DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-185

DIST. 6 REGION

W.P. No. 54-82-05

CONT. No. 86-67

W. O. No.

STR. SITE No. 24-181

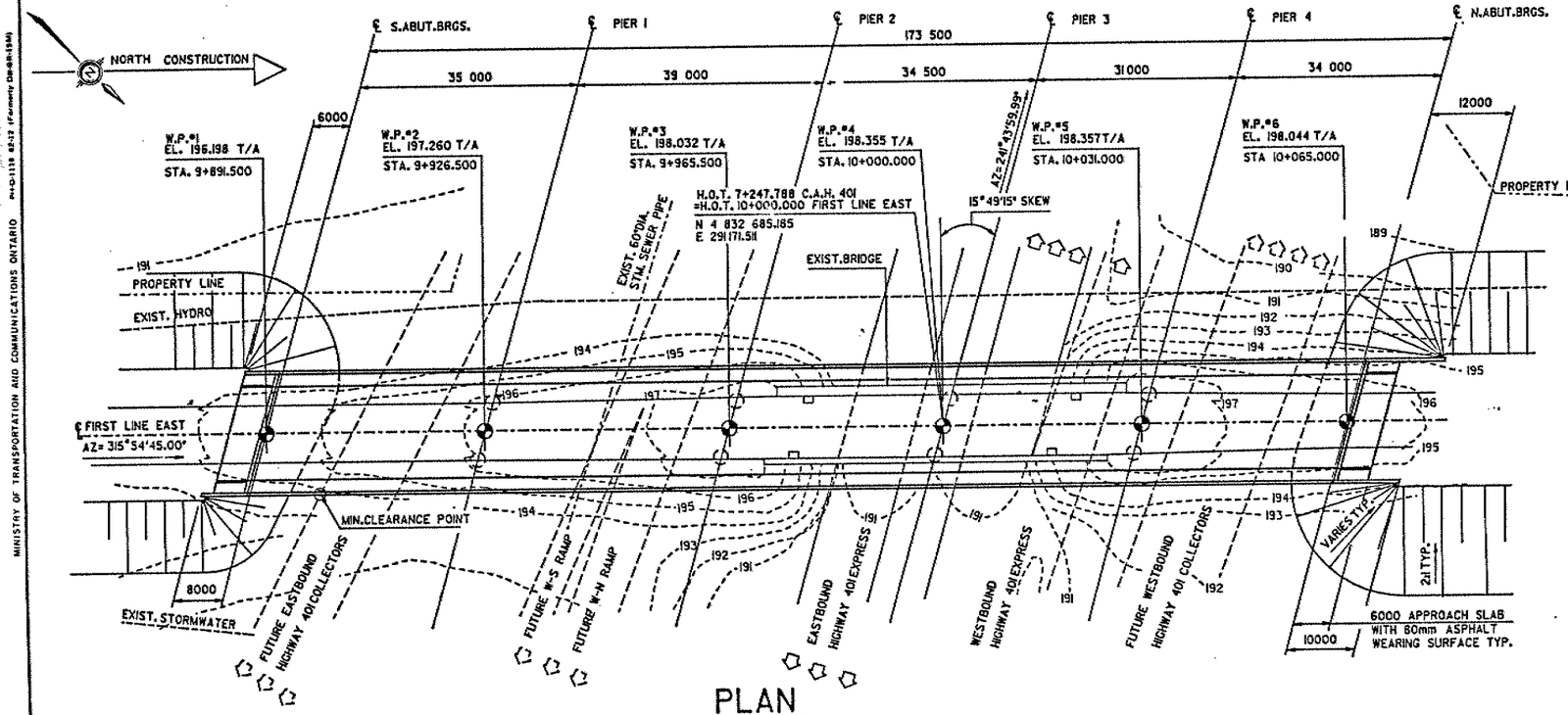
HWY. No. 401 / First Line East

LOCATION Hwy 401 / First Line East

No of PAGES - 1

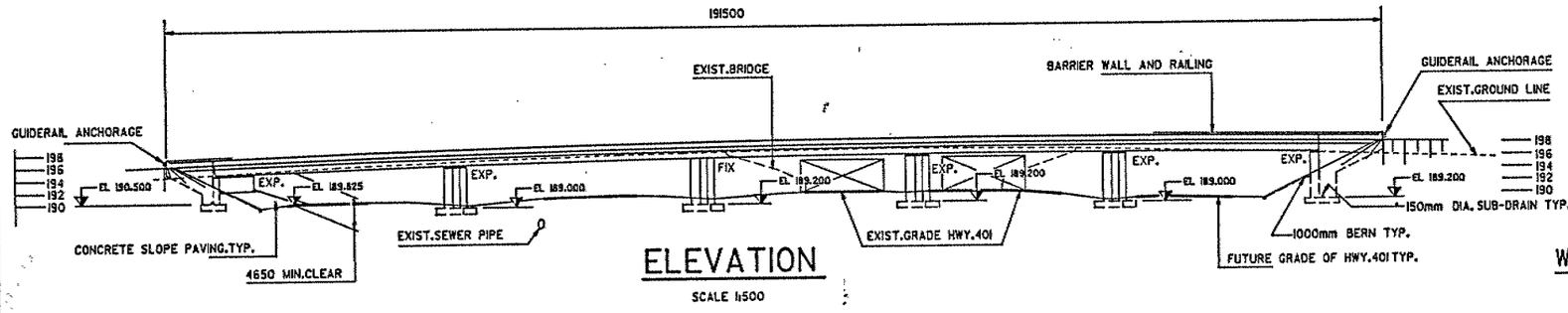
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



PLAN

SCALE 1:500



ELEVATION

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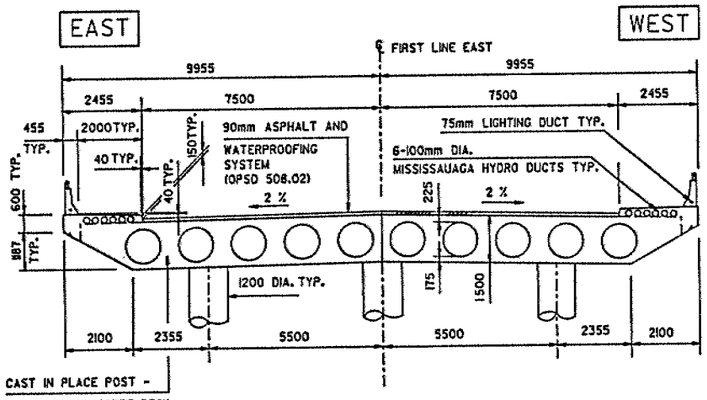

TYP. DECK SECTION

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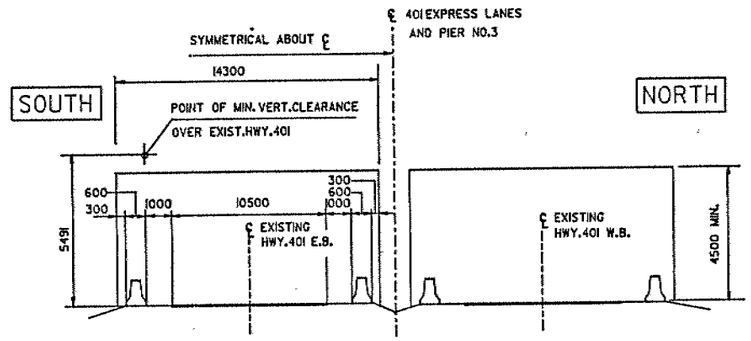
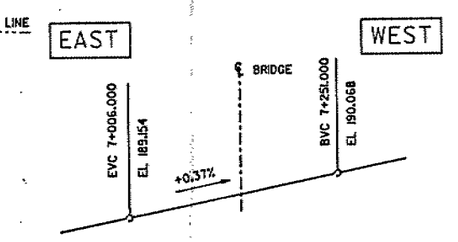


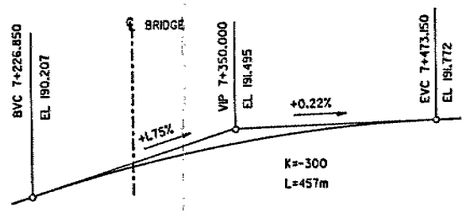
CONSTRUCTION CLEARANCE DIAGRAM

N.T.S.



PROFILE - EASTBOUND COLLECTORS

N.T.S.



PROFILE - WESTBOUND COLLECTORS

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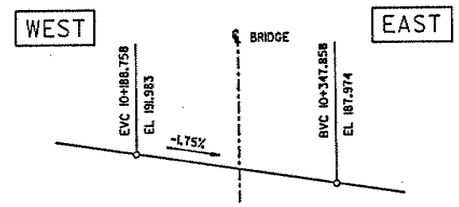
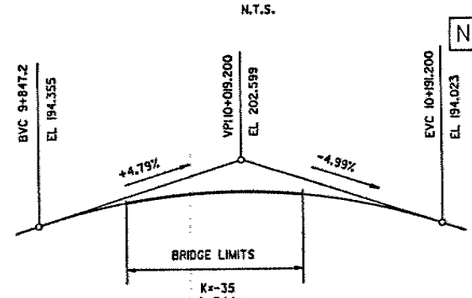


PROFILE
WEST TO NORTH / WEST TO SOUTH RAMP

N.T.S.



PROFILE FIRST LINE EAST

N.T.S.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST 6 HWY 401
CONT No
WP No 54-82-05

HWY 401 UNDERPASS AT FIRST LINE EAST GENERAL ARRANGEMENT

SHEET

COLE, SHERMAN

NOTES

CLASS OF CONCRETE

- FOOTINGS	20 MPa
- PIERS	35 MPa
- ABUTMENTS AND WINGWALLS	30 MPa
- DECK	35 MPa
- BARRIER WALLS	30 MPa
- AND AS NOTED	

CLEAR COVER TO REINFORCING STEEL

- FOOTINGS	100 ± 25
- ABUTMENTS, WINGWALLS	
- FRONT FACE	80 ± 20
- BACK FACE	70 ± 20
- PIERS	80 ± 20
- DECK	
- TOP	70 ± 20
- BOTTOM AND SIDES	50 ± 20
- REMAINDER	
- UNLESS OTHERWISE SPECIFIED	70 ± 20

REINFORCING STEEL

- REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED
- BAR MARKS WITH SUFFIX 'C' DENOTE COATED BARS

CONSTRUCTION NOTES

- THE CONTRACTOR SHALL FINISH THE BEARING SEATS LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm
- W.P. DENOTES WORKING POINT
- T/A DENOTES TOP OF ASPHALT

LIST OF DRAWINGS

REGISTERED PROFESSIONAL ENGINEER G. L. REID PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER CIVIL C. S. LEPPER PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN CSL	CHECK G.L.R.	LOADING CHBDC-A-83	DATE NOV. 85
DRAWING JB	CHECK P.R.	SITE No 24-01-181	DWG 1

METRIC

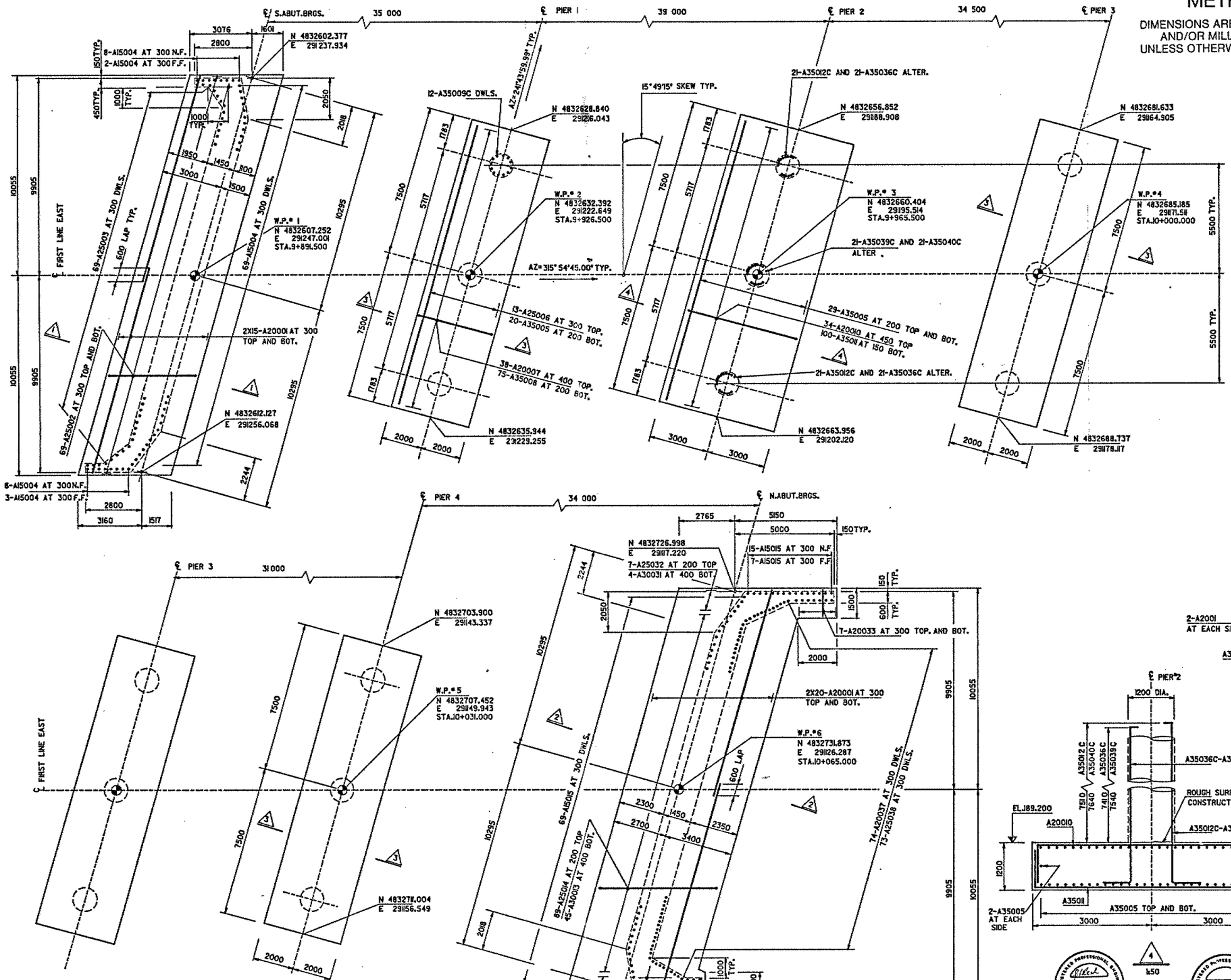
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

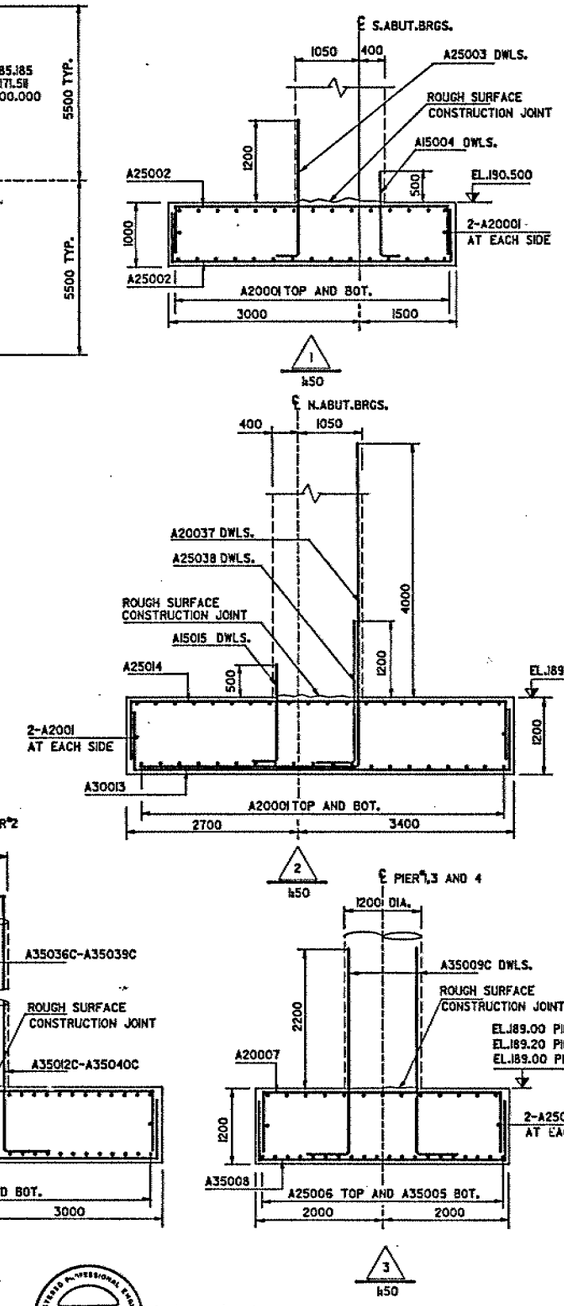
DIST 6 HWY 401
CONT No
WP No 54-82-05

HWY 401 UNDERPASS AT FIRST LINE EAST
FOOTING LAYOUT & DETAILS

SHEET

COLE, SHERMAN





FOOTING LAYOUT

1100

DIMENSIONS & REINF. FOR PIER #1,3 AND 4 - TYPICAL

G. L. REID — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

C. B. LEPPER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN SCL	CHECK GLR	LOADING OHBDC-A-83	DATE NOV.85
DRAWING JB	CHECK PR	SITE No 24-81-181	DWG 3

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 54-82-05 DIST 6

HWY 401 STR SITE 24-81-181

Addendum for Hwy. 401 Underpass
at First Line East

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GEOCRES 30M12-185 DATE

Foundation Investigation Report Addendum
For
W.P. 54-82-05, Site 24-81-181
Hwy. 401 Underpass at First Line East
Hwy.401, District 6, Toronto

INTRODUCTION

This addendum summarizes the results of additional foundation investigations required at this site as a result of a revision in the horizontal alignment of First Line East Road. It is intended to supplement the Foundation Investigation Report prepared for this project by Dominion Soil Investigation Inc.

The fieldwork for the addendum was conducted between 85 03 13 and 85 03 15 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow-stem augers, N casing and a B core barrel.

This work consisted of 5 sampled boreholes.

SUBSURFACE CONDITIONS

The Record of Borehole Sheets (Appendix B.H. #101 to B.H. #105) illustrate the conditions at the borehole locations. The locations and elevations of the boreholes and stratigraphical profiles based on the borehole data have been added to Drawing No. 548205-A&B

At the locations of the boreholes completed for this addendum, up to 2.9 m of silty clay till overlies the shale bedrock. Refer to the original Foundation Investigation Report for a typical description of the silty clay till. For a description of the rock core samples from the addendum boreholes, refer to Table 1-Addendum (Appendix).

DISCUSSION AND RECOMMENDATIONS

It is our understanding that the existing bridge which carries First Line East (Kennedy Road) over Hwy. 401 will be replaced by a 5 span structure located near the centreline of the existing structure, and some 20 m west of the alignment originally proposed.

STRUCTURE FOUNDATIONS

The recommendations in the original Foundation Investigation and Design Report are, in general, applicable to this Addendum.

However, for clarification the following foundation recommendations are applicable.

1) The following design values are recommended for spread footings founded at the elevations indicated in Table 2-Addendum.

   (O.H.B.D.C. Method)

   - Factored Bearing Capacity at U.L.S. = 850 kPa
   - Bearing Capacity at S.L.S. Type II = 500 kPa

   It is noted that these design values are unchanged from those provided in the original Foundation Investigation and Design Report.

TABLE 2 - ADDENDUM

Footing	Location	Highest Footing Elevation	
		left	right
South Abutment	Sta. 9 + 891.5	189.5	189.5
Pier 1	Sta. 9 + 926.5	189.0	190.0
Pier 2	Sta. 9 + 965.5	188.0	190.0
Pier 3	Sta. 10 + 000.0	188.0	189.0
Pier 4	Sta. 10 + 031.0	189.0	189.5
North Abutment	Sta. 10 + 065.0	188.0	189.5

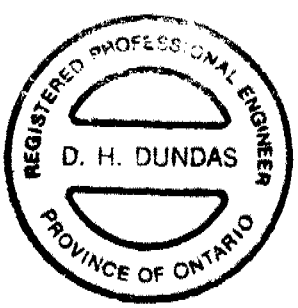
Where required the footings may be stepped or the excavation may be built-up to the designed underside of the footing with mass concrete.

2) It is recommended that the bases of all footing excavations should be protected by a minimum of 150 mm of mass concrete within 6 hours of exposure. This can be accomplished by cleaning up the excavation immediately before pouring the mass concrete.

The fieldwork for this addendum was carried out under the supervision of Mr. H. Sturm, Project Foundations Engineer.

The addendum was written by Mr. D. Dundas, Foundations Engineer, and reviewed by Mr. M. Devata, Chief Foundations Engineer (East).

The drilling equipment was owned and operated by Atcost Soil Drilling Inc.



D. H. Dundas

D. H. Dundas, P. Eng.
Foundations Engineer

M. Devata

M. Devata, P. Eng.
Chief Foundations Engineer
(East)

APPENDIX

TABLE 1 ADDENDUM

DESCRIPTION OF ROCK CORE - W.P. 54-82-05

BOREHOLE NUMBER	DEPTH (m)	% CR*	% RQD*	CORE DESCRIPTION	
				DEPTH (m)	DESCRIPTION
101	3.58 - 3.78	50	0	3.58 - 4.34	Shale (70%), red, highly weathered, high core loss with limestone (30%), green, moderately weathered
	3.78 - 4.90	82	14	4.34 - 4.90	Shale (95%), red, slightly weathered, closely spaced joints, with siltstone (5%), green, unweathered
102	3.43 - 3.68	80	0	3.43 - 3.68	Shale, highly weathered
	3.68 - 4.98	100	24	3.68 - 4.22	Shale (80%), red, moderately weathered, closely spaced joints, with limestone (20%), green to light grey
				4.22 - 4.98	Shale (100%), red, unweathered, medium spaced joints
103	3.58 - 5.18	90	41	3.58 - 5.54	Shale (60%), red, slightly weathered becoming unweathered, closely spaced joints, with limestone (40%), green and light grey, unweathered, closely spaced joints
	5.18 - 5.54	100	0		
104	2.08 - 2.59	100	0	2.08 - 2.59	Shale (95%), red, highly weathered to clayey with limestone (5%), slightly weathered
	2.59 - 3.89	75	0	2.59 - 3.81	Shale (100%), red, moderately weathered, very closely spaced joints
	3.89 - 4.67	90	32	3.81 - 4.67	Limestone (80%), light grey to green, unweathered, closely spaced joints with shale (20%), slightly weathered
105	1.80 - 2.84	100	15	1.80 - 2.79	Shale (100%), red, highly to moderately weathered, very closely spaced joints
	2.84 - 3.84	77	31	2.79 - 3.84	Limestone (80%), light green, unweathered, closely spaced joints with shale (20%), red, unweathered

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

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 (RQD), 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

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
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 101 METRIC

W P 54-82-05 LOCATION Co-Ords N 4832 601.8; E 291 235.2 ORIGINATED BY IW
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger; B Core COMPILED BY HS
DATUM Geodetic DATE 85 03 13 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
192.0 0.0	Ground Surface										
	Silty Clay (Till) trace sand trace gravel very stiff to hard		1	SS	21		191				
			2	SS	70	▼	190				
189.1 2.9			3	SS	114						
	Bedrock Shale		4	SS	129		189				
			5	RC	Rec =50%						
	weathered sound		6	RC	Rec =82%		188				
187.1 4.9	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 102 METRIC

W P 54-82-05 LOCATION Co-Ords: N 4 832 619.0; E 291 213.6 ORIGINATED BY IW
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem, B Core COMPILED BY HS
DATUM Geodetic DATE 85 03 14 CHECKED BY DD

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) / PLASTIC LIMIT Wp – NATURAL MOISTURE CONTENT W – LIQUID LIMIT Wl / WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
192.0	Ground Surface									
0.0	Silty Clay (Till) trace Sand trace Gravel very stiff to hard		1	SS	22	▼	191			
			2	SS	43		190			
			3	SS	126					
189.1							189			
2.9	Bedrock Shale		4	SS	120	0.20m				
			5	RC	Rec =80%					
	weathered		6	RC	Rec =100%		188			
	sound									
187.0										
5.0	End of Borehole									

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 103

METRIC

W P 54-82-05 LOCATION Co-Ords: N 4 832 662.3; E 291 171.4 ORIGINATED BY IW
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger, B Core COMPILED BY HS
DATUM Geodetic DATE 85 03 14 CHECKED BY DD

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.7	Ground Surface										
0.0	Silty Clay (Till) trace Sand trace Gravel										
	Very Stiff to Hard		1	SS	15		190				
			2	SS	18		189				
			3	SS	95		188				
187.8											
2.9	Bedrock Shale		4	SS	77						
	weathered						187				
	sound Occasional limestone seams		5	RC BXL	Rec 90%						RQD 41%
							186				
185.2			6	RC BXL	Rec 100%						RQD 0%
5.5	End of Borehole										

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 104 METRIC

W P 54-82-05 LOCATION Co-Ords: N 4 832 697.3; E 291 127.8 ORIGINATED BY IW
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger, B Core COMPILED BY HS
DATUM Geodetic DATE 85 03 15 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
190.6	Ground Surface										
0.0	Silty Clay (Till) trace Sand trace Gravel					▼	190				
	very stiff		1	SS	17						
189.2											
1.4	Bedrock Shale		2	SS	65		189				
	Occasional limestone seams		3	RC BXL	Rec 100%						RQD 0%
			4	RC BXL	Rec 75%		188				RQD 0%
	weathered sound						187				
	Limestone occasional shale seams		5	RC BXL	Rec 90%						RQD 32%
185.9							186				
4.7	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 105 METRIC

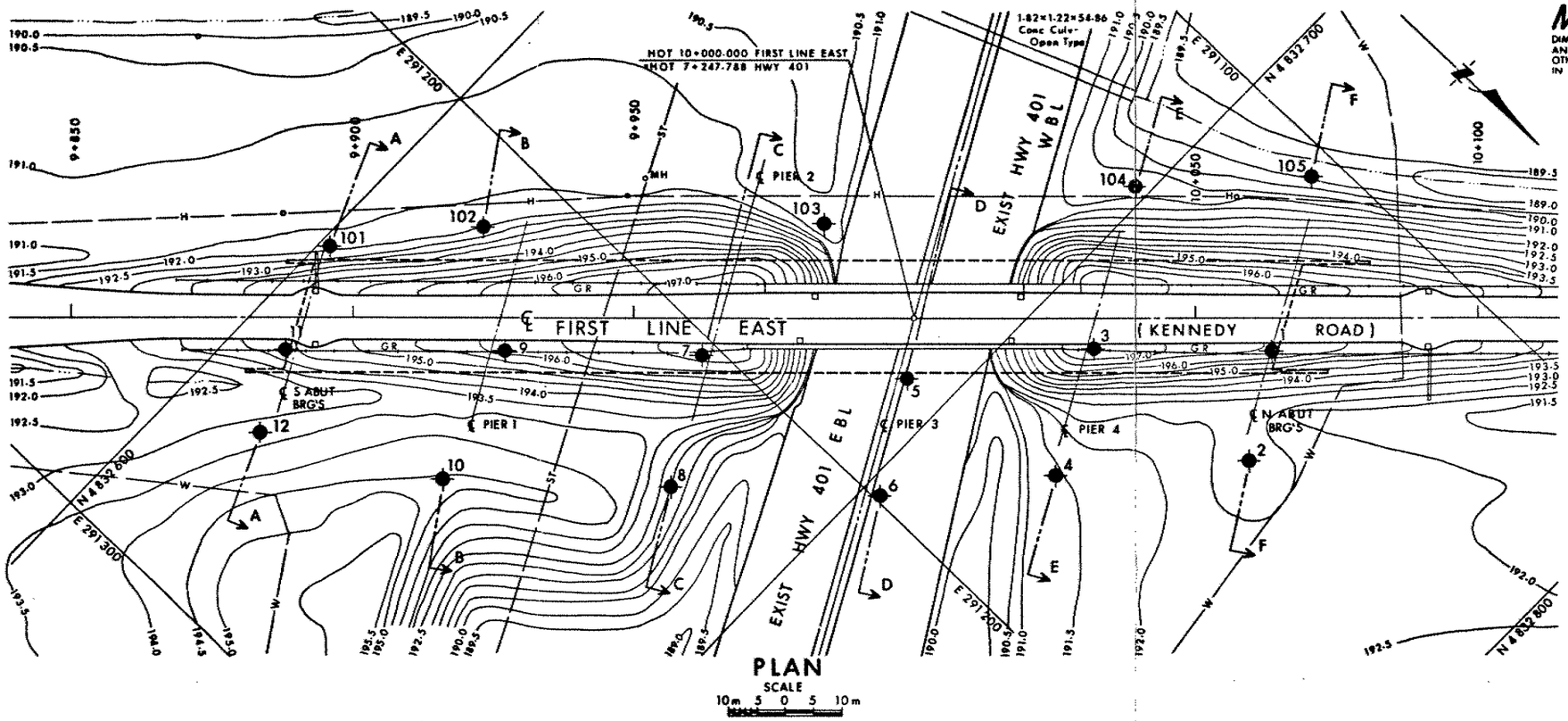
W P 54-82-05 LOCATION Co-Ords: N 4 832 718.4; E 291 104.9 ORIGINATED BY IW
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger, B Core COMPILED BY HS
DATUM Geodetic DATE 85 03 15 CHECKED BY DD

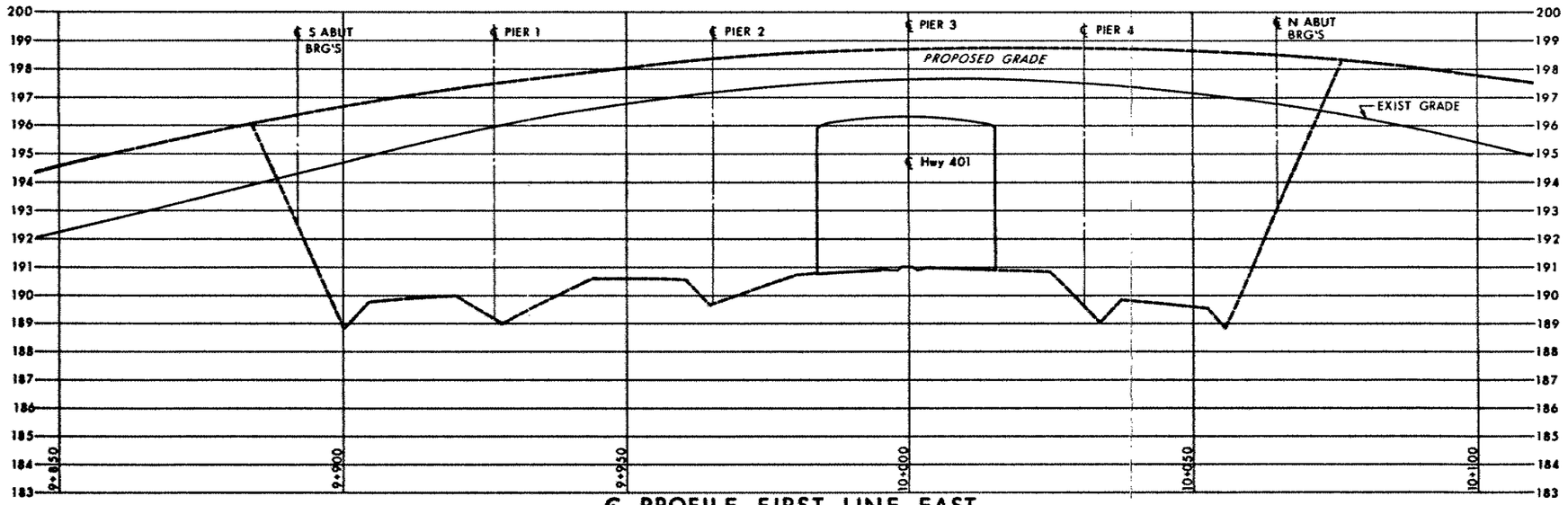
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.5	Ground Surface										
0.0	Silty Clay (Till) trace Sand trace Gravel hard		1	SS	66		189				
188.1											
1.4	Bedrock		2	SS	100	0.10m	188				
			3	RC BXL	Rec 100%		187				RQD 15%
	shale weathered										
	Limestone sound		4	RC BXL	Rec 77%		186				RQD 31%
185.6											
3.9	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



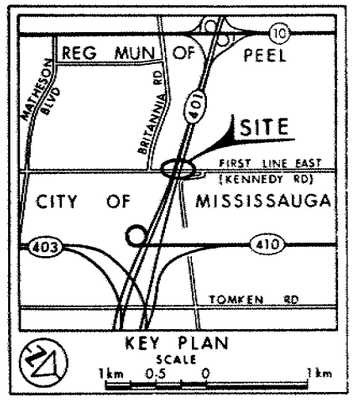


METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No
WP No 54-82-05

HWY 401 UNDERPASS AT FIRST LINE EAST (KENNEDY RD)
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 1983 09 and 1985 03

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	196.6	4 832 735	291 132
2	192.6	4 832 746	291 149
3	197.6	4 832 712	291 154
4	191.5	4 832 723	291 175
5	190.9	4 832 692	291 181
6	190.7	4 832 703	291 199
7	197.5	4 832 663	291 203
8	192.0	4 832 675	291 224
9	196.3	4 832 637	291 227
10	194.7	4 832 645	291 251
11	194.5	4 832 609	291 254
12	193.3	4 832 616	291 268
101	192.0	4 832 601.8	291 235.2
102	192.0	4 832 619.0	291 213.6
103	190.7	4 832 662.3	291 171.4
104	190.6	4 832 697.3	291 127.8
105	189.5	4 832 718.4	291 104.9

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

NOTE:
For Sections and Subsoil Stratigraphy Refer to Dwg No 548205-B

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION

Geocres No 30M12-185

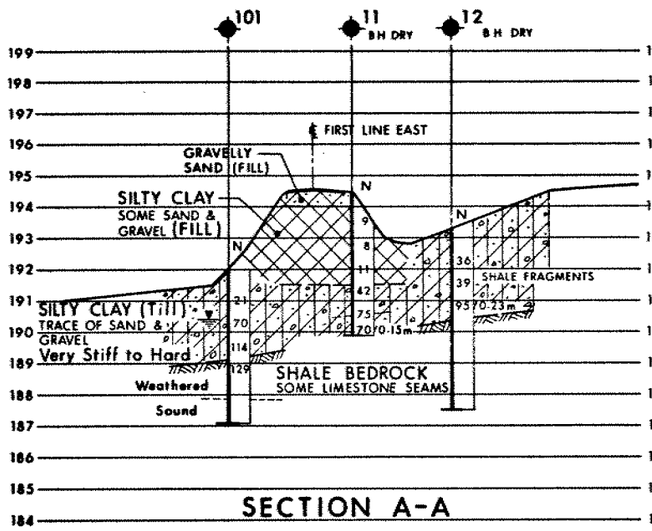
HWY No 401			DIST 6
SUBMD DD	CHECKED	DATE 1985 11 19	SITE 24-181
DRAWN	CHECKED	APPROVED	DWG 548205-A

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

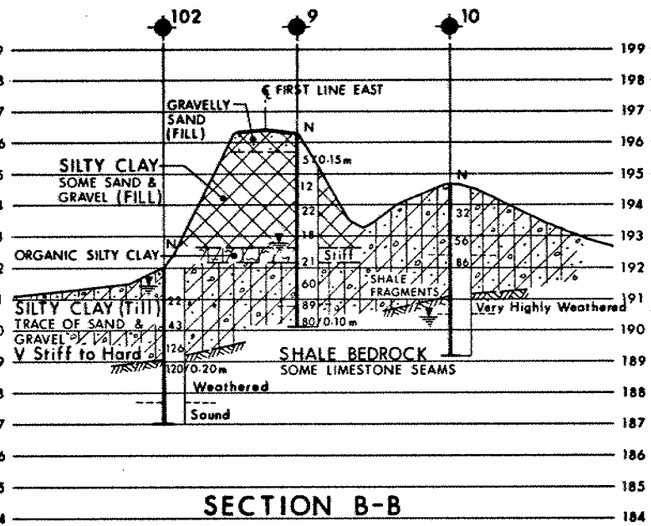
CONT No
WP No 54-82-05

HWY 401 UNDERPASS AT FIRST LINE EAST (KENNEDY RD)
BORE HOLE LOCATIONS & SOIL STRATA

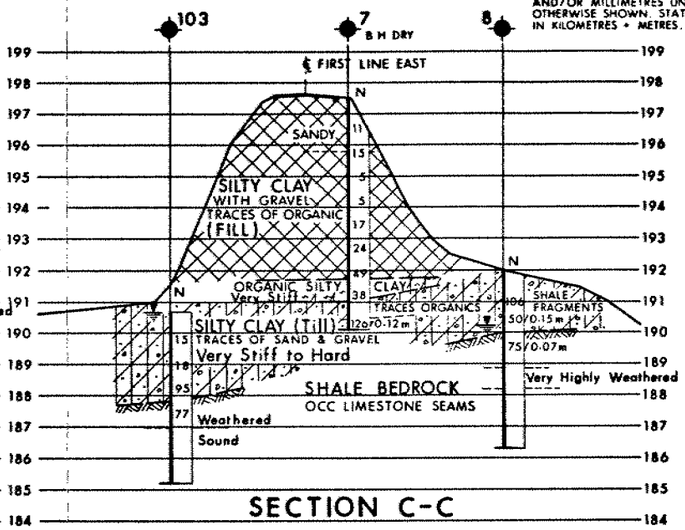
SHEET



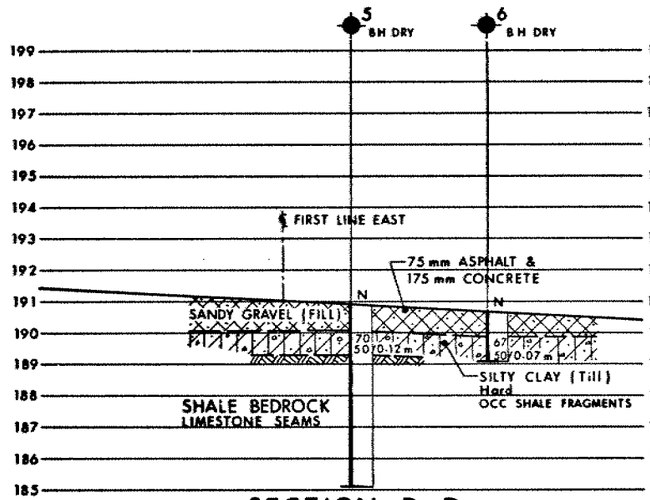
SECTION A-A



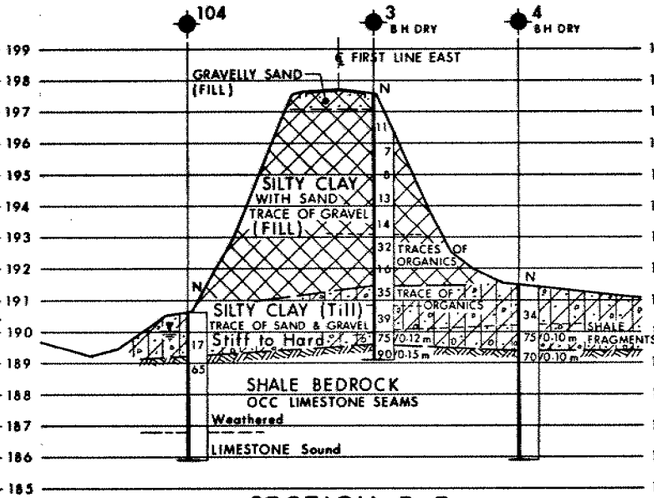
SECTION B-B



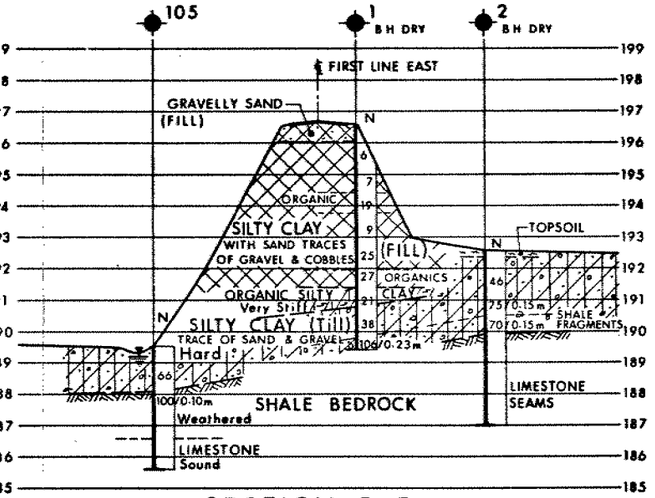
SECTION C-C



SECTION D-D



SECTION E-E



SECTION F-F

SCALE FOR SECTIONS
HOR 10m 5 0 10m
VERT 2m 1 0 2m

NOTE:
For Plan and Profile
Refer to Dwg No 548205-A

SEE DWG No 548205-A

KEY PLAN
SCALE

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 1983 09 and 1985 03

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	196.6		
2	192.6		
3	197.6		
4	191.5		
5	190.9		
6	190.7		
7	197.5		
8	192.0	SEE DWG No 548205-A	
9	196.3		
10	194.7		
11	194.5		
12	193.3		
101	192.0		
102	192.0		
103	190.7		
104	190.6		
105	189.5		

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION

Geocres No 30M12-185

HWY No 401			DIST 6
SUBM'D DD	CHECKED	DATE 1985 11 27	SITE 24-181
DRAWN	CHECKED	APPROVED	DWG 548205-B

DOMINION SOIL INVESTIGATION INC.
CONSULTING SOIL & FOUNDATION ENGINEERS
104 CROCKFORD BLVD., SCARBOROUGH, ONTARIO, CANADA, M1R 3C6 (416) 751-6565

FOUNDATION INVESTIGATION

PROPOSED BRIDGE REPLACEMENT

HIGHWAY 401, FIRST LINE EAST (KENNEDY ROAD)

MISSISSAUGA, ONTARIO

DISTRICT #6, CENTRAL REGION

W.P. 54-82-05 SITE NO. 24-181

Ref. No. 83-8-7
October 1983

Prepared For:
Ministry of Transportation and Communications
Pavement & Foundation Design Section
Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

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Ref. No. 83-8-7

CONTENTS

APPENDICES

ENCLOSURES

1.0 INTRODUCTION

Dominion Soil Investigation Inc., Consulting Geotechnical Engineers, were retained by the Ontario Ministry of Transportation and Communications to conduct a foundation investigation at the site of a proposed bridge replacement at Highway 401 and First Line East (Kennedy Road) intersection in Mississauga, Ontario. Authorization to carry out the work was received from Mr. M.S. Devata, Senior Foundations Engineer, Pavement and Foundation Design Section of the Ministry.

The purpose of the investigation was to determine the subsoil conditions at the site; to define the engineering properties of the substrata; to make recommendations pertaining to the design of the foundations of the proposed structure and to comment on the anticipated construction conditions.

The field work was carried out during the period of August 29 to September 7, 1983, and consisted of drilling twelve boreholes to depths ranging between 1.6 and 8.5 m. The location of the boreholes are shown on Drawing No. 548205-A and the subsurface conditions encountered are presented on the Record of Borehole Sheets.

.../...

2.0 SUMMARIZED SUBSOIL CONDITIONS

The boreholes that were drilled through the shoulder of the existing road encountered up to 6 m of fill. Below the fill and/or topsoil the subsoil generally consists of silty clay till changing to 'till-shale' complex and is underlain by a reddish highly weathered bedrock at relatively shallow depths.

Details of the subsurface conditions encountered in the boreholes are given on the individual Record of Boreholes, and inferred subsoil profiles are presented on Drawing No. 548205-A.

The relevant index and engineering properties of the principal strata are briefly discussed in the following paragraphs.

2.1 Fill

Boreholes 5 and 6 were drilled from the median of Highway 401 and encountered below an asphalt and concrete layer, granular fill extending to about 0.8 m below the ground surface.

Boreholes 1, 3, 7, 9 and 11 were drilled through the shoulder of the existing Kennedy Road embankment and encountered fill extending 3.0 (B.H. 11) to 6.1 m (B.H. 3) below the ground surface. The composition of the fill generally consists of silty clay with some sand and gravel and is similar in composition to the indigenous till. The grain size distribution of a sample from the fill is presented on Figure 1 indicating 5% gravel, 56% sand, 25% silt and 14% clay size particles.

.../...

The following index properties were measured in the laboratory:

Liquid Limit	25 - 35%
Plastic Limit	11 - 15%
Plasticity Index	14 - 20
Moisture Content	13 - 21%

These values are characteristics of clayey soils of low plasticity. Pockets or zones of organic material were also found included in the fill.

From 'N'-values ranging between 5 and 32 blows/0.3 m the fill is considered to be firm to hard and unevenly compacted.

2.2 Organic Silty Clay

Underlying the embankment fill in Boreholes 1, 7 and 9 a 0.4 to 0.7 m thick organic silty clay layer was encountered. Due to the organic content this material could be expected to be relatively weak and compressible but the recorded Standard Penetration Indices of 21 and 38 and the relatively low moisture contents of 22%, indicate that the material has already been considerably compressed under the weight of the embankment fill.

2.3 Silty Clay Till

The natural subsoil below the fill or a thin veneer of topsoil is a reddish brown silty clay till. The till is a well graded mixture of a wide range of particle sizes and as shown on Figure 2, it consists of 6 to 9% gravel, 35 to 38% sand, 38 to 40% silt and 13 to 21% clay size particles.

.../...

An Atterberg Test gave the following values:

Liquid Limit	25%
Plastic Limit	15%
Plasticity Index	10
Moisture Content	13 to 16%

These values indicate clayey soils of low plasticity and the fact that the natural moisture contents are generally at or below the Plastic Limit suggests high strength and low compressibility. From 'N'-values of 32 blows/0.3 m and greater, the till is considered to be hard.

At the borehole locations the till is generally 1 to 2.5 m thick and with increasing depth the frequency of shale content in the till increases. The material at greater depths resembles a highly weathered shale with pockets of till material. This zone can be best described as a 'till-shale complex' and is indicated on the borehole log sheets as zones with "frequent shale fragments". The grain size distribution of a sample from this material is given in Figure 3, indicating 12% gravel, 46% sand, 31% silt and 11% clay size particles. Laboratory tests showed a Liquid Limit of 28 - 34%, Plastic Limit of 15 - 19% with a corresponding plasticity index of 13 - 15 indicating a clayey soil of low plasticity. The measured moisture contents ranged from 8 - 14%.

From 'N'-values of 36 to generally more than 100 blows/0.3 m, the consistency of the 'till-shale complex' is described as hard. Some

.../...

of the boreholes were terminated within this material after penetrating it a short distance. At the boreholes where this zone was fully penetrated, it was 0.5 to 2 m thick and was underlain by the shale bedrock.

2.4 Shale Bedrock

The site is located close to the interface of reddish Queenston and greyish Dundas shale formations and the depth to the surface of the bedrock in the area is known to be generally shallow.

In the majority of the boreholes shale bedrock was encountered at a depth of 1.5 to 8.0 m below the ground surface between Elevations 191.1 and 189.2 m. In some of the boreholes, the rock was penetrated a short distance by augering and in six of the boreholes NXL size cores were recovered by diamond drilling. In these boreholes the rock was penetrated for a vertical distance of 1.9 to 4.0 m. The core recovery ranged from 86 to 100% and the examination of the recovered samples and cores indicates that the bedrock within the depths explored, is a weathered to highly weathered, closely bedded, reddish shale. The shale, identified as belonging to the Queenston Formation, contains some grey limestone and frequent greyish shale bands. R.Q.D. values ranging from 0 to 85% (generally less than 50%) indicate a rock of generally poor quality.

.../...

3.0 GROUNDWATER CONDITIONS

The groundwater conditions in the boreholes were observed during the drilling. After their completion, where feasible, the boreholes were left open and water levels in the open boreholes were re-checked approximately three weeks thereafter. The recorded values are presented on the individual Record of Borehole Sheets.

Based on these observations, it is our opinion that the groundwater level at the time of the investigation was generally between Elevations 191 and 190 m.

.../...

4.0 DISCUSSION

It is understood that the existing bridge which carries Kennedy Road over Highway 401 will be replaced by two, approximately 11 m wide and 175 m long structures. The new structures will be located to the immediate east of the existing bridge which will be demolished.

This investigation has revealed that in general, underlying some fill or a thin veneer of topsoil, the site is underlain by a hard silty clay till which attains a high shale content with increasing depth. The till-shale complex is underlain by the highly weathered reddish shale bedrock (Queenston shale) at relatively shallow depths. The surface of the bedrock at the borehole locations lies between Elevations 191.1 and 189.2 m. The groundwater level at the time of the investigation was generally between Elevations 190 and 191 m.

4.1 Pier Foundations

The undisturbed hard silty clay till is suitable to support normal spread footing foundations for the piers or possibly closed end abutments and wing walls.

The footings should be extended below the fill, topsoil or organic stratum and the surficially weathered upper zones of the till. The recommended foundation levels and corresponding bearing pressures at each borehole location are given in Table I.

.../...

TABLE I

B.H. No.	Existing Ground Elevation (m)	Highest Recommended Foundation Depth Below the Existing Ground Surface and Elevation (m)	Recommended Bearing Capacity Ultimate Limit States kPa	Recommended Bearing Capacity Serviceability Limit States Type II kPa
1	196.6	6.3 (190.3)	600	380
		6.8 (189.8)	850	500
2	192.6	1.2 (191.4)	600	380
		1.8 (190.8)	850	500
3	197.6	7.2 (190.4)	600	380
		7.8 (189.8)	850	500
4	191.5	1.3 (190.2)	600	380
		1.8 (189.7)	850	500
5	190.9	1.1 (189.8)	600	380
		1.5 (189.4)	850	500
6	190.7	1.1 (189.6)	600	380
		1.5 (189.2)	850	500
7	197.5	6.9 (190.6)	600	380
		7.3 (190.2)	850	500
8	192.0	1.1 (190.9)	600	380
		1.6 (190.4)	850	500
9	196.3	4.9 (191.4)	600	380
		5.5 (190.8)	850	500
10	194.7	1.7 (193.0)	600	380
		2.3 (192.4)	850	500
11	194.5	3.7 (190.8)	600	380
		4.2 (190.3)	850	500
12	193.3	1.8 (191.5)	600	380
		2.5 (190.8)	850	500

.../...

Provided that the subsoil is not unduly disturbed during the construction, the total and differential settlements corresponding to the Serviceability Limit State are expected to be less than 25 and 15 mm, respectively. Under inclined loading conditions, the bearing capacity at Ultimate Limit State should be reduced in accordance with Clause 6.7.3.3.5 of the Ontario Highway Bridge Design Code, 1979 (OHBDC). For the evaluation of the sliding resistance of the foundations, the ultimate angle of friction between the underside of the foundations and the hard silty clay till can be taken as 26 degrees.

The footings should have a permanent earth cover of 1.2 m for frost protection. The foundation excavations should be checked and approved by a geotechnical engineer to ensure that the footings rest on undisturbed subsoil or bedrock capable of sustaining the design pressure.

4.2 Perched Abutments

Perched abutments could be supported either on shallow spread footings established within the compacted approach fills or on pile foundations driven through the fill.

4.2.1 Spread Footings on Fill

In the case that the footings are placed on engineered fill, all topsoil, organic and other unsuitable materials should be removed to the surface of the inorganic hard silty clay till. The material used for embankment construction under the footings should be well graded,

.../...

clean granular earth fill (Granular 'A' quality) the width of which at the footing level, should be at least twice the width of the footing and should increase in width below this level at an angle of 1.5 horizontal in 1 vertical or flatter. The fill should be placed in shallow lifts not exceeding 150 mm in thickness and each lift should be uniformly compacted to at least 100% of its Standard Proctor maximum dry density. The horizontal distance measured from the edge of the footing to the face of the embankment slope should not be less than 1.5 times the width of the footing, and the footing should also have a minimum earth cover of 1.2 m.

For footings meeting the above requirements, the Factored Bearing Capacity at Ultimate Limit States (q_f) is 600 kPa. The Bearing Capacity at Serviceability Limit States Type II is 250 kPa. With this value, the maximum total settlement should be limited to 25 mm.

4.2.2 Pile Foundations

End bearing steel-H or tube piles could be used to support the perched abutments.

It is estimated that the piles will encounter refusal at or near the surface of the bedrock, i.e. at about 189.5 m. The piles should be reinforced at the tips by welding steel plates to the flanges, as per standard M.T.C. practice, or with hardened rock points to get a good seating on the bedrock and to avoid damage during driving through possible obstructions and the dense zones of the fill or the hard overburden.

.../...

The estimated pile capacities for some common sizes of steel piles driven to a final set of about 1 blow/1 mm penetration with a hammer capable to deliver an energy of 40 to 70 thousand Joules/blow are tabulated below:

ESTIMATED PILE CAPACITY (kN)

Pile Type	Size	Factored Capacity at Ultimate Limit States (Q_f)	Capacity at Serviceability Limit States Type II (Q_s)
Steel H	HP 310 x 110	1400	970
	HP 310 x 79	1000	690
	HP 250 x 62	750	530
	HP 200 x 54	680	445
Steel Pipe	323 x 9.5	900	650
	273 x 9.3	750	530

It is recommended that the driving of the piles in the field be controlled by a recognized pile driving formula such as the Hiley formula. Unbalanced horizontal forces should be resisted by battered piles and for frost protection, the underside of the pile caps should be established at least 1.2 m below finished grade. Because of their superior ability to penetrate through the hard overburden and highly weathered zones of the rock, relatively heavy section steel H-piles are believed to be better suited for this project.

.../...

4.3 Lateral Earth Pressures

Assuming that free-draining granular material and adequate drainage is provided behind the abutments and the wing walls (Figure 6.9.6.1 OHBDC), the lateral earth pressure can be calculated by assuming active earth pressure conditions and using the following equivalent fluid pressures:

- At Ultimate Limit State: 8 kPa/m
- At Serviceability Limit State Type II: 6.5 kPa/m

The rigid walls of the abutments, however, should be designed to withstand the at-rest earth pressures which can be evaluated using the following equivalent fluid pressures:

- At Ultimate Limit State: 10 kPa/m
- At Serviceability Limit States Type II: 8.5 kPa/m

When using the above values, it is assumed that the slope of the backfill behind the retaining structure is approximately level.

Care should be given to avoid the overcompaction of the backfill and the use of heavy compaction equipment behind the retaining walls and abutments. Compaction equipment, for use behind retaining structures, must be restricted in size as per current MTC specifications.

Water accumulation in the backfill behind the retaining structures should be prevented by the use of perforated pipes and weep holes.

.../...

4.4 Approach Fills

The design of the approach fills will not be limited by the strength of the foundation materials underlying the site and there are no stability problems foreseen. All the organic and unsuitable soils must, however, be removed before placing the fill. In the case that the approach fills are constructed from locally available clean earth fills, 2 horizontal in 1 vertical side slopes can be used. The slopes of the embankment should be adequately protected against surface erosion.

In the case of pile supported perched abutments, rockfill or fill containing large gravel or cobble size particles, should not be used in that part of the embankment through which piles are to be driven.

4.5 Construction

There are no soil related construction problems foreseen.

Excavations in the hard till will stand unsupported with nearly vertical faces to a depth of 1.2 m. Where deeper excavations are required, the face of the excavation should be flattened to 45 degrees to comply with the Safety Regulations of the Province. The existing roadway should be adequately protected during the construction by means of shoring, etc.

Water should not be allowed to accumulate in the excavations and surface water should be removed by pumping from temporary sumps. Any material that might be softened by water ponding in the excavation should be removed by hand before pouring the footings, or a skim coat of concrete should be placed.

.../...

5.0 STATEMENT OF LIMITATION

The Statement of Limitation, as quoted in Appendix 'B', is an integral part of this report.

DOMINION SOIL INVESTIGATION INC.

Z.S. Ozden, P.Eng.

ZSO:bh

APPENDICES

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

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
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$

e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

A P P E N D I X 'B'

STATEMENT OF LIMITATION

The conclusions and recommendations in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigations.

We recommend that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known, in our analysis certain assumptions had to be made. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis.

In cases where these recommendations are not followed, the company's responsibility is limited to report accurately the information encountered in the testholes.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

ENCLOSURES

Ministry of Transportation and Communications
Ontario

Ref. No. 83-8-7
Enclosure No. 1

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 1

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,735N; 291,132E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.09.01 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
196.6	Ground Level										
0.0 / 196.1	Gravelly sand (Road shoulder Fill)										
0.5	Reddish & brown Silty clay with some sand & traces of gravel & cobbles (Fill)		1	SS	6		196				
			2	SS	7		195				
	black & organic		3	SS	19		194				
			4	SS	9						
			5	SS	25		193				
	traces of organics		6	SS	27		192				
191.4											
5.2	Dark grey to black v. stiff Organic silty clay traces of decayed roots		7	SS	21		191				
190.8											
5.8	Light grey, hard Silty clay till with some sand lenses		8	SS	38		190				
	Reddish, frequent Shale fragments		9	SS	106/	0.23m					Borehole dry on completion.
189.4											
7.2	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications
Ontario

Ref. No. 83-8-7
Enclosure No. 2

RECORD OF BOREHOLE No 2

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,746N; 291,149E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER AND NXL ROCK CORE COMPILED BY F.L.
DATUM GEODETIC DATE 1983.08.29 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT W_p / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
192.6	Ground Level										
0.0	0.23 m Topsoil										
	Brown, hard Silty clay till		1	SS	46		192				
			2	SS	75/ 0.15 m	▽	191				
	Frequent shale fragments Reddish		3	SS	70/ 0.15m						
189.9							190				Augering ↕ Diamond Drilling
2.7	Reddish Shale, some greyish shale and limestone seams		4	RC NXL	100%		189				
			5	RC NXL	100%		188				Borehole dry on completion of augering. Wet cave @ 1.6 m Sept. 20/83.
187.0											
5.6	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications Ontario

Ref. No. 83-B-7
Enclosure 3

RECORD OF BOREHOLE No 3

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,712N; 291,154E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.J.
DATUM GEODETIC DATE 1983.09.01 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
197.6	Ground Level										
0.0	Gravelly sand										
197.1	(Road Shoulder Fill)										
0.5	Brown/reddish/grey Silty clay with some sand & traces of gravel (Fill)		1	SS	11		197				
			2	SS	7		196		○		
			3	SS	8		195				
			4	SS	13				○		
			5	SS	14		194		○—○—○		5 55 25 15
	traces of organics		6	SS	32		193		○		
191.5			7	SS	16		192		○		
6.1	Traces of organics some sand lenses		8	SS	35				○		
	Brownish hard Silty clay till		9	SS	39		191		○		9 38 40 13
	Frequent shale fragments		10	SS	75/	0.12m	190		○		15 43 32 10
189.6	Reddish										Borehole dry on completion.
8.0	Reddish Shale										
189.1	Weathered		11	SS	90/	0.15m			○		
8.5	End of Borehole										

$+^3$, $\times^5$: Numbers refer to Sensitivity

$15 \overset{20}{\underset{10}{\diamond}} 5$ (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

Ref. No. 83-8-7
Enclosure No. 4

RECORD OF BOREHOLE No 4

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,723N; 291,175E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER AND NXL ROCK CORE COMPILED BY F.L.
DATUM GEODETIC DATE 1983.08.29 and 1983.09.01 CHECKED BY I.P.L.

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl / WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	0.12 m Topsoil Reddish Silty clay till Stiff to Hard		1	SS	34		191				
	Hard Frequent Shale fragments		2	SS	75/0.10m		190				
189.4 2.1			3	SS	70/0.10m		189				Augering ↕ Diamond Drilling
	Reddish Shale some greyish shale and limestone seams		4	RC NXL	90%		188				
			5	RC NXL	100%		187				
185.9							186				Borehole dry on completion of augering.
5.6	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation and Communications Ontario

Ref. No. 83-B-7
Enclosure No. 5

RECORD OF BOREHOLE No 5

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,692N; 291,181E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.09.07 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
190.9	Ground Level										
0.0	75 mm Asphalt 175 mm Concrete										
190.1	Sandy gravel (Fill)										
0.8	Reddish, hard Silty clay till, with shale fragments		1	SS	70		190		○		
189.3			2	SS	50/	0.12m					
1.8	Reddish Shale some greyish shale and limestone seams						189				Augering Diamond Drilling
			3	RC NXL	93%		188				
			4	RC NXL	86%		187				
			5	RC NXL	100%		186				Borehole dry on completion of augering.
185.1											
5.8	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications Ontario

Ref. No. 83-8-7
Enclosure No. 6

RECORD OF BOREHOLE No 6

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,703N; 291,199E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.09.07 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
190.7	Ground Level										
0.0	75 mm Asphalt 175 mm Concrete Sandy Gravel fill						190				
189.9											
0.8	Reddish, hard Silty clay till, with shale fragments		1	SS	67				d		Borehole dry on completion.
189.1	Reddish weathered shale		2	SS	50/	0.07m					
1.6	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ref. No. 83-8-7
Enclosure No. 7

RECORD OF BOREHOLE No 7

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,663N; 291,203E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.08.30 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
197.5	Ground Level										
0.0	0.1 m Topsoil						197				
			1	SS	11						
							196				
	Sandy		2	SS	15				o		
	Grey/brown/dk.grey Silty clay, with some gravel, traces of organic pockets (Fill)		3	SS	5		195		o		
			4	SS	5				o		
							194				
			5	SS	17				o		
							193				
			6	SS	24				o		
			7	SS	49		192		o		
191.7											
5.8	Dark grey/black Organic silty clay										
			8	SS	38				o		
191.0	V.stiff						191				
6.5	Reddish, hard Silty clay till with traces of organics										Borehole dry on completion
	Frequent shale fragments		9	SS	126/0.12m				o		
190.1											
7.4	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

Ref. No. 83-8-7
Enclosure No. 8

RECORD OF BOREHOLE No 8

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,675N; 291,224E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER AND NXL ROCK CORE COMPILED BY F.L.
DATUM GEODETIC DATE 1893.08.29 and 1983.08.31 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) SHEAR STRENGTH: o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
192.0	Ground Level										
0.0	0.05 m Topsoil										
	Reddish, hard Silty clay till, with shale fragments		1	SS	106		191				
			2	SS	50/	0.15m					
190.0							190				
2.0	Reddish Shale, some greyish shale and limestone seams		3	SS	75/	0.07m					Augering ↕ Diamond Drilling
	Very highly weathered zone		4	RC NXL	93%		189				
							188				
			5	RC NXL	90%		187				Borehole dry on completion of augering. W.L. @ 1.8m & hole caved in @ 2.7m Sept.20/83
186.3											
5.7	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ref. No. 83-8-7
Enclosure No. 9

RECORD OF BOREHOLE No 9

METRIC

W P 54-82-05 LOCATION CO.ORDS. 4,832,637N; 291,227E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.08.30 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) / WATER CONTENT (%) (PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.3	Ground Level									
0.0 / 195.7	Gravelly sand (Fill)						196			
0.6	Sandy		1	SS	5/	0.15m		○		Encountered boulder at 1.1 m. Borehole relocated 1.5m north and re-drilled
	Red/brown/dk.brown Silty clay, with some sand and gravel (Fill)		2	SS	12		195	○		
			3	SS	22		194	○——		
192.6			4	SS	18	▼		○		
3.7 / 192.2	Dark grey/black Organic silty clay		5	SS	21		193	○		
4.1	Some organics									
	Greyish, hard Silty clay till		6	SS	60		192	○——		6 36 38 20
			7	SS	89		191	○——		Borehole dry on completion. Water level @ 3.5m & B.H. caved in @ 3.8 m Sept. 20/83
	Frequent shale fragments Reddish									
190.1			8	SS	80/	0.10m				
6.2	End of Borehole									

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

Ref. No. 83-B-7
Enclosure No. 10

RECORD OF BOREHOLE No 10

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,645N; 291,251E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER AND NXL ROCK CORE COMPILED BY F.L.
DATUM GEODETIC DATE 1983.08.29 and 1983.08.31 CHECKED BY I.P.L.

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
194.7	Ground Level										
0.0	0.15 m Topsoil										
	V.stiff Hard Reddish Silty clay till		1	SS	32		194				
			2	SS	56		193				
	Frequent shale fragments		3	SS	86						Augering
191.1			4	RC NXL	59%		192				Diamond Drilling
3.6	Very highly weathered		5	RC NXL	92%		191				
	Reddish shale, some greyish shale & limestone seams		6	RC NXL	100%	▼	190				Borehole dry on completion of augering. W.L. @ 4.3m & borehole caved-in @ 4.9 m Sept.20/83
189.2											
5.5	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications Ontario

Ref. No. 83-8-7
Enclosure No. 11

RECORD OF BOREHOLE No 11

METRIC

W P 54-82-05 LOCATION CO-ORDS. 4,832,609N; 291,254E ORIGINATED BY H.C.

DIST 6 HWY 401 BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY F.L.

DATUM GEODETIC DATE 1983.08.30 CHECKED BY I.P.L.

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH o UNCONFINED • QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
194.5	Ground Level										
0.0	0.05m Topsoil										
194.0	Gravelly sand (Fill)						194				
0.5	Reddish/brown/dry Silty clay, with some sand and gravel (Fill)		1	SS	9						
			2	SS	8		193				
			3	SS	11		192				
191.5											
3.0	Layered Silty clay V.stiff		4	SS	42						
	Hard Greyish Silty clay till						191				
	Frequent shale fragments		5	SS	75						Borehole dry on completion.
189.9	Reddish		6	SS	70/0.15m		190				
4.6	End of Borehole										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications
Ontario

Ref. No. 83-8-7
Enclosure No. 12

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 12

METRIC

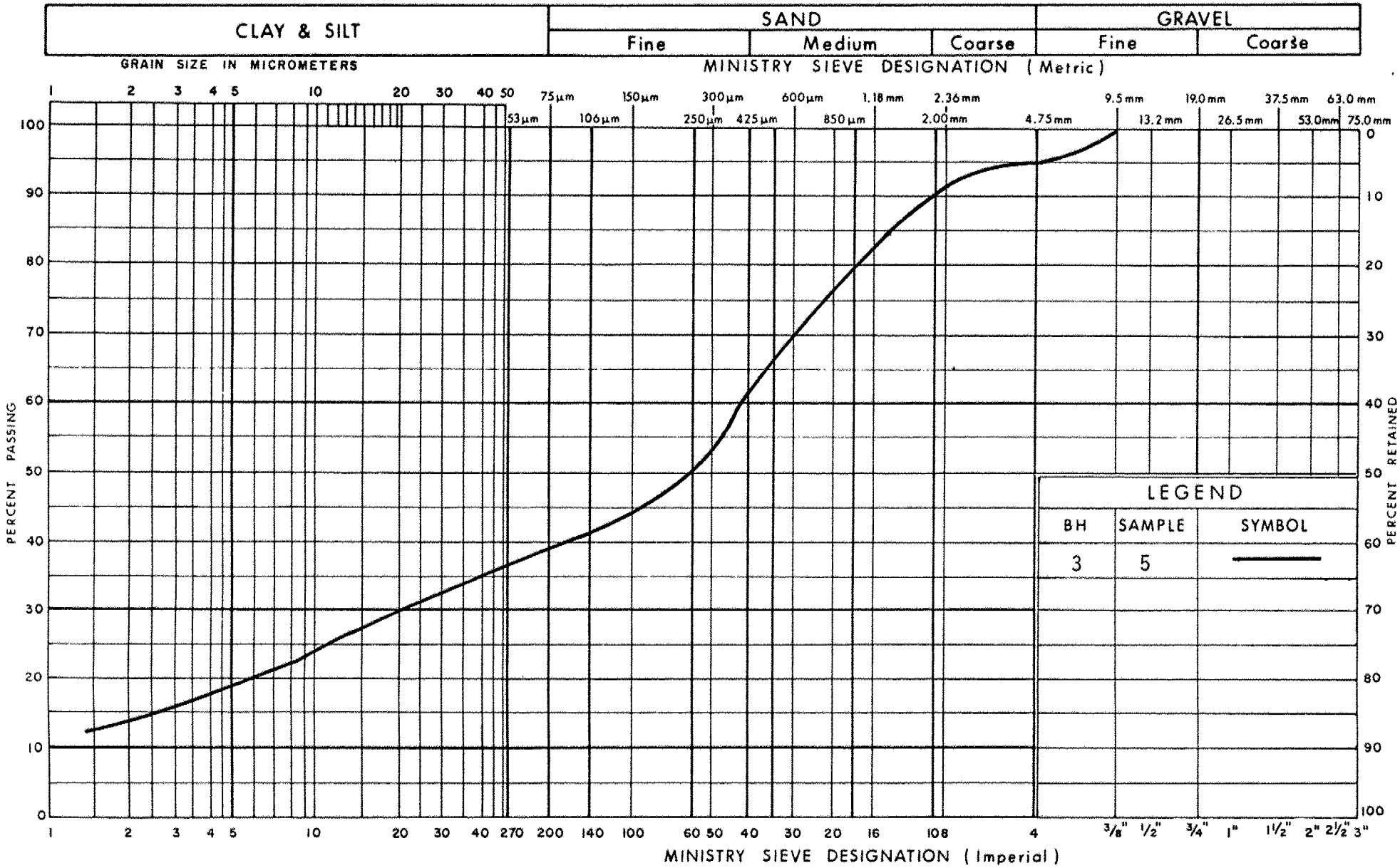
W P 54-82-05 LOCATION CO-ORDS. 4,832,616N; 291,268E ORIGINATED BY H.C.
DIST 6 HWY 401 BOREHOLE TYPE HOLLOW STEM AUGER AND NXL ROCK CORE COMPILED BY F.L.
DATUM GEODETIC DATE 1983.08.29 and 1983.08.31 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
193.3	Ground Level										
0.0	0.15 m Topsoil						193				
	Reddish, hard Silty clay till, with shale fragments		1	SS	36						
							192				
			2	SS	39						
							191				
			3	SS	95/ 0.23m						Augering ↕ Diamond Drilling
190.4											
2.9	Reddish Shale, some greyish shale and limestone seams		4	RC NXL	100%		190				
							189				
			5	RC NXL	100%						Borehole dry on completion of augering.
187.5							188				
5.8	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



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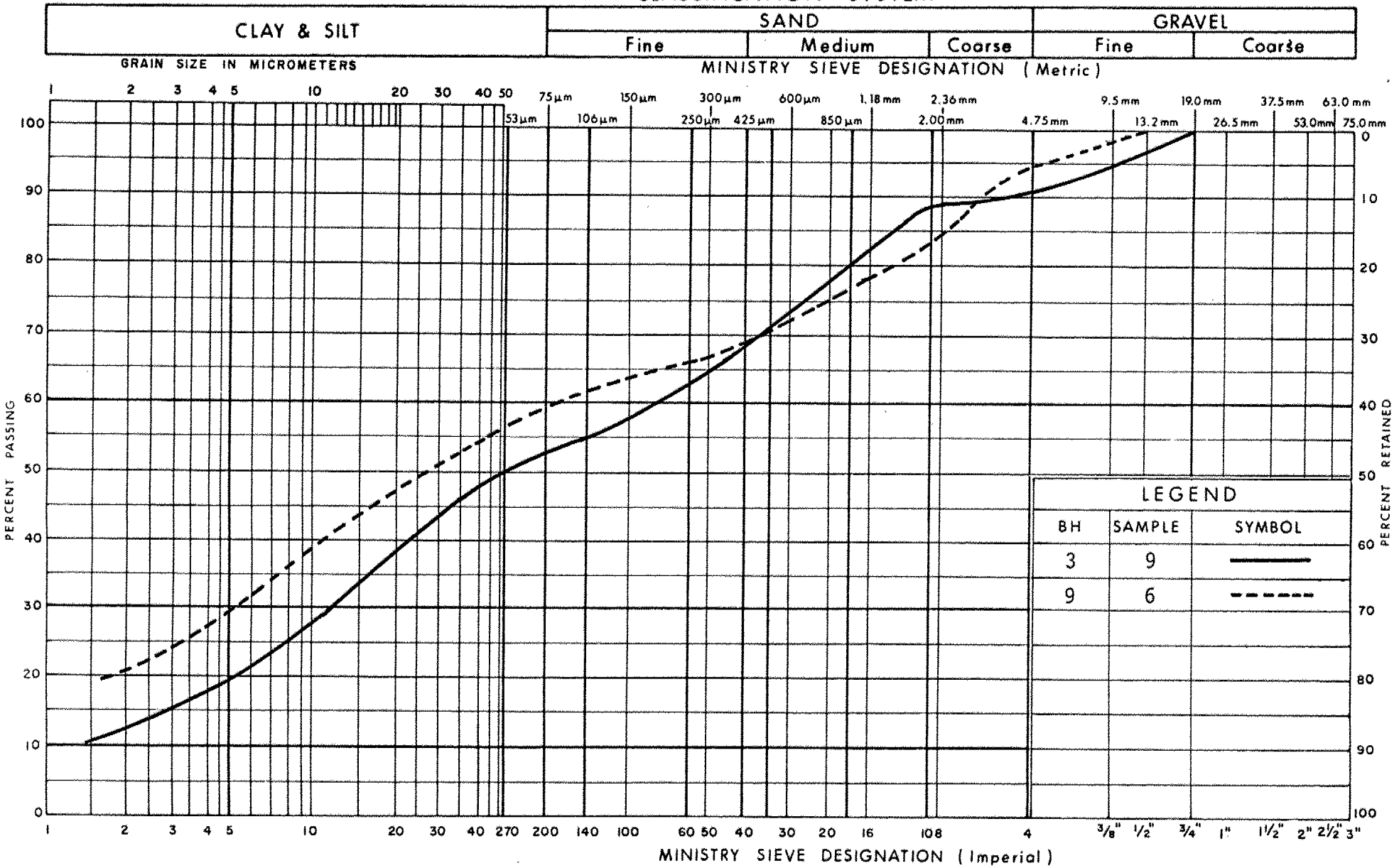
GRAIN SIZE DISTRIBUTION

SILTY CLAY with some Sand & traces of gravel (FILL)

FIG No 1

W P 54-82-05

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL

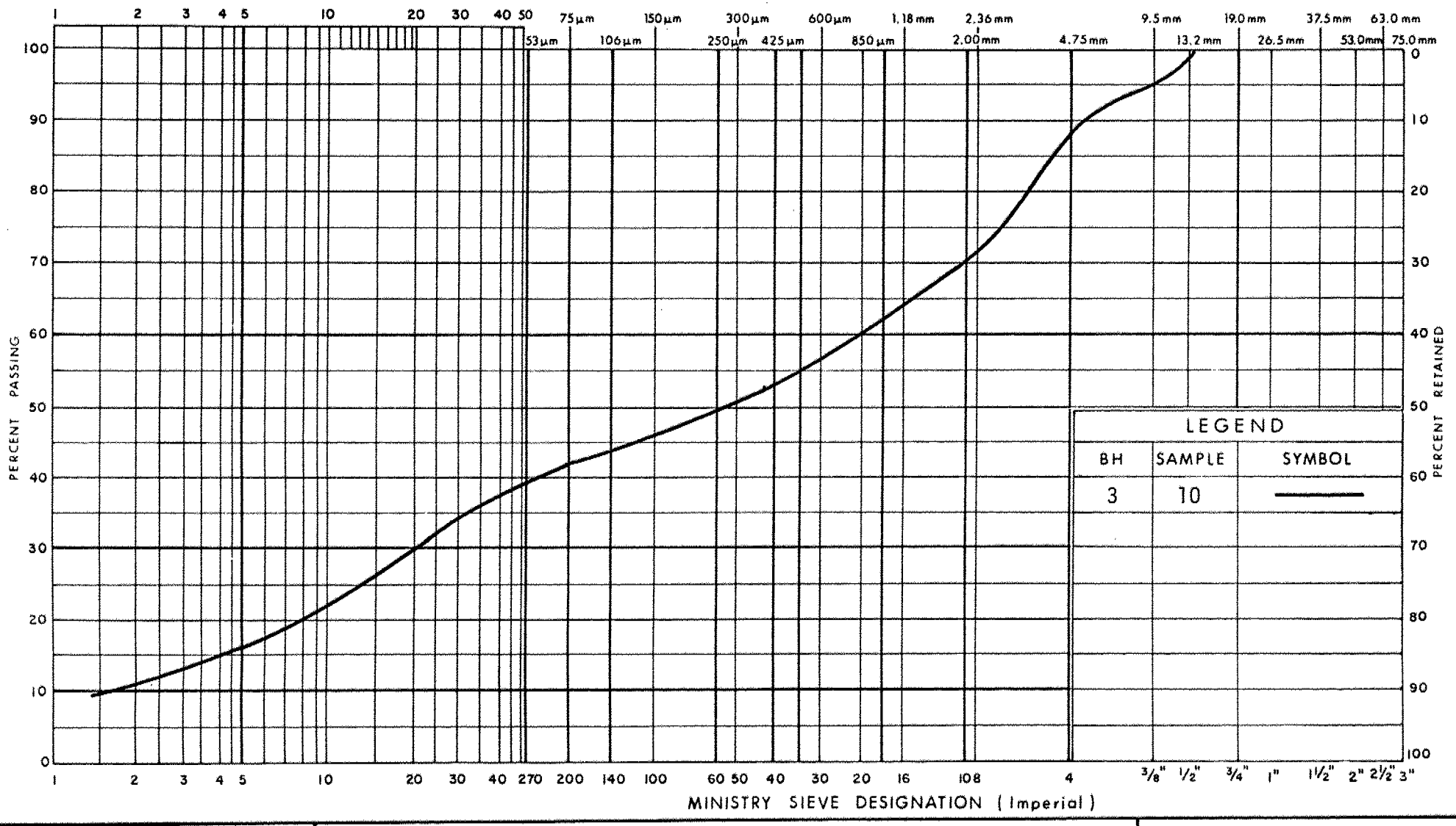
FIG No 2

W P 54-82-05

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



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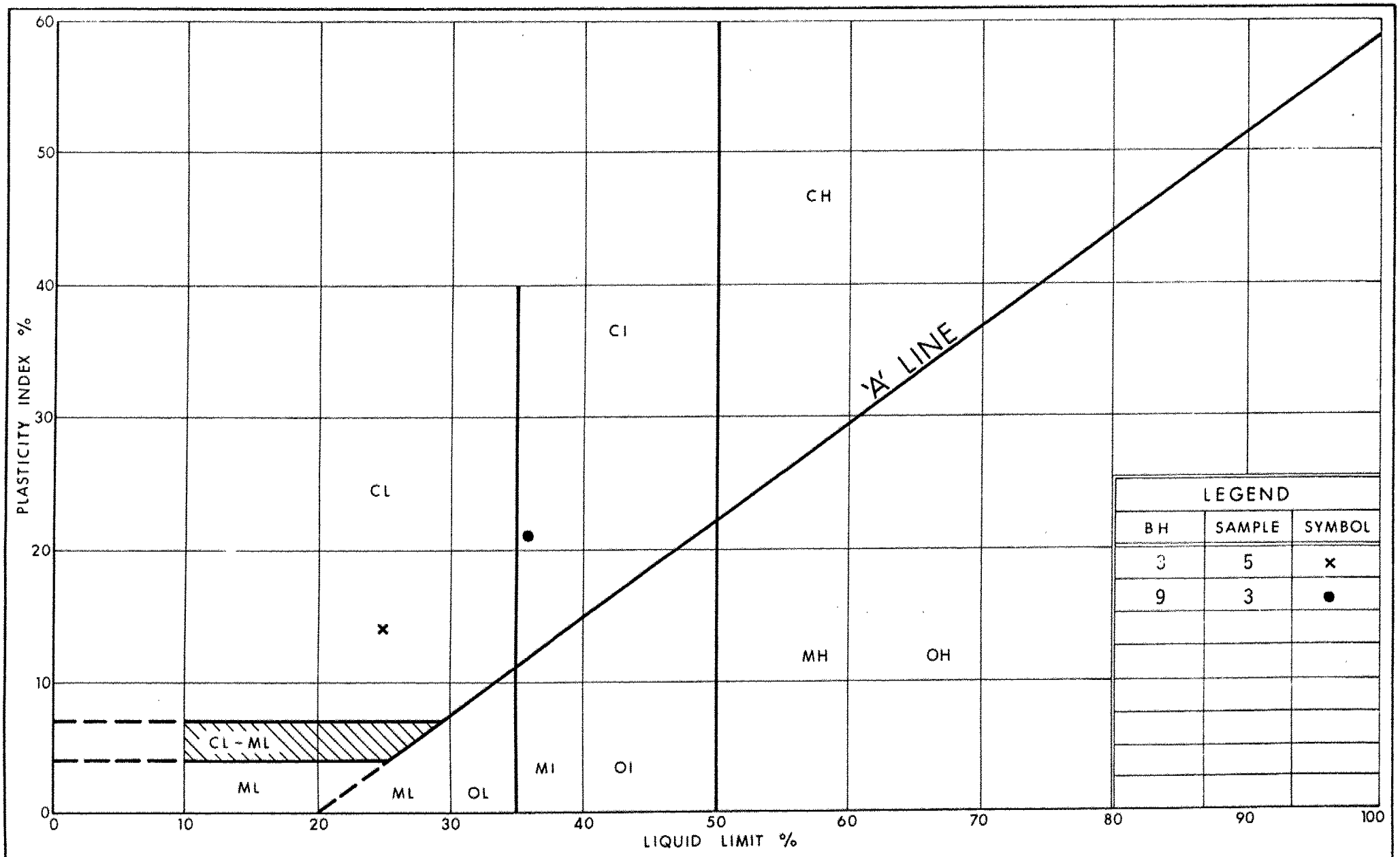
GRAIN SIZE DISTRIBUTION

SILTY CLAY TILL with shale fragments

FIG No 3

W P 54-82-05

Oct 75, FF-S-21



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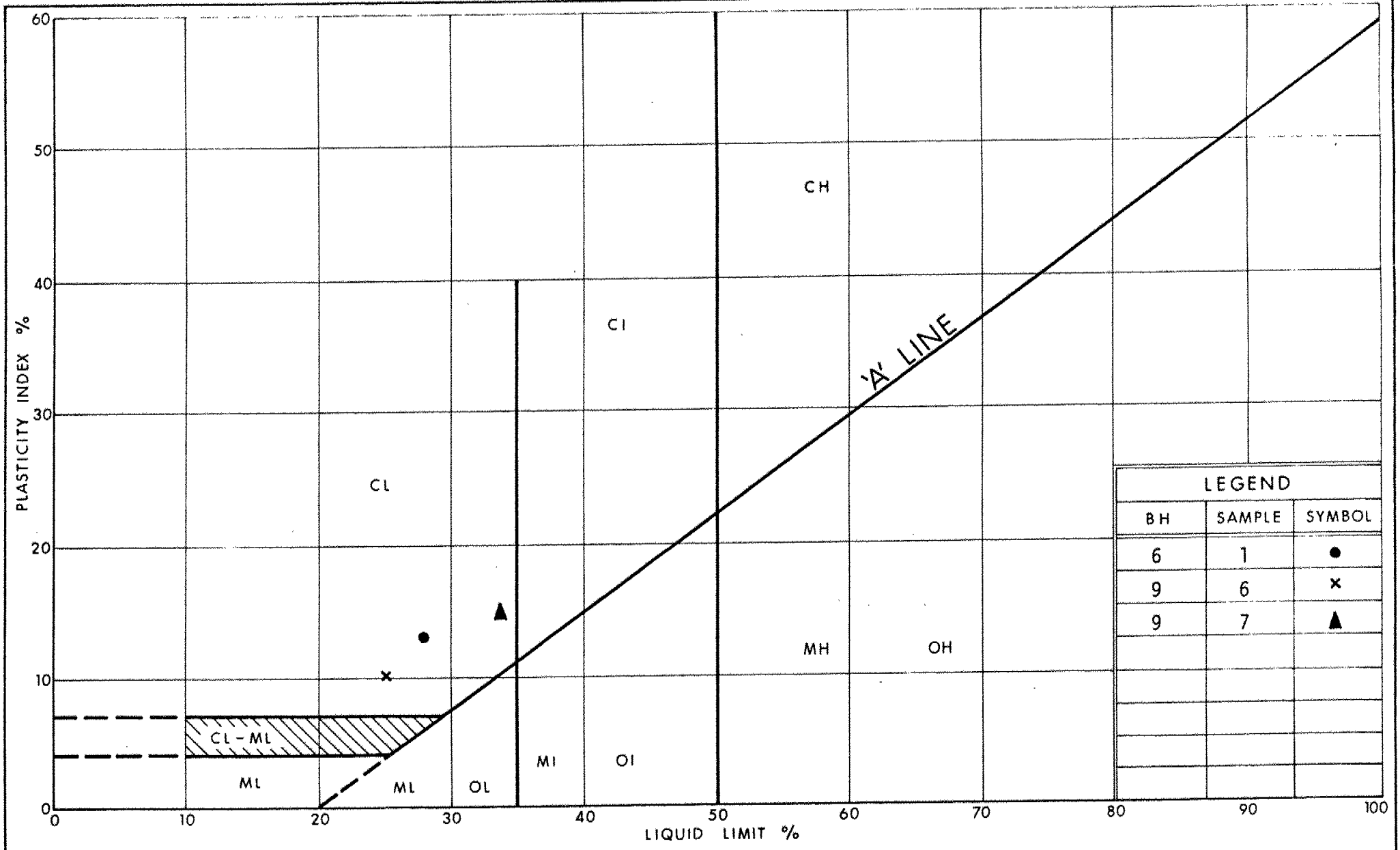
PLASTICITY CHART

SILTY CLAY with some Sand & Gravel (Fill)

FIG No 4

W P 54-82-05

Oct 75, FF-S-21



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PLASTICITY CHART

SILTY CLAY TILL

FIG No 5

W P 54-82-25

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

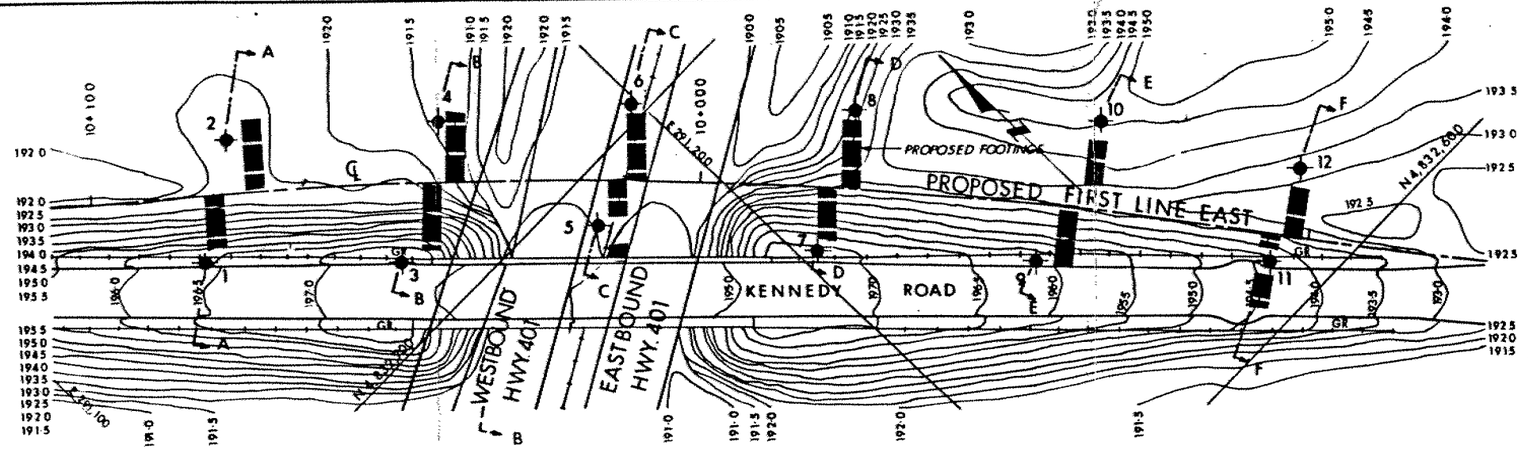
CONT No
WP No 54-82-05

HWY 401 - HWY 410/403 TO HWY 10 FIRST LINE EAST (KENNEDY RD)

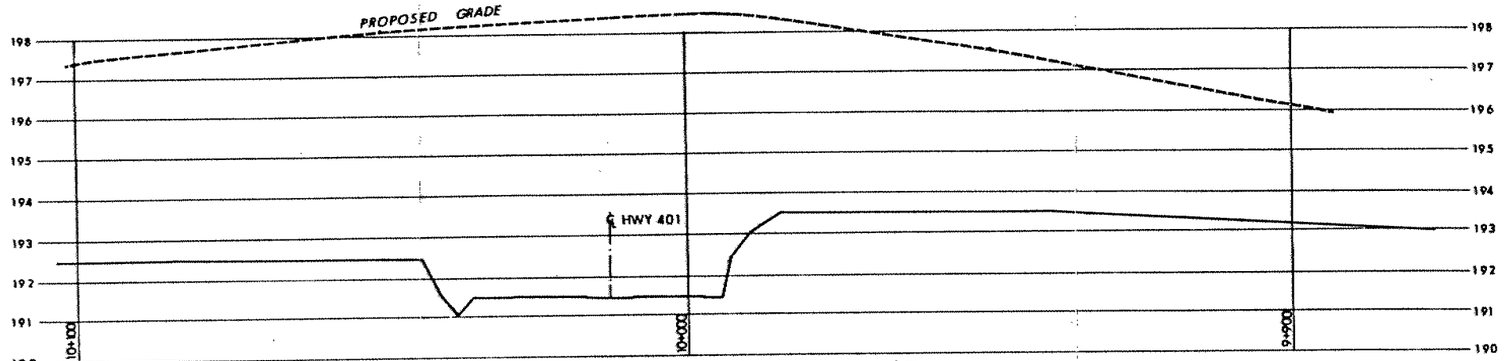
BORE HOLE LOCATIONS & SOIL STRATA

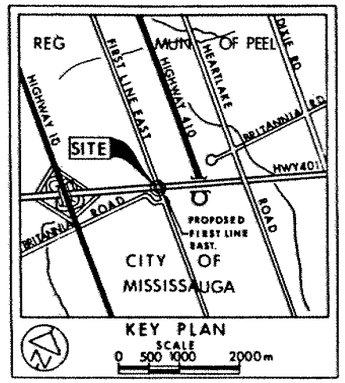
SHEET

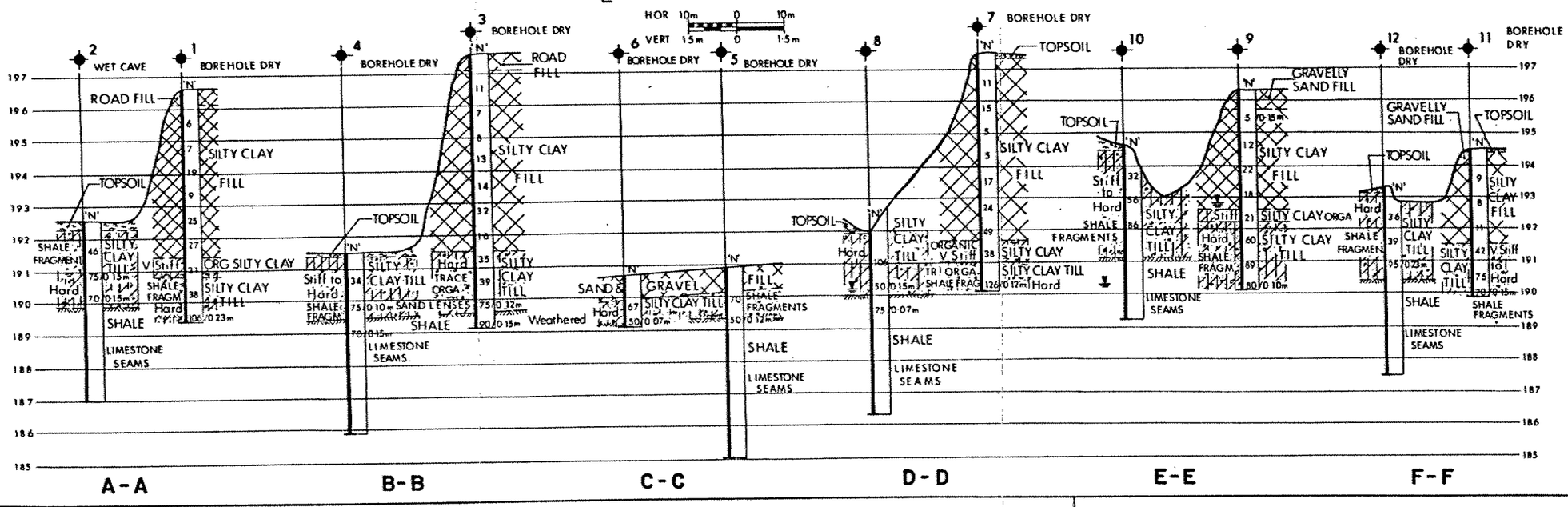
DOMINION SOIL INVESTIGATION INC.



PLAN
SCALE 10m 0 10m







LEGEND
- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 1983 09

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	196.6	4,832,735	291,132
2	192.6	4,832,746	291,149
3	197.6	4,832,712	291,154
4	191.5	4,832,723	291,175
5	190.9	4,832,692	291,181
6	190.7	4,832,703	291,199
7	197.5	4,832,663	291,203
8	192.0	4,832,675	291,224
9	196.3	4,832,637	291,227
10	194.7	4,832,645	291,251
11	194.5	4,832,609	291,254
12	193.3	4,832,616	291,268

REGISTERED PROFESSIONAL ENGINEER Z. S. OZDEN Province of Ontario

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102·2 of Form 100

REV	DATE	BY	DESCRIPTION

Geocres No 30M12-185

HWY No 401			DIST 6
SUBMD HC	CHECKED ZSO	DATE 1983 11 02	SITE 24-181
DRAWN FL	CHECKED ZSO		DWG 548205-A