

**FOUNDATION INVESTIGATION REPORT
HIGHWAY 427 WIDENING
FROM FASKEN DRIVE TO STEELES AVENUE
CN HALTON SUBDIVSION OVERHEAD
TORONTO, ONTARIO
G.W.P. 202-95-00**

Geocres Number: 30M12-288

Report to

SNC-Lavalin

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the design and construction of the proposed widening of the existing mainline bridge structures at the Highway 427 overhead crossing at the CN Halton Subdivision in Toronto, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, provide a borehole location plan, borehole logs, stratigraphic profile and cross-sections and a written description of the subsurface conditions. A model of the subsurface conditions was developed to describe the geotechnical conditions influencing design and construction of the foundations and approach embankments for the structures.

Thurber carried out the investigation as a sub-consultant to SNC-Lavalin under the Ministry of Transportation Ontario (MTO) Agreement Number 2004-E-0071.

During the preparation of this report and in addition to the boreholes drilled for the proposed structure widening, reference has been made to available information on subsurface conditions from a previous investigation documented in the report below.

- MTO report titled “Foundation Investigation and Design Report, Hwy 427 C.N.R. Overhead (Halton Subdivision), W.P. 153-80-02, Site No. 37-1109, Central Region, Toronto”, GEOCRES No.30M12-235, 1981 (Reference 1).

2 SITE DESCRIPTION

The site is located approximately 300 m south of Albion Road and 1.6 km west of Highway 27 in Toronto, Ontario. The site is generally flat except for the embankment fills, and the vegetation is moderate consisting mainly of tall grass and shrubs.

Lands surrounding the site have been developed for commercial and industrial uses.

The existing structure consists of the northbound and southbound (NBL and SBL) bridges of Highway 427 over the existing CN tracks which run in an east-west orientation.

Photographs of the site are included in Appendix D and show the general layout of the adjacent lands.

The site is situated within the South Slope physiographic region. The geology generally comprises a till plain consisting of clayey silt to silty clay (Halton Till) overlying bedrock at relatively shallow depth. The bedrock consists of grey shale with hard siltstone and limestone interlayers of the Georgian Bay Formation.

3 SITE INVESTIGATION AND FIELD TESTING

The present site investigation was carried out from December 1 to 18, 2008. The field program consisted of drilling and sampling ten boreholes (numbered CNH-01 to CNH-10) at the site. Boreholes were drilled at locations of the structure abutments, piers and approaches parallel to the alignments of, and between, the existing Highway 427 bridges.

Boreholes CNH-02 to CNH-04 and CNH-06 to CNH-08 drilled for the proposed piers and abutments were terminated upon refusal in silty sand and silty clay till at depths ranging from 13.9 m to 23.2 m (Elevations 152.4 to 165.7 m). Boreholes CNH-09 and CNH-10 drilled at the south and north approaches, respectively, were terminated in silty clay fill and silty clay till at 6.7 m depth (Elevations 173.1 and 174.6 m).

Boreholes CNH-01 and CNH-05, drilled near the south abutment, were terminated upon refusal in bedrock at 25.0 m and 26.1 m depths (Elevations 155.3 and 154.1 m). Borehole CNH-01 was further advanced into shale bedrock by coring to a depth of 30.9 m (Elevation 149.4 m).

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawing in Appendix E. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A. Records of boreholes (numbered 1 to 8) drilled during the previous investigation (1981) are enclosed in Appendix C.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations. A CN permit was obtained and flagging from CN Rail was used while drilling within the CN right of way.

Solid stem augers were used to advance the boreholes in the overburden and into the shale. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ rock coring equipment was used to recover core samples of the bedrock in Borehole CNH-01. Core samples of the shale bedrock were carefully protected to prevent drying during transport to the laboratory

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, visually examined the recovered samples, and transported them to Thurber's laboratory for further examination and testing.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Three standpipe piezometers consisting of 19 mm PVC pipes with screens were installed in selected boreholes to permit monitoring of groundwater levels. Details of the piezometer installations and other borehole completion details are as shown in Table 3.1.

Table 3.1 – Borehole Completion Details

Foundation Unit		Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
South Approach		CNH-09	None installed	Bentonite holeplug to surface.
South Abutment	Median	CNH-01	None installed	Borehole grouted with bentonite to surface.
	Median	CNH-05	25.0/155.2	Piezometer with 1.5 m slotted screen installed with sand filter to 21.3 m, bentonite holeplug from 21.3 m to 19.8 m, bentonite grout from 19.8 m to 2.4 m, then bentonite holeplug to ground surface.
South Pier	CNR grade	CNH-02	None installed	Bentonite grout to 2.1 m, then bentonite holeplug to surface.
	CNR grade	CNH-06	15.2/156.1	Piezometer with 1.5 m slotted screen installed with sand filter to 13.4 m, bentonite holeplug from 13.4 m to 12.5 m, bentonite grout from 12.5 m to 1.5 m, then bentonite holeplug to ground surface.
North Pier	CNR grade	CNH-03	12.7/158.9	Piezometer with 1.5 m slotted screen installed with sand filter to 7.6 m, bentonite holeplug from 7.6 m to 7.0 m, bentonite grout from 7.0m to 1.5 m, then bentonite holeplug to ground surface.
	CNR grade	CNH-07	None installed	Bentonite grout to 1.5 m, then holeplug to surface.
North Abutment	Median	CNH-04	None installed	Bentonite holeplug and auger cuttings to 0.075m, then asphalt to surface.
	Median	CNH-08	None installed	Bentonite holeplug and auger cuttings to 0.075m, then asphalt to surface.
North Approach		CNH-10	None installed	Bentonite holeplug and auger cuttings to 0.075m, then asphalt to surface.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and rock samples to geological logging. At least 25% of the recovered samples of soil were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. Moisture content determinations were carried out on all soil samples. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B. Laboratory testing results from the 1981 investigation (Reference 1) are also included in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Records of Borehole sheets in Appendix A. Details of the encountered soil and rock stratigraphy are presented in this appendix and on the Borehole Locations and Soil Strata Drawing in Appendix E. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general terms, the soil stratigraphy encountered at this site outside of the railway tracks comprises surficial topsoil or pavement structure overlying fill underlain by native silty clay till and silty sand. Weathered shale bedrock was contacted below the silty sand at the south abutment of the Highway 427 SBL. More detailed descriptions of the individual strata are presented below.

5.1.1 Topsoil

Topsoil was identified surficially in Boreholes CNH-01, CNH-05 and CNH-09. The topsoil thickness generally ranged from 50 mm to 75 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.1.2 Pavement Structure

Pavement structure consisting of approximately 75 mm of asphalt overlying granular (gravelly sand to silt and sand fill) road base was encountered in Boreholes CNH-04, CNH-08 and CNH-10 drilled at the Highway 427 median shoulder. The road base granular fill was 1.0 m thick in Borehole CNH-08 and the fill is in a dense to very dense state with SPT 'N' values ranging from 47 to 60 blows per 0.3 m of penetration. The moisture content of the granular fill is in the order of 5% to 7%.

5.1.3 Sub-ballast

A 200-mm thick layer of rail sub-ballast was encountered surficially in Borehole CNH-03 drilled near the existing north pier of Highway 427 SBL.

5.1.4 Fill

Fill was contacted below the topsoil and the asphalt in boreholes drilled at the existing approaches and embankments (Boreholes CNH-01, CNH-04, CNH-05 and CNH-08 to CNH-10). It is understood that the fill was placed during construction of the existing bridges. The fill generally consists of layers of various types of soils:

- Brown silty clay with sand and trace gravel
- Brown silt and sand containing trace to some gravel and trace clay
- Brown gravelly sand

The thickness of the fill ranged from 6.7 m to 9.1 m at the south abutment and south approach and from 3.9 m to 4.5 m at the north abutment and north approach.

The depths to the base of the fill ranged from 4.0 m to 9.1 m (Elevations 171.1 to 177.3 m).

Borehole CNH-09 was terminated within the silty clay fill at 6.7 m depth (Elevation 173.1m).

Based on SPT 'N' values ranging from 8 to 30 blows per 0.3 m of penetration, the cohesive fill is described as stiff to hard in consistency. The cohesionless fill (silt and sand, and gravelly sand) is described as loose to very dense, based on SPT 'N' values of 7 to 60 blows per 0.3 m of penetration.

The natural moisture contents of the fill samples ranged from 8% to 21%.

Grain size distribution curves for fill samples tested are presented on the Record of Borehole sheets and on Figures B1 and B2 of Appendix B. Atterberg Limit test results are presented on Figure B10 of Appendix B.

The results of laboratory tests are summarized as follows:

Soil Particles	Silty Clay Fill (%)	Silty Sand Fill (%)
Gravel	3 to 8	0
Sand	24 to 31	45 to 55
Silt	34 to 41	39 to 51
Clay	25 to 34	4 to 6
Liquid Limit	36 to 38	-
Plasticity Index	20	-

The above results show that the silty clay fill is typically of medium plasticity with a group symbol of CI.

5.1.5 Silty Clay Till

Native brown to grey silty clay till with sand and trace gravel was contacted below the asphalt, topsoil, sub-ballast and fill at depths ranging from 8.5 m to 9.1 m at the south abutment, 4.0 m to 4.6 m at the north abutment and at 0.2 m at the north pier.

During the present investigation, silty clay till was also contacted superficially in two boreholes drilled at the south pier (Boreholes CNH-02 and CNH-06) and in one borehole drilled at the north pier (Borehole CNH-07). Silty clay till was also encountered superficially in the eight boreholes drilled during the previous investigation.

Thickness of the silty clay till ranged from 7.4 m to 13.8 m.

Layers of clayey silt were encountered within the silty clay till deposit.

A 1.6 m thick layer of silty clay till was also contacted at 9.1 m depth (Elevation 162.5 m) in Borehole CNH-03.

The depth to the base of the silty clay till ranged from 10.7 m to 21.3 m (Elevations 158.9 to 163.4 m).

Boreholes CNH-08 and CNH-10 were terminated within the silty clay till at 15.6 m and 6.7 m depth (Elevations 165.7 and 174.6 m).

Based on SPT 'N' values ranging from 8 to 92 blows for 0.3 m of penetration, the silty clay till is described as firm to hard in consistency. SPT 'N' values higher than 100 blows per 0.225 m of penetration were observed at or below Elevation 169.0 m in Boreholes CNH-04 and CNH-08, and near Elevations 166.0 to 163.0 m in Boreholes 6 and 7.

The natural moisture contents of the samples recovered from the silty clay till layer ranged from 8% to 30%.

Grain size distribution curves for the silty clay till samples tested are presented on the Record of Borehole sheets and on Figures B3 to B5 of Appendix B. Grain size distribution curves for clayey silt samples are presented on Figure B6 of Appendix B. Atterberg Limit test results are presented on Figures B11 to B13 of Appendix B.

Laboratory test results of previous investigation are presented in Appendix C.

The results of laboratory tests are summarized as follows:

Soil Particles	Silty Clay Till (%)	Clayey Silt (%)
Gravel	0 to 23	0
Sand	3 to 46	1 to 4
Silt	27 to 82	74 to 83
Clay	4 to 40	16 to 25

Liquid Limit	18 to 48	-
Plasticity Index	8 to 27	-

The above results show that the silty clay till is typically of low to medium plasticity with a group symbol of CL-CI.

Cobbles and boulders were noted in the silty clay till in Boreholes 3, 5, 6 and 7 drilled during the previous investigation. Glacial tills inherently contain cobbles and boulders which may occur for some high blow counts and resistance to augering.

5.1.6 Silty Sand

Native grey silty sand was contacted below the silty clay till in Boreholes CNH-01 to CNH-03 and CNH-05 to CNH-07, and 1 to 8, drilled for the present and previous investigations, respectively. The silty sand contains trace gravel, trace clay and occasional cobbles, boulders throughout the deposit and shale fragments.

The silty sand layer was fully penetrated in Borehole CNH-01 located at the south abutment, with a thickness of 5.2 m.

A layer of sand was encountered within the silty sand in Borehole CNH-01 near Elevation 157.0 m.

A layer of silt and sand was contacted below the silty clay till at 17.8 m depth in Borehole CNH-04. Borehole CNH-04 was terminated within the silt and sand layer at 23.2 m (Elevation 158.0 m).

Layers of sand and gravel and layers of cobbles and boulders were encountered within the silty sand layer in boreholes drilled during the previous investigation.

Boreholes were terminated within the silty sand layer at depths ranging from 13.9 m to 26.1 m (Elevations 147.7 to 158.0 m). Borehole 3, drilled at the south pier of the Highway 427 NBL, was terminated at 33.4 m depth (Elevation 138.1 m).

SPT 'N' values measured in the silty sand layer generally ranged from 100 to 128 blows per 0.3 m of penetration, indicating a very dense relative density. An SPT 'N' value of 20 blows per 0.3 m of penetration, indicating compact relative density, was measured in Borehole CNH-01 near Elevation 157.0. SPT 'N' values higher than 100 blows per 0.1 m of penetration were measured near borehole termination depths.

The natural moisture contents of the samples recovered from the silty sand layer ranged from 10% to 19%.

Grain size distribution curves for the silty sand samples tested are presented on the Record of Borehole sheets and on Figures B7 and B8 of Appendix B.

Laboratory test results of the previous investigation are presented in Appendix C.

The results of laboratory tests are summarized as follows:

Soil Particles	Sand (%)	Silt and Sand (%)	Silty Sand (%)
Gravel	4	5	0 to 25
Sand	80	37	28 to 85
Silt	-	42	11 to 64
Clay	-	16	1 to 15
Silt & Clay	16	-	-

Occasional cobbles and boulders are reported throughout the silty sand layer, and the lower part of this deposit (just above bedrock) may contain pieces and slabs of bedrock which may account for some high blow counts and resistance to augering.

5.1.7 Sandy Silt

Native grey sandy silt containing trace clay was contacted within the silty clay till in Boreholes CNH-03 and CNH-07 drilled for the present investigation. The thickness of the sandy silt was 1.5 m and 1.0 m in Boreholes CNH-03 and CNH-07, respectively.

The depths to the base of the sandy silt were 9.1 m and 6.9 m (Elevations 162.5 and 164.7 m).

Based on SPT 'N' values of 15 and 60 blows for 0.3 m of penetration, the sandy silt is described as compact to very dense.

The natural moisture contents of the samples recovered from the sandy silt layer were 20%.

Grain size distribution curves for two sandy silt samples tested are presented on the Record of Borehole sheets and on Figure B9 of Appendix B.

The results of laboratory tests are summarized as follows:

Soil Particles	Sandy Silt (%)
Gravel	0
Sand	29 to 46
Silt	50 to 68
Clay	3 to 4

5.1.8 Bedrock

Bedrock was contacted below the silty sand at 25.0 m depth (Elevation 155.3 m) in Borehole CNH-01. The shale encountered in the borehole is described as thinly bedded and contains frequent hard interbedded siltstone and limestone layers, typical of the Georgian Bay Formation. The shale bedrock is highly to moderately weathered within the upper 2 m below which the degree of weathering decreases with depth and the rock strength increases with depth. An SPT 'N' value obtained in the upper part of the shale bedrock was higher than 100 blows per 0.1 m penetration. A moisture content of 11% was measured.

Bedrock cores were collected using NQ sized coring equipment. Total core recovery (TCR) in the bedrock were 80% and 100% in the two core runs.

RQD values recorded in the core runs were 7%, indicating a very poor rock quality.

The shale bedrock typically contains layers of siltstone and limestone that can be significantly harder than the shale itself. The distribution, thickness and strength of these layers vary from location to location, and these layers typically exhibit less pronounced weathering than the shale.

5.1.9 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in three selected boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.1, along with the measurements in the boreholes upon completion of drilling.

Table 5.1 – Measured Groundwater Levels

Foundation Element		Borehole	Date	Water Level (m)		Comment
				Depth (m)	Elevation (m)	
South Abutment	SBL	1	December 11, 1981	0.5	171.4	Perched water
	Median	CNH-05	January 21, 2009	14.5	165.7	In piezometer
			May 5, 2009	14.2	166.0	
			June 8, 2009	14.2	166.0	
	NBL	2	December 14, 1981	0.5	171.1	Perched water
South Pier	SBL	4	December 21, 1981	1.4	170.0	Perched water
	CNR grade	CNH-02	December 9, 2008	8.2	162.9	In open borehole
	CNR grade	CNH-06	January 21, 2009	6.1	165.3	In piezometer
			May 5, 2009	4.9	166.5	
			June 8, 2009	4.9	166.5	
	NBL	3	December 17, 1981	0.9	170.6	Perched water
North Pier	SBL	6	December 21, 1981	0.0	170.6	Perched water
	CNR grade	CNH-03	January 21, 2009	6.1	165.5	In piezometer
			May 5, 2009	5.6	166.0	
			June 8, 2009	5.5	166.1	
	CNR grade	CNH-07	December 12, 2008	0.5	171.1	In open borehole
North Abutment	Median	CNH-04	December 15, 2008	11.6	169.7	In open borehole
	NBL	5	December 18, 1981	5.7	165.8	In open borehole

Groundwater levels measured in the piezometers ranged from Elevations 166.0 to 166.5 m. A higher perched water level was noted at elevations ranging from 170.0 to 171.4 m.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in pockets or zones of more permeable sands and silts within the heterogeneous tills, or within the fill.

6 MISCELLANEOUS

Co-ordinates and ground surface elevations for boreholes of the present investigation were supplied to Thurber by SNC-Lavalin.

The drilling and sampling equipment was supplied and operated by DBW Drilling of Ajax, Ontario and Groundwork Drilling Inc. of Etobicoke, Ontario. The field work was supervised on a full time

basis by Mr. George Azzopardi and Mr. William Ball of Thurber Engineering Ltd. under the direction of Dr. Sydney Pang, P. Eng.

Laboratory testing was carried out at Thurber's Laboratory in Oakville, Ontario.

Overall supervision of the field program was conducted by Dr. Sydney Pang, P. Eng. Interpretation of the data and preparation of the report were carried out by Dr. Sydney Pang, P. Eng, and Ms. R. Palomeque Reyna, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

THURBER ENGINEERING LTD.

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Review Principal



Appendix A

**Record of Borehole Sheets
(Present Investigation)**

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$



Water Level

C_{pen}


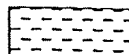



Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. $(W_L < 30\%)$.
		CI	Inorganic clays of medium plasticity, silty clays. $(30\% < W_L < 50\%)$.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION		
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	Field Estimation of Hardness*
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m			
Medium bedded	0.2 to 0.6m	Very Strong	100-250	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m			
Very thinly bedded	20 to 60mm	Strong	50-100	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm			
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	Breaks under single blow of geological hammer.

TERMS				
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen			
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.			

RECORD OF BOREHOLE No CNH-01

1 OF 4

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 049.2 E 294 356.2 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.01 - 2008.12.03 CHECKED BY SKP

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 X LAB VANE				
180.3	TOPSOIL (50mm)						20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
180.0	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown (FILL)		1	SS	16		40 80 120 160 200					
			2	SS	17							8 24 34 34
			3	SS	27							
			4	SS	30							
			5	SS	15							7 31 37 25
			6	SS	24							
171.1	Silty CLAY, trace to some sand, trace gravel, occasional iron oxide Hard Brown (TILL)		7	SS	50							

Continued Next Page

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

RECORD OF BOREHOLE No CNH-01

2 OF 4

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 049.2 E 294 356.2 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.01 - 2008.12.03 CHECKED BY SKP

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		
	Continued From Previous Page							SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					
								WATER CONTENT (%)					
								40 80 120 160 200	20 40 60				
	Silty CLAY, trace to some sand, trace gravel, occasional iron oxide Hard Brown (TILL)						170						
	Occasional layers of clayey silt		8	SS	70		169						0 4 79 17
							168						
			9	SS	63		167						
							166						
			10	SS	81		165						
							164						
	with sand		11	SS	41		163						6 35 43 16
							162						
			12	SS	51		161						
160.5													
19.8													

Continued Next Page

+³ X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-01

3 OF 4

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 049.2 E 294 356.2 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.01 - 2008.12.03 CHECKED BY SKP

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					
	Continued From Previous Page						20 40 60 80 100						
							○ UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL x LAB VANE						
							WATER CONTENT (%)						
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
							w _p w w _L						
							40 80 120 160 200						
							20 40 60						

RECORD OF BOREHOLE No CNH-01

4 OF 4

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 049.2 E 294 356.2 ORIGINATED BY GA
HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
DATUM Geodetic DATE 2008.12.01 - 2008.12.03 CHECKED BY SKP

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
							20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page															
149.4	SHALE, moderately weathered, thinly bedded, frequent limestone and siltstone interbeds Grey		3	RUN		150										RUN 3# TCR=100%, SCR=23%, RQD=7%
30.9	END OF BOREHOLE AT 30.9m. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.															

ONTMT4S 9270.GPJ 6/29/09

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-02

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 073.9 E 294 349 3 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.08 - 2008.12.09 CHECKED BY SKP

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					
								20 40 60 80 100					
								● QUICK TRIAXIAL × LAB VANE					
				○ UNCONFINED + FIELD VANE				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
								WATER CONTENT (%)					
								w _p w w _L					
171.1													
0.0	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown (TILL)		1	SS	13		171						
							170						
			2	SS	28		169						4 28 49 19
	Occasional layers of grey clayey silt						168						0 1 83 16
			3	SS	22		167						
	Grey						166						
			4	SS	25		165						3 26 37 34
165.3							164						
5.8	Hard		5	SS	48		163						
							162						
			6	SS	56								
			7	SS	79								

Continued Next Page

+³ . X³ : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-03

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 094.6 E 294 347.1 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.11 - 2008.12.11 CHECKED BY SKP

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	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
171.6												
0.0	SUB-BALLAST (FILL)		1	SS	13		171					
0.2	Silty CLAY, with sand, trace gravel Stiff Brown (TILL)		2	SS	8		170					
168.9							169					
2.7	Very Stiff to Hard		3	SS	18		168					1 23 53 23
	Occasional layers of grey clayey silt		4	SS	30		167					0 1 74 25
	Grey		5	SS	37		166					
164.0							165					
7.6	Sandy SILT, trace clay Compact Grey Wet		6	SS	15		164					0 29 68 3
162.5							163					
9.1	Silty CLAY, trace to some sand, trace gravel Hard Grey (TILL)		7	SS	55		162					

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

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15
10
(%) STRAIN AT FAILURE

ONTMT4S 9270.GPJ 6/29/09

RECORD OF BOREHOLE No CNH-03

2 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 094.6 E 294 347.1 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.11 - 2008.12.11 CHECKED BY SKP

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						
	Continued From Previous Page						20 40 60 80 100							
							○ UNCONFINED + FIELD VANE							
							● QUICK TRIAXIAL X LAB VANE							
							WATER CONTENT (%)							
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT							
							W _p W W _L							
							40 80 120 160 200							
160.9	Silty CLAY, trace to some sand, trace gravel Hard Grey (TILL)													
10.7	Silty SAND, trace to some gravel, occasional cobbles Very Dense Grey Wet		8	SS	116									
	Shale fragments, occasional inferred cobbles and boulders		9	SS	123									
157.7			10	SS	109/									
13.9	END OF BOREHOLE AT 13.9m. BOREHOLE OPEN TO 12.8m AND WATER LEVEL AT 0.3m UPON COMPLETION OF DRILLING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.01.21 6.1 165.5 2009.05.05 5.6 166.0 2009.06.08 5.5 166.1				.150									

+³, ×³: Numbers refer to Sensitivity



20
15
10
5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-04

1 OF 3

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 119.7 E 294 338.6 ORIGINATED BY WB
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.15 - 2008.12.15 CHECKED BY SKP

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	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE			W _p	W	W _L		
							20	40	60	80	100	20	40	60				
181.3	ASPHALT: (75mm)																	
0.0			SILT and SAND, some gravel, trace clay Dense to Very Dense Brown Moist (FILL)	1	SS	60												
0.1				2	SS	43												
				3	SS	31												
				4	SS	60												
	5	SS		52														
177.3	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown (TILL)																	
4.0			6	SS	23													
			7	SS	25													
			8	SS	48													
			9	SS	44													

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-04

2 OF 3

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 119.7 E 294 338.5 ORIGINATED BY WB
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.15 - 2008.12.15 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT Y 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		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			
							WATER CONTENT (%)						
							W P W L						
							O UNCONFINED + FIELD VANE						
							● QUICK TRIAXIAL X LAB VANE						
							40 80 120 160 200						
							20 40 60						

Continued Next Page

+³ × 3³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-04

3 OF 3

METRIC

GW.P. 202-95-00 LOCATION N 4 845 119.7 E 294 338.5 ORIGINATED BY WB
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.15 - 2008.12.15 CHECKED BY SKP

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 X LAB VANE								
	Continued From Previous Page															
	SILT and SAND, some clay, trace gravel Very Dense Grey Moist				100											
			17	SS	100/ .100											
	Moist to Wet		18	SS	100/ .225											
158.0 23.2	END OF BOREHOLE AT 23.2m AND WATER LEVEL AT 11.6m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.075m, THEN ASPHALT TO SURFACE.															

RECORD OF BOREHOLE No CNH-05

1 OF 3

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 053.1 E 294 358.8 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.04 - 2008.12.04 CHECKED BY SKP

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 (%)			
180.2								20	40	60	80	100						
0.0	TOPSOIL (75mm)							○ UNCONFINED	+ FIELD VANE									
0.1	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown (FILL)		1	SS	14			● QUICK TRIAXIAL	x LAB VANE									
			2	SS	17													
			3	SS	20									6 30 36 28				
			4	SS	18													
			5	SS	22													
			6	SS	27													

Continued Next Page

+ 3 x 3 Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

ONTMT4S 9270.GPJ 6/29/09

RECORD OF BOREHOLE No CNH-05

3 OF 3

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 053.1 E 294 358.8 ORIGINATED BY GA
HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
DATUM Geodetic DATE 2008.12.04 - 2008.12.04 CHECKED BY SKP

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		
	Continued From Previous Page						SHEAR STRENGTH kPa						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
							WATER CONTENT (%)						
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
							40 80 120 160 200						
							20 40 60						
158.9	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		14	SS	92								
21.3	Silty SAND, trace clay, trace gravel Very Dense Grey Wet		15	SS	121								5 64 23 8
	Hard augering												
155.8	Some gravel, some clay, occasional shale fragments, occasional cobbles and boulders Hard augering		16	SS	128								
24.4	Highly weathered shale		17	SS	115								11 45 29 15
154.1			18	SS	105/								
26.1	END OF BOREHOLE AT 26.1m UPON REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 26m AND WATER LEVEL AT 11.8m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.01.21 14.5 165.7 2009.05.05 14.2 166.0 2009.06.08 14.2 166.0				0.150								

+ 3, X 3. Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

ONT\MT4S 9270.GPJ 6/29/09

RECORD OF BOREHOLE No CNH-06

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 080.9 E 294 358.3 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.09 - 2008.12.10 CHECKED BY SKP

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	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
171.4												
0.0	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown (TILL)		1	SS	11		171					3 23 34 40
	Occasional iron oxide staining		2	SS	28		170					
168.5							169					
2.9	Hard trace sand		3	SS	50		168					0 3 68 29
							167					
	Grey		4	SS	48		166					
							165					
			5	SS	34		164					
							163					
	with sand		6	SS	48		162					2 31 47 20
			7	SS	69							

Continued Next Page

+³ X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-06

2 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 080.9 E 294 358.3 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.09 - 2008.12.10 CHECKED BY SKP

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 (%)
								20 40 60 80 100		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					
	Continued From Previous Page							○ UNCONFINED + FIELD VANE		w _p — w — w _L					
								● QUICK TRIAXIAL × LAB VANE							
								40 80 120 160 200	20 40 60						
160.7	Silty CLAY, with sand, trace gravel Hard Grey (TILL)						161								
10.7	Silty SAND, some gravel, trace clay Very Dense Grey Wet		8	SS	101						○		11 55 25 9		
							160								
			9	SS	110		159				○				
	Hard augering						158				○				
			10	SS	122		157								
155.8			11	SS	101		156				○				
15.5	END OF BOREHOLE AT 15.5m. BOREHOLE OPEN TO 15.2m AND WATER LEVEL AT 5.8m UPON COMPLETION OF DRILLING. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.01.21 6.1 165.3 2009.05.05 4.9 166.5 2009.06.08 4.9 166.5														

RECORD OF BOREHOLE No CNH-07

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 100.9 E 294 354.5 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.12 - 2008.12.12 CHECKED BY SKP

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 x LAB VANE				
						WATER CONTENT (%)						

Continued Next Page

+ ³ . x ³ : Numbers refer to
Sensitivity

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10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-07

2 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 100.9 E 294 354.5 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY MFA
 DATUM Geodetic DATE 2008.12.12 - 2008.12.12 CHECKED BY SKP

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	120 140 160 180 200	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
160.9	Silty CLAY, with sand, trace gravel Hard Grey (TILL)						161							
10.7	Silty SAND, trace gravel Very Dense Grey Wet		8	SS	101		160							
			9	SS	115		159							
	Hard augering													
	occasional inferred cobbles						158							
			10	SS	111		157							
156.0			11	SS	122									
15.5	END OF BOREHOLE AT 15.5m. BOREHOLE OPEN TO 14.6m AND WATER LEVEL AT 0.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO 1.5m, THEN SEALED WITH BENTONITE HOLEPLUG TO SURFACE.													

+ 3, x 3: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-08

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 128.7 E 294 354.8 ORIGINATED BY WB
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.18 - 2008.12.18 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y 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	
181.3	ASPHALT: (75mm)											
0.0 0.1	Gravelly SAND Very Dense Brown Moist (FILL)		1	SS	53		181					
180.3	SILT and SAND, trace clay Loose Brown Moist (FILL)		2	SS	7		180					
176.8	Silty CLAY, with sand, trace gravel Hard Brown (TILL)		3	SS	30		179					
4.6	Occasional layers of silty sand		4	SS	42		178					0 55 39 6
			5	SS	30		177					
							176					
							175					0 22 45 33
							174					
							173					
							172					

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-08

2 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 128.7 E 294 354.8 ORIGINATED BY WB
HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
DATUM Geodetic DATE 2008.12.18 - 2008.12.18 CHECKED BY SKP

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				
								20	40	60		
Continued From Previous Page								20 40 60 80 100			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	
								40 80 120 160 200			W _P W W _L	
								O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE			WATER CONTENT (%)	
								40 80 120 160 200			20 40 60	

+³ X³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No CNH-09

1 OF 1

METRIC

G.W.P. 202-95-00

LOCATION N 4 845 035.8 E 294 359.8

ORIGINATED BY GA

HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY AN

DATUM Geodetic

DATE 2008.12.05 - 2008.12.05

CHECKED BY SKP

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 Y 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 (%)					
179.8	TOPSOIL (50mm)													
179	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown (FILL)		1	SS	12									
178			2	SS	16									
177			3	SS	8									
176			4	SS	27									
175			5	SS	26									
174														
173.1														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

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

RECORD OF BOREHOLE No CNH-10

1 OF 1

METRIC

G.W.P. 202-95-00

LOCATION N 4 845 130.8 E 294 336.8

ORIGINATED BY WB

HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY MFA

DATUM Geodetic

DATE 2008.12.17 - 2008.12.17

CHECKED BY SKP

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						
181.3	ASPHALT: (75mm)													
0.0														
0.1	SILT and SAND, trace clay Dense to Compact Brown Moist (FILL)		1	SS	47									
			2	SS	47									
			3	SS	25									
			4	SS	24									
			5	SS	14									
177.0	Silty CLAY, with sand, trace gravel Very Stiff Brown (TILL)													
4.3			6	SS	16									
			7	SS	15									
174.6	END OF BOREHOLE AT 6.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.075m, THEN ASPHALT TO SURFACE.													
6.7														

+ 3, X 3

Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

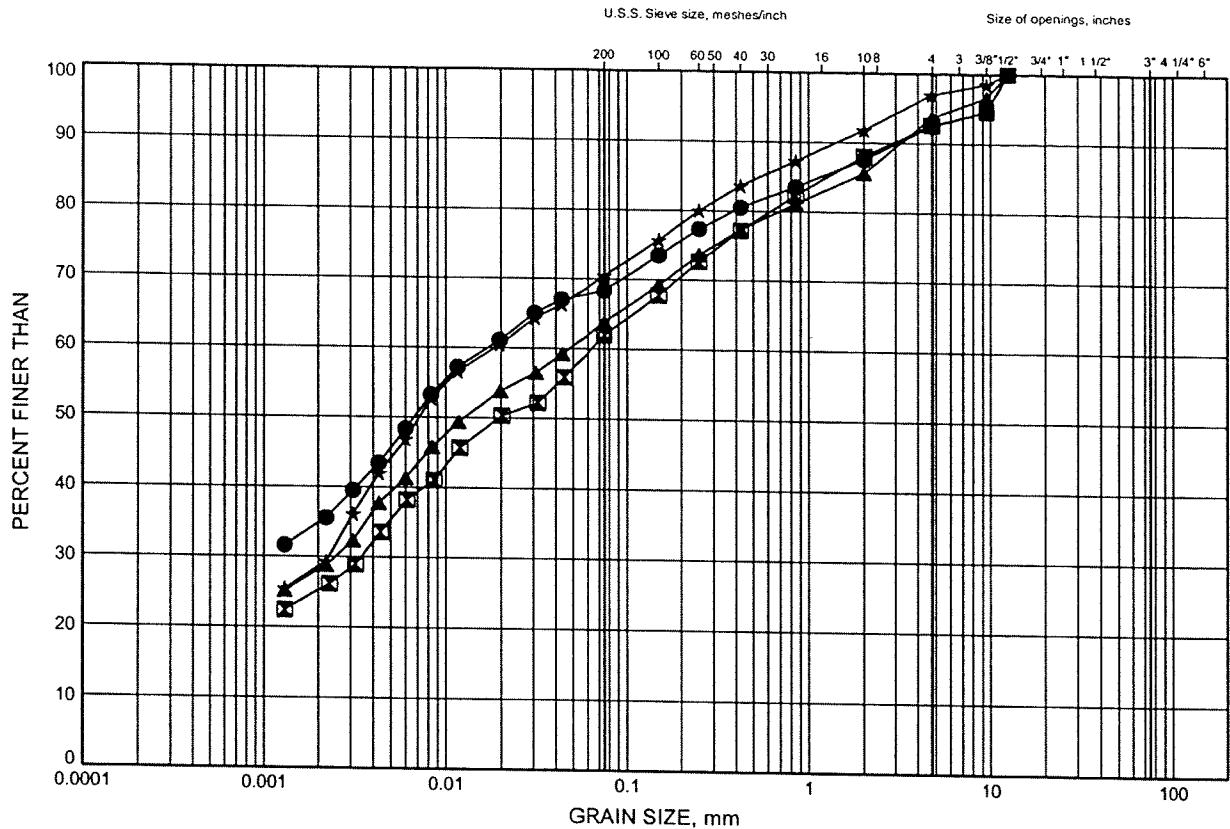
Appendix B

Laboratory Test Results

Hwy 427 Northbound and Southbound GRAIN SIZE DISTRIBUTION

FIGURE B1

SILTY CLAY FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-01	1.83	178.44
⊠	CNH-01	6.40	173.87
▲	CNH-05	3.35	176.81
★	CNH-09	3.35	176.45

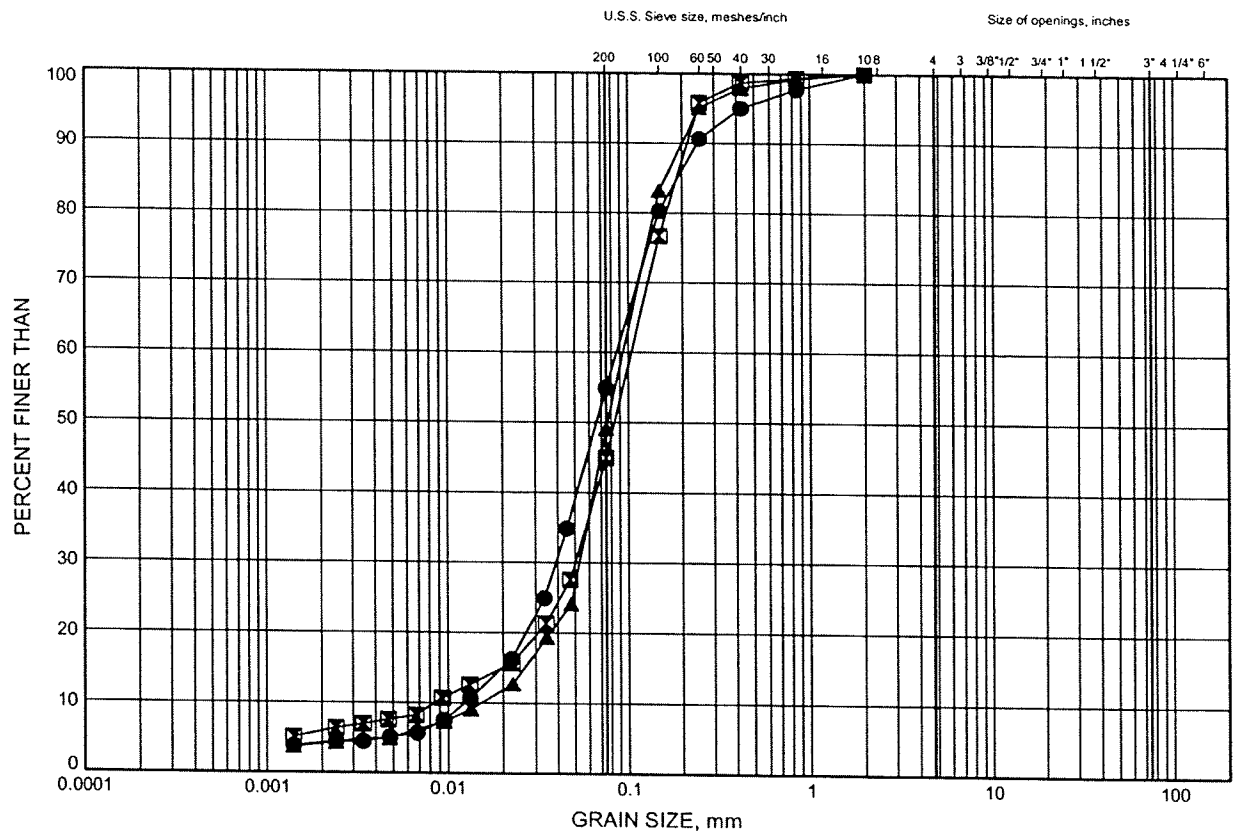


W.P.# 19-92-70
Prepared By AN
Checked By RPR

Hwy 427 Northbound and Southbound GRAIN SIZE DISTRIBUTION

FIGURE B2

SILT & SAND FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-04	2.59	178.68
☒	CNH-08	3.35	177.97
▲	CNH-10	2.59	178.70

GRAIN SIZE DISTRIBUTION - THURBER 9270.GPJ 7/8/09

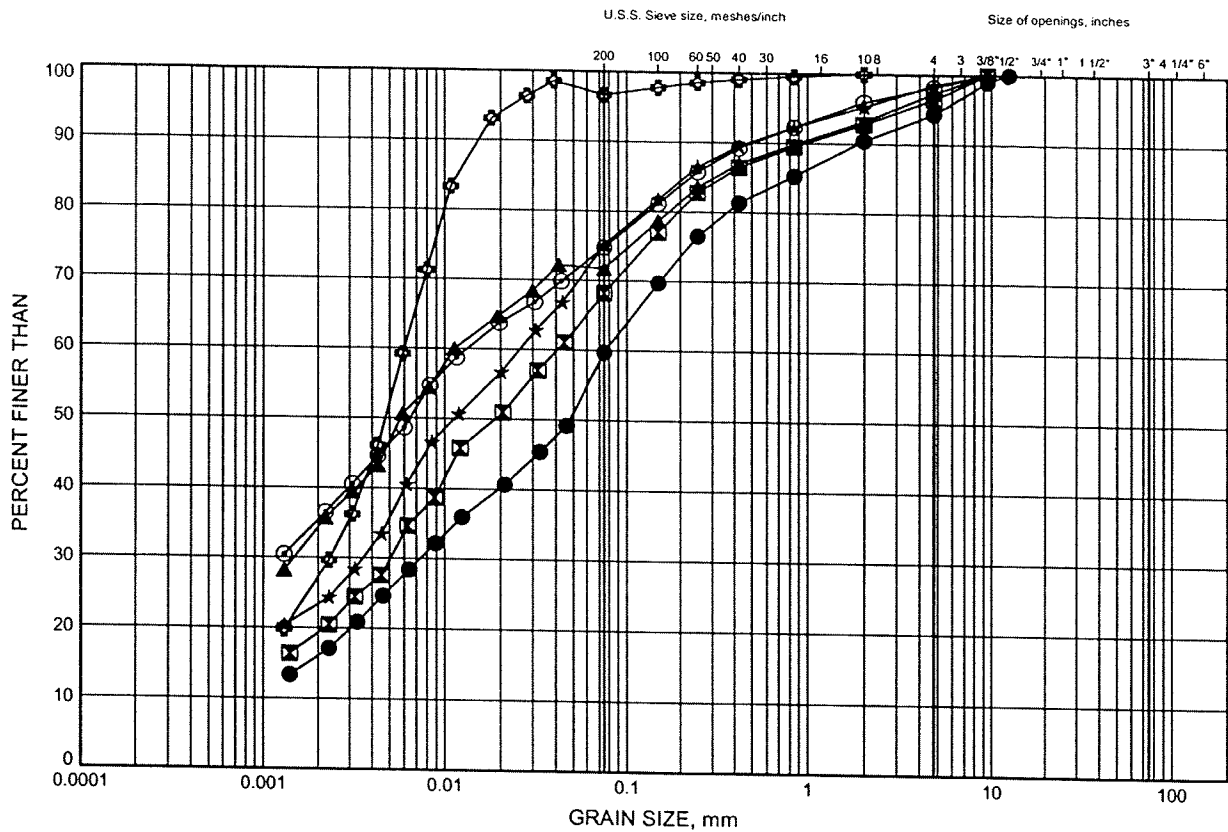
W.P.# 202-95-00
Prepared By AN
Checked By RPR



Hwy 427 Northbound and Southbound GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

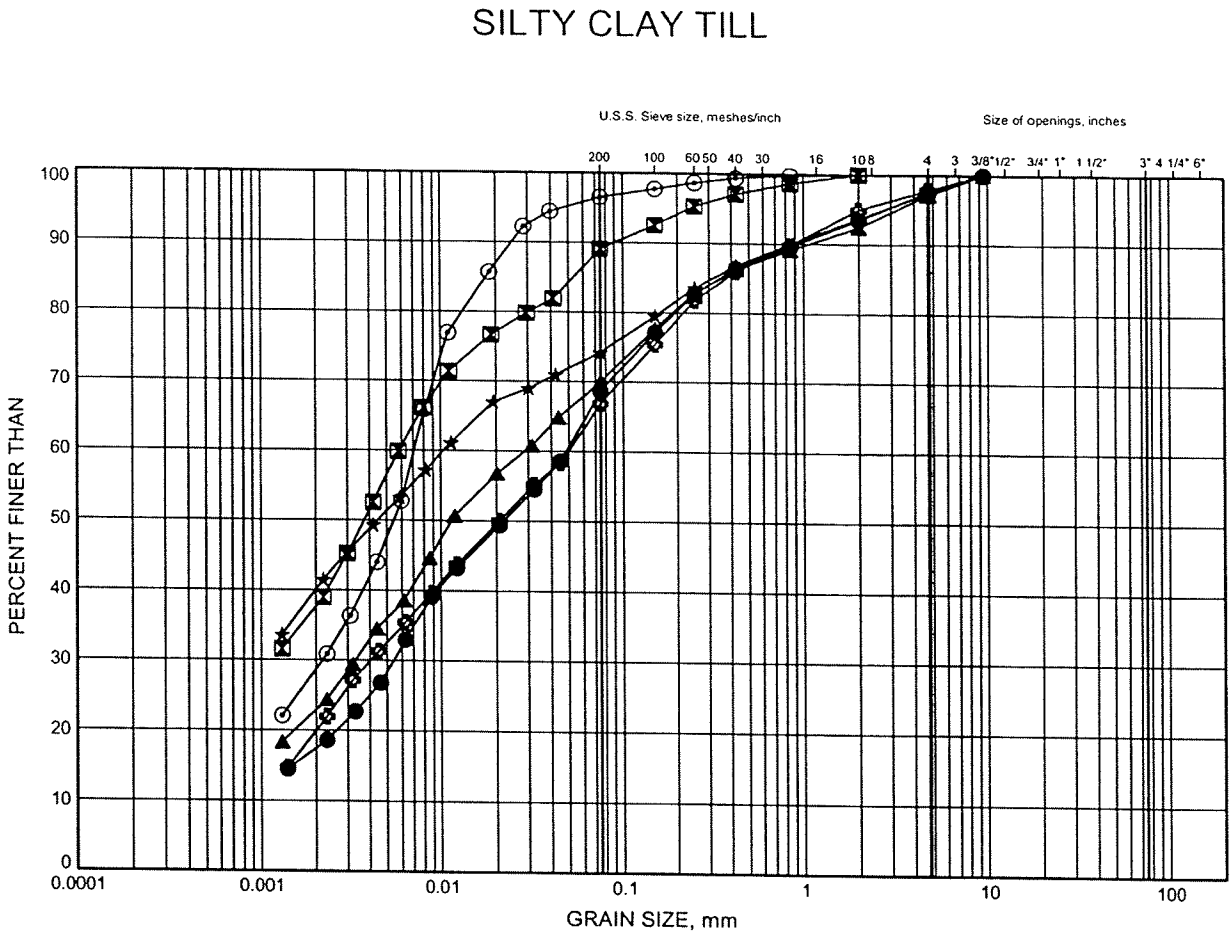
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-01	15.54	164.73
⊠	CNH-02	1.83	169.30
▲	CNH-02	6.40	164.73
★	CNH-03	3.35	168.24
⊙	CNH-04	6.40	174.87
⊕	CNH-04	14.02	167.25



W.P.# 19-92-70
Prepared By AN
Checked By RPR

Hwy 427 Northbound and Southbound
GRAIN SIZE DISTRIBUTION

FIGURE B4



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-04	15.54	165.73
⊠	CNH-05	9.45	170.72
▲	CNH-05	17.07	163.10
★	CNH-06	0.30	171.08
⊙	CNH-06	3.35	168.03
⊗	CNH-06	7.92	163.46

GRAIN SIZE DISTRIBUTION - THURBER 9270.GPJ 5/1/09

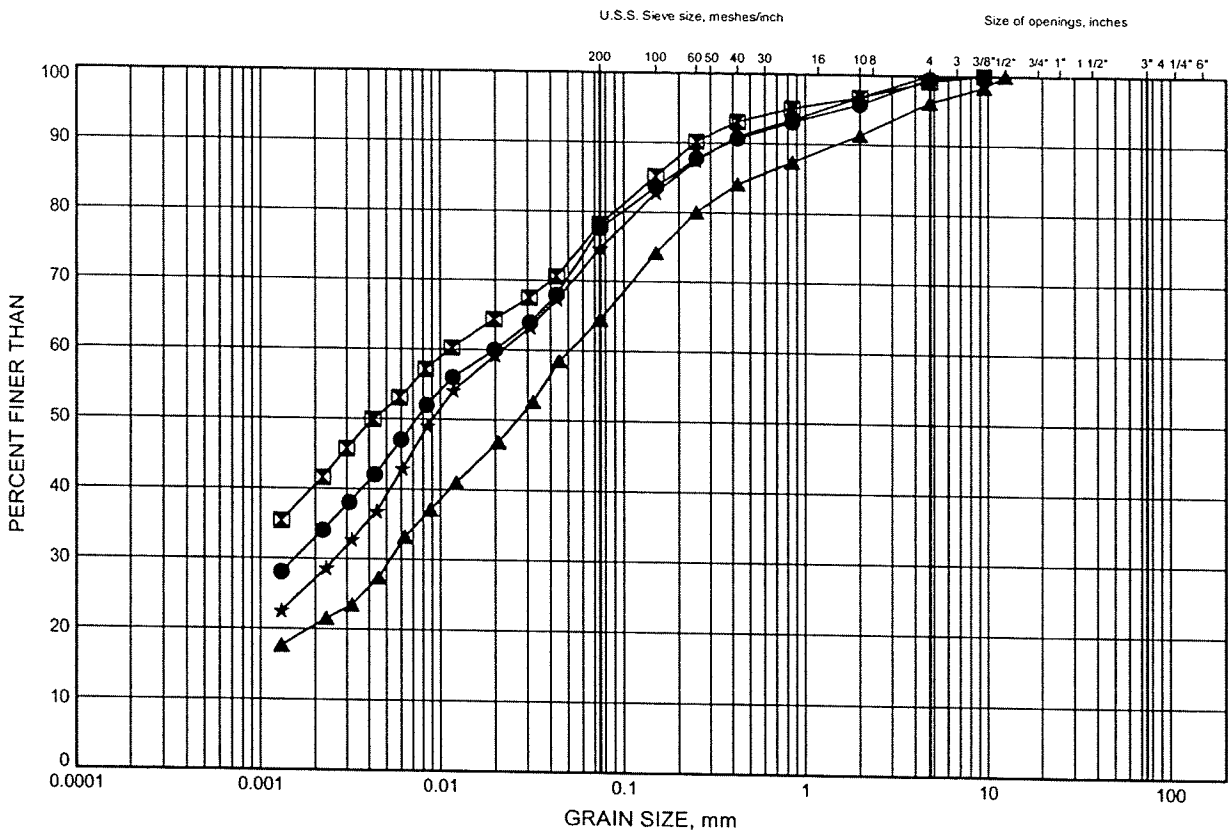
W.P.# 19-92-70.....
Prepared By AN.....
Checked By RPR.....



Hwy 427 Northbound and Southbound
GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-08	6.40	174.92
■	CNH-08	10.97	170.35
▲	CNH-08	15.44	165.88
★	CNH-10	4.88	176.42

GRAIN SIZE DISTRIBUTION - THURBER 9270.GPJ 5/1/09

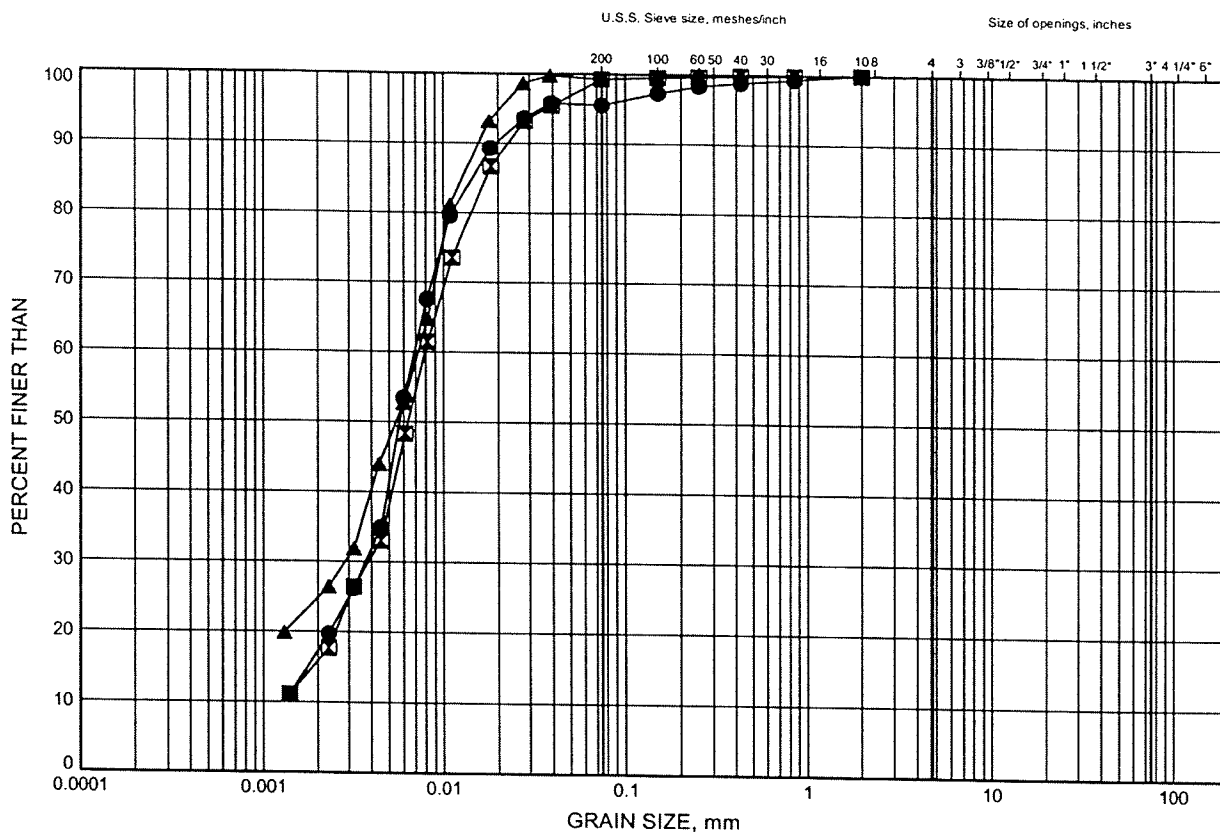
W.P.# 19:92-70
Prepared By AN
Checked By RPR



Hwy 427 Northbound and Southbound GRAIN SIZE DISTRIBUTION

FIGURE B6

CLAYEY SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

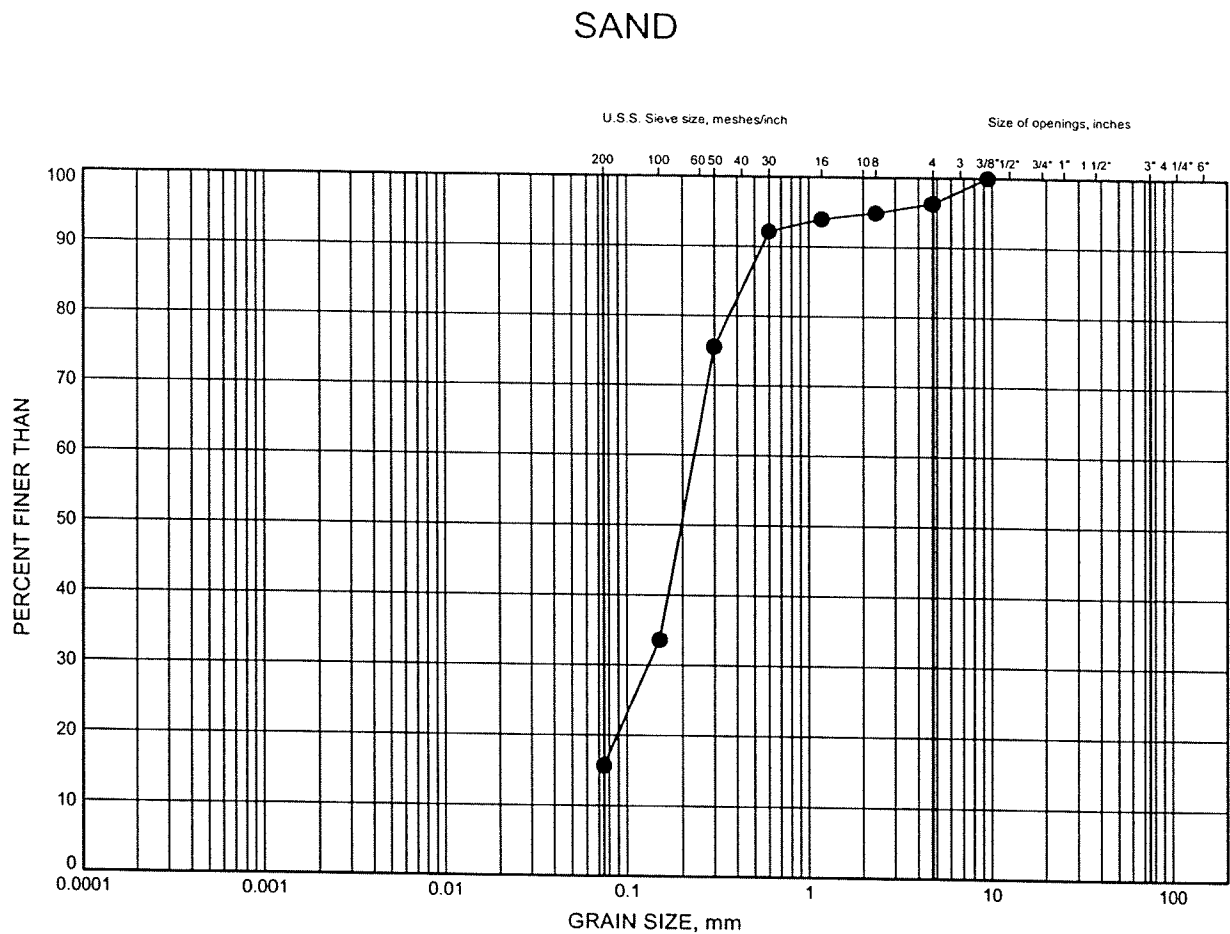
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-01	10.97	169.30
⊠	CNH-02	3.35	167.78
▲	CNH-03	4.88	166.72

W.P.# 19-92-70
Prepared By AN
Checked By RPR



Hwy 427 Northbound and Southbound GRAIN SIZE DISTRIBUTION

FIGURE B7



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-01	23.16	157.11

GRAIN SIZE DISTRIBUTION - THURBER 9270.GPJ 5/1/09

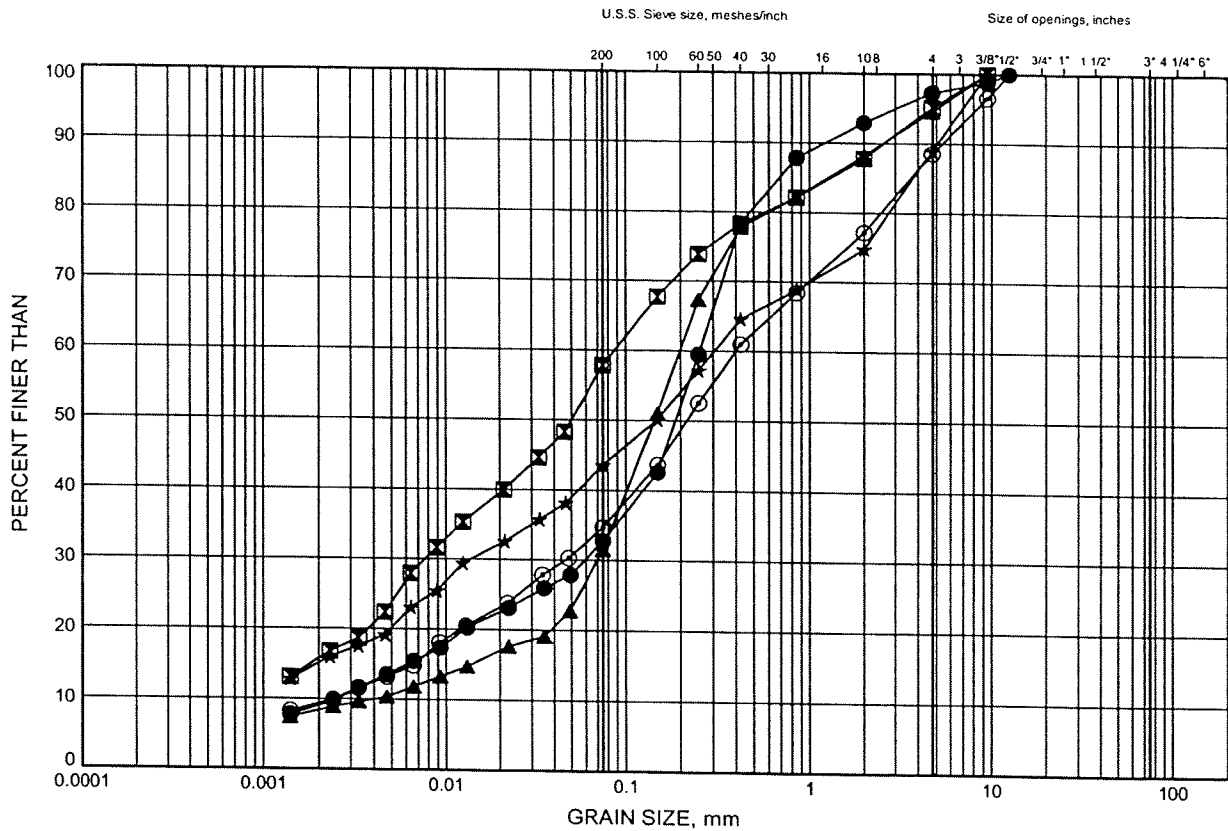
W.P.# .19-92-70.....
 Prepared By .AN.....
 Checked By .RPR.....



Hwy 427 Northbound and Southbound GRAIN SIZE DISTRIBUTION

FIGURE B8

SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-02	12.50	158.63
⊠	CNH-04	18.48	162.79
▲	CNH-05	21.64	158.52
★	CNH-05	24.69	155.48
⊙	CNH-06	10.97	160.41

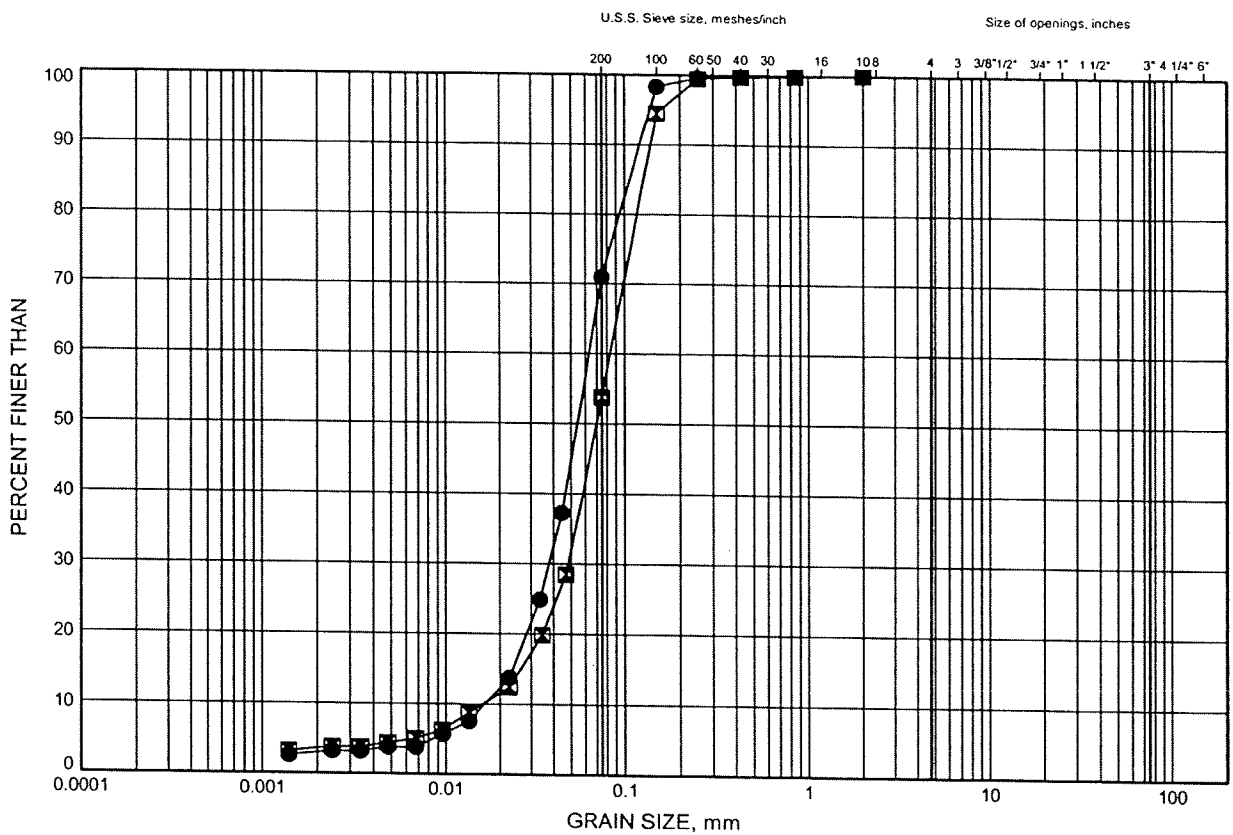


W.P.# .202-95-00.....
Prepared By .MFA.....
Checked By .RPR.....

Hwy 427 Northbound and Southbound
GRAIN SIZE DISTRIBUTION

FIGURE B9

SANDY SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CNH-03	7.92	163.67
⊠	CNH-07	6.40	165.15



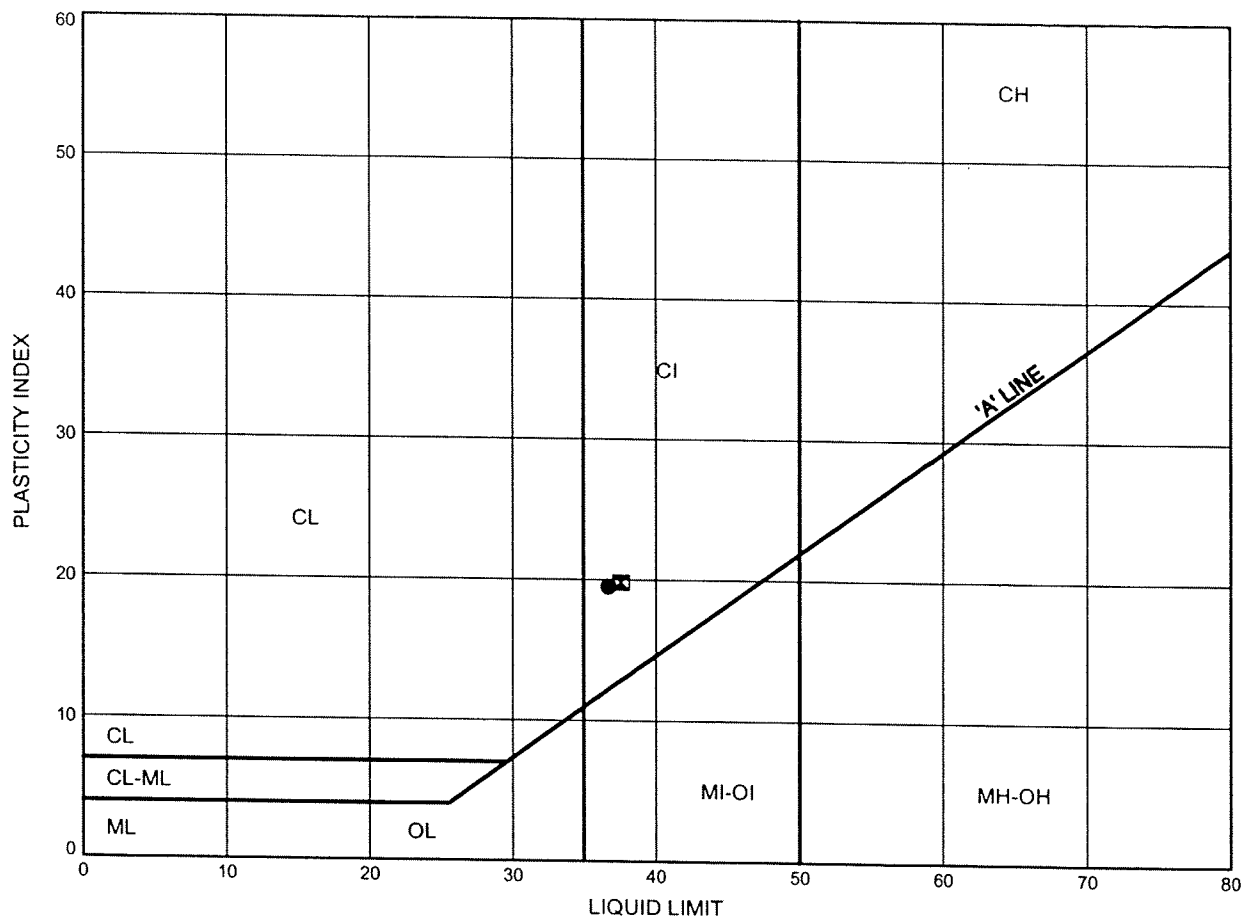
W.P.# 202-95-00.....
Prepared By MFA.....
Checked By RPR.....

GRAIN SIZE DISTRIBUTION - THURBER 9270.GPJ 6/29/09

Hwy 427 Northbound and Southbound ATTERBERG LIMITS TEST RESULTS

FIGURE B10

SILTY CLAY FILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CNH-01	6.40	173.87
⊠	CNH-09	3.35	176.45

Date May 2009

Project 19-92-70



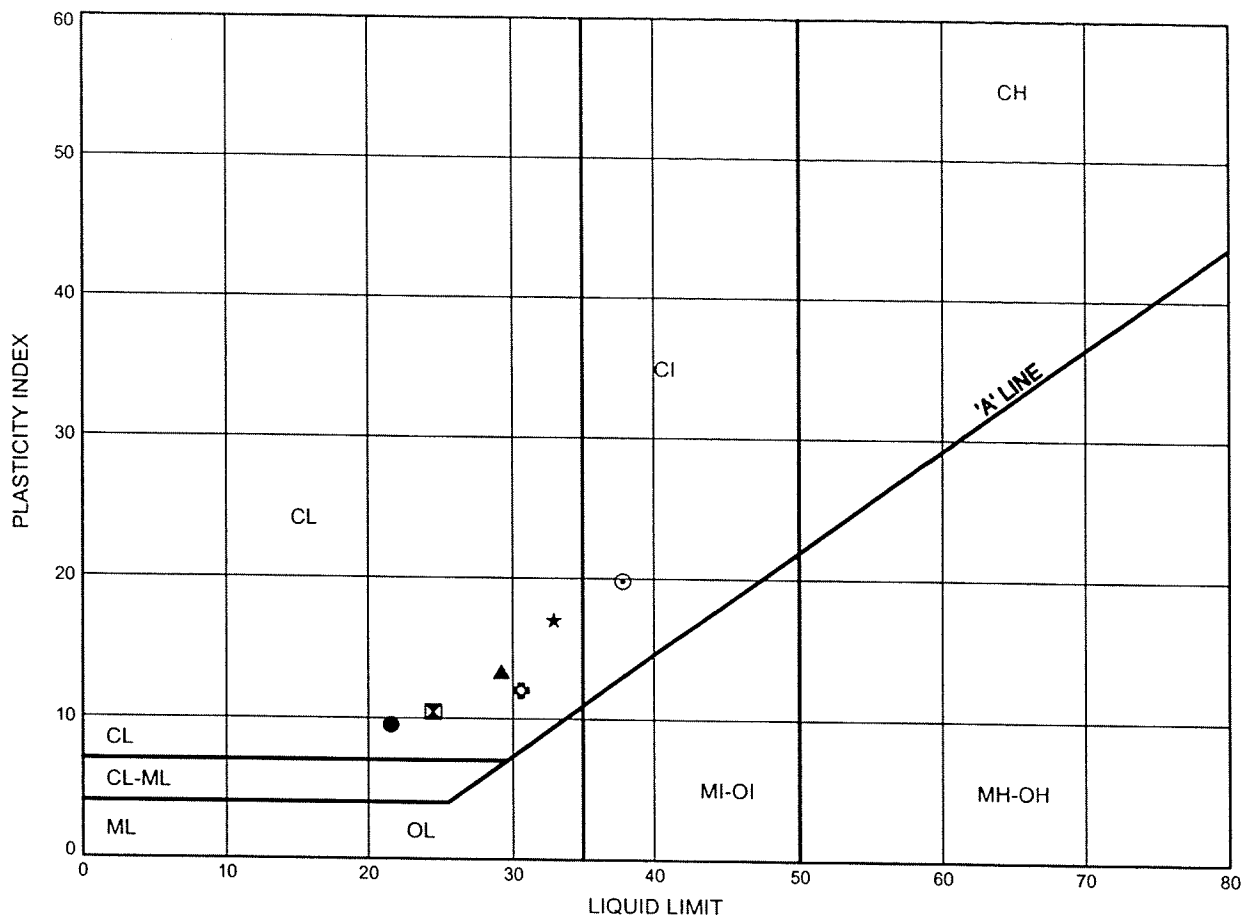
Prep'd AN

Chkd. RPR

Hwy 427 Northbound and Southbound ATTERBERG LIMITS TEST RESULTS

FIGURE B11

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CNH-01	15.54	164.73
⊠	CNH-02	1.83	169.30
▲	CNH-02	6.40	164.73
★	CNH-03	3.35	168.24
⊙	CNH-04	6.40	174.87
⊛	CNH-04	14.02	167.25

THURBALT 9270.GPJ 5/1/09

Date May 2009
Project 19-92-70

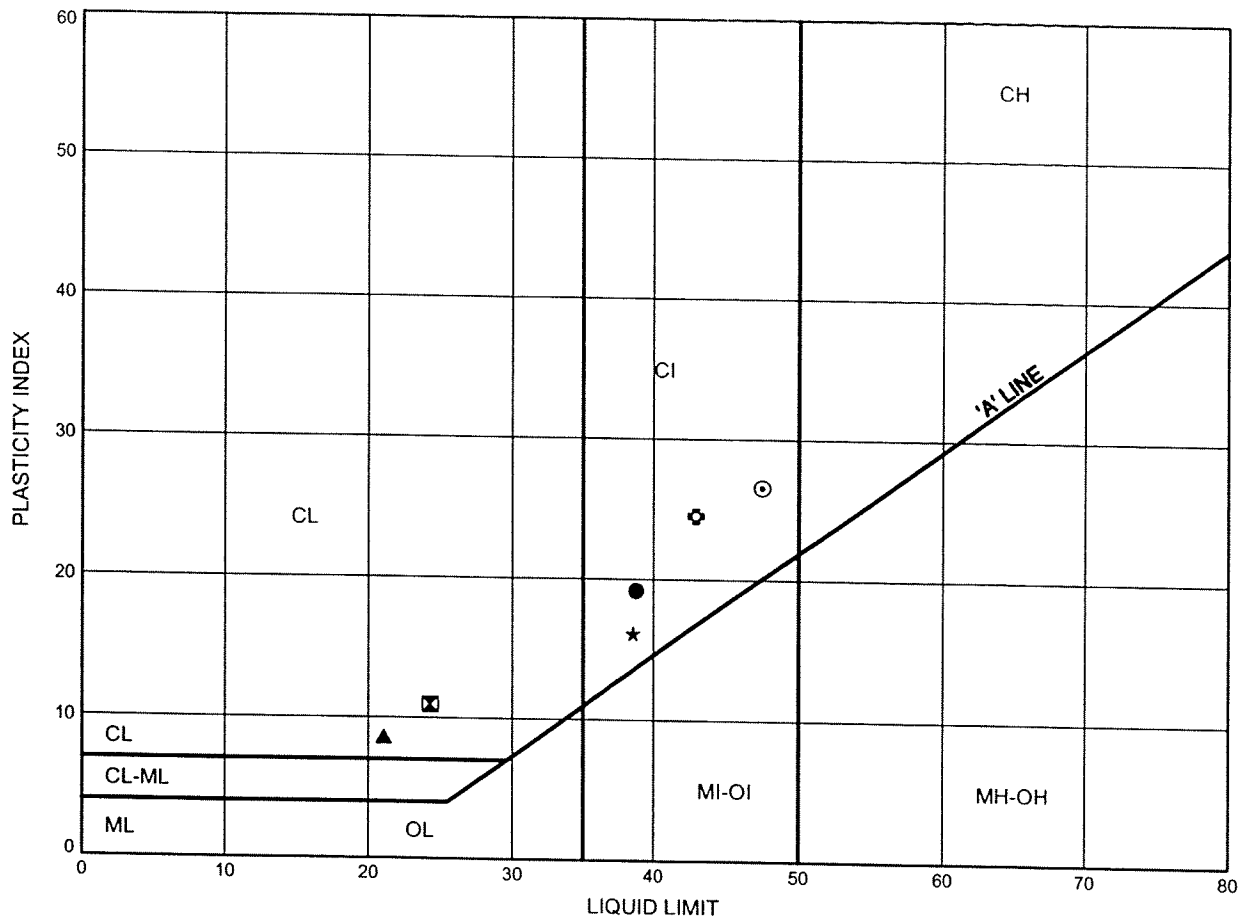


Prep'd AN
Chkd. RPR

Hwy 427 Northbound and Southbound
ATTERBERG LIMITS TEST RESULTS

FIGURE B12

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CNH-05	9.45	170.72
⊠	CNH-05	17.07	163.10
▲	CNH-06	7.92	163.46
★	CNH-07	1.83	169.72
⊙	CNH-08	6.40	174.92
⊕	CNH-08	10.97	170.35

Date May 2009
 Project 19-92-70

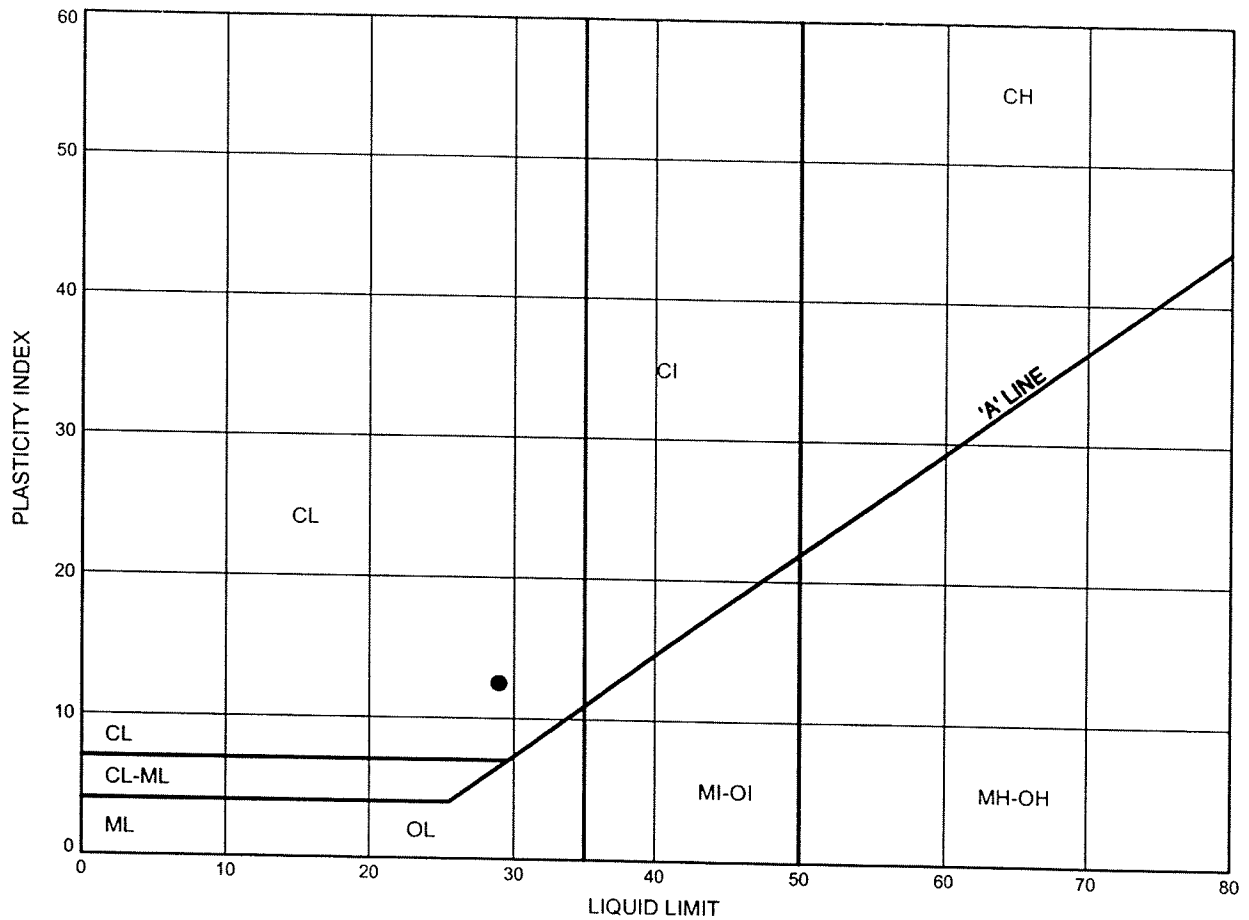


Prep'd AN
 Chkd. RPR

Hwy 427 Northbound and Southbound
ATTERBERG LIMITS TEST RESULTS

FIGURE B13

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	CNH-10	4.88	176.42

Date May 2009
 Project 19-92-70



Prep'd AN
 Chkd. RPR

Appendix C

Record of Borehole Sheets (Previous Investigation)

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1										METRIC			
W P 153-80-02		LOCATION Co-ords. N 4 844 821.2; E 294 328.3		ORIGINATED BY V.P.									
DIST 6 HWY 427		BOREHOLE TYPE Hollow Stem Augers and Cone Test		COMPILED BY V.P.									
DATUM Geodetic		DATE 81-12-10 to 81-12-11		CHECKED BY [Signature]									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
171.9	Ground Surface												
0.0													
	Mottled		1	SS	9								2-20-45-33
			2	SS	13								
			3	SS	29								
			4	SS	27								
			5	SS	21								
			6	SS	15								
			7	SS	14								
			8	SS	16								
			9	SS	53								
			10	SS	37								
160.0													
11.9													
31.9	Silty Sand Dense		11	SS	37								0-28-42-30
158.0													
13.9	Break corebarrel in borehole												
45.4	Abandon hole												
	End of Borehole												
	* Borehole caved at shallow depth. Perched water level at 0.5 metres.												

METRIC

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 3

METRIC

W P 153-80-02 LOCATION Co-ords. N 4 844 869.0; E 294 354.2 ORIGINATED BY V.P.
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers 24.4 m to 33.4 m COMPILED BY V.P.
 DATUM Gondaric DATE R1-12-16, R1-12-17 and Cone Test CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		W _p	W	W _L		
171.9	Ground Surface													
0.0	(Glacial Till)		1	SS	9		170							2-22-55-21
			2	SS	26									
			3	SS	49									
	Brown Grey		4	SS	50		168							
	Silty Clay with Sand trace of Gravel		5	SS	38									5-12-51-32
			6	SS	21		166							
	occ. Cobbles and Boulders		7	SS	26									
			8	SS	30		164							
	Stiff to Hard		9	SS	44		162							
161.1														
10.4	boulder		10	SS	36		160							22-48-25-5
14.1	Grey		11	SS	105									
	Silty Sand to Sand Varying Amounts of Gravel		12	SS	58		158							2-71-25-2
	Occasional Cobbles and Boulders throughout						156							
			13	SS	58	15 cm	154							44-42-(14)
	Alternating Seams and Layers of Silt, Sand and Gravel						152							
			14	SS	105	13 cm								
	Dense to Very Dense						150							
							140							
138.1														
33.4	Refusal to Solid Augers, Possible Boulder or Bedrock End of Borehole													
10.4	* Perched Water Table at 0.9 m Borehole Caved at 1.5 m													
	Note: This borehole is a combination of two borings the first meeting refusal at 10.7 metres on a probable boulder.													

+3, x5 : Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4										METRIC	
W P 153-80-02		LOCATION Co-ords N 4 844 838.7; E 294 313.7		ORIGINATED BY V.P.							
DIST 6 HWY 427		BOREHOLE TYPE Hollow Stem Auger and Cone Test		COMPILED BY V.P.							
DATUM Geodetic		DATE 81-12-18 to 81-12-21		CHECKED BY [Signature]							
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE 'N' VALUES								
171.0	Ground Surface										
0.0	(Glacial Till)		1 SS 42		170						
	Brown Grey		2 SS 60		168						1-17-67-15
	Silty Sand		3 SS 46		166						
	Silty Clay some Sand trace of Gravel		4 SS 75		164						5-15-60-20
	Hard		5 SS 33		162						
			6 SS 83		160						
			7 SS 45		158						
159.8	Cobbles		8 SS 20		156						15-53-30-2
11.6	Grey Compact		9 SS 84		154						
38.1	Silty Sand		10 SS 105/15 cm		152						6-75-(19)
	to Gravel and Cobble layers		11 SS 115/13 cm		150						12-51-33-4
	Sand		12 SS 120/3 cm								
	Varying Amounts of Gravel										
	occasional Cobbles and Boulders throughout										
	Very Dense										
148.5	End of Borehole										
22.9	* Borehole caved at 9.3 metres.										
25.1	Perched Water Table										

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

RECORD OF BOREHOLE No 5

METRIC

W P 151-80-02 LOCATION Co-ords. N 4 844 920.5; E 294 355.5 ORIGINATED BY V.P.
 DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Auger/SW Casing and Cone Test COMPILED BY V.P.
 DATUM Geodetic DATE 81-12-16 to 81-12-17 CHECKED BY SP

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
171.9	Ground Surface																
0.0	(Glacial Till)																
	Silty Clay		1	SS	12												
			2	SS	15												
			3	SS	17												
	Brown Grey		4	SS	18												
	with Sand		5	SS	27												
	trace of Gravel		6	SS	15												
	Stiff to Hard		7	SS	20												
	Cobble		8	SS	41												
	Gravel																
	Cobbles & Boulders																
162.6			9	SS	124												
9.1																	
23.9	Grey Silty Sand to Sand		10	SS	77												
	Varying Amounts of Gravel		11	SS	53												
	occasional Cobbles and Boulders throughout		12	SS	145												
			13	SS	148/	23 cm											
	Very Dense																
149.5			14	SS	147/	23 cm											
21.7	End of Borehole																
21.2	* Note: W.L. after 24 hours Refusal to augering at 8.2 metres Move BH 1.2 m south Drive BW casing and run bi-cone 18.3 to 21.3 metres.																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 153-80-02 LOCATION Co-ords. N 4 844 864.4; E 294 316.3 ORIGINATED BY V.P.
 DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Auger/Drive "B" Casing COMPILED BY V.P.
 DATUM Geodetic DATE 81-12-21 CHECKED BY CP

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					
170.6	Ground Surface															GR SA SI CL
0.0	(Glacial Till)		1	SS	31	*										
			2	SS	44											4-26-52-18
	Brown Grey		3	SS	47											
			4	SS	35											2-4-82-12
	Silty Clay with Sand trace of Gravel		5	SS	40											
			6	SS	100/	8 cm										
			7	SS	36											
	Hard		8	SS	40											
	Gravel & Cobbles		9	SS	31											2-10-56-32
160.5			10	SS	36											24-47-25-4
10.1	Grey		11	SS	74											3-56-35-6
33.1	Silty Sand to Sand		12	SS	149/	23 cm										
	Varying Amounts of Gravel		13	SS	168/	23 cm										
	Occasional Cobbles and Boulders throughout															
	Dense to Very Dense															
149.0			14	SS	145/	21 cm										15-47-32-5
21.6	End of Borehole															
70.8	* Perched Water Level at Ground Surface. BH Caved at 6.9 m.															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 153-80-02 LOCATION Co-ords. N 4 844 880.0; E 294 310.4 ORIGINATED BY V.P.
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY V.P.
DATUM Geodetic DATE 81-12-22 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
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		
171.7	Ground Surface												
0.0	(Glacial Till)		1	SS	27	*							
			2	SS	44								
	Brown Grey		3	SS	30								
	Silty Clay with Sand trace of Gravel occ. cobbles		4	SS	75								
	Very Stiff to Hard		5	SS	122/	22 cm							
161.6			6	SS	40								
10.1			7	SS	107								
33.1	Grey Silty Sand to Sand		8	SS	79								
	Varying Amounts of Gravel		9	SS	103								
	occasional Cobbles and Boulders throughout		10	SS	102								
	Very Dense		11	SS	157/	20 cm							
151.5	End of Borehole												
66.3	* Note: W.L. not established at time of investigation.												

OFFICE REPORT ON SOIL EXPLORATION

* 3, x 5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

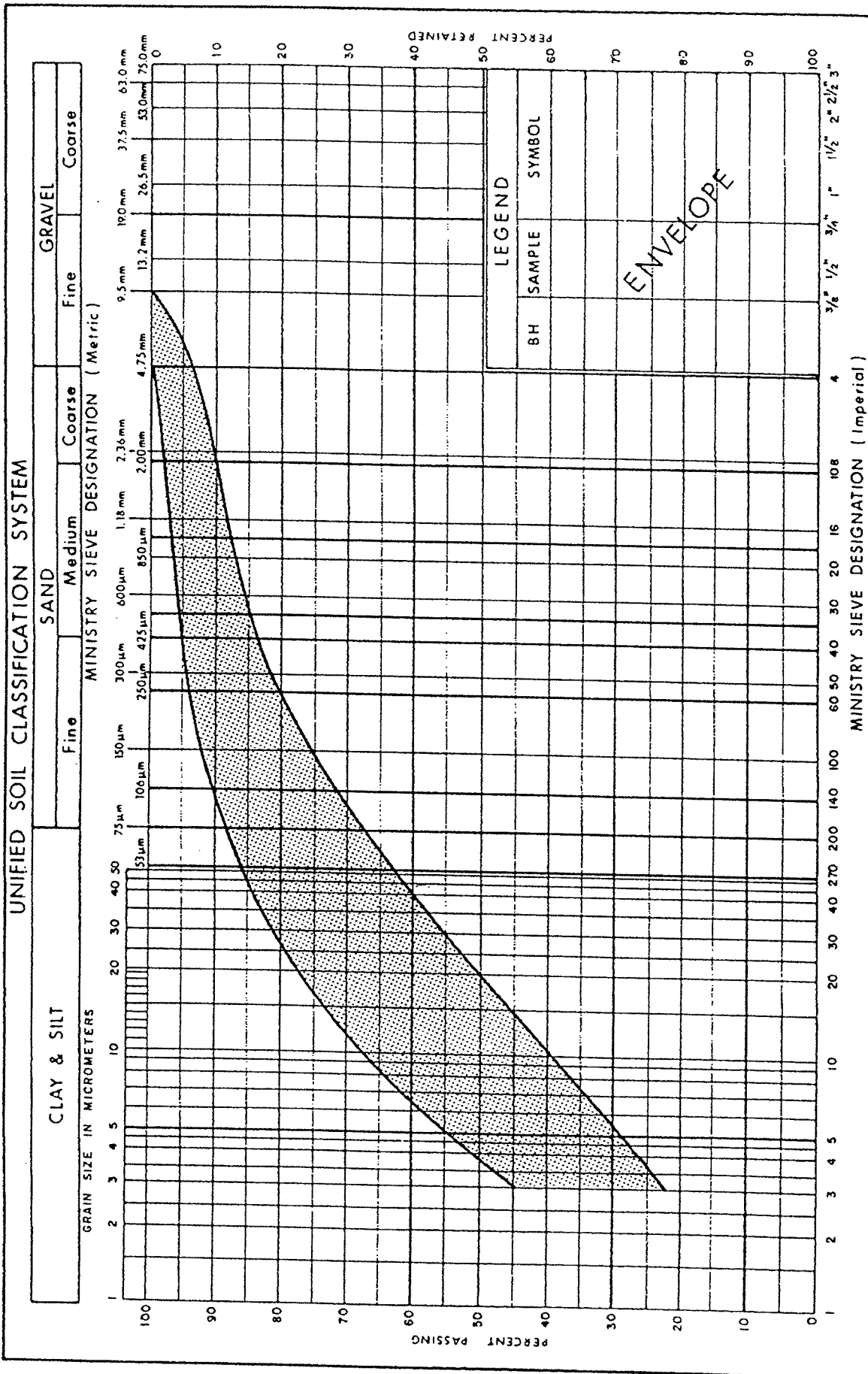
METRIC

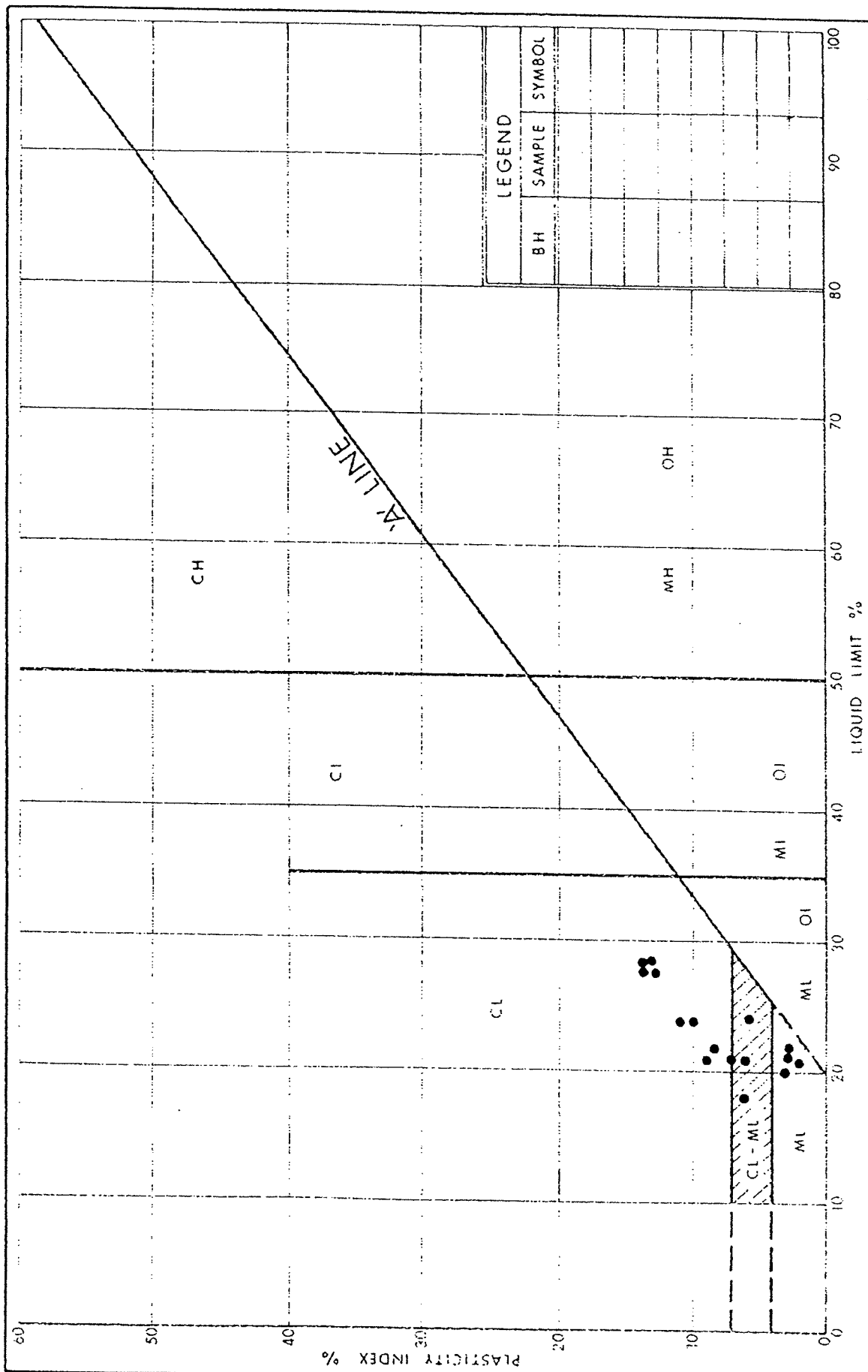
W P 153-80-02 LOCATION Co-ords. N 4 864 895.5; E 294 357.7 ORIGINATED BY V.P.
 DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Auger/"8" Casing COMPILED BY V.P.
 DATUM Geodetic DATE 81-12-22 CHECKED BY [Signature]

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80	100
								SHEAR STRENGTH							WATER CONTENT (%)		
							○ UNCONFINED + FIELD VANE										
							● QUICK TRIAXIAL x LAB VANE										
170.8	Ground Surface													GR SA SI CL			
0.0	(Glacial Till)					*	170										
	Brown Grey		1	SS	31		168										
	Silty Clay with Sand trace of Gravel		2	SS	25		166										
	Silty Sand		3	SS	23		164										
	Very Stiff to Hard		4	SS	27		162										
162.0			5	SS	100		160										
8.8	Grey		6	SS	100		158										
28.9	Silty Sand to Sand		7	SS	118		156										
			8	SS	11		154										
	Varying Amounts of Gravel		9	SS	156		152										
	occasional Cobbles and Boulders Throughout		10	SS	111		150										
	Very Dense		11	SS	100	15 cm	148										
147.7			12	SS	100	8 cm											
23.1	End of Borehole																
75.8	* W.L. not established at time of investigation.																

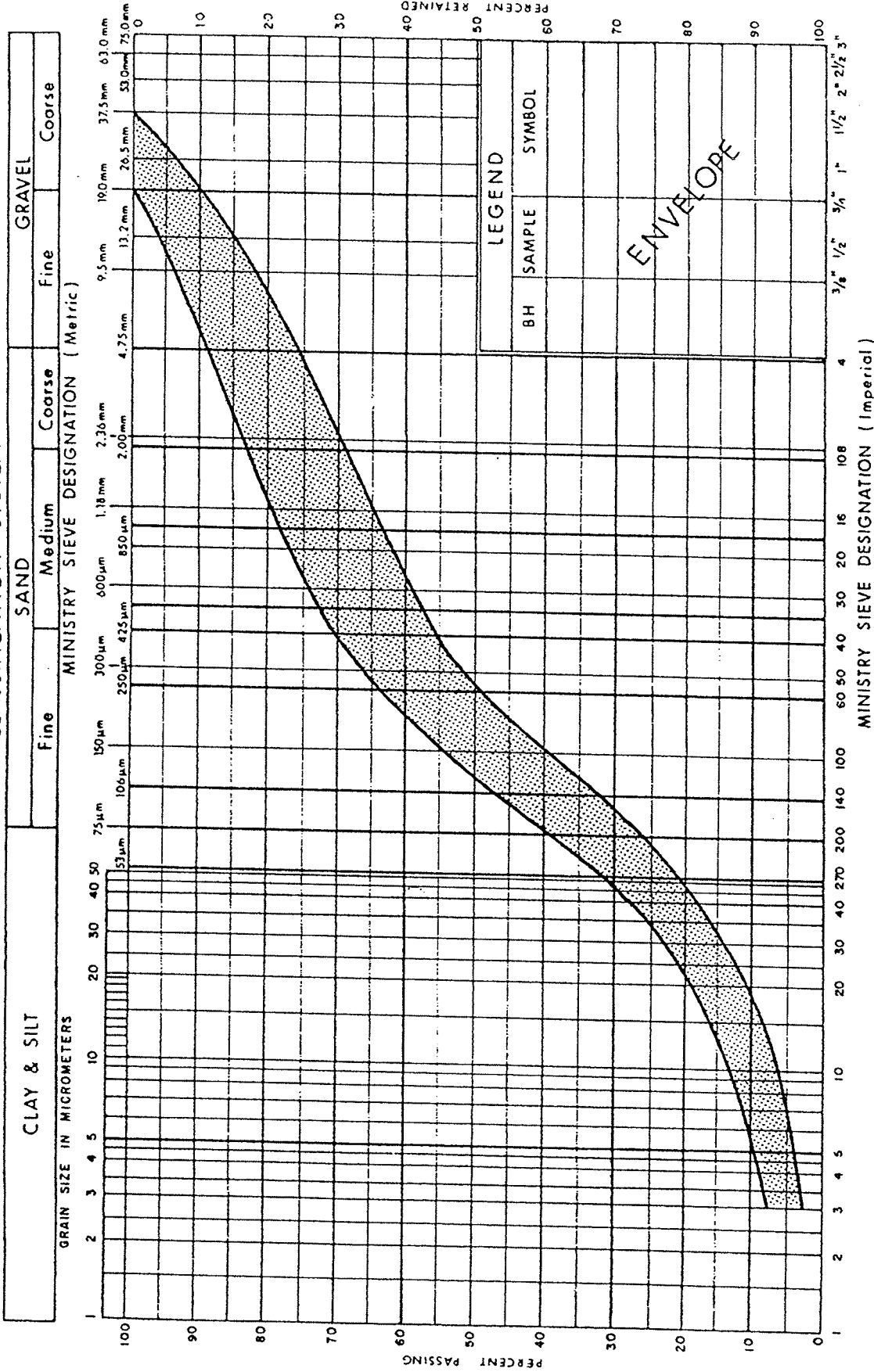
* 1, x 5 : Numbers refer to 20
Sensitivity 15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION





UNIFIED SOIL CLASSIFICATION SYSTEM



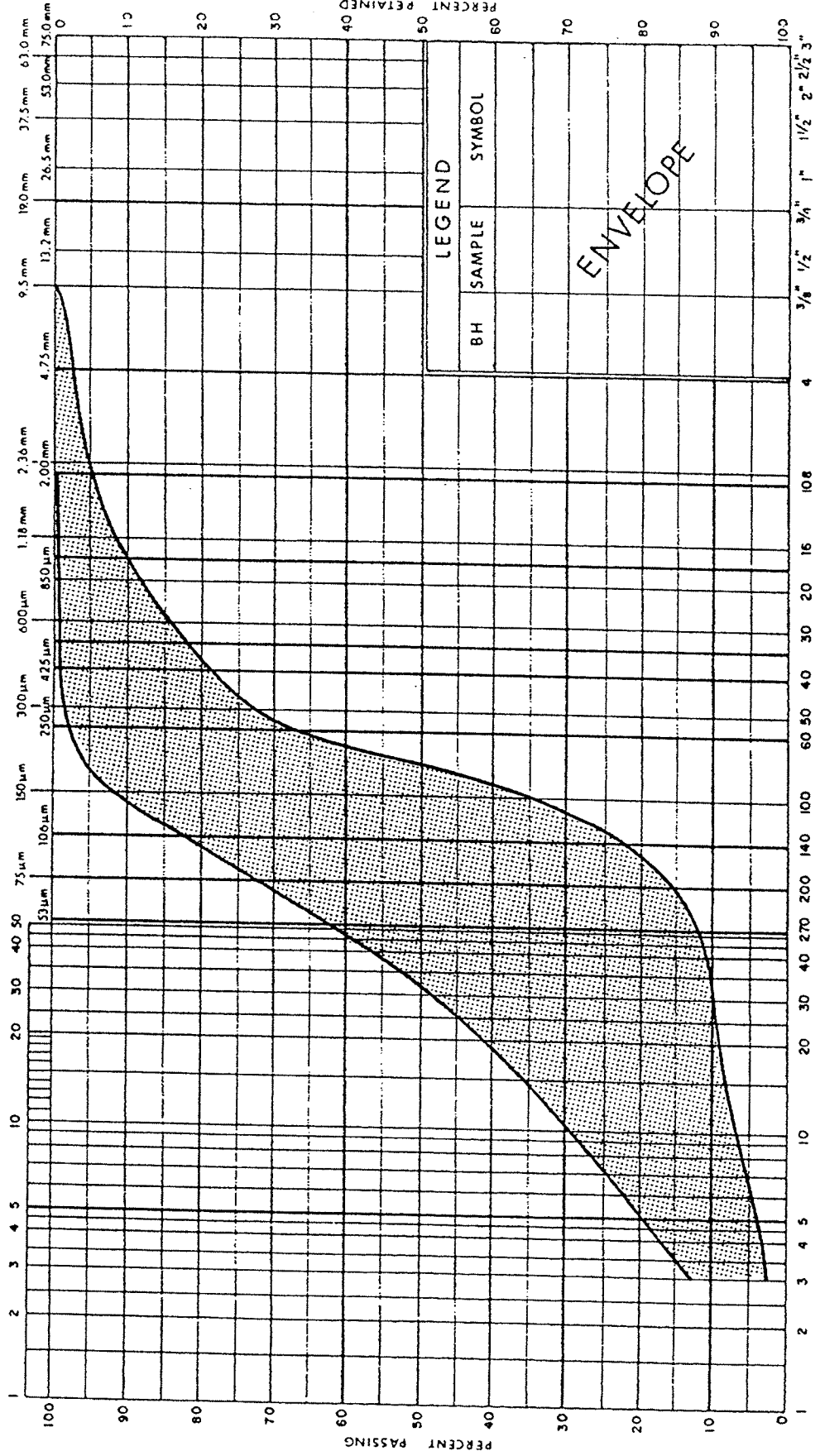
78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION

SILTY SAND

FIG No 3 B

W P 153-80-02

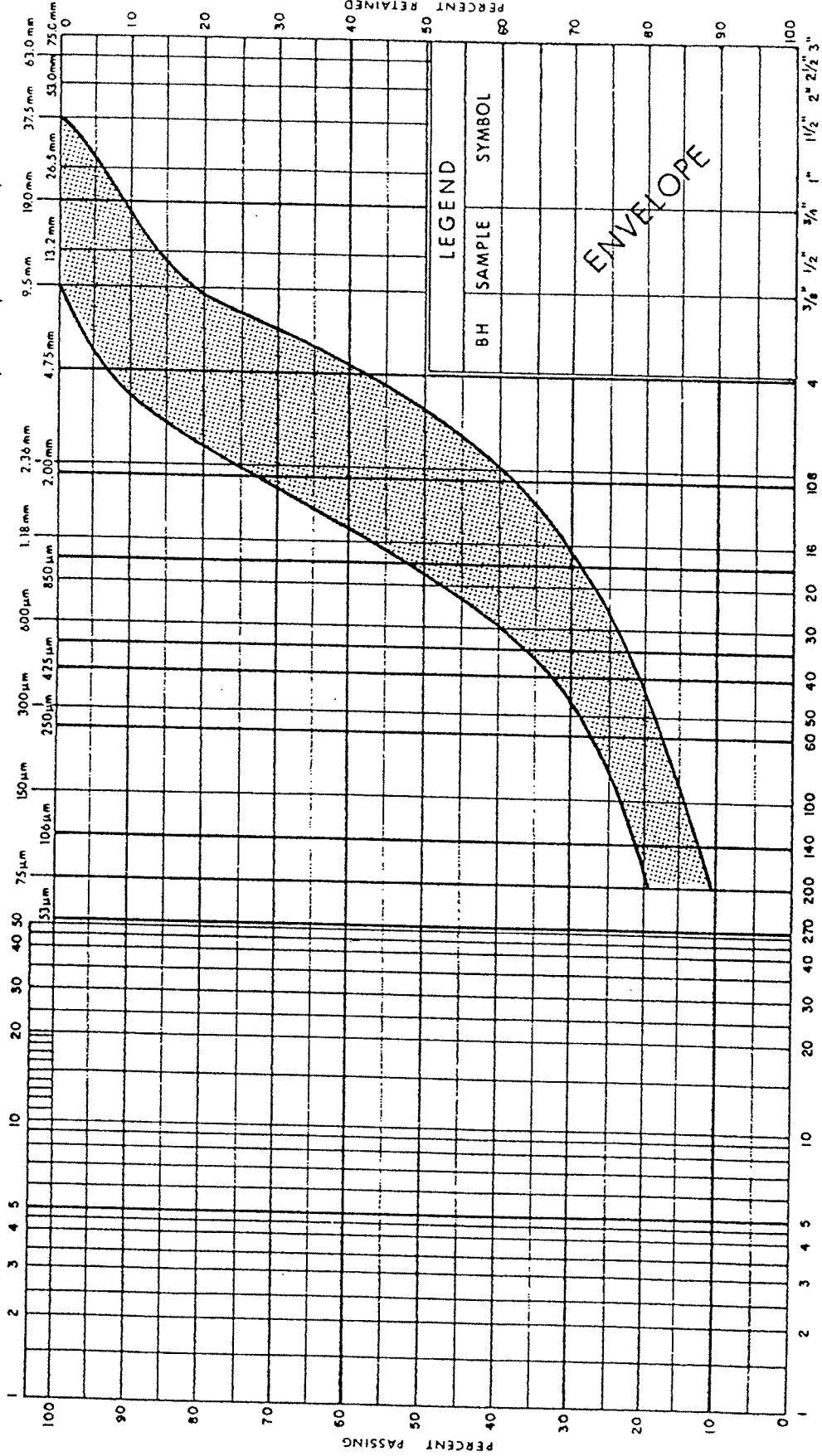
Ontario

10

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse
MINISTRY SIEVE DESIGNATION (Metric)						

GRAIN SIZE IN MICROMETERS



MINISTRY SIEVE DESIGNATION (Imperial)

Ministry of
Transportation and
Communications



GRAIN SIZE DISTRIBUTION

SAND WITH VARYING AMOUNTS OF GRAVEL TRACE OF SILT

FIG No 3C

W P 153-80-02

Appendix D

Site Photographs



Photo 1. Looking at the existing north abutment, Highway 427 SBL



Photo 2. Looking at the south abutment and south pier, Highway 427 SBL



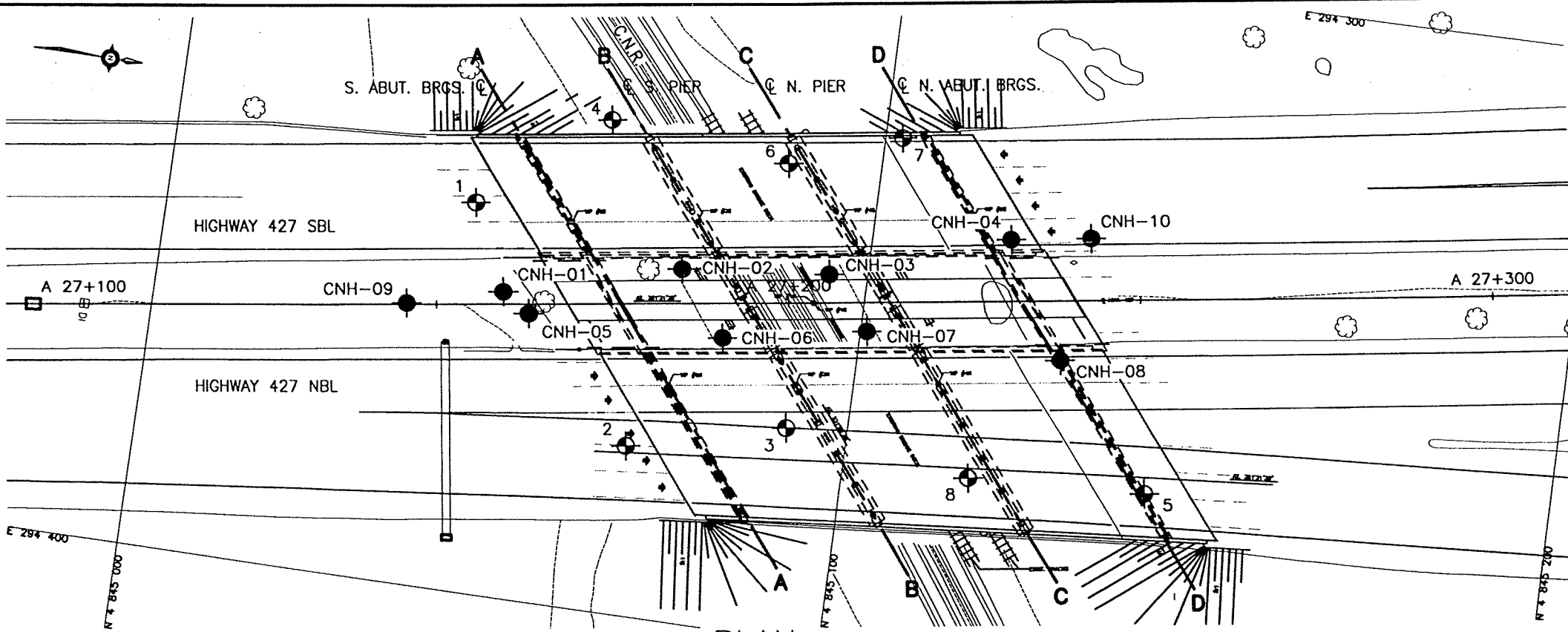
Photo 3. Looking at the existing south abutment and pier, Hwy 427 SBL (Boreholes CNH-02 and CNH-06)



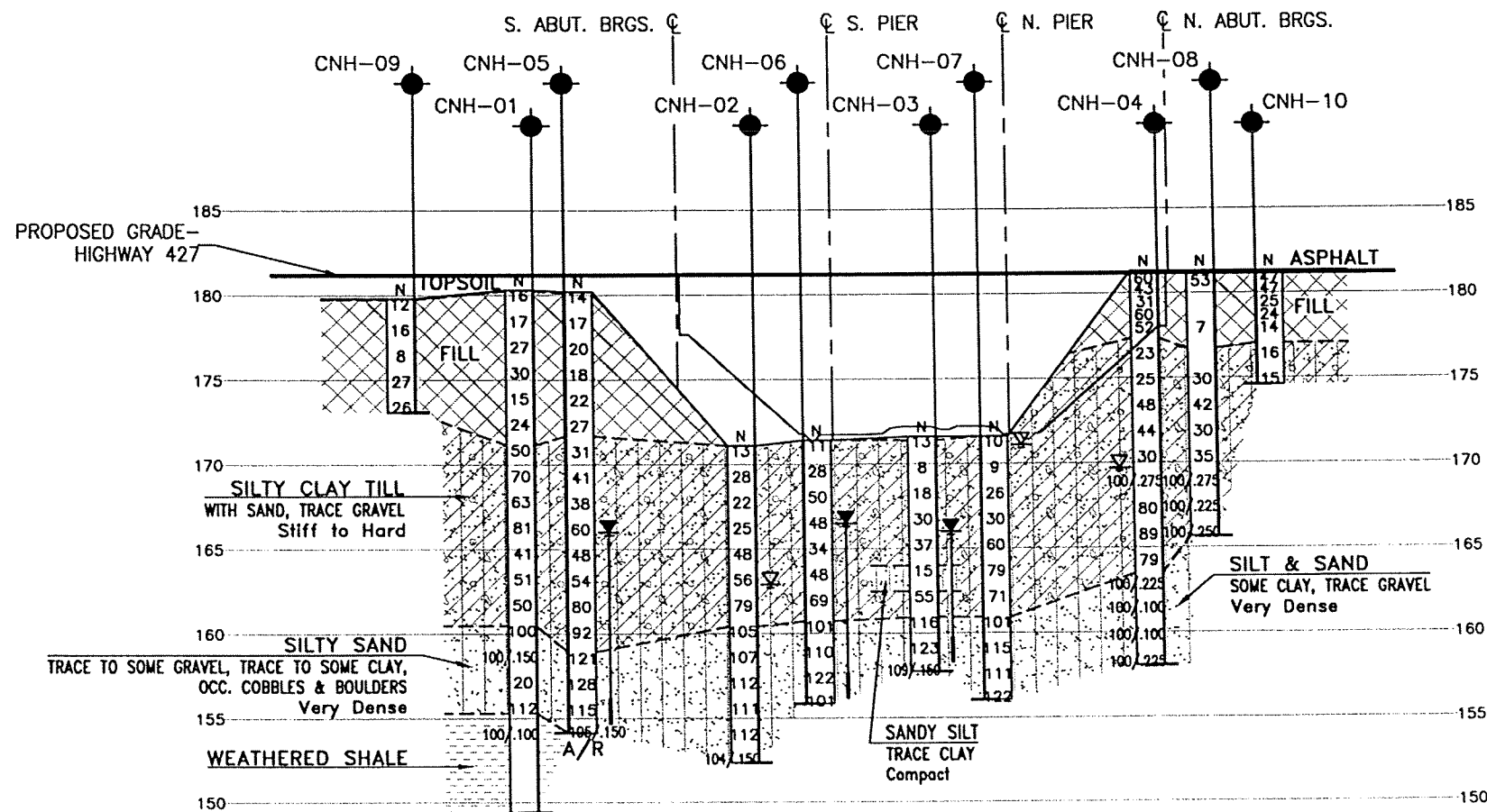
Photo 4. Looking at the existing north abutment and pier, Hwy 427 NBL (Boreholes CNH-03 and CNH-07)

Appendix E

Borehole Locations and Soil Strata Drawing



PLAN



HIGHWAY 427 CL PROFILE

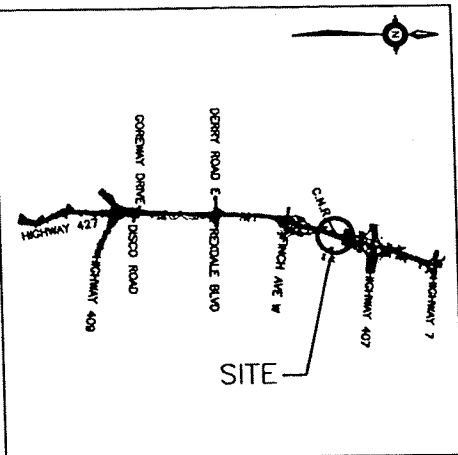
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 202-95-00

HIGHWAY 427
C.N.R. OVERHEAD
REHABILITATION & WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

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KEYPLAN

LEGEND

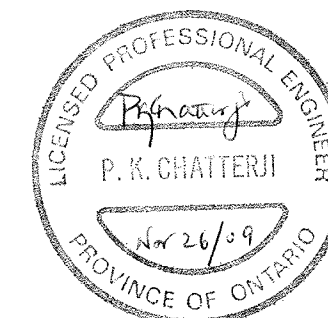
- ◆ Borehole by Thurber (Present Investigation)
- ◇ Borehole by Others (Previous Investigation)
- N
- CONE
- PH
- W
- Water Level in Open Borehole
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CNH-01	180.3	4 845 049.2	294 356.2
CNH-02	171.1	4 845 073.9	294 349.3
CNH-03	171.6	4 845 094.6	294 347.1
CNH-04	181.3	4 845 119.7	294 338.5
CNH-05	180.2	4 845 053.1	294 358.8
CNH-06	171.4	4 845 080.9	294 358.3
CNH-07	171.6	4 845 100.9	294 354.5
CNH-08	181.3	4 845 128.7	294 354.8
CNH-09	179.8	4 845 035.8	294 359.8
CNH-10	181.3	4 845 130.8	294 336.8

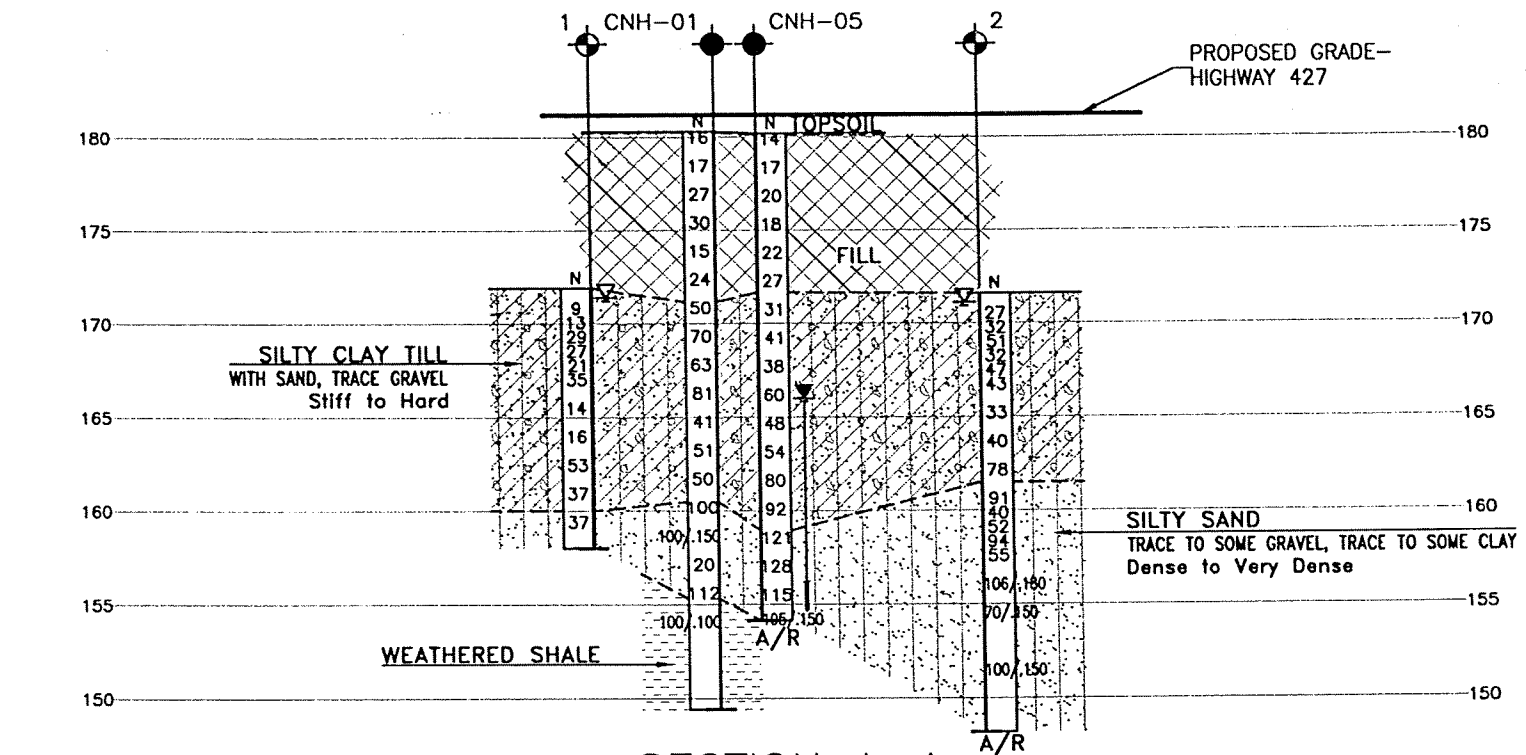
NOTES

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

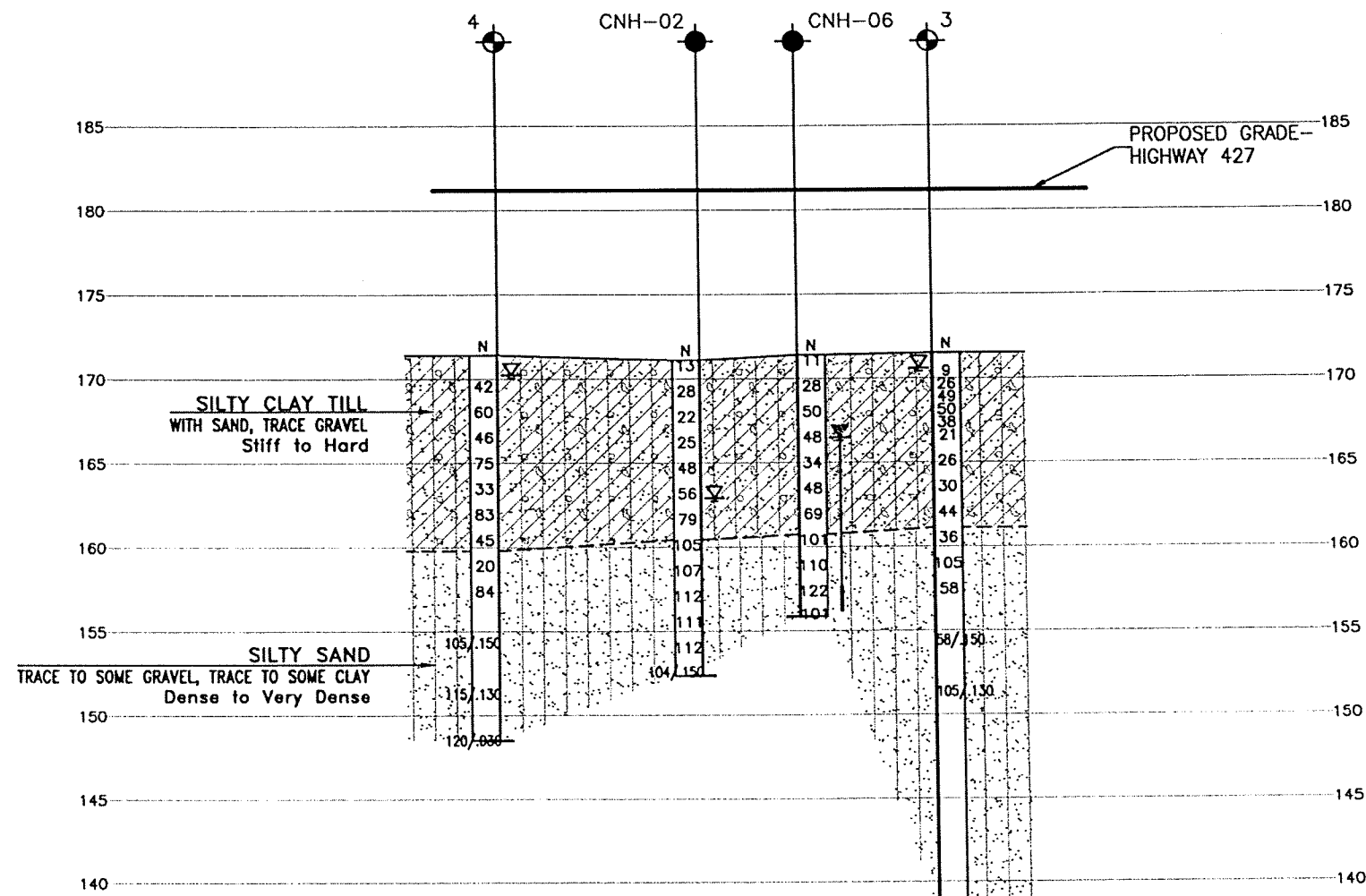
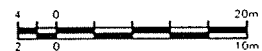
GEOCREs No. 30M12-288



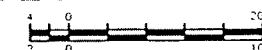
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SECTION A-A



SECTION B-B



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

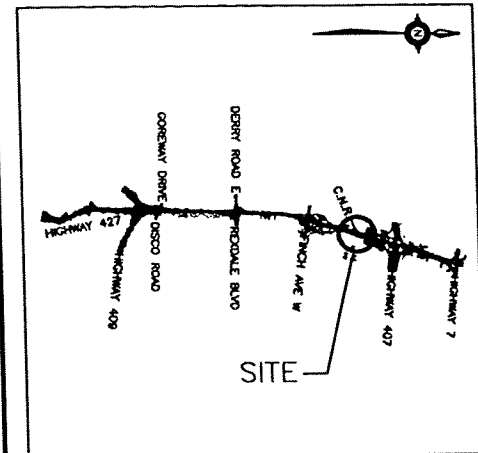
CONT No
GWP No 202-95-00

HIGHWAY 427
C.N.R. OVERHEAD
REHABILITATION & WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

SNC-LAVALIN

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KEYPLAN

LEGEND

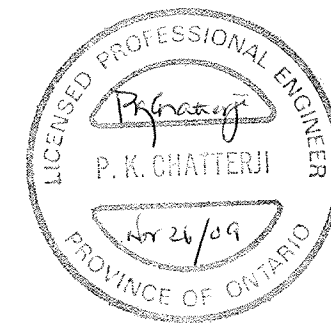
- ◆ Borehole by Thurber (Present Investigation)
- ◊ Borehole by Others (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level in Open Borehole
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

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GEOCRES No. 30M12-288



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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

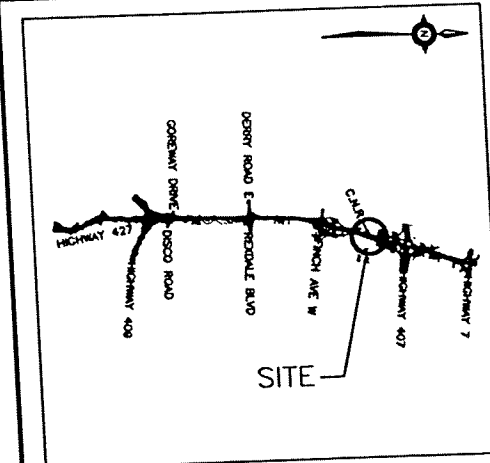
CONT No
GWP No 202-95-00

HIGHWAY 427
C.N.R. OVERHEAD
REHABILITATION & WIDENING
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

SNC-LAVALIN

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KEYPLAN

LEGEND

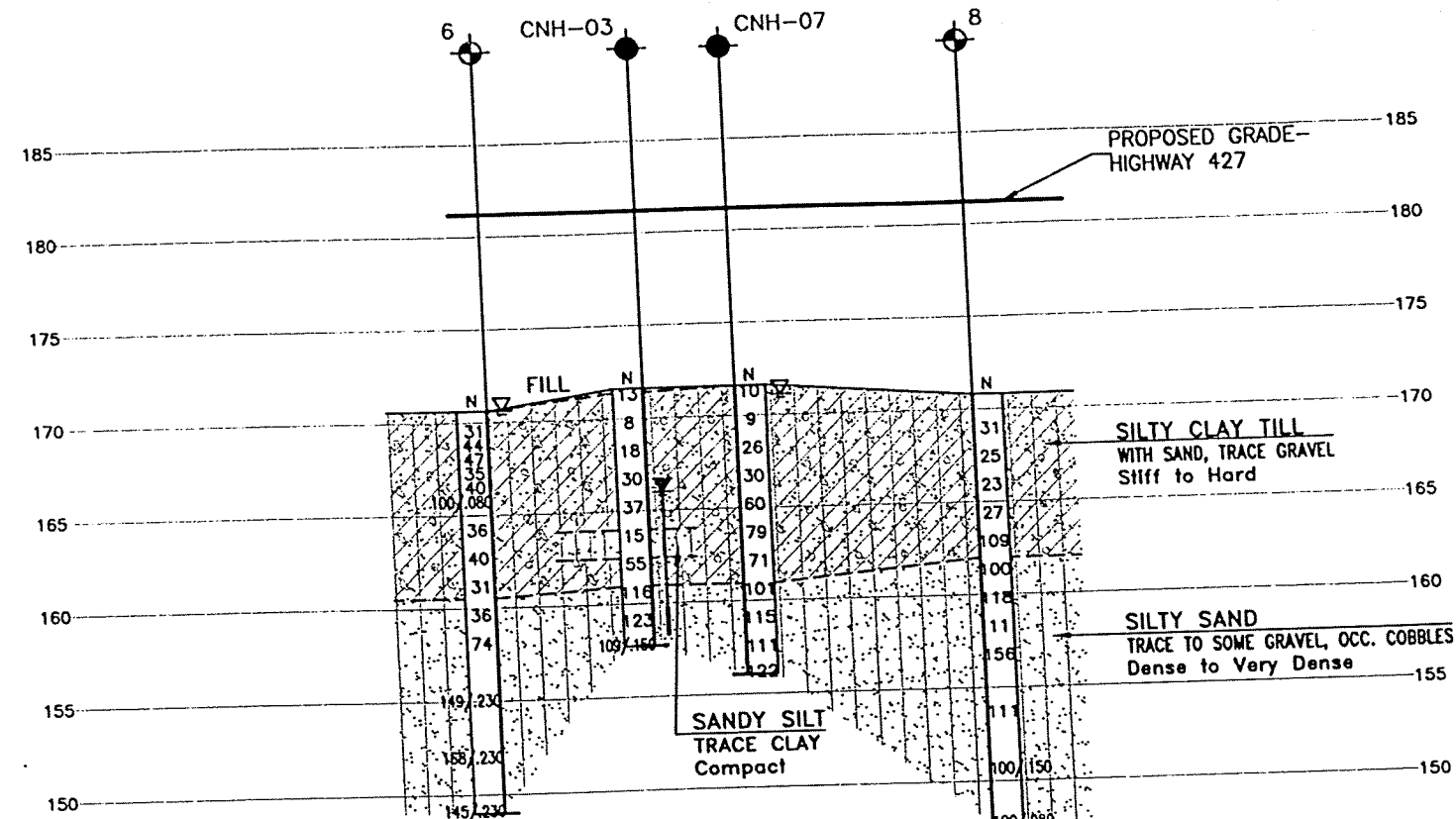
- ◆ Borehole by Thurber (Present Investigation)
- ◆ Borehole by Others (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level in Open Borehole
- W Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
CNH-01	180.3	4 845 049.2	294 356.2
CNH-02	171.1	4 845 073.9	294 349.3
CNH-03	171.6	4 845 094.6	294 347.1
CNH-04	181.3	4 845 119.7	294 338.5
CNH-05	180.2	4 845 053.1	294 358.8
CNH-06	171.4	4 845 080.9	294 358.3
CNH-07	171.6	4 845 100.9	294 354.5
CNH-08	181.3	4 845 128.7	294 354.8
CNH-09	179.8	4 845 035.8	294 359.8
CNH-10	181.3	4 845 130.8	294 336.8

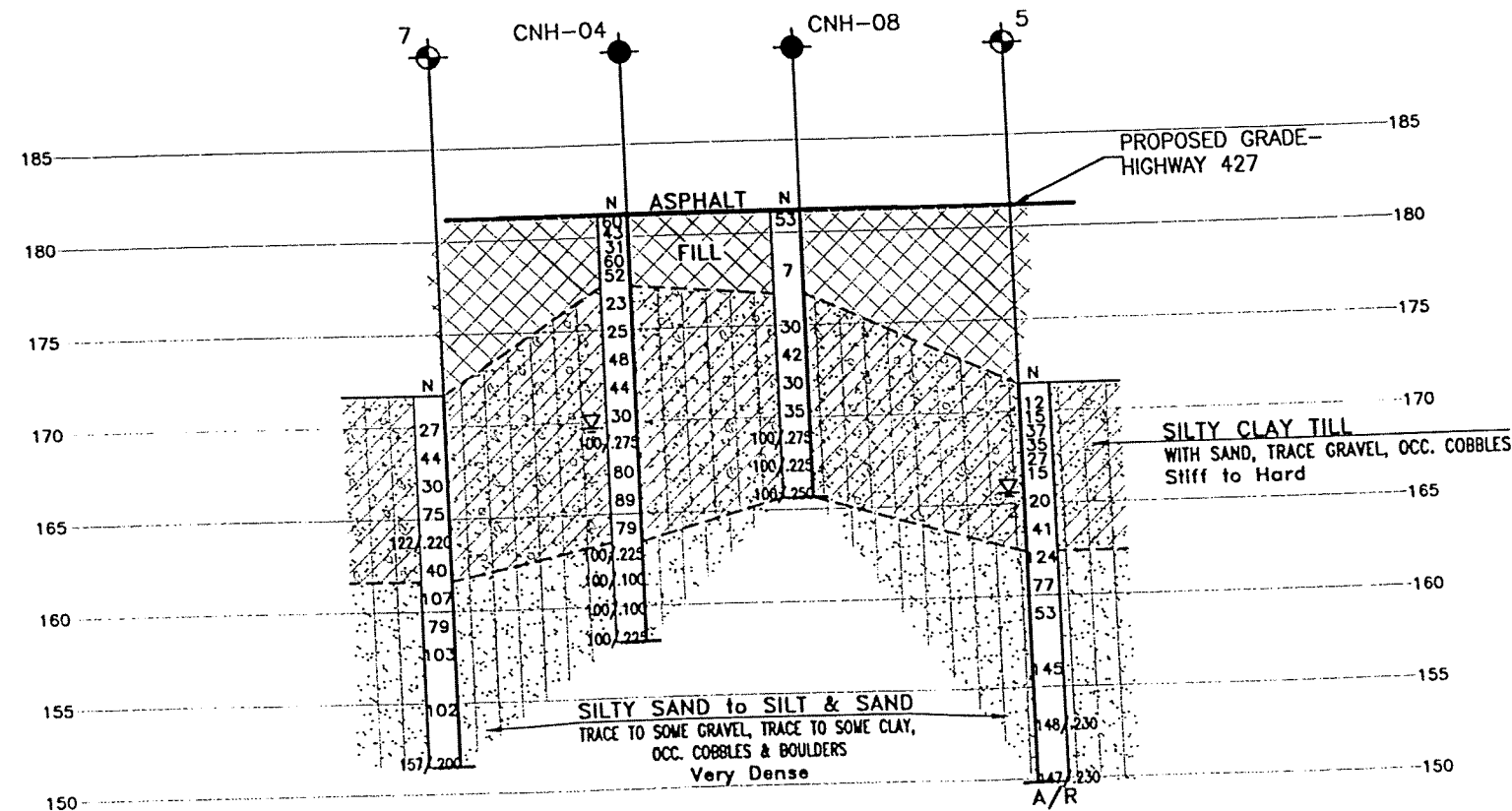
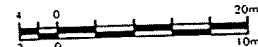
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

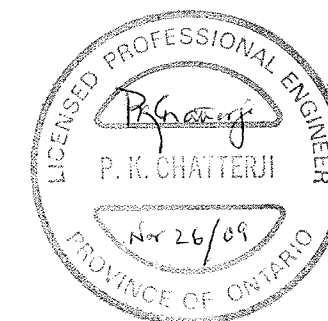
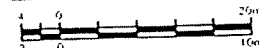
GEOCREs No. 30M12-288



SECTION C-C



SECTION D-D



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	SKP	CHK PKC	CODE
DRAWN	MFA	CHK PKC	SITE
STRUCT	OWG	J	