



FOUNDATION INVESTIGATION AND DESIGN REPORT

for

MERRITT ROAD UNDERPASS

SITE NO. 34-460

HIGHWAY 406 FOUR-LANING

GWP 280-99-00

CITY OF THOROLD, ONTARIO

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PML Ref.: 08TF005D
Index No.: 129FIR and 130FDR
GEOCRES No.: 30M03-240
April 6, 2009



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Appendix B – Site Photographs

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FOUNDATION INVESTIGATION REPORT

for

Merritt Road Underpass
Site No. 34-460
Highway 406 Four-Laning
G.W.P. 280-99-00
City of Thorold, Ontario

1. INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed Merritt Road Underpass at the Highway 406 in the City of Thorold. Peto MacCallum Ltd. (PML) conducted the investigation for McCormick Rankin Corporation (MRC) on behalf of the Ministry of Transportation of Ontario (MTO).

The structure is part of the twinning of the Highway 406 section that extends from Port Robinson Road in the City of Thorold southerly 5.6 km to East Main Street in the City of Welland, Ontario. The proposed new underpass will carry the realigned Merritt Road traffic over the proposed Highway 406 northbound and southbound lanes at approximate Sta. 15+853 and Sta. 15+830, respectively (New Highway 406 chainages).

A Preliminary Foundation Investigation and Design Report, dated November 20, 2008 was prepared by PML for the project (GEOCRES Ref. No. 30M03-233). Copies of this relevant data are enclosed in Appendix A.

This report provides subsurface information pertaining to the proposed underpass foundations and approach embankments to approximately 60 m behind the proposed abutments.

2. SITE DESCRIPTION AND GEOLOGY

The contemplated structure is proposed about 35 m north of the existing Merritt Road and Highway 406 at-grade crossing. The site is about 900 m south of the existing Port Robinson Road intersection at Highway 406.

Land use in the vicinity of the site comprises the transportation corridors of the existing Merritt Road and Highway 406 at-grade intersection. The proposed Merritt Road Underpass will run roughly east to west. The local topography of the structure site is relatively flat. About 6 m high stockpiles were present at the proposed east abutment location and 20 m west of the proposed west abutment location. The areas of the stockpiles are approximately outlined on the attached Drawing MR-1. The eastern stockpile is about 30 m wide and 120 m long while the western stockpile is about 80 m wide and 80 to 100 m long based on the existing survey data. The ground cover beyond the pavements comprises grasses, bushes and stands of trees. Site photographs are included in Appendix B.

The site is located in the Haldimand Clay Plain physiographic region. The topography is gently flat and undulating. The soil cover in the region typically comprises lacustrine silts and clays. Dolostone bedrock of the Salina Formation is anticipated at an approximate depth of 35 m.

3. INVESTIGATION PROCEDURES

The field work for the proposed underpass was carried out during the period from October 20 to 31, 2008.

The scope of the subsurface investigation comprised 8 boreholes, designated 101 to 108 that were drilled through the soil cover to depths of 9.8 to 37.4 m at the locations shown on Drawings MR-1 and MR-2, appended. The soil stratigraphy at each borehole location is also shown on the Drawings MR-1 and MR-2.

Boreholes 102 and 107 were part of the preliminary Pavement Engineering testholes, which were reported in the Technical Memorandum dated October 31, 2008. Borehole 107 was extended from the previous pavement investigation depth of 9.7 to 18.9 m below ground surface.

Callon Dietz Inc. laid-out the preliminary new alignment of Merritt Road at the structure location, including the positions of the boreholes as selected by PML, and determined the horizontal and vertical co-ordinates at those locations. All elevations in this report are expressed in metres.

Boreholes 101 to 108 were advanced using continuous flight solid and hollow stem augers powered by a track and truck mounted CME-55 rigs, equipped for rotary core drilling, supplied and operated by a specialist drilling contractor. The drilling crews worked under the full-time supervision of a member of our engineering staff.

Representative samples of the soils encountered in the boreholes were recovered at frequent depth intervals. In the boreholes advanced with conventional drill rigs, soil samples were obtained using a split spoon sampler in conjunction with standard penetration tests. Where standard penetration tests were not carried out the consistency/relative density of the encountered soils was estimated from manual examination or the rate (ease) of advance of the augers.

At borehole location 103, one dynamic cone penetration test was carried out from 12.5 to 23.8 m depth below ground surface, from elevation 167.9 to 156.6. Boreholes 105 and 106 were extended 4.2 and 3.4 m into the bedrock using NQ diamond rock coring equipment, respectively. Photographs of the rock cores are shown in Appendix C.

The boreholes were backfilled in accordance with the MTO guidelines and MOE regulation 903 for borehole abandonment procedures using a bentonite/cement mixture grout.

The groundwater conditions at the borehole locations were assessed during drilling by visual examination of the soil, the sampler and drill rods as the samples were retrieved and, when appropriate, by measurement of the water level in the open boreholes.

Soils were identified in the field in accordance with the MTO Soil Classification procedures. Recovered soil samples were returned to our laboratory for detailed visual examination and soil classification. The laboratory test program for the current subsurface investigation comprised the following tests:

- Natural moisture content determinations (106)
- Grain size analyses (33)
- Atterberg limits tests (31)
- Organic content (6)
- Unconfined compression tests (3)
- Consolidation tests (2)

The results of the laboratory natural moisture content determinations, grain size analyses, Atterberg limits, organic content and unconfined compression tests are shown on the Record of Borehole sheets. The grain size distribution charts are presented on Figures GS-MR-1 to GS-MR-6. The Atterberg limits are presented on Figures PC-MR-1 and PC-MR-5 and the consolidation tests on Figures MR-OC-1 and MR-OC-2. The Atterberg limits and corresponding sample natural water content determinations are listed in the appended Table A.

4. SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Boreholes 101 to 108 for details of the subsurface conditions including soil classifications, inferred stratigraphy, boundary elevations and groundwater observations.

Reference is also made to the previous Record of Boreholes 1 and 2, grain size distribution and plasticity charts from the Preliminary Foundation Investigation and Design Report, dated July 29, 2008, appended in Appendix A.

Rock core descriptions are included in Table B and photographs of the rock cores of boreholes 105 and 106 are shown in Appendix C. Site photographs are provided in Appendix B.

The borehole locations and stratigraphic profile and cross-sections prepared from the borehole data are presented on Drawings MR-1 and MR-2. The depth of the boreholes and auger probes varies from 9.8 to 37.4 m.

Generally, the soil cover comprised 0.3 to 5.7 m thick of fill unit including two fill stockpiles. The fill and topsoil was overlying a cohesive soft to hard silty clay unit of variable thickness up to 9.9 m, which in turn was overlying a 0.6 to 2.2 m thick very loose to compact silt layer underlain by 0.5 to 16.7 m thick firm to hard clayey silt/clayey silt till. These deposits overlay a layer of 3.8 to 16.1 m thick compact to very dense silt till and silt and sand till. Dolostone bedrock was encountered below the native soils at depths of 36.1 to 37.4 m.

4.1 Fill

A 90 mm thick layer of asphaltic concrete over 190 mm of granular 'A' crushed limestone fill was encountered surficially in borehole 2 drilled near the existing N-W ramp, extending to approximate depth of 0.3 m, elevation 180.1. A 800 mm thick granular 'A' crushed limestone surficial fill was encountered in borehole 105 drilled near the existing Highway 406 west shoulder, extending to elevation 179.6.

About 0.3 m and 1.2 m thick fill was also encountered at the surface of boreholes 104 and 103, respectively, elevations 179.4 and 179.2. Distinct file stockpiles made of cohesive clayey silt to silty clay were encountered in boreholes 101, 102, 107 and 108 extending to 4.3 to 5.7 m depth below ground surface, elevations 179.3 to 180.9. N values in the fill ranged widely from 2 to 20 with an average of 7 and a standard deviation of 4.2. The values indicated that the fill was not compacted to a uniform degree.

Grain size charts of selected fill samples are presented in Figure MR-GS-1. Typically, the fill material is made of 20 to 50% clay, 42 to 58% silt, 4 to 11 % sand and 4 to 11% gravel sized particles. Locally, fill material included 15% clay, 29% silt, 42% sand and 14% gravel sized particles. The plasticity chart of the fill is presented in Figure MR-PC-1. The Atterberg liquid and plastic limits ranged from 22 to 40 and 17 to 23, respectively, with plasticity index values ranging from 5 to 17. The organic content of four selected fill samples ranged from 0.8 to 1.9%. Moisture contents determinations ranged from 11 to 24%.

4.2 Topsoil

A 200 mm thick topsoil unit was encountered at the surface in borehole 106 extending to elevation 180.2 and below the fill in boreholes 101, 107 and 108 extending 4.7 to 6.8 m depth below ground surface, from elevation 179.5 to 180.5. The organic content of a sample of topsoil was determined to be 4.7%. Moisture content determinations ranged from 17 to 29%.

4.3 Peat

A 700 mm thick localized layer of peat was encountered in borehole 102 below the fill material at 5.5 m depth and extending to 6.2 m below ground surface, from elevation 179.3 to 178.6. The organic content of the peat sample was determined to be 35.6%. A moisture content obtained on the peat was about 48%.

4.4 Sandy Silt

A cohesionless sandy silt deposit was encountered at the ground surface in borehole 1 extending to 1.4 m depth, elevation 179.1 and below the peat layer in borehole 102 at 6.2 m depth extending to 6.7 m, elevation 178.1. The relative density ranged from loose to very loose. Two N values obtained were 2 and 7. One moisture content value of about 18% was obtained with soil unit.

4.5 Silty Clay

A deposit with up to 9.9 m thickness of cohesive silty clay was encountered below topsoil in boreholes 102, 107 and 108, below fill in boreholes 2, 103, 104 and 105, below clayey silt (described in the following section) in boreholes 101 and 106 and below sandy silt in borehole 1. The silty clay unit extended to 7.5 to 16.7 m depth below ground surface, elevation 175.0 to 169.7. In borehole 104, a lower silty clay deposit of 5.2 m in thickness was encountered from 26.2 to 31.4 m depths, elevation 153.5 to 148.3.

The consistency of the silty clay ranged from soft to hard and was typically stiff to very stiff. At the location of the structure foundations the upper zone of the silty clay extending to 2.7 to 4.0 m depths, elevations 176.5 to 177.7 was desiccated and exhibited a very stiff consistency. Penetrometer tests ranged from 25 to 225 kPa and field vane tests ranged from 34 to 173 kPa with typical values in the 60 to 80 kPa range below the very stiff zone and sensitivity ranging from 1 to 3. N values for the silty clay ranged from 0 (weight of hammer and rods) to 34. The low N values of 0 to 3 blows were judged to be caused by hydraulic disturbance from scattered layers of wet silt and silty sand in the silty clay deposit and should be disregarded. This judgement is based on the water content of the respective samples that were typically lower than the liquid limits and/or on the results of field vane tests at the level of those N values. Two unconfined compression tests on two silty clay samples

gave shear strength values of 34.6 kPa (strain at failure of 4.3%) and 23.9 kPa (strain at failure of 9.4%). Based on a consolidation test carried out on a silty clay sample from borehole 108 at about 11 m depth, a preconsolidation pressure of 500 kPa was obtained, as shown in Figure MR-OC-1.

Grain size distribution charts of selected silty clay samples are presented in Figures MR-GS-2 and GS-MR-1 (Appendix A). The silty clay comprised 49 to 63% clay, 36 to 50% silt and 1 to 5% sand sized particles. The plasticity chart of the silty clay samples is presented in Figure MR-PC-2 and PC-MR-1 (Appendix A). The Atterberg liquid and plastic limits ranged from 35 to 43 and 19 to 23, respectively, with plasticity index values ranging from 14 to 21. Moisture contents ranged from about 16 to 42%. The field and laboratory test results indicated that the soil has typically low compressibility characteristics.

4.6 Clayey Silt/ Clayey Silt and Sand / Clayey Silt Till

A discontinuous 0.5 m thick deposit of cohesive clayey silt was encountered to 0.7 m depth elevation 179.7 below topsoil in borehole 106. Localized firm to stiff clayey silt and sand was encountered in borehole 101 also below a topsoil unit extending from 4.7 to 5.8 m depth, elevation 180.5 to 179.4.

Continuous firm to hard clayey silt was found at deeper levels of 7.5 to 13.7 m, elevations 168.1 to 172.9 below silty clay in boreholes 103 and 106 and below silt (discussed in Section 4.7) in boreholes 1, 2, 104 and 105. The unit extended to between 20.1 and 25.9 m depths below ground surface, from elevation 154.5 to 160.3.

Lower deposits of 2.3 and 5.8 m thick firm to hard clayey silt till were encountered at 20.1 and 23.2 m depths, elevation 159.6 and 157.2, below clayey silt and silt in boreholes 104 and 106, respectively, extending to depths of 22.4 and 29.0 m elevation 157.3 and 151.4.

N values for the clayey silt ranged from 0 (weight of hammer and rods) to 34, and for clayey silt till ranged from 4 to 50 blows for 25 cm penetration. The very low N values were judged to be caused by hydraulic disturbance firm layers of wet silt and should be disregarded. Two N values obtained in the clayey silt and sand were 5 and 12. The dynamic cone penetration test carried out in borehole 103

from 12.5 to 23.8 m depths, elevation from 167.9 to 156.6 gave N values increasing with depth from 3 to 140.

One field vane test in clayey silt till recorded a shear strength of 108 kPa with a sensitivity value of 2. One laboratory unconfined compression test on a clayey silt sample gave a shear strength value of 52.6 kPa (strain at failure of 8.3%). Based on a consolidation test carried out on a clayey silt sample from borehole 103 at about 8 m depth, a preconsolidation pressure value of 480 KPa was obtained from the deposit as shown in Figure MR-OC-2.

Grain size distribution charts of selected clayey silt/clayey silt till samples are presented in Figures MR-GS-3 and GS-MR-2 (Appendix A). The plasticity charts of the clayey silt/clayey silt till samples are presented in Figures MR-PC-3 and PC-MR-2 (Appendix A). The Atterberg liquid and plastic limits ranged from 21 to 32 and 15 to 19, respectively, with plasticity index values ranging from 4 to 13. Moisture contents determined for clayey silt and clayey silt till ranged from about 17 to 33% and 9 to 16%, respectively.

The grain size distribution and plasticity charts of one clayey silt and sand are presented in Figures MR-GS-4 and MR-PC-4, respectively. The Atterberg liquid and plastic limits were 25 and 19, respectively, giving the plasticity index value of 6. Moisture content values determined on two samples were about 21 and 23%.

The field and laboratory test results indicated that the clayey silt-type soils have relatively low compressibility characteristics.

4.7 Silt

A 0.6 to 2.2 m thick cohesionless deposit of silt was encountered below the silty clay unit in boreholes 1, 2, 101, 104, 105, and 107 and or interbedded with clayey silt in boreholes 103 and 106. The silt unit extended to 10.9 to 18.9 m depth, elevation 167.5 to 169.4. The relative density of the silt ranged from very loose to compact. N values ranged from 3 to 13.

Grain size distribution charts of selected silt samples are presented in Figure MR-GS-5. Moisture contents determinations ranged from about 22 to 25% indicating wet conditions.

4.8 Silt Till/ Silt and Sand Till

A local deposit of cohesionless dense/compact to very dense silt till was encountered in boreholes 1 and 2 below the clayey silt deposit at depths of 23.6 and 25.9 m, respectively, elevation 156.9 and 154.5. The N values in the till typically ranged from 23 to 77. Two N values of 50 and 100 were obtained for 5 and 10 cm sampler penetration in borehole 2.

The composition of the till was variable and included a 1.1 m thick gravel till in borehole 2 between depths of 27.3 and 28.4 m, elevation 153.1 to 152.0. Cobbles and boulders are anticipated in this deposit although not encountered in the boreholes.

The 13.1 and 11.5 m thickness of till deposit in boreholes 1 and 2 mantled the underlying bedrock at depths of 36.7 and 37.4 m, elevation 143.8 and 143.0, respectively.

Local 3.8 to 16.1 m thick deposits of compact to very dense silt and sand till were encountered at 22.4 m depth in between and below clayey silt till and silty clay deposits in borehole 104, below clayey silt in boreholes 105 and 106 at 20.1 and 29.0 m depths, elevation 160.3 and 151.4. The soils extended to the 36.1 to 37.0 m termination depths of the boreholes and mantled bedrock at approximate elevations ranging from 143.4 to 144.2. N values ranged from 26 to 50 blows for 10 cm of sampler penetration.

The grain size distribution charts of representative samples of the silt till are shown on Figure GS-MR-3 and the Atterberg plasticity limits on the Plasticity Chart Figure PC-MR-3 (Figures appended in Appendix A). The liquid limit of the silt till was 16 and the plastic limit 12, giving the plasticity index value of 4. The gravel till sample was non-plastic according to Atterberg determination and manual examination. The water content of the silt till was 7%.

Grain size distribution charts of two selected silt and sand till samples are presented in Figure MR-GS-6. A plasticity chart of one silt and sand sample is presented in Figure MR-PC-5. The

Atterberg liquid and plastic limits are 14 and 12, respectively, with a very low plasticity index value of 2, therefore the material is considered to be non plastic. Moisture contents determined ranged from about 9 to 15%.

4.9 Bedrock

A detailed description of the rock cores retrieved from boreholes 2, 105 and 106 is provided in Table C and summarized on the record of borehole logs.

Dolostone bedrock of the Salina Formation was encountered in five boreholes below the native soils at the levels listed in the following table. Locally in borehole 105 the dolostone was covered by a 1.1 m thick layer of dolomitic limestone between 36.2 and 37.3 m depths.

BOREHOLE No.	DEPTH (m)	ELEVATION	ROCK CORE LENGTH (m) (*)
1	36.7	143.8	-
106	37.0	143.4	3.4
105	36.2	144.2	4.2
2	37.4	143.0	3.0
104	36.1	143.6	-

(*) NXL diamond rock cores obtained.

The bedrock surface was confirmed in boreholes 2, 105 and 106 by drilling core holes 3.0 and 3.4 m, respectively, into the rock from a depth of 37.4 to 40.4 m, elevation 143.0 to 140.0, and 37.0 to 40.4 m, elevation 143.4 to 140.0.

Between boreholes 2 and 104 the bedrock surface slopes downward from south to north at 1.0% from elevation 143.8 to 143.4. Between borehole 1 and 106 the bedrock surface slope rises at 1.6% from elevation 143.0 to 143.6.

The core recovery ranged from was 93 to 100% with typical values of 100%. The rock is of poor quality in borehole 2 with RQD values of 32 and 35%. At borehole 105, the rock exhibited very poor

quality (RQD=0%) for the weathered dolomitic limestone layer in the upper 1.1 m (from elevation 144.2 to 143.1) and fair quality for the bottom 3.1 m (from elevation 143.1 to 140.0) with RQD values of 52 and 56%. In borehole 106, the rock quality ranges from fair to good with RQD values ranging from 71 to 90%. Loss of drilling water was not experienced during drilling in any of the boreholes. The typically unweathered dolostone bedrock exhibited a low to medium strength.

4.10 Groundwater

Groundwater was observed in borehole 1 at 12.3 m below ground surface, elevation 168.2, drilled in November 2001.

A groundwater strike was observed in borehole 102 during drilling at 3.8 m depth below ground surface, elevation 181.0. Upon completion of drilling, groundwater was encountered in boreholes 102, 104, 106 and 107 at depths ranging from 2.7 to 17.4 m below ground surface, elevation ranging from 169.0 to 182.1. Cave-in was observed in borehole 102 at 7.0 m depth below grade, elevation 177.8.

In view of the relatively pervious nature of the silty/sandy materials in the vicinity of the site, the groundwater levels are subjected to fluctuations due to seasonal and rainfall patterns.

5. MISCELLANEOUS

The field work was carried out under the supervision of Mr. Mike Rapsey, Senior Technician and Mr. William Loghrin, Project Supervisor under the direction of Mr. C. M. P. Nascimento, P.Eng., Project Manager. GeoEnvironmental Drilling Inc., Elite Drilling, and Determination Drilling and Soil Investigations Inc. supplied the soil and rock drilling equipment. The laboratory testing was carried out in the PML laboratory in Toronto.

The report was prepared by Mr. N. Rahman, BASc. and Mr. C. M. P. Nascimento, P.Eng. Mr. B. R. Gray, MEng, P.Eng., MTO Designated Principal Contact, carried out an independent review of the report.

Yours very truly

Peto MacCallum Ltd.

**NOTE: Hard copies signed
and stamped**

Carlos M. P. Nascimento, P. Eng.
Project Manager

**NOTE: Hard copies signed
and stamped**

Brian R. Gray, MEng., P.Eng.
MTO Designated Principal Contact

CN/BRG:nr-mi

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Yours very truly

Peto MacCallum Ltd.



Carlos M. P. Nascimento, P. Eng.
Project Manager



Brian R. Gray, MEng., P.Eng.
MTO Designated Principal Contact

CN/BRG:nr-mi

Merritt Road Underpass, Site No. 34-460
Highway 406 Four-Laning
W.P. 280-99-00, Index No.: 129FIR
PML Ref.: 08TF005D, April 6, 2009





TABLE A ATTERBERG LIMITS AND NATURAL WATER CONTENT DETERMINATIONS						
SOIL TYPE	BOREHOLE NO.	SAMPLE NO.	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	NATURAL MOISTURE CONTENT (%)
Silty Clay	101	9	37	20	17	22
	103	3	37	21	16	20
		6	36	22	14	24
	104	4	38	22	16	30
	105	5	43	22	21	31
	106	3	40	23	17	21
	108	1	40	23	17	20
		9	43	23	20	23
		11	36	21	15	29
	1	3	40	20	20	20
Clayey Silt	101	2	22	17	5	16
		4	28	18	10	19
		7	25	19	6	20
		13	31	18	13	33
	102	7	28	20	8	30
	103	9	28	16	12	26
	104	5	35	19	16	36
		10	23	16	7	18
		13	25	18	7	35
		14	28	17	11	21
	105	12	22	17	5	19
	106	7	29	17	12	28
		10	21	15	6	15
		14	24	17	7	20
		15	25	16	9	24
	108	4	33	19	14	18
		5	31	19	12	20
	1	11	22	18	4	20
	2	7	32	19	13	26
		11	22	18	4	19
Silt Till	104	16	14	12	2	9

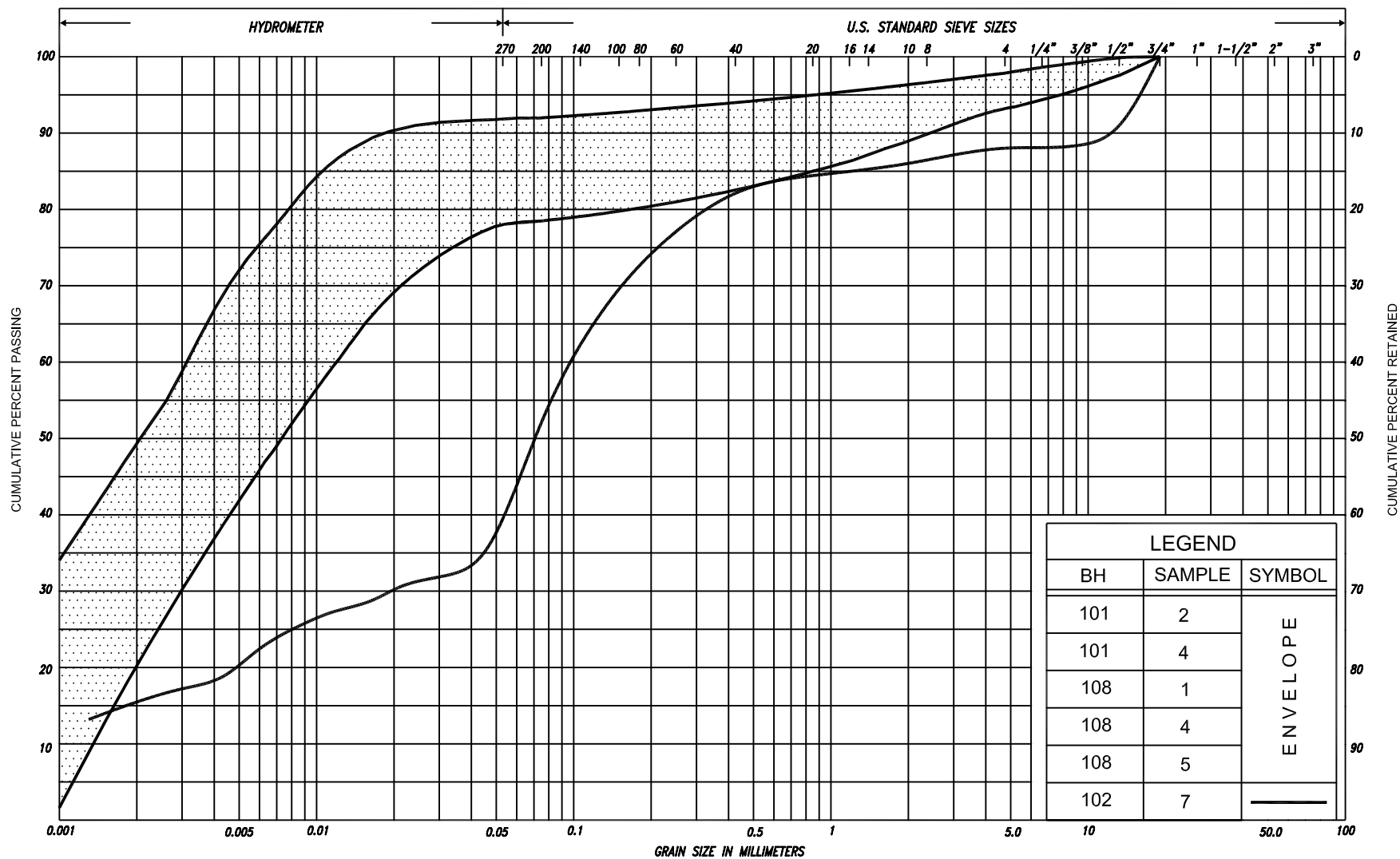


TABLE B
ROCK CORE DESCRIPTION

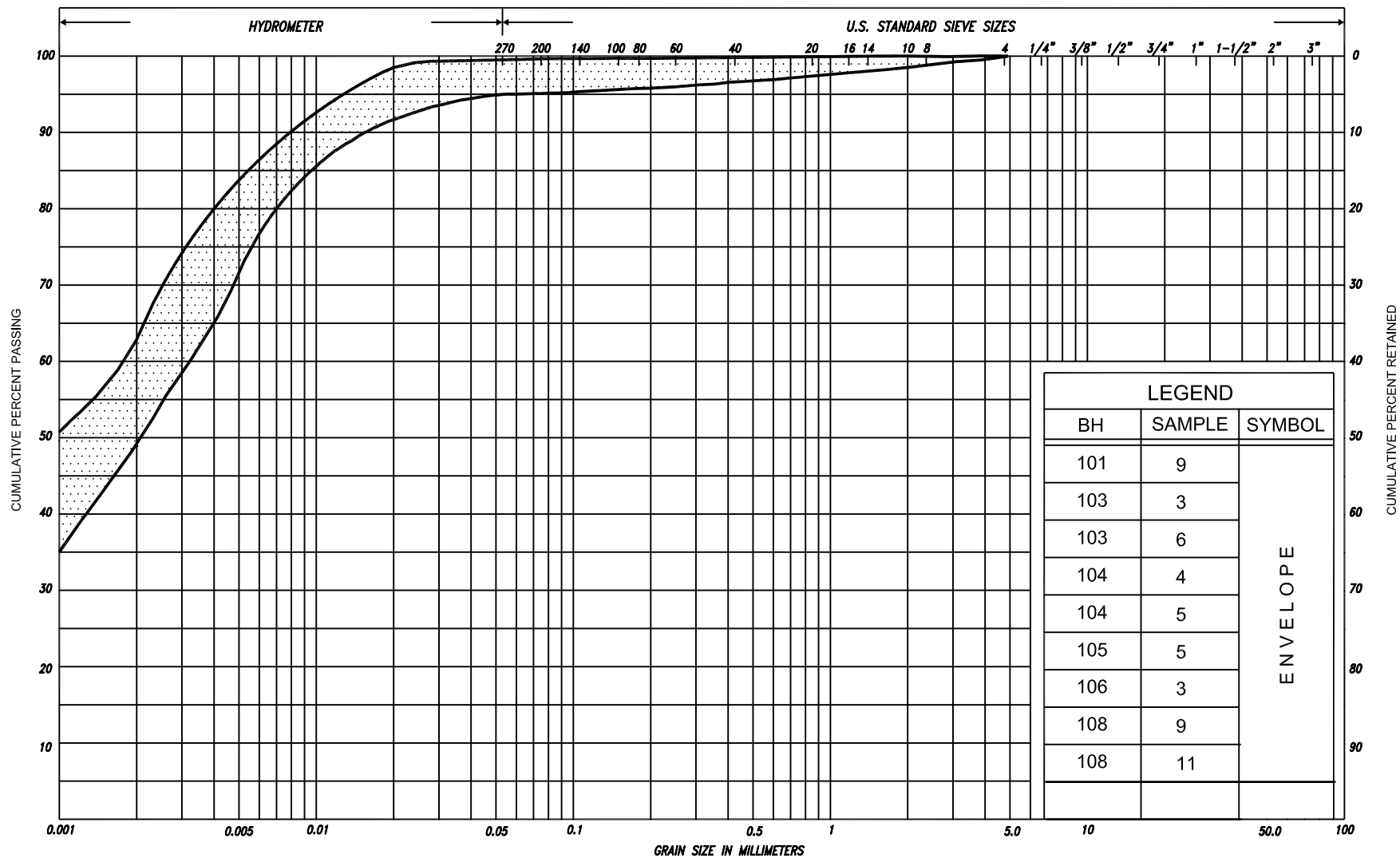
CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	CORE NO.	DEPTH (m)	RECOVERY (%)	RQD (%)	DEPTH (m)	DESCRIPTION
2	19	37.4 – 38.9	93	32	37.4 – 40.4	DOLOSTONE: Buff to grey, fine grained, low to medium strength; unweathered; with occasional irregular black shale partings and occasional seams of gypsum and calcite, close spaced flat bedding layers, rough planar, tight; poor quality. (Salina Formation)
	20	38.9 – 40.4	100	35		
105	19	36.2 - 36.6	100	0	36.2 – 40.4	DOLOMITIC LIMESTONE: Light grey to blue grey, weathered buff, fine grained to aphanitic, with porous zones, medium strength, slightly weathered, highly fractured, possible cobbles/boulders and/or loosened bedrock, very close to close spaced flat bedding layers, but generally lacks continuity with adjacent core, very poor quality. DOLOSTONE: Dark brown to grey, with numerous black bituminous or shale partings, occasional very thin white calcite and/or gypsum seams, fine crystalline to aphanitic, medium strength, unweathered, very close to close spaced flat partings, rough to smooth planar, tight, fair quality.
	20	36.6 – 37.3	79	0		
	21	37.3 – 38.9	98	52		
	22	38.9 – 40.4	100	58		
106	20	37.0 – 38.3	100	90	37.0 – 40.4	DOLOSTONE: Dark brown to grey, with numerous black bituminous or shale partings, occasional very thin white calcite and/or gypsum seams, fine crystalline to aphanitic, medium strength, unweathered, very close to close spaced flat partings, rough to smooth planar, tight, fair to good quality.
	21	38.3 – 39.9	100	71		
	22	39.9 – 40.4	100	75		

NOTES: RQD: Rock Quality Designation

Originated: MR
 Compiled: JFW
 Checked: NR/CN



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED
CLAY	FINE		MEDIUM		COARSE		SAND			GRAVEL			COBBLES	M.I.T.
CLAY		SILT			V. FINE		FINE	MED.	COARSE		GRAVEL			U.S. BUREAU
					SAND									



SILT & CLAY				FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED	
CLAY	FINE		MEDIUM		COARSE		SAND		GRAVEL			COBBLES	M.I.T.		
	SILT				FINE		MEDIUM		COARSE						
CLAY		SILT			V. FINE		FINE		MED.		COARSE		GRAVEL		U.S. BUREAU
							SAND								

GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand

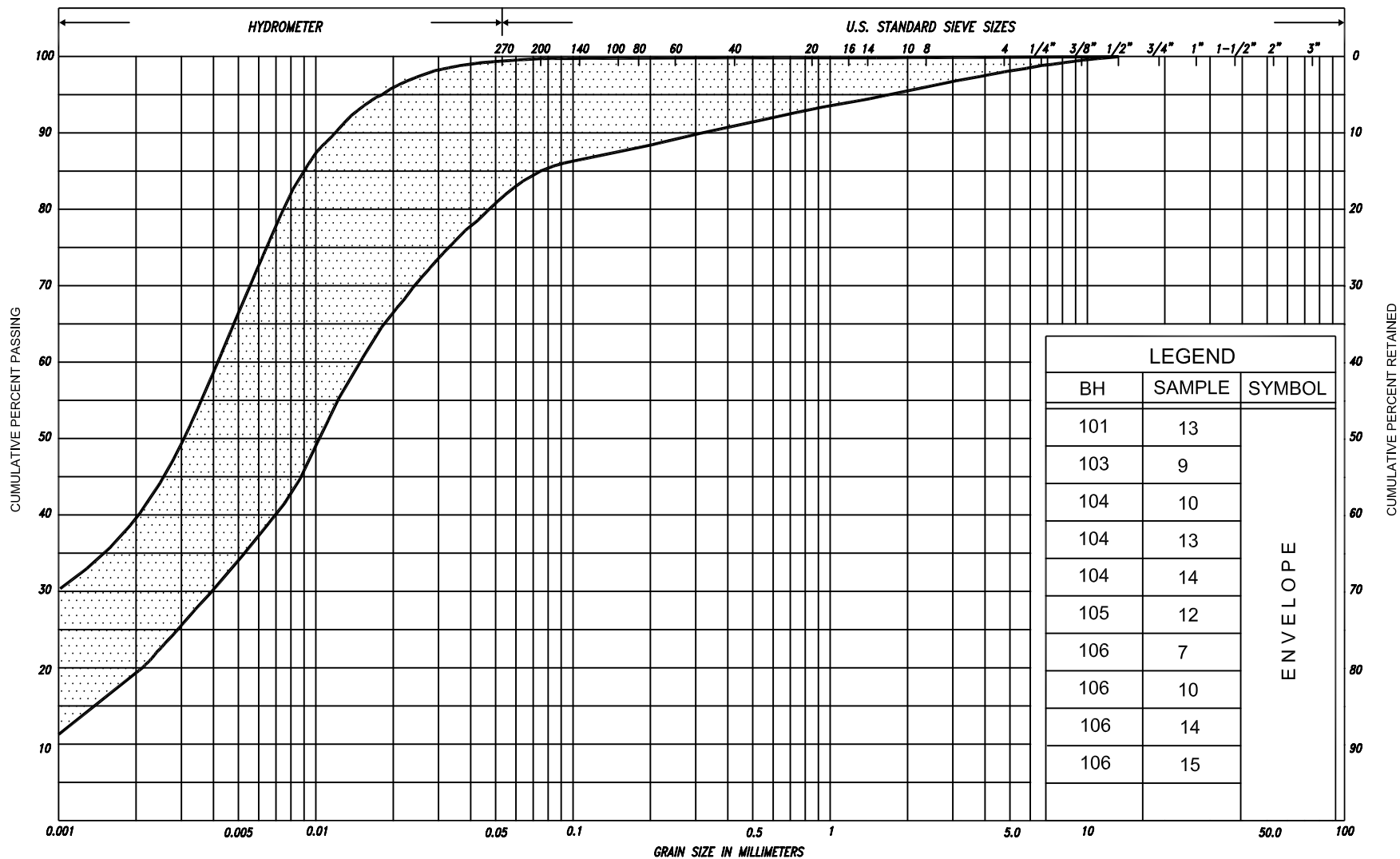
FIG No. MR-GS-2

HWY: 406

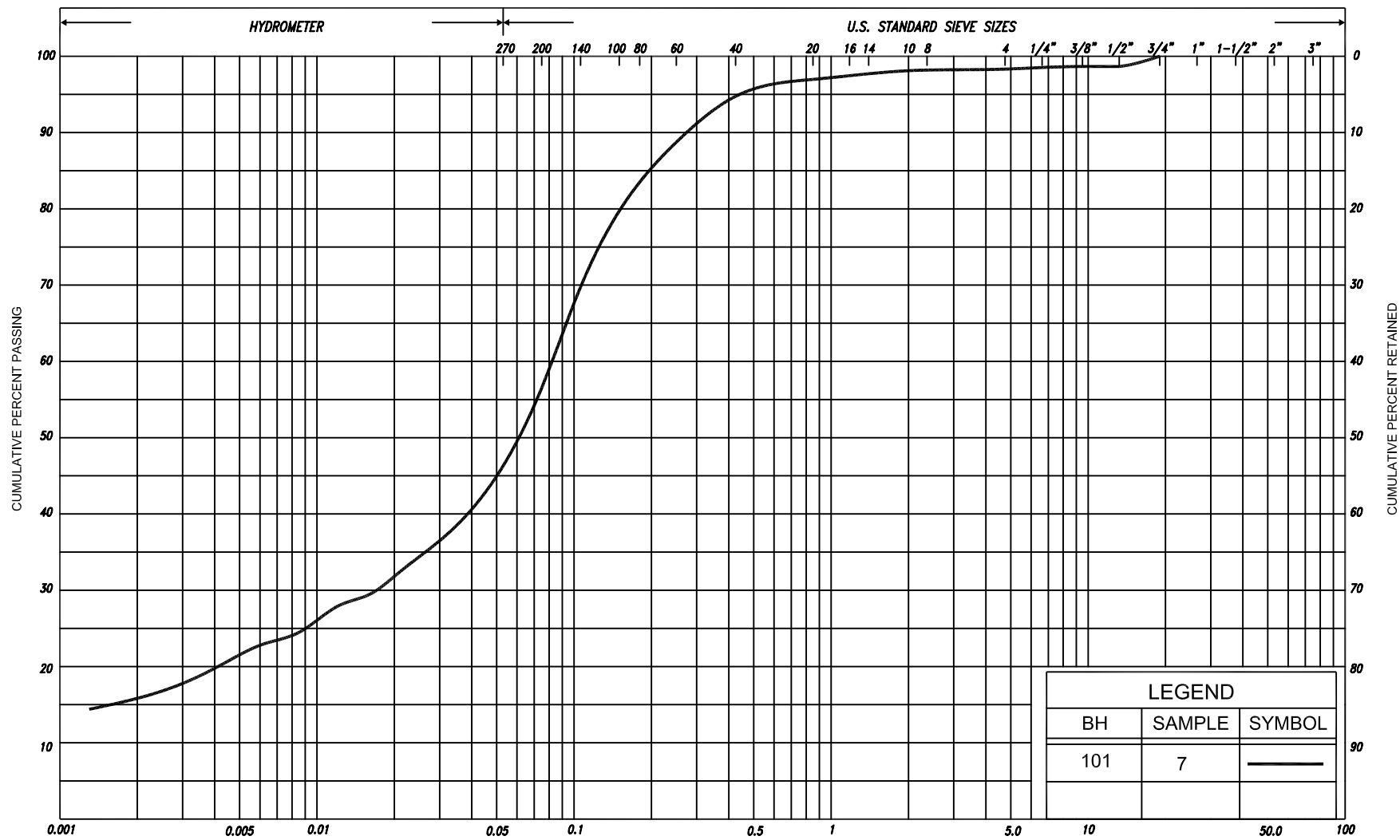
G.W.P. No. 280-99-00



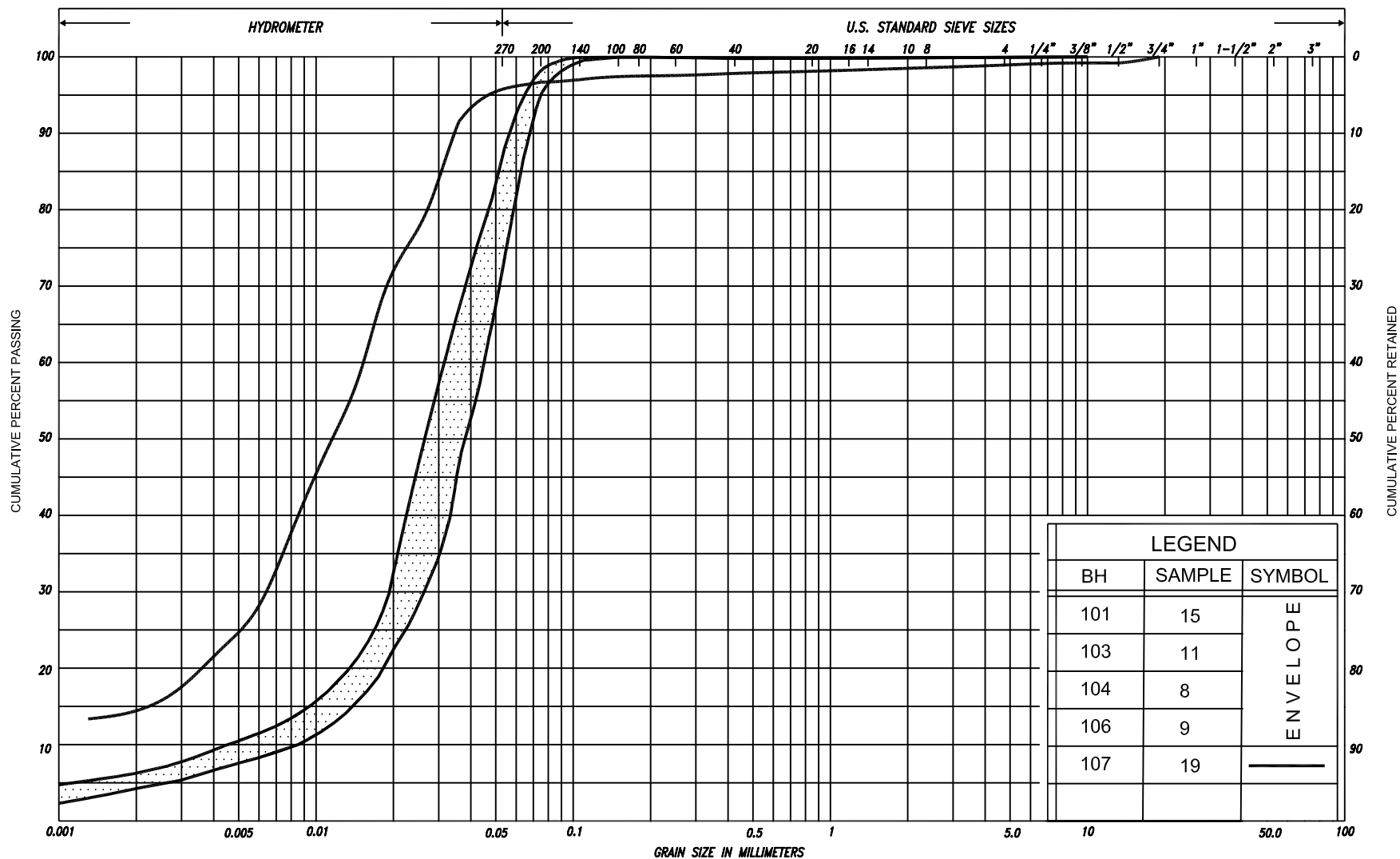
Ministry of
Transportation
Ontario



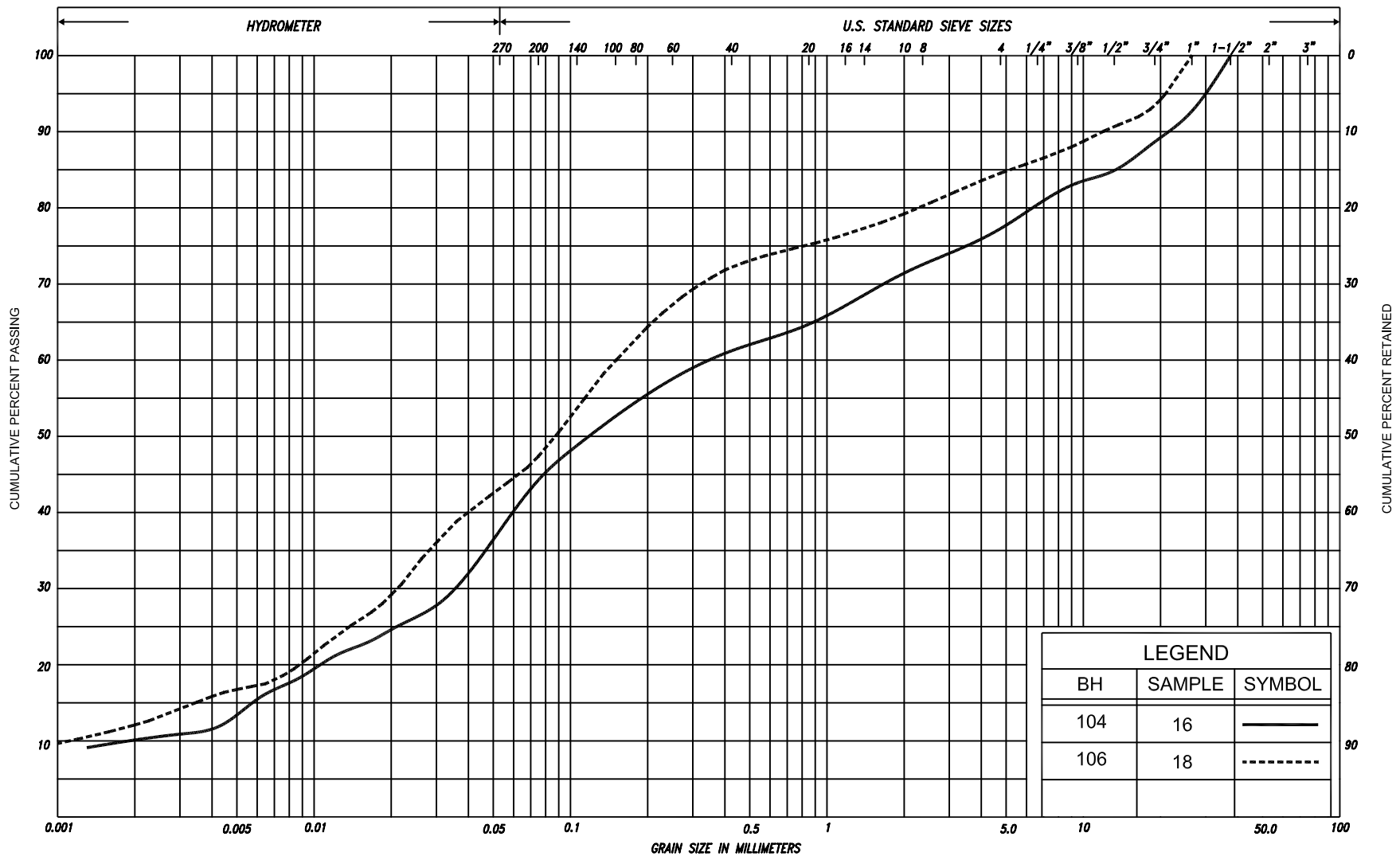
SILT & CLAY					FINE		MEDIUM		COARSE		GRAVEL			COB BLES	UNIFIED	
CLAY	FINE		MEDIUM		COARSE	FINE		MEDIUM		COARSE	GRAVEL			COBBLES	M.I.T.	
	SILT					SAND									U.S. BUREAU	
CLAY		SILT				V. FINE	FINE	MED.	COARSE	GRAVEL						



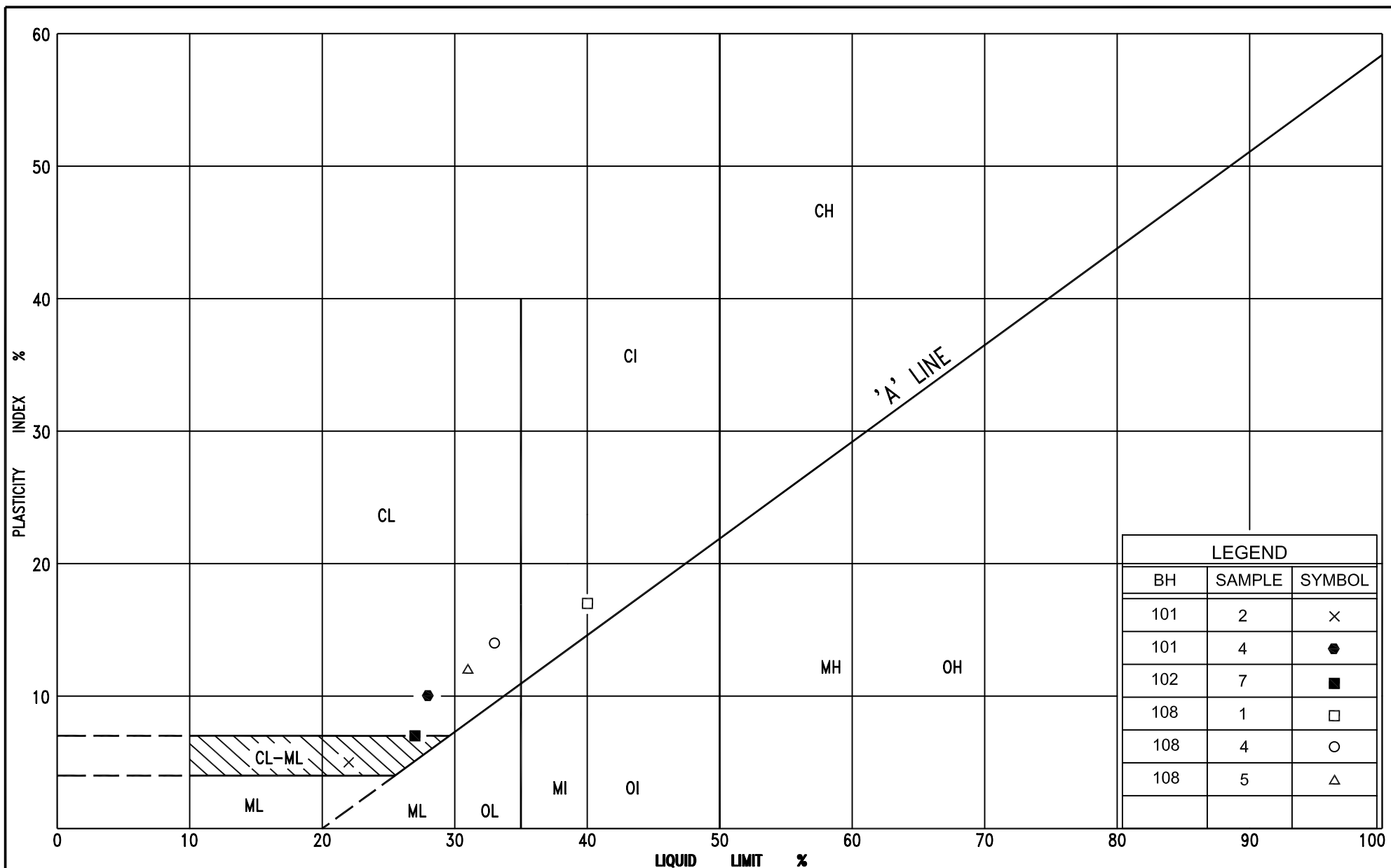
SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED
CLAY	FINE		MEDIUM		COARSE		SAND		GRAVEL		COBBLES	M.I.T.
	SILT				FINE		MEDIUM		COARSE			U.S. BUREAU
CLAY		SILT		V. FINE		FINE		MED.		COARSE		
						SAND						

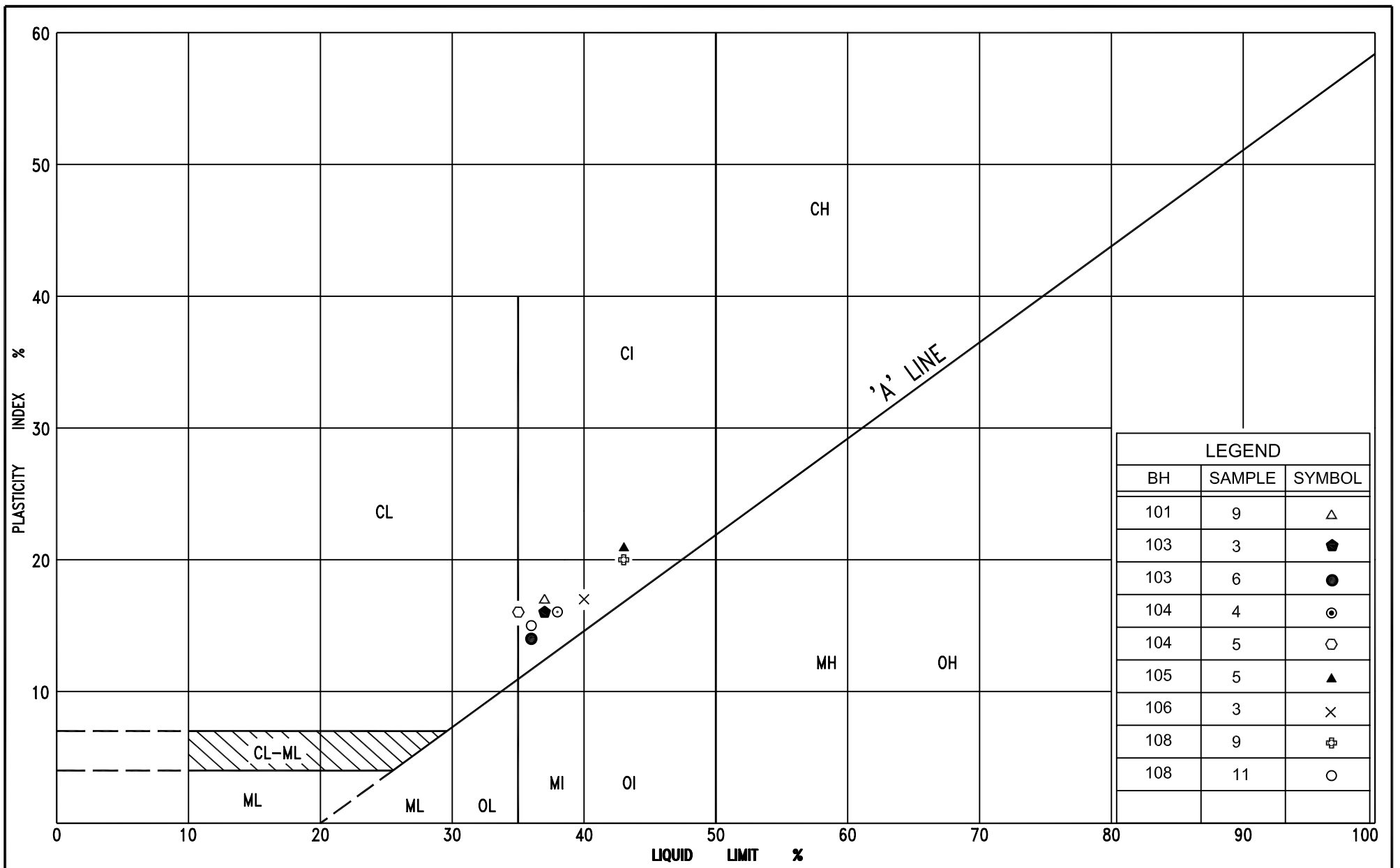


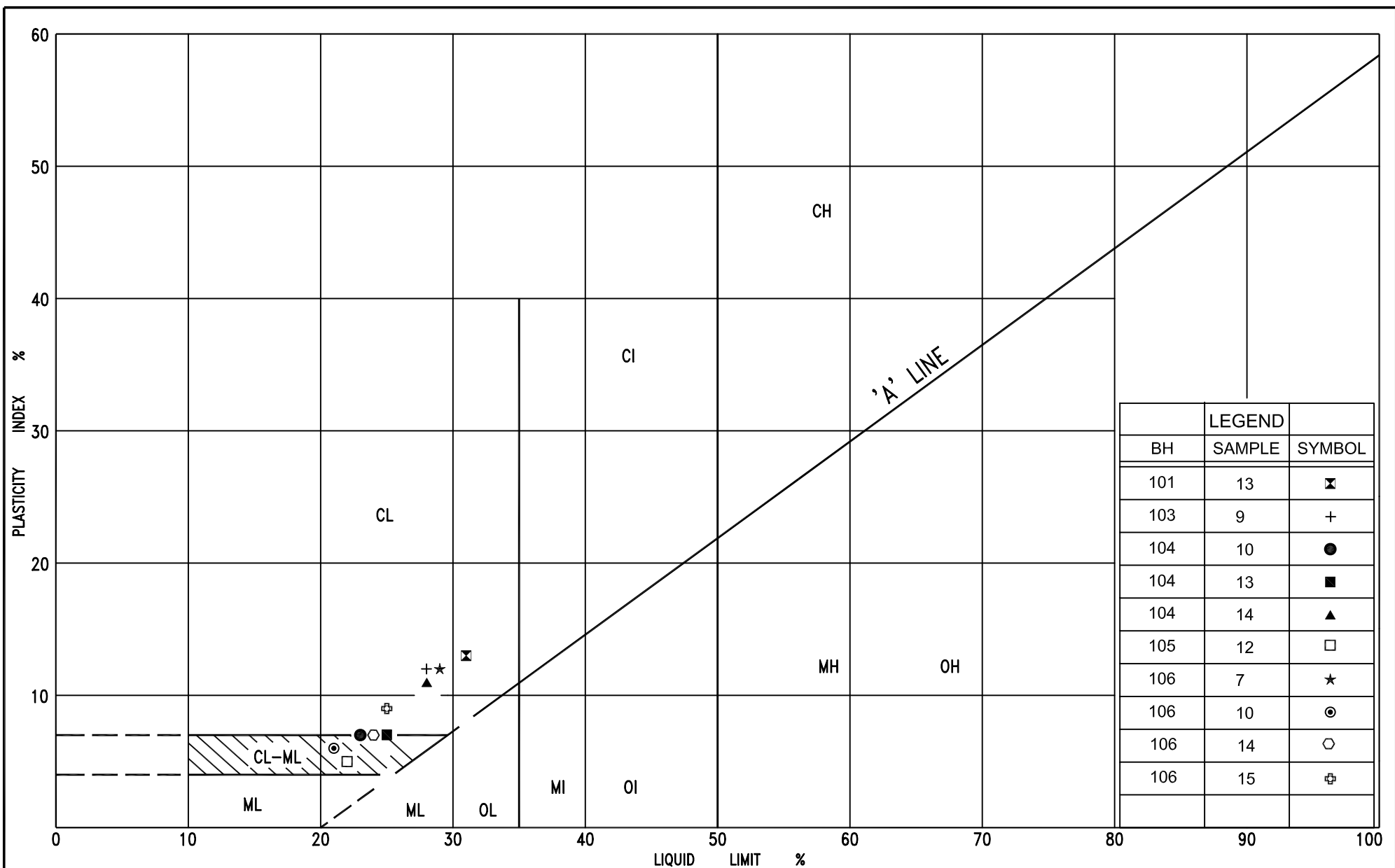
SILT & CLAY				FINE		MEDIUM		COARSE	GRAVEL		COBBLES	UNIFIED			
				SAND											
CLAY	FINE		MEDIUM		COARSE		FINE		MEDIUM		COARSE	GRAVEL	COBBLES	M.I.T.	
	SILT						SAND								
CLAY		SILT			V. FINE		FINE		MED.		COARSE	GRAVEL			U.S. BUREAU
					SAND										

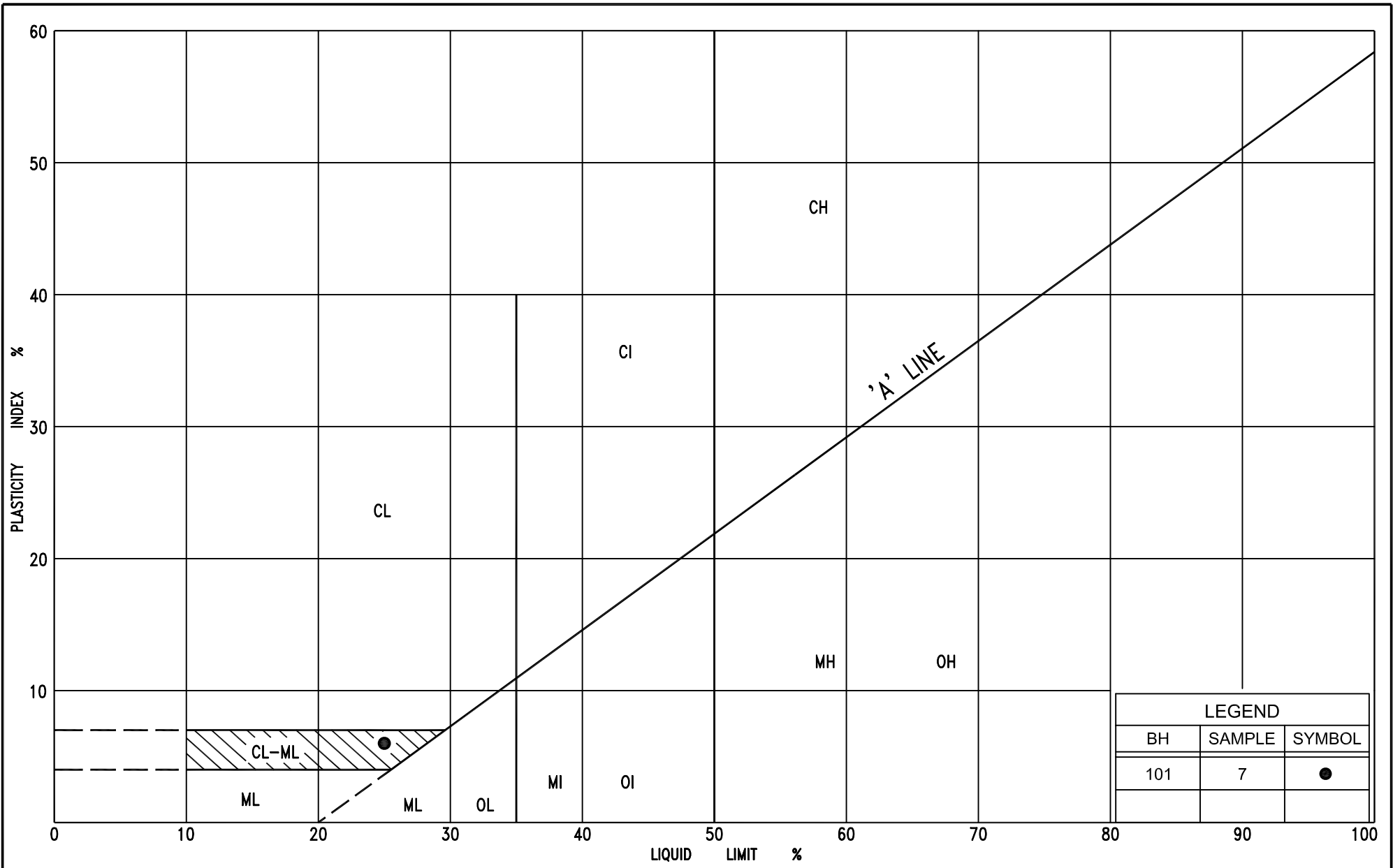


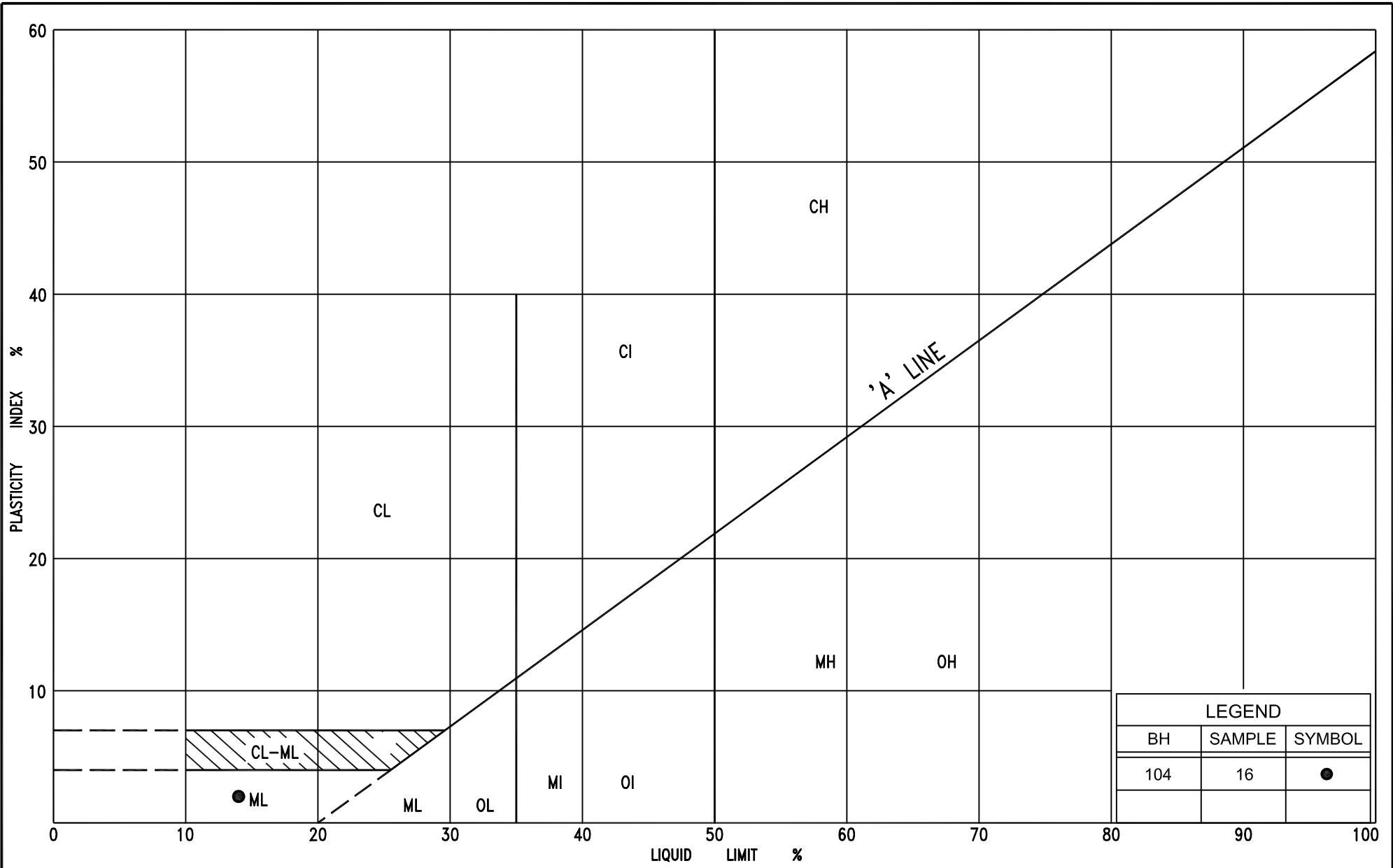
SILT & CLAY				FINE			MEDIUM			COARSE			GRAVEL			COBBLES	UNIFIED
CLAY	FINE			MEDIUM			COARSE			GRAVEL			COBBLES			M.I.T.	
	SILT			SAND			SAND			SAND			SAND			U.S. BUREAU	









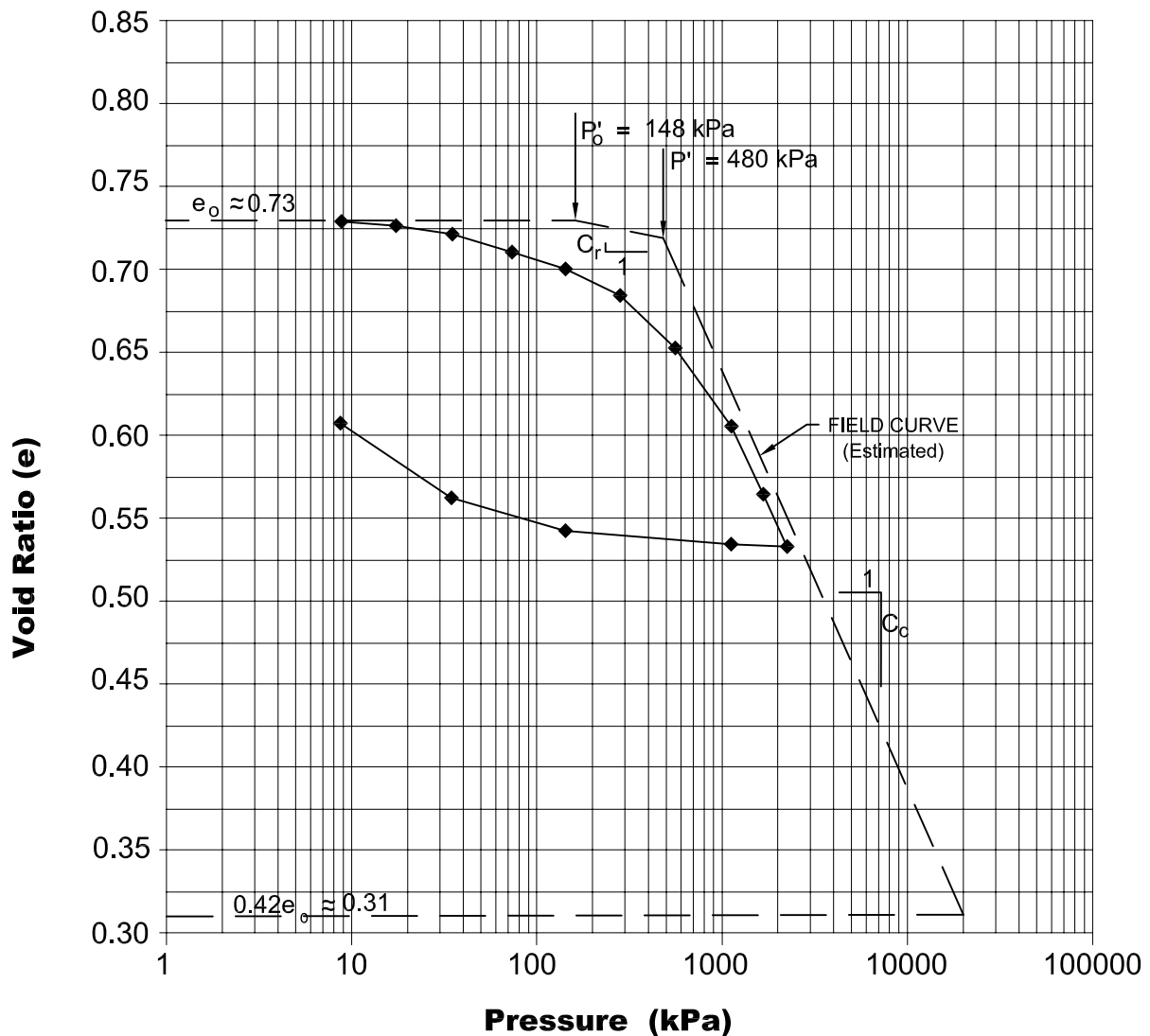


Void Ratio versus Log of Pressure

Laboratory Consolidation Test Results

HWY 406 & Merritt Road Underpass
Borehole 103, Sample No. 9, 7.6 - 8.2 m

Void Ratio versus Log of Pressure



SOIL TYPE: CLAYEY SILT, trace sand

$e_0 \approx 0.73$

$W_0 = 26.1\%$

$\gamma = 19.8 \text{ kN/m}^3$

S.G. = 2.76

$P'_0 = 148 \text{ kPa}$

$P'_c = 480 \text{ kPa}$

$C_c = 0.26$

$C_r = 0.02$

$W_L = 28$

$W_P = 16$

PI = 12

FIG. No: MR-OC-2

HWY: 406

G.W.P. No: 280-99-00

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

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

RECORD OF BOREHOLE No 101

1 of 2

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 765 994 N; 326 490 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.
DATUM Geodetic DATE October 27, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL
185.2	Ground Surface							20	40	60	80	100								
0.0	Clayey silt some sand, trace gravel		1	SS	6		185							o						
	Firm Brown Moist (FILL)		2	SS	7		184							o						
	Soft Mottled brown/grey		3	SS	2		183							o						
			4	SS	3									o						
	Firm		5	SS	8		182							o						
			6	SS	5															
180.9							181													
4.3	Topsoil																			
180.5																				
4.7	Clayey silt and Sand trace gravel		7	SS	5		180							o						
	Firm to Brown Wet stiff		8	SS	12									o						
179.4																				
5.8	Silty clay, trace sand						179							o						
	Hard to Reddish Moist stiff brown		9	SS	31									o						
							178													
			10	SS	21		177							o						
			11	SS	9		176													
							175													
	thin silt partings		12	TW	PH		174							o						
	Firm to stiff			FV																
			13	SS	4		173							o						
				FV			172													
			14	SS	2		171													
				FV																
170.2																				

RECORD OF BOREHOLE No 101

2 of 2

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 765 994 N; 326 490 E ORIGINATED BY M.R.
 DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.
 DATUM Geodetic DATE October 27, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa 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			20	40	60	80	100					
170.2																	
15.0																	
170.0	Silt, trace sand						170										
15.2																	
169.4	Compact Reddish Moist		15	SS	12									o			0 5 90 5
15.8	End of borehole																
	* Borehole dry upon completion of Drilling																
	■ Penetrometer test																

RECORD OF BOREHOLE No 102

1 of 1

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 012 N; 326 508 E ORIGINATED BY W.L.
DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.
DATUM Geodetic DATE September 24, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L					
184.8	Ground Surface							20	40	60	80	100								
0.0	Topsoil		1	SS	10	▼*	▼*							○				12 36 37 15		
	Silty clay, trace sand														○					
	Stiff to Brown Moist soft		2	SS	7										○					
	trace gravel														○					
			3	SS	5										○					
															○					
			4	SS	3										○					
	Clayey silt and sand some gravel topsoil inclusions		5	SS	3								○							
	Soft Wet (FILL)		6	SS	3								○							
			7	SS	2								○							
179.3														○						
5.5	Peat		8	SS	3									○						
178.6														○						
6.2	Sandy silt, trace clay		9	SS	2									○						
178.1	Very loose Brown Moist													○						
6.7	Silty clay, trace sand layers of sandy silt		10	SS	3									○						
	Soft to Brown Moist stiff to wet		11	SS	9									○						
														○						
			12	SS	12									○						
175.0	End of borehole													○						
9.8																				

RECORD OF BOREHOLE No 103

1 of 2

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 016 N; 326 529 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.
DATUM Geodetic DATE October 24, 2008 CHECKED BY C.N.



SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W		
180.4	Ground Surface												
0.0	Silty clay some sand, some gravel		1	SS	4		180			o			
	Soft Silty sand												
179.2	Compact Brown Moist (FILL)		2	SS	12					o			
1.2	Silty clay, trace sand						179						
	Hard Brown/ Moist grey		3	SS	11				213				0 1 50 49
	Reddish brown						178						
			4	SS	13				225				
	thin layers of silt						177						
	Very stiff		5	SS	10				150				
	Stiff						176						0 1 44 55
			6	SS	6								
			7	TW	PH		175					19.6	
				FV									
	Grey						174						
			8	SS	2								
				FV			173					19.8	0 1 63 36
172.9	Clayey silt, trace sand		9	TW	PH								
7.5	Stiff Reddish Moist brown						172						
				FV									
			10	SS	5		171						
170.4	Silt, trace sand						170						
10.0	Compact Reddish Wet brown						169						0 3 91 6
			11	SS	12								
168.2	End of borehole						168						
12.2	Probable clayey silt						167						
	Firm to hard						166						
165.4													

RECORD OF BOREHOLE No 103

2 of 2

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 016 N; 326 529 E ORIGINATED BY M.R.
 DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.
 DATUM Geodetic DATE October 24, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× LAB VANE		
165.4 15.0	Cont'd Probable clayey silt Firm to hard																	
159.0 21.4	Probable clayey silt Hard (TILL)																	
156.6 23.8	End of dynamic cone penetration test * Borehole dry upon completion of drilling ■ Penetrometer test C.F.H.S.A: denotes Continuous Flight Hollow Stem Augers																	

RECORD OF BOREHOLE No 104

1 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 020 N; 326 551 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.
DATUM Geodetic DATE October 22 and 23, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		+ FIELD VANE								○		
								20	40	60	80	100								
179.7	Ground Surface																			
0.0	Silty clay, trace sand		1	SS	6		179													
0.3	Firm Mottled Moist brown (FILL)																			
	Silty clay, trace sand thin lenses of silt		2	SS	23															
	Very stiff Mottled Moist brown		3	SS	17		178													
	Stiff						177													
			4	SS	3		176										0 1 44 55			
				FV																
	thin partings of silt																			
			5	SS	1		175										0 4 46 50			
				FV																
							174													
			6	SS	3		173													
				FV																
							172													
			7	TW	PH		171													
				FV																
171.0																				
8.7	Silt trace sand, trace clay						170													
	Loose Reddish Moist brown to wet		8	SS	7		169										0 2 93 5			
168.8							168													
10.9	Clayey silt trace sand, trace gravel		9	SS	7		167										1 6 70 23			
	Firm Reddish Moist brown						166													
			10	SS	7		165													
			11	TW	PH															
164.7																				

RECORD OF BOREHOLE No 104

2 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 020 N; 326 551 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.
DATUM Geodetic DATE October 22 and 23, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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RECORD OF BOREHOLE No 104

3 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 020 N; 326 551 E ORIGINATED BY M.R.
 DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.
 DATUM Geodetic DATE October 22 and 23, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa 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			20	40	60	80	100					
149.7 30.0	layers of silty sand		18	SS	1		149										
148.3 31.4	Sand and silt, trace clay Very dense Reddish Moist brown/grey (TILL)						148										
							147										
			19	SS	50/10cm		146										
							145										
							144										
143.6 36.1	End of borehole Refusal on probable bedrock Sample 19: sampler bouncing * 2008 10 24 ▼ Water level measured after drilling ■ Penetrometer test WH** denotes penetration due of weight of rods and hammer Low 'N' values in samples 14 and 18 are due to hydraulic disturbance in silt and silty sand layers.																

RECORD OF BOREHOLE No 105

1 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 049 N; 326 574 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.
DATUM Geodetic DATE October 29 and 31, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _P	W	W _L		WATER CONTENT (%)				
180.4	Ground Surface							20	40	60	80	100									
0.0	Sand and gravel, granular "A", crushed limestone						180														
179.6	Brown Moist (FILL)																				
0.8	Silty clay, trace sand		1	SS	15		179														
	Very stiff Brown Moist																				
	layers of silty sand		2	SS	17		178														
							178														
	Reddish brown		3	SS	22		177														
							177														
	Firm to stiff						176														
			4	SS	4		176														
				FV			175														
							175														
			5	SS	3		174														
				FV			174														
							173														
			6	TW	PH		173														
				FV			172														
							172														
							171														
	silt layers		7	SS	6		171														
170.6							170														
9.8	Silt trace sand, trace clay						170														
	Loose Reddish/ Moist brown to wet		8	SS	5		169														
							169														
168.7	Clayey silt, trace sand						168														
11.7	Firm Reddish Moist brown		9	SS	7		168														
							167														
	Stiff		10	SS	9		167														
							166														
165.4	Cont'd						166														

RECORD OF BOREHOLE No 105

2 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 049 N; 326 574 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.
DATUM Geodetic DATE October 29 and 31, 2008 CHECKED BY C.N.




SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa 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			20	40	60	80	100					
165.4 15.0	Cont'd Clayey silt, trace sand Stiff Reddish Moist brown		11	SS	11		165										
							164										
			12	SS	12		163										
							162										
			13	SS	11		161										
							160										
160.3 20.1	Sand and silt, trace clay Compact Reddish Moist brown/grey (TILL)		14	SS	28		159										
							158										
							157										
			15	SS	26		156										
							155										
							154										
							153										
	Very dense		16	SS	80		152										
							151										
150.4	Cont'd																

RECORD OF BOREHOLE No 105

3 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 049 N; 326 574 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.
DATUM Geodetic DATE October 29 and 31, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L						
								○ UNCONFINED	● QUICK TRIAXIAL	✕ LAB VANE	✚ FIELD VANE	WATER CONTENT (%)									
150.4 30.0								20	40	60	80	100									
	Dense		17	SS	33										○						
	Very dense		18	SS	60/10cm																
144.2 36.2	Bedrock		19	RC NQ	REC 100%															RQD 0%	
	Dolomitic limestone																				RQD 0%
	Light grey to blue grey		20	RC NQ	REC 100%																
143.1 37.3	Medium strength																				
	Weathered																				
	Very poor quality																				
	Dolostone		21	RC NQ	REC 100%																RQD 52%
	Dark brown to grey																				
	Medium strength																				
	Unweathered																				
	Fair quality		22	RC NQ	REC 100%																RQD 58%
140.0 40.4	End of borehole						140														
	Sample 18: sampler bouncing																				
	* Borehole charged with drilling water																				
	■ Penetrometer test																				
	C.F.H.S.A: denotes Continuous Flight Hollow Stem Augers																				

RECORD OF BOREHOLE No 106

1 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 074 N; 326 590 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.
DATUM Geodetic DATE October 20 to 22, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL × LAB VANE										
							WATER CONTENT (%)											
							20 40 60 80 100					20 40 60						
180.4	Ground Surface																	
180.2	Topsoil																	
0.2	Clayey silt, some sand oxidized stains		1	SS	4		180											
179.7																		
0.7	Soft Dark Moist brown brown																	
	Silty clay, trace sand		2	SS	7													
	Very stiff Mottled Moist brown brown																	
			3	SS	18													
	thin partings of silt																	
	Stiff																	
			4	SS	9													
			5	SS	1													
				FV														
			6	TW	PH													
				FV														
172.9	Clayey silt, trace sand																	
7.5	Stiff Grey Moist to wet		7	SS	WH**													
				FV														
	thin layers of silt																	
	Reddish brown		8	SS	2													
				FV														
170.0	Silt																	
10.4	trace sand, trace clay																	
	Loose Reddish Moist brown brown		9	SS	7													
168.1	Clayey silt																	
12.3	some sand, trace gravel		10	SS	7													
	Firm Reddish Moist brown brown																	
			11	SS	4													
165.4		Cont'd																

RECORD OF BOREHOLE No 106

2 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 074 N; 326 590 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.
DATUM Geodetic DATE October 20 to 22, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa 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			20	40	60	80	100					
165.4 15.0	trace sand Very stiff		12	SS	6		165										
				FV													
							164										
			13	SS	9		163										
							162										
			14	SS	9		161										
							160										
	Firm						159										
			15	SS	4		158										
							157										
157.2 23.2	Clayey silt with sand, with gravel Hard Reddish Moist brown (TILL)		16	SS	50/25cm		156										
							155										
							154										
			17	SS	61		153										
							152										
151.4 29.0	Sand and silt, trace clay Dense Reddish Moist brown/grey (TILL)						151										
150.4	Cont'd																

RECORD OF BOREHOLE No 106

3 of 3

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 074 N; 326 590 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.
DATUM Geodetic DATE October 20 to 22, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa 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			20	40	60	80	100					
150.4 30.0	some clay, some gravel		18	SS	42		150										15 38 35 12
							149										
							148										
	Very dense		19	SS	50/10cm		147										
							146										
							145										
							144										
143.4 37.0	Bedrock						143										RQD 90%
	Dolostone		20	RC NQ	REC 100%		142										RQD 71%
	Dark brown to grey						141										
	Medium strength		21	RC NQ	REC 100%												
	Unweathered																
	Fair to good quality		22	RC NQ	REC 100%												RQD 75%
140.0 40.4	End of borehole						140										
	Samples 16 and 19: sampler bouncing																
	* 2008 10 22																
	▼ Water level measured after drilling																
	■ Penetrometer test																
	WH** denotes penetration due of weight of rods and hammer																
	* C.F.H.S.A: denotes Continuous Flight Hollow Stem Augers																

METRIC

+⁷, ×⁵: Numbers refer to Sensitivity

20
15 — ○ — 5
10

(%) STRAIN AT FAILURE

METRIC

20
15 — 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 108

1 of 2

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 107 N; 326 655 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.
DATUM Geodetic DATE October 20, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL	
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	WATER CONTENT (%)									
185.3	Ground Surface						20	40	60	80	100										
0.0	Silty clay, trace sand layers of silt																				
	Firm to Mottled Moist stiff brown		1	SS	7																
	trace gravel		2	SS	6																
	lenses of clayey silt		3	SS	6																
	Clayey silt some sand, trace gravel asphalt inclusions thin lenses of topsoil		4	SS	8																
	(FILL)		5	SS	13																
			6	SS	9																
179.7			7	SS	7																
5.6	Topsoil																				
179.5	Silty clay, trace sand		8	SS	15																
5.8	Very stiff Brown Moist																				
	thin partings of silt		9	SS	18																
	Stiff		10	SS	4																
				FV																	
			11	TW	PH																
				FV																	
	Grey		12	SS	WH**																
				FV																	
172.0																					
13.3	End of borehole																				
	Cont'd																				

Cont'd

RECORD OF BOREHOLE No 108

2 of 2

METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 107 N; 326 655 E ORIGINATED BY M.R.
 DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.
 DATUM Geodetic DATE October 20, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES				* GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT						PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa																
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE																
170.3									20	40	60	80	100	20	40	60						
	<div>* Borehole dry upon completion of drilling</div> <div>■ Penetrometer test</div> <div>WH** denotes penetration due of weight of rods and hammer</div>																					

CONT No

GWP No 280-99-00

MERRITT ROAD UNDERPASS

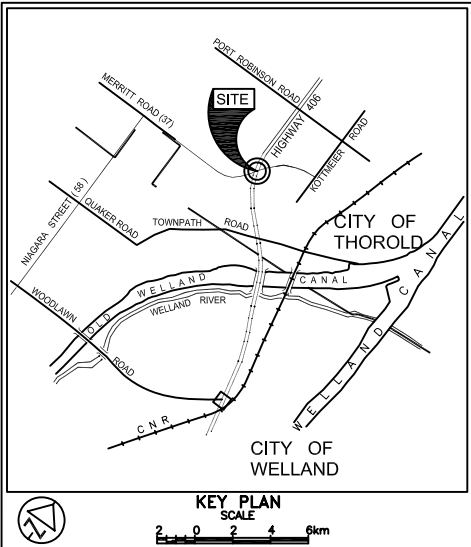
HIGHWAY 406

BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



- LEGEND**
- Borehole
 - Dynamic Cone Penetration Test (Cone)
 - Borehole & Cone
 - N Blows/0.3m (Std. Pen Test, 475 J/blow)
 - CONE Blows/0.3m (60 Cone, 475 J blow)
 - WH Penetration due to weight of hammer and rods
 - PH Thinwall Sample - Advanced Hydraulically
 - W L at time of investigation Oct 2008
 - Head
 - ARTESIAN WATER Encountered
 - PIEZOMETER
- (Legend Continued)

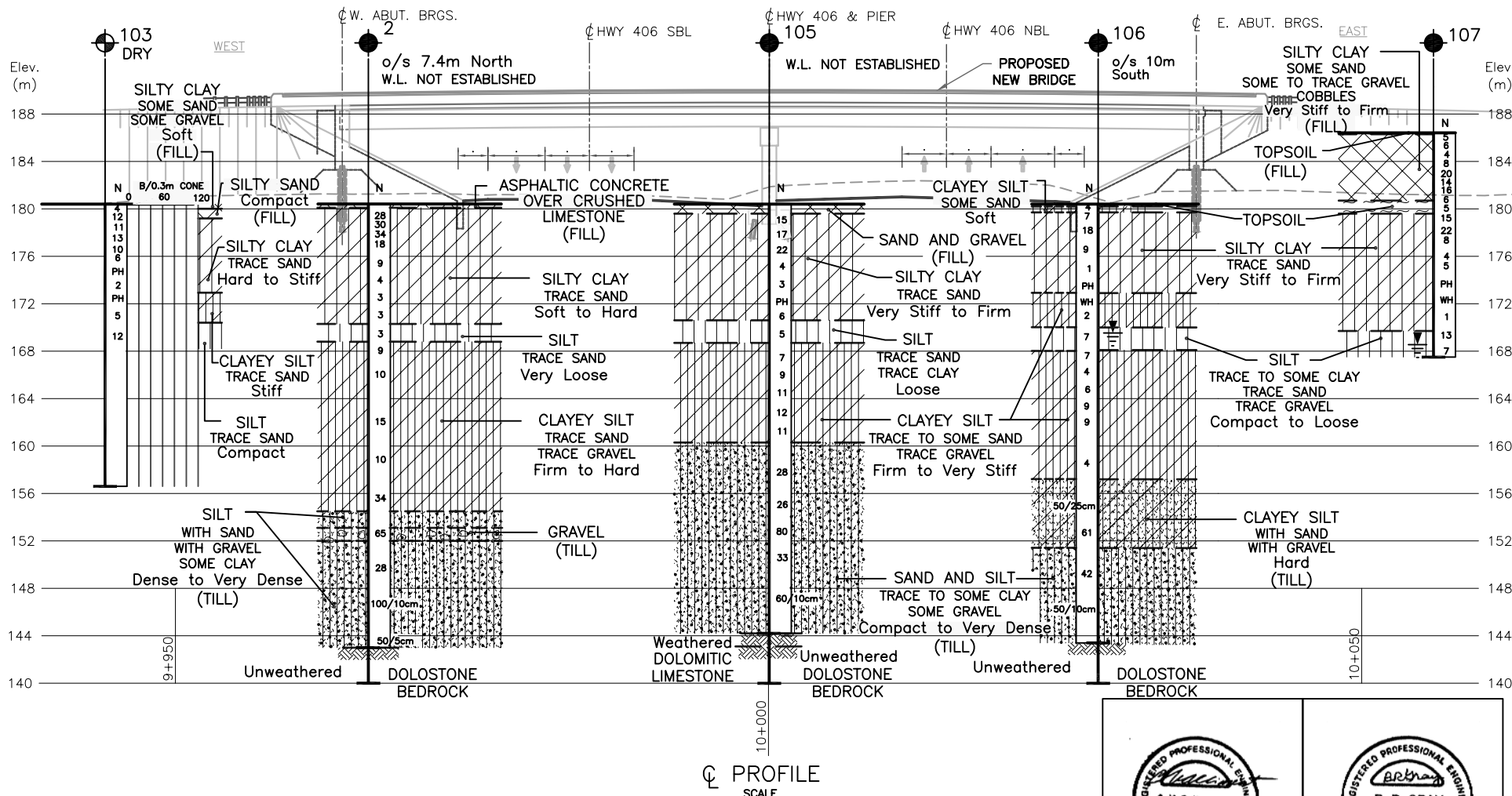
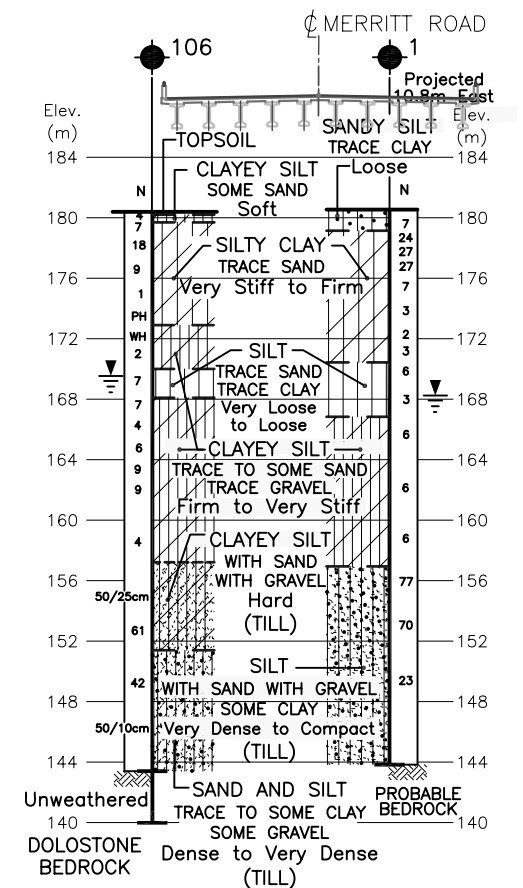
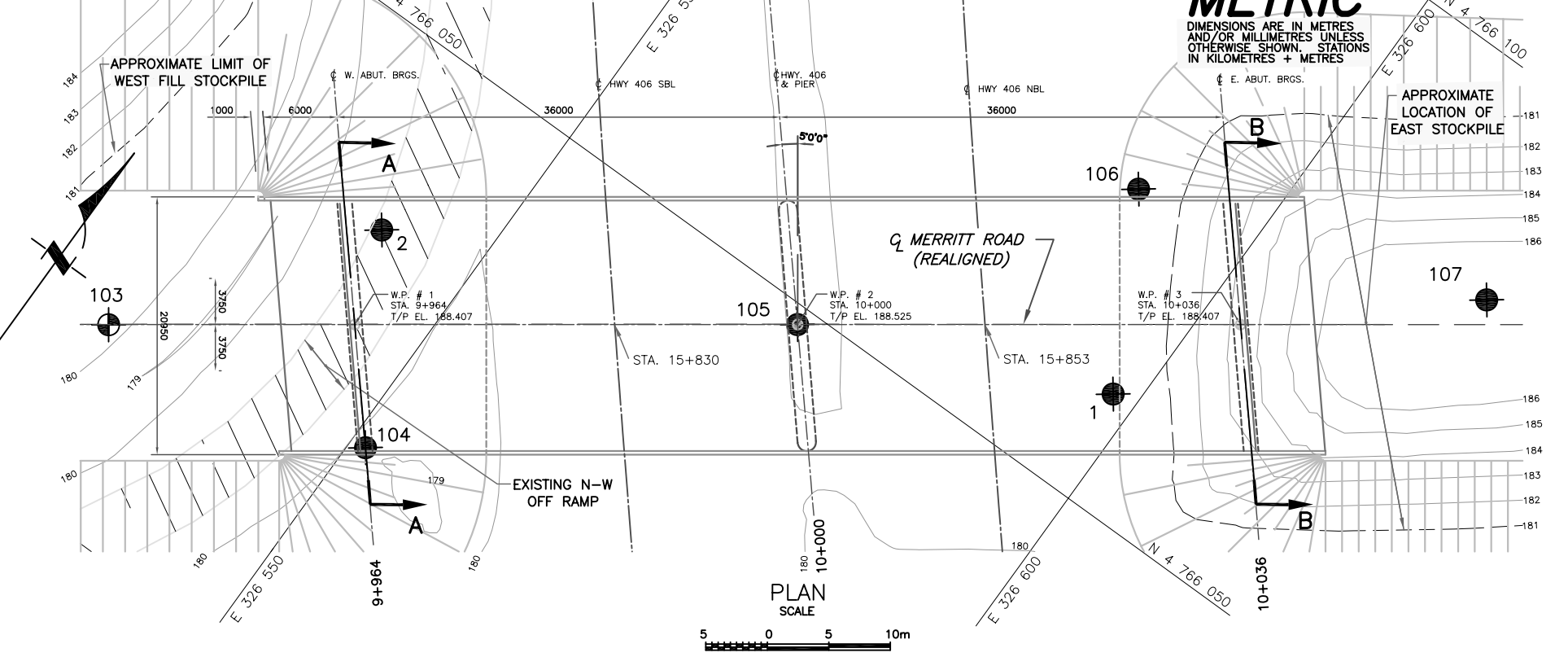
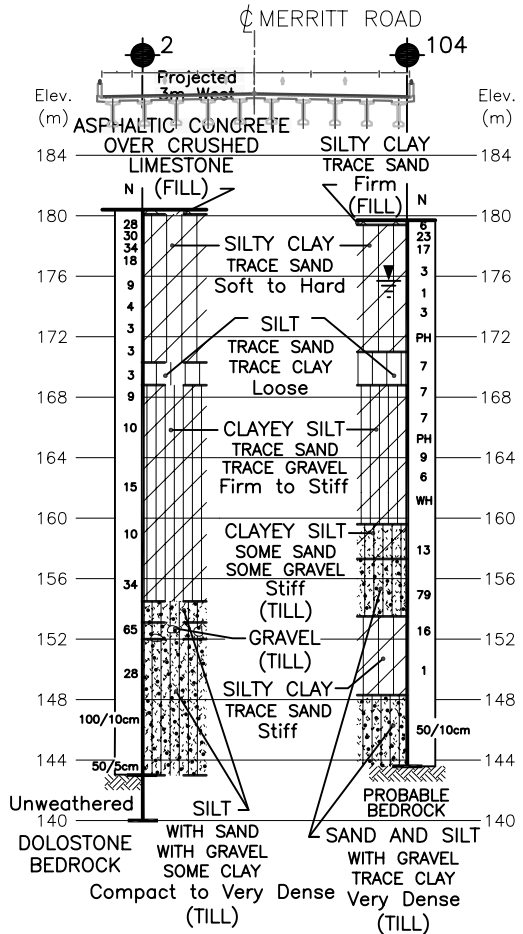
BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
103	180.4	4 766 016	326 529
104	179.7	4 766 020	326 551
105	180.4	4 766 049	326 574
106	180.4	4 766 074	326 590
107	186.4	4 766 083	326 618
1	180.5	4 766 059	326 598
2	180.4	4 766 035	326 542

(Legend Continues in drawing MR-2)

NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 30M03-240			
HWY No 406	CHECKED NR	DATE MAR. 03, 2009	DIST CR
SUBM'D NR	CHECKED NR	SITE 34-460	
DRAWN NA	CHECKED CN	APPROVED BRG	DWG MR-1



NOTE:
THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

REF No. PREFERRED OPTION/old-base map-ONE COLOR.dwg,
Received on Sept.25, 2008
S7303-301-001GA.dwg; Dated JANUARY, 2009



METRIC

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

CONT No

GWP No 280-99-00

MERRITT ROAD UNDERPASS

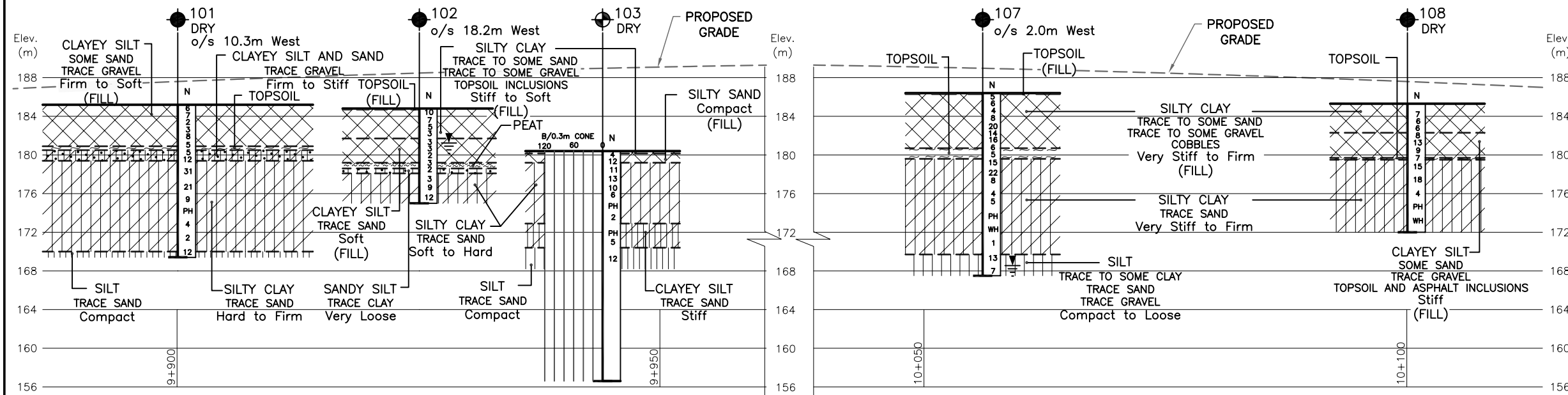
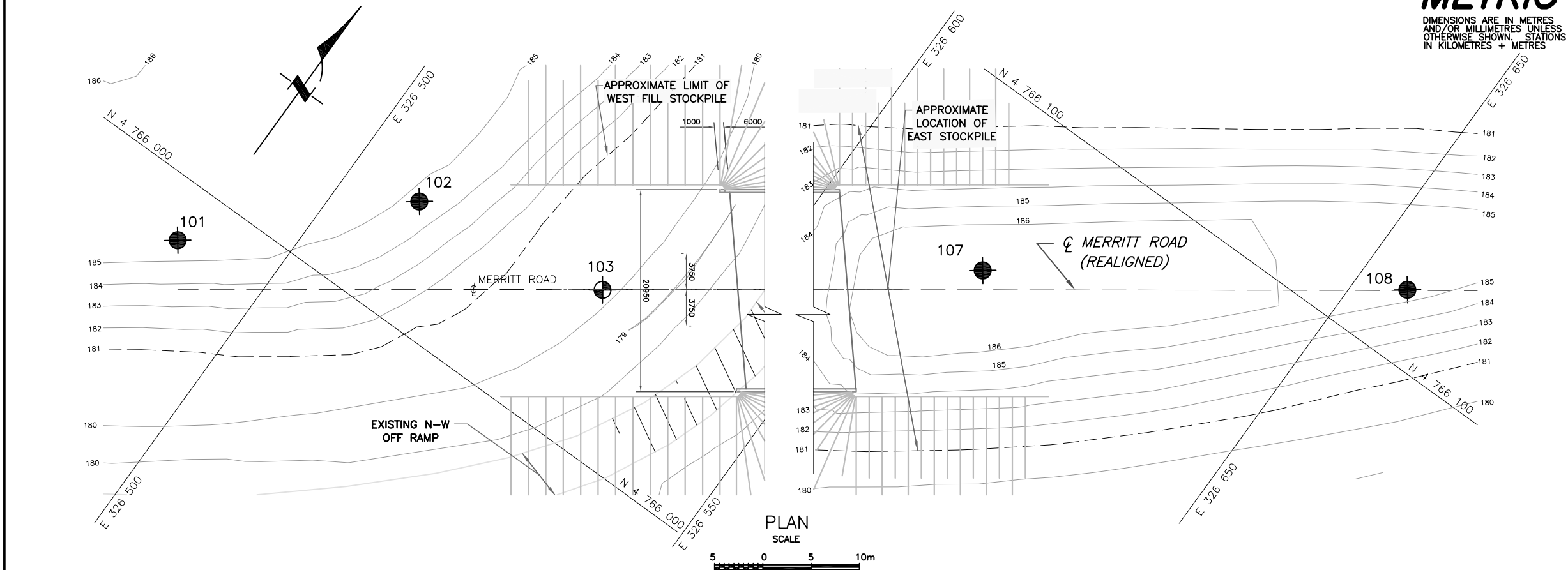
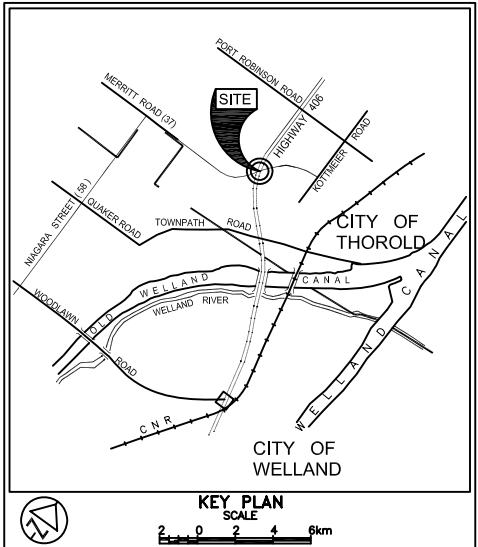
HIGHWAY 406

BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J blow)
- WH Penetration due to weight of hammer and rods
- PH Thinwall Sample - Advanced Hydraulically
- W L at time of investigation Sept-Oct 2008
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

(Legend Continued)

BH No	ELEVATION	CO-ORDINATES	
		NORTHINGS	EASTINGS
101	185.2	4 765 994	326 490
102	184.8	4 766 012	326 508
103	180.4	4 766 016	326 529
107	186.4	4 766 083	326 618
108	185.3	4 766 107	326 655

(Legend Continues in drawing MR-1)

- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 30M03-240



REF No. PREFERRED OPTION/old-base map-ONE COLOR.dwg,
Received on Sept.25, 2008
S7303-301-001GA.dwg; Dated JANUARY, 2009

HWY No	406	DIST	CR
SUBM'D NR	CHECKED NR	DATE MAR. 03, 2009	SITE 34-460
DRAWN NA	CHECKED CN	APPROVED BRG	DWG MR-2

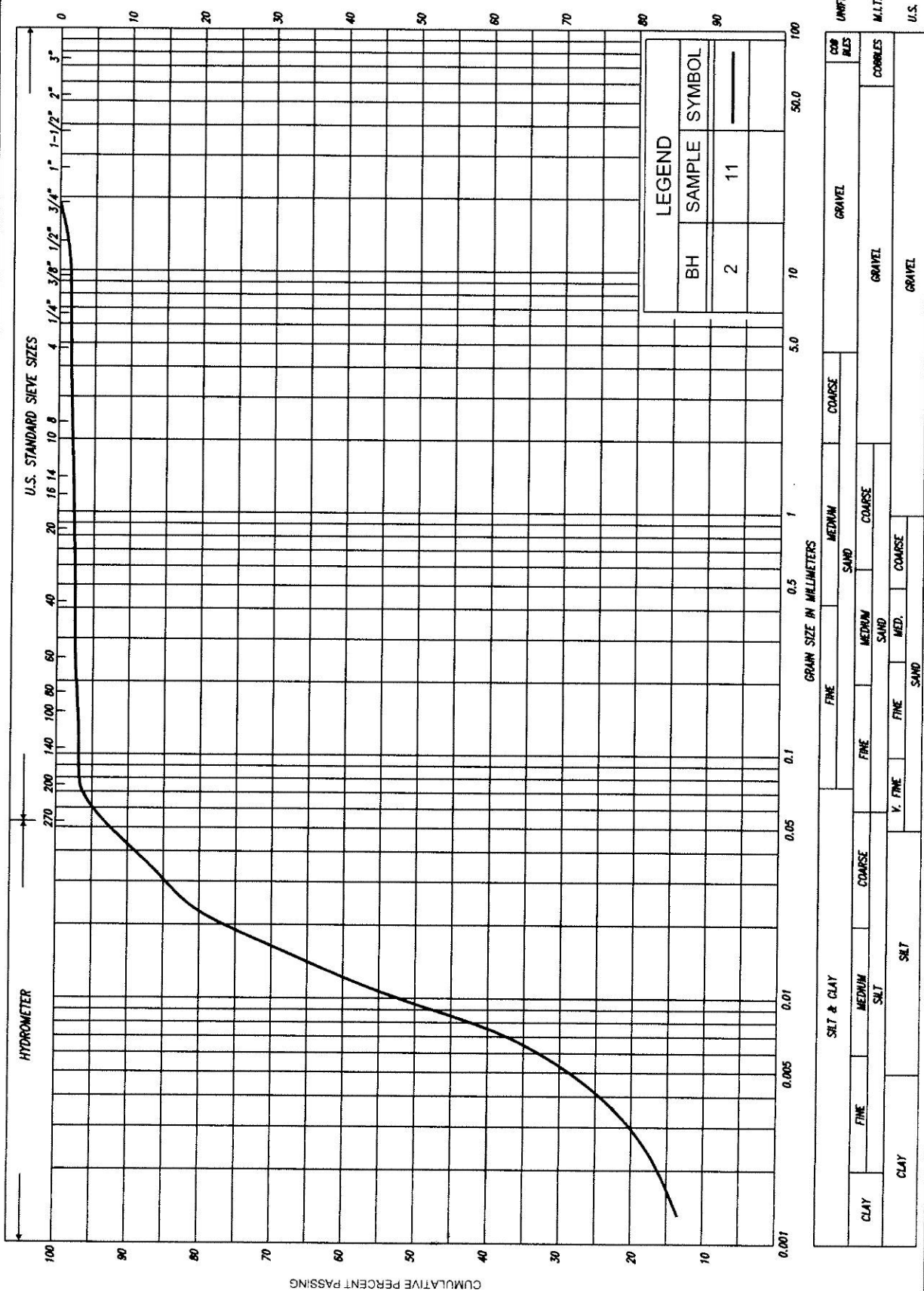
NOTE:

- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.



APPENDIX A

Grain Size Distribution, Plasticity Charts and Record of Borehole Sheets of Boreholes 1 and 2 (Peto MacCallum Ltd. Ref. No. 08TF005D – Preliminary Foundation Investigation and Design Report, Dated November 20, 2008, GEOCREC No. 30M03-233).



Ministry of Transportation
Ontario

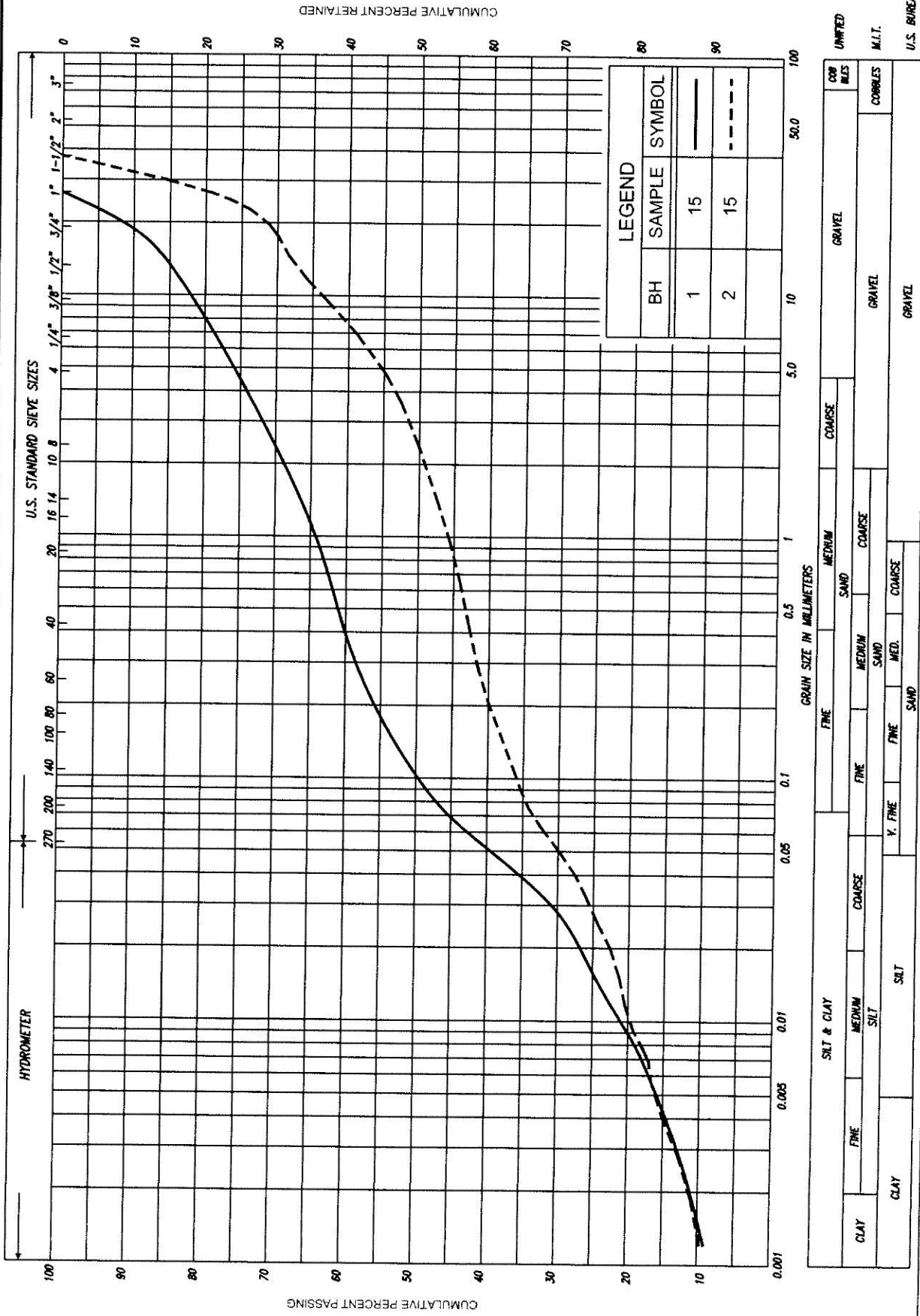
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand, trace gravel

FIG No. GS-MR-2

HWY: 406

G.W.P. No. 280-99-00



GRAIN SIZE DISTRIBUTION

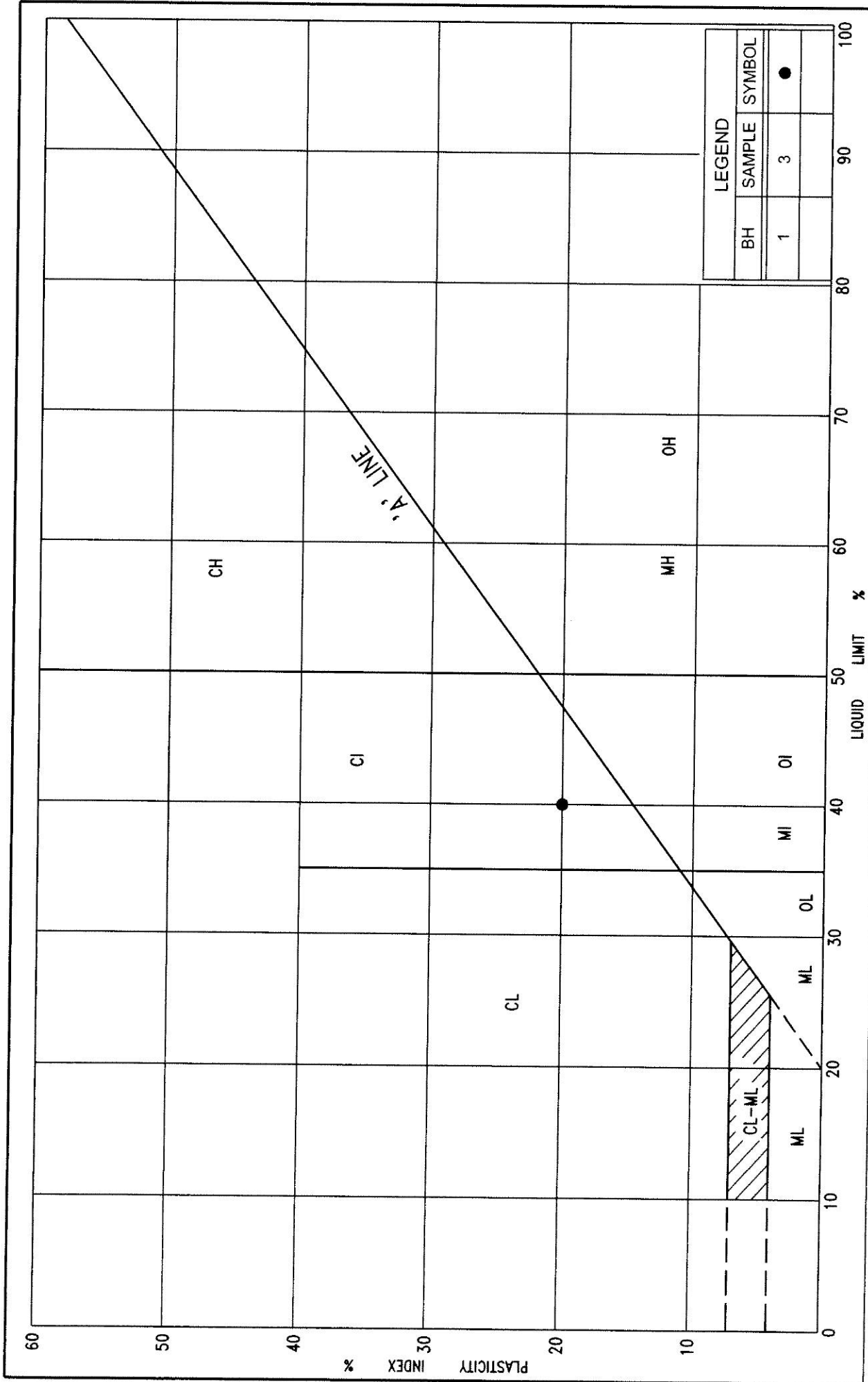
SILT, with sand, with gravel, some clay (Till)

GRAVEL, with sand, with silt, some clay (Till)

FIG No. GS-MR-3

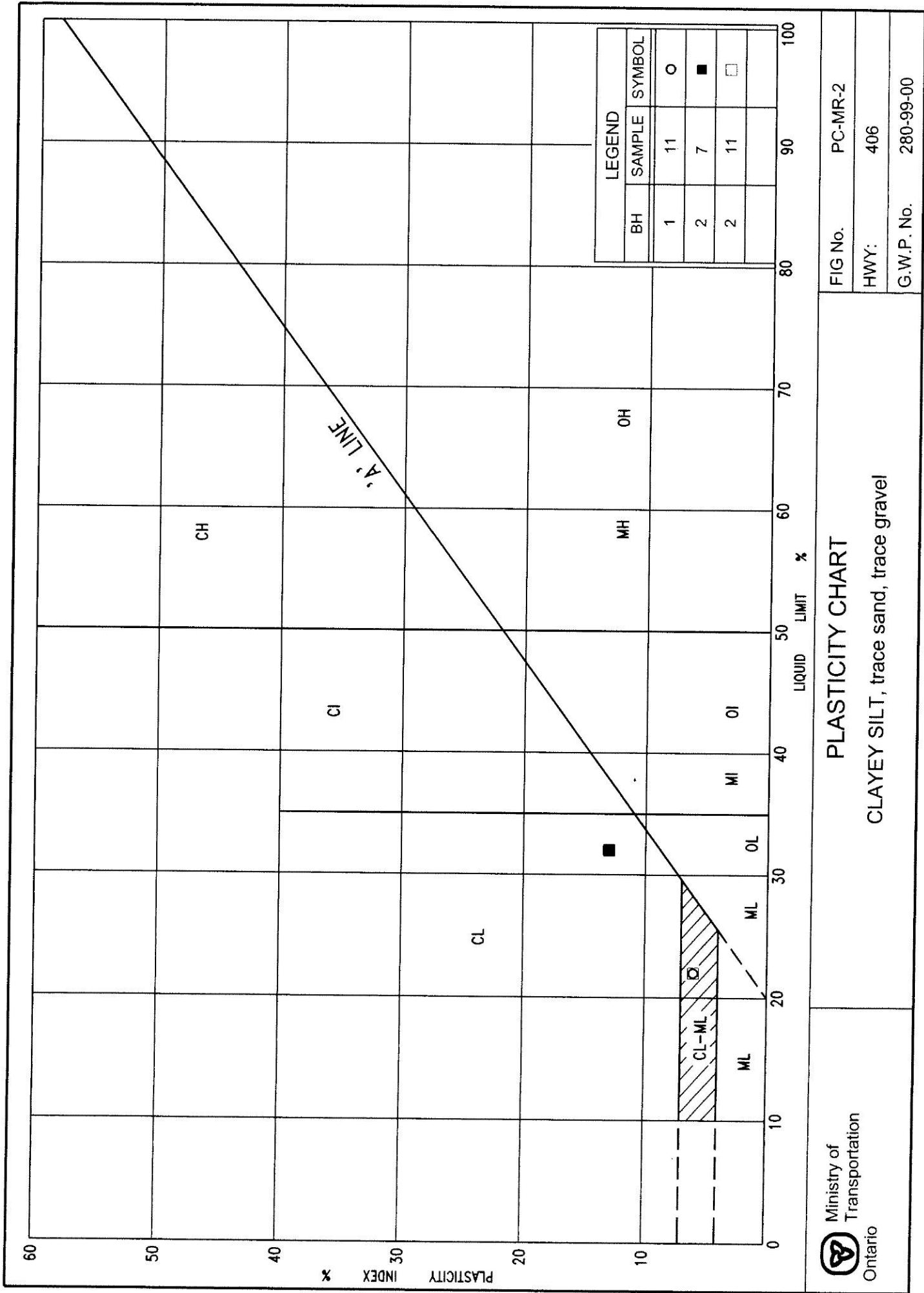
HWY: 406

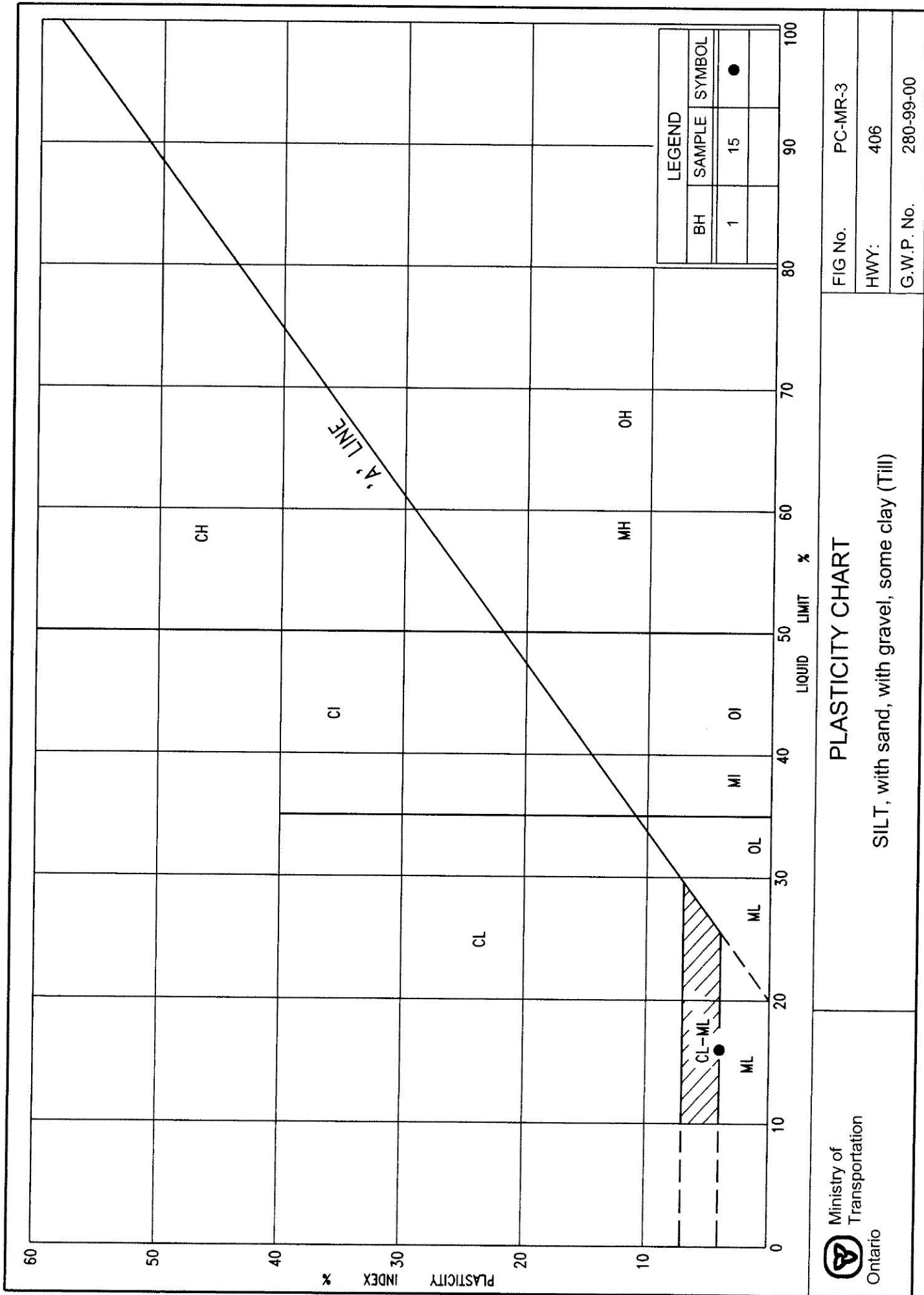
G.W.P. No. 280-99-00



PLASTICITY CHART

SILTY CLAY, trace sand





RECORD OF BOREHOLE No 1

1 of 3

METRIC

G.W.P. 280-99-00

LOCATION

Hwy 406 / Merritt Road Underpass
Co-ords: 4 766 059 N; 326 598 E

ORIGINATED BY M.R.

DIST CR HWY 406

BOREHOLE TYPE

Continuous Flight Hollow Stem Augers

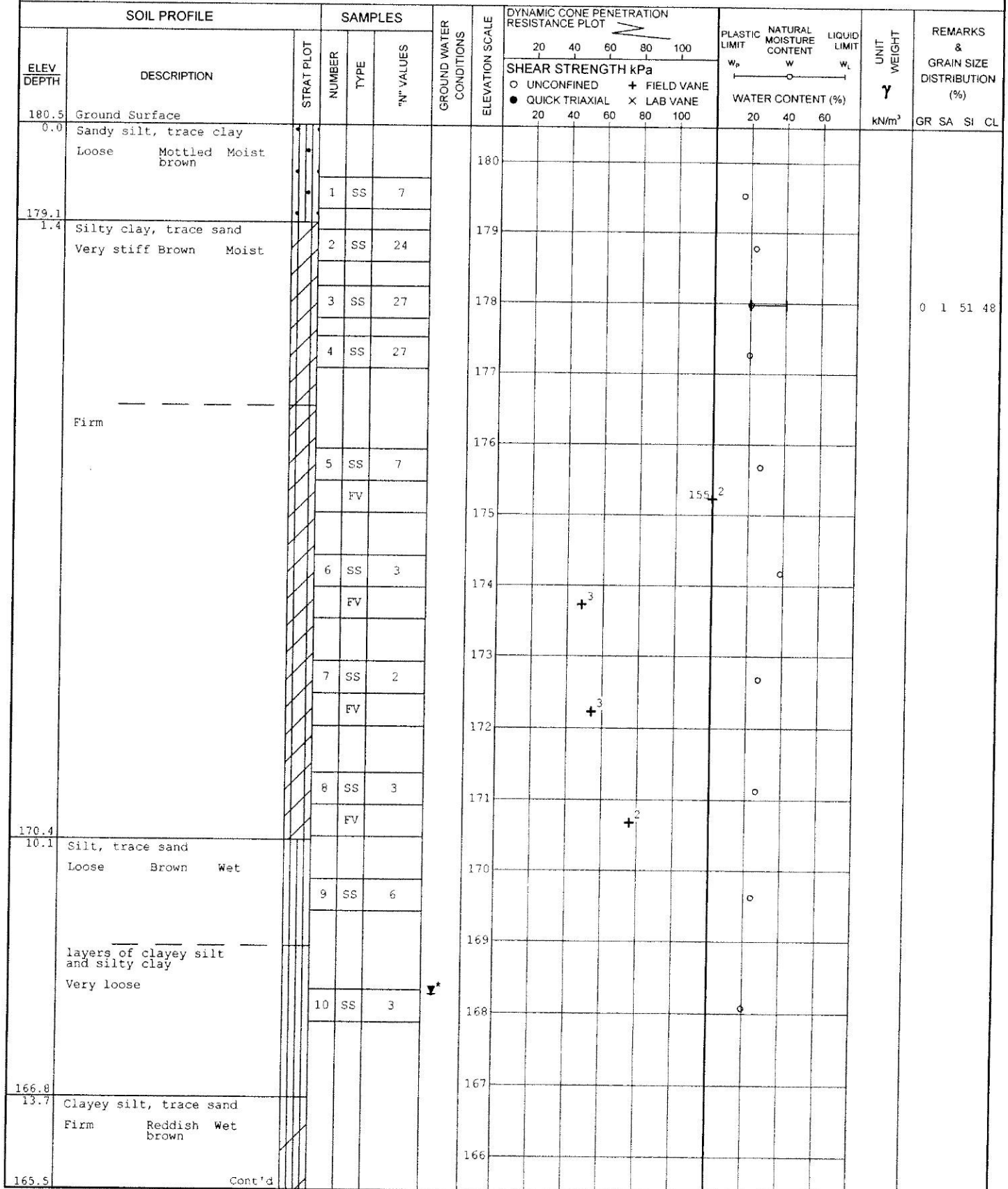
COMPILED BY P.C.

DATUM Geodetic

DATE

November 01, 2001

CHECKED BY D.W.K.



RECORD OF BOREHOLE No 1

2 of 3

METRIC

G.W.P. 280-99-00 LOCATION Hwy 406 / Merritt Road Underpass
Co-ords: 4 766 059 N; 326 598 E
DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers
DATUM Geodetic DATE November 01, 2001
ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY D.W.K.

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								
165.5													
15.0	Clayey silt, trace sand Firm Reddish Wet brown		11	SS	6		165						
							164						
							163						
			12	SS	6		162						
							161						
							160						
			13	SS	6		159						
							158						
156.9							157						
23.6	Silt, with sand with gravel, some clay Very dense Reddish Moist to dense brown (TILL)		14	SS	77		156						
							155						
							154						
			15	SS	70		153						
							152						
							151						
150.5													

RECORD OF BOREHOLE No 1

3 of 3

METRIC

G.W.P. 280-99-00

LOCATION

Hwy 406 / Merritt Road Underpass
Co-ords: 4 766 059 N; 326 598 E

ORIGINATED BY M.R.

DIST CR HWY 406

BOREHOLE TYPE

Continuous Flight Hollow Stem Augers

COMPILED BY P.C.

DATUM Geodetic

DATE

November 01, 2001

CHECKED BY D.W.K.

SOIL PROFILE

SAMPLES

GROUND WATER
CONDITIONS

ELEVATION SCALE

DYNAMIC CONE PENETRATION
RESISTANCE PLOT

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL X LAB VANE

PLASTIC LIMIT
NATURAL MOISTURE CONTENT
LIQUID LIMIT
W_p W W_L
WATER CONTENT (%)

UNIT WEIGHT
γ
kN/m³

REMARKS
&
GRAIN SIZE
DISTRIBUTION
(%)
GR SA SI CL

ELEV
DEPTH

DESCRIPTION

STRAT PLOT

NUMBER

TYPE

"N" VALUES

150.5

30.0

Silt, with sand
with gravel, some clay
Compact Reddish Moist
Brown
(TILL)

16

SS

23

150

149

148

147

146

145

144

143.8

36.7

End of borehole
Refusal on probable bedrock

* 2001 11 01

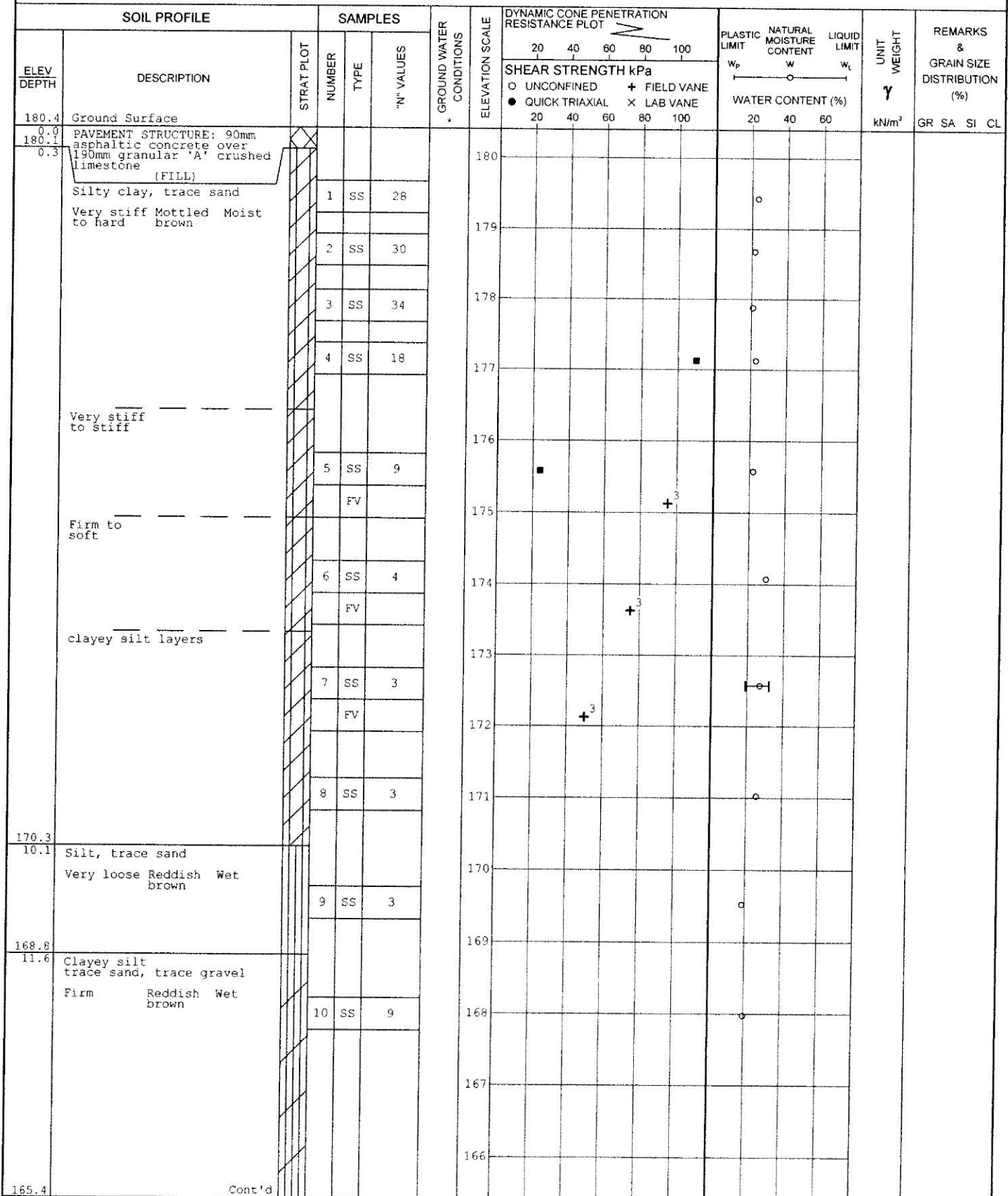
Water level measured
after drilling

RECORD OF BOREHOLE No 2

1 of 3

METRIC

G.W.P. 280-99-00 LOCATION Hwy 406 / Merritt Road Underpass
Co-ords: 4 766 035 N; 326 542 E
DIST CR HWY 406 BOREHOLE TYPE C. F. S. S. A. + NW Wash Borings + NXL Rock Corings
DATUM Geodetic DATE November 05, 2001
ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY D.W.K.



RECORD OF BOREHOLE No 2

2 of 3

METRIC

G.W.P. 280-99-00 LOCATION Hwy 406 / Merritt Road Underpass
Co-ords: 4 766 035 N; 326 542 E
DIST CR HWY 406 BOREHOLE TYPE C. F. S. S. A. + NW Wash Borings + NXI Rock Corings
DATUM Geodetic DATE November 05, 2001
ORIGINATED BY M.R.
COMPILED BY P.C.
CHECKED BY D.W.K.



SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED	+ FIELD VANE							● QUICK TRIAXIAL	× LAB VANE	
165.4							20	40	60	80	100	20	40	60	GR SA SI CL			
15.0	Clayey silt trace sand, trace gravel Firm to Reddish Wet stiff brown		11	SS	10		165								2 1 81 16			
							164											
							163											
			12	SS	15		162											
							161											
							160											
			13	SS	10		159											
							158											
							157											
			14	SS	34		156											
							155											
154.5	Silt, with sand with gravel, some clay Dense Reddish Moist (TILL) brown						154											
25.9							153											
153.1	Gravel, with sand with silt, some clay Very dense Reddish Moist (TILL) brown		15	SS	65		152											
27.3							151											
152.0	Silt, with sand with gravel, some clay Dense Reddish Moist (TILL) brown																	
28.4																		
150.4																		

RECORD OF BOREHOLE No 2

3 of 3

METRIC

G.W.P. 280-99-00 LOCATION Hwy 406 / Merritt Road Underpass
Co-ords: 4 766 035 N; 326 542 E ORIGINATED BY M.R.
DIST CR HWY 406 BOREHOLE TYPE C. F. S. S. A. + NW Wash Borings + NXL Rock Corings COMPILED BY P.C.
DATUM Geodetic DATE November 05, 2001 CHECKED BY D.W.K.

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 (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
150.4							20 40 60 80 100		20 40 60						
30.0	Silt, with sand with gravel, some clay		16	SS	28		150								
	Compact Reddish Moist brown (TILL)						149								
	Very dense						148								
			17	SS	100/10cm		147								
							146								
						145									
						144									
			18	SS	50/5cm		143								
143.0	Bedrock		19	RC NQ	REC 93%		142							RQD 32%	
37.4	Dolostone Buff to gray Low to medium strength Unweathered Poor quality		20	RC NQ	REC 100%		141							RQD 35%	
							140								
140.0	End of borehole														
40.4															
	* Borehole charged with drilling water ■ Penetrometer test C.F.S.S.A. denotes Continuous Flight Solid Stem Augers														

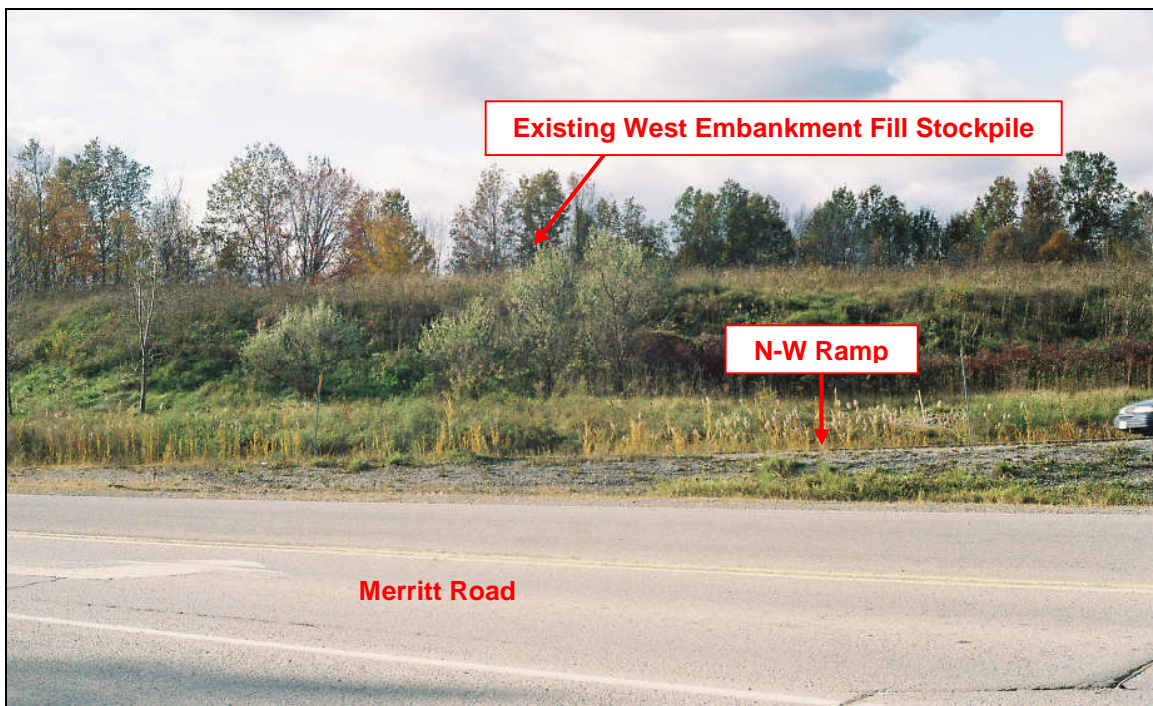


APPENDIX B

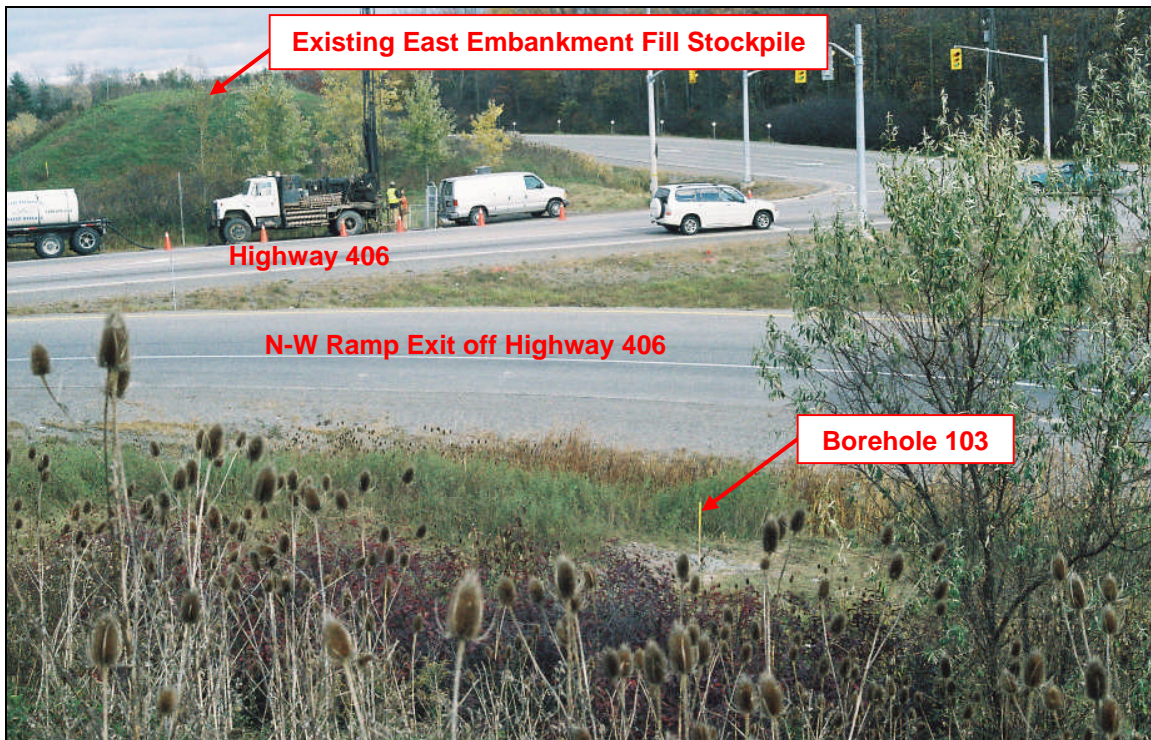
Site Photographs



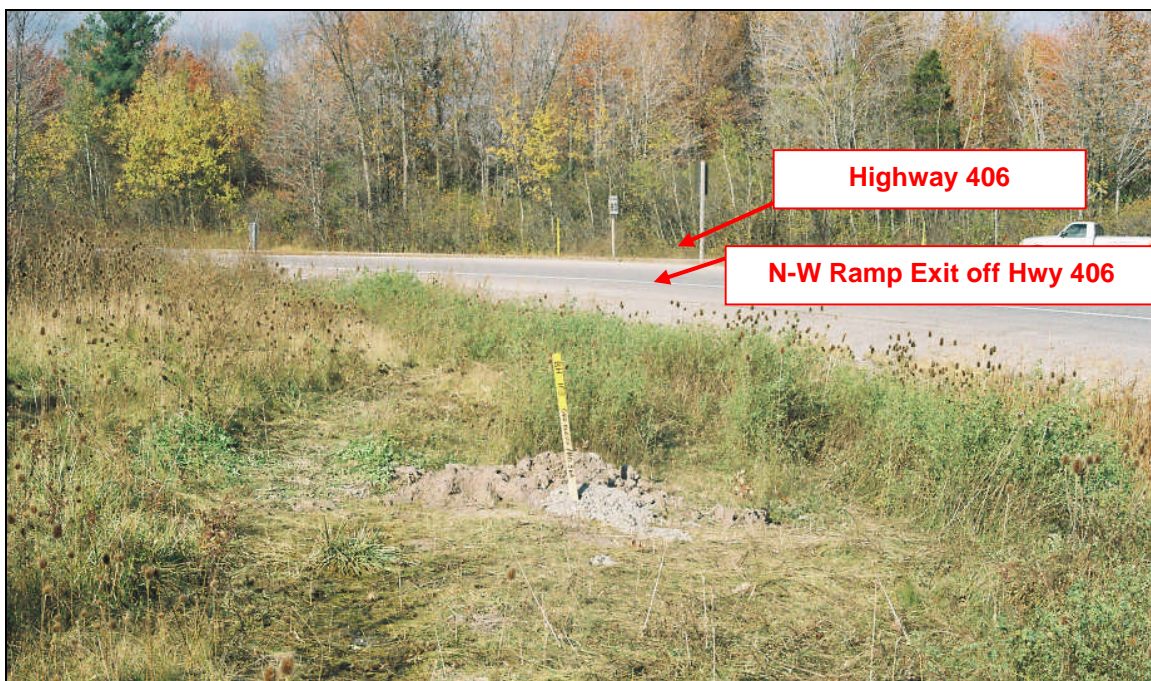
Photograph 1: Looking to the northeast quadrant at the existing east fill embankment stockpile from the southwest corner of the Highway 406 and Merritt Road intersection. (October 31, 2008)



Photograph 2: Viewing north from the southwest corner of Highway 406 and Merritt Road intersection at the existing fill embankment west of Highway 406 and north of Merritt Road. Approaching vehicle at right side of photograph travels on the existing N-W ramp. (October 31, 2008)



Photograph 3: Looking east from the west fill mound west of Highway 406. Borehole 105 is being drilled by a truck-mounted rig at the proposed median. (October 31, 2008)



Photograph 4: Looking north from about Sta. 9+980 at drilled borehole 103. Forested area is visible at the background of the photo. (October 31, 2008)

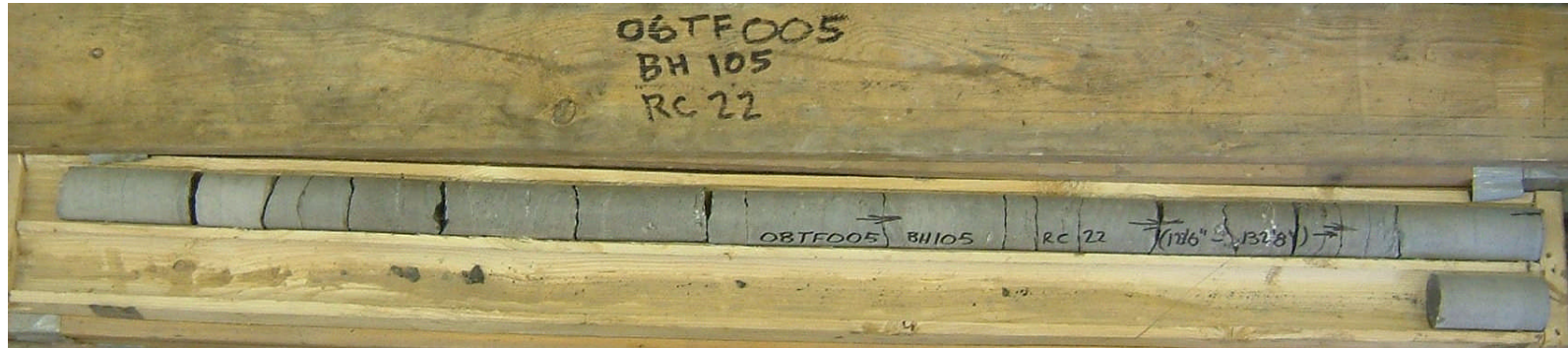


APPENDIX C

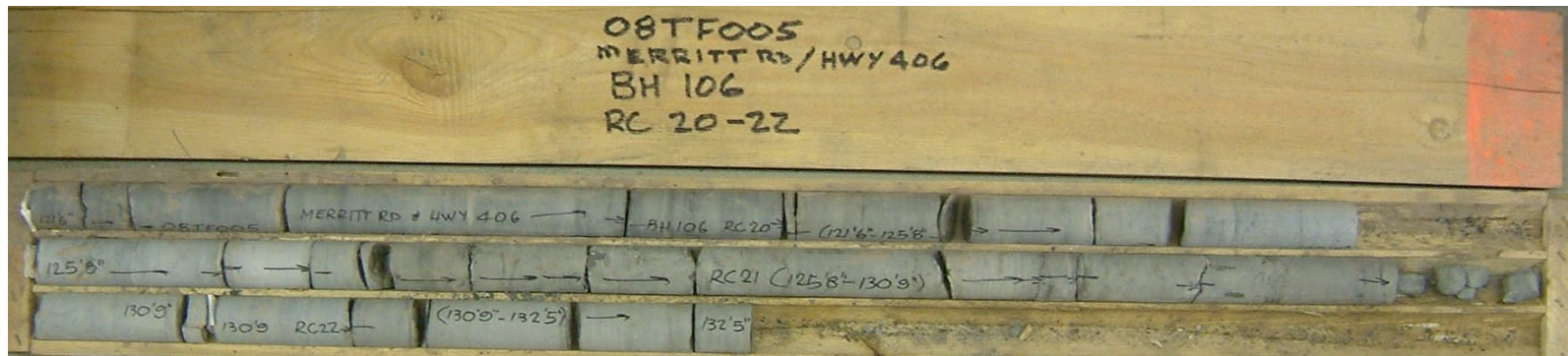
Rock Core Photographs



Photograph 1: Rock core from borehole 105. Samples RC19 to RC21 taken from 36.2 to 38.9 m depths.



Photograph 2: Rock core from borehole 105. Sample RC 22 taken from 38.9 m to 40.4 m depths.



Photograph 3: Rock core from borehole 106. Samples 20 to 22 taken from 37.0 to 40.4 m depths.