



FINAL  
FOUNDATION INVESTIGATION REPORT  
PROPOSED KIRBY SIDEROAD OVERPASS WIDENING  
HIGHWAY 400 INTERIM WIDENING  
VAUGHAN, ONTARIO  
W.P. 192-00-00, CENTRAL REGION

Submitted to:

**Ministry of Transportation**  
Pavements and Foundations Section  
Foundations Group  
Room 223, Building C  
1201 Wilson Avenue,  
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Canada

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5 September 2003

TT22852A

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RECORD OF BOREHOLE SHEETS .....	Borehole Numbers: KSR 1 to KSR 5

#### **APPENDIX 'A'**

Borehole Logs extracted from MTO report dated 15 December 1989  
GEOCRES File No. 30M13-93

#### **APPENDIX 'B'**

Borehole Logs extracted from report prepared by Golder Associates Limited dated June 2001  
GEOCRES File No. 30M13-49

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## 1.0 INTRODUCTION

AMEC Earth & Environmental Limited, Consulting Geotechnical, Materials Quality Control and Environmental Engineers, has been retained by the Ministry of Transportation to conduct a foundation investigation for the replacement and/or widening of the existing Kirby Sideroad Overpass in the City of Vaughan, Regional Municipality of York, Ontario. The site location is as shown on the Key Plan of Drawing No. 1. This project is in conjunction with the proposed interim widening of Highway 400 from Major Mackenzie Drive to South Canal Road.

The purpose of this investigation is to determine the sub-surface conditions at the site of the proposed bridge structure replacement/widening by means of a number of boreholes, in-situ tests and laboratory tests on selected samples. The work carried out for this geotechnical investigation was completed in accordance with AMEC's proposal (ref. P-22280, dated 20 June 2002).

The plan and profile for the proposed bridge replacement/widening and approaches were provided to us by the Ministry of Transportation.

Existing subsurface information and laboratory testing results contained in the following reports were used to supplement this investigation

- MTO. *Proposed Extension of Kirby Sideroad Overpass*. dated December 15, 1989 – GEOCRES File No. 30M13-93.
- Golder Associates Limited. *Preliminary Foundation Investigation and Design Report, Kirby Sideroad Overpass, Highway 400 Widening from North of Major Mackenzie Drive to South Canal Road, G.W.P. 222-97-00, Agreement No. 2005-A-000106*. dated June 2001 – GEOCRES File No. 30M13-49.

## 2.0 SITE DESCRIPTION AND PHYSIOGRAPHY

### 2.1 SITE DESCRIPTION

The existing Kirby Sideroad overpass structure is located about 4.5 km north of Major Mackenzie Drive in the City of Vaughan, Regional Municipality of York.

The original ground at the overpass structure appears to be at about Elevation 256 to 258m. The existing Highway 400 grade is at about Elevation 257m, while Kirby Sideroad grade is at Elevation 251 to 252m at the structure location. Kirby Sideroad is in cut with existing side slopes at about 2H to 1V and about 5 to 6m in height.

.../...



The existing overpass was constructed in the early 1950s under Contract 50-212. It is a single span structure with abutments, wingwalls extending parallel to Highway 400 and retaining walls extending parallel to Kirby Sideroad east of Highway 400. The abutment footings are supported on spread footings founded at about Elevation 249.7m. The retaining walls west of Highway 400 parallel to Kirby Sideroad consist of gabion baskets about 2m in height. In the early 1990s, the overpass was widened on the east side only under Contract 92-95. The widened portion of the structure has also been supported on spread footings at the same elevation as the existing structure. New retaining walls were supported on spread footings on a granular pad which step up from Kirby Sideroad to Highway 400. Photographs of the site are included in Appendix C.

## **2.2 PHYSIOGRAPHY**

Based on available geologic information, the site is located in the South Slope of the Oak Ridges Moraine. Generally after the last glacial withdrawal, glacial till deposits of the Halton Till formation (clayey silt to silty clay till) were deposited over the ice contact and glacial outwash sediments (sands, silts and gravels) of the Oak Ridge Moraine(ORM). The entire interbedded sequence of sands, silts and gravels of the ORM is generally in the order of about 100 m in thickness in the area of the site. Shale bedrock is generally in the order of about 160 m below existing grade. The cohesionless sands and silts in the Oak Ridges moraine is a water bearing aquifer that is used as a source of water for domestic, industrial and municipal water supply and is known to be under excessive hydrostatic pressure.

## **3.0 INVESTIGATION PROCEDURES**

The fieldwork for the current investigation was carried out on 14 and 22 August 2002 and on 16 September 2002, and consisted of drilling and sampling five boreholes (Boreholes KSR 1 to KSR 5, inclusive) to depths of 8.2 m to 22.0 m below the existing ground surface. Boreholes KSR1 and KSR 2 were advanced from the Kirby Sideroad grade, while Boreholes KSR3, KSR 4 and KSR5 were advanced from Highway 400 grade.

Also referenced in this report in Appendix A and B, are boreholes advanced by MTO during a 1989 subsurface investigation (GEOCREs No. 30M13-93, referenced in Section 1.0) and one borehole advanced by Golder Associates in 2001 for a preliminary foundation investigation (GEOCREs No. 30M13-49, referenced in Section 1.0).

Borehole 89, advanced by Golder Associates in 2001, was advanced to a depth of 29.6 m below the existing Kirby Sideroad grade and extended to a depth of about 33.2m by the dynamic cone penetration test method. Boreholes 1, 2 and 3 were advanced by MTO in 1989 to depths of 6.9 to 15.7m. Boreholes 1 and 2 were advanced from the Kirby Sideroad grade, while .../...

Borehole 3 was advanced from the Highway 400 grade.

The plan locations of the boreholes advanced in the current and previous investigations, and selected stratigraphic sections are shown on Drawing Nos. 1, 2 and 3. Details of sub-surface conditions encountered at each borehole location advanced by AMEC, including the results of in-situ testing, are presented on the Record of Borehole sheets.

The boreholes for the current investigation were advanced, using solid stem continuous flight augers with track-mounted and truck-mounted power auger drill rigs (CME 55 and CME 75) owned and operated by Master Soil Investigation Limited, under the full-time supervision of experienced geotechnical personnel from AMEC Earth & Environmental Limited.

Sampling in the AMEC boreholes were carried out at regular intervals of depth (0.75 to 1.5m) by the Standard Penetration Test Method, as specified in American Standards for Testing and Materials Method Number: D-1586. This consists of freely dropping a 63.5 kilogram hammer for a vertical distance of 0.76 m to drive a 51 mm outside diameter split barrel (split-spoon) sampler into the ground. The number of blows of the hammer to drive the sampler into the relatively undisturbed ground for a vertical distance of 0.30 m is recorded as the Standard Penetration Resistance or the 'N'-values of the soil, and this gives an indication of the consistency or the relative density of the soil deposit.

The soil samples recovered by AMEC were transported to our geotechnical laboratory in Toronto (Scarborough) for further examination and classification. A laboratory testing programme, consisting of natural moisture content determinations, grain size analyses, Atterberg Limits tests and unit weight determinations, was performed on selected representative soil samples from the current investigation. The results of the laboratory tests are presented on the appropriate Record of Borehole Sheets and also on Figure Nos. 1, 2, 3, 4 and 5, inclusive.

Groundwater conditions in the current investigation open boreholes were observed throughout and immediately after the drilling operations. A standpipe piezometer was installed in Borehole KSR2, to permit long term monitoring of groundwater levels at the site. All boreholes were adequately backfilled with auger cuttings on completion of the fieldwork.

The borehole locations for the current investigation were initially established in the field by our field personnel based on existing features. The borehole locations in terms of northing and easting co-ordinates, and elevations were surveyed by Holding Jones Vanderveen Inc. We understand that these elevations are referenced to the geodetic datum. The locations and co-ordinates of the boreholes are shown on Drawing No. 1; the co-ordinates and elevations are indicated on the Record of Borehole Sheets.

.../...



As noted by Golder in their report, the borehole northings and eastings of the 1989 investigation by MTO are not consistent with the MTM NAD83 coordinate system currently in use by MTO. The approximate borehole locations have been determined from the borehole location plan in the 1989 MTO report, and their approximate co-ordinates in MTM NAD83 are presented in Drawing No. 1.

#### **4.0 SUB-SURFACE CONDITIONS**

Details of sub-surface conditions encountered at each borehole location for the current and previous investigations by others, including the results of in-situ testing, groundwater observations and laboratory test results are presented on the Record of Borehole Sheets and in Appendices A and B.

##### **4.1 Fill**

Boreholes KSR1 and KSR2 were advanced on Kirby Sideroad and encountered damp, brown sand and gravel fill to a depth of 0.6m below Kirby Sideroad. Borehole 89 advanced by Golder Associates on Kirby Sideroad encountered 0.6m of sand and gravel fill with trace of clay and organics mixed with the fill. A measured 'N'-value of 30 blows per 0.3m was obtained in the fill indicating a compact to dense relative density. Borehole 2 of the 1989 MTO investigation was also advanced on Kirby Sideroad and encountered sand fill with trace gravel to a depth of 1.8m. Measured 'N'-values within this borehole range from 5 to 6 blows per 0.3m indicating that the fill has a loose relative density, although this fill has likely been removed from the structure widening in the early 1990s.

Underlying the pavement fill in Boreholes KSR1 and KSR2, a clayey silt fill deposit was encountered to a depth of 2.2m. The fill is grey and contains some sand. Measured 'N'-values range from 6 to 14 blows per 0.3m, indicating a firm to stiff consistency. Measured natural moisture contents range from 12 to 13%.

At the ground surface of Borehole KSR4, 0.6m of sandy silt fill was encountered at the top of the cut grade adjacent to Highway 400. This fill contains traces of gravel and rootlets. A measured 'N'-value of 32 blows per 0.3m indicates that this fill has a dense relative density.

It should be noted that the thickness of fill may vary in between and beyond the borehole locations.

.../...

## 4.2 Upper Clayey Silt Glacial Till

Below the surficial fill deposits or at the ground surface in Boreholes KSR1, KSR2, 89, 1 and 2, advanced at the Kirby Sideroad grade, a grey cohesive glacial till deposit was encountered to depths of 7.3 to greater than 9.8m below existing Kirby Sideroad grade (or Elevations 244.3 to at least 240.8m). The glacial till is a heterogeneous mixture of silt and clay with trace to with sands and trace gravel. Occasional sand seams and cobbles are noted within the till. Measured 'N'-values range from 8 to 52 blows per 0.3m indicating a firm to hard consistency. In-situ shear vane tests were carried out in Borehole 1 of the MTO 1989 investigation with shear strengths ranging from 40kPa to greater than 120 kPa, confirming the consistency of the till. Measured natural moisture contents range from 10 to 18%.

Boreholes KSR 3, KSR4, KSR5, and Borehole 3 of the MTO 1989 investigation advanced at the Highway 400 grade, encountered a brown to grey clayey silt glacial till underlying the existing ground surface or surficial fill deposits. The till changes colour from brown to grey at a depth of about 3 to 5m. All four boreholes were advanced at the top of the cut slopes adjacent to Highway 400 and were terminated within the cohesive till at depths of 6.9 to 8.3m (or Elevations 248.0 to 250.9m). Measured 'N'-values range from 10 to 56 blows per 0.3m indicating a stiff to hard consistency. Measured natural moisture contents range from 8 to 17%.

Laboratory tests carried out on the clayey silt till are summarized on the various Record of Boreholes, in Appendices A and B and in Figure Nos. 1 and 2. The laboratory results are summarized below.

Natural Moisture Content	8 to 18%
Plasticity Index	6 to 9%
Plastic Limit	9 to 18%
Liquid Limit	12 to 24%
Unit Weight	20.6 to 23.7 kN/m <sup>3</sup>

### Grain Size Distribution (5 samples)

Gravel	0 to 8%
Sand	18 to 30%
Silt	48 to 69%
Clay	3 to 17%

The above results are indicative of an overconsolidated low plasticity clay. One grain size has been omitted from the above summary as it was carried out on a sand layer within the till. The grain size distribution curve from the current investigation is presented on Figure No. 1 and the .../...



Atterberg Limits test results for the current investigation are presented on Figure No. 5.

It should be noted that cobbles and boulders may be encountered within this deposit due to its nature of formation.

#### **4.3 Upper Sands and Silts**

Below the surficial fill and cohesive till, a grey, moist to wet, cohesionless interbedded deposit of sands and silts was encountered in Boreholes KSR2, 89, 1 and 2. Boreholes KSR2 and 89 encountered these sands and silts to depths of 10.5 to 11.7m below Kirby Sideroad (or Elevations 240.5 m). Boreholes 1 and 2 advanced in the 1989 MTO investigation were terminated within these deposits at depths of 12.6 to 15.7m (or Elevations 236.2 to 239.1m). The sands and silts contain trace gravel, clay and varying amounts of sand and silt size particles. Measured 'N'-values range from 15 to 75 blows per 0.3 m indicating a compact to very dense relative density, but in general compact to dense. The high 'N'-values measured may be attributed to probable cobbles and / or boulders. It is noted that the cobbles and boulders could not be sampled with the spoon sampler. One low value of 4 blows per 0.3m was obtained in Borehole 2, however based on the characteristics of this deposit this may be attributed to disturbance. Measured natural moisture contents range from 12 to 20%.

An Atterberg Limits test was carried out on a sample of the silt and the results are presented on Figure No. 5. The results indicate a liquid limit of 21% and a plastic limit of 19%.

#### **4.4 Middle Clayey Silt to Sand and Silt Glacial Till**

Underlying the upper sands and silts in Boreholes 89 and KSR2, at a depth of about 10.5 to 11.7m below Kirby Sideroad (or Elevations 240.5 m), a second grey glacial till deposit was encountered. The till ranges in composition from clayey silt at Borehole KSR2 to sand and silt at Borehole 89. The glacial till is a heterogeneous mixture of clay and silt with sand and trace gravel size particles. This "middle" till deposit was encountered to a depth of about 11.9 to 13.3m (or Elevation 238.9 to 239.1m). Measured 'N'-values of 20 and 61 blows per 0.3m was obtained within the till indicating a hard consistency or compact relative density. For the clayey silt till, a measured moisture content of 13% was obtained and a unit weight of 22.7 kN/m<sup>3</sup> was measured, in the current investigation. A grain size analysis was carried out on a sample of the clayey till and the grain size is presented in Figure No. 2. The results indicate 2% gravel, 30% sand, 48% silt and 20% clay.

It should be noted that Borehole 1, Sample 12 from the 1989 MTO investigation (at Elevation 239.5m or a depth of 12.2m) may be a sandy silt till, as seen from the grain size distribution analysis (15% sand, 76% silt and 9% clay) and slight plasticity indicated on the Record of .../...

Borehole. A measured 'N'-value of 55 blows per 0.3m was obtained at Sample 12 which indicates a very dense relative density.

It should be noted that cobbles and boulders may be encountered within this deposit due to its nature of formation.

#### **4.5 Middle Sands and Silts**

Underlying the middle till deposit and upper silts and sands, a second interbedded grey, wet, silt to silty sand and minor clayey silt deposit was encountered in Boreholes 89 and KSR2. Borehole KSR 2 was terminated within this deposit at a depth of about 22.0m (or Elevation 230.2m). Borehole 89 encountered this deposit to a depth of about 21.3m (or Elevation 229.7m). Measured 'N'-values range from 33 to greater than 100 blows per 0.3m indicating a dense to very dense relative density. Measured natural moisture contents range from 12 to 19%. One grain size analysis was carried out on a sample of the silty sand from Borehole 89 with results indicating 58% sand, 39% silt and 3% clay size particles. A grain size analysis was carried out on a sample of the sandy silt and the results are presented in Figure No. 4. The results indicate 13% sand and 87% fines, with less than 8% clay.

In Borehole KSR2, underlying the middle clayey silt till, a grey, hard clayey silt deposit was encountered to a depth of about 14.8m. An Atterberg Limits test was carried out on this layer and the results are presented on Figure No. 5. The results indicate a liquid limit of 26% and a plastic limit of 18%. A unit weight of a split spoon sample obtained with a result of 21.0 kN/m<sup>3</sup>. A grain size analysis was also carried out on the sample, with results presented on Figure No. 3, indicating 1% sand, 68% silt and 31% clay.

#### **4.6 Lower Silty Clay Glacial Till**

Underlying the second interbedded sand and silt deposit in Borehole 89 is a grey silty clay glacial till that was encountered at a depth of 21.3m (Elevation 229.7m) and was contacted to a depth of about 24.1m (Elevation 226.9m). Measured 'N'-values of 34 and 109 blows per 0.3m were obtained indicating a hard consistency, however the consistency appears to decrease with depth. A measured natural moisture content of 14% was obtained within this deposit.

#### **4.7 Lower Sands and Silts**

Below the lower (third) glacial till deposit in Borehole 89 is a grey, wet, silt to sand and silt deposit. The borehole was terminated within this deposit at a depth of about 29.6m, or Elevation 221.4m. The deposit contains occasional silty clay seams. Measured 'N'-values range from 1 to 27 blows per 0.3m, however in our opinion, these values are likely the result of disturbance and

.../...



the relative density of the deposit is probably much higher. Measured natural moisture contents range from 20 to 25%.

#### **4.8 Groundwater Conditions**

Groundwater levels in the open boreholes were observed during drilling and upon completion of each borehole. To permit long term monitoring of groundwater levels at the site, standpipe piezometers were installed in Borehole 89 within the lower sands and silts and in Borehole KSR2 within the middle sands and silts. At Borehole 89 the water level in the piezometer was 0.5m above ground surface 3 months after installation. At Borehole KSR 2 the water level in the piezometer was 0.1m below existing ground surface one month after installation.

Based on the observations in the piezometers and from tactile and visual observations of the recovered soil samples, in our opinion, the groundwater table at the approaches lies within the upper clayey silt till, about 1 to 2m above the Kirby Sideroad grade (at about Elevation 252 to 253m), dropping to the ground surface level at Kirby Sideroad (Elevation 251 to 252m). Excessive hydrostatic pressure (artesian to sub-artesian) was observed from the piezometer installations within the middle and lower sands and silts.

It should, however, be pointed out that the groundwater at the site would fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.

## 5.0 CLOSURE

Sincerely,

Andrew Drevininkas, P. Eng.  
Assistant Manager  
Geotechnical Services



Kai-Sing Ho, Ph.D., P. Eng.,  
Principal Geotechnical Consultant,  
MTO Designated Contact.



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.../...



## DRAWINGS

METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES - METRES.

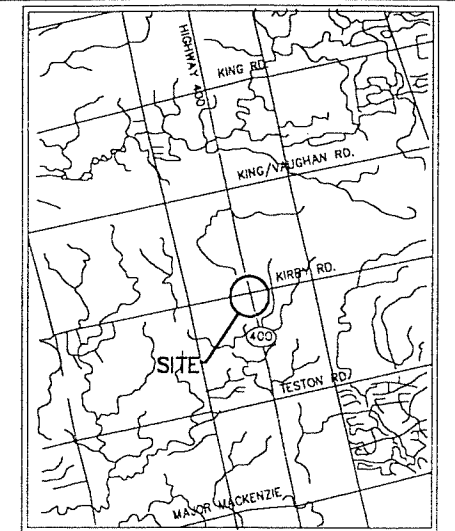
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KIRBY SIDEROAD OVERPASS  
HIGHWAY 400  
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

AMEC Earth & Environmental Limited



KEY PLAN

1 km 0 1 km 2 km 3 km

LEGEND

- Bore Hole - this investigation
- Bore Hole & Cone - previous investigations done by others
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at time of investigation-
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEV	CO-ORDINATES	
		NORTH	EAST
1	251.7	4 860 443	300 207
2	251.9	4 860 434	300 208
3	257.8	4 860 459	300 209
89	251.0	4 860 436	300 187
KSR1	250.6	4 860 423	300 165
KSR2	252.2	4 860 438	300 217
KSR3	256.4	4 860 451	300 183
KSR4	256.6	4 860 402	300 172
KSR5	256.1	4 860 413	300 217

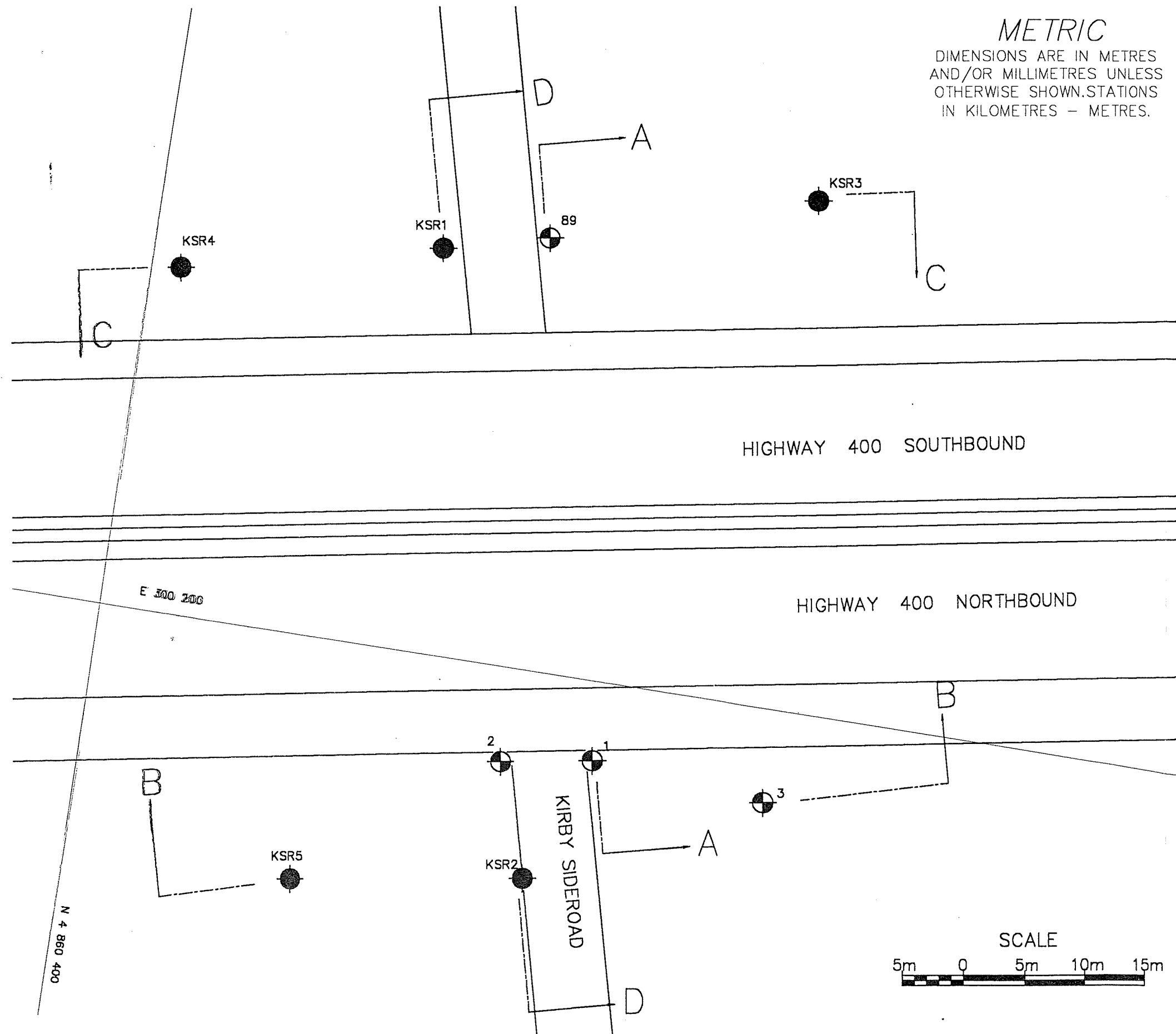
-NOTE-

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV	DATE	BY	DESCRIPTION

HWY No 400	DIST
SUBM'D PPM CHECKED AD DATE Sept, 2002	SITE
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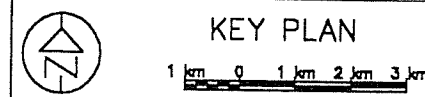
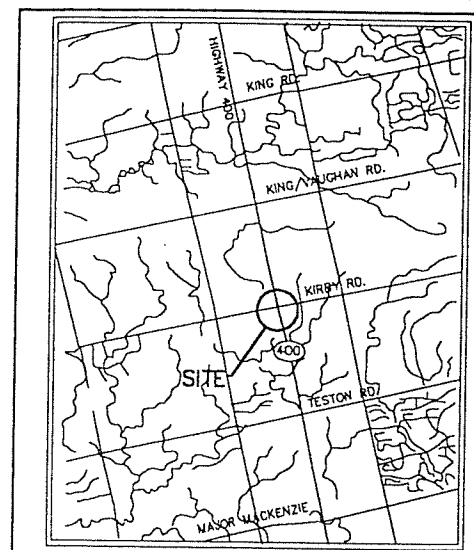


W.P. No. 192-00-00

KIRBY SIDEROAD OVERPASS  
HIGHWAY 400  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



LEGEND

- Bore Hole - AMEC Investigation
- Bore Hole & Cone - previous investigations done by others
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation
- WL in Piezometer
- Piezometer
- End of Borehole

No	ELEV.	CO-ORDINATES NORTH	EAST
1	251.7	4 860 443	300 207
2	251.9	4 860 434	300 208
3	257.8	4 860 459	300 209
89	251.0	4 860 436	300 187
KSR1	250.6	4 860 423	300 185
KSR2	252.2	4 860 438	300 217
KSR3	256.4	4 860 451	300 183
KSR4	256.6	4 860 402	300 172
KSR5	256.1	4 860 413	300 217

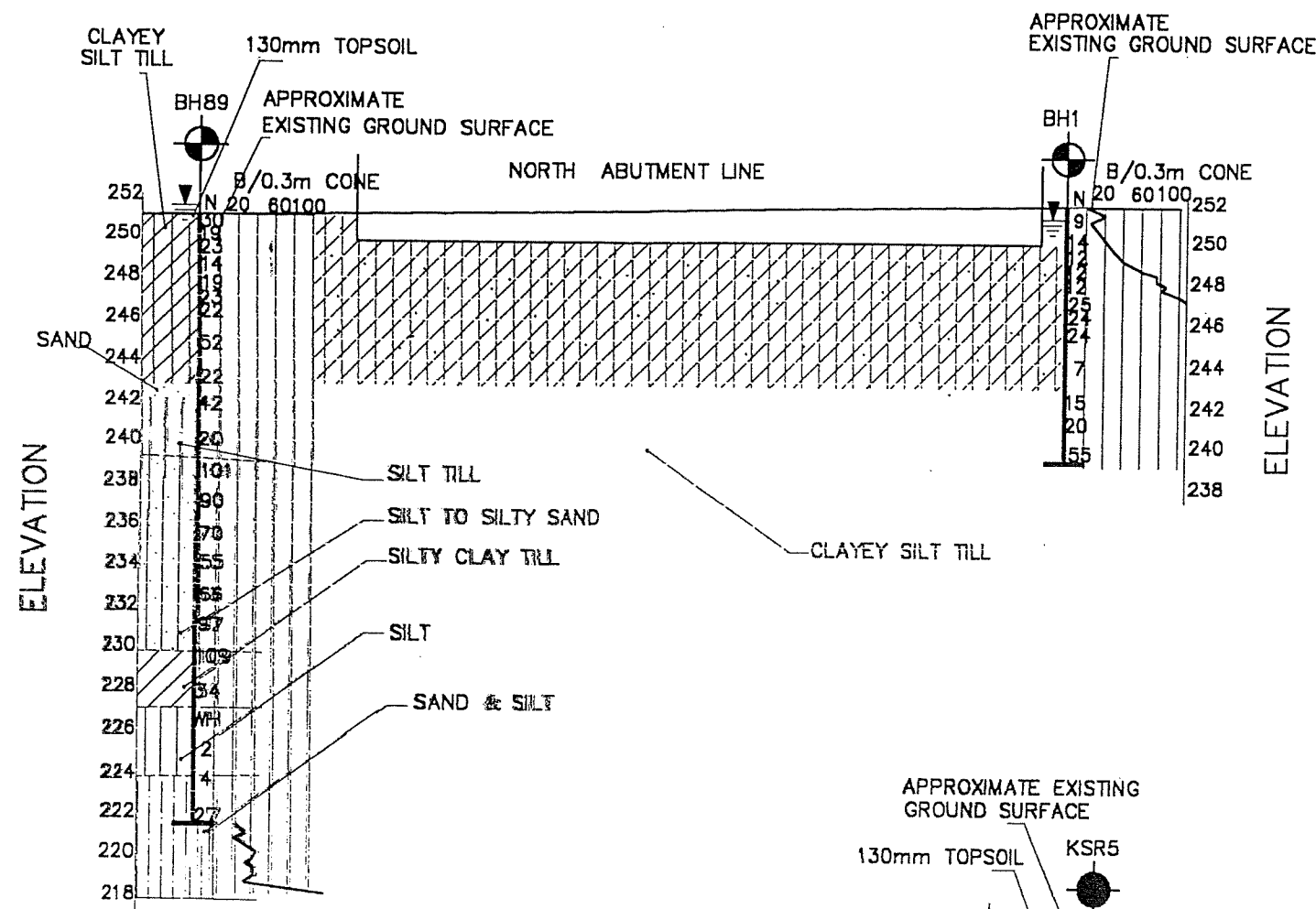
NOTE:-  
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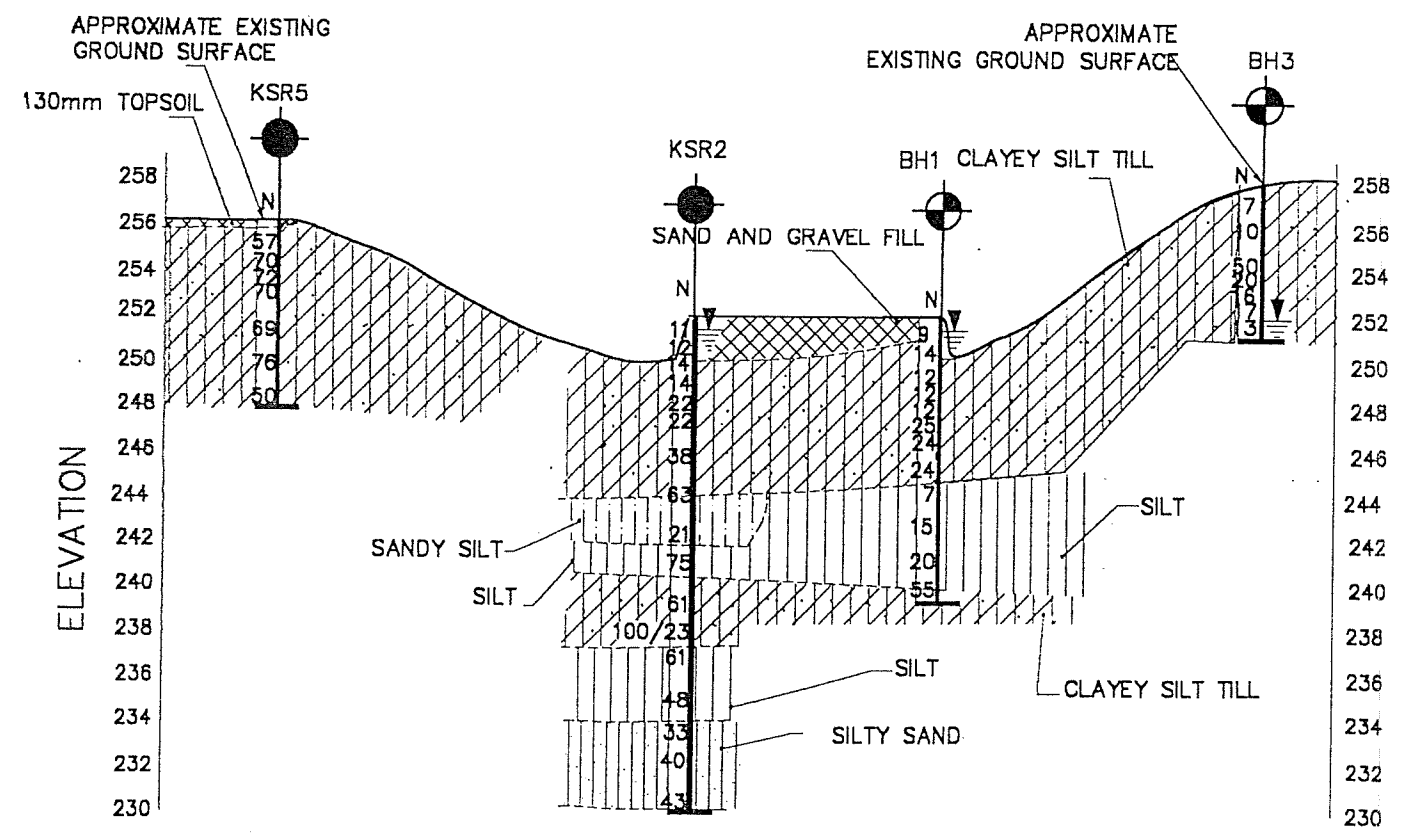
DATE	BY	DESCRIPTION

HWY No 400  
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DWG 2

**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES - METRES.



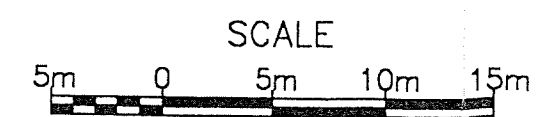
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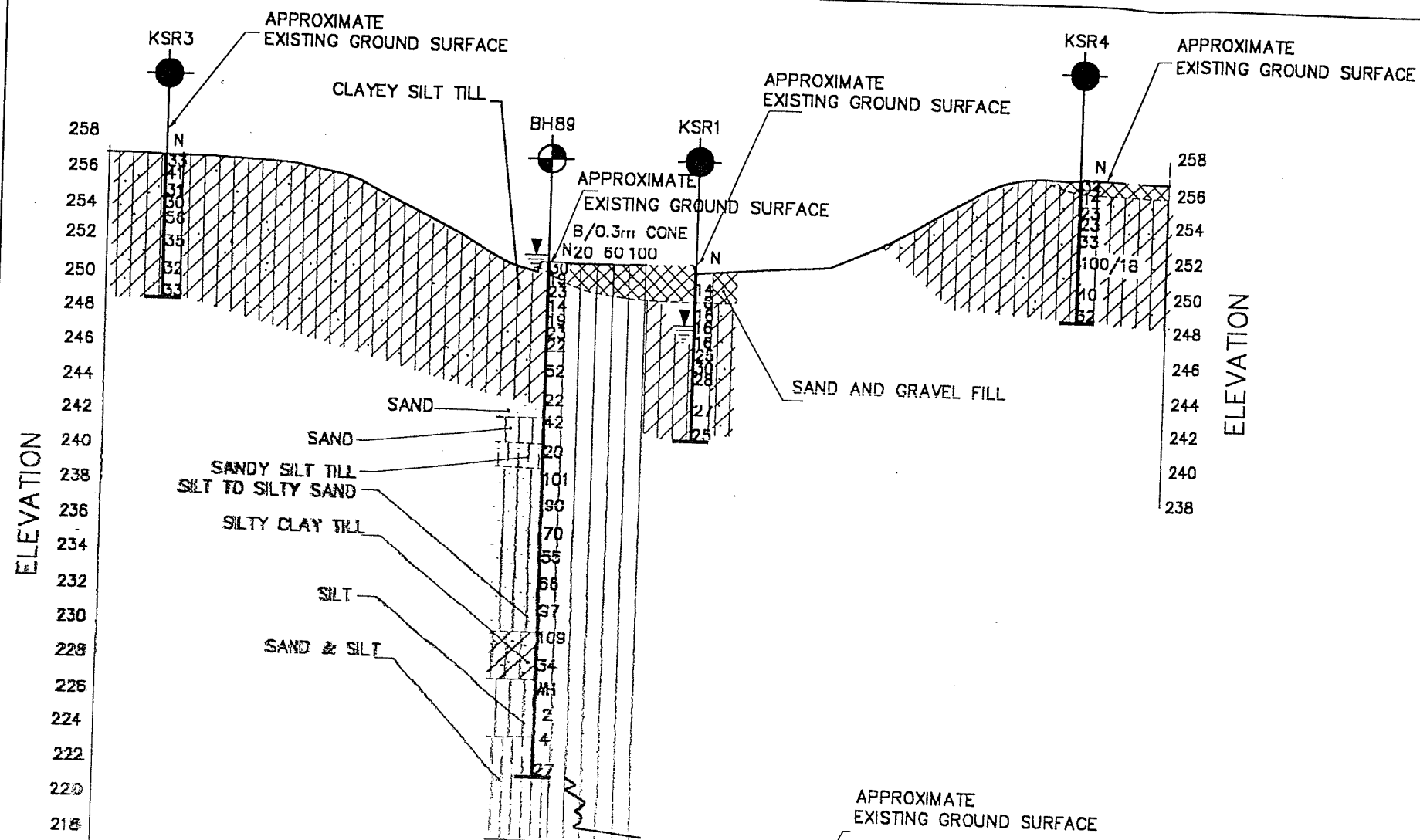
SECTION B-B

SOIL STRATIGRAPHY LEGEND

	SAND and GRAVEL FILL		SILT WITH CLAY AND SAND LENSES Compact to very Dense
	SAND SOME GRAVEL, TRACE SILT, OCCASIONAL COBBLES Very Loose to Very Dense		SANDY SILT, TRACE CLAY, TRACE GRAVEL Loose to Compact
	CLAYEY SILT TILL Stiff to Hard		SILTY SAND, TRACE GRAVEL, OCCASIONAL COBBLES Compact to Very Dense

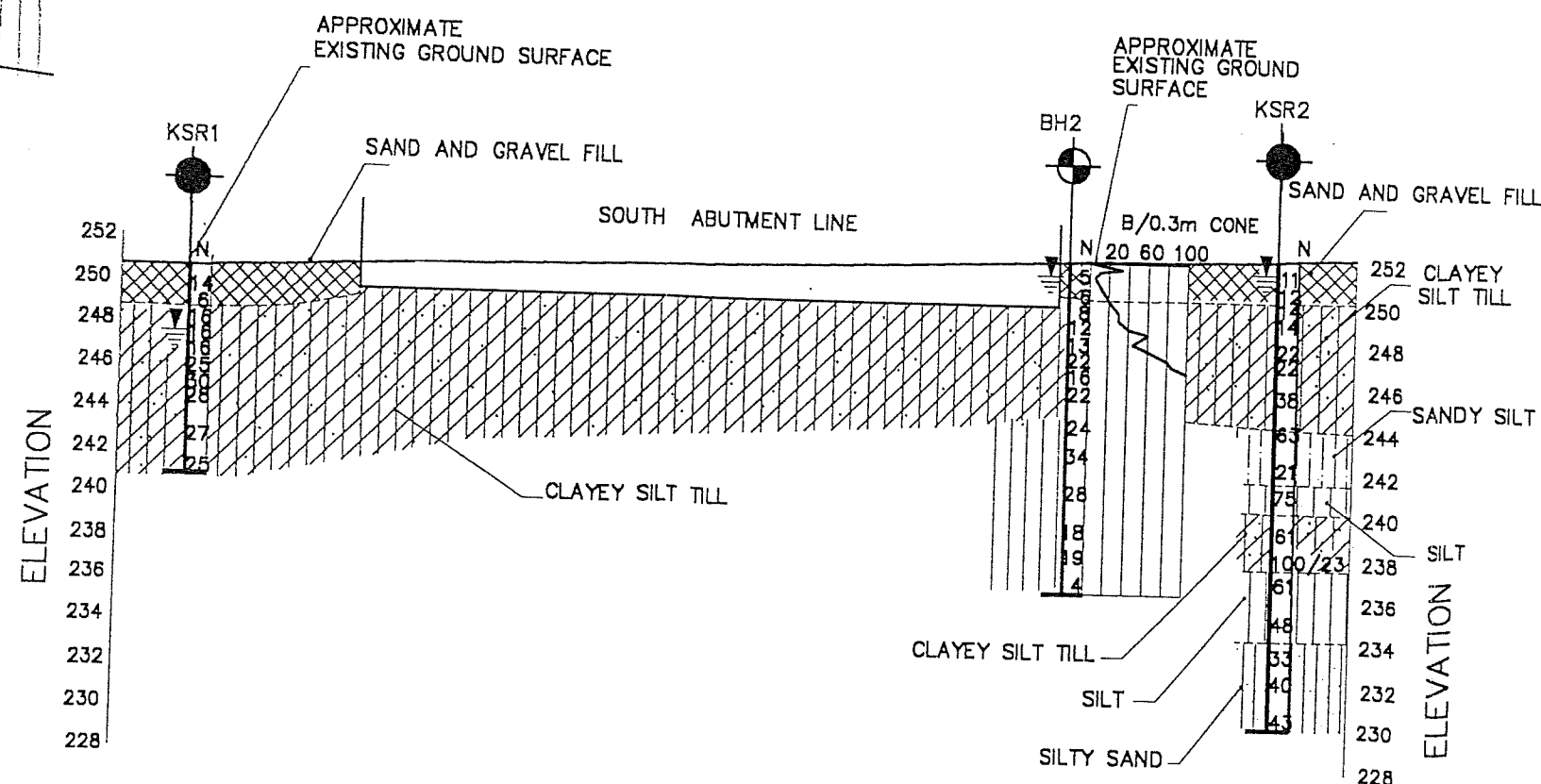
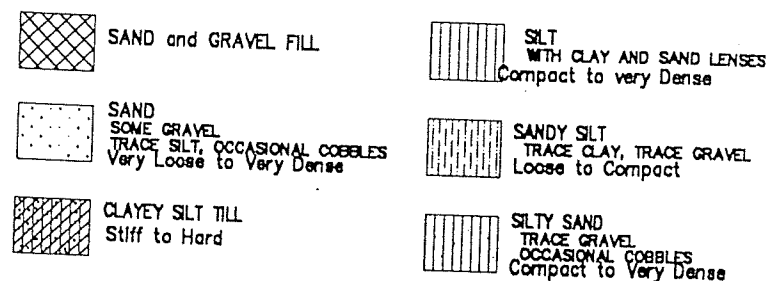


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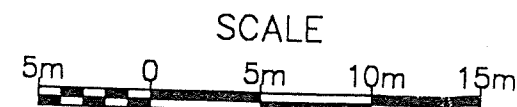


**SECTION C-C**

**SOIL STRATIGRAPHY LEGEND**



**SECTION D-D**



**METRIC**

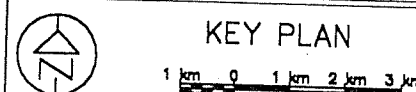
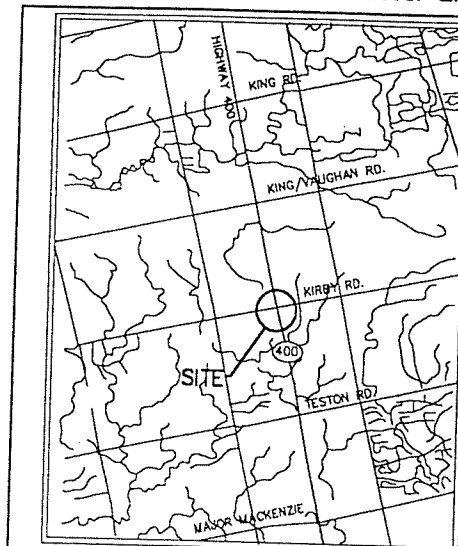
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OTHERWISE SHOWN. STATIONS  
IN KILOMETRES - METRES.

W.P. No. 192-00-00

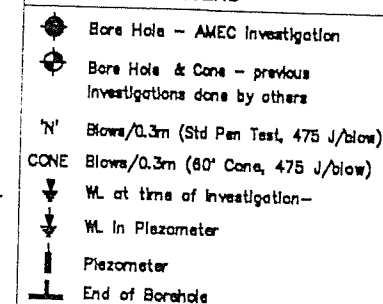
KIRBY SIDEROAD OVERPASS  
HIGHWAY 400  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

AMEC Earth & Environmental Limited



**LEGEND**



No	ELEV	CO-ORDINATES NORTH	EAST
1	251.7	4 860 443	300 207
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3	257.8	4 860 458	300 209
BH	251.0	4 860 438	300 187
KSR1	250.8	4 860 423	300 165
KSR2	252.2	4 860 438	300 217
KSR3	256.4	4 860 451	300 183
KSR4	256.8	4 860 402	300 172
KSR5	256.1	4 860 413	300 217

**-NOTE-**

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

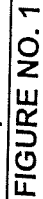
DATE	BY	DESCRIPTION
------	----	-------------

HWY No 400	DATE Sept, 2002	DSST
SUBM'D PPM-CHECKED AD		SITE
DRAWN VK	CHECKED KSH	APPROVED
		DWO 3



## FIGURES

**amec**



# UNIFIED SOIL CLASSIFICATION SYSTEM

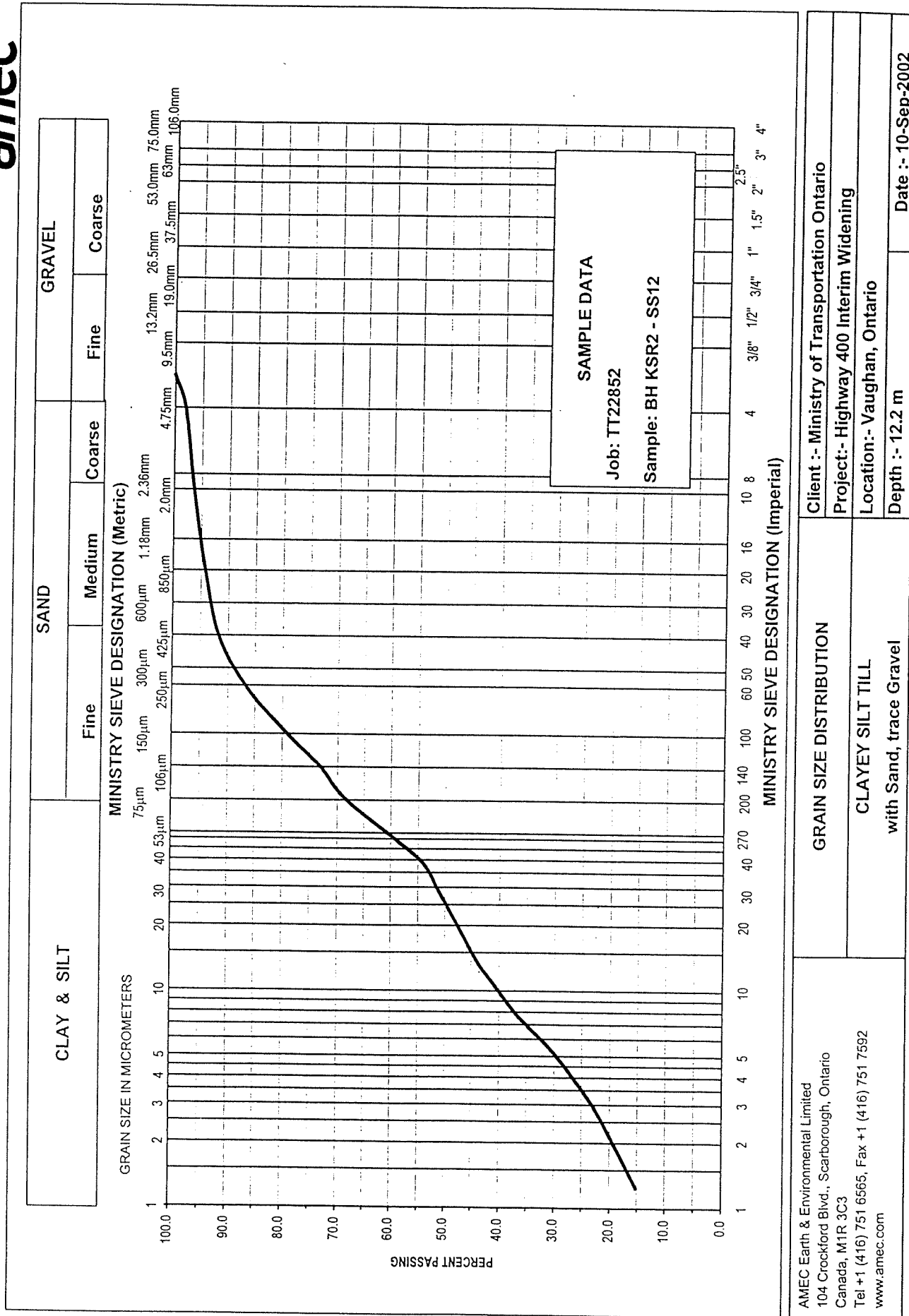
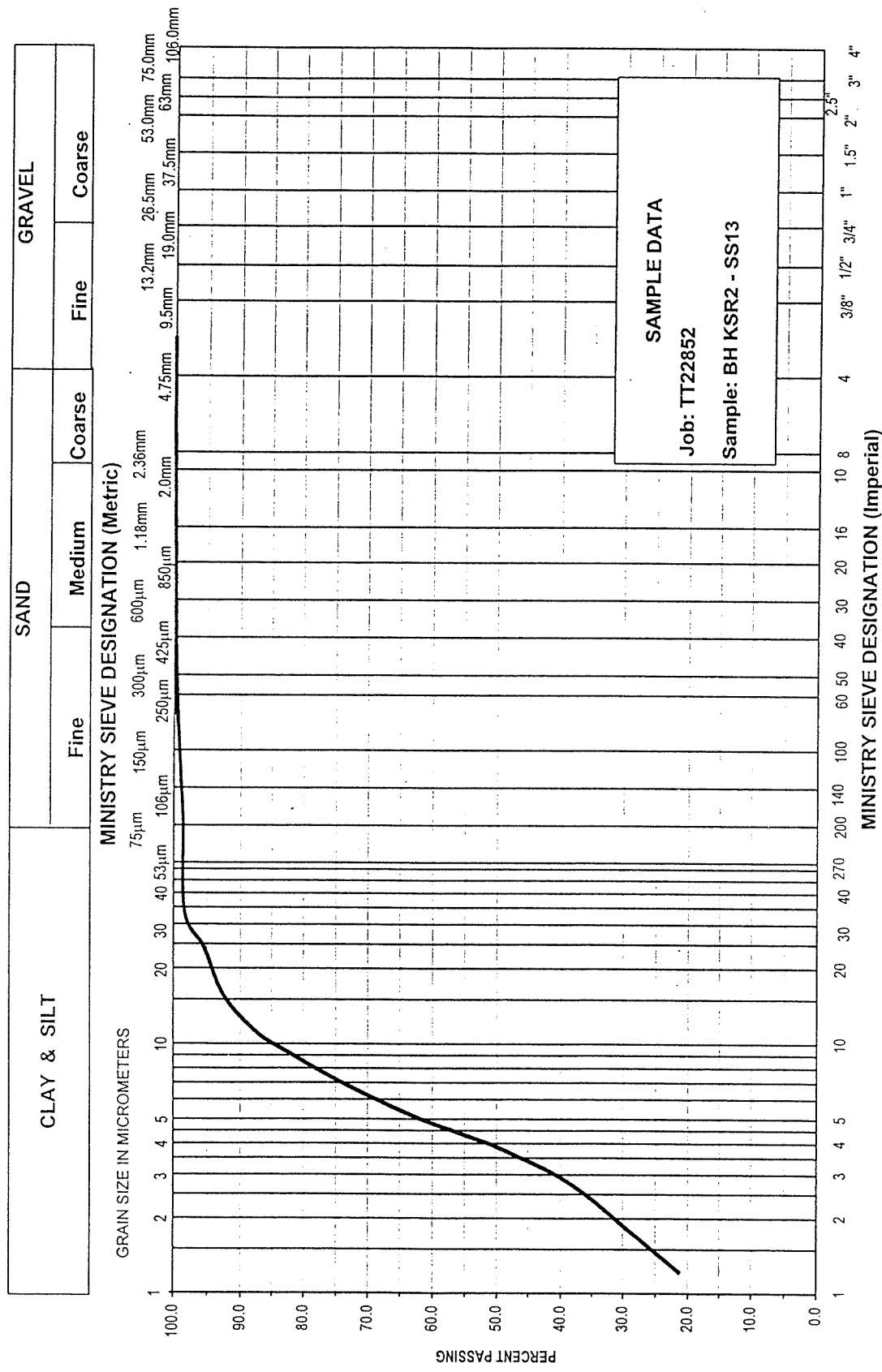


FIGURE NO 2

# UNIFIED SOIL CLASSIFICATION SYSTEM

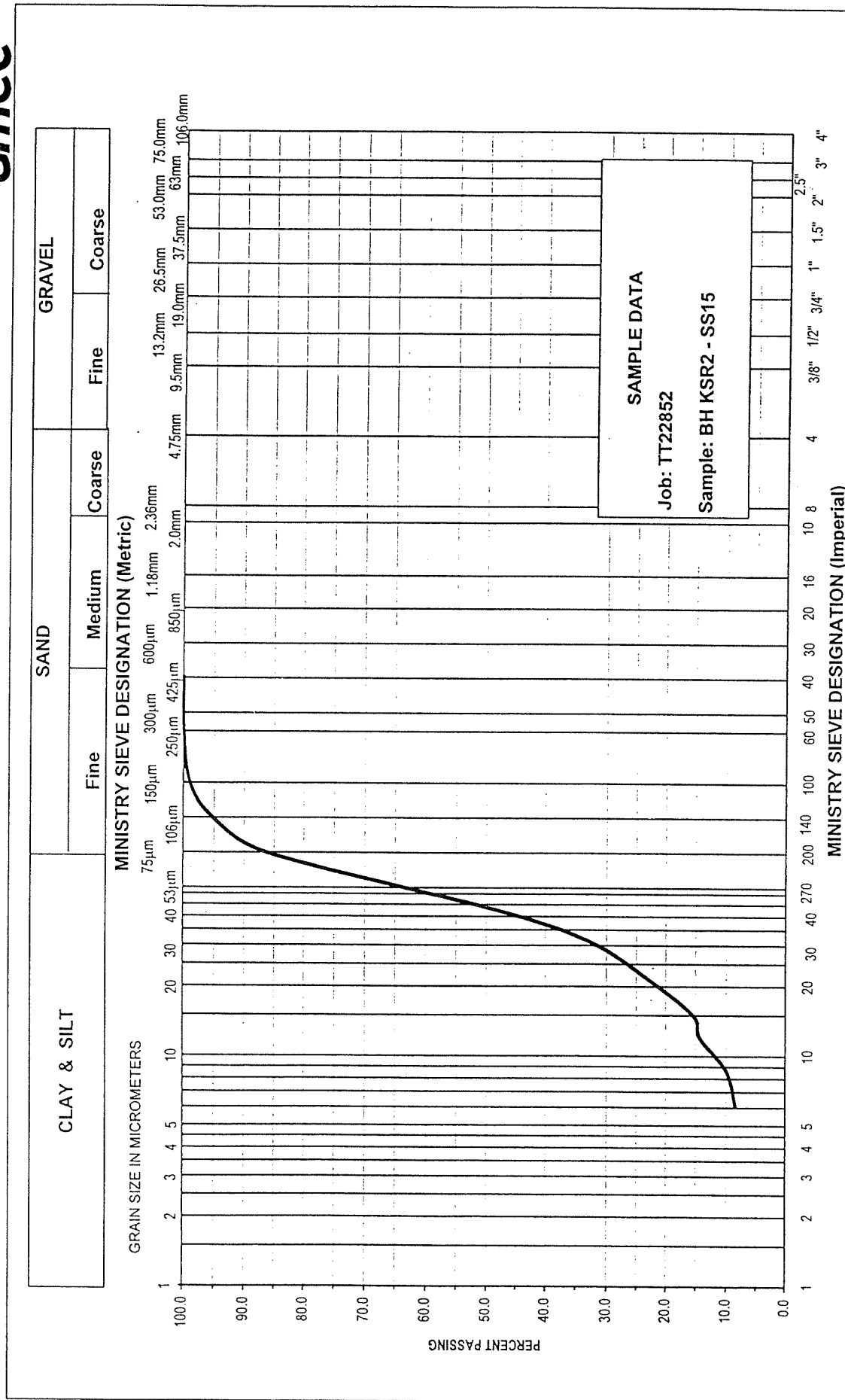


AMEC Earth & Environmental Limited 104 Crockford Blvd., Scarborough, Ontario Canada, M1R 3C3 Tel +1 (416) 751 6565, Fax +1 (416) 751 7592 www.amec.com	<b>GRAIN SIZE DISTRIBUTION</b>		Client :- Ministry of Transportation Ontario
	CLAYEY SILT trace sand		Project:- Highway 400 Interim Widening Location:- Vaughan, Ontario
	Depth :- 13.7 m		Date :- 10-Sep-2002

FIGURE NO. 3

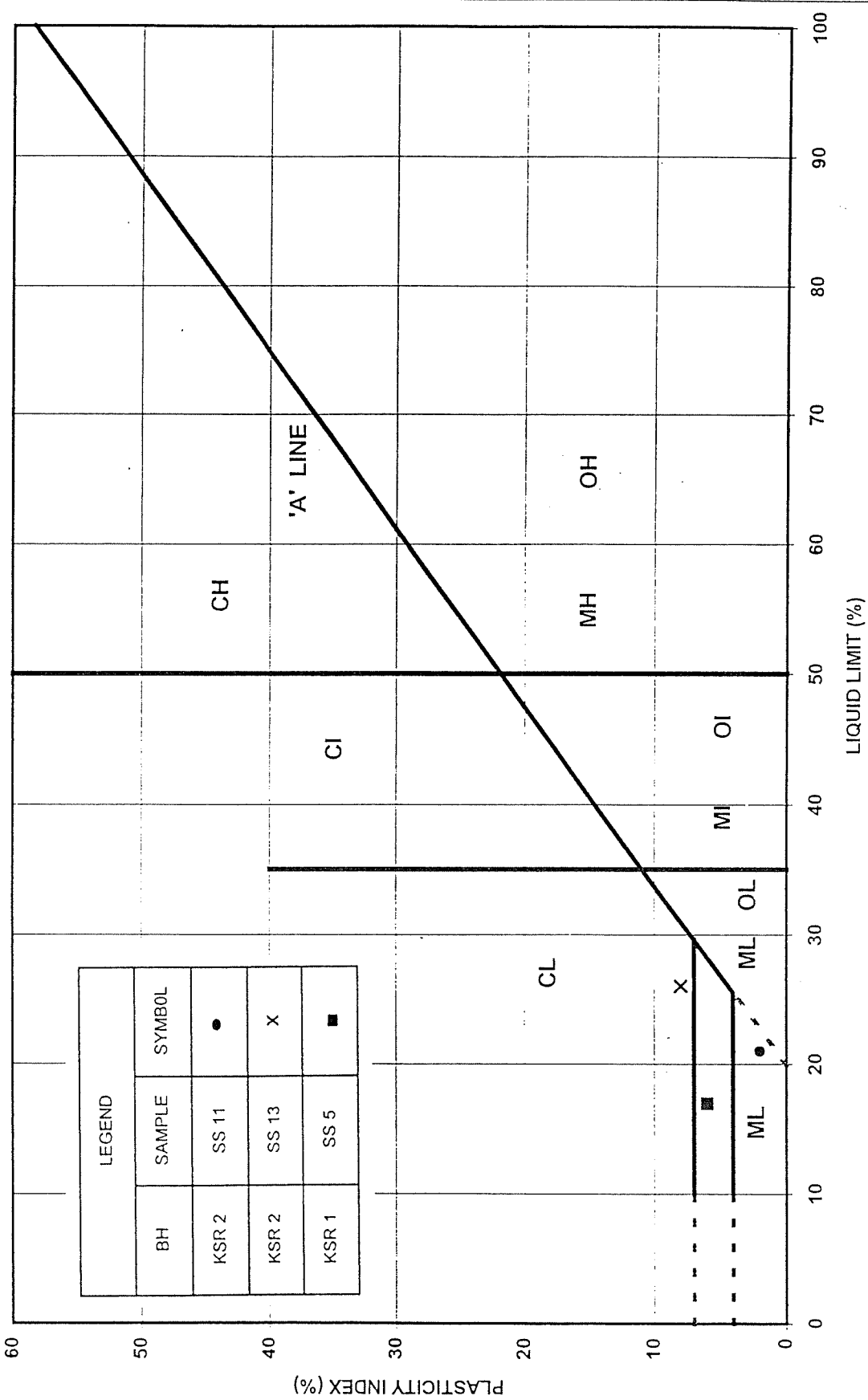


# UNIFIED SOIL CLASSIFICATION SYSTEM



<b>AMEC Earth &amp; Environmental Limited</b> 104 Crookford Blvd., Scarborough, Ontario Canada, M1R 3C3 Tel +1 (416) 751 6565, Fax +1 (416) 751 7592 <a href="http://www.amec.com">www.amec.com</a>	<b>GRAIN SIZE DISTRIBUTION</b>		Client :- Ministry of Transportation Ontario	
	<b>SILT</b> some sand, trace clay		Project:- Highway 400 Interim Widening	
			Location:- Vaughan, Ontario	
			Depth :- 13.7 m	Date :- 10-Sep-2002

**FIGURE NO. 4**



## RECORD OF BOREHOLE SHEETS

# AMEC EARTH AND ENVIRONMENTAL LIMITED

## NOTES TO BOREHOLE LOGS

### DRILLING DATA

Method:  
SolSt Augering - Solid Stem Augering  
HolSt Augering - Hollow Stem Augering  
WB - Washed Boring

### SAMPLES

TYPE:  
SS - Split Spoon  
AS - Auger Sample  
TW - Thinwall Open  
TP - Thinwall Piston  
WS - Washed Sample  
BS - Block Sample  
RC - Rock Core  
PH - Sample Advanced Hydraulically  
PM - Sample Advanced Manually

### LABORATORY DATA

WP - Plastic Limit (%)  
W - Water Content (%)  
WL - Liquid Limit (%)  
Y - Natural Unit Weight (kN/m<sup>3</sup>)  
UNDR STRNG or C<sub>u</sub> - Undrained Shear Strength (kPa)  
Field Vane: St-sensitivity  
PP - Pocket Penetrometer  
UC - Unconfined Compression  
UU - Unconsolidated Undrained at Overburden Pressure  
CU - Consolidated Undrained  
CD - Consolidated Drained  
TOV - Total Organic Vapours

**Standard Penetration Test:** The Standard Penetration Test (SPT) 'N'-values are the number of blows required to cause a standard 51 millimetre o.d. split barrel sample to penetrate 0.3 metres into undisturbed ground in a borehole when driven by a hammer with a mass of 63.5 kilograms falling freely a distance of 0.76 metres. For penetrations of less than 0.3 metres, N-values are indicated as the number of blows for the penetration achieved (e.g. 50/25: 50 blows for 25 centimetre penetration).

**Dynamic Cone Penetration Test:** Continuous penetration of a conical steel point (51 millimetre 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 0.3 metres advance of the conical point into the undisturbed ground.

Soils are described by their composition and consistency or compactness.

**CONSISTENCY:** Cohesive soils are described on the basis of their undrained shear strength (C<sub>u</sub>) or 'N'-values as follows:

C <sub>u</sub> (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
N (blows/0.3 metres)	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30

**COMPACTNESS:** Cohesionless soils are described on the basis of compactness as indicated by 'N'-values as follows:

N (blows/0.3 metres)	0 - 4	4 - 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.

### ROCK QUALITY

**DESIGNATION (RQD):** Sum of those intact core pieces, 100 millimetres in length expressed as a percent of the length of the coring run. Classification of a rock based on the RQD value as follows:

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

### JOINTING AND BEDDING:

SPACING	50 millimetres	50 - 300 millimetres	0.3 - 1.0 millimetres	1.0 - 3.0 millimetres	> 3.0 millimetres
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

# RECORD OF BOREHOLE No KSR1

1 OF 1

W.O. 192-00-00 LOCATION 4860422.5N 300165.1E ORIGINATED BY NNK  
DIST HWY 400 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
DATUM Geodetic DATE 14 August 2002 - 14 August 2002 CHECKED BY AD  
PROJECT Kirby Side Road Over Pass, HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa										WATER CONTENT (%)				
									○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20						40	60	80	100	10
250.6									20	40	60	80	100	10	20	30	kN/m <sup>3</sup>	GR SA SI CL					
0.0	Sand and gravel (FILL) moist, brown																						
250.0								250															
0.6	Clayey Silt, some sand, (FILL) firm to stiff, damp, grey		1	SS	14		1								○								
								249							○								
248.4			2	SS	6		2																
2.2	Clayey Silt, some sand, trace gravel (TILL), very stiff to hard, damp to moist, grey		3	SS	16		3	248							○								
			4	SS	16		4	247							○		23.7						
			5	SS	16		5	246							○		20.6						
			6	SS	25		6	245							○		1 32 45 22						
			7	SS	30		7	244							○		23.0						
			8	SS	28		8	243							○		22.2						
			9	SS	27		9	242							○		21.1						
			10	SS	25			241							○								
240.8																							
9.8	End of Borehole																						
	Groundwater in open bore on completion: 3.6m																						
	Cave on completion: 7.6m																						



# RECORD OF BOREHOLE No KSR2

1 OF 2

W.O. 192-00-00 LOCATION 4860437.7N 300216.9E ORIGINATED BY NNK  
 DIST HWY 400 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 14 August 2002 - 14 August 2002 CHECKED BY AD  
 PROJECT Kirby Side Road Over Pass, HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					
252.2	100mm ASPHALT		1	AS	-		252							
0.0	Sand and Gravel (FILL), moist, brown													
251.5	Clayey Silt, some sand, trace gravel, topsoil, (FILL) stiff, damp, grey		2	SS	11		251							
0.7			3	SS	12									
250.0	Clayey Silt, some sand, trace gravel (TILL) occasional sand seams, stiff to hard, damp to moist, grey		4	SS	14		250							
2.2			5	SS	14		249							
			6	SS	22		248							
			7	SS	22		247							
			8	SS	38		246							
							245							
244.3	Sandy Silt, occasional sand seams compact, wet, grey		9	SS	63		244							
7.9			10	SS	21		243							
242.0	Silt, occasional sand and clay seams very dense, damp, grey		11	SS	75		242							
10.2			12	SS	61		241							
240.5	Clayey Silt, some sand, trace gravel (TILL) hard, damp, grey						240							
11.7							239							
238.9	Clayey Silt, hard damp, grey						238							
13.3														
237.4														

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No KSR2



2 OF 2

W.O. 192-00-00 LOCATION 4860437.7N 300216.9E ORIGINATED BY NNK  
 DIST HWY 400 BOREHOLE TYPE Solid Stem Augering COMPILED BY NNK  
 DATUM Geodetic DATE 14 August 2002 - 14 August 2002 CHECKED BY AD  
 PROJECT Kirby Side Road Over Pass, HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa										WATER CONTENT (%)
									20 40 60 80 100										
									○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
14.8	Silt.some Sand, trace Clay, dense to very dense wet, grey		14	SS	61												SS14: 1.2m backup ins:ce borehole		
			15	SS	48														0 14 (26)
234.2	Silty Sand, dense wet, grey		16	SS	33													SS16: 3.0m backup ins:ce borehole	
18.0																			
			17	SS	40														SS17: 3.0m backup ins:ce borehole
230.2	End of Borehole		18	SS	43													SS18: 4.6m backup ins:ce borehole	
22.0																			
	Groundwater in open bore on completion: 4.3m																		
	Cave on completion: 14.6m																		
	Water Level in Piezometer: 30 Aug./02: 0.1 m 16 Sept./02: 0.1 m																		

W.O.	192-00-00	LOCATION	4860451.0N 300163.4E	ORIGINATED BY	NNK
DIST	HWY 400	BOREHOLE TYPE	Soild Stem Augering	COMPILED BY	IH
DATUM	Geodetic	DATE	22 August 2002 - 22 August 2002	CHECKED BY	AD
PROJECT	Kirby Side Road Over Pass, HWY 400 Widening, Vaughan, Ontario			JOB NO.	TT22852

[illegible]

+<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No KSR4

**amec**

1 OF 1

W.O. 192-00-00	LOCATION 4860403.9N 300175.0E	ORIGINATED BY NNK
DIST _____ HWY 400	BOREHOLE TYPE Soild Stem Augering	COMPILED BY IH
DATUM Geodetic	DATE 22 August 2002 - 22 August 2002	CHECKED BY AD
PROJECT Kirby Side Road Over Pass, HWY 400 Widening, Vaughan, Ontario		JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa				WATER CONTENT (%)					
									○ UNCONFINED		+ FIELD VANE		w <sub>p</sub> w      w <sub>L</sub>					
						● QUICK TRIAXIAL      x LAB VANE												
256.6									20	40	60	80	100					
0.0	Sandy Silt, trace rootlets, gravel (FILL)		1	SS	32													
255.9	damp, dark brown to brown																	
0.7	Clayey Silt, some sand, trace gravel (TILL) stiff to hard, damp to moist, brown to grey		2	SS	14													
			3	SS	23													
			4	SS	23													
			5	SS	33													
			6	SS	100/18													
			7	SS	40													



# RECORD OF BOREHOLE No KSR5



1 OF 1

W.O. 192-00-00 LOCATION 4860412 5N 300216 6E ORIGINATED BY PPM  
 DIST HWY 400 BOREHOLE TYPE Solid Stem Augering COMPILED BY IH  
 DATUM Geodetic DATE 16 September 2002 - 16 September 2002 CHECKED BY AD  
 PROJECT Kirby Side Road Over Pass, HWY 400 Widening, Vaughan, Ontario JOB NO. TT22852

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION SCALE m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLAST. C LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa									
256.1									20	40	60	80	100					
256.0	130mm TOPSOIL		1	SS	7			256										
			2	SS	57		1	255							o			
			3	SS	70		2	254							o			
			4	SS	72		3	253							o		21.9	
	CLAYEY SILT, with sand, trace gravel (TILL) damp. brown to grey, hard		5	SS	70		4	252							o		21.4	
			6	SS	69		5	251							o			
			7	SS	76		6	250							o			
			8	SS	50		7	249							o		23.4	
248.0	End of Borehole																	
8.1	Groundwater in open bore on completion: none																	

## APPENDIX 'A'

**Borehole Logs extracted from MTO report dated 15 December 1989  
GEOCRES File No. 30M13-93**

# RECORD OF BOREHOLE No 1

METRIC

W P 95-85-01 LOCATION Co-ords: N 4 860 219.7; E 300 191.5  
 DIST 6 HWY 400 BOREHOLE TYPE H.S. Auger & Cone Test  
 DATUM Geodetic DATE 89 08 27

ORIGINATED BY AL  
 COMPILED BY AL  
 CHECKED BY TS

OFFICE REPORT ON SOIL EXPLORATION

OFFICE REPORT ON SOIL EXPLORATION

CHECKED BY TS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARK & GRAIN SI DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
251.7	Ground Surface																
0.0	Clayey Silt Some Sand, Trace Gravel (Glacial Till)		1	SS	9												
			2	SS	14		250										
	Grey		3	SS	10												
			4	SS	12												
	Stiff V. Stiff		5	SS	12		248										8 29 48
			6	SS	13												23.7
			7	SS	14		246										22.6
			8	SS	14												2 26 69
243.9			9	SS	7		244										
7.8	Silt Some Sand, Trace Gravel		10	SS	15												
	Grey, Compact to Very Dense		11	SS	20		242										
							240										
239.1			12	SS	55												
12.6	End of Borehole																0 15 75 9

\* 3, x<sup>5</sup>: Numbers refer to  
 Sensitivity  
 20  
 15  
 10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 2

METRIC

W P 95-85-01 LOCATION Co-ords: N 4 860 211.4; E 300 193.0  
 DIST 6 HWY 400 BOREHOLE TYPE H S. Auger & Cone Test  
 DATUM Geodetic DATE 89 08 26  
 ORIGINATED BY AL  
 COMPILED BY AL  
 CHECKED BY TS

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARK & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100			
251.9	Ground Surface													
0.0	Sand Trace Gravel (Fill)		1	SS	5									
250.1	Brown, Loose		2	SS	6									
1.8	Clayey Silt Some Sand, Trace Gravel (Glacial Till)		3	SS	8									
			4	SS	12									
			5	SS	13									
	Grey Firm to V. Stiff		6	SS	22									
			7	SS	16									
	Occ. Sand Seams		8	SS	17									
244.3			9	SS	24									
7.6	Silt Trace Sand, Trace Gravel Grey Compact to Dense		10	SS	34									
			11	SS	38									
			12	SS	18									
			13	SS	19									
236.2			14	SS	2									
15.7	End of Borehole													

\*J, x<sup>S</sup>: Numbers refer to  
 Sensitivity  
 20  
 15  
 10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 3

METRIC

W P 95-85-01

LOCATION Co-ords: N 4 860 236.0; E 300 191.8

DIST 6 HWY 400

BOREHOLE TYPE H. S. Auger

ORIGINATED BY AL

DATUM Geodetic

DATE 89 08 27

COMPILED BY AL

CHECKED BY TS

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	SIRAT PLOT	NUMBER	TYPE			20	40	60	80	100			
257.8	Ground Surface													
0.0	Clayey Silt Some Sand, Trace Gravel  (Glacial Till)		1	SS	10	256							22.5	6 28 56 10
			2	SS	50									
			3	SS	20	254								
			4	SS	16									
			5	SS	17	252							21.9	0 52 38 10
250.9	Occ. Sand Seams		6	SS	13									
6.9	End of Borehole													

3, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  
10  
5 [%] STRAIN AT FAILURE

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Coarse

Coarse

MINISTRY SIEVE DESIGNATION (Metric)

100 90 80 70 60 50 40 30 20 10 0

PERCENT PASSING

GRAIN SIZE IN MICROMETERS

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

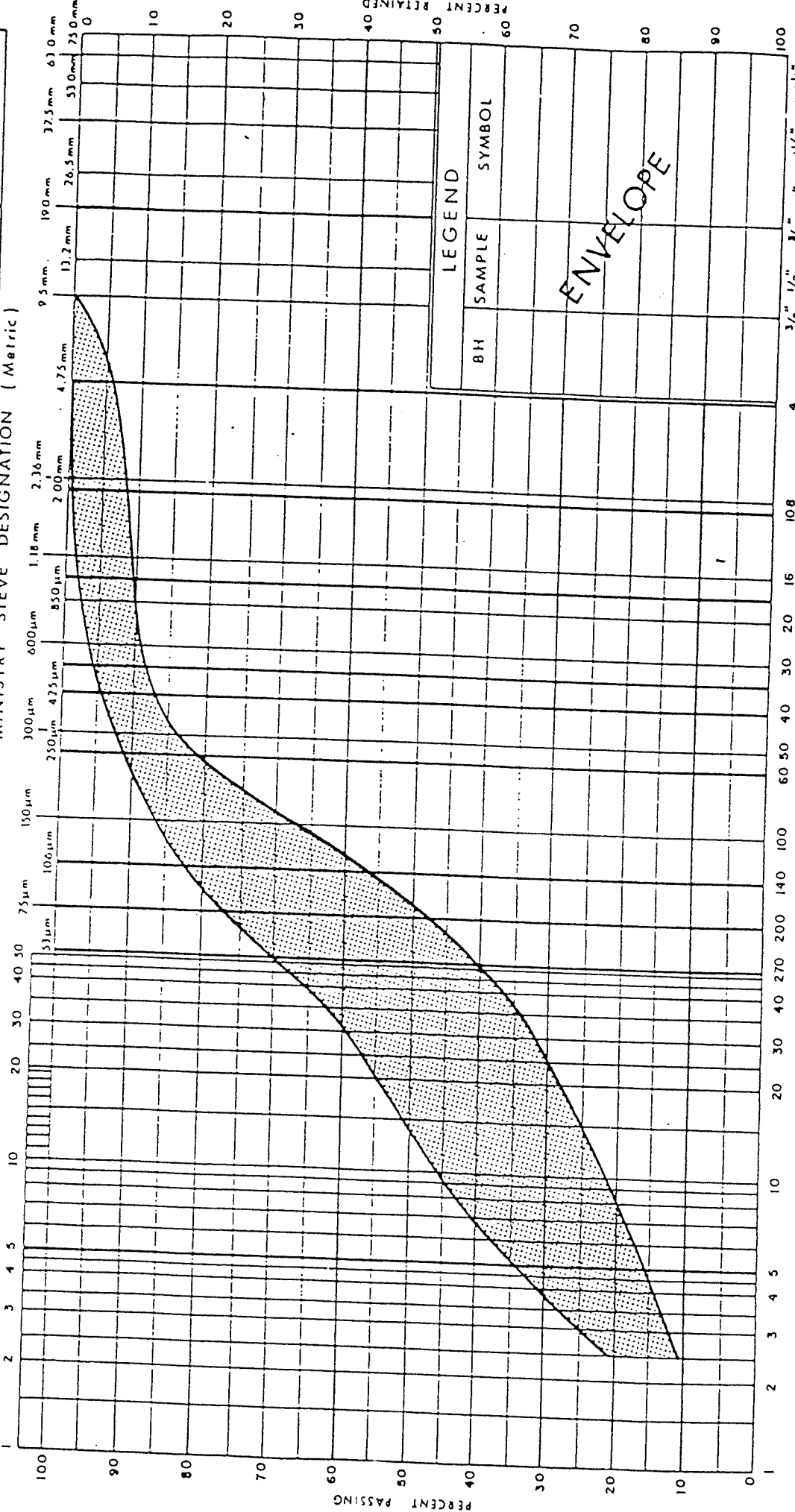
1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 10 20 30 40 50 60 70 80 90 100



LEGEND

BH SAMPLE SYMBOL

ENVELOPE

## APPENDIX 'B'

Borehole Logs extracted from report prepared by  
Golder Associates Limited dated June 2001  
GEOCRES File No. 30M13-49

PROJECT <u>001-1122F</u>		<b>RECORD OF BOREHOLE No 89</b>		1 OF 3	<b>METRIC</b>
W.P. <u>222-97-00</u>	LOCATION <u>N 4860436 E 300167</u>			ORIGINATED BY <u>SS</u>	
DIST <u>Central</u> HWY <u>400</u>	BOREHOLE TYPE <u>108mm I.D. Hollow Stem Augers</u>			COMPILED BY <u>LCC</u>	
DATUM <u>Geodetic</u>	DATE <u>October 10 &amp; 11 2000</u>			CHECKED BY <u>ASP</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT $\gamma$ kNm <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	20	40	60		
251.0	GROUND SURFACE																
0.0	Sand and Gravel, trace clay and organics (FILL) Compact to dense Moist		1	SS	30												
250.4	Brown to grey Clayey Silt with sand, some gravel, occ. cobbles (Till) Stiff to hard Moist Grey		2	SS	19												
			3	SS	23												
			4	SS	14												
			5	SS	19												
			6	SS	23												
			7	SS	22												
			8	SS	52												
243.7	Sand, trace silt Compact Wet Grey		9	SS	22												
241.9	Silt, trace to some Sand to Sand and silt Dense Moist Grey		10	SS	42												
240.5	Sand and Silt, trace clay (Till) Compact Grey Moist		11	SS	20												
239.1	Interlayered Silt, trace to some sand, trace clay Sand and Silt, trace clay and Silty Sand, trace clay Very dense Wet Grey		12	SS	101												
			13	SS	90												



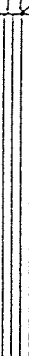
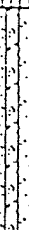

ON MOT 001-1122 GPJ ON MOT G01 12/2/01

Continued Next Page

+3, X3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



PROJECT 001-1122F RECORD OF BOREHOLE No 89 2 OF 3 METRIC  
W.P. 222-97-00 LOCATION N 4860436 E 300167 ORIGINATED BY SB  
DIST Central HWY 400 BOREHOLE TYPE 108mm I.D. Hollow Stem Augers COMPILED BY LCC  
DATUM Geodetic DATE October 10 & 11, 2000 CHECKED BY ASP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100									
— CONTINUED FROM PREVIOUS PAGE —							SHEAR STRENGTH kPa										WATER CONTENT (%)			
						○ UNCONFINED + FIELD VANE					● QUICK TRIAXIAL × REMOULDED									
						20 40 60 80 100					10 20 30					KN/m <sup>3</sup>				
229.7	Intenayered Silt, trace to some sand, trace clay Sand and Silt, trace clay and Silty Sand, trace clay Very dense Wet Grey		14	SS	70															
			15	SS	55															
					16	SS	66													
			17	SS	97															
229.7	Silty Clay trace sand trace gravel to silt, trace clay sand and gravel (Till) Hard/dense Moist Grey		18	SS	109															
21.3																				
	Hard augering between 22.5m and 24m depth		19	SS	34															
226.9	Silt, trace sand occasional silty clay seams Very loose Wet Grey		20	SS	WM															
24.1																				
			21	SS	2															
223.6	Sand and Silt, trace clay Loose to compact Wet Grey		22	SS	4															
27.4																				
			23	SS	27															
221.4																				
29.6	END OF BOREHOLE																			

ON MOT 001-1122 GPJ ON MOT GDT 12/2/01

Continued Next Page

+ 3 X 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

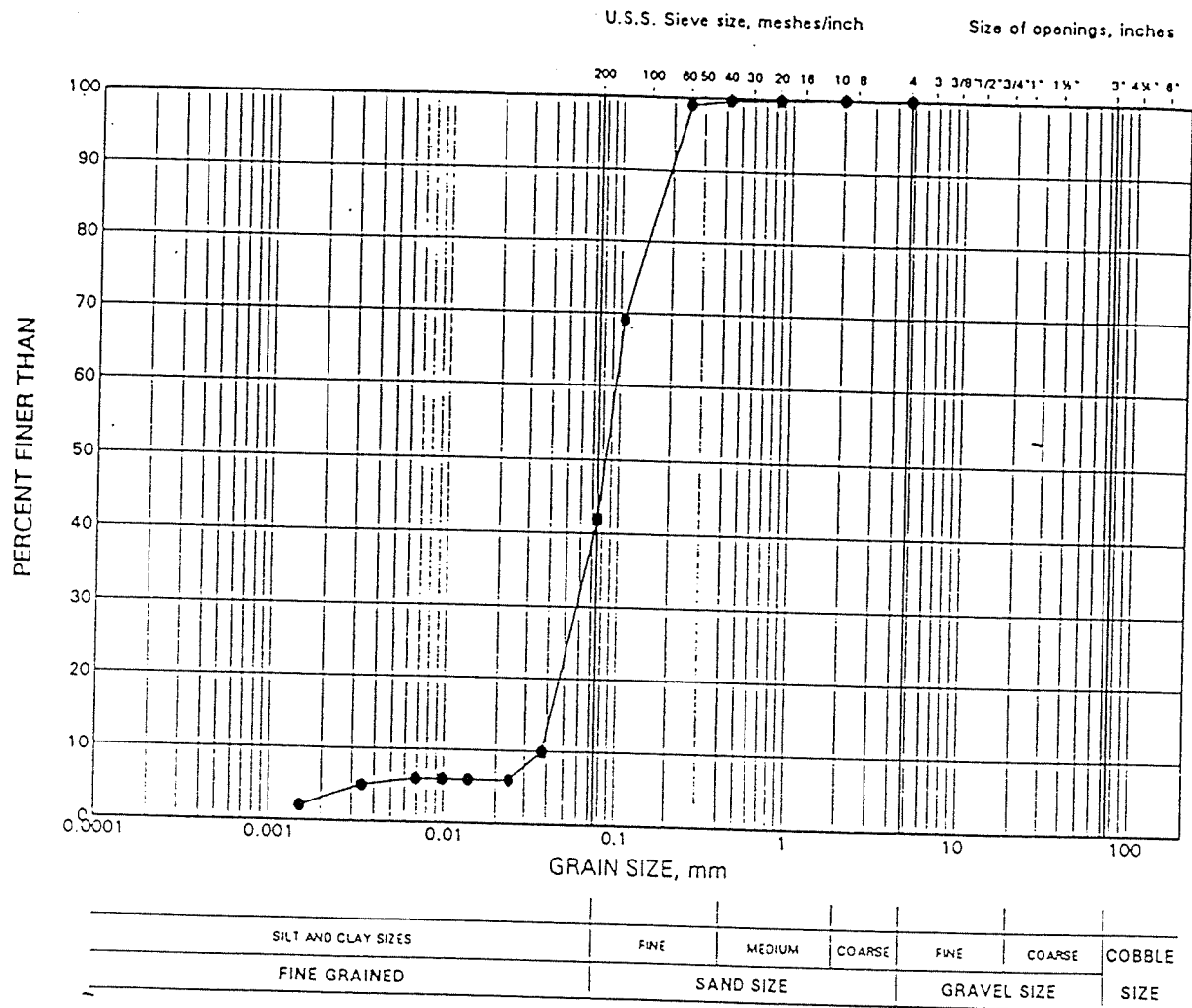
PROJECT 001-1122F RECORD OF BOREHOLE No 89 3 OF 3 METRIC  
W.P. 222-97-00 LOCATION N 4860436 E 300167 ORIGINATED BY SB  
DIST Central HWY 400 BOREHOLE TYPE 108mm I D Hollow Stem Augers COMPILED BY LCC  
DATUM Geodetic DATE October 10 & 11 2000 CHECKED BY ASP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIMIT MOISTURE CONTENT			UNIT WEIGHT  Y  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)			
	— CONTINUED FROM PREVIOUS PAGE —						20 40 60 80 100	20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	10 20 30			
							○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED					
217.8	Driving resistance greater than 100blows/0.3m over final 0.6m.												
33.2	END OF DYNAMIC CONE PENETRATION TEST  Note: The groundwater level was measured in the piezometer at 0.5m above ground surface (Elevation 251.5m) on January 19, 2001.												

ON MOT 001-1122 GPJ ON MOT GDT 12/2/01

# GRAIN SIZE DISTRIBUTION SAND AND SILT

FIGURE 1



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH (m)
•	89	16	18.7

**APPENDIX 'C'**  
**Site Photographs**





Photograph No. 1: Looking west at Kirby Sideroad Overpass Structure at Highway 400.



Photograph No. 2: Looking east at Kirby Sideroad Overpass at Highway 400.