

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M12-190

DIST. 6 REGION

W.P. No. 54-82-10

CONT. No. 88-48

W. O. No.

STR. SITE No. 24-492

HWY. No. 401/410

LOCATION Hwy 401/410 Interchange
Ramp W-N (Bridge #67)

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

METRIC

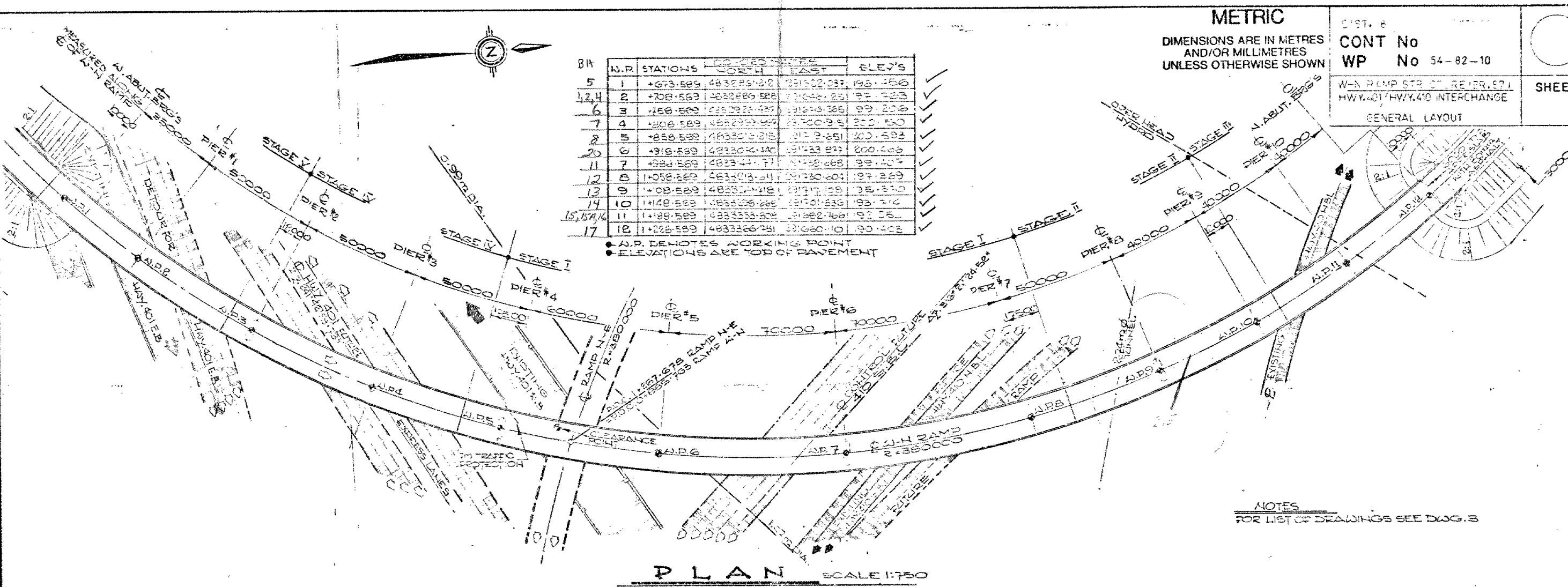
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UNLESS OTHERWISE SHOWN

CONT No
WP No 54-82-10
W-N RAMP STR. OF REVER. 871
HWY. 401/HWY. 410 INTERCHANGE
GENERAL LAYOUT

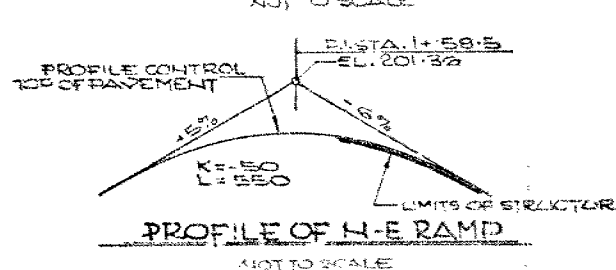
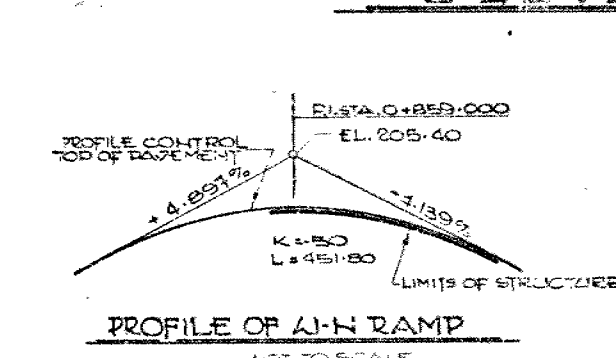
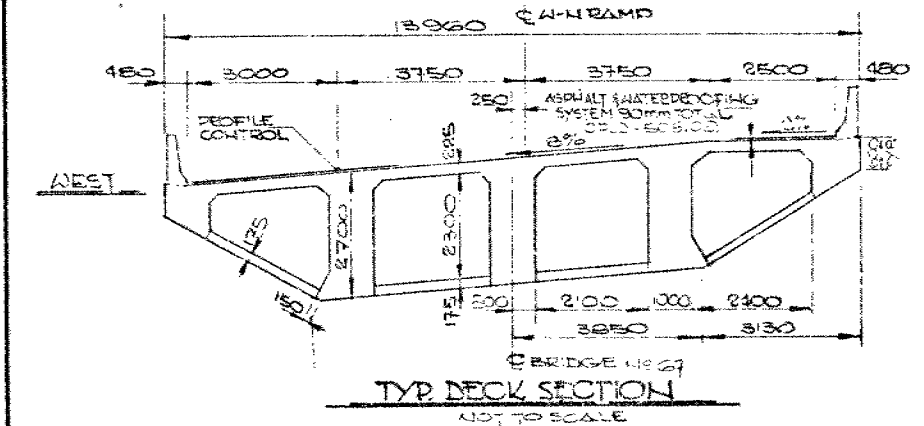
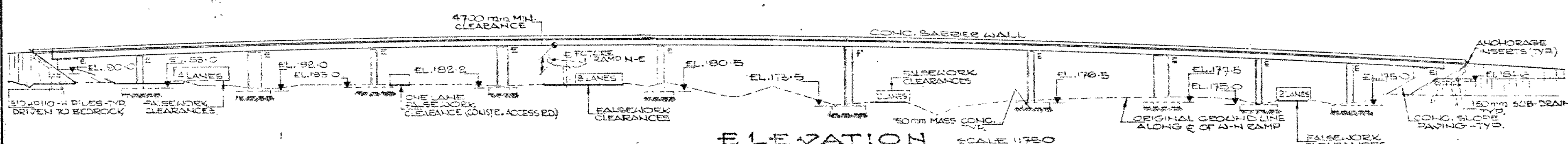
SHEET

STATION	N.P.	STATIONS	ELEVATIONS	ELEVATIONS
5	1	+073.589	483285.20	291502.33
12.4	2	+708.563	483285.58	291502.33
6	3	+158.569	483285.58	291502.33
7	4	+308.569	483285.58	291502.33
8	5	+858.569	483285.58	291502.33
20	6	+918.569	483285.58	291502.33
11	7	+988.569	483285.58	291502.33
12	8	+1058.569	483285.58	291502.33
13	9	+1088.569	483285.58	291502.33
14	10	+1148.569	483285.58	291502.33
15, 15.7, 16	11	+1188.569	483285.58	291502.33
17	12	+1228.569	483285.58	291502.33

• A.P. DENOTES WORKING POINT
• ELEVATIONS ARE TOP OF PAVEMENT



NOTES
FOR LIST OF DRAWINGS SEE DWG. 3



GENERAL NOTES

CLASS OF CONCRETE

FOOTINGS	30 MPa
PIERS	35 MPa
ABUTMENTS AND WINGWALLS	30 MPa
DECK	35 MPa
BARRIER WALLS	30 MPa
APPROACH SLABS	30 MPa

CLEAR COVER TO REINFORCING STEEL

FOOTINGS	100 ± 25
ABUTMENTS AND WINGWALLS	60 ± 20
FRONT FACE	70 ± 20
BACK FACE	80 ± 20
PIERS	80 ± 20
DECK	70 ± 20
TOP SLAB	40 ± 10
BOTTOM SLAB	40 ± 10
TOP	50 ± 10
BOTTOM	40 ± 10
WING WALLS	70 ± 20
APPROACH SLABS	70 ± 20
AND AS NOTED	

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400
UNLESS OTHERWISE SPECIFIED.
BAR MARKS WITH SUFFIX 'D' SHALL
BE COATED BARS.

CONSTRUCTION NOTES

THE CONTRACTOR SHALL FINISH THE
BEARING SEATS DEAD LEVEL TO THE
SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm.
THE SUPERSTRUCTURE SHALL BE BUILT
IN FIVE CONSTRUCTION STAGES AS SHOWN
FOR FALSEWORK CLEARANCE DETAILS SEE DWG. 30



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION	DATE
DESIGN		PC	CHECK	
DRAWING		PC	CHECK	
			LOADING	
			SITE No	
			DWG	

METRIC
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DIST. 6
CONT No
WP No 54-82-10
W-N RAMP STRUCTURE (BR. 67)
HWY. 401/HWY. 410 INTERCHANGE
ABUTMENT FOOTINGS

SHEET

PILE DATA TABLE

LOCATION	BATTER	No.	LENGTH	TYPE
WEST ABUTMENT	1:3	11	7 800	HP 310 x 110
	1:4	6	7 600	
	1:12	4	7 400	
	VERT.	4	7 400	
NORTH ABUTMENT	1:3	11	11 400	HP 310 x 110
	1:4	6	11 100	
	1:12	4	10 800	
	VERT.	4	10 800	

PILE DATA

- PILE TO BE DRIVEN TO BEDROCK.
- PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTING.
- PILE LENGTH SHOWN ON THE DRAWING IS THE THEORETICAL LENGTH BELOW CUT-OFF.
- ALL PILES HAVE DRIVING SHOES. SEE DD-5301.

PILE DESIGN DATA

- CAPACITY AT S.L.S. TYPE II = 1150 kN/PILE.
- FACTORED CAPACITY AT U.L.S. = 1 600 kN/PILE.

FOOTING LAYOUT PLAN

1:100

PILE LAYOUT & FOOTING REINFORCEMENT

(TYPICAL WEST & NORTH ABUTMENT FOOTINGS)
1:75

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

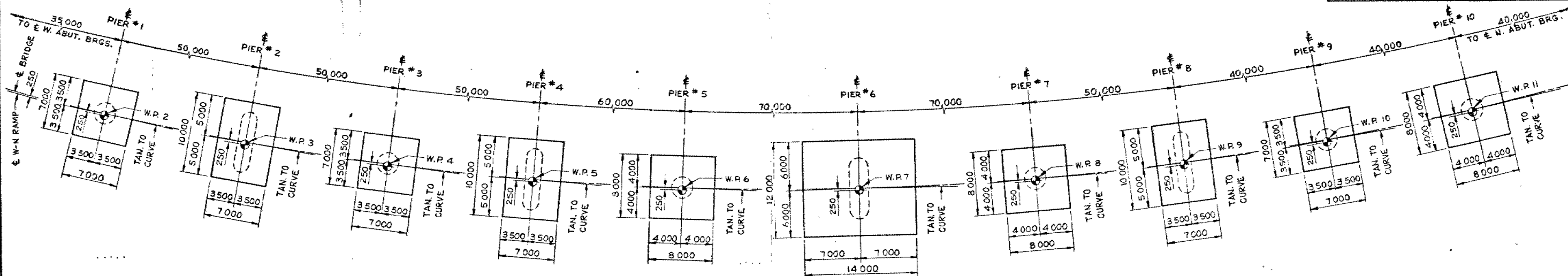
REVISIONS	DATE	BY	DESCRIPTION	DATE
DESIGN	7/85	BY	LOADING	7/85
DRAWING	7/85	CHECK	SITE No	24-31-492
			LONG	4

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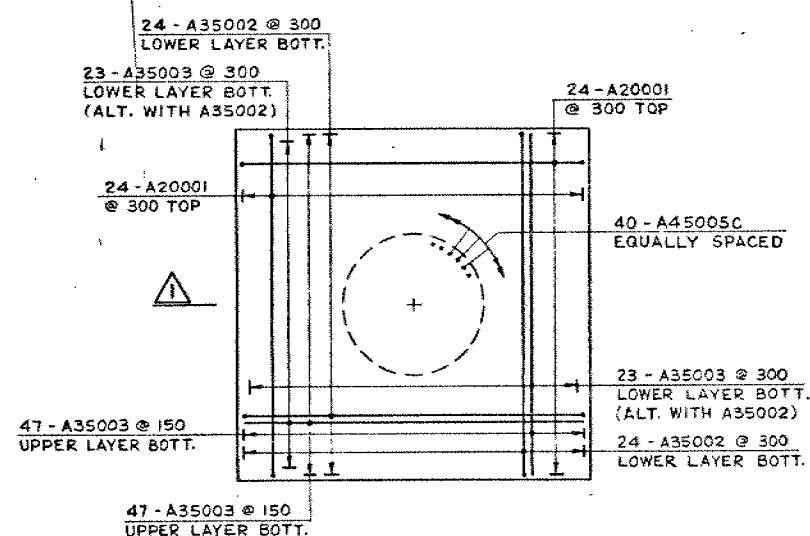
DIST. 6
CONT No
WP No 54-82-10

W-N RAMP STRUCTURE (BR. 67)
HWY. 401/HWY. 410 INTERCHANGE
PIER FOOTINGS I

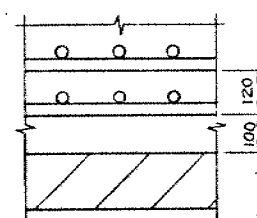
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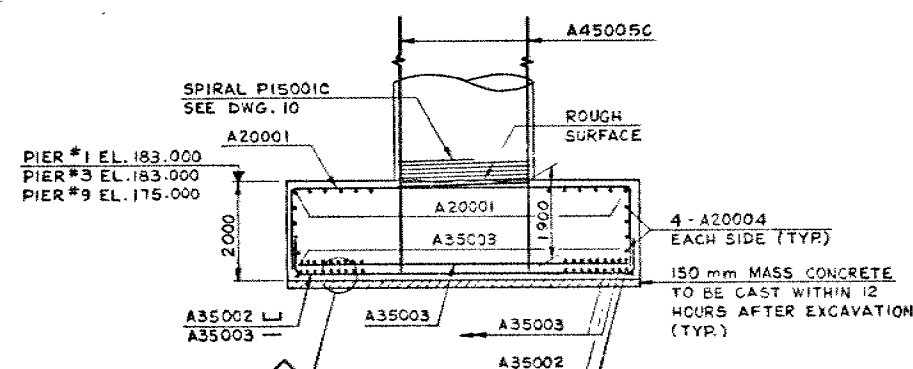
PIER FOOTINGS
1:250



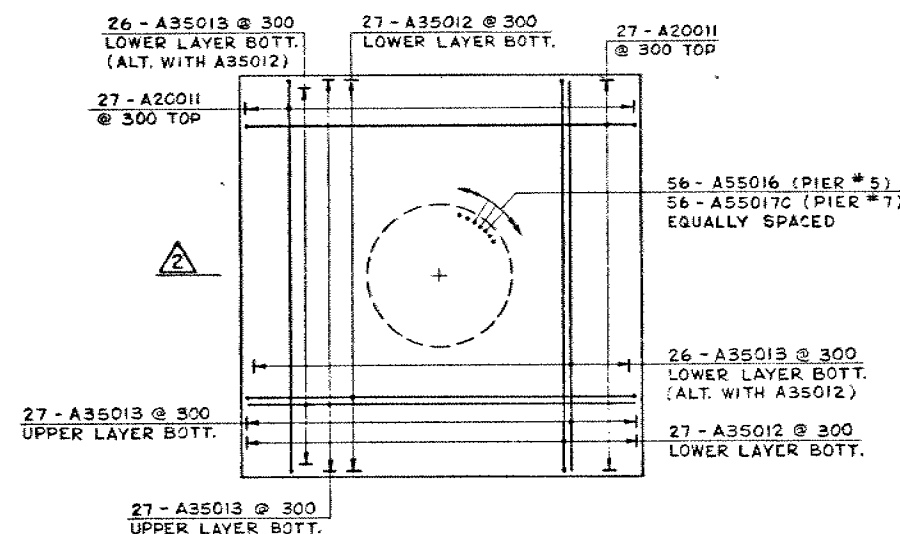
FOOTING PLAN FOR PIERS #1, #3 & #9
1:75



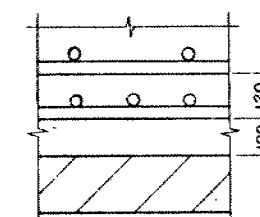
A
1:10



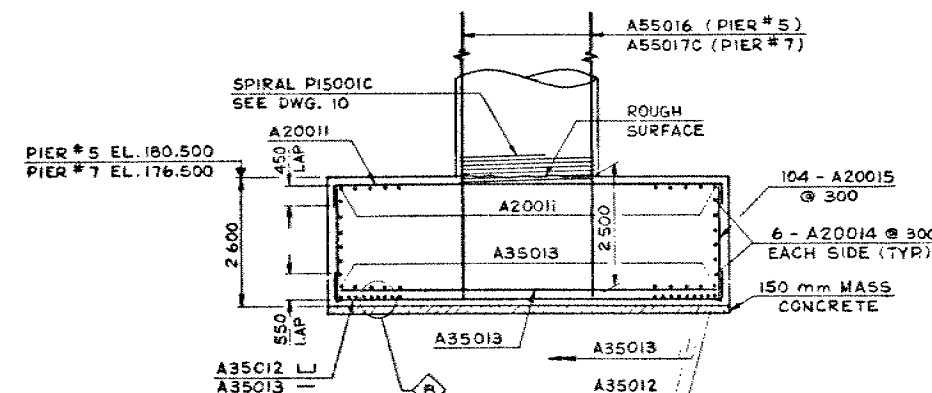
A
1:75



FOOTING PLAN FOR PIERS #5 & #7
1:75



B
1:10



B
1:75

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



REVISIONS	DATE	BY	DESCRIPTION	DATE
DESIGN	1985	10/10/85	CH 300 - A-83	JULY/85
DRAWING	1985	10/10/85	SITE No 54-81-492	DWG. 5



Ontario

Ministry of
Transportation and
Communications

foundation investigation and design report

2 additional B.H.
should be incorporated
for contract pkg.
H. H. H.

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 54-82-10

DIST 6

HWY 401/410 IC

STR SITE 24-492

Bridge #67, Ramp W-N

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FOUNDATION INVESTIGATION REPORT

For

Bridge #67, Ramp W-N

Hwy. 401/Hwy. 410 Interchange

W.P. 54-82-10; Site 24-492

District 6, Toronto

INTRODUCTION:

This report summarizes the results of a foundation investigation required for the proposed ramp and its associated retaining walls.

The fieldwork was conducted from 84 09 24 to 84 10 10 utilizing continuous flight auger machines equipped with solid stem augers and B and N core barrels.

This work consisted of,

- 3 sampled boreholes, and
- 15 sampled boreholes/rock cores

SITE DESCRIPTION

The site is located at the existing partial interchange of Hwy. 401 and Hwy. 410 in the City of Mississauga, Regional Municipality of Peel.

Topographically, the ground surface is generally level, sloping gently towards the east. Near the eastern limit of the site, existing Hwy. 410 is in a 10± m cut.

Physiographically, the site lies in the Peel Plain (Chapman and Putnam, 1969), an area characterized by level to undulating till plains underlain by shale or limestone bedrock.

Land use in the area is predominantly light industrial.

SUBSURFACE CONDITIONS

General

The Record of Borehole Sheets, (Appendix) illustrate the conditions at the borehole locations. The locations and elevations of the boreholes and stratigraphical profiles based on the borehole data, are shown on Drawing No. 548210-A.

At the borehole locations, less than 3.4 m of predominantly silty clay overburden, overlies the shale bedrock.

Overburden

SILTY SAND; occasional gravel zones

This loose material was encountered at the surface at BH #1 where it extended for a thickness of 0.9 m.

SILTY CLAY; with/some sand, some/trace gravel, occasional shaly zones

This firm to hard (typically hard) material was encountered at the surface at all boreholes except BH #1. At BH #1 it underlies the surface SILTY SAND.

The material is a heterogeneous, cohesive mixture, with low plasticity and in some areas occasional organics.

The material overlies the bedrock and ranges in thickness from 0.3 to 3.4 m at the borehole locations.

Physical properties of the material as determined by field tests and laboratory tests are summarized below:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w)	4.5 - 17.5%	9.3%	9.8%
Liquid Limit (w_L)	17.0 - 35.0%	29.3%	30.8%
Plastic Limit (w_p)	17.0 - 20.0%	18.1%	18.8%

Figure 1 illustrates a typical grain size distribution for this material.

Bedrock

The bedrock is Georgian Bay Formation shale containing occasional limestone layers. The upper 1± m is weathered.

Refer to the Record of Borehole Sheets for bedrock elevations and boundaries between weathered and unweathered bedrock.

Refer to the appended Descriptions of Rock Core for detailed descriptions of the bedrock.

Groundwater

The groundwater elevation is variable but generally near the surface. Refer to the Record of Borehole Sheets for groundwater elevations at the borehole locations.

DISCUSSION AND RECOMMENDATIONS

It has been proposed to construct a high-level ramp to carry traffic from Hwy. 401 E-bound to Hwy. 410 N-bound. This proposal will involve the construction of;

- a 10 span structure
- at the south abutment, approach fills $11.5 \pm$ m high, and a $45 \pm$ m long retaining wall (perhaps temporary) between the north side of the approach fill and the proposed Hwy. 401 E-bound detour
- at the north abutment, approach fills $12.5 \pm$ m high, and a $60 \pm$ m long retaining wall between the approach fill and the existing Hwy. 410 N-bound lane.

General recommendations, applicable to all foundations in this project, are provided below.

Recommendations for seven foundation design alternatives follow. From a foundations viewpoint, the combination of alternatives which leads to the least expensive design should be adopted.

GENERAL RECOMMENDATIONS

EARTH PRESSURE CALCULATIONS:

Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the O.H.B.D.C.

For design purposes, the physical properties of the backfill are as follows:

MATERIAL	ϕ	γ
GRANULAR 'A'	35°	22.0 kN/m ³
GRANULAR 'B'	30°	21.2 kN/m ³

For Foundation Alternatives 1-3, the foundations are considered to be non-yielding, and the at-rest condition (K_0) applies.

For Foundation Alternatives 4-7, the foundations are considered to be yielding, and the active condition (K_a) applies.

SETTLEMENT CONSIDERATIONS:

At the recommended design loadings, total and differential settlements of the structures will be negligible.

However total settlements of up to 100 mm are anticipated at the approach embankments. In order to minimize differential settlements between the approach embankments and the abutments, the approach embankments should be constructed for as long as possible, but at least 3 months before completion of the abutments.

If perched abutments are adopted, the entire, approach embankments should be constructed to their final grades, and excavated as required when the abutments are constructed.

SLOPE STABILITY:

No stability problems are anticipated for embankments or cuts less than 10 m high and with slopes of 2 horizontal to 1 vertical. For embankments or cuts greater than 10 m high a 3 m wide mid-height berm is required.

If steeper slopes are required, please contact this Section for recommended slope angles.

All footings on or above a slope, must be located:

- a) outside the limits of a 2:1 line drawn from the toe of the slope,
- and b) a minimum horizontal distance of 2.0 m from the edge of the slope.

FROST PROTECTION:

The minimum cover required for frost protection is 1.2 m.

DE-WATERING:

De-watering is not anticipated to be a major problem. It is expected that groundwater entering excavations can be controlled by conventional pumping techniques.

FOOTING EXCAVATIONS:

Excavations in bedrock may be accomplished without blasting techniques.

Temporary cut slopes in the overburden, and in the upper 1 m of weathered shale bedrock should not be steeper than 1.5 horizontal to 1 vertical. Temporary cut slopes in the weathered shale bedrock below 1 m depth and in the sound shale bedrock should not be steeper than 1 horizontal to 3 vertical.

All soft or loose material at the proposed footing locations should be removed, and the excavation bottom should be covered, within 12 hours of exposure, with a 15 cm pad of mass concrete. Any existing trenches (e.g. underground utilities) encountered within the footing areas should be excavated to sound bedrock and backfilled within 12 hours of exposure, with mass concrete.

RESISTANCE TO LATERAL FORCES:

For design purposes, the following unfactored friction coefficients or adhesion values may be assumed to apply between the bases of footings and the indicated founding strata.

unweathered shale bedrock	$\tan 24^\circ$ (friction)
weathered shale bedrock	$\tan 20^\circ$ (friction)
hard silty clay	100 kPa (cohesion)
compacted Granular 'A'	$\tan 30^\circ$ (friction)

If additional resistance to lateral forces is required, please contact this Section. Keys, dowels and rock anchors may be used to increase resistance.

Foundation Design Alternatives

ALTERNATIVE 1 - SPREAD FOOTINGS ON UNWEATHERED BEDROCK

The structure abutments, the structure piers and the retaining walls may be supported on spread footings founded on unweathered bedrock at or below the elevations indicated in Table A.

The following design values are recommended:

Working Stress Design Method:

- net safe bearing pressure = 1000 kPa

O.H.B.D.C. Method:

- Factored Bearing Capacity at U.L.S. = 1500 kPa

- Bearing Capacity at S.L.S. Type II will not govern design

ALTERNATIVE 2 - SPREAD FOOTINGS ON WEATHERED BEDROCK

The structure abutments, the structure piers and the retaining walls may be supported on spread footings founded on weathered bedrock at or below the elevations indicated in Table A.

The following design values are recommended:

Working Stress Design Method:

- net safe bearing pressure = 670 kPa

O.H.B.D.C. Method:

- Factored Bearing Capacity at U.L.S. = 1000 kPa

- Bearing Capacity at S.L.S. Type II will not govern design

ALTERNATIVE 3 - SPREAD FOOTINGS ON HARD SILTY CLAY

The structure abutments, the structure piers and the retaining walls may be supported on spread footings founded on hard silty clay at or below the elevations indicated in Table A.

The following design values are recommended:

O.H.B.D.C. Method:

- Factored Bearing Capacity at U.L.S. = 750 kPa

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

ALTERNATIVE 4 - PERCHED ABUTMENTS ON STEEL H-PILES

The structure abutments may be supported on steel H-piles, equipped with reinforced tips and driven to bedrock. In this case, to facilitate pile driving, particle sizes in the fill immediately beneath the pile locations should not exceed 75 mm.

The following design values are recommended:

O.H.B.D.C Method:

<u>Pile Type</u>	<u>Factored Capacity at U.L.S.</u>	<u>Capacity at S.L.S. Type II</u>
310 HP 110	1600 KN per pile	1150 KN per pile

For design purposes, it is estimated that the recommended pile capacities will be attained at elevation 181 m at the south abutment and at elevation 173 m at the north abutment.

ALTERNATIVE 5 - PERCHED ABUTMENTS ON COMPACTED GRANULAR 'A' FILL

The abutments may be supported on perched spread footings founded on compacted Granular 'A' fill. Refer to Figure 2 for design details.

TABLE A

REVISED FOOTING	FOOTING DESCRIPTION	APPROXIMATE FOOTING LOCATION (RAMP W-N CHAINAGE)	FOOTING ELEVATION (METRES)		
			FOUNDATION ALTERNATIVE 1 (UNWEATHERED BEDROCK)	FOUNDATION ALTERNATIVE 2 (WEATHERED BEDROCK)	FOUNDATION ALTERNATIVE 3 (HARD SILTY CLAY)
West Abut.		BH 5	182.0 ✓	182.6 ✓	183.0 ✓
Pier 1	SOUTH ABUT.	1/2, 4 0 + 700, C/L	181.0 ✓	182.0 ✓	183.0 ✓
" 2	PIER 1	0 + 752, C/L	179.8	182.0	182.5
" 3	PIER 2	0 + 809, C/L	181.0	N/A	N/A
" 4	PIER 3	0 + 863, C/L	180.2	181.1	182.0
" 5	PIER 4	0 + 902, C/L	179.2	181.2	181.6
" 6	PIER 5	0 + 942, C/L	177.2	N/A	N/A
" 7	PIER 6	0 + 993, C/L	172.3	173.0	N/A
" 8	PIER 7	1 + 053, C/L	176.0	N/A	176.5
" 9	PIER 8	1 + 103, C/L	176.2	N/A	177.0
" 10	PIER 9	1 + 153, C/L	174.6	N/A	N/A
	NORTH ABUT.	1 + 203, C/L	173.2	174.6	175.0
	SOUTH ABUT. RETAINING WALL	0 + 670, 30 LT TO 0 + 700, 12 LT TO 0 + 720, 7 RT (interpolate between stations)	180.2 181.1 179.3	181.7 182.7 180.5	183.0 183.0 183.0
	NORTH ABUT. RETAINING WALL	1 + 200, 5 LT TO 1 + 230, 6 LT TO 1 + 265, 7 LT (interpolate between stations)	173.2 N/A N/A	174.6 176.0 175.0	175.0 176.3 175.5

All loose or soft material beneath the approach embankment at the abutment-locations should be removed.

The following design values are recommended:

O.H.B.D.C. Method:

- Factored Bearing Capacity at U.L.S. = 900 kPa
- Bearing Capacity at S.L.S. Type II = 350 kPa

ALTERNATIVE 6 - REINFORCED EARTH RETAINING WALLS

Permanent retaining walls may be constructed using reinforced earth methods. Please contact this Section for design details, if this option is considered.

ALTERNATIVE 7 - TIE-BACK RETAINING WALLS

Both permanent and temporary retaining walls may be constructed using soldier piles and lagging, tied back with anchors to bedrock or earth. Please contact this Section for Design details, if this option is considered.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. H. Sturm, Project Foundations Engineer, and Mr. D. Thanasse, Student Engineer.

Descriptions of the rock core samples were carried out under the supervision of Mr. E. Magni, Geologist.

The report was written by Mr. D. H. Dundas, Foundations Engineer and reviewed by Mr. M. Devata, Chief Foundations Engineer.

The equipment used was owned and operated by Longyear Canada Ltd., and Master Soil Investigation Ltd.



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

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

APPENDIX

1. The first part of the appendix contains a list of the names of the persons who have been appointed to the various offices of the government since the year 1800.

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

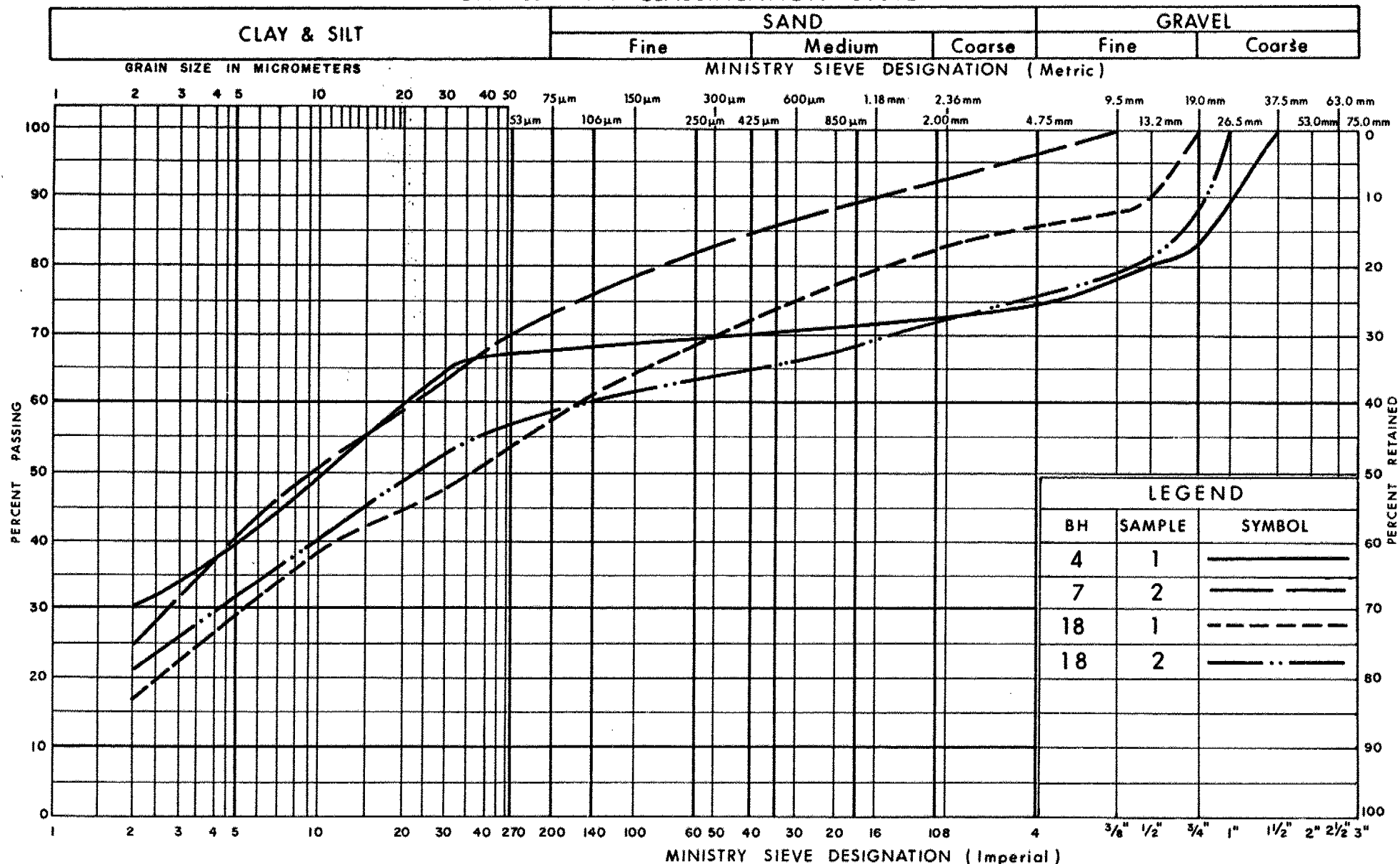
MECHANICAL PROPERTIES OF SOIL

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	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 = $w_L - w_p$	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^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

UNIFIED SOIL CLASSIFICATION SYSTEM

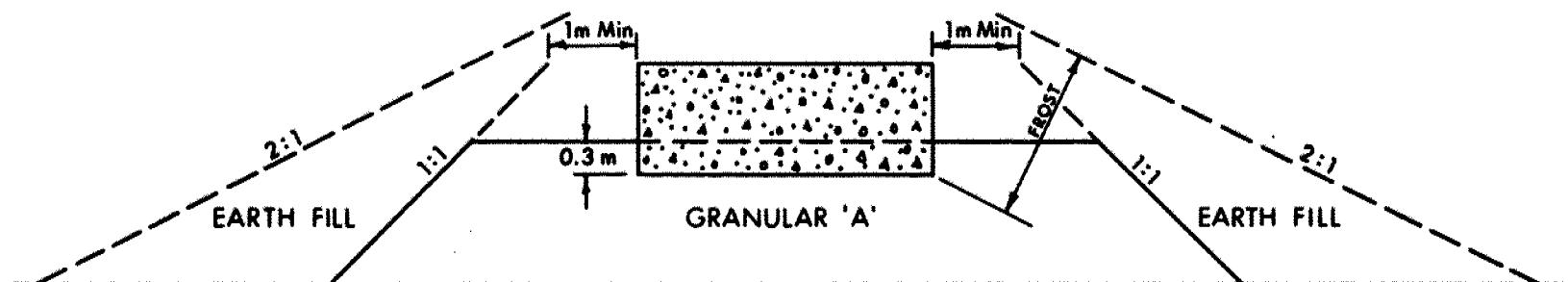


Ministry of
Transportation and
Communications

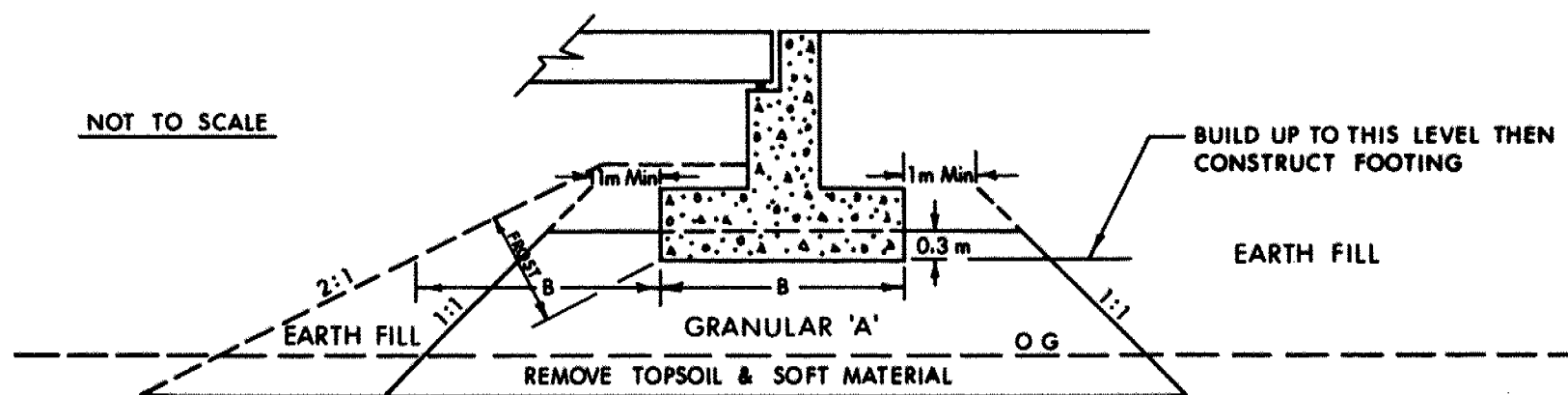
GRAIN SIZE DISTRIBUTION
SILTY CLAY, WITH/SOME SAND SOME/TRACE OF GRAVEL
OCCASIONAL SHALY ZONES

FIG No 1

W P 54-82-10



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T C STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



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Communications

ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

FIG No 2

W P 54-82-10

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
2NW	1.93 - 3.46 - 3.91 - 4.98	38 75 93	10 20 14	1.93 - 3.91 - 4.98	Shale, highly weathered, with limestone layers (high core loss zone) Shales (95%), grey, unweathered, closely spaced joints, with limestone (5%), unweathered, 1 to 10 cm thick layers
3NW	2.85 - 4.35 - 5.72	48 100	12 0	2.85 - 4.35 - 5.72	Shale, highly weathered, very closely spaced joints (high core loss zone) with limestone, 2 to 15 cm thick layers Limestone (60%), grey, unweathered, closely spaced joints, with shale (40%), grey, slightly weathered, with moderately weathered zones, closely spaced joints
4NW	3.46 - 4.47 - 5.85	65 85	0 67	3.46 - 4.47 - 5.85	Shale (50%), moderately weathered, very closely spaced joints, with limestone (50%), 1 to 7 cm thick layers Shale (60%), grey, unweathered, moderately spaced joints, with limestone (40%), grey, 1 to 20 cm thick layers
6NW	3.46 - 5.11	100	39	3.46 - 5.11	Shale (75%), grey, unweathered, closely spaced joints, with limestone (25%), unweathered, closely spaced joints, 2 to 20 cm thick layers
7NW	3.23 - 5.44	100	18	3.23 - 3.39 - 5.44	Soil Shale (50%), grey, slightly weathered to unweathered, closely spaced joints, with limestone (50%), light grey, unweathered, closely spaced joints, 2 to 25 cm thick layers

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
8NW	2.39 - 3.76	80	13	2.39 - 3.76	Limestone (90%), light grey, unweathered, closely spaced joints, with shale (10%), grey, slightly to moderately weathered, very closely spaced joints
9NW	0.89 - 1.45 - 2.32 - 3.41	64 35 84	0 0 30	0.89 - 1.45 - 2.32 - 3.00 - 3.41	Limestone (100%), light grey, slightly weathered, closely spaced joints Shale, highly weathered, with some limestone layers, high core loss zone Shale (95%), grey, moderately weathered, very closely spaced joints, with limestone (5%), 2 to 3 cm thick layers Limestone (100%), light grey, unweathered, moderately spaced joints
10NW	1.98 - 3.13 - 3.74	89 100	42 83	1.98 - 2.72 - 3.74	Limestone (100%), light grey, unweathered, closely spaced joints Shale (80%), grey, slightly weathered to unweathered, closely spaced joints, with limestone (20%), unweathered, 1 to 8 cm thick layers
11NW	0.71 - 0.98 - 2.49 - 3.18	100 100 100	0 42 22	0.71 - 1.30 - 3.18	Shale (50%), grey, moderately weathered, very closely spaced joints, with limestone (50%), light grey, slightly weathered Shale (60%), grey, slightly weathered to unweathered, closely spaced joints, with limestone (40%), light grey, 5 to 15 cm thick layers

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
12NW	0.84 - 1.27 - 2.54	76 100	0 54	0.84 - 1.88 - 2.54	Shale (90%), grey, slightly weathered, very closely spaced joints, with limestone (10%), 20 cm thick layer Shale (100%), grey, unweathered, closely spaced joints
13NW	0.46 - 1.45 - 1.96 - 2.59 - 4.50	33 50 40 91	0 0 16 53	0.46 - 2.59 - 4.50	Shale, moderately to highly weathered, with some limestone, high core loss zone Shale (50%), grey, unweathered, closely spaced joints, with limestone (50%), light grey, unweathered, closely spaced joints
13(A)NW	0.20 - 1.25 - 1.40 - 1.86 - 2.46	29 17 100 100	10 0 0 33	0.20 - 1.40 - 2.46	Soil and boulders Shale (70%), grey, unweathered, closely spaced joints, with limestone (30%), unweathered, 1 to 20 cm thick layers
14NW	0.31 - 1.58 - 1.83	90 100	60 100	0.31 - 1.83	Limestone (70%), grey, unweathered, with shale (30%), unweathered
15NW	2.44 - 3.44 - 5.74	41 74	0 22	2.44 - 3.44 - 5.74	Shale, highly weathered, with some limestone, high core loss zone Limestone (75%), grey, unweathered, closely spaced joints with shale (25%), grey, slightly weathered

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - W.P. 54-82-10

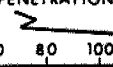
BOREHOLE NUMBER	CORE RECOVERIES			CORE DESCRIPTION	
	DEPTH (M)	% CR*	% RQD*	DEPTH (M)	DESCRIPTION
15(A)NW	1.93 - 3.41 - 4.45	22 78	0 24	1.93 - 3.41 - 3.74 - 4.45	Soil Limestone (100%), light grey, unweathered, closely spaced joints Shale (80%), grey, moderately weathered, very closely spaced joints, with limestone layers 1 to 12 cm thick
17NW	1.83 - 2.27 - 3.36 - 3.66 - 4.04	53 28 58 60	0 0 0 0	1.83 - 4.04	Shale and limestone, highly weathered, high core loss zone
18NW	2.39 - 3.29 - 3.86 - 6.00	20 67 63	0 26 18	2.39 - 3.29 - 6.00	Shale and limestone, highly weathered, high core loss zone Limestone (50%), light grey, slightly weathered, with shale (50%), moderately weathered, high core loss

* CR = CORE RECOVERY; RQD = ROCK QUALITY DESIGNATION

RECORD OF BOREHOLE No 1

METRIC




W P 54-82-10 LOCATION Co-ords. N 4 832 872, E 291 648 ORIGINATED BY HS
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 10 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
184.6	Ground Surface																
0.0	Asphalt																
183.7	Silty Sand occ. gravel zones Loose					**	184										
0.9	Silty Clay (CL) with/some sand some/trace gravel		1	SS	36												
182.8	*		2	SS	114	23 cm	183										
1.8	End of Borehole																
	Probable Bedrock Shale with limestone layers weathered																
	* occ. organics occ. shaly zones hard																
	** groundwater elevation not determined																

RECORD OF BOREHOLE No 2

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 889; E 291 633 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 09-10 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
184.6	Ground Surface													
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Hard		1	SS	39	*	184							
182.8			2	SS	127/	23 cm	183							
1.8	Bedrock Shale with limestone layers -- weathered unweathered		3	RC	REC. 38%		182							
			4	RC	REC. 75%		181							
			5	RC	REC 93%		180							
179.6	End of Borehole													
5.0	* groundwater elevation not determined													

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 880; E 291 597 ORIGINATED BY HS
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Augers, B. Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 10 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N' VALUES			20	40					
184.5	Ground Surface													
0.0	Silty Clay (CL) with some sand some/trace gravel		1	SS	8	20 cm	184							
	occ. organics firm to stiff		2	SS	146/		183							
182.2	occ. shaly zones Hard						182							
2.3	Bedrock Shale with limestone layers		3	RC	REC 48%		181							
	Weathered Unweathered		4	RC	REC 100%		180							
178.8							179							
5.7	End of Borehole * groundwater elevation not determined													



RECORD OF BOREHOLE No 4

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 903; E 291 657 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
DATUM Geodetic DATE 84 10 09 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
183.8	Ground Surface																
0.0	Silty Clay with/some sand some/trace gravel *					**											
182.9			1	SS	120		183									6 19 56 19	
0.9			2	SS	200		182										
	Bedrock Shale with limestone layers						181										
			3	RC	REC 65Z		180										
	Weathered Unweathered		4	RC	REC 85Z		179										
178.0	End of Borehole																
5.8	* occ. shaly zones very stiff to hard **groundwater elevation not determined																



RECORD OF BOREHOLE No 6

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 920; E 291 672 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
DATUM Geodetic DATE 84 10 09 CHECKED BY EP




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
183.3	Ground Surface																
0.0	Probable Silty Clay(CL) with/some sand																
182.5	*some/trace gravel																
0.8	Bedrock Shale with limestone layers		1	SS	180												
			2	SS	70	12 cm											
	Weathered Unweathered																
			3	RC	REC 100Z												
178.2	End of Borehole																
5.1	* occ. shaly zones																



RECORD OF BOREHOLE No 7

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 832 969; E 291 700 ORIGINATED BY JC/DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, N. Core COMPILED BY DD
DATUM Geodetic DATE 84 10 05-09 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100										WATER CONTENT (%)		
								SHEAR STRENGTH										10 20 30		
							O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE													
184.4	Ground Surface																			
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. organics occ. shaly zones Stiff to Hard		1	SS	14		184									4 23 51 22				
			2	SS	29		183													
								182												
181.0			3	SS	20		181													
3.4	Bedrock Shale with limestone layers Unweathered		4	RC	REC 100%		180													
179.0																				
5.4	End of Borehole																			

RECORD OF BOREHOLE No 8

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 020; E 291 721 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, N Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 09 CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
182.8	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. organics occ. shaly zones Hard		1	SS	72												
181.1			2	SS	110/	23 cm											
1.7	Bedrock Shale with limestone layers Weathered Unweathered		3	RC	REC 80%												
179.1																	
3.7	End of Borehole																

RECORD OF BOREHOLE No 9

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 058; E 291 730 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 02 CHECKED BY CP

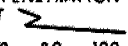


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
182.2	Ground Surface																
0.0	Probable Silty Clay(CL)						182										
181.6	*																
0.6																	
	Bedrock Shale with limestone layers		1	RC	REC 64%		181										
			2	RC	REC 35%												
							180										
	Weathered Unweathered		3	RC	REC 84%												
178.8							179										
3.4	End of Borehole																
	* with/some sand some/trace gravel occ. shaly zones																



RECORD OF BOREHOLE No 10

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 099; E 291 740 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger COMPILED BY DD
DATUM Geodetic DATE 84 10 02 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
179.2	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Hard		1	SS	69	*	179										
177.2			2	SS	39		178										
2.0	Bedrock Shale with limestone layers Unweathered		3	RC	REC 89%		177										
175.5			4	RC	REC 100%		176										
3.7	End of Borehole * groundwater elevation not determined																



RECORD OF BOREHOLE No 11

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 148; E 291 738 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 10 04 CHECKED BY EP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
173.6	Ground Surface																
0.0	Silty Clay (CL) with/some sand		1	SS	14	**	173										
173.0																	
0.6	Weathered Unweathered		2	RC	REC 100%												
	Bedrock Shale with limestone layers		3	RC	REC 100%		172										
			4	RC	REC 100%		171										
170.4	End of Borehole																
3.2	* some/trace gravel stiff to hard **groundwater elevation not determined																

+³, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 12

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 208; E 291 732 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
DATUM Geodetic DATE 84 09 27 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
176.9	Ground Surface																
0.0 176.6 0.3	Probable Silty Clay (CL) Weathered Unweathered Bedrock Shale with limestone layers																
			1	RC	REC 76%		176										
			2	RC	REC 100%		175										
174.4 2.5	End of Borehole * with/some sand some/trace gravel occ. shaly zones																

RECORD OF BOREHOLE No 13

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 258; E 291 719 ORIGINATED BY DT
 DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
 DATUM Geodetic DATE 84 10 01 CHECKED BY CR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.6	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. boulders occ. shaly zones		1	RC	REC 29%		177										
176.2	Hard		2	RC	*17%												
1.4	Bedrock Shale with limestone layers Unweathered		3	RC	REC 100%		176										
175.2			4	RC	REC 100%												
2.4	End of Borehole																
	* REC																



RECORD OF BOREHOLE No 14

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 883 300; E 291 700 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 09 27 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
175.1	Ground Surface																
0.0	Probable Silty Clay*						175										
174.8	Weathered																
0.3	Unweathered																
	Bedrock		1	RC	REC 90%		174										
	Shale																
	with limestone layers																
173.3			2	RC	**100%												
1.8	End of Borehole																
	* with some sand																
	some/trace gravel																
	occ. shaly zones																
	** REC																



RECORD OF BOREHOLE No 15 & 15A

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 343; E 291 670 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 10 04 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.0	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. boulders occ. shaly zones Very Stiff to Hard		1	SS	29	*	176										
			2	SS	48		175										
174.6	Bedrock Shale with limestone layers Weathered Unweathered		3	RC	REC 22%		174										
2.4			4	RC	REC 78%		173										
172.6	End of Borehole																
4.4	* groundwater elevation not determined																

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 16

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 349; E 291 680 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 09 24 CHECKED BY [Signature]


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
178.0	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Very Stiff to Hard		1	SS	23	*	177										
176.0	End of Borehole		2	SS	36												
2.0	Probable Bedrock Shale with limestone layers Weathered * groundwater elevation not determined																




+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 17

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 367; E 291 652 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B. Core COMPILED BY DD
DATUM Geodetic DATE 84 09 25 CHECKED BY 

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.8	Ground Surface																
0.0	Probable Silty Clay(CL) with/some sand some/trace gravel occ. boulders occ. shaly zones																
176.3																	
1.5	Bedrock Shale with limestone layers Weathered		1	RC	REC 53%												
			2	RC	REC 28%												
			3	RC	REC 58%												
			4	RC	REC 60%												
173.8																	
4.0	End of Borehole																




OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 18

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 391; E 291 632 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger, B Core COMPILED BY DD
DATUM Geodetic DATE 84 09 25 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		W _p	W	W _L				
								SHEAR STRENGTH							WATER CONTENT (%)	
							○ UNCONFINED + FIELD VANE	10 20 30								
							● QUICK TRIAXIAL x LAB VANE									
177.6	Ground Surface															
0.0	Silty Clay (CL) with/some sand trace/some gravel occ. boulders occ. shaly zones Very Stiff to Hard						177							14 28 41 17 24 18 38 20		
			1	SS	23											
	2	SS	22													
175.5	Bedrock Shale with limestone layers Weathered		3	RC	REC 20%		175									
2.1			4	RC	REC 67%		174									
			5	RC	REC 63%	173										
171.6							172									
6.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

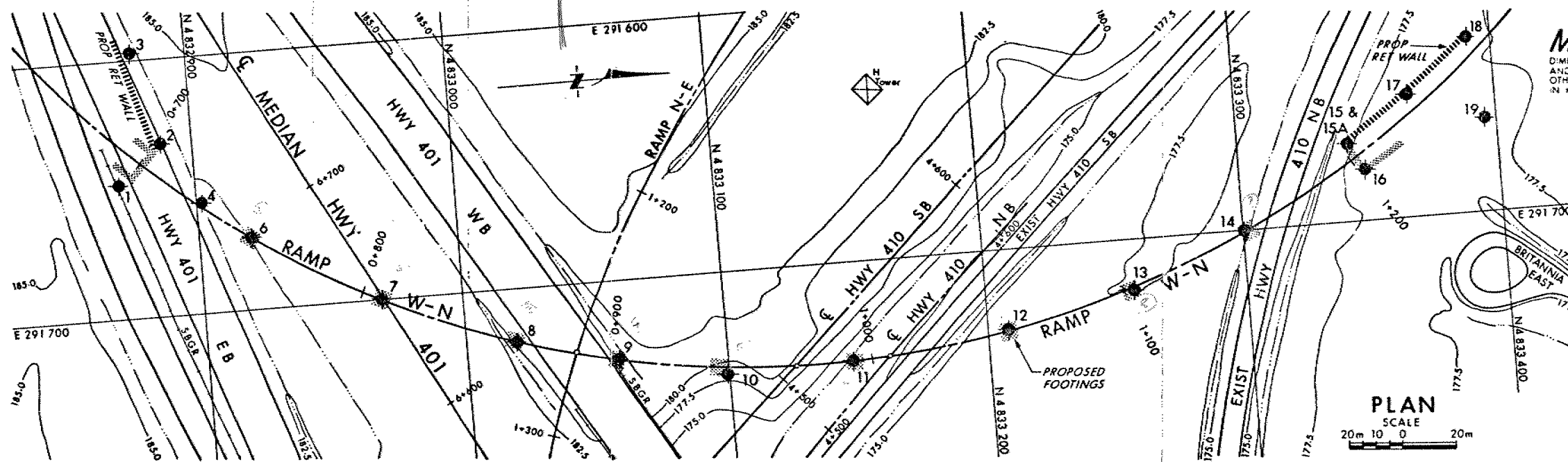


RECORD OF BOREHOLE No 19

METRIC

W P 54-82-10 LOCATION Co-ords. N 4 833 396; E 291 664 ORIGINATED BY DT
DIST 6 HWY 401/410 BOREHOLE TYPE S.S. Auger COMPILED BY DD
DATUM Geodetic DATE 84 09 24 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
177.9	Ground Surface																
0.0	Silty Clay (CL) with/some sand some/trace gravel occ. shaly zones Hard		1	SS	38	*											
176.2			2	SS	37	15 cm											
1.7	End of Borehole Probable Bedrock Shale with limestone layers Weathered * groundwater elevation not determined																



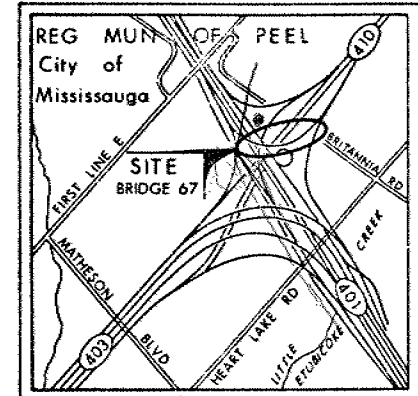
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES - METRES.

CONT No
WP No 54-82-10

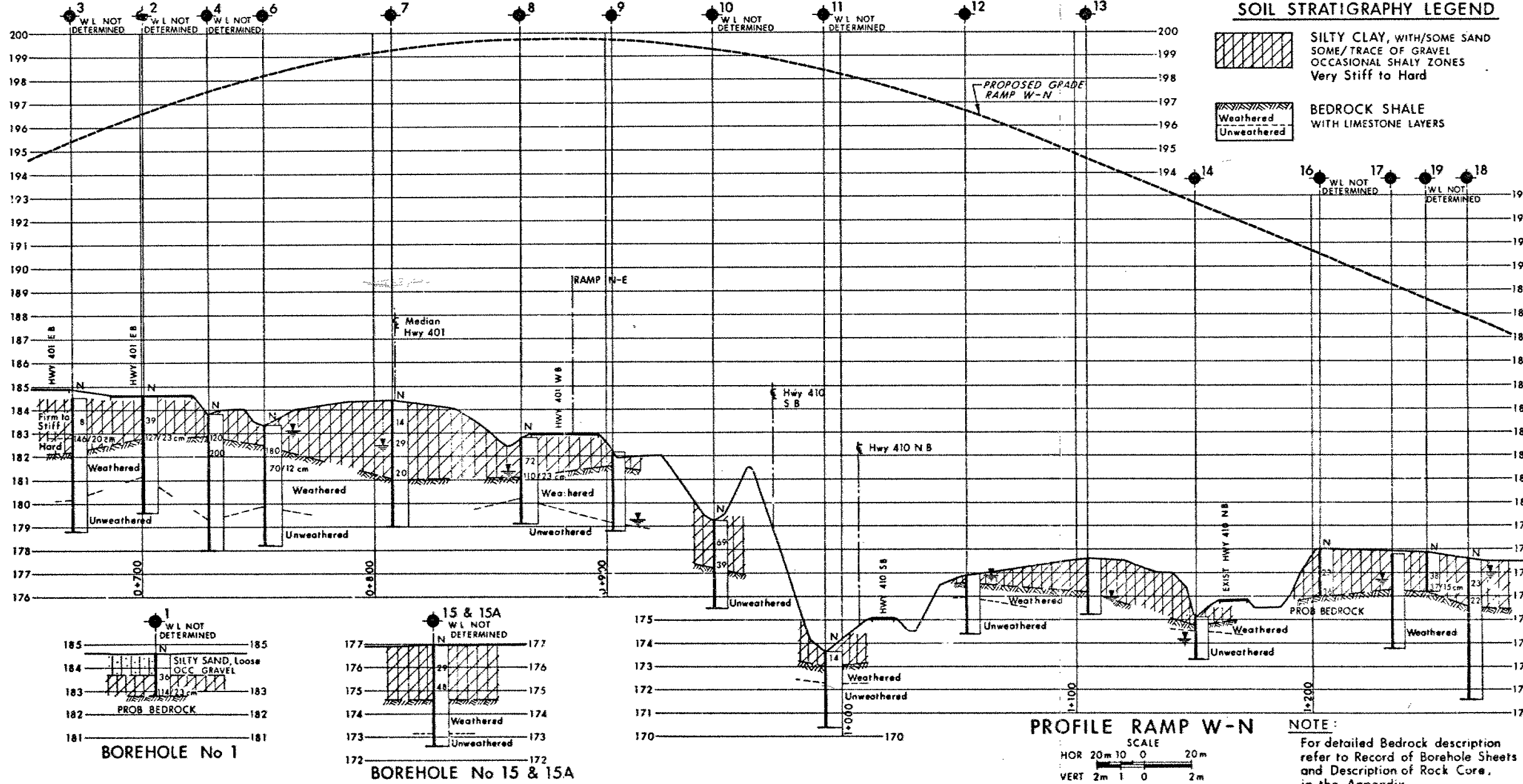
HWY 401/410 INTERCHANGE
RAMP W-N (BRIDGE No 67)
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN
SCALE
0.5km 0 0.5 1km



SOIL STRATIGRAPHY LEGEND

- SILTY CLAY, WITH/SOME SAND
SOME/TRACE OF GRAVEL
OCCASIONAL SHALY ZONES
Very Stiff to Hard
- BEDROCK SHALE
WITH LIMESTONE LAYERS
- Weathered
- Unweathered

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
1984 09 and 1984 10
- W.L. Not Determined in Boreholes
No 1, 2, 3, 4, 10, 11, 15, 16 and 19

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	184.6	4832872	291648
2	184.6	4832889	291633
3	184.5	4832880	291597
4	183.8	4832903	291657
6	183.3	4832920	291672
7	184.4	4832969	291700
8	182.8	4833020	291721
9	182.2	4833058	291730
10	179.2	4833099	291740
11	173.6	4833148	291738
12	176.9	4833208	291732
13	177.6	4833258	291719
14	175.1	4833300	291700
15 & 15A	177.0	4833343	291670
16	178.0	4833349	291680
17	177.8	4833367	291652
18	177.6	4833391	291632
19	177.9	4833396	291664

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
1			
2			
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Geocres No 30M12-19G

HWY No 401/410	DIST 6
SUBMD D D CHECKED	DATE 1984 11 16
DRAWN BY	SITE 24-81-492
CHECKED	APPROVED
	DWG 548210-A

PROFILE RAMP W-N

SCALE
HOR 20m 10 0 20m
VERT 2m 1 0 2m

NOTE:

For detailed Bedrock description refer to Record of Borehole Sheets and Description of Rock Core, in the Appendix.