

GEOCRES No. 30M5-161

DIST. 4 REGION

W.P. No. 199-77-17

CONT. No.

W. O. No.

STR. SITE No. 10-476

HWY. No. 403

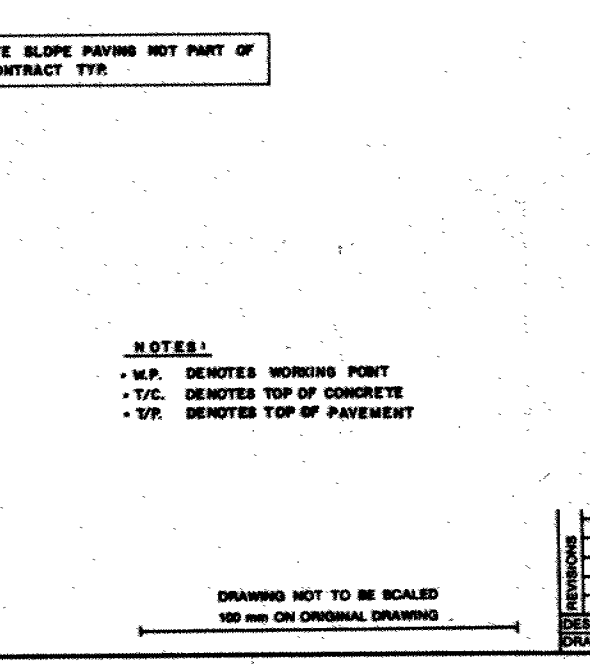
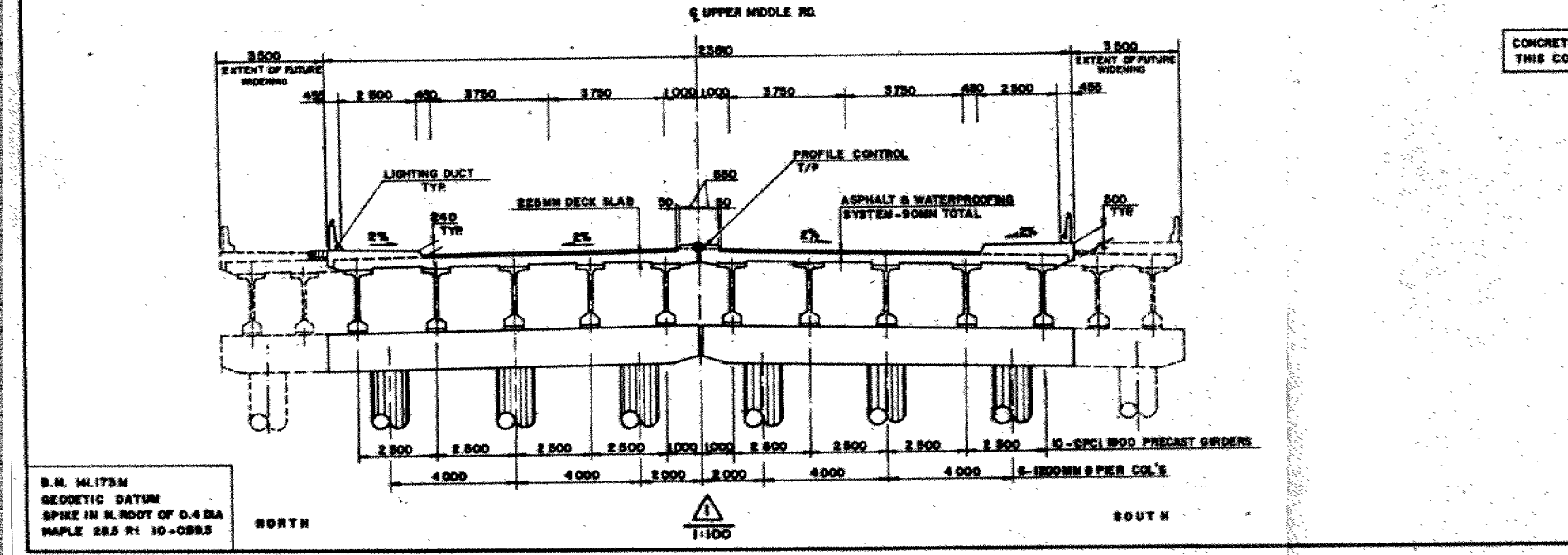
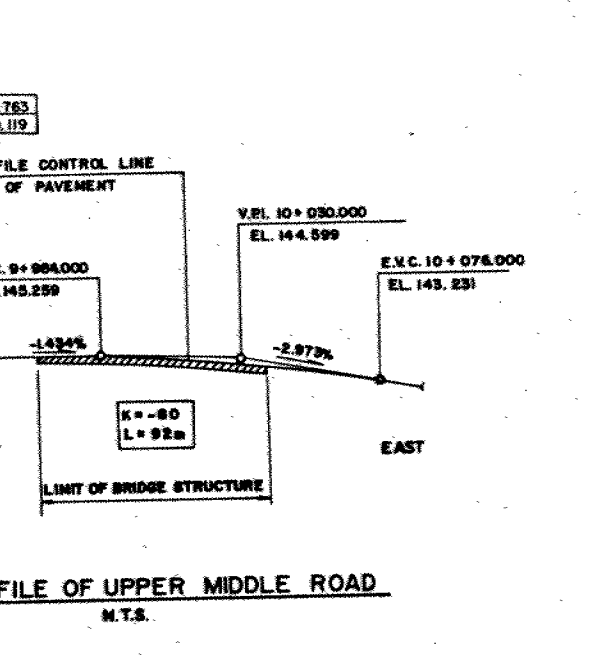
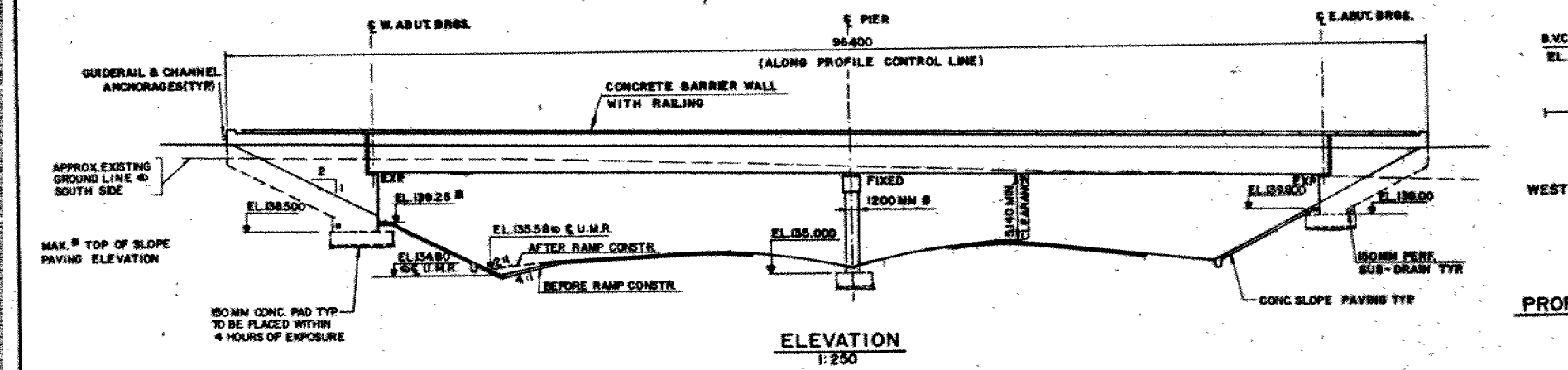
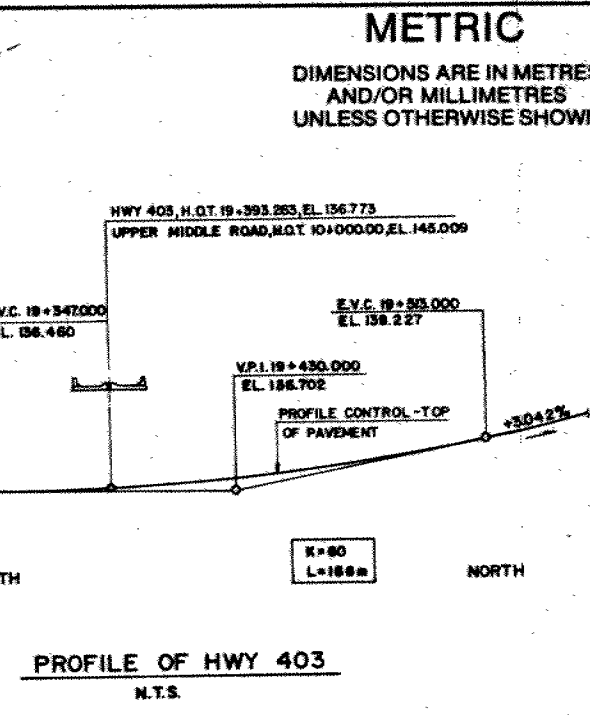
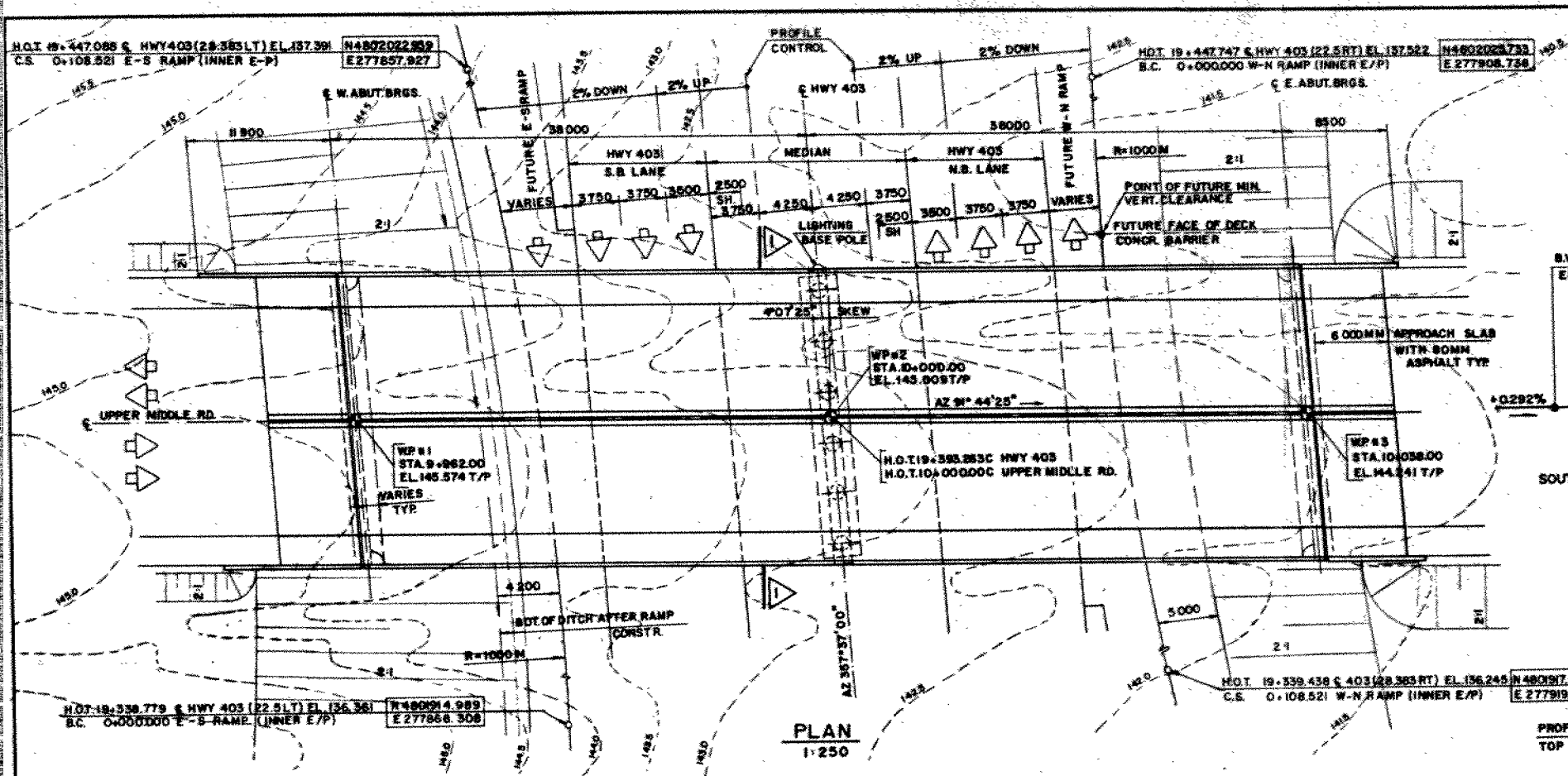
LOCATION Hwy 403 + Upper
Middle Rd UNDERPASS

NOTES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



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

DIST.
CONT No
WP No 199-77-17

**HWY 403/UPPER MIDDLE
ROAD UNDERPASS
GENERAL ARRANGEMENT**

PLAMAC CONSULTANTS LTD.
CONSULTING ENGINEERS & PLANNERS

SHEET

- GENERAL NOTES**
- CLASS OF CONCRETE:**
PRESTRESSED ORDERS 40 MPa
REMAINDER 30 MPa
- REINFORCING STEEL:**
REINFORCING STEEL SHALL BE GRADE 400
UNLESS OTHERWISE NOTED.
BAR MARKS WITH SUFFIX "C" DENOTE COATED BARS.
- 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 40±10
REMAINDER (UNLESS OTHERWISE NOTED) 70±20
- CONSTRUCTION NOTE:**
IF THE ACTUAL BEARING HEIGHTS DIFFER FROM THE ASSUMED HEIGHTS GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SEAT ELEVATIONS AND REINFORCING STEEL TO SUIT THE ACTUAL HEIGHTS.
- LIST OF DRAWINGS:**
1. GENERAL ARRANGEMENT.
2. BORE HOLE LOCATIONS & SOIL STRATA.
3. FOOTING LAYOUT & REINF.
4. WEST ABUTMENT.
5. EAST ABUTMENT.
6. PIER.
7. PRESTRESSED ORDERS & BEARINGS.
8. DECK DETAILS.
9. DECK REINFORCING.
10. BARRIER WALL ON SIDEWALK.
11. RAILING FOR BARRIER WALL.
12. 8000 MM APPROACH SLAB.
13. DETAILS OF CONG. SLOPE PAVING.
14. JOINT ANCHORAGE AND ARMOURING.
15. AS CONSTRUCTED ELEV. & DIM.
16. STANDARD DETAILS.
17. ELECTRICAL EMBEDDED WORK.
18. QUANTITIES - STRUCTURE.
- APPLICABLE STANDARD DRAWINGS:**
SD 3502 MM. GRANULAR BACKFILL REQUIREMENT.

NOTES:
- W.P. DENOTES WORKING POINT
- T/C. DENOTES TOP OF CONCRETE
- T/P. DENOTES TOP OF PAVEMENT

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS

DATE	BY	DESCRIPTION
DESIGN E.S.	CHK MS.	CODE 0000-03 (LOAD CLASS A) DATE JAN. 15, 1991
DRAWN E.M.	CHK E.S.	SITE 10-476 STRUCT. SCHEME DWG. 1

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

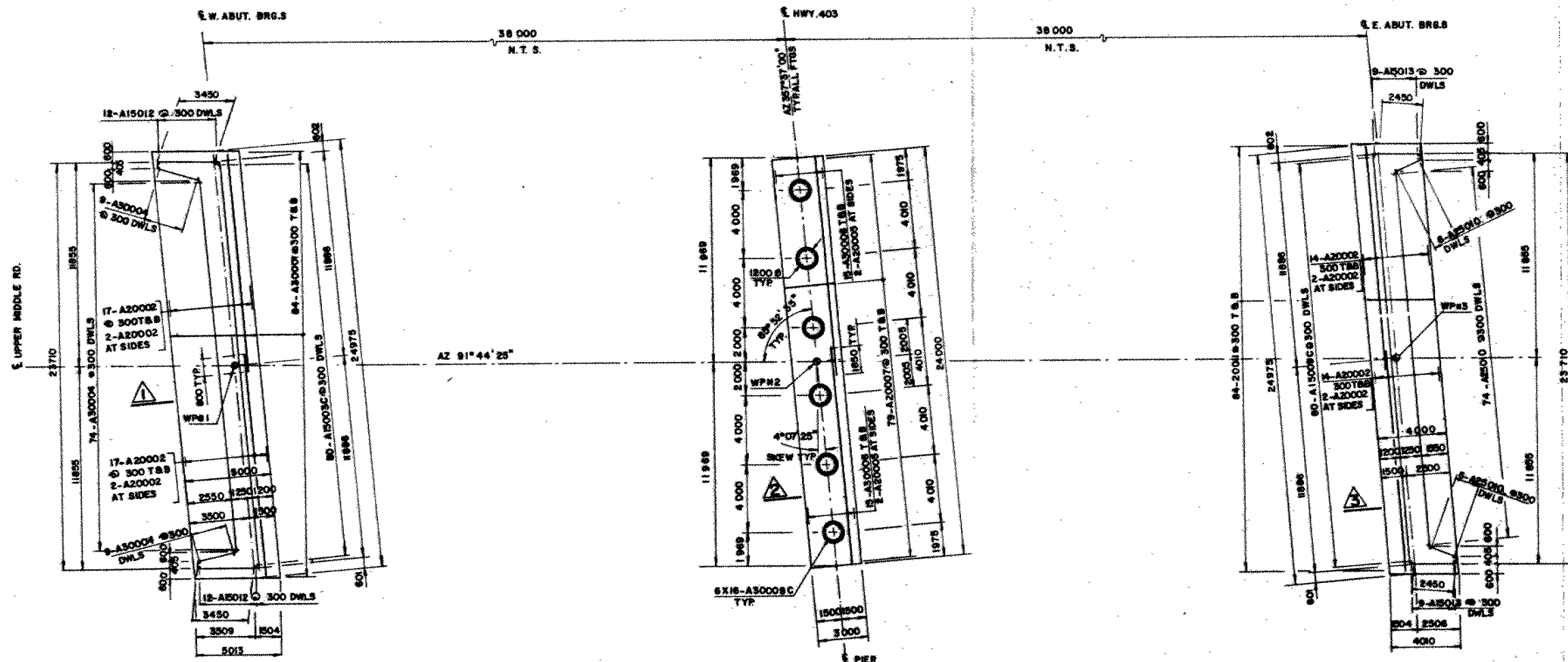
DIST.
CONT No
WP No 199-77-17



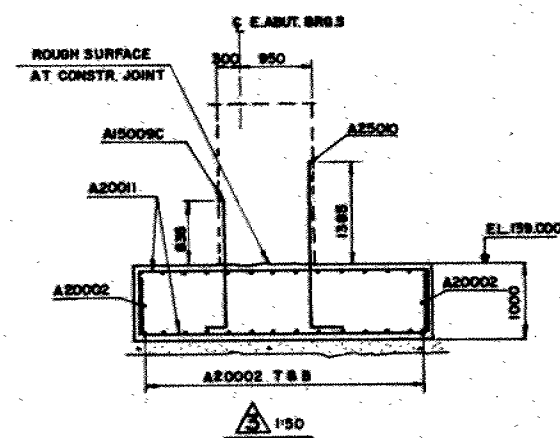
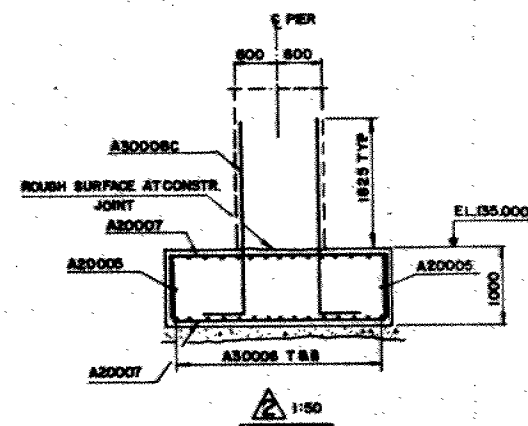
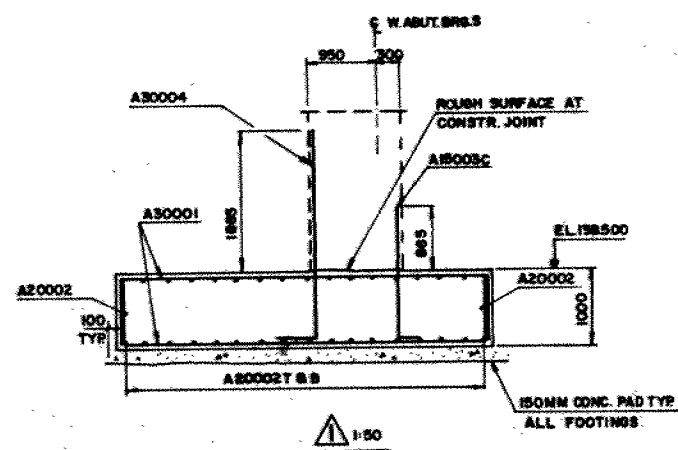
HWY 403/UPPER MIDDLE
ROAD UNDERPASS
FOOTING LAYOUT & REINF.

SHEET

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PLAN
SCALE 1:150



W. P. DATA

W.P.s	STATIONS	CO-ORDINATES	
		NORTH	EAST
1	9+962.00	4 801971.515	277 880.540
2	10+000.00	4 801970.361	277 888.523
3	10+038.00	4 801968.207	277 928.508

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN E.S.	CHK M.S.	CODE 048DC-83	LOAD CLASS A DATE JANIS 1991
DRAWN B.H.	CHK E.S.	SITE 30-478	STRUCT. SCHEME DWG. 3



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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 199-77-17 DIST 4
HWY 403 STR SITE 10-476
Hwy. 403 - Upper Middle Road Underpass

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FOUNDATION INVESTIGATION REPORT
For
Bridge Structure
Hwy. 403 - Upper Middle Road Underpass
W.P. 199-77-17, Site No. 10-476
District 4, Burlington

INTRODUCTION

This report summarizes the information obtained from a foundation investigation carried out at the above mentioned site where two span twin structures are proposed to carry the existing Upper Middle Road over the proposed Hwy. 403.

The fieldwork was carried out between 90 04 18 and 90 04 19. Six boreholes (BH 1 to BH 6) were advanced and sampled as part of this project by means of hollow stem augers with a conventional diamond drill (NW casing and NQ core barrel) adopted for rock sampling purposes. These boreholes extended down to depths of 5.0 and 11.0 m below the existing ground surface.

This report contains factual information obtained from this investigation pertaining to structure foundations, approach embankments and related earthworks for the bridge structure as shown on Dwg. No. 1997717-A.

SITE DESCRIPTION AND GEOLOGY

The site is located on the proposed alignment of Hwy. 403 where it crosses the existing Upper Middle Road in the City of Burlington, Regional Municipality of Halton. The proposed structure is located approximately 1 km west of the existing Guelph Line. The topography in the area is generally flat to gently undulating with ground surface sloping to the southeast. Land use in the vicinity of the site is primarily residential and commercial subdivision development.

Physiographically, the site lies in the area known as the "South Slope" (Ref. Chapman and Putnam, 1984). The characteristic deposit, in the vicinity of the area under investigation, is composed generally of a shale plain overlain by a veneer of glacial drift. These soils have originated, to a large extent from the underlying bedrock, although some imported glacial material is also

present. The bedrock is referred to as Queenston Shale of Paleozoic glacial age which contains thin layers of green siltstone.

SUBSURFACE CONDITIONS

The subsoil conditions are generally uniform across the site. The overburden consists of a shallow deposit of cohesive glacial till composed of a heterogeneous mixture of clayey silt, sand and gravel underlain by shale and siltstone bedrock. The maximum thickness of this deposit was found to be about 2.6 m at BH 1.

The upper portion of the shale was found to be weathered down to approximate El. 136.6 m with a maximum thickness of about 4.9 m at BH 2.

Thin layers of road fill materials and clay silt topsoils were encountered at five borehole locations (BH's 1, 2, 3, 4 and 5).

The boundaries between the various soil types, in situ and laboratory test results are shown on the attached Record of Borehole sheets in the Appendix. The locations and elevations of the boreholes, along with a profile and sections showing soil stratigraphy based on borehole data, are shown on Dwg. No. 1997717-A.

A detailed description of the subsurface conditions encountered is given below.

Fill Material

Four boreholes encountered some 1.7 m of fill material whose composition ranged from a brown reworked clayey silt to sand and gravel.

No Grain Size Distribution analysis was carried out. However, through visual observation, it is apparent that the fill material can be classified as a clayey silt or sand and gravel. Pavement and Granular 'A' material were encountered at BH 's 2 and 4.

Topsoil

Topsoil was encountered at two borehole locations. The thickness of this layer is about 0.8 m at BH 1 and about 0.6 m at BH 3. No Grain Size Distribution analysis was carried out on this material. However, through the visual observation, the material can be classified as a clayey silt.

Heterogeneous mixture of Clayey Silt, Sand and Gravel (Glacial Till)

This stratum encountered from the ground surface at BH 6 and underneath the fill material or topsoil. This deposit consists of a heterogeneous mixture of clayey silt of low plasticity with varying amounts of sand and gravel. The thickness of this layer was found to be maximum 2.6 m at BH 1.

Atterberg Limit tests were performed on these samples and the results are plotted on Figure 1 and summarized as follows:

<u>Property</u>	<u>Range (%)</u>	<u>Average (%)</u>
Natural Moisture Content (w)	8.0-20.5	13.4
Liquid Limit (w_L)	17.0-40.0	26.3
Plastic Limit (w_p)	12.5-18.0	15.0
Plasticity Index (I_p)	5.0-22.5	11.3

From the plasticity chart, it is evident that the layer can be classified as a heterogeneous mixture of clayey silt, sand and gravel with low plasticity (CL or CL-ML).

Grain Size Distribution tests were carried out on this cohesive glacial till material. Figure 2 in the Appendix shows the results. An increasing frequency of fragments of weathered shale was encountered within the lower portion of this till.

In this stratum, the 'N' value ranges from 13 to over 100 blows/0.3 m indicating the consistency of this deposit described as stiff to hard.

Bedrock

In each of the borings, split spoon samples of the weathered portion of the bedrock were recovered before augering was terminated. Sound bedrock was proven in three boreholes by obtaining up to 4.5 m of NQ rock cores at BH 6. The top of the bedrock ranged from El. 139.0 to 142.0 m which are corresponded to 1.4 m and 3.4 m below the existing ground surface. The upper 2.1 m to 4.9 m is in a highly weathered state, with layers of broken shale and red clayey silt.

Atterberg Limit tests were performed on this weathered shale and the results are plotted on Figure 3 and summarized as follows:

<u>Property</u>	<u>Range (%)</u>	<u>Average (%)</u>
Natural Moisture Content (w)	7.0-12.5	10.0
Liquid Limit (w_L)	22.5-29.0	26.2
Plastic Limit (w_p)	13.0-17.0	15.4
Plasticity Index (I_p)	8.0-14.5	10.8

From the plasticity chart, it is evident that the weathered shale can be classified as a clayey silt with trace of sand with low plasticity (CL).

Grain Size Distribution tests were carried out on this material. Figure 4 in the Appendix shows the results. In this stratum, the 'N' values ranges from 38 to over 100 blows/0.3 m indicating the consistency of this deposit as hard.

The bedrock is a red shale with interbedded green siltstone (approximately 77% shale, 23% siltstone) of the Queenston formation. Detailed description of the rock are attached in the Appendix entitled "Rock Core Description".

The Core Recovery (CR) and Rock Quality Designation (RQD) values were determined in situ and also in the laboratory to evaluate the competence and integrity of the rock. Core Recoveries (RC) range between 87 and 100 percent and Rock Quality Designation (RQD) values range from 30 to 74 percent. Based on these results, the rock can be classified as weak to very weak and slightly to unweathered.

GROUNDWATER CONDITIONS

Groundwater level was encountered in all boreholes except BH 5 during the site investigation. BH 5 was dry at the time of site investigation. Groundwater level in open boreholes was found to be approximate Elevation between 137.0 m and 139.5 m which are close to the interface between weathered shale and unweathered shale. Two piezometers were installed at BH's 3 and 5. Upon completion of rock coring, the induced drill water remained perched within the bedrock, indicating a low permeability for both the till and shale strata.

DISCUSSION AND RECOMMENDATIONS

The recommendations in this report apply to the bridge structure and related approaches.

It is proposed to construct underpass structure that will carry the existing Upper Middle Road over the proposed Hwy. 403 eastbound and westbound lanes. The proposed structure is a two span bridge. A proposed Upper Middle Road profile grade, ranging from 144.0 m at east abutment to 145.7 m at west abutment with a proposed Hwy. 403 profile grade of about 136.0 m, will necessitate minimum approach cuts in the order of 9.0 m at west abutment and 6.0 m at east abutment with 1.2 to 2.0 m fill above the existing ground surface.

In consideration of the proximity of competent shale and siltstone bedrock from the ground surface across the site, recommendations pertaining to the foundations of the new structure and related earth and rock works are summarized as follows:

Structure Foundations

Abutments and Piers

In consideration of the competent nature of the subsoils, a perched-type abutment founded on spread footings as high as possible within the glacial till or weathered shale and siltstone bedrock. For spread footings founded on native glacial till, the following design parameters are recommended:

	Factored Bearing Capacity at U.L.S. (kPa)	Allowable Capacity S.L.S. Type II (kPa)	Proposed Footing El. (m)
West Abutment	1000	650	143.0
East Abutment	1000	650	140.0

Sliding resistance may be computed by assuming a coefficient of friction of 0.57 between the underside of footings and the soil.

The design of shallow foundation founded on an unyielding type of medium, such as weathered shale and siltstone, will be not governed by settlement since Bearing Capacity at S.L.S. Type II is much larger than the Factored Bearing Capacity at the U.L.S.

For the purpose of the O.H.B.D.C., the following design values are recommended.

	Factored Bearing Capacity at U.L.S. (kPa)	Proposed Footing El. (m)
West Abutment	670	140.0
East Abutment	670	138.0

Alternatively, the closed-type of abutments can be supported on spread footings within the intact shale for a Factored Capacity at the U.L.S. of 1000 kPa below the El. 136.0 m.

For piers, footings can be supported on shallow spread footings located and designed within the intact shale for a Factored Capacity at the U.L.S. of 1000 kPa below the El. 136.0 m.

Resistance to sliding of the abutment footings can be calculated assuming a coefficient of friction of 0.47 between the underside of the concrete footings and the Queenston Shale surface. If higher resistance is required, dowel into bedrock will provide additional passive resistance. The shale should provide a resisting pressure of 0.5 MPa against lateral forces for a 1.0 m dowel. If the dowel extends more than 1.0 m into the shale, the shale should provide a resisting pressure of 1.0 MPa for that portion of the dowel which is longer than 1.5 m.

A footing width of 2.5 m with an embedded depth of 1.2 m was used in the calculation of the above capacities. The magnitude of the differential settlement of the footings is anticipated to be within 25 mm, provided the subsoil is not disturbed by construction activities.

Other Considerations

Lateral Earth Pressures on Structures

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the abutments to prevent hydrostatic pressure build-up.

Design parameters of the soil are given below for purpose of the O.H.B.D.C.:

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction, ϕ	35°	30°
Unit Weight (kN/m^3), γ	22.8	21.2
Coefficient of Active Earth Pressure (K_A)	0.27	0.33
Coefficient of Earth Pressure at Rest (K_0)	0.43	0.50

The earth pressure coefficient at rest is to be used in design of the abutment walls are rigid and unyielding. Weep holes in the abutment walls should be designed to drain any accumulation of water in the backfill.

Dewatering

No major dewatering difficulties are anticipated for footing excavations in consideration of the relatively low permeability of the shale and siltstone bedrock. However, if localized seepage or surface water to accumulate in excavations, it can be controlled by perimeter ditches and pumping from corner sumps.

Frost Protection

The footings should be placed so as to have a minimum earth cover of 1.2 m to allow for frost protection, since the shale is considered susceptible to frost action.

Approaches and Excavations

The base of all footing excavations should be covered immediately upon exposure with a working slab of lean concrete to protect the exposed shale from weathering and softening within 4 hours of exposure. All organic and softened material should be stripped from within the plan limits of the immediate approach embankments prior to placement of any fill. The site should be properly graded and ditched to allow for free drainage in order to prevent ponding of water around the structure and possible softening of the founding shale.

No stability problems are anticipated for permanent embankment and cut slopes constructed to a 2:1 geometry. However, the slope surface should be protected from erosion of the Queenston shale by a thin layer of top soil.

Temporary cut slopes will stand at a 2.0:1 geometry, however, these slopes will weather rapidly and show signs of surficial distress if not protected in a reasonable length of time.

It should be noted that excavation in bedrock may be accomplished without blasting techniques.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Tae C. Kim, Sr. Foundation Engineer, and Frank Reynolds, Technician for Northwestern Region. The equipment was owned and operated by Marathon Drilling Co. Ltd. and Master Soil Investigation Co. Ltd., Toronto.

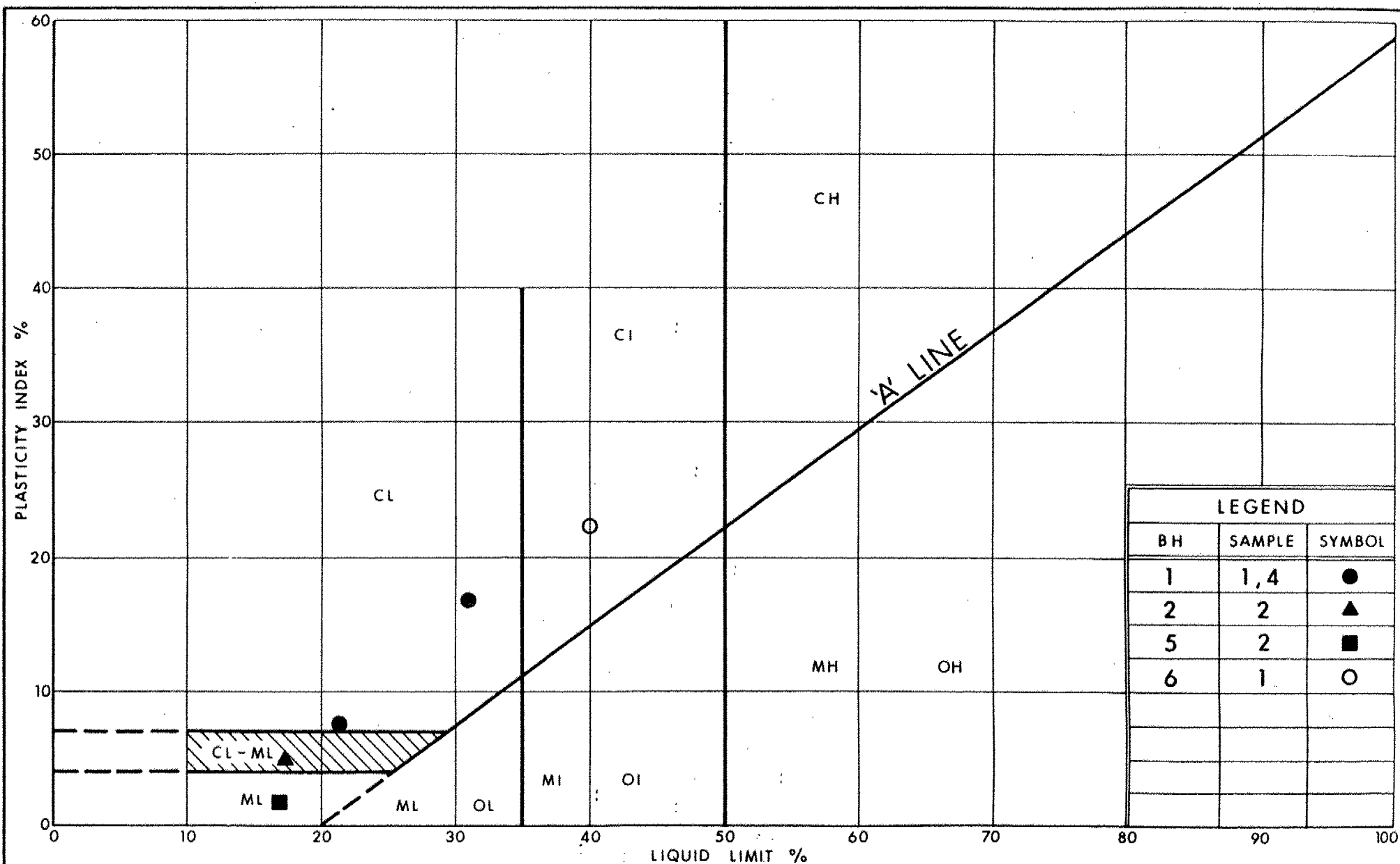
This report was written by Tae C. Kim, Sr. Foundation Engineer, reviewed by P. Payer, Sr. Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.



Tae C. Kim
Tae C. Kim, P.Eng.
Sr. Foundation Engineer

M. Devata
M. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX



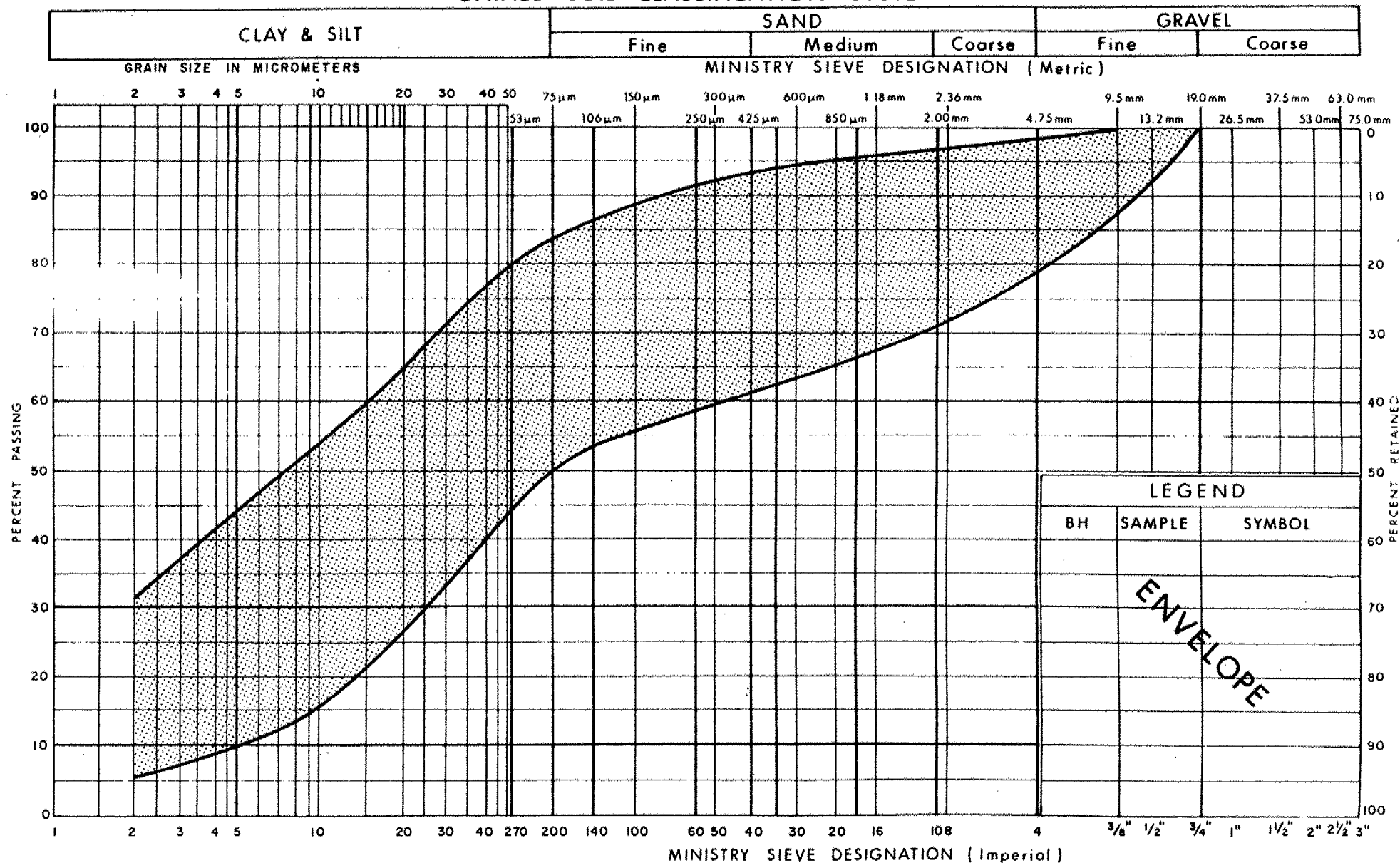
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PLASTICITY CHART HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL (Glacial Till)

FIG No 1

W P 199-77-17

UNIFIED SOIL CLASSIFICATION SYSTEM

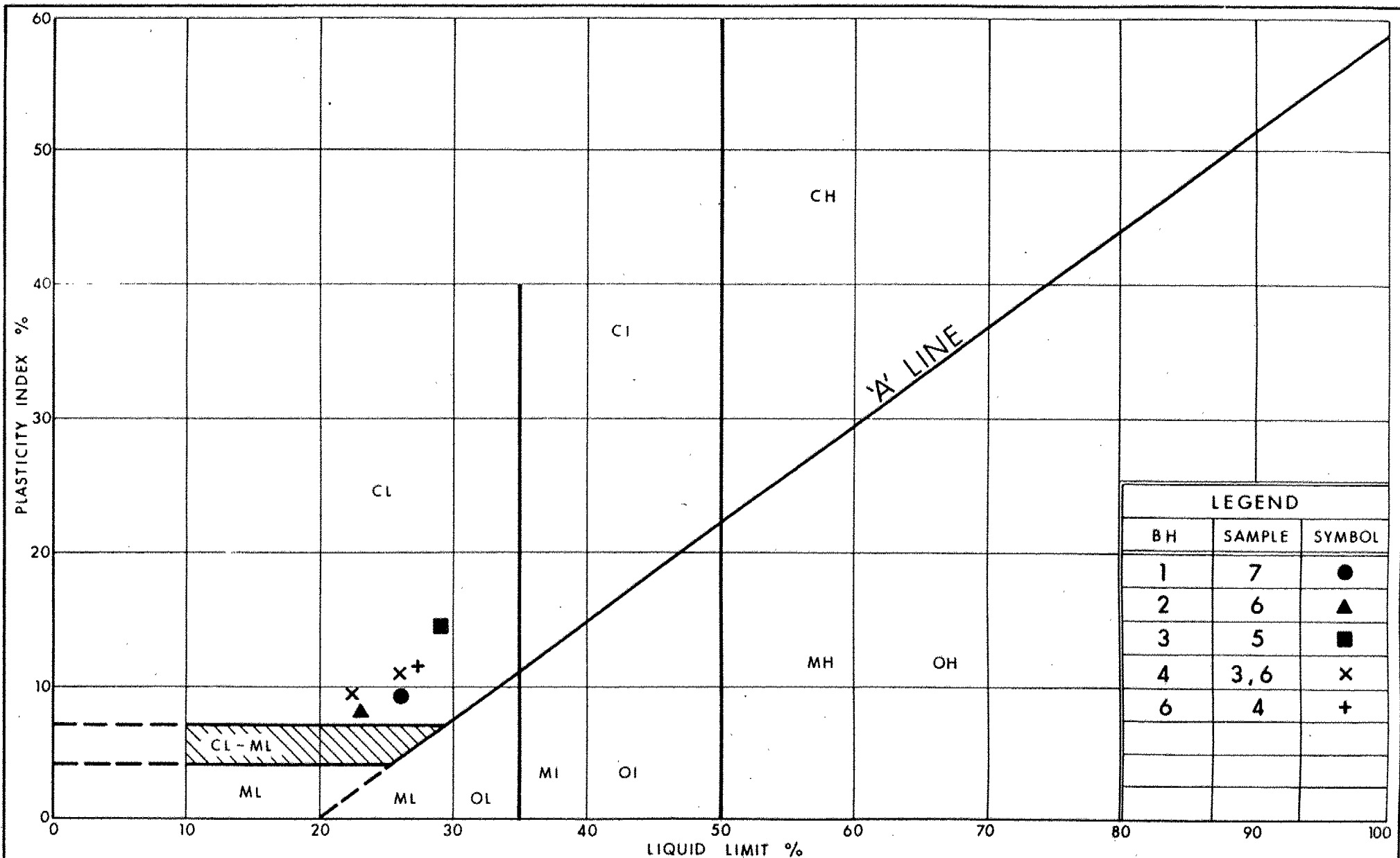


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GRAIN SIZE DISTRIBUTION
HET MIXTURE OF
CLAYEY SILT, SAND & GRAVEL (Glacial Till)

FIG No 2

W P 199-77-17



Ontario

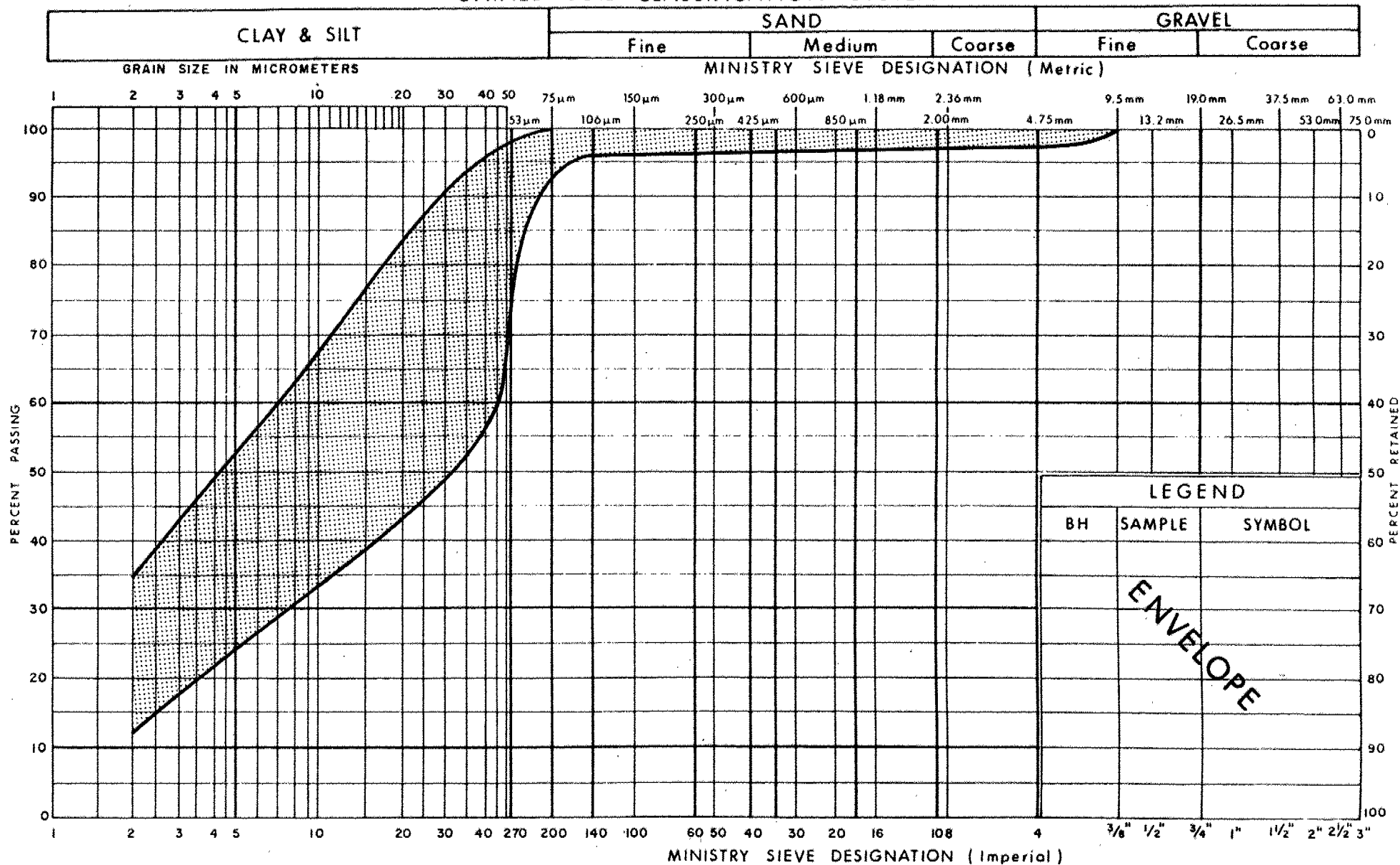
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PLASTICITY CHART Weathered QUEENSTON SHALE

FIG No 3

W P 199-77-17

UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION

Weathered QUEENSTON SHALE

FIG No 4

W P 199-77-17

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

RECORD OF BOREHOLE No 1

1 OF 1 METRIC

W.P. 199-77-17 LOCATION Co-ord: N 4801 981.0 E 277 850.5 ORIGINATED BY F.L.R.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H.S. Auger, and NQ Core COMPILED BY J.L.
 DATUM Geodetic DATE April 19, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
145.3	GROUND SURFACE															
0.0	CLAYEY SILT (Topsoil)						145									
144.5							144									
0.8			1	SS	25											
			2	SS	58											
	HETEROGENEOUS MIXTURE OF CLAYEY SILT, Sand and Gravel Very Stiff to Hard (Glacial Till)		3	SS	90											
141.9			4	SS	52		143									
3.4			5	SS	83		142									
			6	SS	122	/25cm	141									
			7	SS	120	/23cm	140									
			8	SS	120	/5cm	139									
			9	RC	REC 100%		138									
			10	RC	REC 100%		137									
134.3							136									
11.0	End of Borehole						135									

RECORD OF BOREHOLE No 2

1 OF 1 METRIC

W.P. 199-77-17 LOCATION Co-ord: N 4801 958.0 E 277 850.0 ORIGINATED BY F.L.R.
 DIST 4 HWY 403 BOREHOLE TYPE H.S. Auger COMPILED BY J.L.
 DATUM Geodetic DATE April 18, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 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					
144.4	GROUND SURFACE																
0.0	PAVEMENT, GRANULAR 'A' and Bedding Sand						144										
143.6																	
0.8	CLAYEY SILT with Sand Seams (Fill)		1	SS	14												
142.7							143										
1.7	HETEROGENEOUS MIXTURE OF CLAYEY SILT, Sand and Gravel Hard (Glacial Till)		2	SS	127												21 29 45 5
141.7							142										
2.7																	
							141										
							140										
							139										
							138										
							137										
136.7																	
7.7	End of Borehole																

RECORD OF BOREHOLE No 3

1 OF 1 METRIC

W.P. 199-77-17 LOCATION Co-ord: N 4801 977.5 E 277 888.5 ORIGINATED BY T.K.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H.S. Auger, NQ Core COMPILED BY J.L.
 DATUM Geodetic DATE April 19, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	5 10 15 20 25					
142.8	GROUND SURFACE													
0.0	CLAYEY SILT (FILL) Suff													
141.7	Brown		1	SS	12									
1.1	Dark Brown													
141.1	CLAYEY SILT,Stiff (Topsoil) Dark Brown		2	SS	12									1 1 63 35
1.7	Red		3	SS	63									
			4	SS	39									
			5	SS	51									
			6	SS	102									
	BEDROCK QUEENSTON SHALE													
	Weathered Sound		7	SS	109 /8cm									
			8	RC	REC 92%									RQD 30%
			9	RC	REC 87%									RQD 33%
133.8														
9.0	End of Borehole													
	• G.W.L. 5.8 m was not stabilized													

RECORD OF BOREHOLE No 5

1 OF 1 METRIC

W.P. 199-77-17 LOCATION Co-ord: N 4801 984.0 E 277 926.5 ORIGINATED BY F.L.R.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, and H.S. Auger COMPILED BY T.K.
 DATUM Geodetic DATE April 19, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80
141.9	GROUND SURFACE															
0.0	CLAYEY SILT (Fill) Very Stiff	Brown	1	SS	22											
140.5		Reddish Brown	2	SS	86											
1.4	HETEROGENEOUS MIXTURE OF CLAYEY SILT, Sand and Gravel Hard (Glacial Till)	Reddish Brown	3	SS	125											
139.0		Red	4	SS	50											
2.9	BEDROCK QUEENSTON SHALE		5	SS	89											
			6	SS	100 /5cm											
136.9	Weathered															
5.0	End of Borehole Sound															

120/28cm H

• GROUND WATER CONDITIONS

PIEZO. NO.	GROUND WATER ELEVATION (Metres)
1	Dry

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 199-77-17 LOCATION Co-ord: N 4801 951.5 E 277 928.0 ORIGINATED BY F.L.R.
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H.S. Auger, and NQ Core COMPILED BY J.L.
DATUM Geodetic DATE April 18, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
141.7	GROUND SURFACE															
0.0	HETEROGENEOUS MIXTURE OF CLAYEY SILT, Sand and Gravel: Stiff (Glacial Till)		1	SS	13		141									1 15 54 30
140.3	Reddish Brown															
1.4	Red		2	SS	38		140									
			3	SS	45		139									
			4	SS	49		138									0 0 72 28
			5	SS	100		137									
			6	SS	100		136									
			7	RC	REC 88%		135									RQD 75%
			8	RC	REC 100%		134									RQD 80%
			9	RC	REC 100%		133									RQD 75%
132.4	BEDROCK QUEENSTON SHALE															
9.3	End of Borehole															
	* G.W.L. was not stabilized															

ROCK CORE DESCRIPTION

WP 199-77-17

Page 1 of 1

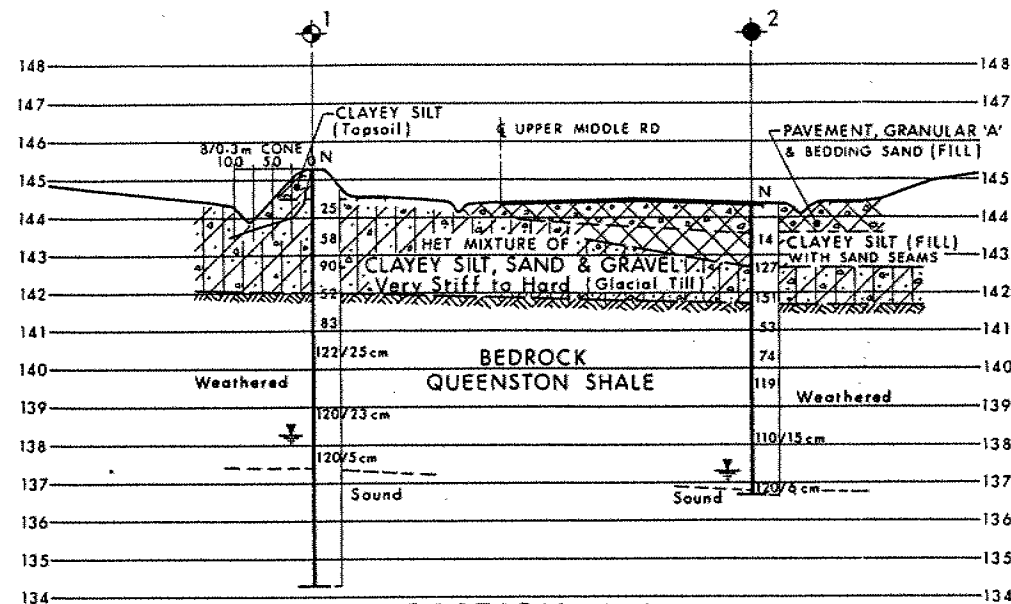
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	9	7.92-9.45	100	72	7.92-10.97	SHALE , dark reddish brown, interbedded with greyish green SILTSTONE (19%); very fine grained; weak to very weak rock; unweathered to slightly weathered; close to very close spaced fractures.
	10	9.45-10.97	100	55		
2						SHALE , expected as above (no core recovered).
3	8	5.97-7.49	92	30	5.97-9.02	SHALE , dark reddish brown, interbedded with greyish green SILTSTONE (23%); very fine grained; weak to very weak rock; unweathered to slightly weathered; close to very close spaced fractures.
	9	7.49-9.02	87	33		
4						SHALE , expected as above (no core recovered).
5						SHALE , expected as above (no core recovered).
6	7	4.78-6.30	88	64	4.78-9.35	SHALE , dark reddish brown, interbedded with greyish green SILTSTONE (27%); very fine grained; weak to very weak rock; unweathered to slightly weathered; close to very close spaced fractures.
	8	6.30-7.82	100	58		
	9	7.82-9.35	100	74		

*CR = CORE RECOVERY

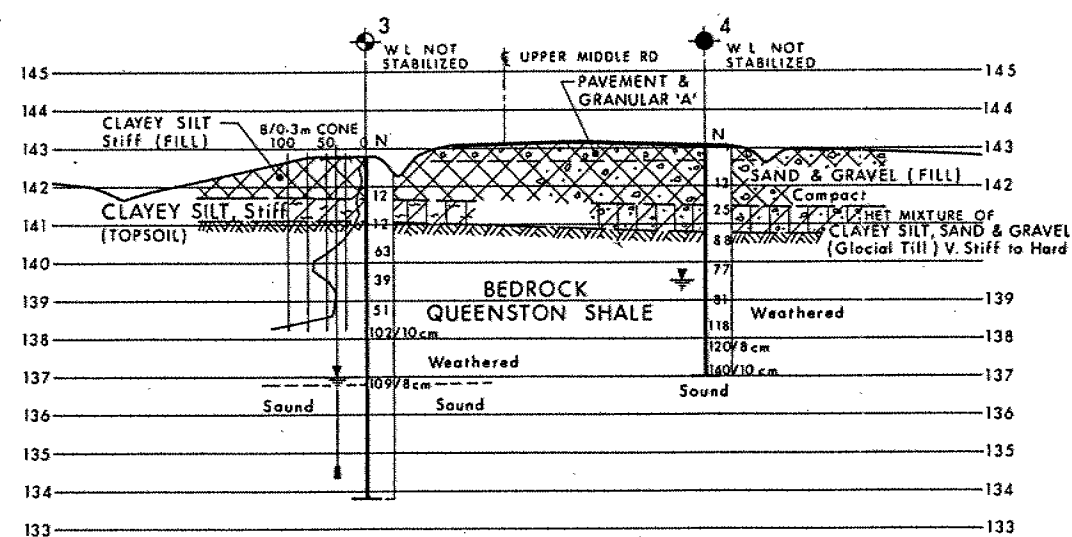
*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

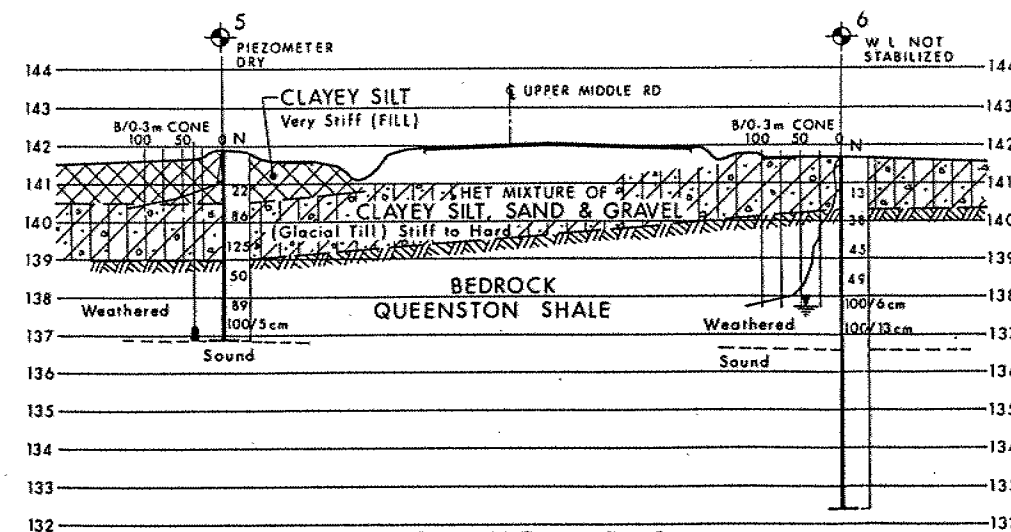
Logged by: DAW, Soils and Aggregates Section



SECTION A-A

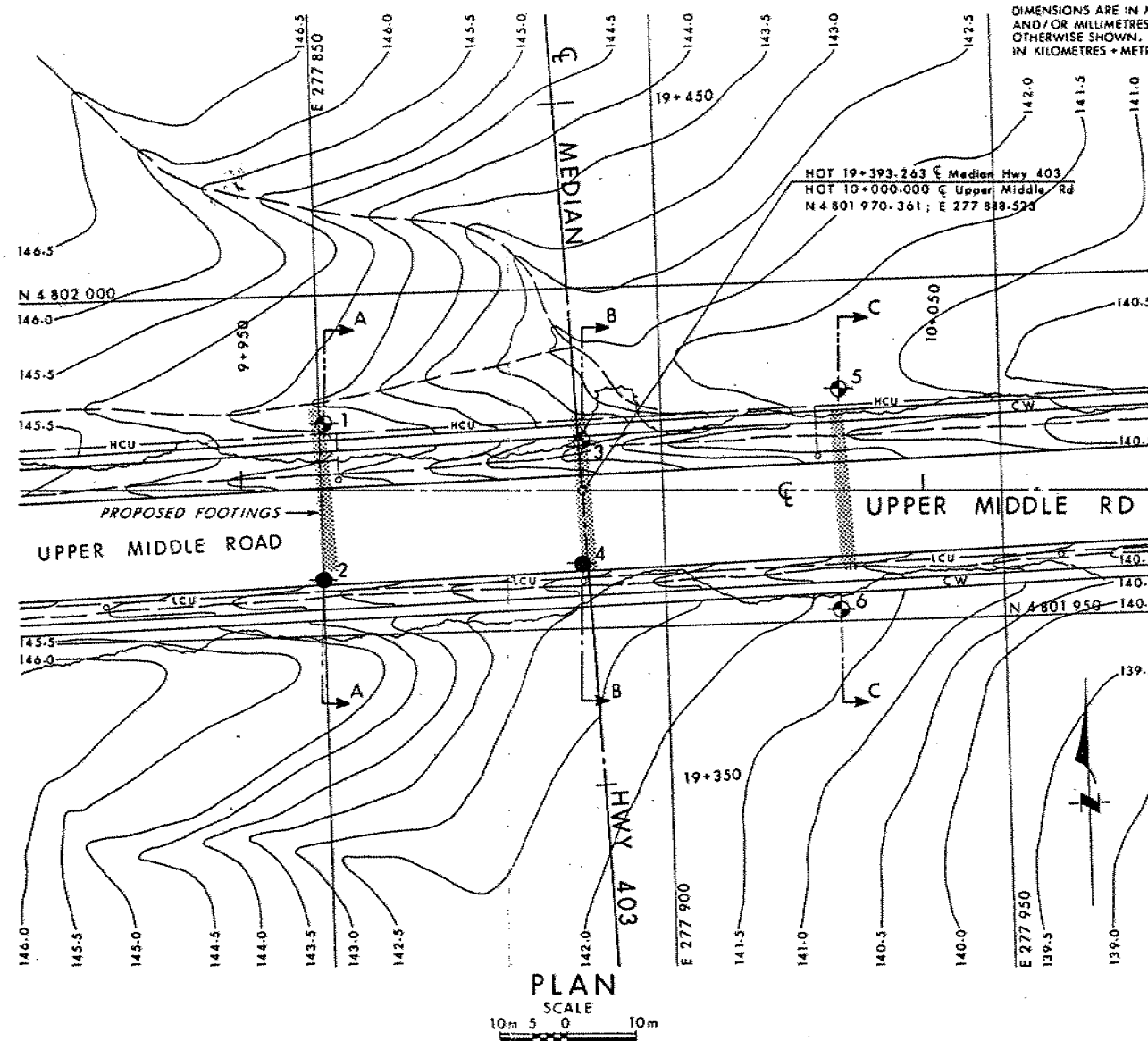


SECTION B-B



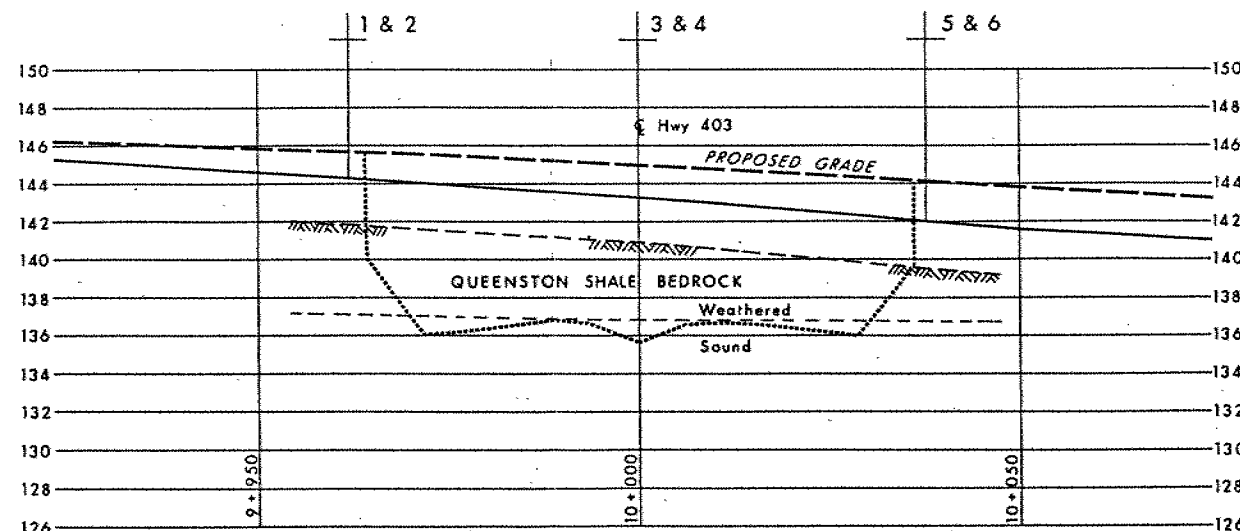
SECTION C-C

SCALE
4m 2 0 4m Hor.
2m 1 0 2m Vert



PLAN

SCALE
10m 5 0 10m



PROFILE UPPER MIDDLE ROAD

SCALE
10m 5 0 10m HOR
4m 2 0 4m VERT

METRIC

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

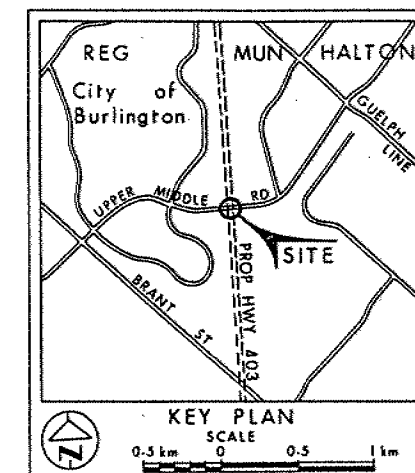
CONT No
WP No 199-77-17

UPPER MIDDLE ROAD

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 1990 04
- W.L. in Piezometer
- ⊕ Piezometer

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	145.3	4801981.0	277 850.5
2	144.4	4801958.0	277 850.0
3	142.8	4801977.5	277 888.5
4	143.1	4801959.5	277 888.0
5	141.9	4801984.0	277 926.5
6	141.7	4801951.5	277 926.0

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 included in accordance with the conditions of Section 102-2 of Form 100.

REV.	DATE	BY	DESCRIPTION
1			

Geocres No 30M5-161

HWY No 403	DIST 4
SUBMITTAL CHECKED/DATE 1990 10 09	SITE 10-476
DRAWN/DATE 1990 10 09	DWG 1997717-A

January 1990

Hwy. 403 - Upper Middle Road U'Pass
W.P. 199-77-17, Site 10-476
District 6, Toronto



Looking West Along U.M.R.
North Side



Looking West U.M.R.
South Side

January 1990

Hwy. 403 - Upper Middle Road U'Pass
W.P. 199-77-17, Site 10-476
District 6, Toronto



Looking East Along U.M.R.
North Side



Looking West Along U.M.R.
South Side