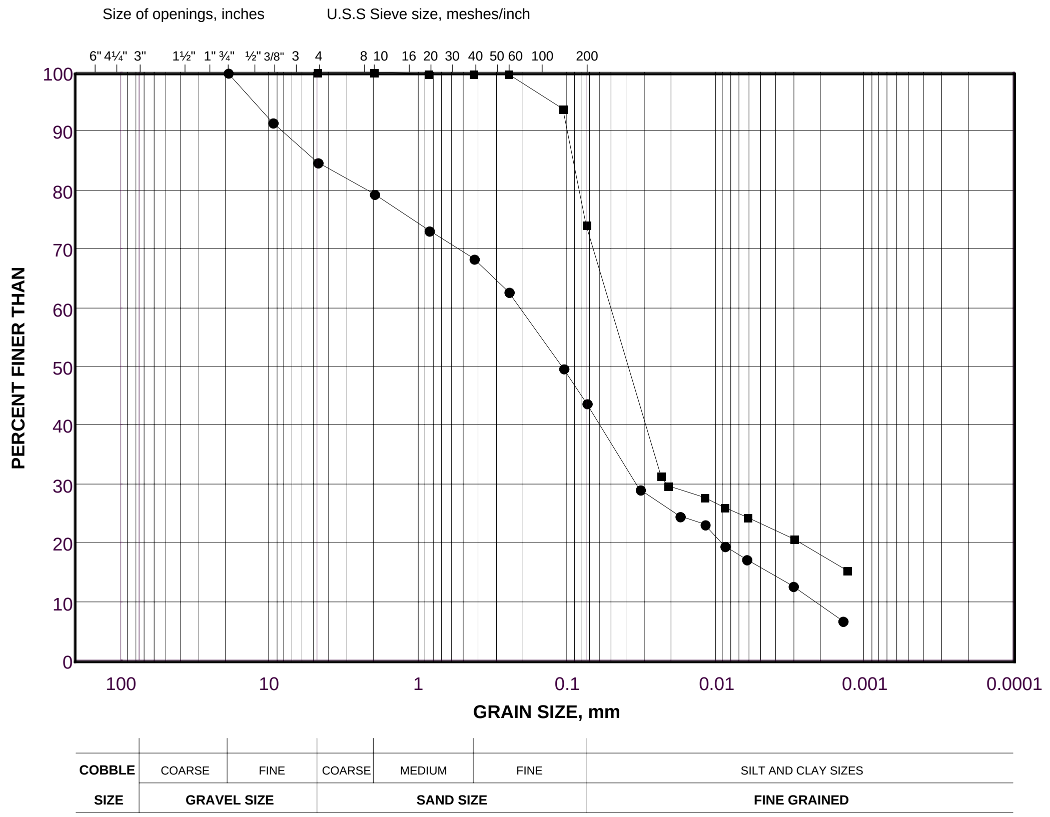
APPENDIX A

LABORATORY TEST RESULTS
(BOREHOLES Y-121 TO Y-132)

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-121

FIGURE A-1



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-121	10	187.2
■	Y-121	13B	182.3

Project Number: 04-1111-054

Checked By: ____________________

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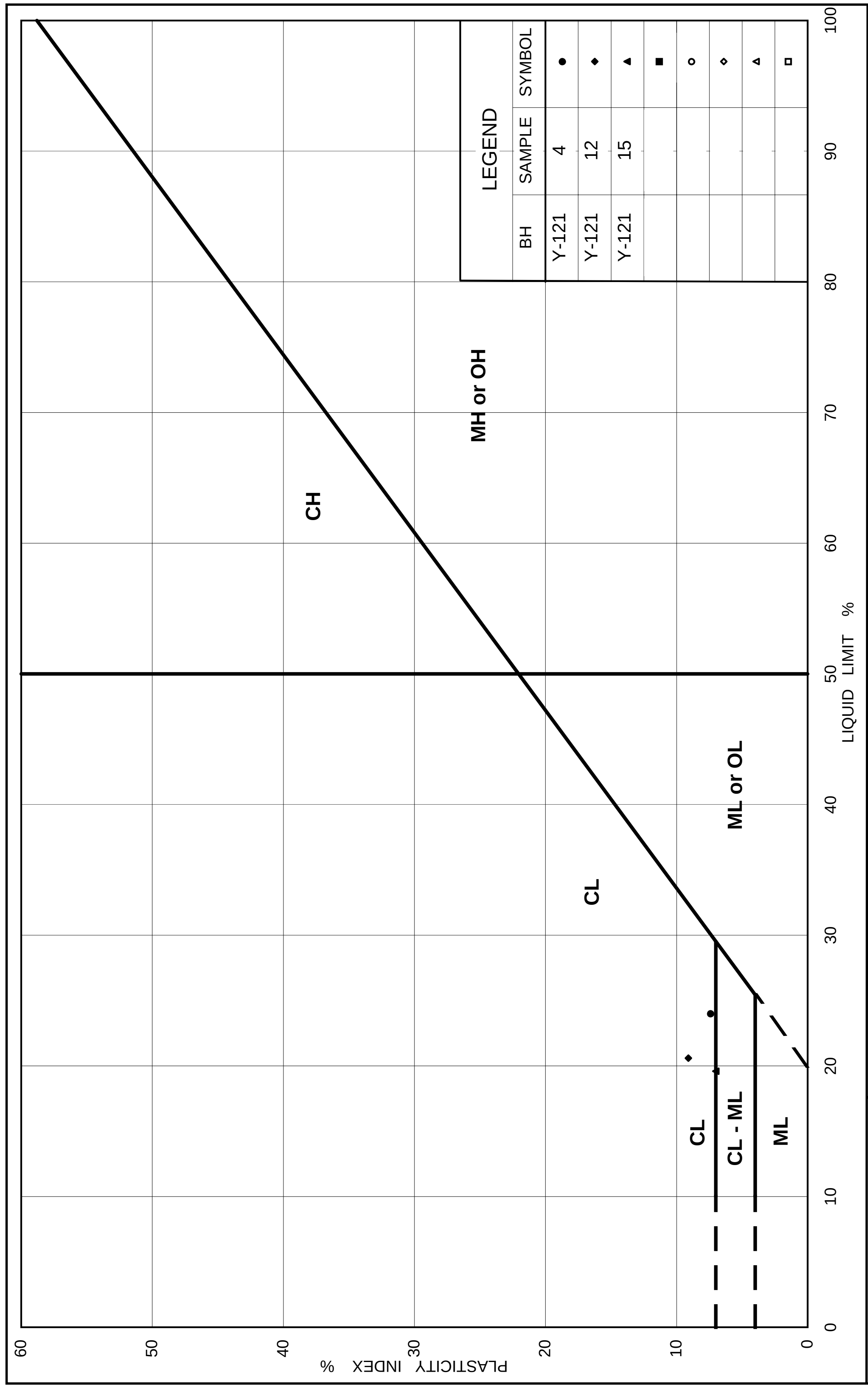
Date: 09-Dec-05



LEGEND

BH	SAMPLE	SYMBOL
Y-121	4	●
Y-121	12	◆
Y-121	15	▲
		■
		○
		◇
		△
		□

PLASTICITY CHART

Borehole Y-121

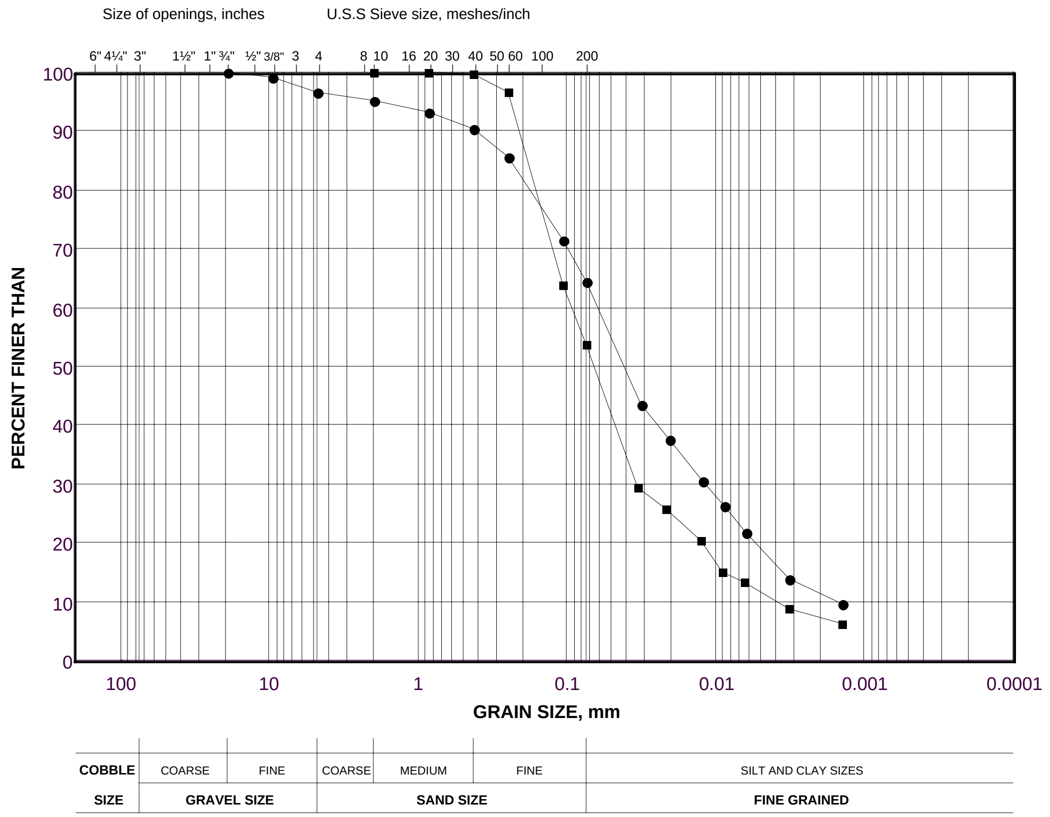
FIG No. A-2

Project No. 04-1111-054

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-122

FIGURE A-3



LEGEND

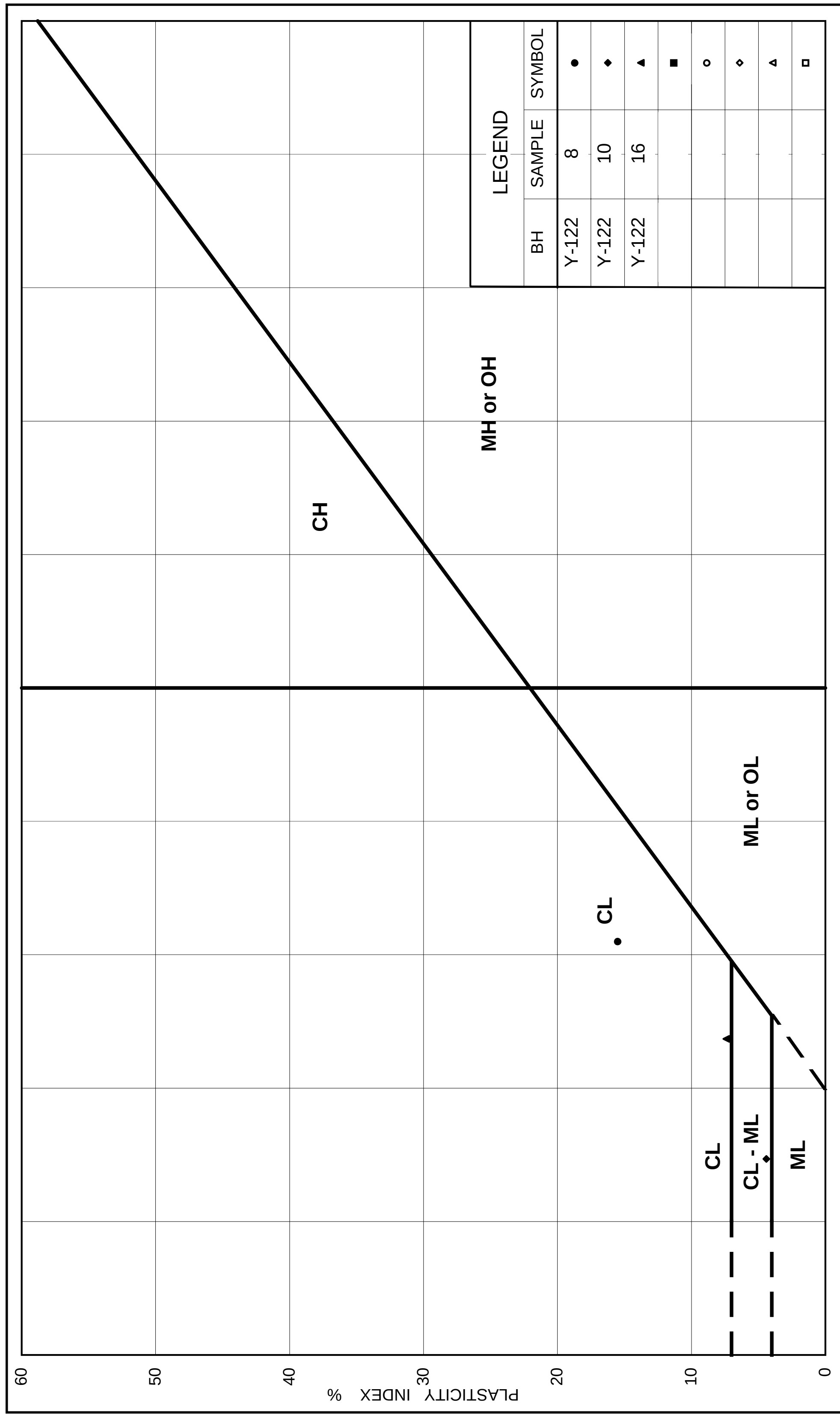
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-122	12	184.0
■	Y-122	17	176.4

Project Number: 04-1111-054

Checked By: ______________

Golder Associates

Date: 09-Dec-05



LEGEND

BH	SAMPLE	SYMBOL
Y-122	8	●
Y-122	10	◆
Y-122	16	▲
		■
		○
		◇
		△
		□

FIG No. A-4

Project No. 04-1111-054

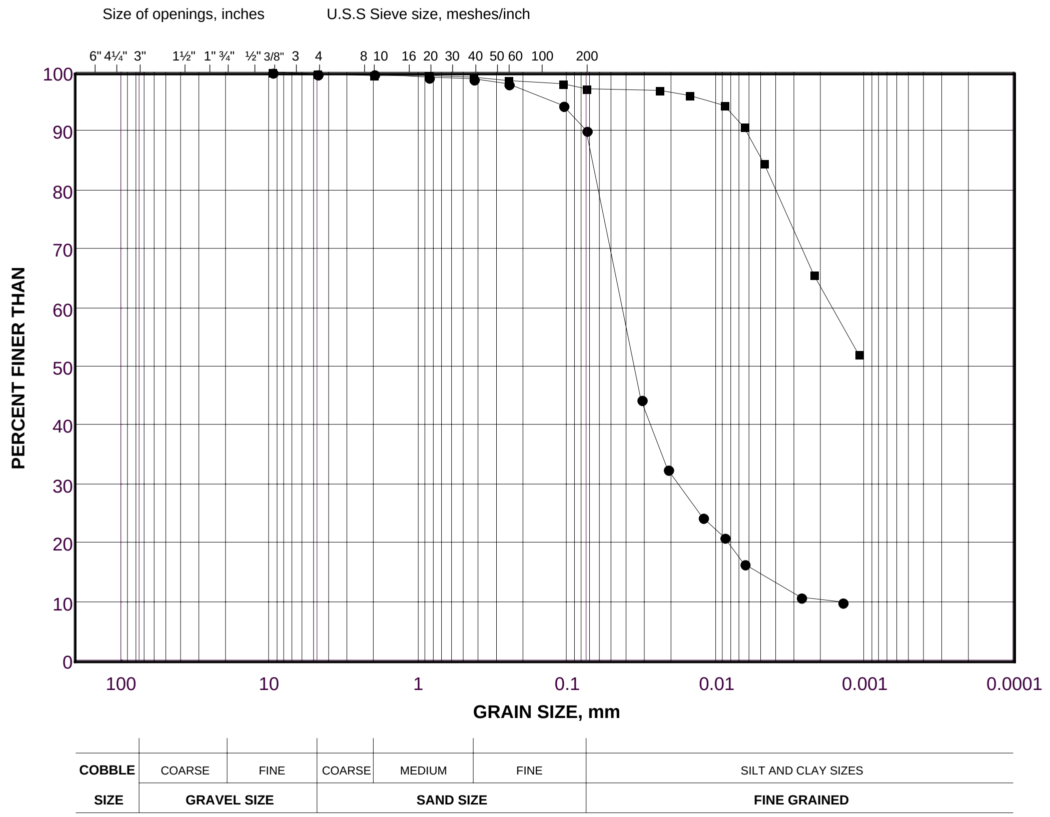
PLASTICITY CHART

Borehole Y-122

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-123

FIGURE A-5



LEGEND

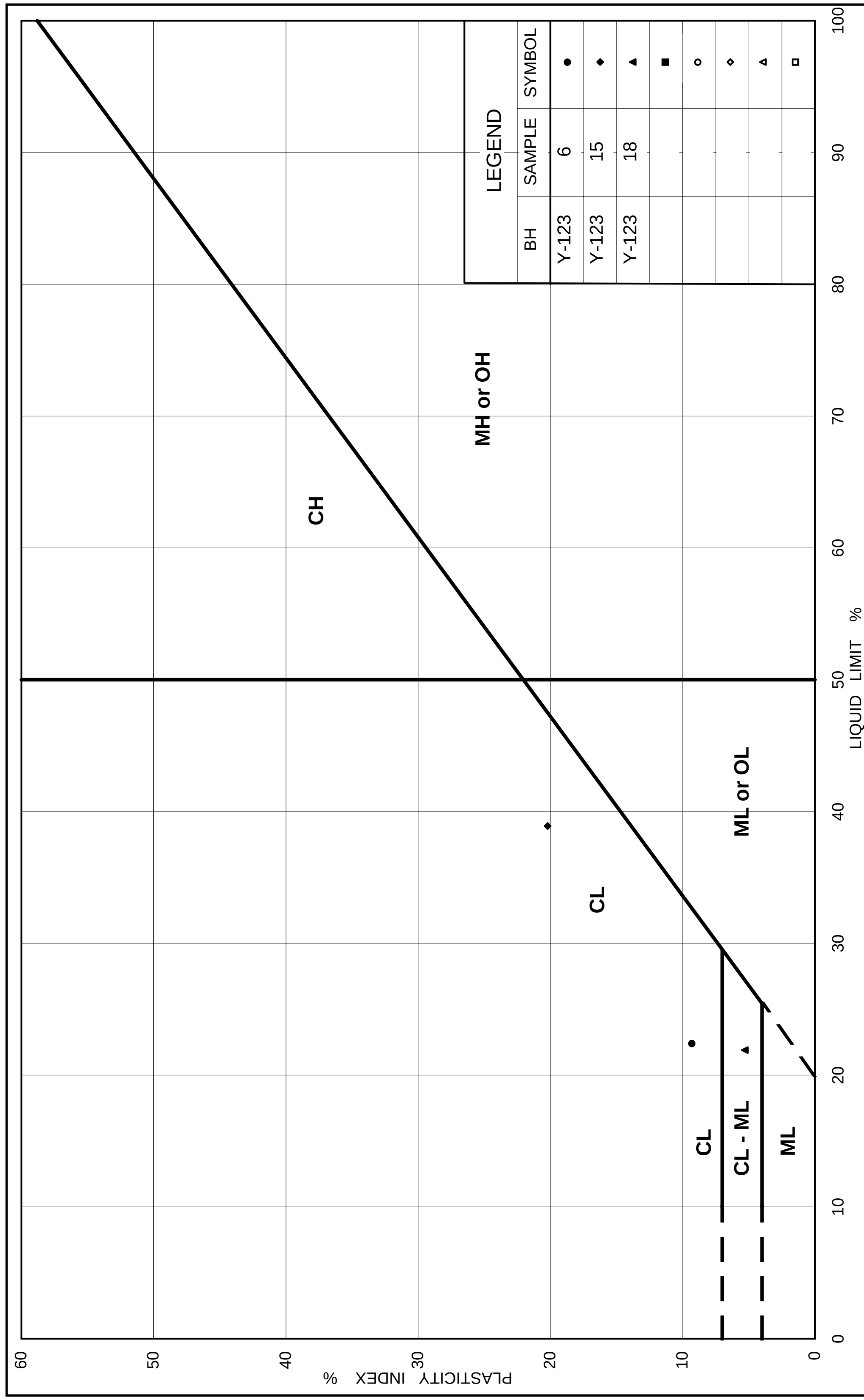
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-123	10	184.3
■	Y-123	13	179.8

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05



LEGEND

BH	SAMPLE	SYMBOL
Y-123	6	●
Y-123	15	◆
Y-123	18	▲
		■
		○
		◇
		△
		□

FIG No. A-6

Project No. 04-1111-054

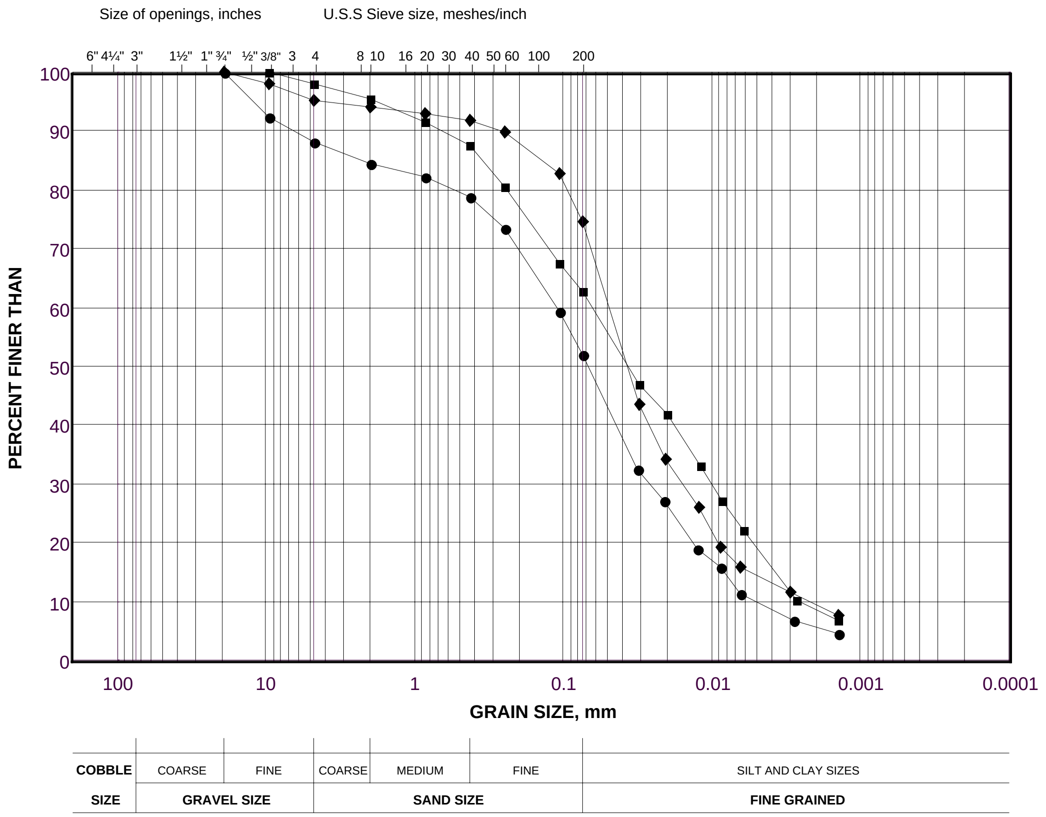
PLASTICITY CHART

Borehole Y-123

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-124

FIGURE A-7



LEGEND

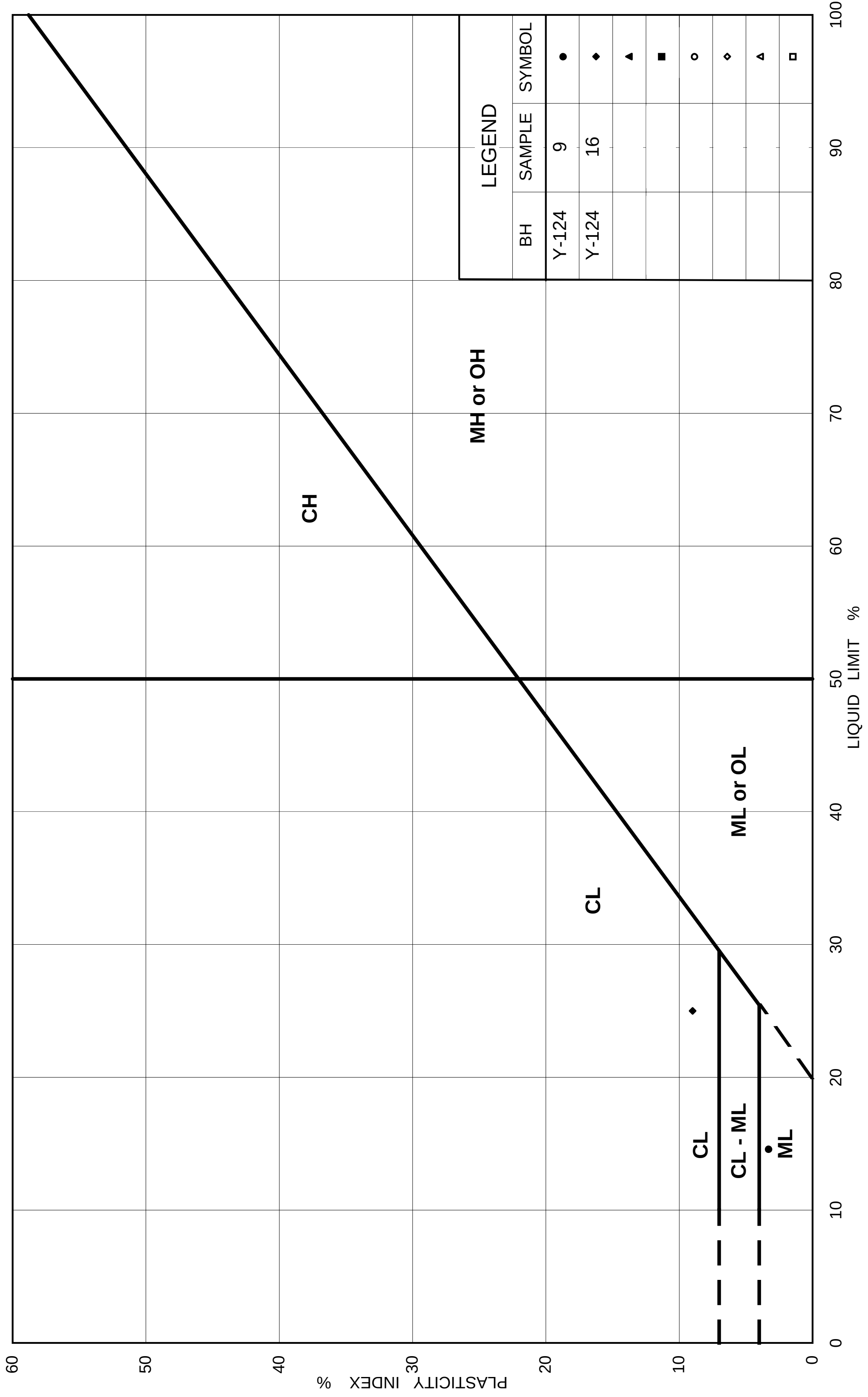
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-124	6	190.5
■	Y-124	9	185.7
◆	Y-124	12	181.5

Project Number: 04-1111-054

Checked By: ____________

Golder Associates

Date: 09-Dec-05



LEGEND

BH	SAMPLE	SYMBOL
Y-124	9	●
Y-124	16	◆
		▲
		■
		○
		◇
		△
		□

PLASTICITY CHART

Borehole Y-124

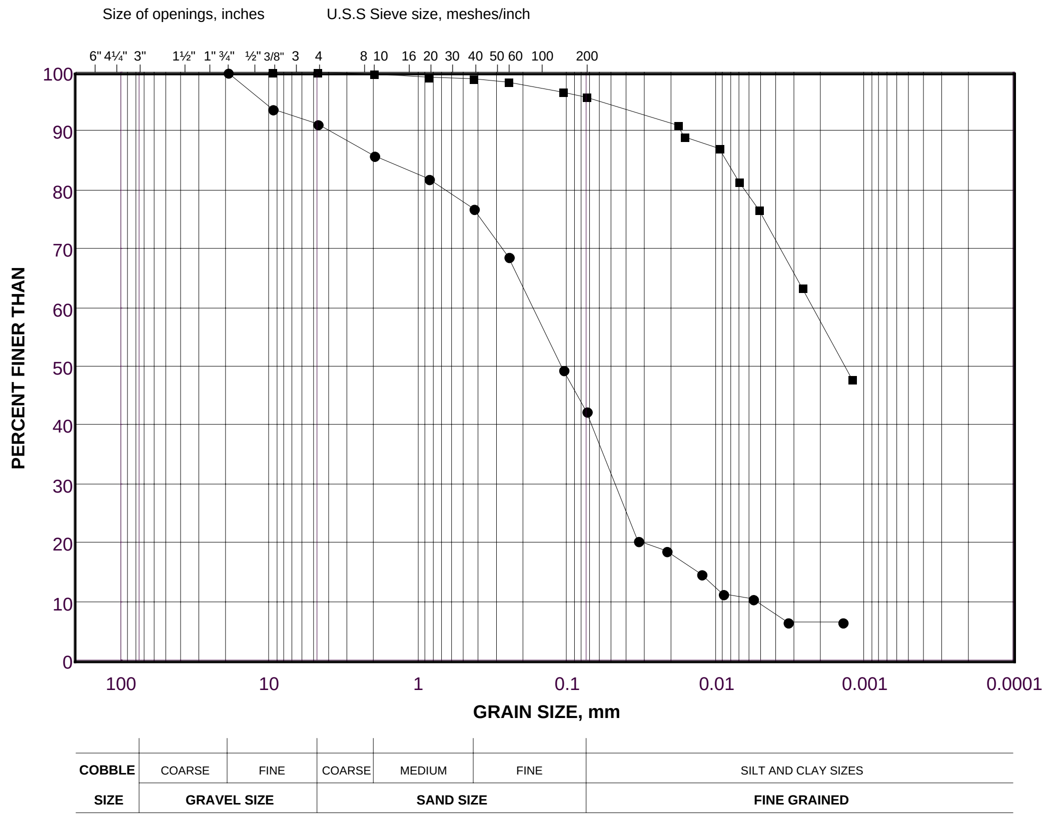
FIG No. A-8

Project No. 04-1111-054

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-125

FIGURE A-9



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-125	8	186.8
■	Y-125	14	177.6

Project Number: 04-1111-054

Checked By: ______________________

Golder Associates

Date: 09-Dec-05

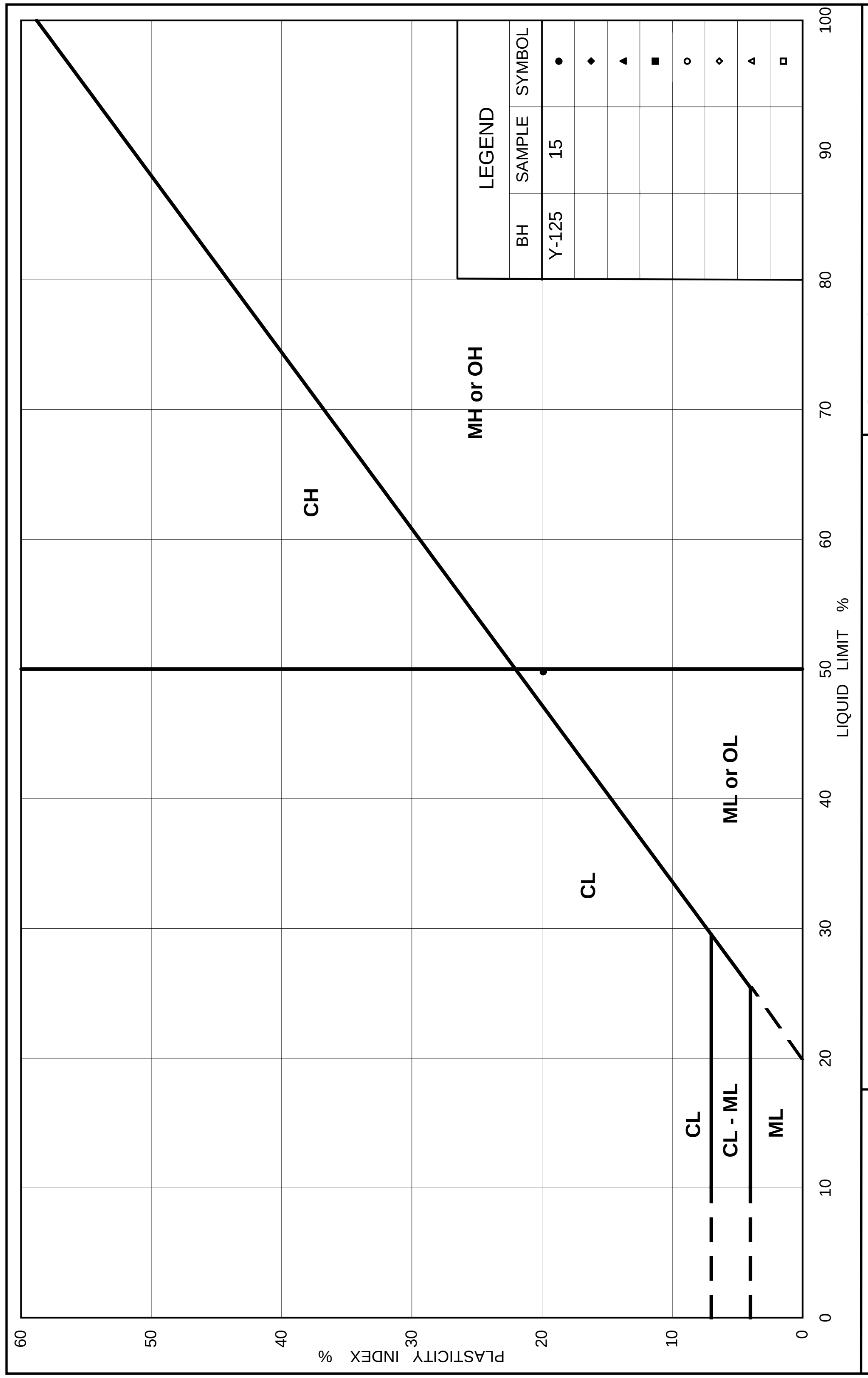


FIG No. A-10

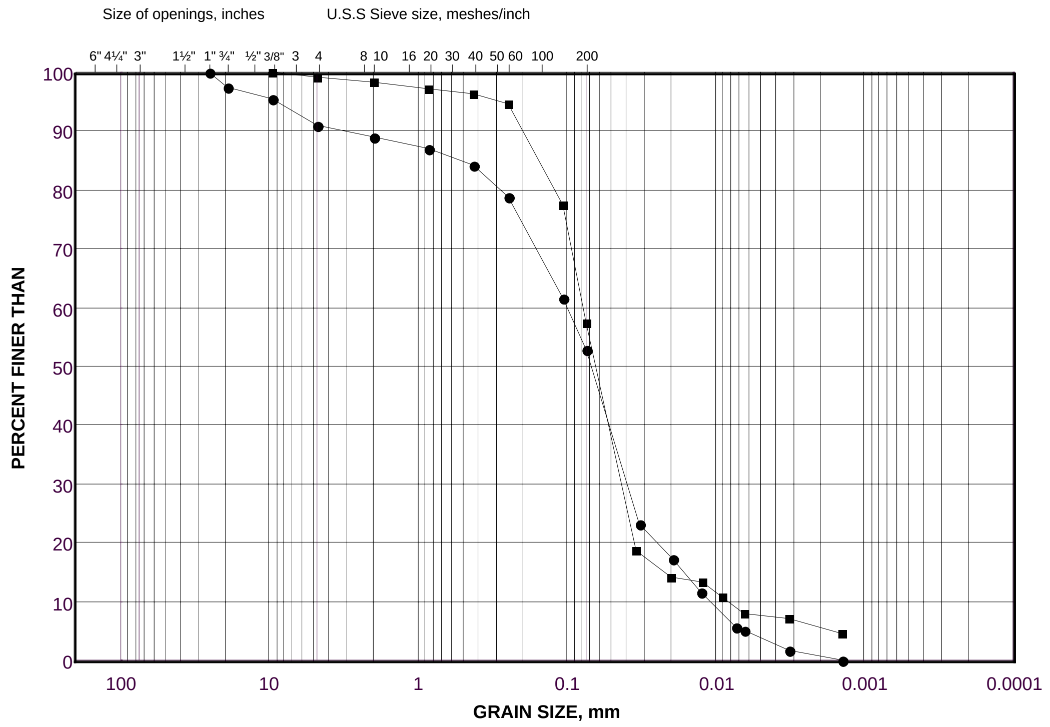
Project No. 04-1111-054

PLASTICITY CHART

Borehole Y-125

GRAIN SIZE DISTRIBUTION TEST RESULTS
Borehole Y-126

FIGURE A-11



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

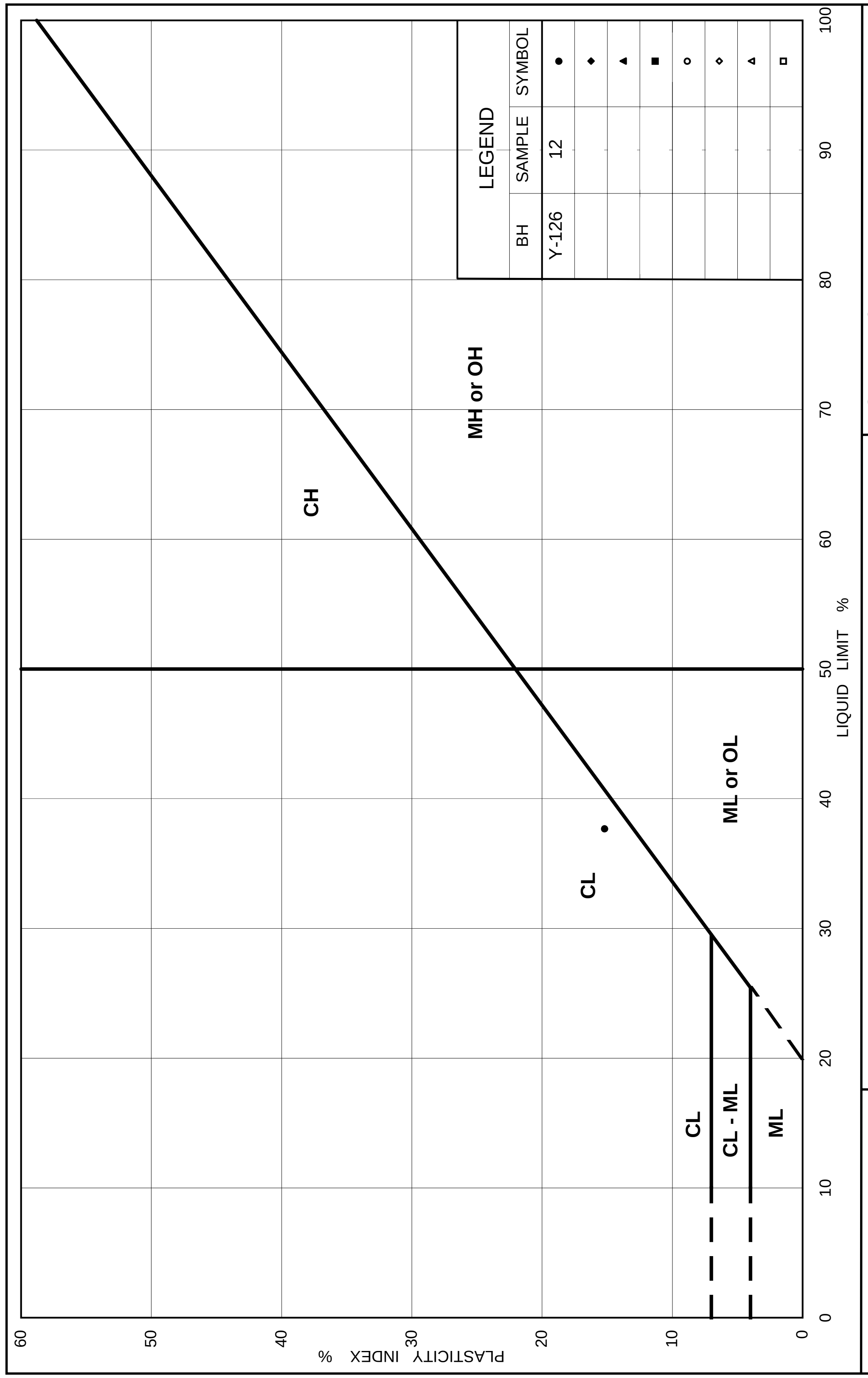
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-126	6	190.2
■	Y-126	11	182.5

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05



LEGEND

BH	SAMPLE	SYMBOL
Y-126	12	●

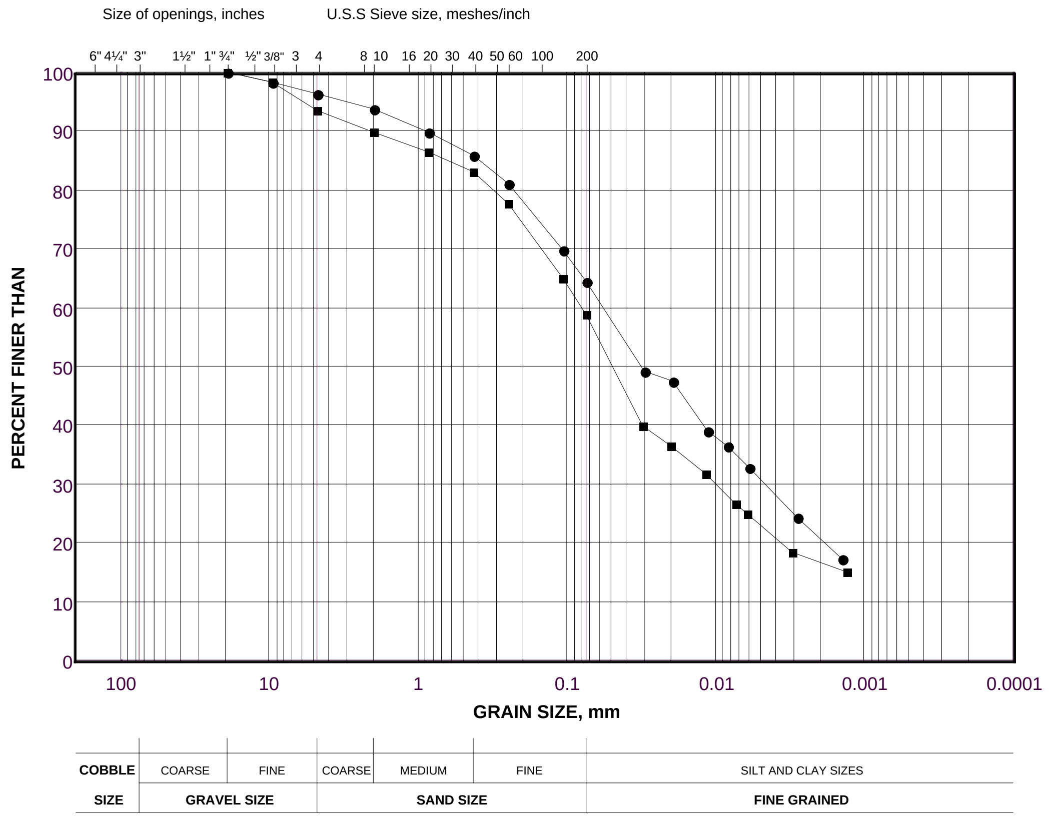
PLASTICITY CHART
Borehole Y-126

FIG No. A-12

Project No. 04-1111-054

GRAIN SIZE DISTRIBUTION TEST RESULTS
Borehole Y-127

FIGURE A-13



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-127	4	194.4
■	Y-127	8	189.9

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05

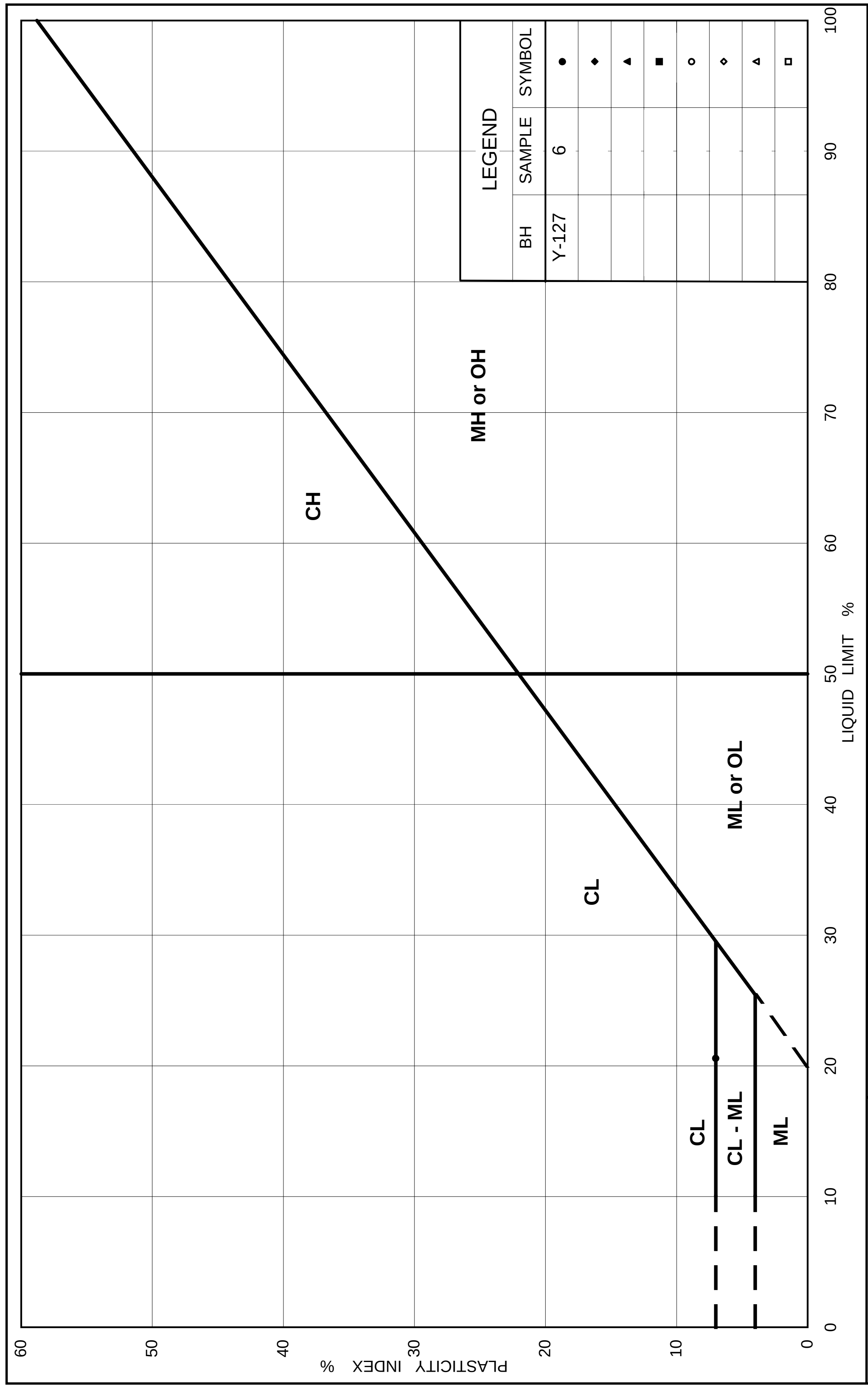


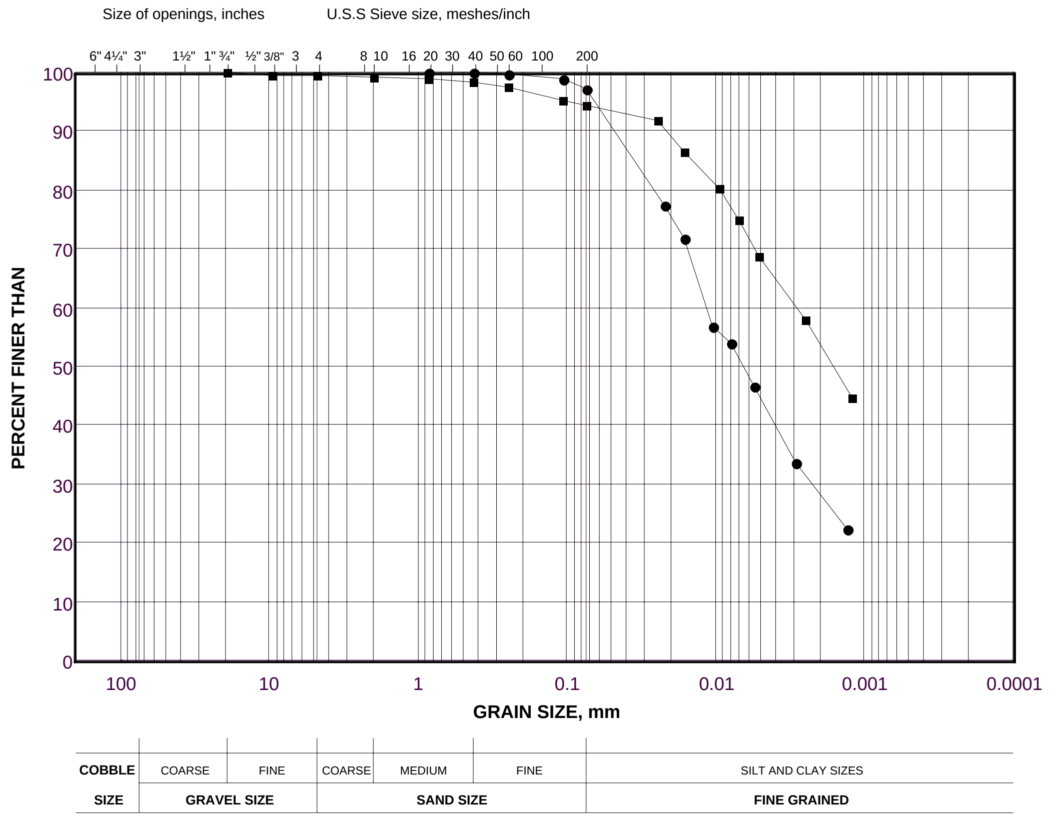
FIG No. A-14
Project No. 04-1111-054

PLASTICITY CHART
Borehole Y-127

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-128

FIGURE A-15



LEGEND

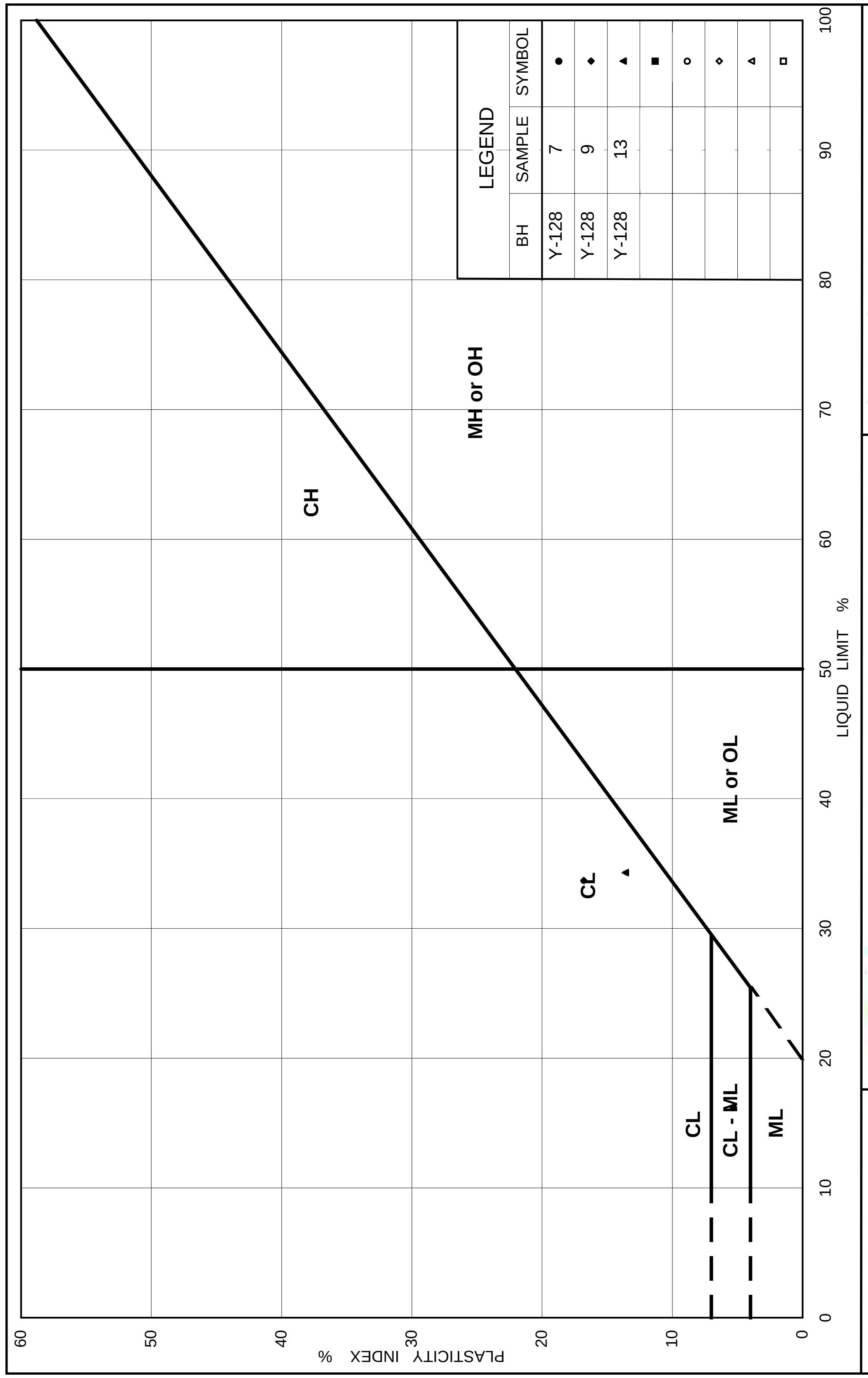
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-128	8	189.5
■	Y-128	11	184.8

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05



LEGEND

BH	SAMPLE	SYMBOL
Y-128	7	●
Y-128	9	◆
Y-128	13	▲
		■
		○
		◇
		△
		□

PLASTICITY CHART

Borehole Y-128

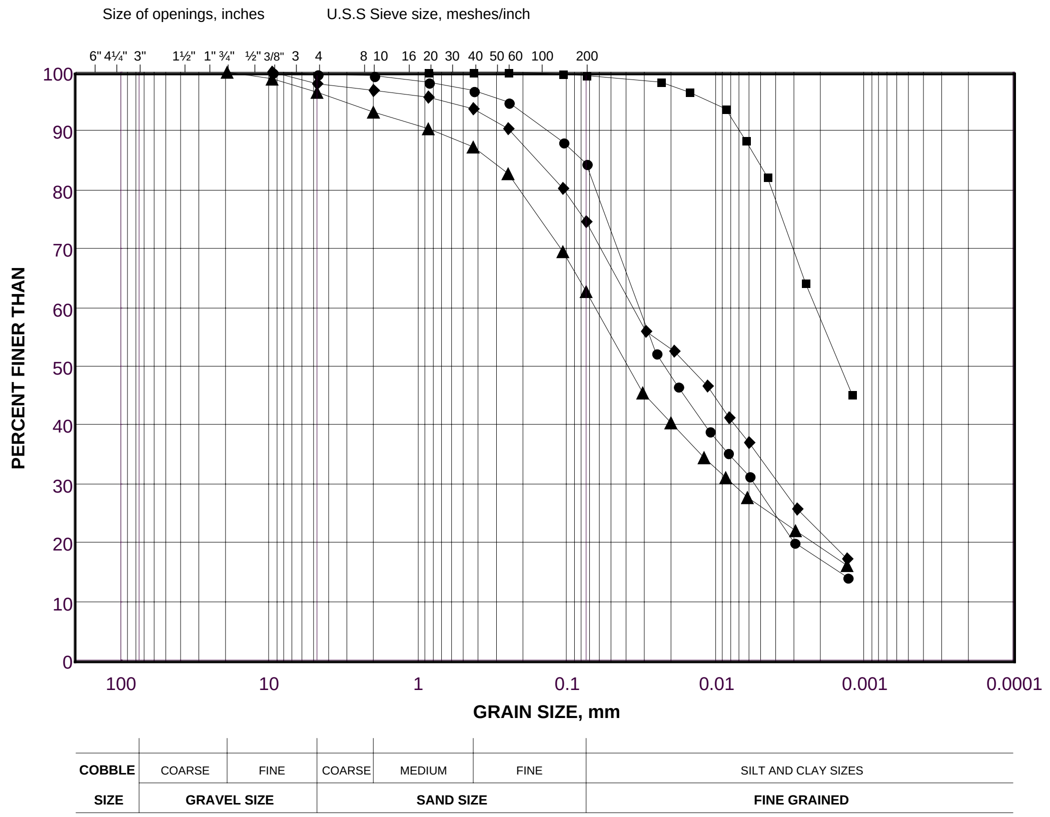
FIG No. A-16

Project No. 04-1111-054

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-129

FIGURE A-17



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-129	11	185.7
■	Y-129	14	181.1
◆	Y-129	8	190.3
▲	Y-129	5	194.0

Project Number: 04-1111-054

Checked By: ________________

Golder Associates

Date: 09-Dec-05

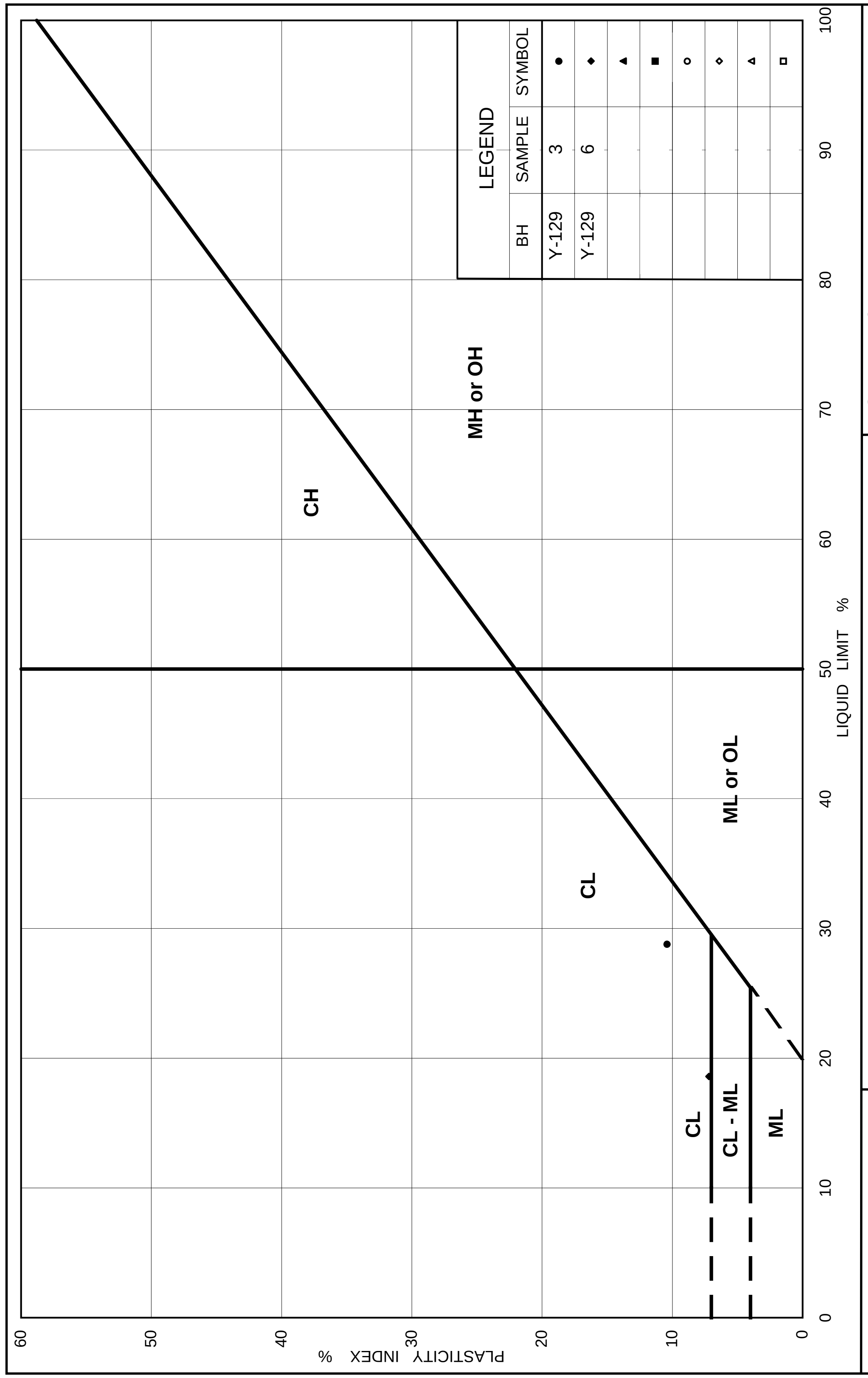


FIG No. A-18

Project No. 04-1111-054

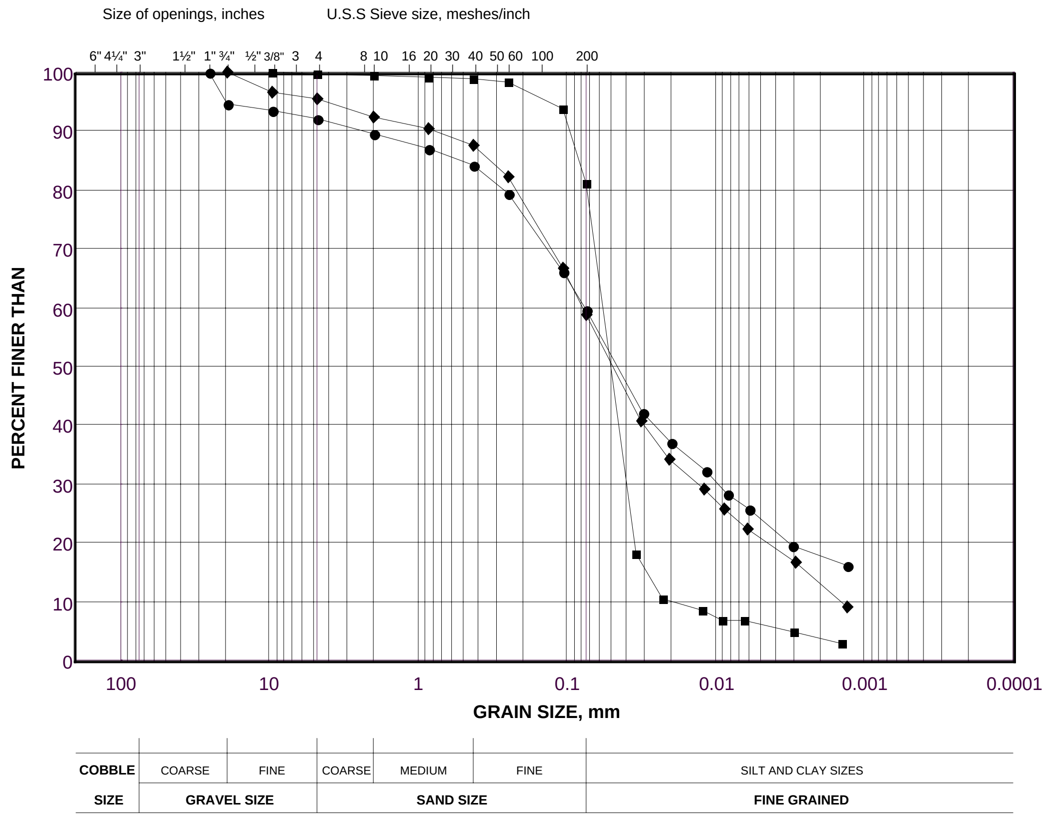
PLASTICITY CHART

Borehole Y-129

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-130

FIGURE A-19



LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-130	6	194.9
■	Y-130	14	182.8
◆	Y-130	9	190.3

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05

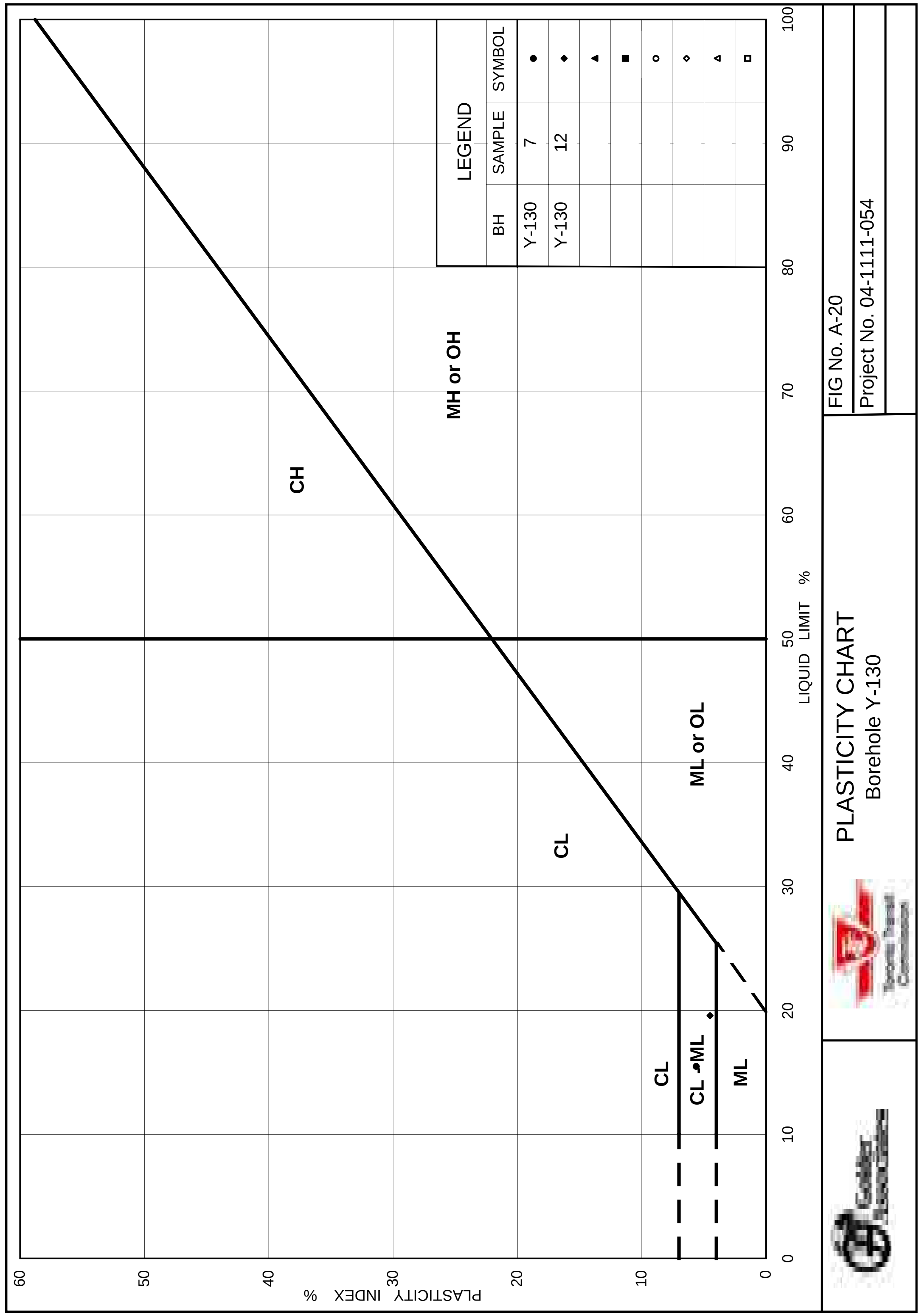


FIG No. A-20

Project No. 04-1111-054

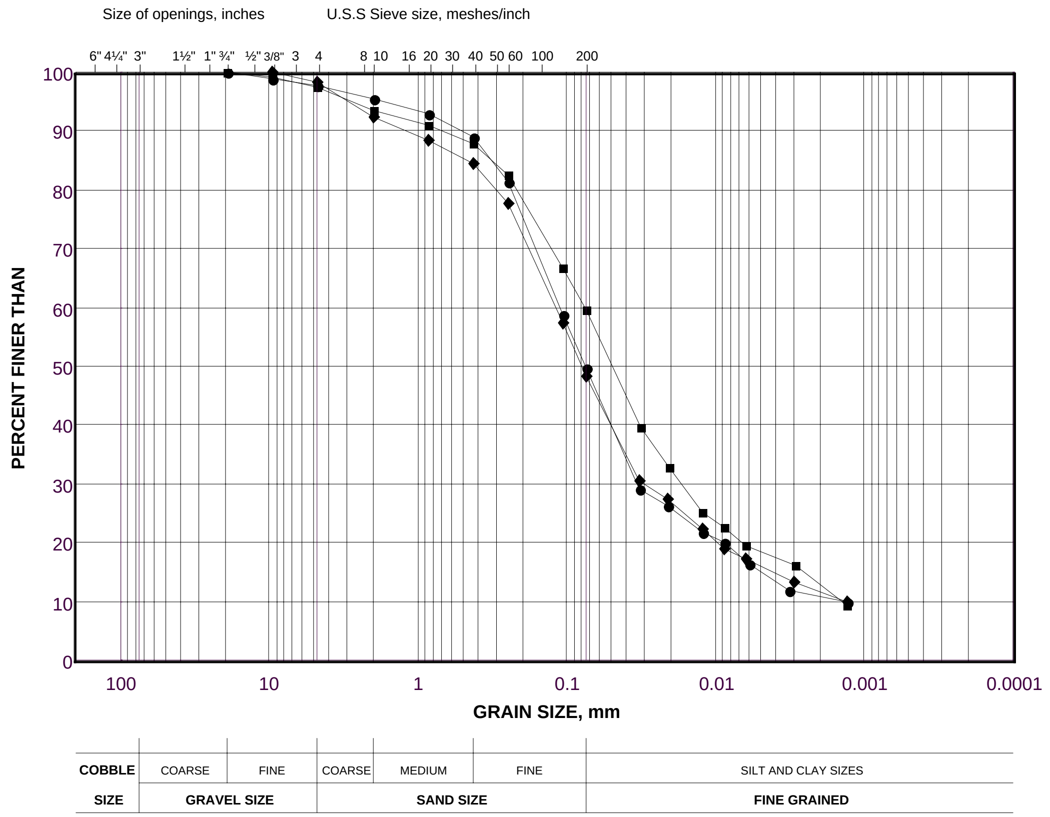
PLASTICITY CHART

Borehole Y-130

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-131

FIGURE A-21



LEGEND

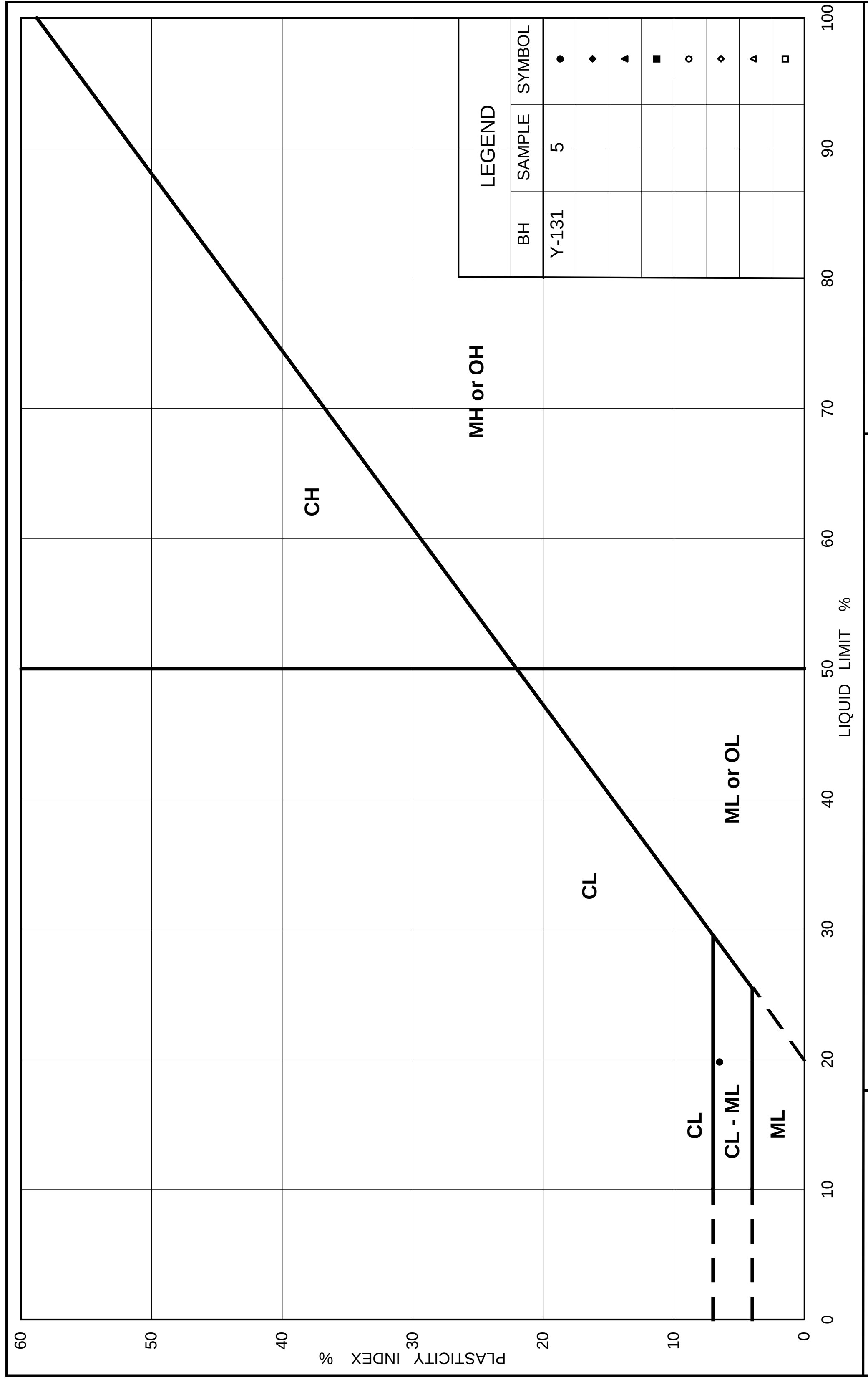
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-131	13	186.1
■	Y-131	11	188.9
◆	Y-131	8	193.6

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05



PLASTICITY CHART

Borehole Y-131

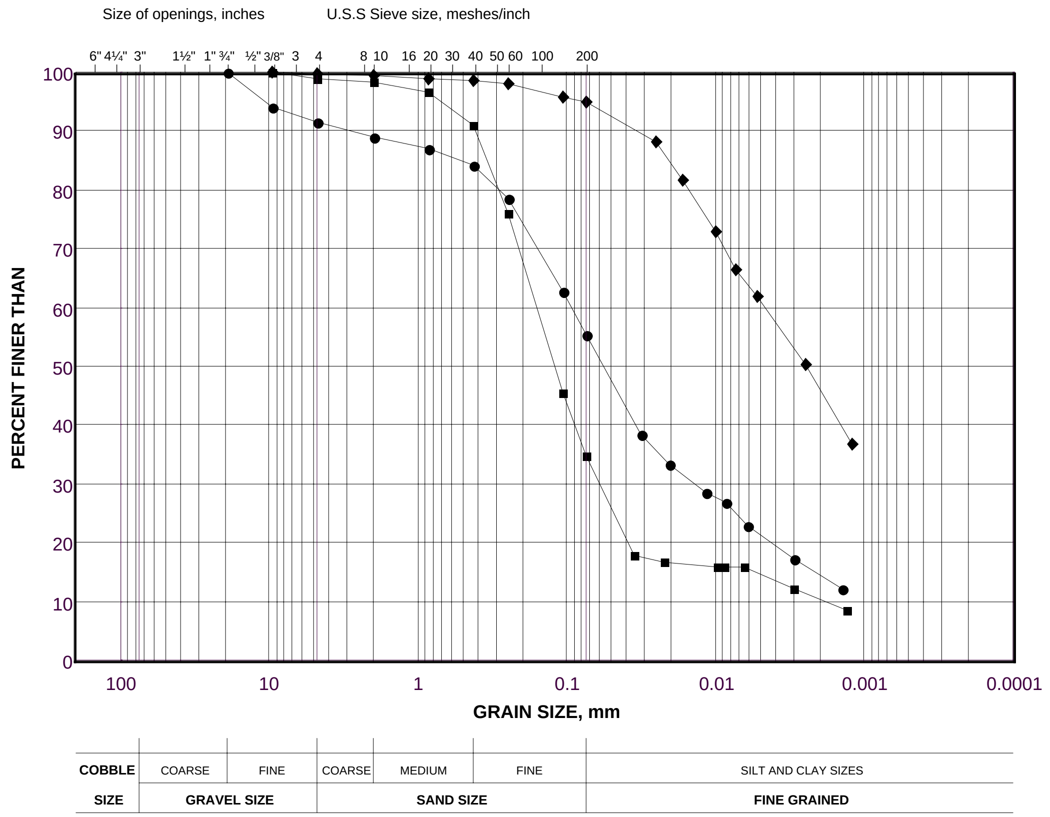
FIG No. A-22

Project No. 04-1111-054

GRAIN SIZE DISTRIBUTION TEST RESULTS

Borehole Y-132

FIGURE A-23



LEGEND

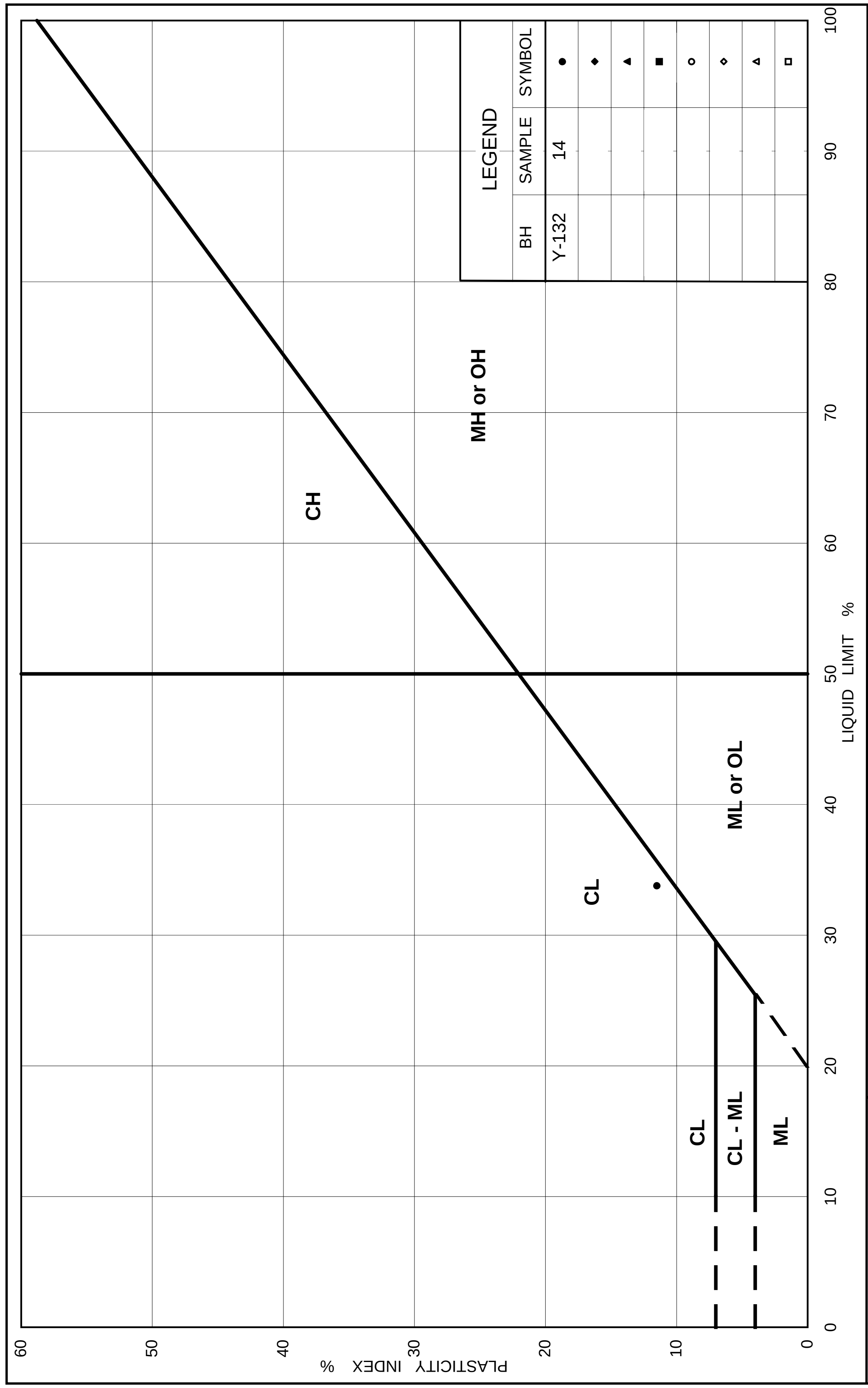
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	Y-132	5	196.6
■	Y-132	8	192.8
◆	Y-132	11	188.2

Project Number: 04-1111-054

Checked By: ____________________

Golder Associates

Date: 09-Dec-05



PLASTICITY CHART

Borehole Y-132

FIG No. A-24

Project No. 04-1111-054

Project Code: 04-1111-154
Project Name: URS/Spadina EA/North York
Date Tested: November, 2005

Borehole No.	Sample No.	Depth (m)	Elevation (m)	Water Content (%)	Atterberg Limits		
					LL	PL	PI
Y-121	3	2.6	195.3	14.5%			
	4	3.4	194.5	14.5%	24.0	16.6	7.4
	5	4.1	193.8	12.8%			
	6	4.9	193.0	12.0%			
	7	6.4	191.5	12.9%			
	8	7.9	190.0	10.9%			
	9	9.4	188.5	10.8%			
	11	12.3	185.6	9.7%			
	12	13.8	184.1	6.8%	20.6	11.5	9.1
	13B	15.6	182.2	16.3%			
	14	17.1	180.8	12.2%			
	15	18.5	179.4	16.4%	19.6	12.6	7.0
Y-122	2	1.8	196.2	15.4%			
	3	2.6	195.4	14.8%			
	4	3.4	194.6	13.7%			
	5	4.1	193.9	14.2%			
	6	4.9	193.1	13.3%			
	7	6.4	191.6	15.5%			
	8	7.9	190.1	28.1%	31.0	15.5	15.5
	9	9.6	188.4	10.0%			
	10	11.0	187.0	8.6%	14.7	10.3	4.4
	11	12.5	185.5	7.4%			
	12	14.0	184.0	16.7%			
	13	15.5	182.5	11.7%			
	14	17.1	180.9	19.4%			
	15	18.4	179.6	9.7%			
	16	20.0	178.0	17.3%	23.7	16.3	7.4
	17	21.6	176.4	17.0%			
	18	23.0	175.0	16.0%			
	19	24.5	173.5	17.7%			

Project Code: 04-1111-154
Project Name: URS/Spadina EA/North York
Date Tested: November, 2005

Borehole No	Sample No	Depth (m)	Elevation (m)	Water Content (%)	Atterberg Limits		
					LL	PL	PI
Y-123	2	1.1	194.2	9.0%			
	3	1.8	193.5	11.8%			
	4	2.6	192.7	13.0%			
	5	3.4	191.9	20.8%			
	6	4.9	190.4	14.0%	22.4	13.1	9.3
	7	6.3	189.0	7.9%			
	8	7.9	187.4	18.4%			
	9	9.4	185.9	13.1%			
	11	12.5	182.8	9.2%			
	12	14.0	181.3	15.8%			
	13	15.5	179.8	15.9%			
	14	17.0	178.3	18.1%			
	15	18.5	176.8	16.7%	38.9	18.7	20.2
	17	21.5	173.8	20.8%			
	18	23.0	172.3		21.9	16.6	5.3
	19	24.5	170.8	18.0%			
Y-124	3	1.8	193.4	10.9%			
	5	3.4	191.8	3.3%			
	7	5.2	190.0	8.8%			
	8	7.7	190.3	6.6%			
	9	9.5	185.7	11.6%	14.6	11.3	3.3
	11	12.2	183.0	13.7%			
	12	13.8	181.4	16.6%			
	13	15.3	179.9	15.5%			
	15	18.4	176.8	15.0%			
	16	20.0	175.2		25.0	16.0	9.0
	17	21.4	173.8	16.7%			
	18	23.0	172.2	14.6%			
	19	24.5	170.7	13.0%			

Project Code: 04-1111-154
Project Name: URS/Spadina EA/North York
Date Tested: November, 2005

SUMMARY OF WATER CONTENT AND ATTERBERG LIMITS							
Borehole No.	Sample No.	Depth (m)	Elevation (m)	Water Content (%)	Atterberg Limits		
					LL	PL	PI
Y-125	1	1.1	193.6	19.4%			
	2	1.8	192.9	12.8%			
	3	2.6	192.1	13.1%			
	4	3.4	191.3	12.1%			
	5	4.1	190.6	11.7%			
	6	4.9	189.8	12.7%			
	7	6.4	188.3	12.1%			
	8	7.9	186.8	9.8%			
	9	9.4	185.3	16.3%			
	10	11.0	183.7	18.6%			
	11	12.5	182.2	18.3%			
	12	14.0	180.7	22.9%			
	13	15.5	179.2	20.6%			
	14	17.1	177.6	20.3%			
	15	18.6	176.1	30.6%	49.8	29.9	19.9
Y-126	2	1.8	193.2	11.9%			
	3	2.6	192.4	11.8%			
	4	3.4	191.6	8.5%			
	5	4.1	190.9	7.6%			
	6	4.8	190.2	7.1%			
	7	6.4	188.6	7.2%			
	8	7.9	187.1	8.2%			
	9A	9.3	185.7	13.3%			
	10	10.9	184.1	8.6%			
	11	12.5	182.5	15.5%			
	12	14.0	181.0	15.2%	37.7	22.5	15.2
	13	15.5	179.5	17.8%			
	14	17.1	177.9	12.0%			
	15	18.6	176.4	27.6%			

Project Code: 04-1111-154
Project Name: URS/Spadina EA/North York
Date Tested: November, 2005

SUMMARY OF WATER CONTENT AND ATTERBERG LIMITS							
Borehole No.	Sample No.	Depth (m)	Elevation (m)	Water Content (%)	Atterberg Limits		
					LL	PL	PI
Y-127	3	2.6	195.2	6.7%			
	4	3.4	194.4	12.1%			
	5	4.1	193.7	8.0%			
	6	4.9	192.9	10.0%	20.6	13.6	7.0
	7	6.4	191.4	7.5%			
	8	7.9	189.9	9.8%			
	9	9.4	188.4	9.4%			
	10	10.8	187.0	8.1%			
	11	12.4	185.4	6.9%			
Y-128	2	1.8	195.5	18.8%			
	3	2.6	194.7	14.6%			
	4	3.4	193.9	12.9%			
	5	4.1	193.2	9.2%			
	6	4.9	192.4	8.9%			
	7	6.4	190.9	9.9%	16.2	10.9	5.3
	8	7.8	189.5	11.1%			
	9	9.4	187.9	15.5%	33.7	16.9	16.8
	10	11.0	186.3	15.0%			
	11	12.5	184.8	16.1%			
	12	14.0	183.3	16.9%			
	13	15.5	181.8	17.6%	34.3	20.7	13.6
	14	17.1	180.2	18.0%			
	15	18.6	178.7	16.6%			

Project Code: **04-1111-154**
Project Name: **URS/Spadina EA/North York**
Date Tested: **November, 2005**

SUMMARY OF WATER CONTENT AND ATTERBERG LIMITS							
Borehole No.	Sample No	Depth (m)	Elevation (m)	Water Content (%)	Atterberg Limits		
					LL	PL	PI
Y-129	1	1.1	197.0	13.1%			
	2A	2.1	196.0	21.1%			
	3	2.6	195.5	19.8%	28.8	18.4	10.4
	4	3.4	194.7	16.6%			
	5	4.1	194.0	9.9%			
	6	4.9	193.2	10.2%	18.6	11.4	7.2
	7A	6.4	191.7	10.8%			
	8	7.8	190.3	8.6%			
	9	9.3	188.8	6.9%			
	10	11.0	187.1	11.1%			
	11	12.4	185.7	11.4%			
	12	13.8	184.3	13.1%			
	13	15.4	182.7	10.0%			
	14	17.0	181.1	17.2%			
	15	18.5	179.6	15.8%			
Y-130	2	1.8	198.0	15.0%			
	3	2.6	197.2	11.0%			
	4	3.4	196.4	10.2%			
	5	4.1	195.7	9.0%			
	6	4.9	194.9	9.9%			
	7	6.4	193.4	9.2%	15.5	9.9	5.6
	8	7.9	191.9	8.8%			
	9	9.5	190.3	6.0%			
	10	11.0	188.8	16.7%			
	11	12.5	187.3	10.3%			
	12	14.0	185.8	15.0%	19.6	15.1	4.5
	13	15.5	184.3	13.2%			
	14	17.0	182.8	13.7%			
	15	18.4	181.4	15.5%			

Project Code: **04-1111-154**
Project Name: **URS/Spadina EA/North York**
Date Tested: **November, 2005**

SUMMARY OF WATER CONTENT AND ATTERBERG LIMITS							
Borehole No.	Sample No	Depth (m)	Elevation (m)	Water Content (%)	Atterberg Limits		
					LL	PL	PI
Y-131	2	1.9	199.5	11.8%			
	3	2.6	198.8	11.4%			
	4	3.4	198.0	10.8%			
	5	4.1	197.3	10.9%	19.8	13.3	6.5
	6	4.9	196.5	8.2%			
	7	6.4	195.0	8.0%			
	8	7.8	193.6	6.9%			
	9	9.4	192.0	7.3%			
	10	11.0	190.4	17.5%			
	11	12.5	188.9	11.0%			
	12B	13.9	187.5	15.9%			
	13	15.3	186.1	9.0%			
	14	16.9	184.5	13.0%			
Y-132	2	1.8	198.9	11.2%			
	3	2.6	198.1	10.0%			
	4	3.4	197.3	9.0%			
	5	4.1	196.6	8.6%			
	6	4.9	195.8	8.8%			
	7	6.4	194.3	14.2%			
	8	7.9	192.8	13.6%			
	9	9.5	191.2	15.3%			
	10	11.0	189.7	13.4%			
	11	12.5	188.2	15.2%			
	12	14.0	186.7	16.5%			
	13	15.5	185.2	15.2%			
	14	17.0	183.7	16.5%	33.8	22.3	11.5
	15	18.6	182.1	15.2%			

APPENDIX B

RISING HEAD TEST RECORDS AND CALCULATIONS
(BOREHOLES Y-121 TO Y-132)

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-121

Test Date : Nov. 24, 2005
Elevation : 197.92 m
Well Installation : 18.29 m depth (Elevation 179.63 m)
Clayey Silt Till (Borehole material symbol: 11)

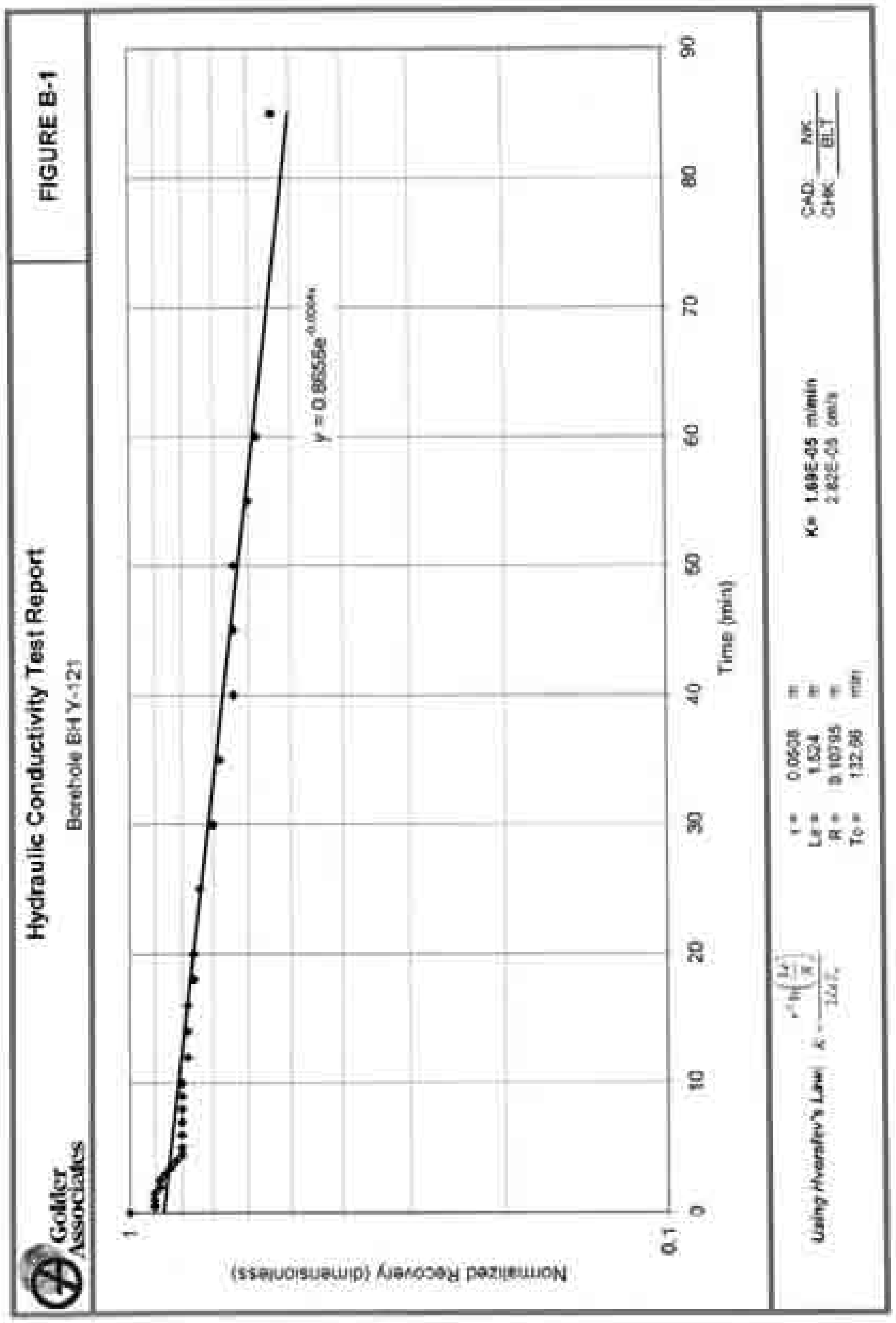
Static Water Level = 14.6 m
H = 183.32 m
Ho = 182.82 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	15.10	182.82	1.00
0.5	15.05	182.87	0.90
1	15.05	182.87	0.90
1.5	15.05	182.87	0.90
2	15.04	182.88	0.88
2.5	15.04	182.88	0.88
3	15.03	182.89	0.86
3.5	15.02	182.90	0.84
4	15.01	182.91	0.82
4.5	15.00	182.92	0.80
5	15.00	182.92	0.80
6	15.00	182.92	0.80
7	15.00	182.92	0.80
8	15.00	182.92	0.80
9	15.00	182.92	0.80
10	15.00	182.92	0.80
12	14.99	182.93	0.78
14	14.99	182.93	0.78
16	14.99	182.93	0.78
18	14.98	182.94	0.76
20	14.98	182.94	0.76
25	14.97	182.95	0.74
30	14.95	182.97	0.70
35	14.94	182.98	0.68
40	14.92	183.00	0.64
45	14.92	183.00	0.64
50	14.92	183.00	0.64
55	14.90	183.02	0.60
60	14.89	183.03	0.58
85	14.87	183.05	0.54
1239	14.75	183.17	▨ 0.30

▨ point not included in calculations

Refer to Figure B-1 for hydraulic conductivity value

FIGURE B-1



Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-122

Test Date: Dec. 9, 2005
Elevation: 198.01 m
Well Installation: 24.38 m depth (Elevation 173.63 m)
Sand (Borehole material symbol 5)

Static Water Level = 11.66 m
H = 186.35 m
Ho = 185.25 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	12.76	185.25	1.00
0.5	12.42	185.59	0.69
1	12.29	185.72	0.57
1.5	12.18	185.83	0.47
2	12.09	185.92	0.39
2.5	11.99	186.02	0.30
3	11.93	186.08	0.25
3.5	11.88	186.13	0.20
4	11.85	186.16	0.17
4.5	11.81	186.20	0.14
5	11.79	186.22	0.12
6	11.74	186.27	0.07
7	11.72	186.29	0.05
8	11.70	186.31	0.04
10	11.68	186.33	0.02
15	11.68	186.33	▨ 0.02
16	11.68	186.33	▨ 0.02
18	11.66	186.35	▨ 0.00

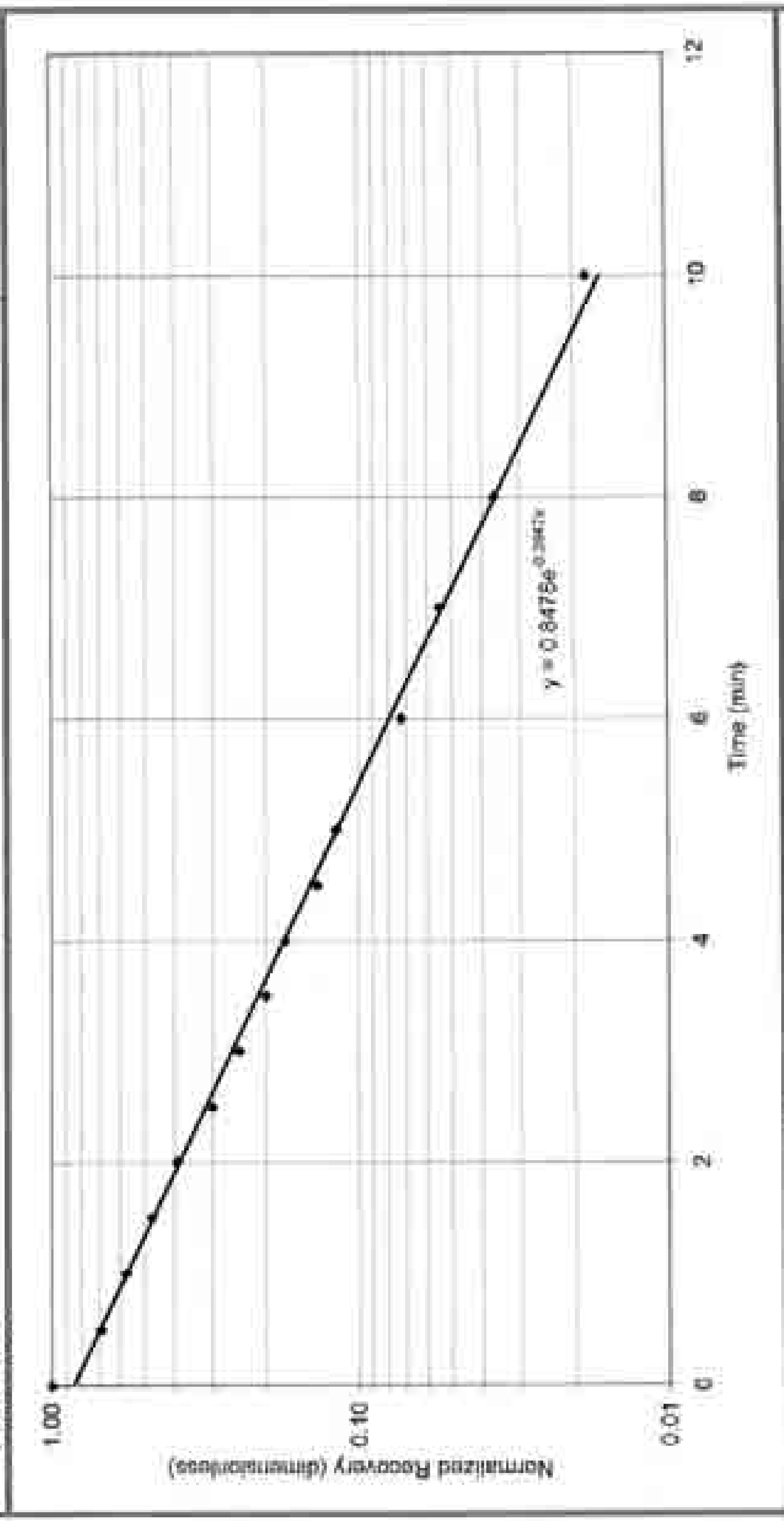
▨ point not included in calculations

Refer to Figure B-2 for hydraulic conductivity value

Hydraulic Conductivity Test Report

Borehole BH Y-122

FIGURE B-2



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 2.10 min

K= 1.07E-03 m/min
1.78E-03 cm/s

CAD: NK
CHK: BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-123

Test Date : Nov. 23, 2005
Elevation : 195.28 m
Well Installation : 24.38 m depth (Elevation 170.90 m)
Clayey Silt (Borehole material symbol 9)

Static Water Level = 13.68 m
H = 181.0 m
Ho = 179.35 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	15.93	179.35	1.00
0.5	15.83	179.45	0.96
1.0	15.75	179.53	0.92
2	15.71	179.57	0.90
2.5	15.71	179.57	0.90
3	15.71	179.57	0.90
3.5	15.71	179.57	0.90
4	15.70	179.58	0.90
4.5	15.69	179.59	0.89
5	15.68	179.60	0.89
6	15.68	179.60	0.89
7	15.66	179.62	0.88
8	15.65	179.63	0.88
9	15.64	179.64	0.87
10	15.62	179.66	0.86
12	15.62	179.66	0.86
14	15.60	179.68	0.85
16	15.57	179.71	0.84
18	15.55	179.73	0.84
20	15.53	179.75	0.82
25	15.49	179.79	0.80
30	15.45	179.83	0.79
35	15.42	179.86	0.77
40	15.37	179.91	0.75
45	15.35	179.93	0.74
50	15.31	179.97	0.72
55	15.27	180.01	0.71
60	15.24	180.04	0.69
65	15.23	180.06	0.68
70	15.19	180.09	0.67
75	15.16	180.12	0.66
80	15.14	180.14	0.65
85	15.11	180.17	0.64
90	15.08	180.20	0.63
100	15.05	180.23	0.61
120	14.95	180.33	0.56

Refer to Figure B-3 for hydraulic conductivity value.

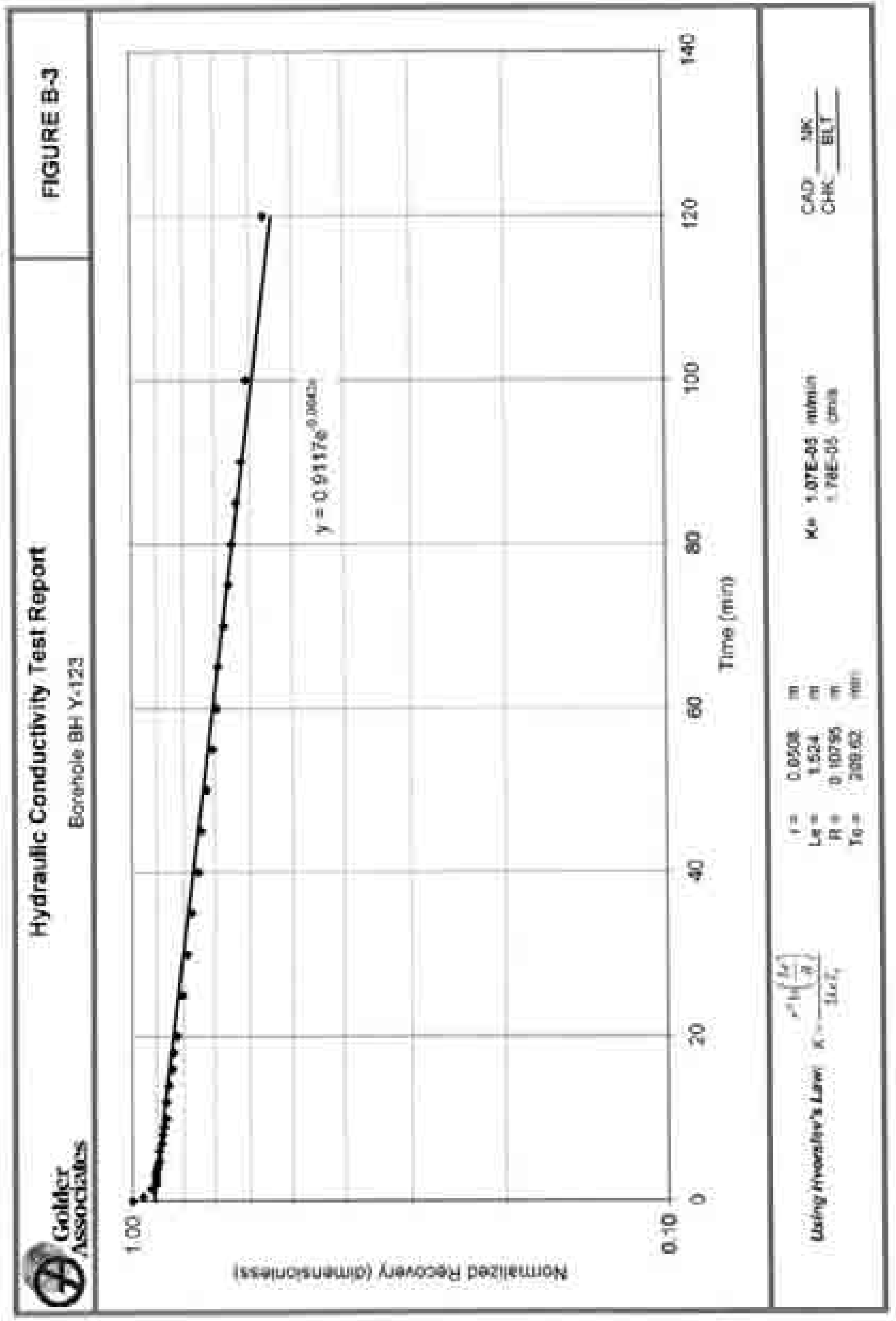


FIGURE B-3

Hydraulic Conductivity Test Report

Borehole BH Y-123

Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_0}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 209.62 min

K= 1.07E-05 m/min
1.78E-05 cm/s

CAD MK
CHK BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-124

Test Date : Nov. 23, 2005
Elevation : 195.20 m
Well Installation : 18.29 m depth (Elevation 176.91 m)
Silt (Borehole material symbol 8)

Static Water Level = 6.13 m
H = 189.07 m
Ho = 185.35 m

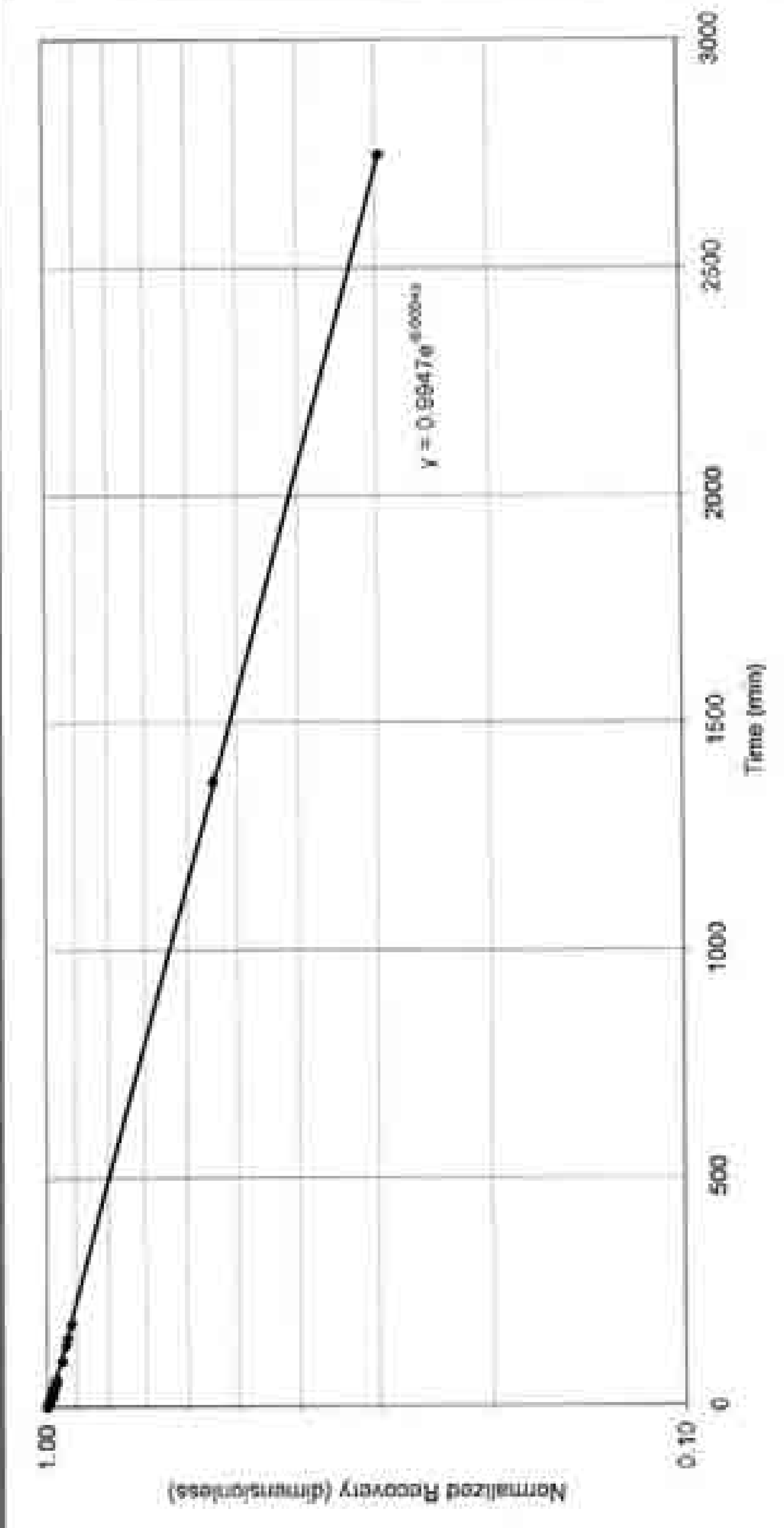
Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	9.85	185.35	1.00
0.5	9.84	185.36	1.00
1	9.84	185.36	1.00
1.5	9.84	185.36	1.00
2	9.83	185.37	0.99
2.5	9.83	185.37	0.99
3	9.83	185.37	0.99
3.5	9.83	185.37	0.99
4	9.83	185.37	0.99
4.5	9.83	185.37	0.99
5	9.83	185.37	0.99
6	9.83	185.37	0.99
7	9.82	185.38	0.99
8	9.82	185.38	0.99
9	9.82	185.38	0.99
10	9.82	185.38	0.99
12	9.82	185.38	0.99
14	9.81	185.39	0.99
16	9.80	185.40	0.99
18	9.80	185.40	0.99
20	9.79	185.41	0.98
25	9.79	185.41	0.98
30	9.78	185.42	0.98
35	9.77	185.43	0.98
40	9.76	185.44	0.98
45	9.75	185.45	0.97
50	9.74	185.46	0.97
55	9.73	185.47	0.97
60	9.72	185.48	0.97
100	9.65	185.55	0.95
135	9.60	185.60	0.93
150	9.58	185.62	0.93
180	9.53	185.67	0.91
1370	8.16	187.04	0.55
2748	7.23	187.97	0.30

Refer to Figure B-4 for hydraulic conductivity value

FIGURE B-4

Hydraulic Conductivity Test Report

Borehole BH Y-124



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 2470.10 min

K= 9.07E-07 m/min
1.51E-06 cm/s

CAD NK
CHK BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-125

Test Date : Nov. 24, 2005
Elevation : 194.66 m
Well Installation : 18.29 m depth (Elevation 176.37 m)
Silty Clay Till (Borehole material symbol 11)

Static Water Level = 1.71 m
H = 192.95 m
Ho = 188.02 m

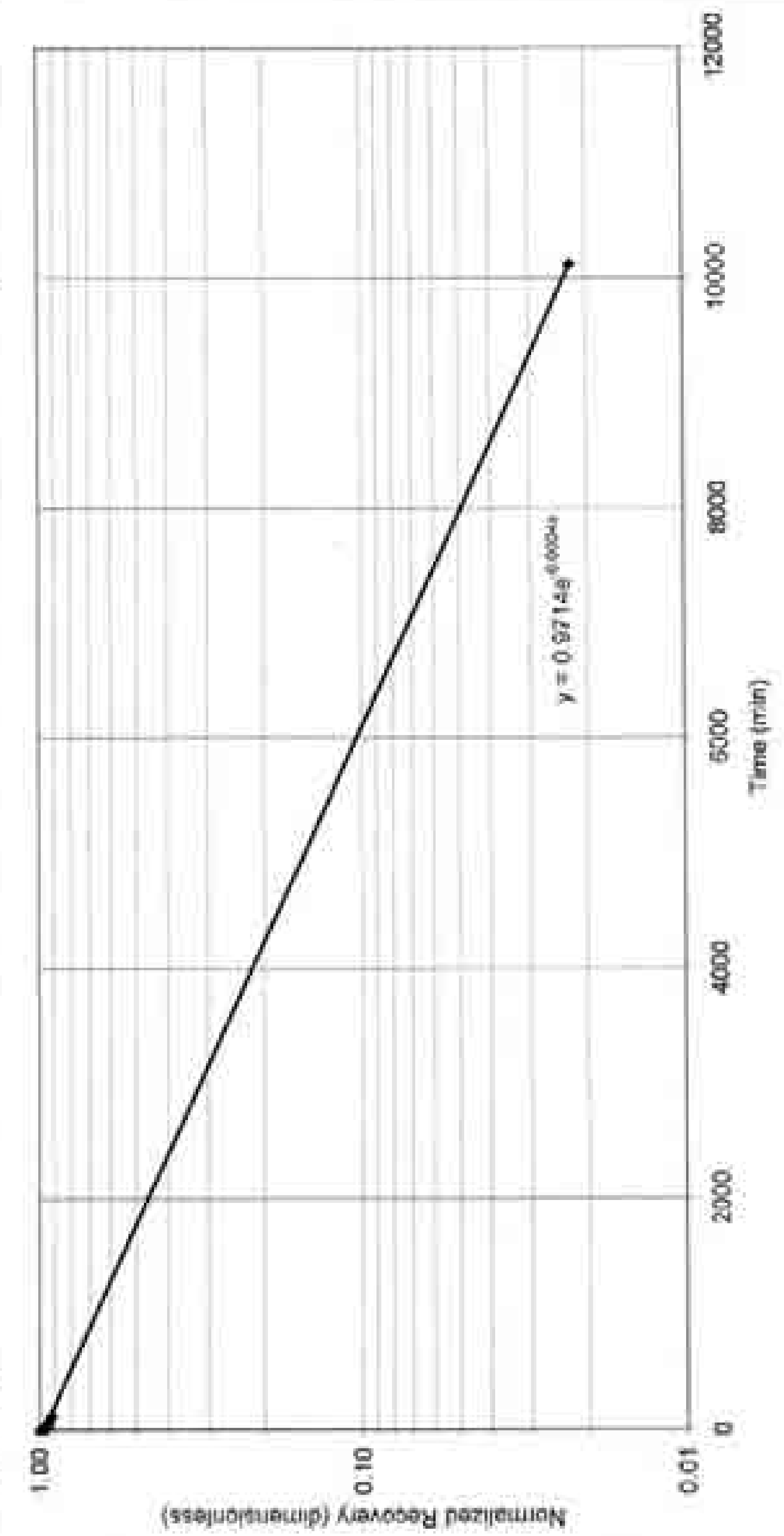
Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	5.74	188.92	1.00
0.5	5.73	188.93	1.00
1	5.71	188.95	0.99
1.5	5.70	188.96	0.99
2	5.70	188.96	0.99
2.5	5.61	189.05	0.97
3	5.61	189.05	0.97
3.5	5.61	189.05	0.97
4	5.61	189.05	0.97
4.5	5.61	189.05	0.97
5	5.61	189.05	0.97
6	5.61	189.05	0.97
7	5.61	189.05	0.97
8	5.61	189.05	0.97
9	5.61	189.05	0.97
10	5.61	189.05	0.97
12	5.61	189.05	0.97
14	5.59	189.07	0.96
16	5.55	189.11	0.95
18	5.55	189.11	0.95
20	5.55	189.11	0.95
25	5.55	189.11	0.95
30	5.55	189.11	0.95
35	5.55	189.11	0.95
40	5.55	189.11	0.95
45	5.55	189.11	0.95
50	5.55	189.11	0.95
55	5.52	189.14	0.95
60	5.52	189.14	0.95
90	5.47	189.19	0.93
120	5.42	189.24	0.92
10121	1.80	192.86	0.02

Refer to Figure B-5 for hydraulic conductivity value.

Hydraulic Conductivity Test Report

Borehole BH Y-125

FIGURE B-5



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.18795 m
To = 2411.34 min

K= **9.30E-07 m/min**
1.55E-06 cm/s

CAD: NK
CHK: BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-126

Test Date: Nov. 24, 2005
Elevation: 194.96 m
Well Installation: 12.95 m depth (Elevation 176.37 m)
Silt and Sand (Borehole material symbol 7)

Static Water Level = 3.25 m
H = 191.71 m
Ho = 189.11 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	5.85	189.11	1.00
0.5	5.81	189.15	0.98
1	5.76	189.20	0.97
1.5	5.72	189.24	0.95
2	5.69	189.27	0.94
2.5	5.68	189.28	0.93
3	5.62	189.34	0.91
3.5	5.60	189.36	0.90
4	5.59	189.37	0.90
4.5	5.58	189.38	0.90
5	5.57	189.39	0.89
6	5.54	189.42	0.88
7	5.51	189.45	0.87
8	5.50	189.46	0.87
9	5.48	189.48	0.86
10	5.43	189.53	0.84
12	5.39	189.57	0.82
14	5.33	189.63	0.80
16	5.30	189.66	0.79
18	5.27	189.69	0.78
20	5.22	189.74	0.76
25	5.14	189.82	0.73
30	5.07	189.89	0.70
35	5.00	189.96	0.67
40	4.94	190.02	0.65
45	4.88	190.08	0.63
50	4.82	190.14	0.60
55	4.77	190.19	0.58
60	4.75	190.21	0.58
70	4.70	190.26	0.56
80	4.62	190.34	0.53
90	4.58	190.38	0.51
100	4.54	190.42	0.50
110	4.50	190.46	0.48
120	4.48	190.48	0.47
130	4.47	190.49	0.47
1348	4.20	190.76	▨ 0.37

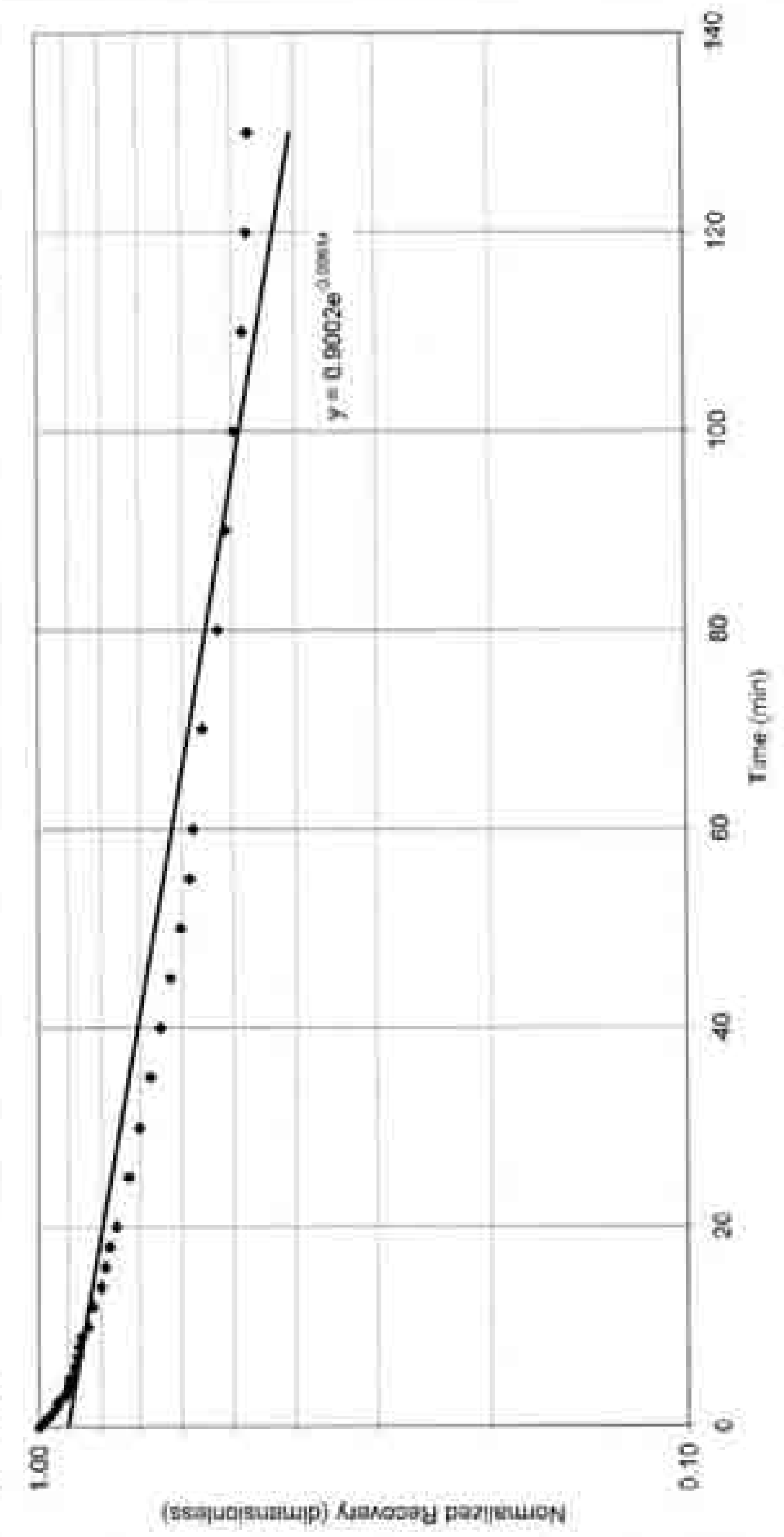
Refer to Figure B-6 for hydraulic conductivity value

▨ point not included in calculations

FIGURE B-6

Hydraulic Conductivity Test Report

Borehole BH Y-126



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2LeT_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 145.77 min

K= 1.54E-05 m/min
2.56E-05 cm/s

CAD NK
CHK BLT

Project Code: **04-1111-054**
Project Name: **URS/Spadina EA/North York**
Borehole: **Y-127**

Test Date : Nov. 24, 2005
Elevation : 197.77 m
Well Installation : 13.56 m depth (Elevation 184.21 m)
Sand (Borehole material symbol 8)

Static Water Level = 4.64 m
H = 193.13 m
Ho = 190.38 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	7.39	190.38	1.00
0.5	7.38	190.39	1.00
1	7.36	190.41	0.99
1.5	7.36	190.41	0.99
2	7.35	190.42	0.99
2.5	7.35	190.42	0.99
3	7.35	190.42	0.99
3.5	7.35	190.42	0.99
4	7.35	190.42	0.99
4.5	7.34	190.43	0.98
5	7.34	190.43	0.98
6	7.32	190.45	0.97
7	7.32	190.45	0.97
8	7.32	190.45	0.97
9	7.30	190.47	0.97
10	7.29	190.48	0.96
12	7.27	190.50	0.96
14	7.24	190.53	0.95
16	7.22	190.55	0.94
18	7.21	190.56	0.93
20	7.20	190.57	0.93
25	7.15	190.62	0.91
30	7.10	190.67	0.89
35	7.07	190.70	0.88
40	7.00	190.77	0.86
45	6.95	190.82	0.84
50	6.92	190.85	0.83
55	6.89	190.88	0.82
60	6.84	190.93	0.80
70	6.77	191.00	0.77
80	6.69	191.08	0.75
90	6.62	191.15	0.72
100	6.54	191.23	0.69
110	6.49	191.28	0.67
120	6.40	191.37	0.64
1668	4.83	192.94	0.07

▨ point not included in calculations

Refer to Figure B-7 for hydraulic conductivity value

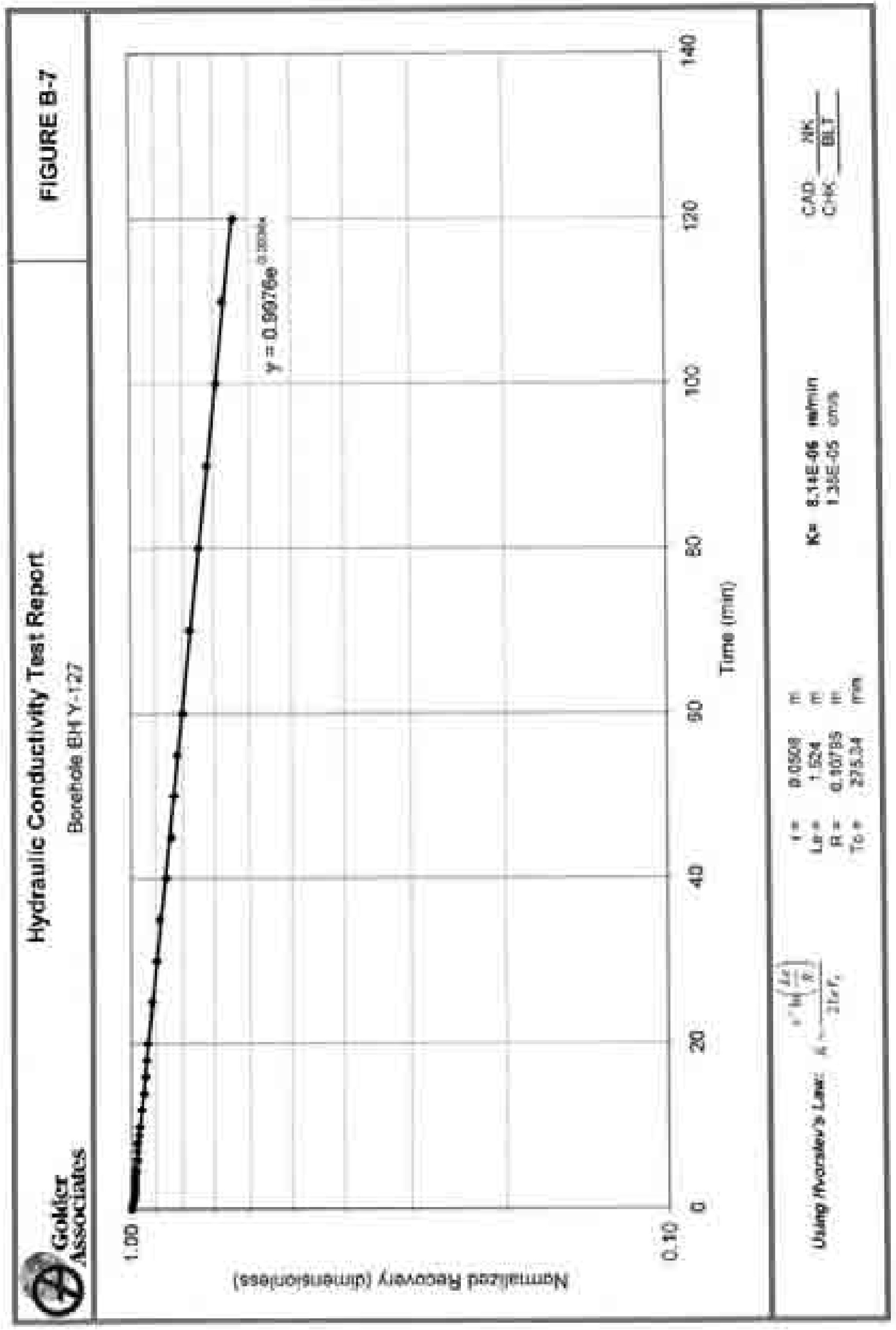


FIGURE B-7

Hydraulic Conductivity Test Report

Borehole BH Y-127

Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 L e T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 275.34 min

K= 8.14E-06 m/min
1.36E-05 cm/s

CAD XK
CHK BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-128

Test Date: Nov. 24, 2006
Elevation: 197.27 m
Well Installation: 18.29 m depth (Elevation 178.98 m)
Silty Clay Till (Borehole material symbol 11)

Static Water Level = 2.5 m
H = 194.77 m
Ho = 190.45 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	6.82	190.45	1.00
0.5	6.82	190.45	1.00
1	6.82	190.45	1.00
1.5	6.82	190.45	1.00
2	6.82	190.45	1.00
2.5	6.82	190.45	1.00
3	6.81	190.46	1.00
3.5	6.81	190.46	1.00
4	6.81	190.46	1.00
4.5	6.81	190.46	1.00
5	6.80	190.47	1.00
6	6.80	190.47	1.00
7	6.80	190.47	1.00
8	6.80	190.47	1.00
9	6.80	190.47	1.00
10	6.80	190.47	1.00
12	6.80	190.47	1.00
14	6.80	190.47	1.00
16	6.79	190.48	0.99
18	6.79	190.48	0.99
20	6.79	190.48	0.99
25	6.79	190.48	0.99
30	6.79	190.48	0.99
35	6.79	190.48	0.99
40	6.79	190.48	0.99
45	6.79	190.48	0.99
50	6.79	190.48	0.99
55	6.79	190.48	0.99
60	6.79	190.48	0.99
90	6.79	190.48	0.99
120	6.79	190.48	0.99
1296	6.75	190.52	0.98
9974	6.76	190.51	0.99

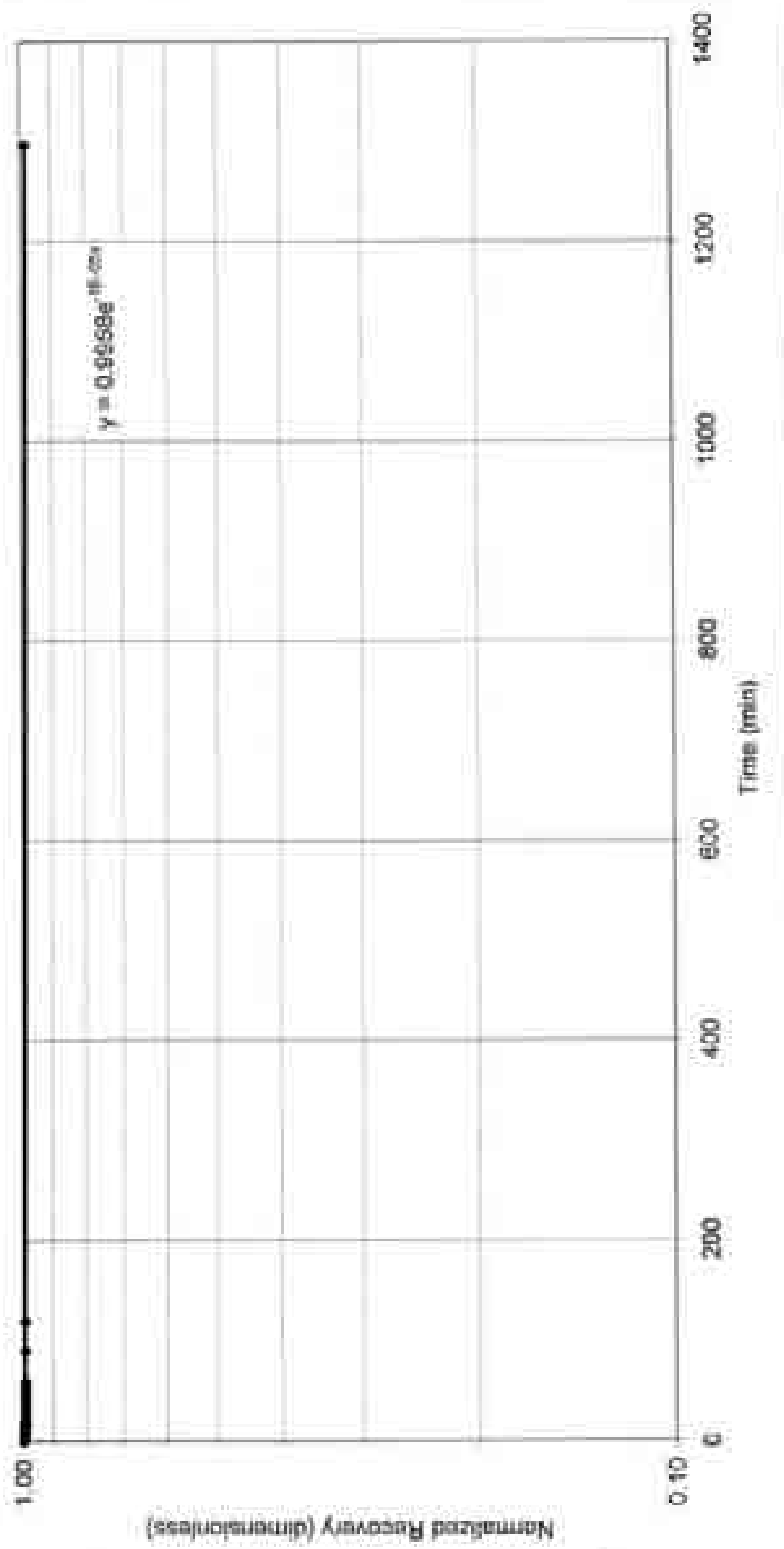
▨ point not included in calculations

Refer to Figure B-8 for hydraulic conductivity value

FIGURE B-8

Hydraulic Conductivity Test Report

Borehole BH Y-128



Using Hvorslev's Law: $K = \dfrac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_o}$

r = 0.0508 m
Le = 1.624 m
R = 0.10795 m
To = 98857.69 min

K = 2.27E-08 m/min
3.78E-08 cm/s

CAD NK
CHK BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-129

Test Date : Nov. 23, 2005
Elevation : 198.07 m
Well Installation : 18.29 m depth (Elevation 179.78 m)
Silty Clay (Borehole material symbol 10)

Static Water Level = 2.47 m
H = 195.6 m
Ho = 191.77 m

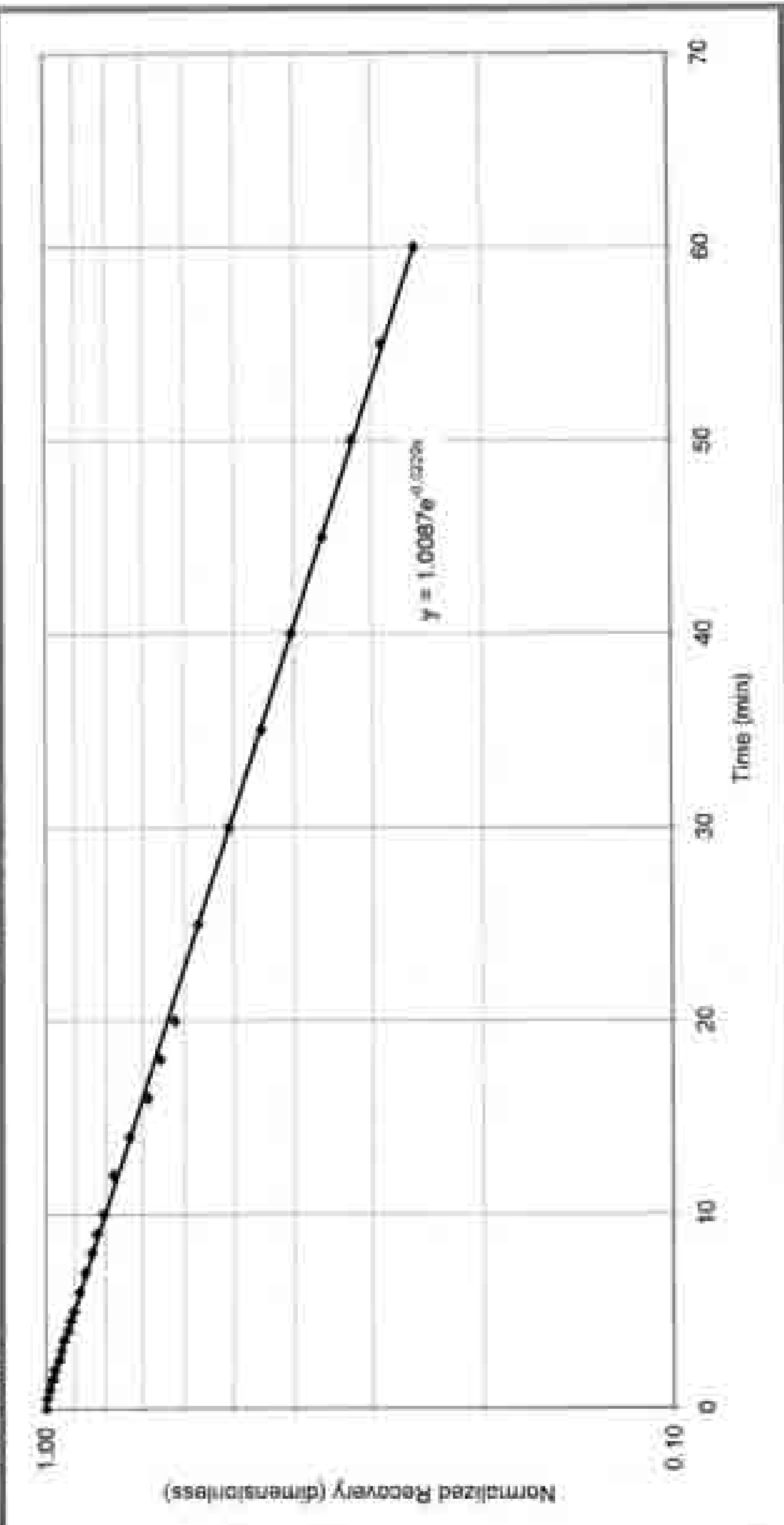
Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	6.30	191.77	1.00
0.5	6.29	191.78	1.00
1	6.25	191.82	0.99
1.5	6.21	191.86	0.98
2	6.18	191.89	0.97
2.5	6.12	191.95	0.96
3	6.09	191.98	0.95
3.5	6.05	192.02	0.93
4	6.00	192.07	0.92
4.5	5.96	192.11	0.91
5	5.92	192.15	0.90
6	5.85	192.22	0.88
7	5.78	192.29	0.86
8	5.70	192.37	0.84
9	5.64	192.43	0.83
10	5.56	192.51	0.81
12	5.45	192.62	0.78
14	5.28	192.79	0.73
16	5.10	192.97	0.69
18	4.98	193.09	0.66
20	4.85	193.22	0.62
25	4.65	193.42	0.57
30	4.42	193.65	0.51
35	4.20	193.87	0.45
40	4.02	194.05	0.40
45	3.85	194.22	0.36
50	3.71	194.36	0.32
55	3.58	194.49	0.29
60	3.45	194.62	0.26

Refer to Figure B-9 for hydraulic conductivity value

Hydraulic Conductivity Test Report

Borehole BH Y-129

FIGURE B-9



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10758 m
To = 43.74 min

K= 5.12E-05 m/min
8.54E-05 cm/s

CAD NK
CHK BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-130

Test Date : Nov. 23, 2005
Elevation : 199.80 m
Well installation : 13.87 m depth (Elevation 185.93 m)
Clayey Silt (Borehole material symbol 9)

Static Water Level = 3.34 m
H = 196.46 m
Ho = 192.57 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	7.23	192.57	1.00
0.5	7.21	192.59	0.99
1	7.19	192.61	0.99
1.5	7.16	192.64	0.98
2	7.15	192.65	0.98
2.5	7.14	192.66	0.98
3	7.13	192.67	0.97
3.5	7.11	192.69	0.97
4	7.09	192.71	0.96
4.5	7.08	192.72	0.96
5	7.06	192.74	0.96
6	7.05	192.75	0.95
7	7.03	192.77	0.95
8	7.00	192.80	0.94
9	7.00	192.80	0.94
10	6.98	192.82	0.94
12	6.95	192.85	0.93
14	6.91	192.89	0.92
16	6.87	192.93	0.91
18	6.83	192.97	0.90
20	6.81	192.99	0.89
25	6.74	193.06	0.87
30	6.67	193.13	0.86
35	6.60	193.20	0.84
40	6.53	193.27	0.82
45	6.49	193.31	0.81
50	6.42	193.38	0.79
55	6.35	193.45	0.77
60	6.30	193.50	0.76
65	6.24	193.56	0.75
70	6.17	193.63	0.73
75	6.13	193.67	0.72
85	6.06	193.74	0.70
90	6.00	193.80	0.68
251	5.40	194.40	0.53
357.5	5.30	194.50	0.50
1439.5	5.22	194.58	0.48

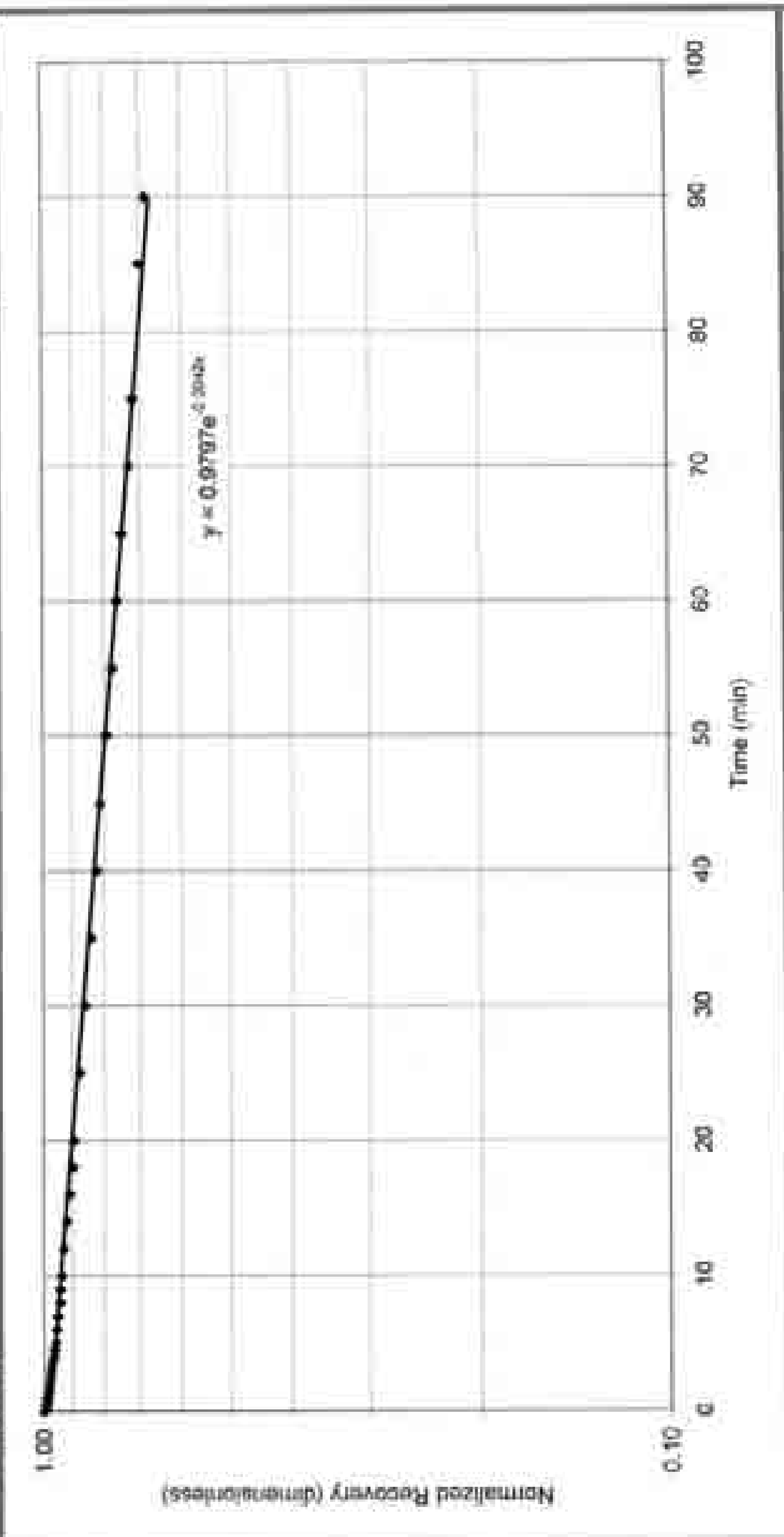
Refer to Figure B-10 for hydraulic conductivity value

▨ point not included in calculations

FIGURE B-10

Hydraulic Conductivity Test Report

Borehole BH Y-130



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 L_e T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 231.58 min

K= 9.68E-06 m/min
1.61E-05 cm/s

CAD NK
CHK BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-131

Test Date : Nov. 23, 2005
Elevation : 201.37 m
Well Installation : 13.11 m depth (Elevation 188.26 m)
Sandy Silt (Borehole material symbol 7)

Static Water Level = 4.52 m
H = 196.85 m
Ho = 193.95 m

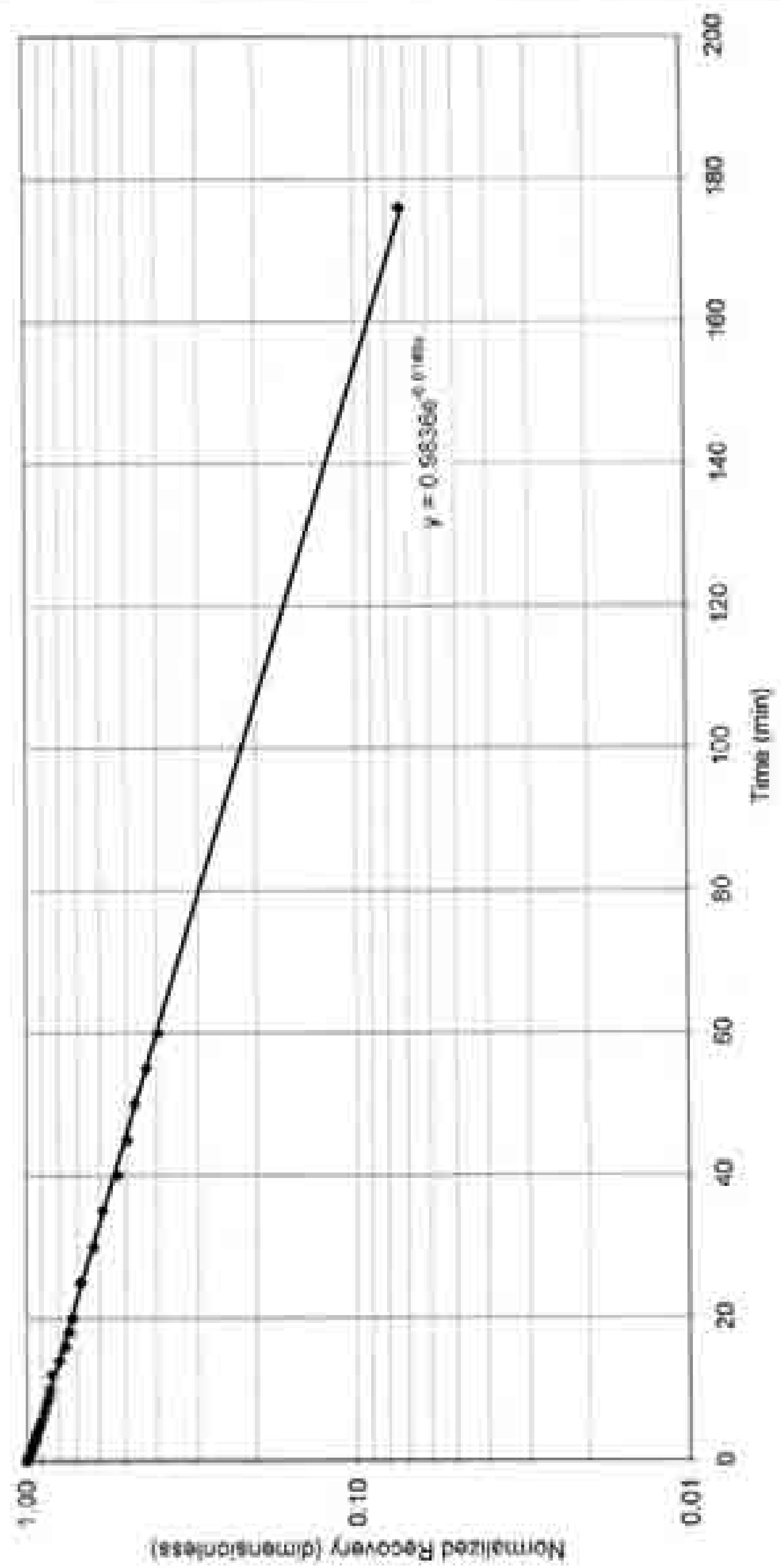
Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	7.42	193.95	1.00
0.5	7.39	193.98	0.99
1	7.36	194.01	0.98
1.5	7.34	194.03	0.97
2	7.31	194.06	0.96
2.5	7.28	194.09	0.95
3	7.25	194.12	0.94
3.5	7.24	194.13	0.94
4	7.22	194.15	0.93
4.5	7.19	194.18	0.92
5	7.17	194.20	0.91
6	7.12	194.25	0.90
7	7.08	194.29	0.88
8	7.05	194.32	0.87
9	7.00	194.37	0.86
10	6.98	194.39	0.85
12	6.95	194.42	0.84
14	6.82	194.55	0.79
16	6.72	194.65	0.76
18	6.67	194.70	0.74
20	6.62	194.75	0.72
25	6.50	194.87	0.69
30	6.33	195.04	0.62
35	6.22	195.15	0.58
40	6.05	195.32	0.53
45	5.95	195.42	0.49
50	5.88	195.49	0.47
55	5.77	195.60	0.43
60	5.67	195.70	0.40
176	4.72	196.64	0.07

Refer to Figure B-11 for hydraulic conductivity value

FIGURE B-11

Hydraulic Conductivity Test Report

Borehole BH Y-131



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{2L_e}{R}\right)}{2L_eT_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 65.57 min

K= **3.42E-05 m/min**
5.70E-05 cm/s

CAD: NK
CHK: BLT

Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-132

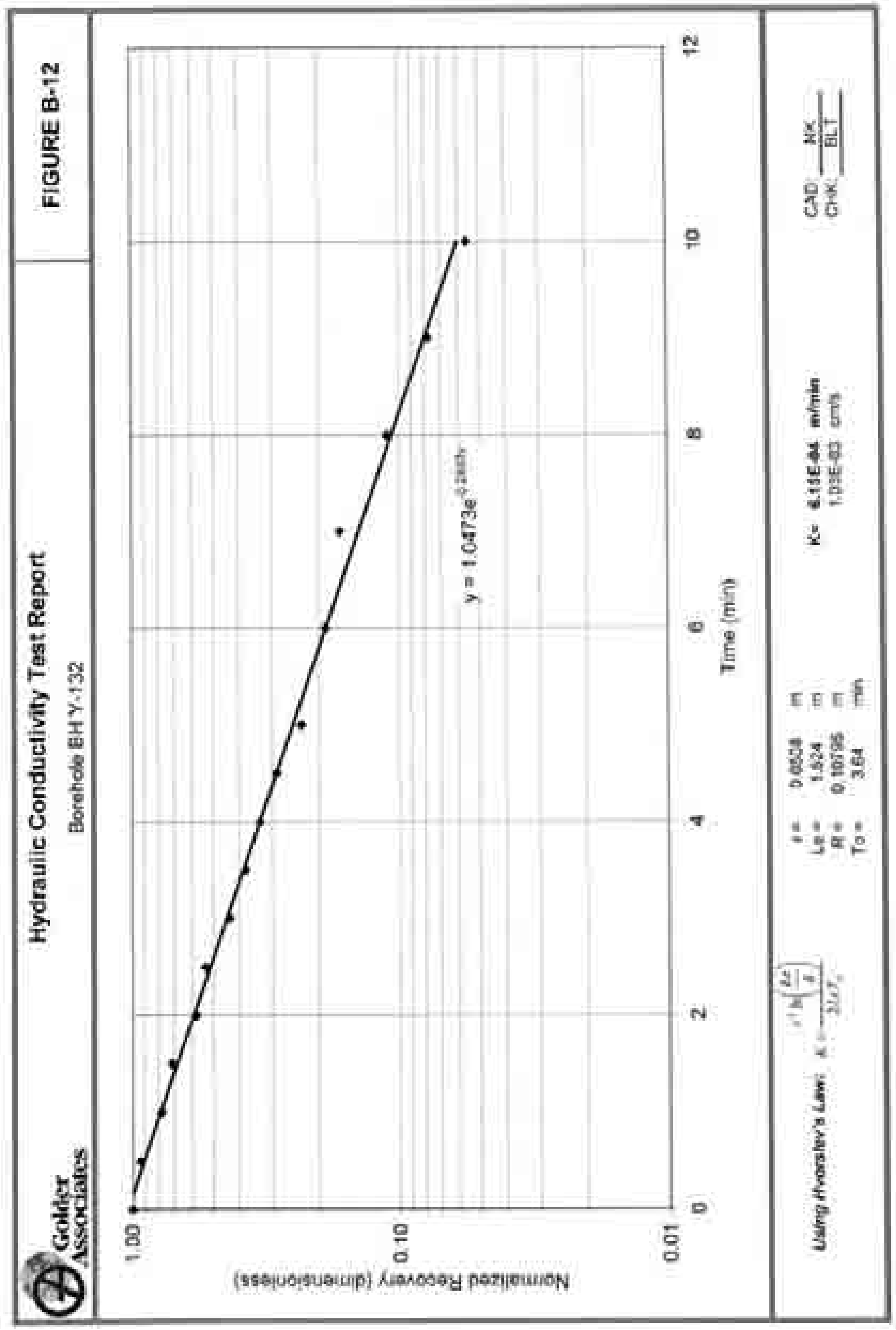
Test Date : Nov. 23, 2005
Elevation : 200.71 m
Well Installation : 12.19 m depth (Elevation 188.52 m)
Sand (Borehole material symbol 5)

Static Water Level = 5.1 m
H = 195.61 m
Ho = 194.71 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	6.00	194.71	1.00
0.5	5.94	194.77	0.93
1	5.80	194.91	0.78
1.5	5.74	194.97	0.71
2	5.62	195.09	0.58
2.5	5.58	195.13	0.53
3	5.49	195.22	0.43
3.5	5.44	195.27	0.38
4	5.40	195.31	0.33
4.5	5.36	195.35	0.29
5	5.31	195.40	0.23
6	5.27	195.44	0.19
7	5.25	195.46	0.17
8	5.20	195.51	0.11
9	5.17	195.54	0.08
10	5.15	195.56	0.06
12	5.10	195.61	▨ 0.00
14	5.10	195.61	▨ 0.00
16	5.10	195.61	▨ 0.00
18	5.10	195.61	▨ 0.00

▨ point not included in calculations

Refer to Figure B-12 for hydraulic conductivity value



Project Code: 04-1111-054
Project Name: URS/Spadina EA/North York
Borehole: Y-132

Test Date : Nov. 23, 2005
Elevation : 200.71 m
Well Installation : 12.19 m depth (Elevation 188.52 m)
Sand (Borehole material symbol 5)

Static Water Level = 4.89 m
H = 195.82 m
Ho = 194.71 m

Δt (min)	Reading (m BGS)	h	H-h/H-Ho
0	6.00	194.71	1.00
0.5	5.89	194.82	0.90
1	5.79	194.92	0.81
1.5	5.72	194.99	0.75
2	5.65	195.06	0.68
2.5	5.58	195.13	0.62
3	5.55	195.16	0.59
3.5	5.47	195.24	0.52
4	5.41	195.30	0.47
4.5	5.37	195.34	0.43
5	5.33	195.38	0.40
6	5.26	195.45	0.33
7	5.19	195.52	0.27
8	5.15	195.56	0.23
9	5.13	195.58	0.22
10	5.08	195.63	0.17
12	5.00	195.71	0.10
14	4.97	195.74	0.07
16	4.94	195.77	0.05
18	4.94	195.77	0.05
20	4.93	195.78	0.04
25	4.91	195.80	0.02
30	4.89	195.82	▨ 0.00
35	4.89	195.82	▨ 0.00

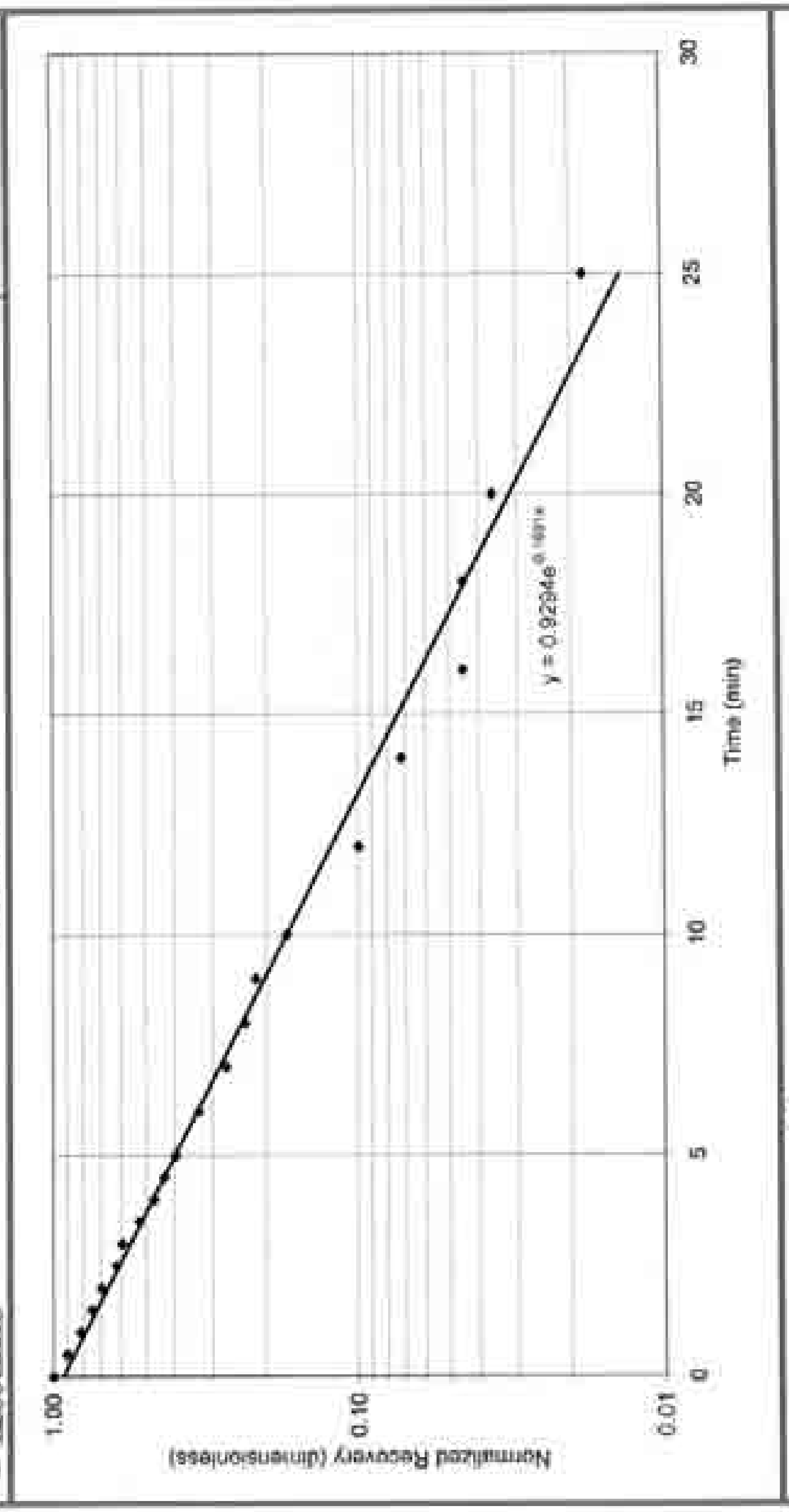
▨ point not included in calculations

Refer to Figure B-13 for hydraulic conductivity value

FIGURE B-13

Hydraulic Conductivity Test Report

Borehole BH Y-132



Using Hvorslev's Law: $K = \frac{r^2 \ln\left(\frac{Le}{R}\right)}{2 Le T_o}$

r = 0.0508 m
Le = 1.524 m
R = 0.10795 m
To = 5.44 min

K= 4.12E-04 m/min
6.86E-04 cm/s

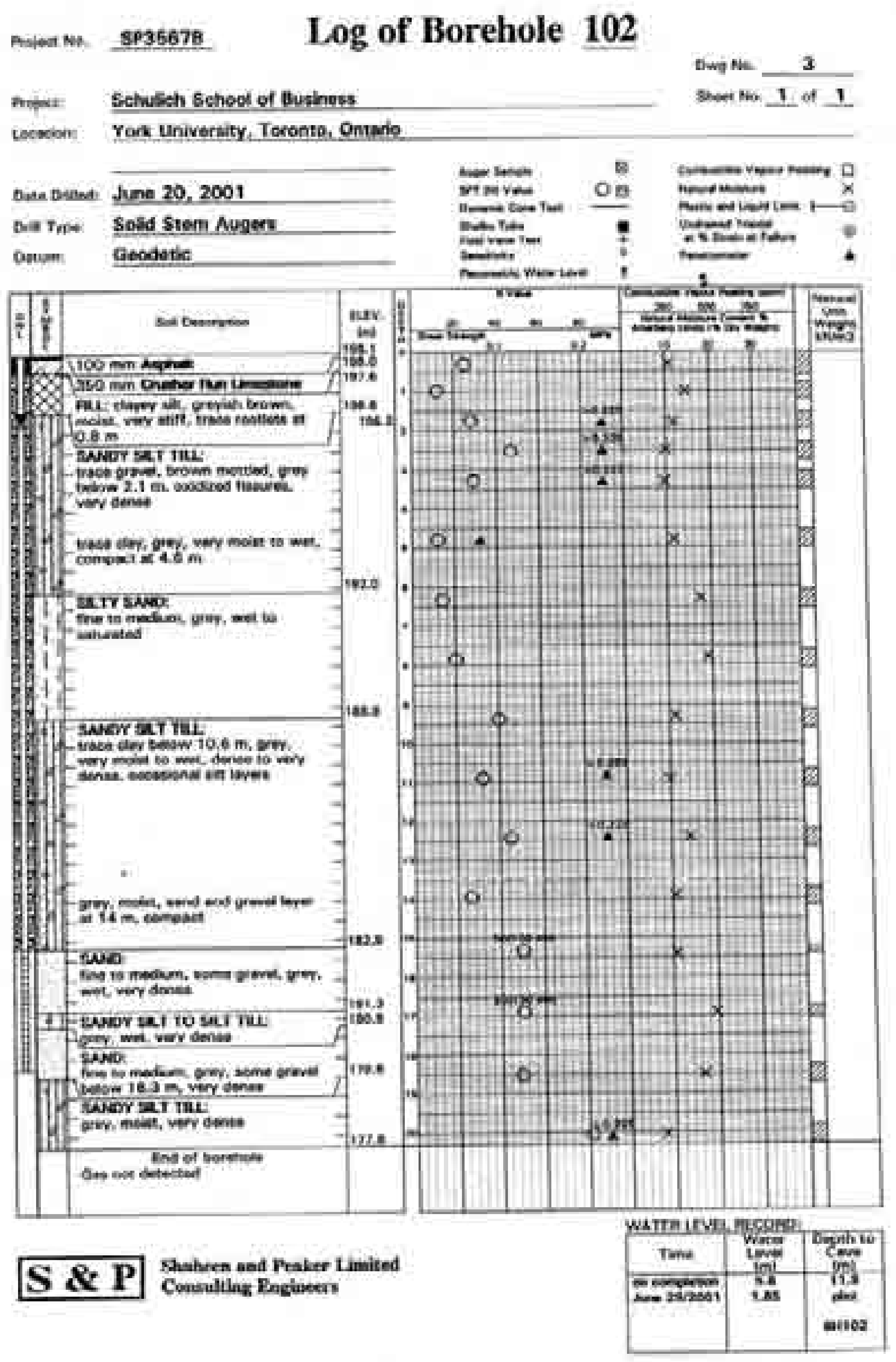
CAD NK
CHK BLT

APPENDIX C

BOREHOLE RECORDS FROM TTC (1993)
(BOREHOLES Y-107, Y-109, Y-201, Y-216, Y-315, Y-320 AND Y-321)

APPENDIX D

BOREHOLE RECORDS FROM YORK UNIVERSITY - SHAHEEN & PEAKER (BOREHOLES 102 TO 104)



Project No. SP35678

Log of Borehole 102

Dwg No. 3

Sheet No. 1 of 1

Project: Schulich School of Business

Location: York University, Toronto, Ontario

Date Drilled: June 20, 2001

Drill Type: Solid Stem Augers

Datum: Geodetic

Soil Description	ELEV. (m)
	198.1
100 mm **Asphalt**	198.0
350 mm **Crusher Run Limestone**	197.6
FILL: clayey silt, greyish brown, moist, very stiff, trace rootlets at 0.8 m	196.8 196.2
SANDY SILT TILL: trace gravel, brown mottled, grey below 2.1 m, oxidized fissures, very dense trace clay, grey, very moist to wet, compact at 4.6 m	192.0
SILTY SAND: fine to medium, grey, wet to saturated	188.8
SANDY SILT TILL: trace clay below 10.6 m, grey, very moist to wet, dense to very dense, occasional silt layers grey, moist, sand and gravel layer at 14 m, compact	182.9
SAND: fine to medium, some gravel, grey, wet, very dense	181.3
SANDY SILT TO SILT TILL: grey, wet, very dense	180.9
SAND: fine to medium, grey, some gravel below 18.3 m, very dense	179.8
SANDY SILT TILL: grey, moist, very dense	177.8
End of borehole Gas not detected	

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	5.8	11.9
June 25/2001	1.85	plot
		BH102

S & P Shaheen and Peaker Limited
Consulting Engineers

Log of Borehole 103

Project No. SP35678

Dwg No. 4

Sheet No. 1 of 1

Project: Schulich School of Business

Location: York University, Toronto, Ontario

Date Drilled: June 20, 2001

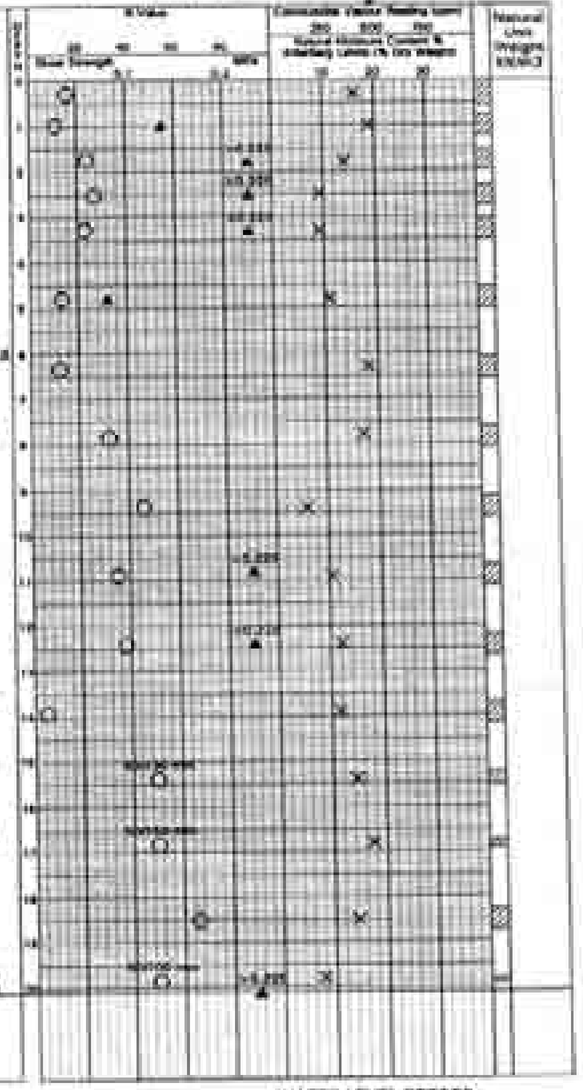
Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ⊡
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test +
Sensitivity S
Piezometric Water Level ▼
Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ├─○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Soil Description	ELEV. (m)
	197.5
90 mm **Asphalt**	197.4
350 mm **Crusher Run Limestone**	197.1
FILL: clayey silt, brown, moist, very stiff trace topsoil, rootlets at 0.8 m	196.4
CLAYEY SILT TILL: trace gravel, brown, grey below 2.1 m, moist, very stiff moist to very moist at 3.0 m sand layer at 4.6 m	191.8
SILTY SAND: fine to medium, grey, wet to saturated, compact to dense	190.0
SANDY SILT TILL: occasional gravel, trace clay below 9.0 m, grey, very moist, very dense	184.2
SAND: fine to medium, grey, wet, loose	182.8
SAND AND GRAVEL: dark grey, wet, with silt and clay layers, very dense	181.1
SILT TILL: grey, very moist to wet, very dense	178.1
SANDY SILT TILL TO SILT TILL: trace clay below 18.3 m, grey, moist, very dense	177.6

End of borehole
Gas not detected



WATER LEVEL RECORD

Time	Water Level (m)	Depth to Cave (m)
on completion	9.1	12.8
		BH103

S & P Shaheen and Peaker Limited
Consulting Engineers

Log of Borehole 104

Project No. SP35678

Dwg No. 5

Sheet No. 1 of 1

Project: Schulich School of Business

Location: York University, Toronto, Ontario

Date Drilled: June 20, 2001

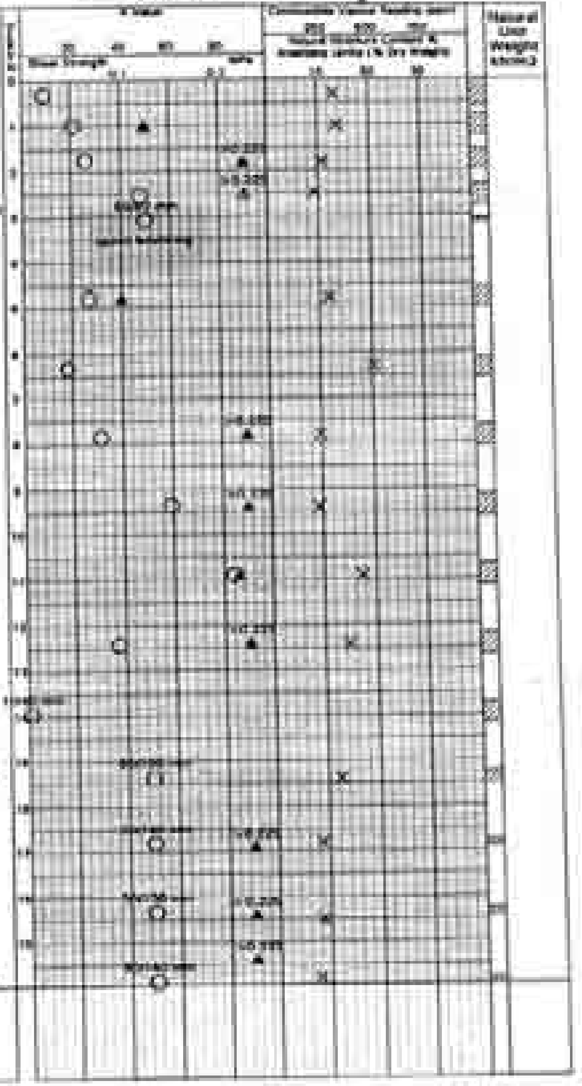
Drill Type: Solid Stem Augers

Datum: Geodetic

Auger Sample ☒
SPT (N) Value ○ ⊡
Dynamic Cone Test —
Shelby Tube ■
Field Vane Test +
Sensitivity S
Piezometric Water Level ▼
Combustible Vapour Reading □
Natural Moisture ×
Plastic and Liquid Limit ├─○
Undrained Triaxial at % Strain at Failure ⊕
Penetrometer ▲

Soil Description	ELEV. (m)
	197.6
112 mm **Asphalt**	197.5
300 mm **Crusher Run Limestone**	197.2
CLAYEY SILT TILL: brown, moist, very stiff	196.1
SANDY SILT TILL: trace gravel, brown mottled, grey below 4.6 m, oxidized fissures, very dense boulders and gravel at 3.0 m trace clay, wet at 4.6 m	194.7 191.5
SANDY SILT: grey, wet to saturated, dense	190.0
SANDY SILT TILL: trace gravel, grey, very moist, very dense	188.5
CLAYEY SILT TILL: trace gravel, sand, grey, moist, hard	187.6
SILT: grey, wet, very dense	185.3
SILT TILL: trace gravel, sand, grey, moist, very dense to dense	183.8
SILTY SAND: trace gravel, grey, wet, very loose to very dense 250 mm sand and gravel layer, grey, wet at 15.5 m	182.3
SANDY SILT TILL: grey, moist, very dense wet silt layer at 18.0 m	177.3

End of borehole
Gas not detected



WATER LEVEL RECORD

Time	Water Level (m)	Depth to Cave (m)
on completion	3.7	10.7
June 20/2001	1.39	Piez
June 26/2001	2.96	Piez
		BH104

S & P Shaheen and Peaker Limited
Consulting Engineers

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

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

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

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

Dynamic Cone Penetration Resistance; N_d:

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

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u,s_u	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. General

π	3.1416
in x,	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\ \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
v	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma$-u)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma$- $\gamma_{w)}$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s/\ \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_1	liquid limit
w_p	plastic limit
l_p	plasticity index $= (w_1 - w_p)$
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p)/I_p$
I_C	consistency index $= (w_1 - w)\ /I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e)\ /\ (e_{max}$ - $e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	over-consolidation ratio $= \sigma'_p/\sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u,s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

Notes:

1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

* density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-121

SHEET 1 OF 3

Toronto Transit Commission

LOCATION: N 4845794.1 ;E 307649.5

BORING DATE: November 3, 2005

DATUM: Geodetic

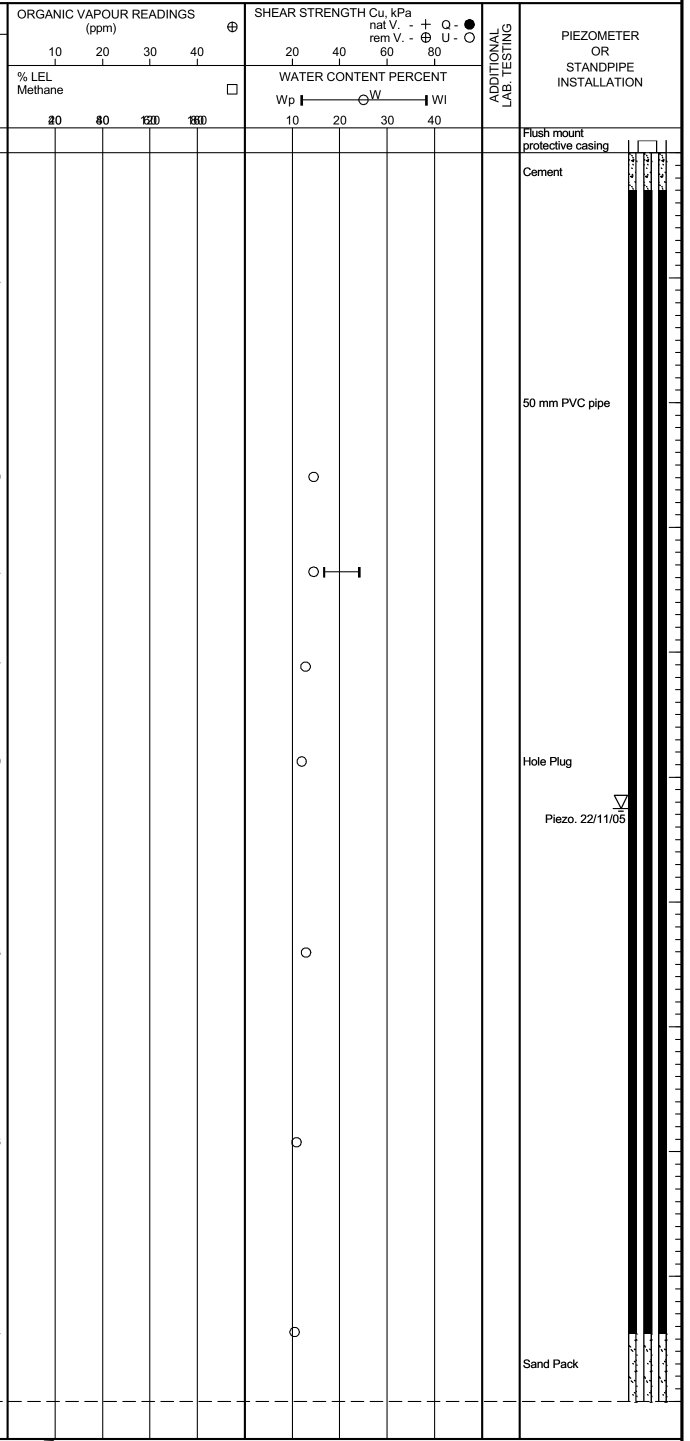
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers / Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
	GROUND SURFACE	197.92
0	TOPSOIL	0.00
	Stiff to hard, heterogeneous, moist, brown clayey SILT, trace sand, trace gravel, trace oxide stain; TILL (CL-ML)	197.71 0.21
6	Stiff to very stiff, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	191.82 6.10
10	*CONTINUED NEXT PAGE*	

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1	50 DO	27
2	50 DO	9
3	50 DO	20
4	50 DO	24
5	50 DO	27
6	50 DO	39
7	50 DO	13
8	50 DO	16
9	50 DO	14



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-121

SHEET 2 OF 3

Toronto Transit Commission

LOCATION: N 4845794.1 ;E 307649.5

BORING DATE: November 3, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

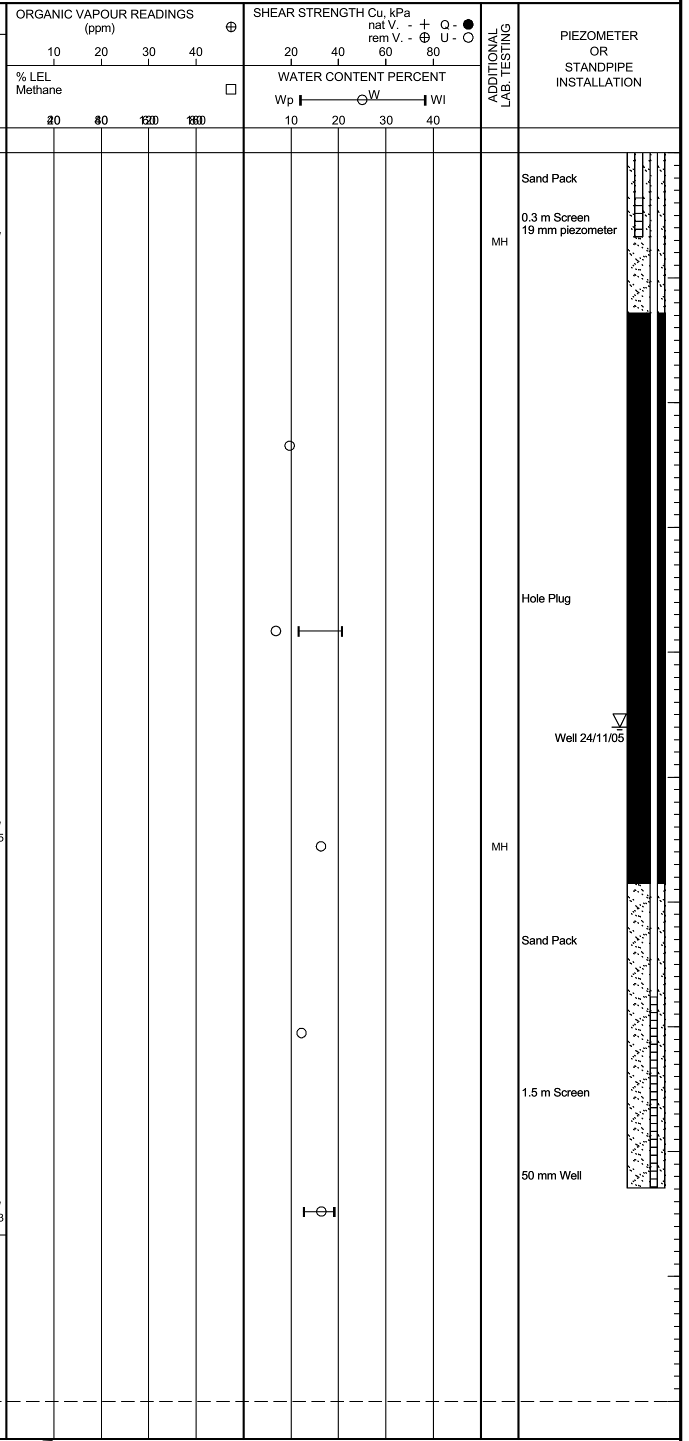
BORING METHOD: Power Auger, 108 mm I.D. Augers / Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
	--- CONTINUED FROM PREVIOUS PAGE ---	
10	Stiff to very stiff, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	
	Hard, heterogeneous, moist, grey silty SAND, some gravel, trace clay; TILL (SM)	187.25 10.67
	Hard, heterogeneous, dry to moist, grey SILT to clayey SILT, trace to some sand, trace gravel; TILL (CL-ML)	186.34 11.58
	Very dense, heterogeneous, moist, grey sandy SILT, some clay (np)	182.45 15.47
	Hard, heterogeneous, moist, grey clayey SILT, trace to some sand, trace gravel; TILL (CL-ML)	15.64
	END OF BOREHOLE	179.25 18.67
20	*CONTINUED NEXT PAGE*	

NOTES:

1. Monitoring well installed at 18.29 m depth (Elev. 179.63 m); piezometer installed at 10.17 m depth (Elev. 187.25 m).

SAMPLES NUMBER	TYPE	BLOWS/0.3m
10	50 DO	50/ .01
11	50 DO	84
12	50 DO	85
13A 13B	50 DO	80/ 0.25
14	50 DO	65
15	50 DO	78/ 0.23



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-121

SHEET 3 OF 3

LOCATION: N 4845794.1 ;E 307649.5

BORING DATE: November 3, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40; % LEL Methane □ 40 80 120 160 | SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

--- CONTINUED FROM PREVIOUS PAGE ---

20

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	7.55	190.37
04/11/05	5.25	192.67
22/11/05	5.25	192.67

Deep/Well

Date	Depth (m)	Elev (m)
On completion	14.4	183.52
04/11/05	14.8	183.12
22/11/05	14.8	183.12
24/11/05	14.6	183.32

21 22 23 24 25 26 27 28 29 30

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NK

CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-122

SHEET 1 OF 3

LOCATION: N 4845857.7 ;E 307292.2

BORING DATE: November 26, 2005

DATUM: Geodetic

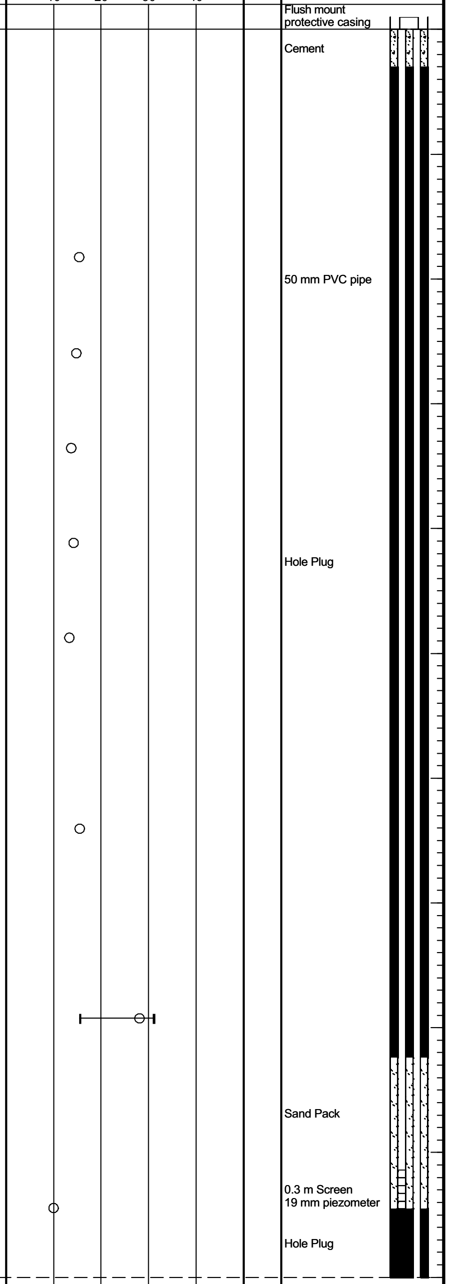
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40; % LEL Methane □ 40 80 120 160 | SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

BORING METHOD: Power Auger, 108 mm I.D. Augers / Hollow Stem Augers

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	198.01			
0	TOPSOIL	0.00			
	Firm to very stiff, heterogeneous, moist, brown clayey SILT, trace sand, trace gravel; TILL (CL-ML)	0.13			
1			1	50 DO	5
2			2	50 DO	16
			3	50 DO	26
3	Thin seam of brown fine sand at 3.05 m depth				
			4	50 DO	25
4			5	50 DO	25
5			6	50 DO	22
6	Stiff to very stiff, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	191.91 6.10	7	50 DO	11
7					
8			8	50 DO	11
9	Thin seam of grey fine sand at 9.45 m depth		9	50 DO	23
10					



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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SB

CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-122

SHEET 2 OF 3

LOCATION: N 4845857.7 ;E 307292.2

BORING DATE: November 26, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

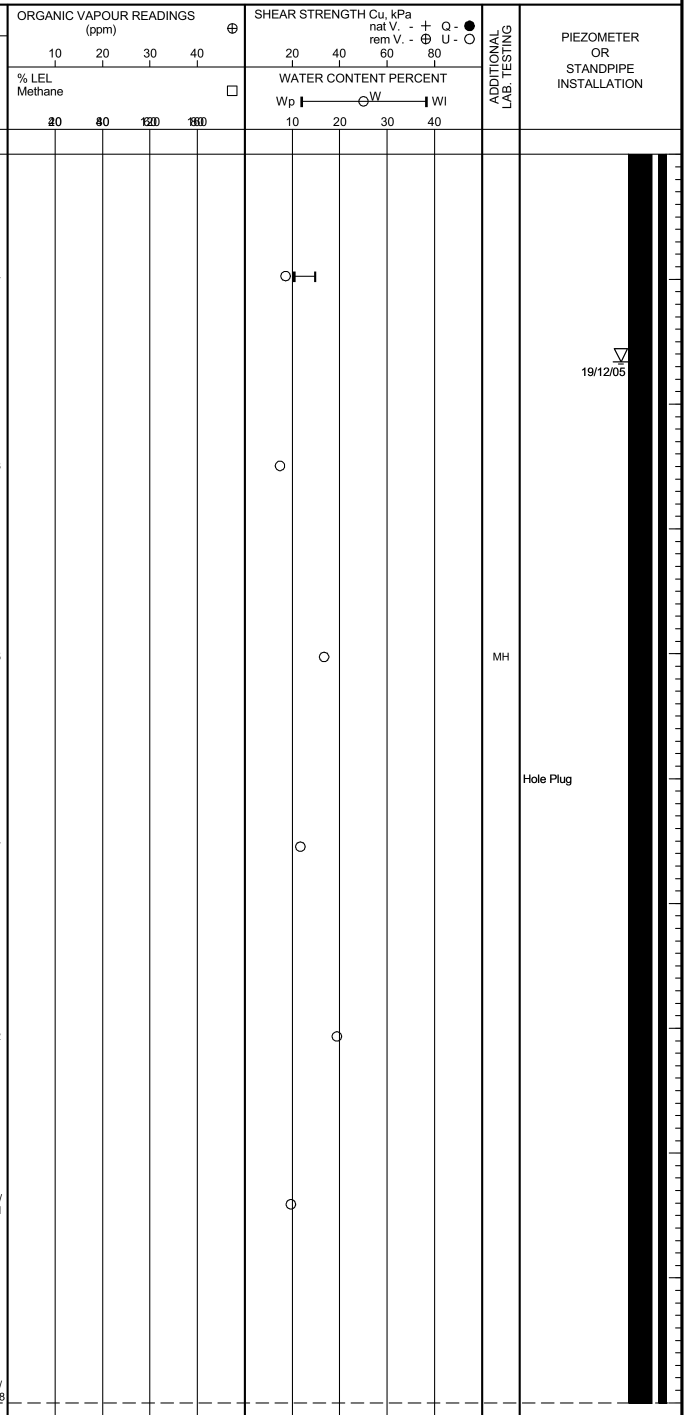
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers
Hollow Stem Augers

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
10	Stiff to very stiff, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	
12.50	Compact to very dense, heterogenous, moist to wet, grey fine sandy SILT, some clay, trace gravel (np)	185.51 12.50
15.24	Compact, heterogenous, subangular, moist to wet, grey, medium to coarse SAND with gravel, trace clay (SW)	182.77 15.24
18.29	Very dense, heterogeneous, subangular, moist, grey silty SAND with gravel, trace clay (SM)	179.72 18.29
19.81		178.20 19.81

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	50 DO	24	
11	50 DO	58	
12	50 DO	15	MH
13	50 DO	27	
14	50 DO	22	
15	50 DO	50/ 0.1	
16	50 DO	76/ 0.28	



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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SB
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-122

SHEET 3 OF 3

LOCATION: N 4845857.7 ;E 307292.2

BORING DATE: November 26, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

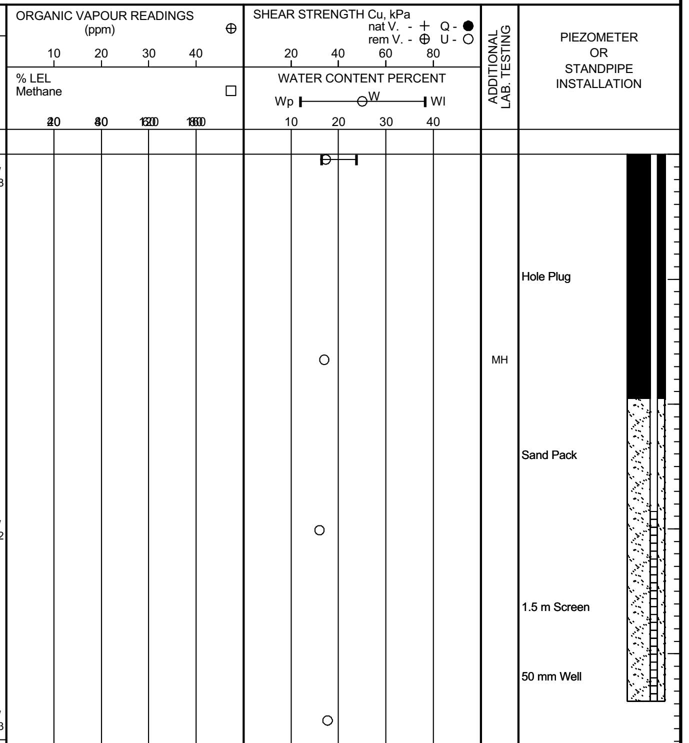
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers
Hollow Stem Augers

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
20	Hard, heterogeneous, subangular, moist, grey clayey SILT, trace to some gravel, trace sand; TILL (CL-ML)	
21.34	Dense, heterogenous, subangular, moist to wet, grey fine SAND and SILT, trace clay (np)	176.67 21.34
22.56	Very dense, heterogeneous, subangular, moist, grey, fine to medium SAND (SW)	175.45 22.56
24.69	END OF BOREHOLE	173.32 24.69

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
16	50 DO	76/ 0.28	
17	50 DO	46	MH
18	50 DO	55/ .012	
19	50 DO	50/ 0.13	



NOTES:

1. Drilling took place over two days due to break down of drilling equipment.

2. Monitoring well installed at 24.38 m depth (Elev. 173.63 m); piezometer installed at 4.45 m depth (Elev. 188.56 m).

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	dry	dry

Deep/Well

Date	Depth (m)	Elev (m)
On completion	8.25	189.76
09/12/05	11.66	186.35

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SB
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-123

SHEET 1 OF 3

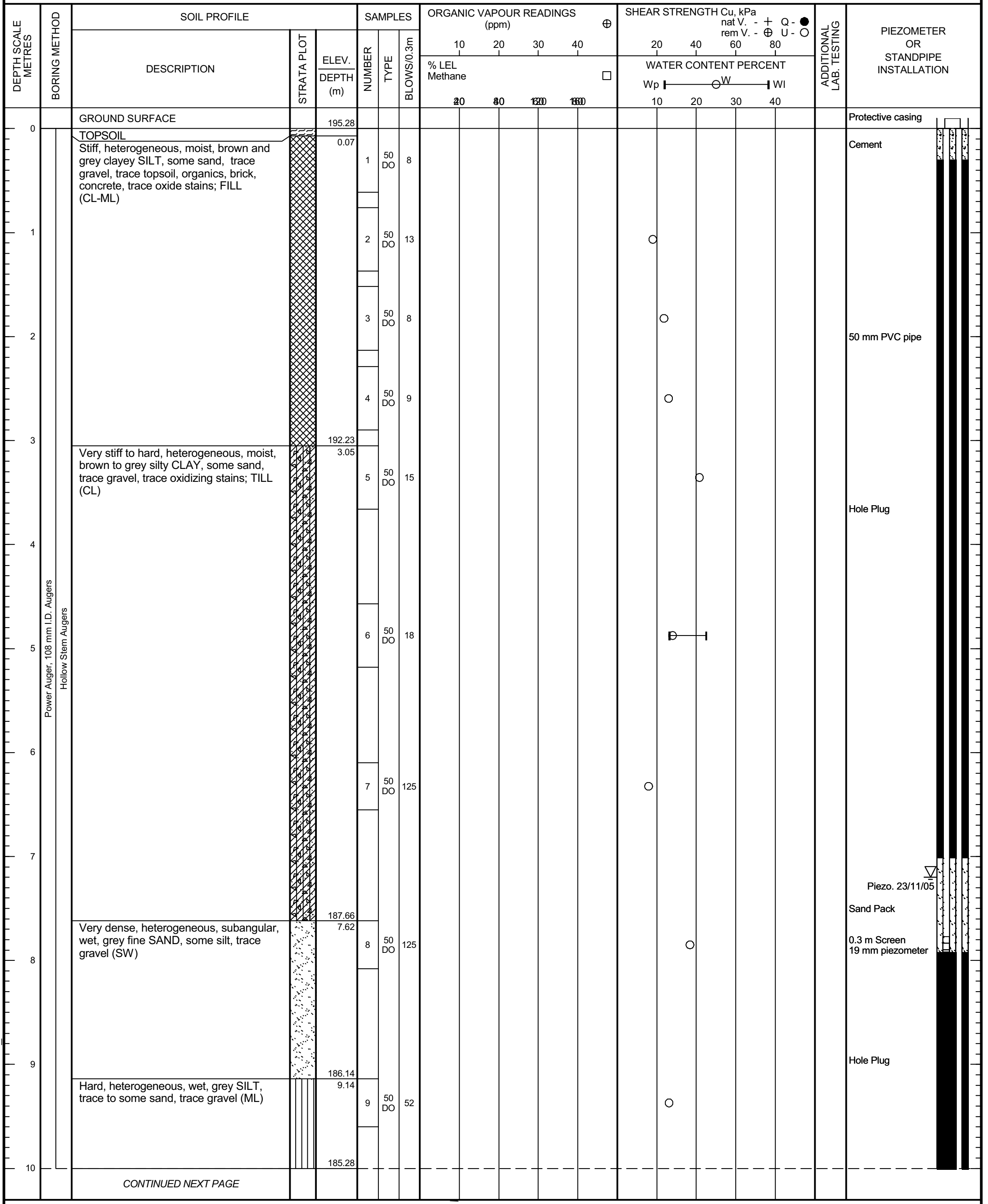
LOCATION: N 4845858.1 ;E 306632.9

BORING DATE: November 10, 11, 14, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	195.28
TOPSOIL	0.07
Stiff, heterogeneous, moist, brown and grey clayey SILT, some sand, trace gravel, trace topsoil, organics, brick, concrete, trace oxide stains; FILL (CL-ML)	192.23 3.05
Very stiff to hard, heterogeneous, moist, brown to grey silty CLAY, some sand, trace gravel, trace oxidizing stains; TILL (CL)	187.66 7.62
Very dense, heterogeneous, subangular, wet, grey fine SAND, some silt, trace gravel (SW)	186.14 9.14
Hard, heterogeneous, wet, grey SILT, trace to some sand, trace gravel (ML)	185.28

NUMBER	TYPE	BLOWS/0.3m
1	50 DO	8
2	50 DO	13
3	50 DO	8
4	50 DO	9
5	50 DO	15
6	50 DO	18
7	50 DO	125
8	50 DO	125
9	50 DO	52

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MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PKS

CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-123

SHEET 2 OF 3

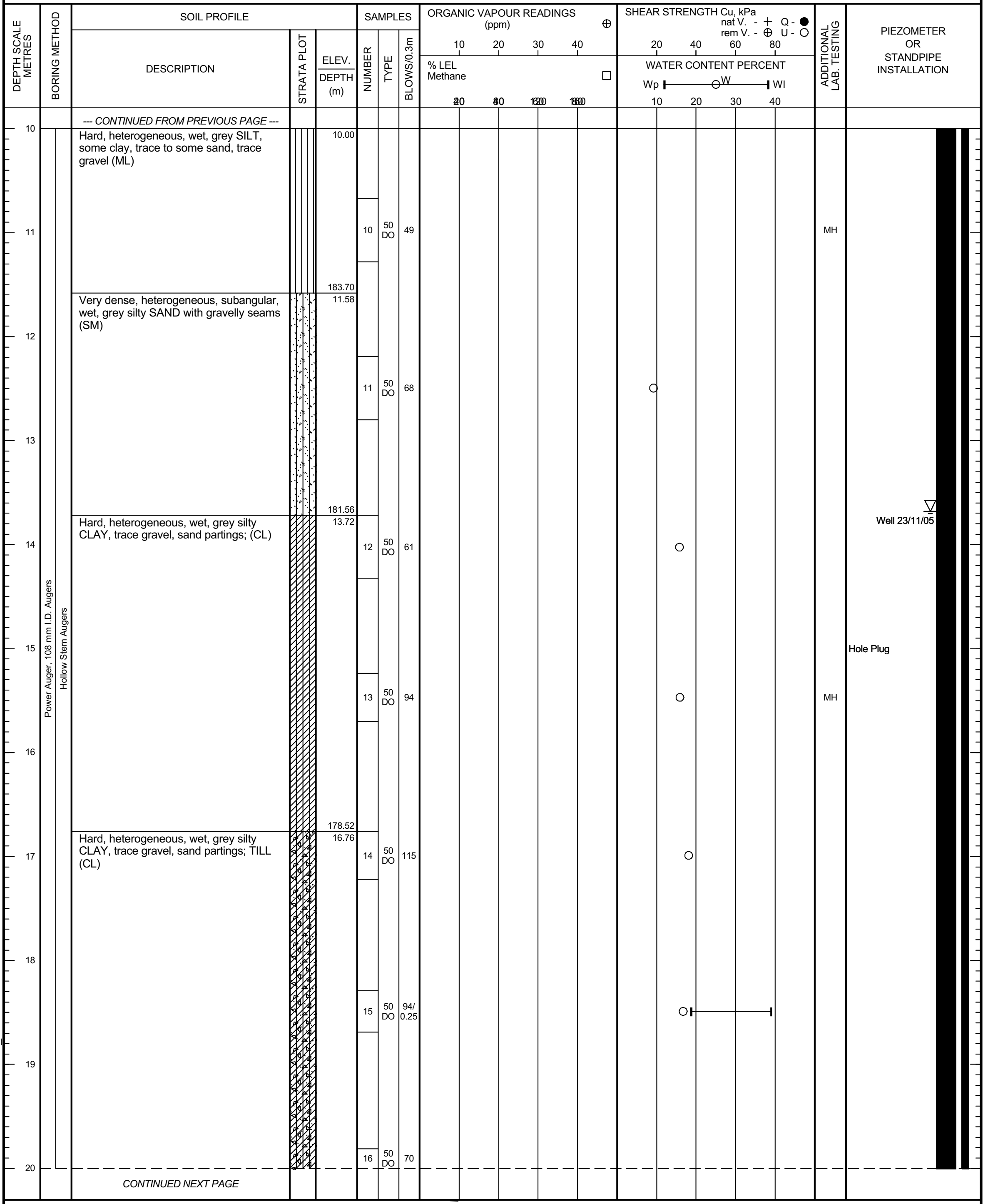
LOCATION: N 4845858.1 ;E 306632.9

BORING DATE: November 10, 11, 14, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



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DESCRIPTION	ELEV. / DEPTH (m)
Hard, heterogeneous, wet, grey SILT, some clay, trace to some sand, trace gravel (ML)	10.00
Very dense, heterogeneous, subangular, wet, grey silty SAND with gravelly seams (SM)	183.70 11.58
Hard, heterogeneous, wet, grey silty CLAY, trace gravel, sand partings; (CL)	181.56 13.72
Hard, heterogeneous, wet, grey silty CLAY, trace gravel, sand partings; TILL (CL)	178.52 16.76

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	50 DO	49	MH
11	50 DO	68	
12	50 DO	61	
13	50 DO	94	MH
14	50 DO	115	
15	50 DO	94/ 0.25	
16	50 DO	70	

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MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: PKS

CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-123

SHEET 3 OF 3

LOCATION: N 4845858.1 ;E 306632.9

BORING DATE: November 10, 11, 14, 2005

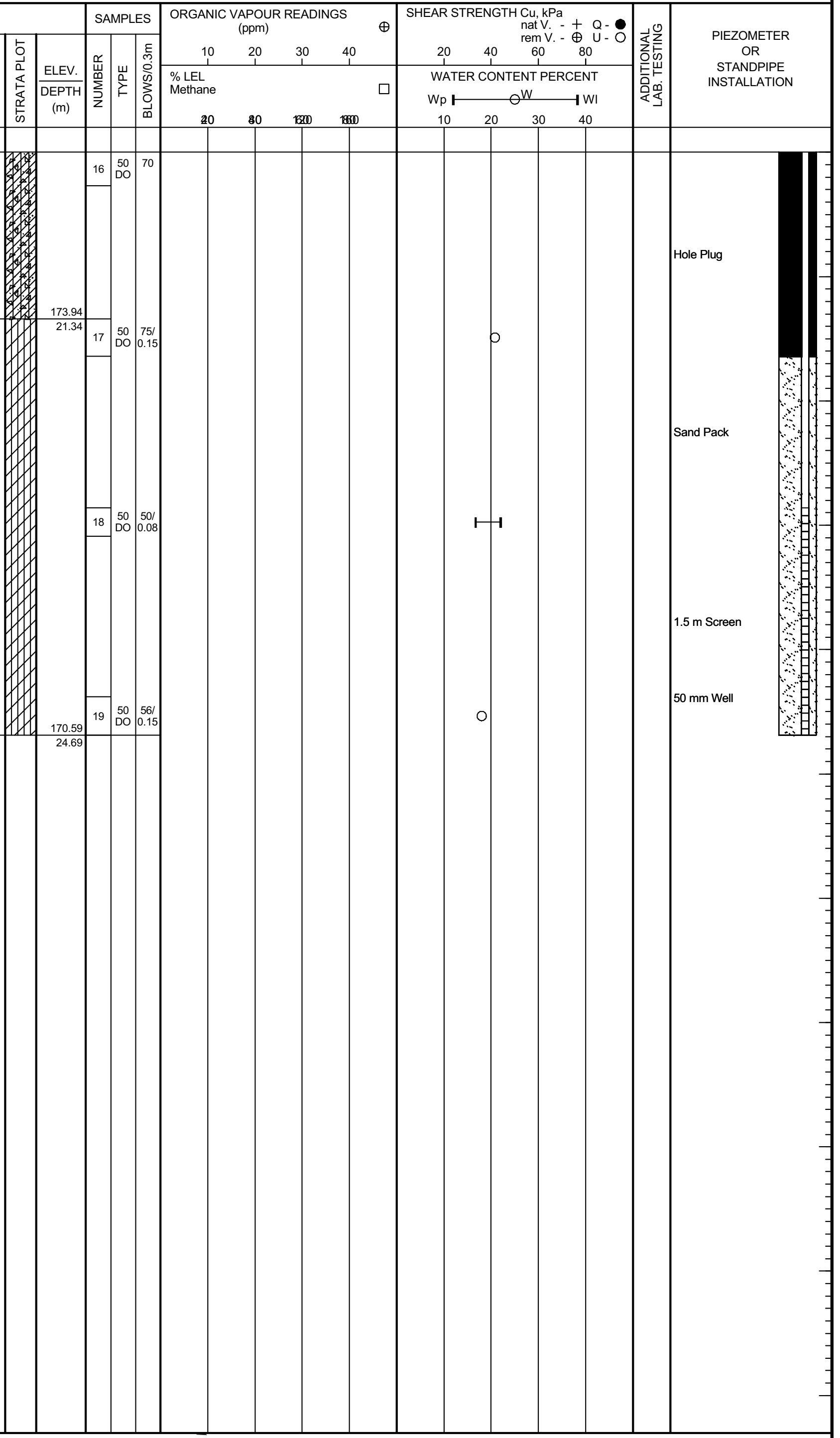
DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 108 mm I.D. Augers; Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
	--- CONTINUED FROM PREVIOUS PAGE ---				
20	Hard, heterogeneous, wet, grey silty CLAY, trace gravel, sand partings; TILL (CL)		16	50 DO	70
21.34	Hard, heterogeneous, wet, grey clayey SILT, trace sand with layers of silt (CL-ML)	173.94 21.34	17	50 DO	75/ 0.15
			18	50 DO	50/ 0.08
			19	50 DO	56/ 0.15
24.69	END OF BOREHOLE	170.59 24.69			



NOTES:

1. Drilling took place over three days due to breakdown of drilling equipment.

2. Well casing left at 1.0 m above ground surface.

3. Monitoring well installed at 24.38 m depth (Elev. 170.9 m); piezometer installed at 7.92 m depth (Elev. 187.36 m).

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	7.62	187.66
23/11/05	7.20	188.08

Deep/Well

Date	Depth (m)	Elev (m)
On completion	4.04	191.24
23/11/05	13.68	181.60

DEPTH SCALE
1 : 50

LOGGED: PKS
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-124

SHEET 1 OF 3

LOCATION: N 4845793.3 ;E 306429.3

BORING DATE: November 14, 15, 16, 2005

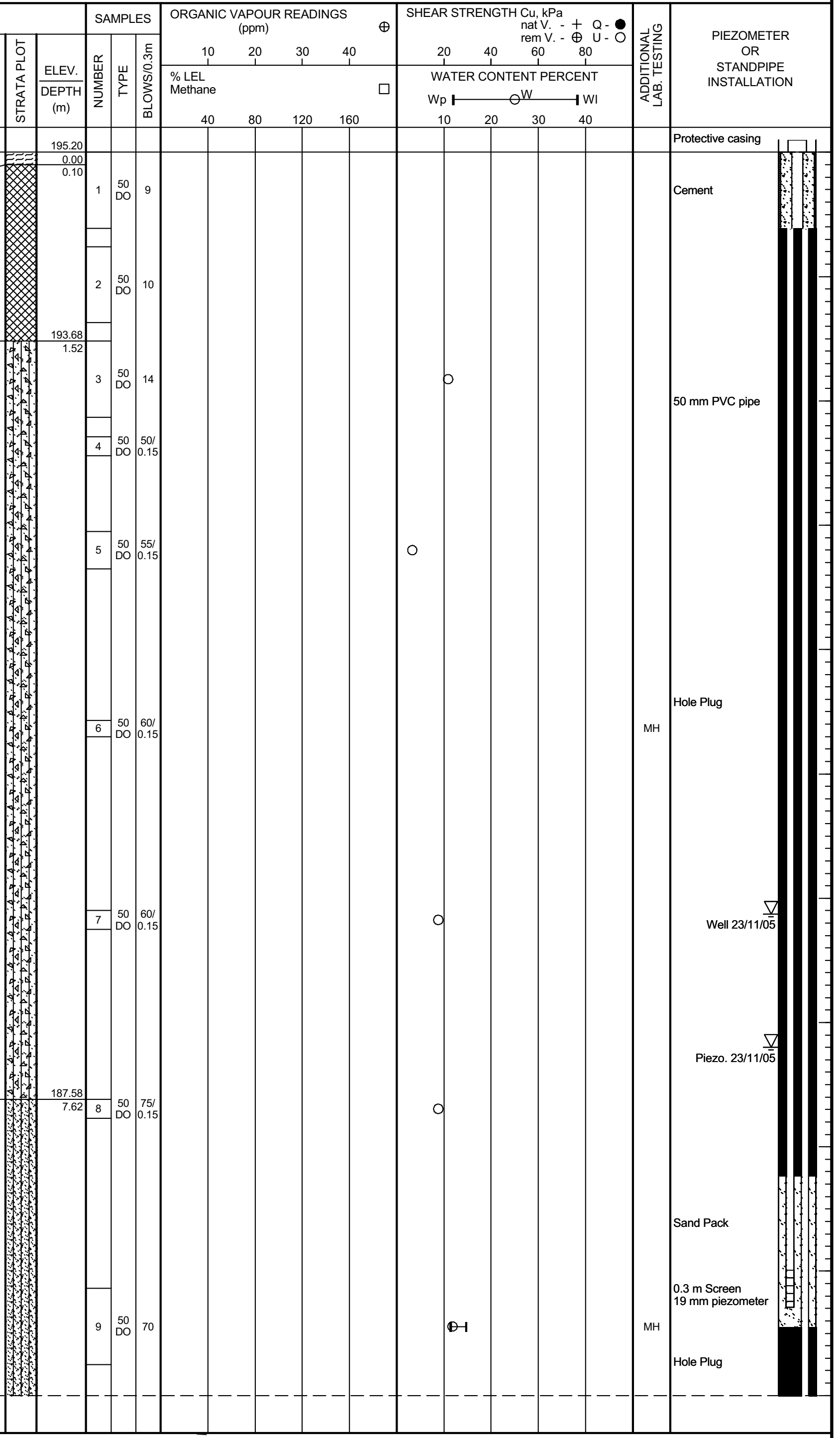
DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 108 mm I.D. Augers; Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	195.20				
0	Sandy TOPSOIL	0.00				
0.10	Compact, heterogeneous, subangular, moist, brown silty SAND, trace gravel, trace organics; FILL (SM)	0.10	1	50 DO	9	
			2	50 DO	10	
1.52	Stiff to hard, heterogeneous, moist, brown sandy SILT, some gravel, trace clay, occasional cobbles; TILL (ML)	193.68 1.52	3	50 DO	14	
			4	50 DO	50/ 0.15	
			5	50 DO	55/ 0.15	
			6	50 DO	60/ 0.15	MH
	Wet and brown below 6.1 m depth		7	50 DO	60/ 0.15	
7.62	Very dense, heterogeneous, wet, grey sandy SILT, trace clay, trace gravel; (np)	187.58 7.62	8	50 DO	75/ 0.15	
			9	50 DO	70	MH
10	CONTINUED NEXT PAGE					



DEPTH SCALE
1 : 50

LOGGED: PKS
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-124

SHEET 2 OF 3

LOCATION: N 4845793.3 ;E 306429.3

BORING DATE: November 14, 15, 16, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

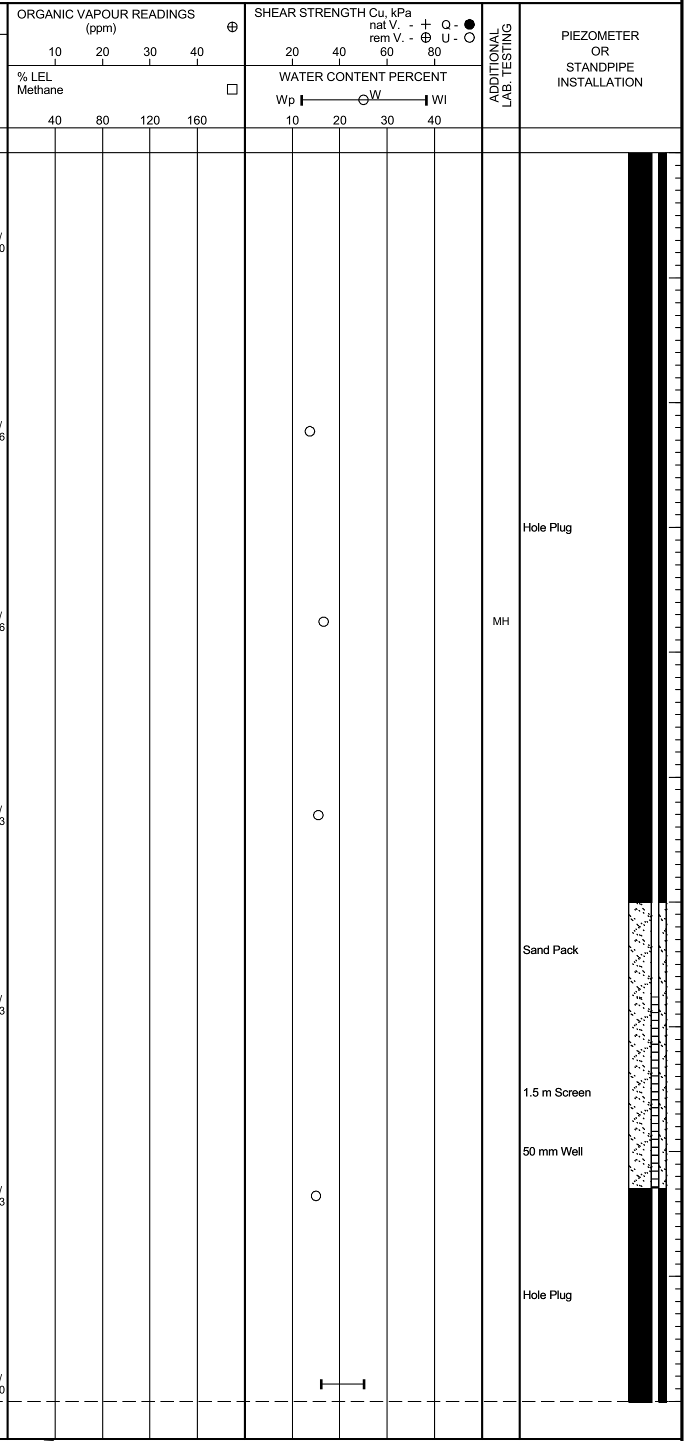
Toronto Transit Commission

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Power Auger, 108 mm I.D. Augers / Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
10	Very dense, heterogeneous, wet, grey sandy SILT, trace clay, trace gravel; (np)	
12.19	Hard, heterogeneous, wet, SILT with sand, trace clay, trace gravel, containing seams of silty clay with sand partings (ML)	183.01 12.19
18.29	Hard, heterogeneous, wet, grey silty CLAY, trace sand, trace gravel, fine sand partings (CL)	176.91 18.29

SAMPLES NUMBER	TYPE	BLOWS/0.3m
10	50 DO	50/ 0.10
11	50 DO	50/ 0.76
12	50 DO	50/ 0.76
13	50 DO	60/ .013
14	50 DO	75/ 0.13
15	50 DO	60/ .013
16	50 DO	60/ 0.10



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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PKS
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-124

SHEET 3 OF 3

LOCATION: N 4845793.3 ;E 306429.3

BORING DATE: November 14, 15, 16, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Power Auger, 108 mm I.D. Augers / Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
20	Hard, heterogeneous, wet, grey silty CLAY, trace sand, trace gravel, fine sand partings (CL)	
24.54	END OF BOREHOLE	170.66 24.54

SAMPLES NUMBER	TYPE	BLOWS/0.3m
17	50 DO	50/ 0.1
18	50 DO	65/ 0.15
19	50 DO	55/ 0.15

NOTES:

1. Drilling took place over three days due to breakdown of drilling equipment.

2. Well casing left at 1.0 m above ground surface.

3. Monitoring well installed at 18.29 m depth (Elev. 176.91 m); piezometer installed at 9.14 m depth (Elev. 186.06 m).

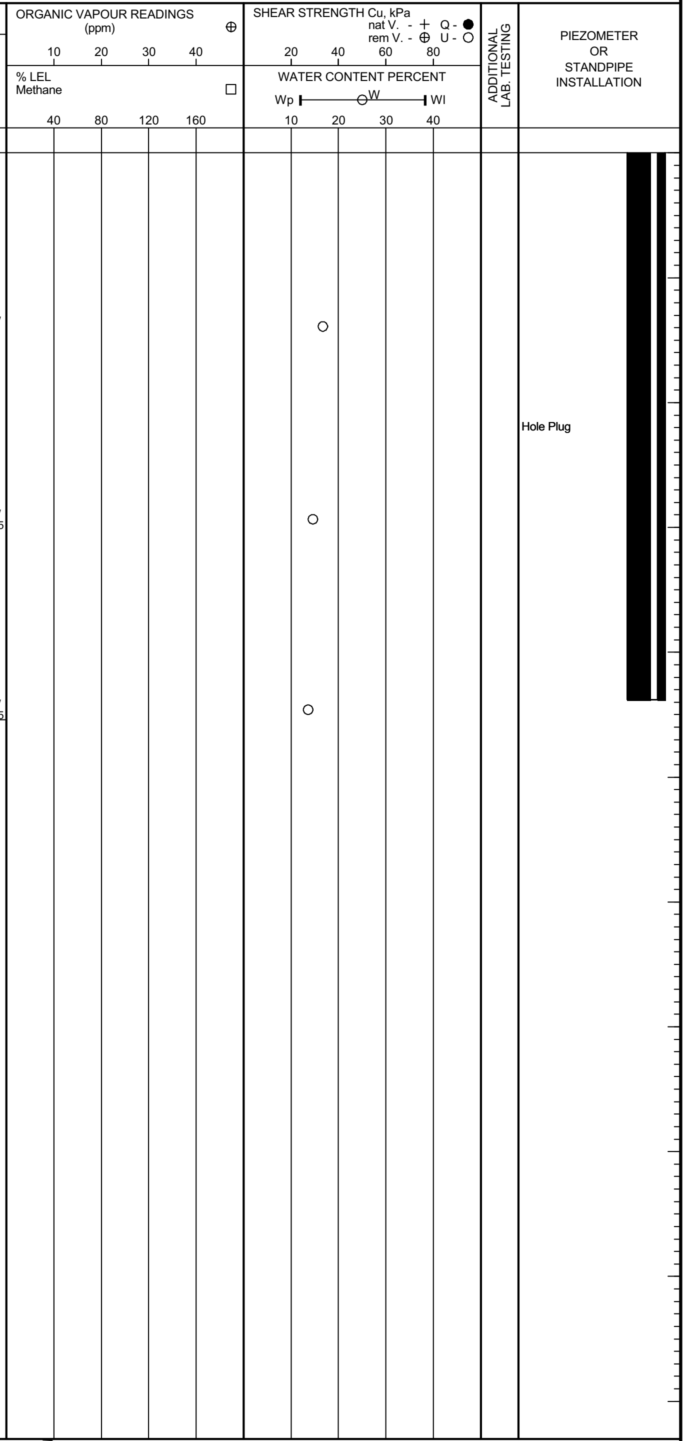
Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	8.40	186.80
23/11/05	7.20	188.00

Deep/Well

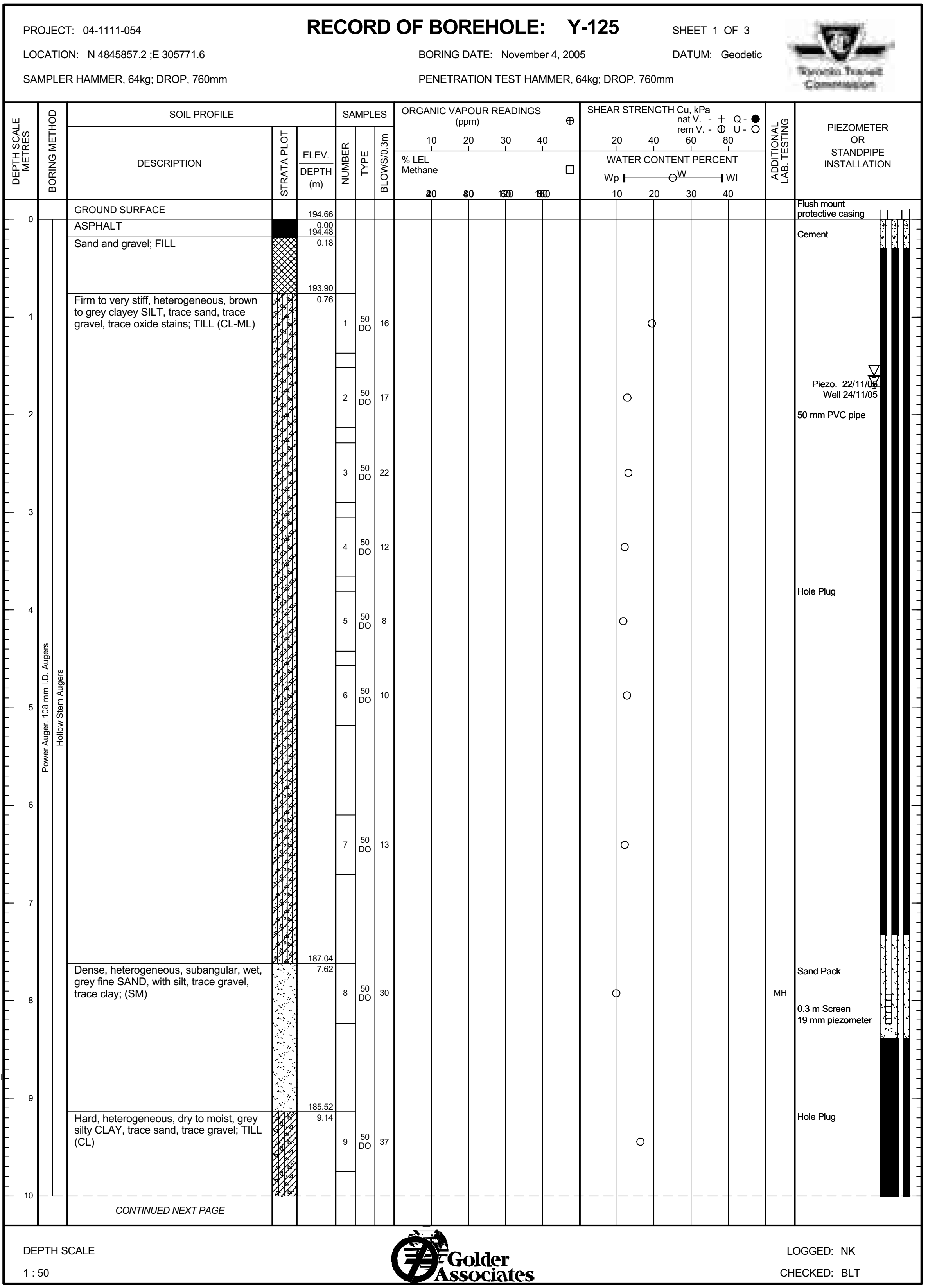
Date	Depth (m)	Elev (m)
On completion	6.80	188.40
23/11/05	6.13	189.07



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: PKS
CHECKED: NK/BLT



PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-125

SHEET 1 OF 3

LOCATION: N 4845857.2 ;E 305771.6

BORING DATE: November 4, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers; Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	194.66
ASPHALT	0.00
Sand and gravel; FILL	194.48 0.18
Firm to very stiff, heterogeneous, brown to grey clayey SILT, trace sand, trace gravel, trace oxide stains; TILL (CL-ML)	193.90 0.76
Dense, heterogeneous, subangular, wet, grey fine SAND, with silt, trace gravel, trace clay; (SM)	187.04 7.62
Hard, heterogeneous, dry to moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	185.52 9.14

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	50 DO	16	
2	50 DO	17	
3	50 DO	22	
4	50 DO	12	
5	50 DO	8	
6	50 DO	10	
7	50 DO	13	
8	50 DO	30	MH
9	50 DO	37	

PIEZOMETER OR STANDPIPE INSTALLATION:

Flush mount protective casing

Cement

Piezo. 22/11/05

Well 24/11/05

50 mm PVC pipe

Hole Plug

Sand Pack

0.3 m Screen

19 mm piezometer

Hole Plug

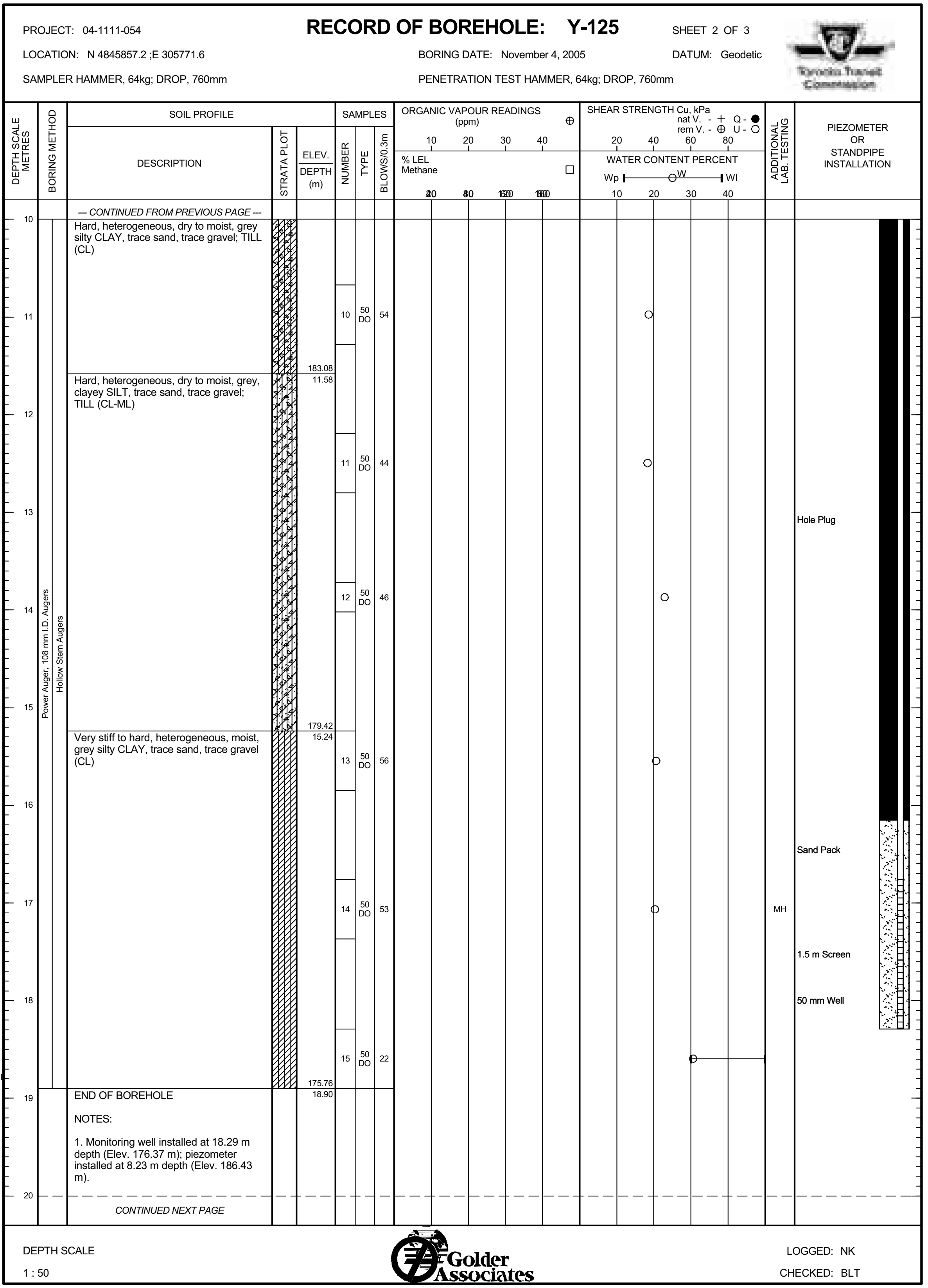
CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: NK

CHECKED: BLT



PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-125

SHEET 2 OF 3

LOCATION: N 4845857.2 ;E 305771.6

BORING DATE: November 4, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Power Auger, 108 mm I.D. Augers; Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
Hard, heterogeneous, dry to moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	
Hard, heterogeneous, dry to moist, grey, clayey SILT, trace sand, trace gravel; TILL (CL-ML)	183.08 11.58
Very stiff to hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel (CL)	179.42 15.24
END OF BOREHOLE	175.76 18.90

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	50 DO	54	
11	50 DO	44	
12	50 DO	46	
13	50 DO	56	
14	50 DO	53	MH
15	50 DO	22	

NOTES:

1. Monitoring well installed at 18.29 m depth (Elev. 176.37 m); piezometer installed at 8.23 m depth (Elev. 186.43 m).

PIEZOMETER OR STANDPIPE INSTALLATION:

Hole Plug

Sand Pack

1.5 m Screen

50 mm Well

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

LOGGED: NK

CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-125

SHEET 3 OF 3

LOCATION: N 4845857.2 ;E 305771.6

BORING DATE: November 4, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40 / % LEL Methane □ 20 40 60 80	SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80 / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		— CONTINUED FROM PREVIOUS PAGE —									
20		Water level measurements									

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	0.30	194.36
22/11/05	1.60	193.06

Deep/Well

Date	Depth (m)	Elev (m)
On completion	0.30	194.36
22/11/05	1.70	192.96
24/11/05	1.71	192.95

21

22

23

24

25

26

27

28

29

30

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-126

SHEET 1 OF 3

LOCATION: N 4846199.8 ;E 305637.1

BORING DATE: October 21, 2005

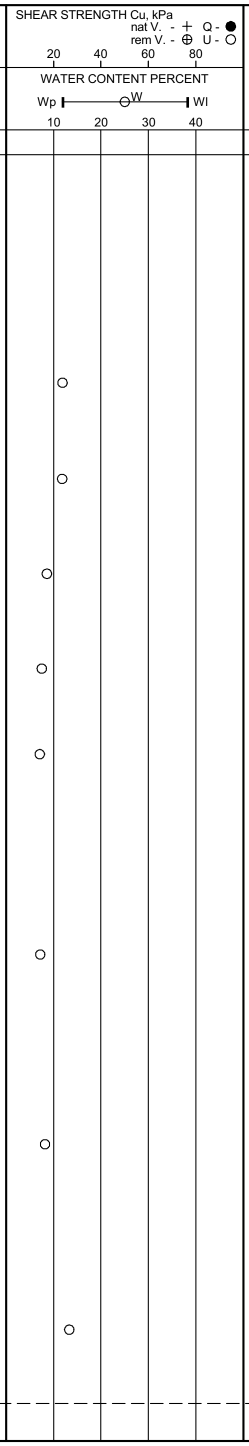
DATUM: Geodetic

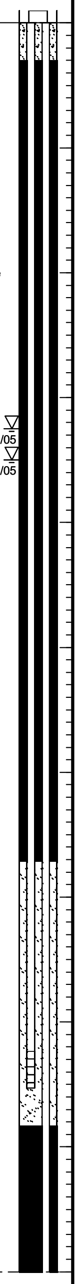
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	194.96					Flush mount protective casing
0	Power Auger, 108 mm I.D. Augers Hollow Stem Augers	TOPSOIL	0.00					Cement
		Stiff to very stiff, heterogeneous, moist, brown clayey SILT, trace sand, trace gravel, trace oxide stains; TILL (CL-ML)	0.15					
1				1	50 DO	10		
2				2	50 DO	18		50 mm PVC pipe
		Compact to very dense, heterogeneous, moist, brown sandy SILT, trace clay; TILL (np)	192.67 2.29	3	50 DO	29		
3				4	50 DO	51		Well 24/11/05 Hole Plug Piezo. 24/11/05
4		Dense to very dense, moist, grey sandy SILT, trace gravel, trace clay (np)	191.15 3.81	5	50 DO	33		
5				6	50 DO	88	MH	
6				7	50 DO	66		
7								Sand Pack
8		Becoming wet at 7.6 m depth		8	50 DO	53		0.3 m Screen 19 mm piezometer
9		Very dense, heterogeneous, subangular, wet, grey SAND with gravel, trace silt (SW)	185.82 9.14	9A	50 DO	57		Hole Plug
		Very dense, heterogeneous, subangular, moist to wet, grey silty SAND, trace clay, trace gravel; TILL (SM)	185.57 9.39	9B				
10		CONTINUED NEXT PAGE						





DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SB/NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-126

SHEET 2 OF 3

LOCATION: N 4846199.8 ;E 305637.1
BORING DATE: October 21, 2005
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

BORING METHOD: Power Auger, 108 mm I.D. Augers
Hollow Stem Augers

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	Very dense, heterogeneous, subangular, moist to wet, grey silty SAND, trace clay, trace gravel; TILL (SM) Seams of grey sand from 10.7 m to 11 m depth		10	50 DO	87/ 0.28	
11.58	Compact, heterogeneous, wet, grey SILT and SAND, trace clay, trace gravel (np)	183.38 11.58	11	50 DO	30	MH
13.41	Hard to very stiff, homogenous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	181.55 13.41	12	50 DO	45	
			13	50 DO	70	
			14	50 DO	49	
			15	50 DO	25	
18.90	END OF BOREHOLE	176.06 18.90				

NOTES:

1. Monitoring well installed at 12.95 m depth (Elev. 176.37 m); piezometer installed at 8.53 m depth (Elev. 186.43 m).

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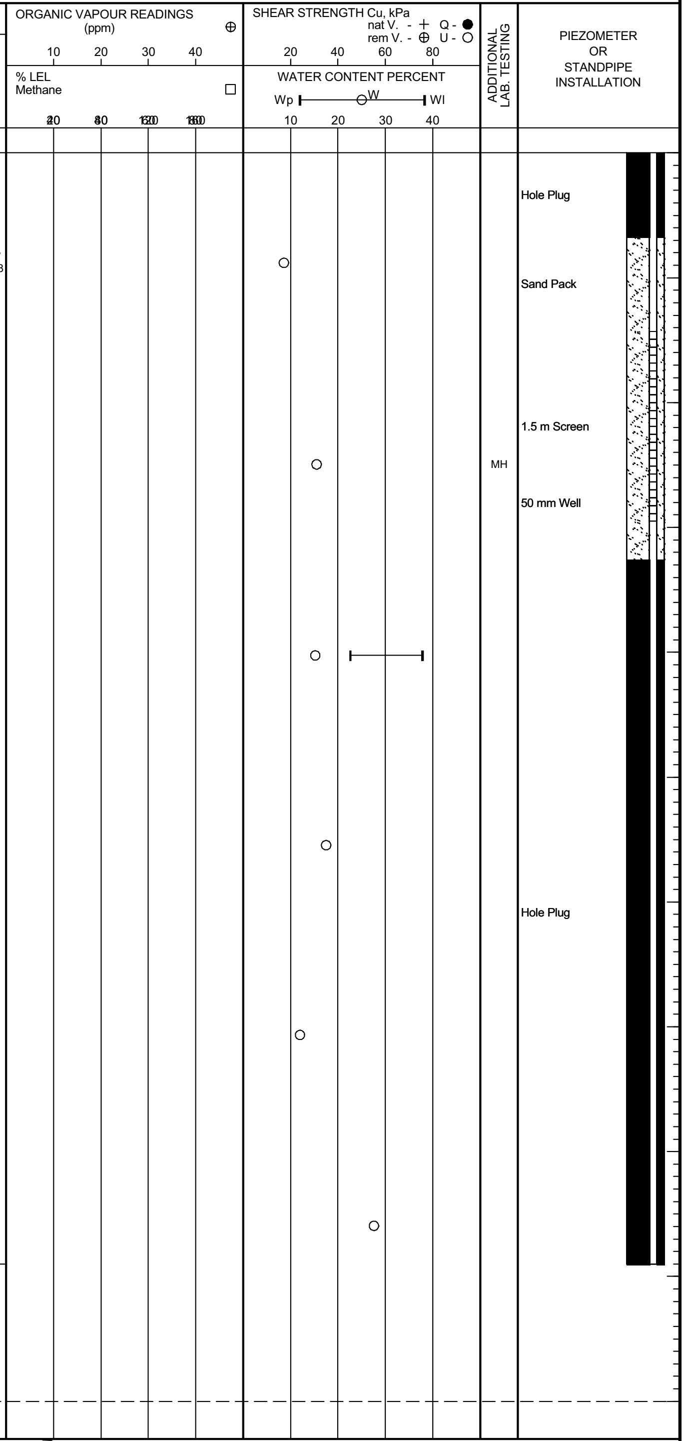


DEPTH SCALE
1 : 50

LOGGED: SB/NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-126

SHEET 3 OF 3

LOCATION: N 4846199.8 ;E 305637.1
BORING DATE: October 21, 2005
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

Water level measurements

Shallow/Piezometer

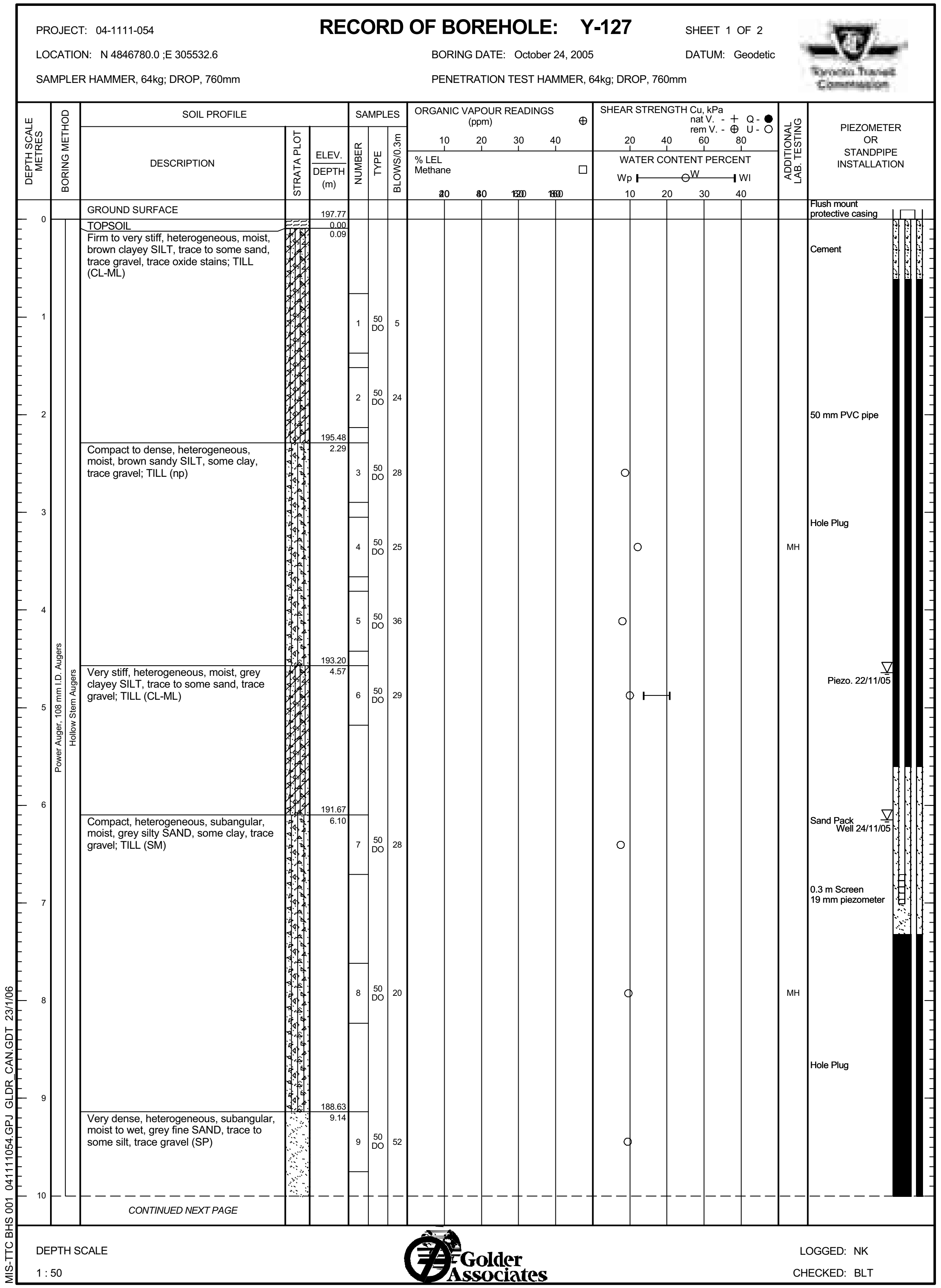
Date	Depth (m)	Elev (m)
On completion	4.3	190.66
22/11/05	2.8	192.16
24/11/05	3.5	191.46

Deep/Well

Date	Depth (m)	Elev (m)
On completion	2.52	192.44
22/11/05	3.25	191.71
24/11/05	3.25	191.71

DEPTH SCALE
1 : 50

LOGGED: SB/NK
CHECKED: BLT



PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-127

SHEET 1 OF 2

LOCATION: N 4846780.0 ;E 305532.6

BORING DATE: October 24, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	197.77				
TOPSOIL	0.00				
Firm to very stiff, heterogeneous, moist, brown clayey SILT, trace to some sand, trace gravel, trace oxide stains; TILL (CL-ML)	0.09				
		1	50 DO	5	
		2	50 DO	24	
Compact to dense, heterogeneous, moist, brown sandy SILT, some clay, trace gravel; TILL (np)	195.48 2.29	3	50 DO	28	
		4	50 DO	25	MH
		5	50 DO	36	
Very stiff, heterogeneous, moist, grey clayey SILT, trace to some sand, trace gravel; TILL (CL-ML)	193.20 4.57	6	50 DO	29	
Compact, heterogeneous, subangular, moist, grey silty SAND, some clay, trace gravel; TILL (SM)	191.67 6.10	7	50 DO	28	
		8	50 DO	20	MH
Very dense, heterogeneous, subangular, moist to wet, grey fine SAND, trace to some silt, trace gravel (SP)	188.63 9.14	9	50 DO	52	

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PIEZOMETER OR STANDPIPE INSTALLATION:

Flush mount protective casing

Cement

50 mm PVC pipe

Hole Plug

Piezo. 22/11/05

Sand Pack

Well 24/11/05

0.3 m Screen

19 mm piezometer

Hole Plug

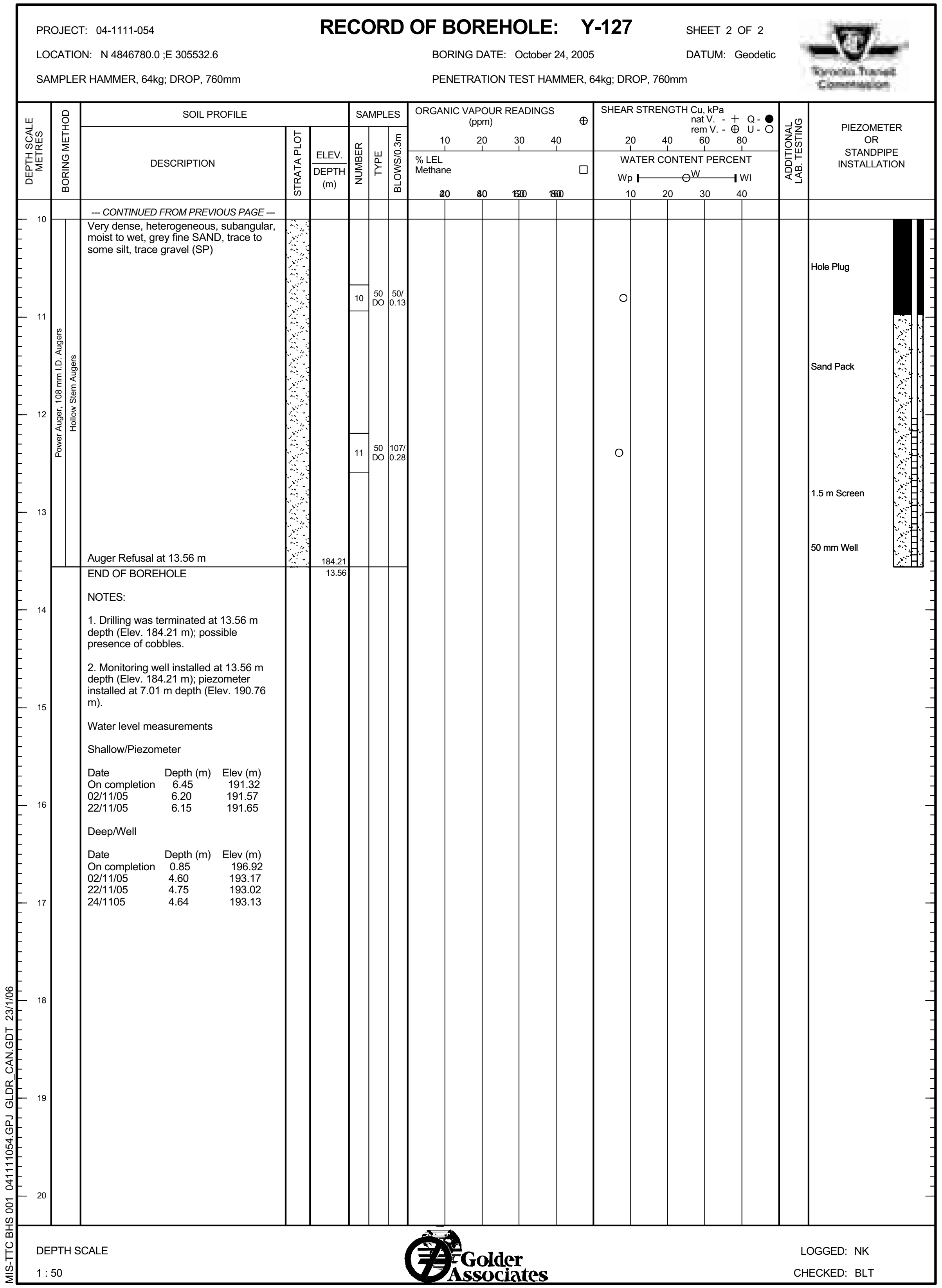
DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NK

CHECKED: BLT



PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-127

SHEET 2 OF 2

LOCATION: N 4846780.0 ;E 305532.6

BORING DATE: October 24, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
Very dense, heterogeneous, subangular, moist to wet, grey fine SAND, trace to some silt, trace gravel (SP)				
		10	50 DO	50/ 0.13
		11	50 DO	107/ 0.28
Auger Refusal at 13.56 m	184.21			
END OF BOREHOLE	13.56			

NOTES:

1. Drilling was terminated at 13.56 m depth (Elev. 184.21 m); possible presence of cobbles.

2. Monitoring well installed at 13.56 m depth (Elev. 184.21 m); piezometer installed at 7.01 m depth (Elev. 190.76 m).

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	6.45	191.32
02/11/05	6.20	191.57
22/11/05	6.15	191.65

Deep/Well

Date	Depth (m)	Elev (m)
On completion	0.85	196.92
02/11/05	4.60	193.17
22/11/05	4.75	193.02
24/1105	4.64	193.13

PIEZOMETER OR STANDPIPE INSTALLATION:

Hole Plug

Sand Pack

1.5 m Screen

50 mm Well

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NK

CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-128

SHEET 1 OF 3

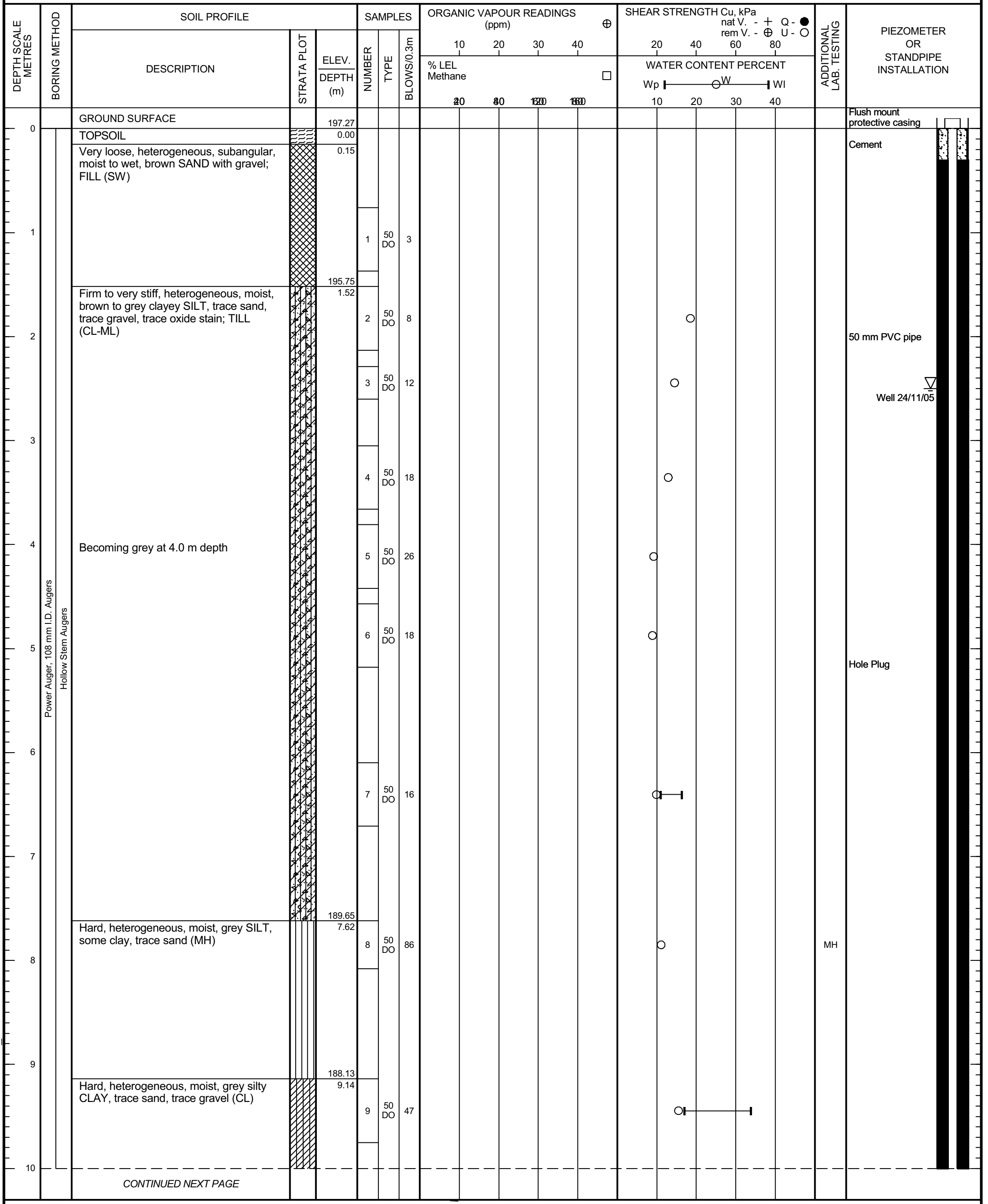
LOCATION: N 4847321.6 ;E 305430.1

BORING DATE: November 7, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	197.27
TOPSOIL	0.00
Very loose, heterogeneous, subangular, moist to wet, brown SAND with gravel; FILL (SW)	0.15
Firm to very stiff, heterogeneous, moist, brown to grey clayey SILT, trace sand, trace gravel, trace oxide stain; TILL (CL-ML) Becoming grey at 4.0 m depth	195.75 1.52
Hard, heterogeneous, moist, grey SILT, some clay, trace sand (MH)	189.65 7.62
Hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel (CL)	188.13 9.14

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	50 DO	3	
2	50 DO	8	
3	50 DO	12	
4	50 DO	18	
5	50 DO	26	
6	50 DO	18	
7	50 DO	16	
8	50 DO	86	MH
9	50 DO	47	

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MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

DEPTH SCALE
1 : 50

LOGGED: SB
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-128

SHEET 2 OF 3

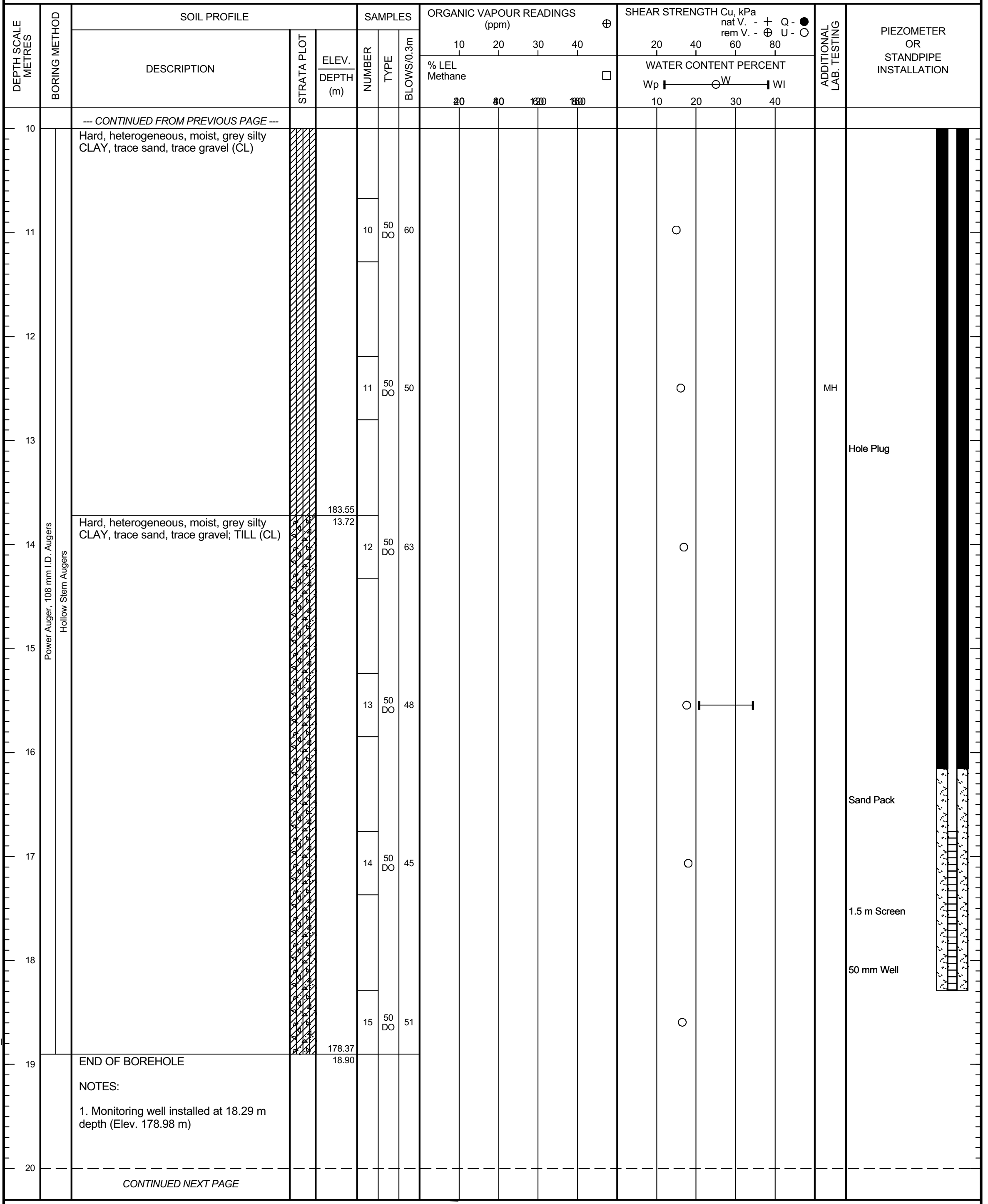
LOCATION: N 4847321.6 ;E 305430.1

BORING DATE: November 7, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm



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DESCRIPTION	ELEV. / DEPTH (m)
Hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel (CL)	
Hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	183.55 13.72
END OF BOREHOLE	178.37 18.90

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	50 DO	60	
11	50 DO	50	MH
12	50 DO	63	
13	50 DO	48	
14	50 DO	45	
15	50 DO	51	

NOTES:

1. Monitoring well installed at 18.29 m depth (Elev. 178.98 m)

CONTINUED NEXT PAGE

MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

DEPTH SCALE
1 : 50

LOGGED: SB
CHECKED: NK/BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-128

SHEET 3 OF 3

LOCATION: N 4847321.6 ;E 305430.1

BORING DATE: November 7, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40 / % LEL Methane □ 20 40 120 160	SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80 / WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m				
		--- CONTINUED FROM PREVIOUS PAGE ---									
20		Water level measurements									

Deep/Well

Date	Depth (m)	Elev (m)
On completion	5.30	191.97
22/11/05	2.35	194.92
24/11/05	2.50	194.77

21

22

23

24

25

26

27

28

29

30

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SB

CHECKED: NK/BLT

MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-129

SHEET 1 OF 3

LOCATION: N 4847758.1 ;E 305229.2

BORING DATE: November 1, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers / Hollow Stem Augers

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	198.07
TOPSOIL	0.00
Firm to stiff, heterogeneous, moist, brown silty CLAY, trace sand, trace gravel, with sand layer, trace oxide stains; TILL (CL)	0.09
Hard, heterogeneous, moist, brown sandy SILT, some clay, trace gravel; TILL (SM)	195.02 3.05
Very stiff, heterogeneous, moist, grey clayey SILT, trace sand, trace gravel; TILL (CL-ML)	193.50 4.57
Very dense, heterogeneous, subangular, moist to wet, grey fine sandy SILT, some clay, trace gravel (np)	191.39 6.68

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	50 DO	14	
2A	50 DO	8	
2B			
3	50 DO	7	
4	50 DO	31	
5	50 DO	34	MH
6	50 DO	27	
7A	50 DO	22	
7B			
8	50 DO	50/ 0.13	MH
9	50 DO	90/ 0.25	

ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40

% LEL Methane □ 20 40 120 160

SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80

WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION

Flush mount protective casing

Cement

50 mm PVC pipe

Piezo. 22/11/05

Well 23/11/05

Hole Plug

Sand Pack

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: NK

CHECKED: BLT

MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-129

SHEET 2 OF 3

LOCATION: N 4847758.1 ;E 305229.2

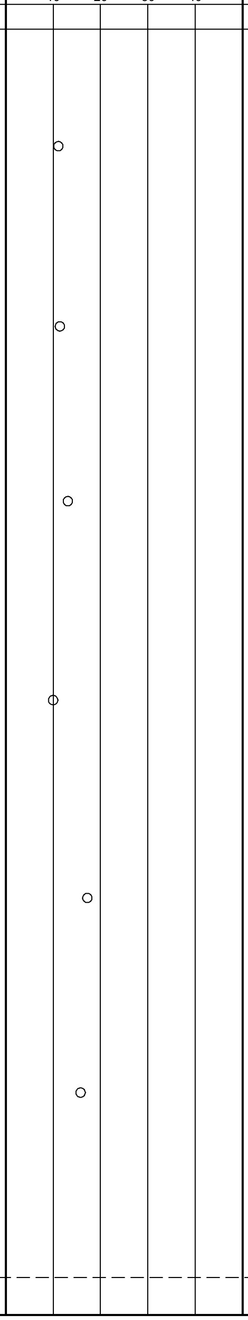
BORING DATE: November 1, 2005

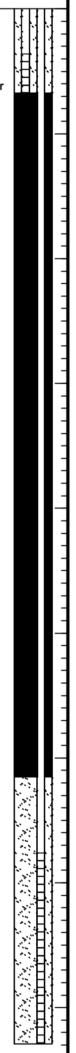
DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40; % LEL Methane □ 20 40 60 80	SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Power Auger, 108 mm I.D. Augers Hollow Stem Augers	Very dense, heterogeneous, subangular, moist to wet, grey fine sandy SILT, some clay, trace gravel (np)									Sand Pack 0.3 m Screen 19 mm piezometer
11					10	50 DO	67				
		Hard, heterogeneous, moist to wet, fine to coarse SILT, some clay, some sand (ML)		186.49 11.58							
12					11	50 DO	93/ 0.23			MH	
13											Hole Plug
		Very dense, heterogeneous, subangular, moist to wet, SAND, some gravel, trace to some silt (SW)		184.35 13.72	12	50 DO	50/ .13				
14											
15					13	50 DO	50/ 0.13				
16											Sand Pack
		Hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; (CL)		181.31 16.76							
17					14	50 DO	82/ 0.25			MH	1.5 m Screen
18					15	50 DO	73/ 0.29				50 mm Well
		END OF BOREHOLE NOTES: 1. Monitoring well installed at 18.29 m depth (Elev. 179.78 m); piezometer installed at 10.67 m depth (Elev. 187.40 m).		179.32 18.75							
19											
20		*CONTINUED NEXT PAGE*									





DEPTH SCALE

1 : 50

LOGGED: NK

CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-129

SHEET 3 OF 3

LOCATION: N 4847758.1 ;E 305229.2

BORING DATE: November 1, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	2.00	196.07
07/11/05	2.55	195.52
22/11/05	2.30	195.77

Deep/Well

Date	Depth (m)	Elev (m)
On completion	1.30	196.77
07/11/05	2.75	195.32
22/11/05	2.40	195.67
23/11/05	2.47	195.60

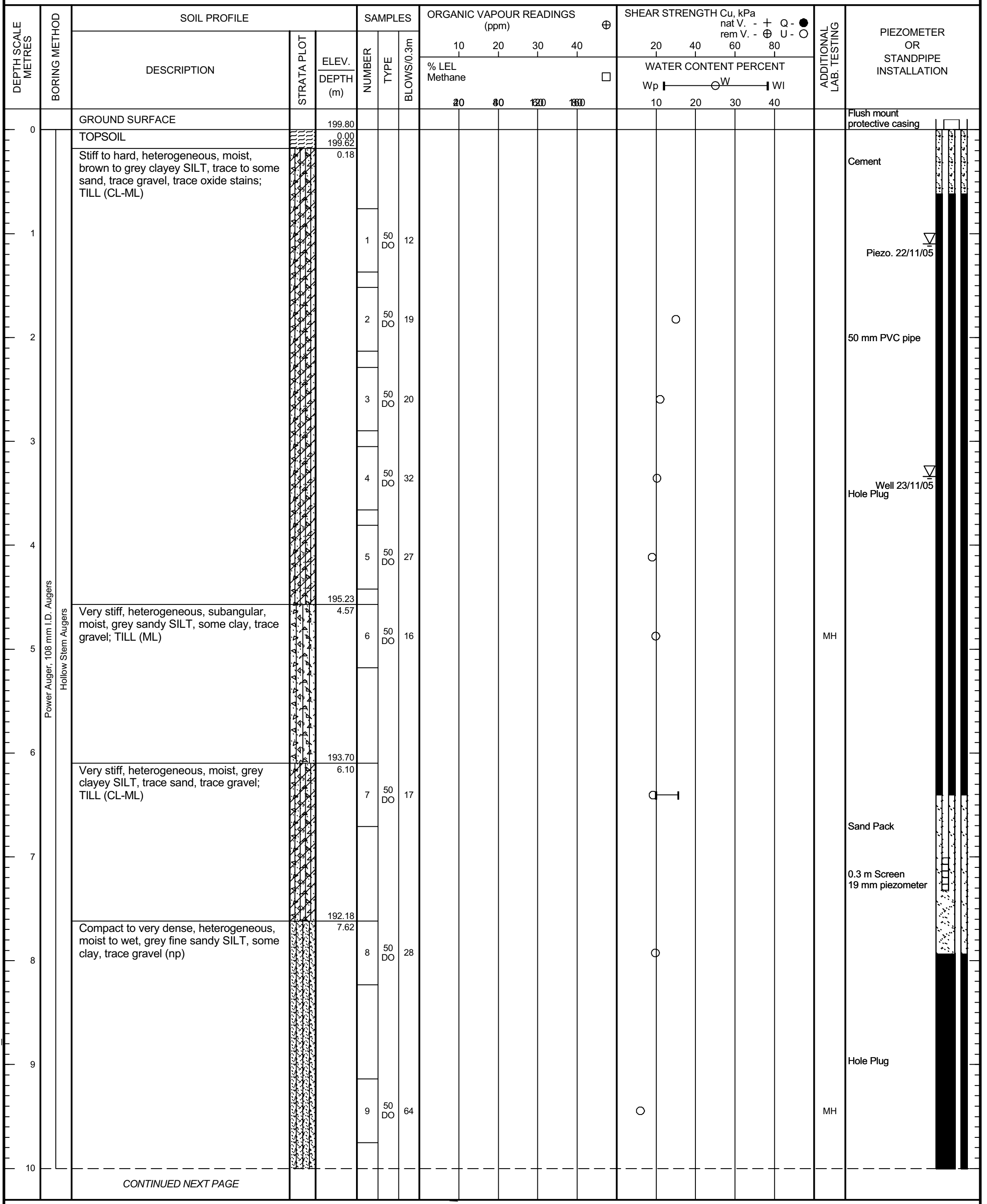
DEPTH SCALE

1 : 50

LOGGED: NK

CHECKED: BLT

PROJECT: 04-1111-054
RECORD OF BOREHOLE: Y-130
SHEET 1 OF 3
LOCATION: N 4847995.2 ;E 304846.2
BORING DATE: October 28, 2005
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm



DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	199.80
TOPSOIL	0.00
Stiff to hard, heterogeneous, moist, brown to grey clayey SILT, trace to some sand, trace gravel, trace oxide stains; TILL (CL-ML)	199.62 0.18
Very stiff, heterogeneous, subangular, moist, grey sandy SILT, some clay, trace gravel; TILL (ML)	195.23 4.57
Very stiff, heterogeneous, moist, grey clayey SILT, trace sand, trace gravel; TILL (CL-ML)	193.70 6.10
Compact to very dense, heterogeneous, moist to wet, grey fine sandy SILT, some clay, trace gravel (np)	192.18 7.62
CONTINUED NEXT PAGE	

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	50 DO	12	
2	50 DO	19	
3	50 DO	20	
4	50 DO	32	
5	50 DO	27	
6	50 DO	16	MH
7	50 DO	17	
8	50 DO	28	
9	50 DO	64	MH

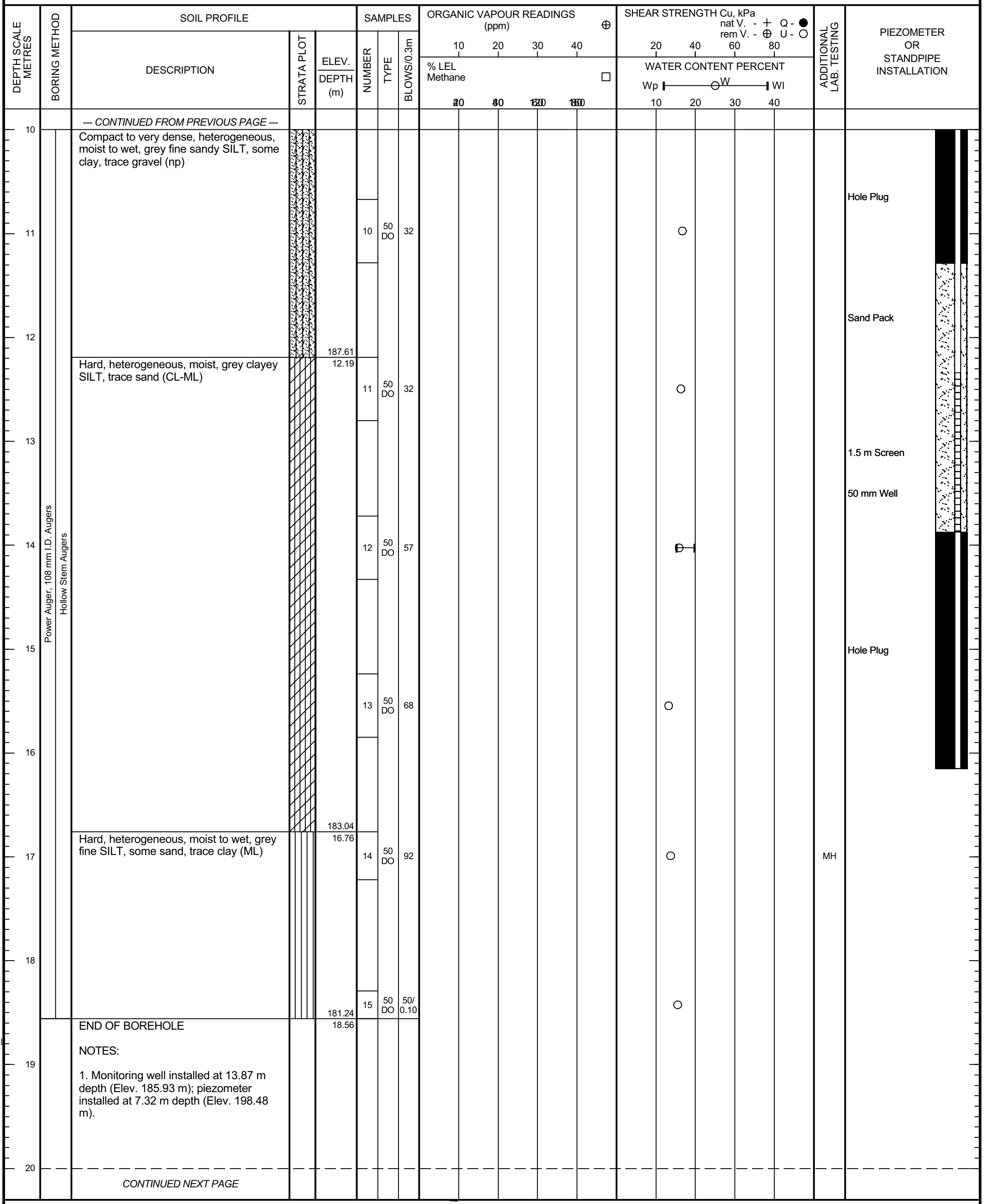
DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

PROJECT: 04-1111-054
RECORD OF BOREHOLE: Y-130
SHEET 2 OF 3
LOCATION: N 4847995.2 ;E 304846.2
BORING DATE: October 28, 2005
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm



DESCRIPTION	ELEV. / DEPTH (m)
--- CONTINUED FROM PREVIOUS PAGE ---	
Compact to very dense, heterogeneous, moist to wet, grey fine sandy SILT, some clay, trace gravel (np)	
Hard, heterogeneous, moist, grey clayey SILT, trace sand (CL-ML)	187.61 12.19
Hard, heterogeneous, moist to wet, grey fine SILT, some sand, trace clay (ML)	183.04 16.76
END OF BOREHOLE	181.24 18.56
CONTINUED NEXT PAGE	

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	50 DO	32	
11	50 DO	32	
12	50 DO	57	
13	50 DO	68	
14	50 DO	92	MH
15	50 DO	50/ 0.10	

NOTES:

1. Monitoring well installed at 13.87 m depth (Elev. 185.93 m); piezometer installed at 7.32 m depth (Elev. 198.48 m).

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

MIS-TTC BHS 001 04111054.GPJ GLDR_CAN.GDT 23/1/06

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-130

SHEET 3 OF 3

LOCATION: N 4847995.2 ;E 304846.2

BORING DATE: October 28, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission

--- CONTINUED FROM PREVIOUS PAGE ---

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	0.00	199.80
22/11/05	1.10	198.70

Deep/Well

Date	Depth (m)	Elev (m)
On completion	0.00	199.80
23/11/05	3.34	196.46

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-131

SHEET 1 OF 3

LOCATION: N 4848143.9 ;E 304428.4

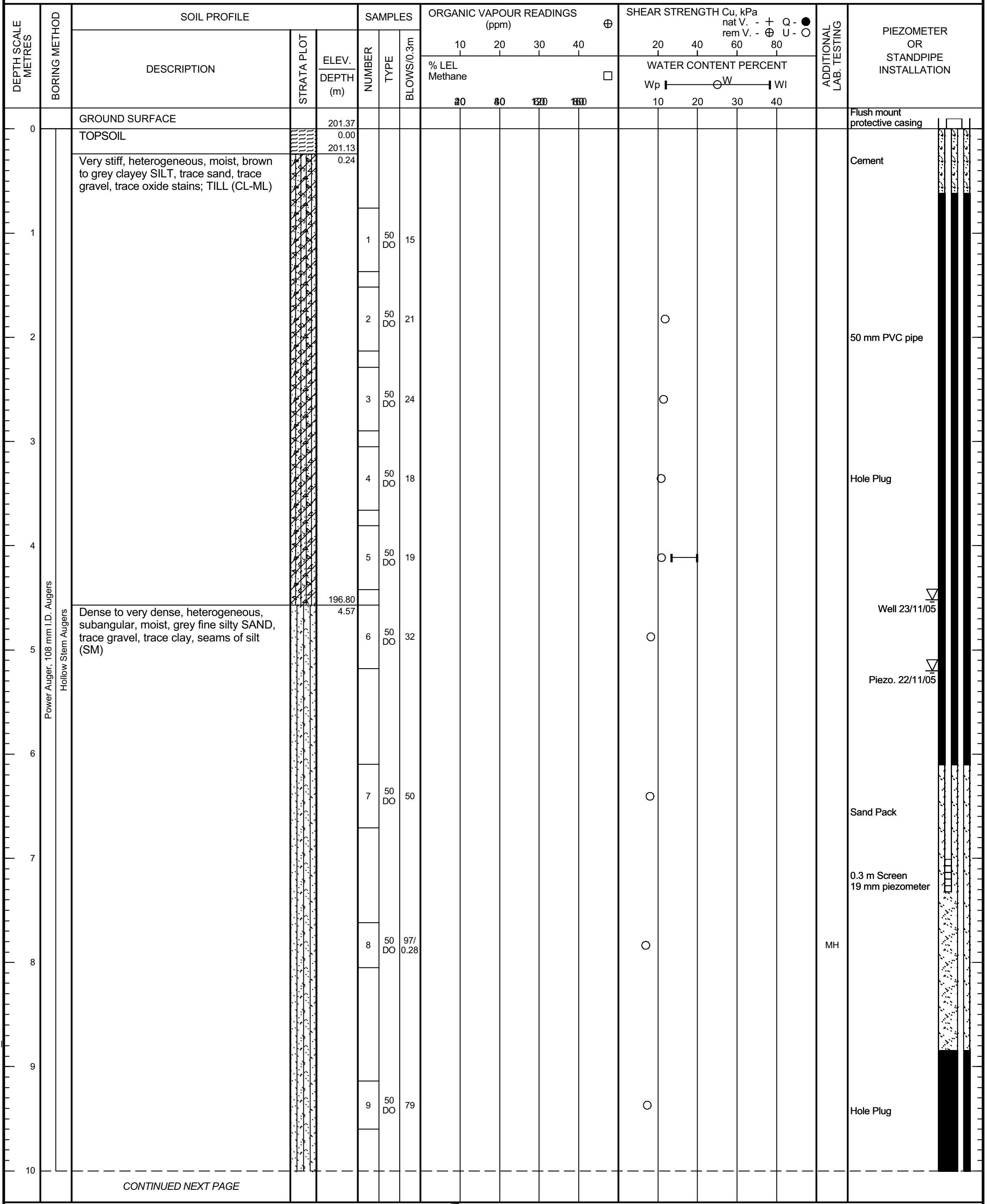
BORING DATE: October 31, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission



DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	201.37
TOPSOIL	0.00
Very stiff, heterogeneous, moist, brown to grey clayey SILT, trace sand, trace gravel, trace oxide stains; TILL (CL-ML)	201.13 0.24
Dense to very dense, heterogeneous, subangular, moist, grey fine silty SAND, trace gravel, trace clay, seams of silt (SM)	196.80 4.57

NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
1	50 DO	15	
2	50 DO	21	
3	50 DO	24	
4	50 DO	18	
5	50 DO	19	
6	50 DO	32	
7	50 DO	50	
8	50 DO	97/ 0.28	MH
9	50 DO	79	

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-131

SHEET 2 OF 3

LOCATION: N 4848143.9 ;E 304428.4

BORING DATE: October 31, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

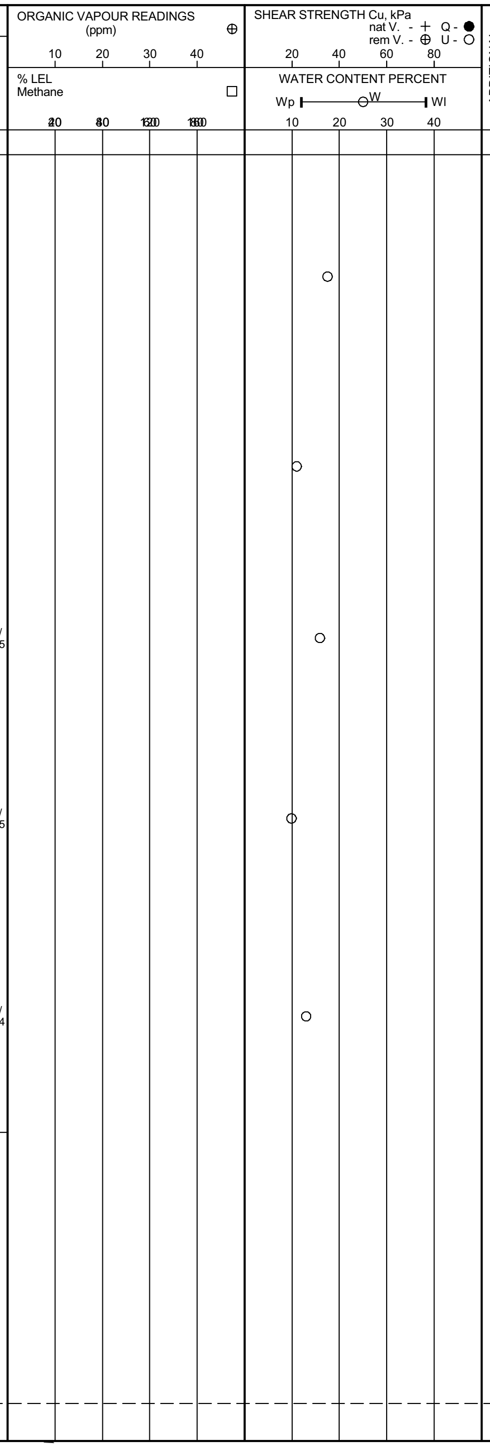
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

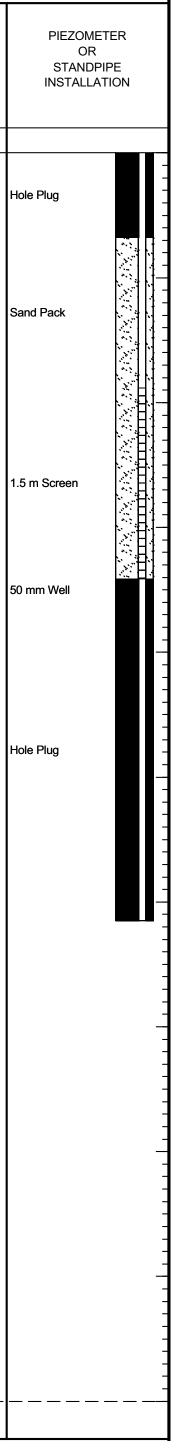
Toronto Transit Commission

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
10	Power Auger, 108 mm I.D. Augers Hollow Stem Augers	Dense to very dense, heterogeneous, subangular, moist, grey fine silty SAND, trace gravel, trace clay, seams of silt (SM)	
		Dense, heterogeneous, moist, grey sandy SILT, some clay, trace gravel (np)	190.70 10.67
		Very dense, heterogeneous, subangular, moist, grey silty SAND, trace clay, trace gravel (SM)	187.65 13.72
		AUGER REFUSAL END OF BOREHOLE	183.54 17.83

SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
10	50 DO	31	
11	50 DO	41	MH
12A 12B	50 DO	50/ 0.15	
13	50 DO	53/ 0.15	MH
14	50 DO	50/ 0.14	





NOTES:

1. Drilling was terminated at 17.83 m depth (Elev. 183.54 m); possible presence of cobbles.

2. Monitoring well installed at 13.11 m depth (Elev. 188.26 m); piezometer installed at 8.23 m depth (Elev. 193.14 m).

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-131

SHEET 3 OF 3

LOCATION: N 4848143.9 ;E 304428.4

BORING DATE: October 31, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES: NUMBER | TYPE | BLOWS/0.3m | ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40 | % LEL Methane □ 20 40 120 160 | SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80 | WATER CONTENT PERCENT Wp W Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

--- CONTINUED FROM PREVIOUS PAGE ---

Water level measurements

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	7.60	193.77
07/11/05	6.30	195.07
22/11/05	5.20	196.17

Deep/Well

Date	Depth (m)	Elev (m)
On completion	0.00	201.37
07/11/05	4.80	196.57
22/11/05	4.50	196.87
23/11/05	4.52	196.85

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-132

SHEET 1 OF 3

LOCATION: N 4848345.5 ;E 303905.8
BORING DATE: October 327, 2005
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers; Hollow Stem Augers

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	200.71				
TOPSOIL	0.00				
Very stiff, heterogeneous, moist, brown clayey SILT, trace to some sand, trace gravel, trace oxide stains; TILL (CL-ML)	0.15	1	50 DO	16	
		2	50 DO	25	
Very stiff to hard, heterogeneous, subangular, moist, brown to grey sandy SILT, some clay, trace gravel; TILL (ML)	198.42 2.29	3	50 DO	29	
		4	50 DO	50/ 0.13	
		5	50 DO	56	MH
		6	50 DO	36	
		7	50 DO	32	
Dense, heterogeneous, subangular, wet, grey fine SAND with silt, some clay, trace gravel (SP)	193.09 7.62	8	50 DO	36	MH
Hard, heterogeneous, moist, grey clayey SILT, trace gravel, trace sand; TILL (CL-ML)	191.57 9.14	9	50 DO	35	

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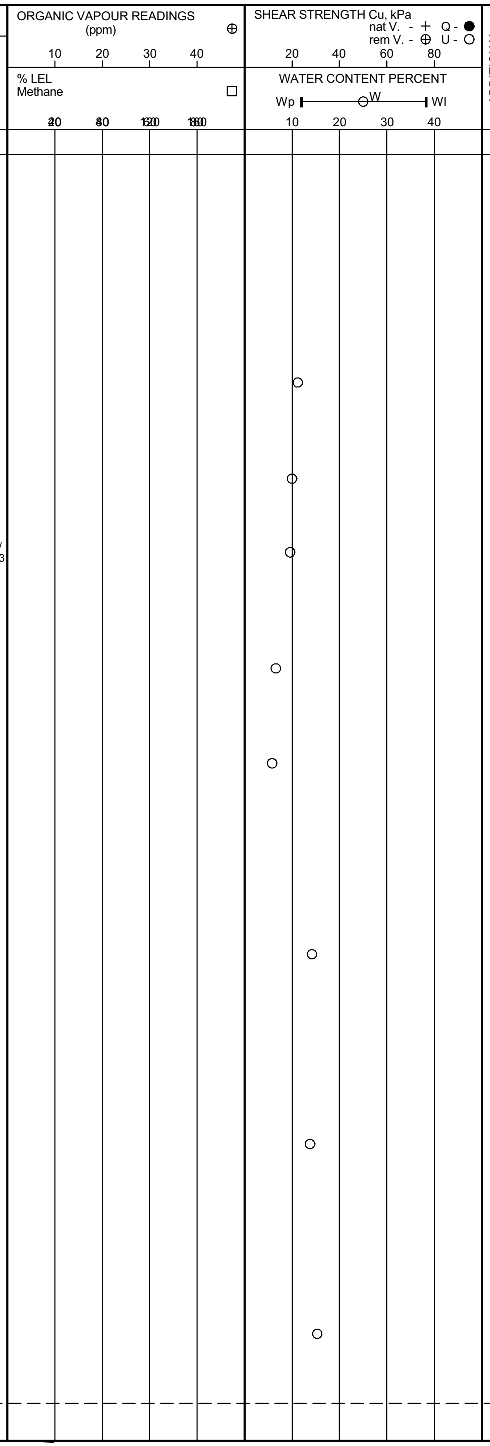

PIEZOMETER OR STANDPIPE INSTALLATION

- Flush mount protective casing
- Cement
- 50 mm PVC pipe
- Hole Plug
- Piezo. 22/11/05
- Well 23/11/05
- Sand Pack
- 0.3 m Screen
- 19 mm piezometer
- Hole Plug
- Sand Pack

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-132

SHEET 2 OF 3

LOCATION: N 4848345.5 ;E 303905.8
BORING DATE: October 327, 2005
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 108 mm I.D. Augers; Hollow Stem Augers

--- CONTINUED FROM PREVIOUS PAGE ---

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
Hard, heterogeneous, moist, grey clayey SILT, trace gravel, trace sand; TILL (CL-ML)					
Compact, heterogeneous, subangular, wet, grey fine to medium SAND, trace gravel; (SP)	190.04 10.67	10	50 DO	26	
Hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel (CL)	188.52 12.19	11	50 DO	71	MH
Hard, heterogeneous, moist, grey silty CLAY, trace sand, trace gravel; TILL (CL)	186.99 13.72	12	50 DO	52	
		13	50 DO	89/ 0.28	
		14	50 DO	81	
		15	50 DO	66	
END OF BOREHOLE	181.84 18.87				

NOTES:

1. Monitoring well installed at 12.19 m depth (Elev. 188.52 m); piezometer installed at 8.53 m depth (Elev. 193.14 m).

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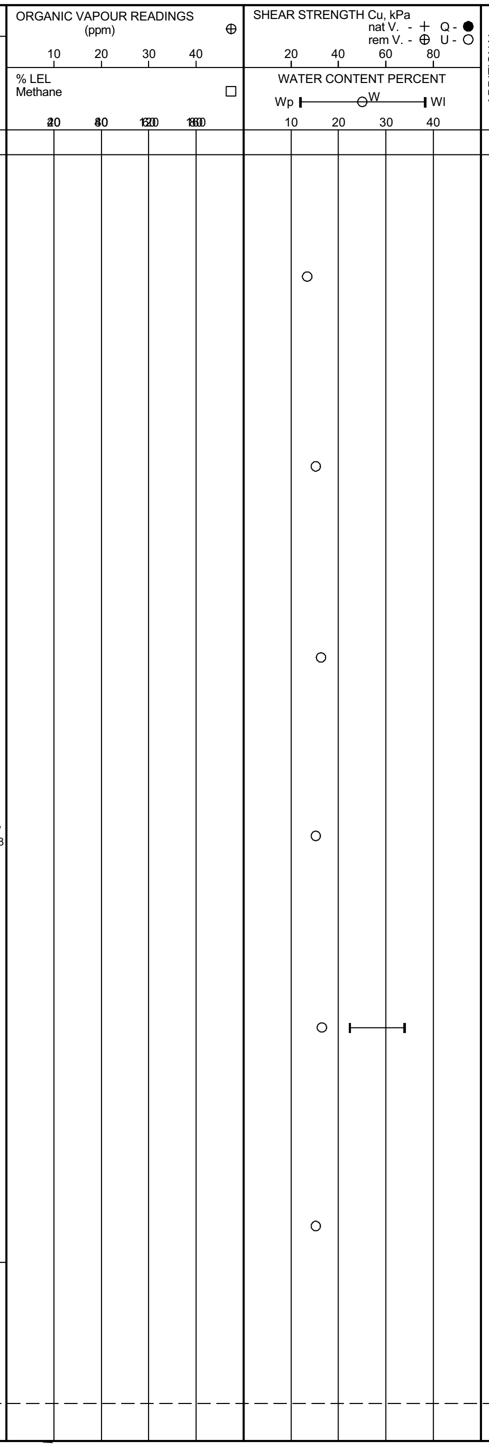

PIEZOMETER OR STANDPIPE INSTALLATION

- Sand Pack
- 1.5 m Screen
- 50 mm Well

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

PROJECT: 04-1111-054

RECORD OF BOREHOLE: Y-132

SHEET 3 OF 3

LOCATION: N 4848345.5 ;E 303905.8

BORING DATE: October 327, 2005

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Toronto Transit Commission

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			ORGANIC VAPOUR READINGS (ppm) ⊕ 10 20 30 40	SHEAR STRENGTH Cu, kPa nat V. - + Q - ● rem V. - ⊕ U - ○ 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	% LEL Methane ☐ 20 80 120 160	WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40		
		--- CONTINUED FROM PREVIOUS PAGE ---									
20		Water level measurements									

Shallow/Piezometer

Date	Depth (m)	Elev (m)
On completion	dry	dry
02/11/05	5.15	195.56
22/11/05	4.50	196.21

Deep/Well

Date	Depth (m)	Elev (m)
On completion	5.50	195.21
02/11/05	5.30	195.41
22/11/05	5.10	195.61
23/11/05	5.10	195.61

21

22

23

24

25

26

27

28

29

30

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: NK
CHECKED: BLT

MIS-TTC BHS 001 041111054.GPJ GLDR_CAN.GDT 23/1/06