FOUNDATION INVESTIGATION AND DESIGN REPORT PROPOSED NON-STRUCTURAL CULVERT REPLACEMENT/EXTENSION HIGHWAY 26 FROM FORMER ST. VINCENT/SYDENHAM TOWNLINE TO MEAFORD

G.W.P. 167-91-00
Agreement # 3006-E-0002

I.E. Group

MTO GEOCRES No. 41A-216

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PART A – FOUNDATION INVESTIGATION

1.0 INTRODUCTION

This report presents the results of a foundation investigation carried out in July and August 2007 by Infrastructure Engineering Group Inc. (IEG) on behalf of Stantec Consulting Ltd. (Stantec).

This assignment involves the rehabilitation of the pavement structure on Highway 26 from 0.3 km west of the former St. Vincent/Sydenham to 0.8 m west of the Town of Meaford west limit.

The project includes the replacement/extension of a single existing structural culvert, as well as many non-structural culvert extensions and replacements. The project also includes intersection improvements, construction of a new truck climbing lane, minor horizontal and vertical alignment improvements and electrical work.

Foundation investigation and recommendations are required for the design and construction of culvert replacements and extension as part of the improvement of Highway 26. A single structural culvert, nineteen (19) non-structural culverts, a swamp area, two high fill areas and a deep cut area are to be investigated.

This report covers the non-structural culvert sites listed in Table 1, with either culvert extensions or replacement as presented in the RFP documents, the 2004 Design Criteria (DC) and the Preliminary Design Report (PDR). The underside of the culvert is estimated from the top of culvert elevations shown on the plan and profiles included in the PDR with the assumption of the culvert top slab of approximately 250 mm above the obvert and the culvert base slab of approximately 250 mm below the invert of the concrete box culverts. The overfill height is also estimated from the PDR plan and profile. Table 1 was prepared by IEG along with data provided by Stantec.

Table 1 - Summary of location, structure type, dimensions

Culvert #	Chainage (m)	Existing Culvert Type and Size, W X H	Existing Overfill (m)	Recommended Replacement Culvert Type and Size	Length (m)	U/S Culvert Invert (m)	D/S Culvert Invert (m)
02B	10+800	1200 X 1067 Box	2.2	Replace with 975 mm diam. Pipe Culvert	19.58	326.32	326.23
03B	10+987	1540 X 925 Box	1.6	Extend Lt and Rt	18.78	326.68	326.53
05B	12+004	914 x 910 Box	1.6	Extend Lt and Rt	28.99	330.80	330.80
06B	12+542	914 X 910 Box	0.9	Extend Lt and Rt	18.26	331.68	331.64

Culvert #	Chainage (m)	Existing Culvert Type and Size, W X H	Existing Overfill (m)	Recommended Replacement Culvert Type and Size	Length (m)	U/S Culvert Invert (m)	D/S Culvert Invert (m)
07B	12+870 Rt	457 CSP	0.5	Replace with 600 mm diam. Pipe Culvert	26.765	322.31	321.04
08B	12+874 Lt	610 CSP	1.0	Replace with 600 mm diam. Pipe Culvert	26.76	321.74	320.20
09B	13+831	2150 x 1535 Box	4.6	Replace with 1800 mm diam. Pipe Culvert or Line Existing	33.09	267.04	266.87
10B	14+293	910 x 910 Box	0.9	Extend Lt and Rt	17.17	259.57	259.51
11B	14+991	1840 x 1220 Box	1.5	Extend Lt and Rt	20.81	239.91	239.72
12B	15+041	1540 x 1220 Box	1.5	Extend Lt and Rt	19.74	239.64	239.59
13B	15+434	910 x 910 Box	2.3	Extend Lt and Rt	21.38	234.99	234.90
14B	15+487	915 x 940 Box	1.9	Extend Lt and Rt	20.91	234.61	234.62
15B	16+692	910 x 910 Box	0.7	Extend Lt and Rt with Header and Gabion Walls	17.21	220.95	220.92
16B	16+998	910 x 910 Box	0.4	Extend Lt and Rt with Header and Gabion Walls	15.77	219.03	219.03
17B	17+412	920 x 630 Box	0.8	Extend Lt and Rt	16.37	214.81	214.71
18B	17+542	910 x 610 Box	1.0	Replace with 800 mm diam. Pipe Culvert	16.25	213.92	213.61
19B	18+470 Rt	470 CSP	0.6	Replace with 600 mm diam. Pipe Culvert	19.462	206.47	205.98
20B	18+866	920 x 910 Box	0.6	Extend Lt and Rt with Header and Gabion Walls	17.07	199.98	199.95
21B	19+838	920 x 940 Box	1.2	Extend Rt	23.13	184.74	184.54

The purpose of the investigation has been to obtain information about the subsurface conditions at the site by means of boreholes and, based on the findings, to provide geotechnical recommendations for the foundation elements. Partial or full replacement, or extension of the culverts may be required pending on the results of the drainage and hydrology study specified under Section 6.4 of the RFP document.

Culverts 7B and 8B are culverts crossing St. Vincent Township 11th Line on the south and north sides of Highway 26, respectively. Culvert 19B crosses St. Vincent Township Road between Concession 6 and 7, on the south side of Highway 26. The remaining culverts are culverts crossing Highway 26. Culvert 21B flows towards the south ditch of Ford Drive at Station 10+116.5 (Ford Drive). Based on the information provided in Plate 24 of the PDR prepared by Earth Tech Canada Inc., Culvert 18B flows from left to right, in a southerly direction.

Culvert 5B is a culvert extension on both the north (Lt) and south (Rt) sides located within the swamp area where a truck climbing lane will be added. Culvert 9B is located within a high fill area (>5m fill height) also within the truck climbing lane widening area. The embankment widening in the swamp area will be covered under a separate report, and the high fill/deep cut will also be covered in a separate report.

The existing culverts are described as box culverts in the PDR and the 2004 DC, and are described in the base plans provided by Stantec as either non-reinforced concrete open (NRFO) or reinforced concrete open (RFO).

The work presented herein was undertaken under MTO G.W.P. 167-91-00, Agreement No. 3006-E-0002.

Authorization to complete this assignment was given by Mr. Dan Green, P. Eng., of Stantec Consulting Ltd., the TPM Consultant who is completing this assignment for MTO under Agreement # 3006-E-0002.

2.0 SITE DESCRIPTION

2.1 Site Location

The nineteen (19) non-structural culverts are located on or beside Highway 26, approximately between 0.5 km and 9.5 km east of the west limit of this Contract (Station 10+300). The east limit of this Contract is located 0.3 km east of the former St. Vincent/Sydenham Township Boundary (Station 10+000). Photographs of the culvert sites are presented in Appendix D. Table 1 summarizes the locations, culvert types and dimensions of the existing and replacement culverts as recommended in the PDR and provided in the RFP documents. Locations of the individual non-structural culverts are illustrated in the Borehole Location Plan, Drawings 1 to 4 presented in Appendix A.

These non-structural culvert sites are generally located within drainage valleys, and surface water flow paths of equalizing culverts between wetlands severed by Highway 26. The overfill heights are approximately between 0.4 m and 4.6 m at the non-structural culvert sites.

The embankment slopes are typically 2.5H to 3H:1V and are grass covered. No signs of embankment slope instability were observed at the time of this foundation investigation. Site photographs were taken during the field work in 2007 and provided in Appendix D.

2.2 Physiography and Topography

Physiography for the area includes from west to east, part of a limestone plain, a till plain and a clay plain. Drumlins occur throughout the region, but were not observed in the project corridor. The underlying bedrock geology is dominated by Silurian sandstone, shale, dolostone and siltstone for one-third of the project area. The remainder of the project area has Ordovician shale, limestone, dolostone and siltstone.

Overall, the physiographic regions include, from west to east, the Bruce Peninsula (i.e., part of the Niagara Escarpment with shallower soils, more irregular rock types, and more water bodies as compared to further south) and the northern tip of the Bighead Valley (i.e., an indentation in the Niagara Escarpment that only touches the east end of the project corridor).

For most of this region, soils are brunisols and podzols (i.e. brown forest soils and grey-brown podzols) that have formed on calcareous till. The pH is neutral to alkaline. Slopes tend to be moderate.

Only two of the Niagara Escarpment Plan zoning designations, Escarpment Natural and Escarpment Rural Area, are located within the project limits within a relatively short section adjacent to the highway right-of-way (ROW). This section of the ROW includes the area where the westbound truck climbing lane is proposed.

The project limit also encroaches onto the plains forest of the Bayview Escarpment Area of Natural and Scientific Interest (ANSI) which was expanded in 1998 to include sections of land adjacent to the north side of Highway 26 (i.e. approximately 1 km of ROW in total), located 1 km east of the Sydenham/St. Vincent Township Line, and falls within the area of the westbound truck Climbing Lane. Much of this area has been disturbed and it is possible that the ANSI boundary extends to the highway simply to act as a buffer to the more sensitive ANSI features that are located further north.

3.0 INVESTIGATION PROCEDURES

3.1 Field Investigation

Between August 2 and 29, 2007, a Bombardier-mounted Diedrich drill rig and a truck-mounted CME 55 drill rig, supplied and operated by London Soil Test Ltd. of London, were used on site for drilling and Standard Penetration Testing (SPT, following the procedures of ASTM D 1586). Three (3) boreholes at each site were drilled and sampled to obtain data for foundation and

bedding design of the proposed replacement culverts. The boreholes were drilled to a minimum depth of 3.0 m (or deeper if required) below the culvert inverts to provide sufficient subsurface information for the evaluation of bearing resistances or support of bedding material for the proposed culverts.

The boreholes were advanced using continuous flight solid stem or hollow stem augers. Soil samples were retrieved at selected intervals throughout the depths of the boreholes in conjunction with Standard Penetration Tests (SPT). Samples were generally taken at intervals of depth of 0.75 m to the maximum depth of exploration.

The culvert borehole numbering system was established from the catchment area numbering system used in the Drainage Report of this project, as agreed with Stantec. A letter "A" or "B" was also added after the culvert numbers to delineate Part A or Part B of this assignment.

For the purpose of proper management of the Borehole Logs within gINT, the borehole logging software, a preceding 0 was added to the culverts numbered 1 to 9, with a letter "A" or "B" also added after the culvert numbers to delineate Part A or Part B of this assignment, and the last number being the borehole number at the culvert site, i.e., "02B-1" refers to Borehole 1 at the location of Culvert 2B, etc.

The boreholes were numbered 02 B-1 to 21B-3 for the subject culverts and the depths of sampling were as follows:

Table 2 - Ground Surface Elevations and Depth of Boreholes

Borehole Number	Ground Surface Elevation, m	Depth, m
02B-1	327.42	4.72
02B-2	329.84	5.79
02B-3	327.32	3.20
03B-1	327.23	3.43
03B-2	329.37	5.56
03B-3	327.44	3.35
05B-1	331.35	3.05
05B-2	333.03	7.32
05B-3	333.07	7.01
05B-4	331.17	4.27
06B-1	331.42	3.51
06B-2	333.80	5.03
06B-3	331.90	3.51
07B-1	322.32	3.51
07B-2	322.35	5.03

Borehole Number	Ground Surface Elevation, m	Depth, m
07B-3	322.21	3.51
08B-1	322.52	3.51
08B-2	322.48	5.03
08B-3	320.77	3.35
09B-1	266.93	6.40
09B-2	273.45	7.62
09B-4	268.55	4.72
10B-1	259.20	3.51
10B-2	261.66	4.80
10B-3	260.81	4.27
11B-1	240.92	4.27
11B-2	242.62	5.79
11B-3	241.17	4.27
12B-1	239.92	4.27
12B-2	242.43	5.18
12B-3	240.32	4.27
13B-1	235.21	4.27
13B-2	238.51	8.08
13B-3	235.51	3.51
14B-1	235.35	5.03
14B-2	237.78	6.55
14B-3	235.13	4.27
15B-1	222.03	4.27
15B-2	222.78	7.32
15B-3	222.80	5.03
16B-1	219.27	3.35
16B-2	220.50	5.79
16B-3	220.59	5.03
17B-1	214.91	3.51
17B-2	216.46	5.03
17B-3	216.51	5.03
18B-1	213.13	3.51
18B-2	215.66	5.49
18B-3	215.73	7.62
19B-1	206.50	3.96
19B-2	207.20	5.03

Borehole Number	Ground Surface Elevation, m	Depth, m
19B-3	207.25	4.80
20B-1	201.77	5.03
20B-2	201.75	5.59
20B-3	200.10	3.51
21B-1	186.37	4.27
21B-2	186.95	5.79
21B-3	185.47	4.27

Field pocket penetrometer testing was conducted on the retrieved SPT samples, where applicable, to determine the undrained shear strength of the cohesive soil deposits. These undrained shear strengths are used to supplement the properties of the cohesive soils. It is noted that the measured shear strength value would be slightly lower than the actual value due to sampling disturbance.

Seepage and water levels were noted in each borehole during and at the completion of drilling and sampling. All boreholes were grouted with a bentonite/cement mix at completion of sampling in accordance with Ontario Regulation 903.

Our field engineer, Mr. Ralph Billings, P. Eng., working under the direction of the project engineer, Mr. Eric Chung, P. Eng., supervised the fieldwork. Our field staff cleared the location of buried utilities and logged the boreholes. The soil samples obtained were placed in labeled containers and transported to our London Office for further examination and laboratory testing.

The stations, offsets and ground surface elevations at the as drilled borehole locations were surveyed by AGM London and provided to Infrastructure Engineering Group Inc. for the purpose of this report.

The results of the drilling, sampling, in-situ testing and groundwater observations are summarized on the Record of Borehole sheets and enclosed in Appendix B.

3.2 Laboratory Analysis

Geotechnical laboratory testing consisted of natural moisture content determinations and visual classifications of all retrieved soil samples. In addition, grain size analyses, Atterberg Limit tests and unit weight tests were performed on selected samples.

The results of the laboratory testing are presented on the Record of Borehole sheets and in the respective figures presented in Appendix B.

4.0 SUBSURFACE CONDITIONS

Reference is made to the respective appendix of each culvert site for the Record of Borehole sheets and Laboratory Test Results (Appendix B) for detailed subsurface soil and groundwater conditions encountered in the boreholes. The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling and, consequently, represent transitions between soil types rather than exact planes of geological change. The soil profiles depicting the subsurface conditions on the respective Borehole Locations will vary between and beyond the borehole locations.

In general, boreholes put down on the existing shoulder encountered a 100 mm to 460 mm thick layer of shoulder gravel placed on a 0.76 mm and 3.51 m of loose to compact mixed embankment fill. Boreholes put down near the existing ditches encountered 75 mm to 460 mm thick layer of topsoil, with localized near surface fill layers.

Boreholes 05B-1 and 05B-2 put down on the existing pavement within the swamp area penetrated a 150 mm thick layer of asphalt, underlain successively by a 0.56 m thick layer of granular fill and a 0.76 m thick layer of mixed fill. The mixed fill in Boreholes 05B-1 and 05B-2 is underlain by a 150 mm thick layer of buried asphalt which is in turn underlain by a 1.23 m thick layer of mixed embankment fill placed on top of a 1.21 m to 1.52 m thick layer of firm buried peat. Boreholes 05B-1 and 05B-4 penetrated a 2.74 m and 3.05 m thick layer of very soft, partially decomposed peat.

A 0.43 m and 0.30 m thick layer of firm, partially decomposed peat is present beneath the embankment fill of Boreholes 16B-2 and 18B-2.

The following is a summary of the general subsurface conditions encountered in the boreholes beneath the pavement, buried pavement, topsoil, peat, embankment fill and buried peat layers:

Culvert Sites	Borehole Number	General Subsurface Condition
02B	02B-1 to 3	Moist, Stiff to Hard Clayey Silt to Silty Clay Till with loose to compact wet silt layers
03B	03B-1 to 3	Moist, Loose to Very Dense Sand and Silt Till
05B	05B-1 to 4	Moist to Wet, Compact to Very Dense Sand and Silt Till, with Thin Moist, Firm to Stiff Upper Silty Clay Layer
06B	06B-1to 3	Wet to Moist, Firm to Hard Silty Clay Till
07B	07B-1 to 3	Wet to Moist, Firm to Hard Silty Clay Till
08B	08B-1 to 3	Moist, Stiff to Hard Silty Clay Till
09B	09B-1, 2 and 4	Moist to Wet, Very Stiff to Hard Clayey Silt to Silty Clay Till
10B	10B-1 to 3	Moist, Very Stiff to Hard Clayey Silt to Silty Clay Till
11B	11B-1 to 3	Moist, Hard to Very Stiff Silty Clay Till
12B	12B-1 to 3	Wet to Moist, Loose to Very Dense Sand and SILT Till

Culvert Sites	Borehole Number	General Subsurface Condition
13B	13B-1 to 3	Wet to Moist, Firm to Hard Clayey Silt to Silty Clay Till, with Moist, Very Dense, Silty Sand and Gravel Layers
14B	14B-1 to 3	Moist, Very Dense Gravelly Silty Sand Till, Moist to Wet, Dense to Very Dense Sand and Gravel, to Moist, Very Stiff to Hard Clayey Silt Till
15B	15B-1 to 3	Moist to Saturated, Compact to Dense Sand, to Moist, Very Dense Sand and Silt Till
16B	16B-1 to 3	Saturated, Compact to Dense Silty Sand, to Wet to Moist, Dense to Very Dense Sand and Silt Till
17B	17B-1 to 3	Moist to Wet, Compact to Very Dense Silt Till
18B	18B-1 to 3	Moist to Wet, Loose to Very Dense Sand and Silt Till, changing to Wet, Very Stiff to Hard Silty Clay Till in Borehole 18B-1
19B	19B-1 to 3	Moist, Stiff to Hard Clayey Silt to Silty Clay Till, with Upper Saturated Sand and Moist Sandy Silt Layers in Borehole 19B-3
20B	20B-1 to 3	Moist, Very Stiff to Hard Clayey Silt to Silty Clay Till
21B	21B-1 to 3	Moist, Very Stiff to Hard Clayey Silt to Silty Clay Till

4.1 Detailed Subsurface Conditions

For the purpose of detailed description of the subsurface conditions, the boreholes are separated into the following five groups based on the major underlying soil types:

Section	Group	Major Subsurface Soil Type	Culvert Sites
4.2	1	Clayey Silt to Silty Clay Till	02B, 06B, 07B, 08B, 10B, 11B, 20B, 21B
4.3	2	Sand and Silt Till to Silt Till	03B, 12B, 17B
4.4	3	Sand, Silty Sand, Silty Sand Till, Sand and Silt Till, Clayey Silt to Silty Clay Till	13B, 14B, 15B, 16B, 18B, 19B
4.5	4	Swamp Area	05B
4.6	5	High Fill Area	09B

4.2 Group 1

The native soils in Boreholes 02B, 06B, 07B, 08B, 10B, 11B, 20B and 21B are mainly clayey silt to silty clay till. The following is a detailed description of the soil stratigraphy encountered for this group of boreholes.

4.2.1 Fill and Organic Soil

The boreholes at the shoulders generally encountered a 0.10 m to 0.76 m thick layer of granular fill (shoulder gravel). The shoulder gravel is underlain by a 1.37 m to 3.05 m thick layer of

mixed fill consisting of brown sand, gravel, silt and clayey silt fill materials with localized zones of organic inclusions.

The boreholes near the ends of the existing culverts generally encountered a 0.075 to 0.46 m thick layer of topsoil. Topsoil is not present in Boreholes 20B-1, and 21B-1.

The topsoil in Boreholes 07B-3 and 21B-3 is underlain by a 1.53 m and 1.07 m thick layer of granular or mixed fill, respectively.

The embankment fill in Borehole 20B-1 consists of a 1.52 m thick layer of granular material underlain by a 0.46 m thick layer of buried peat.

A 0.76 m thick layer of granular or mixed fill was encountered surficially in Borehole 21B-1.

Standard penetration tests taken in the fill and topsoil yielded "N"-values from 1 to 32 blows per 0.3 m, with an average of 11 blow per 300 mm, indicative of typically loose to compact compactness condition with localized very loose and dense zones. The measured natural moisture contents of the mixed fill ranged from 3 to 57%.

Five (5) grain size distribution analyses and three (3) Atterberg Limits determinations of the fill materials were carried out and the results are shown on the following figures of the corresponding culvert site in Appendix B, e.g. Figure C-02B.1 refers to the first figure of Culvert 02B, etc.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
02B	C-02B.1	C-02B.2
06B	-	-
07B	-	-
08B	C-08B.1	-
10B	C-10B.1	C-10B.2
11B	C-11B.1	C-11B.2
20B	C-20B.1	-
21B	-	-

The Atterberg Limits determinations carried out on the fill layers and yielded the following results:

	Minimum	Maximum	Average
Liquid Limit (W_L)	19	26	23.5
Plastic Limit (W_P)	15	18	16.3
Plasticity Index (I_p)	4	9	7.3

The unit weight of the fill was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

The depth and bottom elevation of the topsoil, pavement, fill and buried peat layers are presented in the following table:

Borehole No.	Bottom of Topsoil, Pavement, Fill and Peat, m	Bottom Elevation of Topsoil, Pavement, Fill and Peat, m
02B-1	0.10	327.32
02B-2	3.05	326.79
02B-3	0.20	327.12
06B-1	0.15	331.27
06B-2	1.98	331.82
06B-3	0.15	331.75
07B-1	0.15	322.17
07B-2	1.52	320.83
07B-3	1.68	320.53
08B-1	0.30	322.22
08B-2	2.29	320.19
08B-3	0.20	320.57
10B-1	0.08	259.12
10B-2	2.74	258.92
10B-3	0.15	260.66
11B-1	0.08	240.84
11B-2	3.20	239.42
11B-3	0.15	241.02
20B-1	1.98	199.79
20B-2	2.13	199.62
20B-3	0.46	199.64
21B-1	0.76	185.61

Borehole No.	Bottom of Topsoil, Pavement, Fill and Peat, m	Bottom Elevation of Topsoil, Pavement, Fill and Peat, m
21B-2	0.76	186.19
21B-3	1.37	184.10

4.2.2 Clayey Silt to Silty Clay Till

The topsoil and fill layers are underlain by a major deposit of, brown to reddish brown, clayey silt to silty clay till which extends beyond the vertical limits of the boreholes. Silt seams, pockets and layers are present in Boreholes 10B-1, 10B-3 and 11B-1.

Standard penetration tests taken within the clayey silt to silty clay till yielded "N"-values of between 6 and over 100 blows per 0.3 m, with an average of 52 blows per 300 mm. The natural moisture contents were between 2 and 35% with an average of 11%.

Thirty-eight (38) grain size analyses and Thirty-eight (38) Atterberg Limits determinations were performed on the clayey silt to silty clay till and the results are plotted on the following figures of Appendix B:

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
02B	C-02B.3	C-02B.4
06B	C-06B.3	C-06B.4
07B	C-07B.1	C-07B.2
08B	C.08B.2	C-08B.3
10B	C-10B.3	C-10B.4
11B	C-11B.3	C-11B.4
20B	C-20B.2	C-20B.3
21B	C-21B.1	C-21B.2

The Atterberg Limits determinations carried out on the clayey silt to silty clay till (CL-ML to CL) yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	19	28	22.9
Plastic Limit (W_P)	13	19	15.0
Plasticity Index (I_p)	5	11	7.9

Four (4) grain size distribution analyses and three (3) Atterberg Limits determinations were performed on the silt seams, pockets and layers within the clayey silt to silty clay till and the results are plotted on the following figures of Appendix B:

Culvert Number	Grain Size Figure	Atterberg Limits Figure
02B	C-02B.5	C-02B.6
10B	C-10B.5	C-10B.6
11B	C-11B.5	C-11B.6

The Atterberg Limits determinations carried out on the silt seams (ML), pockets and layers within the clayey silt to silty clay till yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	17	19	18.0
Plastic Limit (W_P)	14	16	15.0
Plasticity Index (I_p)	3	3	3.0

Undrained shear strength of the clayey silt to silty clay till as determined from field pocket penetrometer testing ranged from 87.5 to over 225 kPa, which generally increased with increasing depths.

Unit weight determinations carried out on the clayey silt to silty clay till yielded results of between 18.5 kN/m^3 and 23.9 kN/m^3, with an average of 22.1 kN/m^3.

Based on the above field and laboratory test results, together with visual and tactile examination, the clayey silt to silty clay till deposit generally exhibited a very stiff to hard consistency with localized firm condition within the surface 0.5 m to 1.0 m of the deposit.

The clayey silt to silty clay deposit extends beyond the vertical limit of this group of boreholes at maximum depths of between 3.20 m and 5.79 m below the present ground surface (between Elevations 181.15 m and 328.77 m).

4.3 Group 2

The native soils in Boreholes 03B, 12B, 17B consist mainly of sand and silt till. The following is a detailed description of the soil stratigraphy encountered for this group of boreholes.

4.3.1 Fill and Topsoil

The boreholes at the shoulders generally encountered a 0.61 m and 1.01 m thick layer of granular fill (shoulder gravel). The shoulder gravel is underlain by a 1.53 m to 2.50 m thick layer of

mixed fill consisting of brown sand, gravel, silt and clayey silt fill materials with localized zones of organic inclusions.

The boreholes near the ends of the existing culverts generally encountered a 0.075 to 0.15 m thick layer of topsoil. Topsoil is not present in Boreholes 03B-3.

The topsoil in Boreholes 17B-3 is underlain by a 1.68 m thick layer of mixed fill.

The ground surface of Borehole 03B-3 is covered with a 1.07 m layer of mixed fill. The embankment fill in Borehole 20B-2 is underlain by a 0.46 m thick layer of buried topsoil.

Standard penetration tests taken in the fill and topsoil yielded "N"-values ranging from 3 to 24 blows per 0.3 m, with an average of 13 blows per 0.3 m, indicative of typically loose to compact compactness condition with localized very loose zones. The measured natural moisture contents of the mixed fill ranged from 8 to 43%.

Seven (7) grain size distribution analyses and four (4) Atterberg Limits determinations were carried out on the fill materials and test results are shown on the following figures of the corresponding culvert sites in Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
03B	C-03B.1	C-03B.2
12B	C-12B.1	C-12B.2
17B	C-17B.1	-

The Atterberg Limits determinations carried out on the fill layers and yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	18	32	23.7
Plastic Limit (W_P)	16	20	17.3
Plasticity Index (I_p)	2	12	6.3

The unit weight of the fill was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

The depths and bottom elevation of the topsoil, pavement, fill and buried peat layers are presented in the following table:

Borehole No.	Bottom of Topsoil, Pavement, Fill and Peat, m	Bottom Elevation of Topsoil, Pavement, Fill and Peat, m
03B-1	0.15	327.08
03B-2	3.05	326.32
03B-3	1.07	326.37
12B-1	0.15	239.77
12B-2	3.51	238.92
12B-3	0.075	240.24
17B-1	0.15	214.76
17B-2	2.44	214.02
17B-3	1.83	214.68

4.3.2 Sand and Silt Till

The topsoil and fill layers are underlain by a major deposit of reddish brown sand and silt till which extends beyond the vertical limits of the boreholes. Sand and gravel, and clayey silt layers are present in Boreholes 12B-2 and 12B-3 respectively.

Standard penetration tests taken within the sand and silt till yielded "N"-values of between 5 and over 100 blows per 0.3 m, with an average of 48 blows per 300 mm. The natural moisture contents were between 8 and 27% with an average of 15.2%.

Thirteen (13) grain size analyses and four (4) Atterberg Limits determinations were performed on the sand and silt till and the results are plotted on the following figures of Appendix B:

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
03B	C-03B.3	C-03B.4
12B	C-12B.3	-
17B	C-17B.2	-

The Atterberg Limits determinations carried out on the sand and silt till (SM-ML) yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	16	20	18.0
Plastic Limit (W_P)	15	16	15.3
Plasticity Index (I_p)	1	4	2.8

A single grain size analysis and Atterberg Limits determination were performed on the clayey silt seams, pockets and layers within the sand and silt till and the results are plotted on the following figures of Appendix B:

Culvert Number	Grain Size Figure	Atterberg Limits Figure
12	C-12B.4	C-12B.5

A single Atterberg Limits determination carried out on the clayey silt pockets and layers within the sand and silt till yielded a liquid limit, plastic limit and plasticity index of 19%, 15% and 4% respectively.

Unit weight determinations carried out on the sand and silt till yielded results of between 20.1 kN/m^3 and 21.6 kN/m^3, with an average of 20.9 kN/m^3.

Based on the above field and laboratory test results, together with visual and tactile examination, the sand and silt till generally exhibited a dense to very dense compactness condition, with near surface loose to compact zones.

The sand and silt till deposit extends beyond the vertical limit of this group of boreholes at maximum depths of between 3.35 m and 5.56 m below the present ground surface (between Elevations 211.41 m and 324.09 m).

4.4 Group 3

The native soils in Boreholes 13B, 14B, 15B, 16B, 18B and 19B consist of sand and silt till and clayey silt to silty clay till, with sand, silty sand, silty sand, and clayey silt to silty seams, pockets and layers. The following is a detailed description of the soil stratigraphy encountered for this group of boreholes.

4.4.1 Fill and Organic Soil

The boreholes put down on the existing shoulders generally encountered a 0.15 m to 3.66 m thick layer of brown granular fill (shoulder gravel). The shoulder gravel is generally underlain

by a 0.92 m to 5.03 m thick layer of mixed fill consisting of brown, sand, gravel, silt and clayey silt fill materials with localized zones of organic inclusions.

A 0.43 m and 0.30 m thick layer of firm, partially decomposed peat is present beneath the embankment fill of Boreholes 16B-2 and 18B-2.

The boreholes near the ends of the existing culverts generally encountered a 0.075 m to 0.15 m thick layer of topsoil. Topsoil is not present in Boreholes 15B-3, 16B-3, and 19B-3.

The topsoil in 14B-1 is underlain by a 1.98 m thick layer of granular fill.
The ground surface of Boreholes 15B-3, 16B-3 and 19 BRT-3 is covered with a 0.46 m, 1.52 and 0.3 m or granular fill or mixed fill.

Standard penetration tests taken within the fill layers yielded "N"-values of between 3 and 34 100 blows per 0.3 m, with an average of 11 blows per 0.3 m. The natural moisture contents were between 6 and 39% with an average of 18%.

Nine (9) grain size distribution analyses and two (2) Atterberg Limits determinations were performed and the results are plotted on the following figures of Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
13B	C-13B.1	C-13B.2
14B	C-14B.1	-
15B	C-15B.1	-
16B	C-16B.1	-
18B	C-18B.1	-
19B	C-19B.1	-

The Atterberg Limits determinations carried out on the fill yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	22	31	26.5
Plastic Limit (W_P)	16	20	18.0
Plasticity Index (I_p)	6	11	8.5

The unit weight of the fill was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

Based on the above field and laboratory test results, together with visual and tactile examination, the fill generally exhibited a loose to compact compactness condition with localized very loose to dense zones.

The depths and bottom elevations of the topsoil, pavement, fill and buried peat layers are presented in the following table:

Borehole No.	Bottom of Topsoil, Pavement, Fill and Peat, m	Bottom Elevation of Topsoil, Pavement, Fill and Peat, m
13B-1	0.15	235.06
13B-2	3.66	234.85
13B-3	0.075	235.43
14B-1	2.13	233.22
14B-2	3.35	234.43
14B-3	0.15	234.98
15B-1	0.15	221.88
15B-2	3.66	219.12
15B-3	0.46	222.34
16B-1	0.15	219.12
16B-2	3.05	217.45
16B-3	1.52	219.07
18B-1	0.15	212.98
18B-2	2.74	212.92
18B-3	0.075	215.65
19B-1	0.10	206.40
19B-2	1.68	205.52
19B-3	0.30	206.95

4.4.2 Gravelly Silty Sand Till

A 1.37 m thick layer of brown, gravelly sandy silt till is present beneath the topsoil in Borehole 14B-3.

A single standard penetration test carried out on the sand till yielded an “N”-value of 64 blows per 300 mm. A single moisture content determination yielded a result of 11%.

A single grain size distribution analysis was performed on the sand till and the results are presented in Figure C-14B.2.

These results indicate that the gravelly silty sand till is in a very dense compactness condition.

4.4.3 Sand, Silty Sand, Sand and Gravel to Sandy Silt

A 1.53 m to 4.57 m thick layer of brown to grey sand, silty sand, sand and gravel to sandy silt is present beneath the topsoil, fill and sand till layers in this Boreholes 13B-3, 14B-1, 14B-2, 14B3-3, 15B1, 15B-2, 15B-3, 16B-1 and 19B-3. A 0.61 m thick localized clay pockets is present within the sand and gravel deposit in Borehole 14B-2, at a depth of 3.35 m below the present ground surface.

Standard penetration tests taken within the fill layers yielded "N"-values of between 11 and over 100 blows per 0.3 m. The natural moisture contents were between 5 and 29%, with an average of 16%.

Eleven (11) grain size distribution analyses were performed and the results are plotted on the following figures of Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
13B	C-13B.3	-
14B	C-14B.3	-
15B	C-15B.2 and 3	-
16B	C-16B.2	-
19B	C-19B.2	-

A single grain size distribution analysis was carried out on the silty clay pocket and the results presented in Figure 14B.4. A single Atterberg Limits determination, carried out on the silty clay pocket within the sand and gravel material in Borehole 14B-2, yielded a liquid limit, plastic limit and plasticity index of 27%, 18% and 9% respectively. Test results are presented in Figure C-14B.5

The unit weight of the cohesionless materials was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

Based on the above field and laboratory test results, together with visual and tactile examination, the sand, silty sand, sand and gravel and sandy silt generally exhibited a compact to very dense compactness condition.

The sand to silty sand deposit in Boreholes 15B-1, 15B-3 extends beyond the vertical limit of the boreholes at maximum depths of between 4.27 m and 5.03 m below the present ground surface (Elevations 217.76 m and 217.77 m).

4.4.4 Sand and Silt Till

The topsoil, fill, buried peat, sand, silty sand, sand and gravel and sandy silt layers in Boreholes 15B-2, 16B-1, 16B-2, 16B-3, 18B-1, 18B-2, and 18B-3 is underlain by a 0.92 m to 7.55 m thick m layer of reddish brown sand and silt till., with embedded gravel.

Standard penetration tests taken within the sand and silt till yielded "N"-values of between 5 and over 100 blows per 0.3 m, with an average of 48 blows per 300 mm. The natural moisture contents were between 13 and 22% with an average of 17%.

Thirteen (13) grain size analyses were performed on the sand and silt till and the results are plotted on the following figures of Appendix B:

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
15B	C-15B.4	-
16B	C-16B.3	-
18B	C-18B.2	-
19B	C-19B.2	-

The unit weight of the sand and silt till was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

Based on the above field and laboratory test results, together with visual and tactile examination, the sand and silt till generally exhibited a dense to very dense compactness condition, with near surface as well as localized loose to compact zones.

The sand and silt till deposit in Boreholes 15B-2, 16B-1, 16B-2, 16B-3 and 18B-2 extends beyond the vertical limit of the boreholes at maximum depths of between 3.35 m and 7.32 m below the present ground surface (between Elevations 210.17 m and 215.92 m).

4.4.5 Clayey Silt to Silty Clay Till

The topsoil, fill, buried peat, sand, silty sand, sand and gravel and sandy silt layers in Boreholes 13B-1, 13B-2, 13B-3, 14B-1, 14B-2, 14B-3, 18B.1, 19B-1, 19B-2 and 19B-3 is underlain by a 0.45 m to 4.12 m thick layer of clayey silt to silty clay till deposit with embedded sand and gravel. The clayey silt to silty clay generally has a reddish brown colour.

Standard penetration tests taken within the clayey silt to silty clay till yielded "N"-values of between 11 and over 100 blows per 0.3 m, with an average of 51 blows per 300 mm. The natural moisture contents were between 7 and 20% with an average of 11%.

Ten (10) grain size distribution analyses and nine (9) Atterberg Limits determinations were performed on the clayey silt to silty clay till and the results are plotted on the following figures of Appendix B:

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
13B	C-13B.4	C-13B.5
14B	C-14B.6	C-14B.7
18B	C-18B.3	C-18B.4
19B	C-19B.3	C-19B.4

The Atterberg Limits determinations carried out on the clayey silt to silty clay till (CL-ML to CL) yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	18	29	21.7
Plastic Limit (W_P)	11	21	15.5
Plasticity Index (I_p)	4	8	6.2

The undrained shear strength of the clayey silt to silty clay till as determined from field pocket penetrometer testing ranged from 175 kPa to over 225 kPa.

The unit weight determinations carried out on the clayey silt to silty clay till yielded results of between 20.7 kN/m^3 and 23.0 kN/m^3, with an average of 22.2 kN/m^3.

Based on the above field and laboratory test results, together with visual and tactile examination, the clayey silt to silty clay till deposit generally exhibited hard consistency with stiff to very stiff zones within the upper 0.5 to 1.5 m of the stratum.

The clayey silt to silty clay deposit extends beyond the vertical limit of Boreholes 13B-1, 13B-2, 13B-3, 14B-1, 14B-2, 14B-3, 18B-1, 19B-1, 19B-2 and 19B-3, at maximum depths of between 3.51 m and 8.08 m below the present ground surface (between Elevations 202.17 m and 232.00).

4.4.6 Silty Clay

The sand and silt till layer in Borehole 18B-3 is underlain by a 0.92 m thick layer of grey silty clay. A single standard penetration test taken on the silty clay layer yielded a result of 5 blows per 0.3 m. A single moisture determination yielded a single value of 31%.

Based on the above field results, together with visual and tactile examination, the silty clay exhibited a firm consistency.

The silty clay extends beyond the vertical limit of the borehole at a maximum depth of 7.62 m below the present ground surface, at Elevation 208.11 m.

4.5 Group 4

Boreholes 05B-1 to 4 (also know as Boreholes SW-31A, 31, 32 and 33) were put down in the swamp area, within the truck climbing lane widening section. The area is generally underlain by embankment fill and organic peat deposit over a thin layer of native silty clay and then sand and silt till. The following is a detailed description of the soil stratigraphy encountered for this group of boreholes. A summarized soil profile is provided in Drawing 5.

4.5.1 Pavement, Fill, Buried Pavement and Peat

Boreholes 05B-2 and 05B-3 put down through the existing pavement penetrated a 0.2 m thick layer of asphalt followed by a 0.56 m and 0.76 m of granular fill and upper mixed fill, respectively. The mixed fill is underlain by a 0.15 m thick layer of buried asphalt which is underlain by a 1.23 m thick layer of lower mixed fill. The lower mixed fill is in turn underlain by a 1.21 m and 1.52 m thick layer of black to dark brown, fully decomposed peat.

Boreholes 05B-1 and 05B-4, put down near the existing ditch, penetrated a 2.74 m and 3.05 m thick layer of black, partially decomposed peat, with wood pieces. A 610 mm thick layer of sand and gravel is present within the peat deposit in Borehole 05B-4.

Two (2) grain size analyses and two (2) Atterberg Limits determinations were performed on the fill materials and the results are plotted on the following figures of Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
05B	C-05B.1	C-05B.2

Atterberg Limits determinations on the fill materials yielded liquid limits, plastic limits and plasticity indices of 22% and 26%, 18% and 16%, 8% and 6%, respectively.

The unit weight of the fill and organic layers was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

Standard penetration tests taken within the fill materials yielded “N”-values of between 12 and over 30 blows per 0.3 m. The measured natural moisture contents of the fill materials ranged from 7 to 23%, with an average of 12%

Three (3) grain size analyses and two (2) Atterberg Limits determinations were performed on the peat materials and the results are plotted on the following figures of Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
05B	C-05B.3	C-05B.4

Atterberg Limits determinations on the peat materials yielded liquid limits, plastic limits and plasticity indices of 55% and 14%, 24% and 14%, 31% and 0%, respectively.

Organic content determinations were carried out on four (4) samples which yielded the following results:

Borehole	Sample	Depth, m	Organic Content, %	Peat Organic Content, %
05B-1	2	0.61	45.9	45.9
05B-2	4	3.05	60.1	60.1
05B-3	5	3.81	23.5	23.5
05B-4	3	1.22	15.9	15.9
			Minimum	15.9
			Maximum	60.1
			Average	36.90

Standard penetration tests taken within the peat materials yielded “N”-values of between 1 and over 18 blows per 0.3 m. The measured natural moisture contents of the fill materials ranged from 32 to 658%., with an average of 223%.

Field vane test carried out on the peat material yielded undrained shear strength of between 18.5 and 28 kPa, with an average of 25.1 kPa; sensitivities of between 1 and 3.7, and an average of 2.3.

Based on the above field and laboratory test results, together with visual and tactile examination, the fill material generally exhibited a compact compactness condition, and the peat material exhibited a soft to firm consistency. The peat material is classified as amorphous granular to fibrous.

The bottom depths and elevations of the peat deposit are presented in the following table:

Borehole No.	Bottom of Peat, m	Bottom Elevation of Peat, m
05B-1	2.74	328.61
05B-2	4.11	328.92
05B-3	4.42	328.65
05B-4	3.05	328.12

4.5.2 Silty Clay

The peat layer in all of the boreholes in the swamp area is underlain by a 0.31 m and 0.61 m thick layer of grey silty clay.

Standard penetration tests taken within the silty clay yielded “N”-values of between 8 and 11 blows per 0.3 m. Moisture content determinations of the silty clay samples yielded results of between 13 and 35%.

Two (2) grain size distribution analyses and two (2) Atterberg Limits determinations were performed on the peat materials and the results are presented on the following figures of Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
05B	C-05B.5	C-05B.6

Atterberg Limits determinations on the silty clay layer yielded liquid limits, plastic limits and plasticity indices of 27 and 43%, 18 and 26%, and 9 and 17%, respectively, indicating a CL to CI classification.

The unit weight of the silty clay layer was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

Based on the above field and laboratory test results, together with visual and tactile examination, the clayey silt to silty clay layer generally exhibited a stiff consistency.

The silty clay extends beyond the vertical limit of Borehole 05B-1 at a maximum depth of 3.05 m below the present ground surface at Elevation 328.30 m.

4.5.3 Sand and Silt Till

The silty clay layer in Boreholes 05B-2, 3 and 4 is in turn underlain by a 0.61 m to 2.39 m thick layer of sand and silt till with embedded gravel and a trace of clay. Occasional clayey silt seams and layers are present within the sand and silt till.

Standard penetration tests taken within the sand and silt till yielded "N"-values of between 15 and over 100 blows per 0.3 m, with an average of 60 blows per 0.3 m. The natural moisture contents were between 10 and 16% with an average of 13.0%.

A single grain size distribution analysis was performed on the sand and silt till and the results are plotted on Figure C-05B.7 of Appendix B.

Two (2) grain size distribution analyses and two (2) Atterberg Limits determination were performed on the clayey silt seams, pockets and layers within the sand and silt till and the results are plotted on the following figures of Appendix B:

Culvert Number	Grain Size Figure	Atterberg Limits Figure
05B	C-05B.8	C-05B.9

The Atterberg Limits determination carried out on the clayey silt seams and layers within the sand and silt till yielded liquid limits, plastic limits and plasticity indices of 21%, 15%, and 6%, respectively.

The unit weight of the sand and silt till layer was not determined due to the disturbance of the soil samples during sampling and sample retrieval.

Based on the above field and laboratory test results, together with visual and tactile examination, the sand and silt till generally exhibited a dense to very dense compactness condition, with near surface loose to compact zones.

The sand and silt till deposit extends beyond the vertical limit of Boreholes 15B-3 and 4 at maximum depths of between 7.01 m and 4.27 m below the present ground surface (between Elevations 326.06 m and 326.90 m), respectively.

4.5.4 Shale Bedrock

The sand and silt till in Borehole 05B-2 is underlain by weathered shale bedrock as evidenced by the shale fragments retrieved from the auger cuttings.

This borehole is terminated at a depth of 7.32 m due to auger refusal, at Elevation 325.71 m.

4.6 Group 5

Boreholes 09B-1, 2 and 4 were put down in the high fill area, within the truck climbing lane widening section. The area is generally underlain by embankment fill over native clayey silt to silty clay till. Additional boreholes (Boreholes 09B-3, 5, 6, 7, 8, 9 and 10) were put down for the high fill area covered in a separate report. The following is a detailed description of the soil stratigraphy encountered for this group of boreholes. A summarized soil profile is provided in Drawing 6.

4.6.1 Fill

Borehole 09B-2 put down on the existing shoulder penetrated a 0.3 m of granular fill underlain by a 5.03 m thick layer of mixed embankment fill.

The ground surface of Boreholes 09B-1 and 09B-2 is covered with a 0.15 m thick layer of topsoil.

Standard penetration tests taken within the fill layers yielded "N"-values of between 3 and 7 blows per 0.3 m, with an average of 5 blows per 0.3 m. The natural moisture contents were between 11 and 26% with an average of 20%.

Four (4) grain size distribution analyses and three (3) Atterberg Limits determinations were performed and the results are plotted on the following figures of Appendix B.

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
09B	C-09B.1	C-09B.2

The Atterberg Limits determinations carried out on the fill yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	20	30	26.3
Plastic Limit (W_P)	14	18	16.3
Plasticity Index (I_p)	6	12	10.0

A single unit weight determination of the fill yielded a result of 18.6 kN/m^3.

Based on the above field and laboratory test results, together with visual and tactile examination, the fill generally exhibited a very loose to loose compactness condition.

The depths and bottom elevations of the topsoil and embankment fill are presented in the following table:

Borehole No.	Bottom of Topsoil, Pavement, Fill and Peat, m	Bottom Elevation of Topsoil, Pavement, Fill and Peat, m
09B-1	0.15	266.78
09B-2	5.33	268.12
09B-3	0.15	268.40

4.6.2 Clayey Silt to Silty Clay Till

The topsoil and embankment fill are underlain by a major deposit of reddish brown clayey silt to silty clay till with embedded sand and gravel. Silt seams, pockets and layers are present within the clayey silt to silty clay till.

Standard penetration tests taken within the clayey silt to silty clay till yielded "N"-values of between 19 and over 100 blows per 0.3 m, with an average of 74 blows per 300 mm. The natural moisture contents were between 6 and 21% with an average of 12%.

Four (4) grain size analyses and four (4) Atterberg Limits determinations were performed on the clayey silt to silty clay till and the results are plotted on the following figures of Appendix B:

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
09B	C-09B.3	C-09B.4

The Atterberg Limits determinations carried out on the clayey silt to silty clay till (CL-ML to CL) yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	18	32	22.0
Plastic Limit (W_P)	13	16	14.3
Plasticity Index (I_p)	4	16	7.8

Two (2) grain size distribution analyses and two (2) Atterberg Limits determinations were performed on the silt seams, pockets and layers within clayey silt to silty clay till and the results are plotted on the following figures of Appendix B:

Table of Figures of Laboratory Test Results

Culvert Number	Grain Size Figure	Atterberg Limits Figure
09B	09B.5	09B.6

The Atterberg Limits determinations carried out on the silt seams (ML), pockets and layers within the clayey silt to silty clay till yielded the following results:

Atterberg Limits	Minimum	Maximum	Average
Liquid Limit (W_L)	16	18	17.0
Plastic Limit (W_P)	13	14	13.5
Plasticity Index (I_p)	3	4	3.5

The undrained shear strength of the clayey silt to silty clay till as determined from field pocket penetrometer testing ranged from 100 to over 225 kPa, which generally increased with increasing depths.

Unit weight determinations carried out on the clayey silt to silty clay till yielded results of between 18.7 kN/m^3 and 23.6 kN/m^3, with an average of 21.1 kN/m^3.

Based on the above field and laboratory test results, together with visual and tactile examination, the clayey silt to silty clay till deposit generally exhibited a hard consistency with localized very stiff consistency within the surface 0.5 m to 1.0 m of the deposit.

The clayey silt to silty clay deposit extends beyond the vertical limit of this group of boreholes at maximum depths of between 4.72 m and 7.62 m below the present ground surface (between Elevations 260.53 m and 265.83 m).

4.7 Groundwater

The groundwater condition was monitored during and upon completion of sampling. On completion of drilling, groundwater levels noted in the boreholes are summarized in the following table:

Borehole Number	Ground Surface Elevation, m	Groundwater Level, m	Groundwater Elevation, m
02B-1	327.42	BHD&O	
02B-2	329.84	BHD&O	
02B-3	327.32	BHD&O	
03B-1	327.23	BHD&O	
03B-2	329.37	BHD&O	
03B-3	327.44	BHD&O	
05B-1	331.35	0.30	331.05
05B-2	333.03	2.51	330.52
05B-3	333.07	2.60	330.48
05B-4	331.17	0.61	330.56
06B-1	331.42	BHD&O	
06B-2	333.80	3.35	330.45
06B-3	331.90	BHD&O	
07B-1	322.32	BHD&O	
07B-2	322.35	BHD&O	
07B-3	322.21	BHD&O	
08B-1	322.52	BHD&O	
08B-2	322.48	BHD&O	
08B-3	320.77	BHD&O	
09B-1	266.93	BHD&O	
09B-2	273.45	BHD&O	
09B-4	268.55	BHD&O	
10B-1	259.20	BHD&O	
10B-2	261.66	BHD&O	
10B-3	260.81	BHD&O	
11B-1	240.92	BHD&O	
11B-2	242.62	BHD&O	
11B-3	241.17	BHD&O	
12B-1	239.92	1.83	238.09
12B-2	242.43	4.57	237.86

Borehole Number	Ground Surface Elevation, m	Groundwater Level, m	Groundwater Elevation, m
12B-3	240.32	3.05	237.27
13B-1	235.21	BHD&O	
13B-2	238.51	BHD&O	
13B-3	235.51	BHD&O	
14B-1	235.35	3.07	232.28
14B-2	237.78	5.18	232.60
14B-3	235.13	2.74	232.39
15B-1	222.03	1.78	220.25
15B-2	222.78	1.83	220.95
15B-3	222.80	2.51	220.29
16B-1	219.27	0.73	218.54
16B-2	220.50	2.44	218.06
16B-3	220.59	1.91	218.68
17B-1	214.91	1.98	212.93
17B-2	216.46	2.54	213.92
17B-3	216.51	3.05	213.46
18B-1	213.13	3.35	209.78
18B-2	215.66	2.79	212.87
18B-3	215.73	0.30	215.43
19B-1	206.50	BHD&O	
19B-2	207.20	BHD&O	
19B-3	207.25	BHD&O	
20B-1	201.77	BHD&O	
20B-2	201.75	BHD&O	
20B-3	200.10	BHD&O	
21B-1	186.37	BHD&O	
21B-2	186.95	BHD&O	
21B-3	185.47	2.29	183.18

Note: BHD&O means borehole dry and open at completion

In general, the groundwater was encountered as perched conditions within the upper fill materials and in the wet to saturated sand to sand and gravel deposits. The observed groundwater table at the time of the field work represented the shallow groundwater condition at these culvert sites, and may not have stabilized for the short durations that the boreholes were kept open.

The brown to grey interface encountered in Boreholes 16B-1, 2 and 3 likely reflect a level of permanent saturation.

Groundwater levels within the swamp area could rise to above the ground surface under wet weather conditions.

The groundwater condition will fluctuate seasonally and in response to weather events.

PART B – FOUNDATION DESIGN

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

This section of the report provides our recommendations on the geotechnical aspects of foundation design of the proposed replacement or extension of the non-structural culverts in the St. Vincent Township, based on our interpretation of the factual information obtained during this investigation. It should be noted that the interpretation and recommendations are intended for use only by the design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction method and scheduling.

The nineteen (19) non-structural culverts are located on or beside Highway 26, approximately between 0.5 km and 9.5 km east of the west limit of this Contract (Station 10+300). The east limit of this Contract is located 0.3 km east of the former St. Vincent/Sydenham Township Boundary (Station 10+000). Photographs of this culvert site are presented in Appendix D. Table 1 summarizes the locations, structure types and dimensions of the existing and replacement culverts as recommended by the PDR and provided in the RFP documents. Locations of the individual non-structural culverts are illustrated in the Borehole Location Plan, Drawings 1 to 4 presented in Appendix A.

These non-structural culvert sites are generally located within drainage valleys, surface water flow paths of equalizing culverts between wetlands severed by Highway 26. The overfill heights are approximately between 0.36 m and 4.6 m at the non-structural culvert sites.

Culverts 7B and 8B are culverts crossing St. Vincent Township 11th Line on the south and north sides of Highway 26, respectively. Culvert 19B crosses St. Vincent Township Road between Concession 6 and 7, on the south side of Highway 26. The remaining culverts are culverts crossing Highway 26. Culvert 21B flows towards the south ditch of Ford Drive at Station 10+116.5 (Ford Drive). Based on the information provided in Plate 24 of the PDR prepared by Earth Tech Canada Inc., Culvert 18B flows from left to right, in a southerly direction.

Culvert 5B is a culvert extension on both the north (Lt) and south (Rt) sides located within the swamp area where a truck climbing lane will be added. Culvert 9B is located within a high fill area (>5m fill height) also within the truck climbing lane widening area. The embankment widening in the swamp area will be covered under a separate report, and the high fill/deep cut will also be covered in a separate report.

The embankment slopes are typically 2.5H:1V to 3H:1V and are grass covered. No signs of embankment slope instability were observed at the time of this foundation investigation. Site photographs taken during the field work in 2007 are and provided in Appendix D.

Thirteen (13) of the nineteen (19) non-structural culverts are to be extended at the time of preparing this final report. The maximum size of these existing concrete box culvert is 1840 mm by 1220 mm. Considerations should be given to extending the culverts using corrugated steel pipe (OPSD800.011). This alternative will eliminate the need for cut-off walls at the end of the box culvert extensions. The remaining culverts will be replaced with pipe culverts varying from 600 mm to 1800 mm in diameter.

The following recommendations pertain to conventional reconstruction or extension of the box and pipe culvert with the same or similar culvert types.

5.2 Summarized Construction Conditions

At the time of preparing this final report, Culverts 02B, 07B, 08B, 09B, 18B, and 19B will be replaced with pipe culverts. The types of pipe culverts could be rigid concrete pipes or flexible plastic or CSP pipes. With the exception of Culvert 21B, the remaining culverts will be extended both on the left and right sides. Culvert 21B will be extended on the right side only.

The following table summarizes the anticipated founding subgrade conditions for the replacement culverts and culvert extensions, bedding and backfill requirements and the excavation/cut slope methodology, along with the applicable OPSD's for construction of the proposed culvert replacements/extensions.

The anticipated foundation subgrade was established based on the assumption that the extensions of concrete box culverts will have invert elevations similar to those of the existing culverts, with anticipation of the bedding subgrade to be approximately 0.7 m below the box culvert invert (0.3 m concrete slab over 0.4 m of bedding material) for conventional precast concrete box culvert extensions. The bedding subgrade for replacement pipe culverts of 1 m or less in diameter are assumed to be approximately 0.3 m below the invert (0.15 m bedding and 0.15 m pipe or rib thickness), and 0.15 times of the pipe diameter for pipe diameters greater than 1 m (up to 300 mm), plus the pipe or rib thickness of 0.15m.

Classification of the soil types for excavation in accordance with OHSA and O. Reg. 213/91 and dewatering requirements are also provided in the following table:

Table 3 - Summarized Construction Conditions

Culvert #	ANTICIPATED SOIL TYPE FOR EXCAVATION	BEDDING, BACKFILL	OHSA & O.Reg. 213/91 EXCAVATION SOIL TYPE
02B	Moist, loose to compact mixed fill on moist, very stiff clayey silt to silty clay till	OPSD 802.010, OPSD 802.030, or OPSD 802.031	Type 3
03B	Loose mixed fill on moist, compact to very dense sand and silt till	OPSD 803.010	Type 3
05B Swamp Section	Saturated peat on top of wet, firm silty clay underlain by compact sand and silt till	OPSD 803.010	Types 3 and 4 1.5 m to 2.0 m sub-excavation 2.5 m below water table Dewatering with PTTW required
06B	Moist, very stiff to hard silty clay till	OPSD 803.010	Type 3
07B	Loose to compact fill with organics over firm to very stiff silty clay till	OPSD 802.010, OPSD 802.030, or OPSD 802.031	Type 3 Approximately 0.2 m sub-excavation at Borehole 07B-3
08B	Moist to wet, loose to compact fill on top of moist, stiff to hard silty clay till	OPSD 802.010, OPSD 802.030, or OPSD 802.031	Type 3
09B High Fill Area	Moist to wet, very loose to loose mixed fill on top of moist, very stiff to hard clayey silt to silty clay till	OPSD 802.010, OPSD 802.030, or OPSD 802.031 (Not required if existing culvert is being lined)	Types 2 and 3
10B	Moist, very stiff clayey silt to silty clay till	OPSD 803.010	Types 2 and 3
11B	Moist, very stiff to hard silty clay till	OPSD 803.010	Types 2 and 3
12B	Wet, loose to compact sand and silt till	OPSD 803.010	Type 3
13B	Wet to moist, stiff to hard clayey silt to silty clay till or very dense silty sand and gravel	OPSD 803.010	Type 3
14B	Moist loose to compact fill on top of moist, to wet sand and gravel or gravelly silty sand till	OPSD 803.010	Type 3 Approximately 0.7 m sub-excavation at Borehole 14B-1

Culvert #	ANTICIPATED SOIL TYPE FOR EXCAVATION	BEDDING, BACKFILL	OHSA & O.Reg. 213/91 EXCAVATION SOIL TYPE
15B	Moist to saturated, compact sand with gravel layers	OPSD 803.010	Type 3
16B	Moist to wet mixed fill on top of wet to saturated, compact, silty sand to sand and silt till	OPSD 803.010	Types 3 and 4 Possibly 0.2 m to 0.6 m below water level. Dewatering Required
17B	Moist to wet, compact mixed fill on top of moist, dense sand and silt till	OPSD 803.010	Type 3
18B	Moist to saturated, very loose to compact mixed fill on top of Wet to moist, loose to very dense sand and silt till	OPSD 802.010, OPSD 802.031, or OPSD 802.032	Types 3 and 4 Approximately 0.4 m sub-excavation on south half Excavation 2 m below water table on north side Dewatering with PTTW likely required
19B	Moist to wet loose sand fill on top of moist to saturated, compact, sand and silt or moist stiff to very stiff clayey silt to silty clay till	OPSD 802.010 or OPSD 802.031	Type 3 Possible 0.4 m sub-excavation beneath shoulder Minor dewatering of perched groundwater may be required
20B	Moist lose to compact mixed fill and buried topsoil on top of moist, very stiff clayey silt to silty clay till	OPSD 803.010	Type 3
21B	Moist, compact mixed fill on top of moist, hard clayey silt till	OPSD 803.010	Types 2 and 3

The following table summarizes the anticipated subgrade conditions, design bedding subgrade and anticipated highest subgrade elevations.

Table 4 - Summary of Anticipated Subgrade Conditions, Design Subgrade and highest Subgrade Elevations

Culvert No.	Recommended Replacement/Extension Culvert Type and Size	Anticipated Bedding Subgrade	Design Bedding Subgrade Elevation (m) Upstream/Downstream	Highest Bedding Subgrade Elevation (m) Upstream/Downstream
02B	Replace with 975 mm diam. Pipe Culvert	Moist, very stiff clayey silt to silty clay till	326.02/325.93***	326.02/325.93
03B	Extend Lt and Rt (Existing 1540 X 925 Box)	Moist, compact to very dense sand and silt till	325.98/325.83	325.98/325.83
05B Swamp Section	Extend Lt and Rt (Existing 914 X 910 Box)	Peat over wet, firm silty clay underlain by compact sand and silt till	330.10/330.10	328.10/328.60** 1.5 m to 2.0 m sub-excavation (below groundwater table)
06B*	Extend Lt and Rt (Existing 914 X 910 Box)	Moist, very stiff to hard silty clay till	330.98/330.94	330.98/330.94
07B*	Replace with 600 mm diam. Pipe Culvert	Loose fill over firm to very stiff silty clay till Loose fill in Borehole 07B-3	322.01/320.74***	322.01/320.53** Approximately 0.2 m sub-excavation at Borehole 07B-3
08B*	Replace with 600 mm diam. Pipe Culvert	Moist, stiff to hard silty clay till	321.44/319.90***	321.44/319.90
09B High Fill Area	Replace with 1800 mm diam. Pipe Culvert or Line Existing	Moist, very stiff to hard clayey silt to silty clay till	266.74/266.57***	266.74/266.57
10B*	Extend Lt and Rt (Existing 910 X 910 Box)	Moist, very stiff clayey silt to silty clay till	258.87/258.81	258.87/258.81
11B	Extend Lt and Rt (Existing 1840 X 1220 Box)	Moist, very stiff to hard silty clay till	239.21/239.02	239.21/239.02
12B	Extend Lt and Rt (Existing 1540 X 1220 Box)	Wet, compact sand and silt till.	238.94/238.89	238.94/238.89

Culvert No.	Recommended Replacement/Extension Culvert Type and Size	Anticipated Bedding Subgrade	Design Bedding Subgrade Elevation (m) Upstream/Downstream	Highest Bedding Subgrade Elevation (m) Upstream/Downstream
13B	Extend Lt and Rt (Existing 910 X 910 Box)	Moist, stiff clayey silt to silty clay till or very dense silty sand and gravel	234.29/234.20	234.29/234.20
14B	Extend Lt and Rt (Existing 915 X 940 Box)	Loose fill over moist, dense gravelly silty sand till Loose fill at Borehole 14B-1	233.91/233.92	233.22/233.92** Approximately 0.7 m sub-excavation at Borehole 14B-1
15B*	Extend Lt and Rt with Header and Gabion Walls (Existing 910 X 910 Box)	Wet to saturated, compact sand to silty sand	220.25/220.22	220.25/220.22 (near groundwater table)
16B*	Extend Lt and Rt with Header and Gabion Walls (Existing 910 X 910 Box)	Saturated, loose to compact, silty sand to sand and silt till Loose fill over peat at Borehole 16B-2	218.33/218.33	218.33/218.33** (below groundwater table)
17B*	Extend Lt and Rt (Existing 920 X 630 Box)	Moist to wet, compact to very dense sand and silt till	214.11/214.01	214.11/214.01
18B*	Replace with 800 mm diam. Pipe Culvert	Wet to moist, dense to very dense sand and silt till Loose fill over peat at Borehole 18B-2	213.62/213.31***	213.62/212.92** Approximately 0.4 m sub-excavation on south half (below groundwater table)
19B*	Replace with 600 mm diam. Pipe Culvert	Saturated, compact sandy silt to moist stiff to very stiff clayey silt to silty clay till Loose fill at Borehole 19B-2	206.17/205.68***	206.17/205.52** Possible 0.4 m sub-excavation beneath west shoulder

Culvert No.	Recommended Replacement/Extension Culvert Type and Size	Anticipated Bedding Subgrade	Design Bedding Subgrade Elevation (m) Upstream/Downstream	Highest Bedding Subgrade Elevation (m) Upstream/Downstream
20B*	Extend Lt and Rt with Header and Gabion Walls (Existing 920 X 910 Box)	Moist, very stiff to hard clayey silt to silty clay till	199.28/199.25	199.28/199.25
21B*	Extend Rt (Existing 920 X 940 Box)	Moist, hard clayey silt	184.04/ not applicable	184.04/not applicable

Note * overfill less than 1.4 m design frost depth
** sub-excavation required
*** assumed 0.15 m bedding for pipe culvert and 0.15 m pipe or rib thickness

5.2.1 Design Considerations

The existing culverts at Culverts 02B, 07B, 08B, 09B, 18B and 19B are to be replaced with pipe culverts having diameters of between 600 mm and 1,800 mm. There are no preferences from a geotechnical or foundations perspective on the type of replacement culverts (flexible or rigid pipes). The following considerations are provided for pipe culvert replacements:

a) Select a pipe size and type that could fit into the existing box culvert of 02B, provided that the hydraulics aspects of the replacement culvert are met to eliminate the need for excavation and backfill. Grouting of the void between the inside of the existing culvert and the outside of the replacement culvert will be required in this case.

b) Construct the replacement culvert using horizontal directional drilling (HDD) adjacent to the existing culvert. This is based on the assumption that there are no existing underground utility and cobbles or boulder obstructions within the culvert alignment. Grouting of the existing culvert and minor realignment of the inlet and outlet will be required using this alternative. This alternative likely applies to Culverts 2B, 07B, 08B, 18B and 19B.

c) For the installation of Culvert 09B, jack-and-bore method can be considered.

d) The remaining thirteen (13) non-structural culverts are to be extended at the time of preparing this final report. The maximum size of these existing concrete box culvert is 1840 mm by 1220 mm. Considerations should be given to extending the culverts using corrugated steel pipe (OPSD800.011).

e) The existing Culverts 07B, 08B, and 19B are CSP culverts crossing Township roads and are not transverse culverts crossing Highway 26. These culverts will be replaced with flexible or rigid pipe culverts as stated above.

5.3 Closed Box Culvert

All of the non-structural culvert extensions will likely be replaced with precast concrete box culverts.

The closed box culverts should be designed to OPSS 1821 and CAN/CSA-S6-06 and to withstand the appropriate weight of overfill, traffic loadings (CL-625-ONT), temporary construction loads and critical loading effects during construction. If the base slab does not have adequate frost cover/protection, it should be designed for frost pressures.

As there was no hydrostatic pressure observed during borehole sampling (within the sand and gravel, clayey silt or silty clay till), piping is not considered likely to occur at the founding subgrade of the culvert provided that the subsoil is properly dewatered prior to construction, where required.

As per CAN/CSA-S6-06, Clause 1.9.5.6, a cut-off wall of sufficient depth and strength shall be provided at the ends of the culvert to prevent undermining. The depth of the cut-off wall should be designed cognizant of the hydraulic condition (CAN/CSA-S6-06, Section 1.9) and the frost depth of 1.4 m (OPSD 3090.101).

The top of Culverts 06B, 10B, 15B, 16B, 17B, 20B and 21B will be placed at depths of between 0.4 m and 1.2 m below the finished grade, and are above the frost depth of 1.4 m. Adequate frost treatment (taper) should be provided in accordance with OPSD803.010 for these culverts. The excavation for the installation of the box culverts shall follow OPSS 902 and SSP902S01.

The bedding material, cover and backfill for non-structural precast concrete box culverts (<3m span) shall conform to OPSS 422 and SSP422S01. The bedding should be Granular A and should be 0.15 times of the width of the culvert, and should not be less than 150 mm and not more than 300 mm. The placement and compaction of the bedding layer should conform to OPSS 422.07.07. A 75 mm thick un-compacted Granular A or fine aggregates (OPSS 1002) shall be placed on the bedding layer as leveling course. The bedding subgrade elevations provided in Table 4 will be refined when details of the replacement culverts are known.

Peat of up to 2 m was identified below the design bedding subgrade for precast concrete culvert construction of Culvert 05B. Sub-excavation will be required along with engineered fill as discussed in Section 5.7. A profile of Culvert 05B is presented in Drawing 5 to provide additional data for culvert design.

Fill and organic soils and wet subgrade condition will be encountered at the design bedding subgrade at the locations of Culvert 14B. Sub-excavation to competent subgrade and replacement with engineered fill will be required and discussed in Section 5.7.

Culvert 09B will be constructed within the high fill area within the truck widening lane embankment widening, with embankment heights of up to 7 m high. Roadway protection will have to be carried out at this location to maintain a single lane traffic flow during construction.

Based on the groundwater conditions encountered in the boreholes, dewatering at the locations of Culvert 05B and 16B will be required to facilitate construction in the dry as discussed in Section 5.7.

The granular backfill shall meet the gradation requirements of OPSS 1010 for Granular A, placed in lifts not exceeding 200 mm and compacted to at least 95% SPMDD in accordance with OPSS 501 and OPSS 422.07.11.

5.4 Pipe Culvert

Culverts 02B, 07B, 08B, 09B, 18B and 19B may be replaced with either flexible or rigid CSP or concrete pipe culverts.

The inverts of the CSPs or concrete pipe culverts will be placed at depths of between 1.4 m and 4.9 m deep, and likely be supported on a Class B or C Bedding for rigid pipes. Flexible pipe bedding should be designed in accordance with OPSD 802.010; and rigid pipe bedding in accordance with OPSD 802.031 and 802.032. Frost treatment should be provided in accordance with OPSD 803.030 and 803.031.

As per CAN/CSA-S6-06, Clause 1.9.5.6, a cut-off wall of sufficient depth and strength shall be provided at the ends of the culvert to prevent undermining. The depth of the cut-off wall should be designed cognizant of the hydraulic condition (CAN/CSA-S6-06, Section 1.9) and the frost depth of 1.4 m (OPSD 812.010).

Fill and organic soils and wet subgrade condition will be encountered at the design bedding subgrade at the locations of Culverts 07B, 18B and 19B. Sub-excavation to competent subgrade and replacement with additional bedding material or engineered fill will be required and discussed in Section 5.7.

Based on the groundwater conditions encountered in the boreholes, dewatering at the location of Culvert 18B will be required to facilitate construction in the dry as discussed in Section 5.7.

5.5 Lateral Earth Pressures

The lateral earth pressures acting on the culvert walls, headwalls (wing walls) and retaining walls will depend on the type and method of placement of the backfill materials and on the subsequent lateral movement of the structure whether it is restrained or unrestrained. The lateral earth pressures to be used in the design should be computed in accordance with Section 6.9 of the CAN/CSA-S6-06.

Granular backfill should be constructed behind the culvert walls, headwalls (wing walls) and retaining walls as per OPSD 3121.150, with particular attention to the frost taper requirement. The granular backfill should conform to OPSS 1010 for either Granular A or Granular B Type III. To maintain free draining characteristics in granular fill materials, the maximum percentage passing the No. 200 sieve (75 μm) should be limited to 5%.

The backfill should be constructed as per OPSS 902 and OPSS 501, and SSP 902S01. A perforated subdrain should be installed behind the walls with a positive outlet or wall drains as per OPSD 3190.100 to drain the granular fill above the stream water level. Alternatively, the culvert walls could be designed to resist hydrostatic pressure.

The lateral earth pressure, P_h, may be computed using the equivalent fluid pressures presented in Clause 6.9.2.3 of the CAN/CSA-S6-06, or employing the following equation based on unfactored earth pressure distributions:

$$P_h = K\ (\gamma h + q)$$

Where:

K = earth pressure coefficient, use value from table below

γ = unit weight of soil, = 21.2 kN/m^3 for Granular B
= 22.8 kN/m^3 for Granular A

h = depth below top of wall, m

q = live load surcharge, of 0.8 m of fill as per Clause 6.9.5, CAN/CSA-S6-06

Wall Type	**Earth Pressure Coefficient (K)**	
	Granular A $\phi = 35^o$	**Granular B** $\phi = 30$ **to** 35^o
Restrained Wall (K_o)	0.43	0.50 to 0.43
Unrestrained Wall (K_a)	0.27	0.33 to 0.27

The submerged unit weight of the backfill should be used for any submerged portion of the granular backfill when calculating the lateral earth pressure.

The above parameters are based on a horizontal back slope (not exceeding 5 degrees) behind the headwalls. A compaction surcharge equal to 12 kPa should be included in the lateral earth pressures for the structural design of the headwalls and retaining walls in accordance with Clause 6.9.3 of the CAN/CSA-S6-06.

Vibratory equipment for use behind abutments and retaining walls should be restricted in size as per current MTO practices.

5.6 Embankment Widening

With the exception of Culvert 09B, the existing approach embankments are up to 3.9 m high adjacent to the proposed replacement culvert. Embankments for Culvert 09B is located in the high fill area, and recommendations for embankment widening are provided in a separate report.

For the widening of the embankments in the remaining culverts, the surficial topsoil and any deleterious materials should be stripped or excavated prior to placing fill materials. The embankment widening should then be constructed as per OPSD 202.010, 202.030 and 208.010, with emphasis on adequate benching of the subgrade for receiving the embankment fill. The fill to be used for embankment construction can either be imported silty clay or granular materials. Granular materials are preferred over silty clay for compaction and drainage.

Backfill adjacent to the structure should be carried out in conformance with OPSS 902, SSP902S01 and OPSD 3101.150, and the fill should be placed and compacted in accordance with OPSS 501.

Based on the findings of the field investigation, no foundation stability or settlement problems due to widening the approach embankments on the inorganic native soils are anticipated for embankment slope of 2.5H:1V and up to 3.9 m high. The fill placement should begin at the toe of the embankment, in leveled lifts and each lift compacted to at least 98% standard Proctor maximum dry density (SPMDD). Benching into the existing embankment slope at 1 m high steps is recommended as per OPSD 208.010.

After stripping, the exposed subgrade should be inspected and approved by the geotechnical engineer. The approved subgrade should then be proof-rolled using a heavy compactor, as directed by the engineer. Unless the excavation is carried out in wet weather conditions, no unusual dewatering is anticipated during stripping and preparation of the subgrade to receive the embankment fills. Where necessary, dewatering can be carried out using gravity drainage and pumping from open filtered sumps in accordance with OPSS 517 and 902, and SSP902S01, with emphasis on the requirements of OPSS 518.

Measures should be incorporated into the design and staging to ensure that the slope surfaces are protected from surface erosion in accordance with the requirements of OPSS 577. Proper erosion control measures should be implemented both during construction of the embankment fills and permanently. Properly designed erosion control blankets could also be placed on any new embankments and adjacent disturbed embankments after completion of fill placement. A vegetative cover should be established as soon as practical upon completion of fill placement to minimize the chances of surface erosion. Sediment control during construction should be carried out by installing silt fences.

Revetments such as rip-rap blanket should be provided at the toe of the slope and the ends of the culvert to prevent erosion/scour by stream action in accordance with OPSS 511, SSP511S01, and

OPSD 810.010. The design of the rip-rap blanket should be carried out cognizant of the stream hydraulics.

5.7 Excavation, Groundwater Control and Temporary Support

Excavation for this project will involve the construction of the box culverts, CSP culverts and concrete pipe culverts. Depending on the design that is finally selected, the anticipated maximum depth of excavation below the existing grade of Highway 26 is between less than 1 m and 7.4 m.

Excavation to depths of up to 7.4 m should not present any special difficulties using heavy excavation equipment, provided it is constructed in accordance with OPSS 501, 514, 517, 518, 539, 577 and, 902, SSP421S01, SSP422S01, SSP902S01 and OPSD 803.010 and 3121.150. However, the buried utilities along the west side of the embankment will likely be in conflict with the excavation. Excavation and protection procedures shall conform to SSP105S19 and should be reviewed with the utility companies or authorities prior to construction.

Fill and organic soils and wet subgrade condition will be encountered at the design bedding subgrade at the locations of Culverts 05B, 07B, 14B, 16B, 18B and 19B. The following table provides the estimated depths of excavation:

Table 5 - Estimated Depth of Sub-excavation

Culvert #	Sub-excavation Upstream (m)	Sub-excavation Downstream (m)
05B	2.00	1.5
07B	-	0.2
14B	0.7	-
18B	0.4	-
19B	0.4 (beneath west shoulder)	-

The thickness of the bedding material will have to be increased or the subgrade sub-excavated and replaced with engineered fill described below, at these locations where loose fill or unsuitable soil is encountered at the bedding subgrade level. The sub-excavation should be carried out as per the directions of the Geotechnical Engineer or the Quality Verification Engineer (QVE). The procedures for additional excavation and bedding material are covered in OPSS 421, 422 514 and 902, SSP421S01, SSP422S01 and SSP902S01.

Excavations will be carried out below the anticipated groundwater level at the following locations and the requirements for MOE Permit to Take Water (PTTW):

Culvert #	Depth Below Water Table (m)	Permit To Take Water for Excavations
05B	1.0 to 2.3	Category 2
16B	0.2 to 0.6	N/A to Category 1
18B	0.0 to 2.0	N/A to Category 1

The water in the streams or ditches can be controlled by temporary diversion or dam and pump method. Saturated fine granular soils (sand, silty sand, silt and sandy silt) could be encountered during excavation, and groundwater control will be required to handle surface runoff and minor seepage. The minor groundwater ingress can be controlled using intercept ditches and pumping from filtered sump pits.

It is noted that a PTTW (Regulation 387/04) will be required from the MOE (Ministry of Environment) when the total quantity of water to be handled exceeds 50,000 litres/day while employing temporary pumping of water, flow passages through culverts, stream diversion or dam and pump method as groundwater control measures (unwatering). It may take up to 90 days for MOE to review an application and issue a permit. It is understood that the amount of water to be handled will be based on a two-year storm event.

It should be pointed out that if the founding soil is disturbed, excessive settlements could occur after structural loads are applied. The founding level will be located below the stream bed and, therefore, care should be exercised to minimize disturbance to the bedding subgrade. Any disturbed subgrade should be subexcavated and replaced with thickened and compacted bedding material as per the directions of the Geotechnical Engineer or the QVE.

All excavation must be carried out in compliance with the requirements of the Occupational Health and Safety Act (OHSA). For this purpose, the unsaturated upper fill and loose to compact sandy soils encountered at this site are classified as Type 3 soils and the very stiff to hard clayey silt to silty clay soils are classified as Type 2 soils. Saturated cohesionless soils are classified as Type 4 soils.

For the Type 2 soils, the excavation shall be cut to near vertical in the bottom 1.2 m and then trimmed back to 1H:1V. Within the Type 3 soils and above the water table, the excavation shall be cut to no steeper than 1H:1V throughout. Side slopes of 3H:1V or flatter shall be used for excavation within Type 4 soils.

Temporary support within the overfill of the existing and the new partially constructed embankment/culvert may be required to facilitate culvert construction and to maintain access for construction and local traffic, and emergency vehicles. The staging of different phases of this work should be examined to determine if roadway protection is required. Roadway protection is

generally a contractor design/build item in accordance with Performance Level 2 of OPSS 539, SP105S19 and current MTO practices.

Geotechnical parameters for the design of temporary support structures are provided in Sections 5.3 and 5.4. In addition, a unit weight of 22 kN/m^3 and an internal friction angle, ϕ, of 29^o can be used for design if the existing embankment is to be supported.

5.7.1 Soil Improvement and Engineered Fill

Table 4 presented in Section 5.3 summarizes the recommended replacement culvert type and sizes, the anticipated bedding subgrade soil conditions, the estimated design bedding subgrade elevations as provided by Stantec, and the recommended highest subgrade elevations. Table 5 provides the areas where sub-excavation is required.

Peat and fill materials of up to 2 m could be encountered below the estimated design bedding subgrade elevations of the culverts listed in Table 5. The fill and peat materials could be variable and unpredictable and considered unsuitable for providing indirect support of the culverts, and should be removed to expose the native undisturbed subgrade, and replaced with additional compacted bedding material. Any peat, fill and deleterious materials encountered should be sub-excavated to expose the native inorganic subgrade and replaced with engineered fill as recommended below. Dewatering will be required to allow construction of the engineering fill and bedding under dry conditions.

Subgrade preparation and bedding construction should be carried out expeditiously to minimize the potential for subgrade disturbance. Due to these anticipated conditions, the thickness of the bedding material will likely be increased to 600 mm with anticipation that it may have to be increased to 900 mm or more. Excessive vibration from compaction could cause the wet silty clay, silt, sandy silt, and sand and silt till subgrade to become unstable. In this regard, 16 mm clear crushed stone placed on a Type II non-woven geotextile (Terrafix 360R or equivalent) is recommended to minimize the amount of compaction effort required.

Where unstable saturated subgrade conditions are encountered that are beyond the Contractor's control, or if the subgrade is disturbed, it may be necessary to improve the subgrade. Subgrade improvements should consist of:

a) Sub-excavation to remove any deleterious and disturbed material from the subgrade;

b) Place a Class II non-woven geotextile (OPSS 1860), such as Terrafix 360R of equivalent, to cover the subgrade. The geotextile shall extend above the sides of the crushed stone and a minimum of 600 mm overlap shall be kept at the joints if sewn seams in accordance with 1860.07.04 are not being used;

c) Place a 300 mm to 600 mm thick 16 mm clear stone (OPSS1004) layer on top of the geotextile for stabilization and pumping of groundwater. The clear crushed stone should be placed in thin lifts and tamped to the densest possible state so that the crushed stones are tightly interlocked. Placing and tamping of the clear crushed stone shall be carried out under the full-time supervision and directions of the Geotechnical Engineer or a QVE.

Since the thickness of the additional bedding and stabilizing material could be up to 2 m thick or more for support of the culvert, it should be constructed as engineered fill.

Conventional engineered fill construction is only feasible on a stable subgrade, when groundwater is properly controlled to below the subgrade level. It is considered not feasible to construct conventional engineered fill at these culvert sites. In view of the difficult site conditions, the engineered fill should consist of 16 mm clear crushed stone (OPSS 1004), to minimize the potential for subgrade disturbance due to vibration from compaction, and facilitate construction.

Preparation for engineered fill construction should consist of removing all deleterious organic materials (and fill if encountered) to expose native, undisturbed, layered silty clay subgrade. The engineered fill subgrade should be inspected and approved by the Geotechnical Engineer, or a QVE as per SSP199S48 and SSP902S01, prior to placement of the engineered fill. Depending on the geometry of the engineered fill subgrade, benching (OPSD 208.010) of the subgrade may be required to provide adequate and uniform support of the engineered fill.

A Class II non-woven geotextile (OPSS 1860), such as Terrafix 360R or equivalent, should be placed on the approved subgrade. The geotextile should extend above the sides of the crushed stone, and a minimum of 600 mm overlap shall be kept at the joints if sewn seams in accordance with 1860.07.04 are not being used.

The 16 mm clear crushed stone should be placed in 150 mm to 300 mm thick lifts and tamped to the densest possible state so that the crushed stones are tightly interlocked. The thickness of each lift of bedding material will be dependent on the type of compaction equipment used. The lift thickness of each lift for a small plate tamper should be 150 mm and the lift thickness could be increased to 300 mm for hoe-pac type compaction equipment. It is practically difficult to carry out compaction test on the 16 mm clear crushed stone and the results are generally meaningless. Compactive effort shall cease immediately when there are signs that the subgrade is pumping during compaction of the engineered fill. Placing and compaction of the bedding should be carried out under the full-time supervision and directions of the Geotechnical Engineer or a QVE in accordance with SSP902S01.

The Contractor can elect to place 16 mm crushed stone in lieu of the 200 to 300 mm of conventional Granular A bedding.

Due to the anticipated difficult site conditions, a site review should also be carried out by the Geotechnical Engineer at the time of construction to ensure that the assumptions made in the design is correct, and make any necessary adjustments to the recommendations as required. To avoid duplication, the Geotechnical Engineer could also be retained to verify bedding, soil improvement and engineered fill construction in lieu of the QVE process. A non-standard special provision (NSSP) should be included in the contract documents as per the above recommendations to provide proper guidance for the Contractor.

In the event that the QVE process is used, a certificate of conformance shall be provided to the Contract Administrator at completion of the engineered fill and bedding construction as per the requirements of SSP199S48 and prior to backfilling.

5.7.2 Backfill

The granular backfill shall meet the gradation requirements of OPSS 1010 for Granular A, placed in lifts not exceeding 200 mm and compacted to a minimum of 100% of the material's SPMDD in accordance with OPSS 501 and OPSS 422.07.11.

5.8 Frost Protection

This project is located in the Owen Sound Operations District. The design frost penetration depth for this project is 1.4 m in accordance with OPSD 3090.101. All foundations and spread footings should be provided with at least 1.4 m of soil cover for adequate frost protection.

5.9 Scour Depth

The footings should be founded below the anticipated local and general scour depths as per CAN/CSA-S6-06, Clause 1.9, Hydraulic Design. The permissible velocities of the various soil types which will be exposed at the streambeds (based on American Society of Civil Engineers publication, 1926, reprinted as Design Chart 2.17, MTO Drainage Management Manual 1997) are provided in the following table:

Soil Type	Permissible Velocity (m/sec)
Sand	0.6
Silty Sand	0.7
Sandy Silt	0.8
Silt	0.8
Sandy Silt Till	1.2
Clayey Silt	1.5
Silty Clay	1.5
Silty Clay Till	1.8

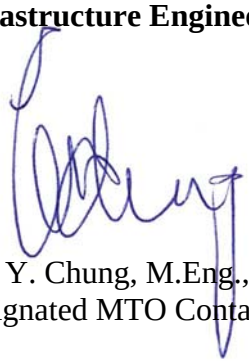
6.0 STATEMENT OF LIMITATION

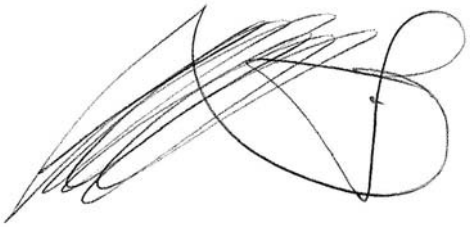
We recommend that once the details of the proposed structure are finalized, our recommendations should be reviewed for their specific applicability.

The Limitations of Report, as quoted in Appendix D, is an integral part of this report.

We trust that we have completed the assignment within the Terms of Reference for this project. If there are any questions concerning this report, please do not hesitate to contact our office.

Yours truly,
Infrastructure Engineering Group Inc.





Eric Y. Chung, M.Eng., P.Eng.
Designated MTO Contact

Joseph Law, P. Eng.
Project Manager

Tom O'Dwyer, P. Eng.
Quality Review Engineer

Appendix A

Drawings 1 to 4
Borehole Location Plans

Drawing 5
Plan & Profile - Culvert 05B

Drawing 6
Plan & Profile - Culvert 09B

METRIC

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WP No GWP 167–91–00

NON–STRUCTURAL CULVERT REPLACEMENT
Highway 26 – Part B
BOREHOLE LOCATION PLAN

SHEET 1

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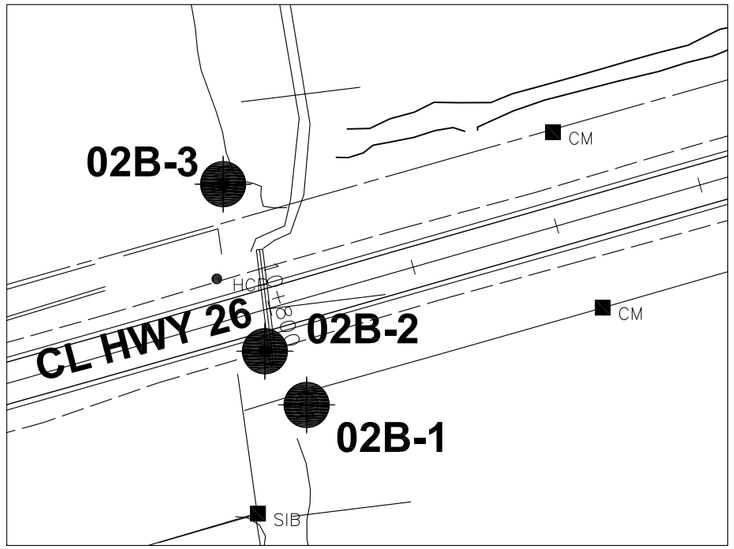

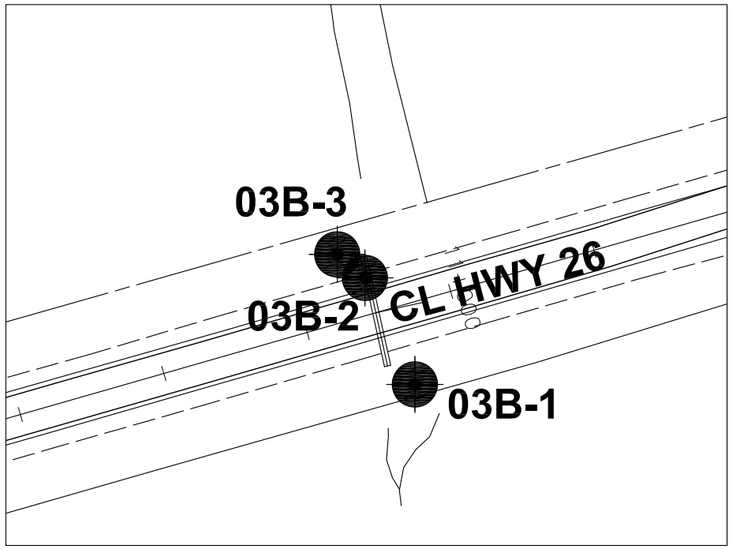

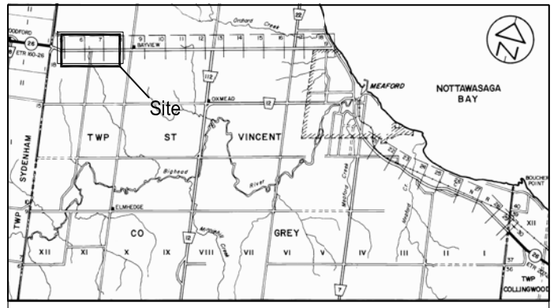

KEYPLAN NTS

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
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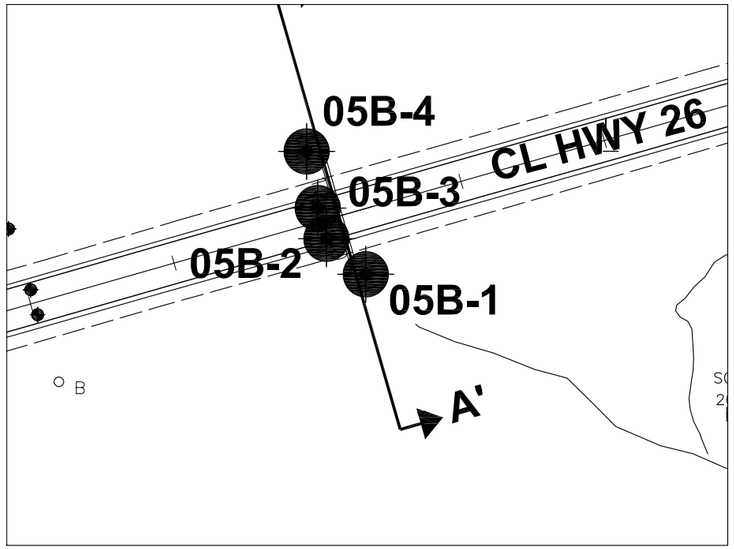
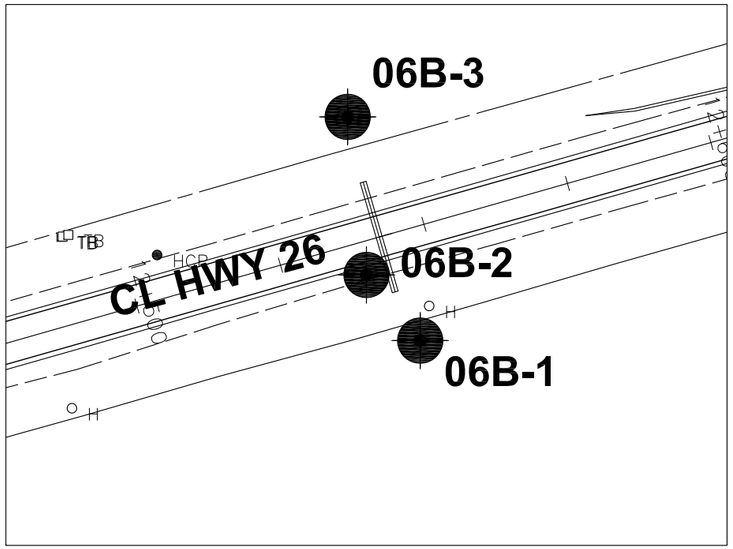
- W L at time of investigation
- Standpipe





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SCALE

NOTES

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02B–2	329.84	4940242	208313	03B–2	329.37	4940307	208492	05B–2	333.03	4940576	209469	06B–2	333.80	4940721	209987
02B–3	327.32	4940270	208306	03B–3	327.44	4940310	208487	05B–3	333.07	4940581	209468	06B–3	331.90	4940747	209984
								05B–4	331.17	4940591	209466				

REVISIONS			
	14/05/10	J.L.	Final Report
	20/11/09	J.L.	Draft Report
	DATE	BY	DISCRIPTION

MTO GEOCRES No. 41A–216

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SUBM'D J.L.	CHECKED E.C.	DATE 15/01/09	SITE 2B, 3B, 5B, 6B
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NON–STRUCTURAL CULVERT REPLACEMENT
Highway 26 – Part B
BOREHOLE LOCATION PLAN

SHEET 2

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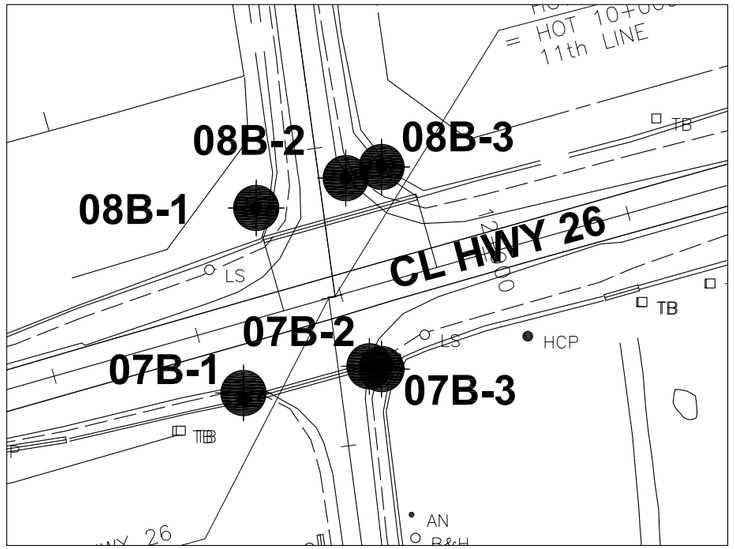

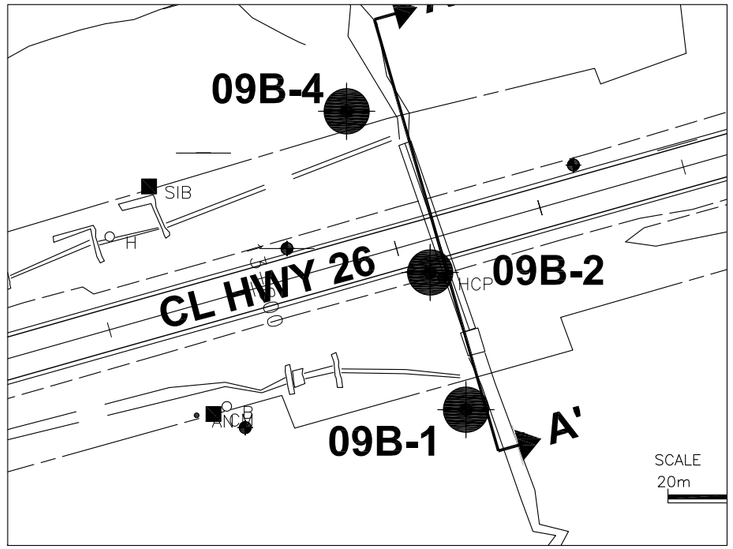

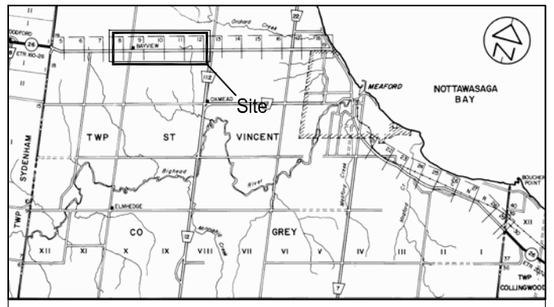

KEYPLAN NTS

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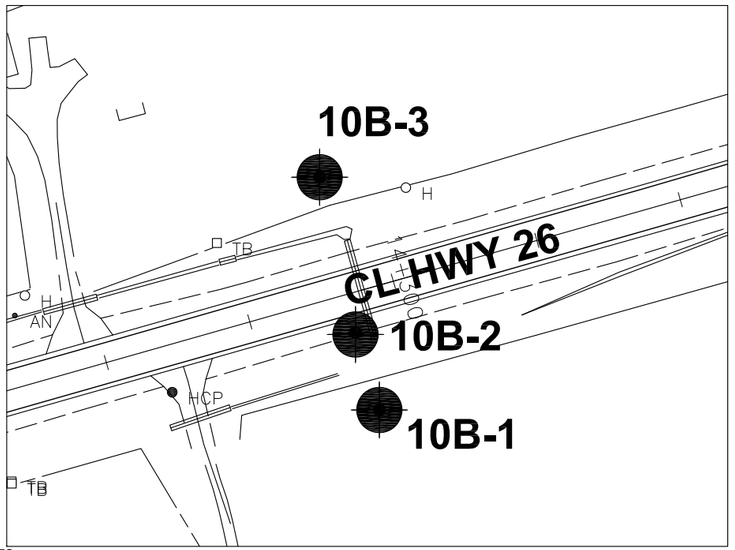

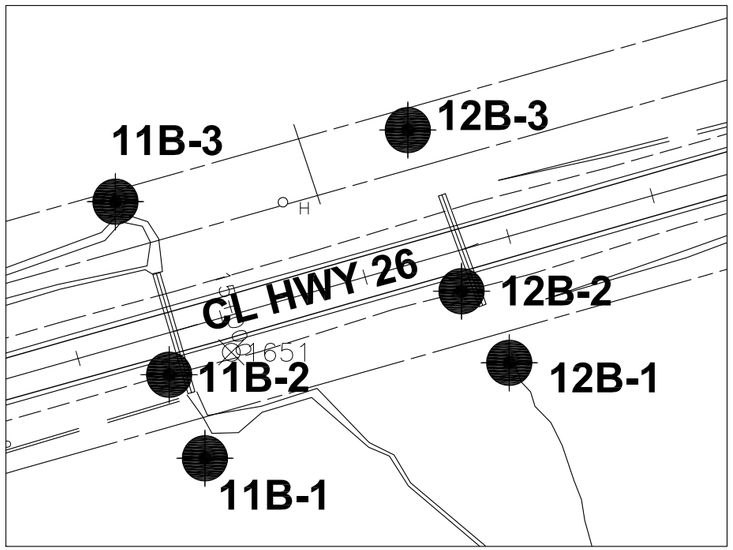

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SCALE

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07B–3	322.21	4940806	210316	08B–3	320.77	4940840	210316	09B–4	268.55	4941100	211215	10B–3	260.81	4941224	211668	11B–3	241.17	4941417	212336	12B–3	240.32	4941429	212385

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DRAWN J.L.	CHECKED J.L.	APPROVED	E.C.	DWG	2

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NON–STRUCTURAL CULVERT REPLACEMENT
Highway 26 – Part B
BOREHOLE LOCATION PLAN

SHEET 3

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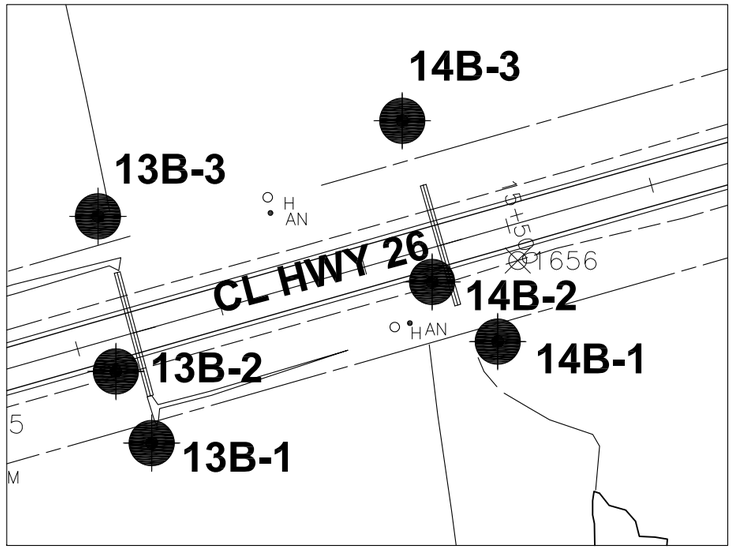

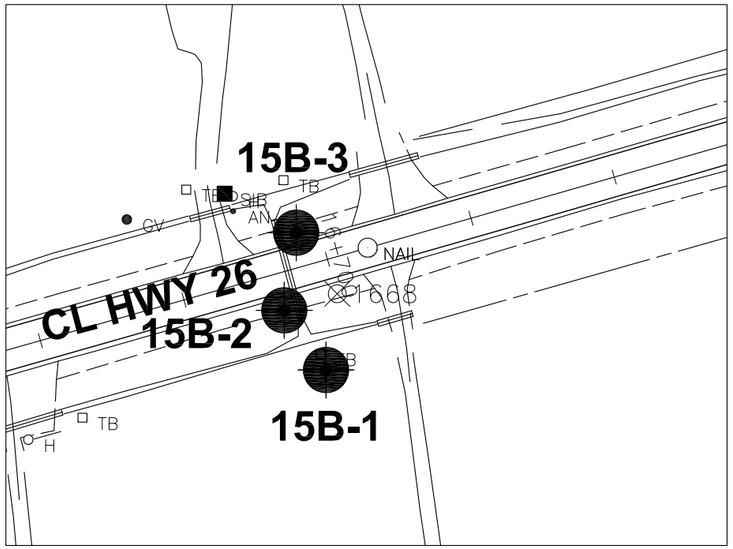

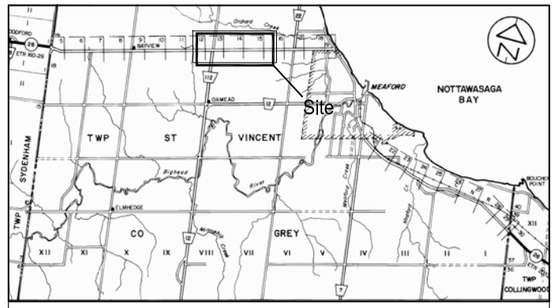

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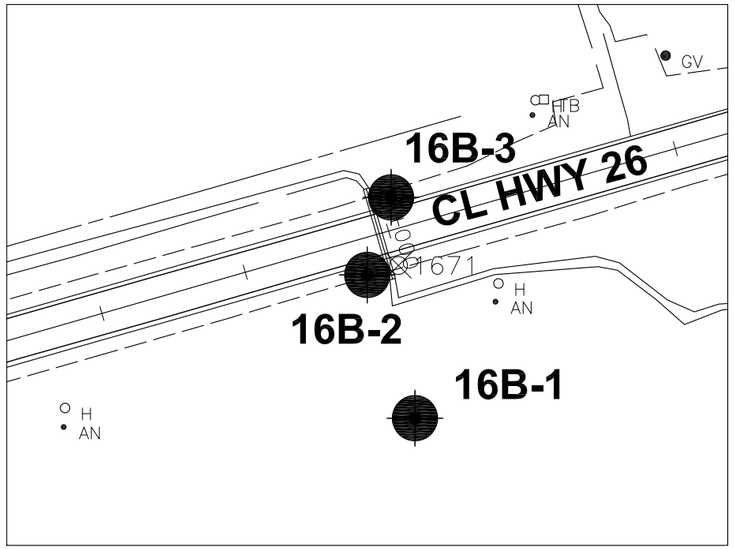

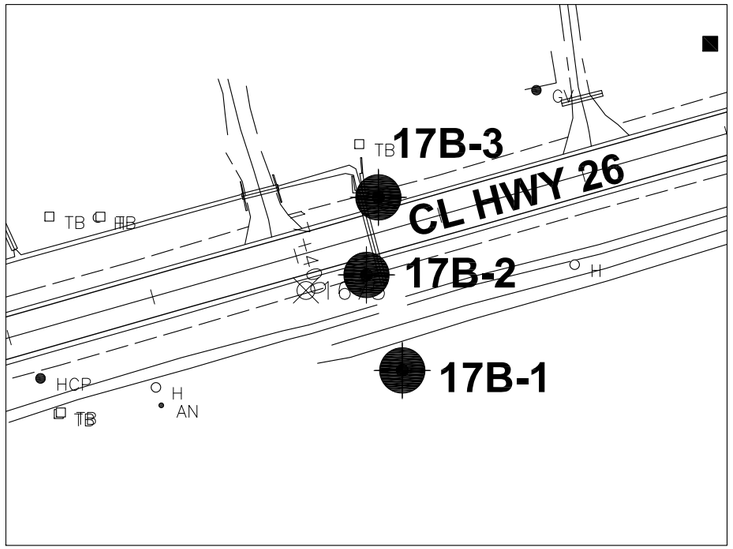

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13B–3	235.51	4941536	212766	14B–3	235.13	4941552	212817	15B–3	222.80	4941853	213982	16B–3	220.59	4941950	214278	17B–2	216.51	4942064	214676

REVISIONS			
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DRAWN J.L.	CHECKED J.L.	APPROVED E.C.	DWG 3

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NON–STRUCTURAL CULVERT REPLACEMENT
Highway 26 – Part B
BOREHOLE LOCATION PLAN

SHEET 4

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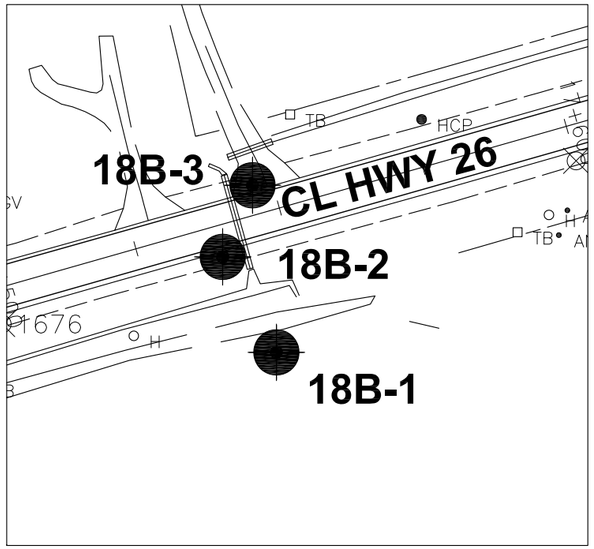
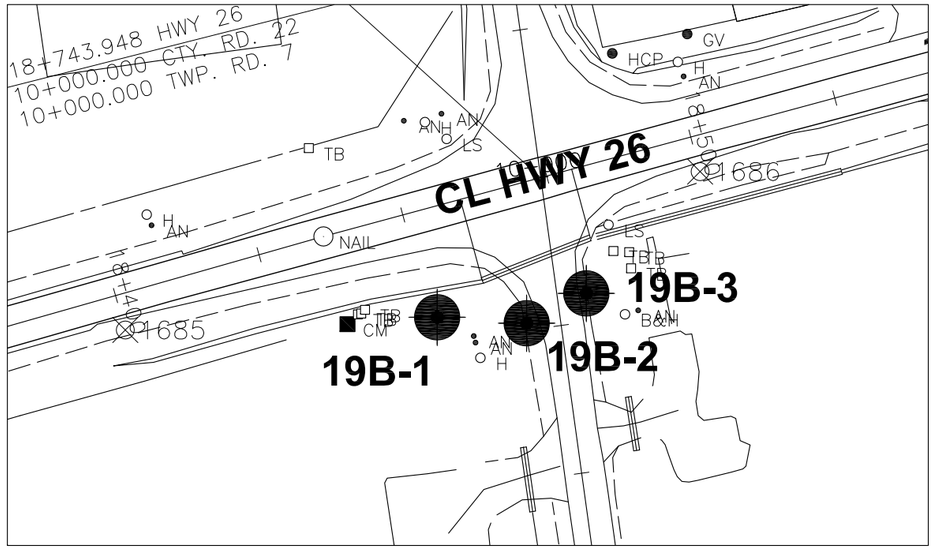
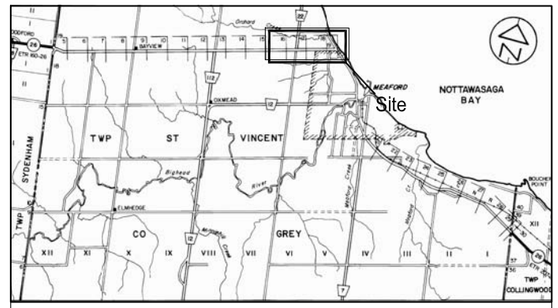


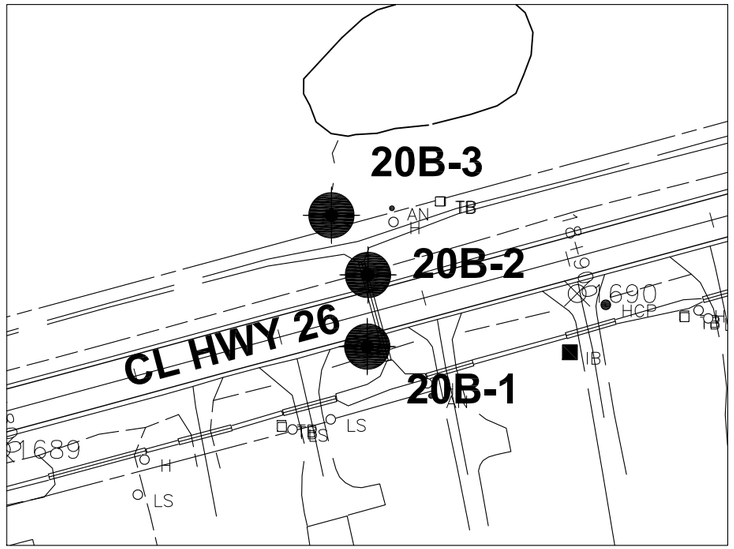


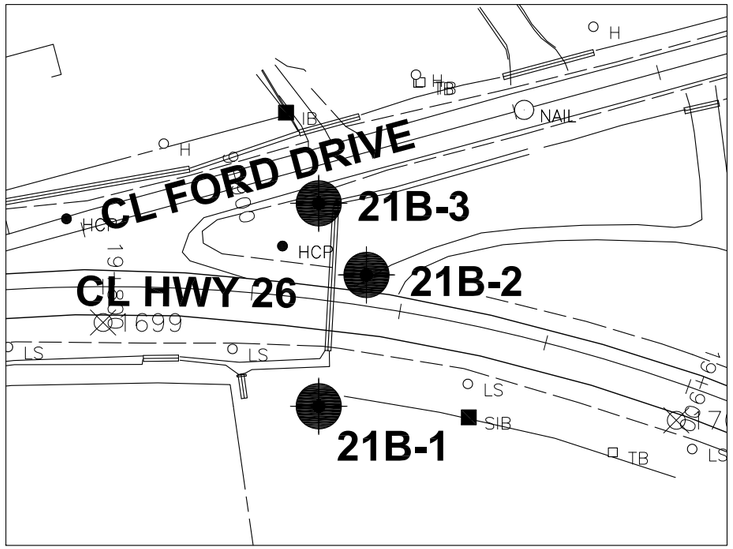


KEYPLAN NTS

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation
- Standpipe





100m 0 50m

SCALE

NOTES

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BOREHOLE NO.	ELEV.	UTM CO–ORDINATES NORTH	UTM CO–ORDINATES EAST	BOREHOLE NO.	ELEV.	UTM CO–ORDINATES NORTH	UTM CO–ORDINATES EAST	BOREHOLE NO.	ELEV.	UTM CO–ORDINATES NORTH	UTM CO–ORDINATES EAST	BOREHOLE NO.	ELEV.	UTM CO–ORDINATES NORTH	UTM CO–ORDINATES EAST
18B–1	213.12	4942071	214806	19B–1	206.50	4942324	215678	20B–1	201.77	4942444	216073	21B–1	186.37	4942665	217013
18B–2	215.66	4942087	214797	19B–2	207.20	4942323	215693	20B–2	201.75	4942456	216073	21B–2	186.95	4942687	217021
18B–3	215.73	4942099	214802	19B–3	207.25	4942328	215703	20B–3	200.10	4942466	216067	21B–3	185.47	4942699	217013

REVISIONS			
14/05/10	J.L.	Final Report	
20/11/09	J.L.	Draft Report	
DATE	BY	DISCRIPTION	

MTO GEOCRES No. 41A–216

HWY No.	HWY 26		DIST	Owen Sound
SUBM'D J.L.	CHECKED E.C.	DATE 15/01/09	SITE	18B, 19B, 19BRT, 20B, 21B
DRAWN J.L.	CHECKED J.L.	APPROVED E.C.	DWG	4

METRIC

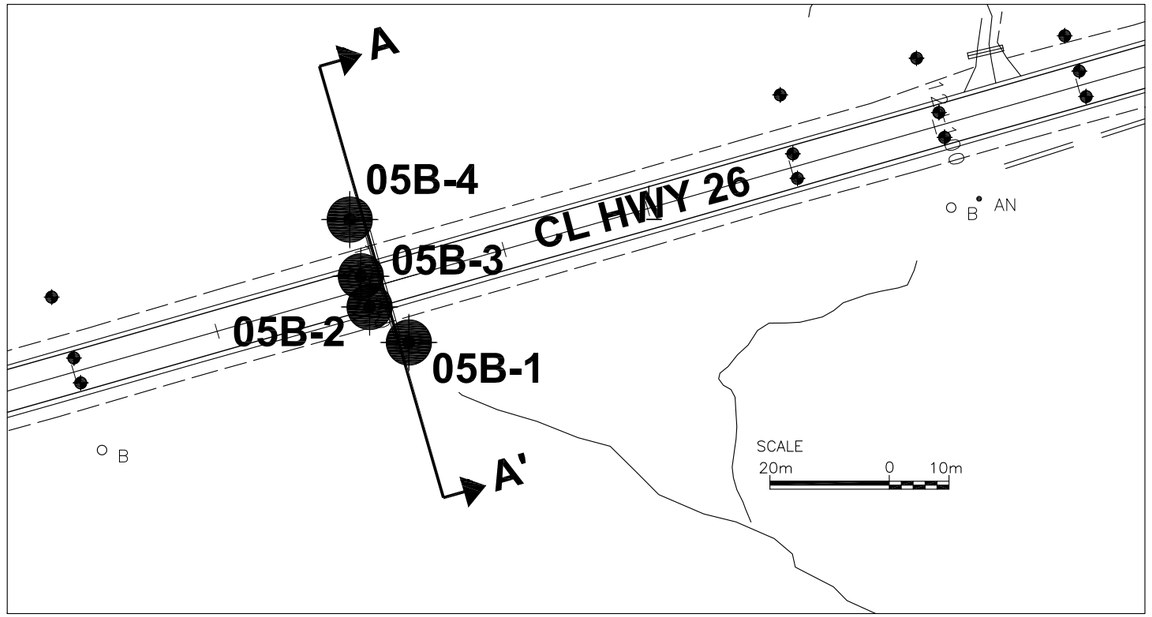
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No xxxx–xxxx
WP No GWP 167–91–00

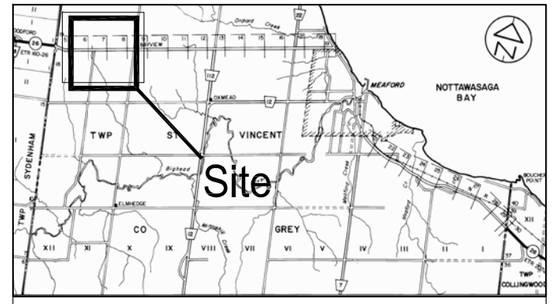
NON–STRUCTURAL CULVERT
Highway 26 – Part B
PLAN AND PROFILE – 05B

SHEET 5

I.E. Group — Infrastructure Engineering Group Inc. Pavement & Construction Materials Consulting Engineers
GTA • Kitchener • London • Windsor



BOREHOLE LOCATION PLAN



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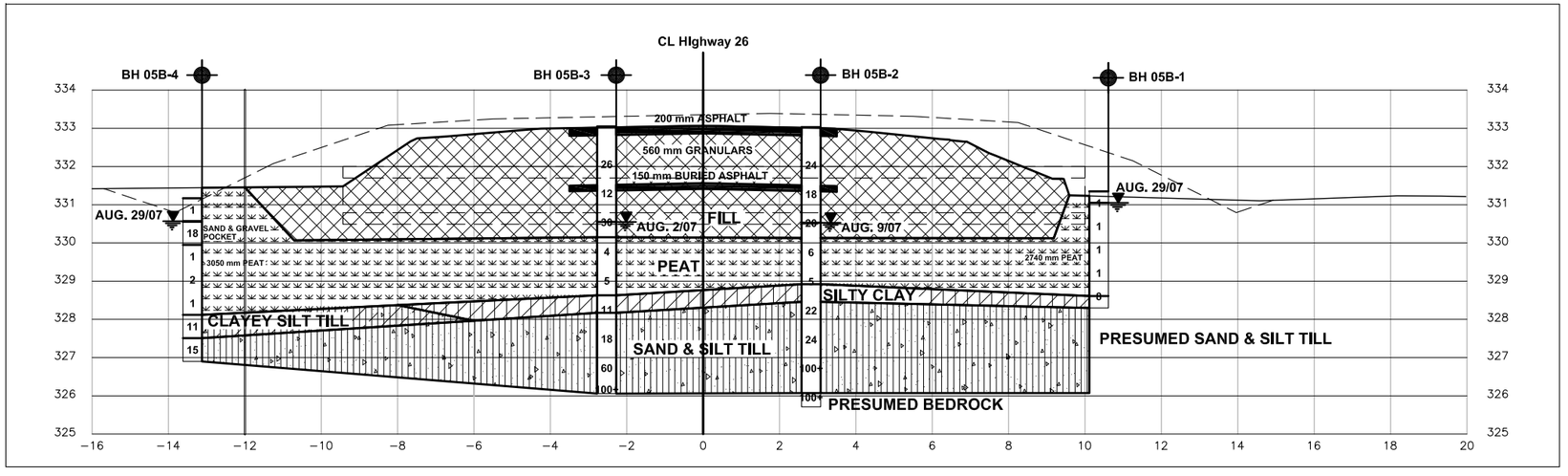

PROFILE A-A'
CENTRELINE OF CULVERT

SCALE
5m 0 2m
Horizontal and Vertical

REVISIONS			
	14/05/10	J.L.	Final
	05/12/09	J.L.	Draft
	DATE	BY	DISCRIPTION

MTO GEOCRES No. 41A–216

BOREHOLE NO.	ELEV.	UTM CO–ORDINATES NORTH	EAST
05B–1	331.35	4940570	209476
05B–2	333.03	4940576	209469
05B–3	333.07	4940581	209468
05B–4	331.18	4940591	209466

HWY No.	HWY 26			DIST	Owen Sound
SUBM'D J.L.	CHECKED E.C.	DATE 24/08/08		SITE	CULVERT 05B
DRAWN J.L.	CHECKED J.L.	APPROVED	E.C.	DWG	5

NOTES

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2. **THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES AND BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.**
3. **THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.**

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No xxxx–xxxx
WP No GWP 167–91–00

NON–STRUCTURAL CULVERT
Highway 26 – Part B
PLAN AND PROFILE – 09B

SHEET 6

I.E. Group — Infrastructure Engineering Group Inc. Pavement & Construction Materials Consulting Engineers
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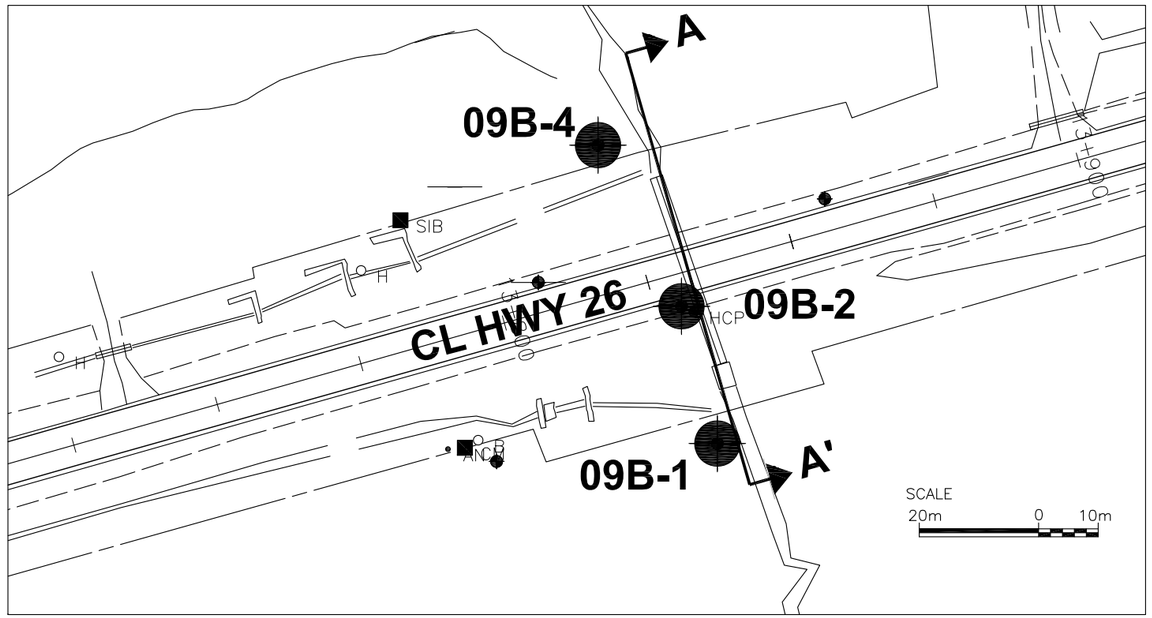
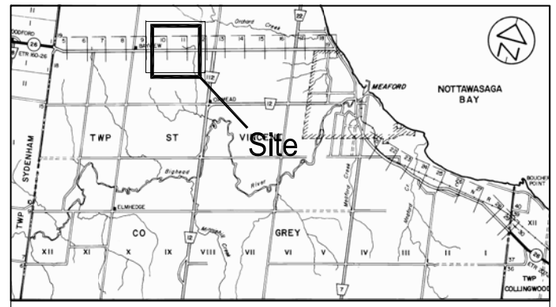


BOREHOLE LOCATION PLAN



KEYPLAN NTS

LEGEND

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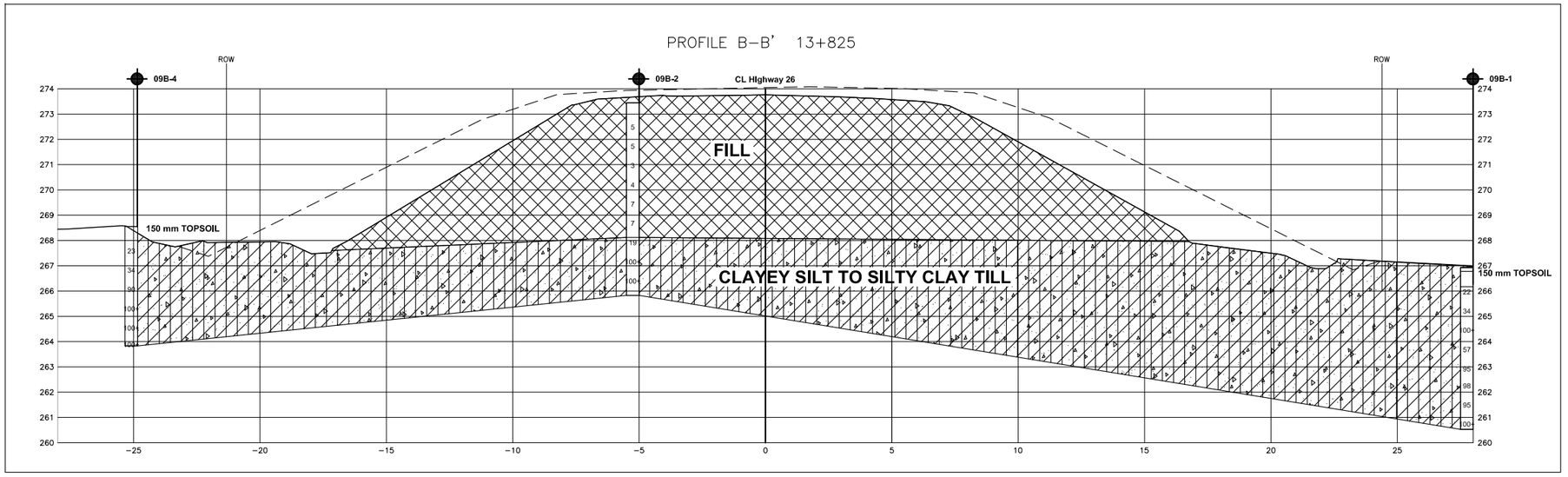

PROFILE A-A'

CENTRELINE OF CULVERT

SCALE
5m 0 2m
Horizontal and Vertical

NOTES
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REVISIONS	DATE	BY	DISCRIPTION
	14/05/10	J.L.	Final
	05/12/09	J.L.	Draft

MTO GEOCRES No. 41A–216

HWY No. HWY 26			DIST Owen Sound
SUBM'D J.L.	CHECKED E.C.	DATE 24/08/08	SITE CULVERT 09B
DRAWN J.L.	CHECKED J.L.	APPROVED E.C.	DWG 6

Appendix B
Explanation of Terms Used in Report
Record of Borehole Sheet - Boreholes SW-01 to 66

Laboratory Test Results

Culvert Number	Borehole Logs	Grain Size Distribution Figures	Atterberg Limits Figures
02B	02B-1 to 3	02B.1, 3, 5	02B.2, 4, 6
03B	03B-1 to 3	03B.1, 3	03B.2, 4
05B	05B-1 to 4	05B.1, 3, 5, 7, 8	05B.2, 4, 6, 9
06B	06B-1 to 3	06B.1,3	06B.2,4
07B	07B-1 to 3	07B.1	07B.2
08B	08B-1 to 3	08B.1, 2, 4	08B.3, 5
09B	09B-1, 2, 4	09B.1, 3, 5	09B.2, 4, 6
10B	10B-1 to 3	10B.1, 3, 5	10B.2, 4, 6
11B	11B-1 to 3	11B.1, 3, 5	11B.2, 4, 6
12B	12B-1 to 3	12B.1, 3, 4	12B.2, 5
13B	13B-1 to 3	13B.1, 3, 4	13B.2, 5
14B	14B-1 to 3	14B.1, 2, 3, 4, 6	14B.5, 7
15B	15B-1 to 3	15B.1, 2, 3, 4	-
16B	16B-1 to 3	16B.1, 2, 3	-
17B	17B-1 to 3	17B.1, 2	-
18B	18B-1 to 3	18B.1, 2, 3	18B.4
19B	19B-1 to 3	19B.1, 2, 3	19B.4
20B	20B-1 to 3	20B.1, 2	20B.3
21B	21B-1 to 3	21B.1	21B.2
02B	02B-1 to 3	02B.1, 3, 5	02B.2, 4, 6

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_s	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C		CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE

e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE No 02B-1

1 OF 1 **METRIC**

W.P. GWP 167-91-00 LOCATION Northing - 4940233, Easting - 208320 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.42	Ground										
0.00	100 mm TOPSOIL.										
326.66							327				
0.76	silt layer		1	SPT	10						0 3 82 14 (97)
326.20											
1.22			2	SPT	18		326		150		14 20 40 26 (66)
			3	SPT	56		325		225+		
	Clayey SILT to Silty CLAY TILL, CL to CL-ML Reddish brown, moist, stiff to hard, with embedded gravel, occasional silt seams and layers.		4	SPT	100+		324		225+		
			5	SPT	100+				225+		14 31 40 15 (55)
322.70			6	SPT	100+		323		225+		
4.72	End of Borehole.										Borehole dry and open @ completion.

+ 3, × 3: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 02B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940242, Easting - 208313 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
329.84	Ground							20 40 60 80 100	10 20 30		
0.00	610 Granular FILL.										
329.23											
0.61	FILL Reddish brown, moist to wet, loose to compact, consisting of mix gravel, sand, silt and clay, with organic stained pockets		1	SPT	18		329				
			2	SPT	5		328				12 32 43 13 (57)
	organic stained pockets		3	SPT	16		327				
326.79											
3.05	Clayey SILT to Silty CLAY TILL, CL to CL-ML Reddish brown, moist, very stiff to hard, with embedded sand and gravel, occasional silt seams and layers.		4	SPT	18						0 35 48 17 (65)
			5	SPT	18		326		162.5		
			6	SPT	78		325				15 33 36 15 (52)
324.05			7	SPT	70					23.7	
5.79	End of Borehole.										Borehole dry and open @ completion.

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

RECORD OF BOREHOLE No 02B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940270, Easting - 208306 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

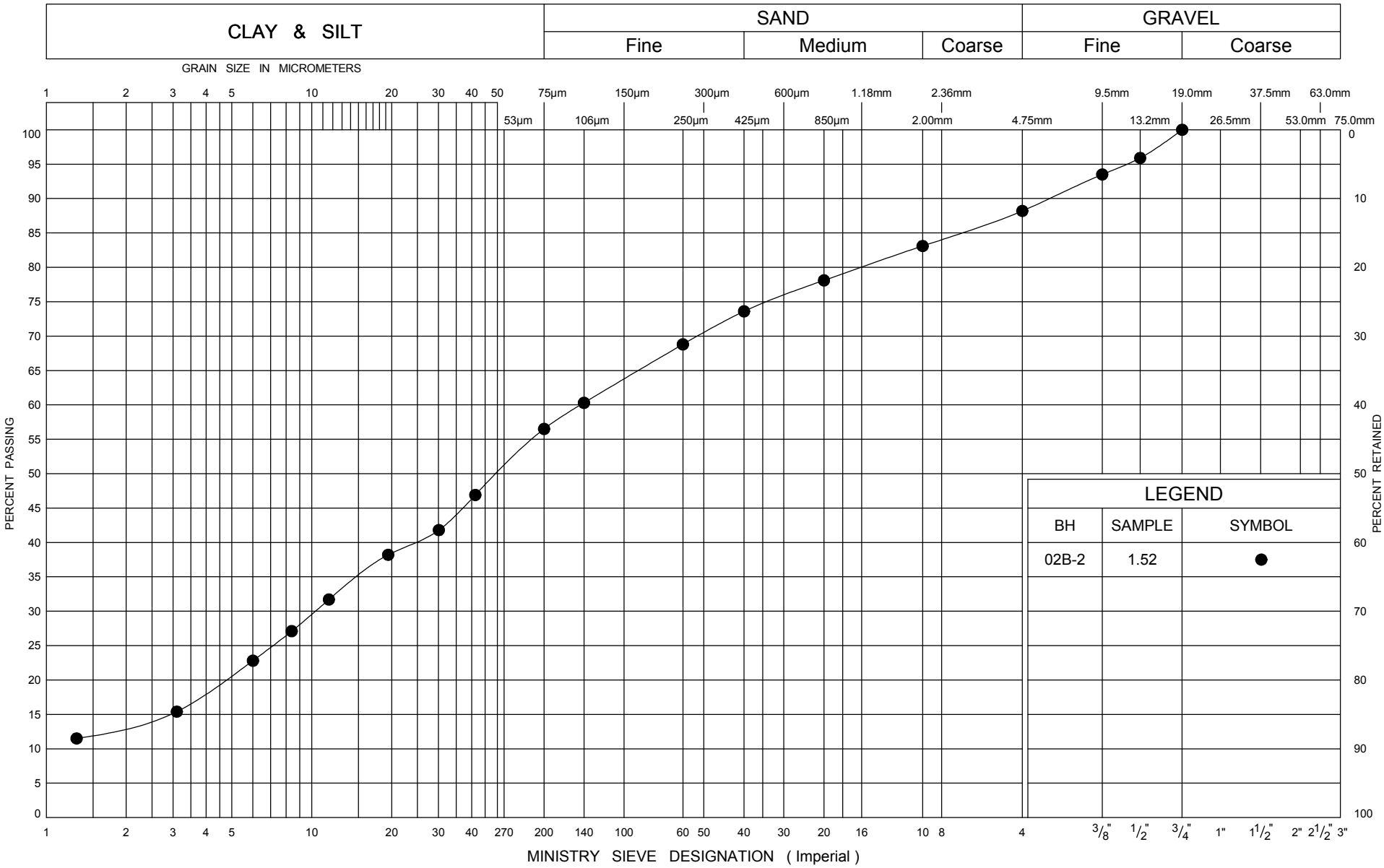
DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.32	Ground										
0.00	200 mm TOPSOIL.						327				
326.56											
0.76	loose silt layer		1	SPT	6						3 16 63 18 (81)
326.10							326				
1.22			2	SPT	22					19.4	
	Clayey SILT to Silty CLAY TILL, CL to CL-ML Reddish brown, moist, very stiff to hard, with embedded sand and gravel, occasional silt seams and layers.		3	SPT	55		325				10 32 42 17 (59)
324.12			4	SPT	100+						
3.20											Sampler refusal @ 3.20 m. Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

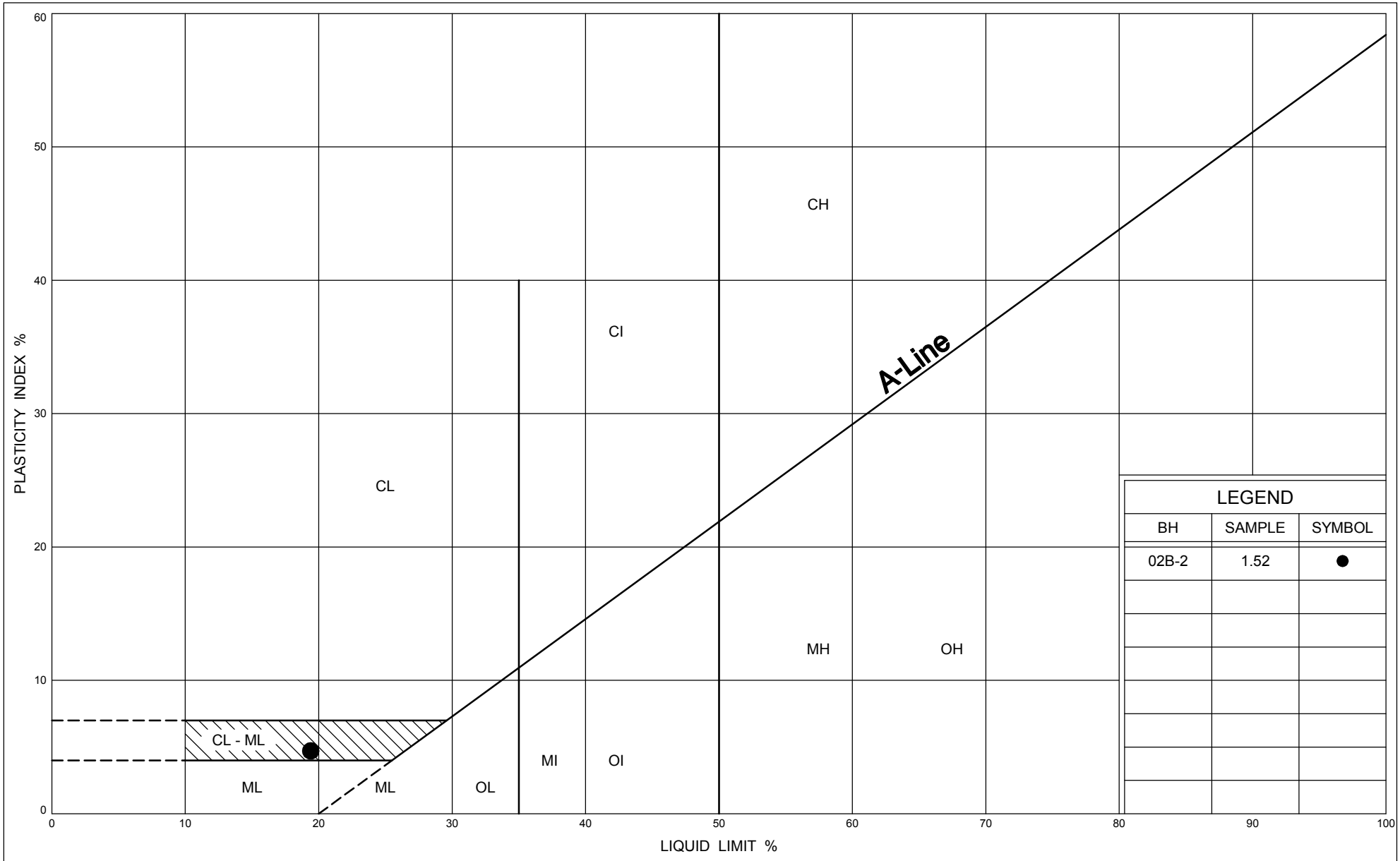
FILL

FIG No C- 02B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 17/11/09

Ministry of Transportation
Ontario

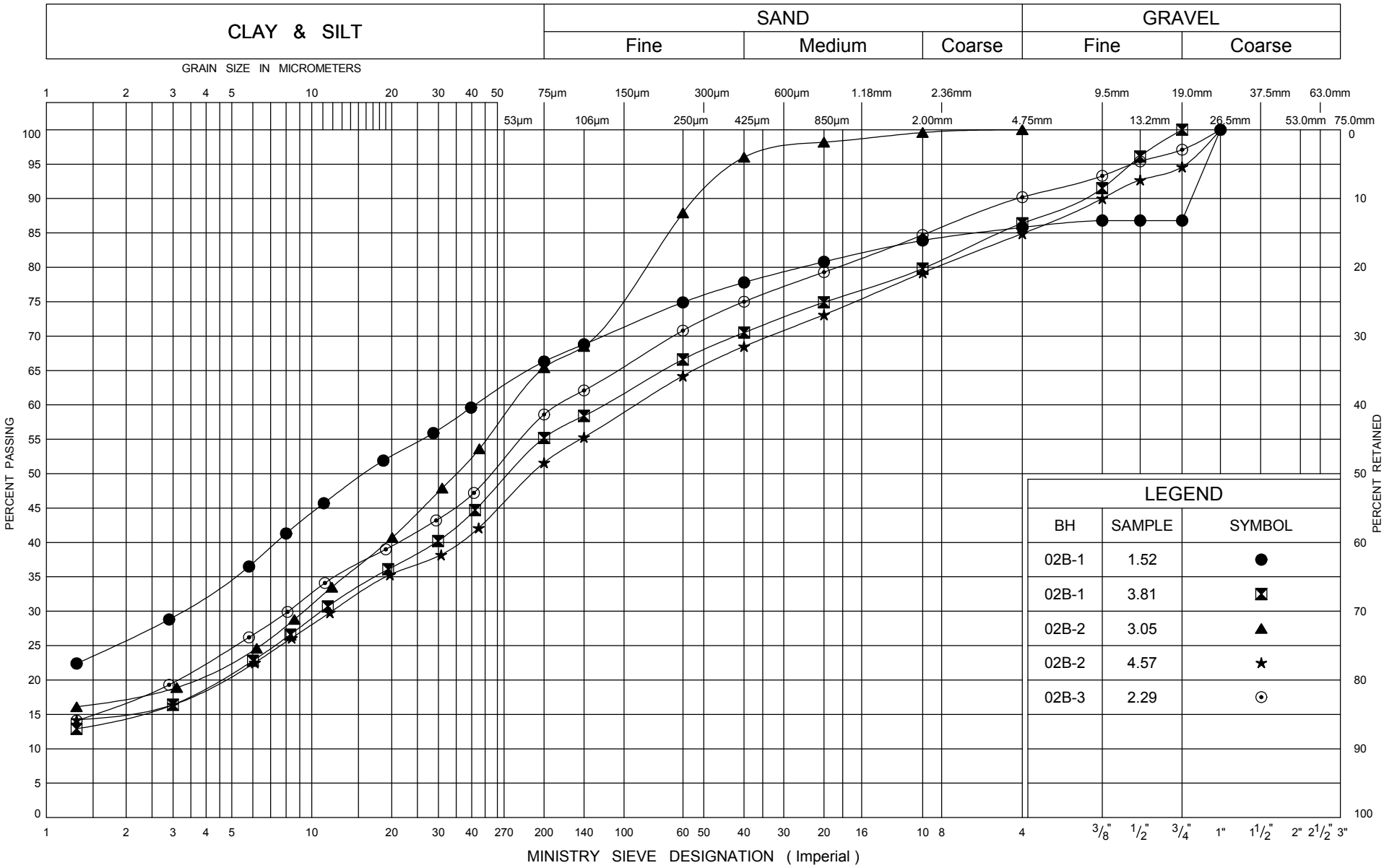
PLASTICITY CHART
FILL

FIG No C- 02B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

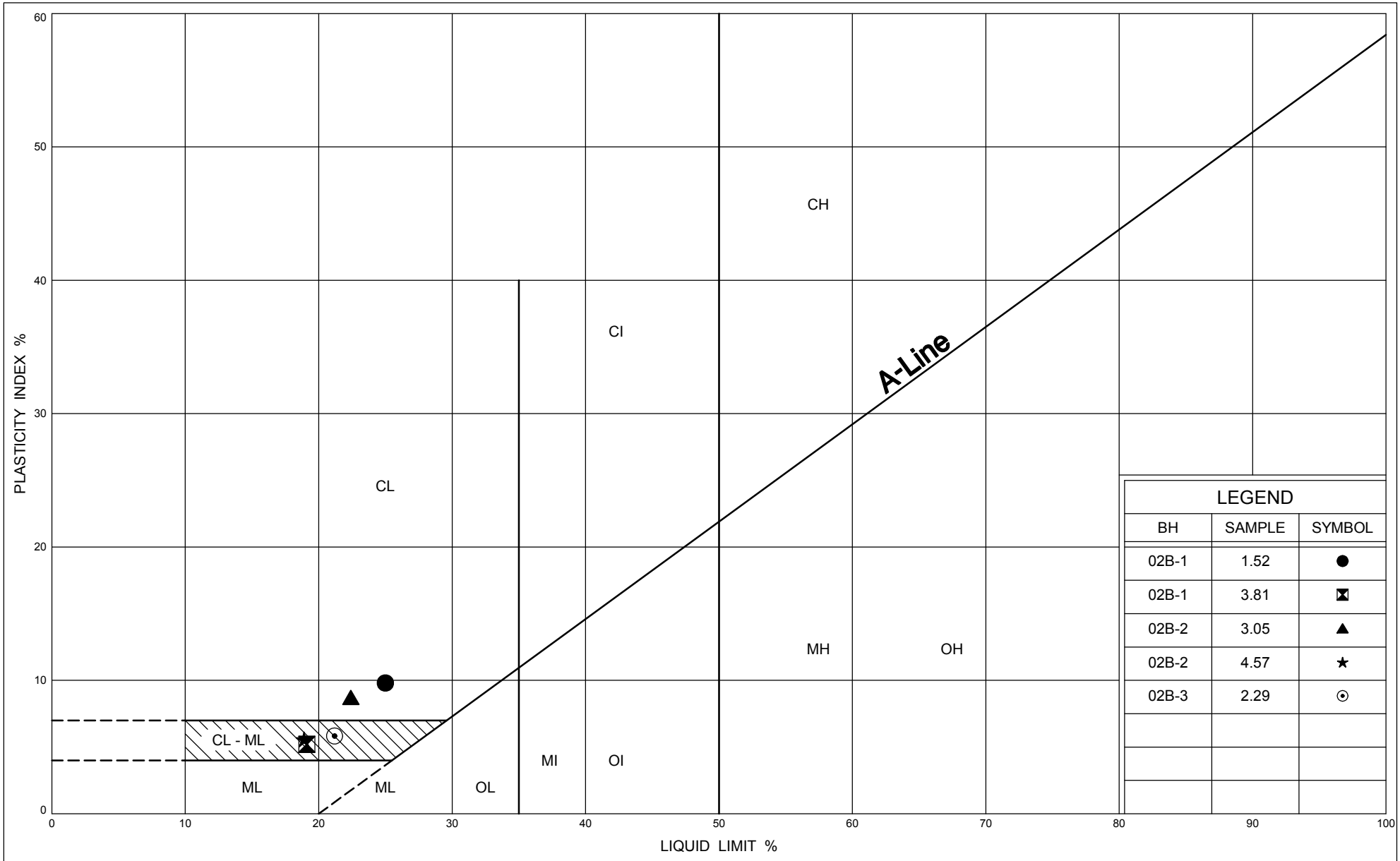
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 02B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 17/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

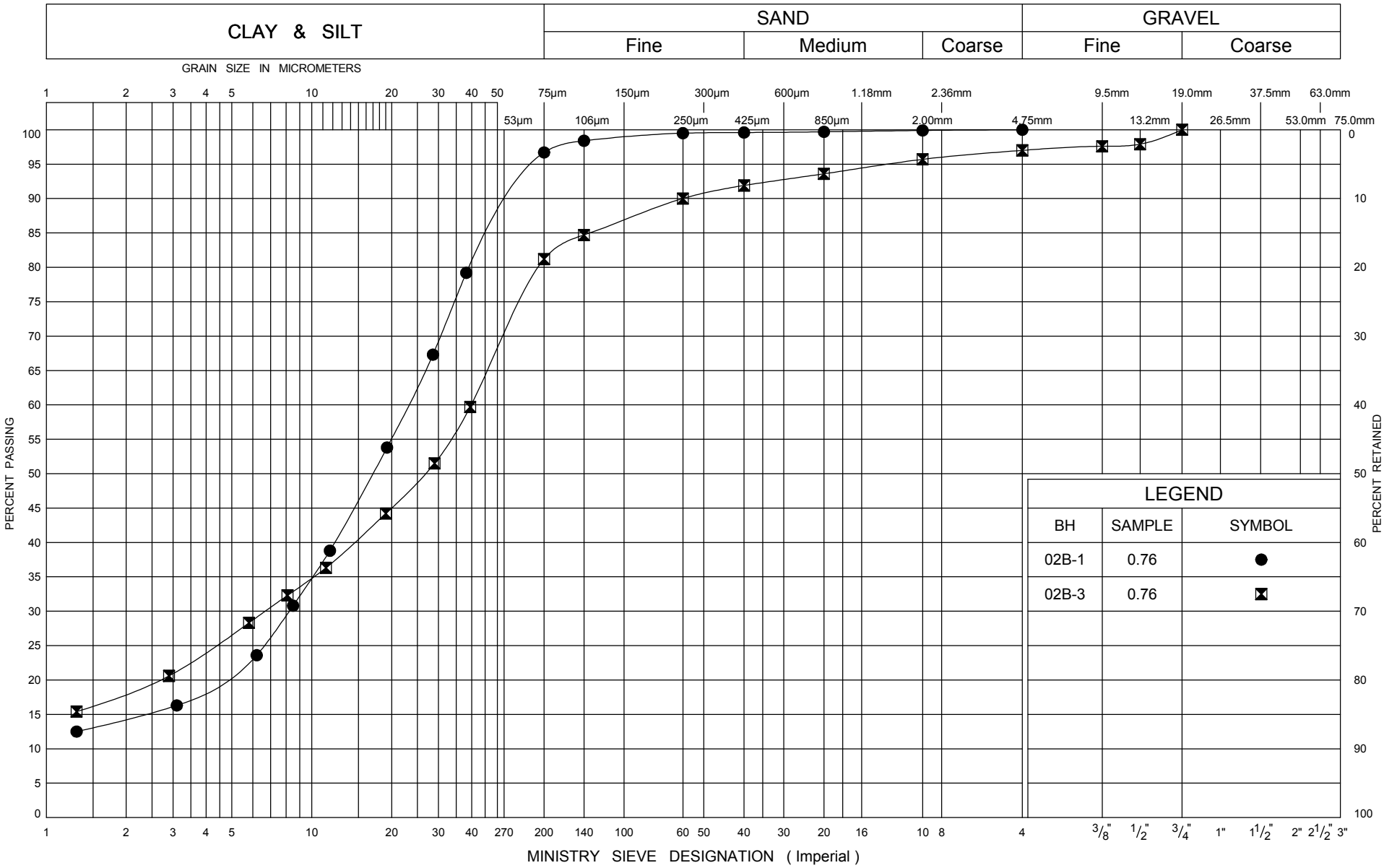
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 02B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

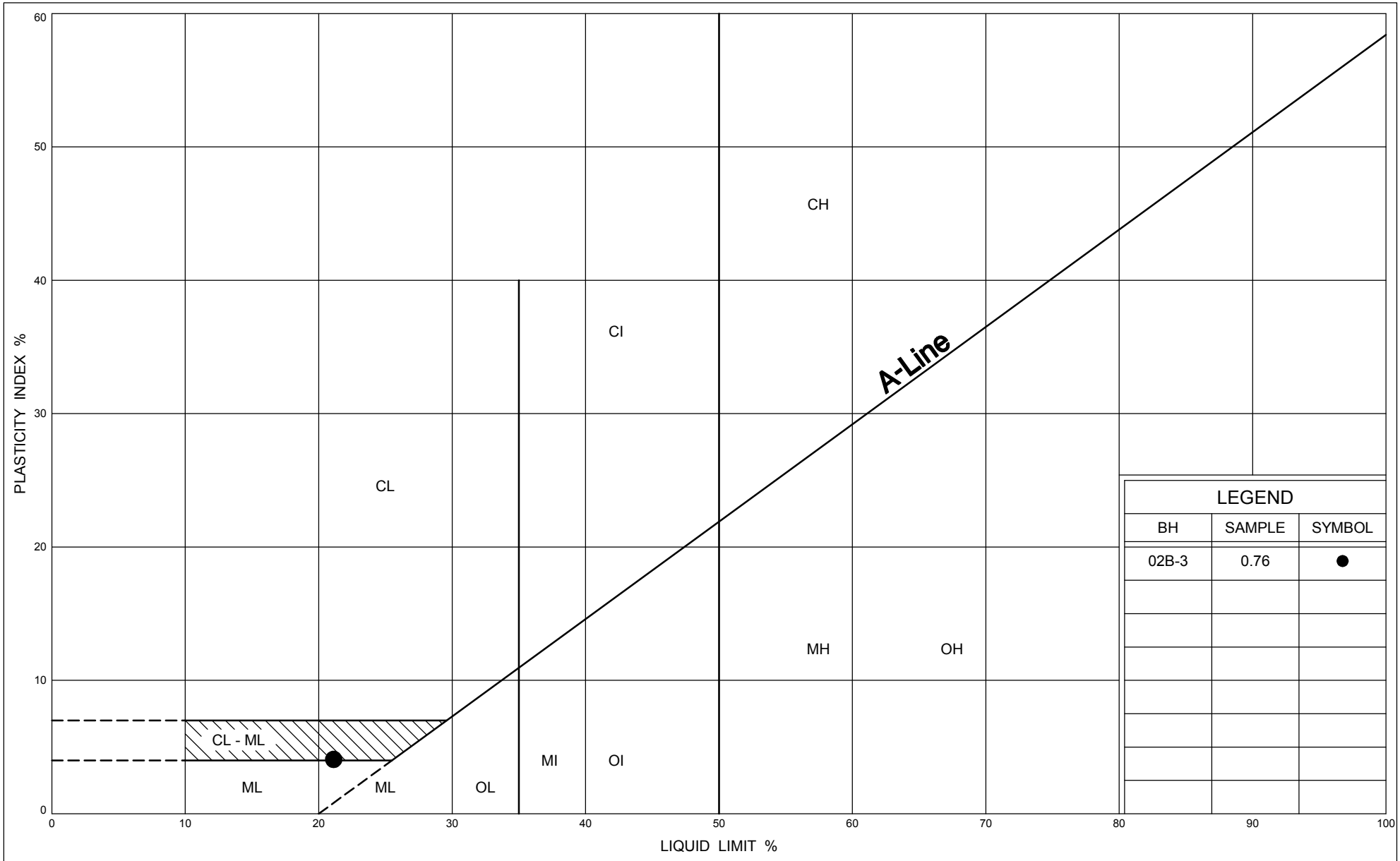
SILT LAYER, ML

FIG No C- 02B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 17/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

SILT LAYER, ML

FIG No C- 02B.6

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 03B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940289, Easting - 208500 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.23	Ground										
0.00	150 mm TOPSOIL.						327				
			1	SPT	36						10 35 46 9 (55)
							326				
	Sand and SILT TILL, SM-ML Reddish brown, moist, compact to very dense, with embedded gravel.		2	SPT	17						
							325				
			3	SPT	100+						
323.80			4	SPT	73		324				5 25 52 18 (70)
3.43	End of Borehole.										Sample refusal possible Bedrock. Borehole dry and open @ completion.

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 03B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940307, Easting - 208492 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
329.37 / 0.00	Ground					
328.76 / 0.61	610 mm Crushed Granular FILL.					
	Brown to dark brown, moist, loose to compact, consisting of mixed gravel, sand, silt, clay and topsoil- organics.	1	SPT	23		11 35 43 11 (54)
		2	SPT	22		
		3	SPT	8		21 30 40 9 (49)
326.32 / 3.05	Organic layer					organic layer observed during drilling.
	Sand and SILT TILL, SM-ML Reddish brown, moist, very dense, with embedded gravel.	4	SPT	58		
		5	SPT	57	21.6	
		6	SPT	100+		24 30 36 10 (46)
323.81 / 5.56		7	SPT	100+		Borehole dry and open @ completion.

ELEVATION SCALE: 329, 328, 327, 326, 325, 324

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

GROUND WATER CONDITIONS

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 03B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940310, Easting - 208487 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 2.8.07 - 2.8.07 CHECKED BY JL

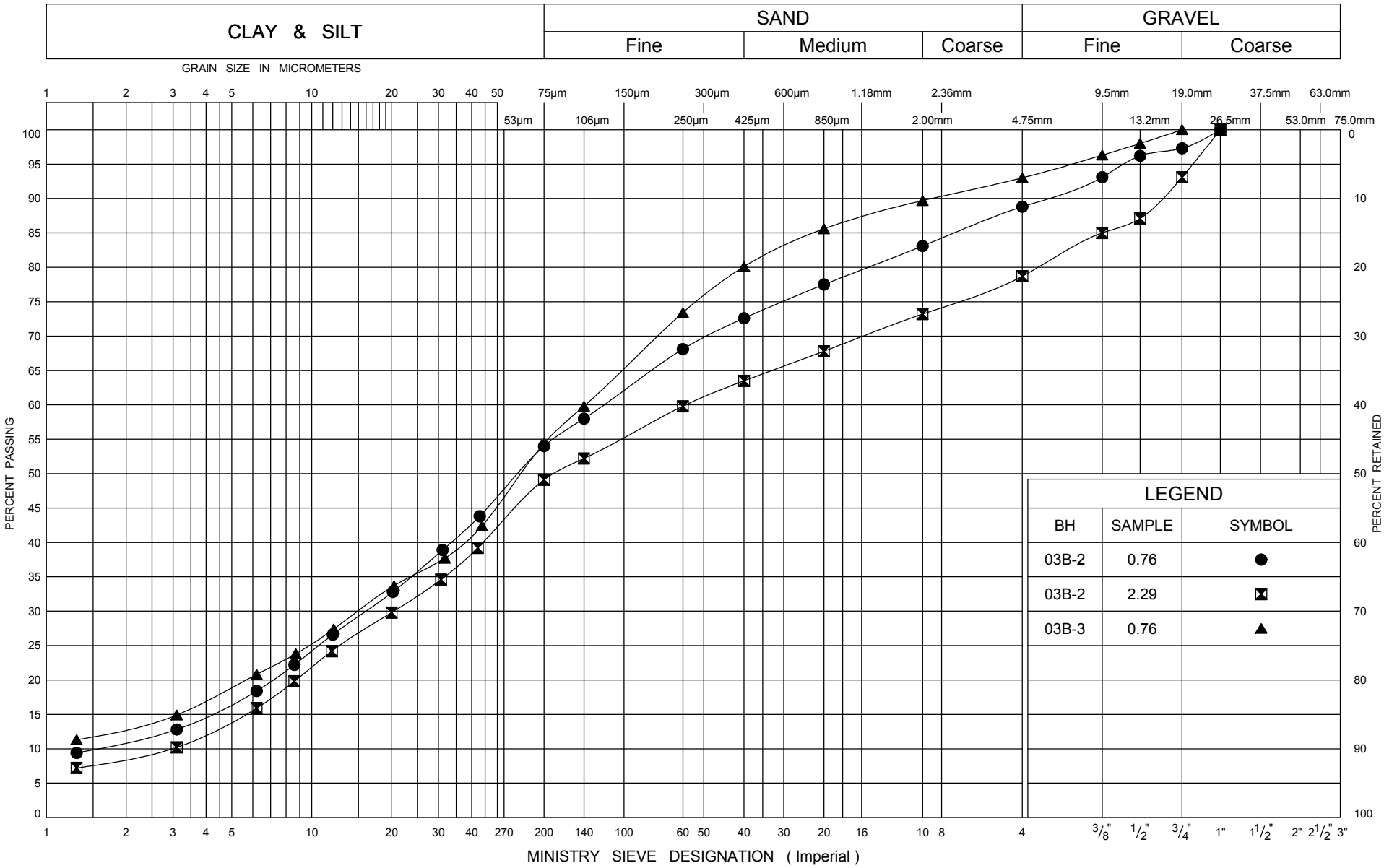
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.44	Ground										
0.00	FILL Black to dark brown, moist, consisting mainly of topsoil and mixed silt, sand some clay and trace gravel.						327				
326.37			1	SPT	7						7 39 41 13 (54)
1.07	Sand and SILT TILL, SM-ML Reddish brown, moist, loose to dense, with embedded gravel.		2	SPT	20		326				
			3	SPT	17		325				23 29 39 9 (48)
324.09			4	SPT	30						
3.35	End of borehole.										Borehole dry and open @ completion.

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

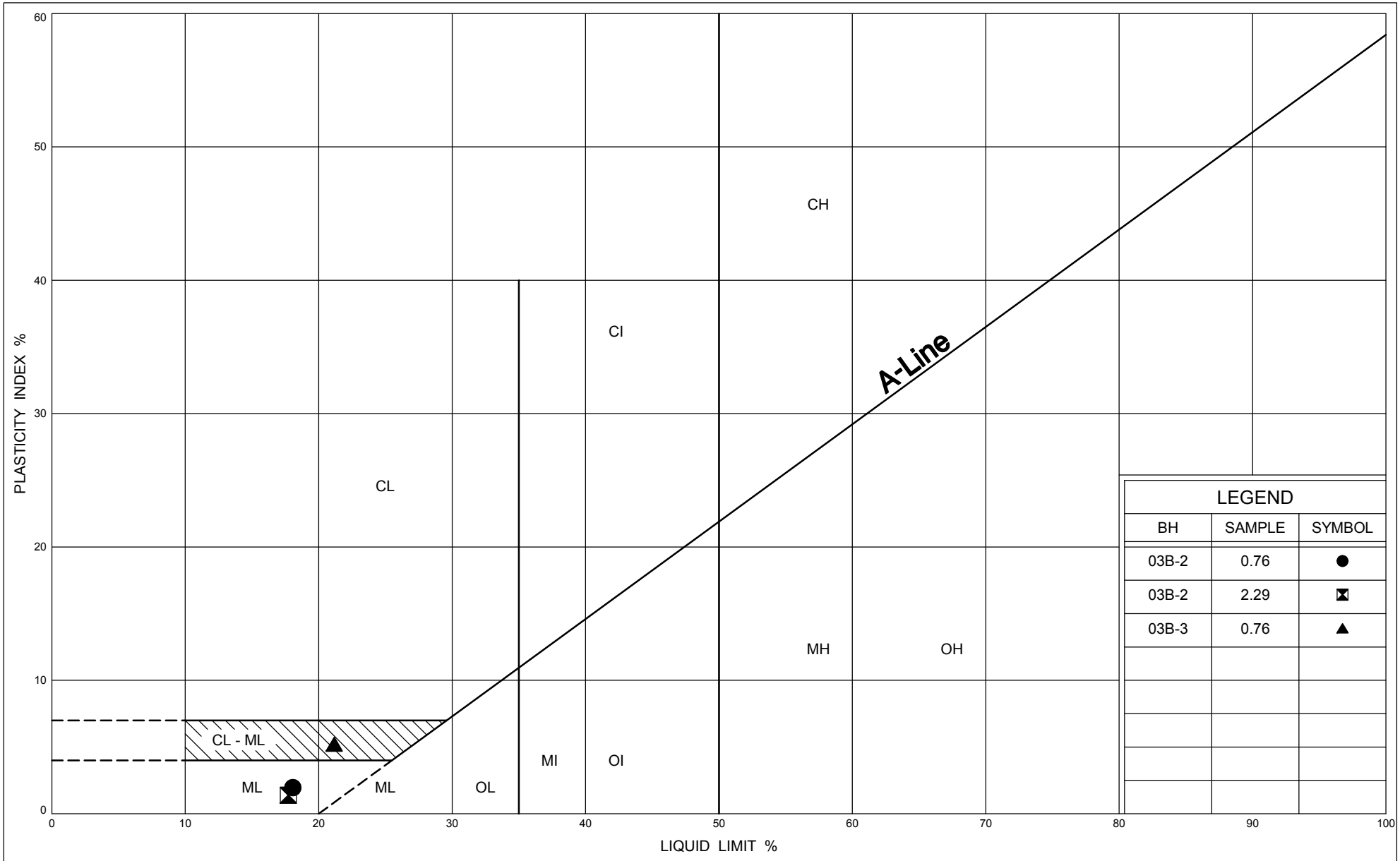
GRAIN SIZE DISTRIBUTION

FILL

FIG No C- 03B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford



Ministry of Transportation
Ontario

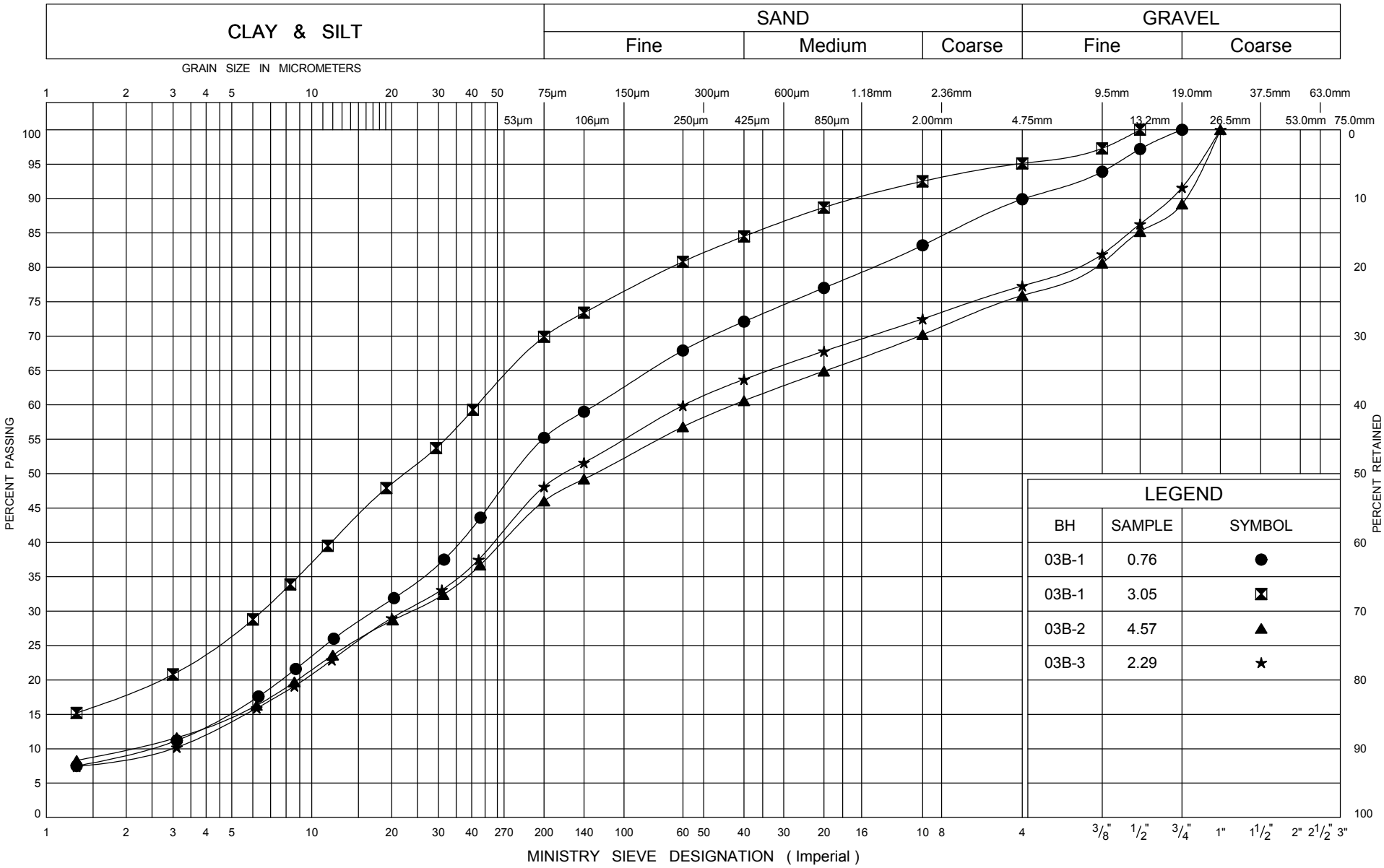
PLASTICITY CHART
FILL

FIG No C- 03B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

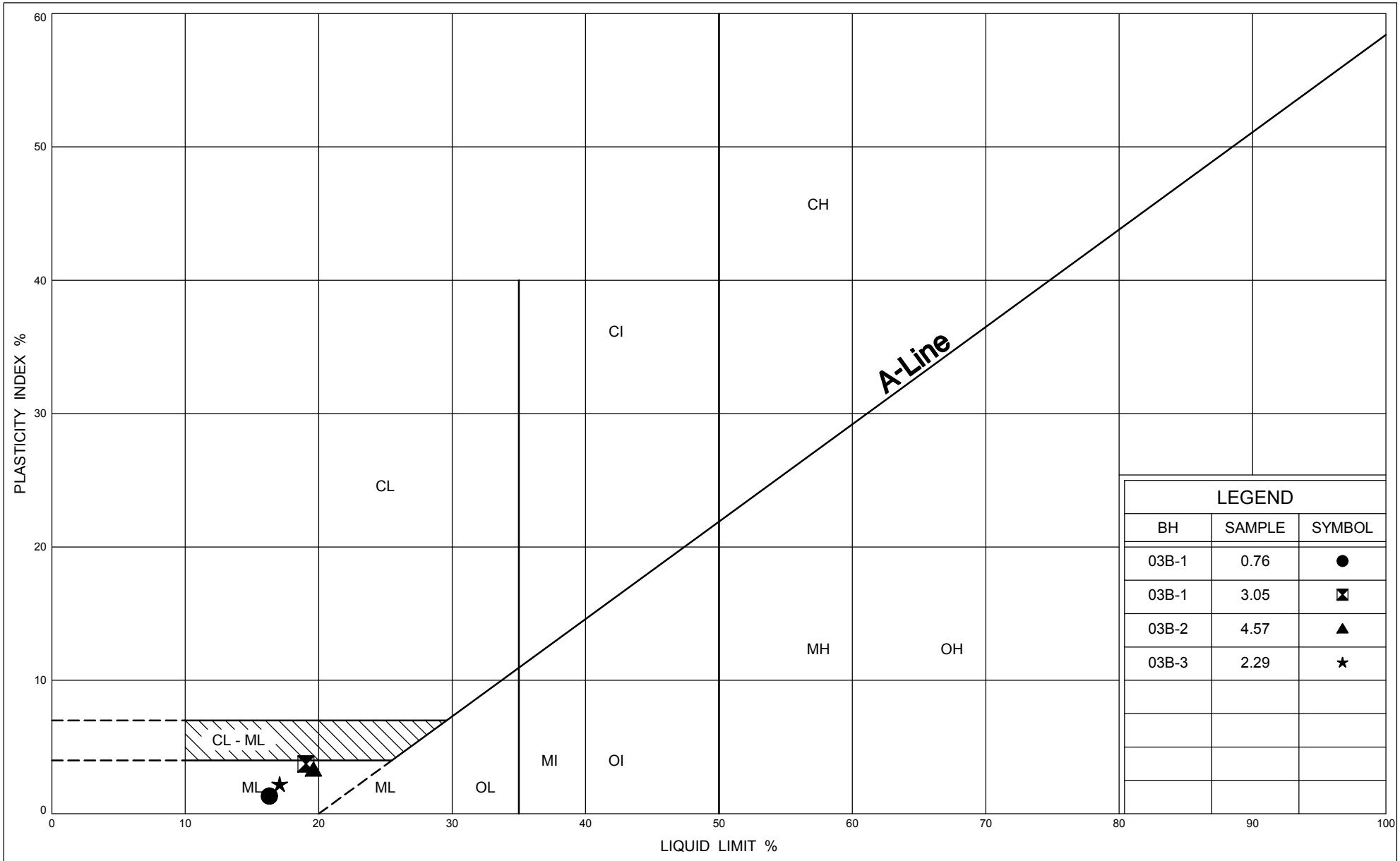
SAND AND SILT TILL, SM-ML

FIG No C- 03B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE	SYMBOL
03B-1	0.76	●
03B-1	3.05	⊠
03B-2	4.57	▲
03B-3	2.29	★

Ministry of Transportation
Ontario

PLASTICITY CHART
SAND AND SILT TILL, SM-ML

FIG No C- 03B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 17/11/09

RECORD OF BOREHOLE No 05B-1

1 OF 1 **METRIC**

W.P. GWP 167-91-00 LOCATION Northing - 4940570, Easting - 209476 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE Hand Drilling COMPILED BY NN

DATUM Geodetic DATE 29.8.07 - 29.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.35	Ground										
0.00	PEAT Black, soft, partially decomposed, wood pieces, interbedded with greenish grey organic silt, and sand and gravel layers. Organic Content - 45.9%		1	SPT	1	▽	331	3.7	133		Water level measured @ 0.3 m @ completion of drilling.
			2	SPT VANE	1			2.6	415		
			3	SPT VANE	1		330	2.3			
			4	SPT VANE VANE	1			1.8	658		40 47 10 3 (13)
328.61							329	1.0			
2.74	Silty CLAY, CL		5	SPT	8				175		8 27 44 22 (66)
328.30	Grey, moist, stiff, with embedded sand and gravel.										
3.05	End of borehole due to excessive cave-in.										Hand drilling terminated due to excessive cave-in. 31.75 Kg (70 lb.) hammer used for driving sampler. N-values corrected for standard 63.5 kg (140 lb.) hammer.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 05B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940576, Easting - 209469 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 8.9.07 - 8.9.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
333.03	Ground				
0.00	200 mm ASPHALT.				
	560 mm Granular FILL.				
332.27					
0.76	FILL Brown, moist to wet, compact, consisting of mixed gravel, sand and silt, trace clay	1	SPT	24	
331.51					
1.52	150 mm ASPHALT.	2	SPT	18	asphalt or granular seal surface treatment
	FILL Brown, moist to wet, compact, consisting of mixed gravel, sand and silt, trace clay	3	SPT	20	27 30 30 13 (43)
330.13					Water level measured @ 2.51 m @ completion of drilling.
2.90	PEAT/TOPSOIL Black to dark brown, dense, fully decomposed, with greenish grey silt seams and pockets. Organic Content - 60.1%	4	SPT	6	
328.92		5	SPT	5	
4.11	Silty CLAY, CL Grey, moist, firm.				
328.46		6	SPT	22	
4.57	SAND & SILT TILL, SM-ML Reddish brown to brown, moist to wet, compact to very dense, with embedded gravel, shale fragments.	7	SPT	24	
		8	SPT	100+	Sampler refusal.
326.07		9	SPT	100+	Sampler refusal.
6.96	SHALE BEDROCK Grey, weathered.				
325.71					
7.32	End of borehole.				Auger refusal @ 7.32 m.

GROUND WATER CONDITIONS: ▽

ELEVATION SCALE: 332, 331, 330, 329, 328, 327, 326

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

UNIT WEIGHT γ kN/m^3

388
67

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 05B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940581, Easting - 209468 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 8.2.07 - 8.2.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
333.07 Ground							
0.00	200 mm ASPHALT.						Culvert 5B-2
	560 mm Granular FILL Brown, moist, compact.						
332.31							
0.76	FILL Brown, moist to wet, compact, consisting of mixed gravel, sand and silt, trace clay		1	SPT	26		17 26 34 24 (57)
331.55							
1.52	150 mm ASPHALT.		2	SPT	12		asphalt or granular seal surface treatment
	FILL Brown, moist to wet, compact, consisting of mixed gravel, sand and silt, trace clay		3	SPT	30	▽	
330.17							Water level measured @ 2.6 m @ completion of drilling.
2.90			4	SPT	4		
	PEAT/TOPSOIL Black to dark brown, dense, fully decomposed, with greenish grey sandy silt seams and pockets. Organic Content - 23.5%		5	SPT	5		0 21 56 24 (79)
328.65							
4.42	Silty CLAY, CI Grey, moist, stiff.		6	SPT	11		0 4 36 60
328.19							
4.88							
327.74							
5.33		clayey silt	7	SPT	18		25 30 36 9 (45)
327.43							
5.64	SAND & SILT TILL, SM-ML Reddish brown to brown, wet to moist, compact to very dense, with embedded gravel and shale fragments, occasional clayey silt seams and layers.		8	SPT	60		22 32 38 7 (46)
326.06			9	SPT	100+		
7.01	End of borehole.						Auger refusal @ 7.01 m.

ELEVATION SCALE: 333, 332, 331, 330, 329, 328, 327

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

UNIT WEIGHT γ kN/m³

275
199
55
25
43
175

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 05B-4

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940591, Easting - 209466 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE Hand Drilling COMPILED BY NN

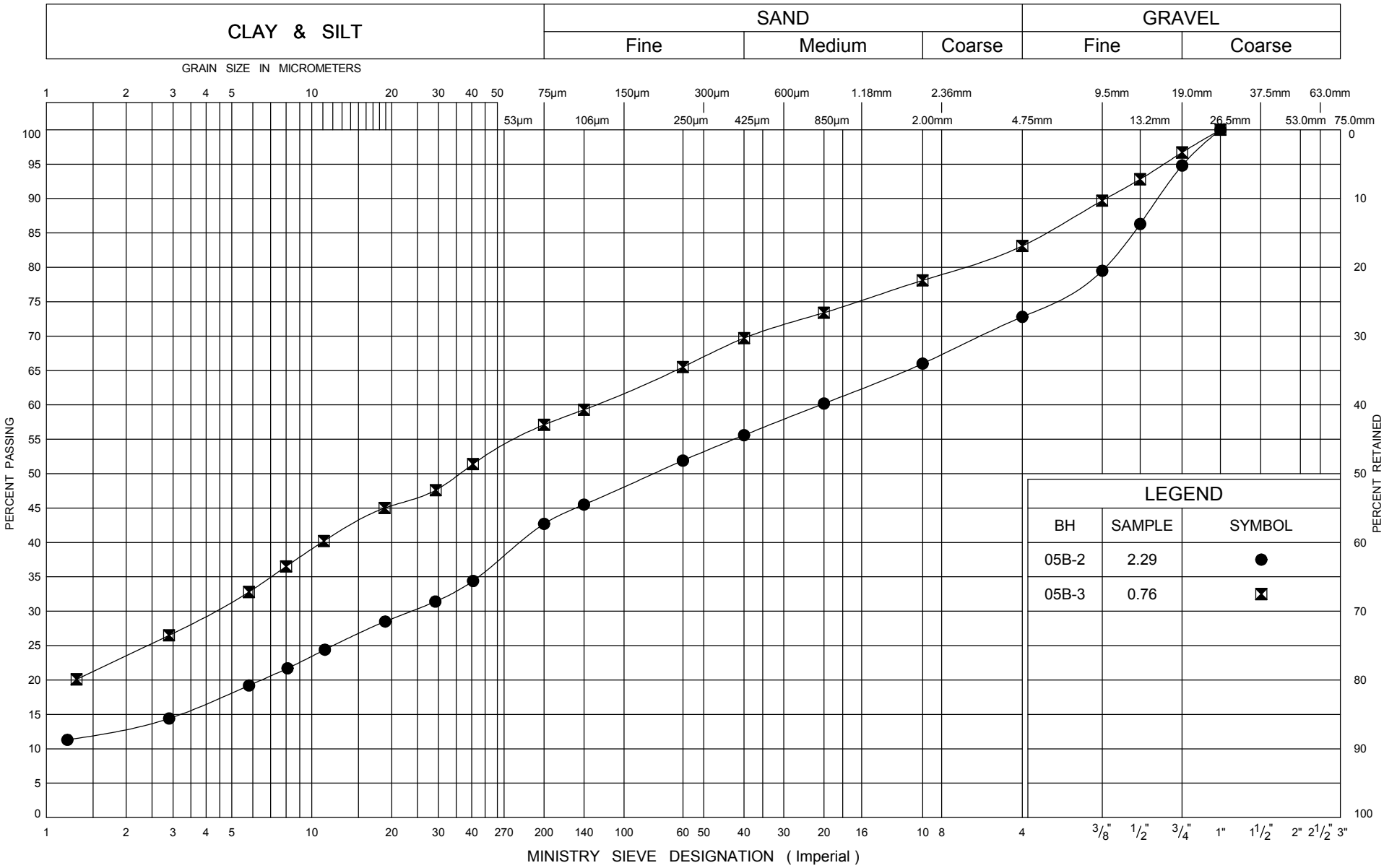
DATUM Geodetic DATE 29.8.07 - 29.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.17	Ground										
0.00			1	SPT	1	▽	331				Culvert 5B-3
330.56											
0.61			2	SPT	18				50		Water level measured @ 0.61 m @ completion of drilling.
329.95	sand and gravel layer						330				
1.22			3	SPT	1				205		
	PEAT Black, very loose, partially decomposed, wood pieces, interbedded with greenish grey organic sand and silt, and gravel layers. Organic Content - 15.9%		4	SPT	2		329				10 45 39 6 (46)
			5	SPT	1						
328.12							328				
3.05	SAND & SILT TILL, SM-ML Grey, moist, compact, shale fragments, with embedded gravel, clayey silt seams and layers.		6	SPT	11						15 38 36 11 (47)
			7	SPT	15						
326.90							327				
4.27	End of borehole due to excessive cave-in.										Hand drilling terminated due to excessive cave-in. 31.75 Kg (70 lb.) hammer used for driving sampler. N-values corrected for standard 63.5 Kg (140 lb.) hammer.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

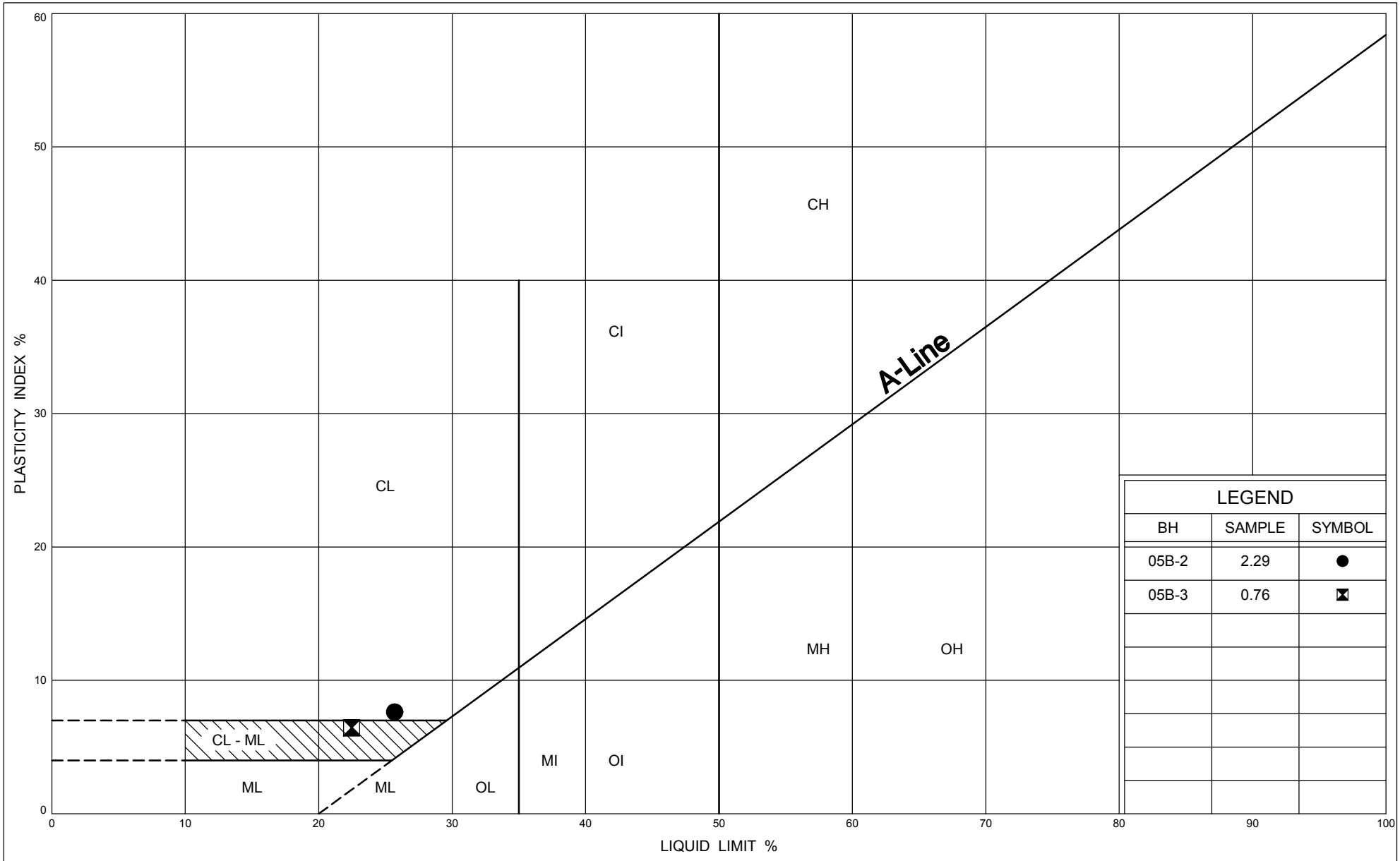
FILL

FIG No C- 05B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

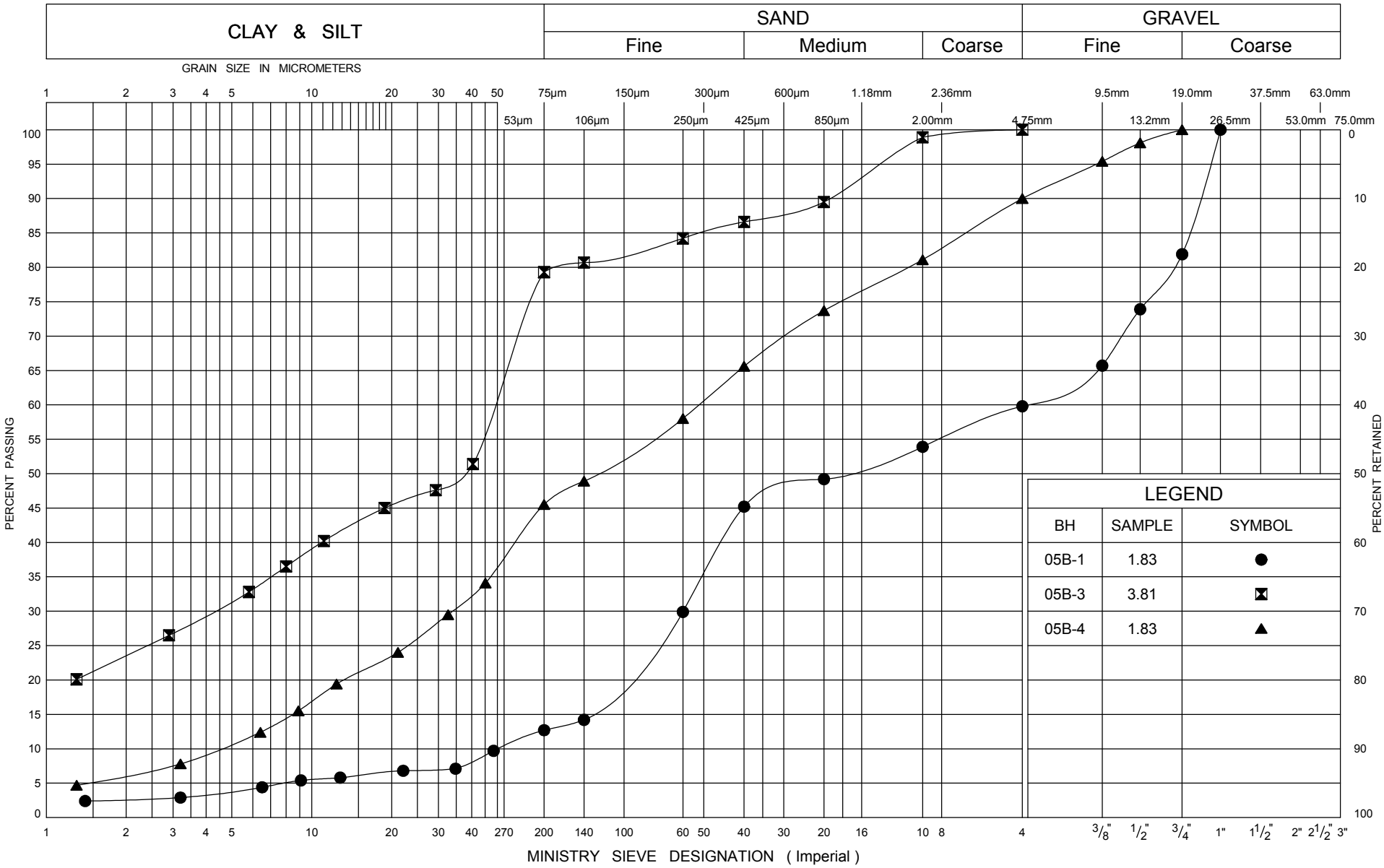
PLASTICITY CHART
FILL

FIG No C- 05B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION

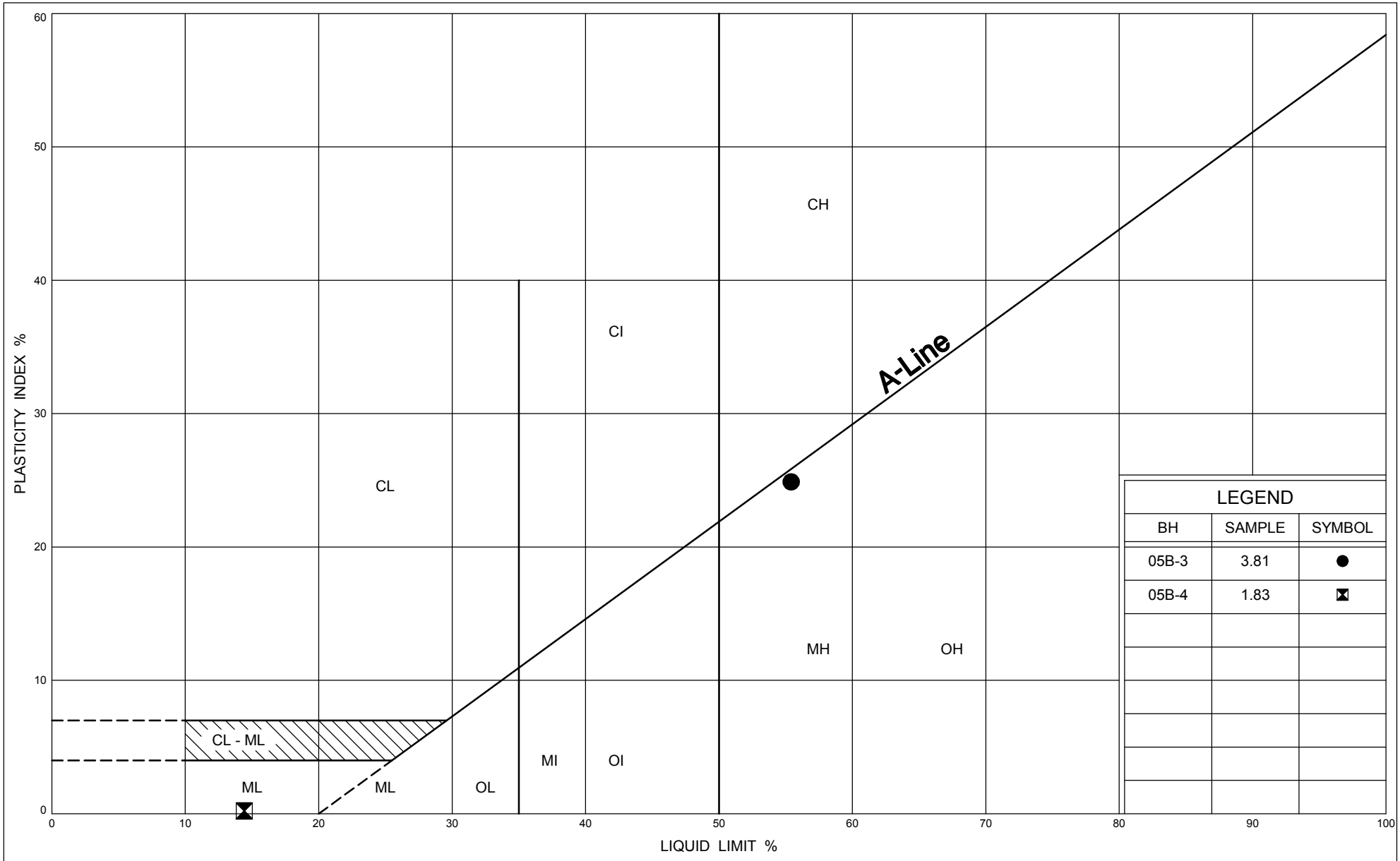
PEAT

FIG No C- 05B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

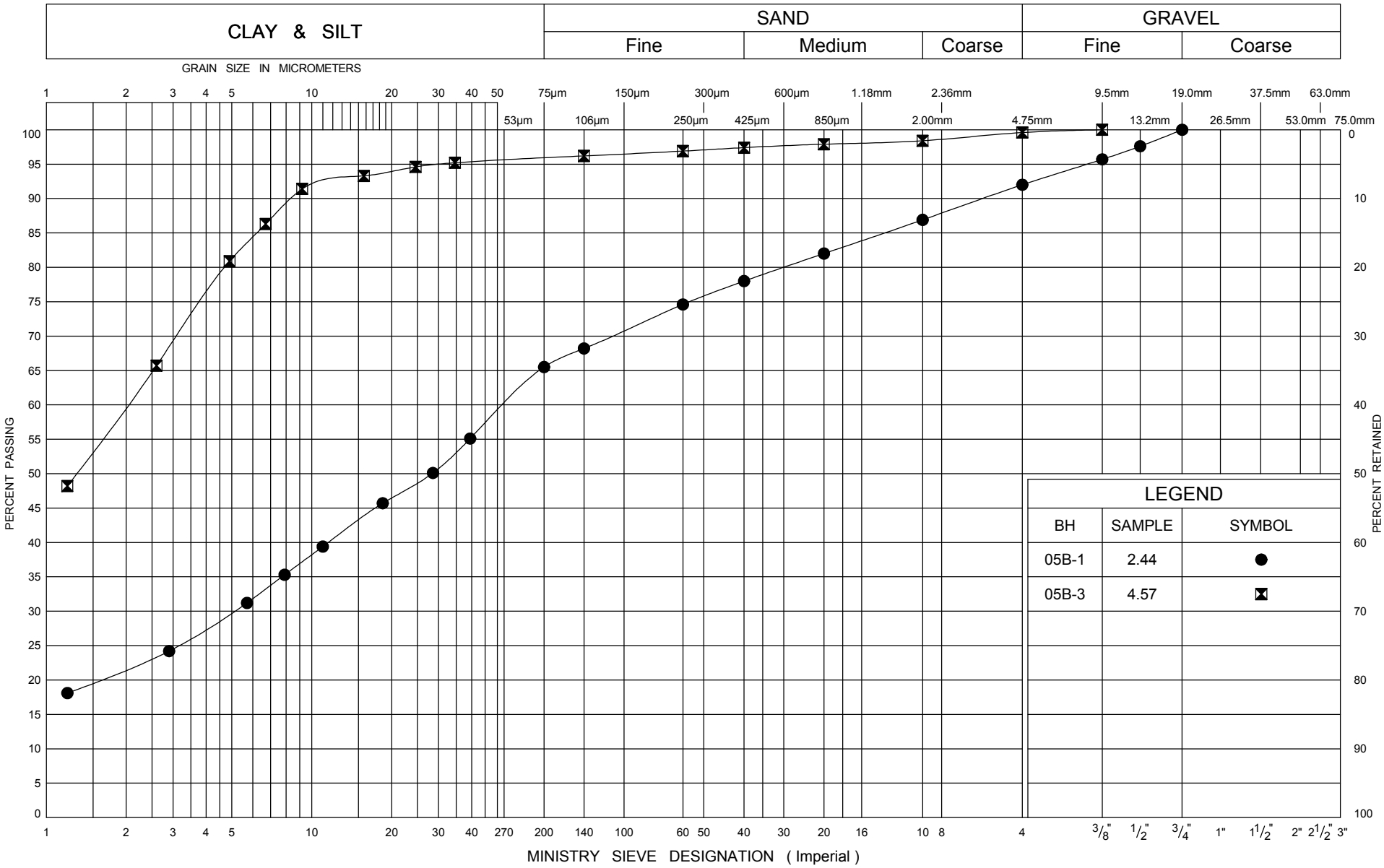
PLASTICITY CHART
PEAT

FIG No C- 05B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

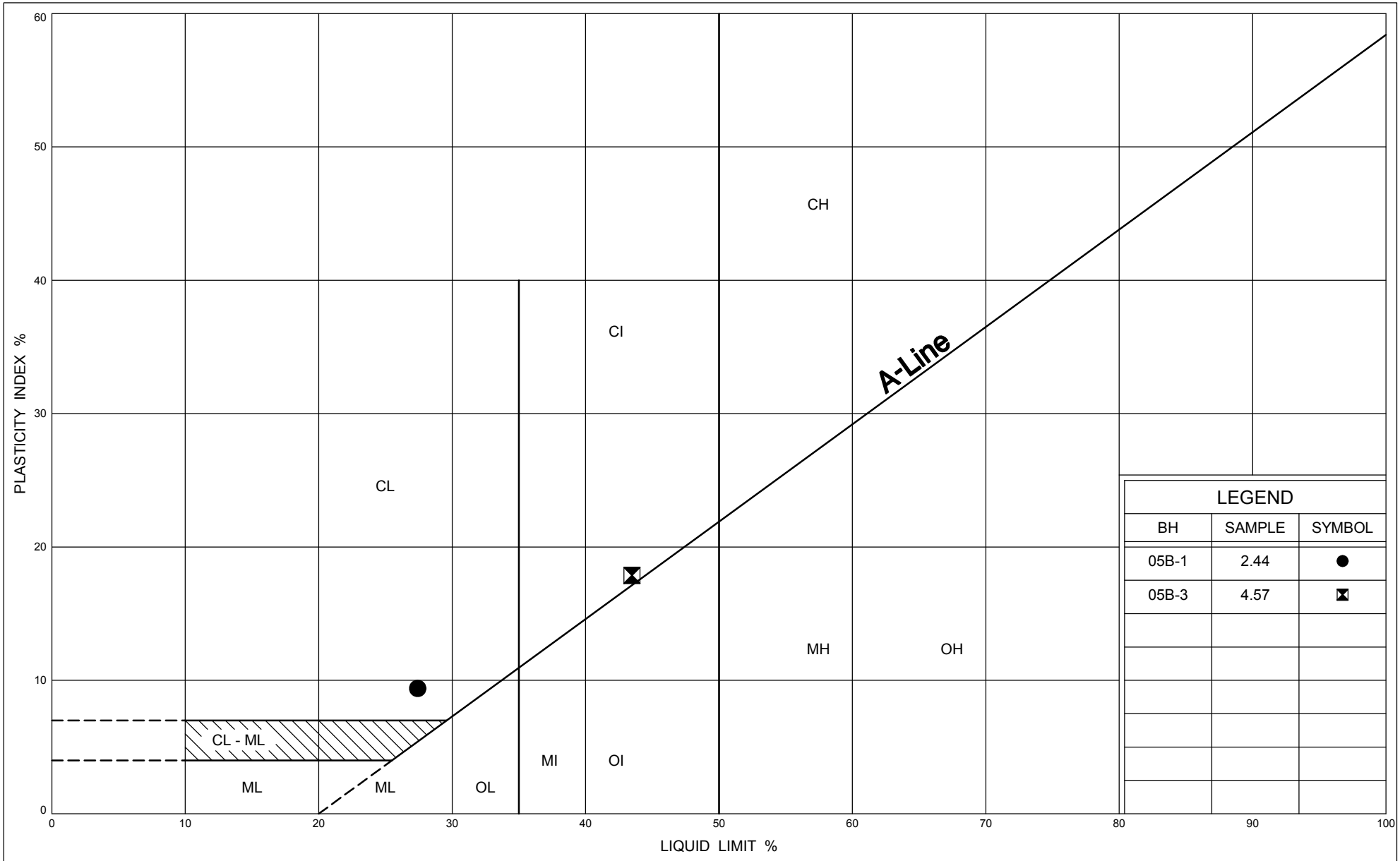
SILTY CLAY, CL to CI

FIG No C- 05B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

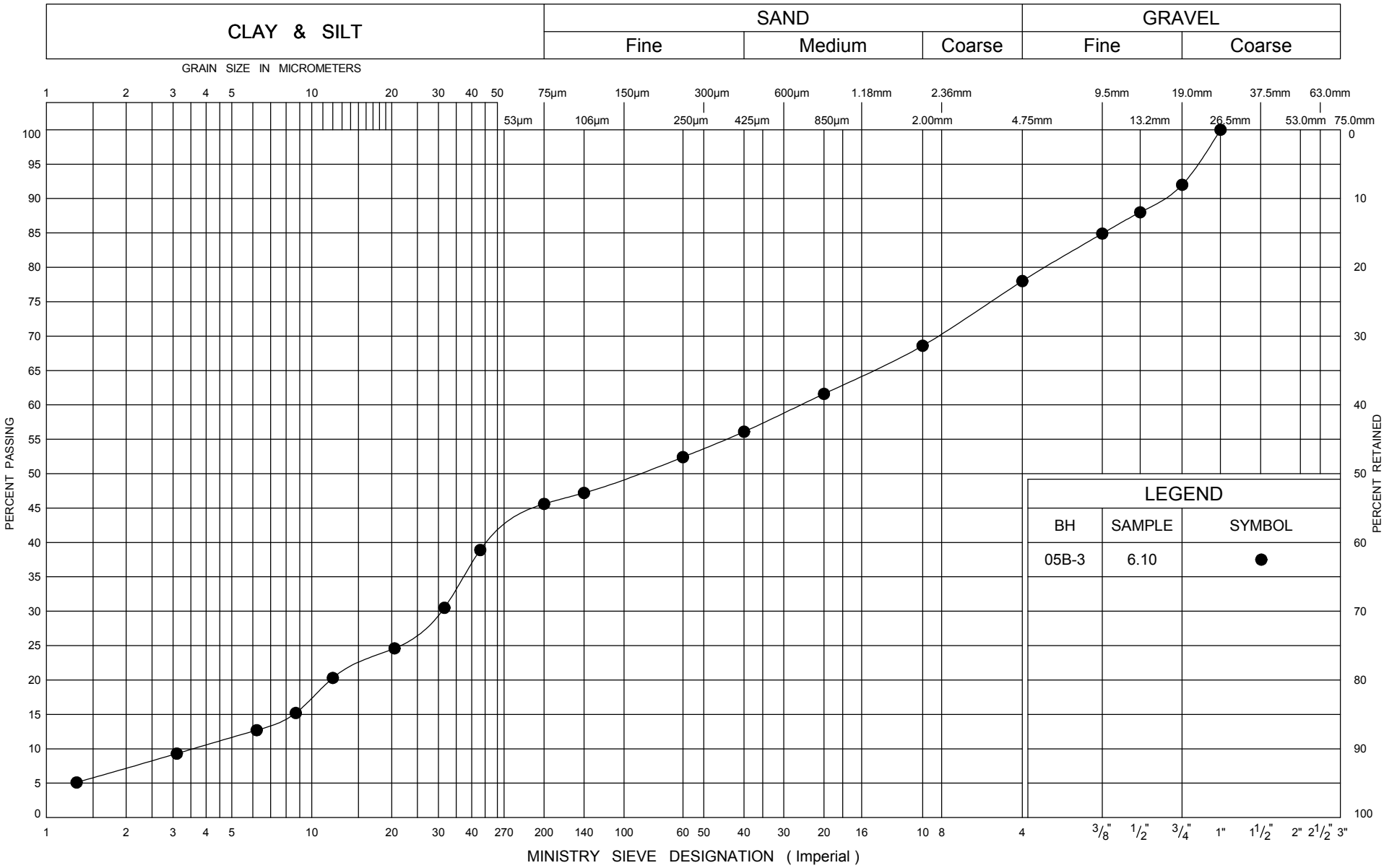
PLASTICITY CHART
SILTY CLAY, CL to CI

FIG No C- 05B.6

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

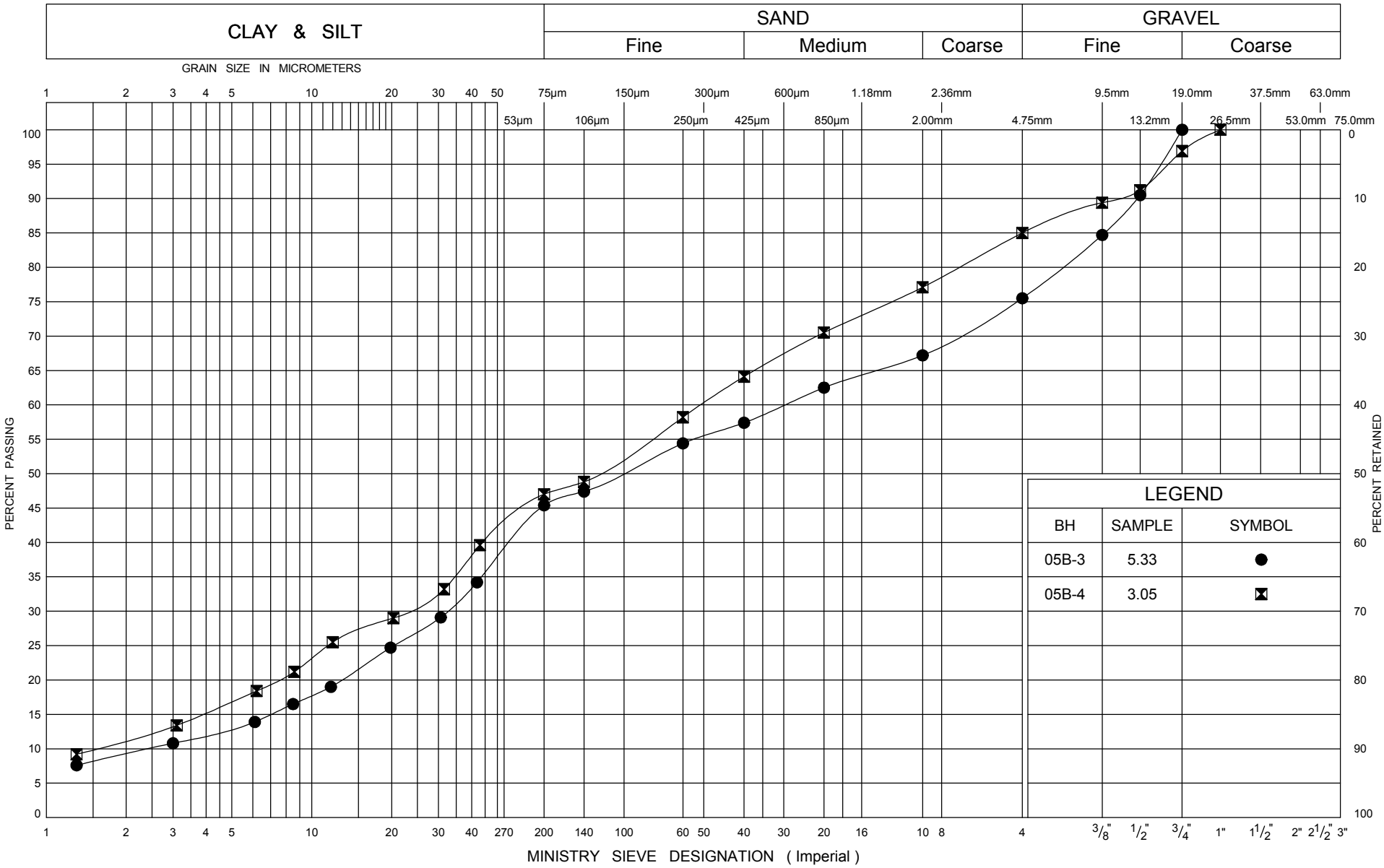
SAND AND SILT TILL, SM-ML

FIG No C- 05B.7

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

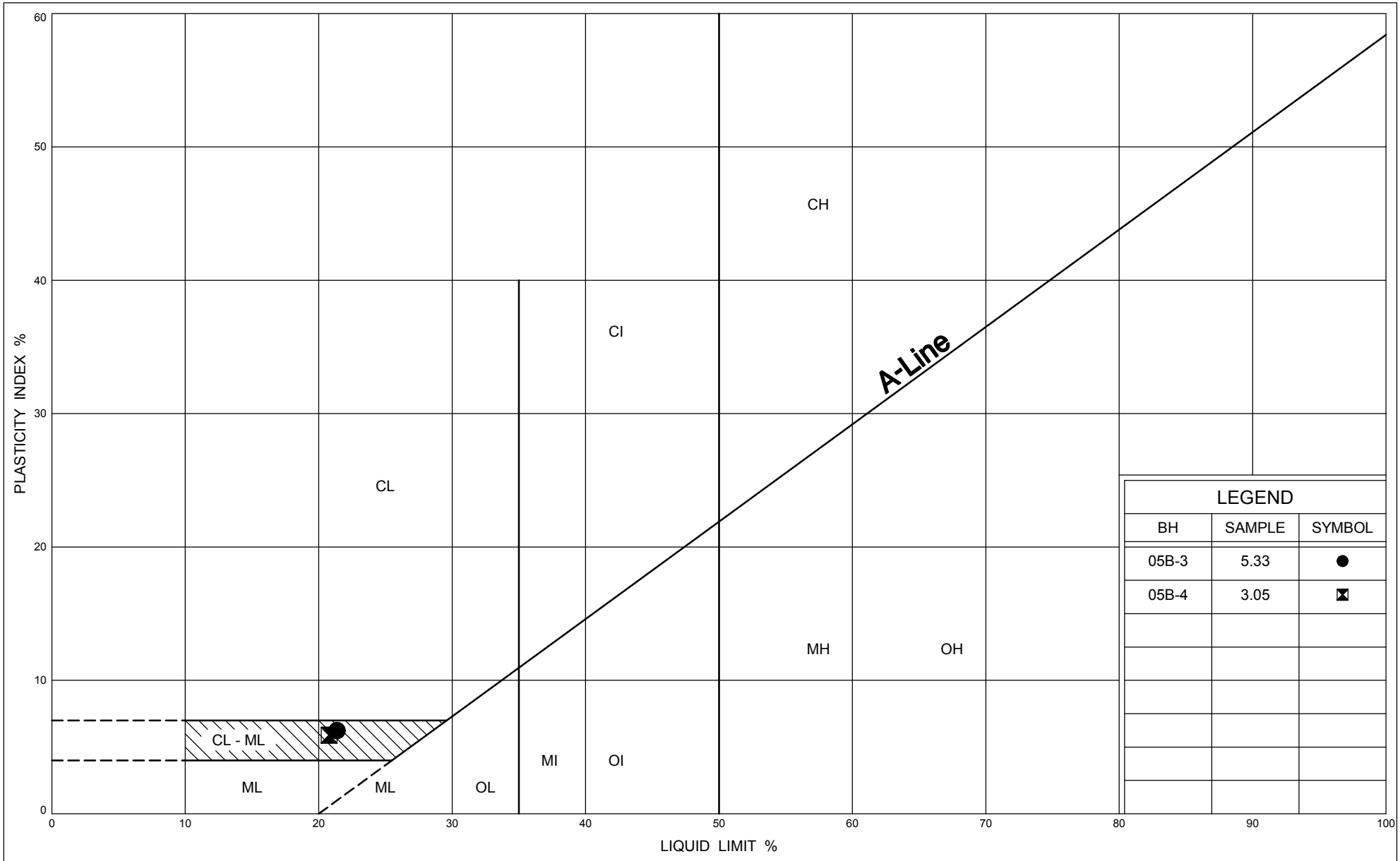
CLAYEY SILT SEAMS AND LAYERS, CL-ML

FIG No C- 05B.8

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT SEAMS AND LAYERS, CL-ML

FIG No C- 05B.9

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 06B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940710, Easting - 209996 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.42	Ground										
0.00	150 mm TOPSOIL.						331				
			1	SPT	31				225+		
							330				
	Silty CLAY TILL, CL Reddish brown, moist, hard, with embedded sand and gravel, occasional clayey silt layers.		2	SPT	40				225+		26 28 32 14 (46)
							329		225+		
			3	SPT	47						
									225+		
327.91			4	SPT	49		328				6 27 42 25 (67)
3.51	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 06B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940721, Easting - 209987 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
333.80	Ground										
0.00	100 mm shoulder gravel.										
	FILL Brown, moist to wet, compact, consisting of sand, silt and gravel.		1	SPT	26		333				
			2	SPT	13		332				
331.82											
1.98			3	SPT	6		331				
	Silty CLAY TILL, CL Reddish brown, wet to moist, firm to hard, with embedded sand and gravel, occasional clayey silt layers.		4	SPT	26	▽		87.5		23.2	10 27 38 25 Water level measured @ 3.35 m @ completion. (63)
			5	SPT	68		330				
			6	SPT	90		329				9 27 38 26 (64)
328.77											
5.03	End of Borehole.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 06B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940747, Easting - 209984 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.90	Ground										
0.00	150 mm TOPSOIL.										
			1	SPT	50		331				
	Silty CLAY TILL, CL Reddish brown, moist, hard, with embedded sand and gravel, occasional clayey silt layers.		2	SPT	100+		330				13 23 40 25 (65)
			3	SPT	55		329				
328.39			4	SPT	38						8 26 42 23 (65)
3.51	End of Borehole.										Borehole dry and open @ completion.

PENETR. RESISTANCE: STANDARD ● DYN. CONE — 20 40 60 80 100

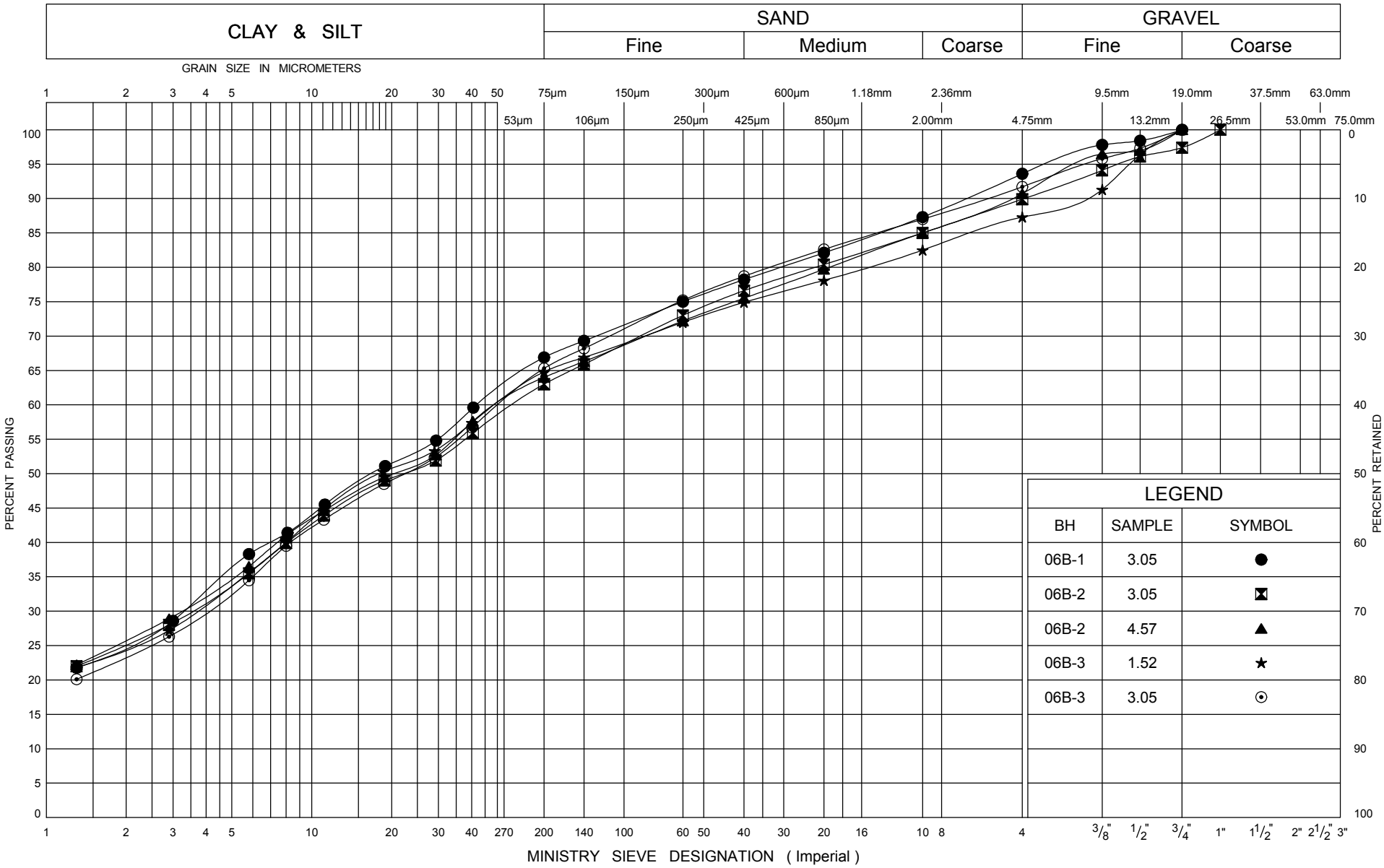
SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT — WATER CONTENT (%) 10 20 30

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

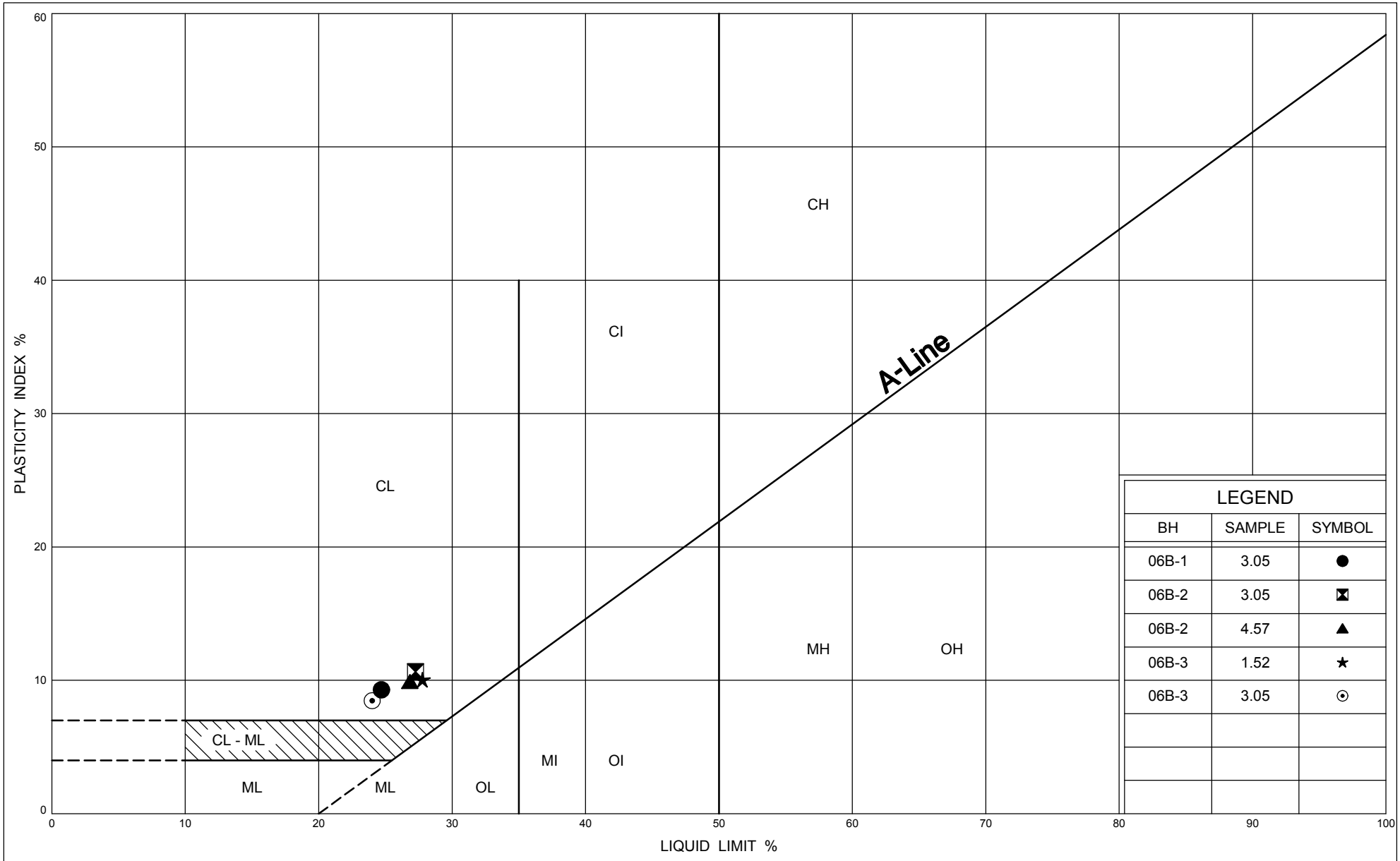
SILTY CLAY TILL, CL

FIG No C- 06B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

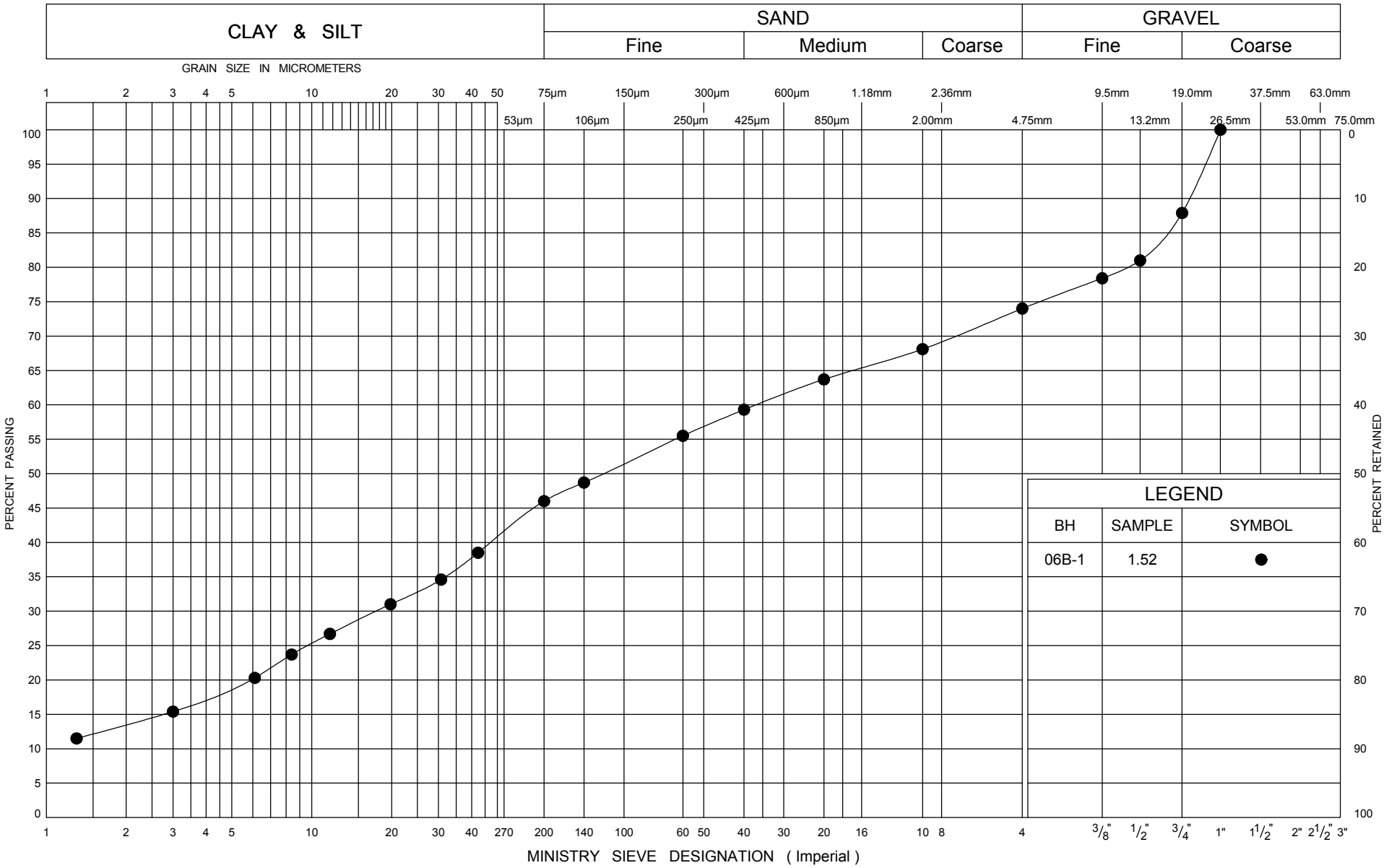
PLASTICITY CHART
SILTY CLAY TILL, CL

FIG No C- 06B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

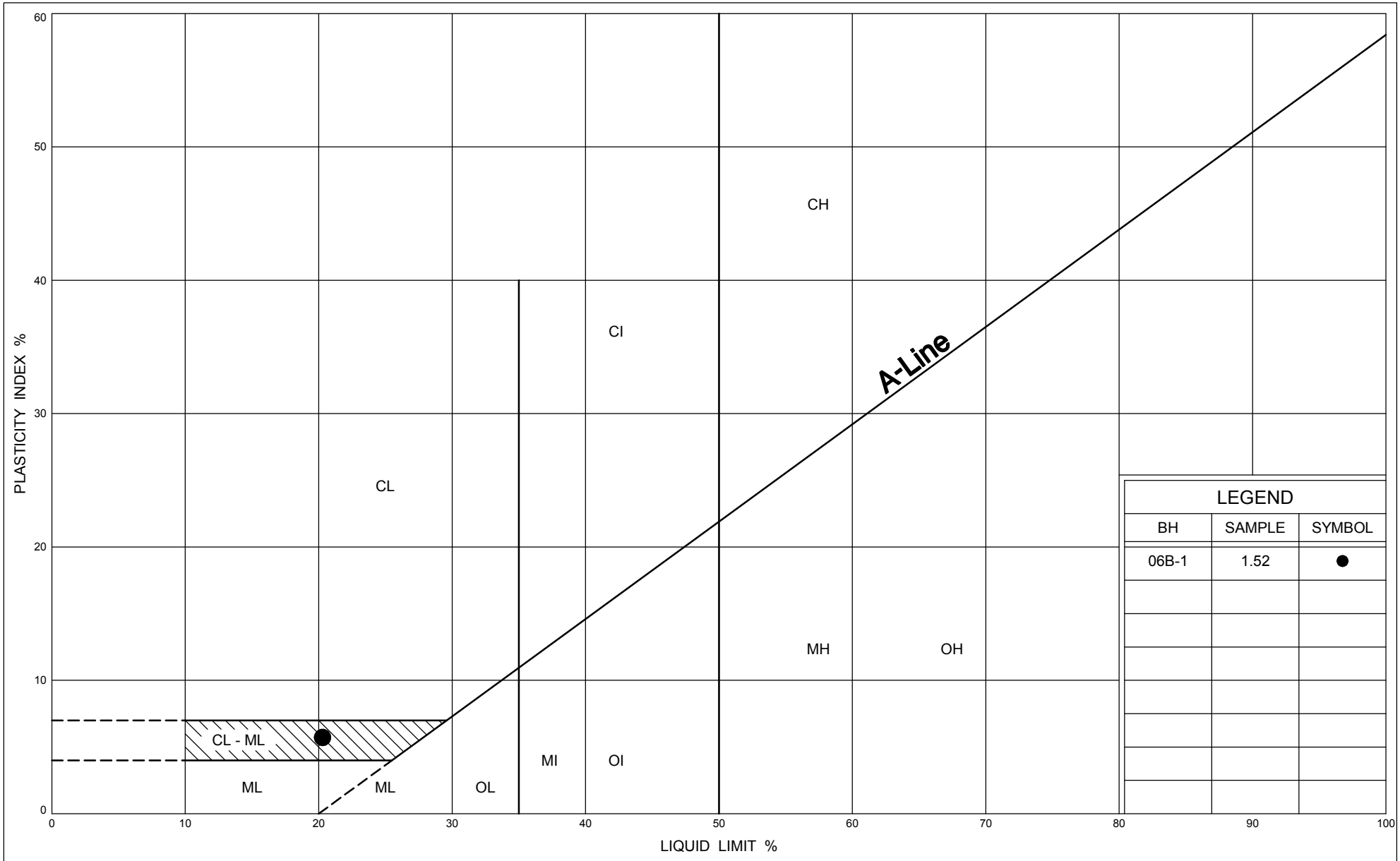
CLAYEY SILT LAYER, CL-ML

FIG No C- 06B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT LAYER, CL-ML

FIG No C- 06B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 07B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940801, Easting - 210293 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.32	Ground										
0.00	150 mm TOPSOIL						322				
			1	SPT	7					18.5	14 19 48 19 (68)
	Silty CLAY TILL, CL Reddish brown, moist, firm to hard, with embedded sand and gravel, occasional sandy layers.						321		225+		
			2	SPT	24						
			3	SPT	49		320		225+		
		sandy	4	SPT	28		319		225+		11 26 38 25 (63)
318.81											
3.51	End of Borehole.										Borehole dry and open @ completion..

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 07B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940806, Easting - 210314 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.35	Ground										
0.00	150 mm Granular FILL.										
	FILL Brown to dark brown, moist, loose, consisting of mixed sand, silt, some clay, gravel and organics.		1	SPT	4						
320.83											
1.52			2	SPT	8						12 39 32 17 (49)
			3	SPT	18						
	Silty CLAY TILL, CL Reddish brown, wet to moist, firm to hard, with embedded sand and gravel, occasional sandy layers.		4	SPT	52						12 26 39 23 (63)
			5	SPT	53						
317.32			6	SPT	44					22.6	5 30 41 24 (65)
5.03	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 07B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940806, Easting - 210316 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

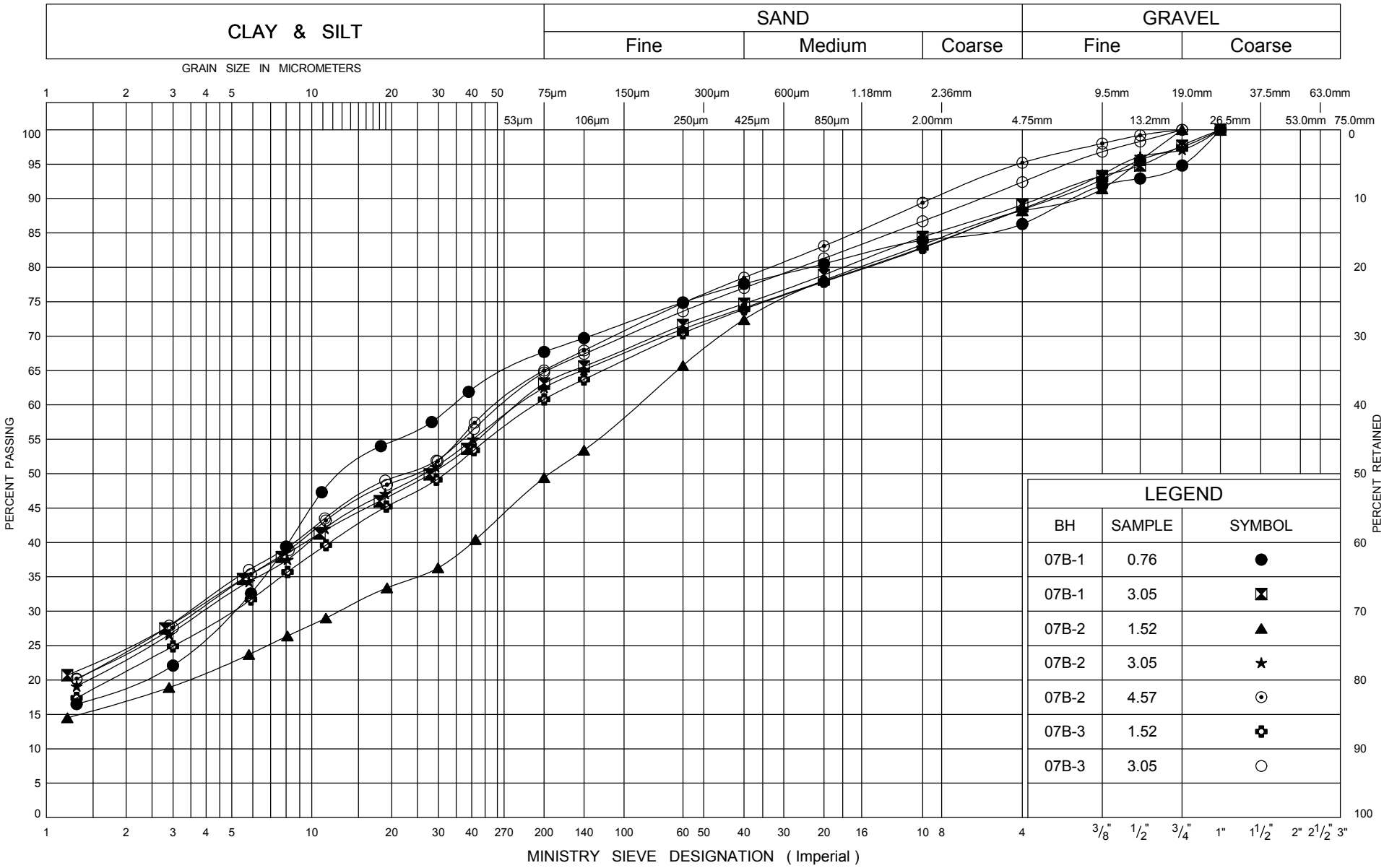
DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.21	Ground										
0.00	150 mm TOPSOIL.						322				
	FILL Brown, moist, loose, consisting of mixed sand, silt and clay, trace organics.		1	SPT	4		321				
320.53			2	SPT	19			225+		22.7	12 28 40 21 (61)
1.68	Silty CLAY TILL, CL Reddish brown, moist, very stiff to hard, with embedded sand and gravel, occasional sandy layers.		3	SPT	30		320	225+			
318.70			4	SPT	34		319	225+		23.9	8 28 40 24 (65)
3.51	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

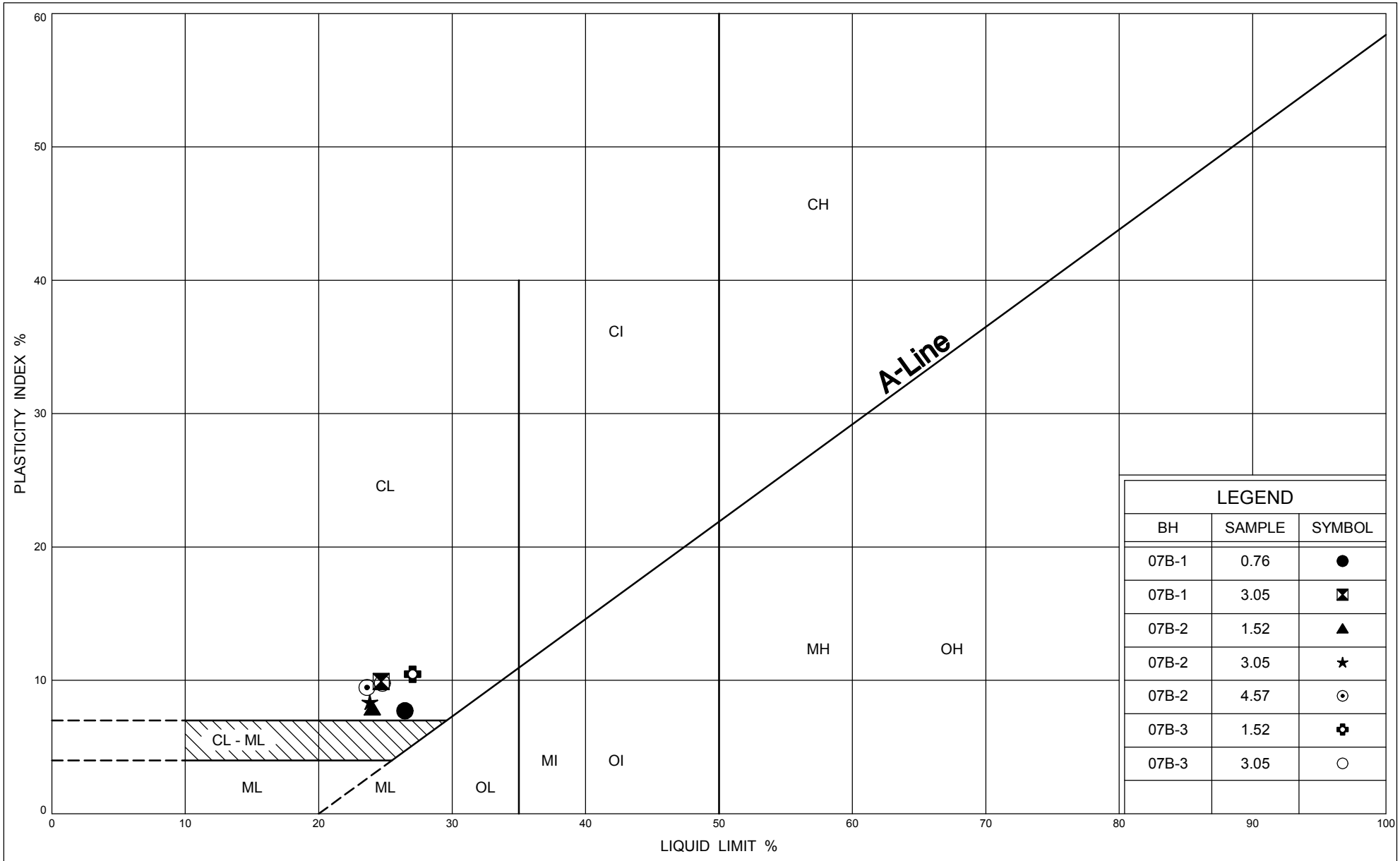
GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL, CL

FIG No C- 07B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford



Ministry of Transportation
Ontario

PLASTICITY CHART
SILTY CLAY TILL, CL

FIG No C- 07B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 08B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940833, Easting - 210295 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.52	Ground										
0.00 322.22	300 mm TOPSOIL										
0.30							322				
			1	SPT	34						7 27 40 26 (66)
							321				
	Silty CLAY TILL, CL Reddish brown, moist, hard, with embedded sand and gravel, occasional clayey silt layers.		2	SPT	68						
			3	SPT	77		320				10 28 38 24 (62)
319.01			4	SPT	35						
3.51	End of Borehole.										Borehole dry and open @ completion.

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 08B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940838, Easting - 210310 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
322.48 Ground											
0.00	200 mm Granular FILL										
	FILL Brown, moist, loose to compact, consisting of gravel, sand some silt and trace clay.		1	SPT	13		322				43 42 12 3 (15)
			2	SPT	9		321				
320.19											
2.29			3	SPT	31		320				19 33 31 16 (48)
	Silty CLAY TILL, CL Reddish brown, moist, hard to very stiff, with embedded sand and gravel, occasional clayey silt layers.		4	SPT	48		319				
			5	SPT	53						16 27 37 20 (57)
317.45			6	SPT	15		318				
5.03	End of Borehole.										Borehole dry and open @ completion.

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 08B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4940840, Easting - 210316 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

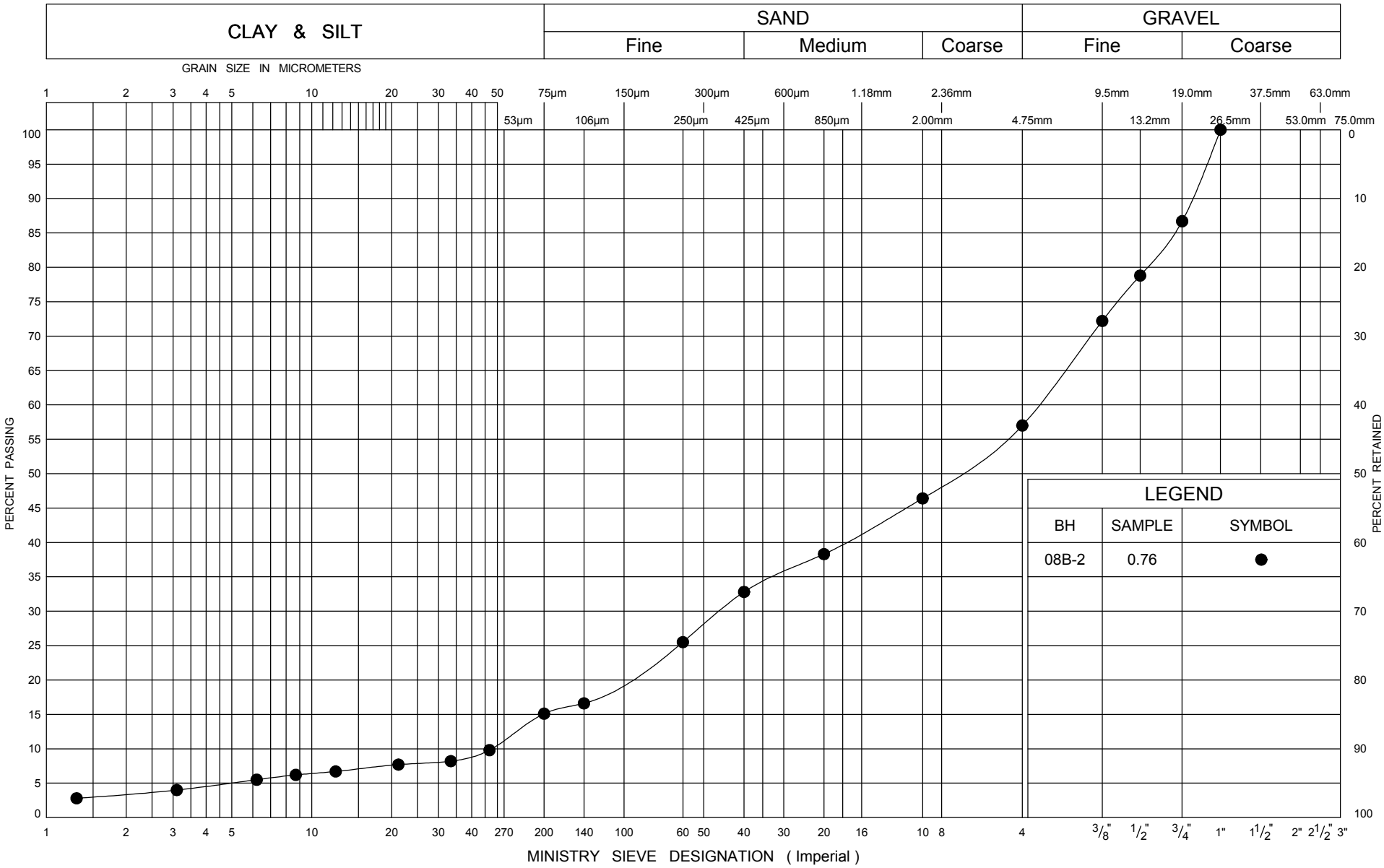
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
320.77	Ground										
0.00	200 mm TOPSOIL										
			1	SPT	13					21.3	15 33 37 15 (52)
	Silty CLAY TILL, CL Reddish brown, moist, stiff to hard, with embedded sand and gravel, frequent clayey silt layers.		2	SPT	36						
			3	SPT	44				212.5		11 28 43 18 (61)
317.42			4	SPT	50						
3.35	End of Borehole.										Borehole dry and open @ completion.

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

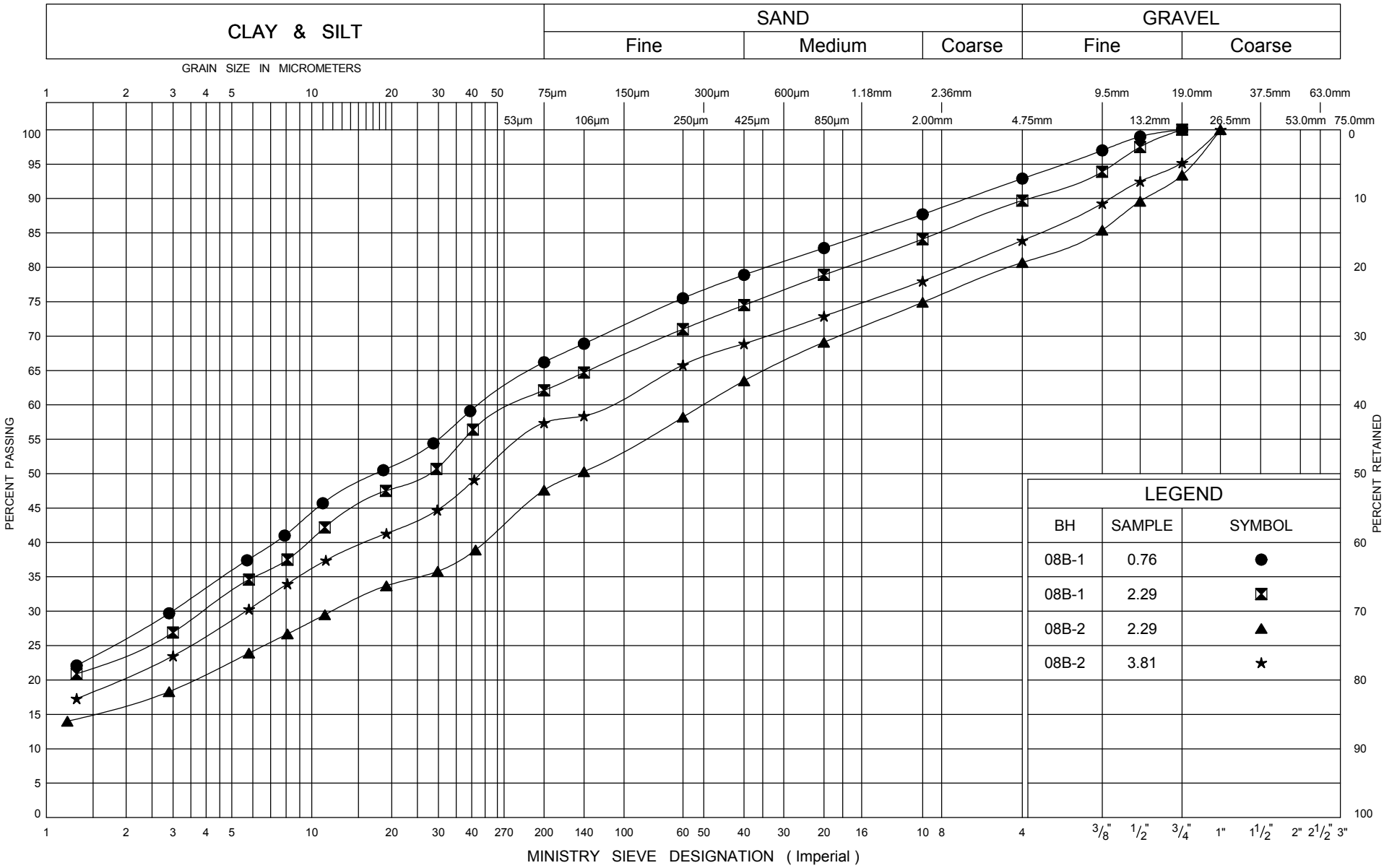
FILL

FIG No C- 08B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

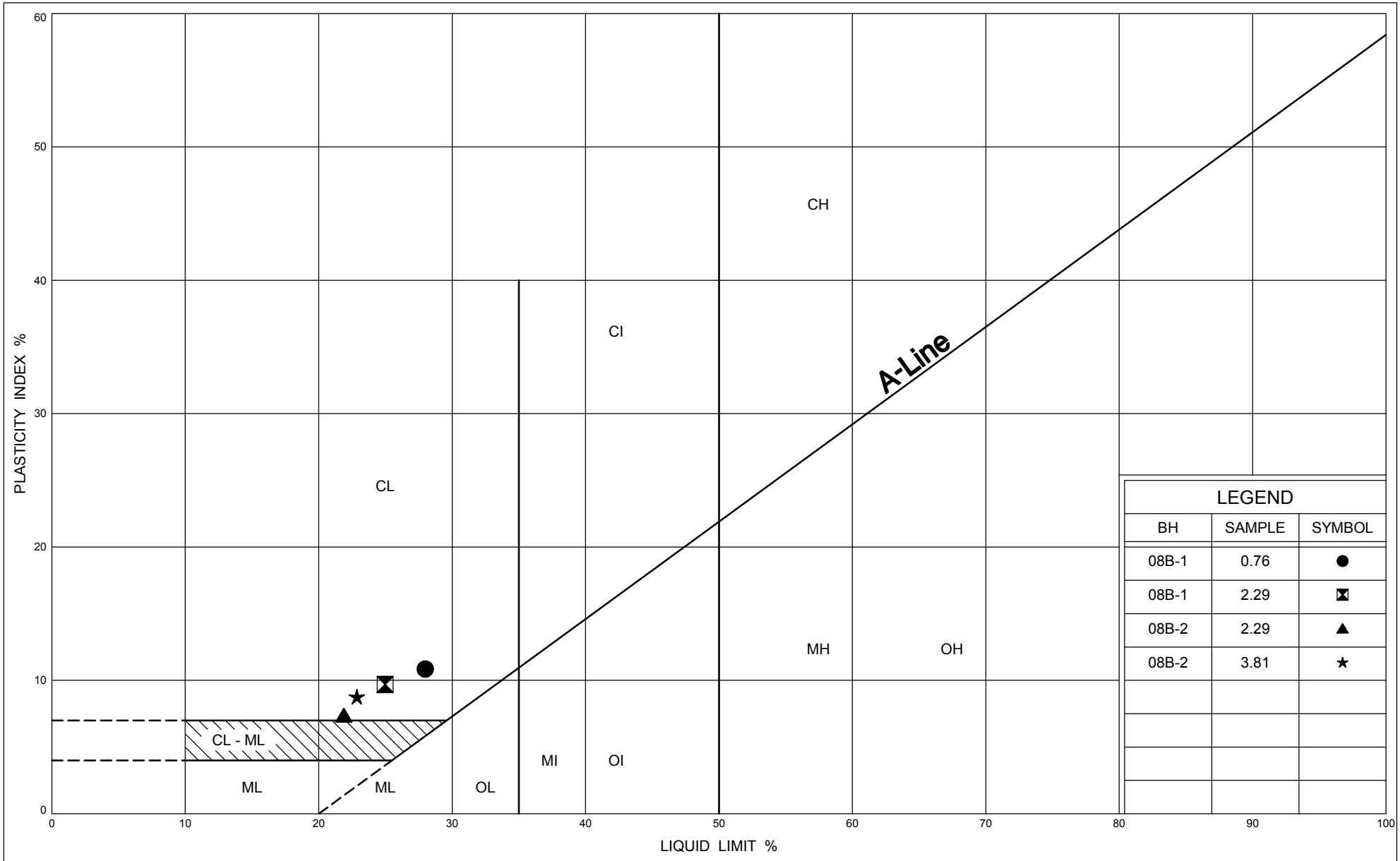
SILTY CLAY TILL, CL

FIG No C- 08B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

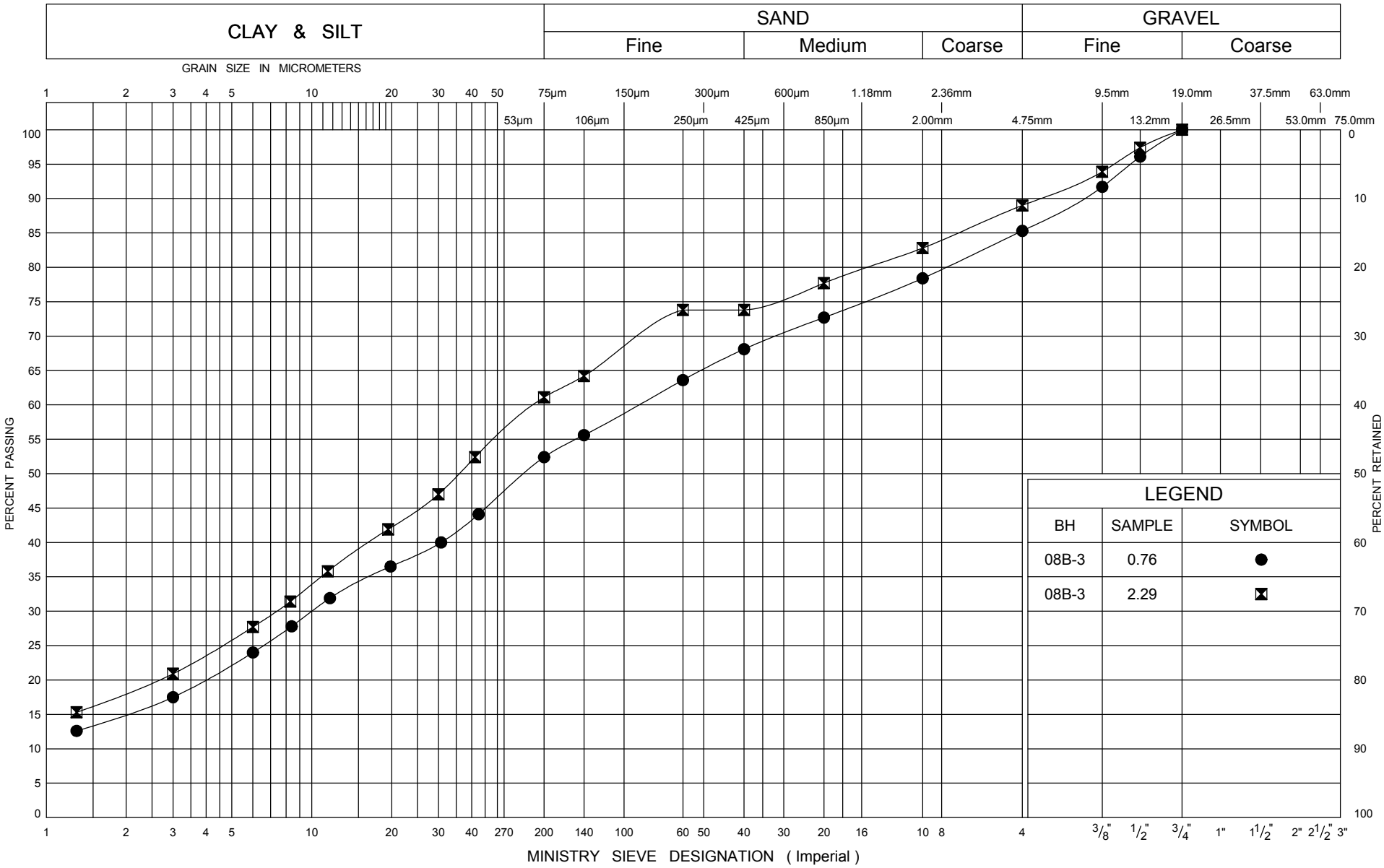
SILTY CLAY TILL, CL

FIG No C- 08B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

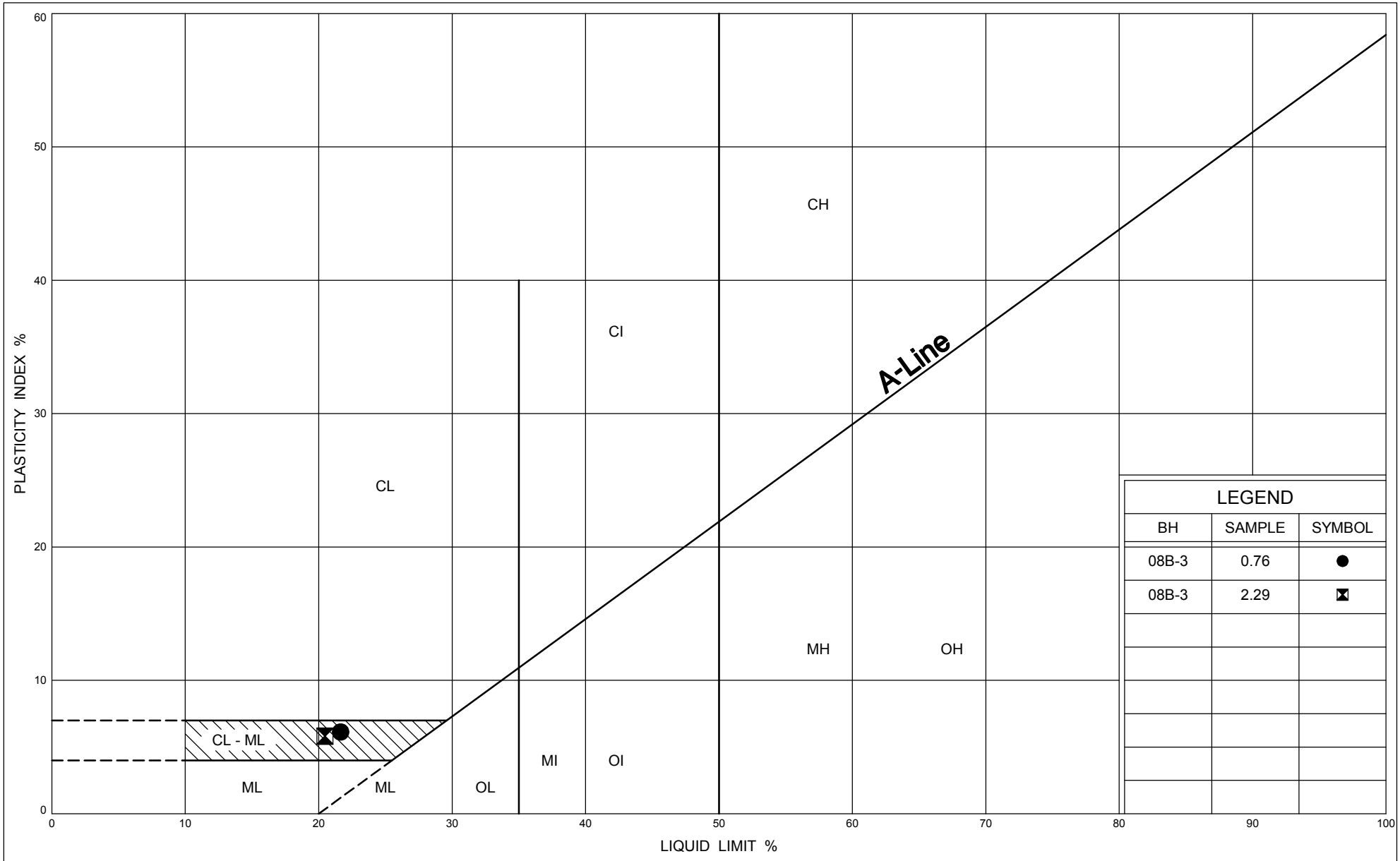
CLAYEY SILT LAYERS, CL-ML

FIG No C- 08B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 18/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT LAYERS, CL-ML

FIG No C- 08B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 09B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941050, Easting - 211235 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 22.8.07 - 22.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL
266.93	Ground							
0.00	150mm TOPSOIL							
			1	SPT	22			
			2	SPT	34			13 22 49 16 (65)
			3	SPT	100+			
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, moist, very stiff to hard, with embedded sand and gravel, silt seams pockets and layers, occasional cobble layers.		4	SPT	57		22.0	2 20 58 21 (79)
			5	SPT	95			
			6	SPT	98			7 24 49 20 (69)
			7	SPT	95			
			8	SPT	100+		23.6	
260.53								
6.40	End of Borehole.							Borehole dry and open @ completion.

ELEVATION SCALE: 266, 265, 264, 263, 262, 261

PENETR. RESISTANCE STANDARD ● DYN. CONE: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE: 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

175 225+ 225+ 225+ 225+ 225+ 225+ 225+

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 09B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941073, Easting - 211229 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
273.45	Ground							
0.00 / 273.15	300 mm Granular FILL.							
0.30	FILL Brown, moist to wet, very loose to loose, consisting of mixed gravel, sand, silt, clayey silt and silty clay.		1	SPT	5			15 32 37 16 (53)
			2	SPT	5			9 27 47 17 (64)
			3	SPT	3		18.6	24 32 30 14 (44)
			4	SPT	4			
			5	SPT	7			
			6	SPT	7			Organic layer @ 4.25 m extending to 4.5 m. 4 29 42 25 (68)
268.12								
5.33	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, moist to wet, very stiff to hard, with embedded sand and gravel and occasional cobble layers.		7	SPT	19			
			8	SPT	100+		18.7	10 27 38 24 (63)
			9	SPT	100+			
265.83								
7.62	End of Borehole.							Auger & Spoon refusal @ 7.62 m on presumed bedrock. Borehole dry and open @ completion.

ELEVATION SCALE: 273, 272, 271, 270, 269, 268, 267, 266

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

125
225+
225+

+ ³, × ³: Numbers refer to Sensitivity

○ ¹⁵⁰ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

RECORD OF BOREHOLE No 09B-4

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941100, Easting - 211215 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

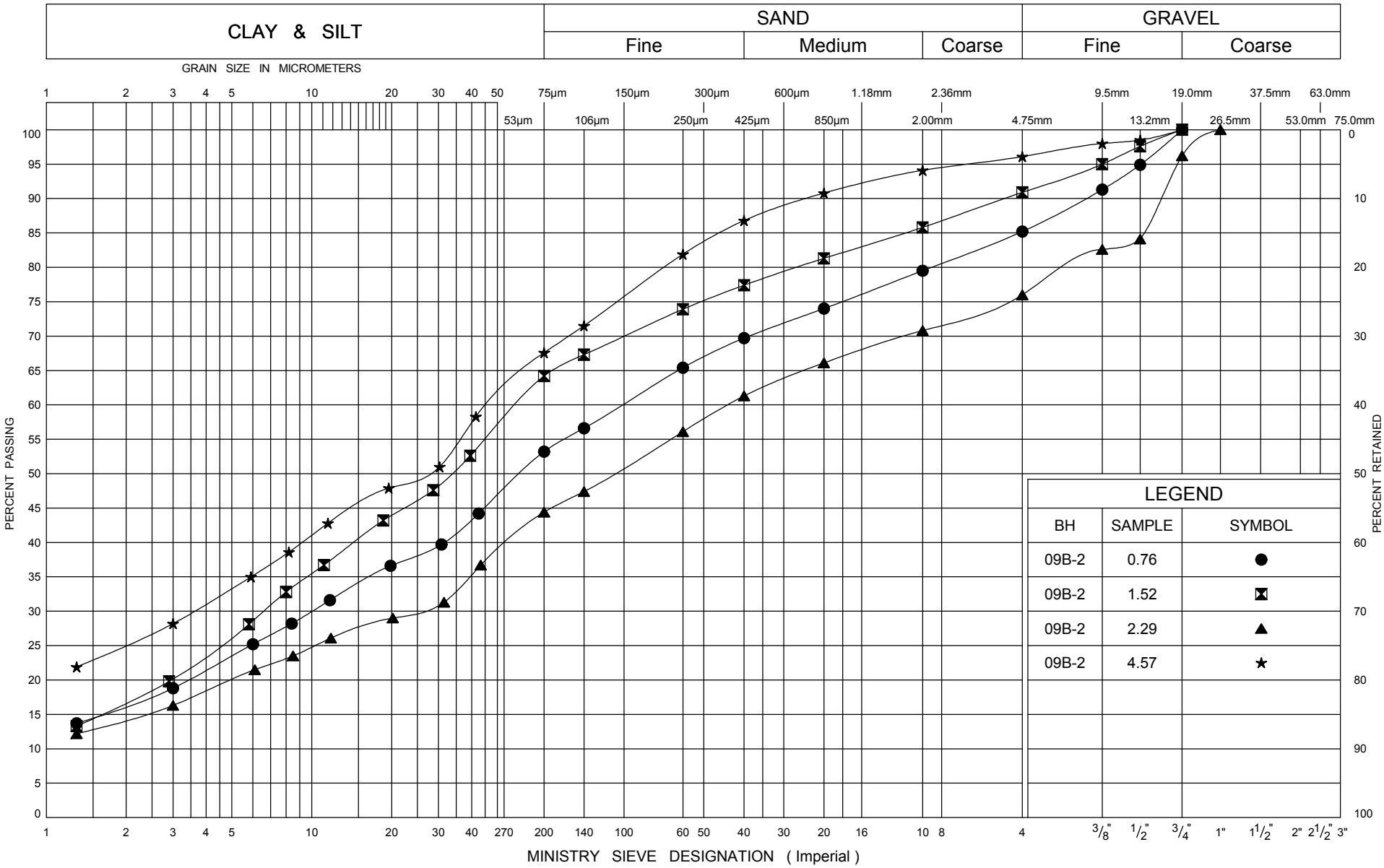
DATUM Geodetic DATE 22.8.07 - 22.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
268.55	Ground										
0.00	150mm TOPSOIL.										
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, moist, very stiff to hard, with embedded sand and gravel, and occasional cobble layers, interbedded with silt seams, pockets and layers.		1	SPT	23		268		150	22.2	
			2	SPT	34		267		225+	19.8	2 27 56 14 (71)
			3	SPT	90		266		225+		
			4	SPT	100+		265		225+		2 37 51 10 (61)
			5	SPT	100+				225+		
263.83			6	SPT	100+		264		225+		
4.72	End of Borehole.										Spoon and auger refusal @ 4.72 m. Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

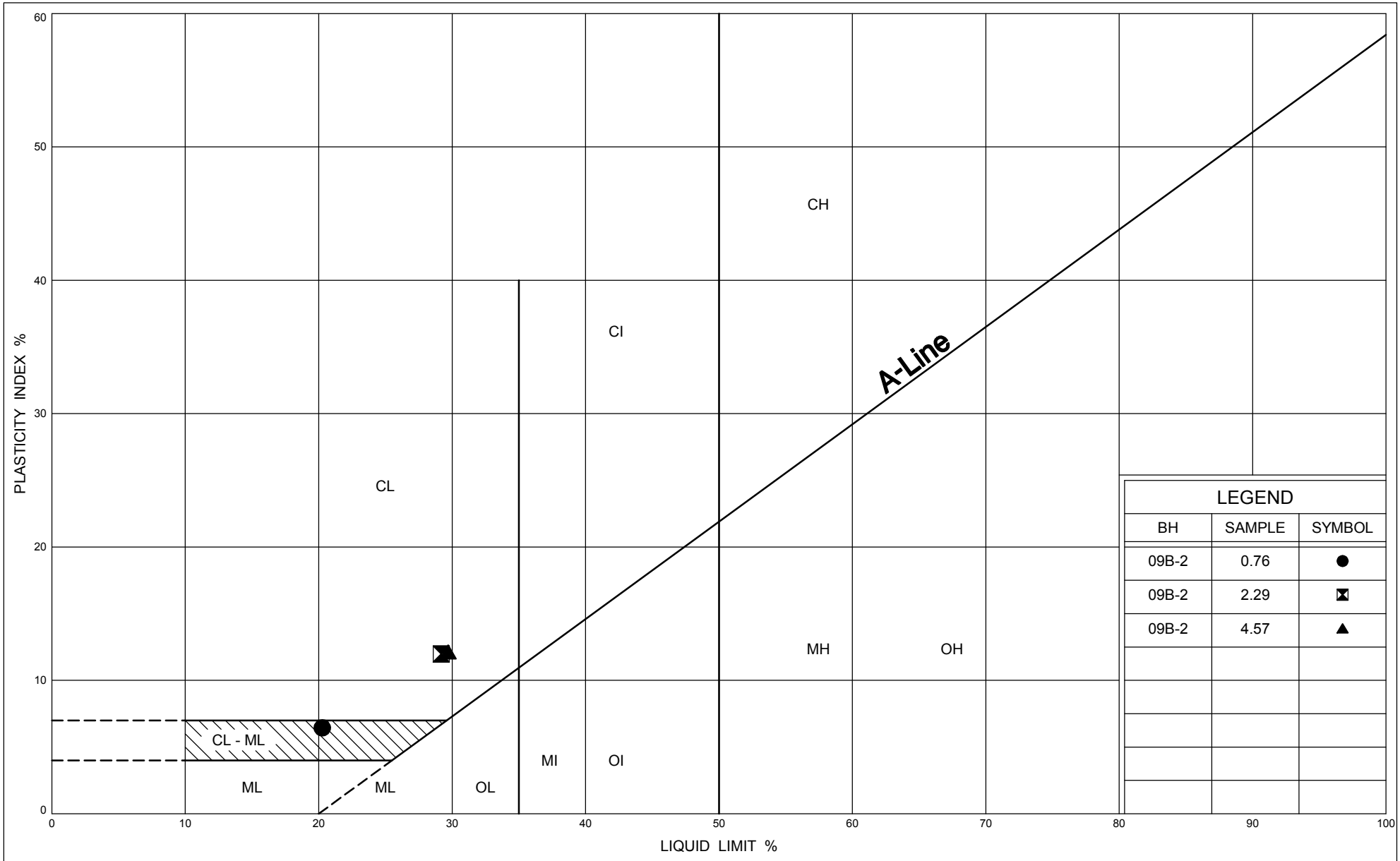
FILL

FIG No C- 09B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

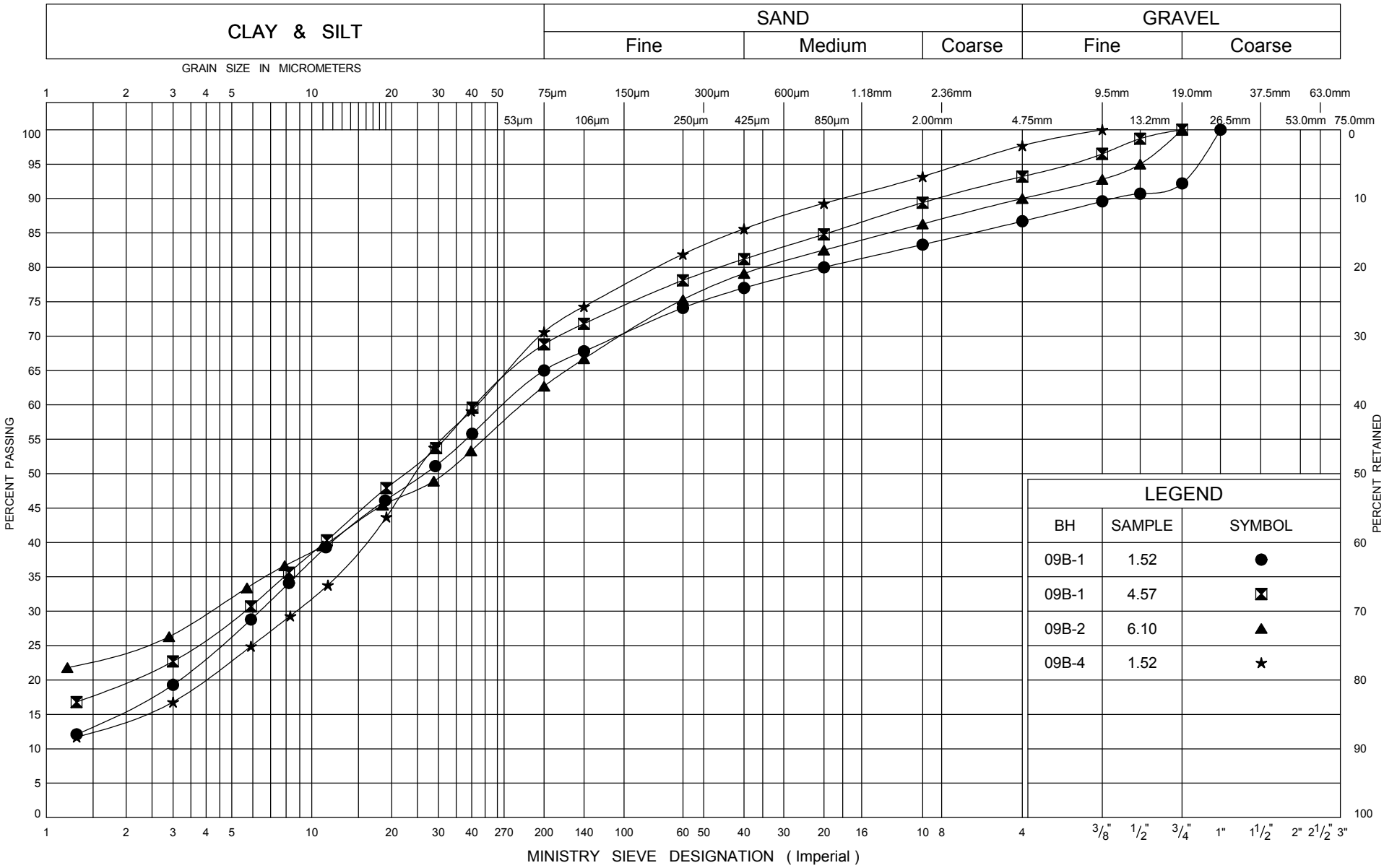
PLASTICITY CHART
FILL

FIG No C- 09B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

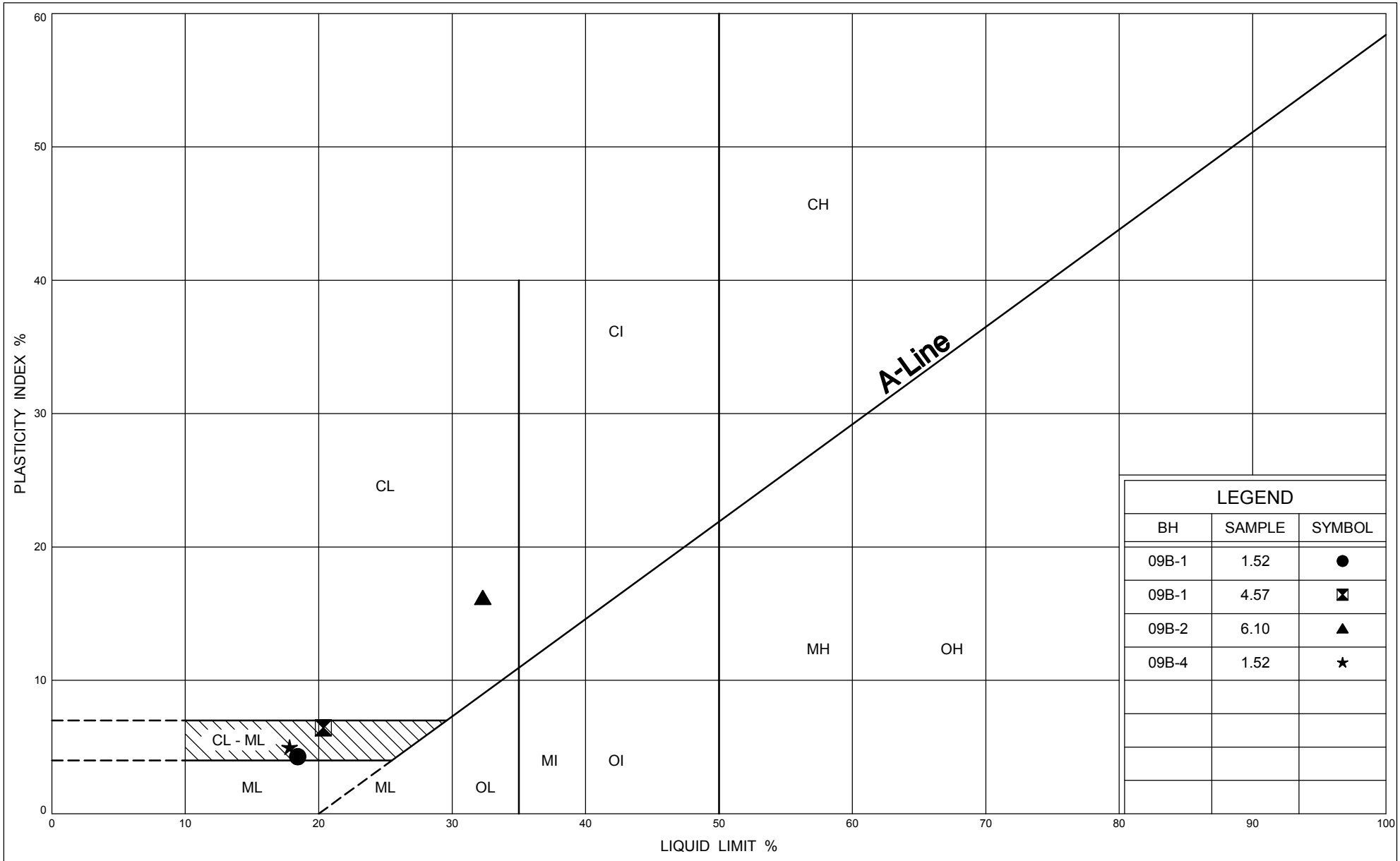
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 09B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

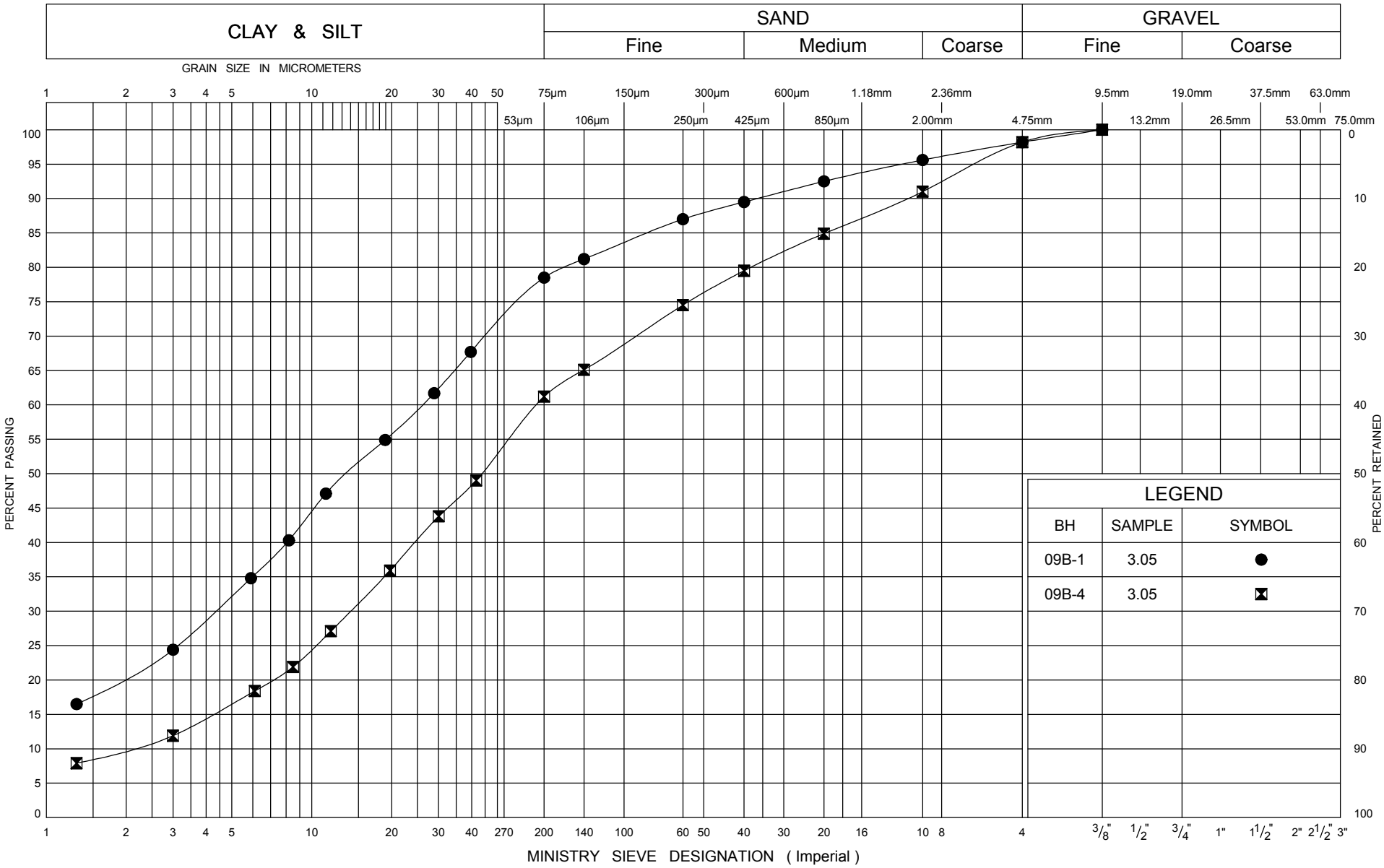
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 09B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

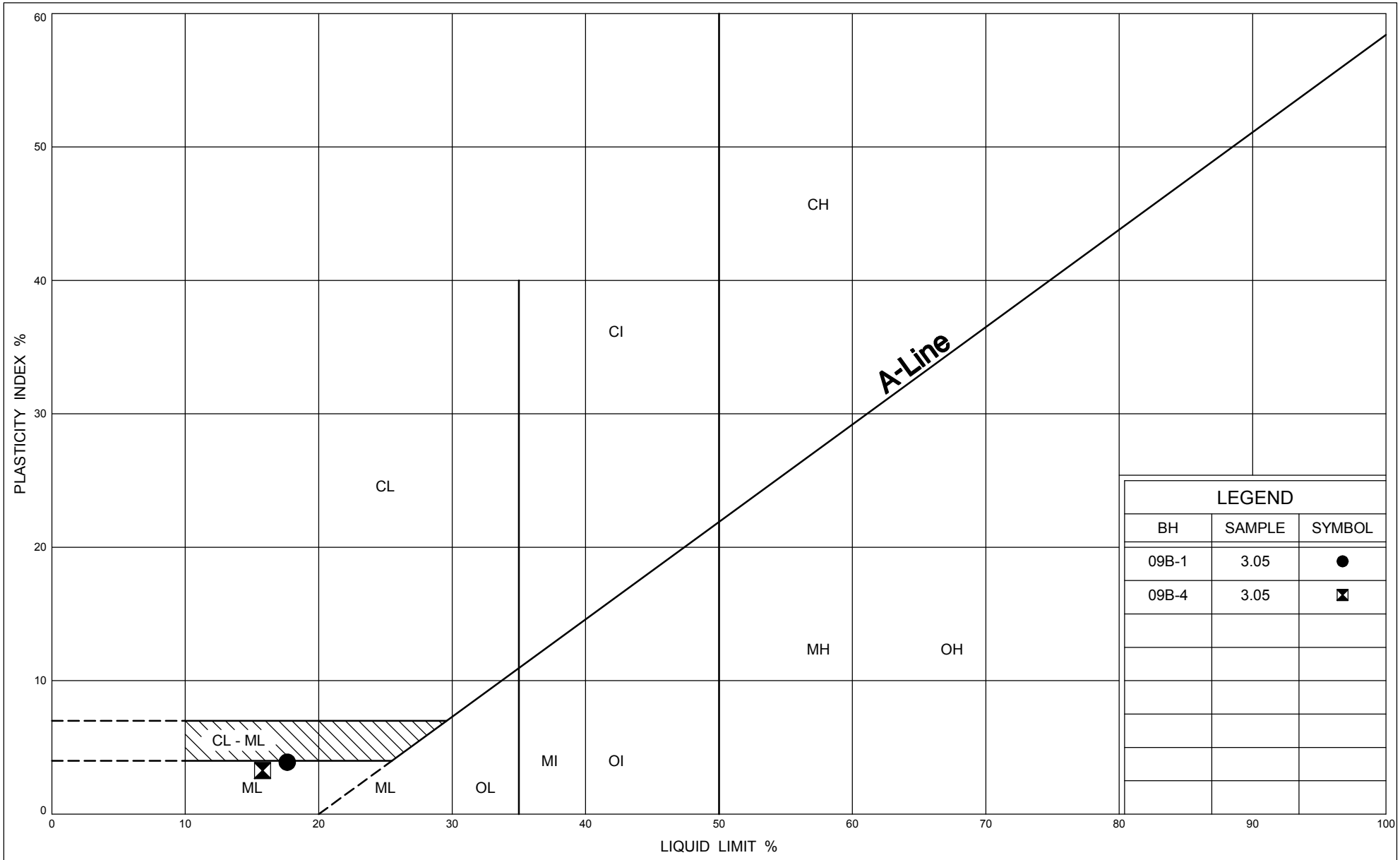
SILT SEAMS, POCKETS AND LAYERS, ML

FIG No C- 09B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

SILT SEAMS, POCKETS AND LAYERS, ML

FIG No C- 09B.6

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 10B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941185, Easting - 211678 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 28.8.07 - 28.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.20	Ground										
0.00	75 mm TOPSOIL.						259				
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, very stiff to hard, with embedded sand and gravel, occasional silt seams, pockets and layers.		1	SPT	20				225+		18 31 39 12 (51)
			2	SPT	26		258		225+		
			3	SPT	80		257		225+		5 29 42 24 (66)
			4	SPT	92		256		225+		
255.69											
3.51	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 10B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941198, Easting - 211674 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
261.66	Ground										
0.00 / 261.05	610 mm Granular FILL.										
0.61	FILL Brown, moist, loose to compact, mixed gravel, sand, silt, clayey silt and silty clay, with organic layer (buried topsoil).		1	SPT	16		261				13 31 36 20 (56)
			2	SPT	24		260				
	organic layer		3	SPT	7	▽	259		41		
258.92 / 2.74	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, very stiff to hard, with embedded sand and gravel, occasional silt seams, pockets and layers.		4	SPT	20		258	175			16 31 37 17 (54)
			5	SPT	30			225+		23.5	
256.86 / 4.80	End of Borehole.		6	SPT	100+		257	225+		21.2	Spoon and auger refusal @ 4.60 m. Borehole dry and open @ completion.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 10B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941224, Easting - 211668 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

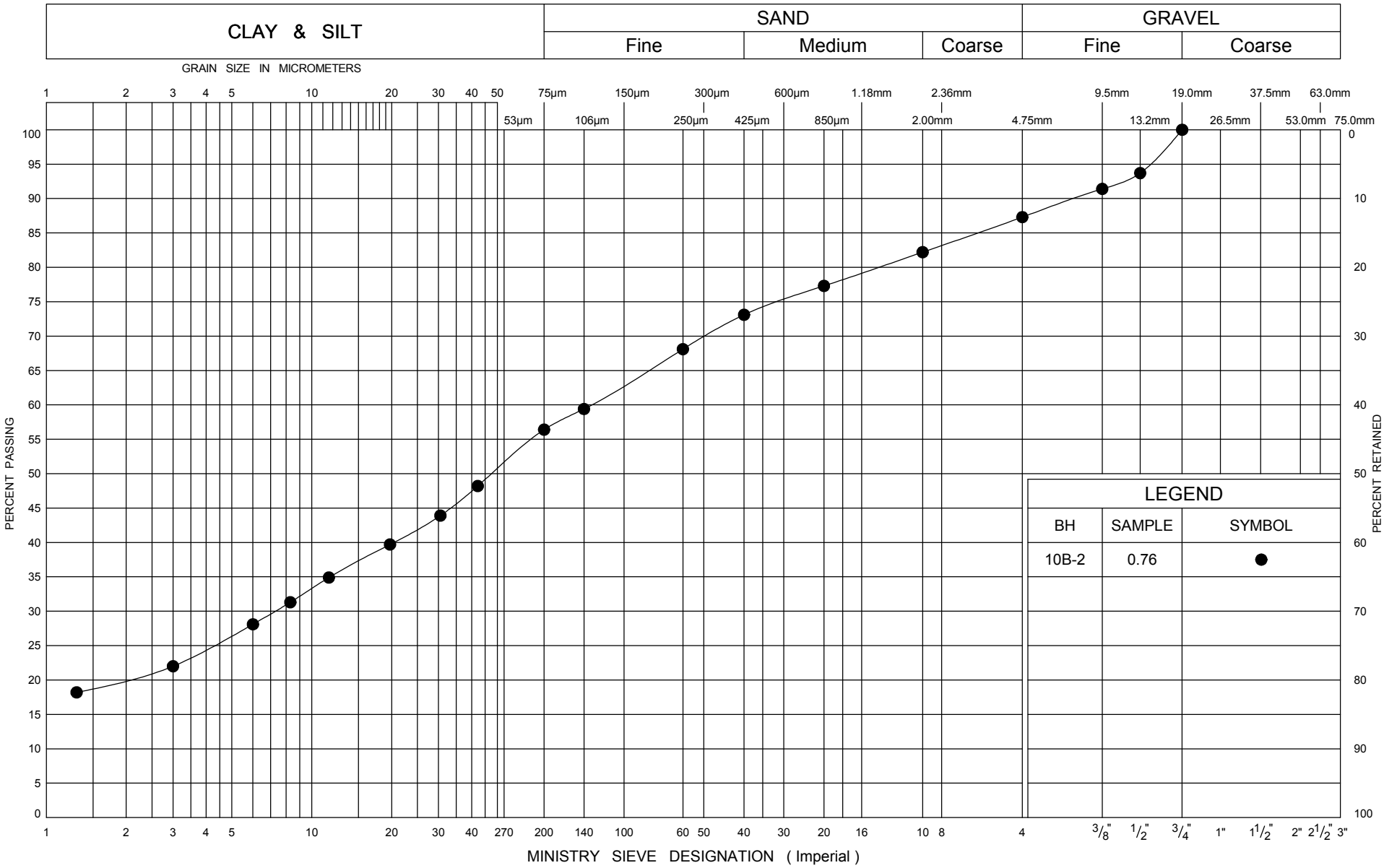
DATUM Geodetic DATE 28.8.07 - 28.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
260.81	Ground										
0.00	150 mm TOPSOIL.										
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, very stiff to hard, with embedded sand and gravel, occasional silt seams, pockets and layers.		1	SPT	16		260		225+		10 31 40 19 (60)
			2	SPT	20		259		225+		
			3	SPT	29				225+		7 35 44 14 (58)
			4	SPT	100+		258		225+		
			5	SPT	100+		257		225+		
256.54											
4.27	End of Borehole.										Borehole dry and open @ completion.

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

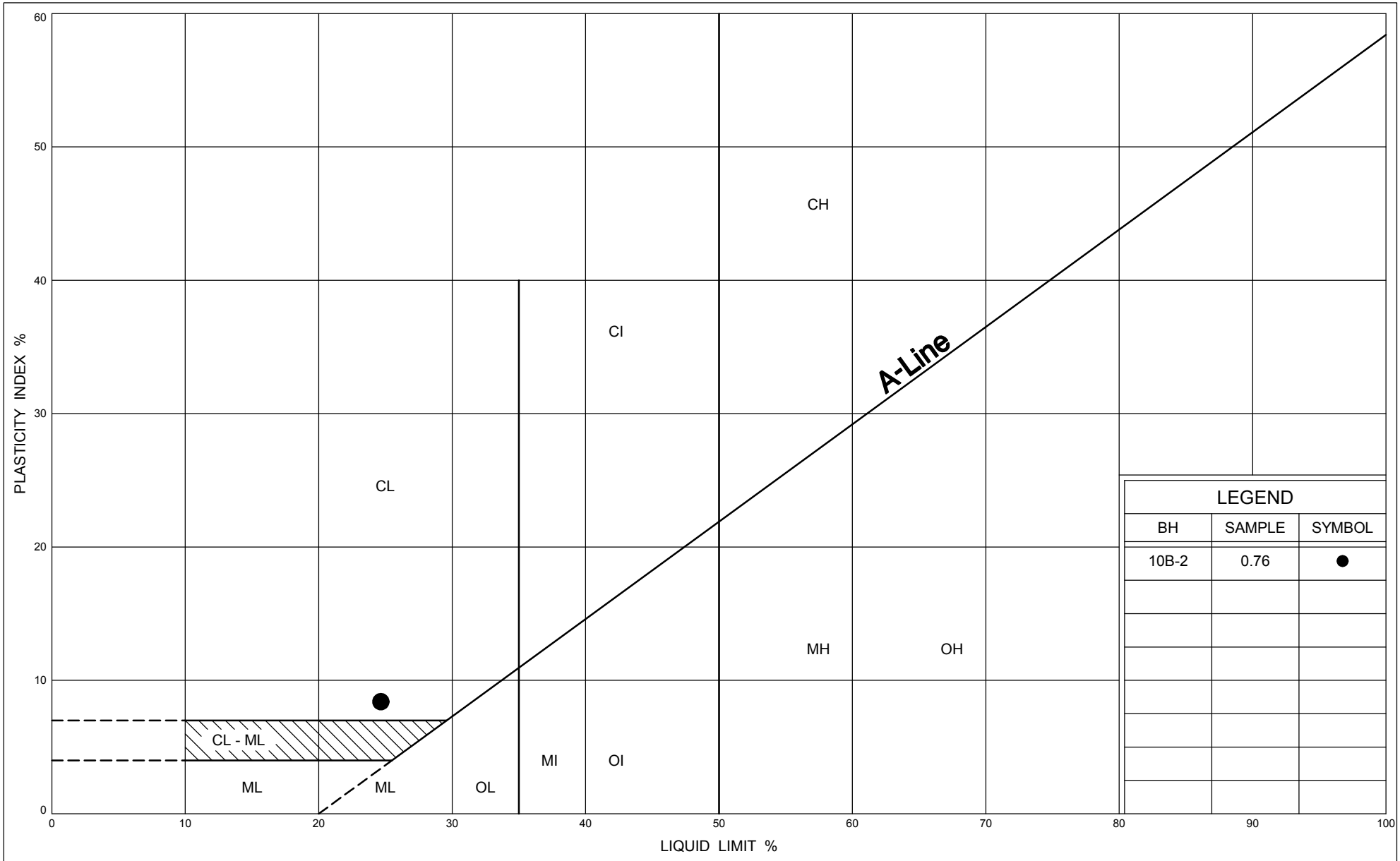
FILL

FIG No C- 10B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

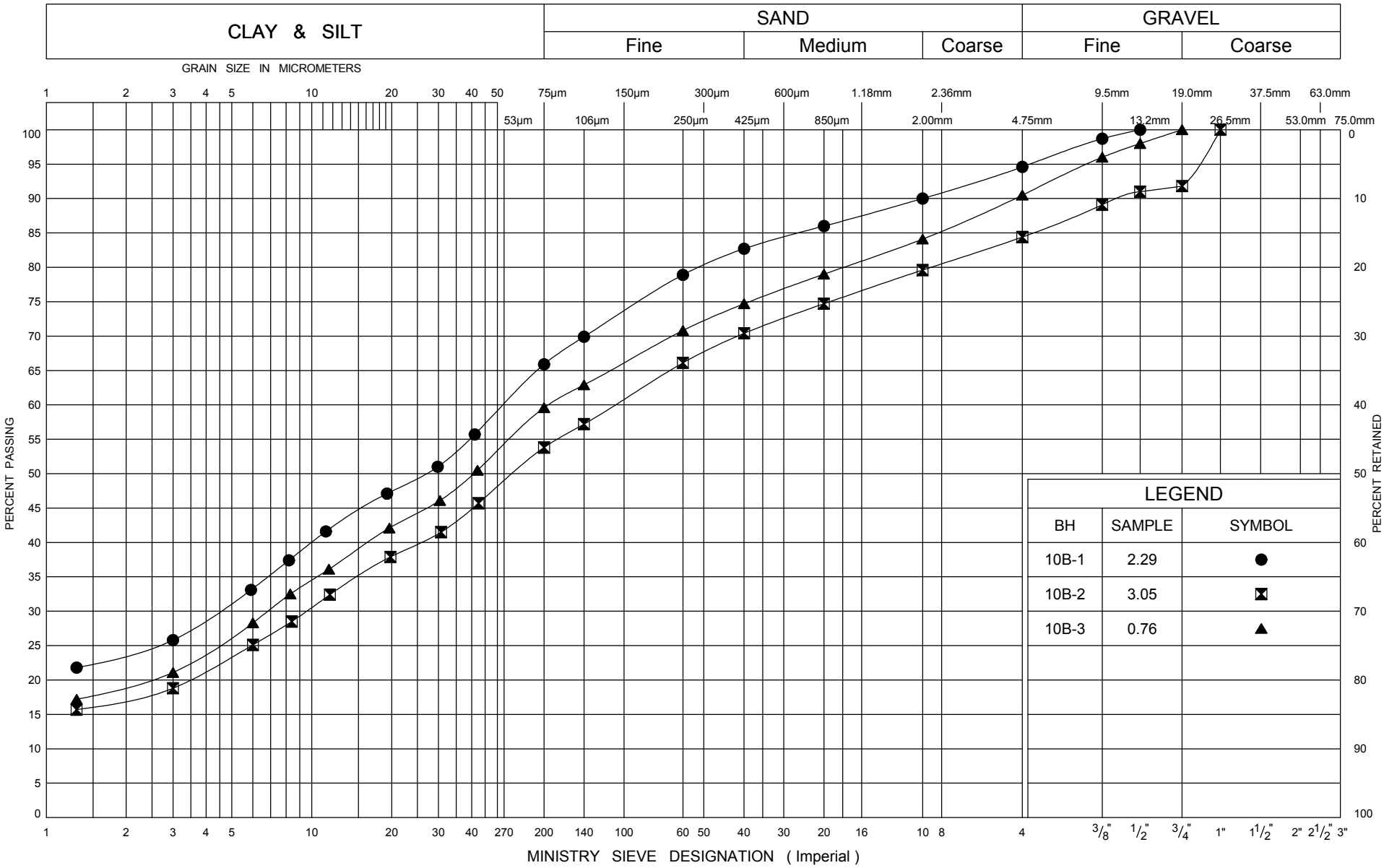
PLASTICITY CHART
FILL

FIG No C- 10B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

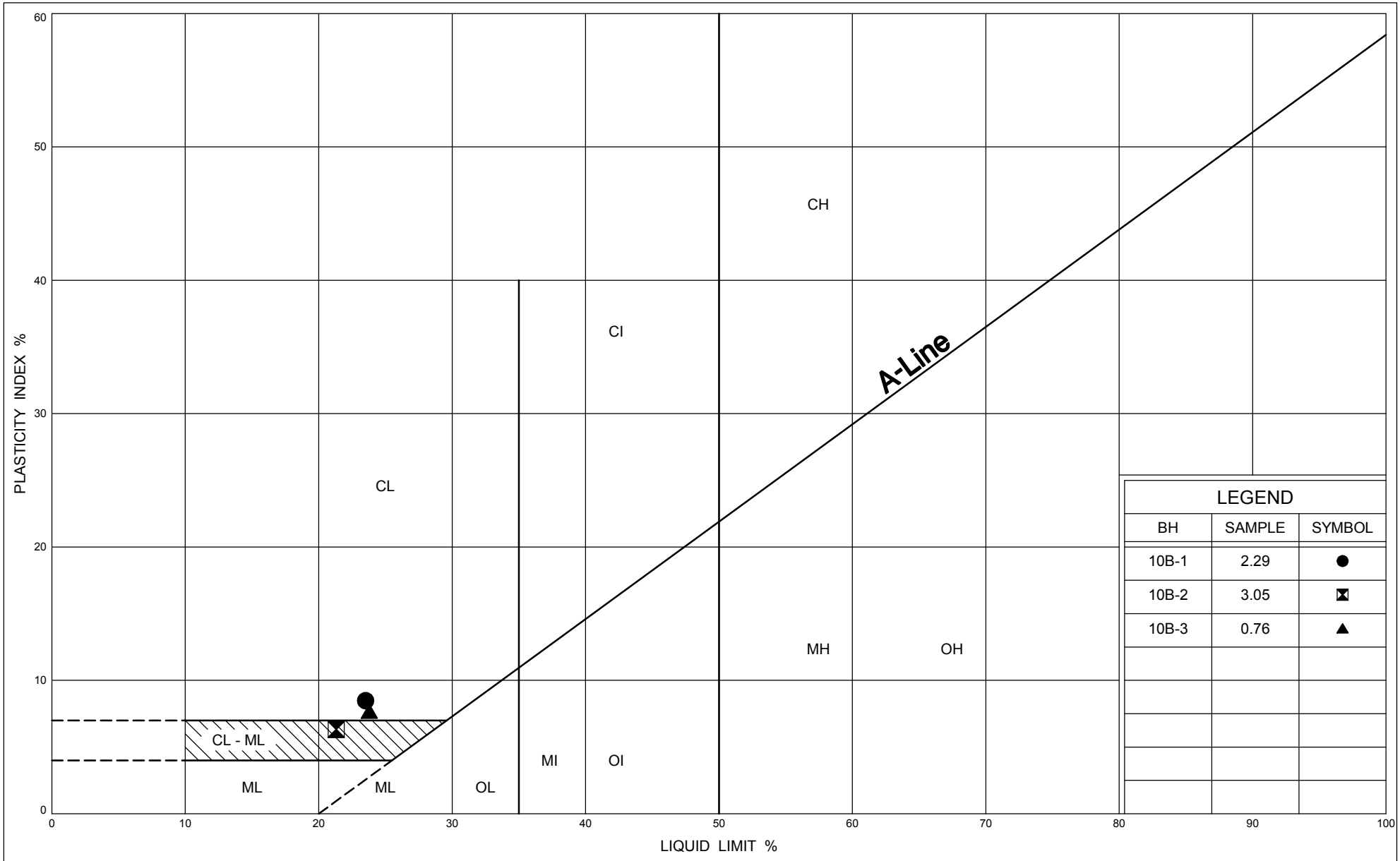
CLAYEY SILT TO SILTY CLAY, CL-ML TO CL

FIG No C- 10B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

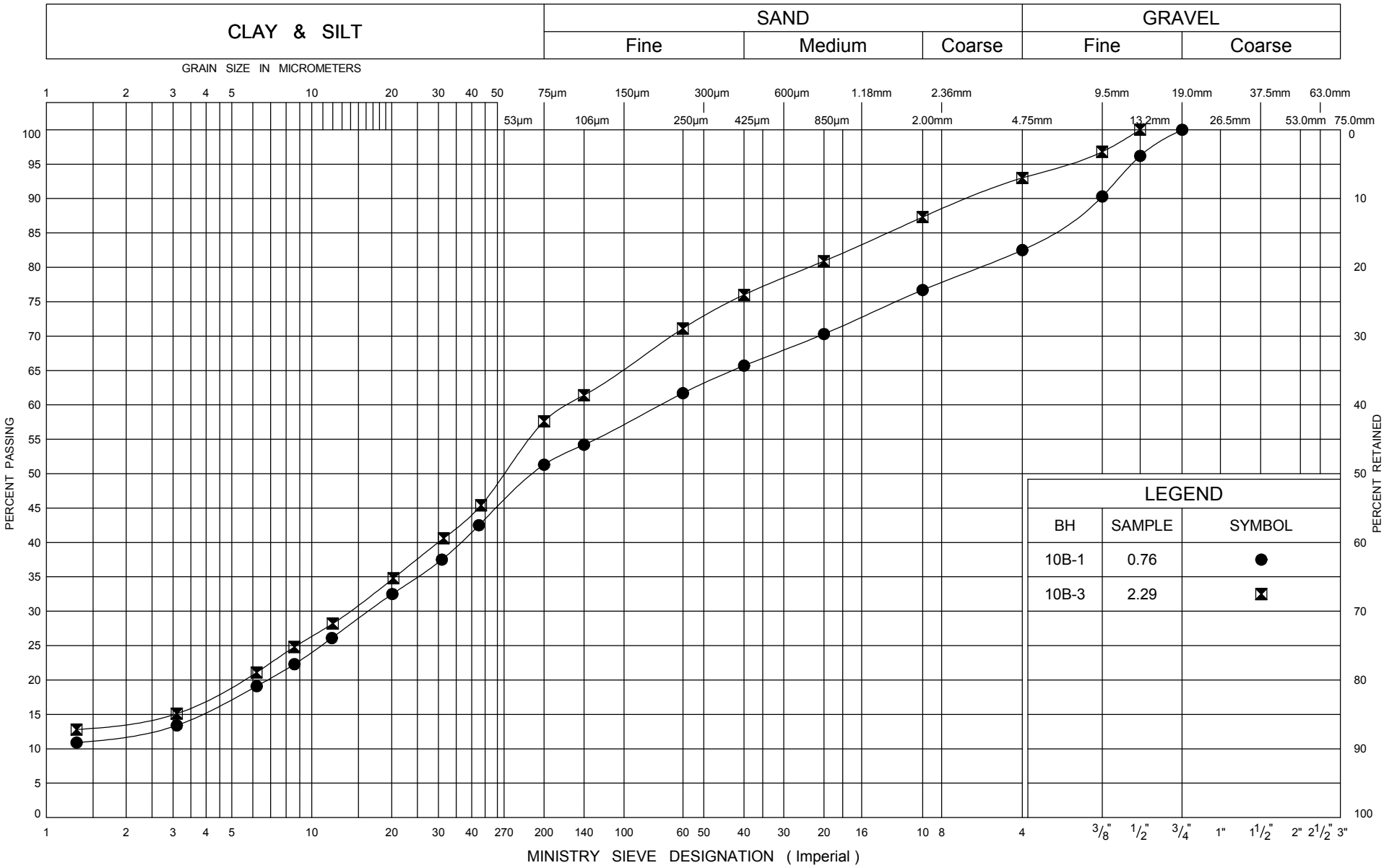
CLAYEY SILT TO SILTY CLAY, CL-ML TO CL

FIG No C- 10B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

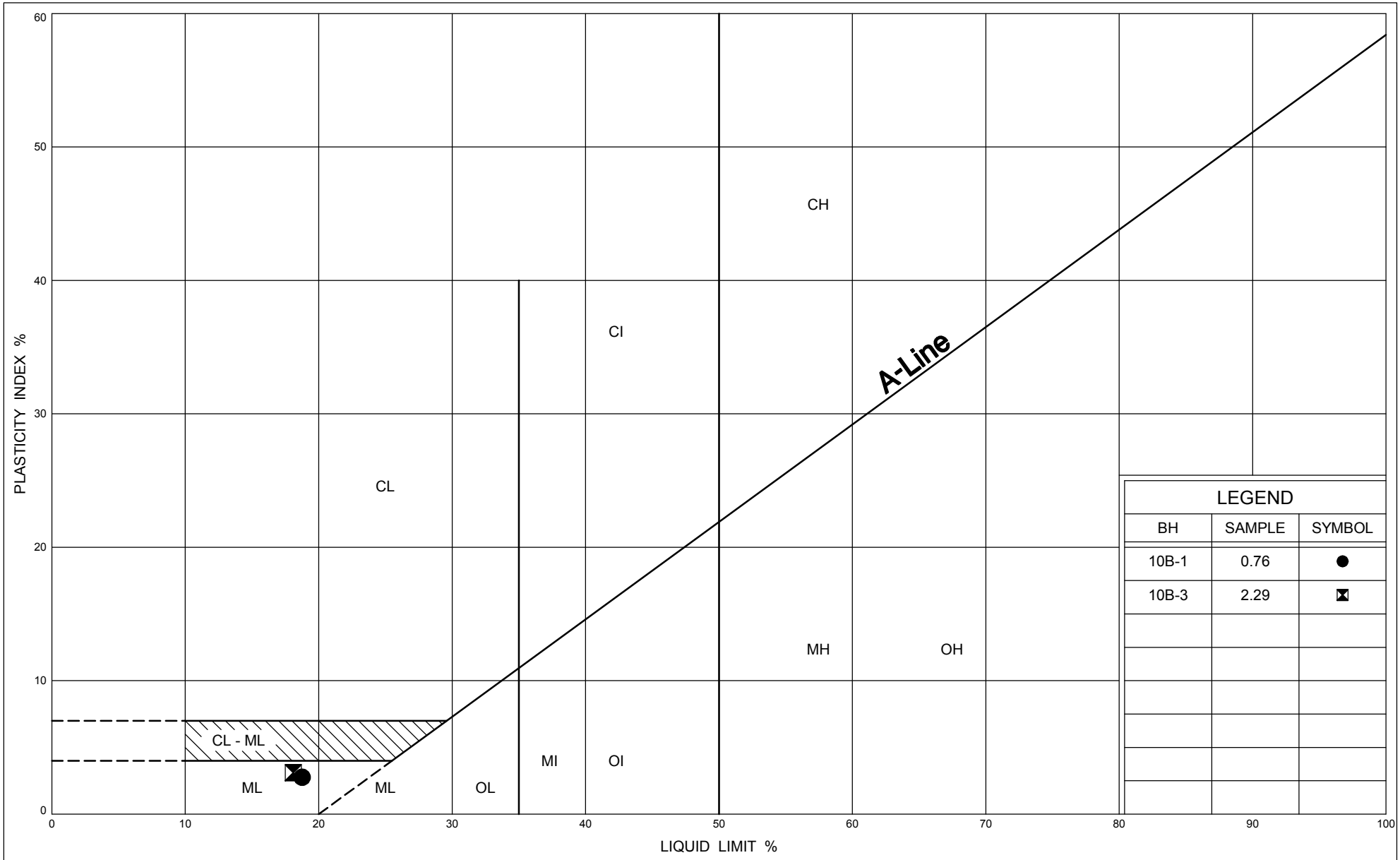
SILT SEAMS, POCKETS AND LAYERS, ML

FIG No C- 10B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

SILT SEAMS, POCKETS AND LAYERS, ML

FIG No C- 10B.6

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 11B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941374, Easting - 212351 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 27.8.07 - 27.8.07 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
240.92	Ground										
0.00	75 mm TOPSOIL.										
			1	SPT	78		240				
			2	SPT	35		239				6 34 33 27 (60)
	Silty CLAY TILL, CL Reddish brown, moist, very stiff to hard, with embedded sand and gravel, occasional silt seams.		3	SPT	23		238				
			4	SPT	36						8 25 53 14 (67)
			5	SPT	39		237				
236.65											
4.27	End of Borehole.										Borehole dry and open @ completion.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 11B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941388, Easting - 212345 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 15.8.07 - 15.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
242.62	Ground								
0.00	150 mm Granular FILL.								
	FILL Brown, moist, very loose to compact, consisting of mixed gravel, sand, silt and silty clay, with buried topsoil between 1.2 m and 1.9 m.		1	SPT	9				7 26 47 20 (66)
			2	SPT	2				
			3	SPT	11				7 57 26 10 (36)
239.42									
3.20	Silty CLAY TILL, CL Reddish brown, moist, hard, with embedded sand and gravel, occasional silt seams.		4	SPT	61				
			5	SPT	62				15 21 40 24 (64)
			6	SPT	100+				hit cobbles.
			7	SPT	40				
236.83									
5.79	End of Borehole.								Borehole dry and open @ completion.

PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100)
SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

ELEVATION SCALE: 242, 241, 240, 239, 238, 237

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 11B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941417, Easting - 212336 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

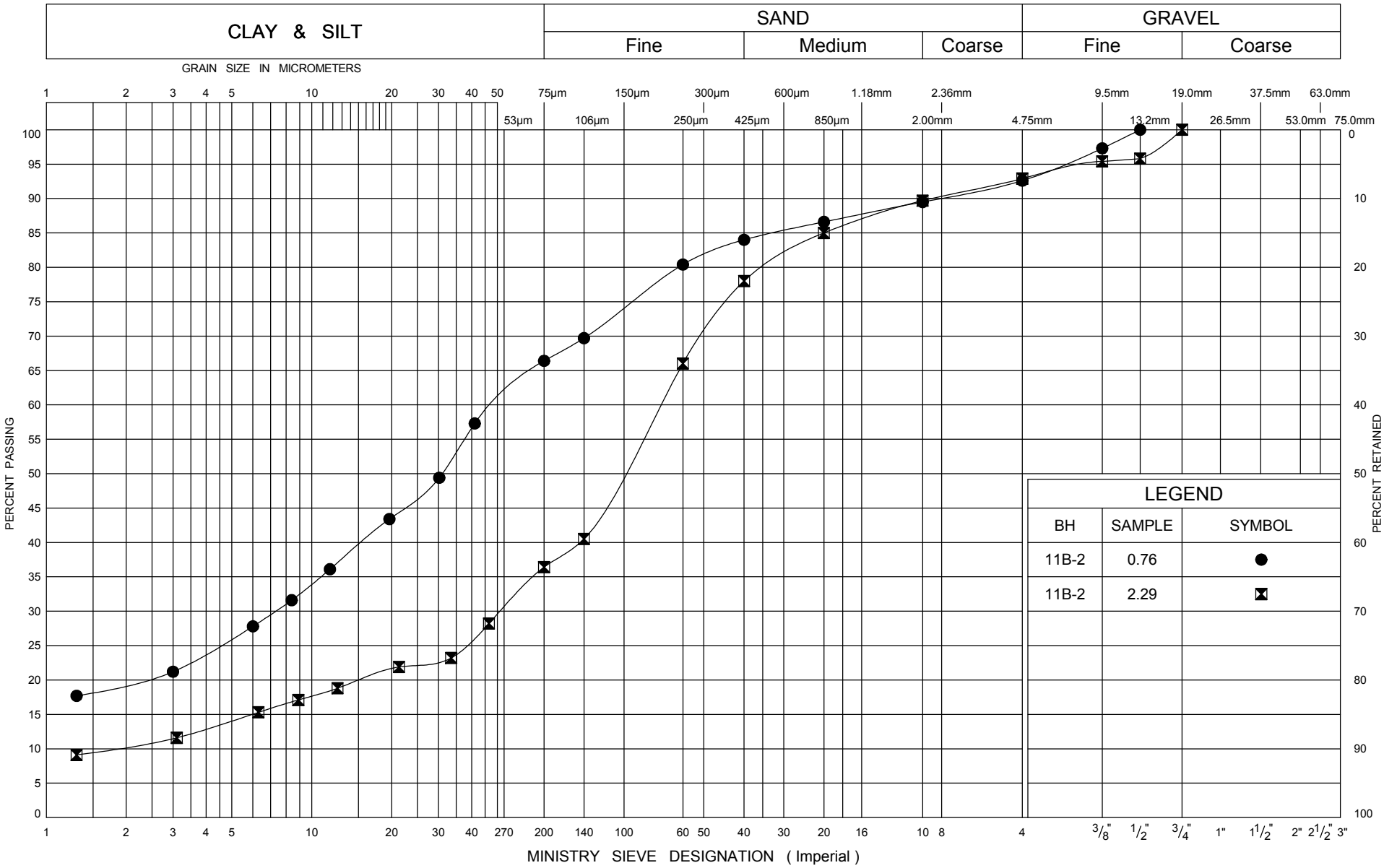
DATUM Geodetic DATE 27.8.07 - 27.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
241.17	Ground										
0.00	150 mm TOPSOIL.						241				
			1	SPT	100+						hit cobbles, no recovery.
							240				
			2	SPT	35						7 25 43 25 (68)
	Silty CLAY TILL, CL Reddish brown, moist, hard, with embedded sand and gravel, occasional silt seams.						239				
			3	SPT	42					22.6	
			4	SPT	44		238				
			5	SPT	53						
236.90							237				
4.27	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

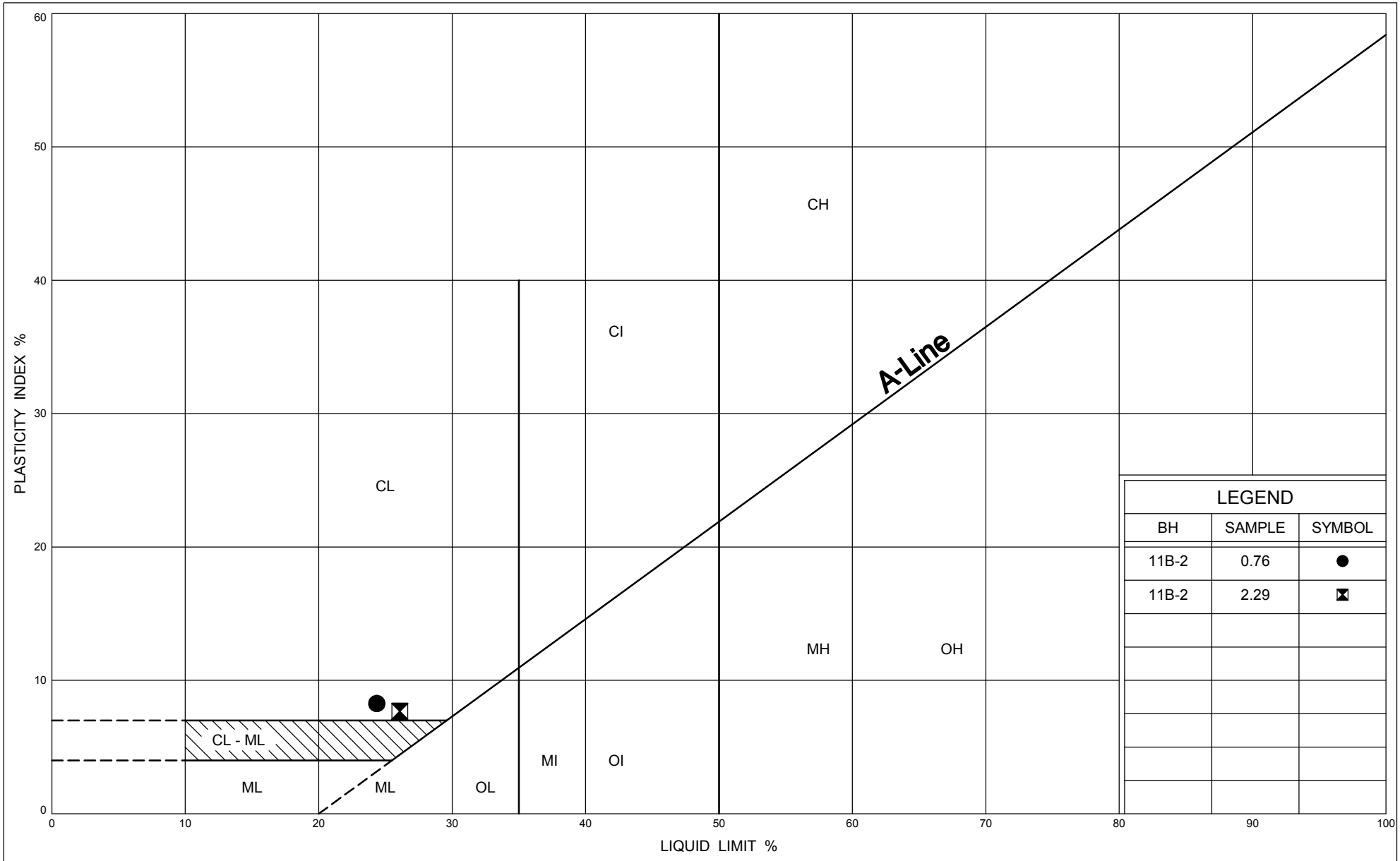
FILL

FIG No C- 11B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

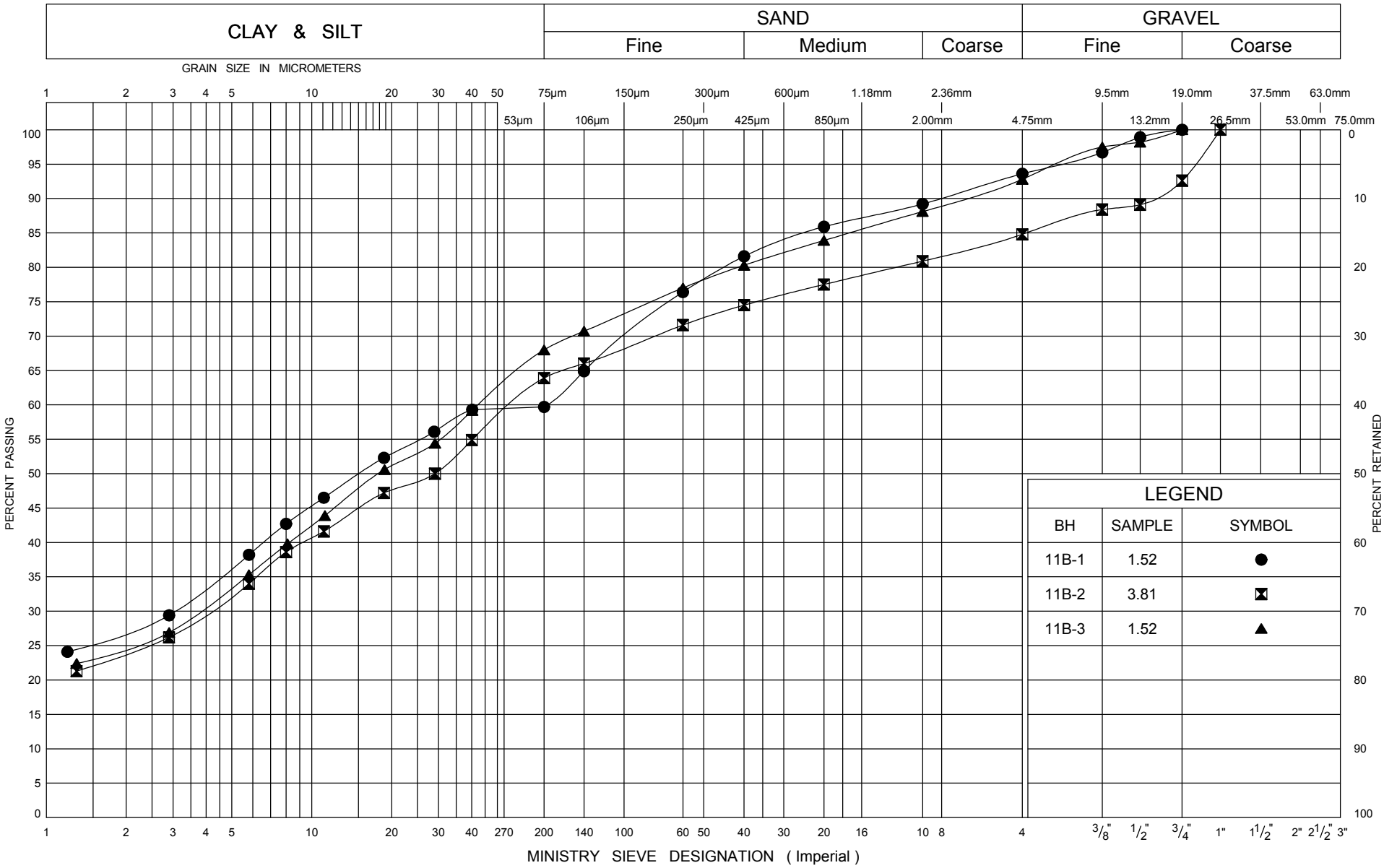
PLASTICITY CHART
FILL

FIG No C- 11B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

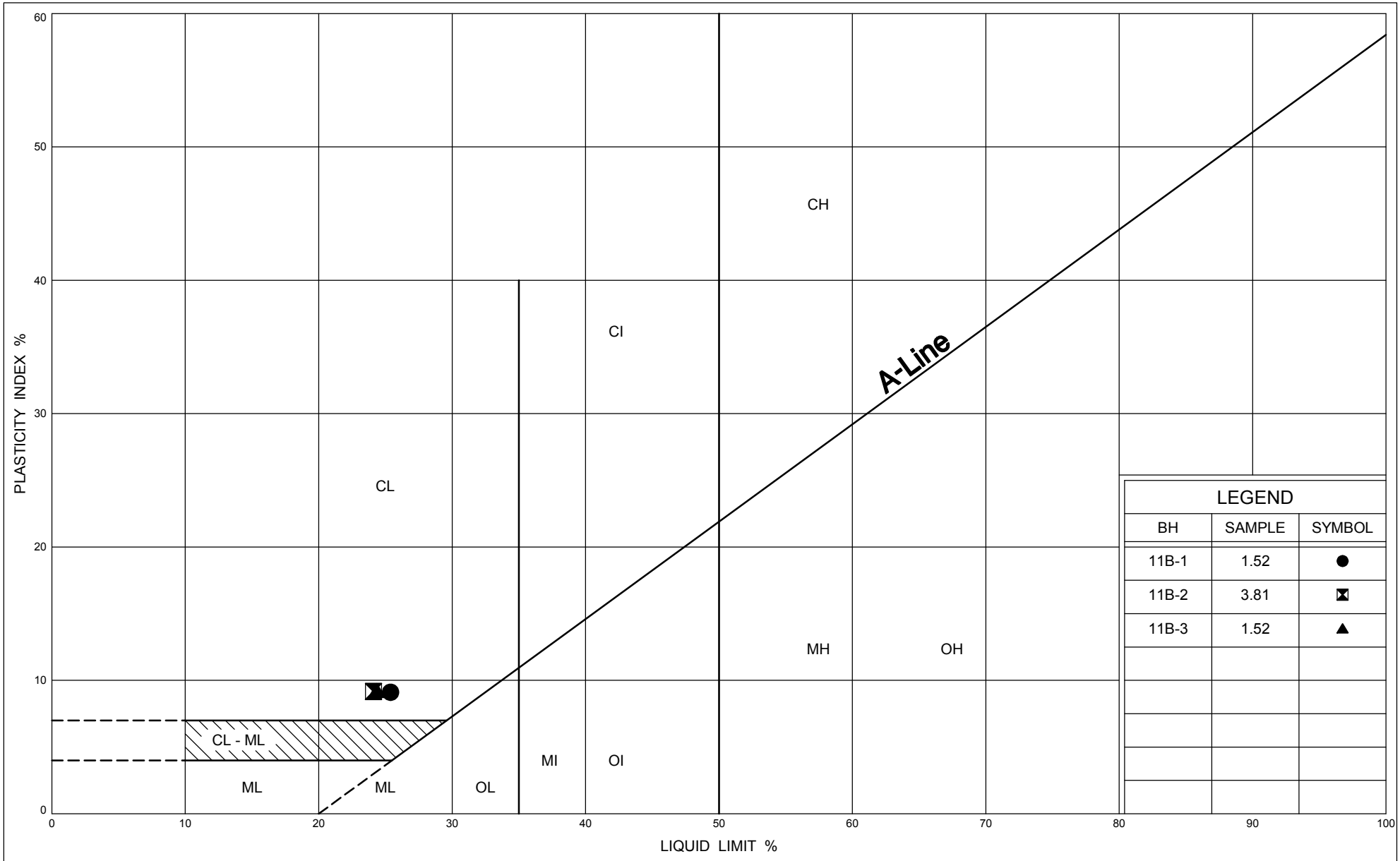
SILTY CLAY TILL, CL

FIG No C- 11B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

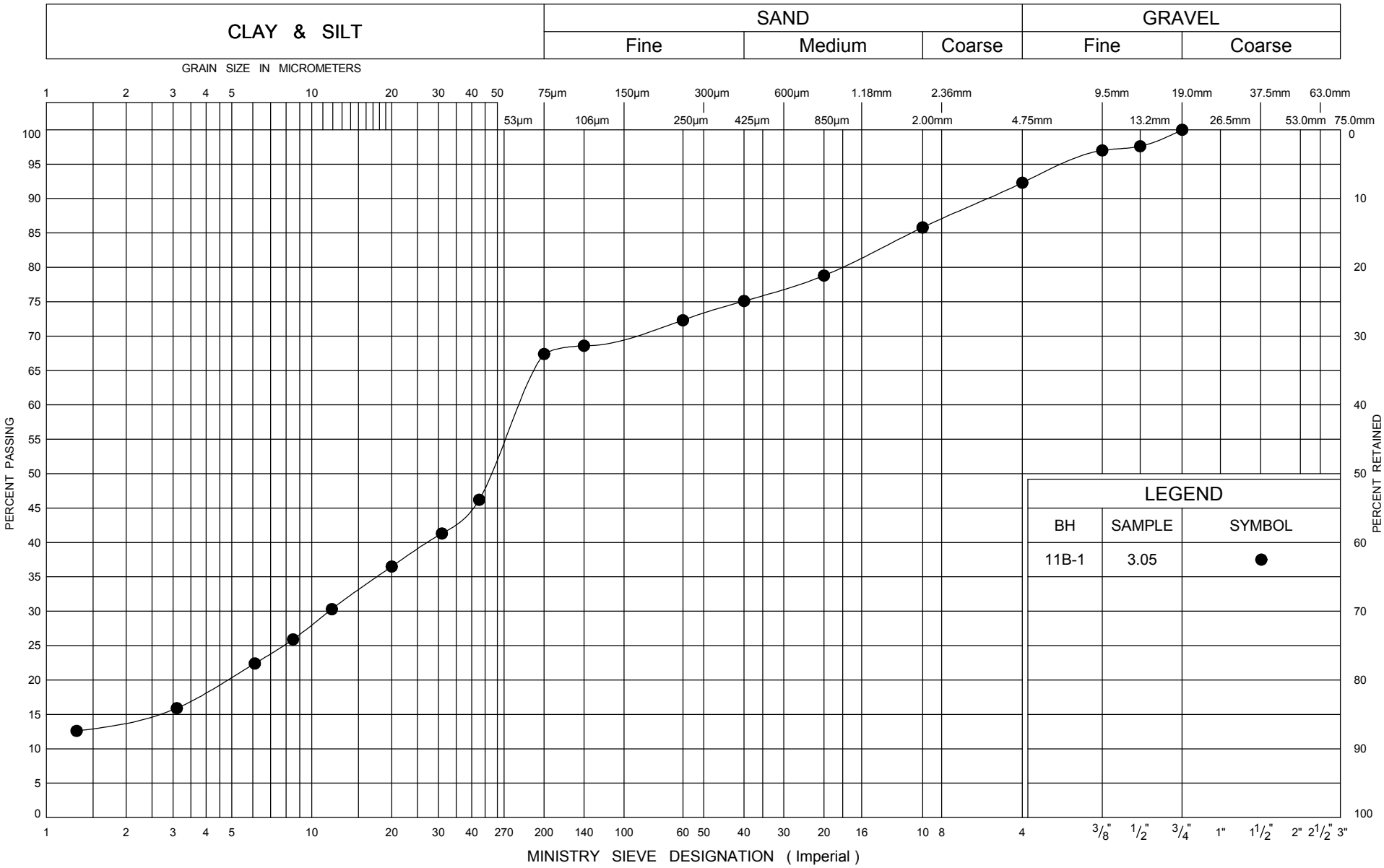
PLASTICITY CHART
SILTY CLAY TILL, CL

FIG No C- 11B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

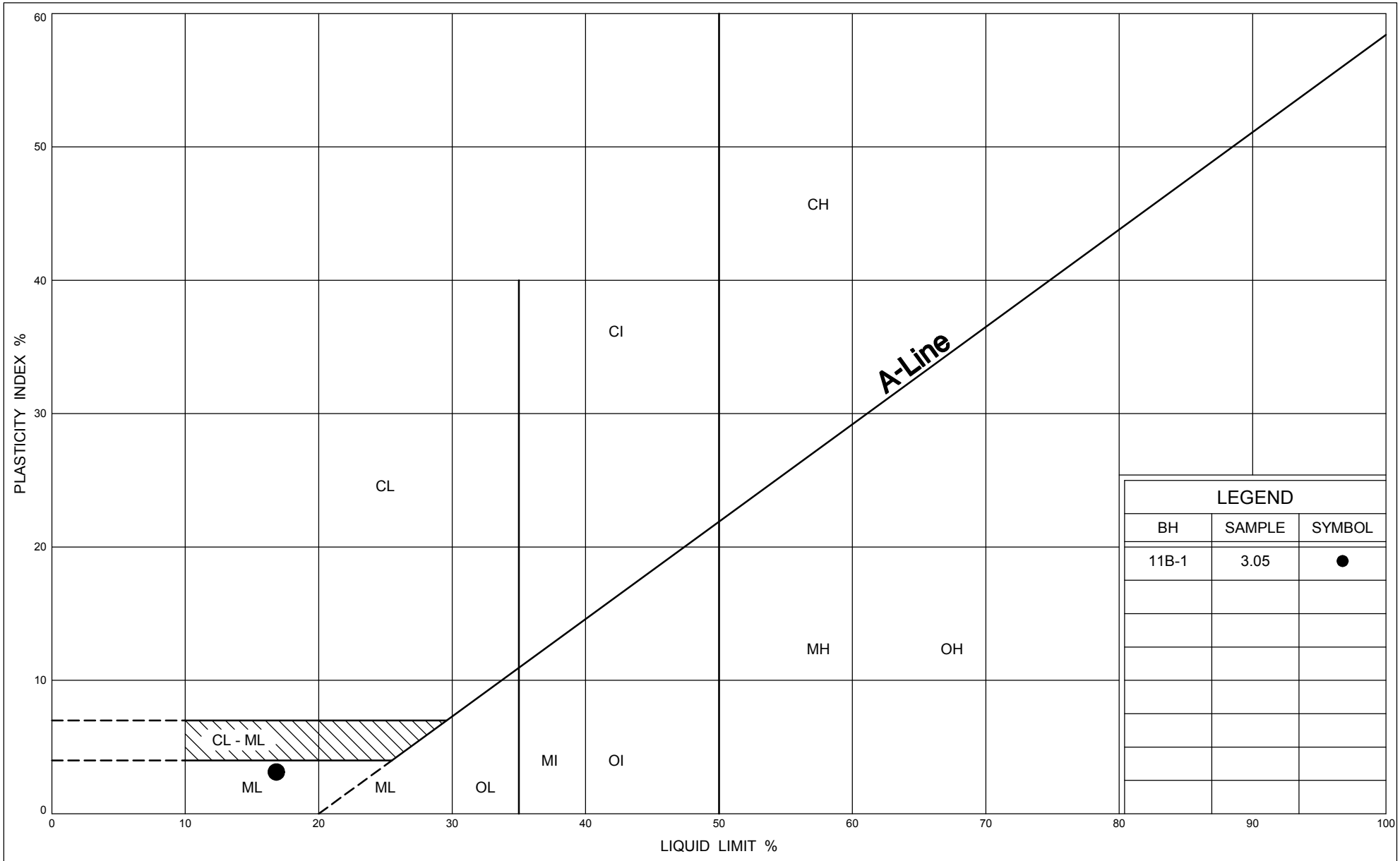
SILT LSEAMS, POCKETS AND LAYERS, ML

FIG No C- 11B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

SILT LSEAMS, POCKETS AND LAYERS, ML

FIG No C- 11B.6

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 12B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941390, Easting - 212402 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 27.8.07 - 27.8.07 CHECKED BY JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
239.92 Ground											
0.00	150 mm TOPSOIL.										
	SAND & SILT TILL, SM-ML Brown, wet to moist, loose to very dense, with embedded gravel, clayey silt layers.		1	SPT	5		239				18 55 18 9 (27)
			2	SPT	27	▽	238				Water level @ 1.83 m @ completion.
			3	SPT	51		237				22 45 26 7 (33)
			4	SPT	87						
			5	SPT	40		236				
235.65 4.27	End of Borehole.										

+ 3, × 3: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 12B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941402, Easting - 212394 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 15.8.07 - 15.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
242.43	Ground						
0.00	Granular FILL Brown, moist, compact.						242
241.42			1	SPT	24		
1.01	FILL Brown, moist, loose, consisting of mixed gravel, sand, silt, and silty clay.		2	SPT	6		241
			3	SPT	5		240
238.92			4	SPT	6		
3.51	SAND & SILT TILL, SM-ML Brown, wet to moist, compact to very dense, with embedded gravel, sand and gravel layer.		5	SPT	29		239
237.86						▽	
4.57	sand and gravel layer		6	SPT	100+		238
237.25							
5.18	End of Borehole.						

PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100)
SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	3	36	40	21 (61)
	9	64	19	8 (27)
Water level @ 4.57 m.				
Auger refusal @ 5.18 m @ completion.				

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 12B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941429, Easting - 212385 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

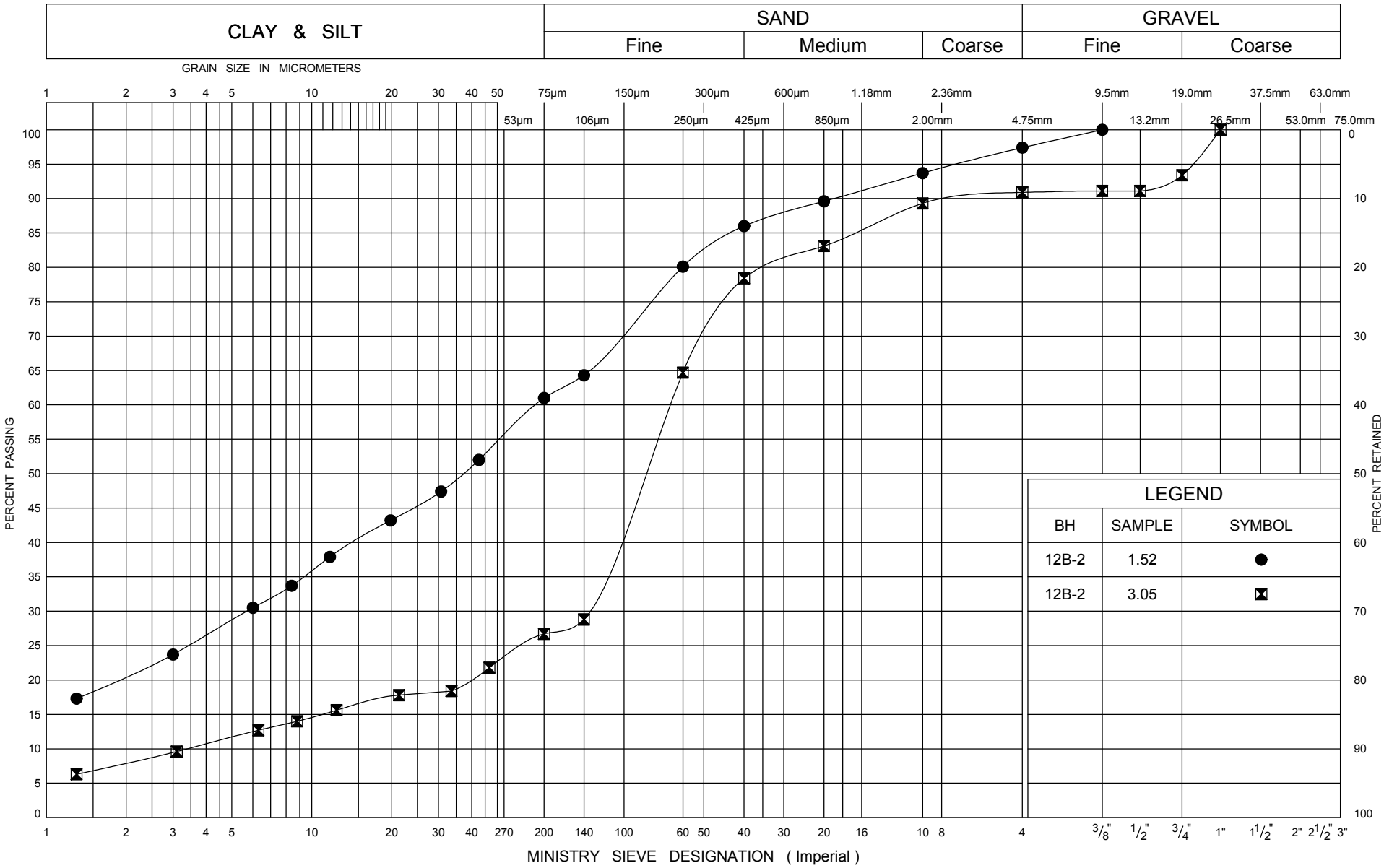
DATUM Geodetic DATE 27.8.07 - 27.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
240.32	Ground										
0.00	75 mm TOPSOIL.						240				
			1	SPT	17						
							239				
			2	SPT	29						6 41 39 13 (53)
	SAND & SILT TILL, SM-ML Brown, wet to moist, compact to very dense, with embedded gravel, clayey silt layers.										
			3	SPT	80+		238			20.1	
						▽					
			4	SPT	100+						Water level @ 3.05 m @ completion.
							237				
			5	SPT	100+						15 31 48 6 (54)
236.05											
4.27	End of Borehole.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

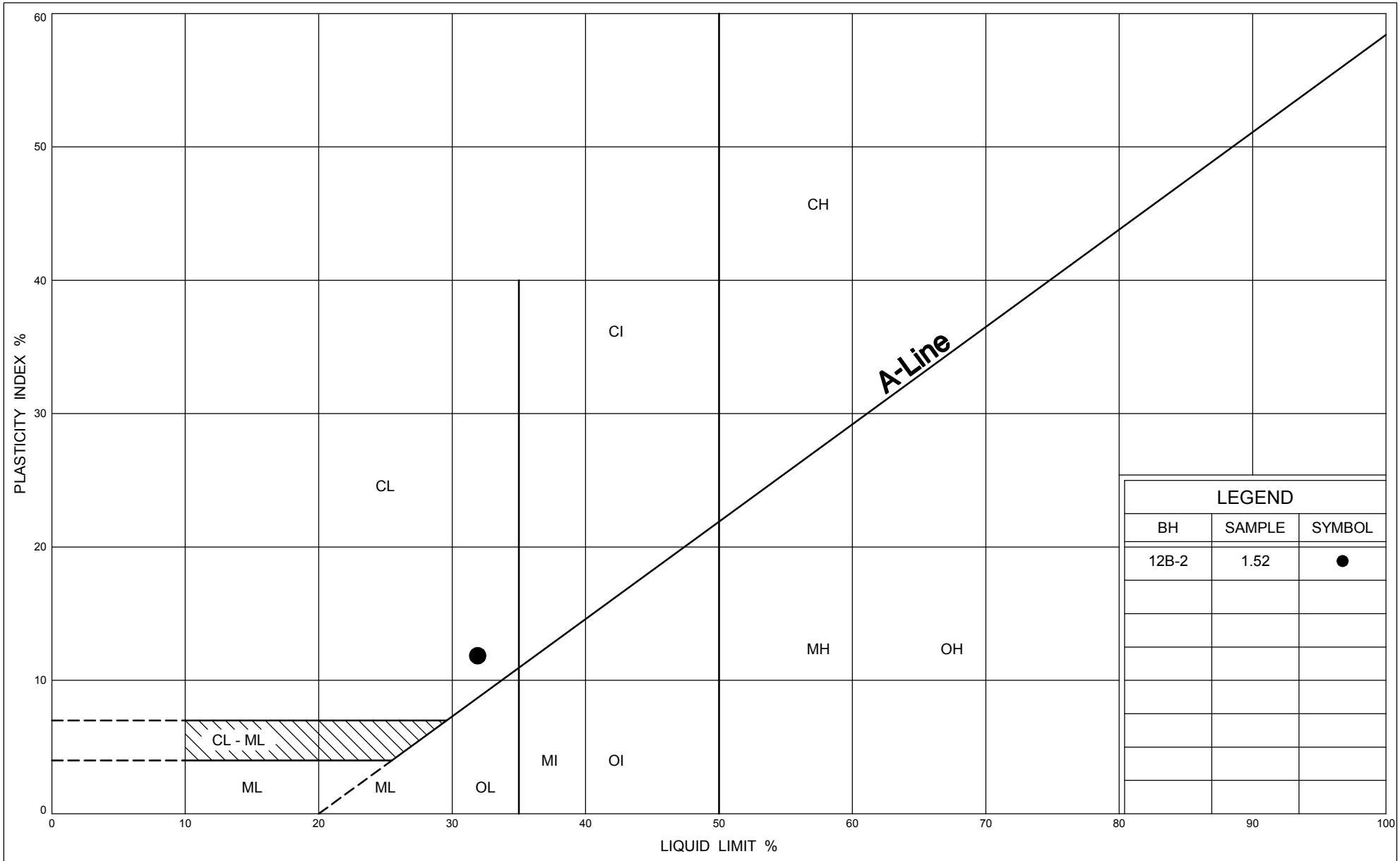
GRAIN SIZE DISTRIBUTION

FILL

FIG No C- 12B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

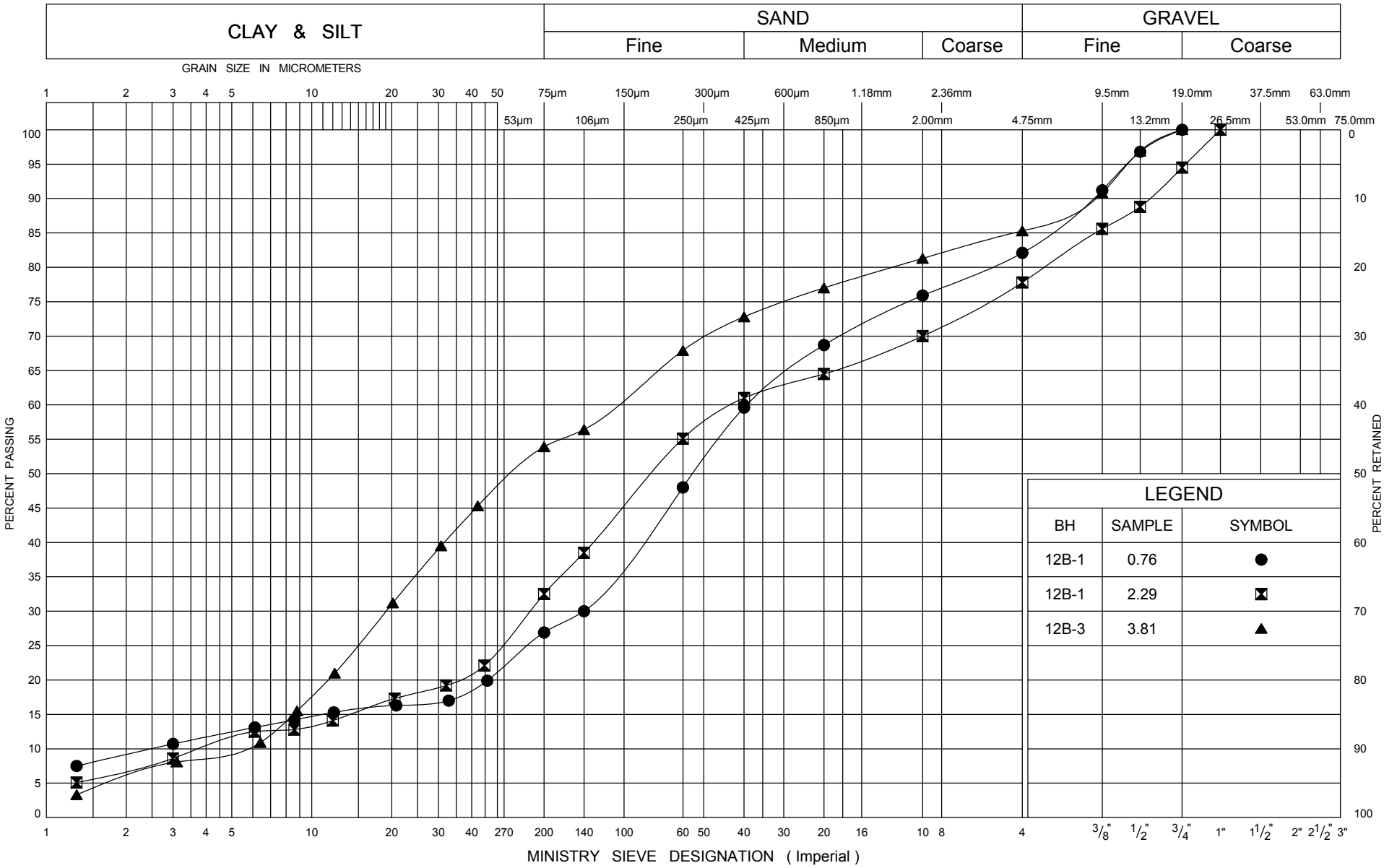
PLASTICITY CHART
FILL

FIG No C- 12B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

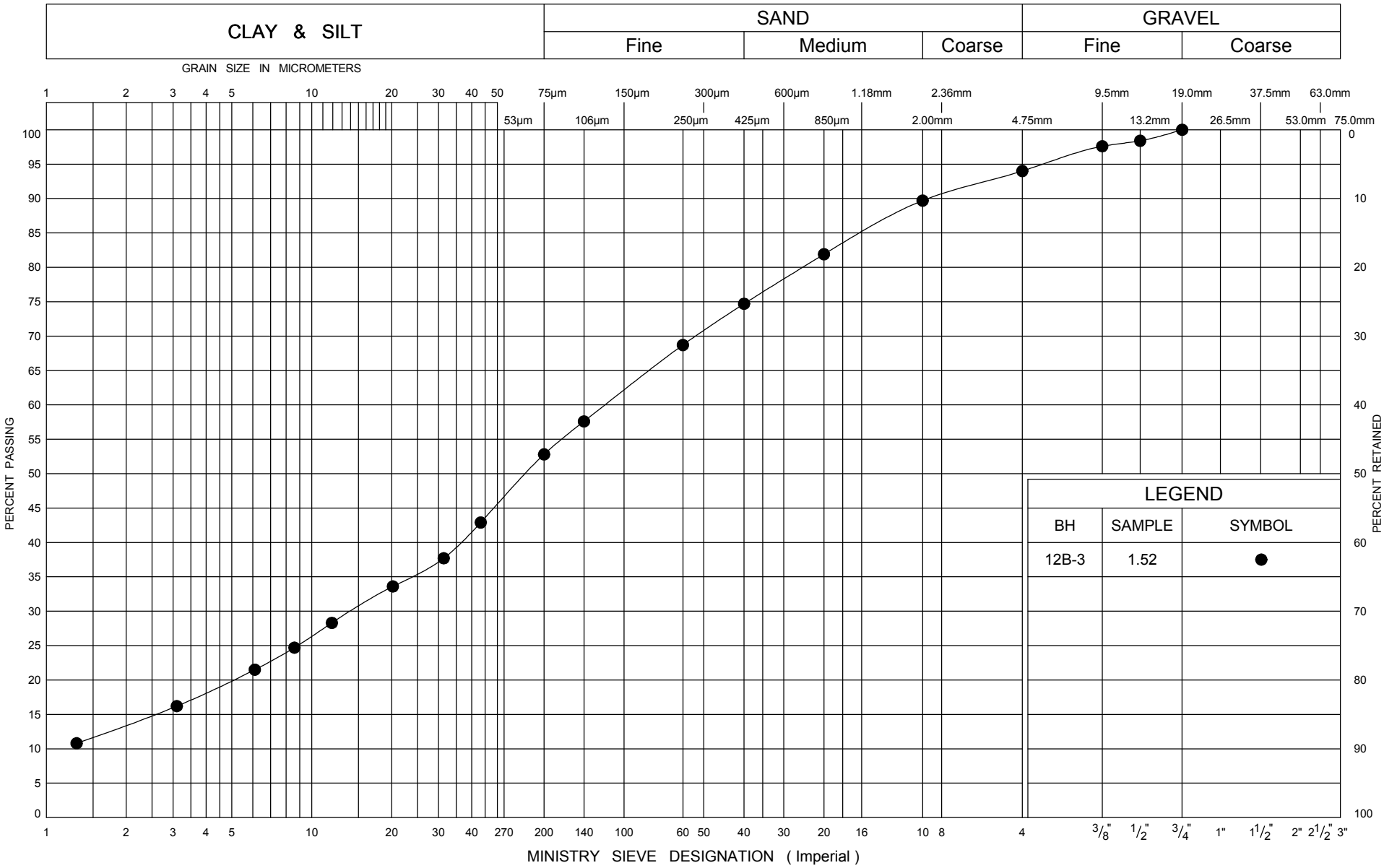
SAND AND SILT TILL, SM-ML

FIG No C- 12B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

CLAYEY SILT LAYERS, CL-ML

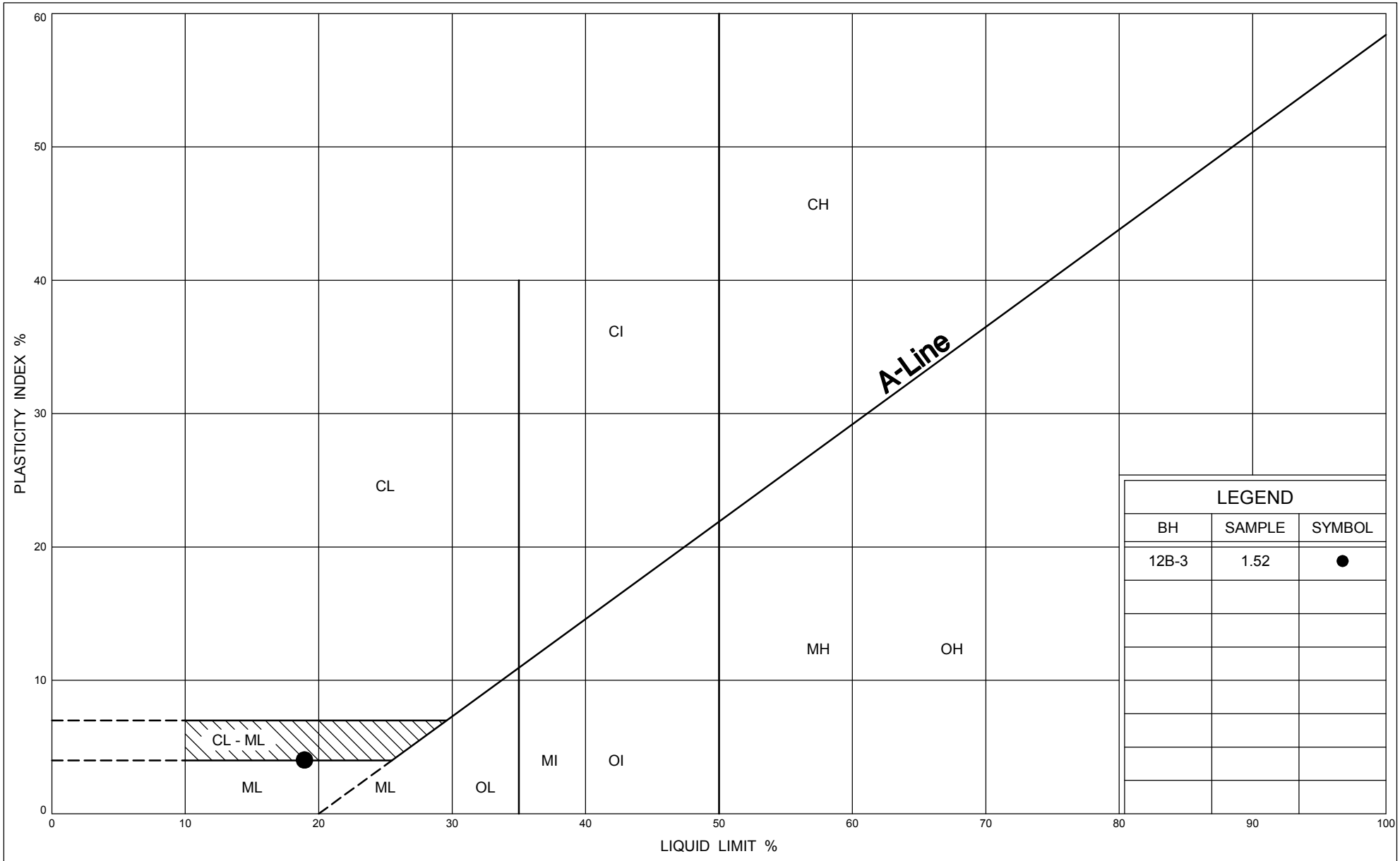
FIG No C- 12B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

ONTARIO MOT GRAIN SIZE SMALL CULVERTS 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT LAYERS, CL-ML

FIG No C- 12B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 13B-1

1 OF 1 **METRIC**

W.P. GWP 167-91-00 LOCATION Northing - 4941498, Easting - 212775 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 23.8.07 - 23.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
235.21	Ground										
0.00	150 mm TOPSOIL.						235				
			1	SPT	11			175			13 30 36 22 (57)
							234				
			2	SPT	22						
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, moist, stiff to hard, with embedded sand and gravel.						233				hit cobbles
			3	SPT	+100						
			4	SPT	35		232				5 23 51 21 (72)
			5	SPT	39					23.0	
230.94							231				
4.27	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 13B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941510, Easting - 212769 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.51	Ground										
0.00	150 mm Granular FILL						238				
			1	SPT	19						20 33 35 12 (47)
	FILL Brown to black, moist, very loose to compact, consisting of mixed gravel, sand, silt, clay and organics.		2	SPT	13		237				
			3	SPT	7		236				
			4	SPT	3						25 33 30 11 (42)
234.85							235				
3.66			5	SPT	6			62.5			18 33 28 21 (49)
			6	SPT	5		234	50			25 35 27 13 (40)
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, wet to moist, firm to hard, with embedded sand and gravel.		7	SPT	35		233		225+		12 21 48 19 (67)
			8	SPT	35		232		225+		
			9	SPT	36				225+	17.2	10 27 45 18 (64)
230.43			10	SPT	24		231		225+	23.6	
8.08	End of Borehole.										Borehole dry and open @ completion.

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

○ ^{150} UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 13B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941536, Easting - 212766 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 27.8.07 - 27.8.07 CHECKED BY JL

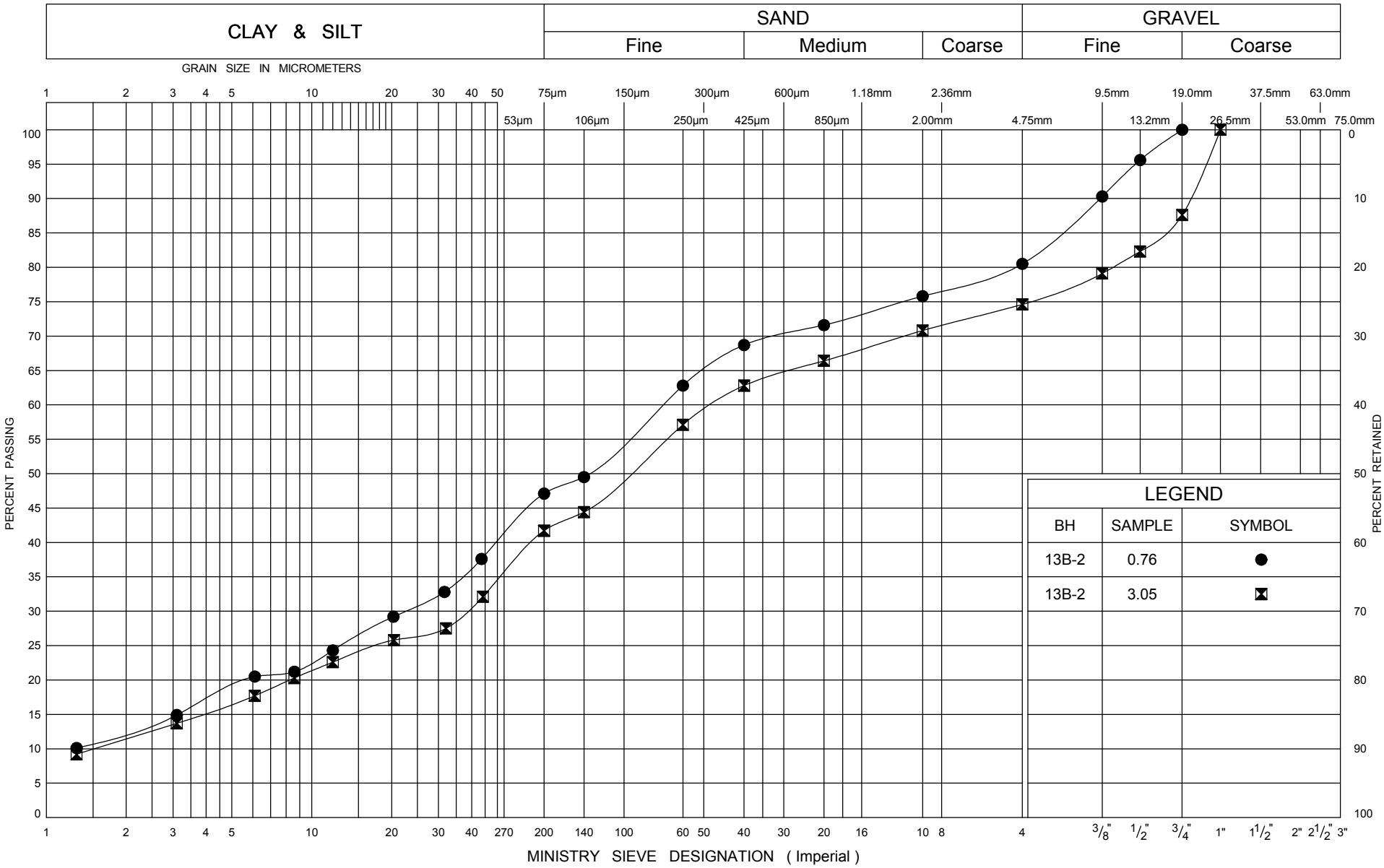
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
235.51	Ground										
0.00 / 235.05	75 mm TOPSOIL. Sandy SILT, ML Dark brown, moist, some gravel.										
0.46	Silty SAND & GRAVEL, SM-GM Brown, moist, very dense.		1	SPT	100+		235				
			2	SPT	68		234				36 43 (21)
233.07			3	SPT	100+		233				sampler tip wet at 2.6 m.
2.44	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, moist, hard, with embedded sand and gravel.		4	SPT	100+			sample not sufficient for grainsize			Sampler refusal @ 3.35 m.
232.00											
3.51	End of Borehole.										Borehole dry and open @ completion.

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

○ ^{150} UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

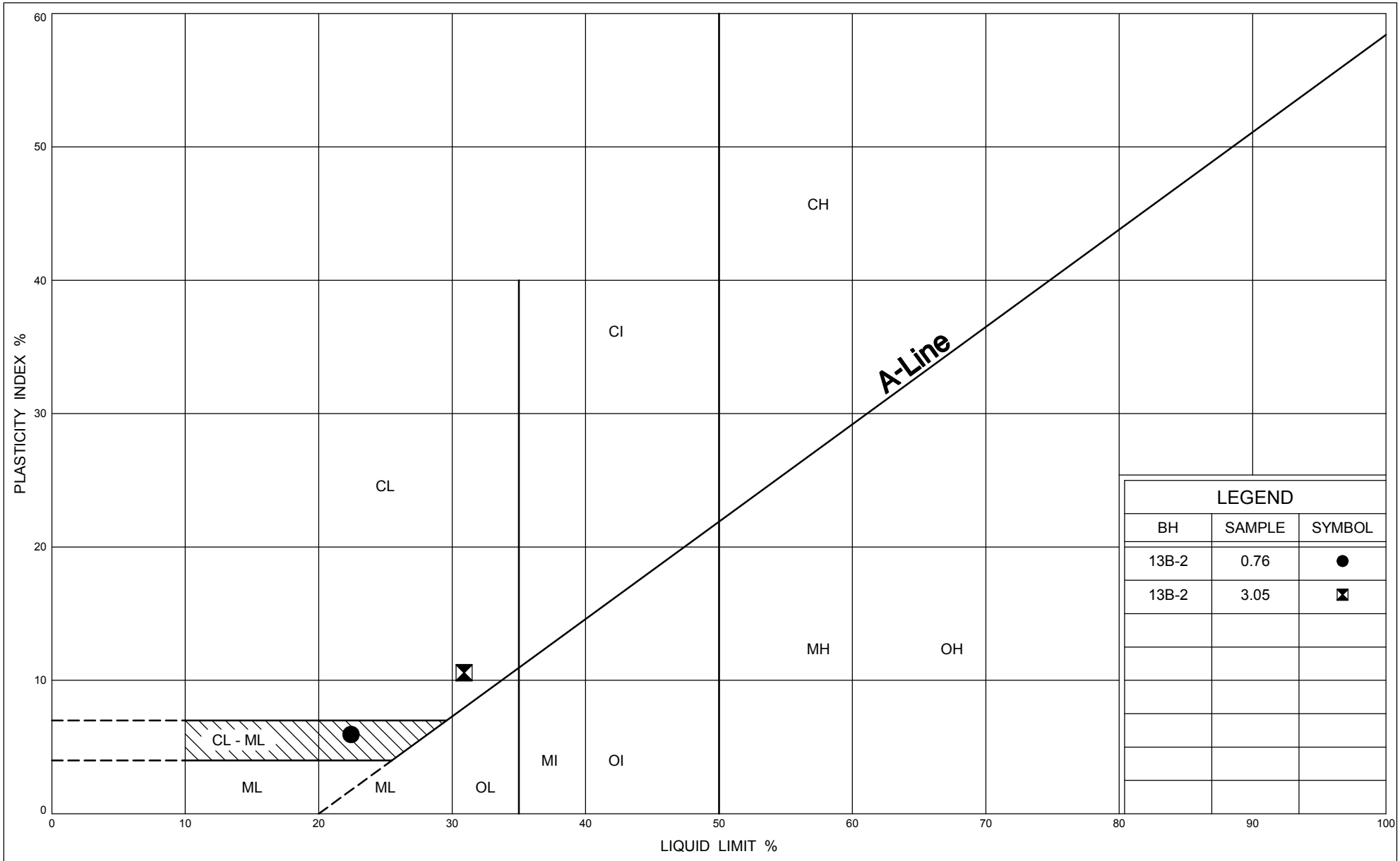
FILL

FIG No C- 13B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

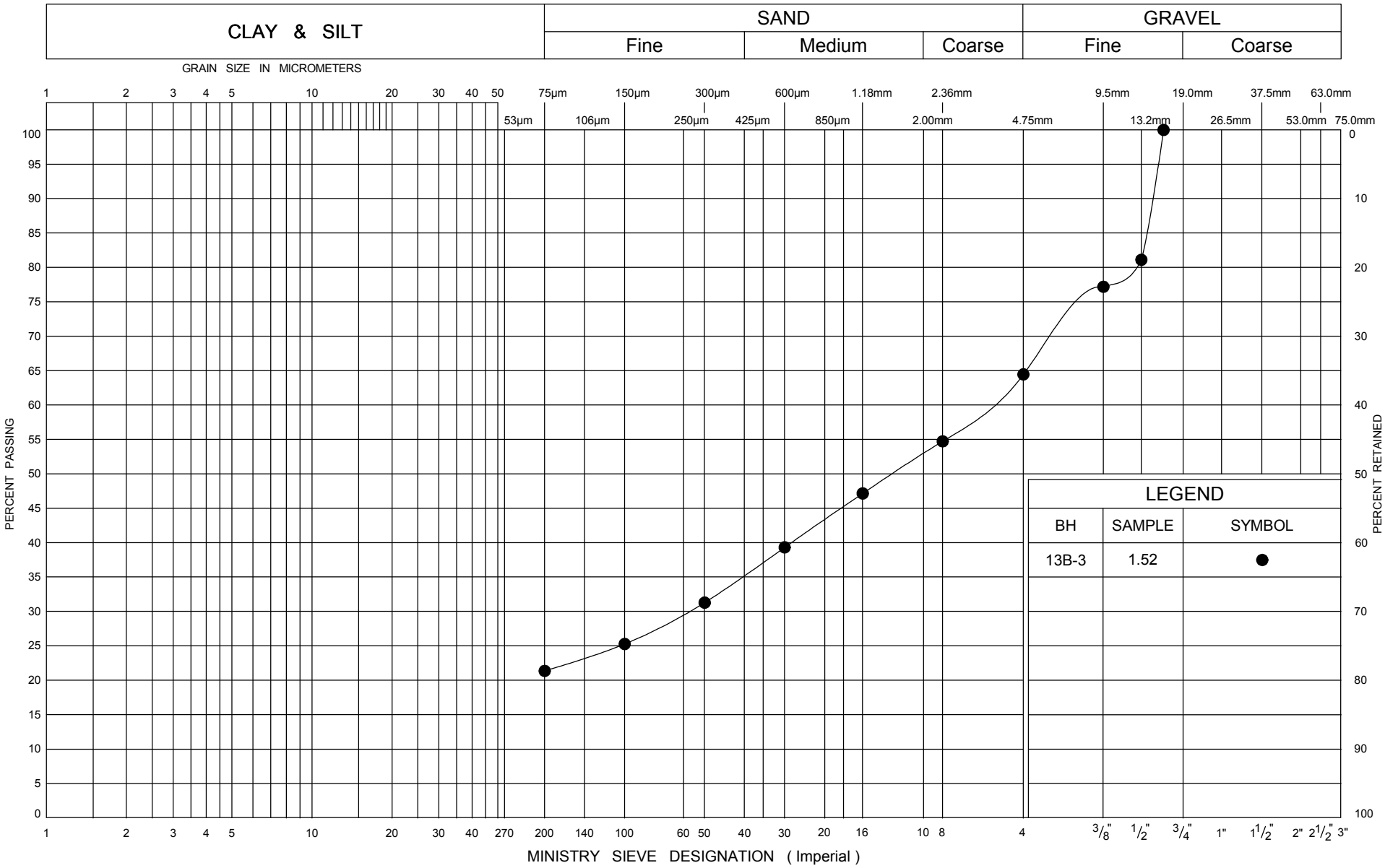
PLASTICITY CHART
FILL

FIG No C- 13B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

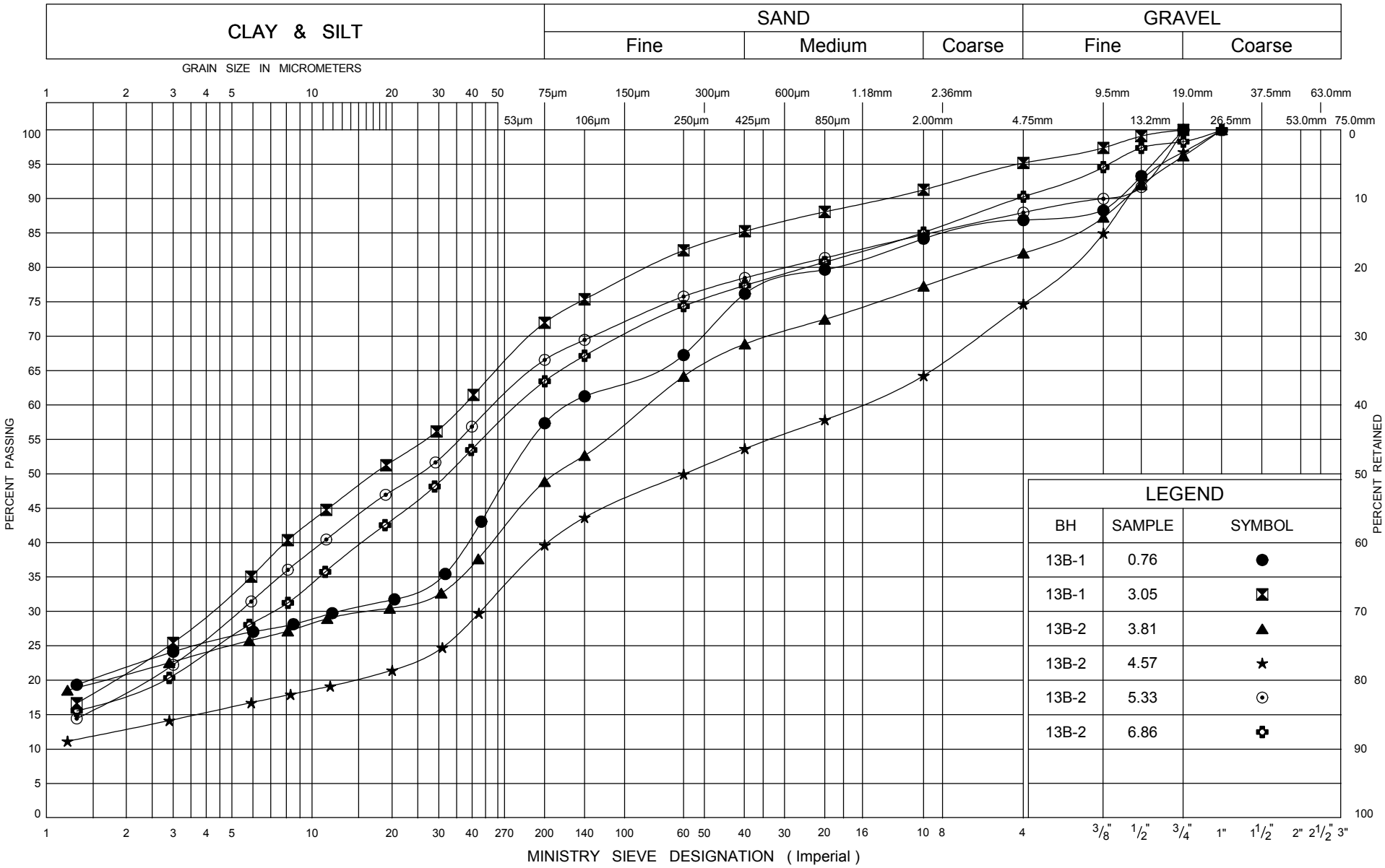
SILTY SAND AND GRAVEL. SM-GM

FIG No C- 13B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

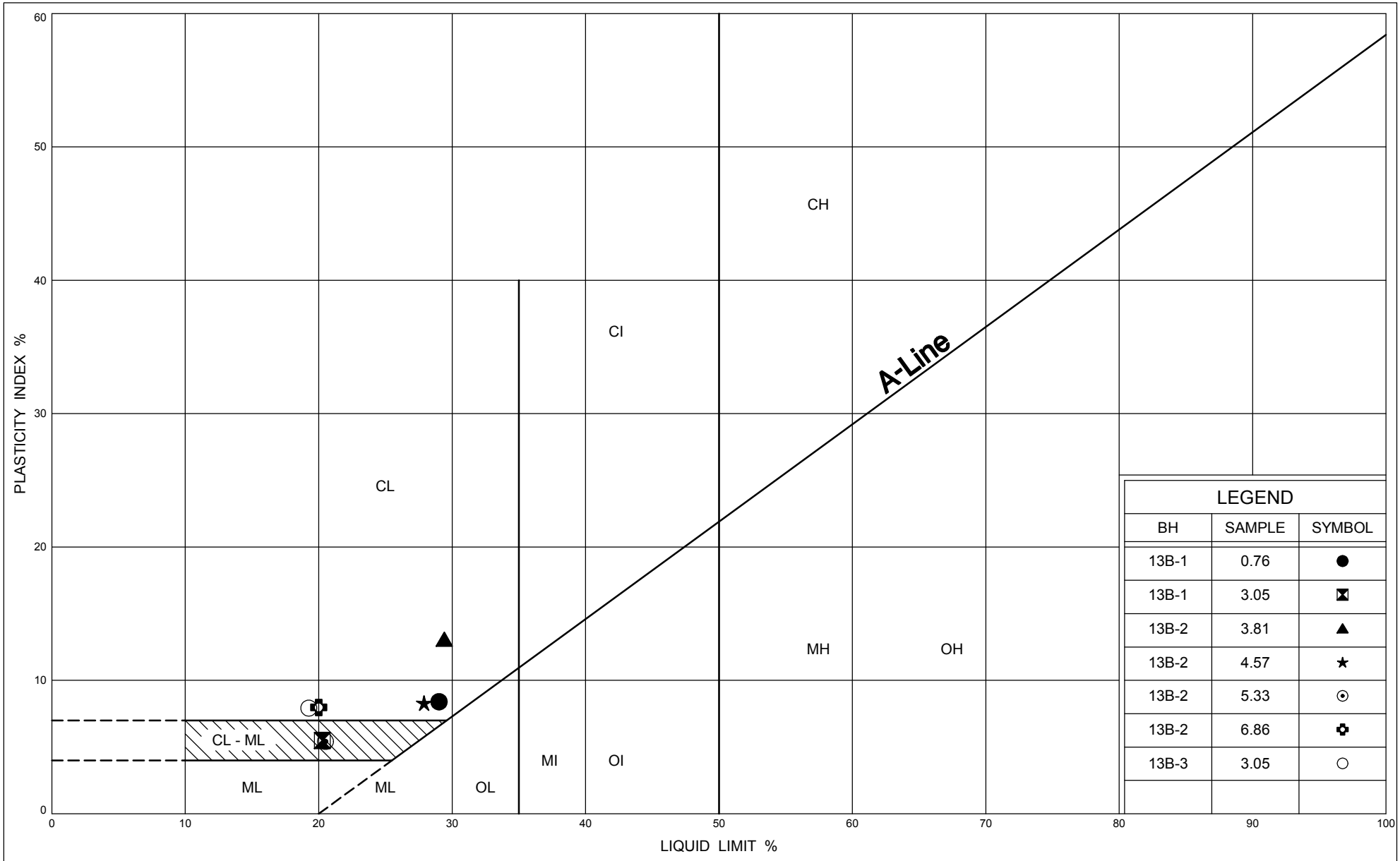
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 13B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT TO SILTY CLAY, CL-ML TO CL

FIG No C- 13B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 14B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941515, Easting - 212833 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 22.8.07 - 22.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
235.35	Ground							
0.00	150 mm TOPSOIL.							
	FILL Dark brown, moist, loose to compact, consisting of mixed gravel, sand, silt and silty clay.		1	SPT	22			
			2	SPT	5			
233.22								
2.13	SAND & GRAVEL, SW-GW Reddish brown, wet to saturated, dense to very dense, some silt.		3	SPT	49	▽		41 44 12 3 (15)
			4	SPT	100+			Water level measured @ 3.07 m @ completion.
231.54								
3.81	Clayey SILTTILL, CL-ML Reddish brown, moist, very stiff to hard, with embedded sand and gravel.		5	SPT	28			11 25 47 17 (64)
			6	SPT	31		23.0	
230.32								
5.03	End of Borehole.							

ELEVATION SCALE: 235, 234, 233, 232, 231

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

225+
187.5

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%)
10 20 30

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 14B-2

1 OF 1 **METRIC**

W.P. GWP 167-91-00 LOCATION Northing - 4941525, Easting - 212822 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.78 / 0.00	Ground					
237.48 / 0.30	300 mm Granular FILL.					
	FILL Brown, moist to wet, loose to compact, consisting mainly of silty sand to sandy silt, some gravel (up to 40 mm size).	1	SPT	16		
		2	SPT	26		46 30 19 5 (24)
		3	SPT	8		
234.43 / 3.35		4	SPT	7		
	clay pockets					
233.82 / 3.96		5	SPT	32		33 42 15 9 (25)
	SAND & GRAVEL, SW-GW Brown, moist to saturated, dense to very dense, some silt, with clay pockets.	6	SPT	80		
		7	SPT	43		Water level measured @ 5.18 m @ completion.
231.68 / 6.10	Clayey SILT TILL, CL-ML Reddish brown, moist, very stiff, with embedded sand and gravel.	8	SPT	20	20.7	
231.23 / 6.55	End of Borehole.					

GROUND WATER CONDITIONS: ▽

ELEVATION SCALE: 237, 236, 235, 234, 233, 232

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

175

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 14B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941552, Easting - 212817 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 27.8.07 - 27.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
235.13	Ground						
0.00	150 mm TOPSOIL.						235
	Gravelly Silty SAND TILL, SM Reddish brown, moist, very dense, clayey pockets.		1	SPT	64		234
233.61							
1.52			2	SPT	33		233
	SAND & GRAVEL, SW-GW Brown, moist to saturated, dense to very dense, some silt.		3	SPT	62	▽	
			4	SPT	40		232
231.32							
3.81	Clayey SILT to TILL, CL-ML Reddish brown, moist, hard, with embedded sand and gravel.		5	SPT	44		231
230.86							
4.27	End of Borehole.						

PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

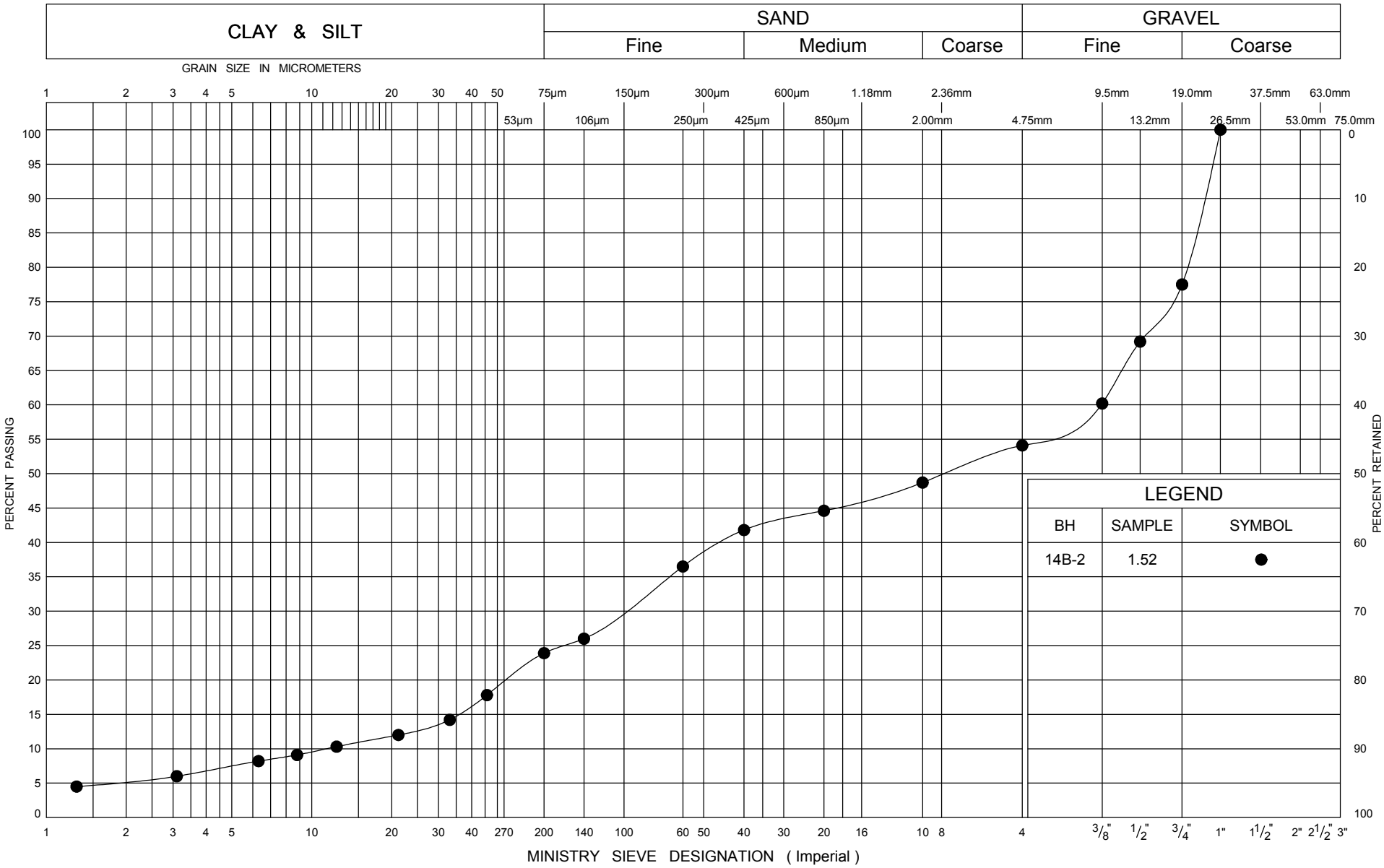
UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
20 37 20 23 sample not sufficient for Atterberg limits (44)				
Water level measured @ 2.74 m @ completion.				
(59)	16	25	44	15

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

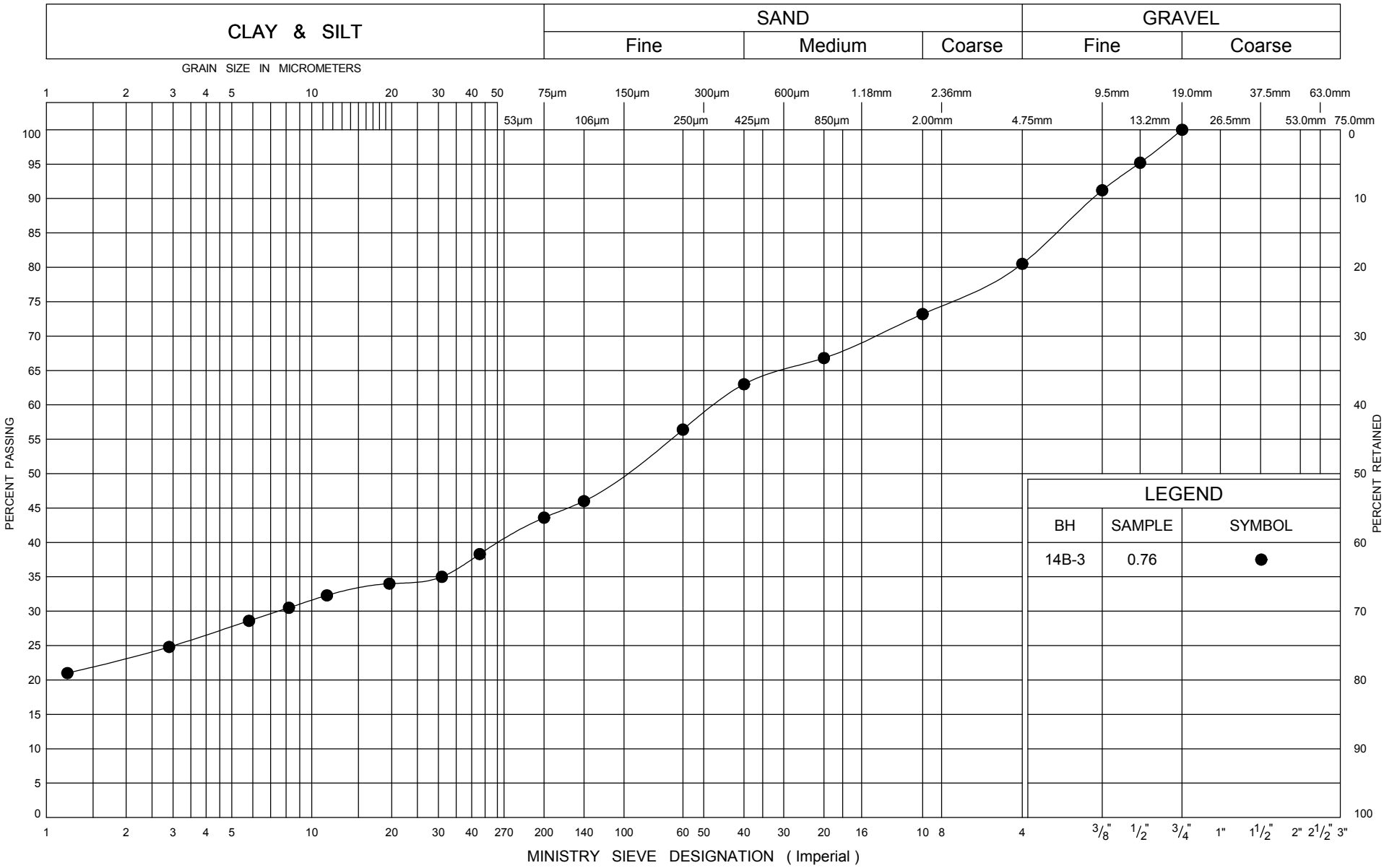
FILL

FIG No C- 14B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

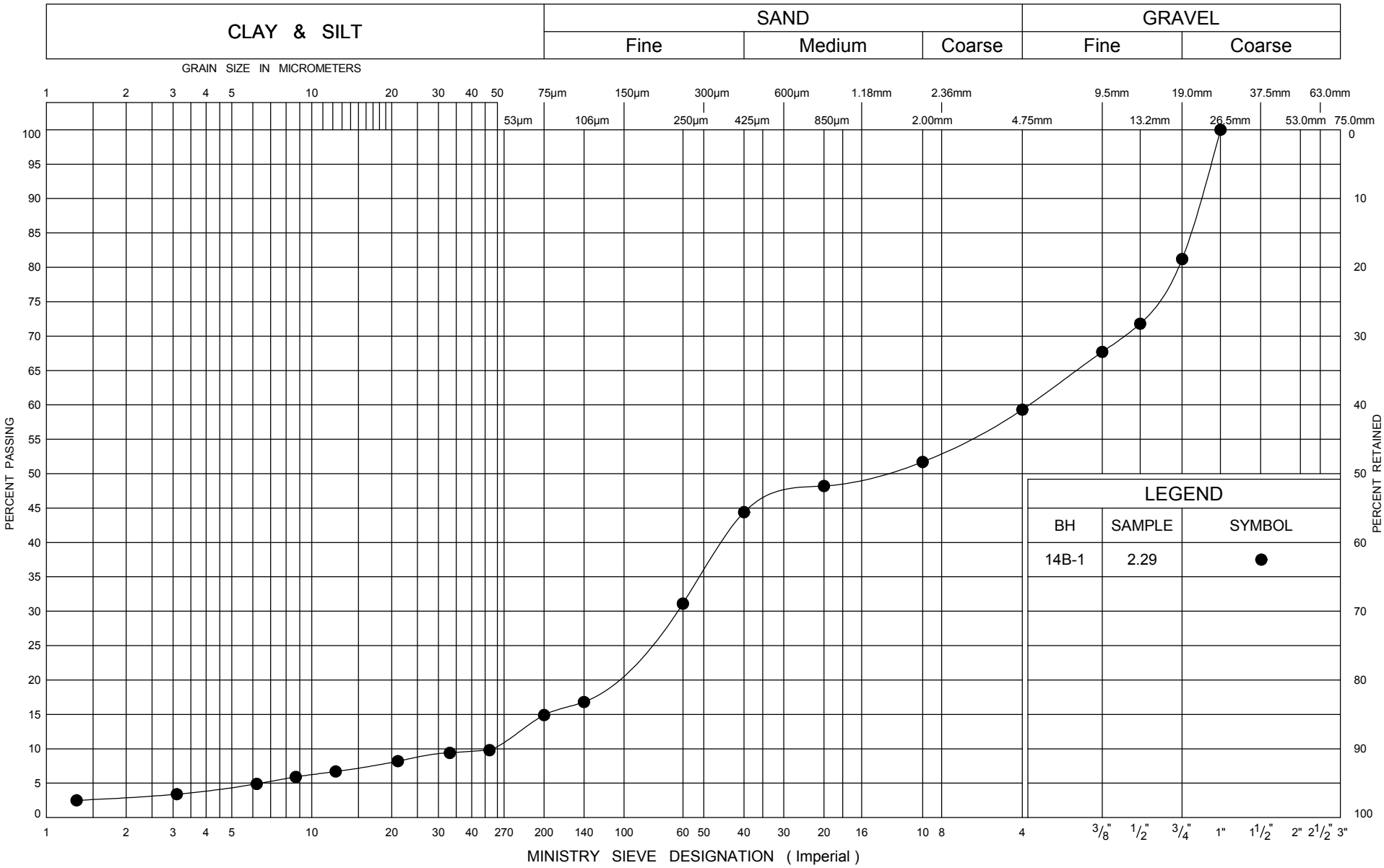
GRAVELLY SILTY SAND TILL, SM

FIG No C- 14B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

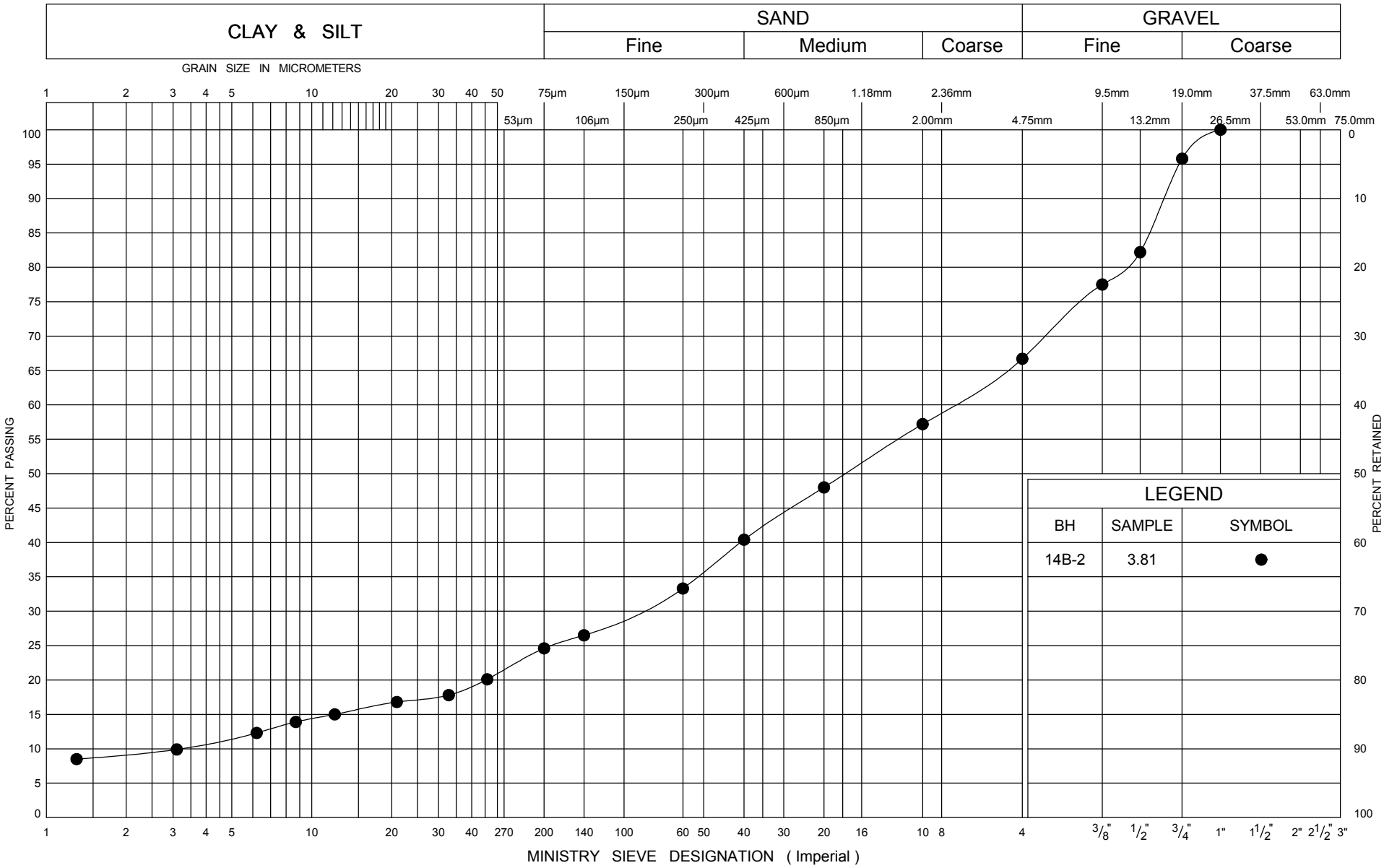
SAND & GRAVEL, SW-GW

FIG No C- 14B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

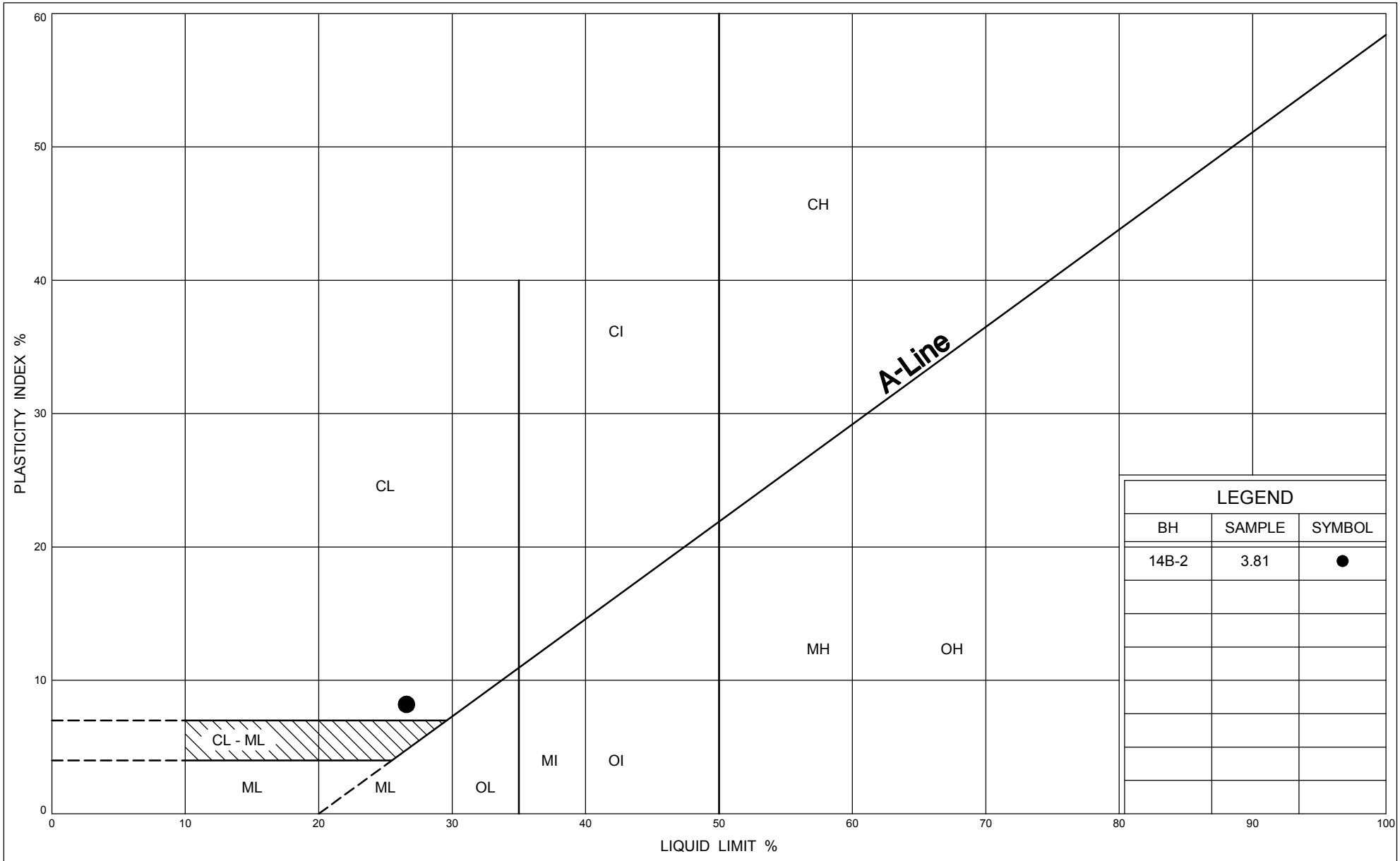
CLAY POCKETS WITHIN SAND AND GRAVEL, CL

FIG No C- 14B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 6/12/09

Ministry of Transportation
Ontario

PLASTICITY CHART

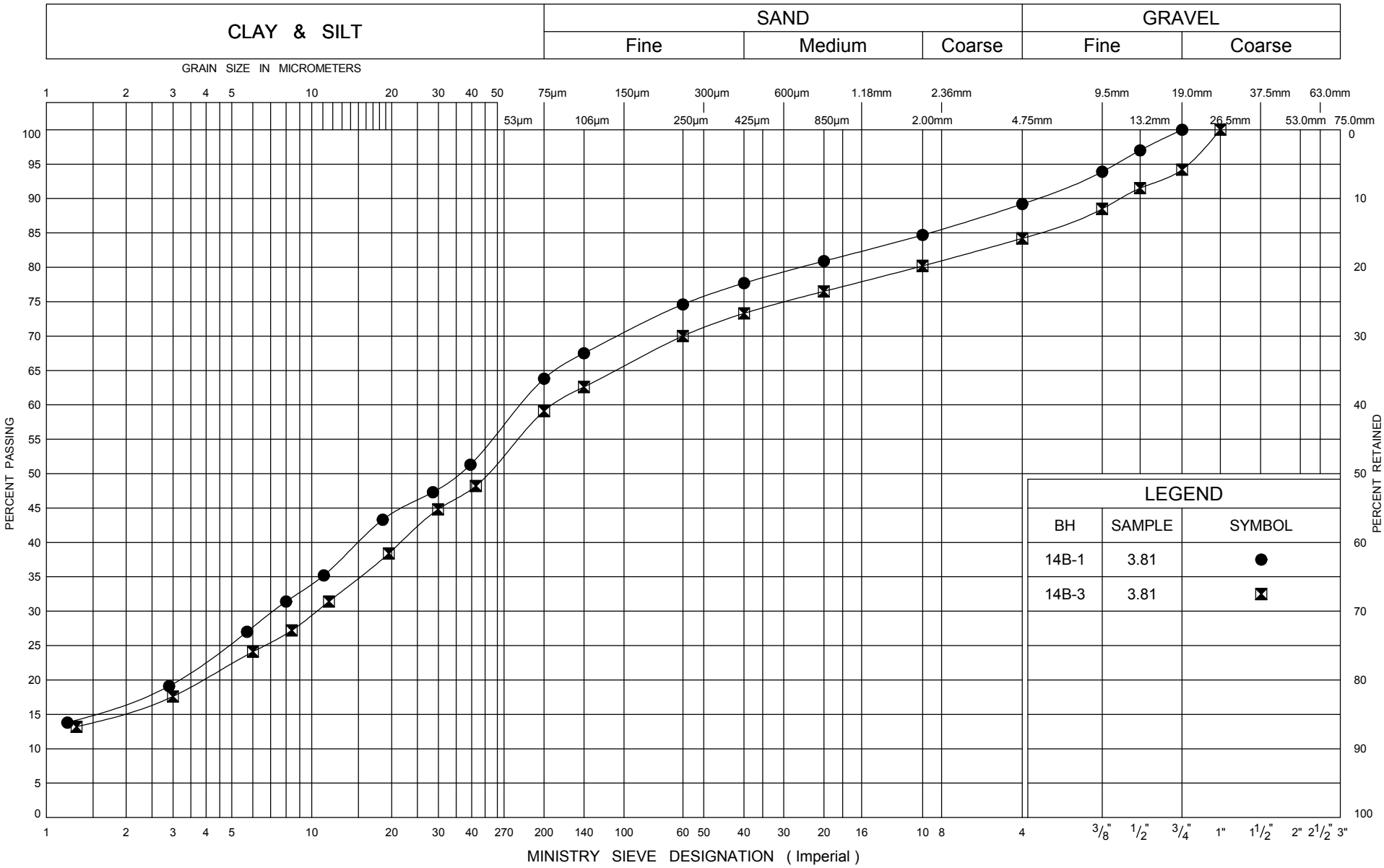
CLAY POCKETS WITHIN SAND AND GRAVEL, CL

FIG No C- 14B.5

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

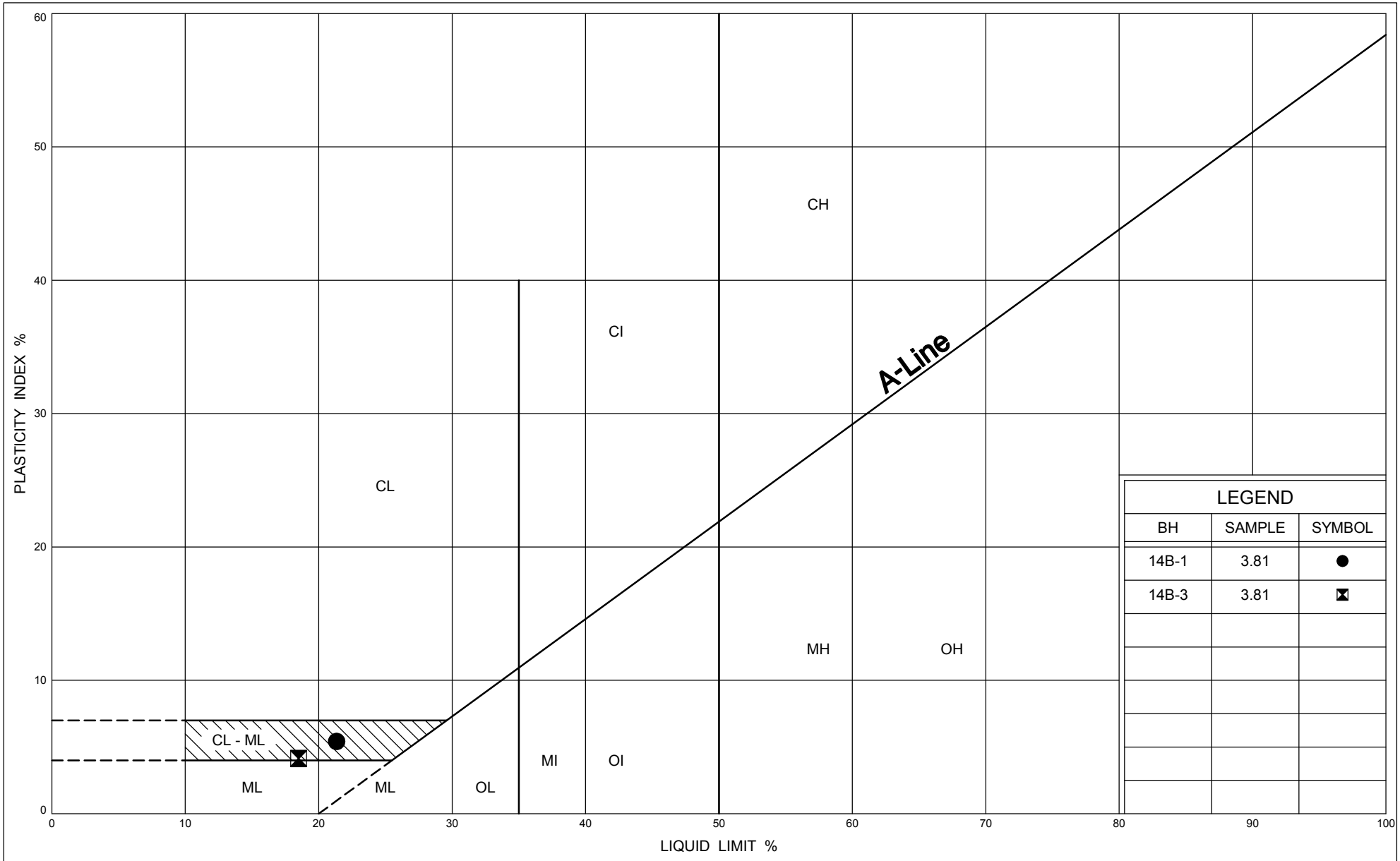
CLAYEY SILT TILL, CL-ML

FIG No C- 14B.6

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 19/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT TILL, CL-ML

FIG No C- 14B.7

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 15B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941843, Easting - 213989 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.03	Ground										
0.00	150 mm TOPSOIL.										
	gravel layer		1	SPT	48		221				49 41 (10)
220.81											
1.22			2	SPT	20	▽	220				Water level measured @ 1.78 m @ completion.
	SAND, SP Dark brown to brown, moist to saturated, dense to compact, trace to some gravel, with occasional gravel and gravelly layers.		3	SPT	11						2 90 (9)
			4	SPT	15		219				0 91 (9)
	gravelly layer		5	SPT	22		218				20 68 (12)
217.76											
4.27	End of Borehole.										

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 15B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941866, Easting - 213984 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE; SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.78	Ground										
0.00	FILL Light brown, moist to saturated, loose to compact consisting of sand to sand and gravel, trace to some silt.		1	SPT	11		222				53 35 (12)
			2	SPT	5	▽	221				Water level @ 1.83 m.
			3	SPT	9		220				
			4	SPT	6						1 88 9 2 (11)
219.12							219				
3.66	SAND, SP Brown and grey, saturated to moist, compact, trace to some silt, trace gravel.		5	SPT	15						
			6	SPT	23		218				8 78 12 2 (14)
			7	SPT	11		217				
216.38			8	SPT	17						0 23 69 8 (77)
6.40	SAND & SILT TILL, SM-ML Brown, moist, compact to very dense, with embedded gravel.						216				
			9	SPT	100+						
215.46											
7.32	End of Borehole.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 15B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941853, Easting - 213982 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 15.8.07 - 15.8.07 CHECKED BY JL

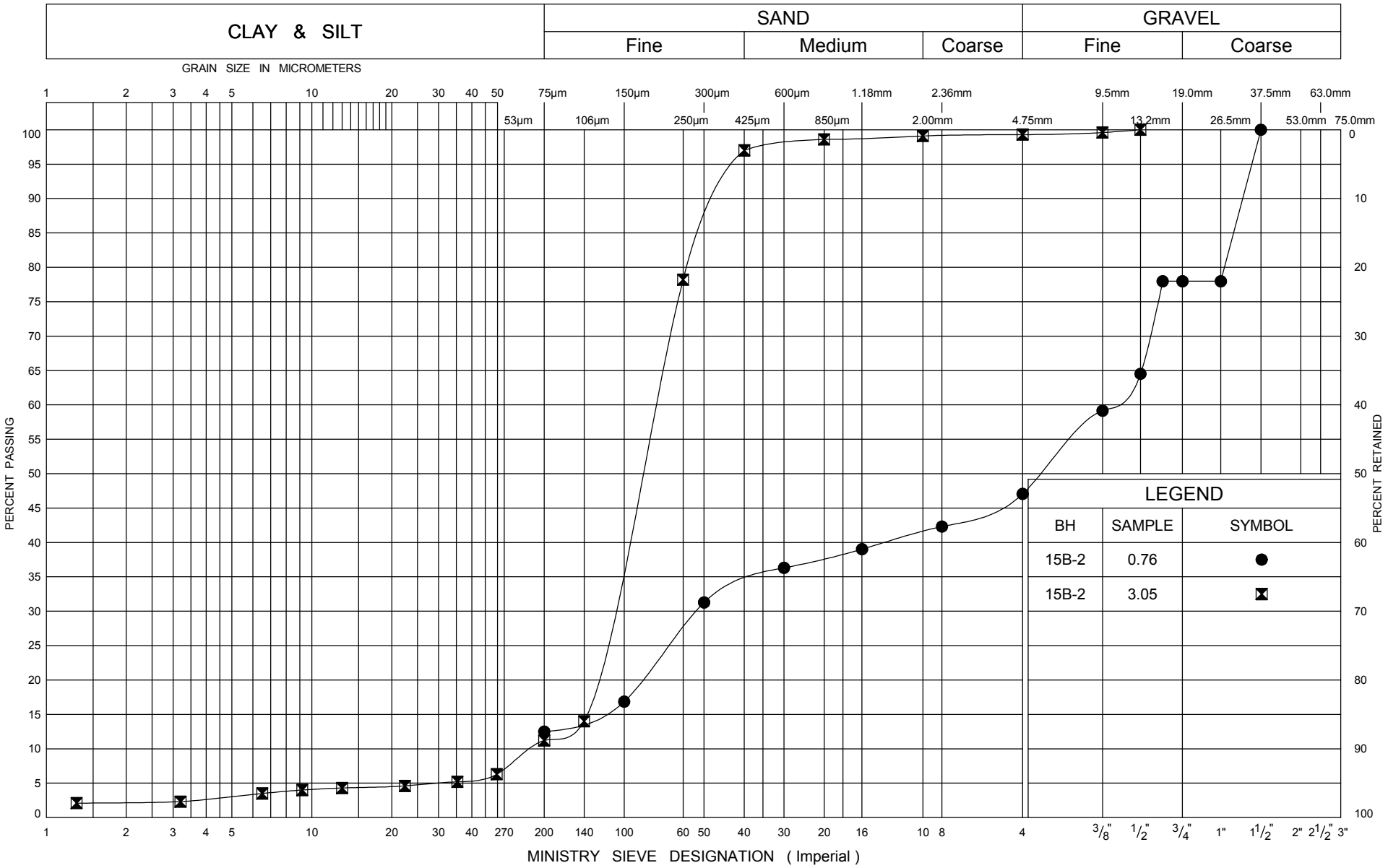
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.80	Ground										
0.00 / 222.34	FILL Brown crushed granulars.										
0.46			1	SPT	31		222				56 31 (13)
	gravel layer										
221.43 / 1.37			2	SPT	24		221				5 58 28 9 (37)
	silty										
220.67 / 2.13			3	SPT	17	▽	220				Water level @ 2.51 m.
	SAND, SP Brown, moist to saturated, compact to dense, occasional gravel and silty layers.		4	SPT	13						
			5	SPT	34		219				0 89 8 3 (12)
217.77			6	SPT	40		218				
5.03	End of Borehole.										

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

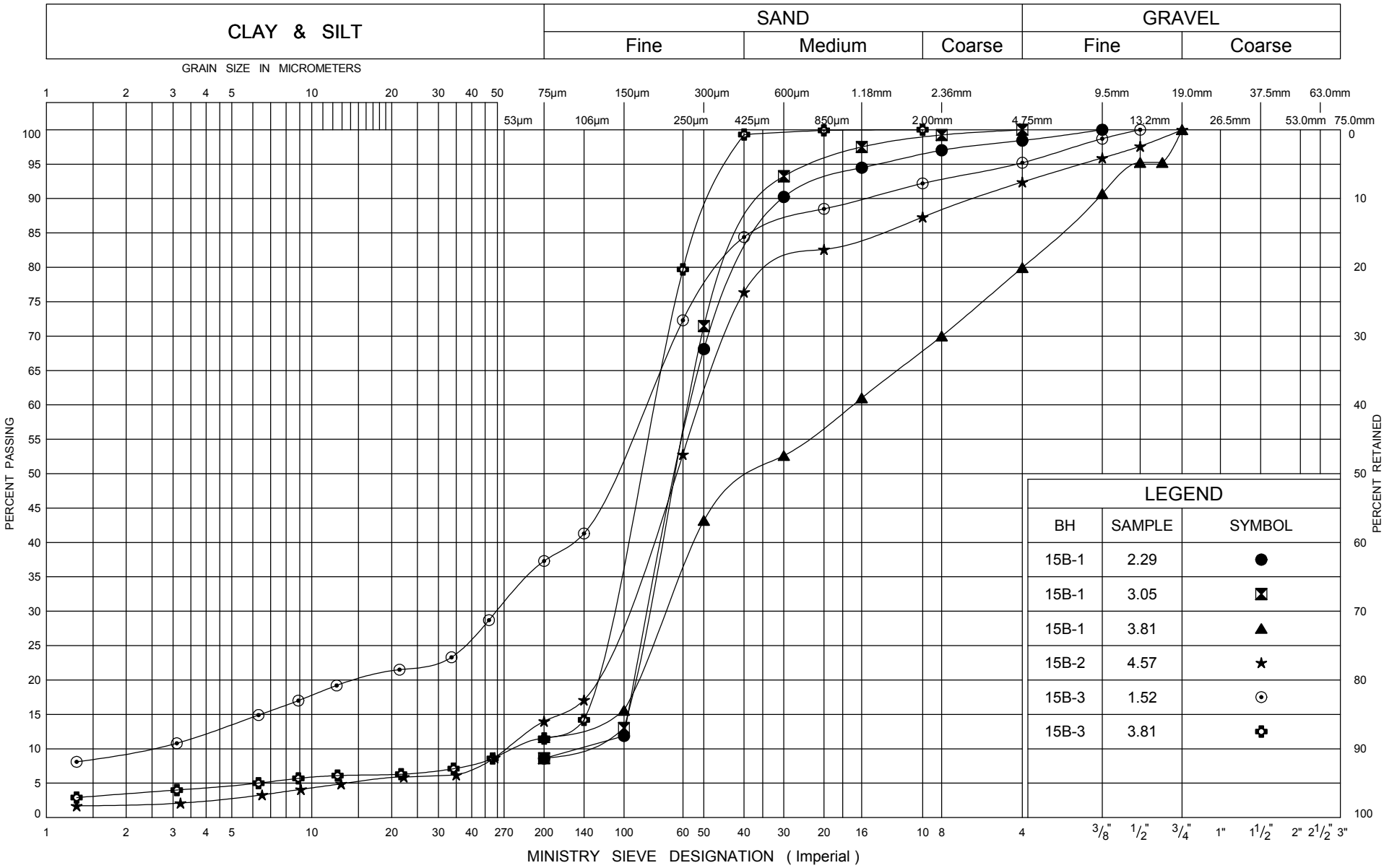
FILL

FIG No C- 15B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

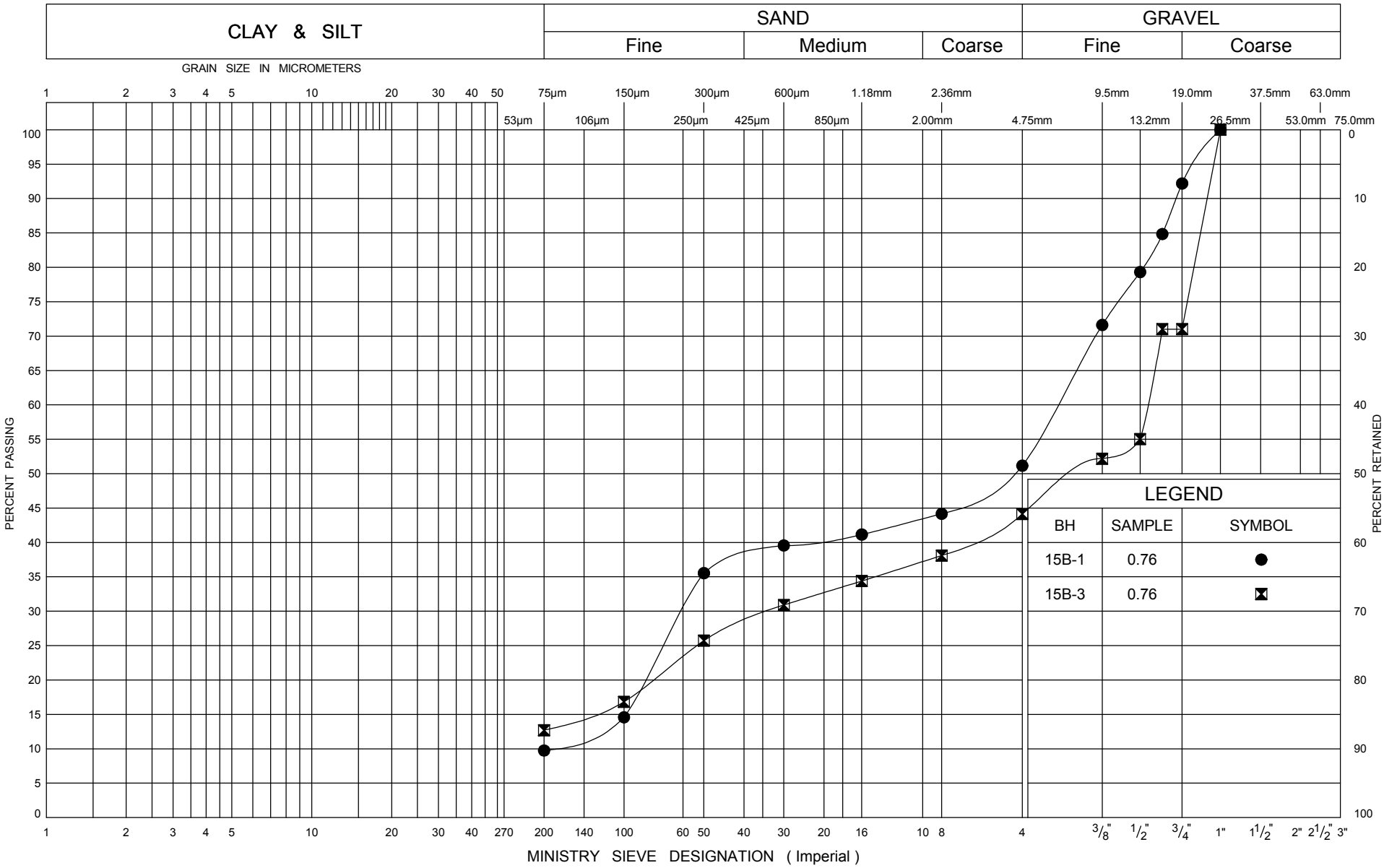
SAND, SP

FIG No C- 15B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

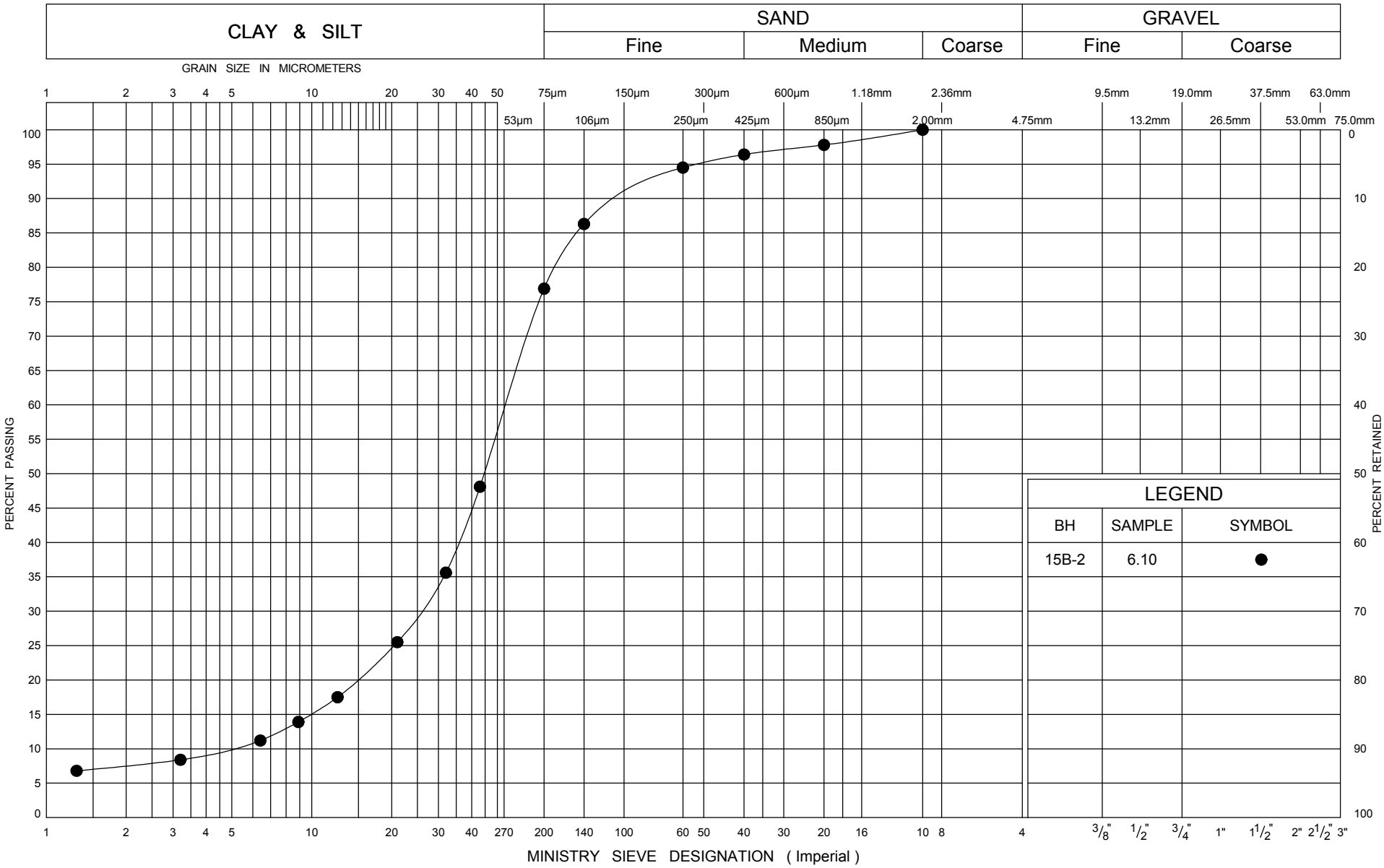
GRAVEL LAYERS, GP

FIG No C- 15B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

SAND AND SILT TILL, SM-ML

FIG No C- 15B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 16B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941913, Easting - 214282 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
219.27	Ground										
0.00	150 mm TOPSOIL.					▽	219				
	Silty SAND, SM Brown, saturated, loose to dense, trace silt, occasional gravel pieces.		1	SPT	11						Water level @ 0.73 m. 0 81 (19)
			2	SPT	32		218				
216.98											
2.29	SAND & SILT TILL, SM-ML Grey, wet to moist, dense to to very dense, trace gravel.		3	SPT	48		217				6 15 67 12 (79)
215.92			4	SPT	100+		216				0 53 39 8 (47)
3.35	End of Borehole.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 16B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941937, Easting - 214274 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.50	Ground								
0.00	FILL Brown, moist, dense, consisting of crushed granulars.		1	SPT	34				44 40 (16)
218.98									
1.52	FILL Grey, wet, very loose to loose, consisting of mainly sand and silt, trace organics and gravel.		2	SPT	3				
217.91			3	SPT	4	▽			Water level @ 2.44 m.
2.59	PEAT Black, wet, soft, partially decomposed.								
217.45			4	SPT	6				
3.05	SAND & SILT TILL, SM-ML Grey, wet to moist, loose to very dense.		5	SPT	41				0 18 74 8 (81)
			6	SPT	50				
214.71			7	SPT	33				
5.79	End of Borehole.								

PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

ELEVATION SCALE: 220, 219, 218, 217, 216, 215

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 16B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4941950, Easting - 214278 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
220.59	Ground				
0.00 / 220.29	300 mm Granular FILL.				
0.30	FILL Dark brown, moist to wet, loose, consisting of mixed gravel and sand, with organic staining and inclusions, trace to some silt.	1	SPT	9	37 53 (10)
219.07					
1.52	SAND & SILT TILL, SM-ML Grey, wet, compact to very dense, trace gravel.	2	SPT	16	2 46 49 3 (52) Water level @ 1.91 m
		3	SPT	27	
		4	SPT	24	
		5	SPT	39	9 35 47 9 (55)
		6	SPT	60	
215.56					
5.03	End of Borehole.				

GROUND WATER CONDITIONS: ▽

ELEVATION SCALE: 220, 219, 218, 217, 216

PENETR. RESISTANCE STANDARD ● DYN. CONE
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

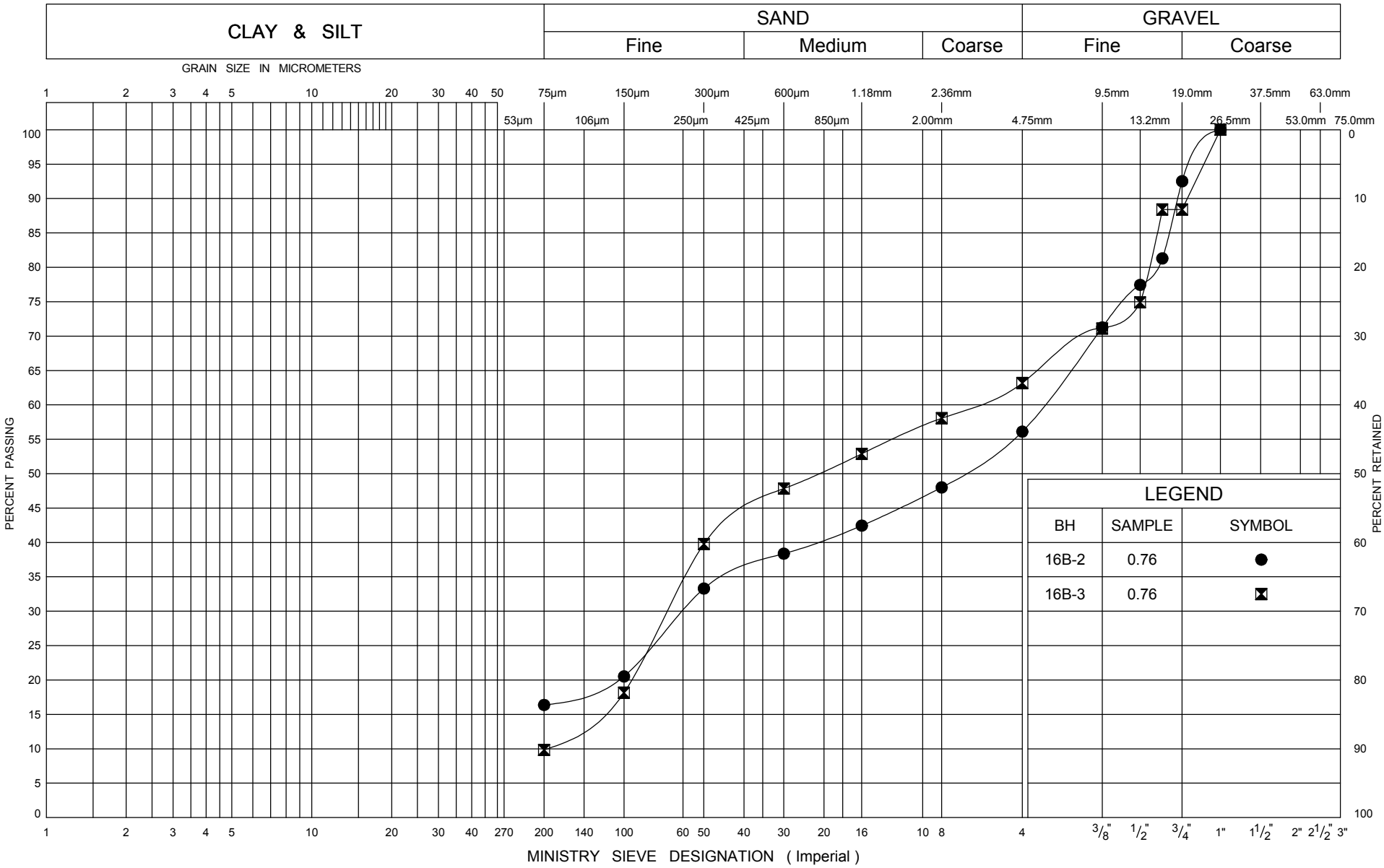
WATER CONTENT (%)
10 20 30

UNIT WEIGHT γ kN/m^3

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

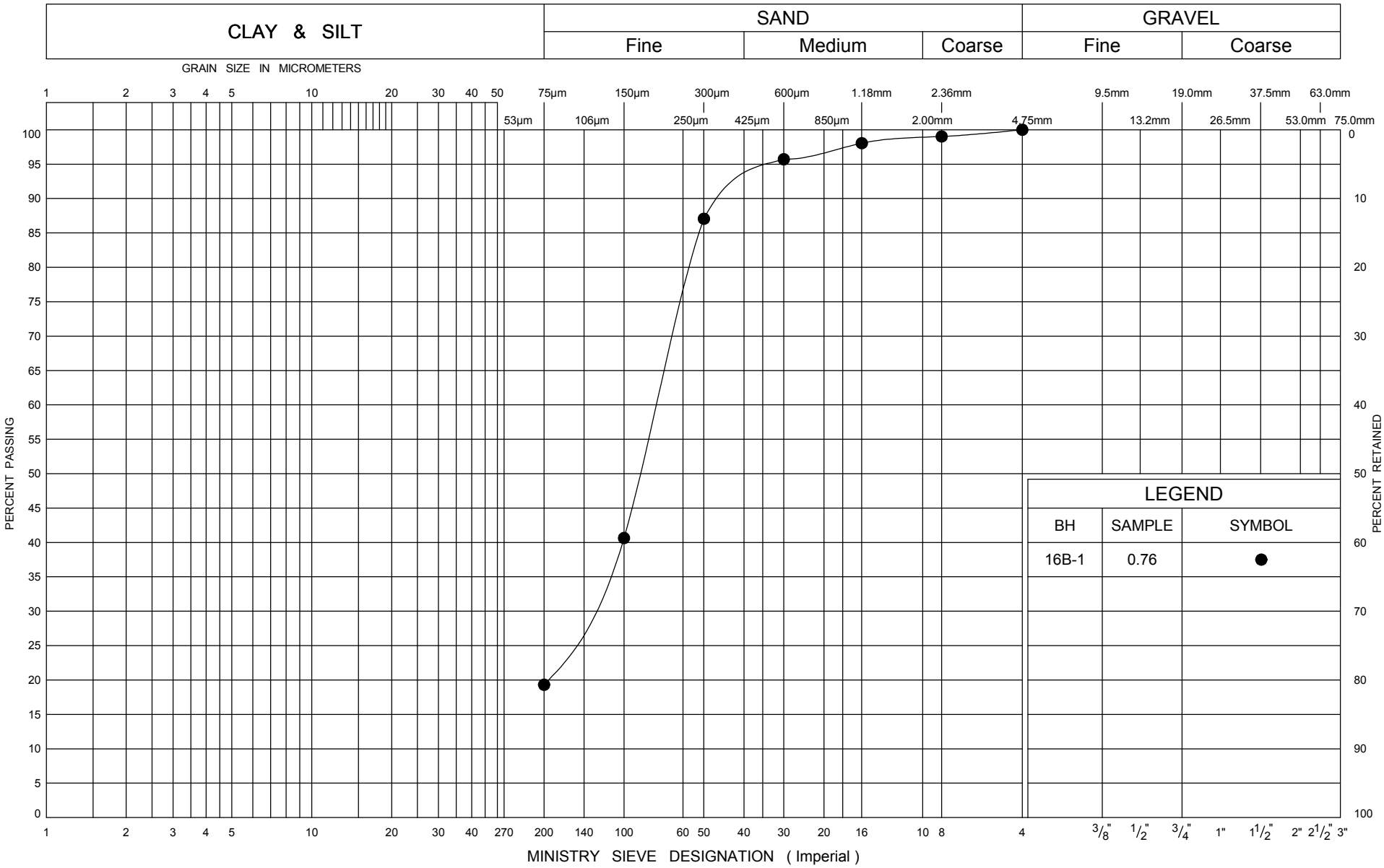
FILL

FIG No C- 16B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

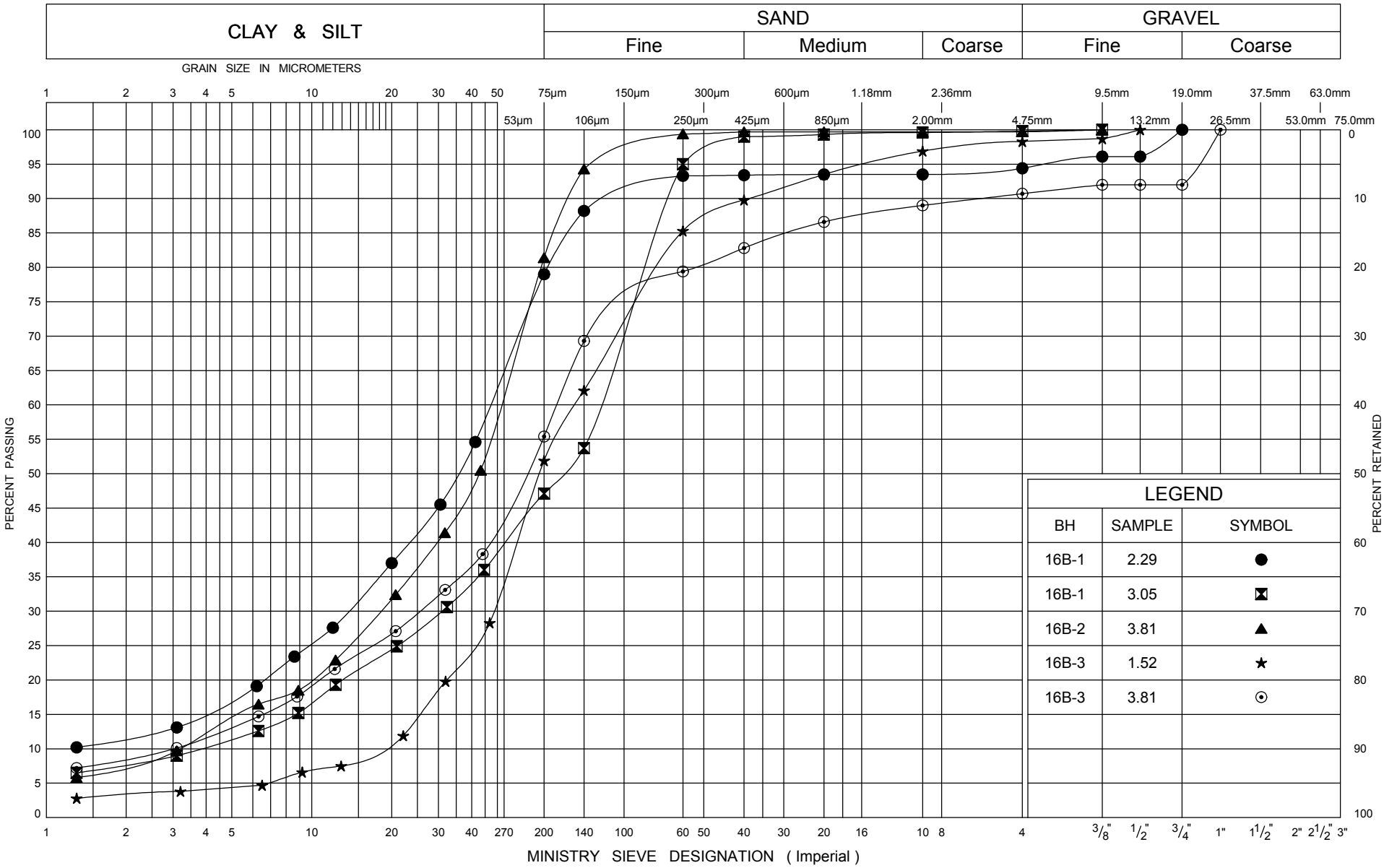
SILTY SAND, SM

FIG No C- 16B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SAND & SILT TILL, SM-ML

FIG No C- 16B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 17B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942035, Easting - 214680 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
214.91	Ground										
0.00	150 mm TOPSOIL.										
			1	SPT	37		214				0 30 62 8 (70)
	SILT TILL, ML Grey, moist to wet, dense to very dense, trace sand to sandy.		2	SPT	70	▽	213				Water level @ 1.98 m.
			3	SPT	66						0 27 65 8 (73)
			4	SPT	57		212				0 5 85 10 (95)
211.40											
3.51	End of Borehole.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 17B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942051, Easting - 214674 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 15.8.07 - 15.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE; SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
216.46	Ground										
0.00	FILL Brown, moist, compact, consisting of crushed granulars.										
215.55			1	SPT	19						
0.91	FILL Grey, saturated, very loose, consistingof sand and silt, with organic inclusions.		2	SPT	3				43		6 56 35 3 (38)
214.02			3	SPT	20	▽					Wet cave-in @ 2.54 m.
2.44	SILT TILL, ML Grey, moist to wet, compact to dense, trace sand to sandy.		4	SPT	30					21.0	0 8 76 16 (92)
			5	SPT	46						
211.43			6	SPT	14						
5.03	End of Borehole.										

+ 3, × 3: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

RECORD OF BOREHOLE No 17B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942064, Easting - 214676 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

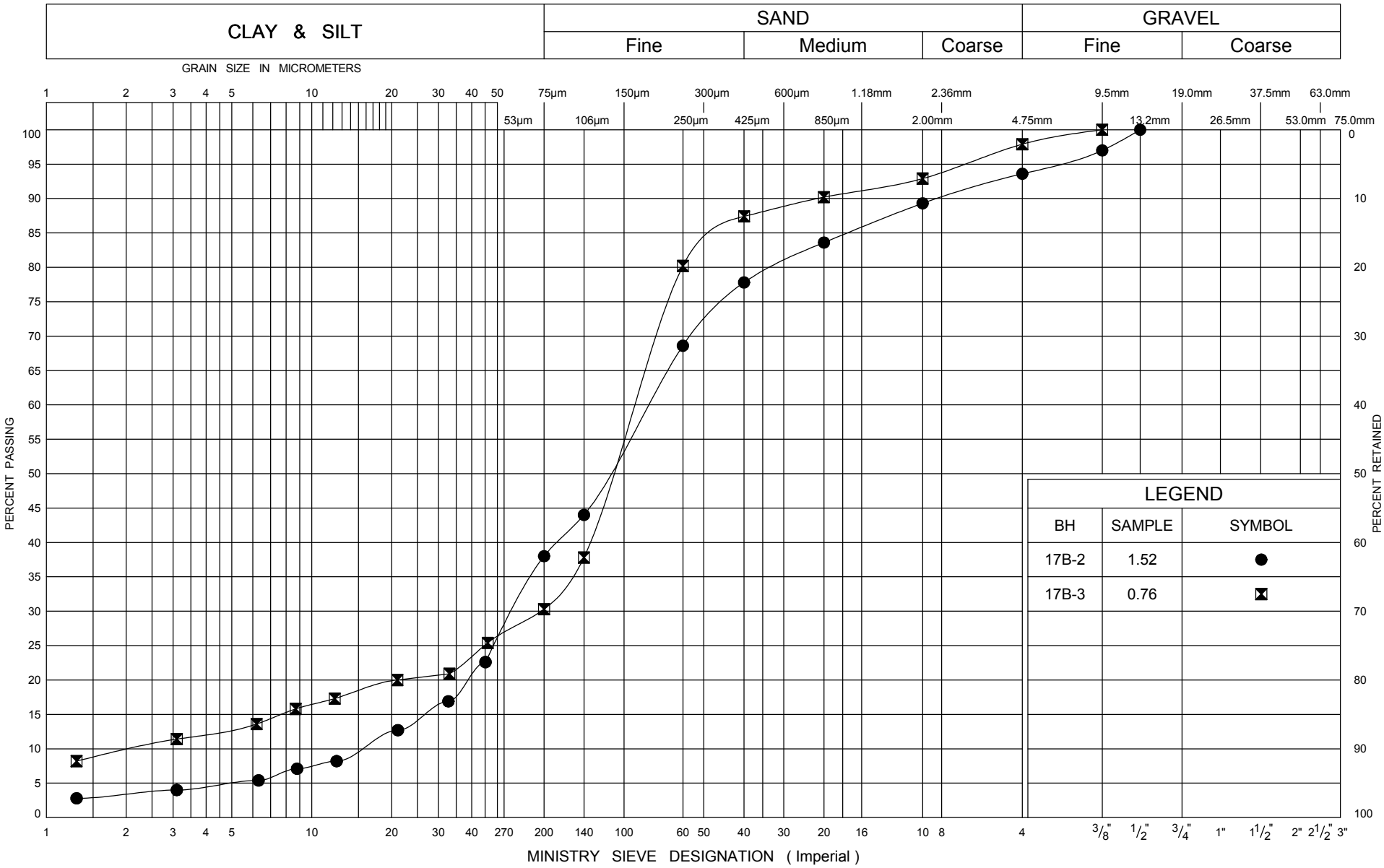
DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
216.51	Ground										
0.00	150 mm TOPSOIL.										
	FILL Dark brown to black, moist, compact, consisting of mixed gravel, sand, silt and organics.		1	SPT	28		216				2 68 21 10 (30)
			2	SPT	28		215				
214.68											
1.83	SILT TILL, ML Grey, moist to wet, compact to dense, trace sand to sandy.		3	SPT	47		214				0 5 88 7 (95)
			4	SPT	47	▽	213				Water level @ 3.05 m.
			5	SPT	40						0 24 71 5 (77)
			6	SPT	37		212				
211.48											
5.03	End of Borehole.										

+ ³, × ³: Numbers refer to Sensitivity

○ ¹⁵⁰ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

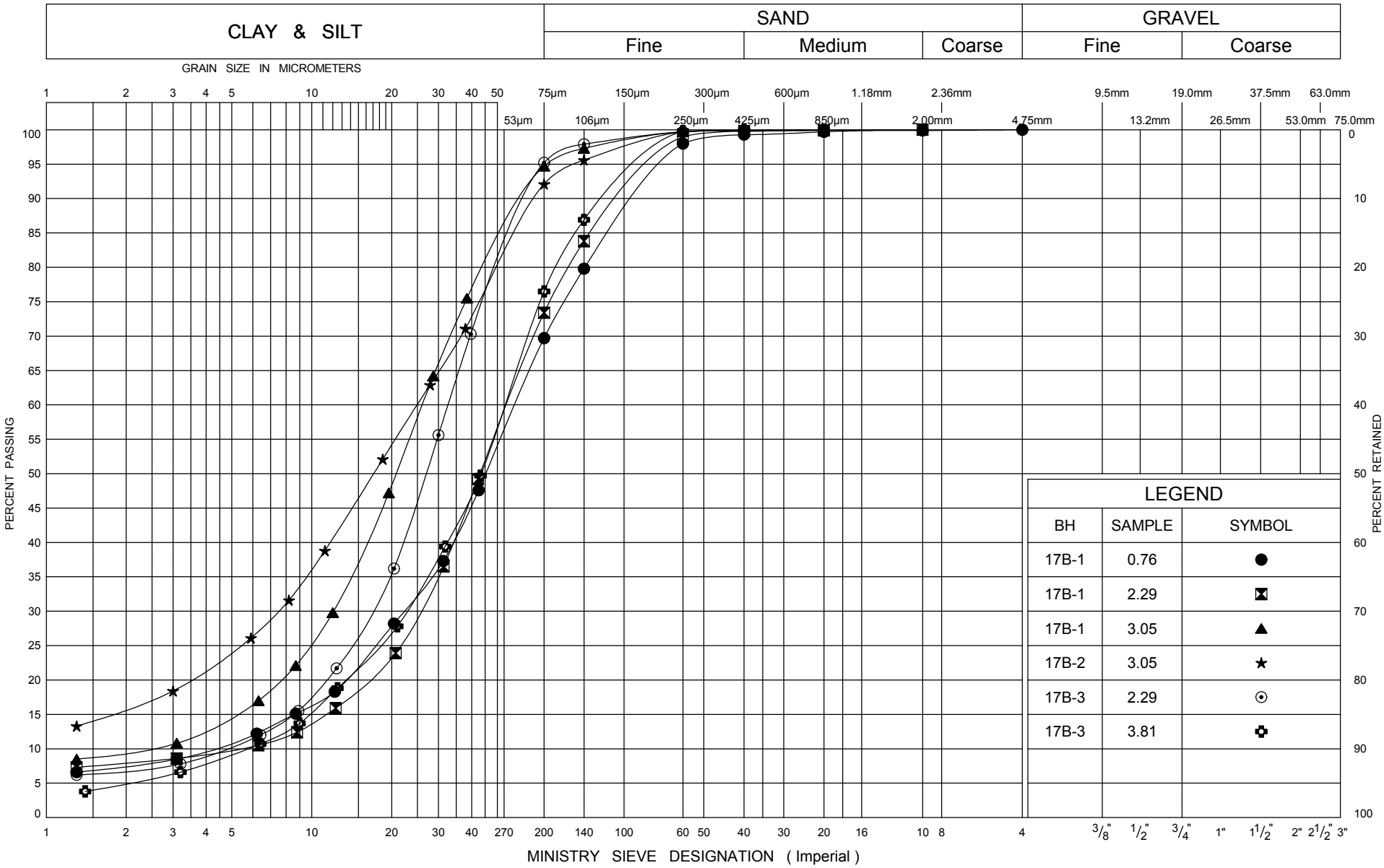
FILL

FIG No C- 17B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SILT TILL, ML

FIG No C- 17B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 18B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942071, Easting - 214806 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 20.8.07 - 20.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
213.13	Ground										
0.00	150 mm TOPSOIL						213				
	SAND & SILT TILL, SM-ML Grey and brown, moist to wet, dense to very dense.		1	SPT	35						0 43 54 3 (57)
			2	SPT	75		212				
210.84											
2.29	Clayey SILT TILL, CL-ML Grey and brown, wet, very stiff to hard, trace sand.		3	SPT	23		211	200			0 2 74 24 (98)
			4	SPT	45	▽	210	225+			
209.62											Water level @ 3.35 m.
3.51	End of Borehole.										

+ ³, × ³: Numbers refer to Sensitivity

○ ¹⁵⁰ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 18B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942087, Easting - 214797 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 15.8.07 - 15.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
215.66 Ground							
0.00	FILL Brown, moist to wet, compact, consisting of granulars.		1	SPT	18		
214.14							
1.52	FILL Brown, moist to saturated, very loose, consisting of mixed gravel, sand, silt and clay.		2	SPT	3		8 67 21 5 (26)
213.22							
2.44	PEAT Black, wet, firm, partially decomposed.		3	SPT	5	▽	
212.92							
2.74	SAND & SILT TILL, SM-ML Grey, moist to wet, very dense to dense.		4	SPT	100+		Water level @ 2.79 m. 2 24 70 5 (75)
			5	SPT	100+		
			6	SPT	43		0 13 80 7 (87)
210.17			7	SPT	100+		
5.49	End of Borehole.						

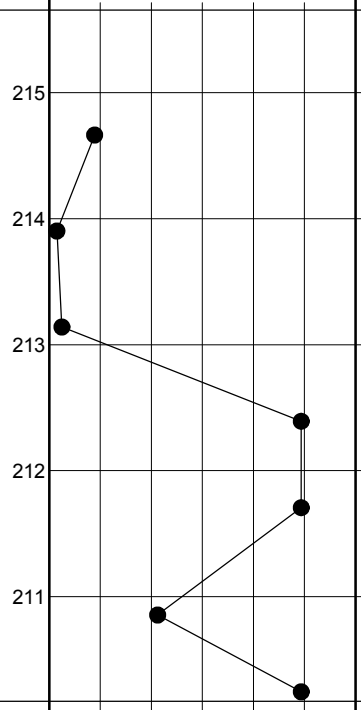
PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

UNIT WEIGHT γ kN/m³



$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 18B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942099, Easting - 214802 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

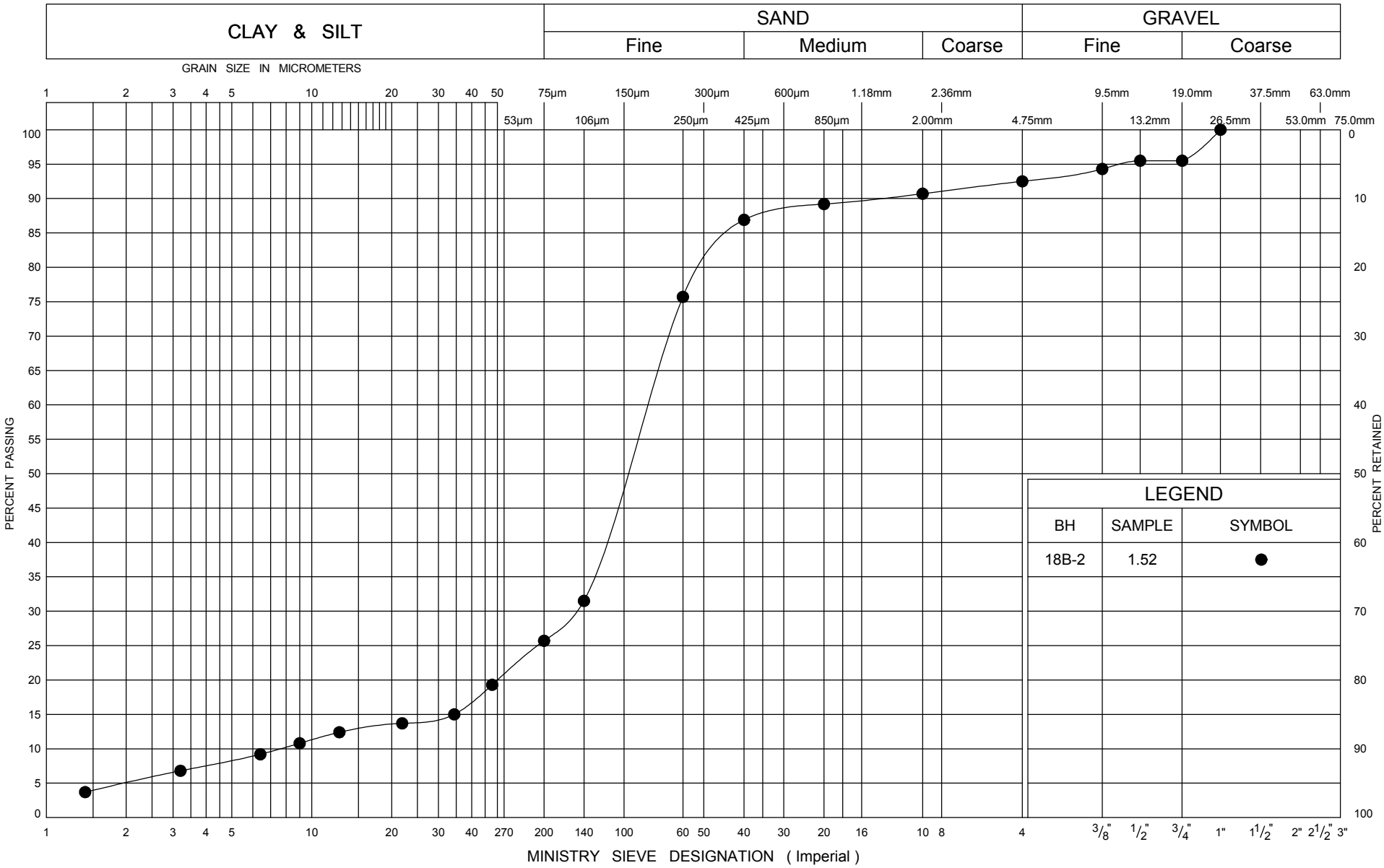
DATUM Geodetic DATE 16.8.07 - 16.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
215.73	Ground										
0.00	75 mm TOPSOIL.					▽					Water level @ 0.3 m.
			1	SPT	5		215				0 79 14 7 (21)
			2	SPT	13		214				
			3	SPT	63		213				1 64 29 5 (34)
			4	SPT	73		212				0 74 24 3 (26)
	SAND & SILT TILL, SM-ML Wet to moist, loose to very dense, occasional silty clay layers.		5	SPT	23						
			6	SPT	69		211				0 23 69 8 (77)
			7	SPT	23		210				
			8	SPT	11						
			9	SPT	5		209				
208.11											
7.62	End of Borehole.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

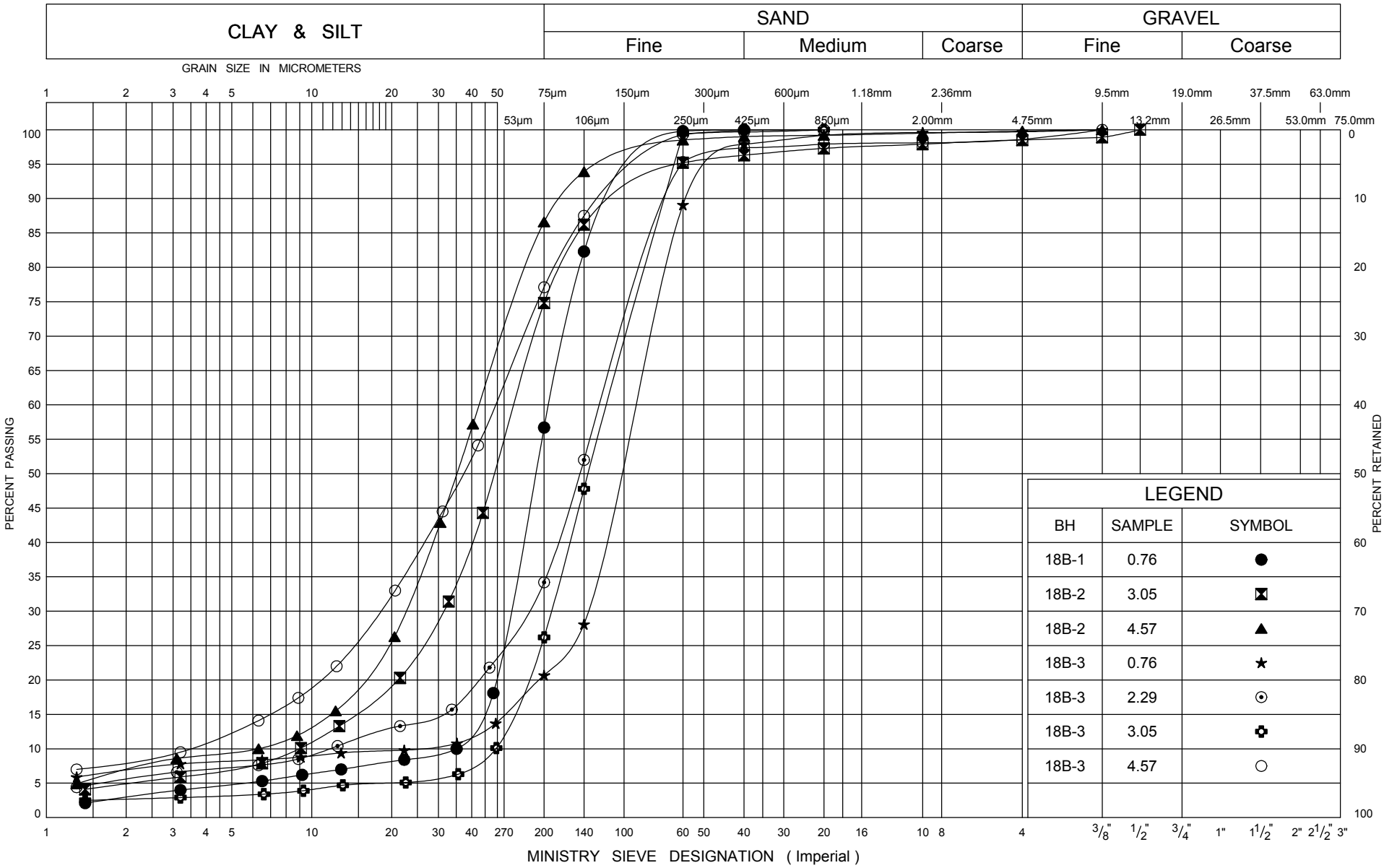
FILL

FIG No C- 18B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

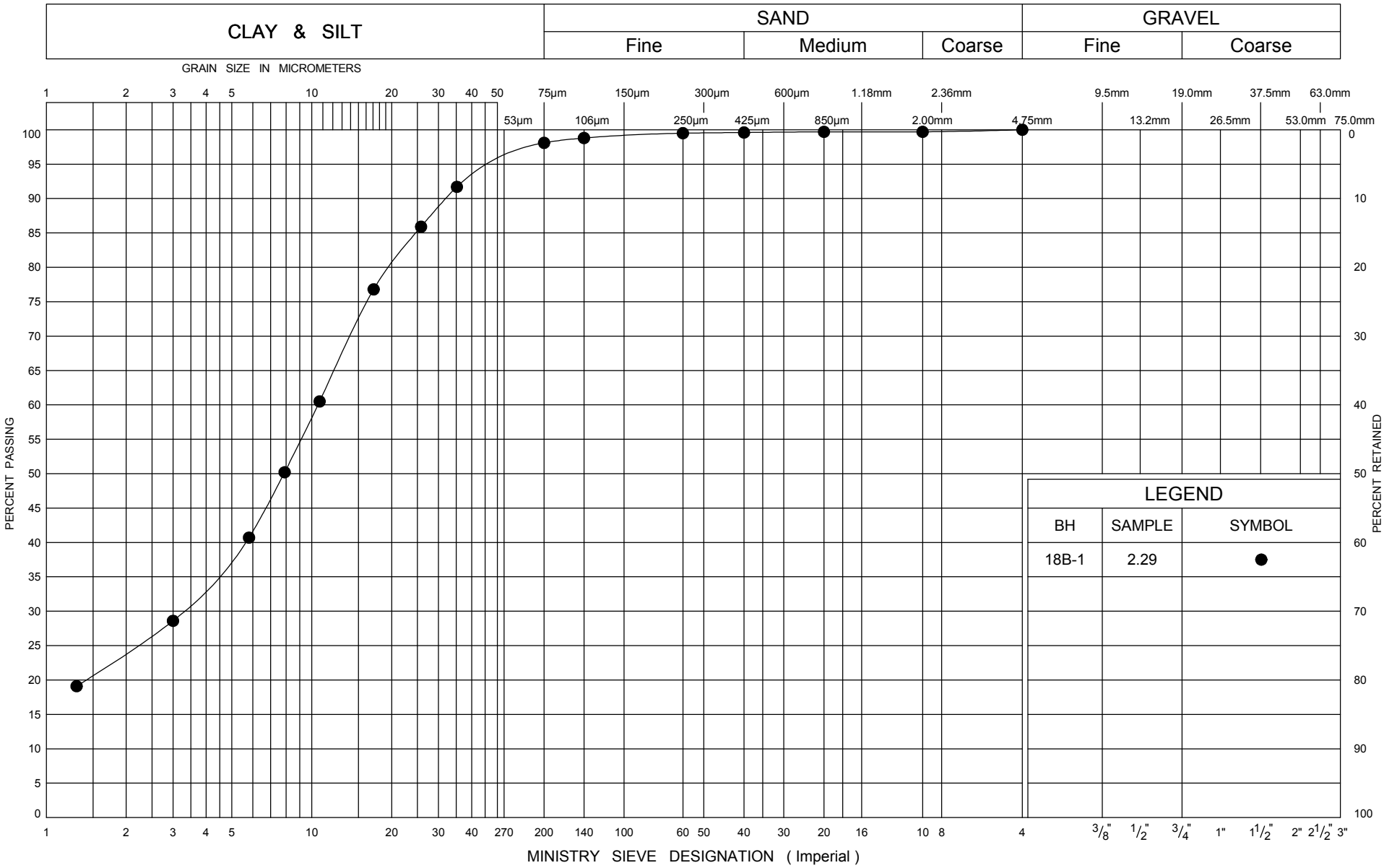
SAND & SILT TILL, SM-ML

FIG No C- 18B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

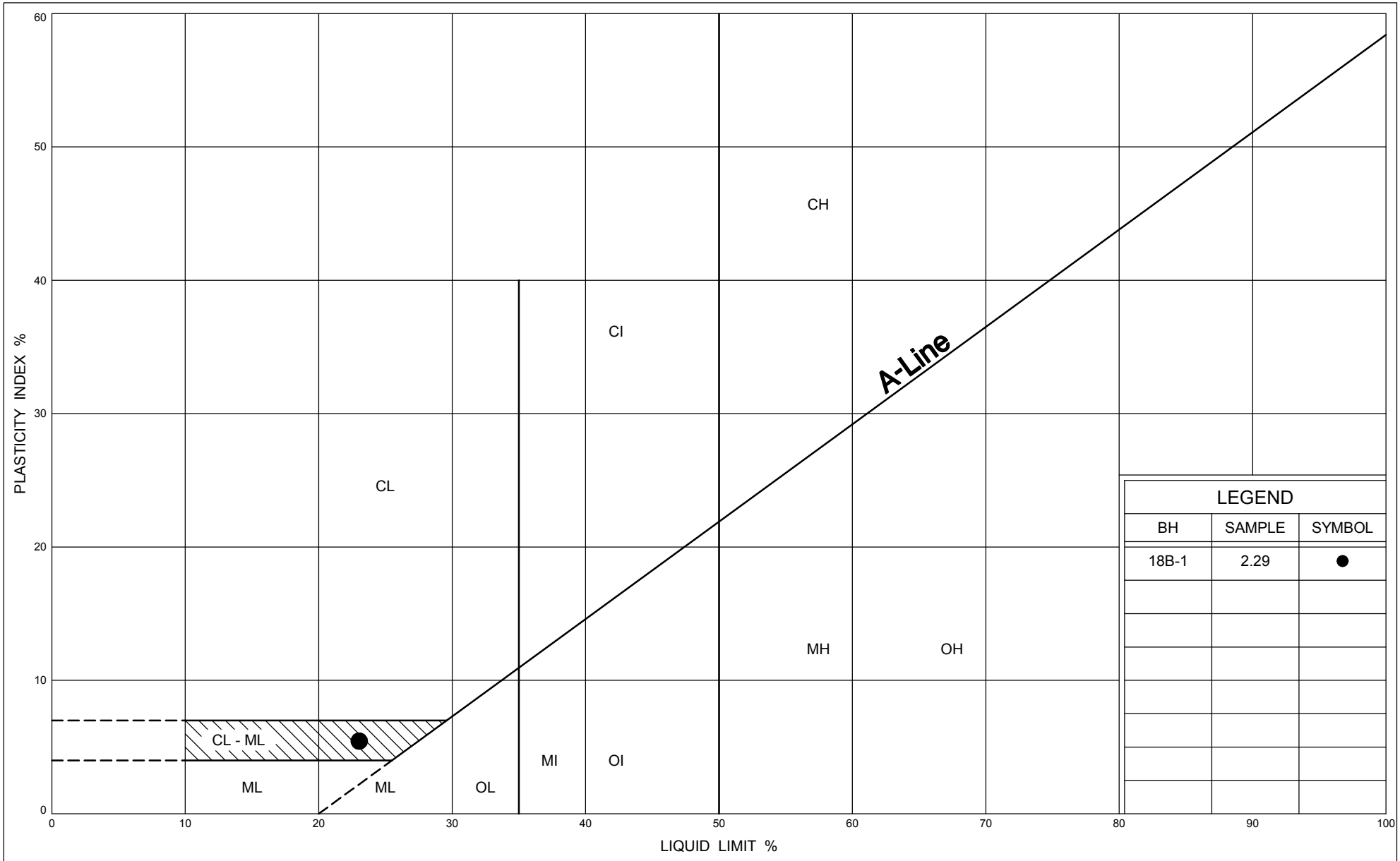
CLAYEY SILT TILL, CL-ML

FIG No C- 18B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 20/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT TILL, CL-ML

FIG No C- 18B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 19B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942324, Easting - 215678 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 22.8.07 - 22.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
206.50	Ground										
0.00	100 mm TOPSOIL.						206				
			1	SPT	24						9 28 45 19 (63)
							205				
	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, very stiff to hard, with embedded sand and gravel, frequent large gravel pieces (up to 40 mm).		2	SPT	23						
			3	SPT	42		204				35 25 27 13 (41)
			4	SPT	53						
202.54			5	SPT	100+		203				
3.96	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 19B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942323, Easting - 215693 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 22.8.07 - 22.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
207.20	Ground										
0.00 / 206.74	460 mm Crushed Granular FILL.						207				
0.46 / 205.52	FILL Brown, moist, consisting mainly of sand, some silt and gravel.		1	SPT	6						12 71 13 4 (17)
			2	SPT	13		206				
1.68 / 202.17	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, stiff to hard, with embedded sand and gravel.		3	SPT	45		205				
			4	SPT	68		204				18 27 39 15 (54)
			5	SPT	75		203				
			6	SPT	45						
5.03	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

RECORD OF BOREHOLE No 19B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942328, Easting - 215703 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

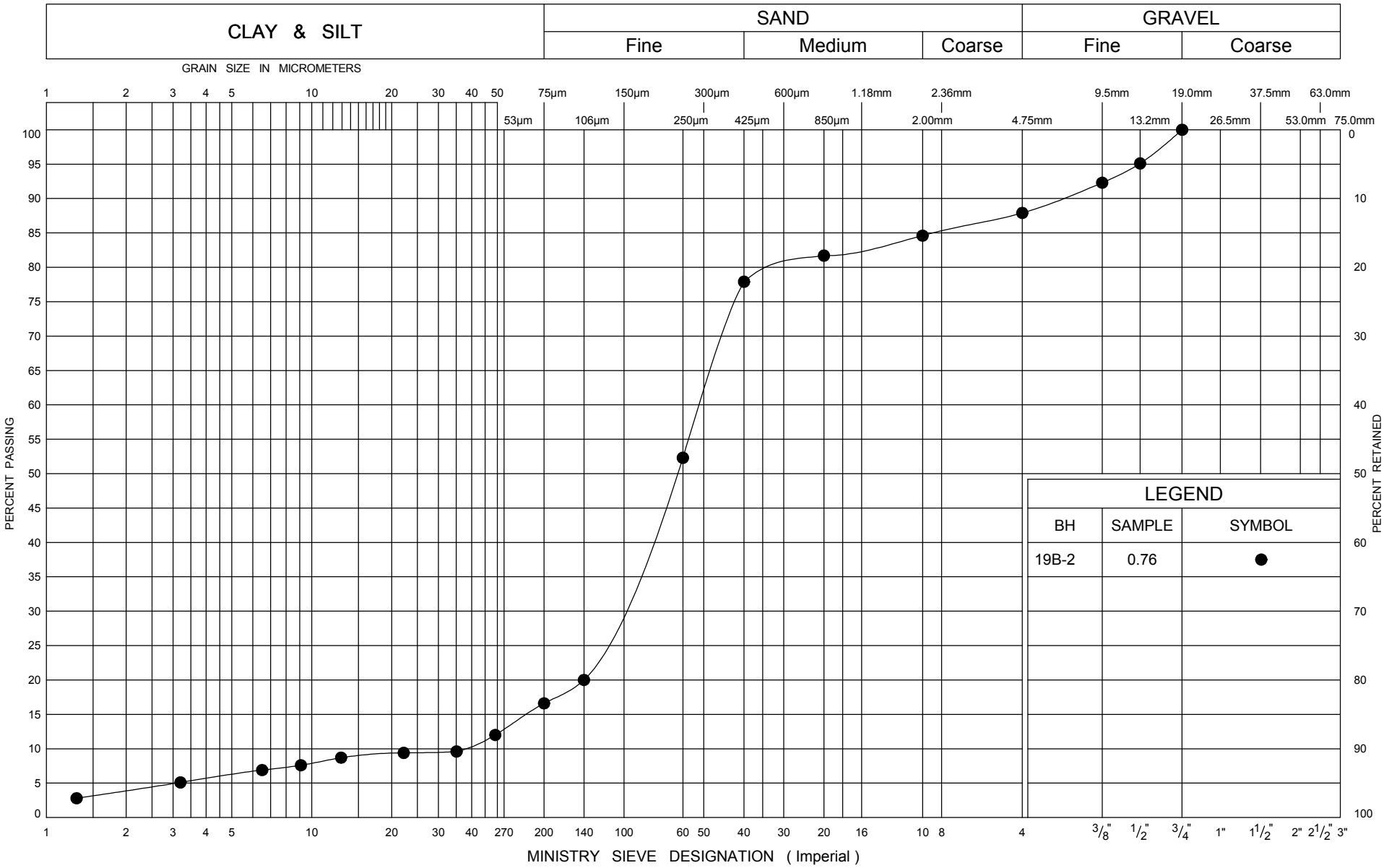
DATUM Geodetic DATE 22.8.07 - 22.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
207.25	Ground										
0.00 / 206.95	300 mm Crushed Granular FILL.						207				
0.30 / 206.03	Fine SAND, SP Brown, moist to wet, compact, trace gravel and silt.		1	SPT	11						
1.22 / 205.42	Sandy SILT, ML Brown, moist, compact.		2	SPT	18		206				7 24 58 11 (69)
1.83	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, very stiff to hard, with embedded sand and gravel, frequent large gravel pieces (up to 40 mm), occasional cobbles.		3	SPT	45		205				
			4	SPT	90		204				20 34 32 14 (46)
			5	SPT	28		203				
202.45			6	SPT	100+						
4.80	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

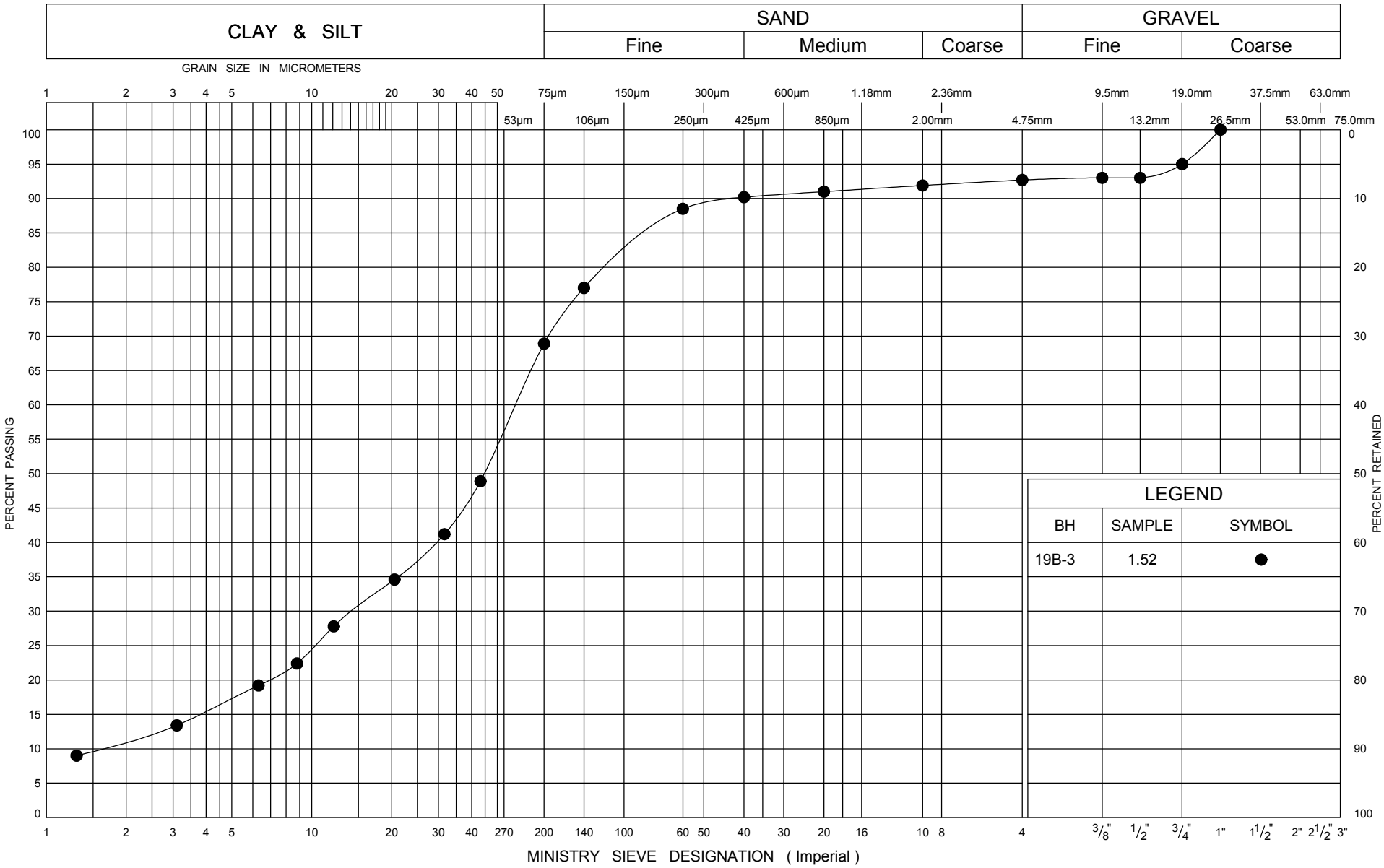
FILL

FIG No C- 19B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

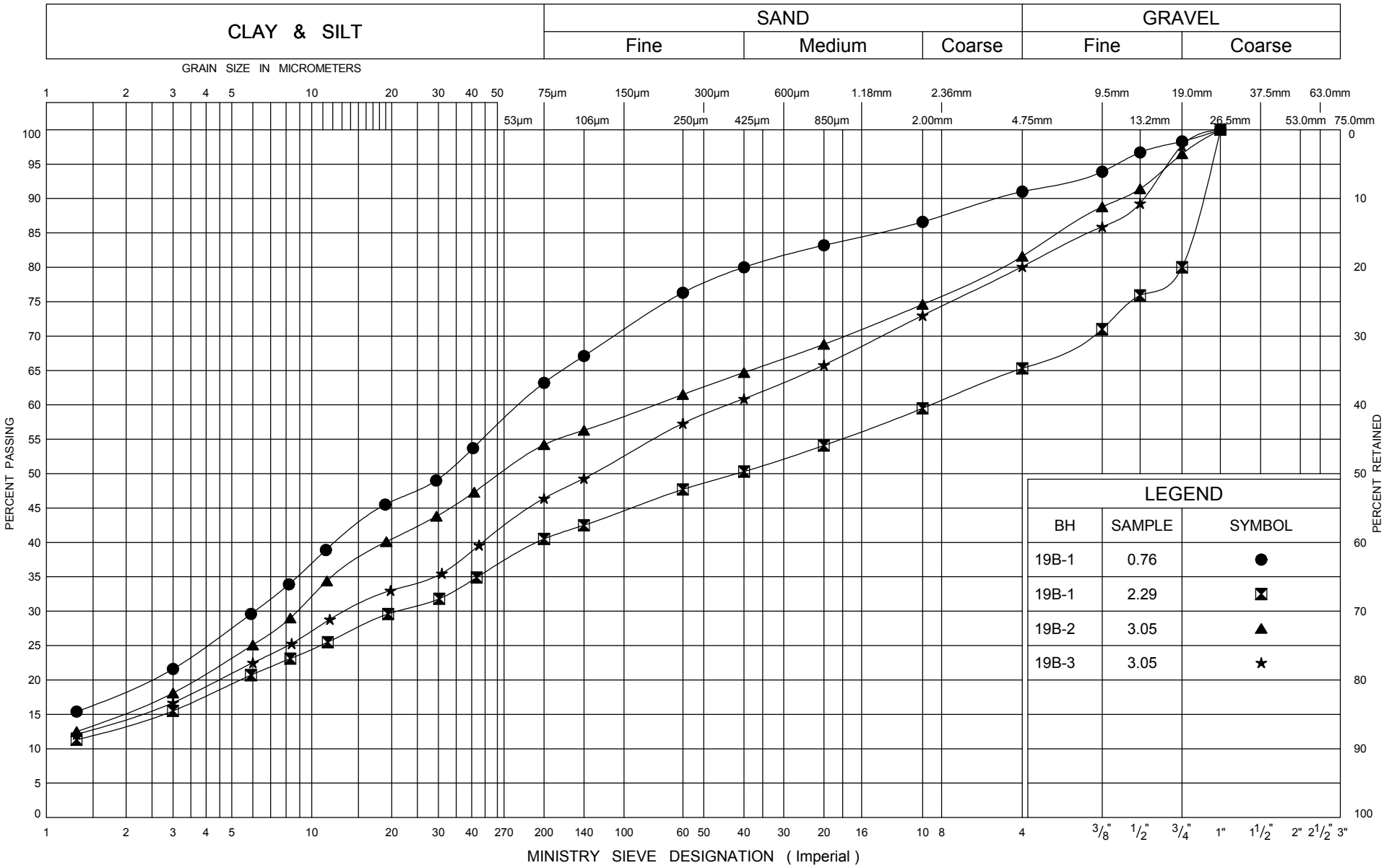
SANDY SILT, ML

FIG No C- 19B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

GRAIN SIZE DISTRIBUTION

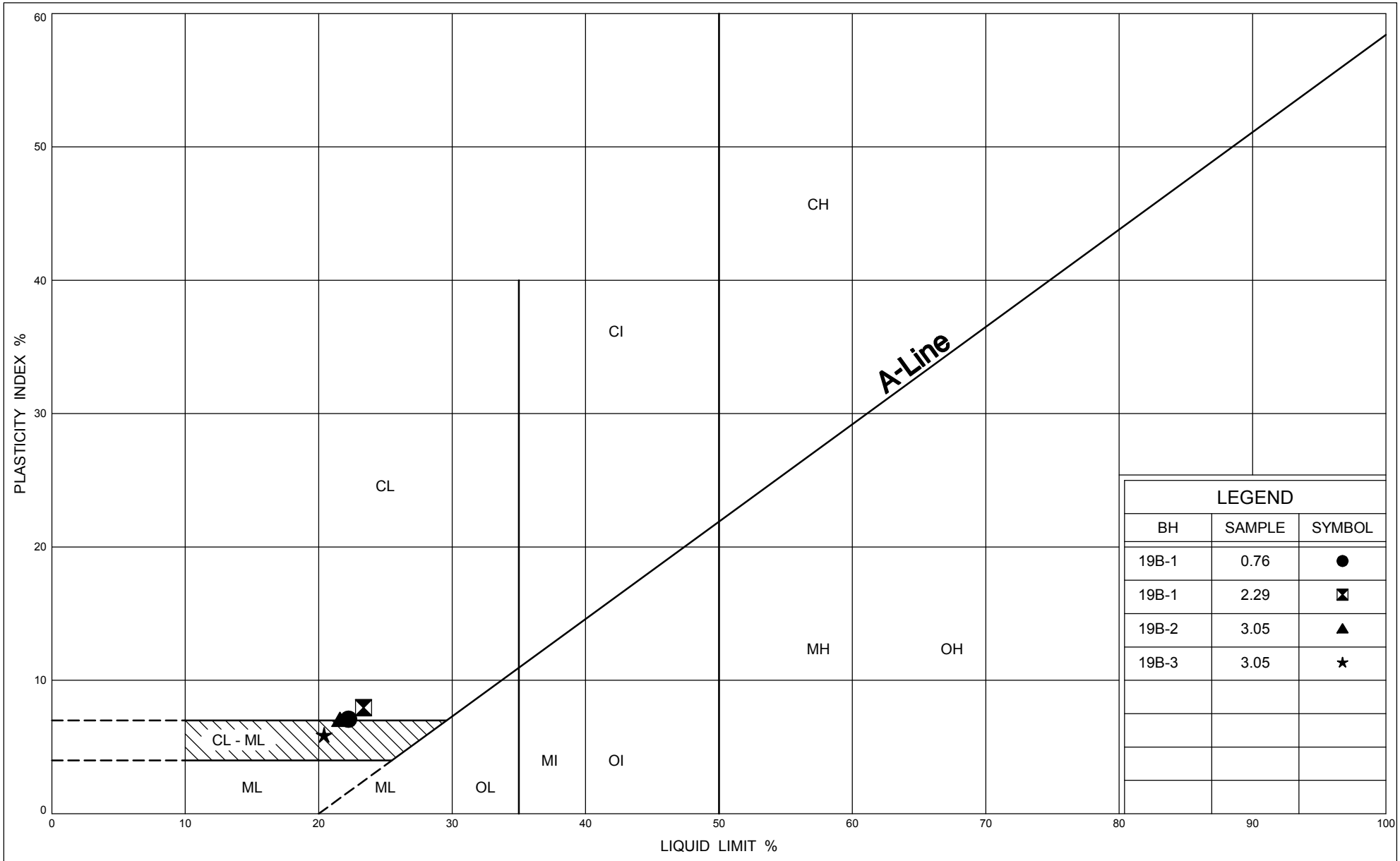
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 19B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 21/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 19B.4

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 20B-1

1 OF 1

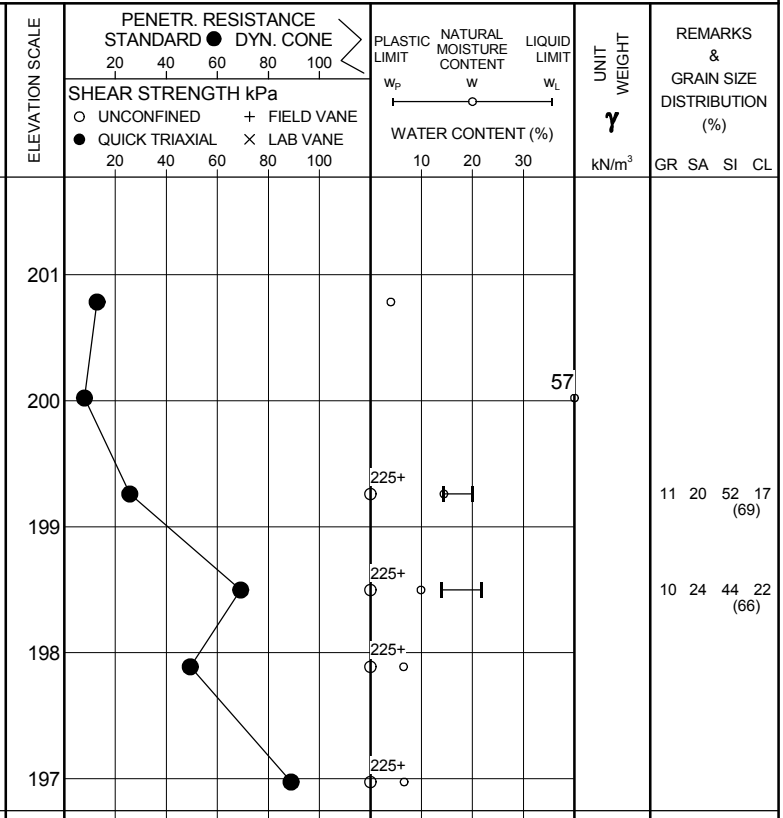
METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942444, Easting - 216073 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS
201.77	Ground					
0.00	FILL Brown, moist, compact, consisting of mixed sand and gravel, some silt to silty.		1	SPT	13	
200.25						
1.52	460 mm Buried Sandy TOPSOIL Black, moist to wet, loose, mixed with silty sand.		2	SPT	8	
199.79						
1.98	Clayey SILT to Silty CLAY TILL, CL-ML to CL Reddish brown, moist, very stiff to hard, with embedded sand and gravel, occasional cobbles.		3	SPT	26	
			4	SPT	70+	
			5	SPT	50+	
			6	SPT	90+	
196.74						
5.03	End of Borehole.					



UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
	11 20 52 17 (69)	
	10 24 44 22 (66)	
	Borehole dry and open @ completion.	

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

RECORD OF BOREHOLE No 20B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942456, Easting - 216073 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL
201.75	Ground							
0.00 / 201.29	460 mm Crushed Granular FILL.							
0.46	FILL Brown to dark brown, moist, dense to loose, consisting of sand and silt mixed with organics, some clay.		1	SPT	32			
			2	SPT	9			3 47 34 15 (50)
199.62 / 2.13	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, hard, with embedded sand and gravel.		3	SPT	55			
			4	SPT	52			6 25 45 24 (69)
			5	SPT	100+			
			6	SPT	80+			11 24 44 21 (65)
196.16			7	SPT	100+			
5.59	End of Borehole.							Borehole dry and open @ completion.

ELEVATION SCALE: 201, 200, 199, 198, 197

PENETR. RESISTANCE
STANDARD ● DYN. CONE
20 40 60 80 100
SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

225+

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 20B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942466, Easting - 216067 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

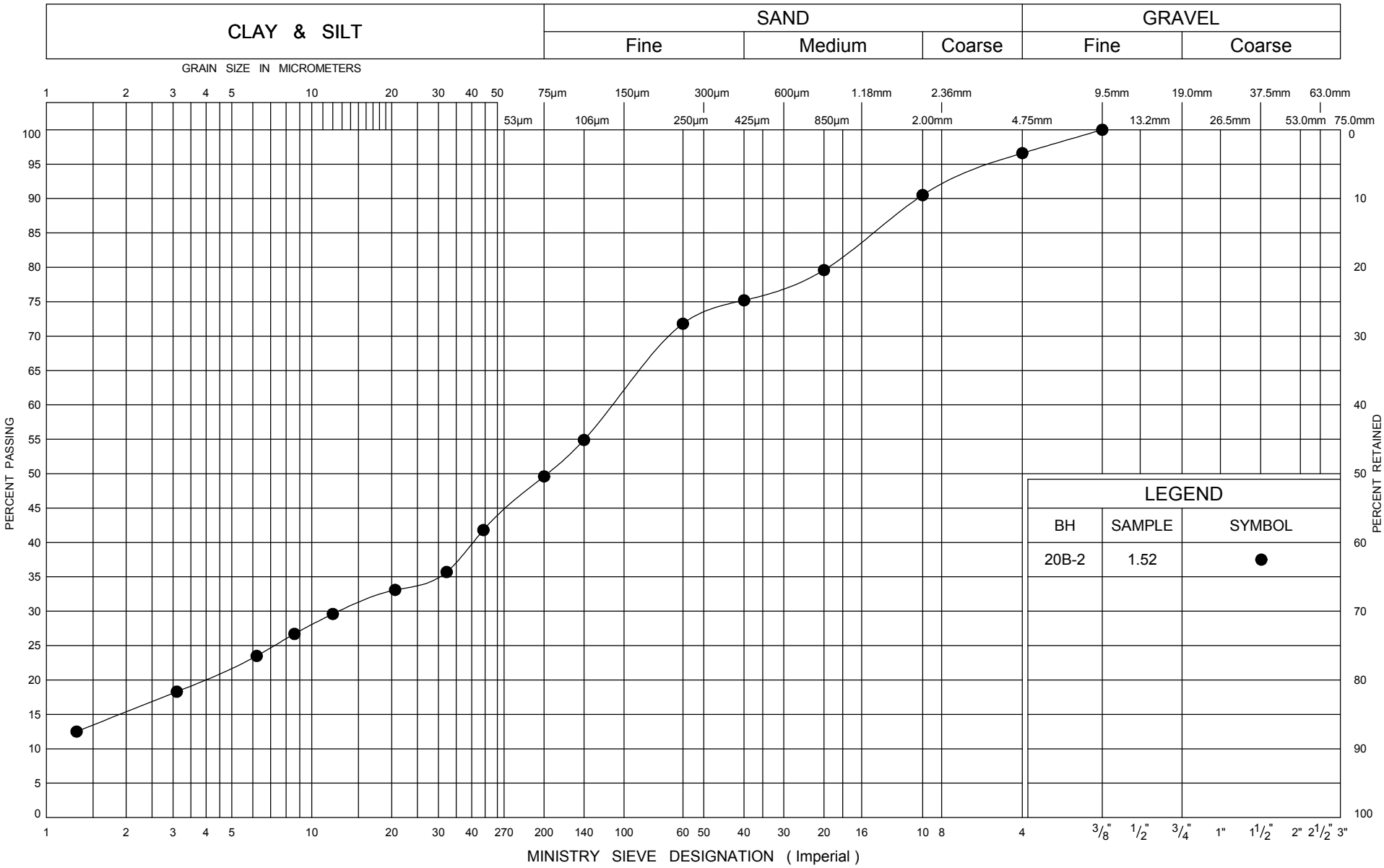
DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
200.10	Ground										
0.00 / 199.64	460 mm TOPSOIL.						200				
0.46	Clayey SILT to Silty CLAY TILL, CL-ML to CL Brown, moist, very stiff to hard, with embedded sand and gravel.		1	SPT	25		199	75			12 25 43 20 (63)
			2	SPT	54		198	225+			
			3	SPT	45			225+			13 22 43 23 (66)
			4	SPT	100+		197	225+			
196.59 / 3.51	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

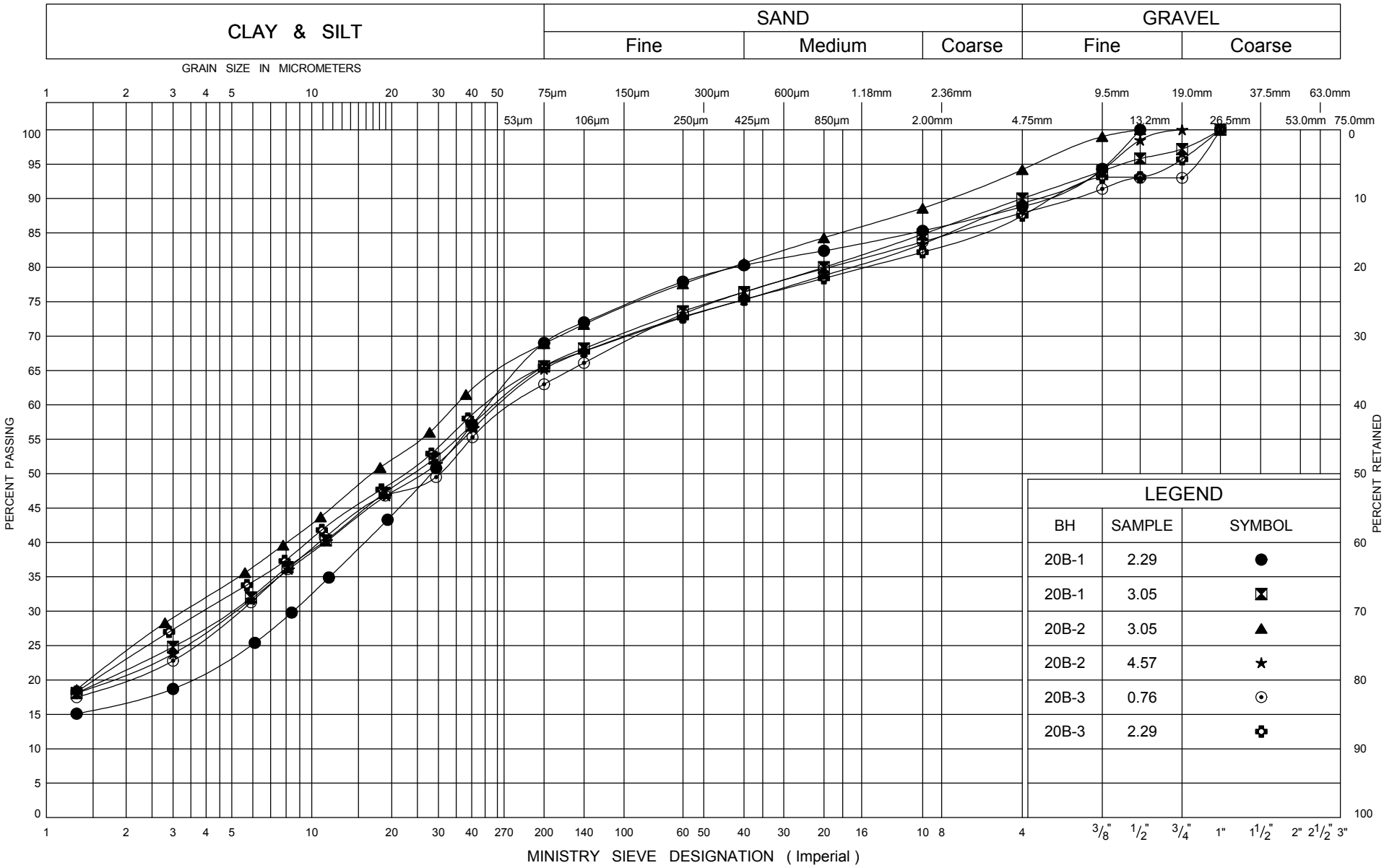
FILL

FIG No C- 20B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

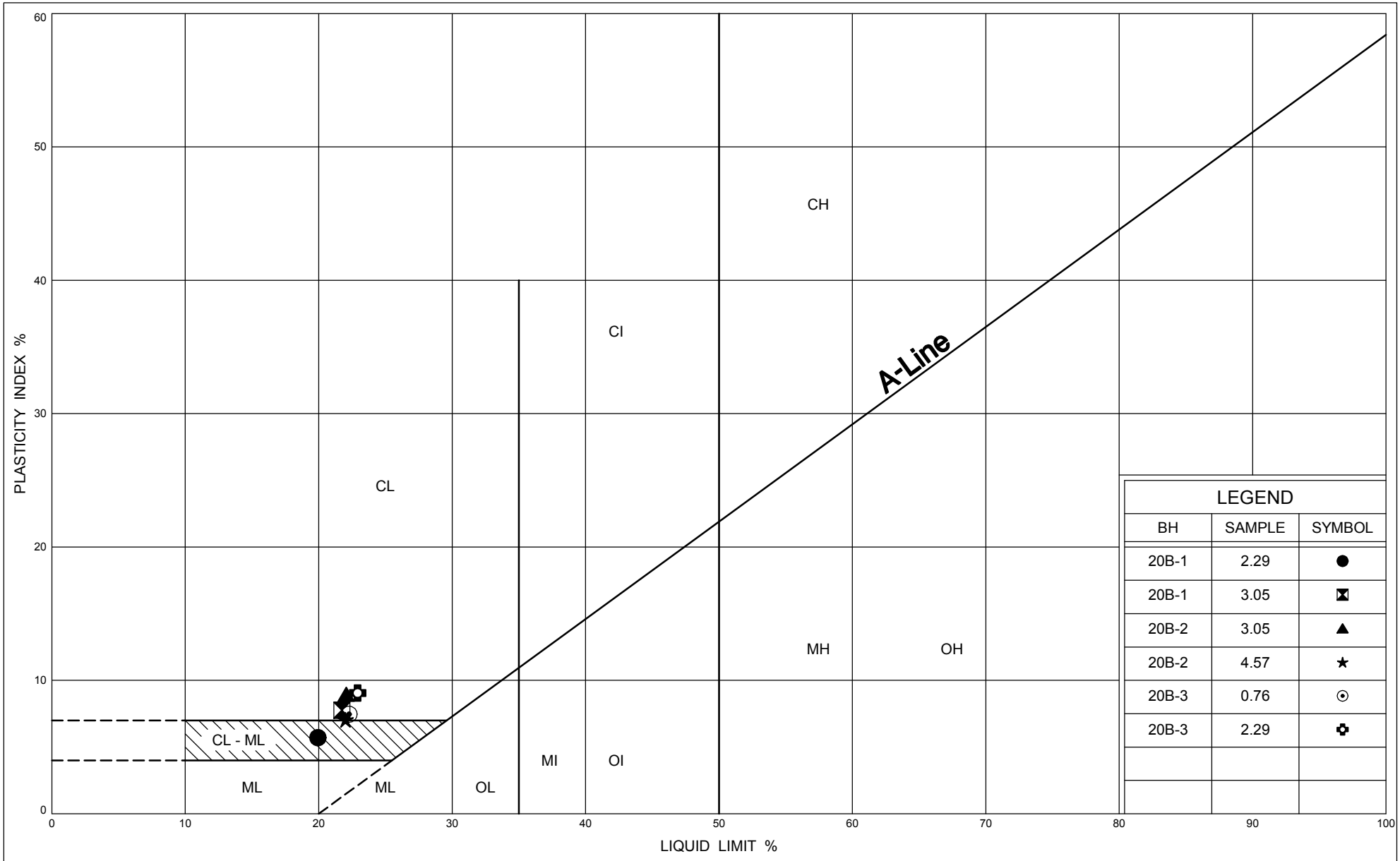
CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 20B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 21/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART

CLAYEY SILT TO SILTY CLAY TILL, CL-ML TO CL

FIG No C- 20B.3

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

RECORD OF BOREHOLE No 21B-1

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942665, Easting - 217013 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.37	Ground										
0.00	FILL Brown, damp, consisting of clayey silt, some gravel and cobbles.						186				
185.61											
0.76	Clayey SILT TILL, CL-ML Grey, moist, hard, with embedded sand and gravel, occasional cobbles.		1	SPT	48		185		225+		8 33 42 17 (59)
			2	SPT	78				225+		
			3	SPT	46		184		225+		15 28 41 16 (57)
			4	SPT	48		183		225+		
182.10			5	SPT	56				225+		
4.27	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No 21B-2

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942687, Easting - 217021 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.95	Ground										
0.00 / 186.19	760 mm Crushed Granular FILL.										
0.76	Clayey SILT TILL, CL-ML Grey, moist, very stiff to hard, with embedded sand and gravel, occasional cobbles.		1	SPT	16		186				
			2	SPT	22		185	225+			9 33 39 19 (58)
			3	SPT	48			225+			
			4	SPT	33		184	225+			4 32 45 20 (64)
			5	SPT	37		183				
			6	SPT	52		182	225+			
181.16			7	SPT	43			225+			
5.79	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

JOE MTO 07-6-IEG1B.GPJ ONTARIO MOT.GDT 8/12/09

RECORD OF BOREHOLE No 21B-3

1 OF 1

METRIC

W.P. GWP 167-91-00 LOCATION Northing - 4942699, Easting - 217013 ORIGINATED BY RB

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY NN

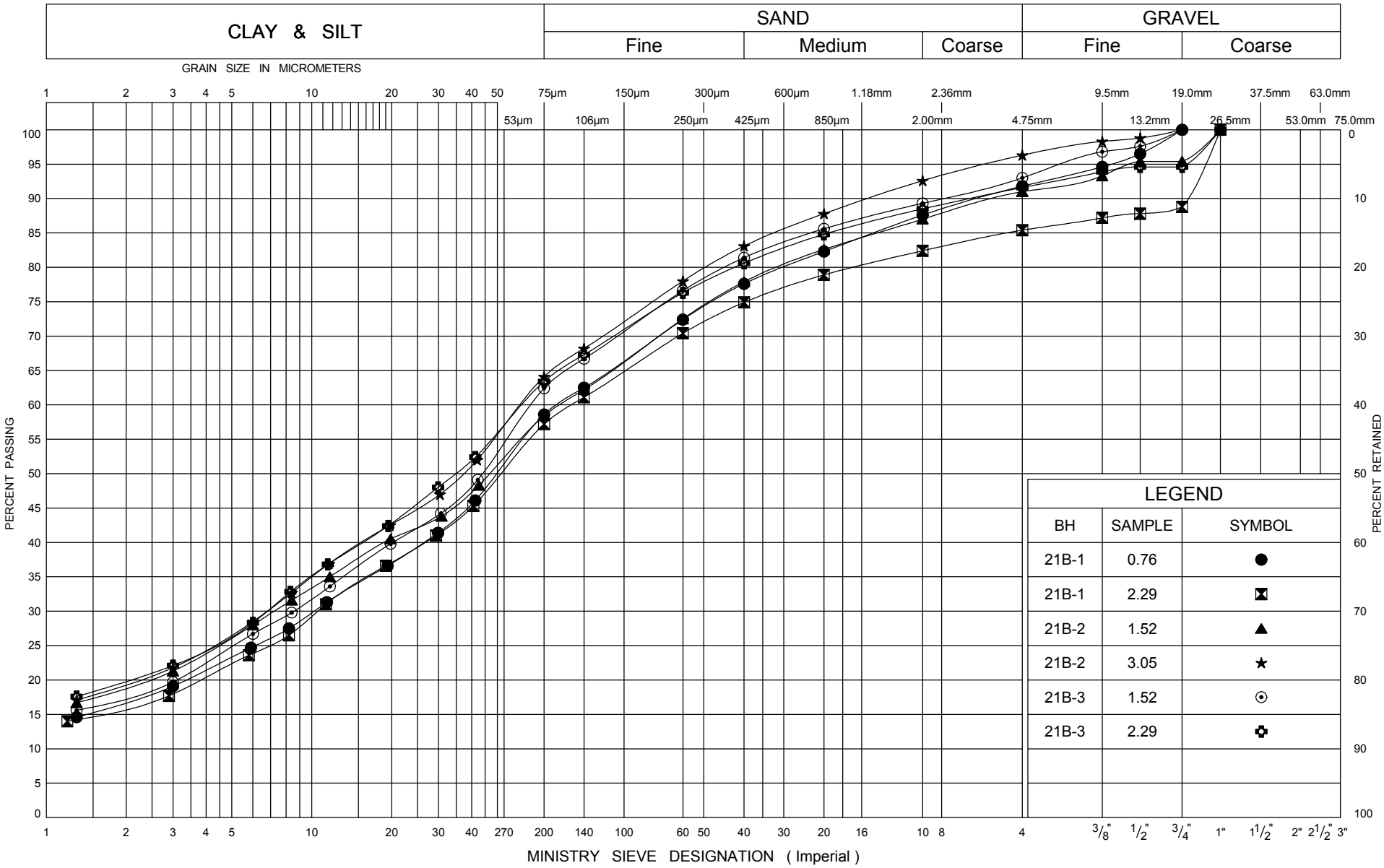
DATUM Geodetic DATE 21.8.07 - 21.8.07 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100) / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.47	Ground										
0.00 / 185.17	300 mm TOPSOIL.										
0.30	FILL Brown, wet, very loose, consisting of mixed gravel, sand and silt.		1	SPT	1		185				
184.10											
1.37			2	SPT	38		184	225+			7 31 45 18 (62)
	Clayey SILT TILL, CL-ML Grey, moist, hard, with embedded sand and gravel, occasional cobbles.		3	SPT	35		183	225+			8 28 43 20 (63)
			4	SPT	100+		182	225+			
181.20			5	SPT	40						
4.27	End of Borehole.										Borehole dry and open @ completion.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

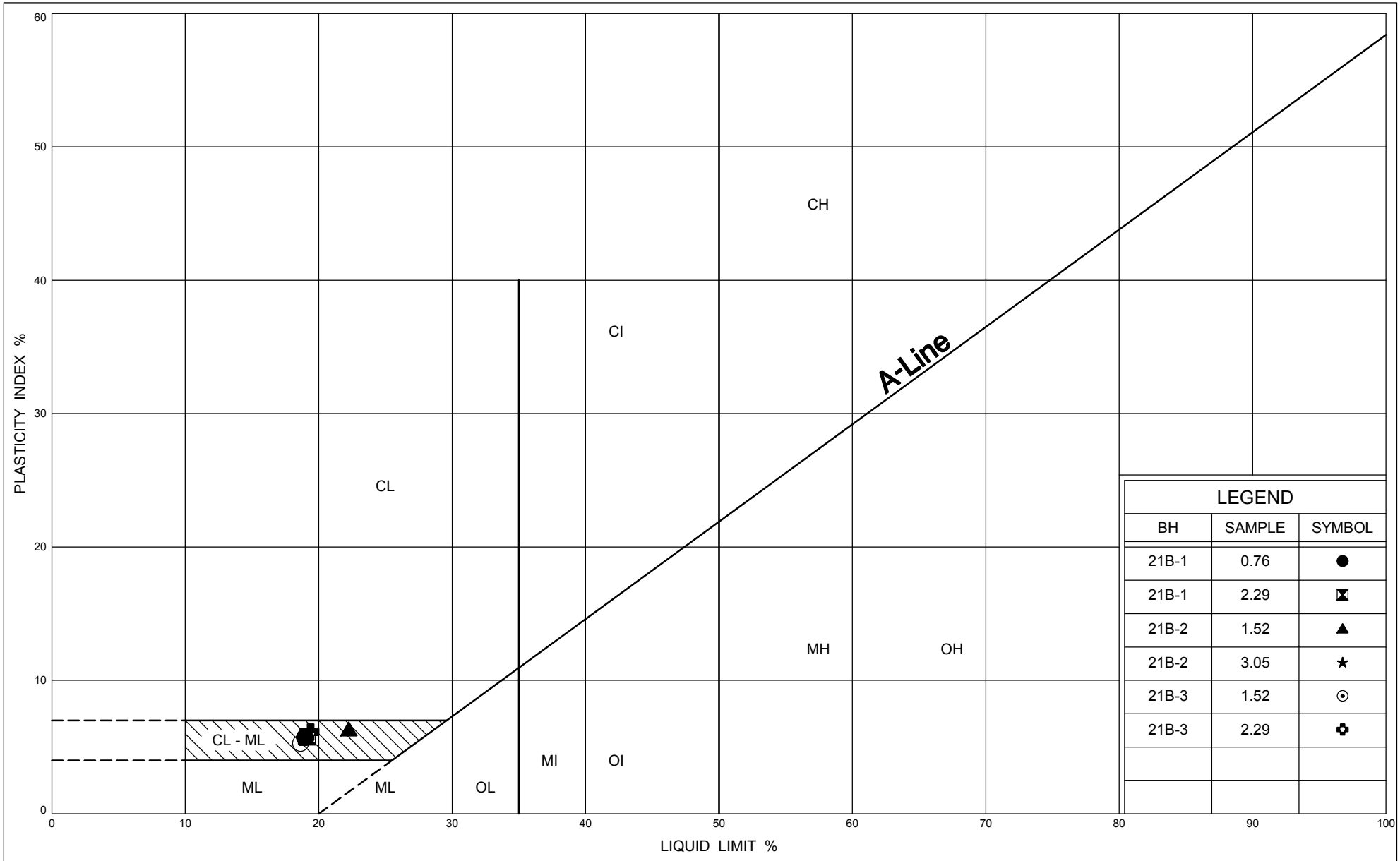
CLAYEY SILT TILL, CL-ML

FIG No C- 21B.1

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART SMALL CULVE 07-6-IEG1B.GPJ ONTARIO MOT.GDT 21/11/09

Ministry of Transportation
Ontario

PLASTICITY CHART
CLAYEY SILT TILL, CL-ML

FIG No C- 21B.2

GWP 167-91-00

Hwy 26 - Sydenham Townline to Meaford

Appendix C

Limitations of Report

APPENDIX C

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

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

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Infrastructure Engineering Group Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, IEG recommends that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Appendix D

Site Photographs

Culvert 2B Inlet

Culvert 2B Outlet

Culvert 3B, Inlet

Culvert 3B, Outlet

Culvert 5B Inlet

Culvert 5B Outlet

Culvert 6B, Inlet

Culvert 6B, Outlet

Culvert 7B Inlet

Culvert 7B Outlet

Culvert 8B, Inlet

Culvert 8B, Outlet

Culvert 9B Inlet

Culvert 9B Outlet

Culvert 10B, Inlet

Culvert 10B, Outlet

Culvert 11B Inlet

Culvert 11B Outlet

Culvert 12B, Inlet

Culvert 12B, Outlet

Culvert 13B Inlet

Culvert 13B Outlet

Culvert 14B, Inlet

Culvert 14B, Outlet

Culvert 15B Inlet

Culvert 15B Outlet

Culvert 16B, Inlet

Culvert 16B, Outlet

Culvert 17B Inlet

Culvert 17B Outlet

Culvert 18B, Inlet

Culvert 18B, Outlet

Culvert 19 Inlet

Culvert 19B Outlet

Culvert 20B, Inlet

Culvert 20, Outlet

Culvert 21B Inlet

Culvert 21B Outlet