

December 2, 2009

PML Ref.: 06TF033C
Index No.: 1924LET
GEOCRES No.: 41H-75

Mr. Francois Doyon, P. Eng.
Assistant Project Manager
McCormick Rankin Corporation
2655 North Sheridan Way
Mississauga Ontario
L5K 2P8

Dear Mr. Doyon

Memorandum
Swamp 310 Swamp Crossing
Highway 69 Four Laning
From 3.8 km North of Highway 522 to 10.7 km North of Highway 522
Township of Mowat
G.W.P. 5203-06-00
District 54, Sudbury, Ontario

This document provides foundation engineering comments concerning swamp 310. A draft report on the Phase 3 swamps was issued in November 2008. At the time, investigations for swamp 310 were limited to the section from Sta. 13+400 to 13+450 SBL/NBL with 14 test holes completed. It was requested by MTO that the foundation investigations for Highway 69 SBL be extended beyond the project limit southerly to Sta. 13+150.

The contents of this memorandum will be incorporated in the Final Report for the swamps and high fill crossings for the project.

A total of 27 test holes comprising 20 boreholes and 7 dynamic cone penetration tests were carried out in swamp 310 that extends from Sta. 13+150 to 13+450 (southbound lanes) and from Sta. 13+400 to 13+450 (northbound lanes) in the Township of Mowat, new Highway 69 chainage. In addition, three boreholes and four dynamic cone penetration tests previously carried out in the swamp by Trow Associates Ltd. were also considered. The records of the test holes for the project are attached.

The subsurface stratigraphy revealed in the boreholes drilled at the site generally comprised embankment fill and/or peat / topsoil overlying a cohesive deposit of clay / silty clay / clayey silt underlain by cohesionless silty/sandy soils extending to bedrock. Cobbles and boulders were encountered in 6 boreholes. The bedrock surface was contacted at depths of 1.9 to 19.5 m. Groundwater was at elevation 193.2 to 195.2 upon completion of drilling. Referring to the draft borehole logs and plan attached, we note the following:

- Fill was present in boreholes 310-2, 310-8, 310-12 and 310-14 drilled on or at the existing highway. This unit was composed of topsoil, sand and gravel, gravelly sand, sand and had a thickness of 1.4 to 4.3 m. It is noteworthy that cobbles and boulders were encountered in the embankment fill at 1.4 m depth (elevation 194.7 and 194.9) in boreholes 310-2 and 310-8. The unit was loose to dense (SPT-'N' values of 7 to 35) and extended to elevation 191.8 to 194.6. The results of grain size distribution analysis performed on a sample of the sand and gravel fill are presented in Figure 310-GS-1. The sample had a moisture content of about 7%.



- A deposit of peat was present surficially in 16 boreholes (covered with some 300 mm of ice/snow in borehole 310-9) and revealed below the embankment fill at a depth of 4.3 m (elevation 191.8) in borehole 310-2. The fine to coarse fibrous / amorphous peat was 0.3 to 4.8 m thick and had an organic content of 9.5 to 58.0%, its moisture content varying broadly between 80 and 988%. The peat was penetrated at depths of 0.3 to 4.8 m (elevation 189.6 to 195.6).
- Topsoil was identified below the fill at 1.4 m depth (elevation 194.4) in borehole 310-12. The topsoil was about 200 mm thick and extended to a depth of 1.6 m (elevation 194.2).
- Directly beneath the peat at depths of 0.3 and 2.4 m (elevation 195.6 and 192.0) in boreholes 310-15 and 310-19 was organic silt. This unit was 0.9 and 1.1 m in thickness, very loose to loose in relative density and penetrated at respective depths of 1.2 and 3.5 m (elevation 194.7 and 190.9).
- Overlain by the fill, peat or organic silt at depths of 0.5 to 4.8 m (elevation 189.6 to 194.7) in 18 boreholes was a cohesive deposit of clay, silty clay and/or clayey silt. This deposit was 2.0 to 11.6 m in thickness and typically very soft to firm in consistency. The shear strength profile is shown in Figure 310-SS-1. The results of in situ vane testing carried out in the clayey soils yielded undisturbed shear strength values in a range of 3 to 52 kPa (soil sensitivity of 2 to 8), with the lower values believed to be affected by the presence of organics. A penetrometer test on a sample of the clayey silt indicated a shear strength of 75 kPa. The deposit contained cobbles in boreholes 310-2, 310-4, 310-9, 310-18 and was penetrated at depths of 3.2 to 15.0 m (elevation 179.4 to 192.7). The results of Atterberg limits testing and grain size distribution analyses conducted on 18 cohesive samples are presented in respective Figures 310-PC-1 to 310-PC-4 and 310-GS-2 to 310-GS-5. The liquid and plastic limits of the clay were 51 to 70 and 24 to 25 respectively, with the plasticity index of 27 to 45. The silty clay units had a liquid limit of 35 to 45, plastic limit of 20 to 23, their plasticity index being 13 to 22. The liquid and plastic limits of the clayey silt ranged from 30 to 35 (23 to 26 if containing layers of silt) and from 18 to 21 respectively, thus giving the plasticity index of 11 to 15 (3 to 7). The moisture content of the clayey soils varied between 25 and 127%.
- Underlying the embankment fill at a depth of 2.9 m (elevation 193.4) in borehole 310-8 or the cohesive deposit at depths of 9.0 to 15.0 m (elevation 179.4 to 185.3) in boreholes 310-18, 310-20, 310-21, 310-23, 310-25, 310-27 was non- to slightly plastic silt. This unit was 0.9 to 3.4 m thick and very loose to compact in relative density. The silt was penetrated at 3.8 m depth (elevation 192.5) in borehole 310-8 and at depths of 10.2 to 18.0 m (elevation 176.7 to 184.1) in the remaining boreholes. The results of Atterberg limits testing and grain size distribution analyses conducted on 4 samples of the silt with layers of clayey silt are presented in respective Figures 310-PC-5 and 310-GS-6. The liquid and plastic limits of the slightly plastic silt were 21 to 25 and 19 to 20 respectively, with the plasticity index of 2 to 5. The moisture content of the silt varied between 17 and 36%.
- A discontinuous stratum of cohesionless sand / silty sand was revealed below the topsoil or clayey soils at depths of 1.6 to 5.8 m (elevation 189.2 to 194.2) in boreholes 310-7, 310-12, 310-14 and below the silt at 18.0 m depth (elevation 176.7) in borehole 310-21. This stratum was 0.3 to 1.6 m in thickness and loose to compact in relative density. The sand / silty sand was penetrated at depths of 1.9 to 6.6 m (elevation 188.4 to 193.9) in boreholes 310-7, 310-12, 310-14 and a depth of 19.5 m (elevation 175.2) in borehole 310-21. It is worth noting that cobbles were



encountered within the stratum in borehole 310-7. The results of grain size distribution analysis performed on a sample of the sand are presented in Figure 310-GS-7.

- Bedrock was inferred by refusal in all the test holes at depths of 1.9 to 19.5 m (elevation 175.2 to 193.9).
- During drilling, water was detected at depths of 0.0 to 0.6 m, locally 2.7 m (elevation 193.2 to 194.9). Upon completion of drilling, groundwater was measured in all the boreholes to be at depths of 0.0 to 2.7 m (elevation 193.2 to 195.2). The groundwater levels at the site are subject to seasonal fluctuations and precipitation patterns.

A summary of the subsurface conditions is compiled in the attached Table A.

According to the vertical alignment received on June 18, 2009, the embankment height between Sta. 13+400 and 13+450 ranges from 1.5 to 3.0 m in the southbound lanes (SBL). The maximum fill height for the SBL section extended south of the project limits to Sta. 13+150 is envisaged to be 3.5 m. No grade raise is planned for the existing Highway 69 embankment to be rehabilitated and used for the new northbound lanes (NBL) within the swamp 310 limits.

The results of slope stability analyses for the existing subsurface conditions at this crossing indicate that a 3.5 m high embankment constructed with rockfill and having side slopes inclined no steeper than 1.25H:1V would be stable without removal of the cohesive soils. The safety factor of about 1.4 obtained for this configuration is regarded adequate for embankment slopes to be stable during construction.

It is noteworthy that all organic soils are to be stripped. It is considered feasible to construct the SBL embankment by any of the following methods to mitigate settlements:

- Without removal of compressible soils. The consolidation settlement of the clayey soils left in place is calculated to be in the order of 525 mm under a 3.5 m high embankment. About 90% of the consolidation settlement would be complete within 42 months. The settlement of rockfill under its self-weight is estimated to be 75 mm. Therefore the maximum total settlement of the embankment surface is some 600 mm. Taking account of the settlements that would occur during the first year after fill placement, the post-construction settlements are not expected to exceed 275 mm. If the clayey soils are preloaded for a period of 24 or 36 months, the remaining total settlement is assessed to be 150 or 80 mm respectively. It is noted that no surcharging is allowed in view of instability issues arising.
- Partial excavation to elevation 187 to remove very soft compressible soils (excavation depth not exceeding 8.5 m; the existing highway remaining stable). If no surcharge is applied, the consolidation settlement of the clayey soils below elevation 187 is calculated to be in the order of 340 mm under a 3.5 m high embankment. About 90% of the consolidation settlement would be complete within 19 months. The settlement of rockfill under its self-weight is estimated to be 170 mm. Therefore the maximum total settlement of the embankment surface is some 510 mm. Taking account of the settlements that would occur during the first year after fill placement, the post-construction settlements are not expected to exceed 160 mm. If the clayey soils are preloaded for a period of 24 or 36 months, the remaining total settlement is assessed to be 60 or 25 mm respectively. Application of 2 m surcharge for a period of 12 months eliminates the consolidation settlement resulting from the embankment loading and reduces post-construction settlements to



about 80 mm. These settlements decrease to some 30 mm after 24 months and 15 mm after 36 months of surcharging.

- Full excavation of compressible soils (excavation depth not exceeding 15 m). The maximum total settlement of the embankment surface due to self-compaction of rockfill is estimated to be 315 mm. Taking into account that about 50% of the total settlement occurs during the first year following fill placement and the remaining 50% at a progressively decreasing rate during the following 5 to 10 year period, the settlements after 12, 24 and 36 months are assessed to be 155, 75 and 35 mm respectively. Applying a 2 m surcharge would reduce these settlements to some 125, 60 and 30 mm. It must be noted that excavation at the centreline median should be limited to maximum 5 m depth or shallower competent ground. This limitation applies to a 5 m wide strip west of the median.

A summary of the maximum settlement of the embankment surface for the above treatment options is as follows:

Method of Swamp Treatment	Maximum Settlement of Embankment Surface, mm			
	Total	Remaining after Preloading / Surcharging for		
		12 months	24 months	36 months
Without removal of compressible soils	600	275	150	80
Partial excavation to elevation 187	510	160	60	25
Partial excavation to elevation 187 with 2 m surcharge	510	80	30	15
Full excavation of compressible soils	315	155	75	35
Full excavation of compressible soils with 2 m surcharge	315	125	60	30

Based on the results of preliminary analysis, it is considered that construction of the SBL embankment involving partial excavation of compressible soils to elevation 187 and surcharging is the preferred treatment option for swamp 310 between Sta. 13+190 and 13+425 (SBL). Full excavation of compressible soils is recommended for the shallower SBL sections at the limits of the crossing (Sta. 13+150 to 13+190 and Sta. 13+425 to 13+450). Installation of wick drains is not necessary at this crossing.

Excerpts from Tables 1, 3 to 6 to be incorporated in the final foundation design report are provided for review by MTO. All of the notes for each table were also included for completeness, although some of the notes apply only to other swamps.



We trust this is sufficient for your immediate purposes. The results of the investigation, discussion and recommended treatment for the crossing will be included in the Final Report after review by MTO.

Sincerely,
Peto MacCallum Ltd.



Grigory O. Degil, PhD, P.Eng.
Senior Foundation Engineer



Carlos Nascimento, P.Eng.
Senior Project Engineer



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

Enclosure(s):

Table A – Summary of Subsoil Conditions
Table B – List of Atterberg Limits and Moisture Content Results
Figure 310-SS-1 – Shear Strength Profile
Figures 310-PC-1 to 310-PC-5 – Plasticity Charts
Figures 310-GS-1 to 310-GS-7 – Grain Size Distribution Charts
Figures 310-C-1 and 310-C-2 – Laboratory Consolidation Test Results
Explanation of Terms Used in Report
Record of Borehole Sheets
Drawings 310-1 to 310-3 – Borehole Locations and Soil Strata
Tables 1, 3 to 6 (FDR)

Distribution:

4 cc: McCormick Rankin Corporation for distribution to MTO + 2 digital copies
2 cc: McCormick Rankin Corporation + 1 digital copy
1 cc: PML Toronto
1 cc: PML Barrie



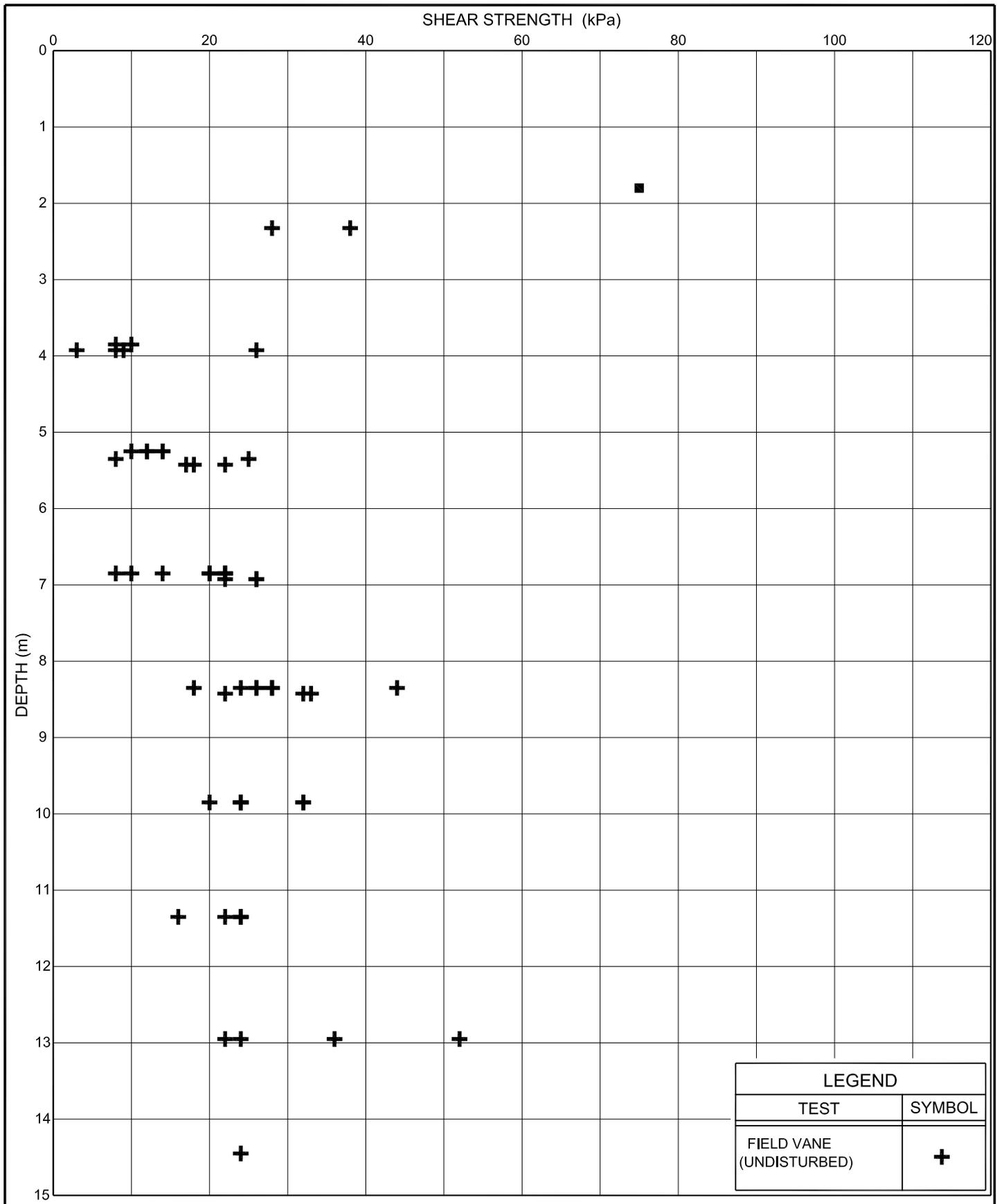
TABLE A
SUMMARY OF SUBSOIL CONDITIONS

SWAMP NO.	LOCATION	NO. OF TEST HOLES	TOPSOIL/PEAT THICKNESS (m)	DEPTH TO BOTTOM OF CLAY (m)	DEPTH TO PROBABLE BEDROCK (m)	NOTES AND/OR SOIL PROFILE
HIGHWAY 69 MAINLINE						
310	Sta. 13+150 to 13+450 (SBL) Sta. 13+400 to 13+450 (NBL) Township of Mowat	27	0.2 – 4.8	3.2 – 15.0 (El. 179.4 – 192.7)	1.9 – 19.5 (El. 175.2 – 193.9)	Pavement and embankment fill encountered in 3 boreholes to depths of 1.8 to 4.3 m. Surficial fill unit present in 1 borehole to 1.4 m depth. Cobbles and boulders encountered in 6 boreholes. Peat present in most boreholes overlies cohesive clayey soils underlain by a localized deposit of cohesionless silt / silty sand / sand extending to bedrock.



TABLE B
LIST OF ATTERBERG LIMITS AND MOISTURE CONTENT RESULTS

SWAMP No.	SOIL TYPE	BOREHOLE NO.	SAMPLE NO.	LIQUID LIMIT (W _L)	PLASTIC LIMIT (W _p)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)	
310	Clay	310-2	7	59	24	35	87	
		310-21	5	70	25	45	118	
		310-25	7	51	24	27	–	
			310-27	4	62	24	38	79
	Silty Clay	310-4	6	43	21	22	75	
		310-4	8	37	23	14	42	
		310-20	4	45	23	22	–	
			310-23	9	35	20	15	52
			310-26	8	36	20	16	54
			310-27	6	35	22	13	59
	Clayey Silt	310-5	6	31	20	11	43	
		310-7	5	30	19	11	61	
		310-13	3	35	20	15	43	
			310-15	2	26	19	7	–
			310-18	7	32	21	11	–
			310-19	5	23	20	3	–
			310-21	10	25	18	7	33
			310-23	4	33	19	14	54
	Silt	310-18	8	25	20	5	–	
		310-20	9	23	20	3	–	
310-21		12	21	19	2	25		
310-25		10	23	20	3	–		

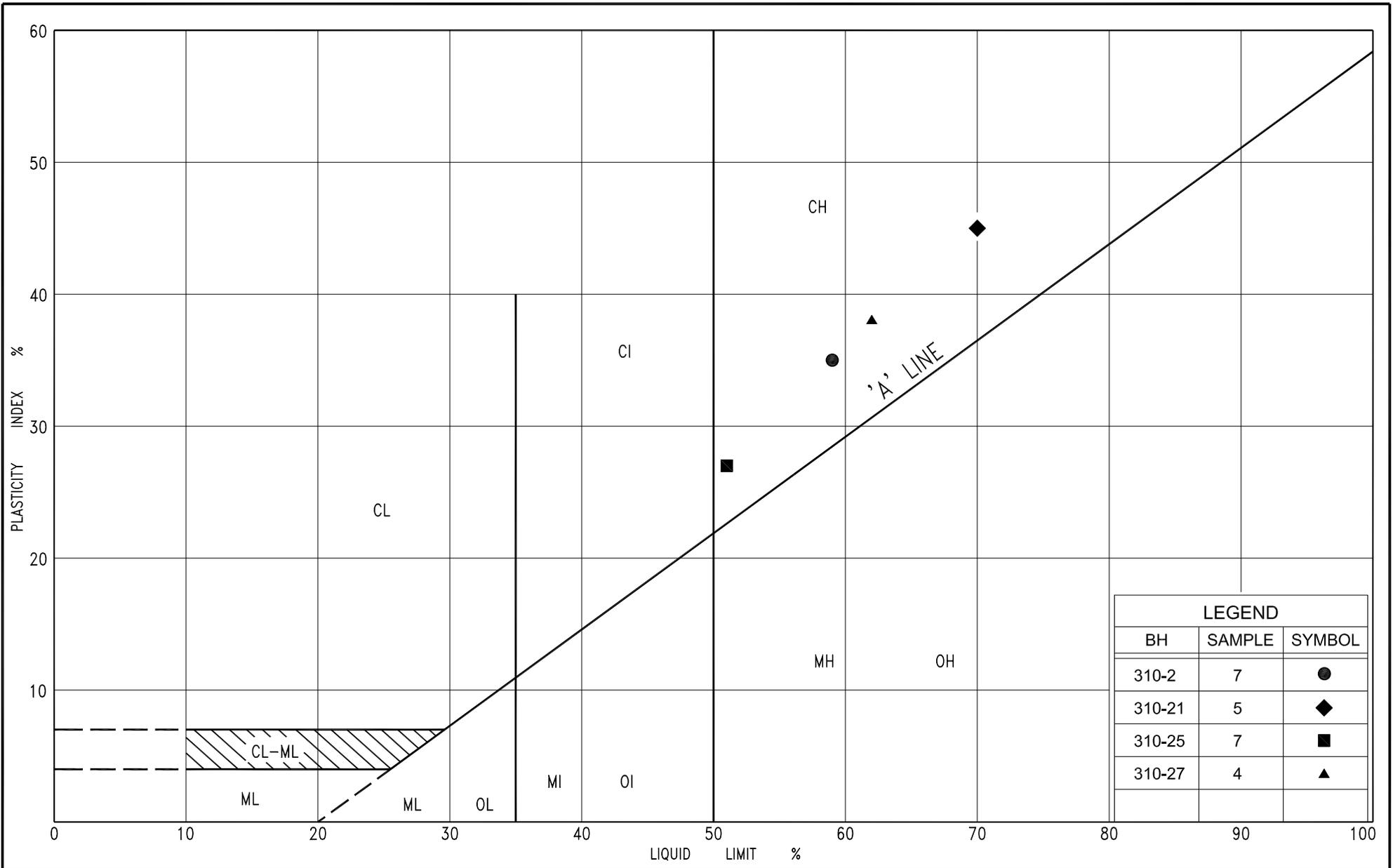


LEGEND	
TEST	SYMBOL
FIELD VANE (UNDISTURBED)	+



**SHEAR STRENGTH
SWAMP 310**

FIG No.	310-SS-1
HWY	69
G.W.P. No.	5203-06-00



LEGEND		
BH	SAMPLE	SYMBOL
310-2	7	●
310-21	5	◆
310-25	7	■
310-27	4	▲



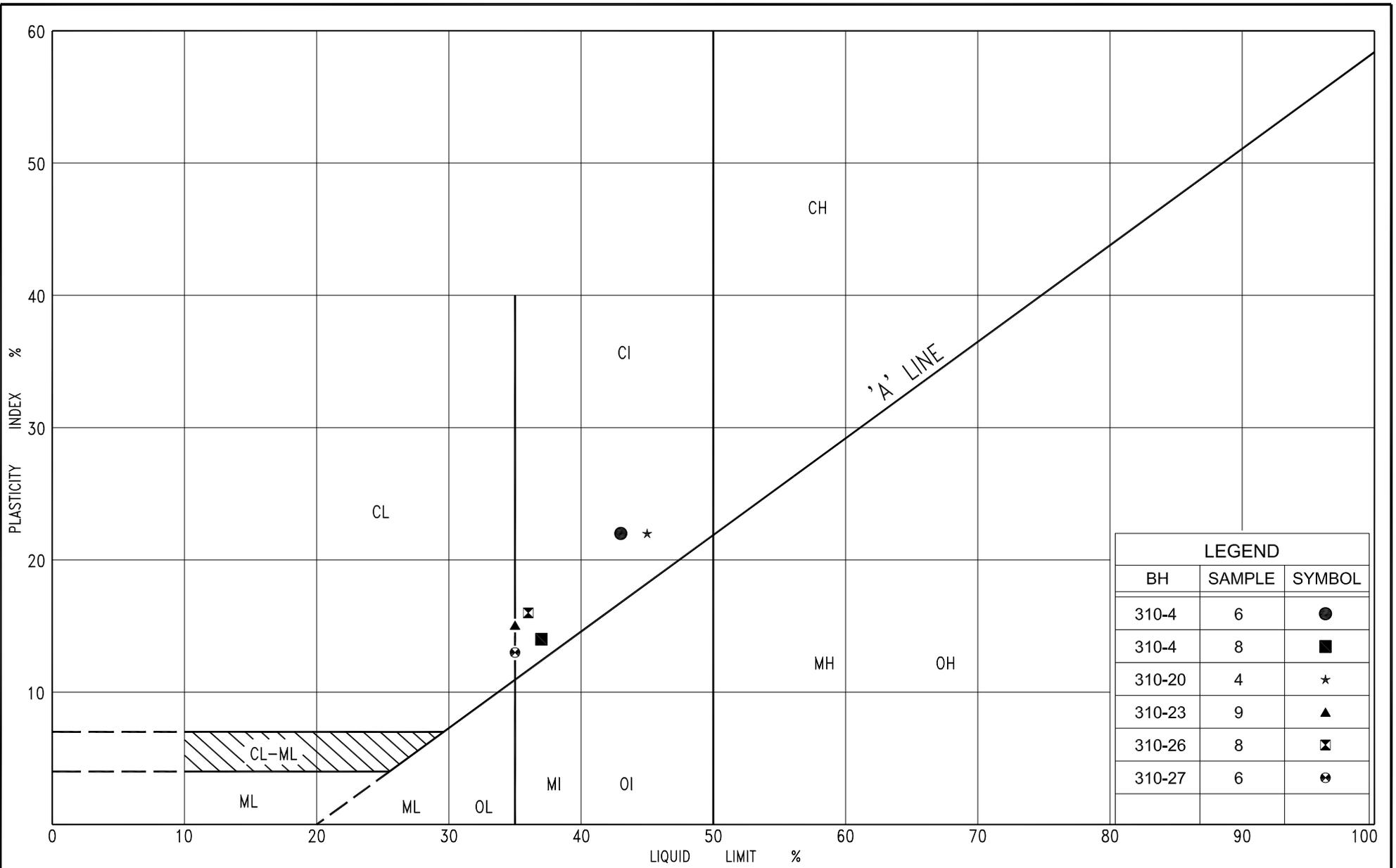
PLASTICITY CHART

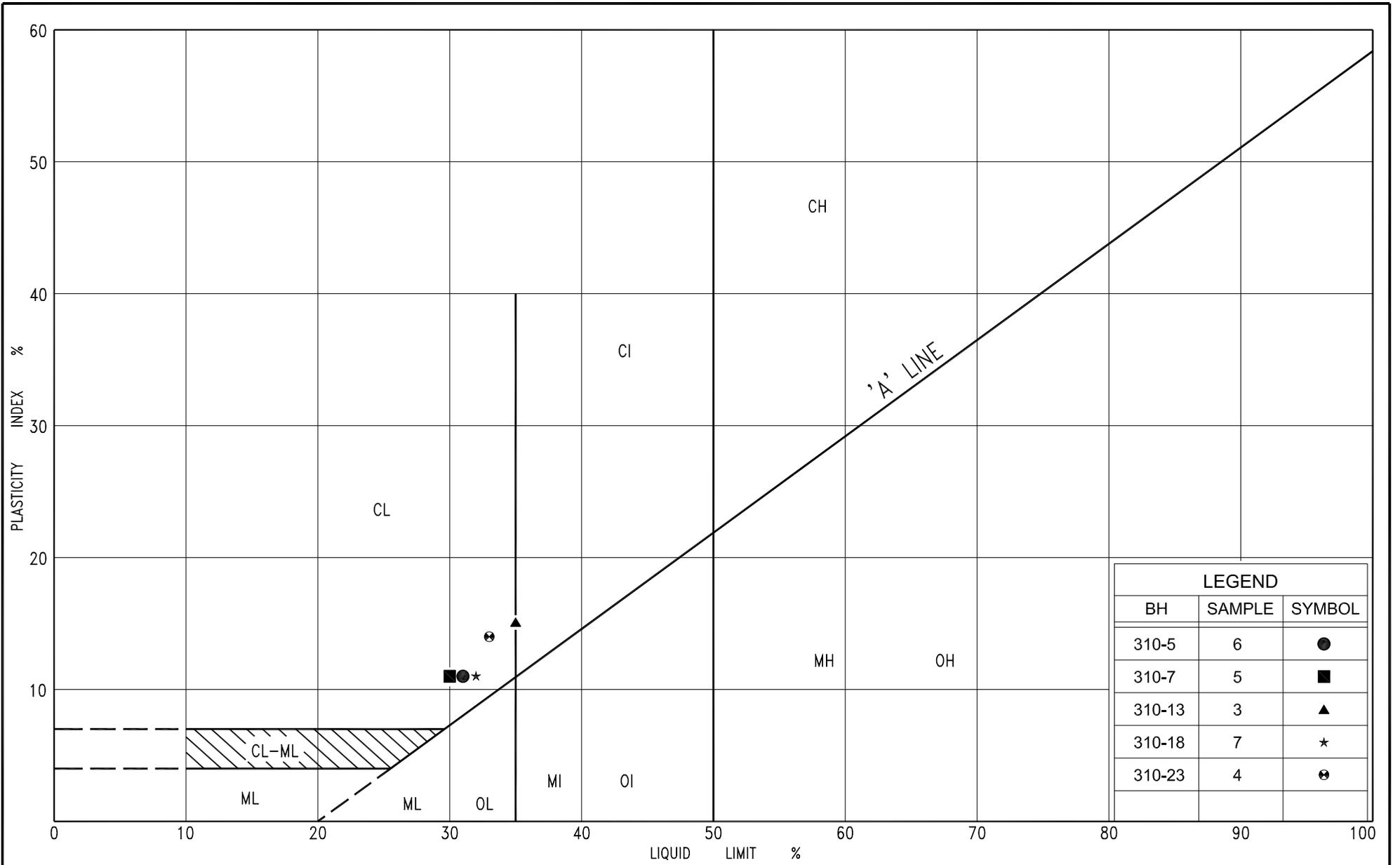
CLAY, trace sand

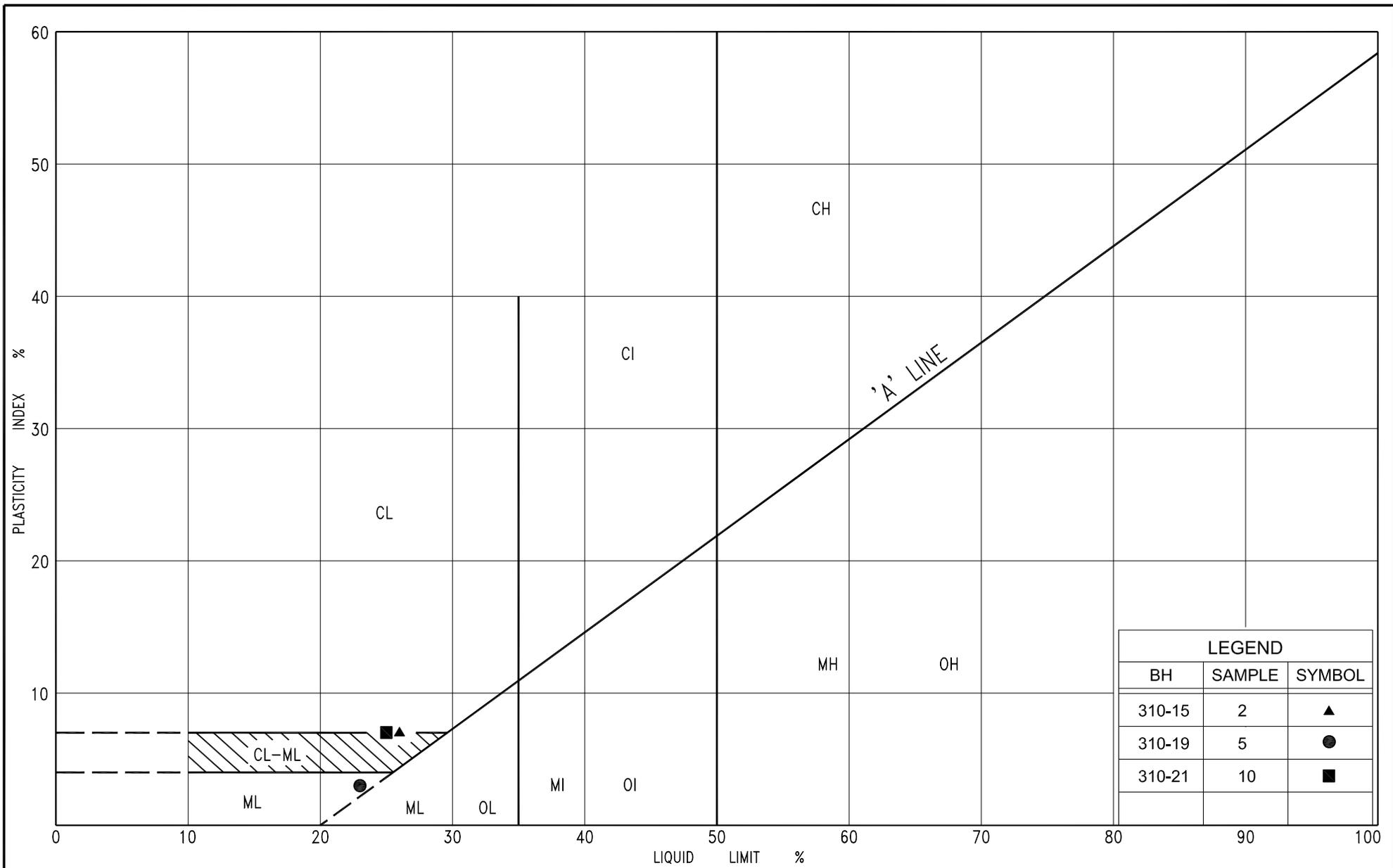
FIG No. 310-PC-1

HWY: 69

G.W.P. No. 5203-06-00





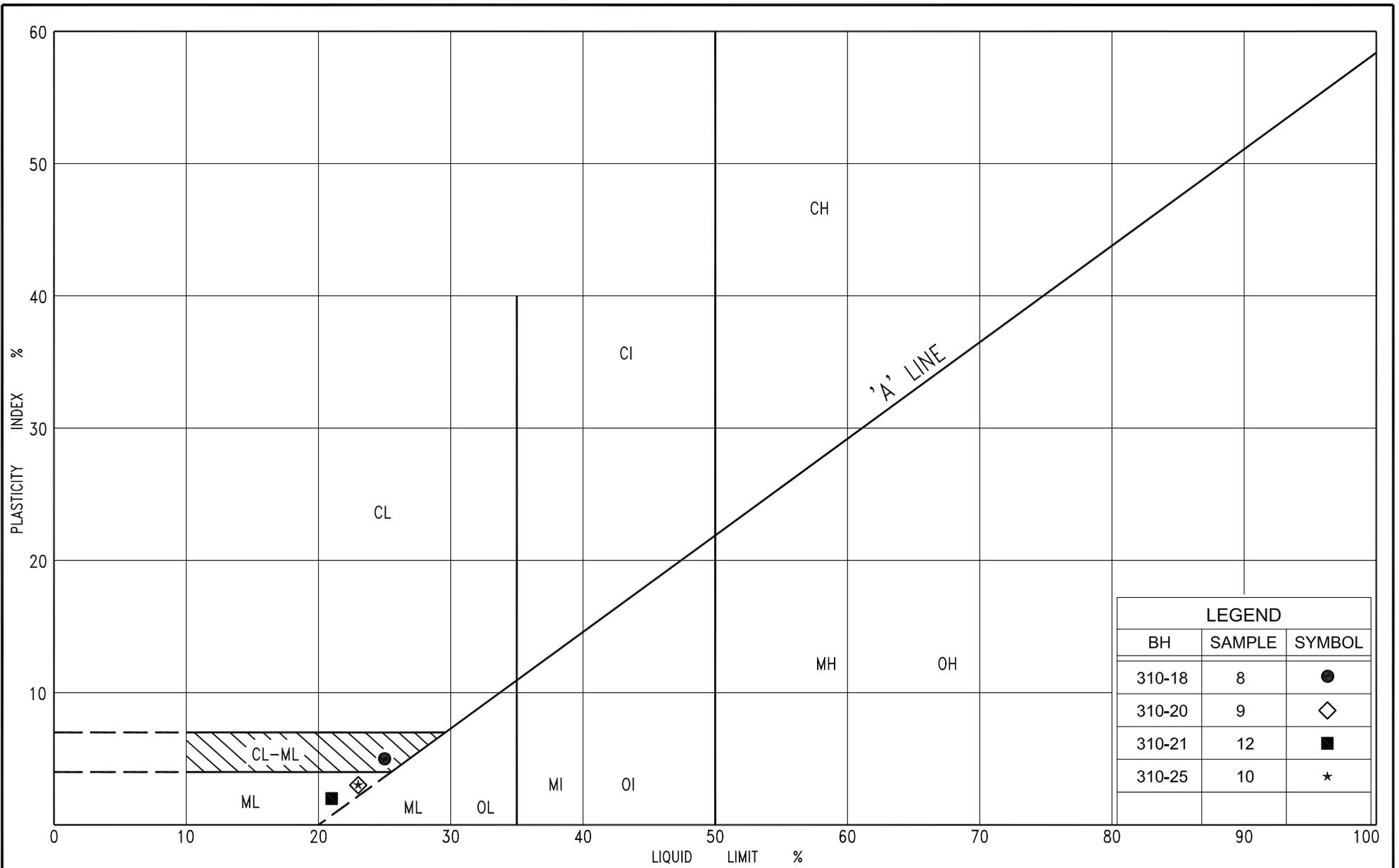


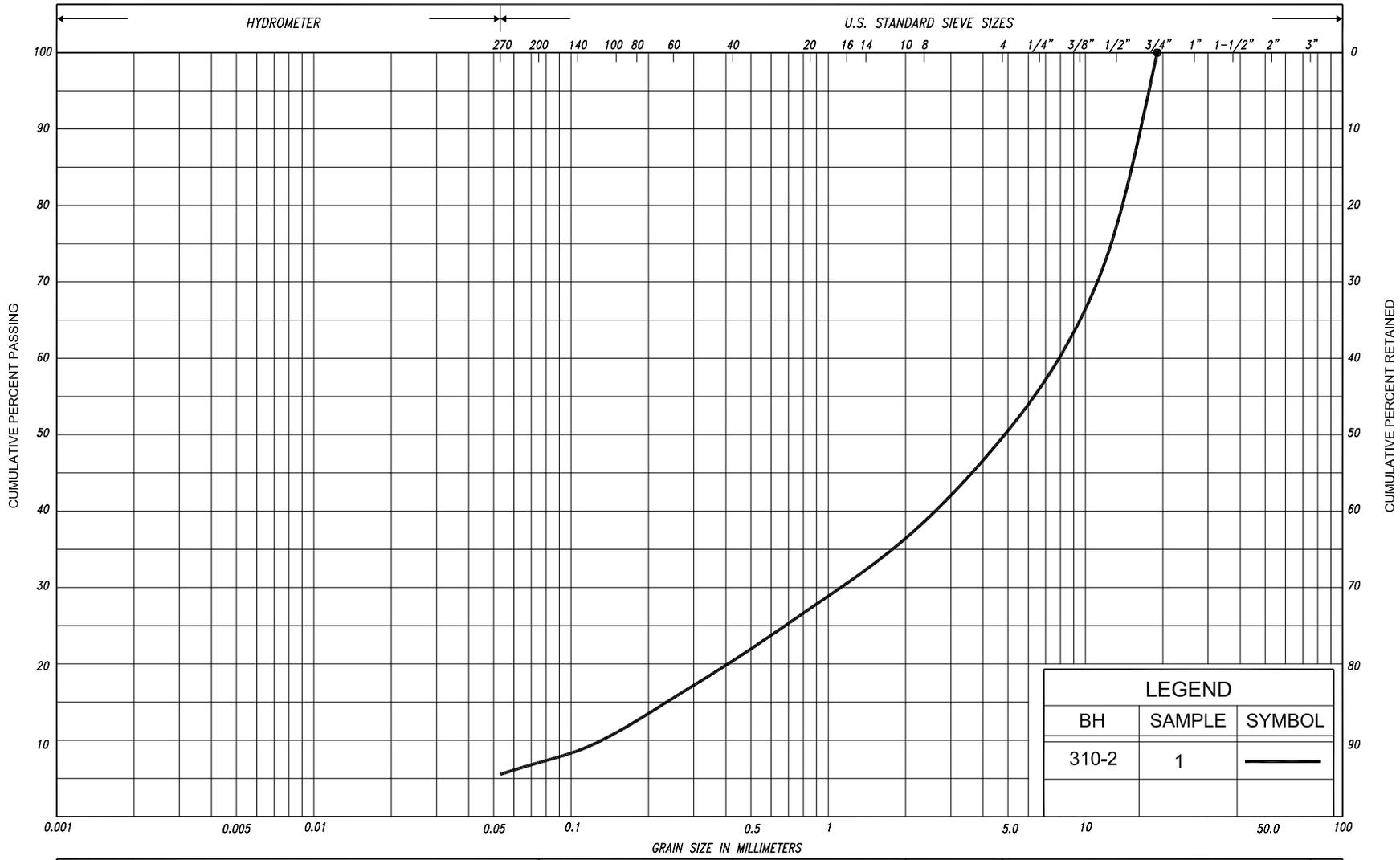
LEGEND		
BH	SAMPLE	SYMBOL
310-15	2	▲
310-19	5	●
310-21	10	■



PLASTICITY CHART
CLAYEY SILT, trace sand

FIG No. 310-PC-4
HWY: 69
G.W.P. No. 5203-06-00





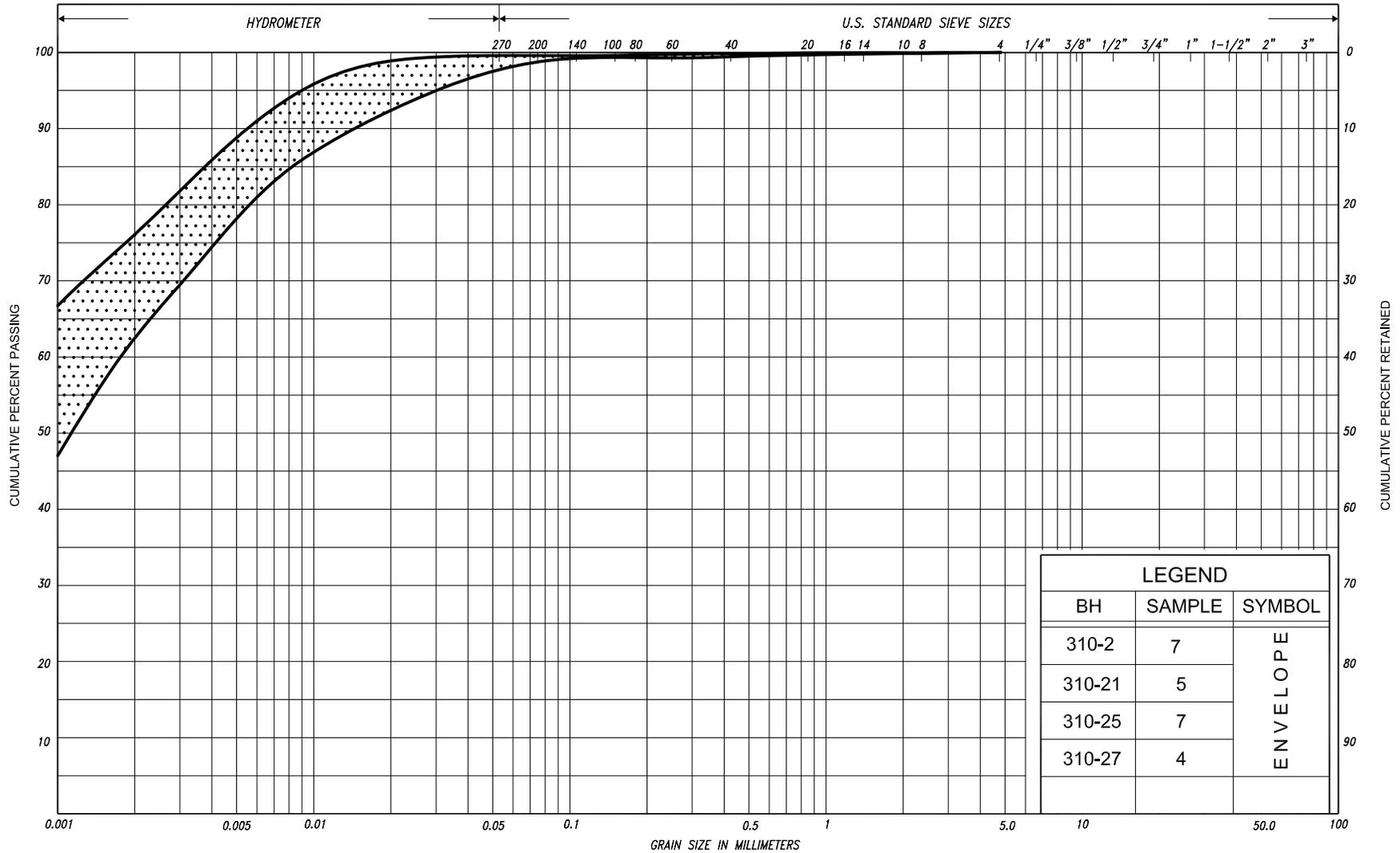
LEGEND		
BH	SAMPLE	SYMBOL
310-2	1	—

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

GRAIN SIZE DISTRIBUTION
SAND and GRAVEL, trace silt
(FILL)

FIG No. 310-GS-1
HWY: 69
G.W.P. No. 5203-06-00





LEGEND		
BH	SAMPLE	SYMBOL
310-2	7	ENVELOPE
310-21	5	
310-25	7	
310-27	4	

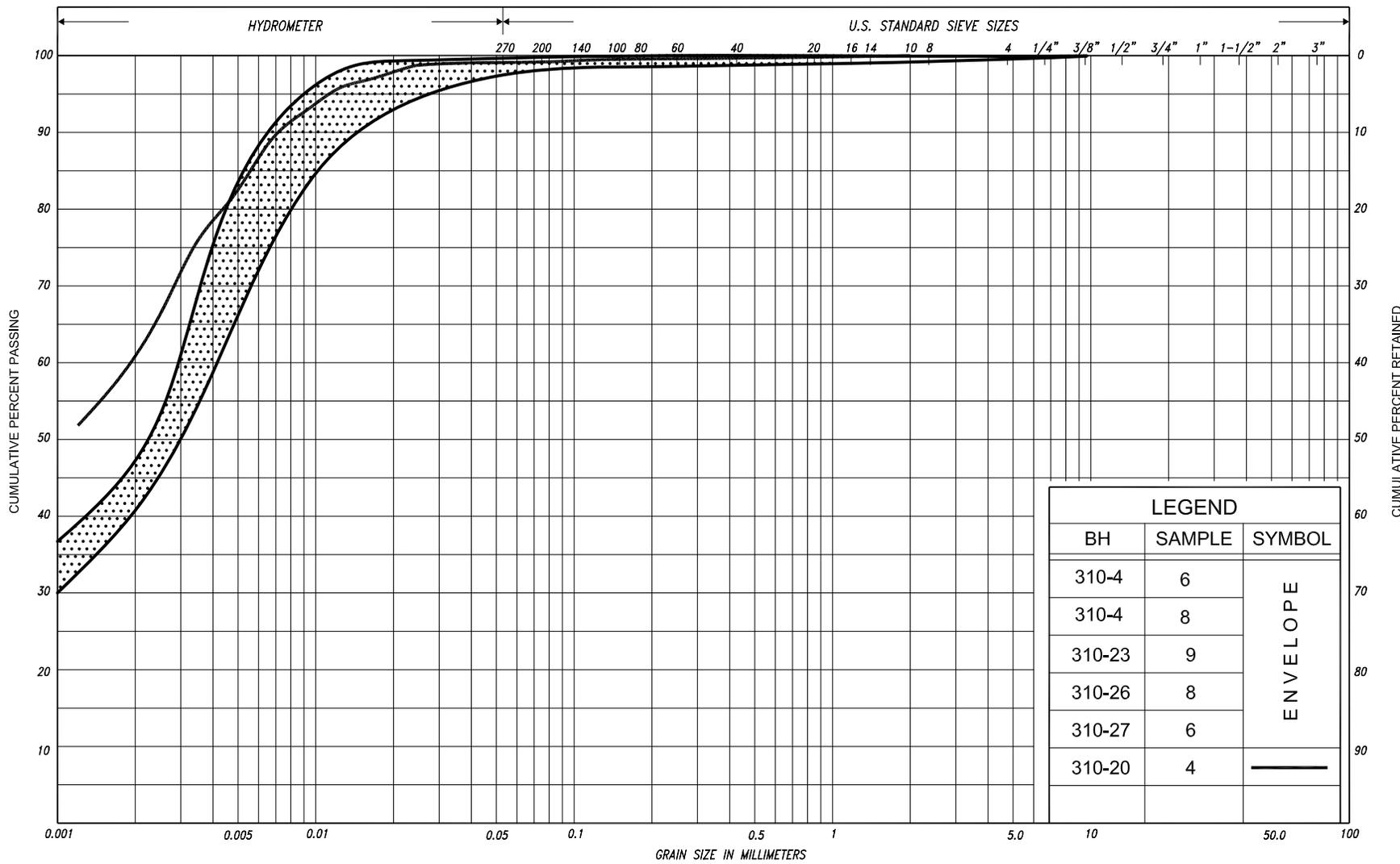
SILT & CLAY			FINE SAND		MEDIUM SAND	COARSE SAND	GRAVEL		COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MEDIUM SAND	COARSE SAND	GRAVEL		COBBLES	M.I.T.
CLAY	SILT		V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			U.S. BUREAU

GRAIN SIZE DISTRIBUTION

CLAY, trace sand



FIG No. 310-GS-2
 HWY: 69
 G.W.P. No. 5203-06-00



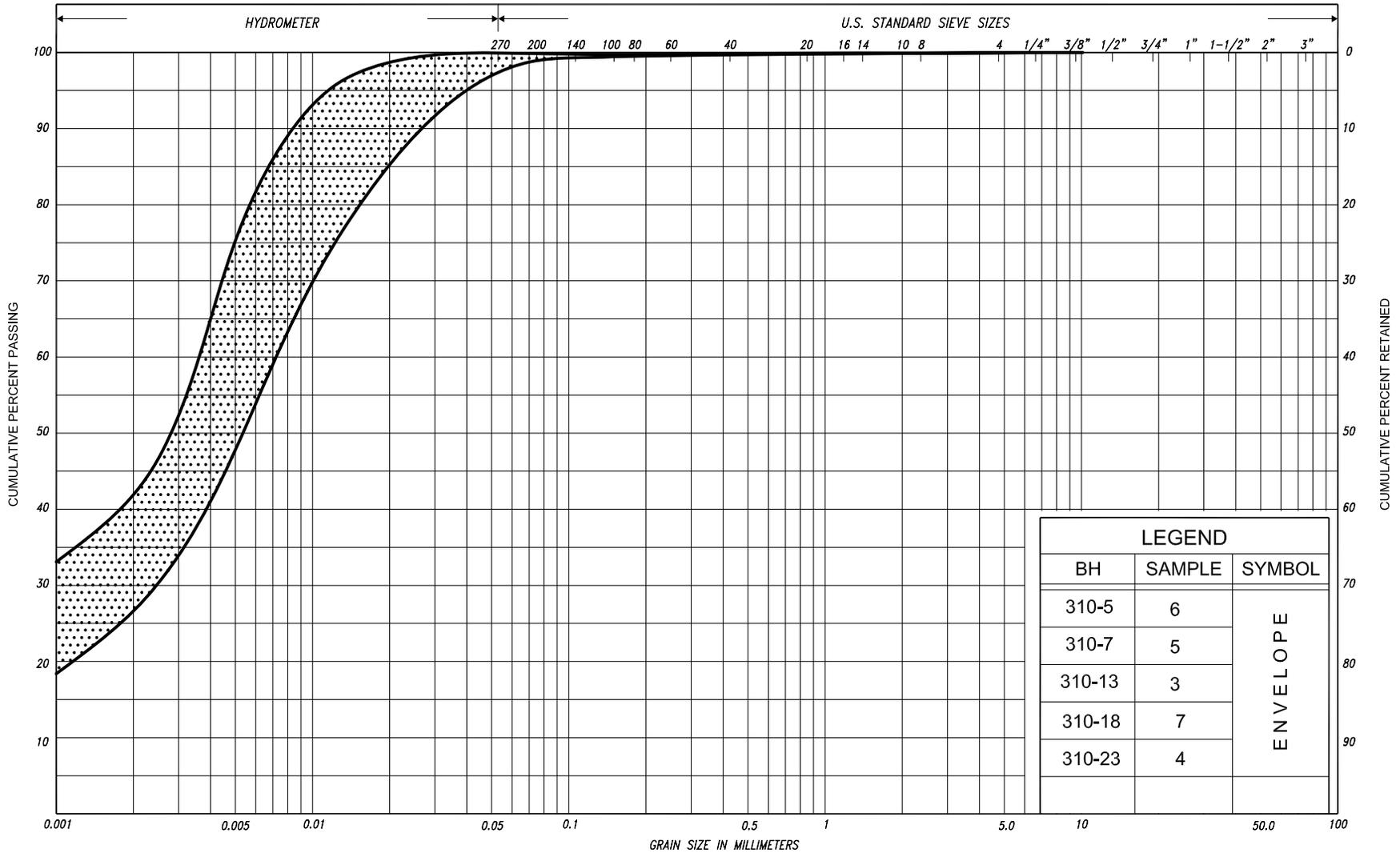
SILT & CLAY				FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL		COBBLES	UNIFIED
CLAY	FINE SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL		COBBLES	M.I.T.
CLAY		SILT		V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND		GRAVEL				U.S. BUREAU



GRAIN SIZE DISTRIBUTION

SILTY CLAY, trace sand, trace gravel

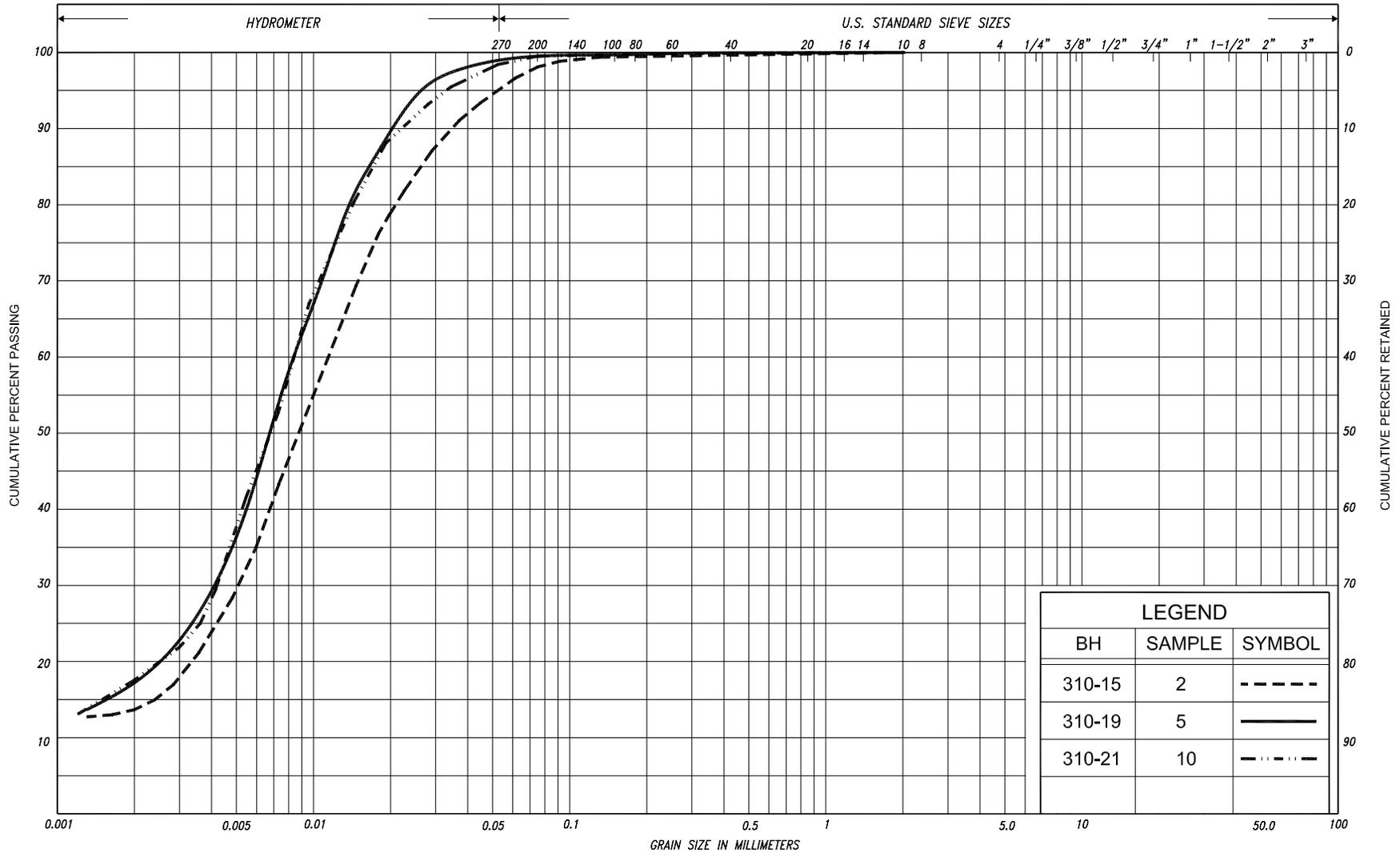
FIG No. 310-GS-3
 HWY: 69
 G.W.P. No. 5203-06-00



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

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand



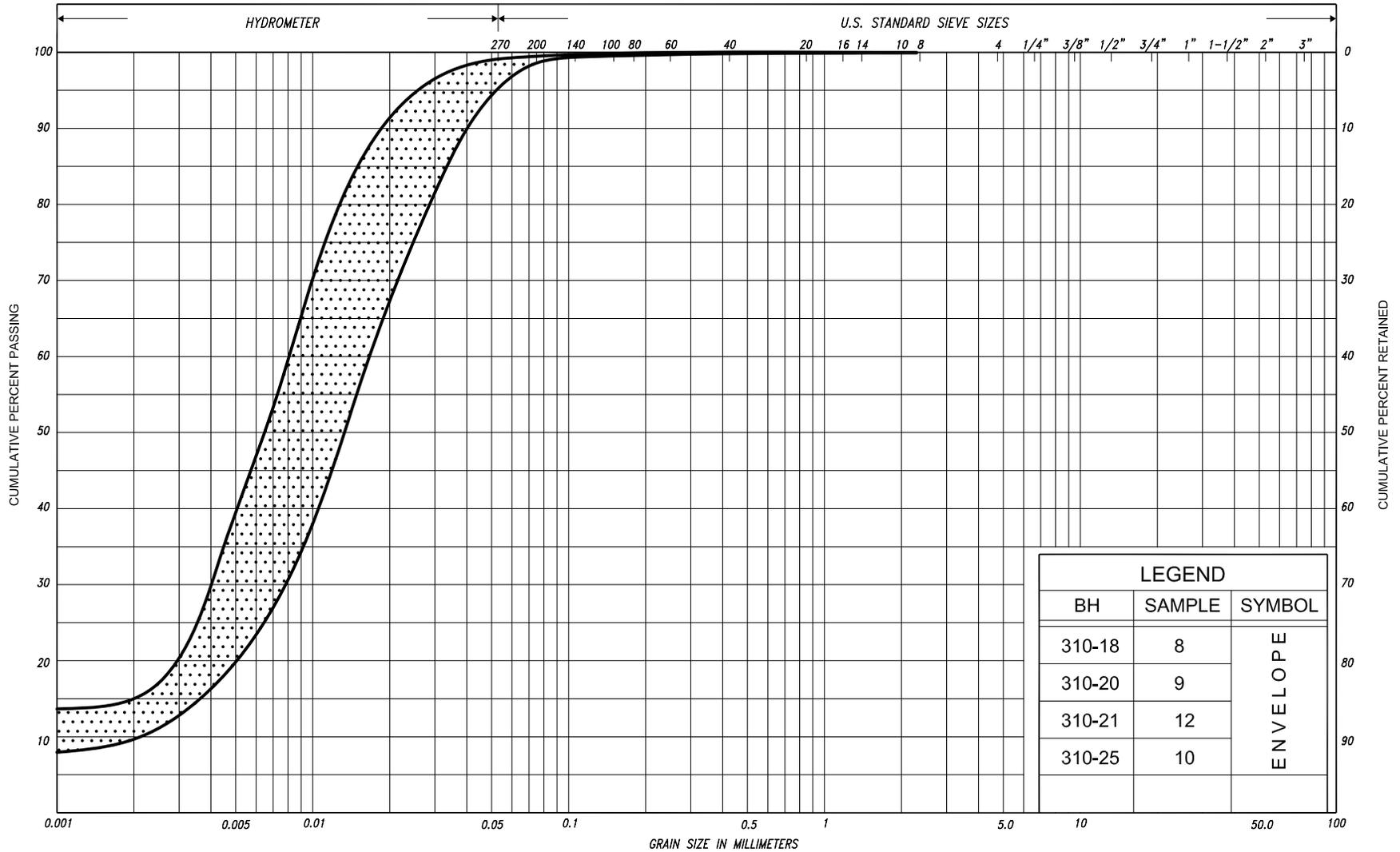
SILT & CLAY			FINE		MEDIUM		COARSE	GRAVEL			COBBLES	UNIFIED
CLAY			FINE		MEDIUM		COARSE	GRAVEL			COBBLES	M.I.T.
CLAY			SILT		SAND		SAND	GRAVEL				U.S. BUREAU
			V. FINE		FINE	MED.	COARSE	GRAVEL				



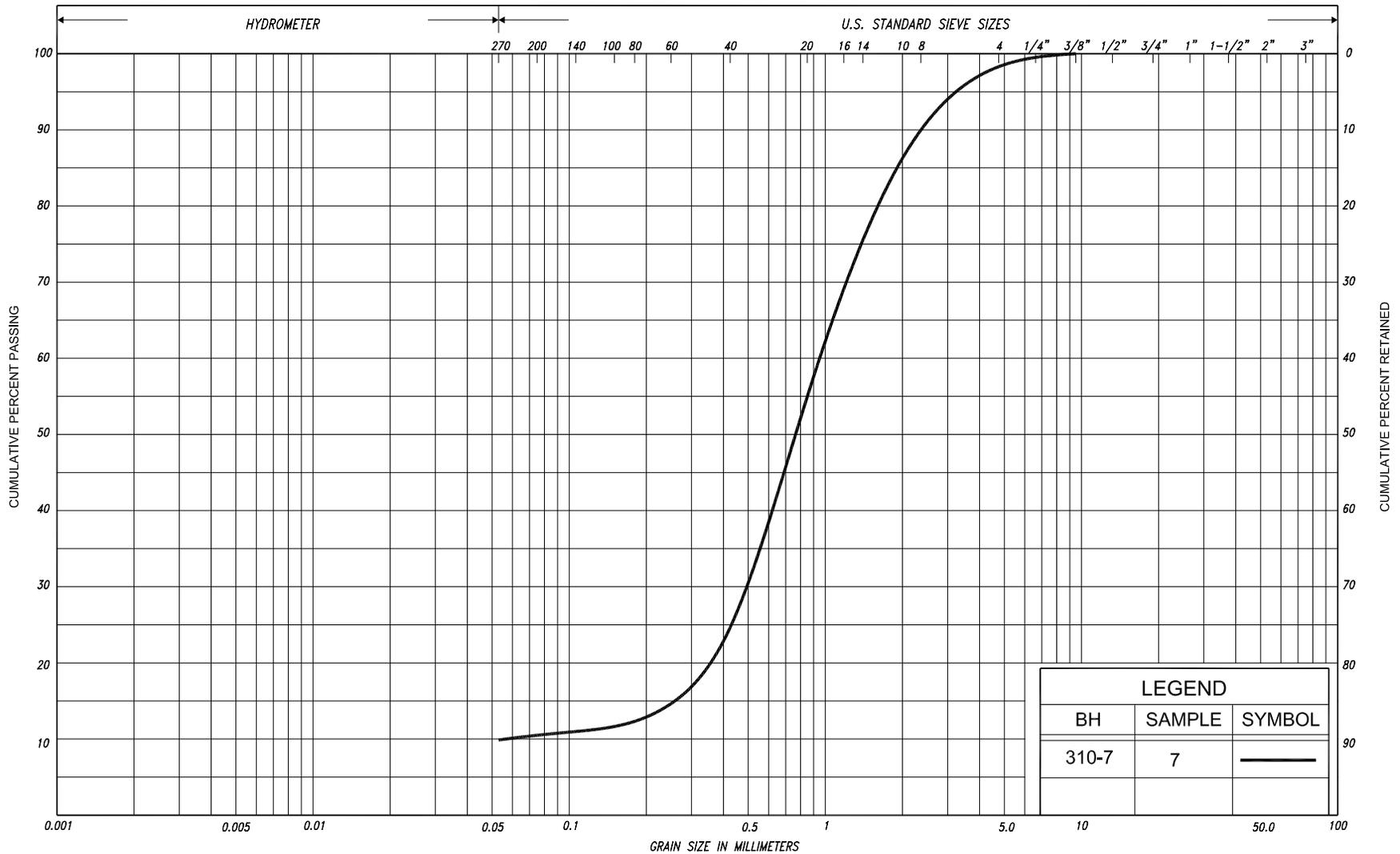
GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand

FIG No. 310-GS-5
 HWY: 69
 G.W.P. No. 5203-06-00



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



LEGEND		
BH	SAMPLE	SYMBOL
310-7	7	—

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



GRAIN SIZE DISTRIBUTION

SAND, trace to some silt, trace gravel

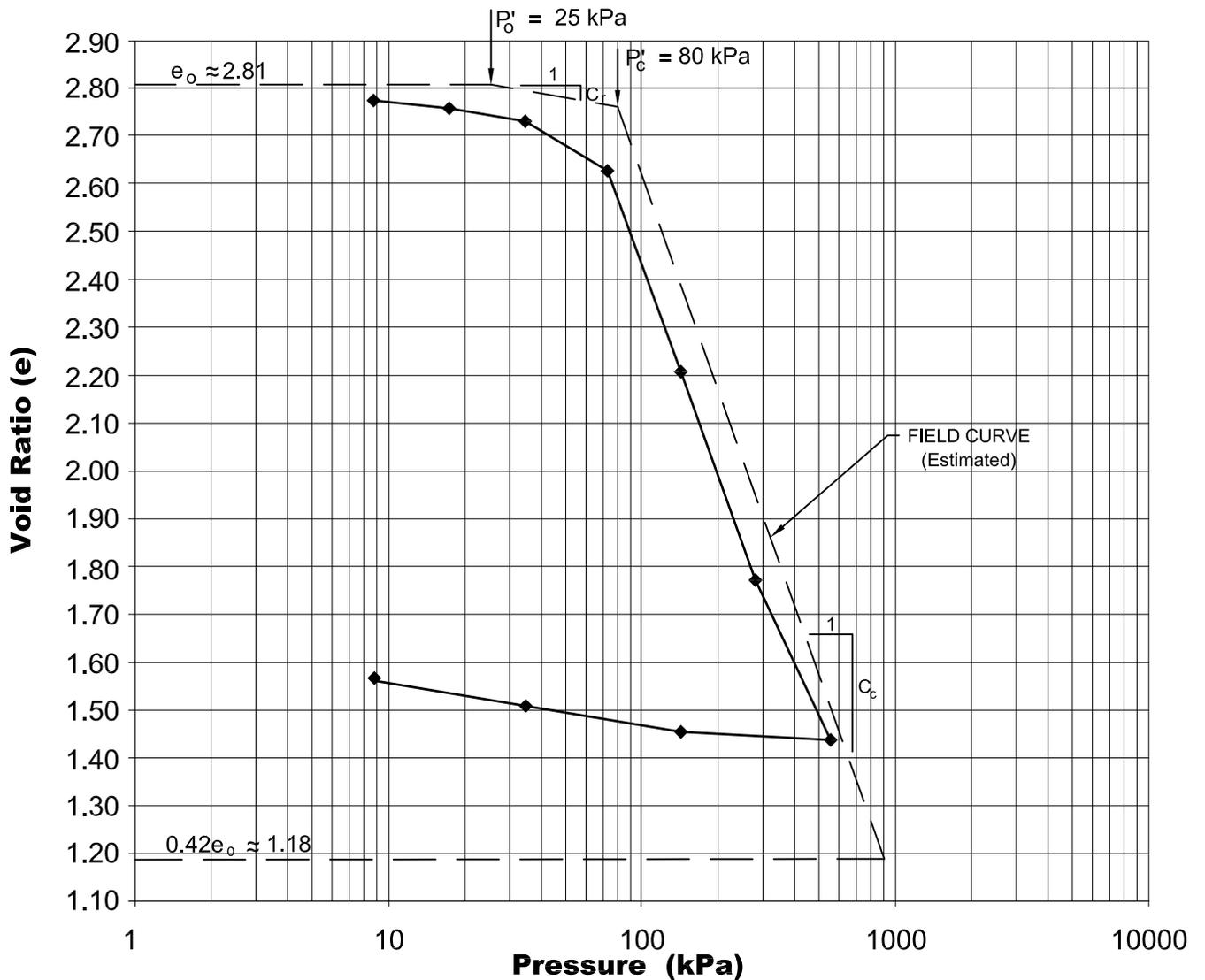
FIG No. 310-GS-7
 HWY: 69
 G.W.P. No. 5203-06-00

Laboratory Consolidation Test Results

Highway 69
 From 3.1 km north of Highway 522 to 10.7 km north of Highway 522
 District 54, Ontario

Swamp 310, Borehole 310-21, Sample 5
 Station 13+275, 54.0 m Lt. \varnothing Median, Depth 6.1 - 6.7 m

Void Ratio versus Log of Pressure



SOIL TYPE: CLAY, trace sand

$e_0 \approx 2.81$

$W_0 = 101\%$

$\gamma = 14.4 \text{ kN/m}^3$

$P'_0 = 25 \text{ kPa}$

$P'_c = 80 \text{ kPa}$

$C_c = 1.49$

$C_r = 0.09$

$W_L = 70$

$W_P = 25$

$PI = 45$

FIGURE No: 310-C-1

HIGHWAY: 69

TOWNSHIP: MOWAT

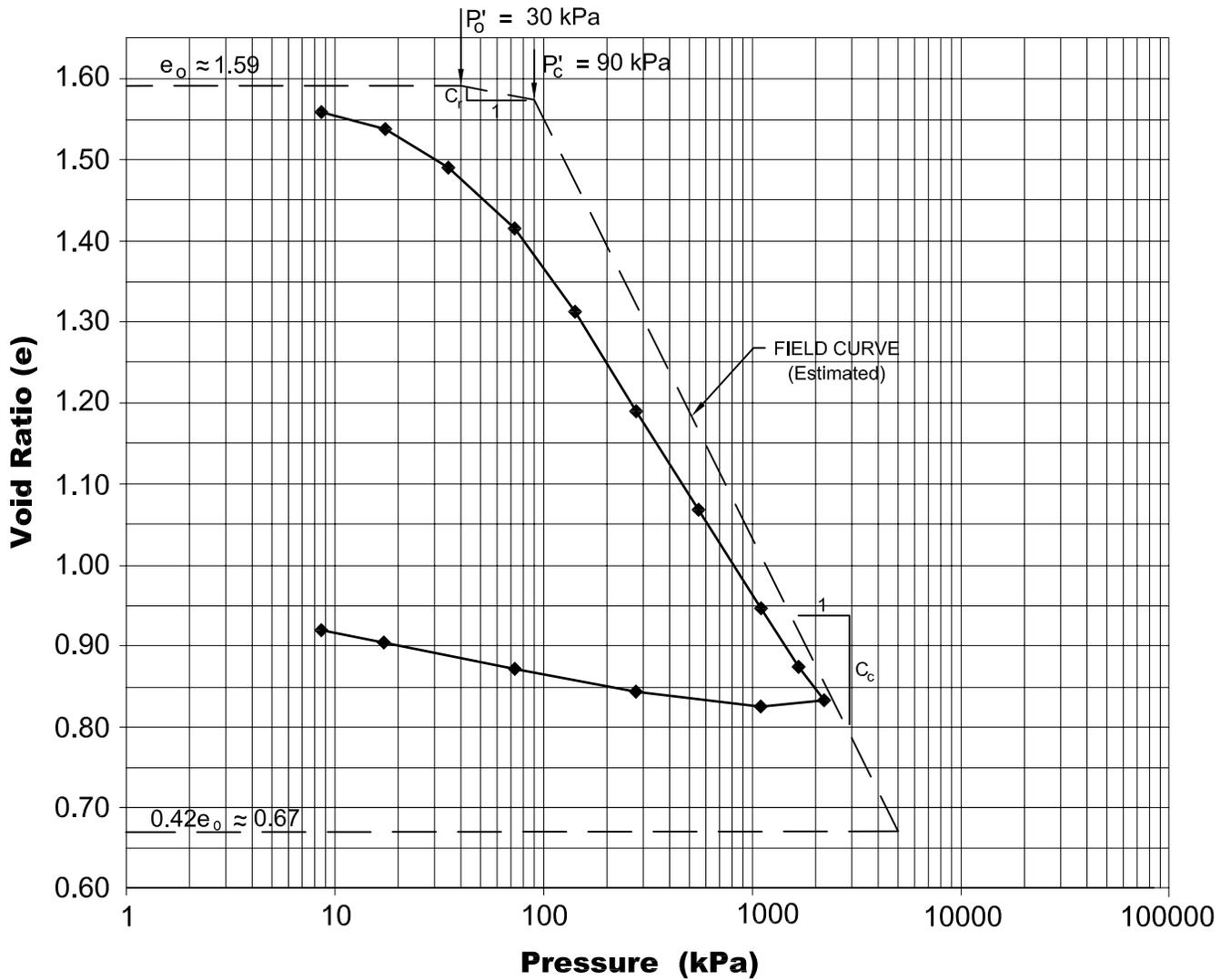
G.W.P. 5203-06-00

Laboratory Consolidation Test Results

Highway 69
 From 3.1 km north of Highway 522 to 10.7 km north of Highway 522
 District 54, Ontario

Swamp 310, Borehole 310-27, Sample 6
 Station 13+375, 53.5 m Lt. \varnothing Median, Depth 7.6 - 8.2 m

Void Ratio versus Log of Pressure



SOIL TYPE: SILTY CLAY, trace sand

$e_0 \approx 1.59$	$P'_0 = 30 \text{ kPa}$	$W_L = 35$	FIGURE No: 310-C-2
$W_0 = 58\%$	$P'_c = 90 \text{ kPa}$	$W_P = 22$	HIGHWAY: 69
$\gamma = 16.7 \text{ kN/m}^3$	$C_c = 0.51$	$PI = 13$	TOWNSHIP: MOWAT
	$C_r = 0.05$		G.W.P. 5203-06-00

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	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 310-1 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+400, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
 DATUM Geodetic DATE March 04, 2007 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			*GROUND WATER CONDITIONS	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								
						20	40	60	80	100	20	40	60		GR SA SI CL
195.0	Ground Surface														
0.0	Peat, coarse fibrous Dark brown fine fibrous		1	CS	-										0.5m frozen
			2	SS	WH**								547	Org. 58.0%	
			3	SS	WH										
	amorphous layers of organic silty clay		4	SS	WH										
191.5	Silty clay, varved organics to 5.0m Very soft Grey Wet to soft		5	SS	WH										
3.5				FV											
			6	SS	WH										
				FV											
			7	SS	WH										
				FV											
			8	SS	WH										
				FV											
	layers of silt		9	SS	1										
184.3	End of borehole Refusal on probable bedrock														
10.7															

RECORD OF BOREHOLE No 310-2 1 of 1 **METRIC**

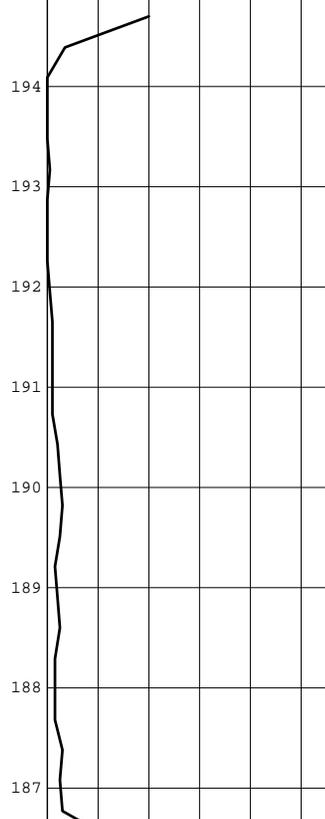
G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+400, o/s 13.3m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE October 13, 2006 CHECKED BY C.N.

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	20
196.1	Ground Surface																	
0.0	Sand and gravel, trace silt Compact Dark Wet brown (PAVEMENT FILL)		1	SS	16													50 43 (7)
194.7	cobbles and boulders (FILL)		2	SS	16													
1.4			3	SS	27													
			4	SS	50/5cm													
191.8	Peat																	
4.3																		
191.4	Clay, trace sand Soft to Grey Wet firm		5	SS	WH**													
4.7			6	SS	WH													
				FV														
			7	SS	WH													
				FV														
	cobbles		8	SS	29													
	layers of silt																	
185.1			9	SS	8/23cm													
11.0	End of borehole Refusal on probable bedrock																	
	Sample 4: Sampler bouncing																	
	* 2006 10 13																	
	Water level measured after drilling																	
	WH** denotes penetration due to weight of rods and hammer																	

RECORD OF PENETRATION TEST No 310-3 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+412.5, o/s 52.5m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2007 CHECKED BY C.N.

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	20	40
195.0 0.0	Ground Surface Probable peat																		
	Probable silty clay Very soft to soft																		
186.3 8.7	End of dynamic cone penetration test Refusal on probable bedrock																		



RECORD OF BOREHOLE No 310-5 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+412.5, o/s 6.5m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE October 13, 2006 CHECKED BY C.N.

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	SHEAR STRENGTH kPa
194.9 0.0	Ground Surface Peat, fine fibrous		1	SS	WH**													
			2	SS	2													
			3	SS	WH													
			4	SS	WH													
191.7 3.2	Clayey silt, trace sand Soft to Grey Wet firm		5	SS	1													
	thin layers of silt		6	SS	1													0 1 72 27
189.4 5.5	End of borehole Refusal on probable bedrock			FV														

* 2006 10 13
 Water level measured after drilling
 WH** denotes penetration due to weight of rods and hammer

RECORD OF PENETRATION TEST No 310-6 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+412.5, o/s 32.5m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE October 14, 2006 CHECKED BY C.N.

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
195.5 0.0	Ground Surface Probable fill Loose Probable clayey silt Soft to firm																
188.8 6.7	End of dynamic cone penetration test Refusal on probable bedrock																

RECORD OF BOREHOLE No 310-7 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+425, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
 DATUM Geodetic DATE March 04, 2007 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			*GROUND WATER CONDITIONS	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								
						20	40	60	80	100					
195.0	Ground Surface														
0.0	Peat, coarse fibrous Dark brown		1	CS	-										0.5m frozen
	amorphous layers of organic silty clay		2	SS	WH**								944		
			3	SS	WH								89		
192.4	Clayey silt organics to 3.1m		4	SS	WH										
2.6	Very soft Grey Wet to soft varved		5	SS	WH										0 0 68 32
				FV											
			6	SS	1										
				FV											
189.2	Sand trace to some silt trace gravel, cobbles		7	SS	10/7cm										2 87 (11)
5.8	Compact Grey Wet														
188.4	End of borehole														
6.6	Refusal on probable bedrock														

RECORD OF BOREHOLE No 310-8 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+425, o/s 24.5m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE October 14, 2006 CHECKED BY C.N.

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					
196.3	Ground Surface															
0.0	Topsoil		1	SS	13											
	Sand, with silt		2	SS	35											
	Compact Brown Dry to dense															
	cobbles and boulders		3	SS	18/15cm											
	Wet															
	inclusions of peat, wood (FILL)		4	SS	7											
193.4	Silt															
2.9	Loose Grey Wet		5	SS	8											
192.5	End of borehole															
3.8	Refusal on probable bedrock															
	Sample 3: Sampler bouncing															
	* 2006 10 14															
	▼ Water level measured after drilling															

RECORD OF BOREHOLE No 310-9 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+437.5, o/s 52.5m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2007 CHECKED BY C.N.

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						20
195.0	Top of Ice/snow																	
0.0	Ice/Snow					▽*												
194.7			1	CS	-													
0.3	Peat, coarse fibrous Dark brown fine fibrous		2	SS	WH**													
193.5																		
1.5	Silty clay organics to 3.0m varved Firm Grey Moist to wet		3	SS	2													
	layers of silt		4	SS	2													
			5	TW	PH													
190.1	layers of sandy silt trace gravel, cobbles		6	SS	10/10cm													
4.9	End of borehole Refusal on probable bedrock																	
	Sample 6: Sampler bouncing																	
	* 2007 03 05																	
	▽ Water level observed during drilling																	
	▽ Water level measured after drilling																	
	WH** Denotes penetration due to weight of hammer and rods																	

RECORD OF PENETRATION TEST No 310-10 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+437.5, o/s 26.5m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2007 CHECKED BY C.N.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
195.0 0.0	Ground Surface Probable peat						20	40	60	80	100					
	Probable silty clay Very soft to soft						20	40	60	80	100					
190.0 5.0	End of dynamic cone penetration test Refusal on probable bedrock						20	40	60	80	100					

RECORD OF PENETRATION TEST No 310-11 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+437.5, o/s 6.5m Rt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N.S.B.
 DATUM Geodetic DATE March 05, 2007 CHECKED BY C.N.

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	20
195.0 0.0	Ground Surface Probable peat																	
	Probable silty clay Very soft to soft																	
191.2 3.8	End of dynamic cone penetration test Refusal on probable bedrock																	

RECORD OF BOREHOLE No 310-12 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+437.5, o/s 32.5m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE October 14, 2006 CHECKED BY C.N.

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	20
195.8	Ground Surface																	
0.0	Topsoil <u>Dark brown</u> Sand, trace silt		1	SS	3													
	Loose <u>Brown</u> <u>Dry</u> with silt (FILL) Wet		2	SS	4													
194.4																		
194.2	Topsoil																	
1.6	Sand, trace silt		3	SS	12/23cm													
193.9																		
1.9	Compact <u>Brown</u> <u>Wet</u> End of borehole Refusal on probable bedrock																	
	Sample 3: Sampler bouncing																	
	* 2006 10 14																	
	Water level measured after drilling																	

RECORD OF BOREHOLE No 310-13 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+450, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.S.B.
 DATUM Geodetic DATE March 04, 2007 CHECKED BY C.N.

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						20
195.2	Ground Surface																	
0.0	Peat, coarse fibrous					▽*												0.4m frozen
194.7	Dark brown		1	SS	8													
0.5	Clayey silt organics to 1.3m																	
	Firm Mottled Moist to wet grey/brown		2	SS	4							o						
	trace sand		3	SS	1								o					0 1 68 31
				FV														
			4	SS	2													
				FV														
	silt and clay layers																	
			5	SS	4													
189.9	End of borehole																	
5.3	Refusal on probable bedrock																	

RECORD OF BOREHOLE No 310-14 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+450, o/s 12.9m Rt. CL Med. ORIGINATED BY M.R.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE October 12, 2006 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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						SHEAR STRENGTH kPa			
											○ UNCONFINED	+	FIELD VANE							
											● QUICK TRIAXIAL	×	LAB VANE							
											WATER CONTENT (%)									
196.4	Ground Surface																			
0.0	Gravelly sand, trace silt Compact Dark Wet brown		1	SS	19															
195.4	(PAVEMENT FILL)																			
1.0	Sand, trace silt Loose Brown Wet		2	SS	10															
194.6	(FILL)																			
1.8	Silty clay, trace sand Firm Brown Wet		3	SS	6								○							
	thin layers of silt																			
			4	SS	5									○						
192.3	Silty sand Loose Grey Wet																			
4.1		5	SS	7																
190.7	End of borehole Refusal on probable bedrock																			
5.7																				

* 2006 10 12
 Water level measured after drilling

RECORD OF BOREHOLE No 310-15 1 of 1 **METRIC**

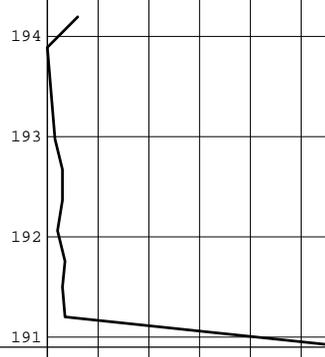
G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+150, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 10, 2009 CHECKED BY C.N.

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	20
195.9	Ground Surface																	
0.0 195.6	Peat, coarse fibrous Dark brown		1	SS	3													
0.3	Organic silt clayey silt layers																	
194.7	Very loose Grey Moist to loose					195												
1.2	Clayey silt, trace sand silt layers																	
	Stiff Mottled Moist grey/brown		2	SS	10	194												0 2 84 14
	layers of sand																	
192.7	trace gravel		3	SS	10/15cm	193												
3.2	Grey Wet																	
	End of borehole Refusal on probable bedrock																	
	Sample 3: Sampler bouncing																	
	* 2009 02 10																	
	▽ Water level observed during drilling																	
	▼ Water level measured after drilling																	
	■ Penetrometer test																	

RECORD OF PENETRATION TEST No 310-16 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+175, o/s 26.5m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE February 10, 2009 CHECKED BY C.N.

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	20
194.5 0.0	Ground Surface Probable peat																	
	Probable clayey silt																	
190.9 3.6	End of dynamic cone penetration test Refusal on probable bedrock																	



RECORD OF BOREHOLE No 310-17 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+187.5, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Power Auger COMPILED BY G.D.
 DATUM Geodetic DATE February 17, 2009 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100
193.9	Ground Surface																
0.0	Peat, coarse fibrous Dark brown																
	fine fibrous																
	amorphous organic silt layers																
191.5	Silty clay, trace sand Grey Wet																
2.4																	
186.4	End of borehole Refusal on probable bedrock																
7.5																	

RECORD OF BOREHOLE No 310-18 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+200, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 11, 2009 CHECKED BY C.N.

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	20
194.3	Ground Surface																	
0.0	Peat, coarse fibrous Dark brown		1	SS	WH**													
	fine fibrous																	
			2	SS	WH													
	amorphous																	
191.9	Silty clay, trace sand Very soft Grey Wet		3	SS	WR***													
2.4																		
	varved																	
	Soft			4	SS	WH												
188.5	Clayey silt, trace sand Soft Grey Wet		5	SS	WH													
5.8																		
	cobbles																	
	Firm		6	SS	7													
			7	SS	WH													0 1 60 39
184.1	Silt, trace sand clayey silt layers		8	SS	WH													
10.2	Very loose Grey Wet to compact																	
			9	SS	20/15cm													
181.8	End of borehole																	
12.5	Refusal on probable bedrock Sample 9: Sampler bouncing																	WH** Penetration due to the weight of rods and hammer
	* 2009 02 11																	WR*** Penetration due to the weight of rods only
	▽ Water level observed during drilling																	
	▽ Water level measured after drilling																	

RECORD OF BOREHOLE No 310-19 1 of 1 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+219, o/s 24.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 10, 2009 CHECKED BY C.N.

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	20
194.4	Ground Surface																	
0.0	Peat, coarse fibrous Dark brown		1	SS	WH**													
	fine fibrous/ amorphous		2	SS	WH													
192.0	Organic silt Very loose Grey Wet																	
2.4			3	SS	WH													
190.9	Silty clay, trace sand Very soft Grey Wet to soft																	
3.5				FV														
			4	SS	WR***													
188.5	Clayey silt, trace sand silt layers Soft to firm Grey Wet		5	SS	1													
5.9				FV														
186.5	End of borehole Refusal on probable bedrock		6	SS	20/10cm													
7.9																		

RECORD OF BOREHOLE No 310-20 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+250, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 09 & 10, 2009 CHECKED BY C.N.

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100						
179.4	* 2009 02 09 & 10 ∇ Water level observed during drilling. ▼ Water level measured after drilling. WH** Penetration due to the weight of rods and hammer. WR*** Penetration due to the weight of rods only.																

RECORD OF BOREHOLE No 310-21 1 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+275, o/s 54.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 09, 2009 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	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 (%)
						20	40	60	80	100						
194.7	Ground Surface															
0.0	Peat, coarse fibrous Dark brown		1	SS	WH**											
	fine fibrous															
			2	SS	1								381			
	amorphous layers of organic silt															
191.7	Clay, trace sand		3	SS	WH								99			
3.0	Very soft Grey Wet															
				4	SS	WH										
					FV											
	varved															
	Soft to firm			5	TW	PM								118	14.4	0 1 26 73
					FV											
				6	SS	WH								88		
					FV											
				7	SS	1										
				FV												
			8	SS	WH											
				FV												
182.7	Clayey silt, trace sand		9	SS	WH											
12.0	Soft to Grey Wet firm															
	layers of silt															
			10	SS	WH											
				FV												
180.1																
14.6																

Cont'd

RECORD OF BOREHOLE No 310-21 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+275, o/s 54.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 09, 2009 CHECKED BY C.N.

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								
						20	40	60	80	100						
179.7	Silt, trace sand clayey silt layers Very loose Grey Wet		11	SS	WH											
			12	SS	3										0 1 89 10	
176.7																
18.0	Sand trace silt, trace gravel Compact Grey Wet		13	SS	19											
175.2																
19.5	End of borehole Refusal on probable bedrock															

* 2009 02 09

∇ Water level observed during drilling

▼ Water level measured after drilling

WH** Penetration due to the weight of rods and hammer

RECORD OF PENETRATION TEST No 310-22 1 of 1 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+275, o/s 25.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE February 09, 2009 CHECKED BY C.N.

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					
194.4 0.0	Ground Surface Probable peat												
	Probable silty clay												
185.5 8.9	End of dynamic cone penetration test Refusal on probable bedrock												

RECORD OF BOREHOLE No 310-23 1 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+300, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 08, 2009 CHECKED BY C.N.

SOIL PROFILE		STRAT PLOT	SAMPLES		GROUND WATER CONDITIONS	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		NUMBER	TYPE		"N" VALUES	20	40	60	80						100
194.4	Ground Surface															
0.0	Peat, coarse fibrous Dark brown		1	SS	WH**	▼*	▼*									
	fine fibrous															
	amorphous layers of organic silt		2	SS	WH								416			
			3	SS	WH								118			
190.1	Silty clay layers of clayey silt		4	SS	WH											
4.3	Very soft Grey Wet to firm			FV												
	varved		5	TW	PM											
				FV												
			6	SS	WH											
				FV												
			7	SS	WH											
				FV												
			8	SS	WH											
				FV												
	trace sand		9	SS	1											
			FV													
180.8	Clayey silt, trace sand silt layers		10	SS	WH											
13.6	Soft to Grey Wet firm															
179.4																

RECORD OF BOREHOLE No 310-23 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+300, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 08, 2009 CHECKED BY C.N.

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
179.4 15.0	Silt, trace sand layers of clayey silt Compact Grey Wet		11	SS	20/15cm												
178.1 16.3	End of borehole Refusal on probable bedrock Sample 11: Sampler bouncing * 2009 02 08 ▽ Water level observed during drilling ▼ Water level measured after drilling WH** Penetration due to the weight of rods and hammer																

RECORD OF PENETRATION TEST No 310-24 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+325, o/s 54.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY G.D.
 DATUM Geodetic DATE February 08, 2009 CHECKED BY C.N.

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	20
179.4 15.0	Probable silt																	
178.8 15.6	End of dynamic cone penetration test Refusal on probable bedrock					179												

RECORD OF BOREHOLE No 310-25 1 of 2 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+325, o/s 25.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 07, 2009 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	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 (%)	
						20	40	60	80	100	20	40	60				
194.4	Ground Surface																
0.0	Peat, coarse fibrous Dark brown		1	CS	-												
	fine fibrous																
	amorphous layers of organic silt																
			2	SS	WH**												
			3	SS	WH												
			4	SS	WH												
189.6	Clay, trace sand varved																
4.8	Very soft Grey Wet to firm																
				5	SS	WR***											
					FV												
				6	SS	WH											
					FV												
			7	SS	WH												
				FV													
			8	SS	WH												
				FV													
	clayey silt layers																
			9	SS	WH												
				FV													
181.0	Silt, trace sand clayey silt layers																
13.4	Very loose Grey Wet																
			10	SS	WH												

Cont'd

+⁷, X⁵: Numbers refer to Sensitivity
 20
 15—○—5 (% STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 310-25 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+325, o/s 25.0m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 07, 2009 CHECKED BY C.N.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
179.4			11	SS	7											
	trace gravel sand layers															
	Loose to compact															
177.6																
16.8	End of borehole Refusal on probable bedrock															
	* 2009 02 07															
	∇ Water level observed during drilling															
	▼ Water level measured after drilling															
	WH** Penetration due to the weight of rods and hammer															
	WR*** Penetration due to the weight of rods only															

RECORD OF BOREHOLE No 310-26 1 of 2 **METRIC**

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+350, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 06, 2009 CHECKED BY C.N.

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	20	40
194.3	Ground Surface																		
0.0	Peat, coarse fibrous Dark brown		1	SS	WH**														
	fine fibrous																		
	amorphous layers of organic silt		2	SS	WH								978						
			3	SS	WR***														
190.3	Silty clay, trace sand varved																		
4.0	Soft to Grey Wet firm		4	SS	WH								127						
					FV														
			5	SS	WH								83						
					FV														
			6	SS	WH								98						
					FV														
			7	SS	WH								92						
					FV														
	clayey silt layers		8	SS	1														
				FV															
		9	SS	1															
				FV															
180.3	trace sand, trace gravel		10	SS	20/10cm														
14.0	End of borehole Refusal on probable bedrock Sample 10: Sampler bouncing Cont'd																		

RECORD OF BOREHOLE No 310-26 2 of 2 METRIC

G.W.P. 5203-06-00 LOCATION Hwy 69(New), Sta. 13+350, o/s 38.8m Lt. CL Med. ORIGINATED BY F.P.
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY G.D.
 DATUM Geodetic DATE February 06, 2009 CHECKED BY C.N.

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100	W _p	w	W _L			
179.3	* 2009 02 06 ▽ Water level observed during drilling ▼ Water level measured after drilling WH** Penetration due to the weight of rods and hammer WR*** Penetration due to the weight of rods only																

RECORD OF BOREHOLE No DCPGL3A-7 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-3Sts 16+275 25 LT, Co-ords: 5089356N, 220737E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Tripod with Dynamic Cone Penetration Test COMPILED BY C. Roy
 DATUM Geodetic DATE 2005.02.25 CHECKED BY T. Crilly

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			T _N VALUES	20	40					
195.5 0.0	Ice Surface probable peat													
191.2 4.3	possible CLAY													
187.6 7.9	End of Dynamic Cone Penetration Test													

ONTARIO MOT. GRUNDY LAKE SWAMP G.F.J. ONTARIO MOT.GDT 05/08/26

3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No DCPGL3A-8 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 89-Grundy Lake 3A - Sta 16+375 23 LT. Co-ords: 5089454N, 220758E
 DIST 54 HWY 69 BOREHOLE TYPE Tripod with Dynamic Cone Penetration Test
 DATUM Geodetic DATE 2005.02.25
 ORIGINATED BY K. Crowe
 COMPILED BY C. Roy
 CHECKED BY T. Crilly

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	T _N VALUES								
195.5 0.0	Ice Surface probable peat												
188.5 7.0	Possible SAND												
187.6 7.9	End of Dynamic Cone Penetration Test												

ONTARIO MOT GRUNDY LAKE SWAMP GPJ ONTARIO MOT GDT 05/08/26

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

RECORD OF BOREHOLE No DCPGL3A-9 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-Sta 16+275 18 5 RT, Co-ords: 5089347N, 220780E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Tripod with Dynamic Cone Penetration Test COMPILED BY C. Roy
 DATUM Geodetic DATE 2005.02.15 CHECKED BY T. Crilly

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			T _N VALUES	20					
159.5 0.0	Ice Surface probable peat												
152.8 8.7	possible CLAY												
150.1 9.4	possible SAND												
149.1 10.4	End of Dynamic Cone Penetration Test												

195.5

ONTARIO MOT. GRUNDY LAKE SWAMP GPJ ONTARIO MOT. DOT 0508/26

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

RECORD OF BOREHOLE No DCPGL3A-10 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-Sta 16+375 18.5 RT. Co-ords: 5089445N, 220801E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Tripod with dynamic cone penetrometer COMPILED BY C. Roy
 DATUM Geodetic DATE 2005 02 25 CHECKED BY T. Cilly

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			T _v VALUES	20	40	60	80			100
195.5 0.0	Ice Surface probable peat	[Hatched pattern]												
193.4 2.1	possible CLAY	[Hatched pattern]												
188.8 6.7	End of Dynamic Cone Penetration Test													

ONTARIO MOT GRUNDY LAKE SWAMP GPJ_ONTARIO.MDT.GDT 05/06/26

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

RECORD OF BOREHOLE No GL3A-16 1 OF 1 **METRIC**

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-Sla 15+300 18.5 RT, Co-ords: 5088393N: 220760E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Hollow Stem Auger COMPILED BY G. Roy
 DATUM Geodetic DATE 2005 01 28 CHECKED BY T. Crilly

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	10
191.8 0.0	Ground Surface Peat, black, frozen																	
190.3 1.5	Clayey Silt, brown, moist, soft, trace oxidation, trace roots		1	SS	2									0	1	82	17	
189.5 2.3	End of Borehole Auger Refusal on Probable Bedrock																	

ONTARIO MOT GRUNDY LAKE SWAMP GPJ ONTARIO MOT GDT 05/08/26

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

RECORD OF BOREHOLE No GL3A-17 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-Sta 16+175 18 LT. Co-ords 5089258N, 220721E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Hollow Stem Auger COMPILED BY C. Roy
 DATUM Geodetic DATE 2005 01 28 CHECKED BY T. Crilly

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
194.5	Water Surface																
0.0	Water																
193.9																	
0.6	Peat, black, wet, fibrous																
193.5																	
1.1	Clay, gray, wet, very soft																
			1	SS	WH												
			2	VANE													
			3	SS	WH												
			4	VANE													
189.4																	
5.2	End of Borehole																
	Auger Refusal on Probable Bedrock																
	Groundwater encountered at surface at time of drilling																

ONTARIO MOT GRUNDY LAKE SWAMP GPJ ONTARIO MOT GDT 05/08/25

3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No GL3A-18 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-STA 16+175 18.5 RT, Co-ords. 5089250N, 220757E ORIGINATED BY K. Crowe
 DIST 54 HWY 69 BOREHOLE TYPE Continuous Hollow Stem Auger COMPILED BY C. Roy
 DATUM Geodetic DATE 2005 01 28 CHECKED BY T. Crilly

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40				60	80
194.5	Water Surface													
0.0	Water													
193.5														
193.2	Peat, black, wet, some wood													
1.2	Clay, grey, wet to moist, very soft													
			1	SS	WH									
			2	VANE					13.3					
191.7														
2.7	End of Borehole													
	Refusal on Probable Bedrock													
	Groundwater encountered at surface at time of drilling													

ONTARIO MOT GRUNDY LAKE SWAMP GPJ ONTARIO MOT GDT 05/08/26

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

RECORD OF BOREHOLE No GL3A-19 1 OF 1 METRIC

G.W.P. 5377-02-00 LOCATION Hwy 69-Grundy Lake 3A-STA 16+225 18.5 RT, Co-ords 5089298N, 220769E ORIGINATED BY K. Crewe
 DIST 54 HWY 69 BOREHOLE TYPE Tripod with Dynamic Cone Penetration Test COMPILED BY C. Roy
 DATUM Geodetic DATE 2005.02.25 CHECKED BY T. Crilly

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	20 40 60 80 100	w _p	w		
195.5	Water Surface												
0.6	Water												
195.9													
0.3	Peat, black, very wet, very soft, fibrous, trace clay seams		1	SS	WH								
			2	SS	1						210		
190.8													
4.7	Sand, brown, wet, very loose		3	SS	2						168		
188.4													
7.1	Clay, gray, very wet, firm, intermediate plasticity, some silt		4	SS	2						93		
185.9													
9.6	Dynamic Cone Penetration Test started probable clay												
182.5													
13.0	End of Dynamic Cone Penetration Test Groundwater encountered at surface at time of drilling												

ONTARIO MOT GRUNDY LAKE SWAMP GPJ ONTARIO MOT GDT 05/08/26

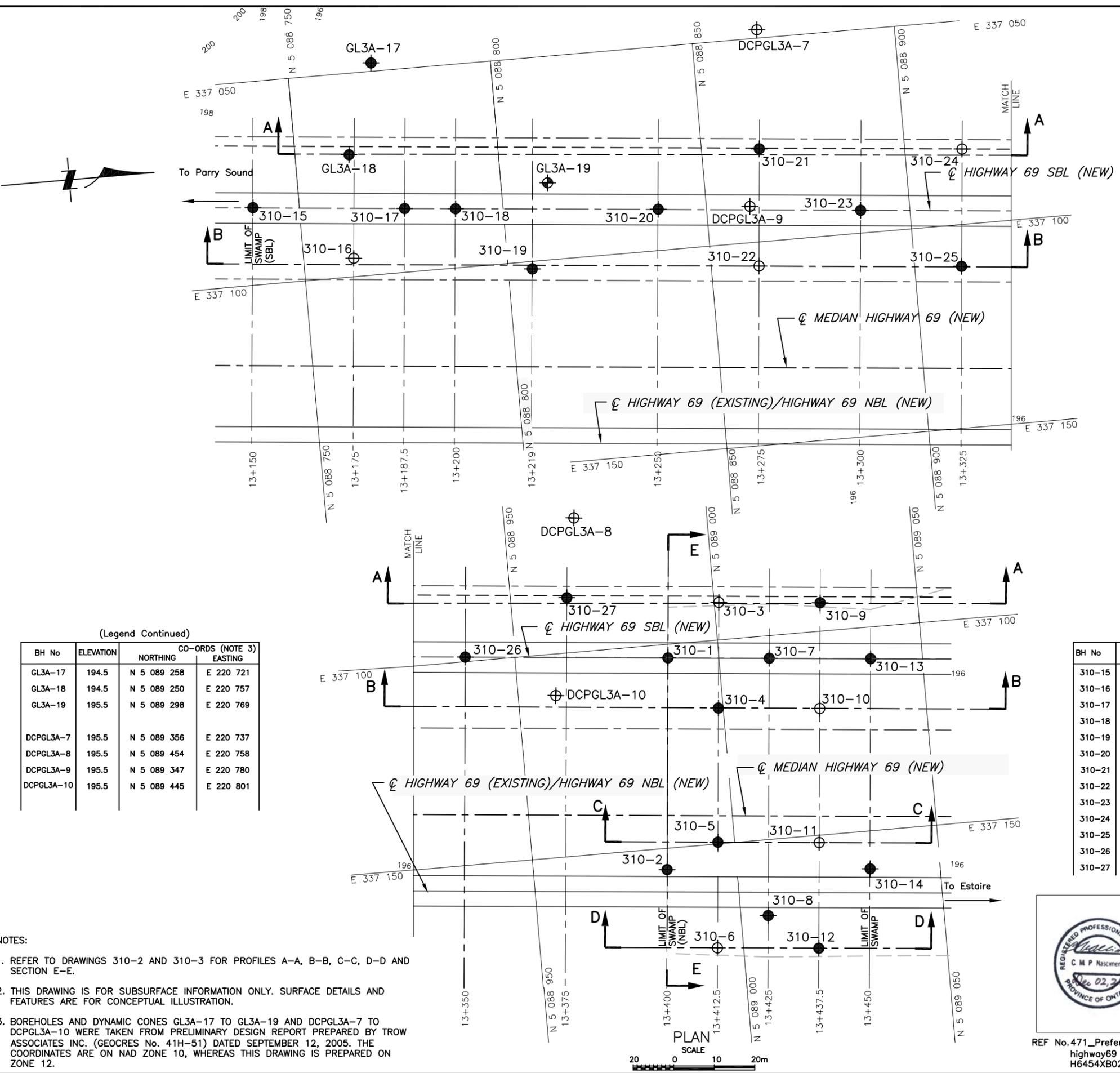
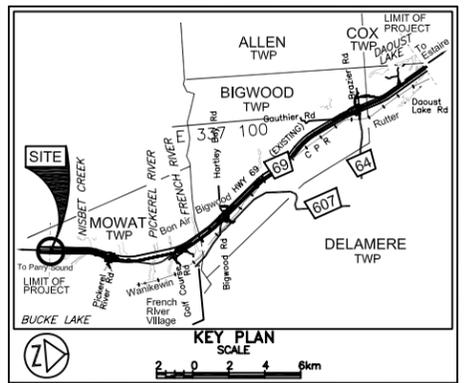
3 x 3 Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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

CONT No
GWP No 5203-06-00
HIGHWAY 69
HIGHWAY 69 FOUR-LANING
SWAMP 310, STA. 13+150 TO 13+450 MOWAT TWP
BOREHOLE LOCATIONS



SHEET



(Legend Continued)

BH No	ELEVATION	CO-ORDS (NOTE 3)	
		NORTHING	EASTING
GL3A-17	194.5	N 5 089 258	E 220 721
GL3A-18	194.5	N 5 089 250	E 220 757
GL3A-19	195.5	N 5 089 298	E 220 769
DCPGL3A-7	195.5	N 5 089 356	E 220 737
DCPGL3A-8	195.5	N 5 089 454	E 220 758
DCPGL3A-9	195.5	N 5 089 347	E 220 780
DCPGL3A-10	195.5	N 5 089 445	E 220 801

(Legend Continued)

BH No	ELEVATION	STA MOWAT TWP	o/s CL MED
310-15	195.9	13+150	38.8m Lt.
310-16	194.5	13+175	26.5m Lt.
310-17	193.9	13+187.5	38.8m Lt.
310-18	194.3	13+200	38.8m Lt.
310-19	194.4	13+219	24.0m Lt.
310-20	194.4	13+250	38.8m Lt.
310-21	194.7	13+275	54.0m Lt.
310-22	194.4	13+275	25.0m Lt.
310-23	194.4	13+300	38.8m Lt.
310-24	194.4	13+325	54.0m Lt.
310-25	194.4	13+325	25.0m Lt.
310-26	194.3	13+350	38.8m Lt.
310-27	194.3	13+375	53.5m Lt.

(Legend Continues)

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
- W L at time of investigation Oct 2006, Mar 2007 and Feb 2009
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	STA MOWAT TWP	o/s CL MED
310-1	195.0	13+400	38.8m Lt.
310-2	196.1	13+400	13.3m Rt.
310-3	195.0	13+412.5	52.5m Lt.
310-4	195.0	13+412.5	26.5m Lt.
310-5	194.9	13+412.5	6.5m Rt.
310-6	195.5	13+412.5	32.5m Rt.
310-7	195.0	13+425	38.8m Lt.
310-8	196.3	13+425	24.5m Rt.
310-9	195.0	13+437.5	52.5m Lt.
310-10	195.0	13+437.5	26.5m Lt.
310-11	195.0	13+437.5	6.5m Rt.
310-12	195.8	13+437.5	32.5m Rt.
310-13	195.2	13+450	38.8m Lt.
310-14	196.4	13+450	12.9m Rt.

(Legend Continues)

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

NOTES:

- REFER TO DRAWINGS 310-2 AND 310-3 FOR PROFILES A-A, B-B, C-C, D-D AND SECTION E-E.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
- BOREHOLES AND DYNAMIC CONES GL3A-17 TO GL3A-19 AND DCPGL3A-7 TO DCPGL3A-10 WERE TAKEN FROM PRELIMINARY DESIGN REPORT PREPARED BY TROW ASSOCIATES INC. (GEOCREs No. 41H-51) DATED SEPTEMBER 12, 2005. THE COORDINATES ARE ON NAD ZONE 10, WHEREAS THIS DRAWING IS PREPARED ON ZONE 12.

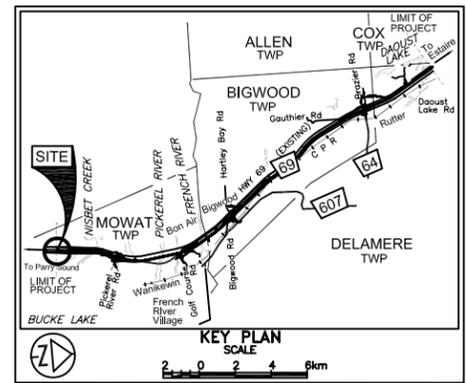


REF No. 471_Preferred_Plan_PDR_FINAL1.dwg;
highway69 basemapping sept 14_2007\
H6454XB02 contours zone 12.dwg;

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41H-75

HWY No 69	DIST 54
SUBM'D NSB	CHECKED GD
DATE DEC. 02, 2009	SITE ---
DRAWN NA	CHECKED CN
APPROVED BRG	DWG 310-1



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
- WR Penetration due to weight of rods only
- PM Thinwall Sample - Advanced Manually
- W L at time of investigation Oct 2006, Mar 2007 and Feb 2009
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

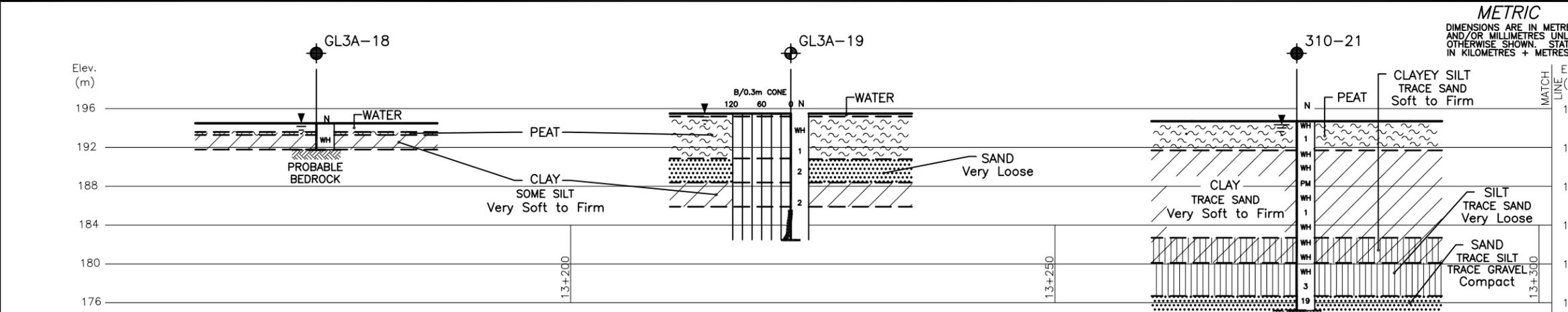
BH No	ELEVATION	STA MOWAT TWP	o/s CL MED
SEE DRAWING 310-1 FOR DETAILS			

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

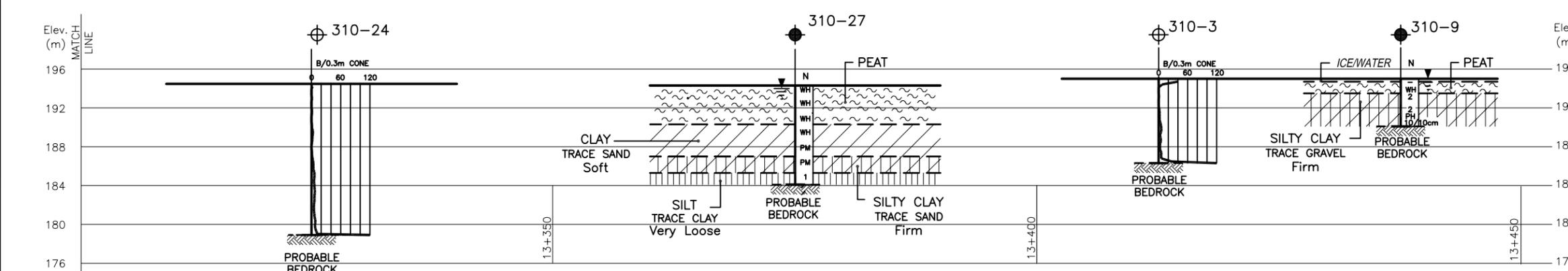
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 41H-75

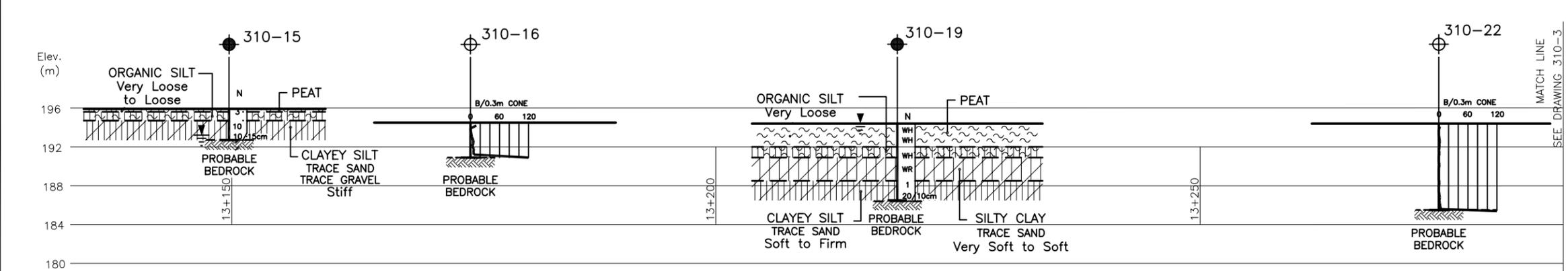
HWY No 69	DIST 54
SUBM'D NSB	CHECKED GD
DATE DEC. 02, 2009	SITE --
DRAWN NA	CHECKED CN
APPROVED BRG	DWG 310-2



PROFILE A-A



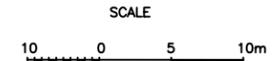
PROFILE A-A (Continued)



PROFILE B-B

NOTES:

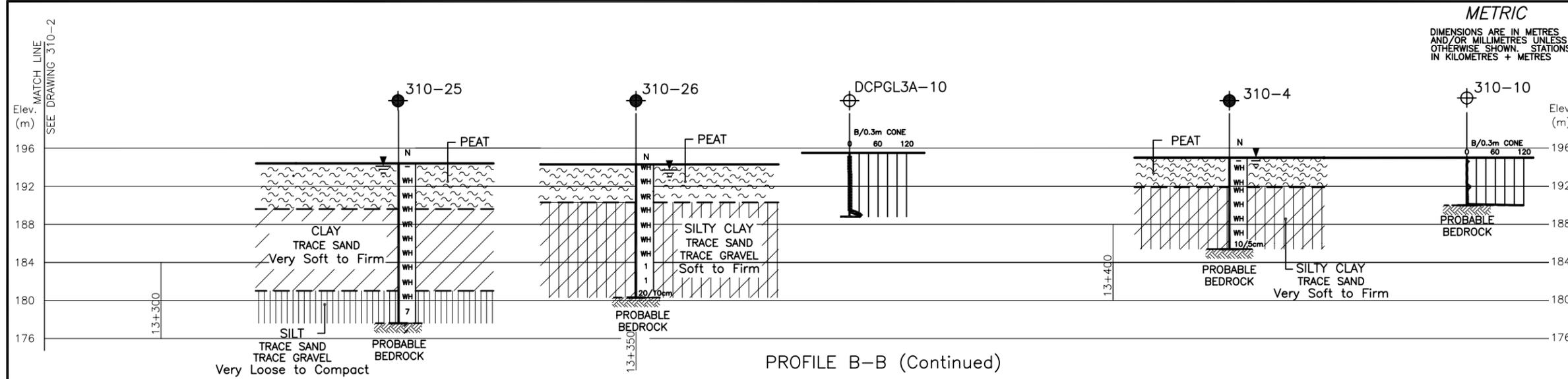
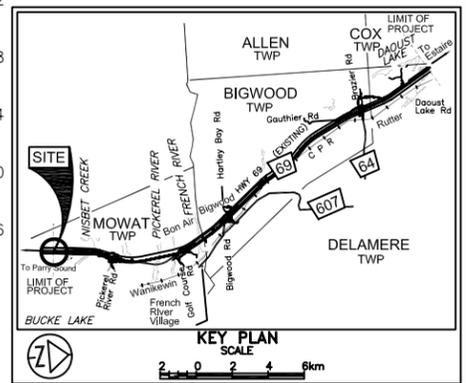
- REFER TO DRAWING 310-1 FOR BOREHOLE LOCATIONS PLAN AND DRAWING 310-3 FOR PROFILES B-B (Continued), C-C, D-D AND SECTION E-E.
- THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.



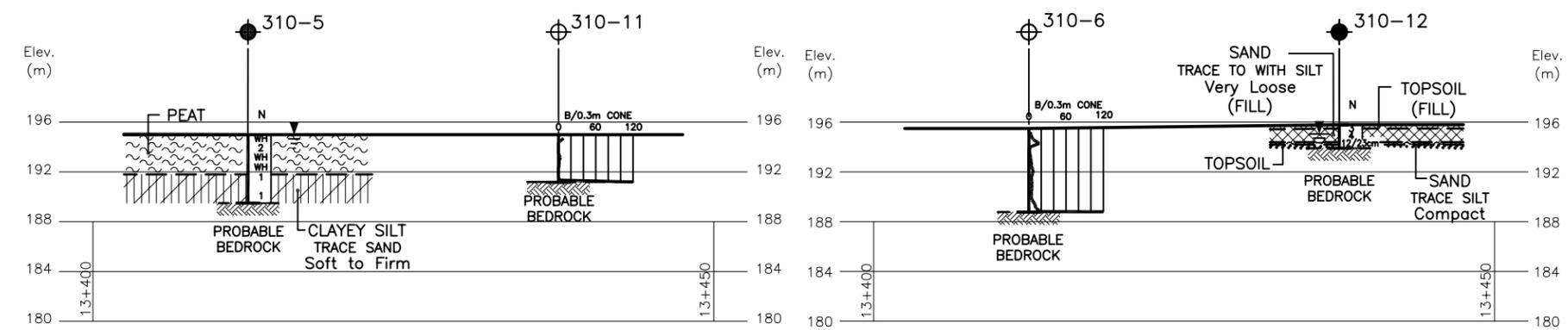
REF No. 471_Preferred_Plan_PDR_FINAL1.dwg;
highway 69 basemapping\sept14_2007\
H6454xb02 contours zone 12.dwg;

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

CONT No
GWP No 5203-06-00
HIGHWAY 69
HIGHWAY 69 FOUR-LANING
SWAMP 310, STA. 13+150 TO 13+450 MOWAT TWP
SOIL STRATA
SHEET

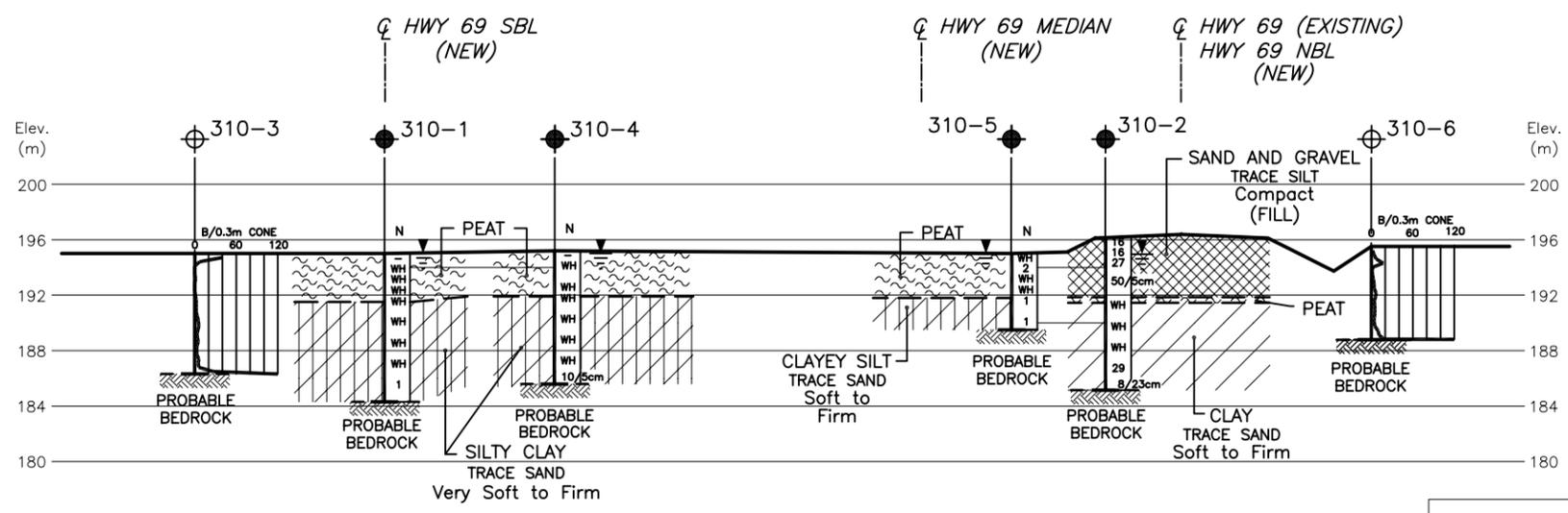


PROFILE B-B (Continued)



PROFILE C-C

PROFILE D-D



SECTION E-E

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
- WR Penetration due to weight of rods only
- PM Thinwall Sample - Advanced Manually
- W L at time of investigation Oct 2006, Mar 2007 and Feb 2009
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

BH No	ELEVATION	STA MOWAT TWP	o/s CL MED
SEE DRAWING 310-1 FOR DETAILS			

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



NOTES:
1. REFER TO DRAWING 310-1 FOR BOREHOLE LOCATIONS PLAN AND DRAWING 310-2 FOR PROFILES A-A AND B-B.
2. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.



REF No. 471_Preferred_Plan_PDR_FINAL1.dwg;
highway 69 basemapping\sept14_2007\
H6454xb02 contours zone 12.dwg;

REVISIONS

DATE	BY	DESCRIPTION

Geocres No. 41H-75

HWY No 69	DIST 54
SUBM'D NSB/CHECKED GD	DATE DEC. 02, 2009 SITE ---
DRAWN NA	CHECKED CN APPROVED BRG DWG 310-3



TABLE 1
SUMMARY OF SUBSOIL CONDITIONS AND RECOMMENDED TREATMENT

PML SWAMP No.	LOCATION	ADDITIONAL FILL HEIGHT, m	DEPTH TO COMPETENT SOIL, m	SOIL BELOW EXCAVATION BASE	DEPTH TO PROBABLE BEDROCK, m	EXCAVATION PROCEDURE	RECOMMENDED TREATMENT
HIGHWAY 69 MAINLINE							
310	Sta. 13+400 to 13+450 (NBL)	~0.0 (NBL)	3.2 – 15.0	Very loose to compact silt / sand extending to bedrock	1.9 – 19.5 (El. 175.2 – 193.9)	Not required	NBL – Pavement rehabilitation
	Sta. 13+150 to 13+190 (SBL) Sta. 13+425 to 13+450 (SBL)	1.5 – 3.5 (SBL)				Earth excavation	SBL – Full excavation of compressible soils
	Sta. 13+190 to 13+425 (SBL) Township of Mowat						SBL – Partial excavation to elevation 187 and preloading / surcharging

- NOTES:
1. Embankment fill height is based on profile prepared by MRC in April 2009 and received by PML on June 18, 2009.
 2. Depths to competent soil and probable bedrock are based on both borehole and dynamic cone penetration test data.
 3. Swamp excavation is expected where substantial thickness of peat and organic clay occurs. All peat and organic soils are to be removed from the swamp crossings.
 4. Recommendation of pavement rehabilitation assumes no centreline shift as well as adequacy of platform width.
 5. Recommended surcharge period and estimated settlement due to surcharging are given in Table 3.



TABLE 3
SETTLEMENT OF EMBANKMENT SURFACE

SWAMP No.	RECOMMENDED TREATMENT OPTION	FILL HEIGHT (m)	TOTAL ROCKFILL SETTLEMENT (mm)	RECOMMENDED SURCHARGE PERIOD (months)	SETTLEMENT DUE TO SURCHARGE (mm)	REMAINING LONG-TERM SETTLEMENT (mm)
HIGHWAY 69 MAINLINE						
310				N/A		
Sta. 13+400 to 13+450 (NBL)	NBL – Pavement rehabilitation	-0.0	N/A			
Sta. 13+150 to 13+190 (SBL) Sta. 13+425 to 13+450 (SBL)	SBL – Full excavation of compressible soils	1.5 – 3.5	70 – 165	12	100	65
Sta. 13+190 to 13+425 (SBL) Township of Mowat	SBL – Partial excavation to elevation 187 and preloading / surcharging		510 (see Note 3)	24 / 36	470 / 490	40 / 20

- Notes:
- Crossing 304 is located in rock cuts area.
 - Includes rockfill settlement above and below grade / water table.
 - Includes consolidation settlement of clayey subgrade soil left in place.
 - Refer to Section 2.3.3 of the report for estimated rate of settlement.
 - Recommended surcharge period is estimated to induce some 60% reduction in post-construction settlements.
 - Settlement due to surcharging is based on a surcharge height of 2 m except at crossings 305 (NBL) and 306 (NBL).
 - Surcharge period of 12 months is required for all embankment widening sections.



TABLE 4

SUMMARY OF DEPTH TO COMPETENT SOIL

SWAMP No.	TEST HOLE No.	LOCATION OF EXCAVATION TO COMPETENT SOIL	COMPETENT SOIL AT	
			DEPTH (m)	ELEVATION
310	310-1	Sta. 13+400, o/s 38.8m Lt. CL median	10.7 (8.0)	184.3 (187.0)
	310-2 (*)	Sta. 13+400, o/s 13.3m Rt. CL median	11.0	185.1
	310-3	Sta. 13+412.5, o/s 52.5m Lt. CL median	8.7 (8.0)	186.3 (187.0)
	310-4	Sta. 13+412.5, o/s 26.5m Lt. CL median	9.6 (8.0)	185.4 (187.0)
	310-7	Sta. 13+425, o/s 38.8m Lt. CL median	5.8	189.2
	310-8 (*)	Sta. 13+425, o/s 24.5m Rt. CL median	2.9	193.4
	310-12	Sta. 13+437.5, o/s 32.5m Rt. CL median	1.6	194.2
	310-14 (*)	Sta. 13+450, o/s 12.9m Rt. CL median	4.1	192.3
	310-18	Sta. 13+200, o/s 38.8m Lt. CL median	10.2 (7.3)	184.1 (187.0)
	310-19	Sta. 13+219, o/s 24.0m Lt. CL median	7.9 (7.4)	186.5 (187.0)
	310-20	Sta. 13+250, o/s 38.8m Lt. CL median	11.9 (7.4)	182.5 (187.0)
	310-21	Sta. 13+275, o/s 54.0m Lt. CL median	14.6 (7.7)	180.1 (187.0)
	310-22	Sta. 13+275, o/s 25.0m Lt. CL median	8.9 (7.4)	185.5 (187.0)
	310-23	Sta. 13+300, o/s 38.8m Lt. CL median	15.0 (7.4)	179.4 (187.0)
	310-24	Sta. 13+325, o/s 54.0m Lt. CL median	15.0 (7.4)	179.4 (187.0)
	310-25	Sta. 13+325, o/s 25.0m Lt. CL median	13.4 (7.4)	181.0 (187.0)
	310-26	Sta. 13+350, o/s 38.8m Lt. CL median	14.0 (7.3)	180.3 (187.0)
310-27	Sta. 13+375, o/s 53.5m Lt. CL median	9.0	185.3	



TABLE 4
SUMMARY OF DEPTH TO COMPETENT SOIL

SWAMP No.	TEST HOLE No.	LOCATION OF EXCAVATION TO COMPETENT SOIL	COMPETENT SOIL AT	
			DEPTH (m)	ELEVATION
310	GL3A-19	(See Drawing 310-1 for location)	>13.0 (8.5)	<182.6 (187.0)
	DCPGL3A-7	(See Drawing 310-1 for location)	>7.9 (8.5)	<187.6 (187.0)
	DCPGL3A-8	(See Drawing 310-1 for location)	7.0	188.5
	DCPGL3A-9	(See Drawing 310-1 for location)	9.4 (8.5)	186.1 (187.0)
	DCPGL3A-10	(See Drawing 310-1 for location)	>6.7 (8.5)	<188.8 (187.0)

- NOTES:
1. Competent soil is either bedrock or probable bedrock for all other test hole locations.
 2. Swamp excavation is to primarily remove peat/topsoil and cohesive (clayey) soils.
 3. Allowance for additional 100 to 300 mm penetration of rockfill below the levels indicated should be made depending on the relative density of underlying soils.
 4. (*) Under existing Hwy 69/New NBL pavement, cohesive soils need not be excavated for road grade raises less than 0.5 m.
 5. Depths/elevations in brackets correspond to base of excavation for recommended treatment.



TABLE 5
ADVANTAGES, DISADVANTAGES AND RELATIVE COSTS OF SWAMP TREATMENT ALTERNATIVES

PML SWAMP No.	TREATMENT TYPE	ADVANTAGES	DISADVANTAGES	RELATIVE COSTS	RISKS/ CONSEQUENCES	RANK
310 (SBL)	Full excavation (3.2 to 15.0 m)	<ul style="list-style-type: none"> Minimises issues of stability and long-term settlement by removing all soft and compressible soils Facilitates future highway maintenance 	<ul style="list-style-type: none"> Increased disposal of excavated soil Increased rockfill quantities 	<ul style="list-style-type: none"> Increased costs for swamp excavation Increased costs for soil disposal Increased rockfill costs 	<ul style="list-style-type: none"> Lesser risk than other options due to higher safety factor for stability Controlled long-term settlements 	<p align="center">2</p> <p align="center">3</p> <p align="center">(Sta. 13+190 to 13+425)</p>
	Partial excavation to elevation 187 and preloading/ surcharging	<ul style="list-style-type: none"> Reduced disposal of excavated soil Reduced rockfill quantities Surcharging reduces post-construction settlements 	<ul style="list-style-type: none"> Increased long-term settlements in relation to full excavation option Potentially requires more frequent highway maintenance to correct settlements 	<ul style="list-style-type: none"> Cost savings in swamp excavation, rockfill quantities and disposal of excavated soil are offset by future maintenance costs 	<ul style="list-style-type: none"> Adequate safety factor for stability Settlements of embankment rockfill and foundation soil Settlements due to secondary consolidation will occur 	<p align="center">1</p> <p align="center">(Sta. 13+190 to 13+425)</p>
	Wick drains	<ul style="list-style-type: none"> Reduced disposal of excavated soil Reduced rockfill quantities Increased rate of consolidation settlements in relation to preloading / surcharging option 	<ul style="list-style-type: none"> Potentially requires more frequent highway maintenance to correct settlements Requires monitoring of settlements during construction and may induce construction schedule delays 	<ul style="list-style-type: none"> Cost savings in rockfill quantities and disposal of excavated soil are offset by material, installation and future maintenance costs for depths less than 8 m No significant estimated cost savings for the use of wick drain in this section 	<ul style="list-style-type: none"> Settlements of embankment rockfill and foundation soils Settlements due to secondary consolidation will occur 	<p align="center">3</p> <p align="center">2</p> <p align="center">(Sta. 13+190 to 13+425)</p>

- Notes:
- Crossing 304 is located in rock cuts area where swamp excavation is not required.
 - Swamp sections where road rehabilitation is planned were not discussed since no excavation/treatment is required. These include the NBL sections in swamps 307 to 310.
 - The following Alternative Swamp Treatment options were considered not applicable to most swamps and were excluded from the discussion in this Table:
 - Partial excavation and preloading / surcharging (recommended only for the SBL section in swamp 310)
 - Construction of a bridge to span the swamp/compressible soil (too costly)
 - Lengthening the construction schedule (not practical/acceptable)
 - Use of lightweight fill (too costly for current project)



TABLE 6
TEMPORARY BACKSLOPE INCLINATION FOR SWAMP EXCAVATION

SWAMP NO.	TEMPORARY BACKSLOPE FOR SWAMP EXCAVATION (H:V)
310	Sta. 13+190 to 13+425 (SBL) – 2:1
	Other locations – 1:1

NOTE:

1. Recommended sideslopes for new embankment construction are 1.25H:1V for rockfill and 2H:1V for earth fill.