

**PRELIMINARY FOUNDATION INVESTIGATION REPORT
CUT AND FILL SECTIONS
PROPOSED HIGHWAY 11 REALIGNMENT AND MUNICIPAL ROAD
KATRINE, ONTARIO
W.P. 314-99-00**

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December 20, 2001**

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Table of Contents

1. INTRODUCTION	1
2. SITE DESCRIPTION AND GEOLOGY	2
3. INVESTIGATION PROCEDURES	3
4. SUBSURFACE CONDITIONS	6
4.1 Site 1 - Highway 11/Three Mile Lake Road Crossing Area (Station 11+960 TO ~12+210 south shore of Magnetawan River-North Crossing – Boreholes 11+960SBL, 11+960NBL, 11+978SBL, 11+995SBL, 11+995NBL, TMS1 through 4, TMN1 through 4, 12+110SBL, 12+110NBL, 12+144NBL, 12+147, MRS1-2-3, MRN1-2-3 and MR1-2-3)	6
4.1.1 Peat and Topsoil	8
4.1.2 Fill	8
4.1.3 Surficial Silt	8
4.1.4 Silty Clay	9
4.1.5 Silt	11
4.1.6 Surficial Alluvial Deposits (South Shore of Magnetawan River)	12
4.1.7 Fine Sand	13
4.1.8 Gravel and Sand with Cobbles and Boulders	14
4.1.9 Bedrock	15
4.1.10 Groundwater Conditions	15
Drawing No. 1	Borehole Location Plan
Appendix A1	Record of Boreholes
Appendix B1	Laboratory Test Results
4.2 Site 2 - Highway 11 Crossing Under Proposed Municipal Road (Boreholes 12+920SBL and 12+923NBL)	17
4.2.1 Topsoil	17
4.2.2 Silty Clay	17
4.2.3 Silt	18
4.2.4 Groundwater Conditions	19
Drawing No. 2	Borehole Location Plan
Appendix A2	Record of Boreholes
Appendix B2	Laboratory Test Results
4.3 Site 3 – Highway 11 Alignment Swamp Crossing Between Stations 13+110 and 13+150 (Boreholes 0H11, 13+119, 13+122SBL, 13+125, 13+125A, 13+130, 13+130A, 13+132NBL)	20
4.3.1 Site Description	20
4.3.2 Fieldwork	20
4.3.3 Subsurface Conditions	21

	Drawing No. 3.....	Borehole Location Plan
	Appendix A3.....	Record of Boreholes
	Appendix B3.....	Laboratory Test Results
4.4	Site 4 – Highway 11 Crossing Over Swampy Area Between Station 15+625 and 15+965 (Boreholes 15+625NBL, 15+650, 15+788NBL, 15+788SBL, 15+850SBL, 15+900 and 15+965SBL)	25
4.4.1	Topsoil and Peat	25
4.4.2	Fill	25
4.4.3	Surficial Silt	26
4.4.4	Silty Clay.....	26
4.4.5	Lower Silt.....	28
4.4.6	Silty Sand With Some Gravel	28
4.4.7	Groundwater Conditions	28
	Drawing No. 4.....	Borehole Location Plan
	Appendix A4.....	Record of Boreholes
	Appendix B4.....	Laboratory Test Results
4.5	Site 5 – Highway 11 Alignment – Cut Section Between Stations 15+965 and 16+200 (Boreholes 15+965SBL, 16+050, 16+085SBL, 16+125 and 16+200SBL)	30
4.5.1	Topsoil and Peat	31
4.5.2	Surficial Silt	31
4.5.3	Silty Sand with Traces to some gravel	32
4.5.4	Silty Clay/Clay	32
4.5.5	Lower Silt.....	33
4.5.6	Bedrock	34
4.5.7	Groundwater Conditions	34
	Drawing No. 5.....	Borehole Location Plan
	Appendix A5.....	Record of Boreholes
	Appendix B5.....	Laboratory Test Results
4.6	Site 6 – Municipal Service Road Alignment – Swampy Area Crossing/High Fill Area Between Stations 7+662 and 7+723 – Boreholes 7+662, 7+675, 7+685(DCPT) 7+692, 7+704, 7+711 (DCPT) and 7+723.....	35
4.6.1	Fill	36
4.6.2	Topsoil	36
4.6.3	Upper Silt.....	36
4.6.4	Silty Clay.....	37
4.6.5	Lower Silt.....	37
4.6.6	Bedrock	38
4.6.7	Groundwater Conditions	39
	Drawing No. 6.....	Borehole Location Plan
	Appendix A6.....	Record of Boreholes
	Appendix B6.....	Laboratory Test Results

4.7	Site 7 – Municipal Service Road – Deep Cut Section Between Stations 7+740 and 7+900 – Boreholes 7+723, 7+750,7+900,7+925 and Test Pits 7+775, 7+800, 7+825, 7+850, 7+865, 7+875 and 7+905.....	40
4.7.1	Overburden.....	41
4.7.2	Bedrock	43
4.7.3	Groundwater Conditions	44
	Drawing No. 6..... Borehole Location Plan	
	Appendix A7..... Records of Boreholes and Test Pits	
	Appendix B7..... Laboratory Test Results	
	Appendix C..... Explanation of Terms Used in Report	

SITE LOCATION PLAN**DRAWING A**

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1. INTRODUCTION

Shaheen & Peaker Limited (S&P) was retained by Stantec Consultants Limited to conduct a preliminary foundation investigation for a number of cut and fill sections along the proposed realignment of Highway 11 and a new municipal road across Katrine.

The sections investigated are designated as Sites 1 through 7 for the purposes of this report (see Drawing A), as follows:

- Site 1 - Highway 11/Three Mile Lake Area – Station 11+960 (about 100 m south of Three Mile Lake Road) to Station 12+210 (near the south shore of Magnetawan River) – High Fills
- Site 2 - Highway 11 crossing under proposed municipal road (Station 12+920) – High Fills.
- Site 3 - Highway 11 crossing over a swampy area between Stations 13+110 and 13+150 – High Fills
- Site 4 - Highway 11 crossing over a swampy area between Stations 15+625 and 15+965 – Shallow Fills
- Site 5 - Highway 11 alignment between Stations 15+965 and 16+200 – Cuts
- Site 6 - Municipal Road crossing over a swampy area between Stations 7+662 and 7+723 – High Fills
- Site 7 - Municipal Road alignment between Stations 7+740 and 7+900 - Cuts

The purpose of the investigation was to obtain preliminary subsurface information at the site by means of a limited number of boreholes and test pits.

The findings of the investigation are presented in this report.

2. SITE DESCRIPTION AND GEOLOGY

In general, the proposed Highway 11 and the new municipal road alignments in the vicinity of Katrine cross through a landscape which is undulating, hummocky and well treed. It is characterized by two crossings (designated as north and south crossings) of Magnetawan River which meanders across the middle portion of the proposed alignment. In addition to the valleys created by the Magnetawan River, there are several other valleys along with some adjacent high points (hills) generally showing rock outcrops (or rock knobs with a shallow overburden cover).

Available geological information indicates that the site is located within an area of ice-contact sediments. After the last glacial withdrawal, ice-contact sediments of sand and gravel, followed by glacio-fluvial sediments of deltaic and nearshore sands and gravel, as well as lake bottom silts and clays, were deposited on top of the existing sandy glacial till or directly on the Precambrian bedrock. The area was then inundated by the glacial lake Algonquin, depositing sands, silts and clays in low-lying areas. The bedrock underlying the general area is known to consist of Precambrian (igneous) gneiss formations encountered at depths ranging from the ground surface to more than 50 m.

3. INVESTIGATION PROCEDURES

The fieldwork for the investigation was performed during the period of March-July 2001 and consisted of the following:

Site 1	-	26 boreholes
Site 2	-	2 boreholes
Site 3	-	8 boreholes
Site 4	-	7 boreholes
Site 5	-	5 boreholes
Site 6	-	7 boreholes
Site 7	-	4 boreholes and 7 test pits

The boreholes were advanced using track mounted drilling rigs owned and operated by Groundworks Drilling Inc., under the full time supervision of geotechnical personnel from S&P. The shallow boreholes were extended using solid stem and/or hollow stem continuous flight augers, while in the deep boreholes casing and washboring methods were utilized especially where fine sand with high groundwater was encountered. In most cases, heavy drilling mud had to be used in the casing to counterbalance the hydrostatic head. The rods and the sampler were withdrawn slowly while pouring mud into the hole to prevent soil back-up and to minimize disturbance of the in-situ soil. In spite of these precautionary measures, some inevitable disturbance may have affected N-values recorded.

Sampling in the boreholes was effected at frequent intervals of depth by the Standard Penetration Test method (SPT), as specified in ASTM Method D1586. This consists of freely dropping a 63.5 kg. hammer a vertical distance of 0.76 m to drive a 51 mm diameter O.D. split barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance or the N-value of the soil and this gives an indication of the consistency or the compactness condition of the soil deposit.

Where the consistency of the soil permitted in the cohesive (clayey) deposits, the undrained shear strength of the soil was measured in-situ by means of

field vane tests using an MTO type field vane and relatively undisturbed samples were taken by means of thin walled Shelby tube samplers.

In addition, dynamic cone penetration tests (DCPT) were performed adjacent to, from within and from the bottom of some of the boreholes. This test consists of driving a 60°-point, 50 mm diameter cone continuously into the undisturbed ground with a driving energy of 475J (63.5 kg hammer dropping freely a distance of 76 cm) per blow, similar to SPT. The number of blows for each 300 mm of penetration is recorded and this provides an indication of the relative changes in the soil density with depth.

Due to the presence of cobbles and boulders frequent coring had to be resorted to in the deep boreholes below a depth of about 35 to 40 m.

Piezometers were installed in a number of boreholes to enable us to monitor the groundwater level over a prolonged period of time without interference from surface water. Water levels in the piezometers were monitored during subsequent site visits.

The results of drilling, in-situ testing and water level observations are given on the Record of Borehole Sheets in Appendices A1 through A7.

Upon their completion, the boreholes were backfilled to about 8 m below the ground surface with soils brought up by augering (i.e. auger cuttings). The upper 8 m of the open boreholes was then grouted using a cement/bentonite mixture.

Site 3 was inaccessible with a regular, motorized drill rig and, therefore, the majority of the boreholes at this site were put down using portable equipment. The boreholes were advanced by driving a standard split-spoon sampler into the ground using a 31.75 kg hammer, as elaborated in Section 4.3.2 of this report.

Test pits were dug at Site 7, using a backhoe.

A laboratory testing programme, consisting of natural moisture content, bulk unit weight, Atterberg Limits, consolidation, quick triaxial compression tests and grain-size analyses, was performed on selected soil samples. The results of laboratory tests are presented on the appropriate Record of Borehole Sheets and also in Appendices B1 through B7.

4. SUBSURFACE CONDITIONS

4.1 SITE 1 - HIGHWAY 11/THREE MILE LAKE ROAD CROSSING AREA (STATION 11+960 TO ~12+210 NEAR SOUTH SHORE OF MAGNETAWAN RIVER-NORTH CROSSING – BOREHOLES 11+960SBL, 11+960NBL, 11+978SBL, 11+995SBL, 11+995NBL, TMS1 THROUGH 4, TMN1 THROUGH 4, 12+110SBL, 12+110NBL, 12+144NBL, 12+147, MRS1-2-3, MRN1-2-3 AND MR1-2-3)

At about Station 11+800, the existing grade along the proposed new alignment of Highway 11 is about 304 m and from thereon, northerly towards the Three Mile Lake Road crossing (Station 12+050) it drops to a low of about 294.5 m. Further north, it rises for a horizontal distance of about 100 m to about Elevation 298 m, remains relatively level for about 40 m then falls to the south shore of Magnetawan River, within about 50 m to about Elevation 294 m, the bottom Elevation for the River being about 289 m.

Boreholes 11+960SBL, 11+960NBL, 11+978SBL, 11+995SBL and 11+995NBL drilled in a wooded area between Station 11+960 and the Three Mile Lake Road crossing (Elevation 298-296), showed, below a veneer of topsoil, the presence of silt to depths ranging between 2.1 and 4.4 m, underlain by silty clay to clayey silt with a thickness of about 5 to 6 m. The silty clay to clayey silt is in turn underlain by a lower silt deposit to the full depth of the investigation (about 10 to 11 m).

At Boreholes TMS1-4 and TMN1-4, which were drilled at the Three Mile Lake Road crossing sites (Station 12+013-12+077; Elevation 296-294 m), the surficial silt was found to extend to 1.5 to 3.0 m below the ground surface, underlain by silty clay. The thickness of the silty clay to clayey silt was found to be 6.0 to 7.5 m in the boreholes drilled on the south side of the Road and 1.5 to 3.6 m on the north side. The silty clay to clayey silt is underlain by the lower silt deposit. Below depths of about 6 to 9 m, the site is underlain by an extensive deposit of fine sand with a variable silt content and some sandy silt, silty sand and fine to medium sand zones. Underlying this sand deposit, a gravel and sand deposit with cobbles and boulders was contacted at depths of 35 to 41 m, except in Borehole TMS1 which was extended to in excess of 47 m without contacting this coarser deposit.

At this middle section of the site, the groundwater level at the time of our investigation was recorded close to the ground surface and a slight artesian condition (i.e. water level slightly above the ground surface) was found in one of the deep piezometers installed.

Further north, in Boreholes 12+110SBL, 12+110NBL, 12+144NBL and 12+147 (Elevation 298-295 m) between the Three Mile Lake Road crossing and the north crossing of the Magnetawan River, the surficial silt deposit is missing and the underlying silty clay to clayey silt was contacted immediately beneath the topsoil or surficial fill. In these boreholes, the silty clay to clayey silt extends to depths of about 4 to 6 m and is underlain by the lower silt which is in turn underlain by silty fine sand at depths of 7 to 8 m.

Further to the north, boreholes drilled near the south shore of Magnetawan River for proposed bridge structures (Boreholes MRS1-2-3, MRN1-2-3, MR1-2-3, Elevations 299.9 –293.6 m) showed the presence of the silty clay to clayey silt in only four of the boreholes drilled away from the shore and/or at higher elevations. In these four boreholes (MRS3, MRN3, MR1 and MR3) the silty clay to clayey silt extended to depths of between 0.8 and 4.6 m or to Elevations 296.0 to 292.2 m. Underlying this silty clay or immediately below the topsoil, the boreholes showed the presence of fine grained granular deposits (generally of alluvial origin) ranging from silt to silty fine sand to depths of between 1.4 and 7.3 m (Elevations 294.4 and 288.4 m). These are underlain by an extensive deposit of fine sand (similar to the Three Mile Lake Road crossing) which extends to depths of 16.5 (Elevation 278.1 m) and 22.0 m (Elevation 273.8 m). Observations made in the deep boreholes indicate that, similar to the Three Mile Lake Road crossing, this deposit is under excess upward hydrostatic pressure.

In the deep boreholes, the fine sand is underlain by sand and gravel with frequent cobbles and boulders, to the surface of gneiss bedrock at depths ranging from 19.0 m (Elevation 275.8 m) to 23.9 m (Elevation 271.4 m). The groundwater level was recorded 0.2 to 0.3 m below the ground surface.

Details of the subsurface conditions encountered in the boreholes are presented on the Record of Borehole Sheets in Appendix A1. The individual strata are briefly described in the following paragraphs.

4.1.1 PEAT AND TOPSOIL

In Boreholes TMS1 and TMS4, drilled at the Three Mile Lake Road crossing site, peat was contacted, extending to depths of 150 and 300 mm, respectively, while in most of the remaining boreholes a 50 to 700 mm thick layer of topsoil was contacted. In Borehole MRS3, a 200 mm thick topsoil layer was contacted underlying a granular fill. It should be pointed out that at the time of our investigation the surface zones were generally frozen and this rendered an accurate identification of the upper zones of the subsoil rather difficult.

4.1.2 FILL

Fill was contacted in Boreholes MRS3, MRN3, 12+147, 12+144NBL and 12+110SBL (all located to the north of the Three Mile Lake Road crossing) to depths extending between 0.2 and 0.9 m. The fill contacted in these boreholes were generally granular (sand and gravel or gravelly sand) which in places was found to be mixed with some organics and topsoil.

In Boreholes MRN1, a layer of silt with traces of organics was contacted extending to a depth of 1.0 m below the ground surface. This is a fine-grained granular material and was identified as 'possible fill.' Based on an N-value of 2 blows/0.3 m, its denseness condition is described as very loose.

4.1.3 SURFICIAL SILT

Underlying the topsoil and peat all the boreholes drilled at or to the south of the Three Mile Lake Road crossing contacted a surficial silt overlying a deposit of silty clay to clayey silt.

This deposit extended to a depth of about 4 m at the most southerly borehole drilled at Station 11+960. Its thickness was found to decrease to about 3 m further north, approaching the Three Mile Lake crossing. At this crossing, its thickness was recorded from about 3.0 to 1.5 m and further north it disappeared.

It consists of silt with sandy silt zones and occasional clayey silt and silty sand seams/lenses. The grain size distribution of samples from the deposit is given in Figure B1-1, Appendix B1. These show the following grain size distribution:

Gravel:	0%
Sand:	5-27%
Silt:	66-85%
Clay:	5-14%

In general, depending on the clay content, the soil exhibits a non-cohesive (fine-grained granular) character, with occasional cohesive zones.

Standard Penetration tests performed in this deposit gave N-values ranging from 2 to 17 blows/0.3 m (generally 4 to 10 blows) indicating a very loose to compact condition with occasional soft to firm (cohesive) zones.

In Borehole TMS3, the upper 1.8 m of the soil was identified as a possible fill material. From 1.8 m to 2.3 m, the soil consisted of organic silt to clayey silt. This material was dark grey to black in color and from an N-value of 2 blows/0.3 m, along with visual and tactile examination of the soil sample, it is described as very soft and highly compressible.

4.1.4 SILTY CLAY

Underlying the surficial silt, all boreholes at and south of the Three Mile Lake Road crossing encountered silty clay to clayey silt. This deposit was also contacted immediately below the surficial fill or topsoil in the boreholes drilled north of the road crossing except near the shore of the River.

The thickness of this deposit generally ranges from about 5 to 6 m to the south of the Three Mile Lake Road crossing, increasing to about 6 to 7.5 m at the south side of the crossing while on the north side of the crossing the thickness decreases to 1.5 to 3.6 m. Further north the silty clay to clayey silt comes to the surface and extends to about 4 to 6 m below grade, tapering off to about 0.8 m towards the River. It was not contacted in the majority of the boreholes drilled at the south shore of the River.

At most locations, this deposit is a layered material with very thin (2 to 3 mm thick) clay and thin (15-30 mm) silty clay to clayey silt and occasional silt seams, akin to a varved clay; it does not, however, exhibit a true varved clay structure with regular yearly seams/layers ranging from clay to silt or fine sand.

Some zones of the deposit do not exhibit this layered structure where the material was noted to exhibit a dilatant structure in spite of its relatively high clay size particle content. This can be attributed to clay size particles being inactive (e.g. rock flour rather than true clay particles).

The results of grain-size distribution analyses carried out on seven selected samples are given in Figure B1-2, Appendix B1. They indicate the following particle size distribution:

Gravel	=	10%
Sand	=	3-13%
Silt	=	45-65%
Clay	=	23-50%

In general, the material is more silty near the surface and near the bottom of the deposit in comparison with the middle portion. The grain size distribution of samples from these more silty zones of the material is given in Figure B1-3 of Appendix B1 as follows:

Gravel	=	0%
Sand	=	10-20%
Silt	=	55-64%
Clay	=	16-35%

This deposit is described as a cohesive material and Atterberg limits tests performed in the laboratory on samples from the deposit gave the following index values.

Liquid Limit:	27-44%
Plastic Limit:	21-25%
Plasticity Index:	6-19%

As shown in Figures B1-4 and B1-5 in Appendix B1, these values are characteristic of clayey soils of low to medium plasticity. As the overall behavior of the soil would be that of a silty clay, the material has been entitled 'silty clay.' The measured natural moisture contents generally range from 20 to 46%, that is, generally near or in excess of the measured liquid limit values (except in the upper

desiccated zone to the north of the Three Mile Lake Road where the deposit surfaces near the existing ground levels).

When analyzing these laboratory test results, it must be remembered that in many cases the tested samples consisted of individual seams of predominantly plastic clay to relatively thicker low plasticity silty clay and silt seams of little or no plasticity.

Standard Penetration tests performed in this deposit yielded N-values ranging from 1 to 9 blows but generally 2 to 6 blows/0.3 m, except to the north of the road crossing towards the River where the deposit comes close to the surface and in the upper desiccated zones in this stretch, the recorded values generally range from 5 to 16 within the upper 1.5 m. Field vane tests yielded undrained in-situ shear strength values ranging from 32 to in excess of 100 kPa. A quick triaxial compression laboratory test gave a value of 44 kPa. These values indicate that the consistency of material can be described as being soft to stiff but typically stiff except for the upper desiccated zone in the boreholes drilled to the north of the Three Mile Lake Road crossing where it can be described as stiff to very stiff.

Three consolidation tests were performed on samples from the deposit (from Boreholes TMS1, 11+960SBL and 12+140SBL) and the results are presented in Figures B1-6, B1-7 and B1-8 in Appendix B1. From the results, an overconsolidation ratio (OCR) i.e. $P_c' - P_o' / P_o'$ of between 3 and 5 can be assigned to the deposit.

4.1.5 SILT

The varved-like silty clay to clayey silt to the south of the River crossing site, attains, with increasing depth, a relatively coarser texture and becomes primarily silt with some clayey silt, silty clay and very thin clay seams and occasional sandy zones. This lower silt deposit was contacted underlying the silty clay at depths ranging between about 4 and 9 m (Elevations 293.7 and 286.8 m) in the boreholes drilled south of the River crossing. Some of the boreholes were terminated in this deposit while in others the lower silt is underlain by silty fine sand or fine sand at depths of about 6 to 10 m below the ground surface.

N-values recorded in this deposit generally range from 2 to 15 blows/0.3 m. Lower N-values were also recorded but these can be attributed to disturbance due to unbalanced hydrostatic pressures while sampling and testing. Based on these results, the denseness condition of the deposit can be described as very loose to compact, but generally loose.

The grain-size distribution of samples from the deposit is given in Figure B1-9, Appendix B1. These indicate the following grain-size distribution range.

Gravel:	0%
Sand:	1-43%
Silt:	55-96%
Clay:	0-4%

The silt was observed to be in a saturated condition with measured natural moisture contents generally ranging from 18 to 36%.

4.1.6 SURFICIAL ALLUVIAL DEPOSITS (SOUTH SHORE OF MAGNETAWAN RIVER)

Underlying the topsoil, surficial fill or the laminated silty clay, all boreholes drilled at the River crossing site contacted alluvial silt to silty sand materials. In general, these materials contain some organics (e.g. decomposed roots) and decayed wood. These alluvial soils extend at the site of the Highway 11 SBL Bridge (i.e. MRS series boreholes) from 6.0 to 7.3 m below the ground surface or to about Elevation 288.5 m; at the Highway 11 NBL bridge site (MRN series boreholes) from 2.1 to 4.5 m below the ground surface or to Elevation 293.2-290.0 m and at the E, W-N bridge site (MR series boreholes) from 1.4 to 6.1 m depth or to Elevation 294.4 to 293.8 m.

These are considered basically fine grained granular soils with occasional cohesive silt zones. The grain size distribution of typical samples from the deposit is given on Figures B1-10 and B1-11 (Appendix B1).

These indicate the following particle sizes.

Gravel:	0%
Fine sand:	4 - 45%
Silt:	51-96%
Clay:	0-3%

Figure B1-12 in Appendix B1 shows the grain size distribution of samples obtained from the cohesive zones which indicate

Gravel:	0%
Fine sand:	1 - 13%
Silt:	82-91%
Clay:	5-8%

Standard Penetration tests performed in these surficial alluvium in Boreholes MRS1, 2 and 3 ranged from 0 to 6 blows/0.3 m while in MRN and MR series boreholes they ranged from 2 to 10 blows/0.3 m. Based on these values, together with Dynamic Cone Penetration test results, these materials are considered to be very loose to loose with occasional soft to firm zones.

4.1.7 FINE SAND

The alluvium at the River's south shore (at depths ranging from 1.4 to 7.3 m) and the lower silt in the remaining areas (at depths ranging from about 6 to 10 m depth) are underlain by an extensive fine sand deposit.

This deposit was explored in the deep boreholes drilled at the Three Mile Lake Road crossing where it extended to depths ranging from about 35 to in excess of 47 m and also at the River crossing (south shore) where it extended to 16.5 to 22 m below the ground surface.

This is a fine grained granular (i.e. non-cohesive) material with a variable silt content. Silty zones and occasional fine to medium sand and sandy silt zones/layers were also contacted.

The grain-size distribution of typical samples from the deposit is given in Figures B1-13 and B1-14 in Appendix B1, while Figures B1-15, B1-16, B1-17 and

B1-18 show the grain size distribution of samples from the silty sand/sandy silt zones and a silt layer in the deposit.

This deposit is water bearing and based on observations made while advancing the boreholes it is considered to be under excess hydrostatic pressure.

N-values recorded in the upper zones of the deposit (i.e. to 12 to 15 m below the ground surface) generally range from 0 to 17 blows/0.3 m while some of the low values may be due to inevitable disturbance during sampling caused by the upward hydrostatic pressures in the deposit. Nevertheless, the results indicate that in this upper section the material is generally very loose to loose with some compact zones. Below about 12 to 15 m depth, the recorded values range from 3 to 53 blows/0.3 m. Based on these values together with dynamic cone penetration test results, the relative density below 12 to 15 m is described as being generally compact to dense with occasional possible loose zones.

4.1.8 GRAVEL AND SAND WITH COBBLES AND BOULDERS

The majority of the deep boreholes contacted a coarse grained granular soil consisting of gravel and sand with cobbles and boulders underlying the fine sand at depths of 35 to 41 (Elevation 260-254 m) at the Three Mile Lake Road crossing site and 16.5 to 22.0 m depth (Elevation 278-274 m) at the south shore of the River crossing.

The majority of the boreholes at the Three Mile Lake Road crossing was terminated in this deposit at depths from 43 to 47 m (Elevation 252-248 m), while at the south shore of the River bedrock was contacted underlying this deposit at depths ranging from 19.0 to 21.3 m or at Elevation 275.6 m to 273.8 m.

Based on the recorded N-values together with the dynamic cone penetration test results, the denseness condition of the deposit is inferred to be compact to very dense.

4.1.9 BEDROCK

Bedrock was contacted at the south shore of the River crossing at the following depths/elevations:

Bridge Site	Borehole No.	Bedrock Depth (m)	Elevation (m)
Highway 11 SBL	MRS1	19.0	275.6
	MRS2	21.3	273.8
Highway 11 NBL	MRN1A	22.3	271.6
	MRN2	23.9	271.4
E,W-N Ramp	MR1	22.4	273.4

The bedrock consists of Precambrian gneiss with a color ranging from white to various shades of grey. From the recovered cores, the bedrock is considered to be generally massive and unweathered with some slightly to moderately weathered and jointed zones.

4.1.10 GROUNDWATER CONDITIONS

Water level observations in the boreholes were made where feasible during the drilling and at the completion of each borehole. In most cases, water and/or drilling mud was added to the boreholes to counterbalance the hydrostatic pressures in the lower silt and fine sand deposits. For these reasons, the recorded values in the open boreholes are unlikely to represent the stabilized water levels.

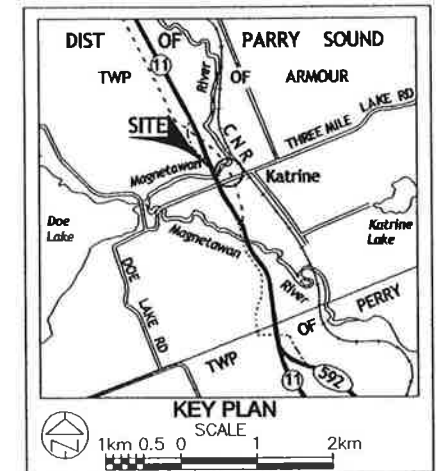
To enable us to monitor groundwater level over a prolonged period of time without interference from surface water, piezometers were installed in some of the deep boreholes (TMN1, TMS2, MRS2, MRN2 and MR1). The recorded water levels in the piezometers were generally 0.1 to 0.3 m below the ground surface, except in one case where water level was up to 0.3 m above the ground surface (Borehole TMN2), indicating a slight artesian condition, emanating from within the lower portions of the fine sand or from the gravel and sand deposit.

In our opinion, the groundwater level at the time of our investigation to the south and north of the Three Mile Lake Road sites, where the ground surface elevation is relatively higher, was about 1 to 2 m below the ground surface, while at the Three Mile Lake Road crossing site where the grade is lower, it was generally within 1 m of the ground surface. At the River crossing, the boreholes drilled at the

south shore indicate that the water level was within 1 m and generally about 0.3 m below the ground surface.

The groundwater table can be expected to fluctuate seasonally and in response to major weather events.

BOREHOLE LOCATION PLAN
SITE 1 - HIGHWAY 11
THREE MILE LAKE ROAD CROSSING AREA



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
MR1	295.8	5 048 558.7	316 421.4
MR2	294.6	5 048 560.1	316 416.9
MR3	299.9	5 048 553.3	316 435.3
MRN1	293.6	5 048 546.9	316 388.0
MRN1A	293.9	5 048 543.4	316 390.2
MRN2	295.3	5 048 533.8	316 395.9
MRN3	297.0	5 048 516.2	316 406.2
MRS1	294.6	5 048 539.9	316 348.9
MRS2	295.1	5 048 527.9	316 348.2
MRS3	295.8	5 048 513.8	316 362.6
TMN1	295.0	5 048 364.9	316 478.4
TMN2	294.9	5 048 391.7	316 467.1
TMN3	294.9	5 048 401.7	316 461.9
TMN4	295.8	5 048 343.0	316 484.0
TMS1	295.8	5 048 343.2	316 441.2
TMS2	294.8	5 048 373.3	316 423.0
TMS3	294.8	5 048 385.9	316 425.4
TMS4	295.8	5 048 327.5	316 446.6
11+960NBL	297.1	5 048 287.9	316 499.3
11+960SBL	297.9	5 048 278.7	316 466.5
11+978SBL	297.0	5 048 295.2	316 459.7
11+995NBL	296.3	5 048 323.5	316 493.8
11+995SBL	296.2	5 048 312.5	316 459.0
12+110NBL	295.9	5 048 429.5	316 443.7
12+110SBL	295.0	5 048 414.4	316 409.9
12+144NBL	298.2	5 048 459.8	316 427.2
12+147	298.2	5 048 459.0	316 418.7

NOTE:
FOR DETAILED SUBSURFACE
CONDITIONS REFER TO
RECORD OF BOREHOLE SHEETS.

50 m
ON ORIGINAL DRAWING

SCALE 1:1000	DRAWING No. 1	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTW	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F

APPENDIX A1

Site 1


Records of Boreholes

RECORD OF BOREHOLE No 11+960 SBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 278.7; E 316 466.5 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T
DATUM Geodetic DATE 22.04.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) w _p w w _L						
297.9	Ground Surface							20	40	60	80	100							
0.0	100 mm Topsoll		1	SS	4		297								○			19.5	0 5 81 14
	SILT <i>Sandy</i>		2	SS	6		296								○				
	trace clay and sand, brown to 1.4 m, grey below, some clayey silt layers below 1.4 m, very loose to loose, moist to wet		3	SS	2		295								○				
			4	SS	5		294								○				
			5	SS	5		293								○				
			6	SS	4		292								○				
293.5			7	TW	PH		291												
4.4	occasional silt lenses		8	SS	3		290									○			
	SILTY CLAY very soft to stiff, grey, moist to wet		9	SS	2														
289.8			10	SS	2														
8.1	End of borehole *Water level at 0.6 m (not stabilized) and hole open to 6.8 m on completion																		

+³, ×³: Numbers refer to
Sensitivity


20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 11+960 NBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 287.9; E 316 499.3 ORIGINATED BY S.O
 DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers COMPILED BY G.T
 DATUM Geodetic DATE 19.04.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE					
297.1	Ground Surface						20	40	60	80	100					
0.0	150 mm Topsoil		1	SS	8								○			0 5 85 10
	SILT trace clay and sand, brown becoming grey at 1.4 m, loose to compact, wet		2	SS	11								○			
			3	SS	9								○			
			4	SS	10								○			
			5	SS	11								○			
293.4				6	SS		6							○		
3.7	SILTY CLAY laminated, occasional silt and fine sand seams soft to stiff, grey		7	SS	6									○		
			8	TW	PH									○	4.1	
			9	SS	2									○	3.8	
			10	SS	5									○	6	
288.5				11	SS		9								○	
8.6	SILT grey, wet	occasional clay partings stiff compact													○	
286.0				12	SS	15									○	
11.1	End of borehole *Water level at 3.4 m (not stabilized) and hole open to 8.8 m on completion															

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 11+978 SBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 295.2; E 316 459.7 ORIGINATED BY R.A.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers COMPILED BY G.T.
DATUM Geodetic DATE 19.04.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
297.0	Ground Surface						20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
0.0	75 mm Topsoll		1	SS	7									
	SILT	loose												
	with clayey silt	sandy												
	and silty fine sand	compact												
	seams													
	brown/moist													

	grey/wet													
		loose												
294.1														
2.9														
						</								

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 11+995 SBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11-Katrine, On - Coords: N 5 048 312.5; E 316 459.0 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers COMPILED BY GT
DATUM Geodetic DATE 02.04.01 CHECKED BY Z.O

SOIL PROFILE		STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
296.2	Ground Surface																
0.0	75 mm Topsoil		1	SS	8	*	296									21.0	0 3 59 38
	moist ----- wet		2	SS	9		295									19.6	
			3	SS	8		294									19.3	
294.1			4	SS	2		293										
2.1	SILTY CLAY soft to stiff grey		5	TW	PH		292									16.9	
			6	SS	1		291									17.3	
			7	SS	2		290										
			8	SS	2		289										
			9	SS	2												
		frequent silt layers		10	SS	7											
288.1																18.3	
8.1	End of borehole *Water added to hole to counter balance hydrostatic uplift. Water level not stabilized and borehole open to 7.2 m on completion.																

+ 3, x 3; Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 11+995 NBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrina, ON - Coords N 5 048 323.5; E 316 493.8 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers. COMPILED BY G.T
DATUM Geodetic DATE 18.04.01 CHECKED BY Z.O

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100	W P	W	W L		
296.3	Ground Surface															
0.0	150 mm Topsoil		1	SS	4											
			2	SS	13											
	SILT trace clay and sand, brown to 1.9 m, grey below, loose to compact wet		3	SS	14											
			4	SS	7											
			5	SS	5											
292.6			6	SS	6											
3.7	SILTY CLAY soft to stiff, grey		7	SS	5											
			8	TW	PH											
			9	SS	2											
	----- occasional silt layers		10	SS	5											
287.7			11	SS	15											
8.6	SILT laminated, compact, grey, wet		12	SS	13											
	occasional clay partings															
285.2																
11.1	End of borehole *Water level at 3.0 m (not stabilized) and hole open to 3.7 m on completion															

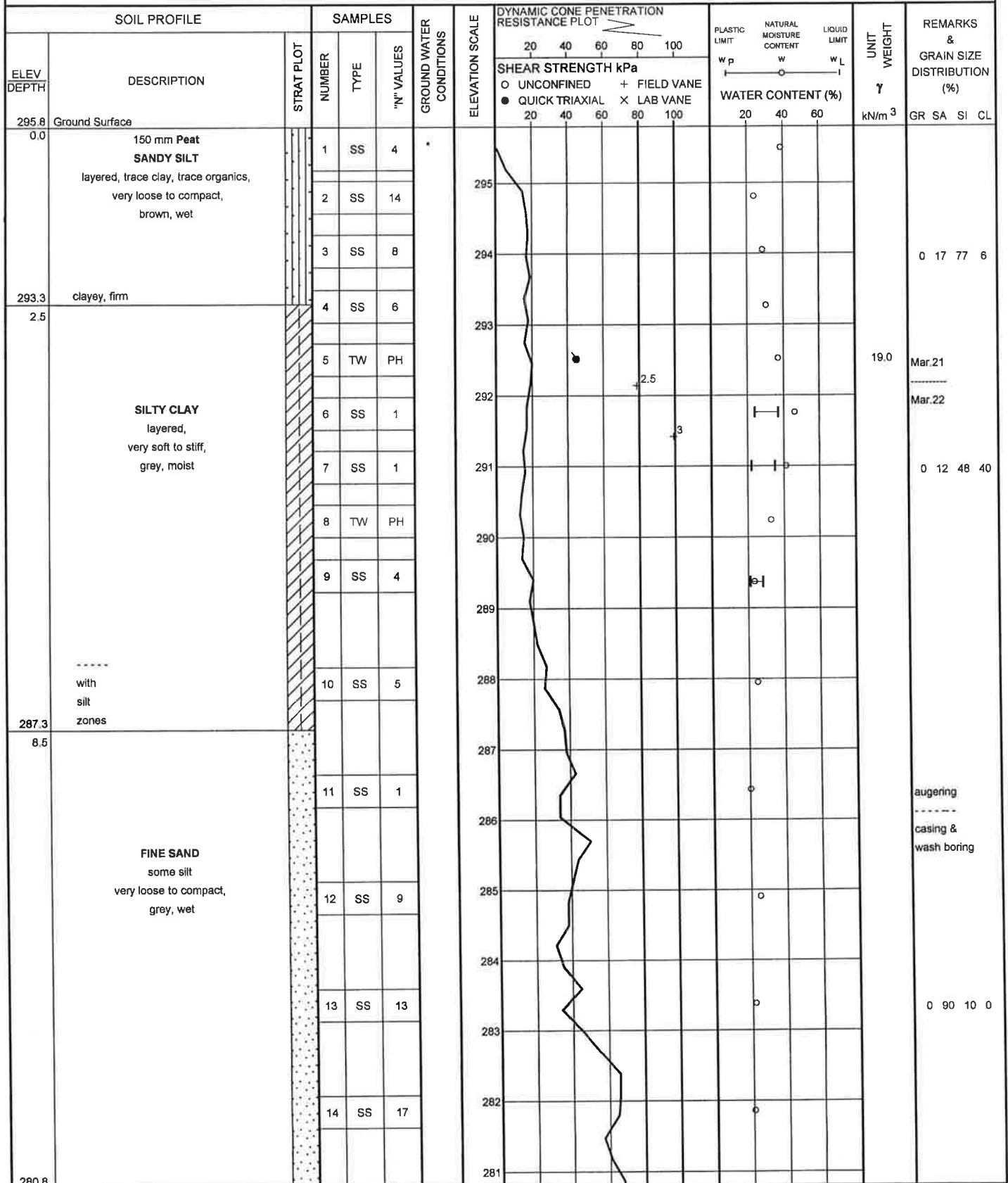
+ 3, x 3, Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS1

1 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 343.2; E 316 441.2 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 21.03.01 to 26.03.01 CHECKED BY Z.O



15.0

Continued Next Page

+ 3 . X 3 : Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

2 OF 4

METRIC

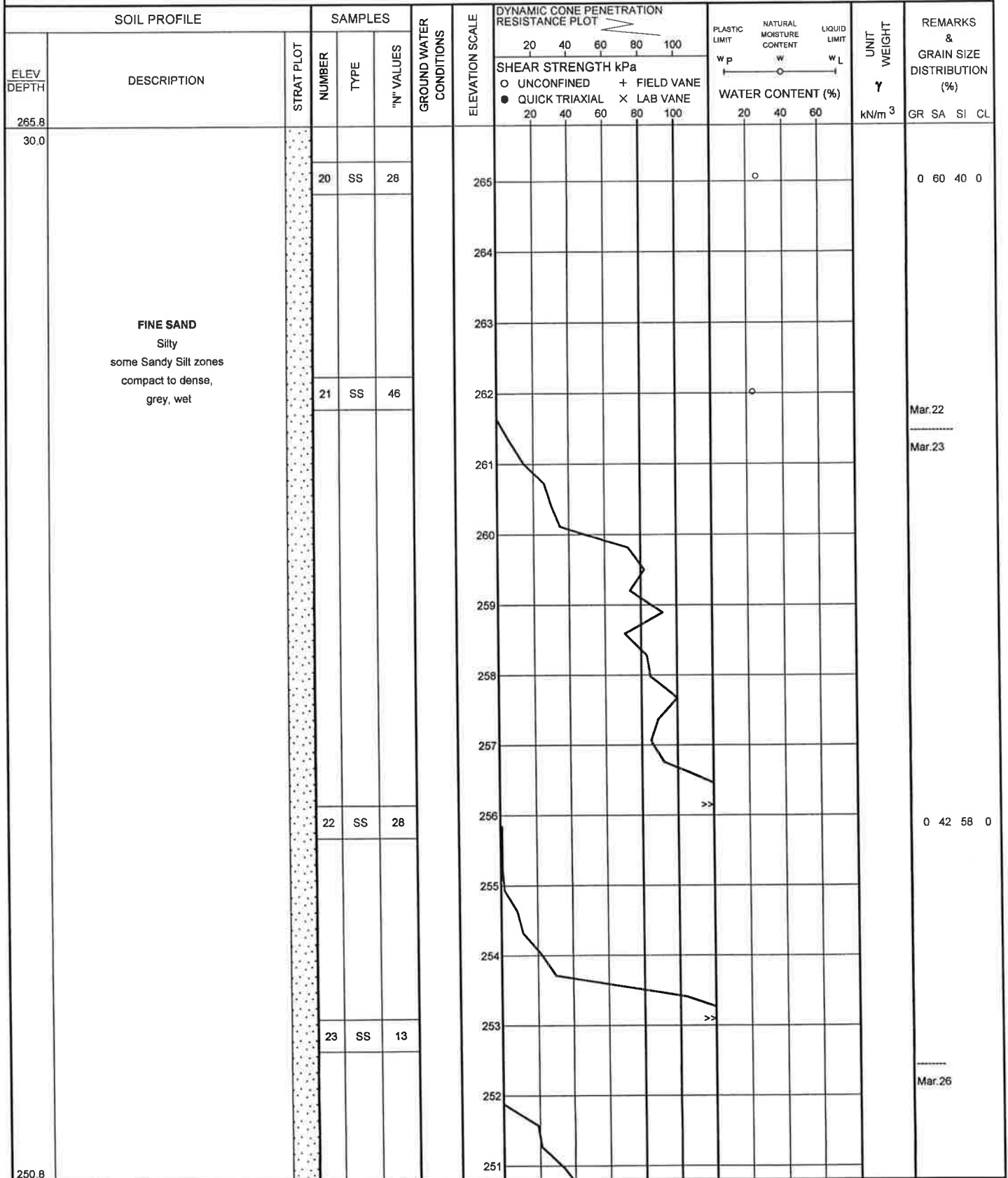
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS1

3 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 343.2; E 316 441.2 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 21.03.01 to 26.03.01 CHECKED BY Z.O



Continued Next Page

+³, x³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS1

4 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 343.2; E 316 441.2 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 21.03.01 to 26.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
250.8								<div>20 40 60 80 100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div> <div>w_p w w_L</div> <div>WATER CONTENT (%)</div>				
45.0	FINE SAND Silty, compact, grey, wet							<div>20 40 60 80 100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div> <div>w_p w w_L</div> <div>WATER CONTENT (%)</div>				
248.0			24	SS	8							
47.8	End of borehole Water used for wash boring and drilling mud for counter-balancing hydrostatic uplift *Water level not stabilized upon completion Wash boring from 9.1 m Sand rising in borehole (quick condition) from 36.5 m Dynamic Cone Penetration Test performed from 34.0 m to 39.6 m, soil stratigraphy inferred only. Dynamic Cone Penetration test performed from 40.0 m to 42.6 m, soil stratigraphy inferred only. Dynamic Cone Penetration test performed from 43.9 m to 46.3 m, soil stratigraphy inferred only. Dynamic Cone Penetration Test (DCPT) performed adjacent to the borehole from ground surface to 21.0 m											

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS2

1 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 373.3; E 316 423.0 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and Washboring, NQ Rock Coring & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 14.03.01 to 21.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W P W W L	W P W W L		
294.8	Ground Surface												
0.0	150 mm Topsoil SANDY SILT trace clay, occasional thin silty clay seams, very loose to compact, brown, moist		1	SS	3		294						0 27 66 7
			2	SS	8								
292.7			3	SS	17		293						
2.1	SILTY CLAY layered, soft to stiff, grey		4	SS	4		292					16.9	0 13 64 23
			5	TW	PH								
			6	SS	6		291						0 16 76 8
	with silt zones		7	SS	5		290						
289.6			8	SS	11		289						
5.2	SILT compact, grey, wet, dilatant		9	SS	10								
			10	SS	0		288						* low N-value probably due to hydrostatic uplift
	Sandy loose		11	SS	5		287						0 40 60 0
286.3							286						
8.5			12	SS	4		285						
	FINE SAND some silt, very loose to compact, grey, wet		13	SS	4		284						augering ----- casing and wash boring
			14	SS	10		283						
			15	SS	7		282						
							281						0 82 18 0
279.8							280						

15.0

Continued Next Page

+ ³, × ³ : Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS2

2 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 373 3; E 316 423 0 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and Washboring, NQ Rock Coring & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 14.03.01 & 21.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
279.8												
15.0			16	SS	15		279					March 14
												March 15
			17	SS	13		278					
			18	SS	14		277					
			19	SS	14		276					
			20	SS	16		275					
			21	SS	21		274					
			22	SS	19		273					
			23	SS	18		272					
			24	SS	23		271					
			25	SS	19		270					
							269					
							268					
							267					
							266					
							265					

FINE SAND
some silt,
compact,
grey, wet

Silty sand/Sandy Silt
zones

0 27 71 2

264.8

30.0

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS3

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Katrine - Three Mile Lake Road - Co-ords: N 5 048 385.9; E 316 425.4 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T.
DATUM Geodetic DATE 30.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE				W _p	W	W _L
294.8	Ground Surface						20 40 60 80 100		20 40 60						
0.0	150 mm Topsoil SILT some clay and sand some organics, brown, very soft, (possible fill)		1	SS	2										
			2	SS	4										
293.0			3	SS	2										
1.8	ORGANIC SILT & CLAYEY SILT very soft, dark grey/black														
292.5															
2.3	SILT some sand and clay, rootlets & organics, very soft, grey		4	SS	2										
291.8															
3.0	SILTY CLAY layered very soft to stiff grey		5	SS	4										
			6	TW	PH										
290.0			7	SS	2										
4.8	SILT some clay seams, loose, grey, wet, dilatent		8	SS	8										
			9	SS	8										
287.8															
7.0	Silty FINE SAND some silt, very loose to loose grey, wet		10	SS	4										
285.2			11	SS	5										
9.6	End of borehole *Water level at 1.8 m (not stabilized) and hole caved at 3.0 m upon completion														

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMS4

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Katrine - Three Mile Lake Road - Co-ords: N 5 048 327.5; E 316 446.6 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T
DATUM Geodetic DATE 02.04.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								WATER CONTENT (%)						
295.8	Ground Surface													
0.0	300 mm Peat (frozen) SILT some sand, trace to some clay, firm to stiff, brown		1	SS	5									
			2	SS	9									
	Clayey, firm		3	SS	8									
293.7														
2.1	SILTY CLAY very soft to firm, brown to 2.6 m, grey below		4	SS	4									
			5	SS	3									
			6	TW	PH									
			7	SS	1									
			8	SS	2									
			9	SS	2									
	with silt zones		10	SS	6									
287.3														
8.5	SILTY SAND trace of organics, loose, grey, wet, dilatent													
286.2			11	SS	6									
9.6	End of borehole *Water level at 5.7 m (not stabilized) and hole caved at 7.0 m upon completion													

+ 3 x 3 Numbers refer to
Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMN1

1 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 364.9; E 316 478.4 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing & washboring, NQ Rock Core & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 27.03.01 to 30.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
295.0	Ground Surface							20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		GR SA SI CL
0.0	700 mm Topsoil clayey, soft		1	SS	2			○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)				
294.3								20 40 60 80 100	20 40 60				
0.7	SANDY SILT loose, brown, wet		2	SS	9								
293.2			3	SS	4								
1.8	SILTY CLAY layered, very soft to stiff brown to 2.3 m, grey below		4	SS	4							0 6 56 38	
			5	SS	1							0 6 49 45	
			6	TW	PH								
			7	SS	2								
			8	SS	3								
			9	TW	PH								
			10	SS	9							0 10 82 8	
286.5													
8.5		silty		11	SS	6							Commenced wash boring @ 9.1 m
	FINE SAND loose to compact, grey, wet		12	SS	12								
			13	SS	3							0 92 (8) * low N-value probably due to hydrostatic uplift	
			14	SS	15								
280.0													

15.0

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

METRIC

SOIL PROFILE	SAMPLES	R	E	DYNAMIC CONE PENETRATION RESISTANCE PLOT		REMARKS
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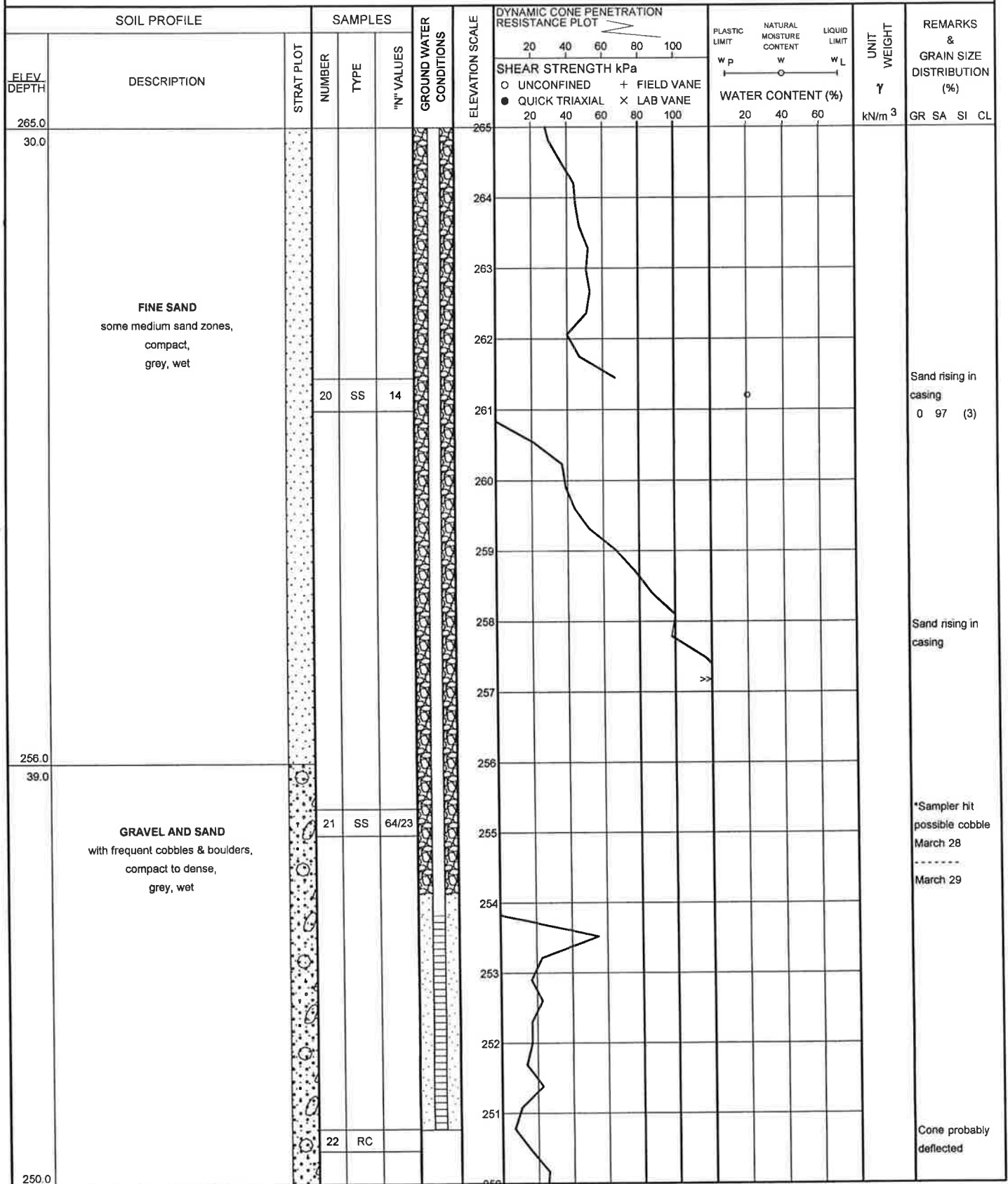
+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No TMN1

3 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 364.9, E 316 478.4 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing & washboring, NQ Rock Core & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 27.03.01 to 30.03.01 CHECKED BY Z.O



45.0

Continued Next Page

+ 3, X 3
Sensitivity

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMN1

4 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine - Three Mile Lake Road - Co-ords: N 5 048 364.9; E 316 478.4 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing & washboring, NQ Rock Core & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 27.03.01 to 30.03.01 CHECKED BY Z.O

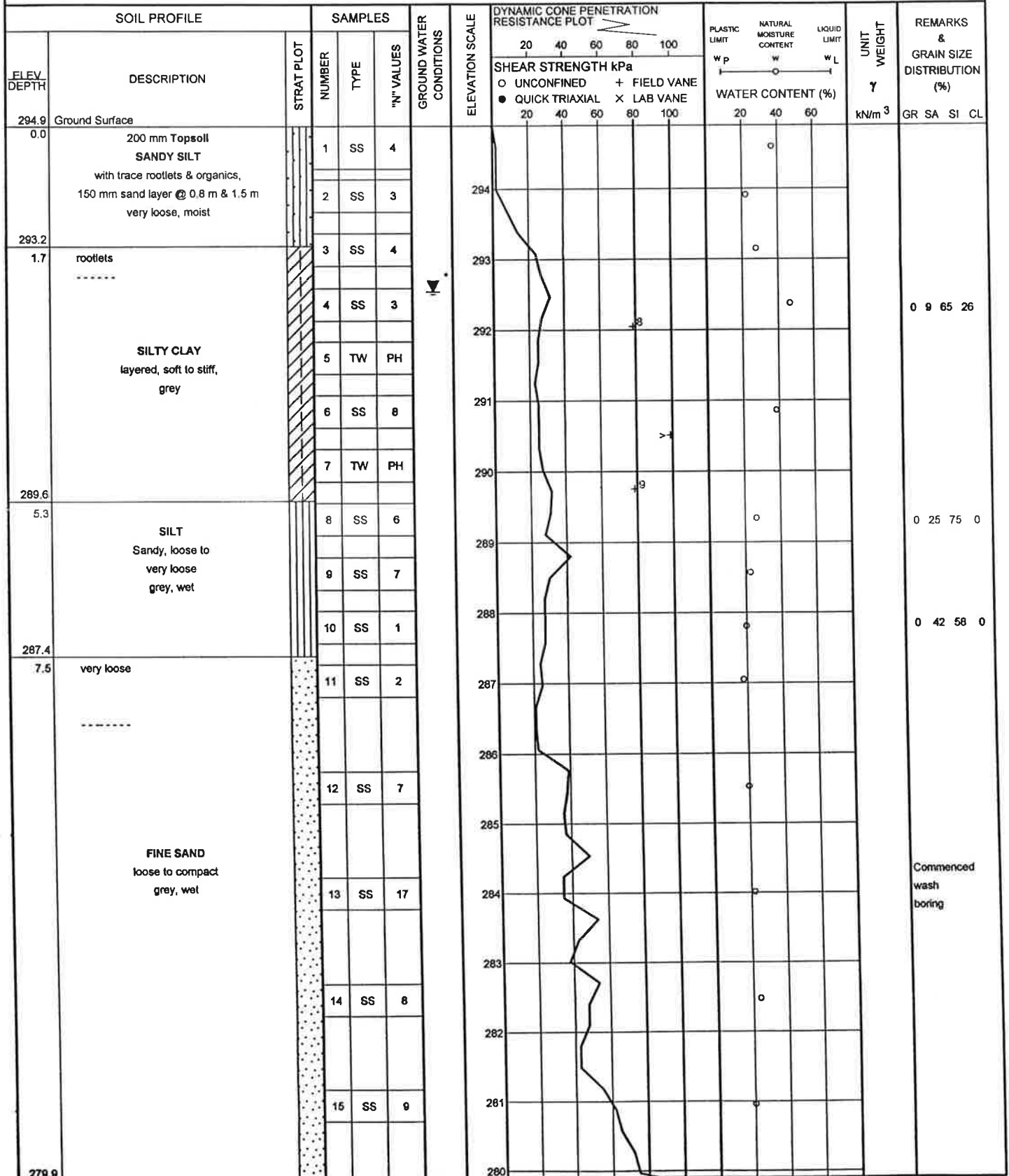
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
250.0														
45.0	GRAVEL AND SAND with frequent cobbles & boulders, compact to dense, grey													
249.3														
45.7	End of borehole													
247.7														
47.3	End of Dynamic Cone Penetration Test Dynamic Cone Penetration Test performed from 27.8 m to 33.5 m; 34.0 to 38.0 m; 41.0 to 47.3 m Soil stratigraphy inferred only Piezometer installed at 44.2 m Water level in piezometer: April 06/2001 - 0.1 m April 09/2001 - 0.05 m April 11/2001 - 0.05 m													

RECORD OF BOREHOLE No TMN2

1 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 391.7; E 316 467.1 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring, NQ Rock Core & D.C.P.T COMPILED BY G.T
DATUM Geodetic DATE 16.03.01 to 27.03.01 CHECKED BY Z.O



0 9 65 26

0 25 75 0

0 42 58 0

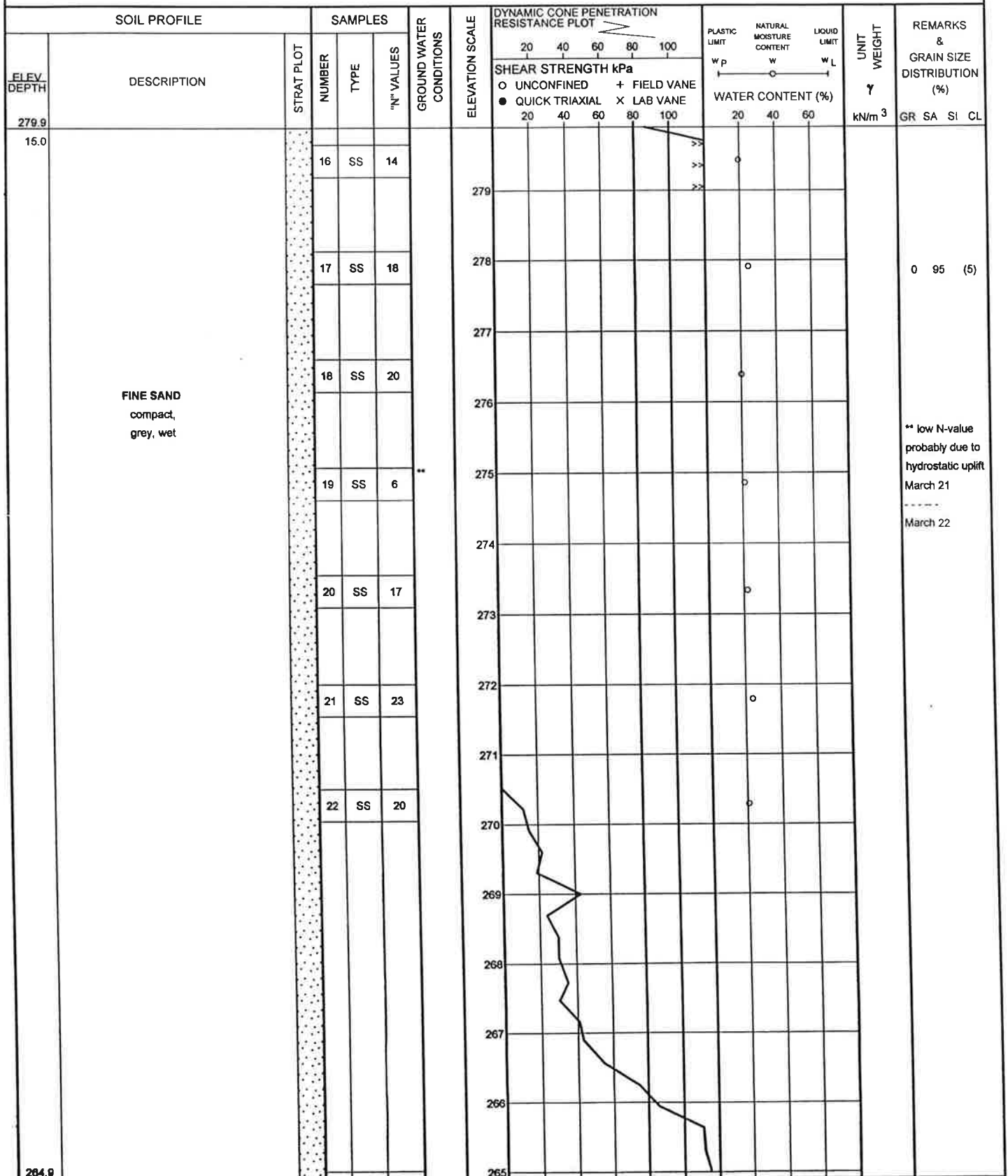
Commenced wash boring

RECORD OF BOREHOLE No TMN2

2 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 391 7, E 316 467 1 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring, NQ Rock Core & D.C.P.T. COMPILED BY G.T.
DATUM Geodetic DATE 16.03.01 to 27.03.01 CHECKED BY Z.O.

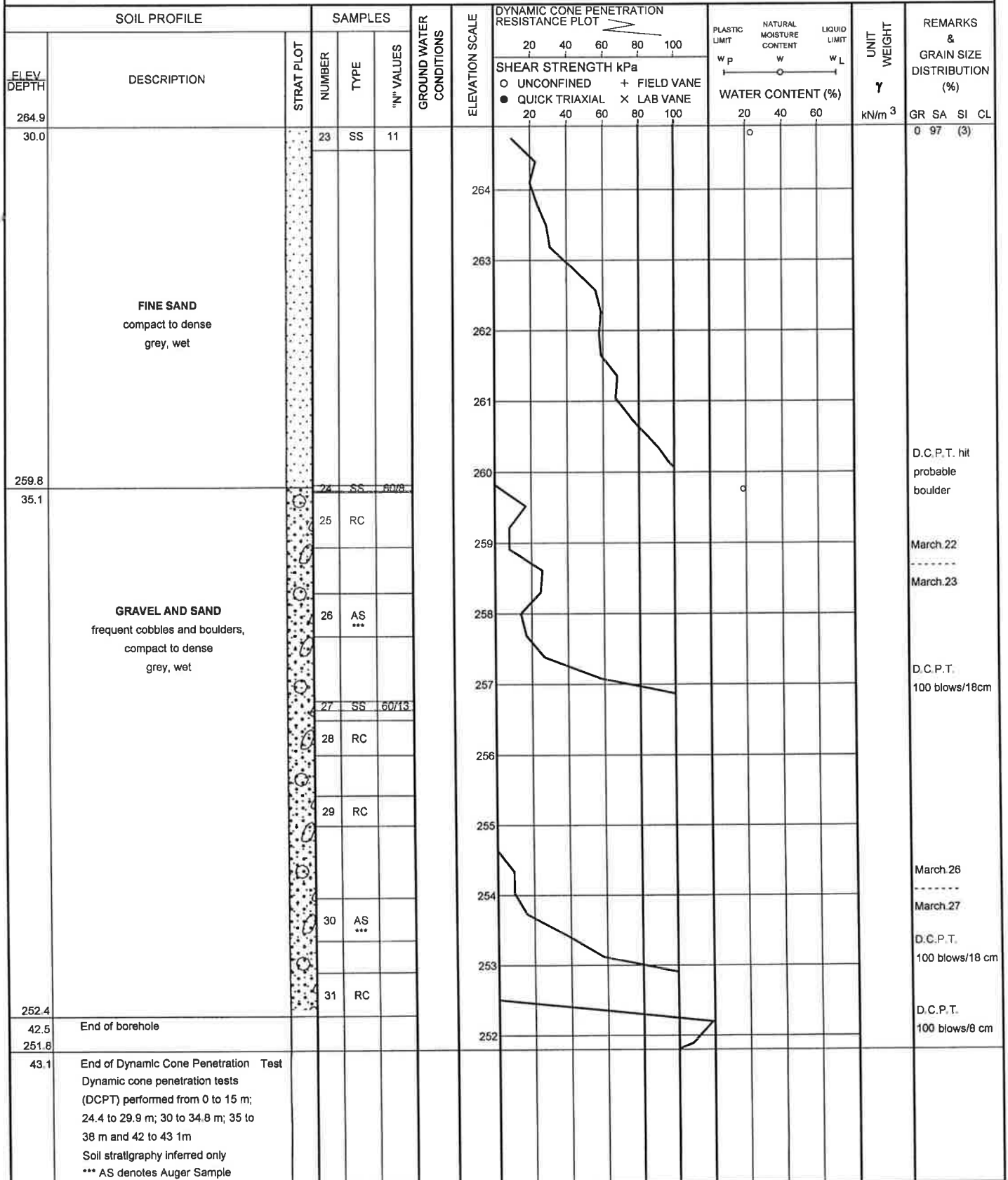


RECORD OF BOREHOLE No TMN2

3 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine - Three Mile Lake Road - Co-ords: N 5 048 391.7, E 316 467.1 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring, NQ Rock Core & D.C.P.T. COMPILED BY G.T
DATUM Geodetic DATE 16.03.01 to 27.03.01 CHECKED BY Z.O



Continued Next Page

+ 3, x 3 Numbers refer to 20
Sensitivity 15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMN2

4 OF 4

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 391.7; E 316 467.1 ORIGINATED BY G I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring, NQ Rock Core & D.C.P.T. COMPILED BY G T
DATUM Geodetic DATE 16.03.01 to 27.03.01 CHECKED BY Z O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
	*Water added to the hole for facilitating drilling and counter balancing hydrostatic pressure; water level not stabilized on completion													

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMN3

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 401.7, E 316 461.9 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T
DATUM Geodetic DATE 30.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
294.9	Ground Surface							20 40 60 80 100		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
										W _P	W	W _L		
										WATER CONTENT (%)				

+ 3, X 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TMN4

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Katrine -Three Mile Lake Road - Co-ords: N 5 048 343.0, E 316 484.0 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T
DATUM Geodetic DATE 03.04.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
295.8	Ground Surface													
0.0	200 mm Topsoil SANDY SILT some silty sand layers, trace rootlets, loose, brown, moist		1	SS	9		295						19.8	
			2	SS	8								19.9	
294.3			3	SS	8		294						19.8	0 12 76 12
1.5			4	SS	6								19.5	
	SILTY CLAY layered, soft to stiff, grey, moist		5	SS	5		293						18.9	
			6	TW	PH		292							
			7	SS	2		291						16.4	0 5 45 50
			8	SS	2		290						17.0	
			9	SS	2		289							
			10	SS	4		288							
286.8							287							
9.0	SILT: Sandy, compact, grey, wet		11	SS	13									
286.2														
9.6	End of borehole * Water level at 3.3 m on completion (not stabilized)													

+ 3, x 3: Numbers refer to
Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 12+110 SBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 414.4; E 316 409.9 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers. COMPILED BY G.T
DATUM Geodetic DATE 16.03.01 CHECKED BY Z.O

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
295.0	Ground Surface					295							
0.0	SAND AND GRAVEL (FILL)		1	SS	18								
294.5	with organics, compact, dark brown, moist		2	SS	12								
0.5		stiff	3	SS	4								
	SILTY CLAY	soft to firm	4	SS	4								
	brown to 3.0 m, grey below, moist		5	TW	PH								
		frequent silt seams	6	SS	6								
290.8			7	SS	7								
4.2	SILT	loose	8	SS	2								
	laminated, grey, wet	very loose	9	SS	2								
	Sandy zones		10	SS	2								
287.5			11	SS	5								
7.5	SILTY FINE SAND	very loose											
	grey, wet	loose											
285.4													
9.6	End of borehole *Water level at 2.7 m (not stabilized) and hole open to 5.9 m upon completion												

+ 3, × 3: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 12+110 NBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 429.5; E 316 443.7 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers. COMPILED BY G.T
DATUM Geodetic DATE 16.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
295.9	Ground Surface												
0.0	50 mm Topsoil		1	SS	8							19.6	
	trace organics		2	SS	5							18.1	
	SILTY CLAY		3	SS	3							17.1	
	laminated, brown to 0.7 m, grey below soft to stiff		4	SS	3								
			5	TW	PH								
	frequent silt seams		6	SS	6								
291.6			7	SS	6								
4.3	SILT		8	SS	2								
	Sandy zones		9	SS	5								
	grey, wet												
	loose												
	very loose												
	loose												
288.8													
7.1	SILTY FINE SAND												
	very loose, grey, wet		10	SS	0	**							** low blow count probably due to quick condition
287.8													
8.1	End of borehole												
	*Water level at 2.7 m (not stabilized) and hole open to 7.2 m on completion												

RECORD OF BOREHOLE No 12+144 NBL

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 459.8; E 316 427.2 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers COMPILED BY G.T
DATUM Geodetic DATE 20.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
298.2	Ground Surface													
0.0	Mixed Topsoil, clay and silt with trace		1	SS	4	*	298							
297.8	organics, very loose, brown, moist													
0.4			2	SS	13		297							
	SILTY CLAY		3	SS	7		296							
	soft to stiff		4	SS	4		295							
			5	SS	5		294							
	brown		6	SS	3		293							
	grey		7	SS	1		292							
			8	TW	PH		291							
292.3	frequent silt and clayey silt seams		9	SS	8									
5.9	SILT													
	loose,													
	grey, wet													
291.1	SILTY FINE SAND		10	SS	5									
7.1	loose,													
	grey, wet													
290.1														
8.1	End of borehole													
	*Water level not measured													

+ 3 x 3 Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 12+147

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Highway 11- Katrine, ON - Coords N 5 048 459.0; E 316 418.7 ORIGINATED BY S.O
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers and Hollow Stem Augers COMPILED BY G.T
DATUM Geodetic DATE 21.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) W P W W L				
298.2	Ground Surface							20	40	60	80	100				
0.0	Mixed Sand and Gravel with trace organics		1	SS	2		298									
297.5	FILL very loose, brown, moist		2	SS	16		297									
0.7		very stiff firm to stiff	3	SS	8		296									
	SILTY CLAY brown to 2.1 m, grey below,		4	SS	5		295									
			5	SS	4		294									
293.7			6	TW	PH		293									
4.5	SILT laminated, loose, grey, wet	occasional clayey silt seams occasional silty sand seams	7	SS	6		292									
			8	SS	8		291									
			9	SS	8											
290.1			10	SS	4											
8.1	End of borehole *Water level at 5.8 m (not stabilized) and hole open to 6.4 m on completion															

+³, x³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRS1

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 SBL over Magnetawan River Co-ords: N 5 048 539.9; E 316 348.9 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Solid and Hollow Stem Augers, Washboring & Casings, NQ Rock Core COMPILED BY G.T.
DATUM Geodetic DATE 07.03.01 & 08.03.01 CHECKED BY Z.O.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
294.6	Ground Surface												
0.0	75 mm Topsoil		1	SS	2								
	brown		2	SS	1								

	SANDY SILT TO SILTY SAND		3	SS	1								
	trace of organics,												
	occasional organic pockets/lenses,		4	SS	2								
	grey to dark grey,												
	very loose, wet		5	SS	2								
			6	SS	2								
			7	SS	1								
			8	SS	2								
288.6			9	SS	2								
6.0			10	SS	1								
	brown		11	SS	1								

	grey		12	SS	5								
	FINE SAND		13	SS	9								
	very loose to 8.5 m												
	loose below, wet		14	SS	10								
			15	SS	8								

	brown												
279.6													

15.0

Continued Next Page

+ ³ , x ³ ; Numbers refer to 20
Sensitivity 15-5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRS1

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 SBL over Magnetawan River Co-ords: N 5 048 539.9: E 316 348.9 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Solid and Hollow Stem Augers, Washboring & Casings, NQ Rock Core COMPILED BY G.T.
DATUM Geodetic DATE 07.03.01 & 08.03.01 CHECKED BY Z.O

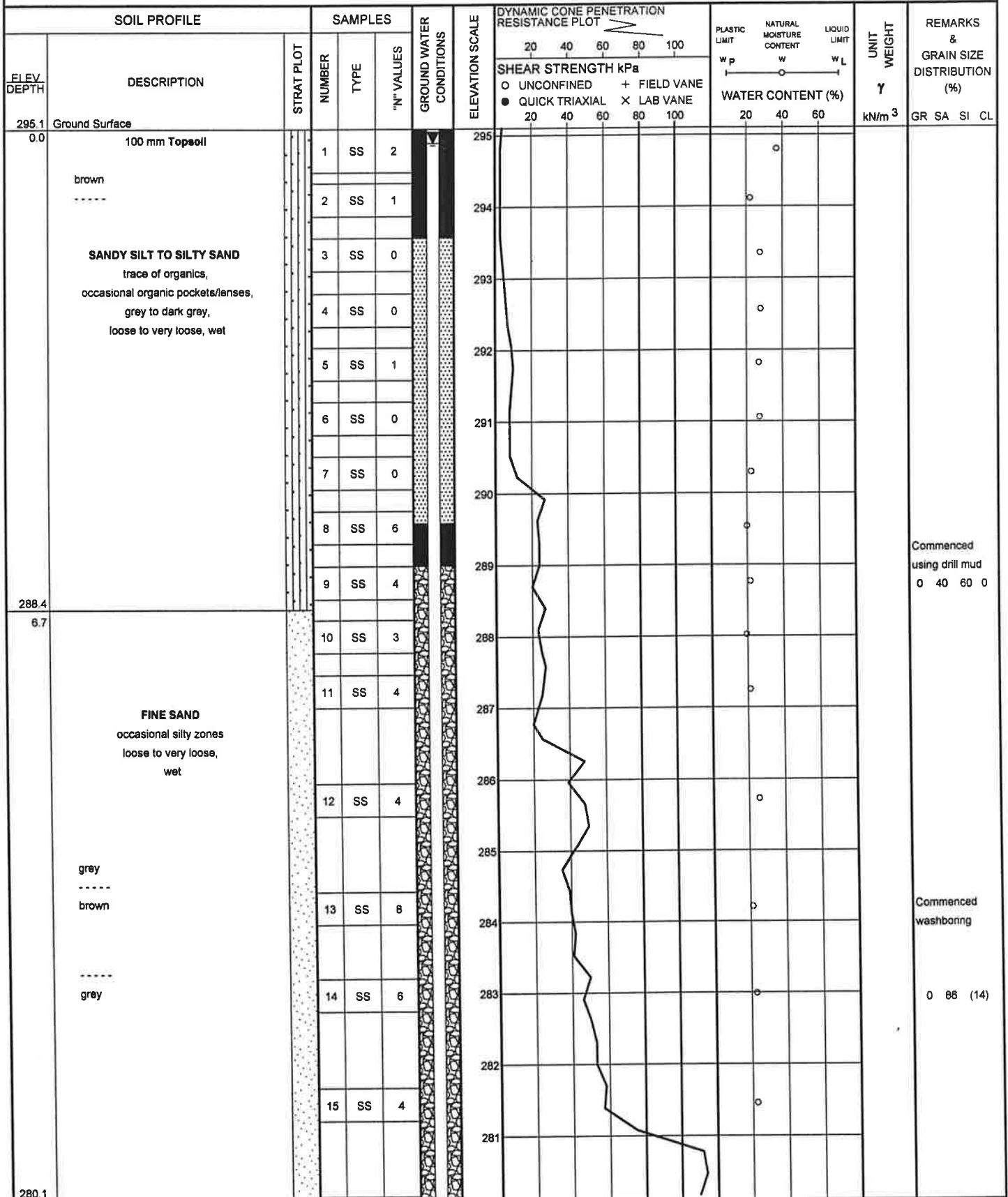
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								20 40 60 80 100										
279.6																		
15.0	FINE SAND grey, compact, wet		16	SS	26		279									0 91 (9)		
278.1																		
18.5	GRAVEL AND SAND frequent cobbles and boulders grey, dense, wet		16A	RC			278									March 07		
			17	SS	35											March 08		
			18	SS	80/14**		277									** possible cobble		
275.6							276											
19.0	GNEISS BEDROCK grey unweathered ----- moderately to slightly weathered ----- unweathered		19	NQ RC	Rec. 100%		275									RQD=100%		
			20	NQ RC	Rec. 100%											RQD=100%		
			21	NQ RC	Rec. 86%		274									RQD=60%		
272.5			22	NQ RC	Rec. 100%		273									RQD=100%		
22.1	End of borehole *Water level at 2.3 m (not stabilized) on completion																	

RECORD OF BOREHOLE No MRS2

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 SBL over Magnetawan River Co-ords: N 5 048 527.9; E 316 348.2 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, NQ Rock Core & D.C.P.T COMPILED BY G.T
DATUM Geodetic DATE 06.03.01 & 07.03.01 CHECKED BY Z.O



15.0

Continued Next Page

+ 3 . X 3 : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRS2

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 SBL over Magnetawan River Co-ords: N 5 048 527.9: E 316 348.2 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, NQ Rock Core & D.C.P.T COMPILED BY G.T.
DATUM Geodetic DATE 06.03.01 & 07.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
								WATER CONTENT (%)													
280.1							20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	GR	SA	SI	CL			
15.0	FINE SAND some silty zones, loose to compact, grey, wet		16	SS	3		280												0 65 35 0		
					17		SS	18	279												
277.6							278														
17.5	GRAVEL AND SAND trace to some silt, boulders below 19.0 m, dense to very dense, grey, wet		18	SS	36		277												43 42 15 0		
					19		SS	52	276												
273.8			20	SS	49		275														
21.3	GNEISS BEDROCK grey unweathered ----- slightly to moderately weathered		21	NQ RC	Rec. 100%		274												RQD=100%		
																				RQD=100%	
					22		NQ RC	Rec. 100%	273												
					23		NQ RC	Rec. 93%	272												RQD=46%
270.8			24	NQ RC	Rec. 100%		271												RQD=10% March 06 March 07		
24.3	End of borehole Hole open to 24.2 m on completion Dynamic Cone Penetration Test performed from 0 to 15.0 m Piezometer installed at 21.3 m on completion Water level in piezometer at: March 06/2001 - 2.30 m March 07/2001 - 1.20 m March 08/2001 - 0.90 m March 12/2001 - 0.80 m March 13/2001 - 0.75 m March 20/2001 - 0.75 m March 21/2001 - 0.70 m March 26/2001 - 0.70 m March 27/2001 - 0.65 m March 28/2001 - 0.60 m April 02/2001 - 0.60 m April 04/2001 - 0.55 m April 06/2001 - 0.45 m April 09/2001 - 0.35 m April 11/2001 - 0.20 m																				

+ 3, x 3: Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRS3

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 SBL over Magnetawan River Co-ords: N 5 048 513.8; E 316 362.6 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY G.T.
DATUM Geodetic DATE 09.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
295.8	Ground Surface														
0.0	FILL: Gravelly Sand		1	SS	35*										* frozen
294.9			2	SS	5									16.8	
294.7	TOPSOIL: Clayey														
1.1	SILTY CLAY with Clayey Silt & Silt layers trace of organics, some organic zones grey to dark grey, soft to very stiff		3	SS	14									18.8	
			4	SS	8									19.2	0 10 63 27
			5	SS	2									18.5	
292.2															
3.6	SILT loose, grey, wet		6	SS	6										0 4 96 0
291.3	SANDY SILT TO SILTY SAND loose, grey to dark grey, occasional organics and organic zones		7	SS	4										Commenced using drill mud
4.5			8	SS	5										
			9	SS	4										
288.5															
7.3	FINE SAND very loose to compact, grey, wet		10	SS	1										
286.2			11	SS	19										
9.6	End of borehole Dynamic Cone Penetration Test performed from 9.1 m to 15.3 m **Water level on completion at 2.1 m (not stabilized)														
280.8															

15.0

Continued Next Page

+³, X³: Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRS3

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 SBL over Magnetawan River Co-ords: N 5 048 513.8; E 316 362.6 ORIGINATED BY G.I
 DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augers & D.C.P.T. COMPILED BY G.T
 DATUM Geodetic DATE 09.03.01 CHECKED BY Z.O

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa											
280.8									20	40	60	80	100				
15.0																	
280.5																	
15.3	End of Dynamic Cone Penetration Test																

RECORD OF BOREHOLE No MRN1

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 546.9; E 316 388.0 ORIGINATED BY R.A.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & NQ Rock Core COMPILED BY G.T.
DATUM Geodetic DATE 06.03.01 & 07.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
293.6	Ground Surface						20 40 60 80 100						
0.0	SILT, trace organics, very loose, grey, wet (possible fill)		1	SS	2								
292.6			2	SS	2								
1.0	ORGANIC SILT-sandy												
292.3	dark gray/black, very loose												
1.3	SILTY FINE SAND		3	SS	3								
	trace of organics and decayed wood, grey/dark grey, very loose to loose, wet		4	SS	7								
290.7													
2.9	SILT, trace organics, very loose, grey, wet		5	SS	4								
290.0													
3.6			6	SS	5								
			7	SS	10								
			8	SS	4								
			9	SS	5								
			10	SS	6								
			11	SS	14								
			12	SS	15								
			13	SS	10								
			14	SS	16								
278.6													

15.0

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity

20
15 10 5 0
(%) STRAIN AT FAILURE

0 98 2 0

Sand becoming quick, casing and washboring started @ 4.5 m

RECORD OF BOREHOLE No MRN1

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 546.9, E 316 388.0 ORIGINATED BY R.A.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & NQ Rock Core COMPILED BY G.T.
DATUM Geodetic DATE 06.03.01 & 07.03.01 CHECKED BY Z.O.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
FLYV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
278.6													
15.0	FINE SAND traces to some silt, some silty zones, grey, wet		15	SS	17	278							0 94 (6)
	compact		16	SS	18	277							
	dense					276							
	-----		17	SS	45	275							March 06
	gravel and sand inferred					274							March 07
273.8													
19.8	End of borehole Casing advanced to 21.3 m (probably bent). Casing advanced to 24.4 m where casing broke (probably sliding on sloping rock surface). *Water level not stabilized on completion. Borehole grouted on completion Moved 4.0 m to the south and redrilled See borehole NRN1A												

RECORD OF BOREHOLE No MRN1A

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 543.4; E 316 390.2 ORIGINATED BY R.A.
 DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & NQ Rock Core COMPILED BY G.T.
 DATUM Geodetic DATE 12.03.01 to 14.03.01 CHECKED BY Z.O.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		W _p	W		
293.9 0.0	Ground Surface						20 40 60 80 100		20 40 60				
	Borehole extended to 18.5 m without sampling; see MRN1						20 40 60 80 100		20 40 60				
278.9 15.0							20 40 60 80 100		20 40 60				

Continued Next Page

+³, ×³; Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

METRIC

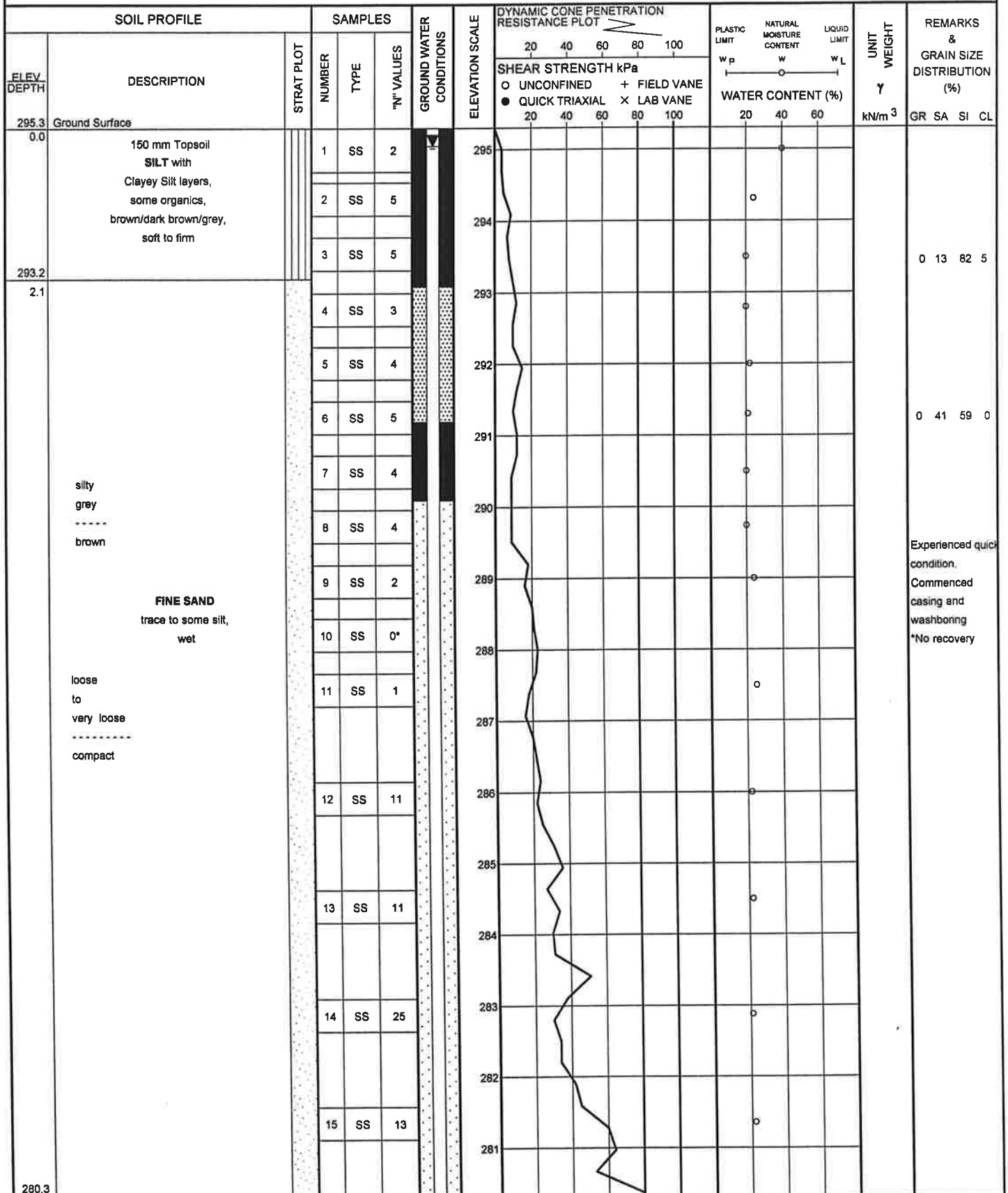
+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MRN2

1 OF 3

METRIC

W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 533.8; E 316 395.9 ORIGINATED BY R.A.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring, NQ Rock Core & D.C.P.T. COMPILED BY G.T.
DATUM Geodetic DATE 14.03.01 to 20.03.01 CHECKED BY Z.O.



15.0

Continued Next Page

+ 3, x 3

Numbers refer to
Sensitivity

20
15
10


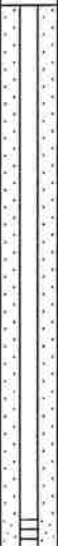

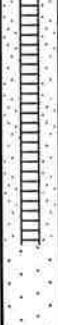




(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRN2

2 OF 3

METRIC

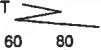
W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 533.8; E 316 395.9 ORIGINATED BY R.A.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring, NQ Rock Core & D.C.P.T. COMPILED BY G.T.
DATUM Geodetic DATE 14.03.01 to 20.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE				
280.3							20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L			
15.0	FINE SAND trace to some silt, compact, wet		16	SS	10		280					Artesian condition noted @ 17.0 m while drilling	
							279						
							278						
							277						
							276						
	silt and clayey silt seams		19	SS	22		275					0 59 41 0	
274.7	COBBLES & BOULDERS with sand						274					March 16 ----- March 19	
20.6							273						
							272						
							271						
							270						
271.4	GNEISS BEDROCK grey unweathered		20	NQ RC	Rec. 100%		269					RQD=97%	
23.9							269					RQD=70%	
268.4	End of borehole Piezometer installed at 23.1 m Water level at: March 23/2001 - 0.70 m March 26/2001 - 0.60 m March 27/2001 - 0.60 m March 28/2001 - 0.55 m March 29/2001 - 0.55 m April 02/2001 - 0.50 m April 04/2001 - 0.55 m April 06/2001 - 0.55 m												
26.9													

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

METRIC

SOIL PROFILE					
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT  20 40 60 80 100</div> <div>SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100</div> <div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w_p w w_L WATER CONTENT (%) 20 40 60</div> <div>UNIT WEIGHT γ kN/m³</div> <div>REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL</div>					
	April 09/2001 - 0.30 m April 11/2001 - 0.25 m Borehole extended by coring from 21.0 m to 23.3 m				

+ ³, × ³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MRN3

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 516.2; E 316 406.2 ORIGINATED BY R.A.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers & D.C.P.T. COMPILED BY G.T.
DATUM Geodetic DATE 08.03.01 & 09.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
297.0	Ground Surface						297					
296.8	SAND AND GRAVEL (FILL)		1	SS	11		296				18.7	
296.0	SILTY CLAY layered stiff, grey		2	SS	7		295					
1.0	SILT some clayey seams, firm to stiff, grey wet, dilatant		3	SS	7		294				17.5	0 1 91 8
			4	SS	8		293					March 08
			5	SS	6		292					March 09
	sandy, very loose		6	SS	3		291					0 25 75 0
292.5			7	SS	6		290					
4.5	FINE SAND occasional silt and thin silty clay seams, brown, greyish brown, loose, wet		8	SS	6		289					
	silty		9	SS	8		288					
	some silt		10	SS	2		287					
287.4			11	SS	6		286					
9.6	End of borehole *Water level at 2.5 m upon completion (not stabilized) Dynamic Cone Penetration Test performed from 9.6 m to 15.6 m						285					
282.0							284					
							283					
							282					

15.0

Continued Next Page

+ 3, X 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MRN3

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Hwy 11 NBL over Magnetawan River Co-ords: N 5 048 516.2; E 316 406.2 ORIGINATED BY R.A.
 DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers & D.C.P.T. COMPILED BY G.T.
 DATUM Geodetic DATE 08.03.01 & 09.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
282.0							282							
15.0														
281.4														
15.6	End of Dynamic Cone Penetration Test													

+ 3, x 3; Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MR1

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Ramp E, W-N Crossing over Magnetawan River Co-ords: N 5 048 558.7; E 316 421.4 ORIGINATED BY G.I
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers, Casing and wash boring & NQ Rock Core COMPILED BY G.T
DATUM Geodetic DATE 12.03.01 to 14.03.01 CHECKED BY Z.O

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
280.8													
15.0	FINE SAND trace to some silt, occasional sandy silt zones, dense to very dense brown/gray, wet		16	SS	33								
			17	SS	30								
			18	SS	53								
276.3													
19.5	SILT trace clay and sand, firm, gray, wet		19	SS	7								
274.8													
21.0	FINE SAND dense		20	SS	34								
273.4	frequent cobbles below 22.0 m												
22.4			21	NQ RC	Rec. 100%								RQD=100%
	GNEISS BEDROCK grey, unweathered		22	NQ RC	Rec. 100%								RQD=100%
			23	NQ RC	Rec. 100%								RQD=100%
270.2													
25.6	End of borehole Piezometer installed at 20.0 m, upon completion Water level in piezometer at: Mar. 14/2001 - 0.9 m Mar. 15/2001 - 0.75 m Mar. 16/2001 - 0.75 m Mar. 19/2001 - 0.70 m Apr. 02/2001 - 0.70 m Apr. 04/2001 - 0.65 m Apr. 06/2001 - 0.65 m Apr. 09/2001 - 0.90 m Apr. 11/2001 - 0.30 m												

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MR2

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Ramp E, W-N Crossing over Magnetawan River Co-ords: N 5 048 560.1; E 316 416.9 ORIGINATED BY G.I
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.T
 DATUM Geodetic DATE 09.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
294.6 0.0	Ground Surface												
294													
293													
292													
291													
290													
289													
288													
287													
286													
285													
284													
283													
282													
281													
280													

279.6
15.0

Continued Next Page

+³, ×³; Numbers refer to Sensitivity
 20
 15 10-5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MR2

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Ramp E. W-N Crossing over Magnetawan River Co-ords: N 5 048 560.1; E 316 416.9 ORIGINATED BY G.I
 DIST 52 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.T
 DATUM Geodetic DATE 09.03.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W	W _L		
279.6																	
15.0																	
279.0																	
15.6	End of Dynamic Cone Penetration Test						276										

RECORD OF BOREHOLE No MR3

1 OF 2

METRIC

W.P. 314-99-00 LOCATION Ramp E, W-N Crossing over Magnetawan River Co-ords: N 5 048 553.3; E 316 435.3 ORIGINATED BY G.I.
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers & D.C.P.T. COMPILED BY G.T.
DATUM Geodetic DATE 09.03.01 CHECKED BY Z.O.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
299.9	Ground Surface											
0.0	125 mm Topsoil		1	SS	5							
	brown											
	grey		2	SS	8		299					0 10 55 35
	SLTY CLAY: layered, occasional rootlets to 0.8 m, layered, firm to very stiff		3	SS	7		298					
			4	SS	5							0 20 64 16
			5	TW	PH		297					
			6	SS	10		296					
295.3												
4.6	SANDY SILT layered, very loose to loose grey, wet		7	SS	10		295					
			8	SS	3							0 28 69 3
293.8							294					Started to use drilling mud
6.1			9	SS	8		293					
	FINE SAND some silt, loose to very loose, grey, wet		10	SS	2		292					
							291					
290.3			11	SS	0							
9.8	End of borehole *Water level at 5.6 m (not stabilized) on completion Dynamic Cone Penetration Test (DCPT) performed from 9.8 m to 18.3 m						290					
							289					
							288					
							287					
							286					
284.9							285					

15.0

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MR3

2 OF 2

METRIC

W.P. 314-99-00 LOCATION Ramp E, W-N Crossing over Magnetawan River Co-ords: N 5 048 553.3; E 316 435.3 ORIGINATED BY G.I
 DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers & D.C.P.T. COMPILED BY G.T
 DATUM Geodetic DATE 09.03.01 & CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
284.9 15.0																	
284																	
283																	
282																	
281.6 18.3	End of Dynamic Cone Penetration Test																

+ 3, X 3; Numbers refer to
Sensitivity

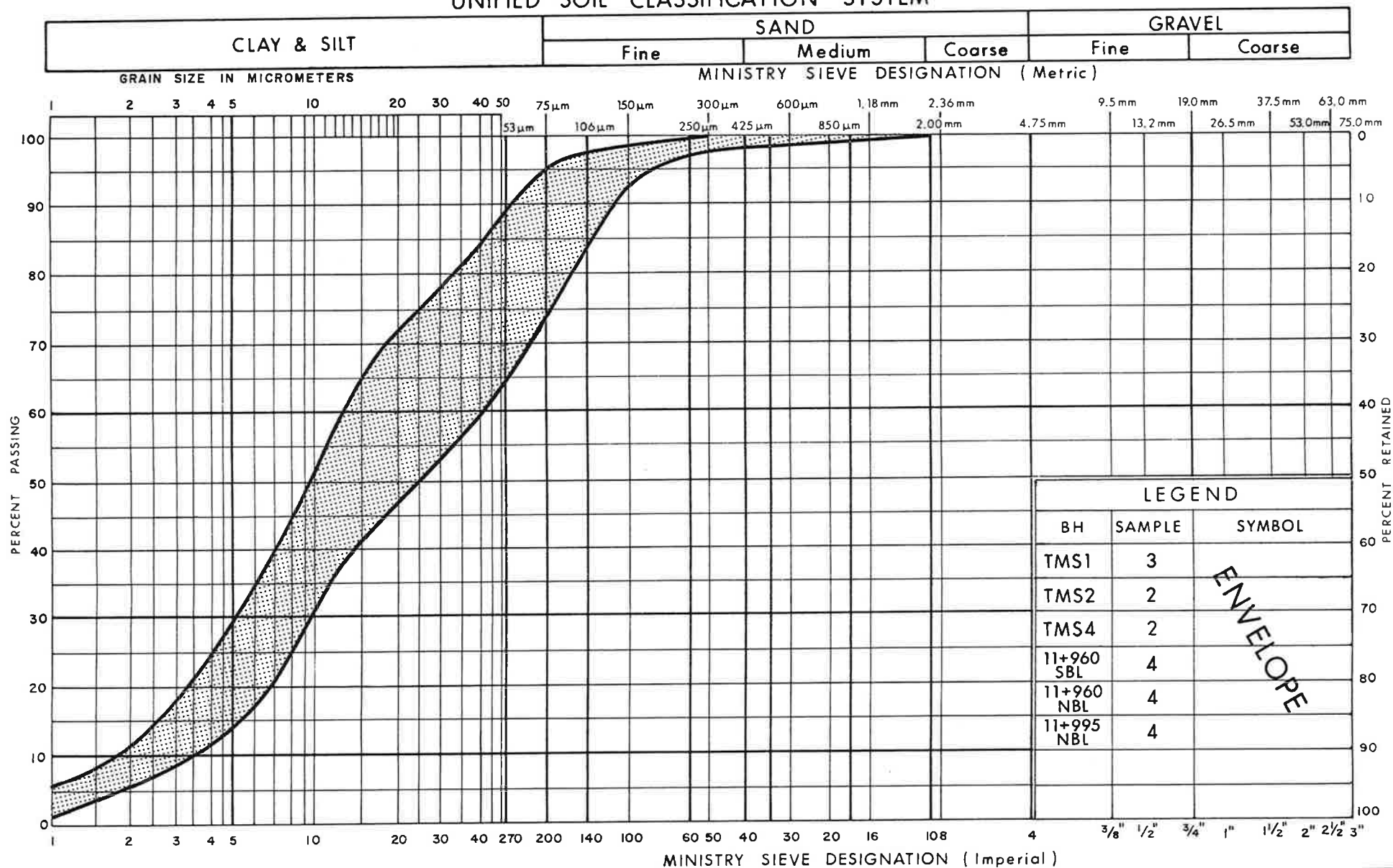
20
15 5
10 (%) STRAIN AT FAILURE

APPENDIX B1

Site 1

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

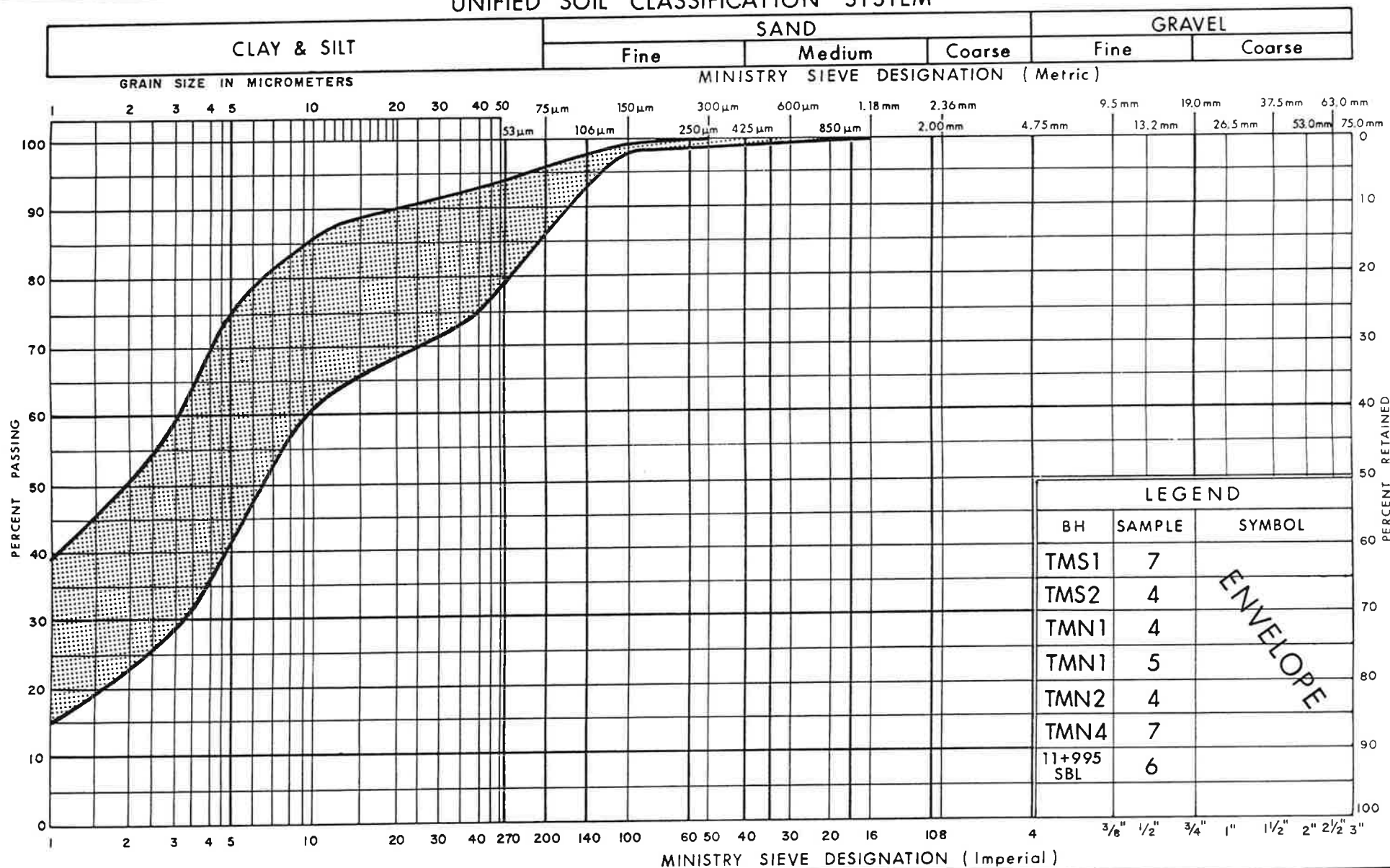
GRAIN SIZE DISTRIBUTION SILT TO SANDY SILT

FIG No B1-1

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No B1-2

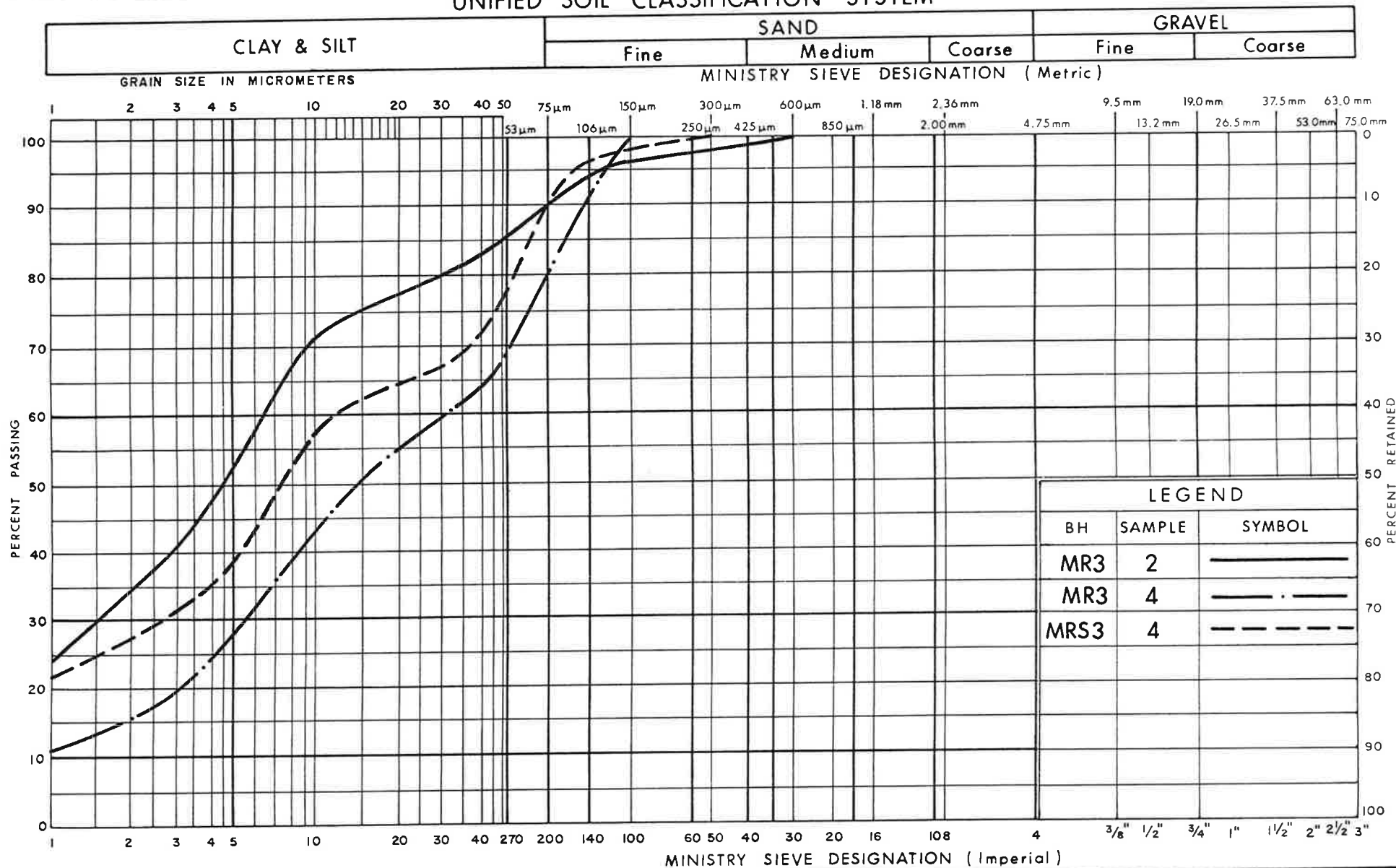
W P 314-99-00

SPT 1010F



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UNIFIED SOIL CLASSIFICATION SYSTEM



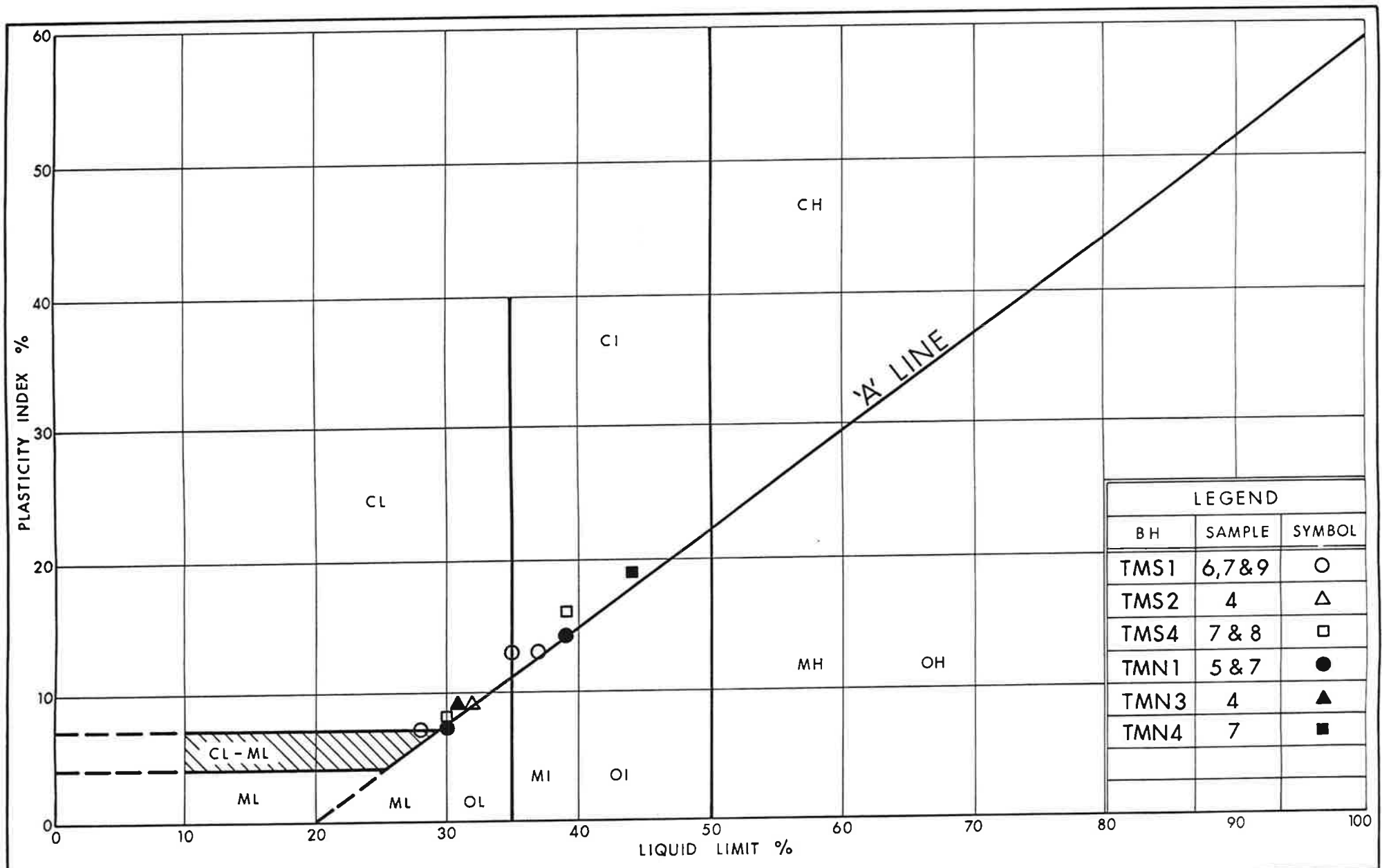
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No B1-3

W P 314-99-00

SPT 1010F



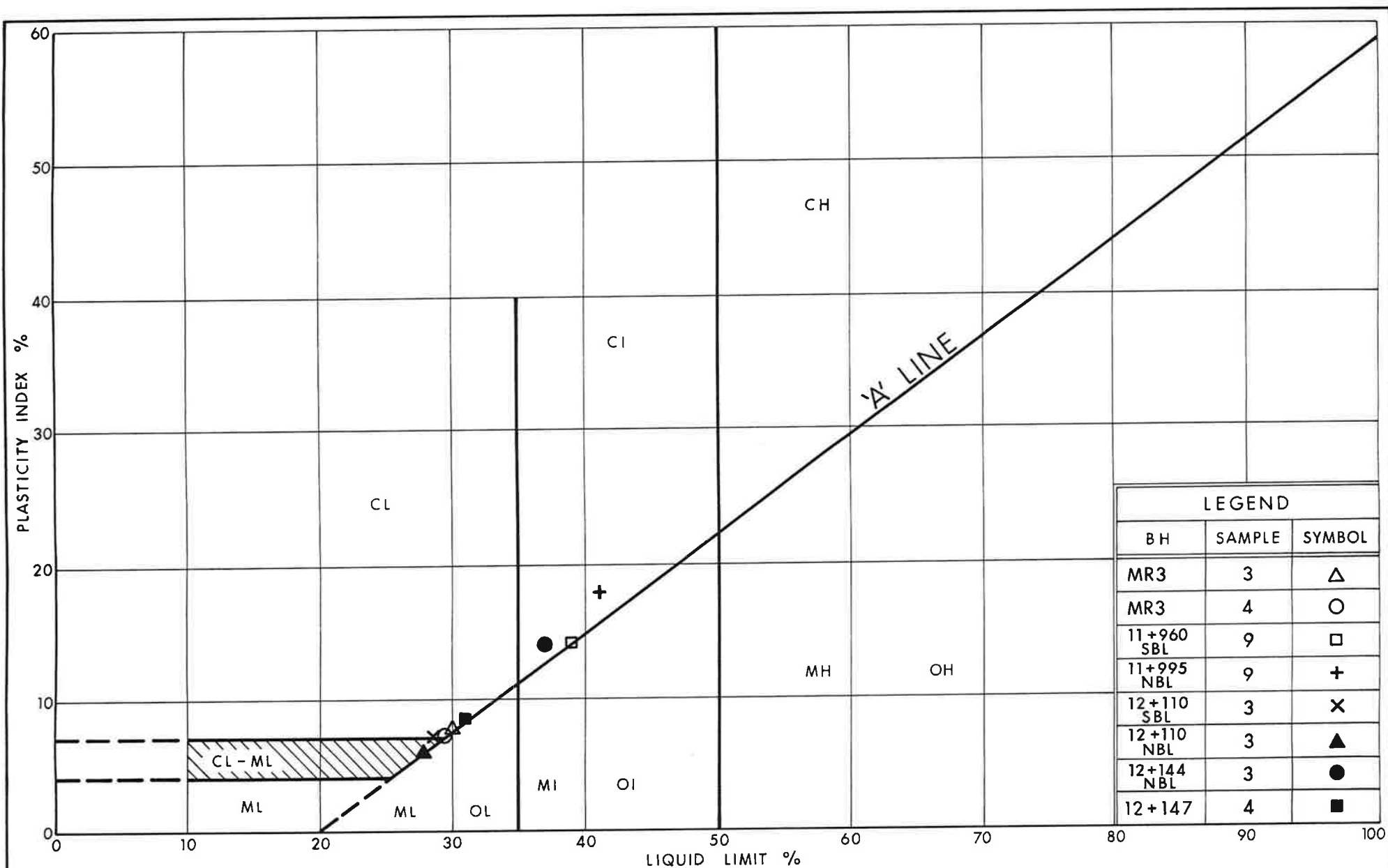
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Ontario

PLASTICITY CHART SILTY CLAY

FIG No B1-4

W P 314-99-00

SPT 1010F



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PLASTICITY CHART SILTY CLAY

FIG No B1-5

W P 314-99-00

SPT 1010F

Project: Hwy 11, Alignment Review
Katrine, Ontario. WP 314-99-00

Date: 22 May 2001

BH#: TMS1

SPT 1010F

Fig. No. B1-6

Depth(m): 3.28

Sample TW 5

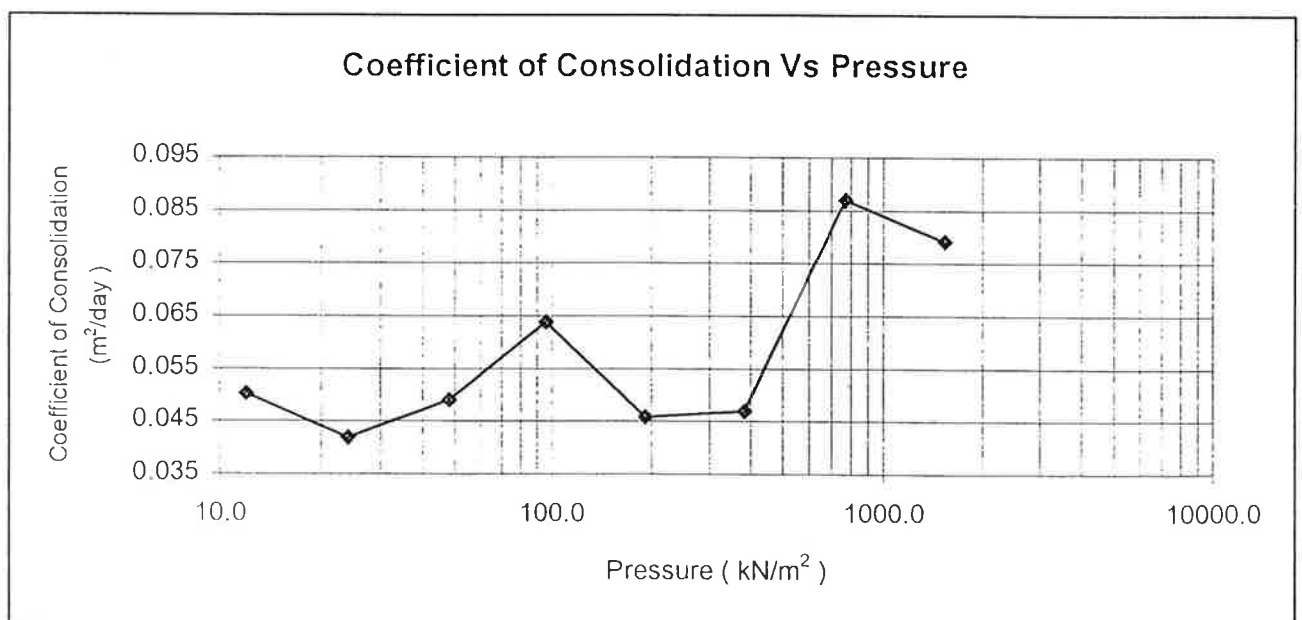
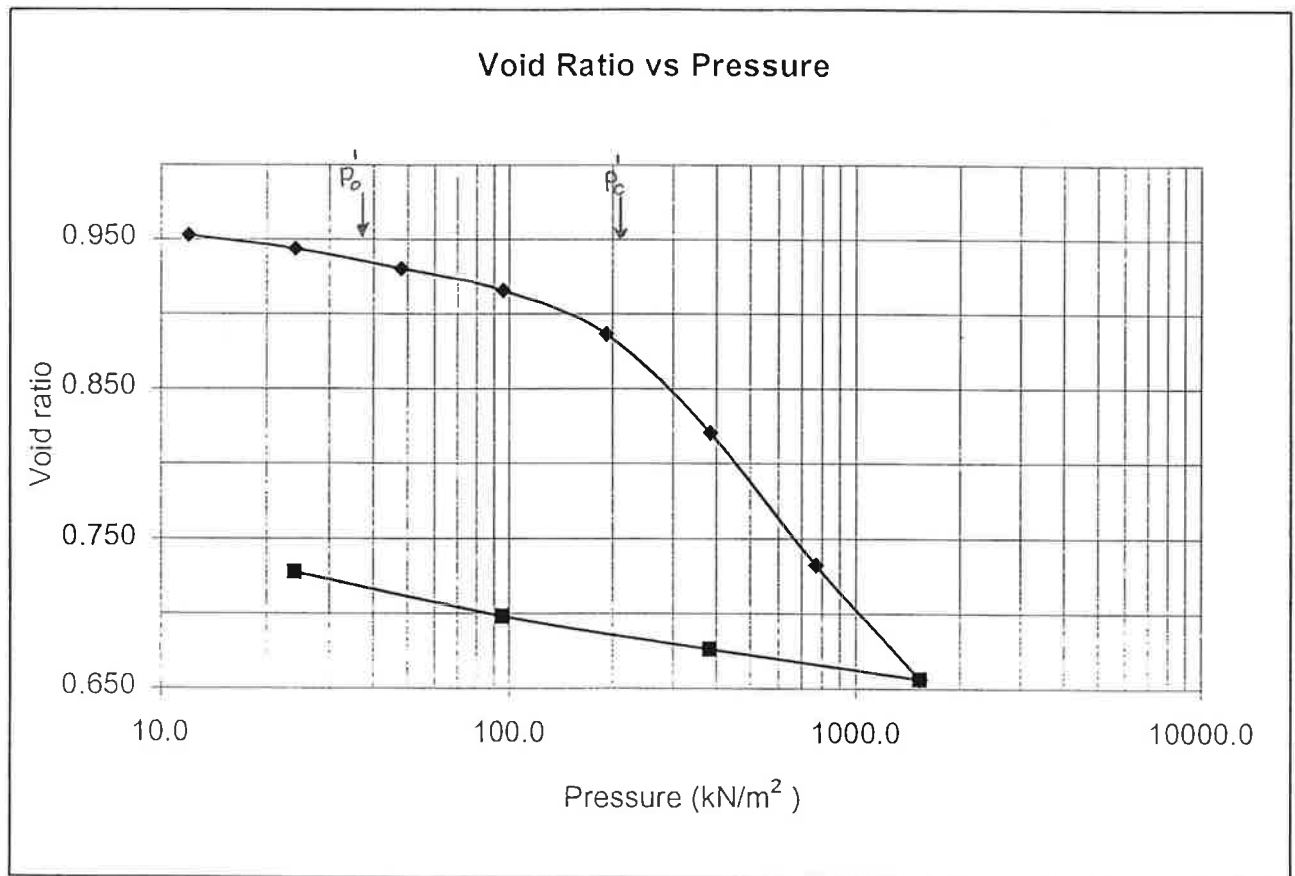


Fig No B1-6

Project: Hwy 11, Alignment Review
Katrine, Ontario. WP 314-99-00
Date: 27 May 2001 BH#: 11+960 SBL
SPT 1010F

Fig. No. B1-7

Depth(m): 4.80
Sample TW 7

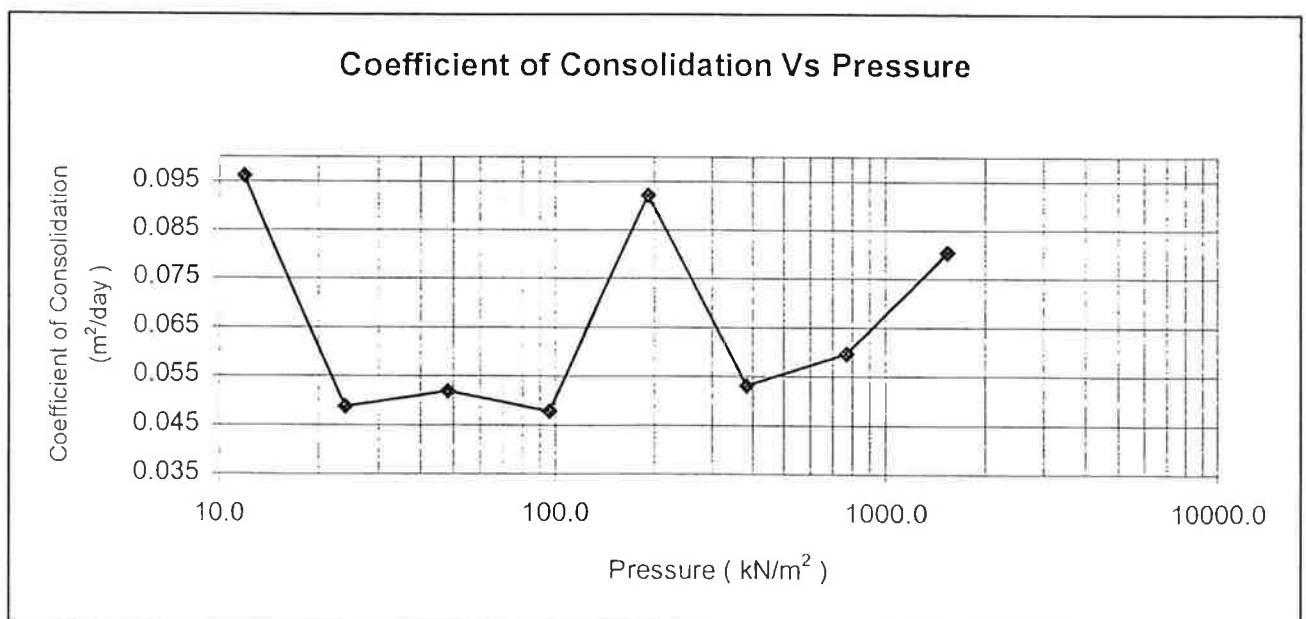
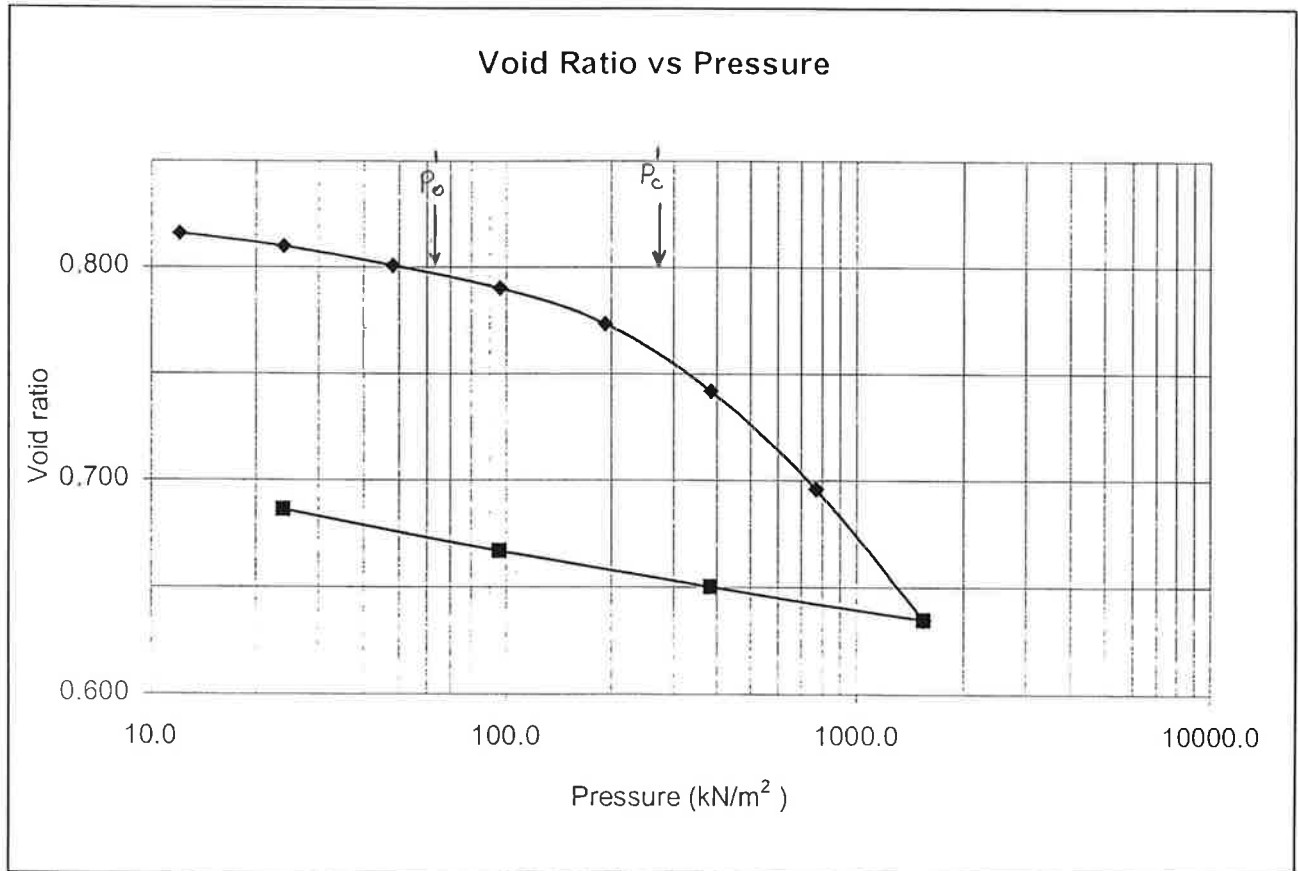


Fig No B1-7

Project: Hwy 11, Alignment Review
 Katrine, Ontario. WP 314-99-00
 Date: 22 May 2001 BH#: Sta 12 +147
 SPT 1010F

Fig. No. B1- 8

Depth(m): 4.04
 Sample TW 6

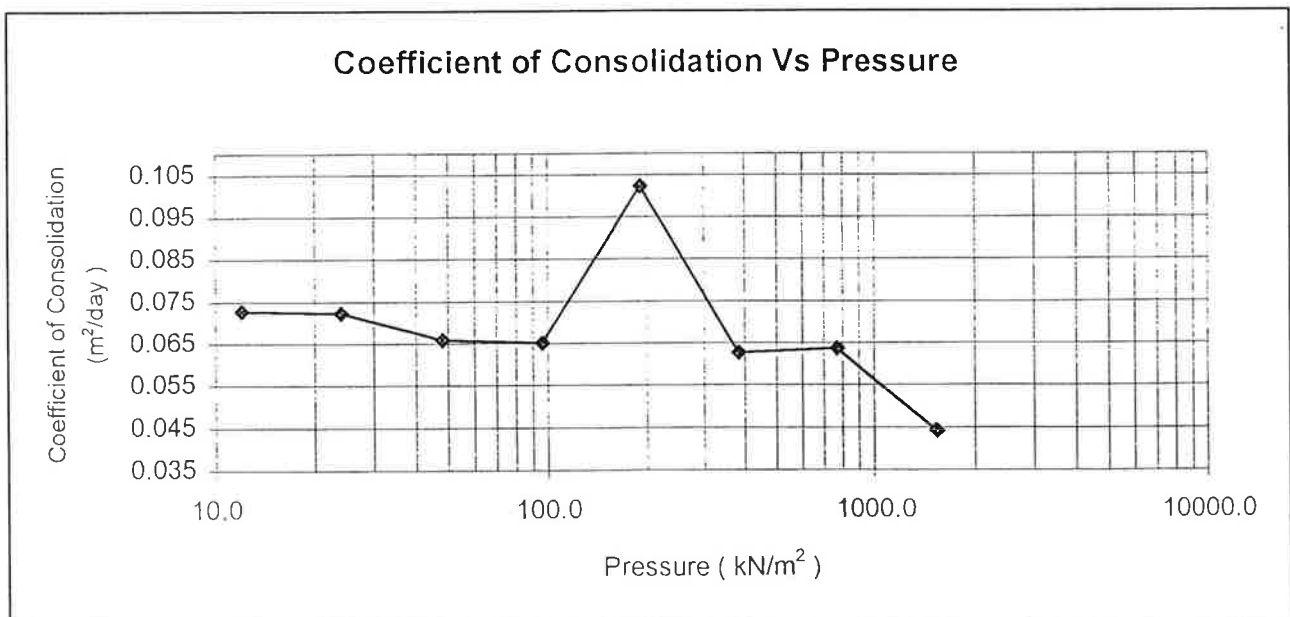
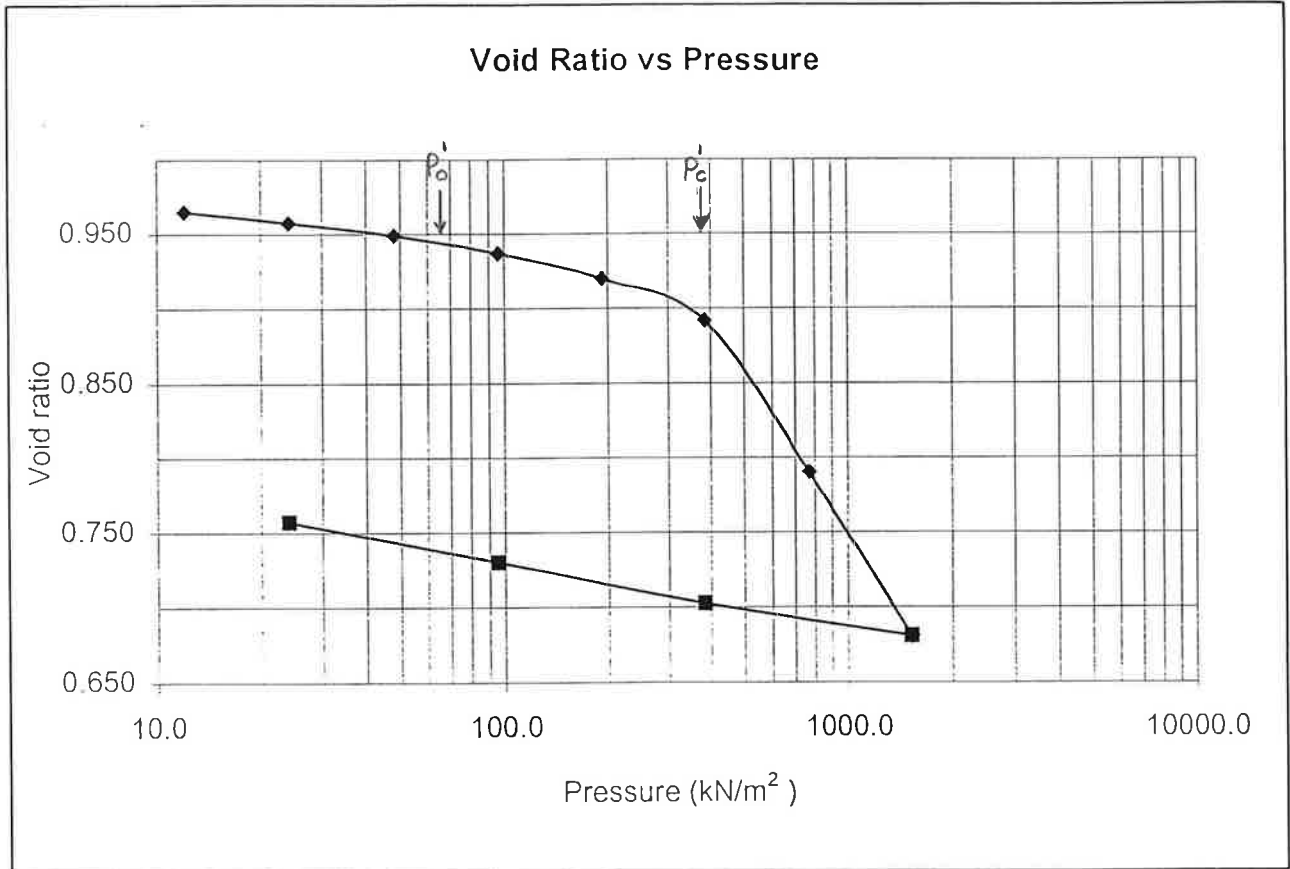
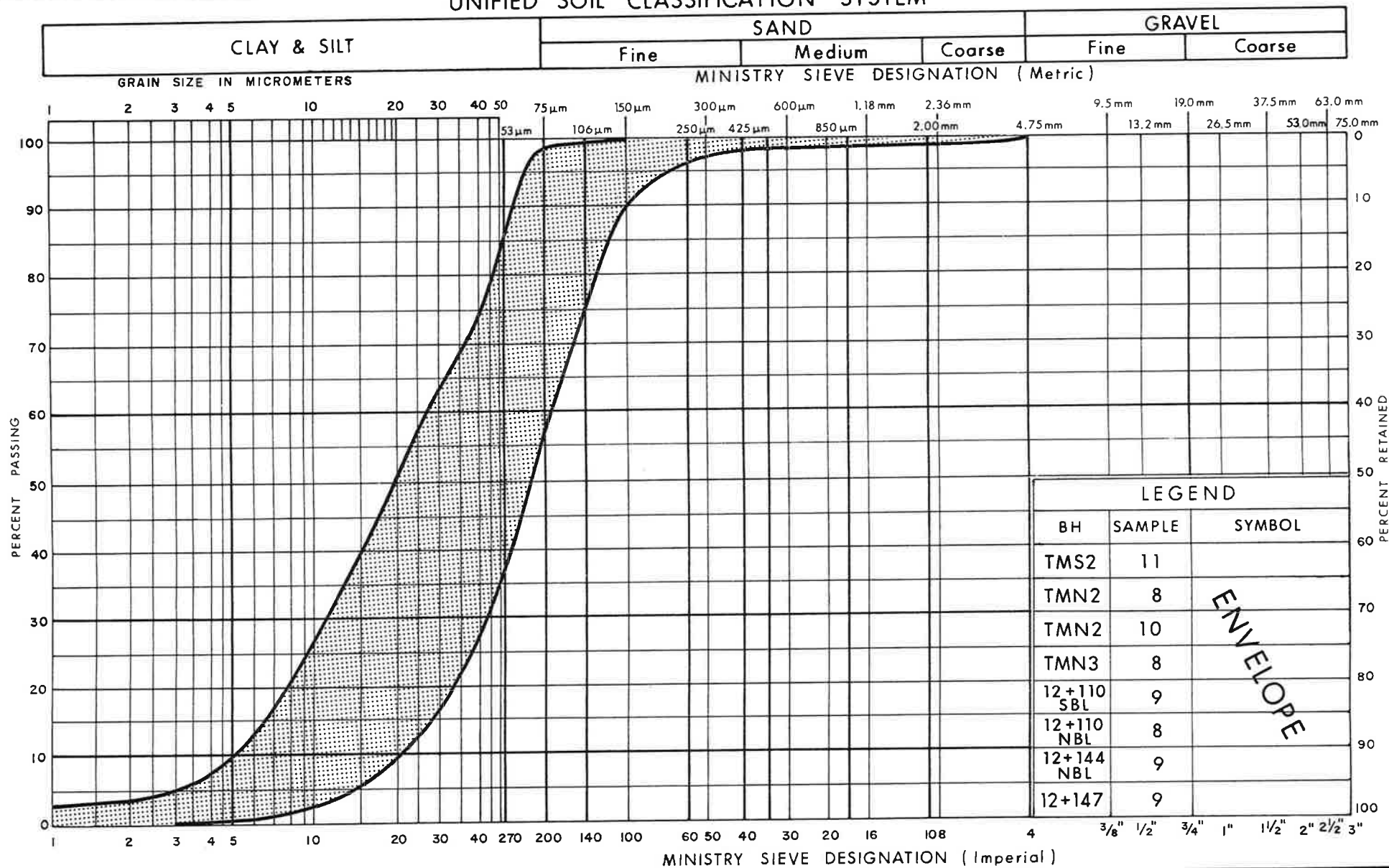


Fig No B1-8

UNIFIED SOIL CLASSIFICATION SYSTEM



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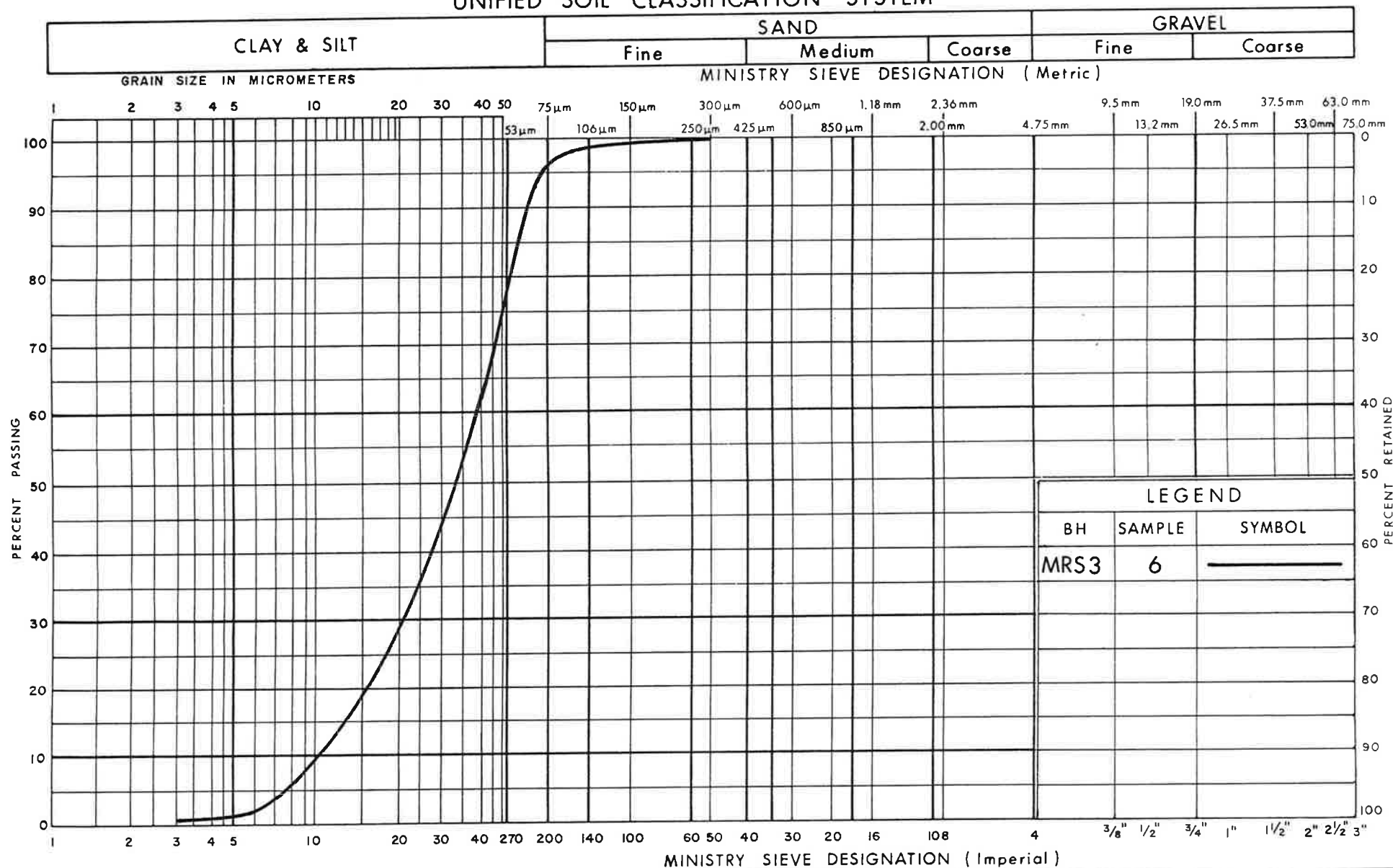
GRAIN SIZE DISTRIBUTION SILT

FIG No B1-9

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



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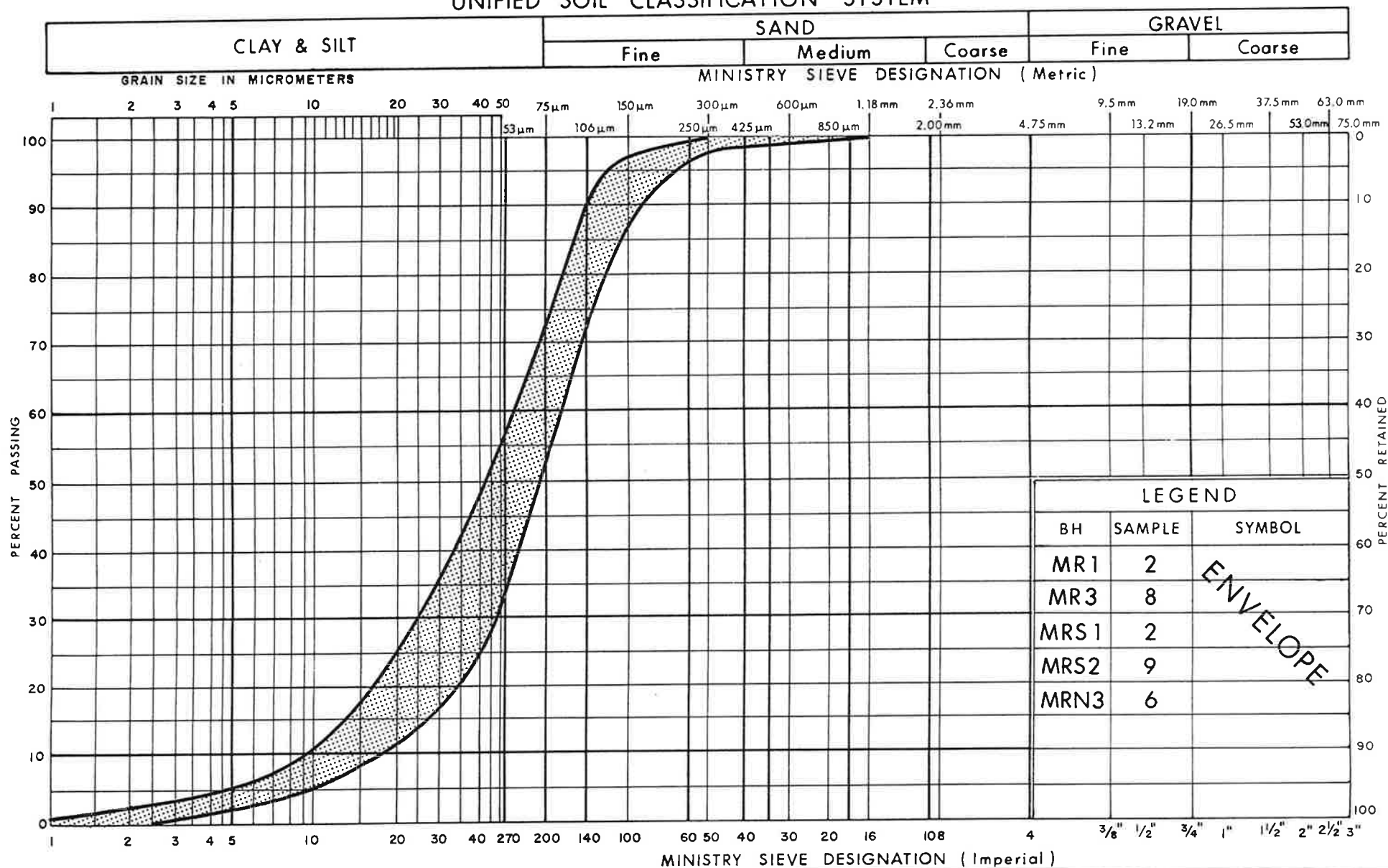
GRAIN SIZE DISTRIBUTION SILT

FIG No B1-10

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

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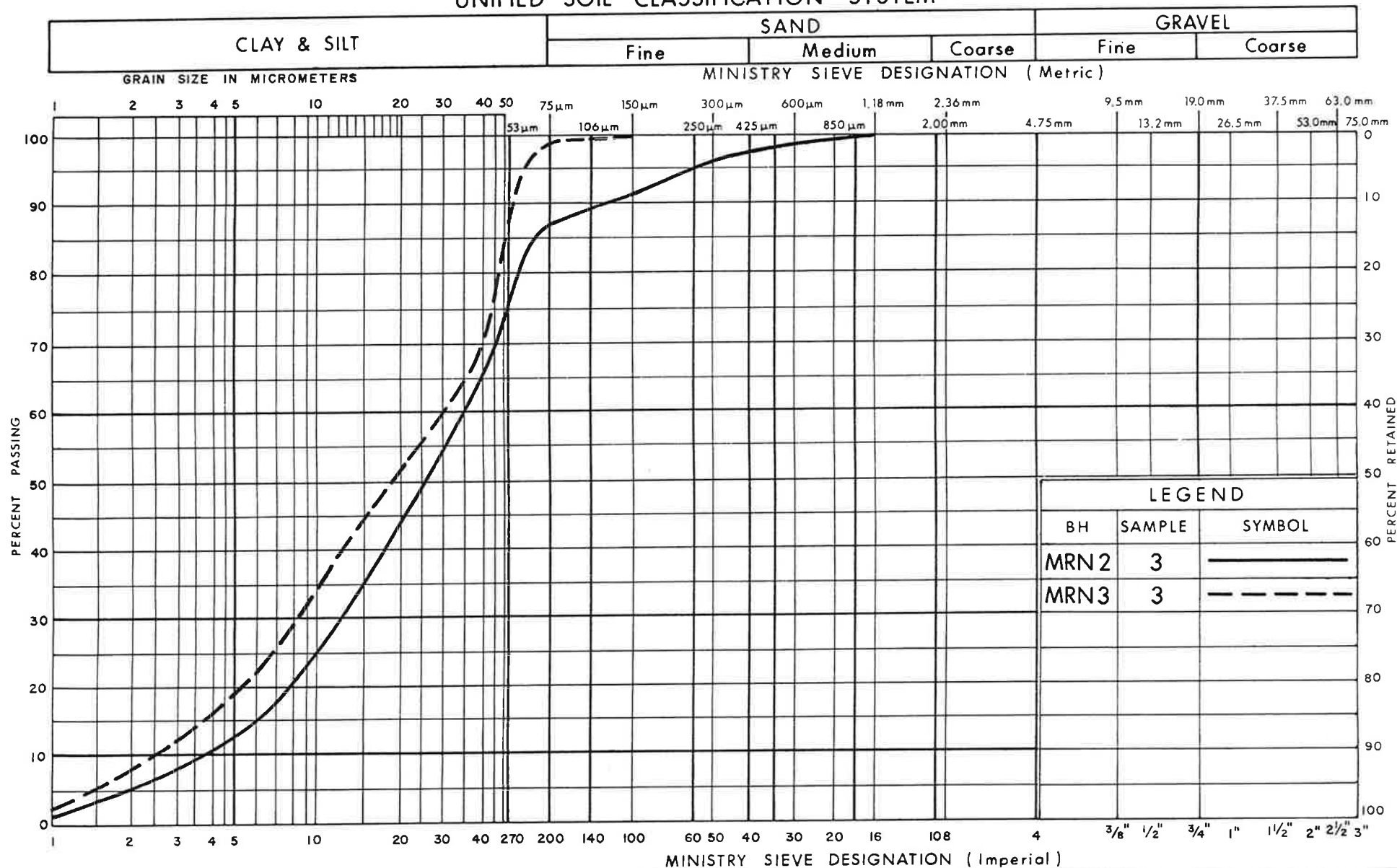
GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

FIG No B1-11

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION

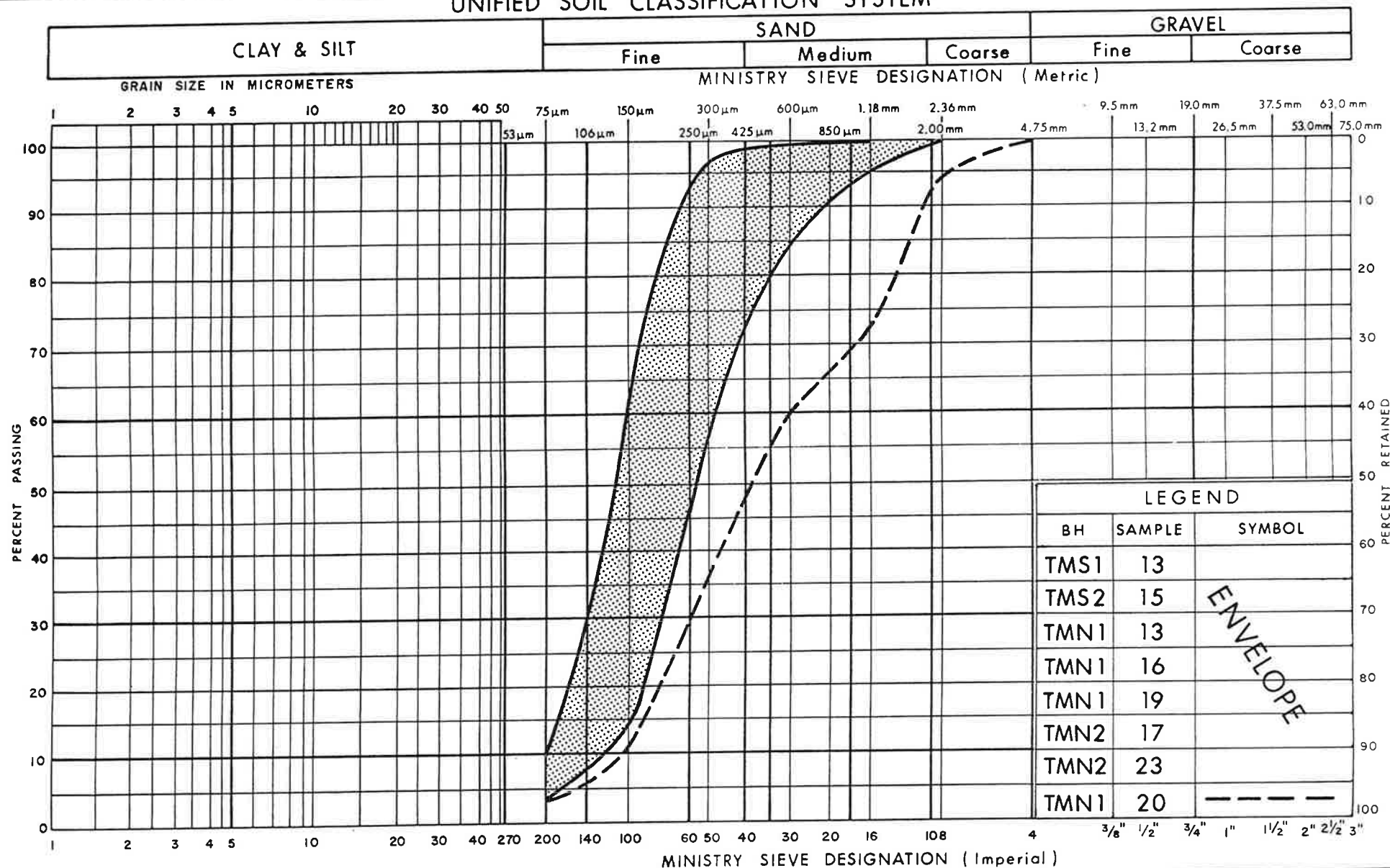
SILT, TRACE CLAY

FIG No B1-12

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM

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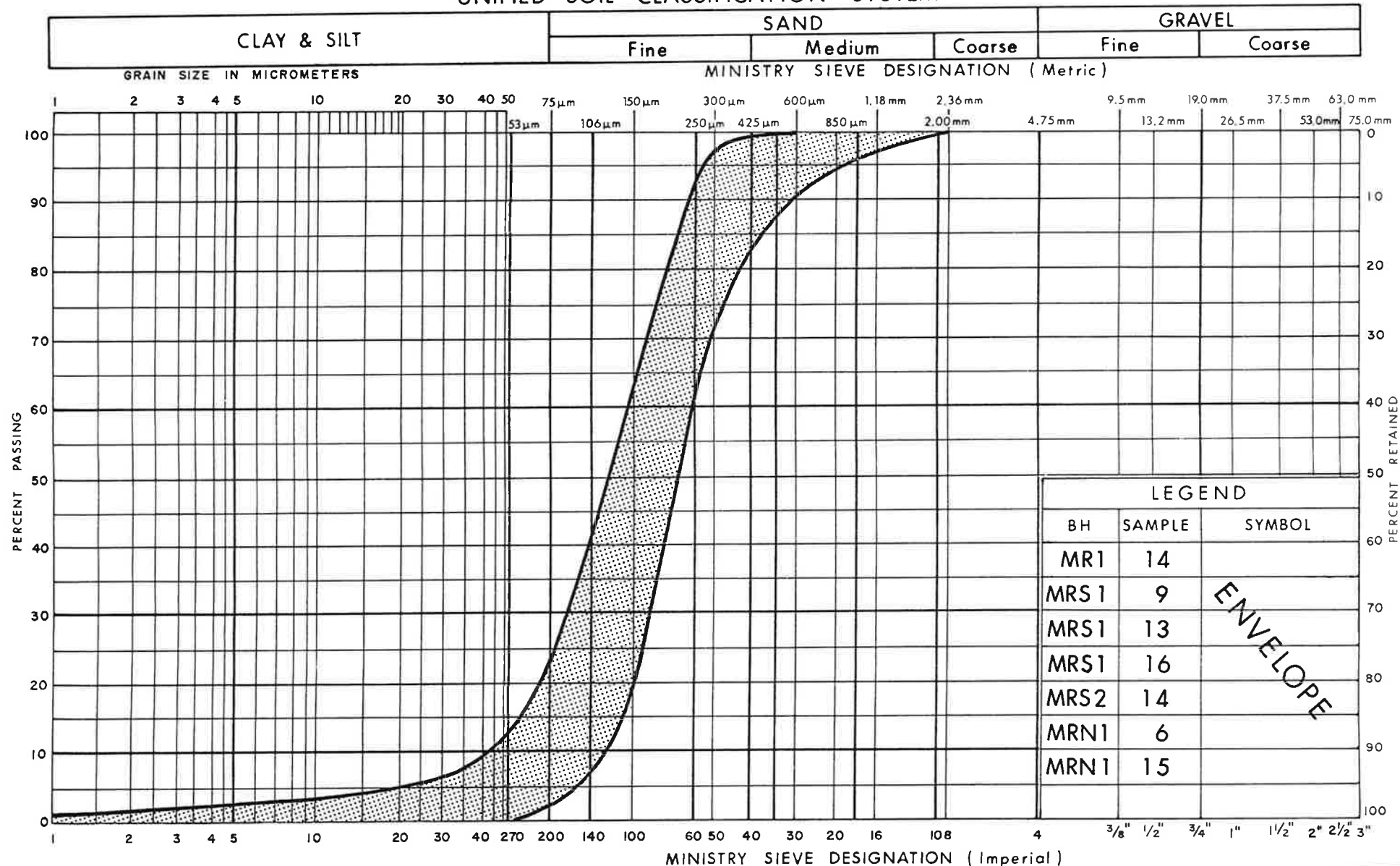
GRAIN SIZE DISTRIBUTION
FINE SAND

FIG No B1-13

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



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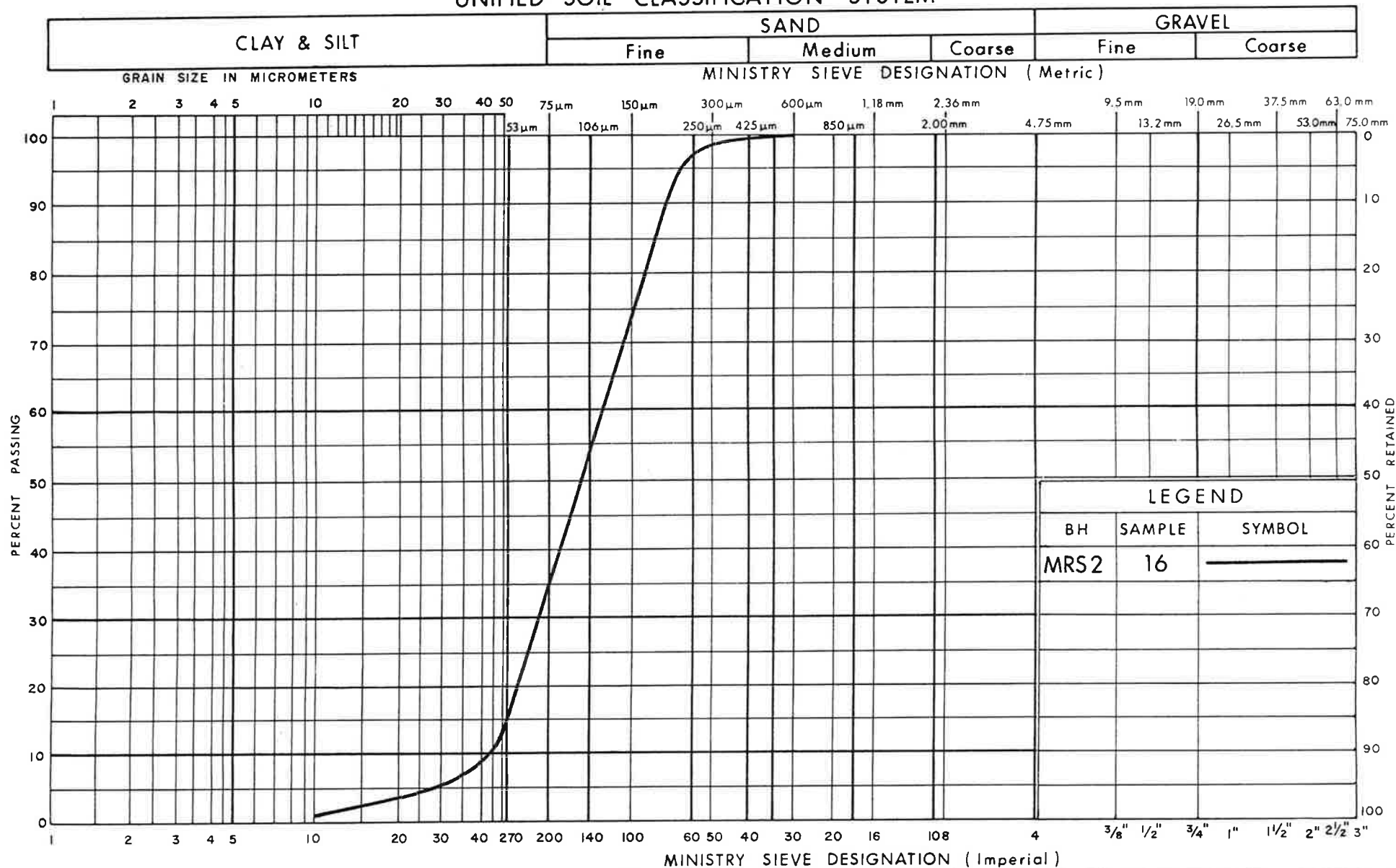
GRAIN SIZE DISTRIBUTION FINE SAND

FIG No B1-14

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



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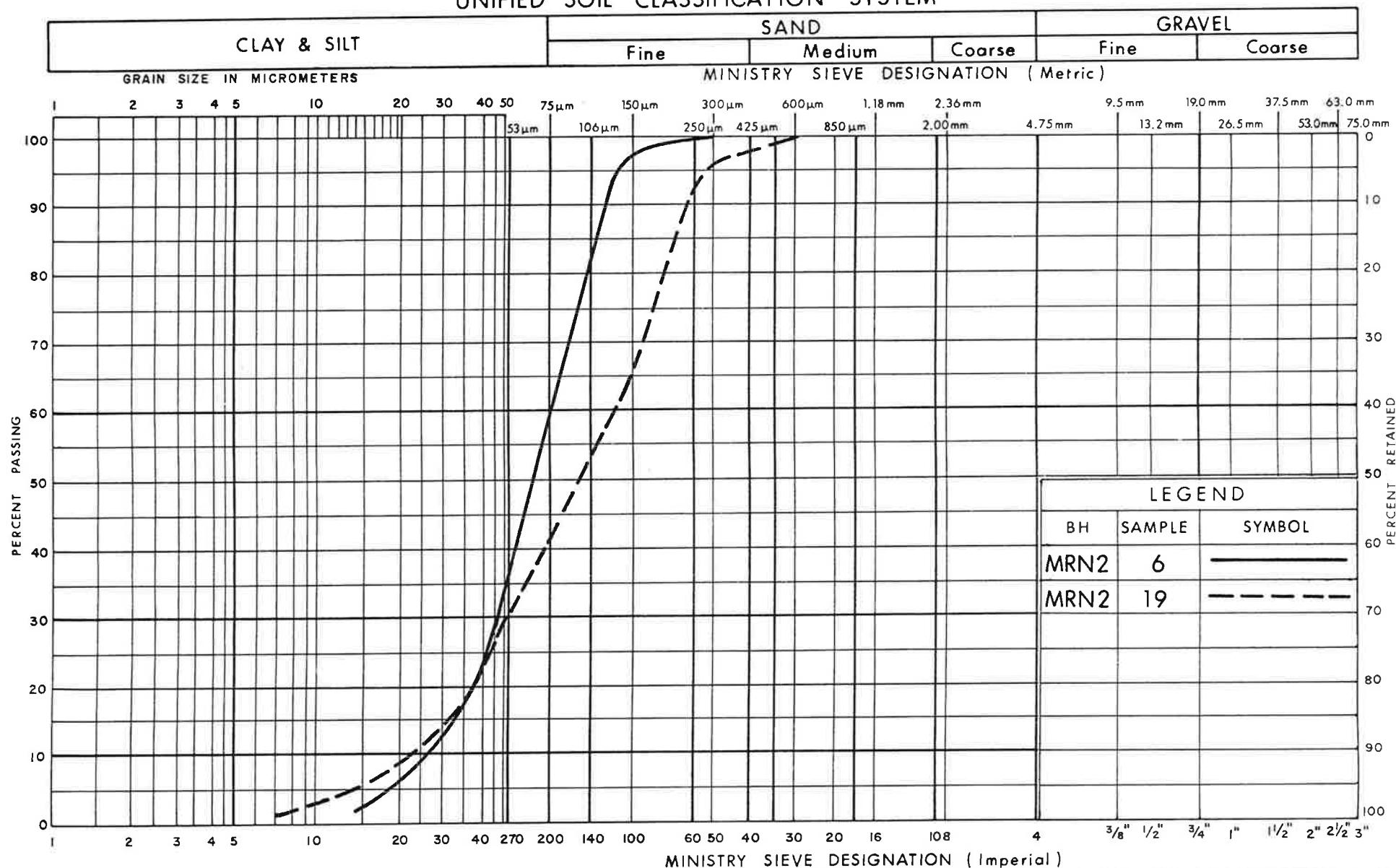
GRAIN SIZE DISTRIBUTION
SILTY FINE SAND

FIG No B1-15

W P 314-99-00

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GRAIN SIZE DISTRIBUTION
SANDY SILT / SILTY SAND

FIG No B1-16

W P 314-99-00

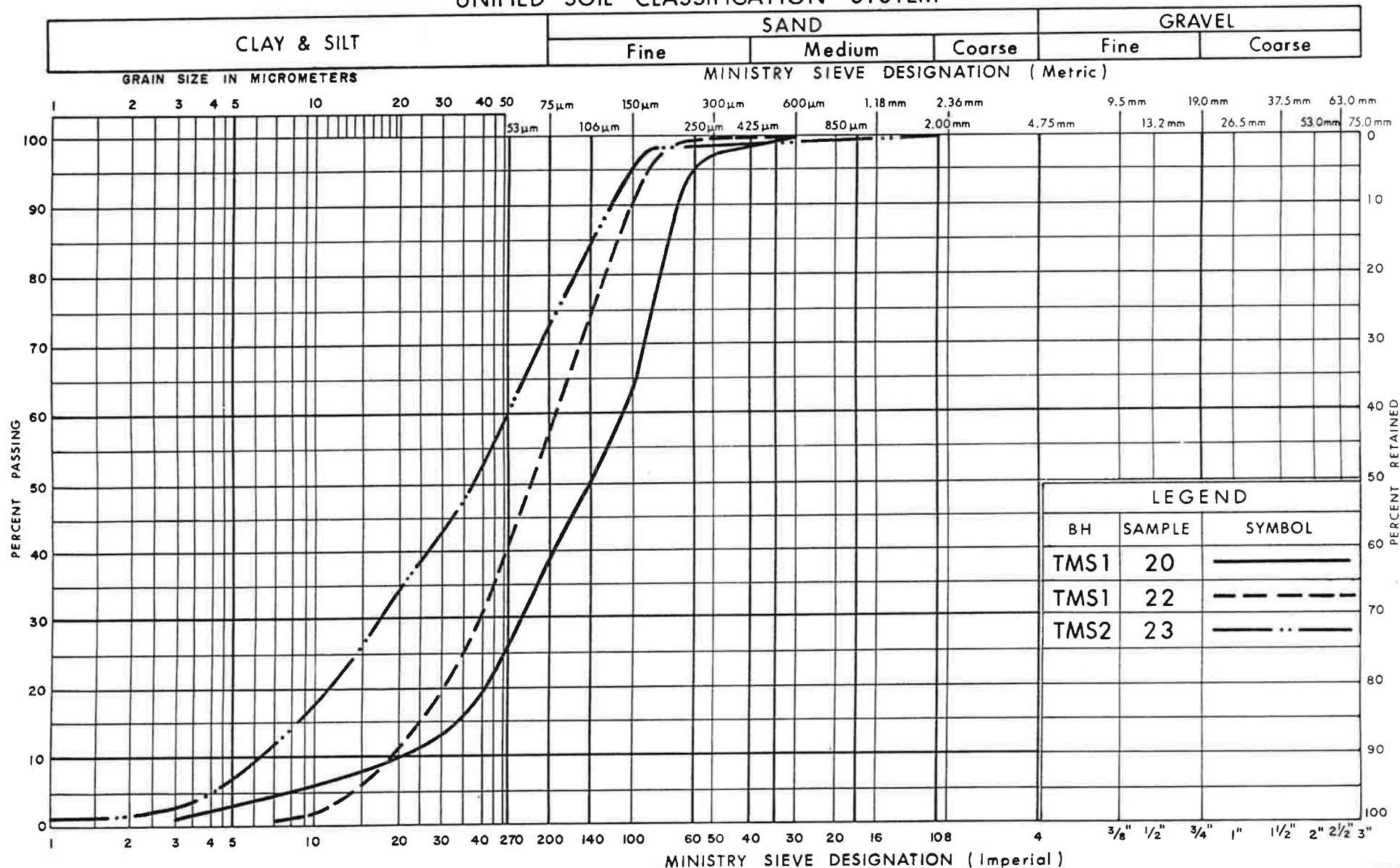
SPT 1010F



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GRAIN SIZE DISTRIBUTION

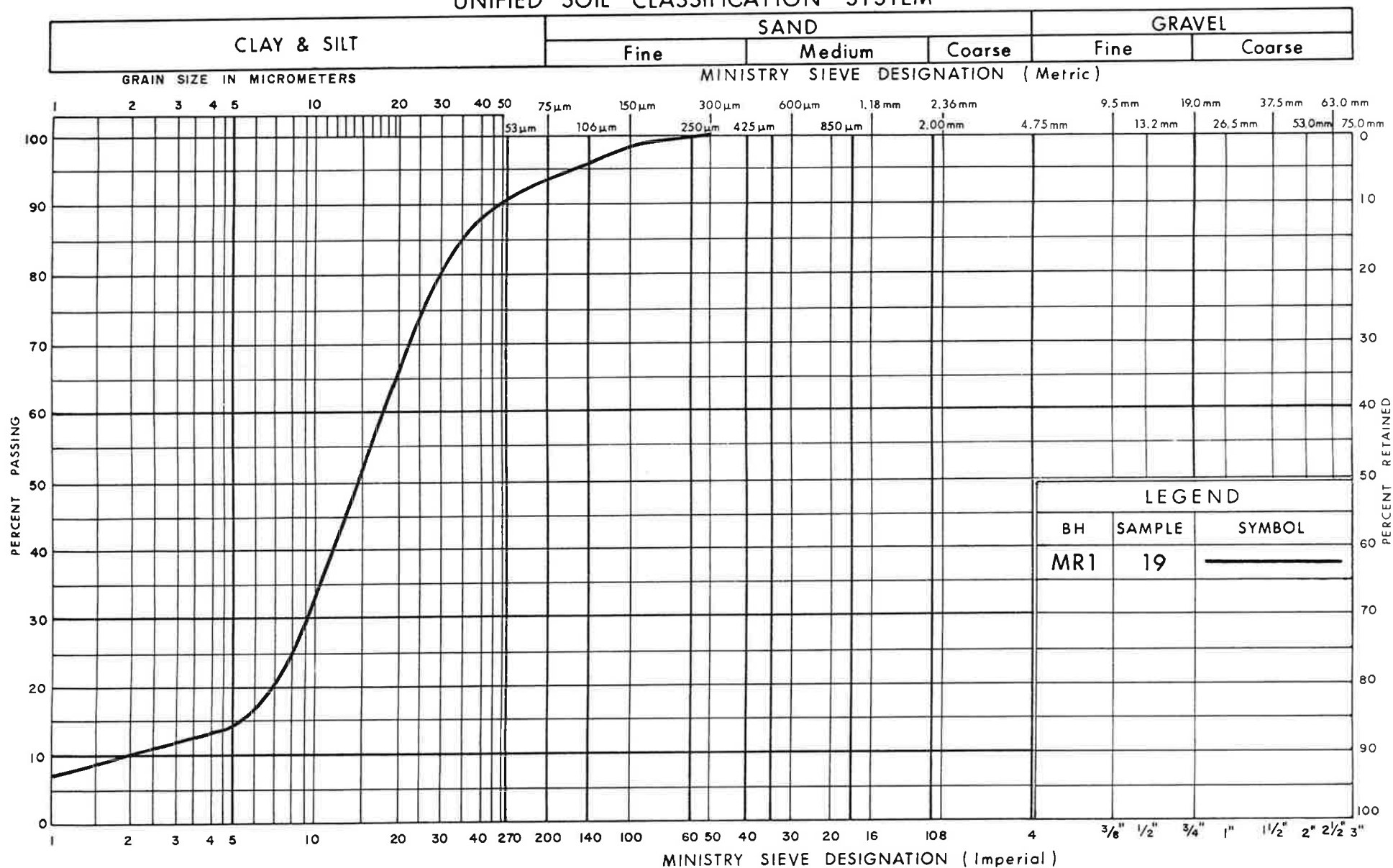
SANDY SILT ZONES IN FINE SAND DEPOSIT

FIG No B1-17

W P 314-99-00

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GRAIN SIZE DISTRIBUTION

SILT



Ontario

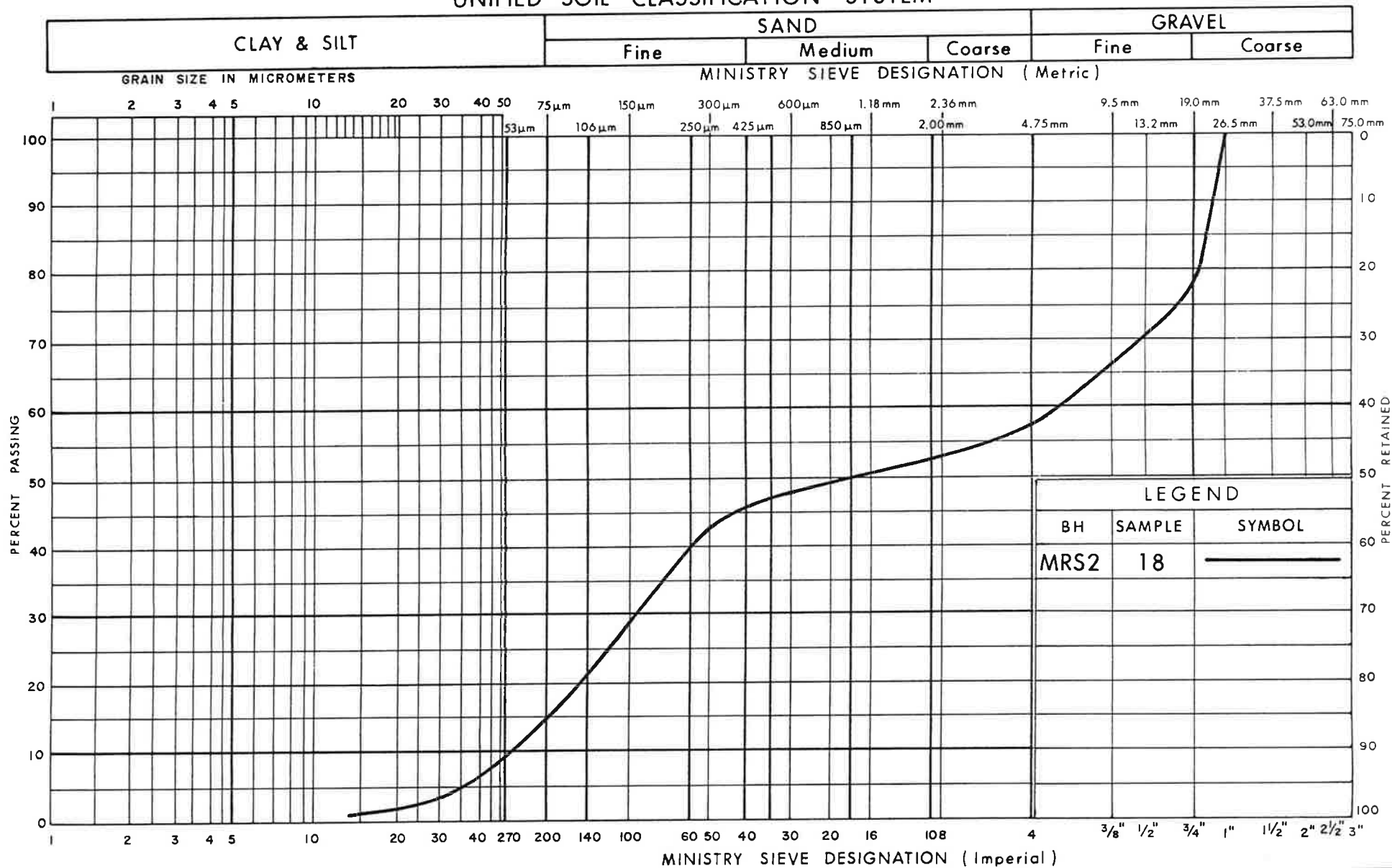
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FIG No B1-18

W P 314-99-00

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GRAIN SIZE DISTRIBUTION GRAVEL & SAND

FIG No B1-19

W P 314-99-00

SPT 1010F

4.2. **SITE 2 - HIGHWAY 11 CROSSING UNDER PROPOSED MUNICIPAL ROAD (BOREHOLES 12+920SBL AND 12+923NBL)**

The site is located to the immediate west of the existing Highway 11 and it is understood that a new bridge (underpass) will carry traffic from the new municipal service road over the realigned Highway 11. The site is in an open field that is surrounded on all sides by heavily forested areas. The area is hummocky, and is probably utilized for grazing, and drains towards the Magnetawan River via a wide swale that slopes from west to east. The Magnetawan River meanders approximately 150 m east of the site. The existing Highway 11 is located in between the Magnetawan River and the new realignment site.

The ground surface elevation is between Elevation 303 m and 313 m, generally rising towards the north and towards the west. To the south, the grade first rises and then drops towards the Magnetawan River while to the north the grade first rises and then drops sharply into the valley of a small watercourse.

Boreholes 12+920SBL and 12+923NBL were drilled just west of the proposed crossing of the re-aligned Highway 11 and the new Municipal Road, as shown on Drawing No. 2.

These boreholes show, below a 200 m thick layer of topsoil, the presence of silty clay to clayey silt to depths ranging between 3.7 and 4.4 m or to Elevation 306.5 and 304.7 m, respectively, underlain by silt to the full depth of the exploration (i.e. 8.1 m).

Details of subsoil conditions contacted in the boreholes are presented on the Record of Borehole Sheets in Appendix A2. The following paragraphs are only meant to complement these data.

4.2.1 TOPSOIL

The boreholes contacted a 200 mm thick topsoil layer.

4.2.2 SILTY CLAY

Underlying the topsoil, both boreholes encountered a silty clay to clayey silt deposit which extends to depths of 3.7 m (Elevation 306.5) and 4.4 m

Preliminary Foundation Investigation Report, Cut and Fill Sections, Proposed Highway 11 Realignment and Municipal Road, Katrine, Ontario

(Elevation 304.7) in Boreholes 12+920SBL and 12+923NBL, respectively. This is generally a layered material consisting of thin silty clay, silt and very thin clay seams, sometimes exhibiting a varved-like structure. Its overall behavior would be akin to a silty clay soil.

Two Atterberg Limits tests performed in the laboratory on samples from the deposit gave the following index values:

Liquid Limit:	32-38%
Plastic Limit:	22-23%
Plasticity Index:	10-15%

As shown in Figure B2-1 in Appendix B2, these results indicate clayey soils of low to intermediate plasticity. This is a cohesive deposit. The measured natural moisture contents of samples generally ranged from 26 to 38%. The measured moisture contents of the two samples tested for Atterberg Limits were at or slightly in excess of measured liquid limits, but this can perhaps be attributed to the layered nature of the soil.

The measured N-values in this deposit ranged from 7 to 23 blows/0.3 m. Based on these field test results, together with pocket penetrometer tests performed on the recovered samples, the consistency of the deposit is described as stiff to very stiff with a firm zone (containing frequent silt seams) in Borehole 12+923NBL, below about 3.6 m depth.

4.2.3 SILT

With increasing depth, the frequency of the silt seams in the silty clay deposit increased and the deposit attained a basically non-cohesive, fine-grained granular character. The unit extended to the full depth of both boreholes (i.e. 8.1 m).

The grain-size distributions of samples from the deposit are given in Figure B2-2, Appendix B2. These show the following grain-size distribution:

Gravel:	0%
Sand:	1 - 7%
Silt:	93-99%
Clay:	0%

Standard Penetration tests performed in this deposit yielded N-values ranging from 19 to 28 blows/0.3 m which indicate a compact material. In Borehole 12+920SBL an N-value of 41 blows was recorded near the bottom of the borehole and this indicates the presence of a dense zone.

4.2.4 GROUNDWATER CONDITIONS

Both boreholes were dry on completion. This, however, may not indicate a stabilized groundwater condition. The color of the soil changed from brown to grey at a depth of 1.8 m below the ground surface and this may represent the groundwater level.

The groundwater table at the site can be expected to fluctuate seasonally.

APPENDIX A2

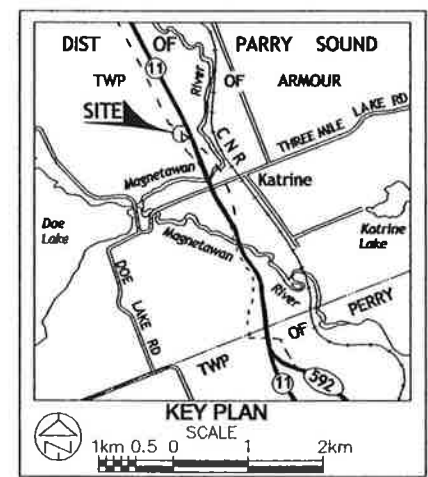
Site 2

Records of Boreholes

SITE 2		RECORD OF BOREHOLE No 12+920 SBL				1 OF 1		METRIC							
W.P. 314-99-00		LOCATION Highway 11- Katrine, ON - Coords N 5 049 008.2; E 315 882.1				ORIGINATED BY S.O									
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T									
DATUM Geodetic		DATE 12.04.01				CHECKED BY Z.O									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
310.2 0.0	Ground Surface														
	200 mm Topsoll	brown	1	SS	15										
	SILTY CLAY laminated very stiff, damp	grey	2	SS	15										
			3	SS	16										
			4	SS	18										
			5	SS	20										
306.5 3.7			6	SS	25										
	SILT trace sand, grey, damp		7	SS	26										
			8	SS	22										
			9	SS	24										
		compact													
		dense													
302.1 8.1	End of borehole Borehole dry (water level not stabilized) and hole open to 7.5 m on completion		10	SS	41										

SITE 2		RECORD OF BOREHOLE No 12+923 NBL				1 OF 1		METRIC								
W.P. 314-99-00		LOCATION Highway 11- Katrine, ON - Coords N 5 049 034.5; E 315 904.7				ORIGINATED BY S.O										
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T										
DATUM Geodetic		DATE 12.04.01				CHECKED BY Z.O										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
309.1 0.0	Ground Surface						20	40	60	80	100					
	200 mm Topsoil	fim	1	SS	7								○			
	SILTY CLAY laminated, damp to moist brown	very stiff	2	SS	23								○			
	grey moist to wet	stiff	3	SS	11								○			
			4	SS	9								○			
			5	SS	9								○			
		fim	6	SS	7								○			
304.7	frequent silt seams															
4.4			7	SS	20								○			
	SILT compact grey, wet laminated		8	SS	28								○			0 1 99 0
			9	SS	19											
301.0			10	SS	21								○			
8.1	End of borehole Ground water not stabilized on completion of boring *Water level estimated from change of colour of sample															

BOREHOLE LOCATION PLAN
SITE 2 - HIGHWAY 11
CROSSING UNDER PROPOSED
MUNICIPAL ROAD



LEGEND

●

Bore Hole

⊕

Dynamic Cone Penetration Test (Cone)

⊗

Bore Hole & Cone

CONE

Blows/0.3m (60° Cone, 475 J/blow)

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
12+920SBL	310.2	5 049 008.2	315 882.1
12+923NBL	309.1	5 049 034.5	315 904.7

NOTE:
FOR DETAILED SUBSURFACE
CONDITIONS REFER TO
RECORD OF BOREHOLE SHEETS.

25 m

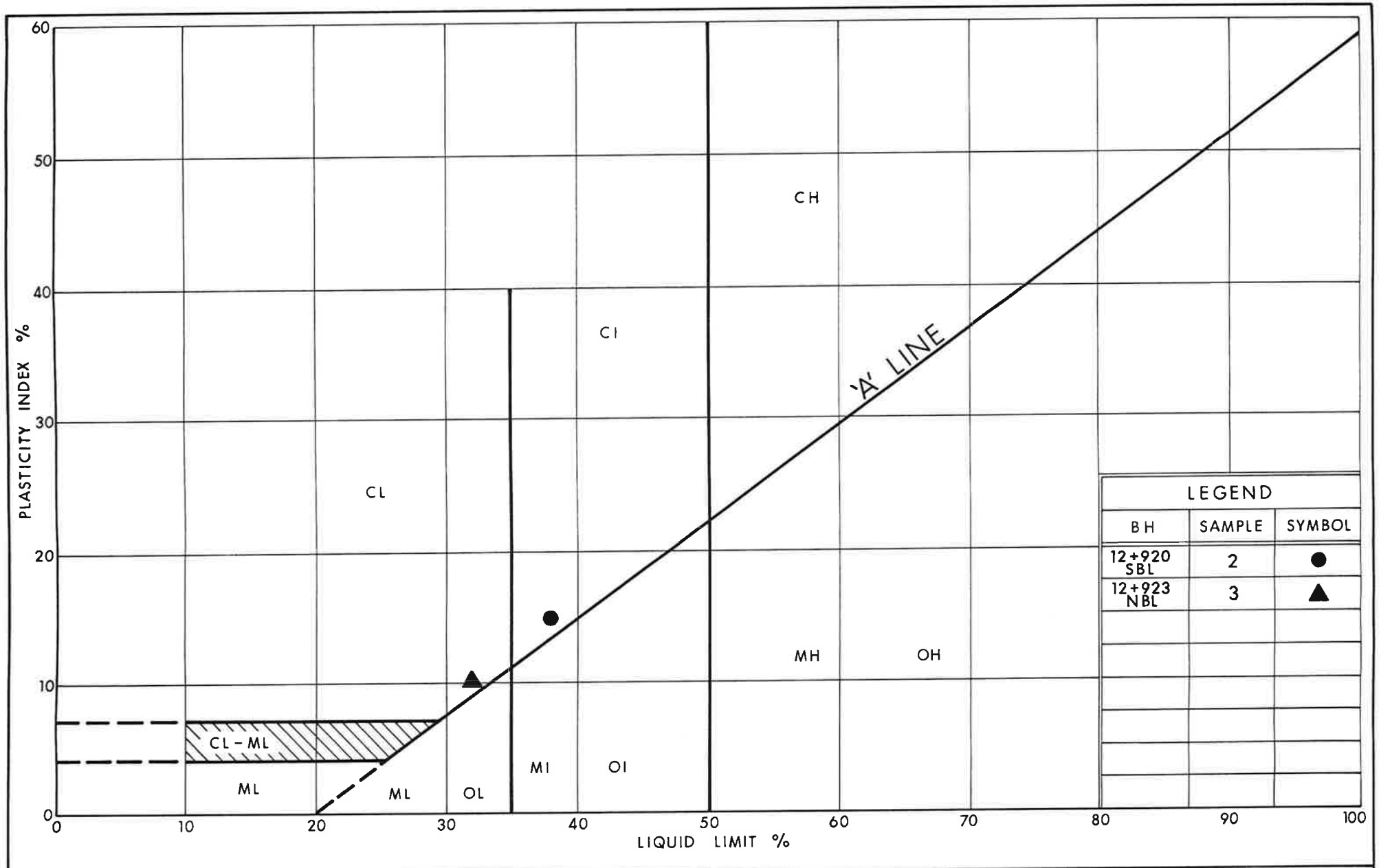
ON ORIGINAL DRAWING

SCALE 1:500	DRAWING No. 2	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTW	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F

APPENDIX B2

Site 2

Laboratory Test Results



Ministry of
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Ontario

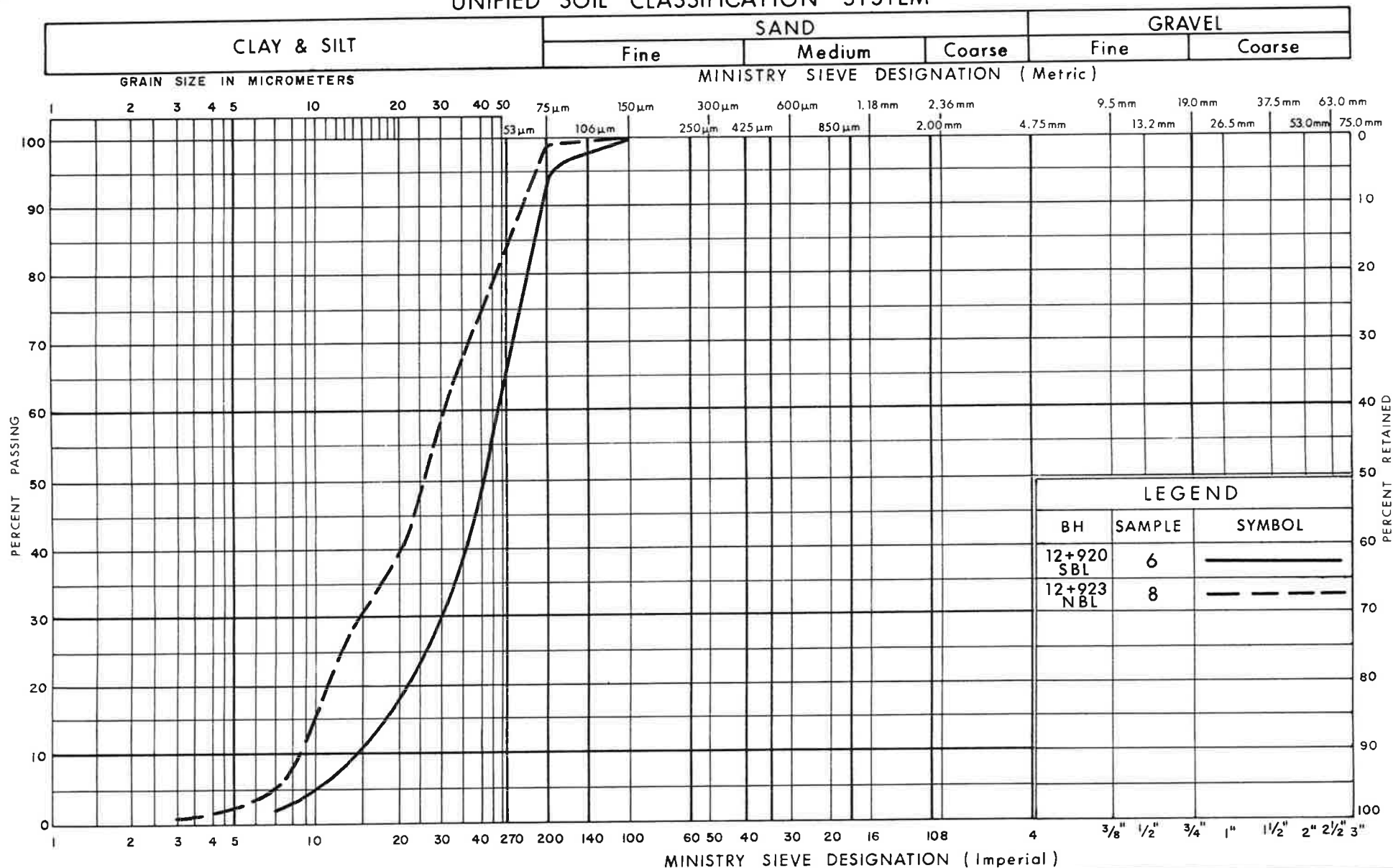
PLASTICITY CHART SILTY CLAY

FIG No B2-1

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION SILT

FIG No B2-2

W P 314-99-00

SPT 1010F

4.3 **SITE 3 – HIGHWAY 11 ALIGNMENT SWAMP CROSSING BETWEEN STATIONS 13+110 AND 13+150 (BOREHOLES OH11, 13+119, 13+122SBL, 13+125, 13+125A, 13+130, 13+130A, 13+132NBL)**

4.3.1 SITE DESCRIPTION

The crossing is located approximately 150 m west of the existing Highway 11 and 1 km north of the intersection of the Highway with Three Mile Lake Road.

The site consists of a deep valley with relatively steep side slopes which are approximately 5 to 8 m high on the south side and 12 to 15 m high on the north side. It is approximately 40 to 50 m wide at the bottom and accommodates a meandering watercourse the bed of which is not well defined as the site is covered with tall grass. The east side of the valley is flanked by the old Highway 11 embankment which is now abandoned and further east is the existing Highway 11 embankment crossing the same valley. The watercourse drains into a small pond at the west toe of the now unused, old Highway 11 embankment.

4.3.2 FIELDWORK

Due to the heavy tree cover on steeply sloping ground on both sides of the valley, access to the site with a motorized vehicle has not been possible and boreholes were drilled by hand drilling methods, supported by a portable tripod and motorized winch system on one of the legs of the tripod. The boreholes were extended by driving a standard split-spoon sampler (attached to a drill rod) into the undisturbed ground by means of a 31.8 kg hammer dropping freely a vertical distance of 0.76 m. The sampler was driven into the ground by up to 0.60 m and then retrieved. The soil sample was then taken out and the sampler put back into the ground and extended to the next sampling depth. As the split-spoon sampler was driven by means of a hammer weighing only half as much as the standard hammer used in Standard Penetration testing, the number of blows of the hammer was divided by two in order to obtain an approximately equivalent, or modified N-value. These values are shown on the appropriate Record of Borehole Sheets presented in Appendix A3.

Using this procedure, the boreholes were extended to depths ranging between 1.5 and 4.9 m. In some of the boreholes a 'modified dynamic cone penetration test' was performed from the bottom of the boreholes. This consisted of driving continuously a conical steel point (51 mm O.D., 60 degree cone angle) by means of the 31.8 kg hammer, dropping freely 0.76 m on "A" size drill rods. The resistance to cone penetration was measured and recorded as the number of blows for each 0.3 m advance of the conical point into the undisturbed ground. In this case too, as the weight of the hammer was only half of the standard hammer, the recorded number was divided by two to arrive at an approximate equivalent dynamic cone penetration test (DCPT) value. Since the manual method has limited depth capability, a conventional drill rig was utilized to advance one borehole (Borehole OH11) from the top of the old Highway 11 embankment which is located to the east of the site. This borehole was extended to a depth of 12.6 m below the top of the embankment, with a DCPT performed from 13.1 to 16.9 m (below the top of the embankment fill which is approximately 2.5 to 3 m higher in elevation in comparison with the manually drilled boreholes).

4.3.3 SUBSURFACE CONDITIONS

The ground surface elevation at the borehole locations drilled from the bottom of the valley ranges from 301.7 to 301.2 m while the elevation of the Borehole OH11 is 304.2 m.

In general, the boreholes contacted 0.2 to 0.3 m of peaty topsoil (i.e. rich in rootlets) underlain by silt which is in turn underlain in most boreholes by silty fine sand to sand. The lower portion of this deposit contained traces of some gravel and most boreholes were terminated in this material identified as possible glacial till.

Details of the subsurface conditions encountered in the boreholes are presented on the Record of Borehole Sheets presented in Appendix A3. The following paragraphs are only meant to summarize these data.

4.3.3.1 FILL

Borehole OH11 which was drilled from the top of the old Highway 11 embankment contacted fill extending to a depth of about 5.5 m below the ground surface or to Elevation 298.7 m. Below a veneer of topsoil, the fill at this borehole

location consisted of a layer of granular soil and silt to a depth of 1.1 m, which is dark brown and contains traces of organics. An N-value of 8 blows/0.3 m was recorded in this material indicating a loose condition.

The silt fill is underlain by a clayey silt to silty clay fill material, which is made up of layered indigenous soils with a varved like structure. Based on recorded N-values of 4 to 5 blows/0.3 m, its consistency is described as firm.

4.3.3.2 TOPSOIL

All boreholes drilled from the bottom of the valley encountered an approximately 0.2 m thick topsoil which is very rich in vegetation (root mat) content. In Borehole 13+130 the topsoil was found to be richer in vegetation (i.e. peaty) and extended deeper to 0.3 m.

4.3.3.3 SILT

Underlying the topsoil and fill (Borehole OH11) all boreholes contacted a silt deposit which extends to depths of 0.7 m (Elevation 301.0 m) to 2.7 m (Elevation 298.5 m) in the boreholes drilled from the bottom of the valley and to the full depth sampled portion of Borehole OH11 (Elevation 291.6 m).

The material ranges from a basically cohesive clayey silt to non-cohesive sandy silt with occasional silty fine sand zones. In general, the upper zones of the deposit were somewhat cohesive and plastic, becoming non-cohesive with increasing depth. The presence of organics (i.e. frequent roots and decayed wood) was noted and in some cases the soil exhibited a somewhat organic nature especially in the upper zones. Some of the apparent plasticity may have been imparted by the organic content. Several samples were tested for Atterberg Limits and these showed little plasticity only (i.e. basically non-plastic).

The grain size distribution of samples from the deposit is shown in Figures B3-1, 2 and 3, Appendix B3. Figure B3-1 represents a typical silt material with traces to some clay content while Figure B3-2 has less clay and more sand; Figure B3-3 represents a more sandy zone in the deposit.

N-values and modified N-values recorded in the deposit ranged from 1 to 8 blows/0.3 m, indicating a very soft to firm or loose to very loose material. In

some of the boreholes, with increasing depth modified N-values of between 10 and 40 blows/0.3 m were also recorded indicating compact or stiff to hard zones (Boreholes 13+119 and 13+132 NBL).

4.3.3.4 SILTY FINE SAND/SAND

In some of the boreholes, the silt deposit is underlain by silty fine sand (Borehole 13+132NBL), silty sand (Borehole 13+125) and sand (Borehole 13+122SBL), with sandy silt seams. In the majority of the boreholes, this material was noted to contain some organics and decayed wood, indicating an alluvial origin. The presence of sandy to clayey silt zones/lenses/seams was also noted.

This unit was contacted at depths ranging between 0.7 and 2.7 m (Elevation 301.0 and 298.8 m) and extended to depths of between 1.5 and 3.9 m. This is a basically fine-grained granular (non-cohesive) soil and can be considered a transition zone to the underlying till-like deposit.

The grain size distribution of a sample from this deposit is given in Figure B3-4, Appendix B3.

Modified N-values in this deposit ranged from 3 to 26 blows/0.3 m and in one case the split-spoon sampler sank under the weight of the sampler and rods. Based on these data, the denseness condition of the material is described as very loose to compact, but generally very loose to loose.

4.3.3.5 SILTY SAND WITH TRACES TO SOME GRAVEL, TRACES OF CLAY

Underlying the silt or the silty fine sand/sand described in the preceding paragraphs, all boreholes, except for Borehole OH11, contacted at depths ranging from 1.5 to 3.9 m below the ground surface or at Elevation 300.2 to 297.3 m, a relatively well graded soil which resembled a glacial till, consisting of silty sand with traces of some gravel and clay. This granular (non-cohesive) deposit extended to the full depth of the boreholes (2.1 to 4.9 m).

The grain size distribution of three samples from this deposit is given in Figure B3-5, Appendix B3. These indicate the following grain size distribution:

Gravel:	3-22%
Sand:	43-63%
Silt:	17-41%
Clay:	1-5%

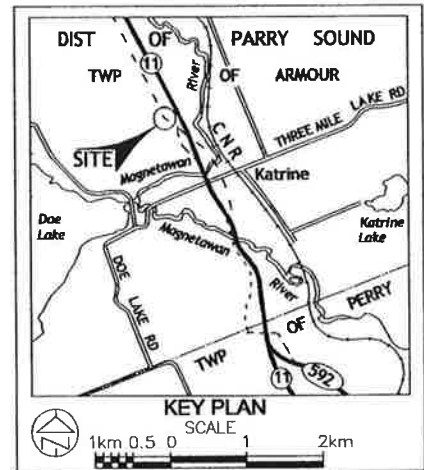
Modified N-values recorded in this deposit ranged from 12 to in excess of 50 blows/0.3 m. These values give indication of a compact to very dense material.

4.3.3.6 GROUNDWATER CONDITIONS

At the time of the investigation (i.e. July 2001) the water level in the boreholes drilled from the bottom of the valley was recorded at 0.2 to 0.4 m below the ground surface. The presence of standing water was also noted in between the proposed north bound lane of the Municipal Road and the old Highway 11 embankment to the east.

It should be pointed out that the presence of standing water was also noted throughout much of the site during the late winter and early spring months.

The groundwater level at the site can be expected to fluctuate seasonally and in response to major weather events.

S & P**SHAHEEN & PEAKER LIMITED**
CONSULTING ENGINEERS**BOREHOLE LOCATION PLAN**SITE 3 - HIGHWAY 11
SWAMP CROSSING
STN 13+110 TO 13+150**LEGEND**

- Bore Hole
 - Dynamic Cone Penetration Test (Cone)
 - Bore Hole & Cone
- CONE Blows/0.3m (60" Cone, 475 J/blow)

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
OH11	304.2	5 049 207.4	315 844.3
13+119*	301.7	5 049 171.0	315 764.5
13+122SBL*	301.7	5 049 162.3	315 748.4
13+125*	301.7	5 049 175.7	315 760.8
13+125A*	301.7	5 049 174.5	315 759.2
13+130*	301.7	5 049 179.7	315 757.7
13+130A*	301.7	5 049 178.5	315 756.1
13+132NBL*	301.2	5 049 193.5	315 772.3

NOTE:

* REFERS TO NON-STANDARD BOREHOLES
ADVANCED BY CONTINUOUS PENETRATION
TECHNIQUES. REFER TO RECORD OF
BOREHOLE SHEETS FOR FURTHER
INFORMATION.

SCALE 1:500	DRAWING No. 3	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTW	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F


APPENDIX A3

Site 3

Records of Boreholes

SITE 3		RECORD OF BOREHOLE No OH11				1 OF 2		METRIC	
W.P. 314-99-00		LOCATION Highway 11- Katrine, ON - Coords: N 5 049 207.4; E 315 844.3				ORIGINATED BY R.A			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers, Hollow Stem Augers and D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 24.05.01 to 25.05.01				CHECKED BY Z.O			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w _p	w	w _L		
304.2	Ground Surface																
0.0	50 mm Topsoll over 150 mm Sand and Gravel (pavement fill) SILT (FILL) : trace organics, loose, dark brown, moist		1	SS	8												
303.1																	
1.1			2	SS	5												
	CLAYEY SILT / SILTY CLAY (FILL) firm, grey																
			3	SS	4												
			4	SS	4												
298.7			5	SS	6												
5.5	CLAYEY SILT with silt, sand and silty clay seams, organics seams, brown/grey/dark grey, firm, wet		6	SS	6												
			7	SS	4												
296.7			8	SS	3												
7.5	SILT / SANDY SILT with silty fine sand zones from 9.0 m to 10.5 m, loose, grey, wet		9	SS	5												
	very loose		10	SS	6												
			11	SS	4												
			12	SS	5												
			13	SS	6												
			14	SS	6												
291.6	End of borehole																
12.6																	
289.2																	

SITE 3		RECORD OF BOREHOLE No OH11				2 OF 2		METRIC				
W.P. 314-99-00		LOCATION Highway 11- Katrine, ON - Coords: N 5 049 207.4; E 315 844.3				ORIGINATED BY R.A						
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers, Hollow Stem Augers and D.C.P.T.				COMPILED BY G.T						
DATUM Geodetic		DATE 24.05.01 to 25.05.01				CHECKED BY Z.O						
SOIL PROFILE		SAMPLES				DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa		WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
289.2							20 40 60 80 100	O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE		W _p W W _L 20 40 60	γ	GR SA SI CL
15.0							289					
287.3							286	20 40 60 80 100				
16.9	End of Dynamic Cone Penetration Test *Water level at 5.9 m (not stabilized) and hole open to 6.9 m on completion. Dynamic Cone Penetration Test performed from 13.1 m to 16.9 m											

SITE 3			RECORD OF BOREHOLE No 13+119				1 OF 1		METRIC					
W.P. 314-99-00			LOCATION Highway 11, Katrine, ON - Coords N 5 049 171.0; E 315 764.5				ORIGINATED BY R.A.							
DIST 52 HWY 11			BOREHOLE TYPE Continuous Penetration with Split Spoon & modified D.C.P.T.				COMPILED BY G.T.							
DATUM Geodetic			DATE 13.07.01				CHECKED BY Z.O.							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	MODIFIED DYNAMIC CONE PENE- TRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	* "N" VALUES			SHEAR STRENGTH kPa <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> 20 40 60 80 100 20 40 60 80 100 </div>						
301.7	Ground Surface													
0.0	200 mm Topsoil		1	SS	1									** No recovery bulk sample collected
	SILT		2	SS	3									
	some clay, somewhat organic, brown		3	SS	40									0 13 77 10
	some root fibres to 0.9 m, -----													
	very soft to soft to 1.2 m, grey													
	hard below, wet													
299.9	SILTY SAND, some gravel, trace		4	SS	25/21									22 43 30 5
1.8	clay, very dense, grey, wet													
299.6	End of borehole													
2.1	End of modified DCPT													
299.3	Water level at 0.3 m on 14.07.01													
2.4	*Modified Dynamic Cone Penetration													
	Test performed from 2.1 m to 2.4 m.													
	*Modified N-values and Dynamic													
	Cone Penetration Test (31.6 kg													
	hammer dropping 0.76 m; recorded													
	value divided by 2)													

+ 3, × 3: Numbers refer to Sensitivity

SITE 3		RECORD OF BOREHOLE No 13+125				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Highway 11, Katrine, ON - Coords N 5 049 175.7; E 315 760.8				ORIGINATED BY R.A			
DIST 52 HWY 11		BOREHOLE TYPE Continuous Penetration with Split Spoon				COMPILED BY G.T			
DATUM Geodetic		DATE 17.07.01				CHECKED BY Z.O			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	MODIFIED DYNAMIC CONE PENE- TRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	* "N" VALUES			20	40	60	80	100	W P	W	W L		
301.7	Ground Surface																
0.0	200 mm Topsoil SILT with some clay, somewhat organic, some root fibres, very soft, brown, wet		1	SS **	1	***							o			** No recovery bulk sample collected 0 66 31 3	
300.4	with sand		2	SS	3								o				
300.2	SILTY SAND: trace of organics, very loose, grey, wet		3A	SS	3								o				
1.5	End of borehole Split Spoon refusal at 1.5 m probably on tree-stump. Borehole moved 2.0 m west and extended to 1.8 m without sampling (see Borehole 13 + 125A) *Modified N-values (31.8 kg hammer dropping 0.76 m; recorded value divided by 2). *** Water level not measured due to obstruction		3B														

SITE 3		RECORD OF BOREHOLE No 13+125A				1 OF 1		METRIC								
W.P. 314-99-00		LOCATION Highway 11, Katrine, ON - Coords N 5 049 174.5; E 315 759.2				ORIGINATED BY R.A										
DIST 52 HWY 11		BOREHOLE TYPE Continuous Penetration with Split Spoon & modified D.C.P.T.				COMPILED BY G.T										
DATUM Geodetic		DATE 17.07.01				CHECKED BY Z.O										
SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	MODIFIED DYNAMIC CONE PENE- TRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	* "N" VALUES			20 40 60 80 100	20 40 60 80 100	W P	W	W L				
301.7	Ground Surface															
0.0	Borehole extended to 1.8 m without sampling (see BH13+125 for Soil Stratigraphy)															
299.9																
1.8	SILTY SAND: some gravel and clay, trace of organics, dense, grey, wet		1	SS	50/28											
299.4																
2.3	End of borehole															
299.1																
2.6	End of modified DCPT Water level at 0.3 m on 18.07.01 *Modified Dynamic Cone Penetration Test performed from 2.3 m to 2.6 m. *Modified N-value and Dynamic Cone Penetration Test (31.8 kg hammer dropping 0.76 m; recorded value divided by 2)															

SITE 3		RECORD OF BOREHOLE No 13+130				1 OF 1		METRIC									
W.P. 314-99-00		LOCATION Highway 11, Katrine, ON - Coords N 5 049 179.7; E 315 757.7				ORIGINATED BY R.A											
DIST 52 HWY 11		BOREHOLE TYPE Continuous Penetration with Split Spoon				COMPILED BY G.T											
DATUM Geodetic		DATE 17.07.01				CHECKED BY Z.O											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	MODIFIED DYNAMIC CONE PENE- TRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			* "N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)				
301.7	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					20 40 60 W P W L				GR SA SI CL	
0.0	300 mm Peat and Topsoil SILT some clay, frequent rootlets and organics, very soft to 1.0 m, firm below, grey, wet		1	SS	1	***	301							○			** No recovery bulk sample collected
			2	SS	5									○			
300.1			3	SS	5									○			
1.6	End of borehole Split Spoon refusal at 1.6 m, probably on tree-stump. Borehole moved hole 2 m west and extended to 1.2 m without sampling (see Borehole 13 + 130A). * Modified N-value (31.8 kg hammer dropping 0.76 m; recorded value divided by 2). *** Water level not measured due to obstruction.																

SITE 3		RECORD OF BOREHOLE No 13+130A				1 OF 1		METRIC					
W.P. 314-99-00		LOCATION Highway 11, Katrine, ON - Coords N 5 049 178.5; E 315 756.1				ORIGINATED BY R.A							
DIST 52 HWY 11		BOREHOLE TYPE Continuous Penetration with Split Spoon & modified D.C.P.T.				COMPILED BY G.T							
DATUM Geodetic		DATE 17.07.01				CHECKED BY Z.O							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	MODIFIED DYNAMIC CONE PENE- TRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			* "N" VALUES	SHEAR STRENGTH kPa					
301.7	Ground Surface						<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>○ UNCONFINED + FIELD VANE</p> <p>● QUICK TRIAXIAL x LAB VANE</p> </div> <div> <p>20 40 60 80 100</p> <p>WATER CONTENT (%)</p> <p>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</p> <p>W P W W L</p> </div> </div>						
0.0	Borehole extended to 1.2 m without sampling (see BH 13+130 for Soil Stratigraphy)												
300.5													
1.2	SILT: some clay, traces of rootlets and organics, firm, grey, wet		1	SS	5							18.3	
299.9													
1.8	SILTY SAND: traces of gravel and clay, traces of organics, some sandy silt zones/layers, compact to 2.5 m, dense below, grey, wet		2	SS	19								3 51 41 5
298.7			3	SS	50							22.3	
3.0	End of borehole												
298.4													
3.3	End of modified DCPT Water level at 0.2 m and hole open to 1.5 m two hours after completion *Modified Dynamic Cone Penetration Test performed from 3.0 m to 3.3 m. *Modified N-vlaue and Dynamic Cone Penetration Test (31.8 kg hammer dropping 0.76 m; recorded value divided by 2).												

SITE 3		RECORD OF BOREHOLE No 13+132 NBL				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Highway 11, Katrine, ON - Coords N 5 049 193.5; E 315 772.3				ORIGINATED BY R.A			
DIST 52 HWY 11		BOREHOLE TYPE Continuous Penetration with Split Spoon & modified D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 18.07.01				CHECKED BY Z.O			

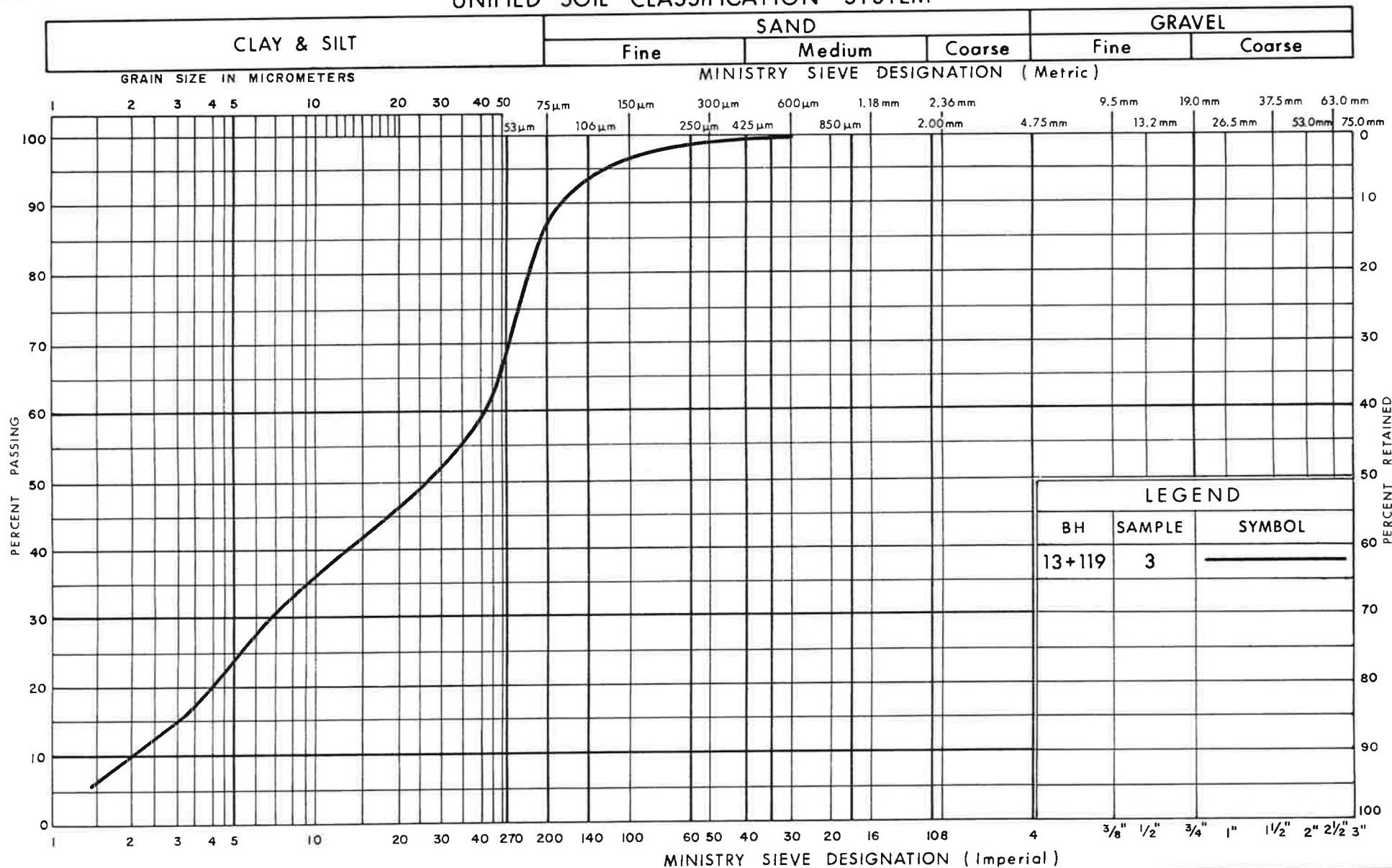
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	MODIFIED DYNAMIC CONE PENE- TRATION RESISTANCE PLOT					PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	* "N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
301.2	Ground Surface																
0.0	200 mm Topsoil		1	SS	1												
	SILT some clay, traces of organics to 1.8 m, very soft to 1.2 m, stiff below, grey, wet	sandy	2	SS	2											19.9	
			3	SS	10											19.9	
			4	SS	16											20.0	0 32 62 6
298.5		sandy compact	5A														
2.7	SILTY FINE SAND with sandy silt zones, very loose to compact, grey, wet		5B	SS	6												0 56 36 8
			6	SS	***												*** spoon sinking under own weight
297.3			7	SS	18												
3.9	SILTY SAND : traces to some gravel, trace clay, compact, grey, wet (Soil Stratigraphy inferred below 4.3 m)		8	SS	****												**** no recovery
296.3																	
4.9	End of borehole																
295.4																	
5.8	End of modified DCPT **Water level at 0.7 m (not stabilized) and hole open to 3.7 m on completion *Modified Dynamic Cone Penetration Test performed from 4.9 m to 5.8 m. *Modified N-value and Dynamic Cone Penetration Test (31.8 kg hammer dropping 0.76 m; recorded value divided by 2).																

APPENDIX B3

Site 3

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
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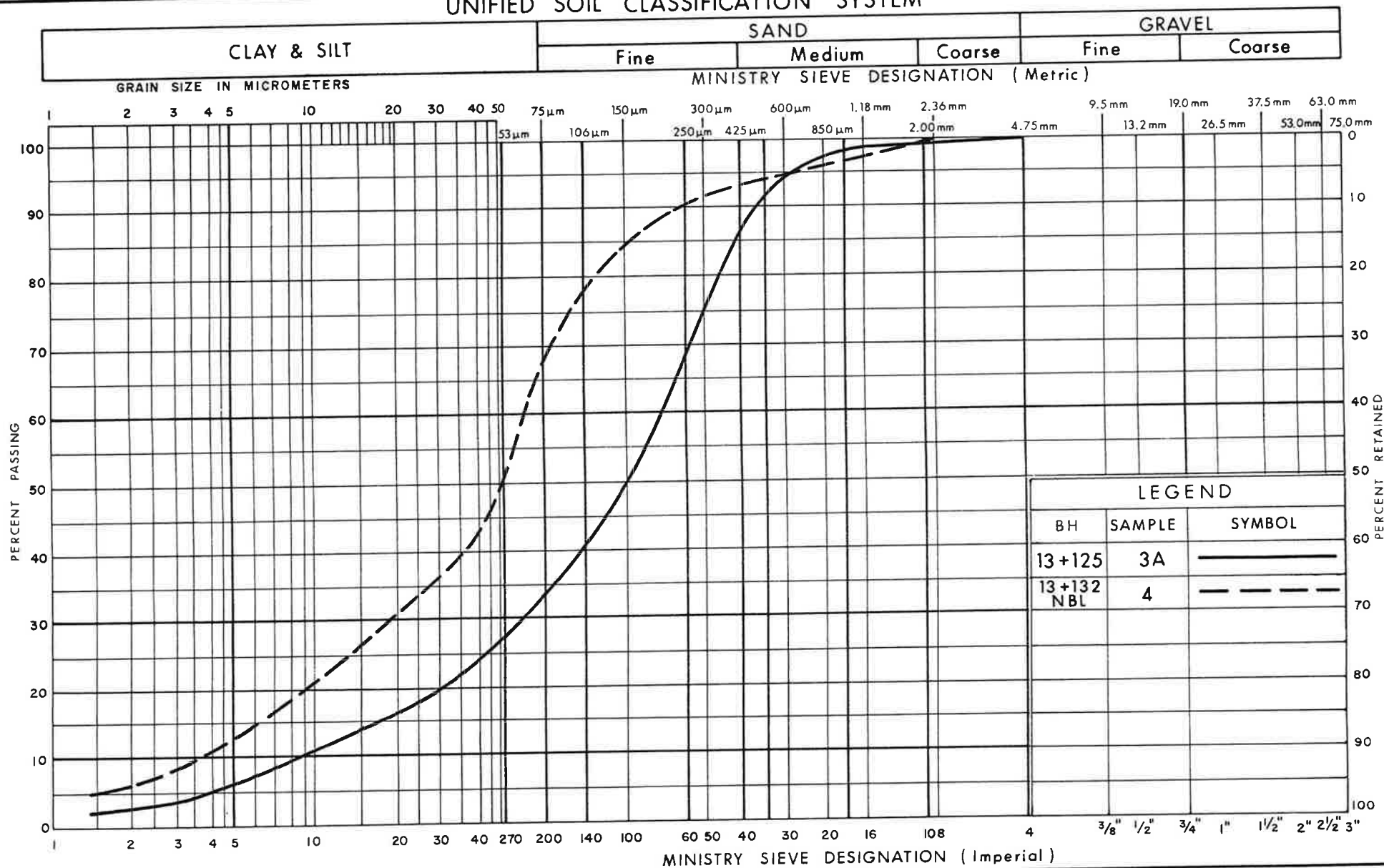
GRAIN SIZE DISTRIBUTION SILT

FIG No B3-1

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

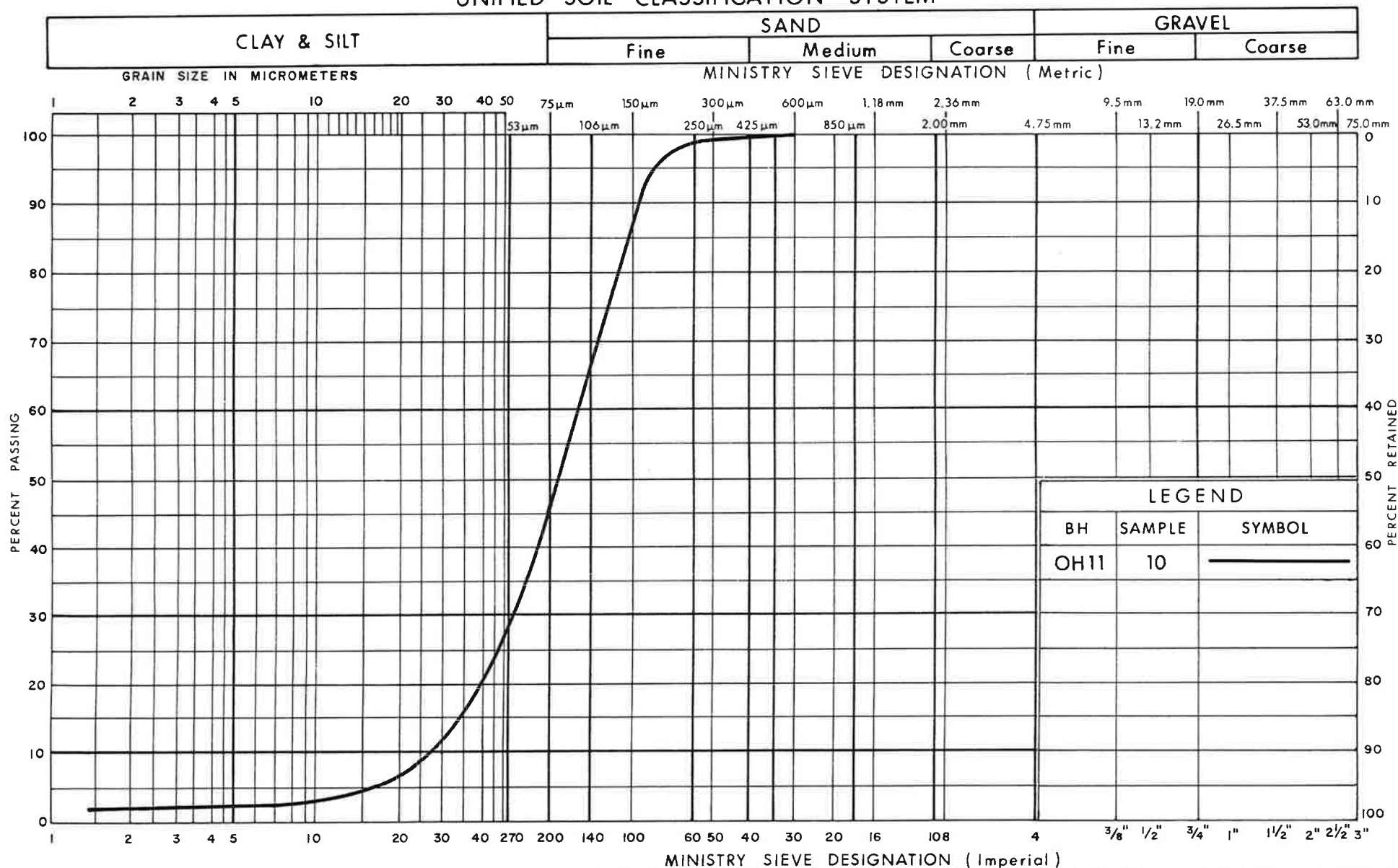
GRAIN SIZE DISTRIBUTION SANDY SILT

FIG No B3-2

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

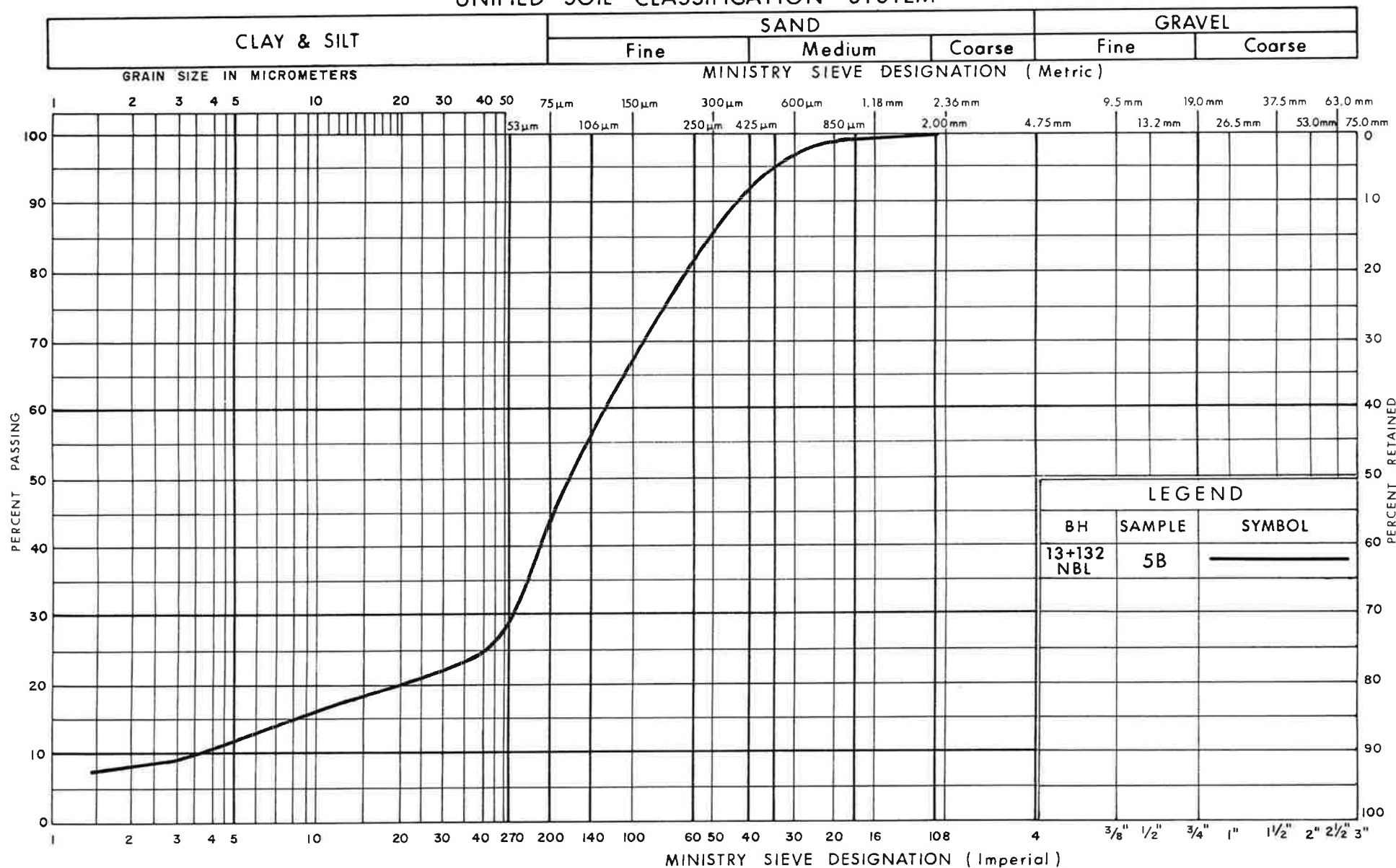
GRAIN SIZE DISTRIBUTION SILT/SANDY SILT

FIG No B3-3

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
SILTY FINE SAND



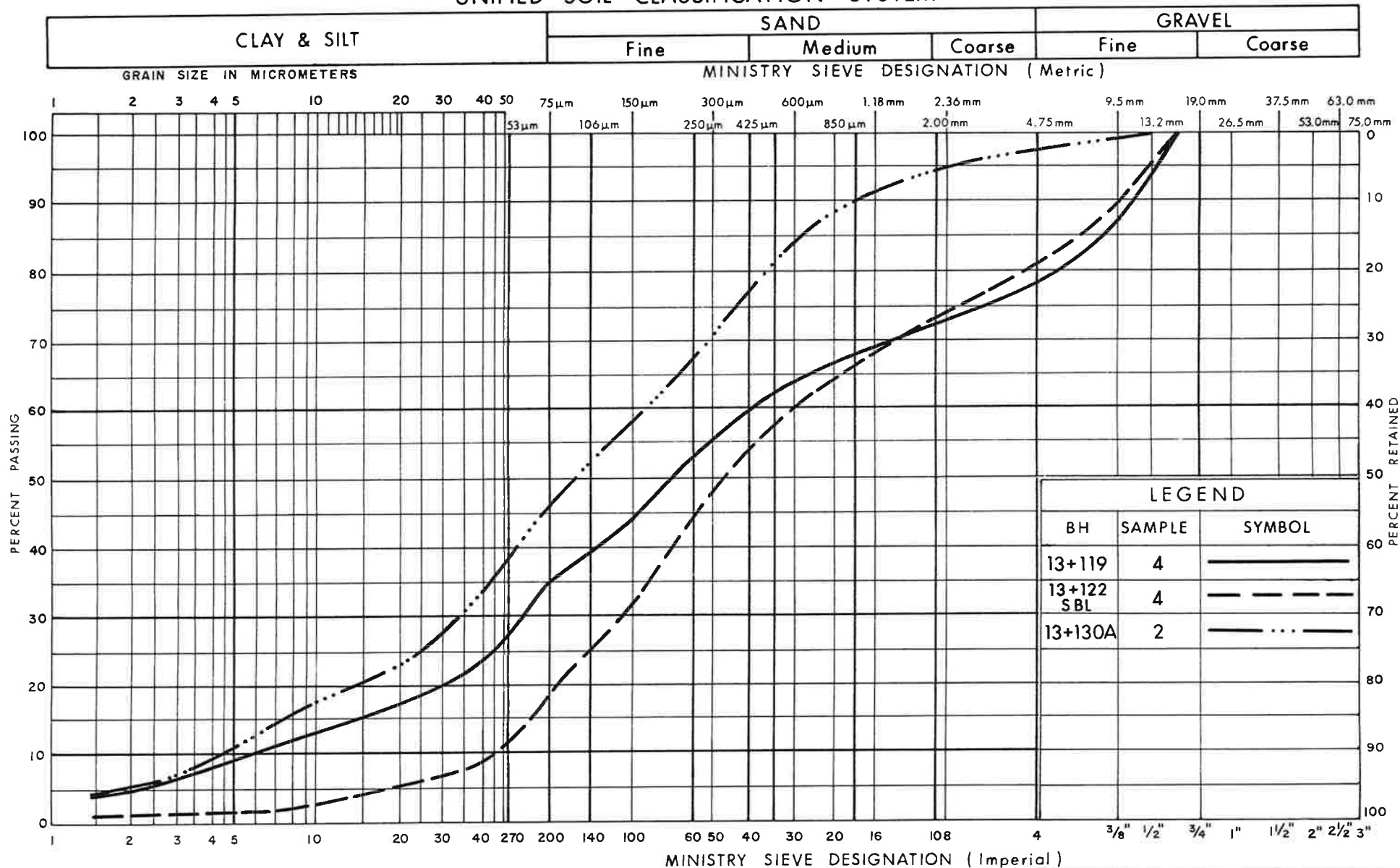
Ministry of
Transportation

FIG No B3-4

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY SAND
TRACES TO SOME GRAVEL, TRACES OF CLAY

FIG No B3-5

W P 314-99-00

SPT 1010F

4.4 SITE 4 – HIGHWAY 11 CROSSING OVER SWAMPY AREA BETWEEN STATIONS 15+625 AND 15+965 (BOREHOLES 15+625NBL, 15+650, 15+788NBL, 15+788SBL, 15+850SBL, 15+900 AND 15+965SBL)

The site is a waterlogged wide and shallow valley immediately west of the existing Highway 11. (North is considered in the direction of increasing station numbering for the purposes of this discussion.) A small stream which meanders in the valley, crosses under the Highway via a 1.8 diameter x 27 m long corrugated pipe culvert near the south end of the site. In general, the existing grade is lowest along this watercourse (about Elevation 298 m) and rises gradually to the south and north. About 100 m north, near the middle portion of the site, is a gravel driveway which is breached in times of high water (e.g. spring thaw). The grade here is about Elevation 300 m and rises to about Elevation 301 further 100 m north and from thereon starts rising more steeply towards a high hill (see Site 5).

The boreholes drilled in this section (Borehole Location Plan, Drawing No. 4) showed the presence of some surficial silt underlain by silty clay to clay.

Details of the subsurface conditions encountered in the boreholes are presented on the Record of Borehole Sheets in Appendix A4. The individual strata are briefly described in the following paragraphs:

4.4.1 TOPSOIL AND PEAT

A number of the boreholes contacted topsoil which ranged from 50 to 75 mm, underlain by approximately 200 mm of very organic rich soil, while in two of the boreholes, drilled towards the north end, a clayey peat was found extending to 0.4 and 0.7 m below the ground surface.

4.4.2 FILL

Borehole 15+788NBL, which was drilled from a driveway, contacted fill extending to a depth of 2.6 m below the ground surface (Elevation 297.2 m).

The samples recovered from the borehole indicate that the driveway fill consists of very mixed materials which include gravel and sand with silt and silty clay and organics. From the recorded N-values which range from 1 to 10 blows/0.3 m

the relative density of the fill at the location drilled is described as very loose to loose.

4.4.3 SURFICIAL SILT

In the majority of the boreholes a surficial silt deposit was contacted generally extending to depths ranging between 0.7 and 1.4 m below the ground surface or to Elevations between 300.8 and 296.7 m, except in Borehole 15+965SBL which was drilled in relatively high ground and here the silt extended to 2.7 m or to Elevation 301.4 m.

The composition of the silt ranged from sandy silt to clayey silt but in general, it is considered a granular (non-cohesive) material with some cohesive zones. The grain size distribution of a sample from the deposit is presented in Figure B4-1, Appendix B4. This shows 16% sand, 81% silt and 3% clay size particles. In the upper zones of the silt, immediately below the ground surface or topsoil or peat, the presence of organics was noted. In general, the recorded N-values range from 5 to 14 blows/0.3 m which indicate loose to compact or firm to stiff material. In one case, a zero blow count was recorded at the ground surface level, but this can be attributed to the presence of organics as well the fact that the soil had just thawed out.

4.4.4 SILTY CLAY

Underlying the fill, peat or the surficial silt cap, all the boreholes, except for Borehole 15+965SBL (drilled at the northern extremity of the site), contacted at depths ranging between 0.4 and 2.6 m (driveway fill) below the ground surface or at Elevations 301.1 and 296.7 m, a major silty clay/clay deposit which extends to the full depth of most of these boreholes (8.1 to 12.6 m) and probably deeper.

At most locations, the deposit is a layered material with thin silty clay, clayey silt, clay and silt seams.

The grain size analysis of seven selected samples from the deposit is given on the appropriate Record of Borehole Sheets and in Figure B4-2, Appendix B4. These indicate the following grain size distribution:

Gravel:	0%
Sand:	1-9%
Silt:	48-70%
Clay:	27-43%

This deposit is described as a cohesive material and Atterberg Limits tests performed on selected samples in the laboratory gave the following values:

Liquid Limit:	31-40%
Plastic Limit:	16-24%
Plasticity Index:	14-16%

As shown in Figure B4-3 of Appendix B4, these results indicate low to intermediate plasticity. The measured natural moisture contents range between 23 and 73% but generally between 30 and 50% (i.e. generally near or above the measured liquid limit values).

When studying the laboratory and field test results, it must be remembered that the material consists of alternating layers of low plastic to highly plastic material and one or the other may predominate within the sample/zone tested.

Standard Penetration tests conducted in the deposit gave N-values which range from 0 (i.e. sampler sunk under its own weight and that of the attached rods) to 17 blows/0.3 m. The higher values (i.e. 4 to 17 blows) were recorded in some of the boreholes near the ground surface probably caused by partial desiccation. Some of the relatively higher values (i.e. 2 and 6 blows) were also recorded in the lower zones in some of the boreholes where the soil deposit was noted to be relatively siltier. Field vane tests yielded undrained in-situ shear strengths ranging from 18 to in excess of 100 kPa, but typically 18 to 36 kPa. Values in excess of 36 kPa were generally measured within the upper somewhat desiccated zone or otherwise may have been influenced by the siltier seams in the deposit.

Based on these field test results, the consistency of the deposit below the upper desiccated zones is considered to be very soft to firm.

Dynamic cone penetration tests were extended below some of the boreholes. One of these tests (Borehole 15+788SBL) extended to 21.3 m without encountering refusal.

4.4.5 LOWER SILT

In some of the boreholes the frequency and thickness of silt seams in the silty clay/clay deposit increased with depth (e.g. Boreholes 15+625NBL and 15+900) while in Borehole 15+650, the silty clay below 7.1 m (Elevation 291.0 m) is underlain by silt with occasional silty clay seams. This is a basically fine-grained granular (non-cohesive) material and it extended to the full depth of the borehole (i.e. 12.6 m) and possibly beyond.

The grain size distribution curve of a sample from the deposit is given in Figure B4-4, Appendix B4.

The silt is wet and dilatant and based on N-values of 0 to 6 blows/0.3 m its denseness condition is described as very loose to loose.

4.4.6 SILTY SAND WITH SOME GRAVEL

In Borehole 15+965 which was drilled at the north end of the site from an approximately 4 m higher ground, the weak silty clay/clay deposit was not encountered underlying the surficial silt cap. Instead a relatively well graded granular soil was contacted. This material, which was also contacted in several of the boreholes drilled further north at Site 5, consists of silty sand with some gravel, resembling a glacial till deposit. This material is discussed in more detail in Section 4.5.3 of this report.

N-values recorded in this deposit in this borehole (i.e. Borehole 15+965) ranged from 6 to 12 blows/0.3 m, indicating a loose to compact material.

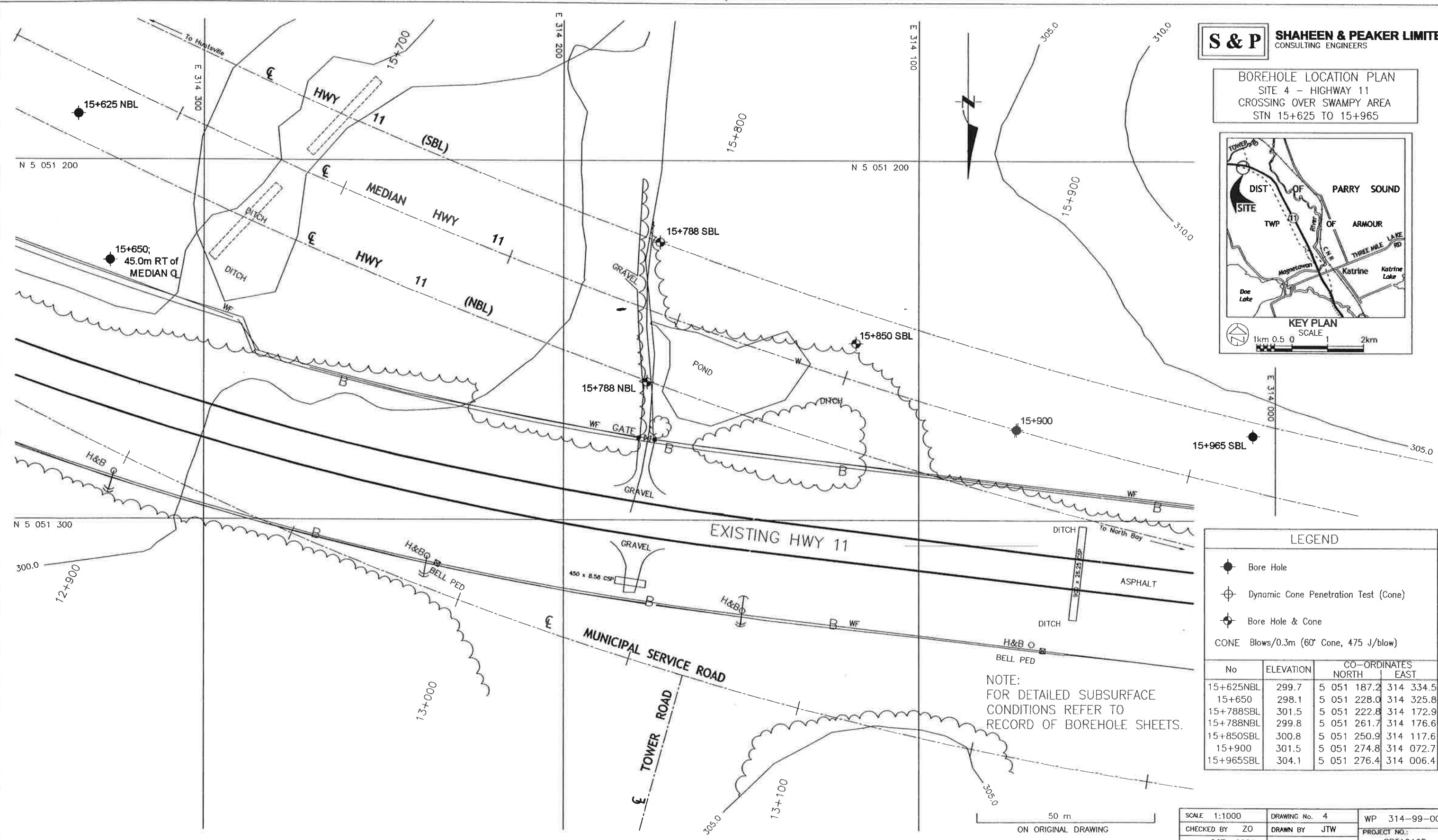
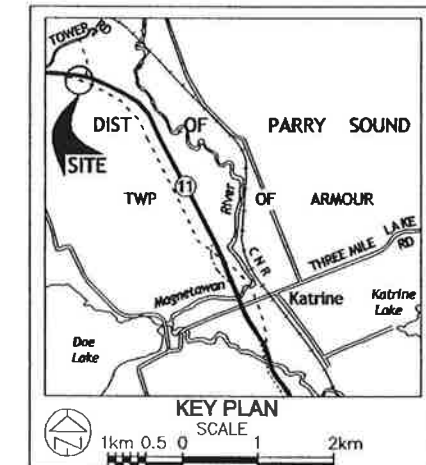
4.4.7 GROUNDWATER CONDITIONS




Water level observations in the open boreholes were made while drilling and at the completion of each borehole. The recorded values are shown on the individual Record of Borehole Sheets.

Due to the clayey nature of the soil, the recorded values are unlikely to represent the stabilized groundwater conditions. However, based on the observed site conditions at the time of drilling (i.e. Spring 2001) and the moisture contents of the soil samples, the groundwater table at the time of our investigation is believed to be very close to the ground surface (i.e. generally within 0.5 m).

The groundwater level can be expected to fluctuate seasonally and in response to major weather events.

BOREHOLE LOCATION PLAN
SITE 4 - HIGHWAY 11
CROSSING OVER SWAMPY AREA
STN 15+625 TO 15+965



LEGEND				
	Bore Hole			
	Dynamic Cone Penetration Test (Cone)			
	Bore Hole & Cone			
CONE Blows/0.3m (60° Cone, 475 J/blow)				
No	ELEVATION	CO-ORDINATES		
		NORTH		EAST
15+625NBL	299.7	5 051 187.2	314 334.5	
15+650	298.1	5 051 228.0	314 325.8	
15+788SBL	301.5	5 051 222.8	314 172.9	
15+788NBL	299.8	5 051 261.7	314 176.6	
15+850SBL	300.8	5 051 250.9	314 117.6	
15+900	301.5	5 051 274.8	314 072.7	
15+965SBL	304.1	5 051 276.4	314 006.4	

SCALE 1:1000	DRAWING No. 4	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTJ	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F

APPENDIX A4

Site 4

Records of Boreholes

SITE 4		RECORD OF BOREHOLE No 15+625 NBL				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 187.2; E 314 334.5				ORIGINATED BY S.O			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T			
DATUM Geodetic		DATE 05.04.01				CHECKED BY Z.O			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W P W W L					
							20	40	60	80	100	20	40	60			
299.7	Ground Surface																
0.0	50 mm Topsoil		1	SS	6											20.4	
	brown																
	grey		2	SS	9											21.0	
298.3	SILT/CLAYEY SILT some sand, firm to stiff,																
1.4			3	SS	1											15.4	
			4	SS	1												
			5	TW	PH												
			6	SS	0.												
	SILTY CLAY laminated, very soft to firm, grey		7	SS	0.												
			8	SS	1												
			9	SS	2												
			10	SS	2												
287.1	End of borehole *Water level 1.1 m (not stabilized) and hole open to 3.3 m on completion																

+³, ×³: Numbers refer to Sensitivity

20
15
10

(%) STRAIN AT FAILURE

SITE 4		RECORD OF BOREHOLE No 15+650				1 OF 1		METRIC													
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 228.0; E 314 325.8				ORIGINATED BY S.O															
DIST 52 HWY 11		BOREHOLE TYPE Hollow Stem Augers				COMPILED BY G.T															
DATUM Geodetic		DATE 10.04.01				CHECKED BY Z.O															
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa													
							<div style="display: flex; justify-content: space-between; font-size: small;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between; font-size: x-small;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE </div>					<div style="display: flex; justify-content: space-between; font-size: x-small;"> PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT </div> <div style="display: flex; justify-content: space-between; font-size: x-small;"> W_p W W_L </div>									
298.1	Ground Surface																				
0.0	75 mm Topsoll		1	SS	5																
	SILT firm	rootlets brown ----- grey	2	SS	8																
296.7																					
1.4			3	SS	1																
	SILTY CLAY laminated, very soft to firm, grey, wet		4	TW	PH **								0 4 64 32								
			5	TW	PH ***																
			6	TW	PH ****								**** No recovery								
			7	TW	PH **																
			8	SS	1																
			9	TW	PH																
291.0																					
7.1			10	SS	3								0 1 99 0								
	SILT occasional silty clay seams, grey, wet		11	SS	0 *****								***** Spoon sinking under own weight								
		very loose ----- loose																			
285.5			12	SS	6																
12.6	End of borehole *Water level at 3.6 m (not stabilized) and hole open to 4.9 m on completion. ** No recovery, disturbed sample collected using split spoon. *** Disturbed sample collected after falling out of Shelby tube.																				

SITE 4		RECORD OF BOREHOLE No 15+788 NBL				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 261.7; E 314 176.6				ORIGINATED BY S.O			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers, Hollow Stem Augers & D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 11.04.01				CHECKED BY Z.O			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	20 40 60 80 100	W P W W L		
299.8 0.0	Ground Surface	cobble	1	SS	50/5	..						**SS1
	Gravel and Sand with Silt and Silty Clay organics	very loose	2	SS	1							High N-value caused by a cobble
	FILL	-----	3	SS	10							
	dark brown, wet	loose	4	SS	6							
297.2 2.6			5	SS	1							
	SILTY CLAY		6	TW	PH							
	laminated,		7	SS	0	***						0 4 60 36
	very soft to firm, grey		8	SS	0	***						*** Spoon sinking under own weight
			9	SS	1							
291.7 8.1	End of borehole											
287.6 12.2	End of Dynamic Cone Penetration Test											
	*Water level at 4.6 m (not stabilized) and hole open to 7.5 m on completion.											
	Dynamic Cone Penetration Test (D.C.P.T.) performed from 7.6 m to 12.2 m.											

METRIC

(%) STRAIN AT FAILURE

SITE 4		RECORD OF BOREHOLE No 15+788 SBL				2 OF 2		METRIC	
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 222.8; E 314 172.9				ORIGINATED BY S.O			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers, Hollow stem Augers & D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 11.04.01				CHECKED BY Z.O			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
286.5							20 40 60 80 100	20 40 60 80 100					
15.0							20 40 60 80 100	20 40 60 80 100					
280.2							20 40 60 80 100	20 40 60 80 100					
21.3	End of Dynamic Cone Penetration Test. Dynamic Cone Penetration Test (D.C.P.T.) performed from 9.6 m to 21.3 m. *Water level at 4.4 m (not stabilized) and hole open to 10.0 m on completion.						20 40 60 80 100	20 40 60 80 100					

SITE 4		RECORD OF BOREHOLE No 15+850SBL				1 OF 1		METRIC				
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 250.9, E 314 117.6				ORIGINATED BY S.O						
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & D.C.P.T.				COMPILED BY G.T						
DATUM Geodetic		DATE 11.04.01				CHECKED BY Z.O						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)		
300.8	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		20 40 60 W P W L			
0.0	SANDY SILT/SILT: with rootlets and organics, very loose, brown, wet firm --- very soft to firm SILTY CLAY laminated, brown becoming grey at 1.8 m		1	SS	0				○			0 2 57 41 ** Spoon sinking under own weight
300.1			2	SS	8				○			
0.7			3	SS	6				○			
			4	TW	PH		5.1					
			5	SS	0	**			○			
			6	SS	0	**	3.1			○		
			7	SS	0	**			○			
			8	SS	2		10.5			○		
292.7			9	SS	1					○		
8.1	End of borehole											
288.6	End of Dynamic Cone Penetration Test. Dynamic Cone Penetration Test (D.C.P.T.) performed from 8.1 m to 12.2 m. *Water level at 5.5 m (not stabilized) and hole open to 7.6 m on completion.											

+ 3, × 3: Numbers refer to Sensitivity

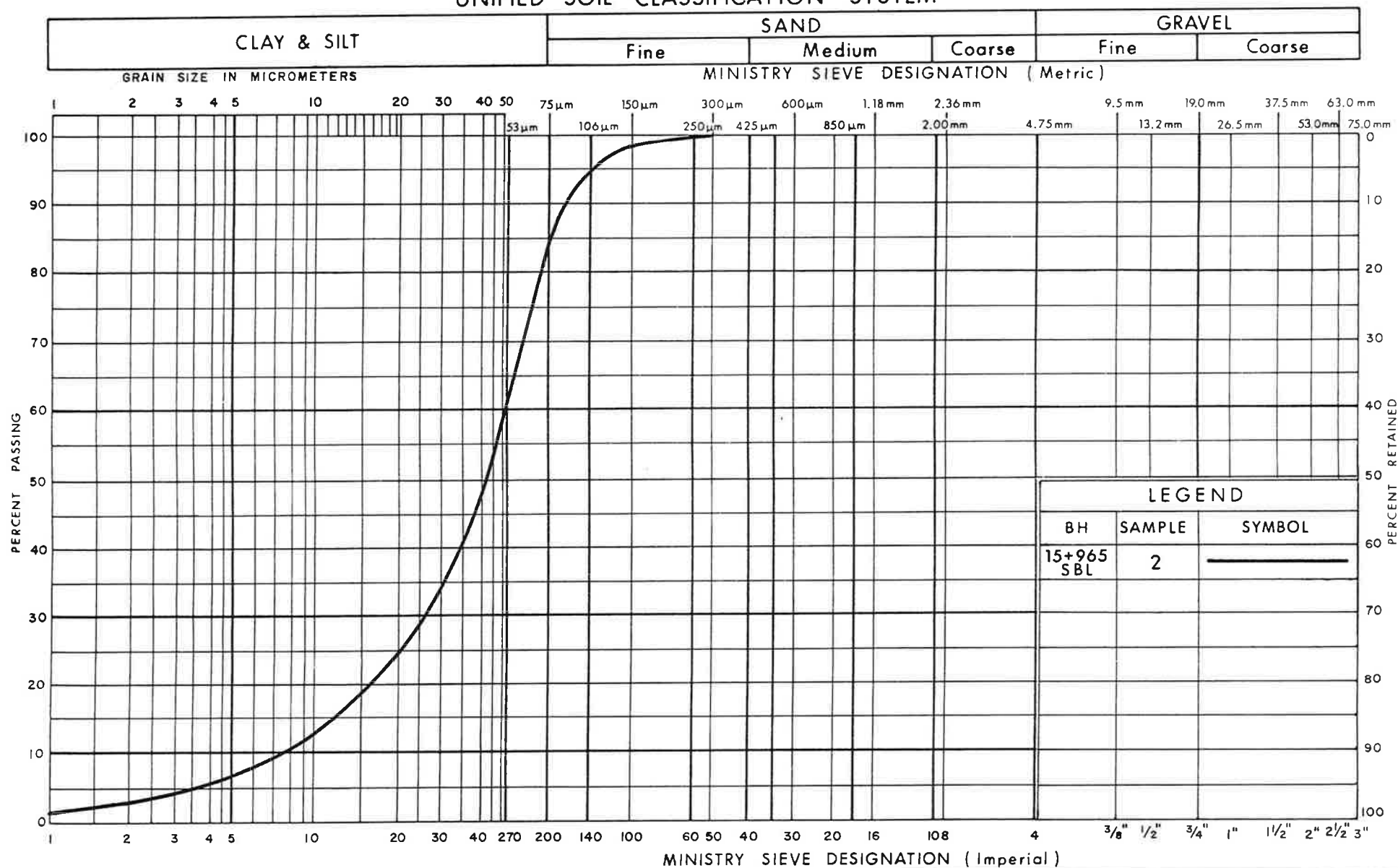
+ 3, x 3 Numbers refer to Sensitivity

APPENDIX B4

Site 4

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



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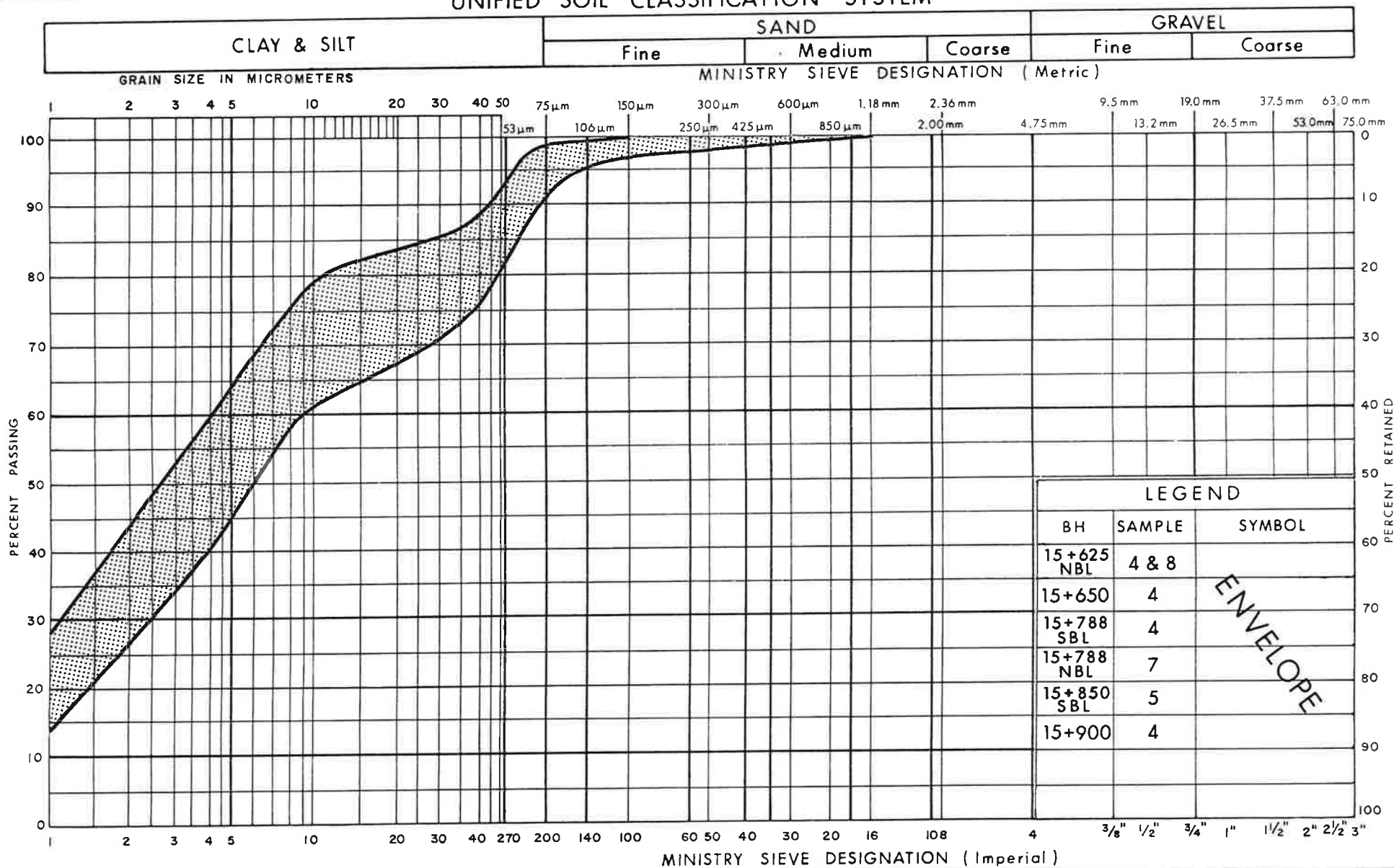
GRAIN SIZE DISTRIBUTION SILT

FIG No B4-1

W P 314-99-00

SPT 1010F

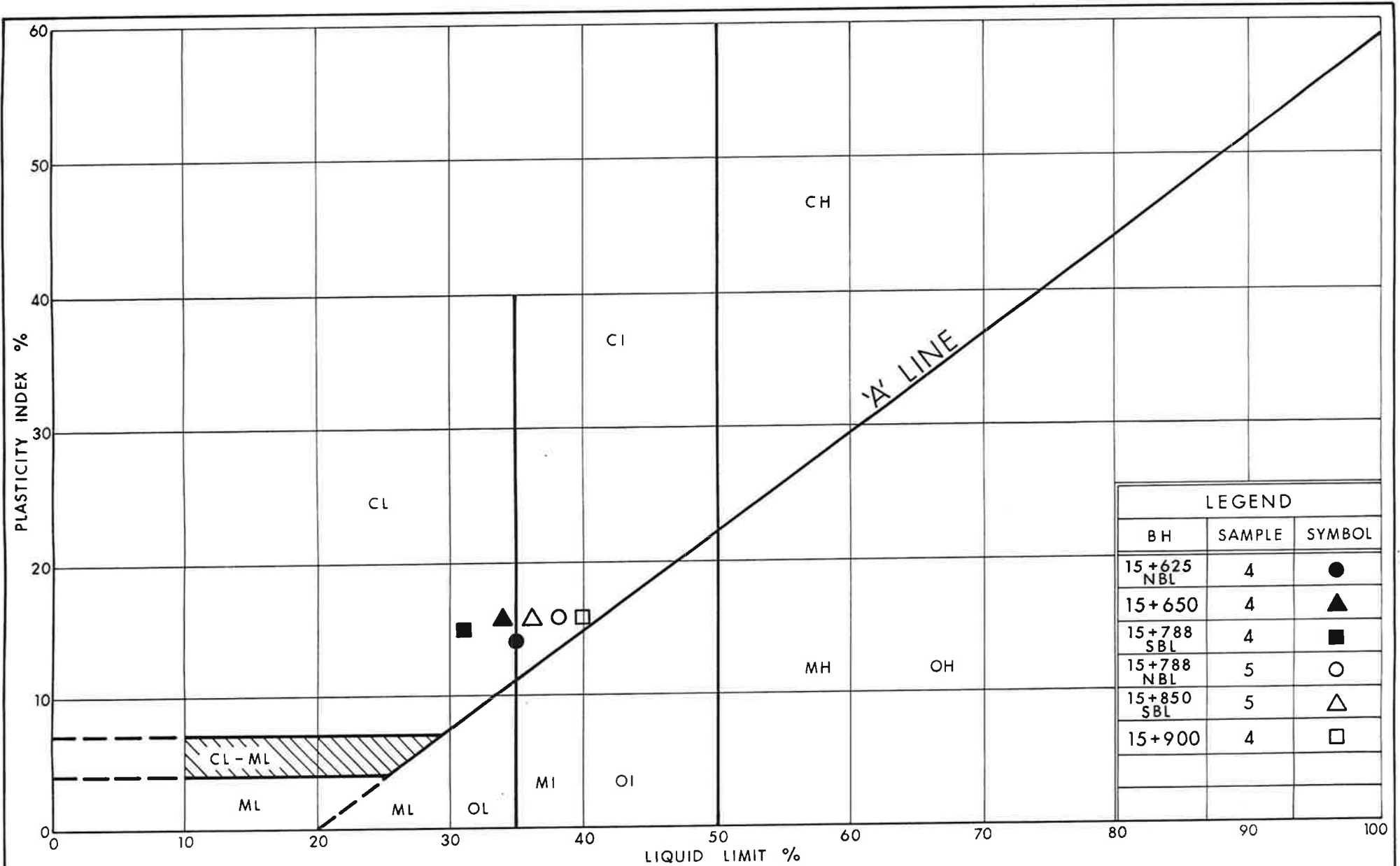
UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No B4-2
W P 314-99-00
SPT 1010F



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Ontario

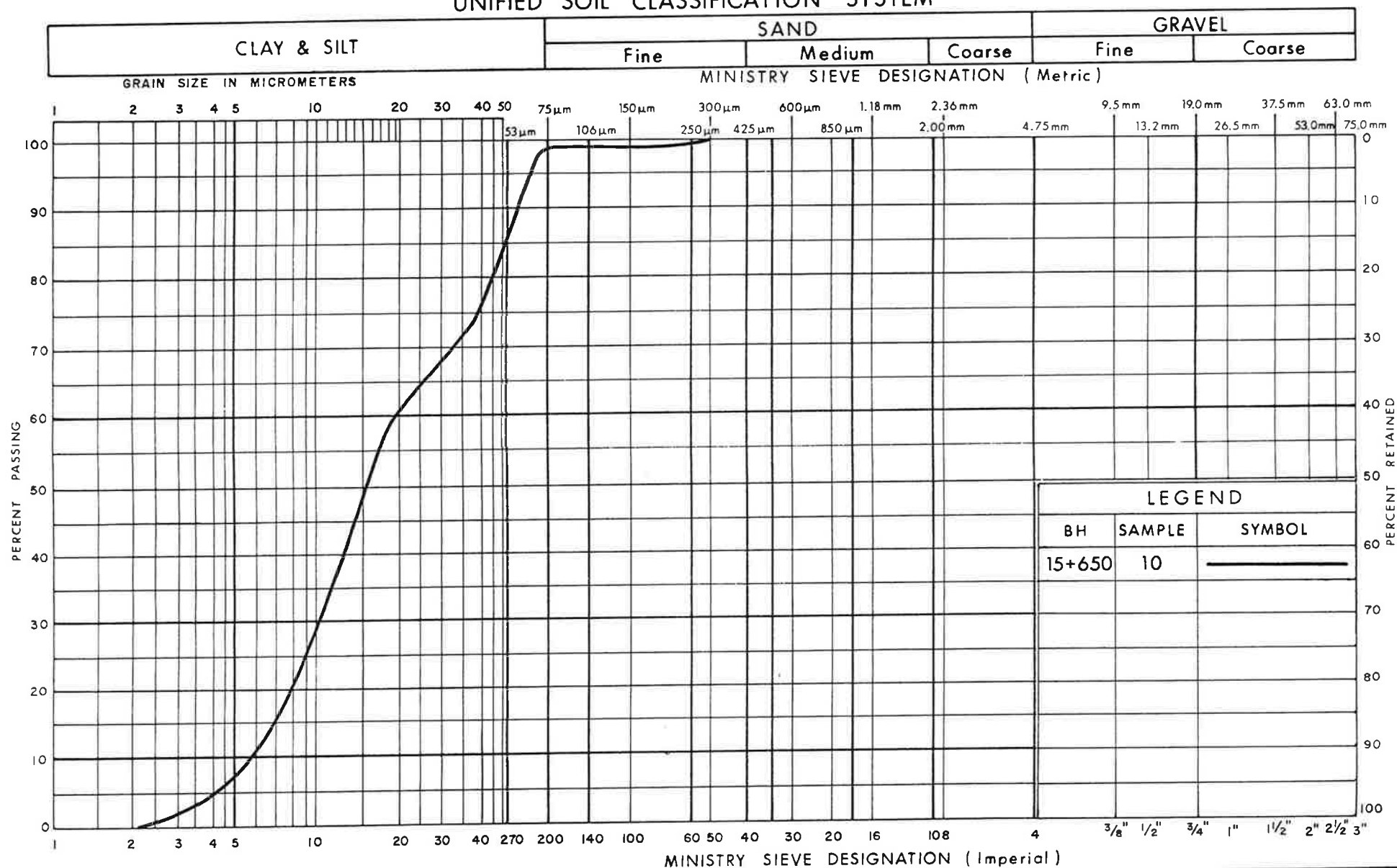
PLASTICITY CHART SILTY CLAY

FIG No B4-3

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

Lower SILT

FIG No B4-4

W P 314-99-00

SPT 1010F

4.5 SITE 5 – HIGHWAY 11 ALIGNMENT – CUT SECTION BETWEEN STATIONS 15+965 AND 16+200 (BOREHOLES 15+965SBL, 16+050, 16+085SBL, 16+125 AND 16+200SBL)

Five boreholes were drilled along this potential cut section of Highway 11 alignment at the north end of the project as shown on Drawing No. 5. This section is characterized by a relatively high hill (approximately 20 to 24 m high) west of the proposed new alignment for Highway 11 and of the existing Highway 11. (For the purposes of this discussion, north will be considered towards increasing stations.)

Boreholes 15+965SBL, 16+085SBL and 16+200SBL were drilled along the southbound lane of the proposed alignment near the eastern toe of the hill (Borehole Elevations 307.1-304.1 m), while Boreholes 16+050 and 16+125 were drilled further west from the higher ground (borehole Elevations 323 and 318 m \pm , along the east face of the hill. It should be mentioned that the locations and elevations of these two boreholes should be considered to be approximate only.

The hill itself appears to be a rock knob with some overburden cover. The rock is exposed, as shown on Drawing No. 5, between about stations 16+055 and 16+075 (Elevations 319 – 316 m \pm). Borehole 16+050 was located close to the top of this rock outcrop, to the southwest. In this borehole refusal to augering was encountered at a depth of 4.6 m or at about Elevation 318 m. The borehole was moved to 5 m north and re-drilled and refusal was again encountered at 4.3 m depth, both probably on the surface of bedrock (or possibly on boulders). Borehole 16+085SBL was drilled at Station 16+085, some 30 m east of the rock face, and here refusal was contacted at a depth of 7.0 m or at Elevation 300 m. In Borehole 16+125 drilled further north at about Station 16+125, about halfway up the hill (Borehole Elevation 318 \pm m), auger refusal was encountered twice at 2.3 m depth (Elevation 316 \pm m), probably due to cobbles, judging from the behaviour of the augers. From these results, it would appear that the rock knob is covered with a variable depth of overburden.

The overburden in the boreholes generally consisted of a surficial silt cap below a veneer of topsoil, peat or organic rich soil. The silt cap is underlain by

a relatively well graded, till-like silty sand deposit with traces to some gravel. It appears that this till-like silty sand may be the predominant soil overlying the rock.

In Borehole 16+200SBL, which is the most northerly borehole near the toe of the hill, the surficial silt is underlain by an approximately 5 m thick silty clay/clay deposit which is in turn underlain by a lower silt deposit at Elevation about 302 m. The silt is 3.3 m thick and is underlain by the till-like silty sand deposit.

Details of the subsurface conditions encountered in the boreholes are presented on the individual Record of Borehole Sheets presented in Appendix A5. The following paragraphs are only meant to complement these data.

4.5.1 TOPSOIL AND PEAT

Borehole 15+965SBL contacted a 0.7 m thick peat layer. In Borehole 16+085, a 200 mm thick topsoil layer was recorded while in the remaining boreholes the surficial silt immediately below the ground surface was found to be rich in organics and root fibres, but there was no clear topsoil layer. It should be pointed out that at the time of our investigation, the ground was snow covered and partially frozen and therefore the description of surface zones may not be very accurate.

4.5.2 SURFICIAL SILT

All five boreholes contacted a surficial silt layer which extended to depths ranging from 0.4 to 2.7 m below the ground surface.

The grain size distribution of a sample from the silt is given in Figure B5-1, Appendix B-5. The results indicate 16% sand, 81% silt and 3% clay size particles.

This is a basically fine-grained granular (i.e. non-cohesive) material and the Standard Penetration tests performed yielded N-values from 2 to 20 blows/0.3 m, indicating a very loose to compact material.

4.5.3 SILTY SAND WITH TRACE TO SOME GRAVEL

In all of the boreholes except for Borehole 16+200SBL, a relatively well graded silty sand deposit resembling a glacial till was contacted immediately underlying the surficial silt cap at depths ranging between 0.7 and 2.7 m below the ground surface or at Elevation 321.9-301.4 m. In Borehole 16+200SBL, this deposit was encountered at greater depths (underlying the lower silt deposit at 8.5 m or at Elevation 298.6 m). In all of the boreholes this unit extended to the full depth of our exploration. The grain size distribution of a typical sample from this deposit is given in Figure B5-2 which indicates the following particle sizes.

Gravel	=	6%
Sand	=	65%
Silt	=	29%
Clay	=	0%

This is a cohesionless (i.e. granular) material and is believed to contain cobbles and boulders, especially at greater depths (as inferred during drilling). In Borehole 16+050 and 16+125, which were drilled from high ground towards the top of the hill, the recorded N-values ranged from 32 to in excess of 50 blows/0.3 m, indicating a dense to very dense material. In the remaining boreholes, the recorded values range from 5 to 33 blows/0.3 m, indicating a loose to dense but generally loose to compact condition.

4.5.4 SILTY CLAY/CLAY

Borehole 16+200SBL located at the northern boundary of the project site, contacted at a depth of 0.4 m, or at Elevation 306.7 m, a layered material with very thin seams of fat clay and thin seams of leaner silty clay, clayey silt and silt, similar to the silty clay deposit encountered at Site 4, immediately south of this particular site.

The grain size distribution of a sample from this deposit is given in Figure B5-3, which indicates 1% sand, 48% silt and 51% clay size particles.

This is a cohesive material and an Atterberg Limits test carried out in the laboratory on a sample from the deposit gave the following values:

Liquid Limit:	42%
Plastic Limit:	25%
Plasticity Index:	17%

As shown in Figure B5-4, Appendix B5, these results are characteristic of clayey soils of intermediate plasticity. The measured natural moisture contents are generally between 36 and 58%, that is, near or in excess of the measured liquid limit value.

As was previously mentioned in various sections of this report, the tested samples are generally made up of individual thin seams of fat and lean clay to clayey silt and silt and therefore test results may vary depending on the relative occurrence of such seams within the sample tested.

In the upper 1.5 m \pm of the deposit, the recorded N-values are 7 and 3 blows/0.3 m. This represents an upper somewhat desiccated crust which is relatively more competent in comparison with the underlying very weak zone. In this upper zone, the measured natural moisture contents range from 23 to 38%.

In the underlying 1.5 m \pm zone an N-value of 1 blow/0.3 m was recorded and the measured natural moisture contents are 55 and 58% (i.e. much higher in comparison with the measured values from the upper zone). A field vane test gave an undrained shear strength value of 20 kPa. Based on these values, this middle section of the deposit is described as very soft to soft and highly compressible.

In the underlying 2 m \pm thick zone the presence of more frequent silt seams was noted and in this zone the recorded N-values are 2 blows/0.3 m and an undrained in-situ shear strength value of 45 kPa was recorded. Based on these values, this lower zone is considered somewhat more competent (i.e. soft to firm consistency) in comparison with the middle zone, probably due to the presence of more frequent silt seams.

4.5.5 LOWER SILT

Borehole 16+200SBL contacted, underlying the silty clay deposit, below 5.2 m (Elevation 301.9 m), a 3.3 m thick silt layer. The grain size distribution

of a sample from this material is given in Figure B5-5, Appendix B5. This lower silt deposit is a fine-grained granular (i.e. cohesionless) soil and based on N-values of 1 to 5 blows/0.3 m, it is considered loose to very loose. This unit is underlain at 8.5 m (Elevation 298.6 m) by silty sand with some gravel.

4.5.6 BEDROCK

The hill located to the west of the proposed highway alignment is believed to represent a rock knob covered with a variable depth but generally shallow overburden. In addition to the exposed rock outcrop face described in the preceding paragraphs, the presence of several outcrops near the top of the hill was also noted. Based on a visual examination of the rock outcrop face, the bedrock is believed to be gneiss with granitic zones and migmatitic and mafic infills.

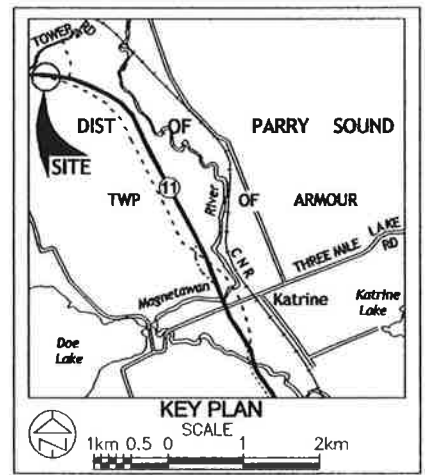
Published geological data indicate that in the general area, the bedrock belongs to the central Gneiss Belt and consists of migmatitic rocks and gneisses.

4.5.7 GROUNDWATER CONDITIONS

Based on the water levels recorded in the boreholes and the moisture contents of the soil samples, it is our opinion that at the time of the investigation (i.e. Spring 2001) a high water level prevailed at the site (generally between 0.3 and 1.5 m below the ground surface).

The groundwater level can be expected to fluctuate seasonally and in response to major weather events.

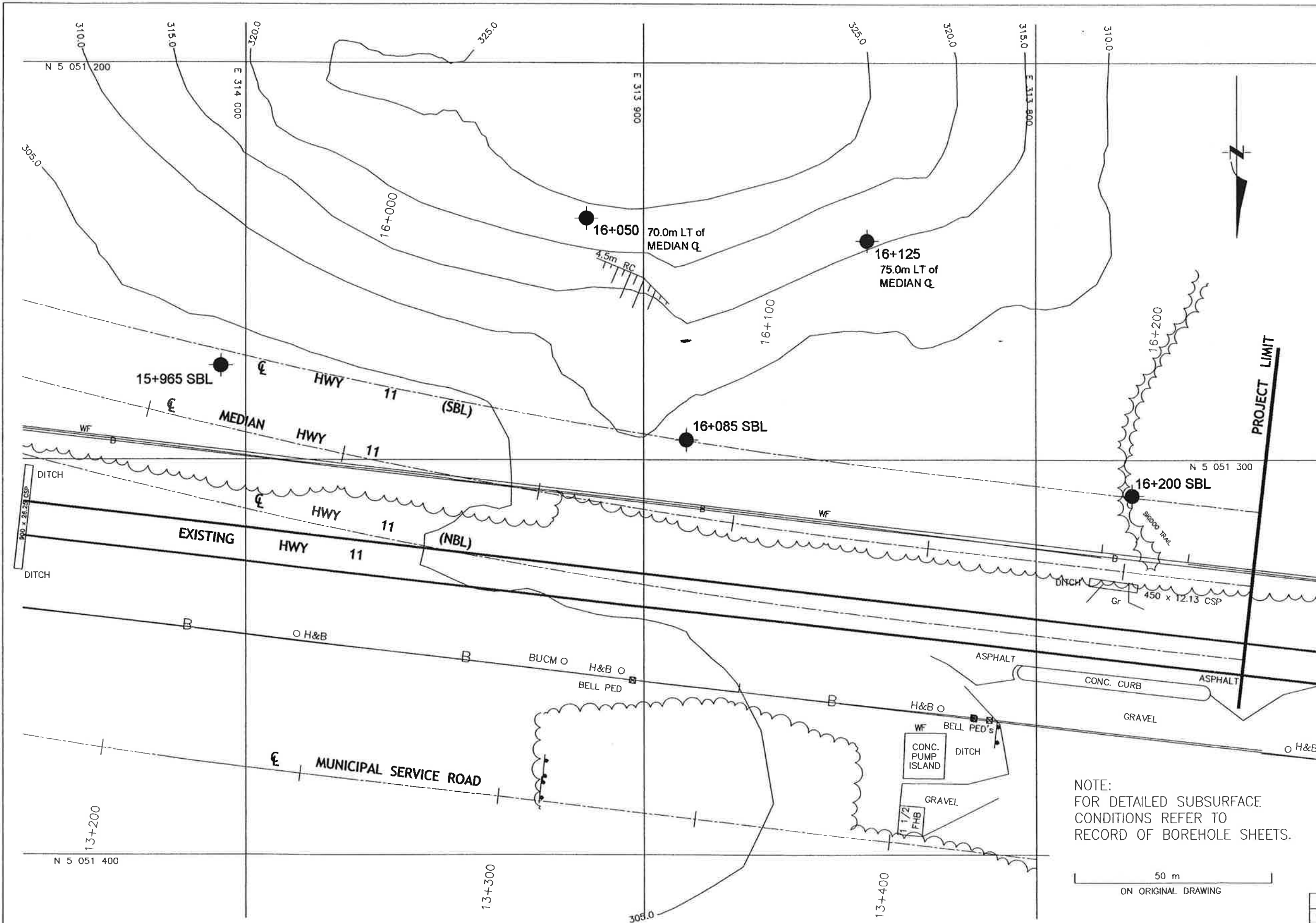
BOREHOLE LOCATION PLAN
SITE 5 -- HIGHWAY 11
CUT SECTION
STN 15+965 TO 16+200



LEGEND

- Bore Hole
 - ⊕ Dynamic Cone Penetration Test (Cone)
 - ⊕ Bore Hole & Cone
- CONE Blows/0.3m (60' Cone, 475 J/blow)

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
15+965SBL	304.1	5 051 276.4	314 006.4
16+050	322.8	5 051 239.2	313 914.4
16+085SBL	307.0	5 051 295.0	313 889.2
16+125	318.3	5 051 244.9	313 842.9
16+200SBL	307.1	5 051 309.2	313 775.7



SCALE 1:1000	DRAWING No. 5	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTW	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F

APPENDIX A5

Site 5

Records of Boreholes

SITE 5		RECORD OF BOREHOLE No 15+965 SBL				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 276.4; E 314 006.4				ORIGINATED BY S.O			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T			
DATUM Geodetic		DATE 04.04.01				CHECKED BY Z.O			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) w P w w L				
304.1	Ground Surface																
0.0	PEAT black, wet		1	SS	-**											**Refusal on log	
303.4																	
0.7	SILT some sand, loose to compact, grey, wet		2	SS	10											0 16 81 3	
			3	SS	9												
301.4			4	SS	14												
2.7	SILTY SAND some gravel, grey, wet																
			5	SS	9												
			6	SS	6												
	loose																
	compact																
297.5			7	SS	12												
6.6	End of borehole *Water level at 0.3 m and hole open to 0.6 m on completion.																

SITE 5			RECORD OF BOREHOLE No 16+050				1 OF 1		METRIC							
W.P. 314-99-00			LOCATION Highway 11 Katrine, ON - Coords N 5 051 239.2; E 313 914.4				ORIGINATED BY R.A									
DIST 52 HWY 11			BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T									
DATUM Geodetic			DATE 05.04.01				CHECKED BY Z.O									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
322.8	Ground Surface															
0.0	SILT with rootlets and organics, very loose, dark brown, moist		1	SS	2	*										
321.9			2	SS	67/28	**	322								19.7	** High blow counts probably due to cobbles below spoon tip
0.9	SILTY SAND trace to some gravel, some silty fine sand, layers, dense to very dense grey, moist		3	SS	48		321									
			4	SS	50/13	**	320									
			5	SS	53		319									
318.2			6	SS		***										*** Spoon bouncing
4.6	End of borehole Auger refusal at 4.6 m probably on bedrock or boulder *Hole dry (Water level not stabilized) and open to 3.4 m on completion Borehole moved 5.0 m North and redrilled, refusal at 4.3 m															

SITE 5

RECORD OF BOREHOLE No 16+085 SBL

1 of 1

METRIC

W.P. 314-99-00 LOCATION Highway 11 Katrine, ON - Coords N 5 051 295.0; E 313 889.2 ORIGINATED BY SO
 DIST 52 HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY G.T
 DATUM Geodetic DATE 04.04.01 CHECKED BY Z.O

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
307.0	Ground Surface						20	40	60	80	100		
0.0	200 mm Topsoil SILT trace organics, brown, moist	very loose	1	SS	2								
305.9		compact	2	SS	20								
1.1	SILTY SAND traces of gravel, some fine sand layers, loose to compact, grey, moist to wet		3	SS	5								
			4	SS	6								
			5	SS	11								
			6	SS	12								
			7	SS	33								
300.0													
7.0	End of borehole Auger refusal at 7.0 m probably on bedrock (or boulder). *Water level at 1.2 m (not stabilized) and hole open to 1.2 m on completion												

+ ³ , X ³ ; Numbers refer to 20
Sensitivity 15-25
10 (%) STRAIN AT FAILURE

SITE 5		RECORD OF BOREHOLE No 16+125				1 OF 1		METRIC								
W.P. 314-99-00		LOCATION Highway 11, Katrine, ON - Coords N 5 051 244.9; E 313 842.9				ORIGINATED BY SO										
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY GT										
DATUM Geodetic		DATE 05.04.01				CHECKED BY ZO										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
318.3	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					20 40 60 ○				
0.0	SILT: some sand, some organics, very loose, dark brown, moist		1	SS	2		318							○		
317.6																
0.7	SILTY SAND trace gravel, brown, moist to wet	dense ----- very dense	2	SS	32		317							○		
			3	SS	79	▼								○		
316.0			4	SS	50/0	**	316									** Spoon refusal
2.3	End of borehole Auger refusal at 2.3 m probably on boulder *Water level at 1.7 m (not stabilized/surface water flowing into hole) and hole open to full depth on completion Borehole moved 3.0 m South and redrilled, refusal again at 2.3 m															

SITE 5		RECORD OF BOREHOLE No 16+200 SBL				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Highway 11 Katrine, ON - Coords N 5 051 309.2; E 313 775.7				ORIGINATED BY SO			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T			
DATUM Geodetic		DATE 04.04.01				CHECKED BY Z.O			

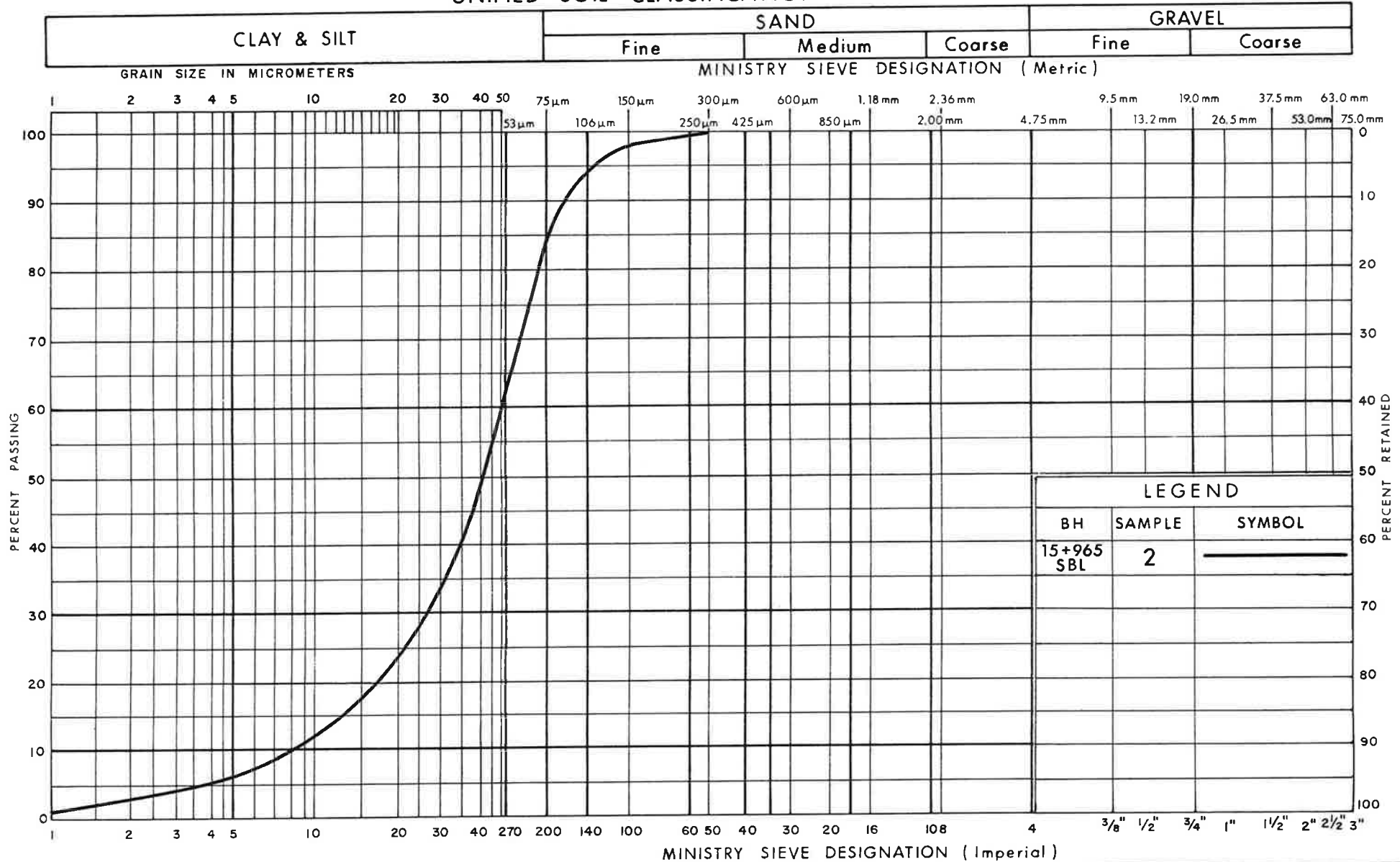
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60	20 40 60	20 40 60				
307.1	Ground Surface															
0.0	SILT: some clay, with organics, dark brown, frozen		1	SS	26											**Soil frozen N-value not applicable
0.4			2	SS	7											
			3	SS	3											
	SILTY CLAY/CLAY layered, grey, wet		4	SS	1											0 1 48 51
			5	TW	PH											
	frequent silt seams		6	SS	2											
			7	SS	2											
301.9			8	SS	5											0 5 92 3
5.2			9	SS	2											
	SILT laminated, grey, wet															
			10	SS	1											
298.6																
8.5	SILTY SAND some gravel, compact, grey, wet		11	SS	22											
297.8																
9.3	End of borehole *Water level at 2.1 m (not stabilized) and hole open to 4.6 m on completion															

APPENDIX B5

Site 5

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



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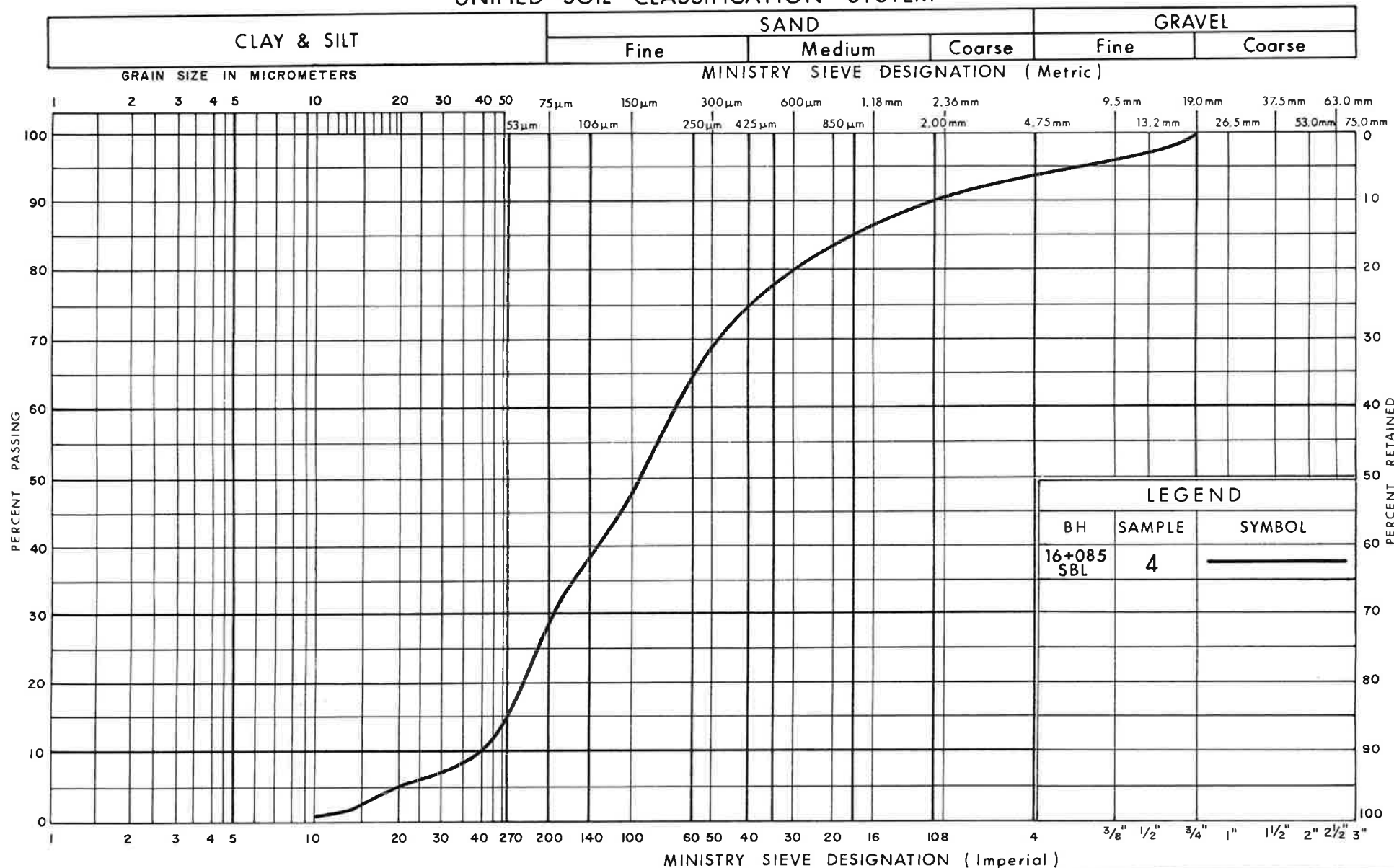
GRAIN SIZE DISTRIBUTION SILT

FIG No B5-1

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

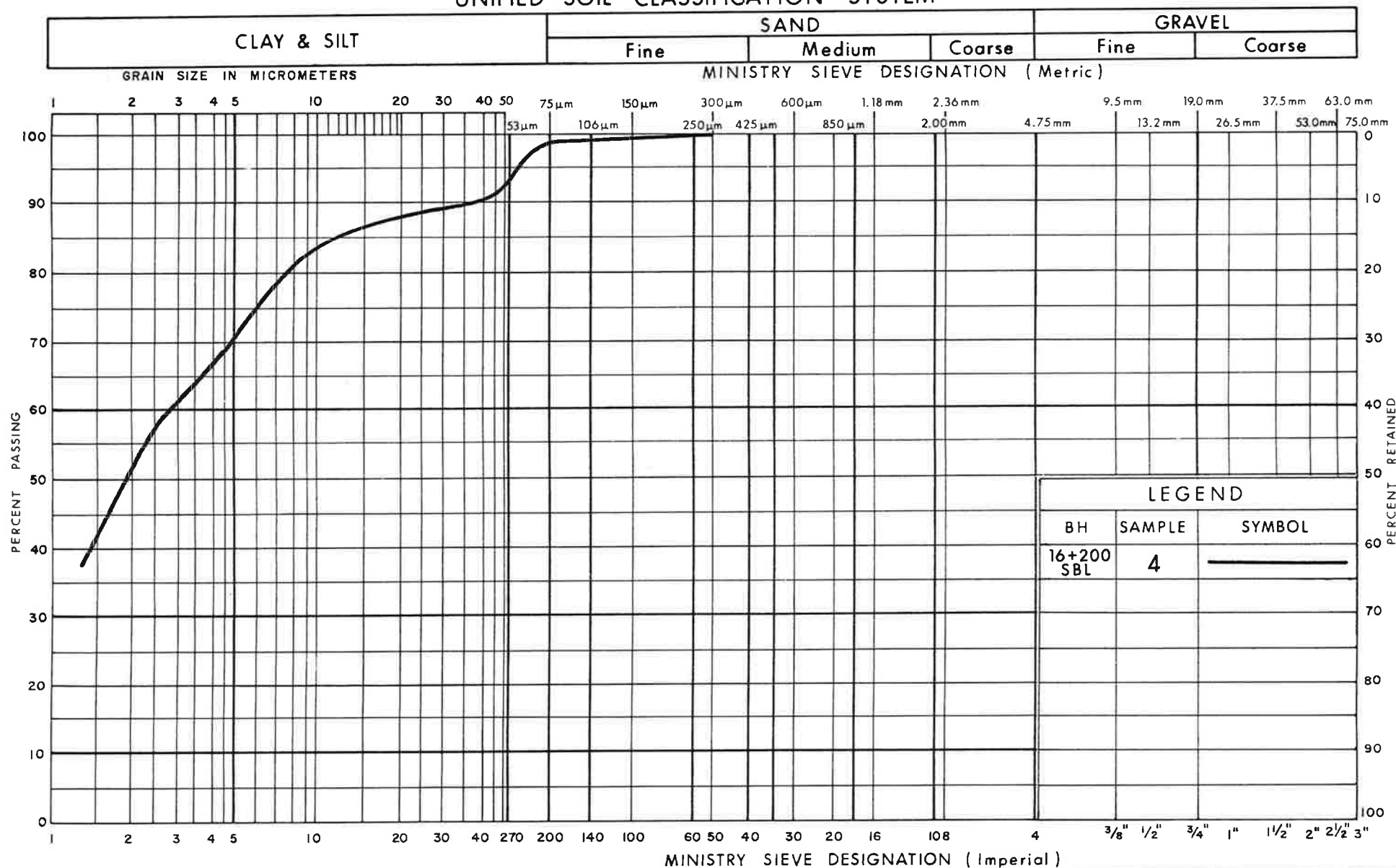
GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE TO SOME GRAVEL

FIG No B5-2

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



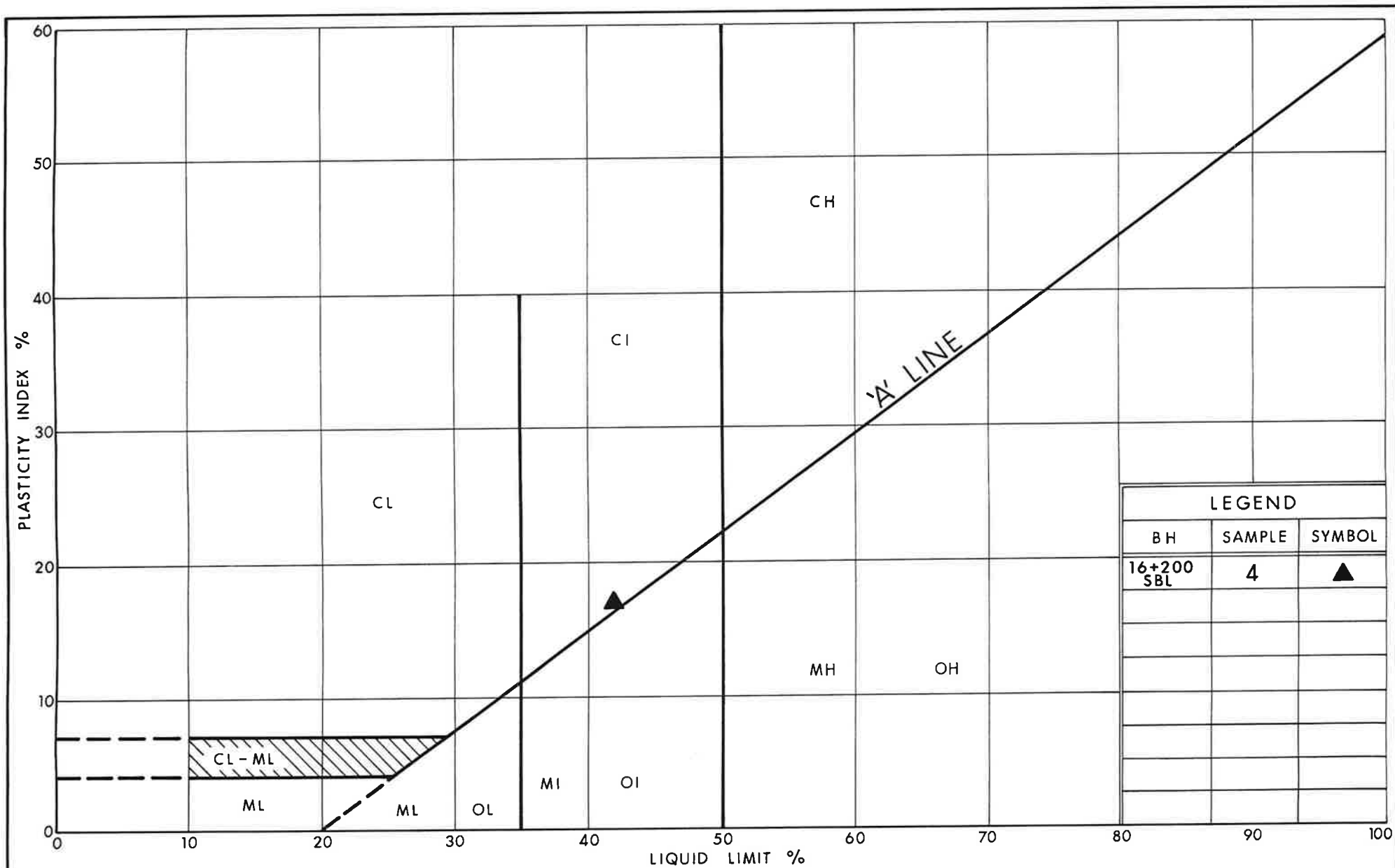
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION SILTY CLAY / CLAY

FIG No B5-3

W P 314-99-00

SPT 1010F



LEGEND		
BH	SAMPLE	SYMBOL
16+200 SBL	4	▲



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Transportation
Ontario

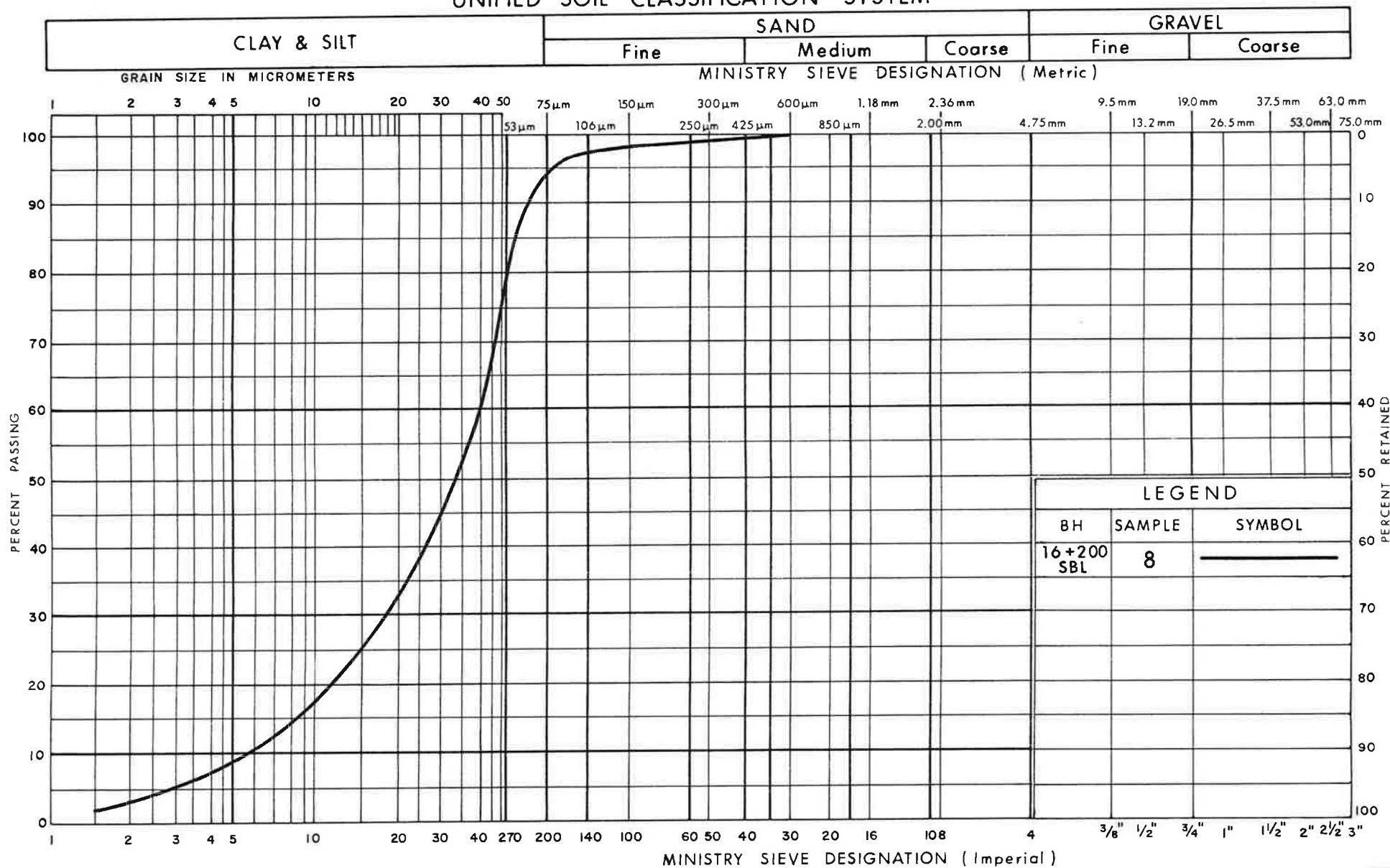
PLASTICITY CHART SILTY CLAY/CLAY

FIG No B5-4

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
Lower SILT

FIG No B5-5

W P 314-99-00

SPT 1010F



Ontario

Ministry of
Transportation

4.6 SITE 6 – MUNICIPAL SERVICE ROAD ALIGNMENT – SWAMPY AREA CROSSING/HIGH FILL AREA BETWEEN STATIONS 7+662 AND 7+723 – BOREHOLES 7+662, 7+675, 7+685 (DCPT), 7+692, 7+704, 7+711 (DCPT) AND 7+723

The proposed alignment of the new Municipal Road will cross a deep gorge immediately west of the existing Highway 11. The gorge has steep banks about 12 m high in the south side and 24 m high in the north side. A small watercourse flows in an approximately north-south direction in the valley and drains under the existing Highway 11 embankment via a 1.5 x 2.5 m concrete box culvert, which is about 65 m long (see Borehole Location Plan, Drawing No. 6).

The existing ground elevations at the boreholes drilled from the bottom of the valley ranges from about 298.6 to 301.6 m, while the elevations of the most southerly and most northerly boreholes (i.e. Boreholes 7+662 and 7+723) drilled towards edges of the valley are 302.0 and 303.6 m, respectively. To the south, the existing grade along the proposed alignment rises to about Elevation 305 m while on the north side, it rises very steeply to about Elevation 325 m.

Boreholes drilled within the valley showed the presence of about 2 to 4 m of surficial silt with sandy silt, clayey silt and silty fine sand layers/lenses and some organics content. These alluvial deposits are generally underlain by a silty clay/clayey silt deposit, which extends to a depth of about 5 to 7 m. It in turn is underlain by a lower silt deposit. Boreholes drilled towards the toe of the valley contacted auger refusal from about 3 m (Borehole 7+723) to 9 m (Borehole 7+662) while the two boreholes drilled near the midpoint (Boreholes 7+675 and 7+692) were terminated in the lower silt without encountering refusal at depths of about 13 and 11 m, respectively. A dynamic cone penetration test (DCPT) put down at Station 7+685 encountered refusal (i.e. blow counts in excess of 100 blows/0.3 m) at a depth of 18.5 m below the ground surface or at Elevation 281.0 m.

Details of the subsurface conditions encountered in the boreholes are presented on the Record of Borehole Sheets in Appendix A6. The following paragraphs are only meant to amplify and complement these data.

4.6.1 FILL

At Borehole 7+704, 7+711 and 7+723 locations approximately 0.7 m fill was placed to enable us to gain access to the site. The fill consisted of locally excavated soil ranging from sand and silt to clay with some topsoil.

4.6.2 TOPSOIL

An approximately 100 mm thick topsoil layer was contacted in the majority of the boreholes, followed in most boreholes, by an organic and root-mat rich upper layer.

4.6.3 UPPER SILT

Alluvial deposits consisting of silt with some organic content were contacted in the majority of the boreholes. The silt contains silty fine sand layers and sandy silt, clayey silt and fine sand seams/lenses and frequent organics such as decayed wood and vegetation. The presence of occasional thin organic silt/clayey silt seams/lenses was also noted. It should be pointed out that the thickness of topsoil and organic deposits can be expected to vary in low-lying areas, especially near watercourses.

The alluvium are basically fine-grained granular (cohesionless) soils with some cohesive zones. The results of an Atterberg Limits test from the deposit are given in Figure B6-1, Appendix B6.

At the borehole locations, these alluvial deposits extend to depths ranging between 1.6 m (Elevation 300.4 m) and 3.6 m (Elevation 295.0 m in Borehole 7+692 located adjacent to the existing watercourse).

Standard Penetration tests performed in the alluvium yielded N-values ranging between 1 and 8 blows/0.3 m in the boreholes drilled from the mid-section (base) of the valley, indicating a very loose to loose condition with some very soft zones, while higher N-values of 11 and 12 blows/0.3 m were generally recorded which indicate a generally compact condition in the boreholes near the toe (i.e. Boreholes 7+662 and 7+704).

An upper silt deposit was also contacted in Borehole 7+723 drilled from the relatively higher ground near the south toe of the ravine slope (Elevation 303.6 m). This material did not contain organics and the N-values recorded ranged from 24 to 29 blows/0.3 m, indicating a compact condition.

4.6.4 SILTY CLAY/CLAYEY SILT

Underlying the alluvium, all the boreholes (except for Borehole 7+723 which was drilled near the north toe of the valley) encountered a cohesive deposit consisting of silty clay and clayey silt with some silt and thin clay seams. At Borehole 7+704 location this deposit was found to extend to auger refusal at 4.6 m (Elevation 294.6 m) while in Boreholes 7+662, 7+675 and 7+692 it extended from 5.9 to 6.6 m depth (Elevation 295.4-292.7 m).

The grain-size distribution of samples from this deposit is given in Figure B6-2 in Appendix B6. The test results indicate 1% sand, 78-80% silt and 19-21% clay size particles. Atterberg Limits tests performed in the laboratory on three samples from the deposit showed the following index values:

Liquid limit:	30-36%
Plastic limit:	22-23%
Plasticity Index:	7-14%

As shown in Figure B6-3, Appendix B6, these values are characteristic of clayey soils of generally low plasticity. The measured natural moisture contents generally range from 28 to 40%, that is, near the measured liquid limit values.

N-values recorded in this deposit range from 4 to 17 blows/0.3 m. Field vane tests performed on this deposit gave in-situ undrained shear strength values of 32/40/44/44/64 and >100 kPa. Based on these field test results, the consistency of the deposit is described as firm to very stiff but generally firm.

4.6.5 LOWER SILT

At depths ranging from 5.9 to 6.6 m (Elevation 295.4-292.7 m) Boreholes 7+662, 7+675 and 7+692 contacted a layered silt deposit with occasional thin clay seams (in the upper zones) and some sandy silt seams or zones. This unit was found to extend to a depth of 9.1 m or Elevation 292.9 m (refusal, probably on

bedrock) in Borehole 7+662 while the remaining two boreholes were terminated in this deposit at depths of 11.1 and 12.6 m (Elevation 289.0 and 287.5 m).

This is a fine-grained granular (non-cohesive) material and the grain size distribution of a sample is given in Figure B6-4 in Appendix B6. This shows the following particle size distribution:

Gravel	=	0%
Sand	=	3%
Silt	=	94%
Clay	=	3%

Standard Penetration tests performed yielded N-values ranging from 3 to 10 blows/0.3 m which indicate a very loose to loose but generally a loose condition. An N-value of 37 blows/0.3 m was also recorded in Borehole 7+675 at about 11 m (Elevation 288 m) depth indicating a dense zone. It should be pointed out that a Dynamic Cone Penetration test performed 10 m north of this borehole at Station 7+685 showed the possible presence of a relatively more competent soil at about 10.5 m depth (Elevation 289 m) and refusal as defined by blow counts in excess of 100 was encountered at 18.5 m or Elevation 281.0 m.

4.6.6 BEDROCK

The most southerly Borehole 7+662 drilled near the toe of the south slope of the valley encountered refusal on the augers at 9.1 m (Elevation 292.9 m) possibly on bedrock.

On the north side, in Borehole 7+704 refusal was contacted at 4.6 m or at Elevation 294.6 m. A dynamic cone penetration test (DCPT) conducted 7 m to the north at Station 7+711 encountered refusal at 4.7 m or Elevation 294.8 m. Further north at Station 7+723 refusal to augering was contacted at 2.7 m (Elevation 300.9 m) and a DCPT conducted 1 m away contacted refusal at 3.2 m or Elevation 300.4 m. As shown on Drawing No. 6, an approximately 2.5 to 4 m high and, about 70 m long rock cut face is visible between Stations of about 7+790 and 7+860 along the existing Highway 11. In addition, the presence of rock was inferred in test pits from the top of the valley on the north side (see Site 7 – Section 4.7). From these, together with the behaviour of the augers and the DCPT at refusal, the

refusal depths at the north side are likely to represent the surface (or the close vicinity of the surface) of the bedrock. The bedrock underlying the site is known to be gneiss with some mafic and migmatitic intrusions.

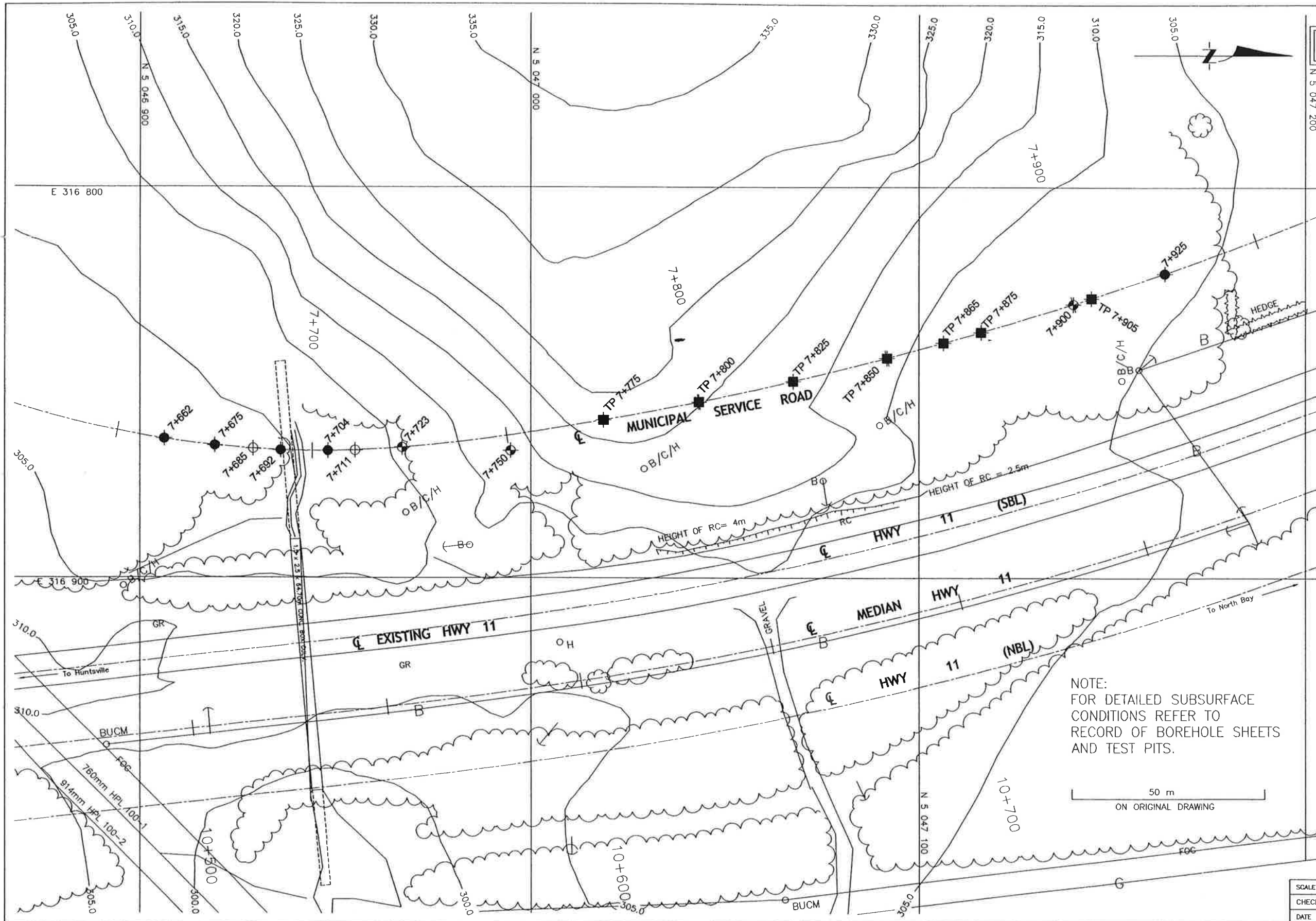
4.6.7 GROUNDWATER CONDITIONS

Water levels in the boreholes were observed during the drilling and in addition a piezometer was installed in Borehole 7+675 to enable us to monitor the groundwater level over a prolonged period of time without interference from surface water.

Visual observations made during the early spring months indicated that the groundwater level at the site was generally at the ground surface. In the piezometer installed in Borehole 7+675 the groundwater level in early June was recorded at 3.3 m below the ground surface or at Elevation 298.3 m.

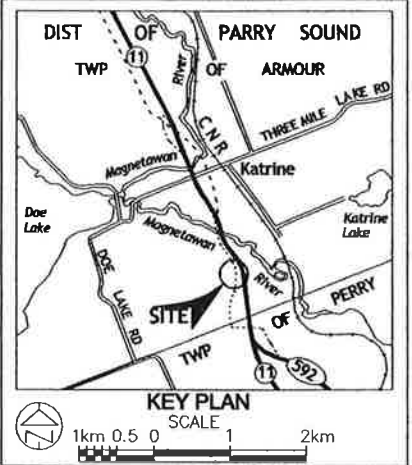
Based on these findings, within the base of the valley the groundwater level at the time of our investigation was at Elevation 298.3 m (i.e. about 0.3 to 3.3 m below the ground surface) depending on the ground surface elevations. In the early spring, however, the groundwater level can be expected to rise to ground surface level.

The groundwater table can be expected to be subject to seasonal fluctuations and in response to major weather events.



S & P SHAHEEN & PEAKER LIMITED
CONSULTING ENGINEERS

BOREHOLE LOCATION PLAN
SITE 6 & 7
MUNICIPAL SERVICE ROAD
CUT AND FILL AREA



LEGEND

- Bore Hole
 - ⊕ Dynamic Cone Penetration Test (Cone)
 - ⊙ Bore Hole & Cone
 - Test Pit
- CONE Blows/0.3m (60' Cone, 475 J/blow)

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
7+662	302.0	5 046 906.2	316 864.5
7+675	301.6	5 046 919.1	316 866.2
7+685	299.5	5 046 929.0	316 867.0
7+692	298.6	5 046 936.0	316 867.4
7+704	299.2	5 046 948.0	316 867.5
7+711	299.5	5 046 955.0	316 867.4
7+723	303.6	5 046 967.0	316 866.7
7+750	313.6	5 046 994.4	316 867.5
7+900	307.1	5 047 139.8	316 830.0
7+925	305.9	5 047 163.6	316 822.1
TP7+775	322.5	5 047 018.5	316 859.7
TP7+800	320.4	5 047 043.1	316 855.0
TP7+825	318.7	5 047 067.5	316 849.7
TP7+850	316.6	5 047 091.8	316 843.8
TP7+865	312.6	5 047 106.3	316 839.9
TP7+875	309.2	5 047 115.9	316 837.2
TP7+905	307.2	5 047 144.6	316 828.5

NOTE:
FOR DETAILED SUBSURFACE
CONDITIONS REFER TO
RECORD OF BOREHOLE SHEETS
AND TEST PITS.

50 m
ON ORIGINAL DRAWING

SCALE 1:1000	DRAWING No. 6	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTW	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F

APPENDIX A6

Site 6

Records of Boreholes

SITE 6		RECORD OF BOREHOLE No 7+662				1 OF 1		METRIC							
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 906.2; E 316 864.5				ORIGINATED BY A.J									
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & Hollow Stem Augers				COMPILED BY G.T									
DATUM Geodetic		DATE 31.05.01				CHECKED BY Z.O									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
302.0	Ground Surface														
0.0	100 mm Topsoil	very loose ----- stiff	1	SS	0										
	SILT with silt and clayey silt layers, frequent decayed vegetation and organics to 0.7 m, grey		2	SS	12										
300.4															
1.6	SILTY CLAY laminated, firm to stiff, grey		3	SS	5									17.4	
			4	SS	5									17.1	
298.7			5	TW	PH										
3.3	CLAYEY SILT laminated, firm to stiff, grey		6	SS	9										
			7	SS	7										
			8	SS	9										
			9	SS	5										
295.4			10	SS	8										
6.6	SILT laminated, loose, grey, wet		11	SS	6										
292.9			12	SS											**Bouncing spoon
9.1	End of borehole. Auger refusal possibly on bedrock *Water level not measured														

SITE 6		RECORD OF BOREHOLE No 7+675				1 OF 1		METRIC					
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 919.1; E 316 866.2				ORIGINATED BY A.J							
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & Hollow Stem Augers				COMPILED BY G.T							
DATUM Geodetic		DATE 01.06.01				CHECKED BY Z.O							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
301.6	Ground Surface												
0.0	100 mm Topsoil		1	SS	6								
	SANDY SILT/SILTY FINE SAND with decayed vegetation and organics, dark brown to 0.7 m, grey below, wet loose ----- very loose ----- loose		2	SS	7								
			3	SS	1								
			4	SS	8								
298.7			5	SS	4								
2.9	CLAYEY SILT/SILTY CLAY laminated, grey, wet firm ----- frequent silt seams stiff to very stiff		6	SS	4								
			7	TW	PH								
			8	SS	12								
			9	SS	17								
295.0	SILT with some sandy silt and silty fine sand seams, grey, wet loose ----- very loose ----- loose		10	SS	7								
6.6			11	SS	3								
			12	SS	9								
			13	SS	5								
			14	SS	3								
289.0													
12.6	End of borehole Hole open to 8.5 m on completion *Piezometer installed at 8.2 m Water level on: June 05/2001 - 3.3 m June 07/2001 - 3.3 m												

+³, X³: Numbers refer to Sensitivity

20
15
10
5
0

(%) STRAIN AT FAILURE

SITE 6		RECORD OF BOREHOLE No 7+685				1 OF 2		METRIC					
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 929.0; E 316 667.0				ORIGINATED BY A.J							
DIST 52 HWY 11		BOREHOLE TYPE D.C.P.T.				COMPILED BY G.T							
DATUM Geodetic		DATE 07.06.01				CHECKED BY Z.O							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
299.5 0.0	Ground Surface						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE </div>						
299	Dynamic Cone Penetration Test (D.C.P.T.)												
298													
297													
296													
295													
294													
293													
292													
291													
290													
289													
288													
287													
286													
285													
284.5 15.0													

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

SITE 6		RECORD OF BOREHOLE No 7+685				2 OF 2		METRIC	
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 929.0; E 316 867.0				ORIGINATED BY A.J			
DIST 52 HWY 11		BOREHOLE TYPE D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 07.06.01				CHECKED BY Z.O			

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
284.5							20 40 60 80 100	20 40 60 80 100						
15.0							20 40 60 80 100	20 40 60 80 100						
284														
283														
282														
281.0														
18.5	End of D.C.P.T.													

SITE 6		RECORD OF BOREHOLE No 7+692				1 OF 1		METRIC							
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 936.0; E 316 867.4				ORIGINATED BY A.J									
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & Hollow Stem Augers				COMPILED BY G.T									
DATUM Geodetic		DATE 07.06.01				CHECKED BY Z.O									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
298.6	Ground Surface														
0.0	100 mm Topsoil SILTY FINE SAND with organics, very loose <i>brown to 0.7 m. grey below. wet</i>		1	SS	4										
297.6			2	SS	1										
1.0	SILT with Clayey Silt zones, decayed vegetation and organics, occasional sandy silt seams, occasional thin organic seams, very soft, grey, wet		3	SS	1										
			4	SS	2										
			5	SS	2										
295.0															
3.6	CLAYEY SILT/SILTY CLAY firm, grey, wet <i>with silt seams</i>		6	TW	PH										
			7	SS	7										
			8	SS	7										
292.7															
5.9	SILT occasional sandy silt and silty fine sand seams, grey, wet <i>loose</i> <i>compact</i> <i>dense</i>		9	TW	PH										
			10	SS	8										
			11	SS	7										
			12	SS	10										
			13	SS	37										
287.5															
11.1	End of borehole *Water level not measured														

SITE 6		RECORD OF BOREHOLE No 7+704				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 948.0; E 316 867.5				ORIGINATED BY A.J			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers				COMPILED BY G.T			
DATUM Geodetic		DATE 11.06.01				CHECKED BY Z.O			

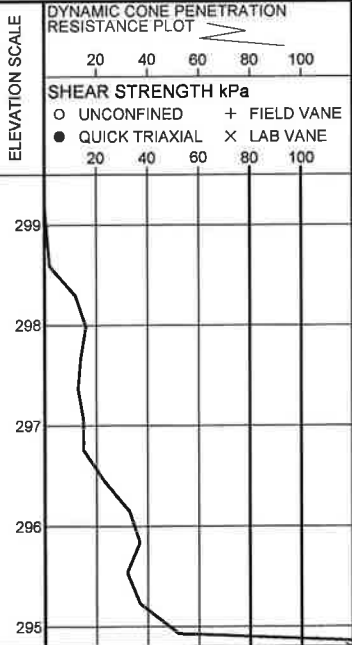
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W P	W	W L		
299.2	Ground Surface																
0.0	FILL:: mixed silt, clay and organics, very loose, dark brown, moist		1	SS	0												
298.5																	
0.7	SILT trace organics, compact, brown, moist		2	SS	11												
			3	SS	11												
297.1																	
2.1	SILTY CLAY laminated, trace organics, grey		4	SS	14												
			5	SS	10												
			6	SS	5												
294.6	stiff firm frequent Silt seams		7	SS	60/8												
4.6	End of borehole. Auger refusal probably on bedrock. *Hole dry (water level not stabilized) and open to full depth on completion. 0.7 m fill added to provide access for drilling. Borehole elevation adjusted																

+ 3, × 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

SITE 6		RECORD OF BOREHOLE No 7+711				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 955.0; E 316 867.4				ORIGINATED BY A.J			
DIST 52 HWY 11		BOREHOLE TYPE D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 11.06.01				CHECKED BY Z.O			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		W P W W L			
299.5 0.0	Ground Surface						<div style="display: flex; justify-content: space-between;"> 20 40 60 80 100 20 40 60 80 100 </div> <div style="display: flex; justify-content: space-between;"> ○ UNCONFINED + FIELD VANE </div> <div style="display: flex; justify-content: space-between;"> ● QUICK TRIAXIAL x LAB VANE </div>		<div style="display: flex; justify-content: space-between;"> 20 40 60 20 40 60 </div>				
	Dynamic Cone Penetration Test (D.C.P.T.)												
294.8 4.7	End of D.C.P.T.												

SITE 6		RECORD OF BOREHOLE No 7+723				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 967.0; E 316 866.7				ORIGINATED BY A.J.			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & D.C.P.T.				COMPILED BY G.T.			
DATUM Geodetic		DATE 11.06.01				CHECKED BY Z.O.			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L				
303.6	Ground Surface													
0.0	FILL: mixed sand, silt and topsoil, with rootlets and wood pieces, very loose, dark brown, moist		1	SS	2									
302.9														
0.7	SILT sandy to 2.0 m, brown to 1.4 m, grey below, compact, moist		2	SS	29									
			3	SS	25									
			4	SS	24									
300.9	trace fine gravel													
2.7	End of borehole. Auger refusal probably on bedrock													
300.4														
3.2	End of D.C.P.T. *Hole dry (water level not stabilized) and open to full depth on completion Dynamic Cone Penetration Test performed 1.0 m east of borehole from 0 to 3.2 m**. 0.7 m fill added to provide access for drilling. Borehole elevation adjusted.													

+³, ×³;
Sensitivity

Numbers refer to
Sensitivity

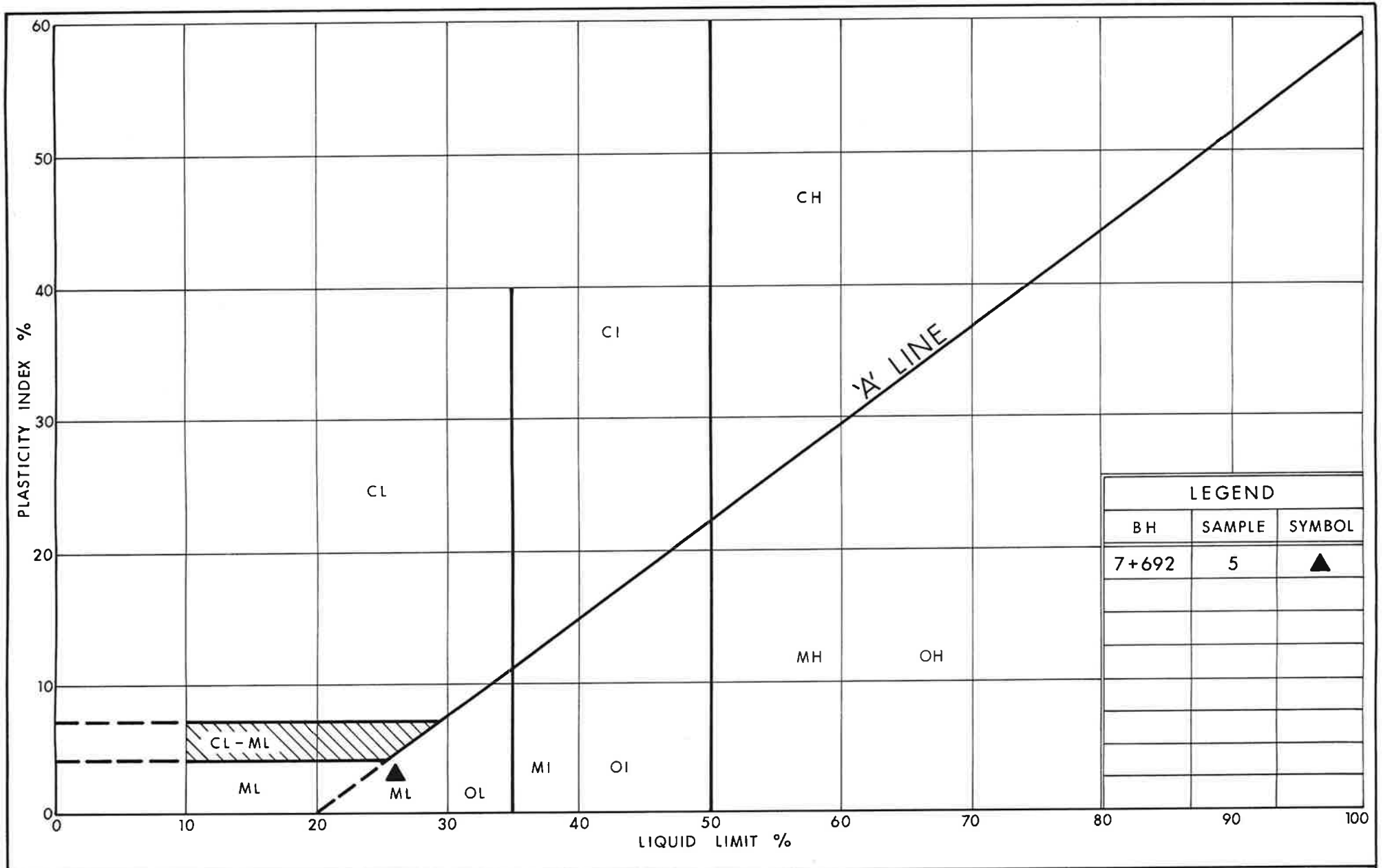
20
15
10
5
0

(%) STRAIN AT FAILURE

APPENDIX B6

Site 6

Laboratory Test Results



Ministry of
Transportation
Ontario

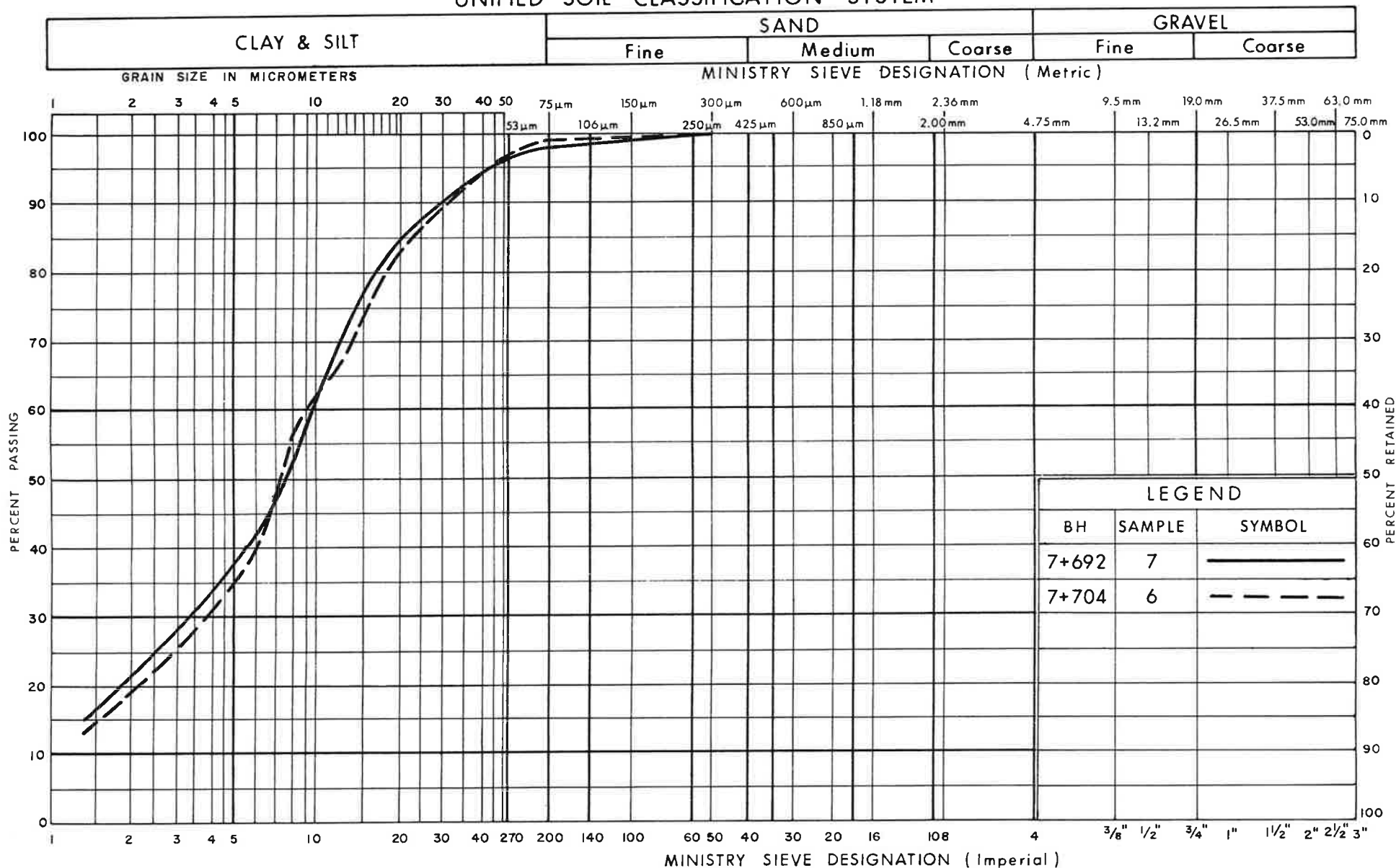
PLASTICITY CHART Upper SILT (Alluvium)

FIG No B6-1

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



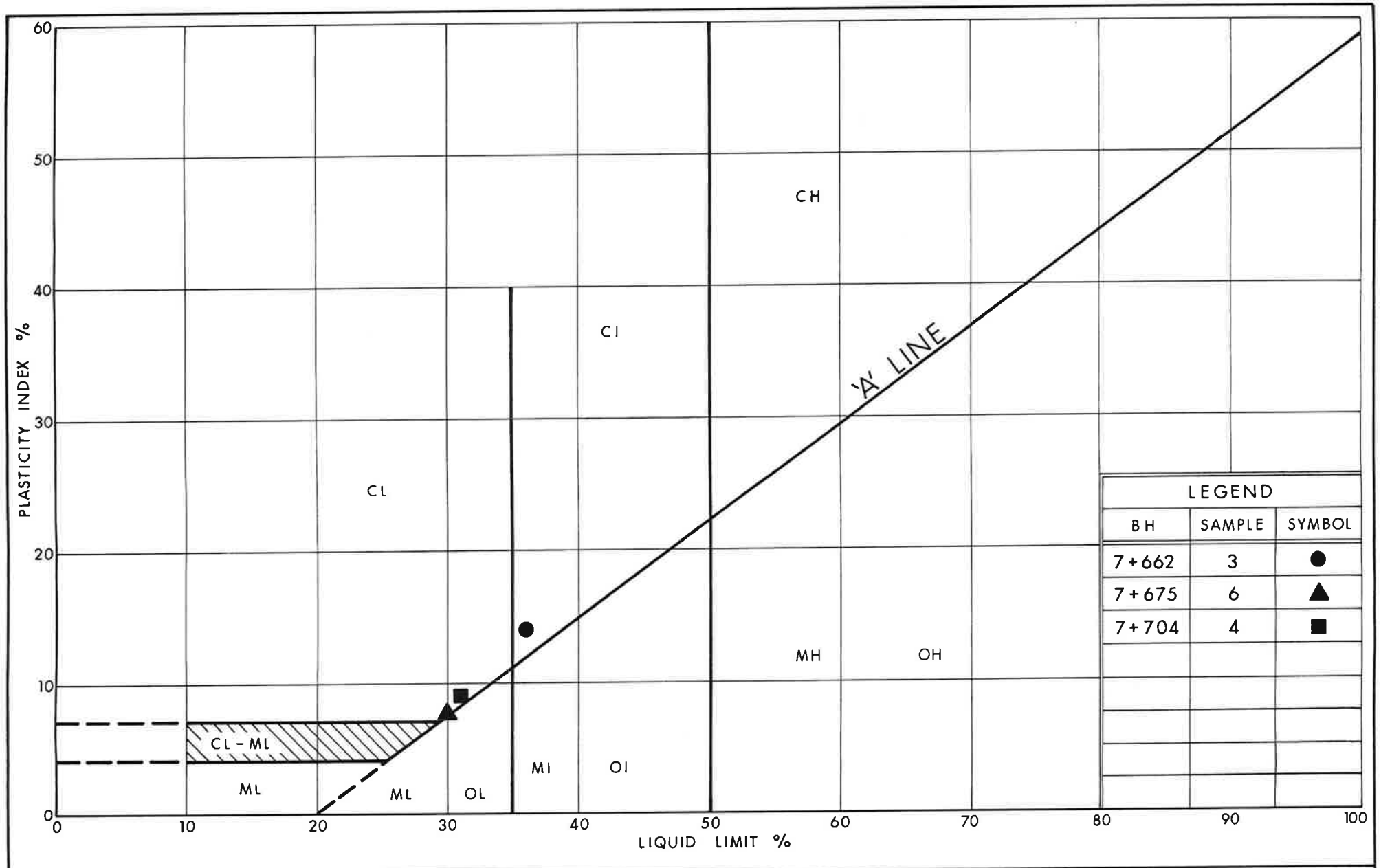
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION CLAYEY SILT / SILTY CLAY

FIG No B6-2

WP 314-99-00

SPT 1010F



Ministry of
Transportation
Ontario

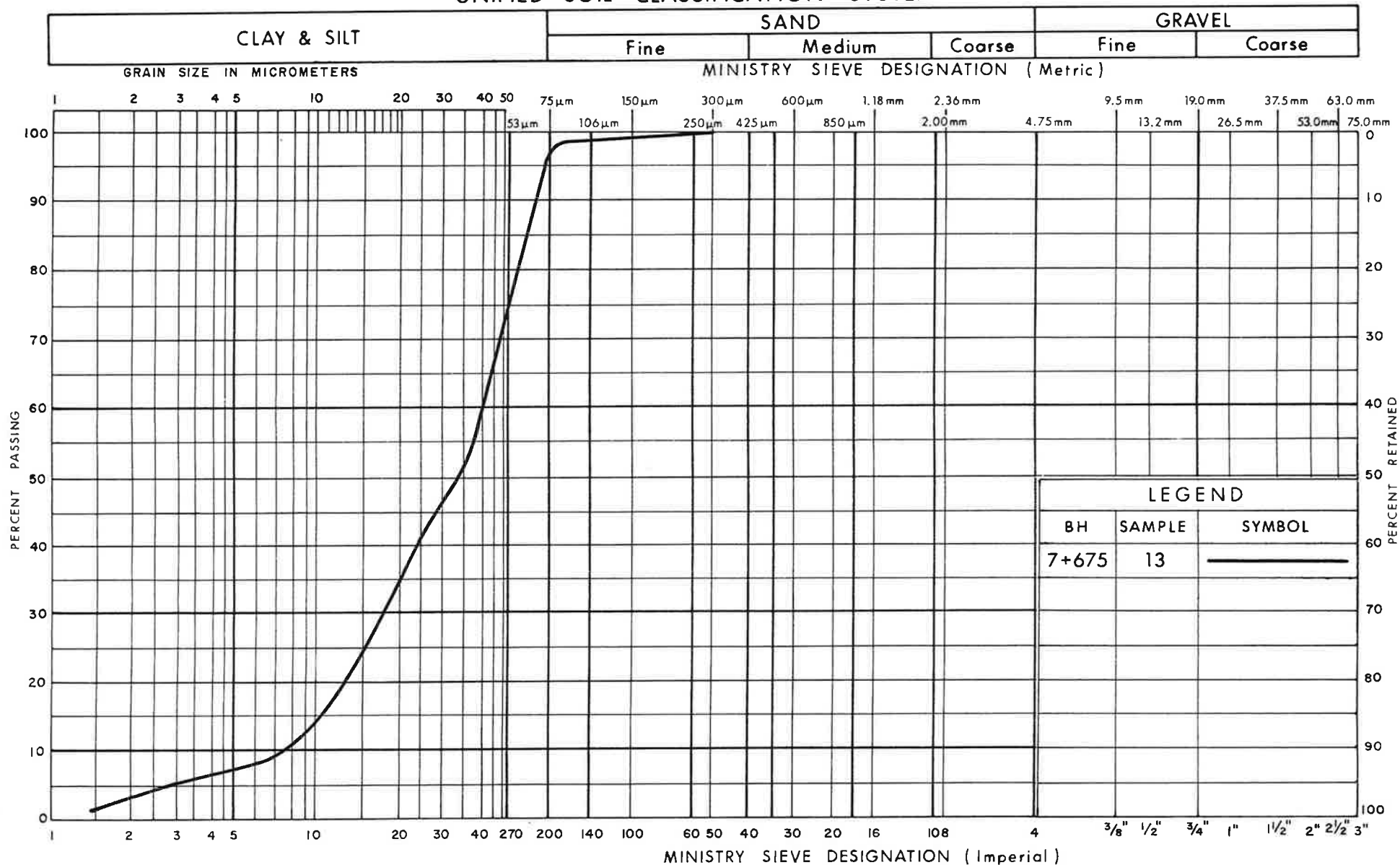
PLASTICITY CHART CLAYEY SILT/SILTY CLAY

FIG No B6-3

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

Lower SILT

FIG No B6-4

W P 314-99-00

SPT 1010F

4.7 SITE 7 – MUNICIPAL SERVICE ROAD – DEEP CUT SECTION BETWEEN STATIONS 7+740 AND 7+900 – BOREHOLES 7+723, 7+750, 7+900, 7+925 AND TEST PITS 7+775, 7+800, 7+825, 7+850, 7+865, 7+875 AND 7+905

The alignment of the proposed Municipal Service Road traverses through the east face of a hill which is approximately 35 m high. The existing ground elevation along the centerline of the proposed road rises from about Elevation 300 m in a stream valley to the south of the hill to about Elevation 322.5 m (at about Station 7+775) in a horizontal distance of about 70 m. It then drops northerly to about Elevation 308 m about 100 m further north. As shown on Drawing No. 6, the centerline of the proposed road is on the east face of the hill and the hill rises westerly to about Elevation 335 m near the top (within a horizontal distance of about 80 m). To the east of the hill is the existing Highway 11 (Elevation 315-310 m). A hydro R.O.W. was recently constructed in between the Highway and the proposed municipal road alignment.

The fieldwork for the project consisted of drilling and sampling four boreholes with a drill rig and putting down seven test pits with a backhoe. All boreholes and test pits were located along the centerline of the proposed road alignment at the stations shown as the borehole and test pit numbering (e.g. Borehole 7+723 was drilled at Station 7+723). Dynamic cone penetration tests (DCPT) were also performed adjacent to three of the boreholes and in the fourth one from the bottom of the borehole.

Boreholes 7+723 and 7+750 were drilled near the south toe of the slope and these contacted a shallow overburden of about 3 and 1 m, respectively to auger and DCPT refusal. In the test pits dug between Stations 7+775 and 7+875, refusal to further digging was encountered 0.3 to 3.2 m depth on the bedrock or on the probable bedrock surface. About 35 m east of the centerline of the proposed road alignment in between about Stations 7+790 and 7+860, a rock cut face is visible along Highway 11. From these findings, it is evident that the high hill is a rock knob covered with variable but generally shallow overburden, typical of the general area.

Further north in Borehole 7+900 which was drilled near the north toe of the hill (about Elevation 307 m), auger refusal was encountered at about 5 m or

about Elevation 302 m while in the DCPT which was put down adjacent to the borehole, refusal was recorded at 6 m depth, both probably on the bedrock surface or near it. In this borehole the overburden consisted of silt underlain by silty clay, which is in turn underlain, by a lower silt.

In Borehole 7+925, which was drilled 25 m, further north, refusal to augering was encountered at 11.7 m or Elevation 294.2 m. Underlying a veneer of topsoil, the overburden in this borehole consisted of 2.2 m of sand followed by a 2.6 m thick silt layer. The silt layer is underlain by silty clay to about 7.5 m depth and it in turn is underlain by a lower silt deposit.

Details of the stratigraphy encountered in the boreholes and test pits are given on the individual Record of Borehole Sheets and composite Record of Test Pits, both in Appendix A7. The individual strata are briefly discussed in the following paragraphs.

4.7.1 OVERBURDEN

Approximately 100 to 300 mm of topsoil followed by some organic rich upper horizon soil was contacted.

In Borehole 7+723 below some fill (which was placed for access for the drill rig) a silt deposit was contacted to refusal at 2.7 m. From recorded N-values of 24 to 29 blows/0.3 m, the denseness condition of this material is described as compact.

In Borehole 7+750, drilled further up the hill face, the overburden consisted of about 1 m of silty fine sand (followed by auger refusal). In this material, an N-value of 1 blow/0.3 m was recorded which indicates a very loose condition.

In Test Pit 7+775, put down 25 m further north, near the alignment centerline peak, refusal was contacted at 3.2 m depth. Beneath a veneer of topsoil the overburden consisted of sand.

Further north in test pits put down between Stations 7+800 and 7+875, refusal was encountered at depths between 0.3 and 1.4 m below the ground surface. Below some topsoil and organic rich soil the overburden was found to be basically granular (i.e. silty sand to gravelly sand with some cobbles).

Further north near the north toe in Boreholes 7+900 and 7+925, below some topsoil, the overburden consisted of sandy silt (Borehole 7+900) to 0.7 m depth; and sand to 2.4 m depth (Elevation 303.5 m) in Borehole 7+925. The grain size distribution of a sample from the sand deposit is presented in Figure B7-1, Appendix B7. The following particle size distribution is indicated:

Gravel:	2%
Sand:	96%
Silt and clay:	2%

The sand is a granular deposit and based on a recorded N-value of 3 blows/0.3 m the upper 0.7 m of the sand is considered very loose, followed by a compact condition (N=22 blows/0.3 m).

These surficial deposits are underlain by a deposit of silt which is 2.2 and 2.6 m thick in Boreholes 7+900 and 7+925, respectively. This is a cohesive deposit and the results of an Atterberg Limits test performed on samples from the material are given in Figure B7-2, Appendix B7. Based on N-values of between 11 and 34 blows/0.3 m, the consistency of the deposit is described as very stiff to hard.

At 2.9 to 5.0 m below the ground surface (Elevation 304.2 and 300.9 m) both boreholes contacted a more plastic deposit which consisted of cohesive silty clay to clayey silt with some silt seams. In Borehole 7+900, this deposit extended to 4.4 m depth (Elevation 302.7 m) while in Borehole 7+925 it extended to 7.5 m depth or Elevation 298.4 m. The measured natural moisture contents of samples from the deposit generally range from 24% to 46%.

N-values recorded in this deposit range from 5 to 10 blows/0.3 m and field vane tests gave undrained in-situ shear strength values of 80 to generally in excess of 100 kPa. Based on these test results, the consistency of the deposit is described as firm to very stiff.

Underlying the silty clay to clayey silt in both boreholes is a basal silt. In Borehole 7+900, this deposit was contacted at 4.4 m (Elevation 302.7 m) and extended to the full depth of the borehole at 4.9 m where refusal to augering was encountered. In Borehole 7+925 this silt was encountered at 7.5 m depth (Elevation 298.4 m) and also extended to the full depth of borehole (i.e. refusal at

11.7 m or Elevation 294.2 m). The upper zones of this deposit were found to be somewhat clayey and plastic (i.e. a cohesive material). The grain-size distribution of a sample from this cohesive zone is given in Figure B7-3, Appendix B7. It indicates 4% sand, 89% silt and 7% clay size particles. Below this zone in Borehole 7+925 the deposit is sandy (i.e. non-cohesive) and from N-values of 12 to 88 blows/0.3 m, the denseness condition of the material is described as compact, changing to very dense below about 10 m depth.

4.7.2 BEDROCK

As mentioned before, based on visual observations made, together with borehole and test pitting results, the high hill is believed to be a rock knob with variable but generally shallow overburden cover.

There was no rock coring done for this preliminary investigation to verify the presence, quality and type of rock. However, based on the observations made in the boreholes and test pits, the estimated probable bedrock depths/elevations along the proposed road centerline are given in the following table.

Table 4.7.2.1
Estimated Probable Bedrock Depths and Elevations
Along the Proposed Road Centerline

Borehole/Test Pit	Refusal (Probable Bedrock Depth)	Approximate Elevation
7+723	2.7	300.9
7+750	1.0	312.6
7+775	3.2	319.3
7+800	1.4	319.0
7+825	0.3	318.4
7+850	0.9	315.7
7+865	0.5	312.1
7+875	0.3	308.9
7+900	4.9	302.2
7+925	11.7	294.2

From the published data, other work done in the general area, observations made in the test pits and the exposed rock face, the bedrock is

believed to be a gneiss formation with granitic zones, migmatitic and mafic infills. It is a basically hard rock and is generally quite massive with some weathered zones, especially near the surface.

4.7.3 GROUNDWATER CONDITIONS

Boreholes and test pits were backfilled immediately upon their completion when groundwater levels had not yet stabilized. However, based on the observed moisture contents of the soils samples, the groundwater level at the time of our investigation was generally within 1 m of the ground surface.

The groundwater table can be expected to fluctuate seasonally and in response to major weather events.

Yours truly

SHAHEEN & PEAKER LIMITED

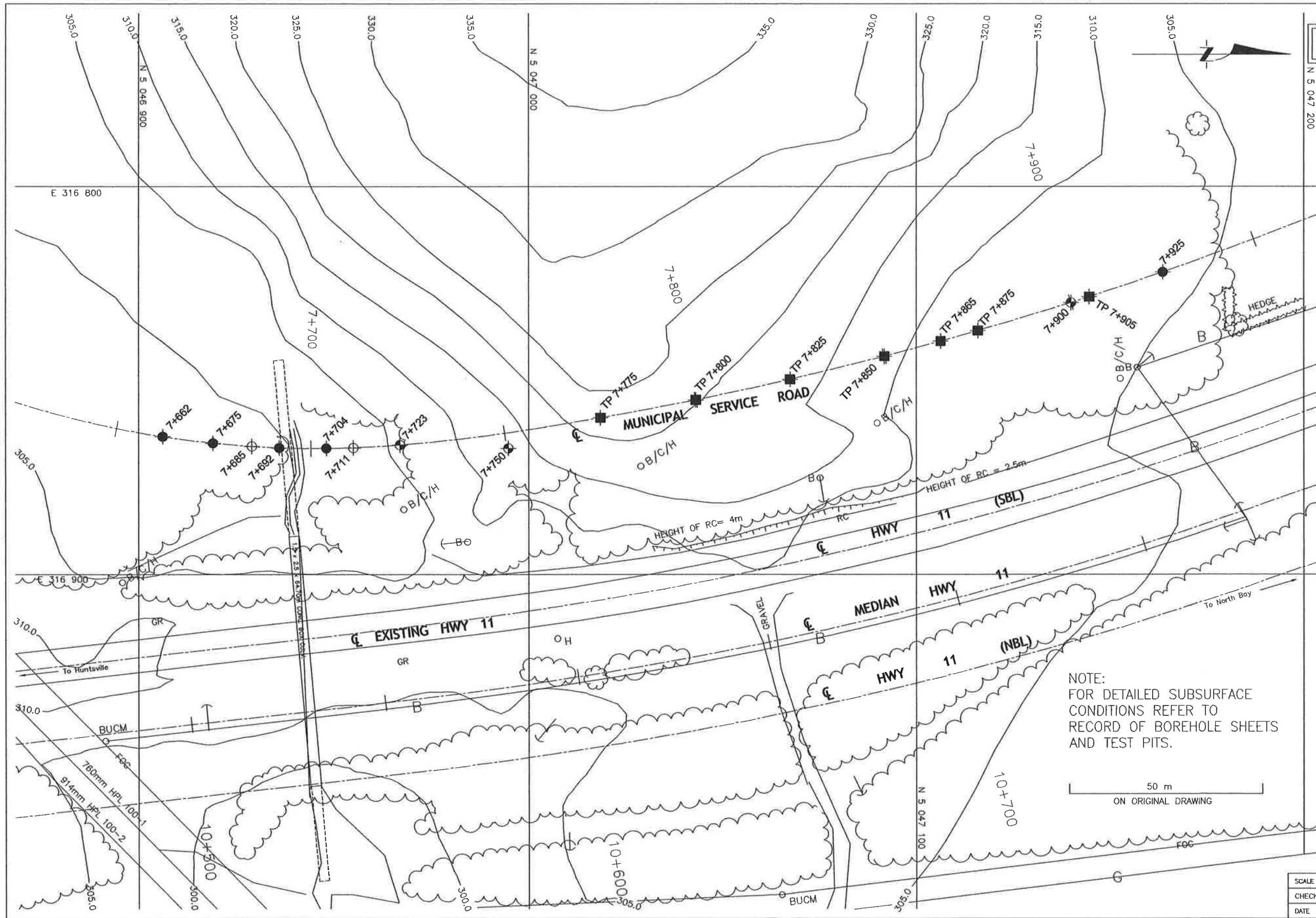


Zuhtu Ozden, P.Eng.

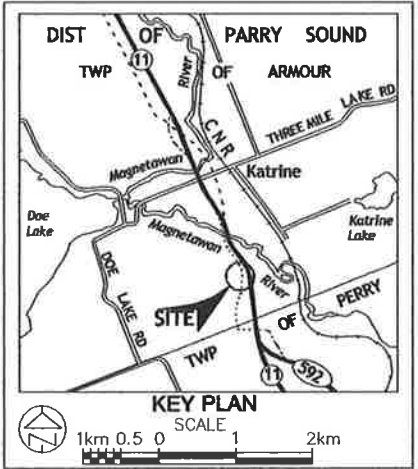


K. R. Peaker, Ph.D., P.Eng.





BOREHOLE LOCATION PLAN
SITE 6 & 7
MUNICIPAL SERVICE ROAD
CUT AND FILL AREA



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- CONC Blows/0.3m (60' Cone, 475 J/blow)
- Test Pit

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
7+662	302.0	5 046 906.2	316 864.5
7+675	301.6	5 046 919.1	316 866.2
7+685	299.5	5 046 929.0	316 867.0
7+692	298.6	5 046 936.0	316 867.4
7+704	299.2	5 046 948.0	316 867.5
7+711	299.5	5 046 955.0	316 867.4
7+723	303.6	5 046 967.0	316 866.7
7+750	313.6	5 046 994.4	316 867.5
7+900	307.1	5 047 139.8	316 830.0
7+925	305.9	5 047 163.6	316 822.1
TP7+775	322.5	5 047 018.5	316 859.7
TP7+800	320.4	5 047 043.1	316 855.0
TP7+825	318.7	5 047 067.5	316 849.7
TP7+850	316.6	5 047 091.8	316 843.8
TP7+865	312.6	5 047 106.3	316 839.9
TP7+875	309.2	5 047 115.9	316 837.2
TP7+905	307.2	5 047 144.6	316 828.5

SCALE 1:1000	DRAWING No. 6	WP 314-99-00
CHECKED BY ZO	DRAWN BY JTW	PROJECT NO.:
DATE OCT., 2001	SHEET 1 OF 1	SPT1010F

APPENDIX A7

Site 7

Records of Boreholes

SITE 7		RECORD OF BOREHOLE No 7-723				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 967.0; E 316 866.7				ORIGINATED BY A.J			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 11.06.01				CHECKED BY Z.O			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W P	W	W L			
303.6	Ground Surface													
0.0	FILL: mixed sand, silt and topsoil, with rootlets and wood pieces, very loose, dark brown, moist SILT sandy to 2.0 m, brown to 1.4 m, grey below, compact, moist ----- trace fine gravel		1	SS	2									
302.9														
0.7			2	SS	29									
			3	SS	25									
300.9			4	SS	24									
2.7	End of borehole. Auger refusal probably on bedrock													
300.4														
3.2	End of D.C.P.T. *Hole dry (water level not stabilized) and open to full depth on completion Dynamic Cone Penetration Test performed 1.0 m east of borehole from 0 to 3.2 m**. 0.7 m fill added to provide access for drilling. Borehole elevation adjusted.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
0

(%) STRAIN AT FAILURE

SITE 7		RECORD OF BOREHOLE No 7+750				1 OF 1		METRIC					
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 046 994.4; E 316 867.5				ORIGINATED BY A.J							
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & D.C.P.T.				COMPILED BY G.T							
DATUM Geodetic		DATE 12.06.01				CHECKED BY Z.O							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
313.6	Ground Surface												
0.0	SILTY FINE SAND: with organics, very loose moist		1	SS	1	*							**bouncing spoon probably on bedrock
312.6			2	SS	60/8	**							
312.5	End of borehole Auger refusal												***bouncing cone probably on bedrock
1.1	End of D.C.P.T. Dynamic Cone Penetration Test performed 5.0 m East of borehole from 0 to 1.1 m. *Hole dry (water level not stabilized) and open to full depth on completion												

SITE 7		RECORD OF BOREHOLE No 7+900				1 OF 1		METRIC	
W.P. 314-99-00		LOCATION Municipal Service Road - Katrine, ON - Coords: N 5 047 139.8; E 316 830.0				ORIGINATED BY A.J			
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem Augers & Hollow Stem Augers & D.C.P.T.				COMPILED BY G.T			
DATUM Geodetic		DATE 12.06.01				CHECKED BY Z.O			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W P	W	W L		
307.1	Ground Surface													
0.0	100 mm Topsoil		1	SS	1	*	307							
306.4	SANDY SILT with rootlets, very loose, dark brown, moist													
0.7	SILT with clayey silt layers, brown	hard ----- very stiff	2	SS	34		306							
			3	SS	24									
			4	SS	23									
304.2	SILTY CLAY firm to stiff, grey		5	SS	8		304							
2.9			6	TW	PH		303							
302.7	SILT trace clay, grey, moist		7	SS	60/13	**	302							
4.4														
302.2	End of borehole. Auger refusal probably on bedrock													
4.9														
301.1	End of D.C.P.T. Refusal probably on bedrock. Dynamic Cone Penetration Test performed 3.0 m North of hole, from 0.0 m to 6.0 m. * Water level not measured													

+ 3, × 3; Numbers refer to Sensitivity

APPENDIX A7

RECORD OF TEST PITS – SITE 7

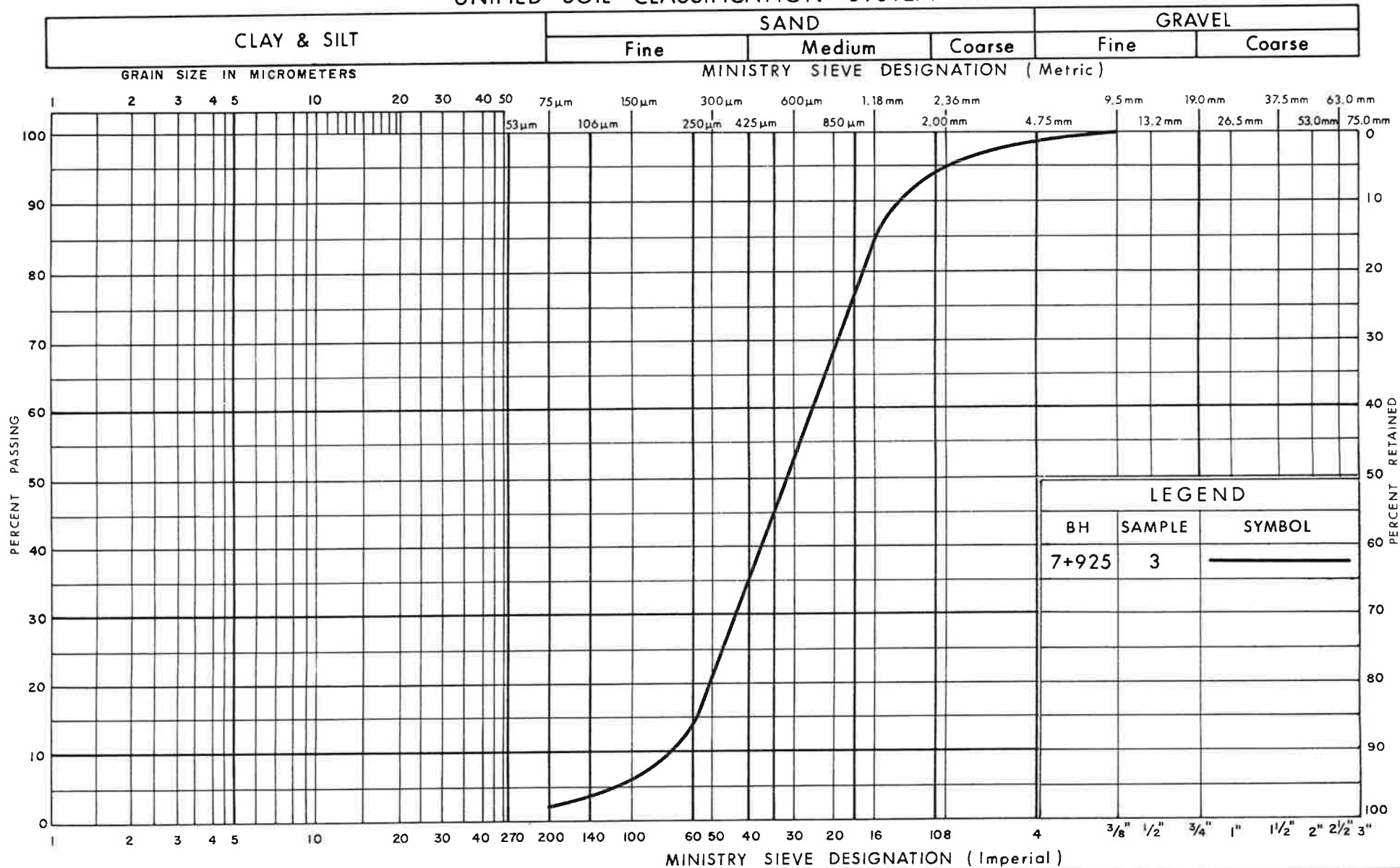
Station/Offset	Approximate Test Pit Elevation	Soil Profile
7+775 centerline	322.5	0-100 mm Topsoil 0.1-3.2 m Sand Refusal @ 3.2 m probable bedrock
7+800 centerline	320.4	0 – 1.4 m Sand (organic rich to 0.75 m) Refusal @ 1.4 m probable bedrock
7+825 centerline	318.7	0 – 300 mm Topsoil Refusal @ 0.3 m on bedrock
7+850 centerline	316.6	0 – 0.6 m Silty sand some organics and cobbles 0.6 – 0.9 m Gravelly sand Refusal @ 0.9 m on bedrock
7+865 centerline	312.6	0 – 0.5 m Silty sand some organics and cobbles Refusal @ 0.5 m on bedrock
7+875 centerline	309.2	0 – 0.3 m Sandy Topsoil with cobbles Refusal @ 0.3 m on bedrock
7+905 centerline	307.2	0 – 0.3 Sandy Topsoil 0.3 – 3.3 m Silt/Clayey Silt/ Silty Clay

APPENDIX B7

Site 7

Laboratory Test Results

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

SAND

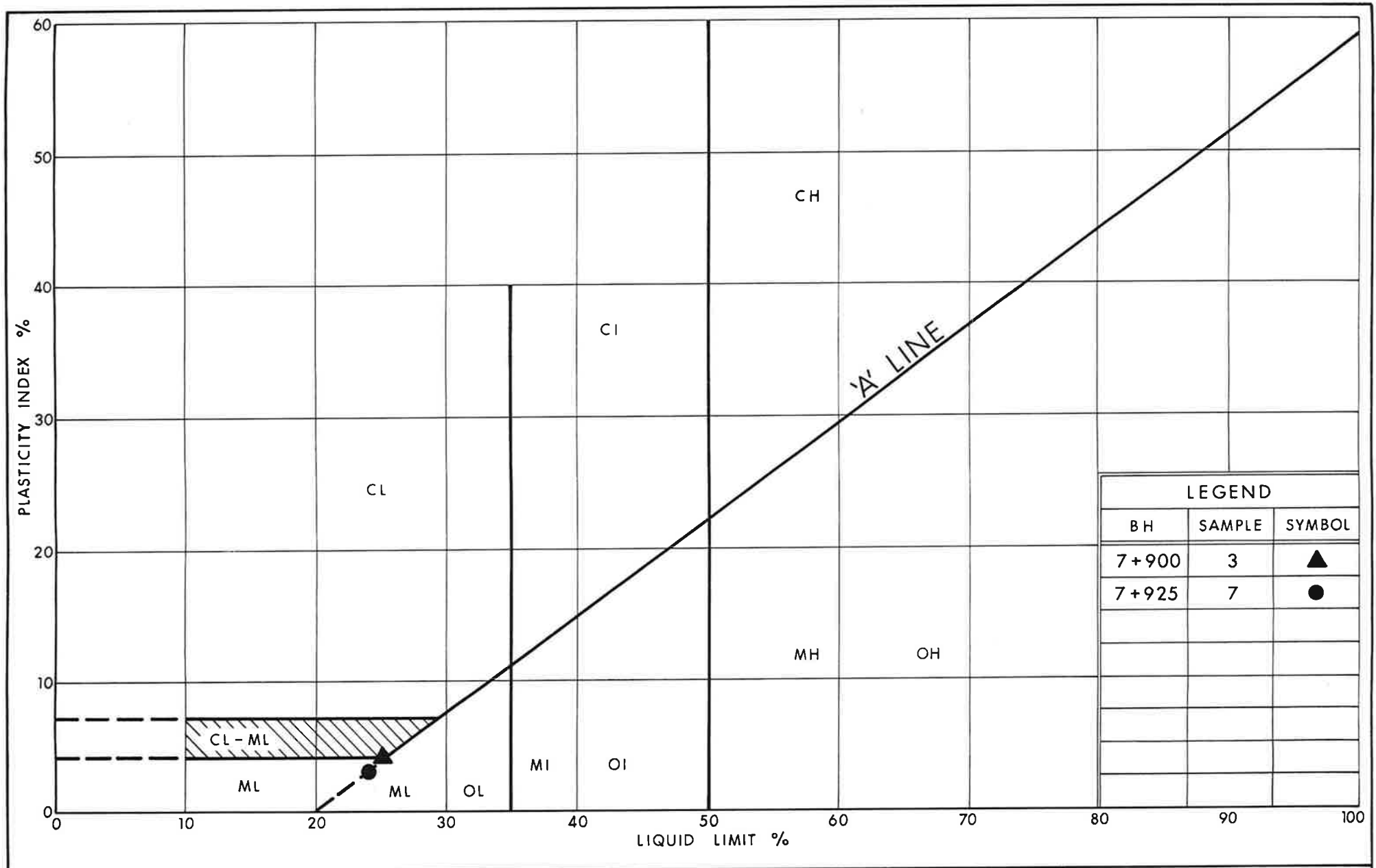
FIG No B7-1

W P 314-99-00

SPT 1010F


 Ministry of
Transportation

Ontario



Ministry of
Transportation

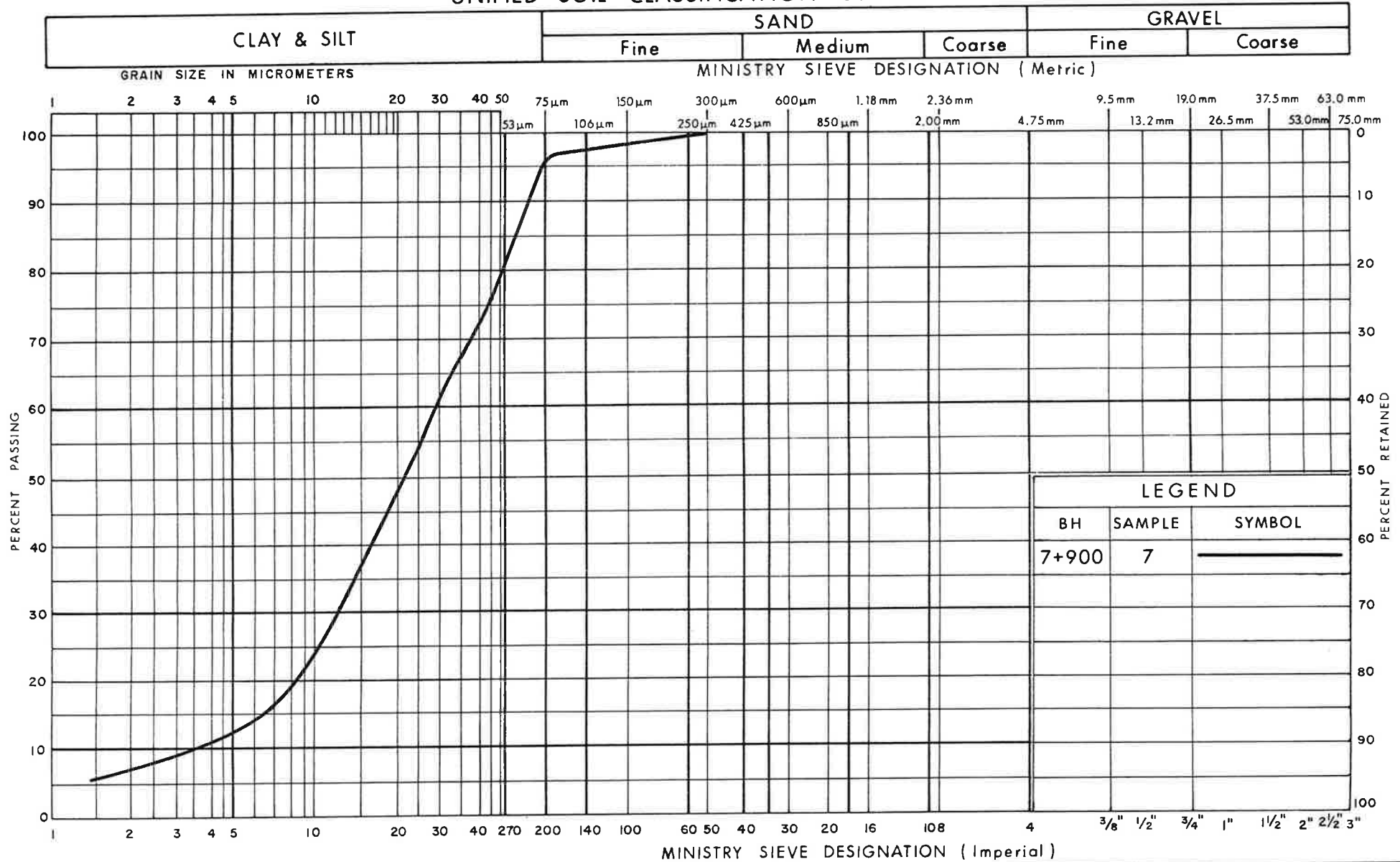
PLASTICITY CHART Upper SILT

FIG No B7-2

W P 314-99-00

SPT 1010F

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
Lower SILT

FIG No B7-3

W P 314-99-00

SPT 1010F

APPENDIX C

Explanation of Terms Used in Report

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:

R Q D (%)	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

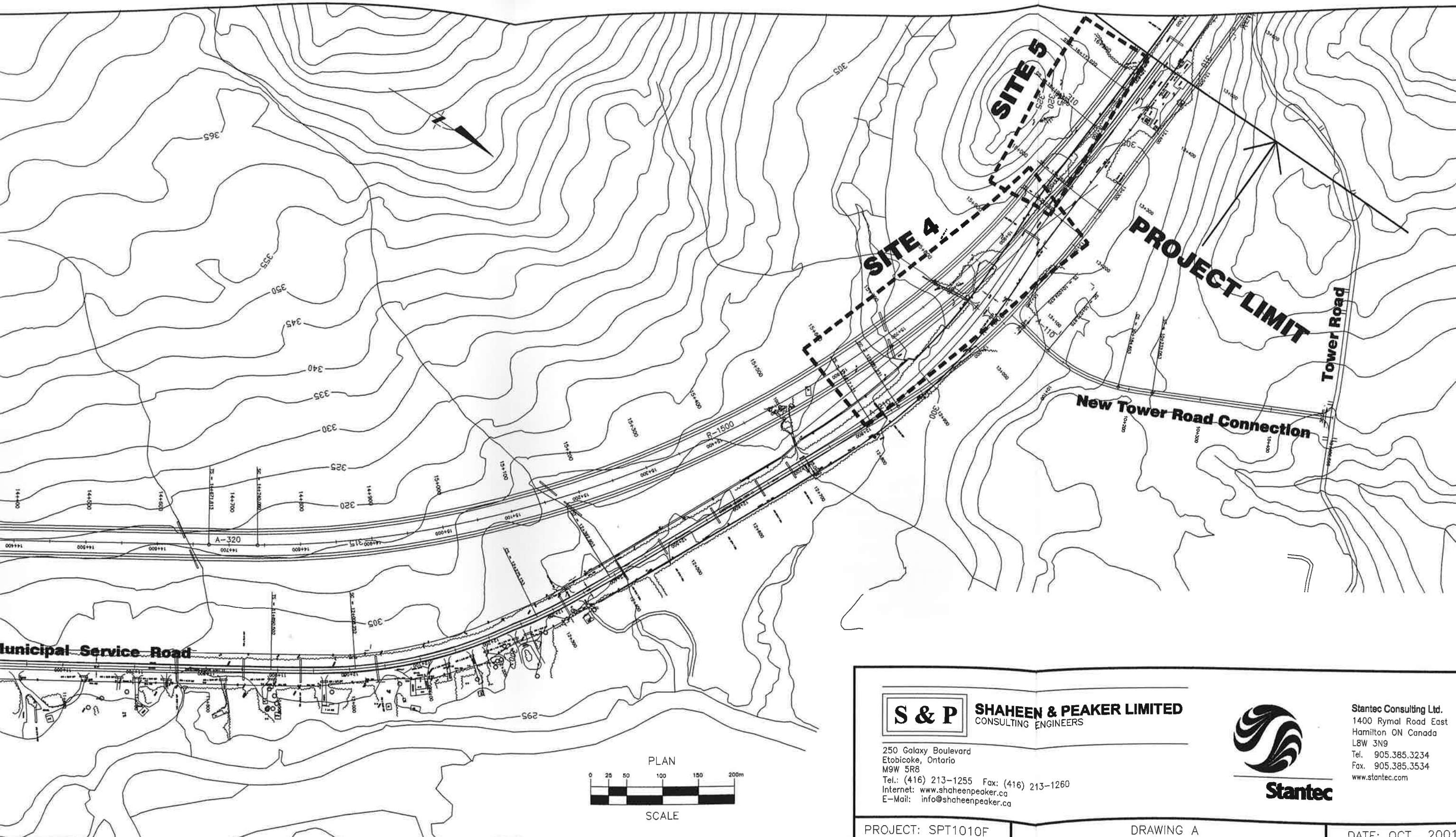
u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS 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'_{v0}	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_i	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ²	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



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PROJECT: SPT1010F

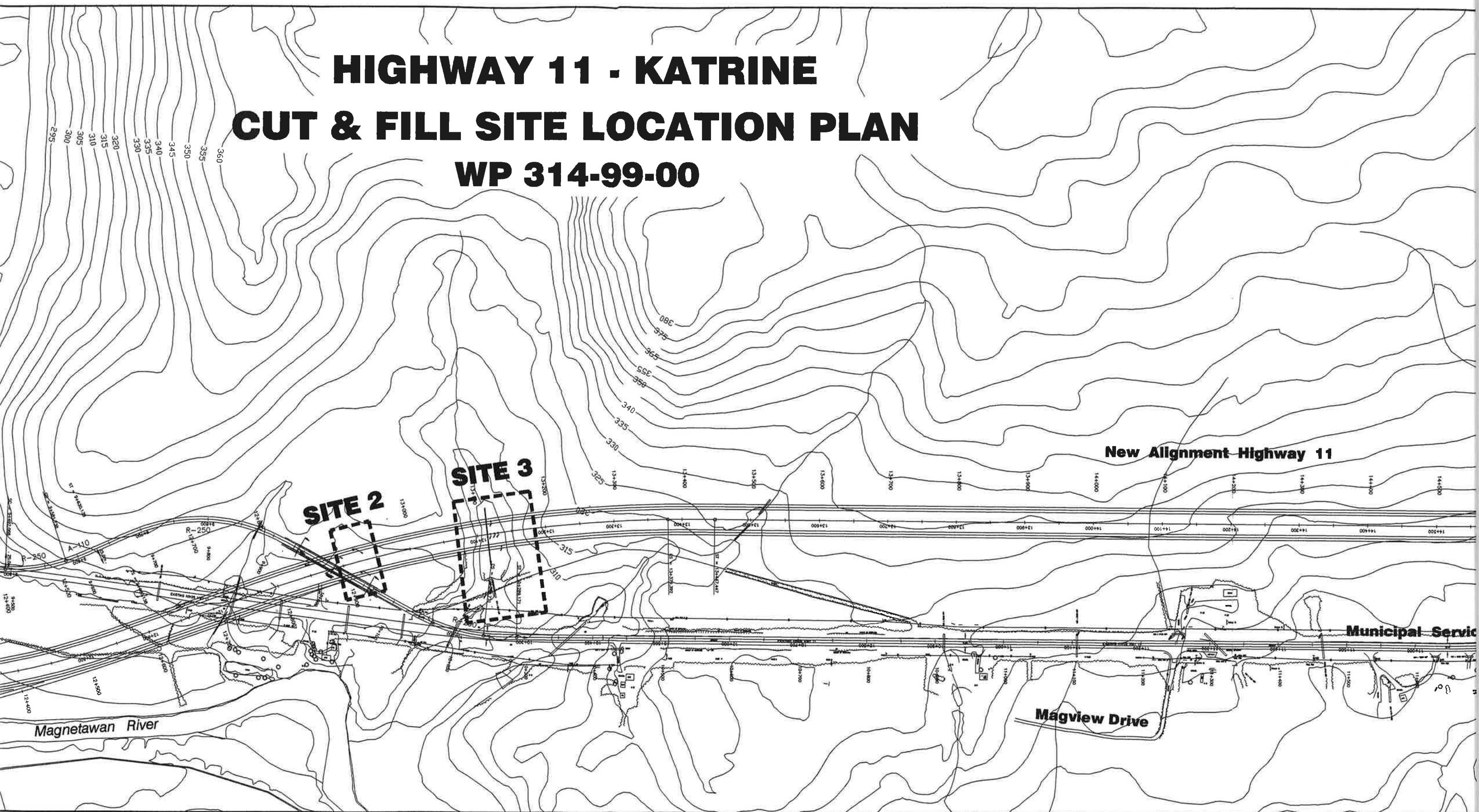
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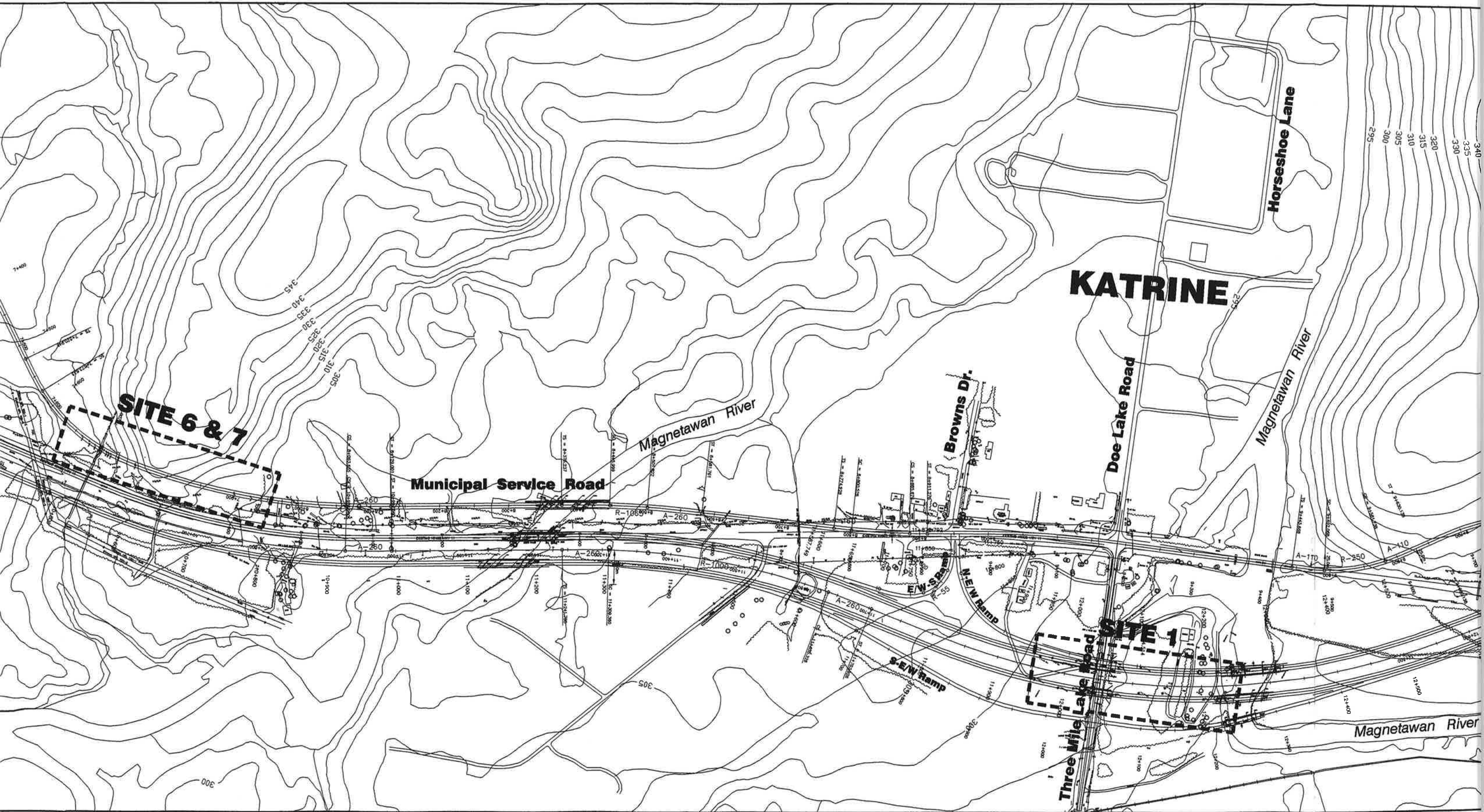
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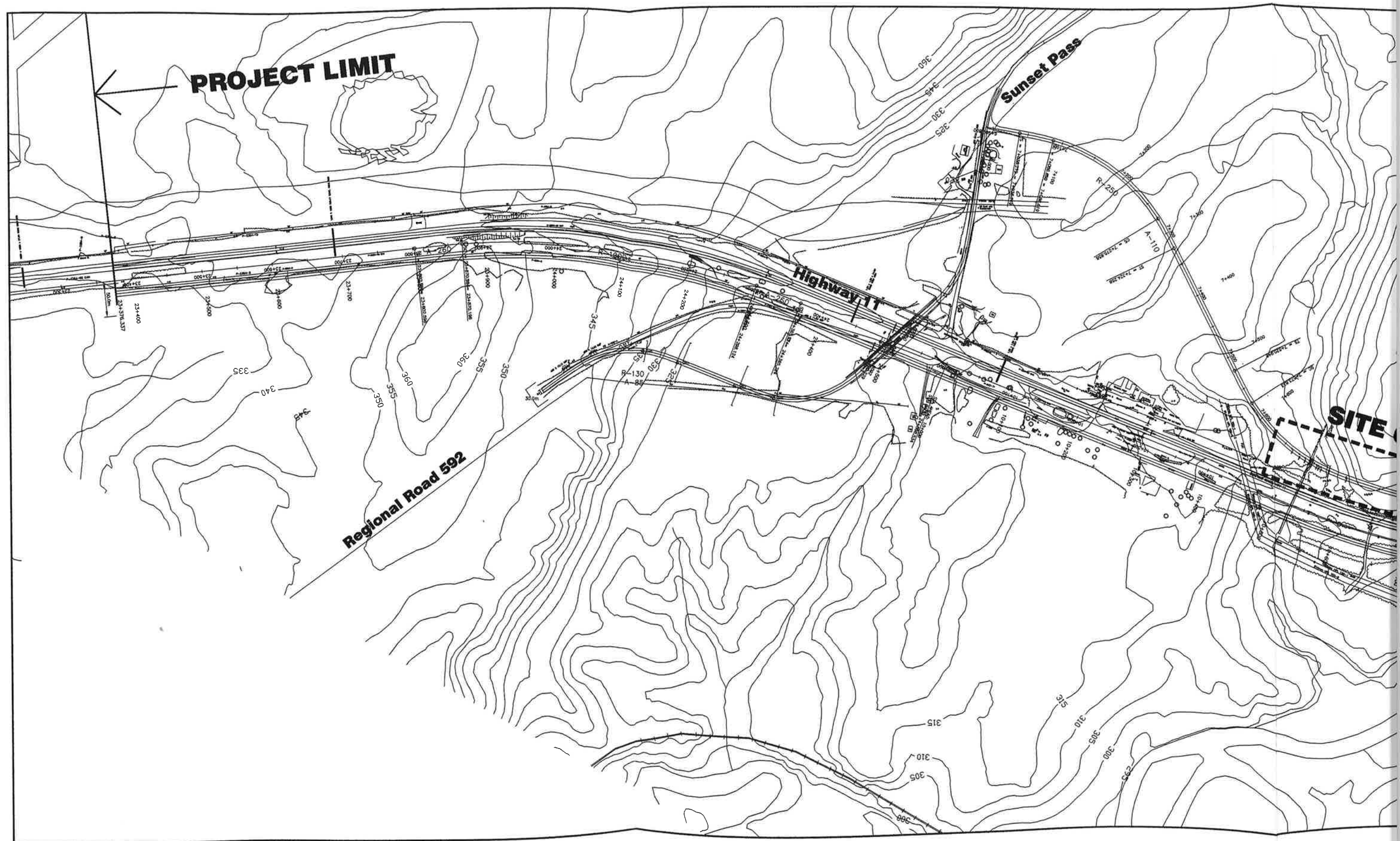
HIGHWAY 11 - KATRINE

CUT & FILL SITE LOCATION PLAN

WP 314-99-00







**PRELIMINARY FOUNDATION DESIGN REPORT
CUT AND FILL SECTIONS
PROPOSED HIGHWAY 11 REALIGNMENT AND MUNICIPAL ROAD
KATRINE, ONTARIO
W.P. 314-99-00**

Prepared For:

STANTEC CONSULTING LTD.

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1010F
December 20, 2001**

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Table of Contents

5.	DISCUSSION AND RECOMMENDATIONS	45
5.1	Site 1 - Highway 11/Three Mile Lake Area (Station 11+960 to 12+230).....	45 45
5.2	Site 2 - Highway 11 Crossing Under Proposed Municipal Road (Boreholes 12+920SBL and 12+923NBL)	49 49
5.3	Site 3 – Highway 11 Alignment Swamp Crossing Between Stations 13+110 and 13+150.....	51
5.4	Site 4 – Highway 11 Crossing Over Swampy Area Between Stations 15+625 and 15+965.....	53
5.5	Site 5 – Highway 11 Alignment – Cut Section Between Stations 15+965 and 16+200.....	56
5.6	Site 6 – Municipal Service Road Alignment – Swamp Crossing/High Fill Area Between Stations 7+662 and 7+723.....	58
5.7	Site 7 – Municipal Service Road – Deep Cut Section Between Stations 7+740 and 7+900	63
6.	CLOSURE	64

APPENDICES

LIMITATIONS OF REPORT

APPENDIX D

**PRELIMINARY FOUNDATION DESIGN REPORT
CUT AND FILL SECTIONS
PROPOSED HIGHWAY 11 REALIGNMENT AND MUNICIPAL ROAD
KATRINE, ONTARIO
W.P. 314-99-00**

5. DISCUSSION AND RECOMMENDATIONS

5.1 SITE 1 - HIGHWAY 11/THREE MILE LAKE AREA (STATION 11+960 TO 12+210)

The twenty-six boreholes to depths ranging between 8 and 48 m drilled in this area (see Section 4.1 of this report) generally showed at and to the south of the Three Mile Lake Road crossing site the presence of very loose to compact silt/sandy silt to depths ranging between 1.5 and 4.4 m below the ground surface, underlain by silty clay. The silty clay is generally firm to stiff and has a thickness of about 5 to 7.5 m.

To the north of the Road crossing at the borehole locations, the surficial silt/sandy silt tapers off and the silty clay surfaces to near the ground level. The silty clay extends from 4 to 6 m below grade tapering off to zero further north at the River Valley. In general, the silty clay in this area has stiff consistency.

The silty clay across much of the area is underlain by a lower silt layer to depths ranging between 6 and 10 m below the ground surface and is in turn underlain by an extensive fine sand deposit.

At the south bank area of the River, alluvial sandy silt to silty sand materials with some organic inclusions were encountered to depths ranging between about 2 and 7 m below the ground surface. These materials are considered to be generally very loose to loose with occasional soft to firm zones and are underlain by the fine sand encountered elsewhere in the area.

The fine sand and the underlying coarse granular soils were found to be under excess upward hydrostatic pressure and the groundwater level was generally near the ground surface.

According to the preliminary vertical grade requirements, the grade along this section of the proposed Highway 11 alignment is expected to be raised by about 6.0 m at Station 11+960 to the south of the Three Mile Lake Road, decreasing very rapidly further south and increasing northerly to about 7.0 m at the Three Mile Road crossing (Station 12+040). On the north side of the Road crossing, the grade is expected to be raised by about 7.5 m, decreasing to about 4.5 at Station 12+140. Further north, the grade is expected to be raised by about 3 to 4 m between Stations 12+140 and 12+200; the height of the embankment will then increase to about 5.0 to 7.0 m towards the proposed three bridge sites near the south shore of the Magnetawan River. This latter section beyond Station 12+210 was discussed for the proposed bridges, under our report for the bridges.

Based on the available borehole and laboratory data and our preliminary analysis carried out using limit state equilibrium (Bishop's simplified method by the computer programme Slope W), no foundation failures are anticipated for the proposed up to 5.0 to 7.5 m high embankments, (as detailed in the preceding paragraph), provided that all organic, weak or otherwise unsuitable materials are removed as per MTO standards before placing the fill. Our preliminary analysis indicates that assuming properly compacted, acceptable inorganic earth fill material, 2 horizontal in 1 vertical side slopes can be used.

Proper erosion control measures should be implemented both during the construction and permanently. This can be achieved by immediate seeding or sodding (OPSS 572). For embankment heights in excess of 6 m, an at least 2 m wide mid-height berm should be provided for erosion control and surficial slope stability.

Alternatively, the approach embankments could be constructed using rock fill, if available. Permanent side slopes for rock fill embankments should not be maintained steeper than 1¼ H:1V. For embankment heights in excess of 6 m, an at least 2 m wide mid-height berm should be provided for erosion control at surficial slope stability.

For embankment construction, all organic and other unsuitable soils should be removed within an envelope given by an imaginary slope no steeper than

1:1 from the toe of the proposed embankment. Based on the available borehole data, for estimating the average thickness of the unsuitable soils to be stripped can be expected to be variable but for preliminary estimating purposes on the average, it can be assumed to be about 0.3 m. Where the thickness of the soil to be removed is more than 0.3 m and the height of the embankment is 6 m or more, the stripping and the replacement of the stripped soil with suitable granular materials should extend to about 3 m beyond the toe of the embankment.

After stripping, the exposed subgrade should be inspected, approved and properly compacted from the surface, using a heavy compactor, suitable for the prevailing site conditions (i.e. high water table and silty soils). These conditions will probably necessitate some dewatering especially in the lower lying areas in order to achieve proper compaction and the first one or two lifts of the fill will probably need to consist of granular materials.

The materials used for the construction of the embankment fills should consist of approved, acceptable earth or rock fill. The fills should be placed in lifts not exceeding 300 mm before compaction and each lift of earth fill should be uniformly compacted to at least 95% of the material's Standard Proctor dry density. The degree of compaction within the upper 0.5 m of the fill (i.e. subgrade immediately beneath the granular subbase) should be increased to 98%. The settlement of embankment fills prepared as described above should not exceed 40 to 60 mm. However, the underlying foundation soils can be expected to settle an additional 60 mm under the weight of the approximately 4.5 m high embankment fill at about station 12+144 about 120 mm at Station 11+960 (6.0 m fill); about 250 mm in the south (up to 7 m of fill) and north (up to 7.5 m of fill) sides of the Road crossing; (and up to about 320 mm (7 m high fill) near the bridge abutments on the south side of the Magnetawan River. Approximately, 50% of the quoted settlements can be expected to take place immediately upon completion (i.e. within about one to two weeks of the completion) of the embankment to its full height, and the remaining 50% will be due to the long-term consolidation of the silty clay to clayey silt deposit. Near the shores of the Magnetawan River, where the thickness of the silty clay to clayey silt layer is relatively less, the ratio of the long-term consolidation to total settlement will be somewhat lower.

We recommend that the embankment fills be placed about to their final subgrade elevations about 5 months ahead of paving on the south side of the Three Mile Lake Road and about 2 months on the north side, in order to effect about 80 to 90% of these quoted settlements prior to paving the roadways. Such residual settlements would be considered acceptable.

The groundwater table throughout much of the area covered was near the ground surface, especially in the lower lying areas (i.e. Road crossing and River Valley). This aspect should be taken into consideration when carrying out stripping and backfilling.

Depending on the groundwater conditions at the time of construction, dewatering for stripping, replacing of the stripped soils and the construction of the embankments will likely consist of gravity drainage by means of trenches and pumping from strategically placed sumps. The depth and the frequency of the trenches and the sumps will depend on the groundwater conditions encountered at the time of the construction. In general, however, increased depths and frequencies both for the trenches and the sumps can be expected in the lower lying areas (i.e. the Three Mile Lake Road crossing and when approaching the shores of the Magnetawan River). In addition, as mentioned before, the first one or two lifts of the fill may need to consist of granular materials, especially in the lower lying areas.

5.2 SITE 2 - HIGHWAY 11 CROSSING UNDER PROPOSED MUNICIPAL ROAD (BOREHOLES 12+920SBL AND 12+923NBL)

The proposed Municipal Road will cross over the realigned Highway 11, north of the north crossing of Magnetawan River. This will require up to about 6 m high embankments to create a sufficient grade differential between the two roadways.

Boreholes 12+920SBL and 12+923NBL which were drilled in this area showed, beneath a veneer of topsoil, the presence of a 3.7 to 4.4 m thick silty clay deposit which is generally stiff to very stiff. The silty clay is underlain by a compact silt deposit (with a lower dense zone in Borehole 12+923NBL) to the full depth of the boreholes (8.1 m). The groundwater table is estimated to be about 2 m below the ground surface.

Based on the borehole results, up to 6 m high embankments with conventional 2H:1V side slopes will not present instability problems due to foundation conditions, provided all the organic, weak and otherwise unsuitable materials are removed as per MTO standards before placing the embankment fills. Based on the results of the two boreholes drilled at the site for this preliminary investigation, the thickness of the soils to be stripped can be expected to be about 250 mm.

Rock fill can be also be used for embankment construction, if available. As was discussed in the preceding section of this report, rock fill slopes can be maintained at no steeper than 1¼ H:1V side slopes.

The details of the recommended construction procedures were given in Section 5.1 of this report and will not be repeated here. The settlement of up to 6 m high embankment fills constructed in the manner described in Section 5.1 should not exceed 40 mm. Underlying foundation soils can be expected to settle up to about 50 mm. Settlements of this magnitude would be acceptable, since some of the settlements would take place prior to paving the road.

Based on the borehole results, we do not anticipate major problems due to the groundwater during the process of stripping and backfilling. Normal gravity drainage and pumping from open sumps will suffice, if and where required.

5.3 SITE 3 – HIGHWAY 11 ALIGNMENT SWAMP CROSSING BETWEEN STATIONS 13+110 AND 13+150

Boreholes 13+119, 13+122SBL, 13+125, 13+125A 13+130, 13+130A, 13+132NBL were drilled from the bottom of the valley by manual drilling methods and one borehole (Borehole OH11) was drilled with a standard drill rig from the top of the old highway embankment (to the east of the crossing site).

The boreholes showed the presence of alluvial silt, silty fine sand and sand materials with some organic matter content, which extend to depths ranging between 1.5 and about 4 m below the ground surface at the bottom of the valley. These deposits are generally very soft to firm or very loose to loose, as well being somewhat organic in the upper zones. These are underlain by a glacial till-like silty sand deposit with traces to some gravel and traces of clay. A high water table (at or near the ground surface) exists along the bottom of the waterlogged valley.

The valley will be filled for the construction of the embankment, which can be expected to be up to about 11 m high.

The boreholes drilled and observations made for this preliminary investigation show that the site will have to be sufficiently drained and the upper organic soils will have to be removed for the construction of the embankment. The depth of stripping can be expected to range from about 0.6 m to 1.5 m, but generally about 1 m. Provided that all the unsuitable and organic soils are removed as described, up to 11 m high embankments with conventional 2H:1V side slopes are not expected to present instability problems. Rock fill can also be used with no steeper than 1 ¼H:1V side slopes. Our analyses indicate that the critical slip circles extend approximately 6 m beyond the toe of the proposed embankment. The stripping should, therefore, be extended at least 6 m beyond the toe of the embankment to maintain stability. The stripped soils should be replaced with compactable granular soils. Our preliminary analyses indicate that if this is not done, the factor of safety is reduced, as the weight and parameters of the resisting soil (i.e. existing soils) would be less favourable than those of compacted granular soils. These conclusions should, however, be further looked into after drilling deeper and additional boreholes. In any event, for embankment heights in excess

of 6 m, a 2 m wide mid-height berm should be provided for erosion control and surficial slope stability purposes.

The details of recommended construction procedures were described in Section 5.1 of this report and will not be repeated here for the sake of brevity. As mentioned before, however, considerable stripping will need to be implemented. Depending on the conditions, stripping may need to be conducted in short sections/narrow strips followed by immediate backfilling. The first several lifts of the backfill should consist of suitable granular materials. Proper clearing and benching of the existing valley slopes as per MTO procedures should be implemented.

As mentioned before, the valley will have to be properly drained prior to the construction. After draining and prior to stripping, dewatering by means of gravity drainage and pumping from closely spaced sumps will need to be implemented. Depending on the success of drainage and dewatering of the site, after stripping the placement of a bi-axial geogrid may be needed for equipment access and proper compaction of the initial layers of the fill.

The settlement of up to 11 m embankment fills (under own weight) as constructed above and in Section 5.1 of the report should not exceed 75 mm. Based on the available data, the settlement of the foundation soils could be about 175 mm, bringing the total to 250 mm. Significant portions of the quoted settlement should take place during and within several weeks of the completion of the construction of the embankment to its full height and therefore surcharging is not considered necessary. We recommend, however, additional and deeper boreholes be drilled, including along the width of the embankment, to verify the subsurface conditions in more detail.

5.4 **SITE 4 – HIGHWAY 11 CROSSING OVER SWAMPY AREA BETWEEN STATIONS 15+625 AND 15+965**

The site is a waterlogged, wide and shallow valley, immediately west of the existing Highway 11. For the purposes of this discussion, increasing station direction is considered north. A small stream, which meanders in the valley, crosses under the Highway via a 1.8 m diameter and 27 m long corrugated steel pipe culvert near the south end of the site, i.e. at about Station 15+625. In general, the existing grade is lowest along this watercourse at about Elevation 298 m and rises gradually to the north and south.

Boreholes 15+625NBL, 15+650, 15+788NBL, 15+788SBL, 15+850, 15+900 and 15+965SBL, drilled at the site, showed the presence of a veneer of topsoil and peat (in two boreholes) ranging from 50 to 700 mm in thickness, underlain by an organic rich soil horizon which is generally 200 mm thick. In most cases, these surficial soils are underlain by a surficial silt cap, extending generally to 0.7 to 1.4 m below the ground surface and the silt is in turn underlain by a weak and compressible silty clay/clay deposit, in most cases, to depths in excess of 12 m. The surficial silt is generally loose or firm and the underlying silty clay has a crust of firm to stiff consistency. The combined depth of these relatively somewhat more competent soils generally range from 1.5 to 2 m. Field vane tests conducted below this upper relatively stronger zone indicated undrained in-situ shear strength values generally ranging from about 18 to 36 kPa. Some higher values were also obtained but these are believed to be due to the presence of silt seams. Based on the field test results (i.e. field vane and Standard Penetration tests) together with visual and tactile examination of the soil samples, the consistency of the material is considered very soft to firm.

It is our understanding that along this stretch the grade will be raised by about 2 to 3.5 m.

Based on the findings in the boreholes, the subsoil is considered to be capable of supporting embankment fills up to the proposed design heights (i.e. up to 3.5 m in height), provided that all the peat, topsoil and otherwise organic and unsuitable soils are removed as per MTO standards before placing the embankment

fills. Our preliminary analysis indicates that, assuming properly compacted, acceptable inorganic earth fill is used, 2H:1V side slopes would be stable.

Prior to the start of the construction, the valley will have to be properly drained to discharge any surface water. The depth of unsuitable soils to be stripped ranged from 100 to 700 mm at the borehole locations. For preliminary estimating purposes, an average value of 400 mm could be assumed. It is believed that for stripping, at most locations gravity drainage by means of trenches and pumping from open sumps will suffice.

As discussed in Section 5.1 of this report, the embankments should be constructed in accordance with MTO procedures. Owing to the poor soil conditions and high water levels, depending on the site conditions at the time of construction, a thick granular layer or the placement of reinforcing geotextile or a bi-axial geogrid may be required where the upper relatively more competent (i.e. desiccated) soils may be too thin or absent. In most areas, the use of partial subexcavation technique is not recommended, as this would remove the upper desiccated zones of the surficial soils. On the other hand, in the low-lying areas where the crust is absent or where otherwise unsuitable soils may exist (e.g. organic rich soils at or within the close vicinity of the watercourse or its tributaries) partial sub-excavation may be necessary.

The use of rock fill to construct the embankments may also be considered, if available (e.g. rock blasted from the rock knob immediately north, designated as Site 5 in this report). For rock fill, normal 1 ¼ H:1V side slopes may not be stable, depending on the height of the fill. In this case, the side slopes will need to be flattened or more effectively a toe berm can be incorporated, depending on the findings of the detailed investigation. Our preliminary analysis indicates that for a 3.5 m high embankment with 1 ¼ H:1V side slopes, a toe berm about 4 m in length and 1 m in height would be sufficient.

For three meter high embankments prepared in the manner described, the settlement of the embankment fills under their own weight should not exceed 25 mm, while the settlement due to the stresses imposed by the embankment fills on the foundation soils could range from 150 to 200 mm, depending on the relative

thickness of the 'crust' and the frequency of the underlying silt seams/layers. About 10 to 15% of the quoted settlements should be instantaneous (i.e. short term) and should take place within one week of the completion of the embankment to its full height while the remaining 85 to 90% will be due to the long-term consolidation of the extensive silty clay to clayey silt deposit underlying the site. A portion of the anticipated settlements could be effected prior to paving the road, if the embankment is constructed sufficiently ahead of paving (e.g. about four months). The placement of an approximately 0.7 m thick surcharge over and above the final road grade (i.e. top of the paved road surface) can be considered for accelerating the consolidation settlements to reduce the residual settlements after the four month preloading period. The use of wick drains to accelerate the consolidation process is not believed to be warranted, based on cost.

5.5 SITE 5 – HIGHWAY 11 ALIGNMENT – CUT SECTION BETWEEN STATIONS 15+965 AND 16+200

Between Stations 15+965 and 16+200, the new alignment for Highway 11 virtually parallels the existing Highway 11, and the two alignments merge several hundred meters further north (for the purposes of this discussion north is considered to coincide with increasing station numbering). This area is characterized by an approximately 20 to 24 m high hill, immediately west of the proposed alignment. This hill is believed to represent a rock knob covered with variable but generally shallow overburden. The overburden appears to be primarily a granular (glacial till-like) material consisting of silty sand with traces to some gravel and some cobbles and boulders. This is capped with a veneer of surficial silt. The bedrock appears to be gneiss with granitic zones and migmatitic and mafic infills.

The bedrock is exposed along a face about 35 m west of the centerline of the proposed southbound lanes alignment between Stations 16+055 and 16+075 and Elevation 319 and 316 m, as shown on Drawing No. 5. The presence of several isolated, small outcrops was also noted elsewhere near the top of the hill. The east face of the hill appears to be between 3H:1V to 2H:1V side slopes, except of course at the aforementioned rock face which is much steeper. At the two boreholes drilled from this hillside, the overburden consisted of a silt cap extending to 0.7 to 0.9 m depth, followed by a relatively well-graded till-like deposit of silty sand with some gravel. The presence of cobbles and boulders was also noted in this deposit. Refusal to augering was contacted in one borehole at 4.6 m, probably on bedrock, while in the other one refusal was encountered at 2.3 m but probably on cobbles. This overburden type is believed to be typical throughout much of the site.

As shown on Drawing No. 5, the southbound lane of the proposed alignment encroaches this hill, particularly between about Stations 16+000 and 16+120. This will require minor cuts (i.e. up to 1 m) for vertical alignment but the side slopes may require cutting back into the face of the hill, depending on the design, cross sections required, etc. Based on the results from this present investigation, we recommend that 2½H:1V side slopes be used for preliminary planning in the overburden. Depending on the findings of the detailed investigation,

it may be possible to steepen the slopes 2 ¼H:1V. In the design, allowance should be made for at least a 2 m mid-height berm, as per MTO Northern Region requirements for cuts in excess of 6 m in height. Between about Station 16+040 and 16+100, the backslopes in the overburden will probably eventually extend and encounter bedrock which can then be sloped at much steeper (i.e. nearly vertical) faces, similar to the existing rock face slope.

The soil samples were in a wet to moist condition indicating a high water table at the time of our investigation (i.e. springtime) and therefore, allowance should be made for gravel sheeting in the overburden for borrow drainage, where required.

Below the surficial topsoil, peat and the surficial wet silt cap, the underlying silty sand overburden will be a suitable borrow material for the construction of earth fill embankments, but the moisture contents may need to be somewhat adjusted.

The bedrock consists of hard and relatively massive rock (i.e. generally gneiss with granitic zones) and therefore blasting will likely have to be resorted to for excavation purposes. Blasting should, however, be conducted carefully so as not to induce a sliding type failure of the overburden soils over the steeply sloping bedrock surface. The presence of boulders in the overburden may create problems during the removal of the overburden soils.

5.6 SITE 6 – MUNICIPAL SERVICE ROAD ALIGNMENT – SWAMP CROSSING/HIGH FILL AREA BETWEEN STATIONS 7+662 AND 7+723

Boreholes 7+662, 7+775, 7+688 (DCPT), 7+692, 7+704, 7+711 (DCPT) and 7+723, put down at or near the bottom of this deep gorge crossing, showed the presence of an approximately 2 to 4 m deep silt/silty fine sand deposit with some organic content (i.e. decayed vegetation, wood, roots, etc.). This surficial alluvial deposit is thicker in the boreholes drilled near the center of the valley and the existing watercourse and contains occasional thin organic silt and clayey silt seams or lenses. This deposit is generally in a very loose to loose condition with some very soft zones. It is underlain at most borehole locations by a silty clay/clayey silt deposit which near the center of the valley extends to depths ranging between 5.9 and 6.6 m below the ground surface. Its consistency is generally firm.

In the central portion of the valley in Boreholes 7+662, 7+675 and 7+692, the silty clay/clayey silt is underlain by an extensive silt deposit which is generally in a loose condition to depths of about 11 to more than 13 m below the ground surface.

At the time of our investigation, the groundwater level was at about 0.3 to 3.3 m below the ground surface but can be expected at or near the ground surface during the early spring months.

The construction of an embankment is required across the valley for the new Municipal Road. We understand that the embankment will be up to 11 m high near the existing creek and Borehole 7+692, where the existing grade is lowest, reducing to about 7 m near the edges of the valley (e.g. Borehole 7+723).

Based on our preliminary investigation and preliminary stability calculations, embankment earth fills (11 m high) with normal 2H:1V side slopes will not be stable.

In order to overcome this problem, consideration may be given to reducing the height of the fill by adjusting the vertical alignment.

Alternatively, the following design and construction procedures can be adopted which will enable the construction of up to 11 m high embankments. This process will necessitate:

- a) stripping of all the alluvium under the footprint of the embankment and at least 5 m beyond the toe.
- b) for embankments in excess of 7 m in height, the construction of a 6 m wide mid-height berm instead of the normal 2 m wide berm. If a 6 m wide mid-height is unacceptable then a toe berm can be considered.

The following stripping procedures are recommended.

All the surficial organic rich upper silt silty fine sand should be removed from within the bottom of the valley and replaced with granular soil. The following stripping depths are recommended:

Borehole 7+662 (Station 7+662) – 2 m
Borehole 7+675 (Station 7+675) – 3 m
Borehole 7+692 (Station 7+692) – 4 m
Borehole 7+704 (Station 7+704) – 2 m

Further north at Station 7+723 only nominal stripping (i.e. topsoil, etc. as well as the existing fill) would be required while to the south of Borehole 7+662, no information is available but it is anticipated that similar to the north tip of the valley, the stripping depths would be reduced within a short distance where the existing grades rise to higher elevations and the height of the proposed embankment fill diminishes to less than 7 m. On the other hand, the thickness of the soil to be stripped may increase to more than 4 m at the existing watercourse location.

The stripping will need to extend under the footprint of the embankment and at least 5 m beyond the toe of the embankment. All the soils removed will need to be replaced with suitable granular soils under the entire footprint of the embankment and at least 5 m beyond. The stripping of the existing

soils and their replacement with compacted granular soils at least 5 m beyond the toe of the embankment are necessary because our analyses indicate that the critical potential slip (failure) circles extend approximately 5 m beyond the toe of the embankment. In order to achieve proper stripping and the compaction of the granular backfill, the site will need to be properly dewatered prior to construction. The removal of the unsuitable soils and backfilling will need to be carried out in a manner so as not to jeopardize the stability of the existing adjacent high ground (i.e. valley slopes and the hydro road embankment). For this purpose, stripping in narrow and short strips will likely be necessary, followed by immediate backfilling of each strip.

With these procedures, properly prepared earth fill embankments (as detailed in Section 5.1 of this report) of up to 11 m in height would be stable at 2H:1V side slopes provided that an at least 6 m wide mid-height berm is constructed (instead of the usual 2 m wide mid-height bench) for embankments in excess of 7 m.

In addition, as was mentioned earlier, the removal of unsuitable soils (i.e. stripping) and their replacement with compacted granular materials will need to extend at least 5 m beyond the footprint of the embankment.

Rock fill could also be considered especially since rock fill is expected to be available from the cutting of the adjoining hilltop. For this purpose, if normal 1½H:1V side slopes are to be utilized then 2.5 m high and 10 m wide toe berms would be required, along with the stripping procedures detailed above. Alternatively, a 9 m wide mid-height berm can be considered but in this instance a toe berm would be more cost effective. For rock fill, the stripping will need to extend beneath the full footprint of the toe (or the mid-height) berm, as well as the embankment itself. With rock fill, the stripping of the unsuitable soils to at least 5 m beyond the toe of the toe (or mid height) berm will also be needed (similar to earth fill embankments), unless the existing surficial soils can be sufficiently improved, by pushing rock fill into them to increase the weight and the resistance parameters. Such details can however be looked into when the detailed investigation is conducted. An at least 2 m wide mid-height berm should be provided for erosion control and surficial slope stability purposes for embankments in excess of 6 m in height.

For keying in, proper clearing and benching of the existing slopes will be required.

These recommendations should be reviewed when the detailed investigation is conducted.

Section 5.1 of this report details the recommended procedures for the construction of the earth fill embankments and will not be repeated here. As mentioned before, in order to effect the removal of the alluvium and the compaction of the granular soils placed to replace the alluvium, proper dewatering procedures will be required. This may consist of gravity drainage and pumping from deep sumps. This will likely be supplemented by pumping from filtered wells extending into the clayey silt to silty clay stratum underlying the alluvium. The presence of this practically impervious clayey silt to silty clay stratum can greatly reduce the effectiveness of dewatering methods such as deep wells and/or vacuum well points and this aspect should be taken into consideration in the design of an effective dewatering system. Conditions may also necessitate the placement of a bi-axial geogrid layer to facilitate construction equipment mobility and to effect the compaction of the granular soils to be placed below the existing ground level.

The settlement of 11 m high embankment (under own weight) constructed in the manner detailed in Section 5.1 should not exceed 80 mm, reducing to about 40 mm where the height of the fill reduces to 6 m with a further reduction in the settlement as the height of the embankment fill reduces up the valley toe slopes. In addition to the greater anticipated settlement of the higher embankments towards the center of the valley, the foundation settlements will also be greater. This is because the higher the embankment fill, the greater the stresses imposed on the foundation soils. As well, poorer soil conditions and greater overburden depths were encountered towards the center of the valley. For example, at Station 7+692, where the fill is expected to be about 11 m high, the anticipated foundation settlement is 250 mm, bringing the total to 330 mm (when the settlements due to embankment's settlement under its own weight is added to the foundation settlements). At Station 7+675 where the height of the fill can be expected to be about 9 m, the foundation settlement is anticipated to be about 200 mm, with a combined settlement figure of about 270 mm. (These settlement

calculations assume that the alluvial soils containing organics will be removed and replaced with granular soils, as detailed in the preceding paragraphs.) Approximately 100 mm of the foundation settlements at Stations 7+692 and 7+675 can be expected to be due to the long-term consolidation of the clayey silt/silty clay stratum underlying the alluvium. On the other hand at Station 7+723 where the overburden is of limited depth and the height of the fill is also less, the total settlement (including settlement under embankment's own weight) would not exceed 60 mm. Most of the foundation settlements at this location can be expected to be of short-term (immediate) type (i.e. can be expected to be completed within about two weeks of the completion of the construction). For this reason, we recommend that consideration be given to constructing the embankments about 3 months prior to paving the new road in order to reduce the anticipated total and differential settlements to tolerable limits. Consideration could be given to the use of other methods such as wick-drains in the middle, low-lying portion of the valley where the soil conditions are less favourable and where the height of the embankment will be higher, in order to accelerate the rate of settlements. In our opinion, however, such expense is unwarranted if a preloading period of three months is not objectionable. A modest surcharging over and above the proposed embankment height can, however, be considered. The details of this should however be decided when the exact alignment, height and width of the proposed embankment are finalized.

We recommend that a detailed investigation be conducted followed by a more detailed analysis.

5.7 SITE 7 – MUNICIPAL SERVICE ROAD – DEEP CUT SECTION BETWEEN STATIONS 7+740 AND 7+900

Between Stations 7+740 and 7+900, the proposed alignment of the new Municipal Service Road is located along the east face of a hill. (For the purposes of this discussion, north is considered in the direction of increasing station numbers.) Approximately 80 m west of the proposed alignment, the hill top elevation is approximately 335 m, as shown on Drawing No. 6; while along the centerline of the proposed road alignment, the high point of the existing ground surface is about Elevation 322.5 m (at about Station 7+775). From thereon, the grade drops both towards the south and north. The findings of this preliminary investigation indicate that the hill is a rock knob with a variable but generally shallow overburden cover.

The proposed road grade ranges from about 309.5 m at Station 7+740 to about 305.5 m at Station 7+900, indicating that up to about 13 m of cut will be required in this section (along the centerline). The magnitude of cuts will increase towards the western limit of the road alignment, as the existing grade here is even higher (i.e. rising hill side slope). The findings of this preliminary investigation indicate that most of the cut can be expected to be in the bedrock once the excavation proceeds below the relatively shallow overburden. The bedrock is believed to be a granitic gneiss which is generally hard and massive and can stand unsupported at nearly vertical side slopes. For preliminary estimating purposes, average slopes of about 6 vertical in 1 horizontal can be assumed (i.e. about 80°), depending on the slope heights, rock quality, etc. The overburden generally consists of granular soils with some cobbles and for preliminary design 2½H:1V side slopes can be assumed in the overburden overlying the bedrock. Allowance should be made for some gravel sheeting in the overburden. As well allowance for benching should be made in the overburden. A 2 m wide bench is required for each 6 m height of earth cut.

The granular overburden will generally be suitable for re-use (e.g. for the construction of earth embankments) after the removal of the topsoil and the upper organic rich zones. Depending on the time of construction, some conditioning

APPENDIX D

Limitations of Report

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the 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. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of 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 conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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