

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31D-310

DIST. 7 REGION                     

W.P. No. 128-86-00  
(Refer to 74-70-05)

CONT. No. 89-57

W. O. No.                     

STR. SITE No.                     

HWY. No. 115

LOCATION Hwy 115 & 7A Ramp NS-W

No of PAGES -

                      
                      
                      
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     

REMARKS:                     

G.I.-30 SEPT. 1976



# RECORD OF BOREHOLE No 25

METRIC

W P 74-70-05

Co-ORDS LOCATION  $\checkmark$  N 4896327.3; E 388879.8

ORIGINATED BY JBF

DIST 7 HWY 115/7A

BOREHOLE TYPE CONE TEST, HOLLOW-STEM AUGERS

COMPILED BY JBF

DATUM GEODETIC

DATE 880815 - 880816

CHECKED BY DD

## SOIL PROFILE

## SAMPLES

## GROUND WATER CONDITIONS

## ELEVATION SCALE

## DYNAMIC CONE PENETRATION RESISTANCE PLOT

## PLASTIC LIMIT

## NATURAL MOISTURE CONTENT

## LIQUID LIMIT

## UNIT WEIGHT

## REMARKS & GRAIN SIZE DISTRIBUTION (%)

ELEV  
DEPTH

DESCRIPTION

STRAT PLOT

NUMBER

TYPE

'N' VALUES

GROUND WATER CONDITIONS

ELEVATION SCALE

20 40 60 80 100

SHEAR STRENGTH KPa

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL x LAB VANE

20 40 60 80 100

W<sub>p</sub>

W

W<sub>L</sub>

WATER CONTENT (%)

20 40 60

γ

kN/m<sup>3</sup>

GR SA SI CL

199.8 GROUND SURFACE

0.0

Silty Sand

trace gravel

trace clay

loose to compact

199.4

2.4

silt

5

Silty Clay (CL to CI)

trace gravel

trace clay

firm to very stiff

197.4

8.5

Sandy Silt to Silty Sand

trace clay

compact

191.3

11.3

Silty Clay (CL to CI)

trace sand

firm

188.5

12.7

END OF BOREHOLE

probable silty clay

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

184.6

15.2

END OF CONE TEST

\* disturbed

+3, x5: Numbers refer to  
Sensitivity

20  
15 0-5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 26

METRIC

W P 74-70-05

LOCATION GORDS N 4896316.4; E 388 886.9

ORIGINATED BY JBF

DIST 7 HWY 115/7A

BOREHOLE TYPE CONE TEST, HOLLOW-STEM AUGERS

COMPILED BY JBF

DATUM GEODETIC

DATE 880815

CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
200.2	GROUND SURFACE																
0.0	Silty Sand trace gravel, trace clay loose to compact		1	SS	6		200										
199.0			2	SS	12		198										0 1 65 34
1.2			3	SS	14		196										
	Silty Clay (CL to CI) trace gravel trace clay very soft to very stiff		4	SS	12		194										0 1 34 65
			5	SS	9		192										0 2 60 38
			6	SS	4		190										
			7	SS	1		188										
191.7			8	SS	1		186										
8.5	Sandy Silt to Silty Sand trace clay compact		9	SS	1*												
			10	SS	15												
188.6			11	SS	18												
11.6	Silty Clay (CL to CI) trace sand firm to very stiff																
13.6	END OF BOREHOLE probable silty clay																
15.2	END OF CONE TEST																
	* disturbed																

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 24

## METRIC

WP 74-70-05

LOCATION *Co. 0205* *N 4896335.5; E 388 897.0*

ORIGINATED BY JBF

DIST 7 HWY 115/7A

BOREHOLE TYPE CONE TEST, HOLLOW-STEM AUGERS

COMPILED BY JBF

DATUM GEODETIC

DATE 880815

CHECKED BY DD

[illegible]

+3, x<sup>5</sup> : Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

# memorandum



To: Mr. P.G. Verok  
Senior Project Manager  
Planning & Design Section  
Central Region

Date: 1989 03 16

From: Foundation Design Section  
Room 315, Central Building

RE: Ramp NS-W, Hwy. 115/7A I.C.  
W.P. 128-86-00 (refer to W.P. 74-70-05)  
Hwy. 115, District #7, Port Hope

As requested in your memo dated July 18, 1988. we have completed foundation investigations for the above-noted ramp. This portion of the project had been deferred pending property clearance.

This additional fieldwork (3 boreholes) verified that subsurface conditions along Ramp NS-W are similar to those that have been assumed for design of its embankments. Hence, the recommendations previously submitted under cover of W.P. 74-70-01 (with reference to W.P. 74-70-05) should be applied to this ramp. The additional boreholes will be added to the Foundation Investigation Report for the contract package.

If there are any questions please advise.

*D. H. Dundas*  
D. H. Dundas, P. Eng.  
Sr. Foundation Engineer.

DHD/ms

0	-	100 mm	water
100	-	150	br.si.sa.
150	-	550	dk.br.si.cl.tps.
550	-	1.2 m	br.si.cl. (MP) moist

#### 10+315 €

0	-	200 mm	dk.br.si.sa.tps.
200	-	1.5 m	br.cl.si. moist
1.5	-	2.0	br.si. moist

### Soil DATA

## RAMP NS-W

#### 10+080 €

0	-	300 mm	dk.br.si.sa.tps.
300	-	2.7 m	br.cl.si. wet 700 mm + moist 2.2 m+, water ent. 1.8 - 2.0 m, hole water filled to 1.8 m

#### 10+100 €

0	-	300 mm	dk.br.si.sa.tps.
300	-	700	br.cl.si.
700	-	1.2 m	gry.sa. wet
1.2	-	2.0	br.cl.sa. wet
2.0	-	2.3	gry.cl.si. moist-wet

#### 10+150 €

0	-	450 mm	dk.br.si.sa.tps.
450	-	1.7 m	br.sj.sa. wet
1.7	-	2.0	gry.cl.si. moist firm

#### 10+200 €

0	-	300 mm	br.sa.si.tps. dry
300	-	550	br.sa.si. moist
550	-	1.6 m	br.cl.si. moist

#### 10+250 €

0	-	280 mm	dk.br.sa.si.tps.
280	-	1.5 m	br.si. moist

#### 10+300 €

0	-	300 mm	dk.br.sa.si.tps.
300	-	1.7 m	br.cl.si. moist

## TWP RD N

#### 10+025 €

0	-	200 mm	dk.br.si.cl.tps.
200	-	300	br.cl.sa. wet

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31D-310

DIST. 7 REGION

W.P. No. 74-7005 (REVISED WP 128-86-00  
127-86-00  
14-86-00  
15-86-00)

CONT. No. 89-57

W. O. No.

STR. SITE No. 21-39-446

HWY. No. 115

LOCATION Hwy 7A Underpass

No of PAGES -

=====  
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

G.I.-30 SEPT. 1976

Cont. 89-57



Ministry  
of  
Transportation

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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**



ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 74-70-05

DIST 7

HWY 115

STR SITE 21-39-446

Hwy. 7A Underpass (Revised)

DISTRIBUTION

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# FOUNDATION INVESTIGATION REPORT

For

W.P. 74-70-05; Site 21-39-446

Hwy. 7A Underpass

Hwy 115, District 7, Port Hope

## INTRODUCTION

This report summarizes the results of a foundation investigation required for the proposed underpass and its approach embankments between Sta. 9+900 and Sta. 10+100 (Hwy 7A chainage) along Hwy 7A.

The fieldwork was conducted during the period from 85 05 22 to 85 05 29 utilizing continuous flight auger machines equipped with 82 mm I.D. hollow-stem augers, B casing, and B core barrels.

This work consisted of;

- 1 cone penetration tests,
- 2 sampled boreholes,
- 8 cone penetration tests/sampled boreholes.

## SITE DESCRIPTION

The site is located at Lot 16, Con. 8, Twp. of Cavan, in the County of Peterborough, at the proposed crossing of Hwy. 7A and Hwy. 115, immediately south of the existing Hwy. 7A/Hwy. 115 intersection.

The existing intersection is a level crossing.

The local topography is relatively flat.

The area is described physiographically by Chapman and Putnam (1984), as the Peterborough Drumlin Field.

## SUBSURFACE CONDITIONS

### General

The Record of Borehole Sheets (Appendix, BH #1 to BH #11), 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. 747005-A.

At this site, approximately 25 m of overburden overlies the bedrock. The overburden is essentially alternating layers of silty sand and silty clay.

A simplified sequence of materials from the surface (elev. 200± m) downwards is summarized below:

Elevation (m)	
200.0 - 198.5	Organics
198.5 - 197.5	Silty Sand
197.5 - 191.0	Silty Clay
191.0 - 189.0	Sandy Silt to Silty Sand
189.0 - 185.5	Silty Clay
185.5 - 184.0	Sandy Silt to Silt
184.0 - 179.5	Silty Clay
179.5 - 175.0	Silty Sand, Occ. boulders
175.0 -	Bedrock

#### Overburden

##### Organics

This soft deposit was encountered at all borehole locations except BH #11.

Its thickness is variable and ranges up to 1.5 m at the borehole locations.

##### Silty Sand; trace gravel, trace clay

This deposit underlies the surface organics. it was encountered at all borehole locations except BH #11.

Based on the N values (4-29) and field interpretation, the denseness of this deposit is described as loose to compact.

Its thickness ranges from 0.9 m to 1.5 m at these borehole locations.

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

It should be noted that this material is highly susceptible to disturbance (boiling) under conditions of unbalanced hydrostatic head. If excavations in the dry are required within this material, the prevailing groundwater level should be lowered a minimum of 0.6 m below the base of the excavation.

Upper Silty Clay (CL to CI); trace gravel, trace sand

This deposit underlies the Silty Sand at all borehole locations except BH #11 where it is the surface deposit.

Based on the N values (0-24), the shear strength tests and field interpretation, the consistency of this deposit is described as soft to very stiff.

Its thickness ranges from 6.1 m to 11.6 m at these borehole locations.

Physical properties of the material, as determined from field and laboratory tests, are summarized as follows:

		<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content	(w)	23.5 - 37.5%	29.5%	28.8%
Liquid Limit	(w <sub>L</sub> )	24.0 - 43.5%	32.8%	33.5%
Plastic Limit	(w <sub>p</sub> )	12.5 - 19.5%	16.9%	17.0%
Shear Strength	(C <sub>u</sub> )	11 - 100+ kPa	N/A	N/A
Unit Weight	(γ)	17.8 - 19.3 kN/m <sup>3</sup>	18.6 kN/m <sup>3</sup>	18.4 kN/m <sup>3</sup>

The shear strength characteristics of this deposit vary with depth. The upper half has shear strengths in the order of 100 kPa, while the lower half has shear strength in the order of 20 - 25 kPa.

Figure 2 illustrates a typical grain size distribution for this material.

The results of consolidation testing indicate that the majority of settlements will occur within the lower half of this deposit. Following is a summary of the consolidation characteristics of this material.

BH	Depth (m)	Pc(Casagrande) kPa	Pc(Schmertmann) kPa	Cc	e <sub>0</sub>
1	6.5	137	120	0.186	0.738
3	7.8	232	150	0.225	0.812
6	5.6	522	620	0.212	0.596
7	4.8	510	510	0.400	0.964

BH	Depth (m)	Pc(Casagrande) kPa	Pc(Schmertmann) kPa	Cc	e <sub>o</sub>
7	7.8	245	245	0.562	0.889
9	6.2	237	237	0.427	0.935
10	4.8	100	100	0.095	0.685
10	8.0	235	253	0.038	0.938

Figure 3 illustrates a typical consolidation curve for this material. It should be noted that this curve can not be directly applied to settlement calculations.

Sandy Silt to Silty Sand; trace clay

This compact to very dense material was encountered beneath the Upper Silty Clay layer at all borehole locations except BH #10.

The N values are considered to be disturbed results.

Its thickness ranges from 1.6 m to 2.5 m at these borehole locations.

A typical grain size distribution for this material is illustrated below.

gravel	0%
sand	45 - 63%
silt	34 - 52%
clay	2 - 3%

Middle Silty Clay (CL to CI); trace sand

This firm to very stiff deposit (N values 4 - 29) underlies the Sandy Silt to Silty Sand layer at all borehole locations except BH #10.

Its thickness ranges from 2.7 m to 4.2 m.

Physical properties of the material, as determined from field and laboratory tests, are summarized as follows:

		Range	Average	Median
Natural Moisture Content	(w)	24.0 - 26.0%	25.1%	25.5%
Liquid Limit	(w <sub>L</sub> )	18.0 - 27.5%	24.2%	27.0%
Plastic Limit	(w <sub>p</sub> )	16.0 - 17.5%	16.8%	17.0%
Shear Strength	(C <sub>u</sub> )	30 - 100+ kPa	N/A	N/A

A typical grain size distribution for this material is illustrated below:

gravel	0%
sand	1 -- 3%
silt	50 - 81%
clay	18 - 50%

Sandy Silt to Silt; trace clay

This compact to very dense deposit (N values 0 - 77) underlies the Middle Silty Clay layer.

The lower N values are considered to be disturbed results.

Its thickness ranges from 1.2 m to 1.8 m.

Lower Silty Clay (CL); trace/some gravel, trace sand

This hard deposit (N values 43 - 100+) underlies the Sandy Silt to Silt layers.

Its thickness ranges from 3.6 m to 4.6 m.

Silty Sand; with gravel, trace sand, occasional boulders

This very dense deposit (N values 44 - 120+) underlies the Lower Silty Clay and immediately overlies the bedrock. Occasional boulders were encountered within this deposit.

Its thickness ranges from 4.3 m to 5.3 m.

Bedrock

The bedrock is sound limestone, containing some shale, of the Trenton and Black River Group. A more detailed description of the bedrock is included in Table 1, Description of Rock Core, in the Appendix.

The bedrock surface is relatively level, sloping from elev. 176+ m at Sta. 9+941 to elev. 174+ m at Sta. 10+076.

Groundwater

At the time of the field investigation, the groundwater elevation was essentially at the existing ground surface (elev. 200± m).

## DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a 4 - span structure to carry re-aligned Hwy 7A over Hwy 115 at a grade of 209± m. The proposed grade of Hwy 115 is 201± m. This proposal will involve approach fills in the order of 8 m at the west abutment and 9 m at the east abutment.

A number of foundation alternatives, especially in the embankment design, are recommended. The alternatives which lead to the least expensive design should be adopted.

The recommendations in this report are applicable to the immediate approaches (Sta. 9 + 900 to Sta. 10 + 100, Hwy 7A chainage). As requested by the Regional Planning and Design Section, our recommendations regarding the high approach embankment outside of these limits will be provided to P & D in a separate memo.

Slope stability is the main foundation problem at this site. Settlements of the approach embankments also present a problem.

### SLOPE STABILITY

The geometry of the approach embankments was designed with the aid of Bishop's total stress analysis. The assumptions used for this analysis are illustrated in Table 2. For the normal fill design, it is essential that the unit weight of the fill does not exceed 20.4 kN/m<sup>3</sup>.

Based on these evaluations, it was determined that forward and transverse berms are required to ensure the stability of the approach embankments.

The recommended geometry of the berms is illustrated in Figure 4. The recommended 1 m surcharge has been incorporated into the embankment geometry design. Design details are provided in Table 3.

The geometry consists of berms at the mid-height elevations of the final embankments.

For the temporary surcharge, the upper portion of the embankment (above the berm) should have a slope of 1.5 H:1V, while the lower portion of the embankment (below the berm) should have a slope of 2H:1V.

In the transverse direction, when the surcharge is removed, the upper portion of the slope should be re-graded to 2H:1V and the surcharge berm length should be maintained.

In the forward direction, part of the embankment will require subexcavation in order to construct the abutment. In this case the surcharge berm length should be altered to conform with the recommended final forward geometry.

If the embankments immediately behind the abutments were to be constructed using light weight fill ( $<15.7 \text{ kN/m}^3$ ), the length of the forward berm could be reduced considerably. Should this option be considered, please contact this office for design details.

#### SETTLEMENT

Differential settlements of the proposed abutments and piers will be negligible if they are constructed in accordance with recommendations provided in this report.

Under the proposed loadings, the total settlements beneath the approach embankments are anticipated to be in the order of 15 to 20 cm. It is predicted that this total settlement will occur within 5 to 6 years. However, at least 50% of this total settlement is expected to occur within a period of 1 year.

In order to minimize residual settlements, pre-loading (with an additional 1 m surcharge) of the approach embankments is recommended. The embankment should be pre-loaded for a minimum period of 1 year. The embankment pre-load requirements are applicable to the forward direction (including the areas over the proposed abutments) as well as the transverse directions.

The settlements of the embankments should be monitored using settlement plates. The installation of these settlement plates should be incorporated into the embankment design. Should more information regarding settlement monitoring be required, please contact this office.

The recommended surcharge and final embankment geometry is illustrated in Figure 4. Design details are provided in Table 3.

#### STRUCTURE DESIGN DETAILS

The proposed structure may be supported on steel H-piles, equipped with reinforced tips (to facilitate pile driving) and driven to bedrock. The bedrock elevations at the abutment locations are estimated to be;

-176+ m at the west abutment,

-174+ m at the east abutment.

Estimated bedrock elevations at the pier locations may be interpolated between these two values.



The following design values are recommended for the piers:

<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
310 HP 79	1150 kN per pile	830 kN per pile

Due to settlement of the approach embankments, negative skin friction will be imposed on the piles supporting the abutments. These forces, combined with movement of the subsoil due to the strain imposed by the embankment loading, will tend to move the piles laterally. In order to minimize rotation of the abutments, the wing walls should also be supported on steel H-piles driven to bedrock.

The following design values are recommended for the abutments and wing walls.

<u>Pile Type</u>	<u>Factored Capacity at U.L.S.</u>	<u>Capacity at S.L.S. Type II</u>
310 HP 110	1440 kN	1035 kN
310 HP 79	1035 kN	750 kN

If desired, the abutment footings (supported on Steel H-Piles) may be perched within the embankment fill. In this case, to facilitate pile driving, particle sizes in the fill immediately beneath the pile locations should not exceed 75 mm.

#### 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	$\phi$	$\gamma$
Granular 'A'	35°	22.0 kN/m <sup>3</sup>
Granular 'B'	30°	21.2 kN/m <sup>3</sup>

From a geotechnical viewpoint the foundation is considered to be non-yielding as the piles will be driven to bedrock and the at-rest condition applies insofar as lateral earth pressures are concerned. However, from a structural viewpoint, the active condition may control the earth pressure design due to the lengths of the piles.

#### FROST PROTECTION

For frost protection, earth cover of 1.6 m, or equivalent is required.

#### DE-WATERING

De-watering will be required for pile caps founded in non-cohesive (silty sand) material, below the prevailing groundwater elevation. The need for de-watering might be reduced if the pile caps were founded in the underlying cohesive (silty clay) material (below elev. 198± m).

Where excavations are based in cohesive material, the water in the excavation may be controlled by sump pumping.

#### CONSTRUCTION CONSIDERATIONS

The required berms should be constructed before the height of the approach embankments is increased above the design berm heights.

The approach embankments should be pre-loaded for a period of 1 year before the abutment piles are installed.

The upper 1.5 m of material under the plan limits of the approach embankments between Sta. 9 + 900 and Sta. 10 + 100 should be sub-excavated.

Backfill placed below the prevailing groundwater level should consist of non-cohesive (free-draining) material.

MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. F. Saccon, Project Foundations Engineer, and Mr. I. Richardson, Student Engineer. The description of the bedrock core was carried out by Mr. E. Magni, Geologist.

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

The drilling equipment used was owned and operated by Dominion Soil Investigation Inc.



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

for

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

A P P E N D I X

# RECORD OF BOREHOLE No 1

METRIC

W P 74-70-05 LOCATION Co-ords. N 4 896 336.2; E 388 980.4 ORIGINATED BY IR  
 DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers, B-Core COMPILED BY DD  
 DATUM Geodetic DATE 85 05 22 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH kPa									
200.2	Ground Surface																
0.0	Silty Sand trace gravel organics trace clay Loose to Compact		1	SS	8												
198.1			2	SS	15												2 73 22 3
2.1			3	SS	4												
			4	TW	PH												0 0 63 37
	Silty Clay (CL to CI) trace gravel trace sand Soft to Very Stiff		5	SS	4												
			6	TW	PH												
			7	TW	PH												
			8	SS	3												
191.7			9	TW	PH												
8.5	Sandy Silt to Silty Sand trace clay Compact to Very Dense		10	SS	9												
189.2			11	SS	28												0 45 52 3
11.0			12	SS	16												
	Silty Clay (CL to CI) trace sand Stiff		13	SS	8												0 2 50 48
			14	SS	8												
185.6																	
14.6	Sandy, Silt to Silt trace clay Compact to Very Dense		15	SS	0												
184.0																	
16.2			16	SS	65												13 4 55 28
	Silty Clay (CL) trace/some gravel trace sand Hard		17	SS	43												
			18	SS	47												
179.5																	
20.7	Silty Sand with gravel trace clay occasional boulders Very Dense		19	RC													
	some clay (slightly cohesive)		20	SS	120A	10 cm											
175.2																	
25.0	Bedrock Limestone Sound		21	RC	REC 100%												
			22	RC	REC 95%												
171.9			23	RC	REC 100%												RQD = 100%
28.3	End of Borehole																

+3, x5: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 2

METRIC

W P 74-70-05 LOCATION Co-ords. N 4 896 342.0; E 388 953.3 ORIGINATED BY IR  
 DIST 7 HWY 115 BOREHOLE TYPE Hollow-Stem Auger COMPILED BY IR  
 DATUM Geodetic DATE 85 05 22 CHECKED BY *CP*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
200.5	Ground Surface																
0.0																	
	Organics		1	SS	7												
	Silty Sand, trace		2	SS	9												
197.8	gravel, trace clay		3	SS	29												
	Loose to Compact																
2.7			4	SS	15												
	Silty Clay		5	TW	PH												
	(CL to CI)																
	trace gravel		6	SS	10												
	trace sand		7	SS	7												
	Firm to		8	TW	PH												
	Very Stiff																
191.0			9	SS	6												
9.5	Sandy Silt to																
	Silty Sand																
	trace clay		10	SS	17												
189.0	Compact to Very Dense																
11.5			11	SS	15												
	Silty Clay																
	(CL to CI)		12	SS	6												
	trace sand																
	Firm to																
	Stiff																
185.6			13	SS	0												
14.9	Sandy Silt to Silt																
	trace clay																
184.0	Compact to Very Dense		14	SS	72												
16.5			15	SS	55												
	Silty Clay (CL)		16	SS	47												
	trace/some gravel																
	trace sand																
	Hard																
179.8			17	SS	150/23 cm												
20.7	Silty Sand		18	SS	74												
	with gravel																
	trace clay		19	SS	125/8 cm												
	occasional boulders																
	Very Dense																
	some clay																
	(slightly cohesive)		20	SS	125/8 cm												
174.5																	
26.0	End of Borehole																
	Probable Bedrock																

+3, +5 : Numbers refer to Sensitivity  
 20  
 15  
 10  
 5 (% STRAIN AT FAILURE)

## RECORD OF BOREHOLE No 3

METRIC

W P 74-70-05

LOCATION Co-ords. N 4 896 351.7; 388 950.0

ORIGINATED BY IR

DIST 7 HWY 115

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY DD

DATUM Geodetic

DATE 85 05 23

CHECKED BY *[Signature]*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH kPa					
200.2	Ground Surface													
0.0	Organics													
197.5	Silty Sand, trace gravel, trace clay Loose to Compact		1	SS	17									
2.5	Silty Clay (CL to CI) trace gravel trace sand Soft to Very Stiff		2	SS	11									
			3	SS	7									
			4	TW	PH									
			5	SS	3									
			6	TW	PH									
191.4	Sandy Silt to Silty Sand trace clay Compact to Very Dense		7	SS	0									
188.9			8	SS	15									
11.3	Silty Clay (CL to CI) trace sand Stiff		9	TW	PH									
185.6			10	SS	8									
14.6	Sandy Silt to Silt trace clay Dense to Very Dense		11	TW	PH									
184.0			12	SS	75									
16.2	Silty Clay (CL) trace/some gravel trace sand Hard		13	SS	83									
181.5			14	SS	47									
18.7	End of Borehole													

+3, x5; Numbers refer to Sensitivity

20  
15  
10

5 (%) STRAIN AT FAILURE

## RECORD OF BOREHOLE No 4

METRIC

W P 74-70-05

LOCATION Co-ords. N 4 896 341.5; E 388 987.2

ORIGINATED BY FS

DIST 7 HWY 115

BOREHOLE TYPE Cone Test

COMPILED BY IR

DATUM Geodetic

DATE 85 05 23

CHECKED BY *GP*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
200.1	Ground Surface												
0.0	Organics												
198.0	Probable Silty Sand*** trace gravel, trace clay												
2.1	Probable Silty Clay (CL to CI) trace gravel trace sand Soft to Very Stiff												
191.3	Probable Sandy Silt to Silty Sand trace clay Compact to Very Dense												
8.8	Probable Silty Clay (CL to CI) trace sand Stiff												
189.1	Probable Silty Clay (CL to CI) trace sand Stiff												
11.0	Probable Sandy Silt to Silt trace clay **												
185.5	Probable Silty Clay (CL)												
14.6	Probable Silty Clay (CL)												
183.9	Probable Silty Clay (CL)												
16.8	End of Cone Test												
	*** Loose to Compact												
	** Dense to Very Dense												
	* trace/some gravel trace sand Hard												

\*<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity20  
15 5 (%) STRAIN AT FAILURE  
10



OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5										METRIC				
W P 74-70-05		LOCATION Co-ords. N 4 896 325.0; E 389 030.3		ORIGINATED BY FS										
DIST 7 HWY 115		BOREHOLE TYPE Hollow-Stem Augers, Cone Test		COMPILED BY IR										
DATUM Geodetic		DATE 85 05 24		CHECKED BY <i>CP</i>										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
200.2	Ground Surface													
0.0	Organics		1	SS	25									
	Silty Sand trace gravel trace clay		2	SS	15									
197.5	Loose to Compact		3	SS	9									
2.7	Silty Clay (CL to CI) trace gravel trace sand		4	SS	13									
	Soft to Very Stiff		5	SS	10									
			6	TW	PH									
			7	SS	4									
			8	TW	PH									
			9	SS	0									
191.4	Sandy Silt to Silty Sand, trace clay Compact to Very Dense.		10	SS	10									
8.8			11	SS	2									
188.9	Silty Clay (CL to CI) trace sand Stiff		12	SS	11									
11.3			13	TW	PH									
186.2	Sandy Silt to Silt trace clay		14	SS	72									
14.0	Dense to Very Dense		15	SS	43									
184.7	Silty Clay (CL) trace/some gravel trace sand Hard		16	SS	48									
15.5			17	SS	66									
180.2														
20.0	End of Borehole													

+3, x5: Numbers refer to Sensitivity  
 20  
 15 5 (%) STRAIN AT FAILURE  
 10

## RECORD OF BOREHOLE No 6

METRIC

W P 74-70-05

LOCATION Co-ords. N 4 896 338.2; E 388 939.0

ORIGINATED BY IR

DIST 7 HWY 115

BOREHOLE TYPE Hollow-Stem Augers, Cone Test

COMPILED BY IR

DATUM Geodetic

DATE 85 05 26

CHECKED BY *CP*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
200.2	Ground Surface										
0.0	Organics						200				
197.8	Silty Sand trace gravel, trace clay, Loose to Compact		1	SS	4		198				
2.4	Silty Clay (CL to CI) trace gravel trace sand Firm to Very Stiff		2	TW	PH		196				
			3	SS	12		194				
			4	TW	PH		192				
			5	SS	7		190				
191.4	Sandy Silt to Silty Sand trace clay Compact to Very Dense		6	TW	PH		188				
8.8			7	TW	PH		186				
189.2	Silty Clay (CL to CI) trace sand Firm to Very Stiff		8	SS	9		184				
11.0			9	SS	10		182				
			10	SS	6		180				
185.3	Sandy Silt to Silt trace clay Compact to Very Dense		11	SS	24						
14.9			12	SS	100						
184.1	Silty Clay (CL) trace/some gravel trace sand Hard		13	SS	44						
16.1			14	SS	66						
179.5	Silty Sand		15	SS	70						
20.7	*										
178.4	End of Borehole										
21.8	* with gravel trace clay occasional boulders Very Dense										

+3, x5: Numbers refer to Sensitivity  
20  
15 5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 7

METRIC

W P 74-70-05

LOCATION

Co-ords. N 4 896 334.5; E 389 026.7

ORIGINATED BY IR

DIST 7 HWY 115

BOREHOLE TYPE

Hollow-Stem Augers, Cone Test

COMPILED BY IR

DATUM Geodetic

DATE

85 05 27

CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							20 40 60		
199.8	Ground Surface																
0.0	Organics		1	SS	12												
	Silty Sand		2	SS	17									0 87 11 2			
197.4	trace gravel, trace clay																
2.4	Loose to Compact		3	SS	6												
	Silty Clay (CL to CI)		4	TW	PH								18.1	0 1 34 65			
	trace gravel		5	SS	5												
	trace sand		6	TW	PH												
	Soft to Very Stiff																
191.3													19.3	0 0 76 24			
8.5	Sandy Silt to Silty Sand		7	SS	10												
189.4	trace clay		8	SS	16												
	Compact to Very Dense		9	SS	19												
10.4	Silty Clay (CL to CI)		10	SS	12												
	trace sand		11	SS	14												
	Firm to Very Stiff		12	SS	67												
185.2																	
14.6	Sandy Silt to Silt																
183.6	trace clay																
	Compact to Very Dense																
16.2	Silty Clay (CL)																
	trace/some gravel																
	trace sand																
	Hard																
180.0																	
19.8	Silty Sand		13	SS	44												
	with gravel																
	occasional boulders																
177.9	Dense to Very Dense																
21.9	End of Borehole																

+3, x5: Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 8

METRIC

W P 74-70-05

LOCATION

Co-ords. N 4 896 338.5; E 389 037.5

ORIGINATED BY IR

DIST 7 HWY 115

BOREHOLE TYPE

Hollow-Stem Augers, Cone Test

COMPILED BY IR

DATUM Geodetic

DATE

85 05 28

CHECKED BY *GP*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT			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	W <sub>p</sub> W W <sub>L</sub>	W <sub>p</sub> W W <sub>L</sub>	W <sub>p</sub> W W <sub>L</sub>		
200.2	Ground Surface												
0.0	Organics		1	SS	21								
197.8	Silty Sand trace gravel, trace clay Loose to Compact		2	SS	14								5 75 15 5
2.4			3	SS	24								
			4	SS	24								
	Silty Clay (CL to CI) trace gravel trace sand Firm to Very Stiff		5	TW	PH								
			6	SS	11								
			7	SS	6								
			8	TW	PH								
191.4			9	SS	5								
8.8	Sandy Silt to Silty Sand, trace clay, Compact to Very Dense		10	SS	8								
189.8			11	SS	29								
10.4	Silty Clay (CL to CI) trace sand Stiff to Very Stiff		12	SS	23								
			13	TW	PH								
185.6			14	SS	21								
14.6	Sandy Silt to Silt trace clay Compact		15	SS	73								
184.4													
15.8	Silty Clay (CL)												
183.6	*												
16.6	End of Borehole												
	* trace/some gravel trace sand Hard												

+3, x5: Numbers refer to Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 9

METRIC

W P 74-70-05

LOCATION Co-ords. N 4 896 348.8; E 388 926.5

ORIGINATED BY FS

DIST 7 HWY 115

BOREHOLE TYPE Hollow-Stem Augers, Cone Test

COMPILED BY IR

DATUM Geodetic

DATE 85 05 28

CHECKED BY *CP*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
199.8	Ground Surface													
0.0	Organics													
197.4	Silty Sand, trace gravel, trace clay Loose to Compact		1	SS	12									
2.4			2	SS	11									
	Silty Clay (CL) trace gravel trace sand Firm to Very Stiff		3	SS	6									
			4	TW	PH									
			5	SS	5									
191.0														
8.8	Sandy Silt to Silty Sand trace clay Compact to Very Dense		6	SS	9									
189.1			7	TW	PH									
10.7	Silty Clay (CL to CL) trace sand Stiff to Very Stiff		8	SS	18									
186.4			9	SS	9									
13.4	Sandy Silt to Silt trace clay Compact to Dense													
184.6			10	SS	100/									
15.2	Silty Clay (CL) trace/some gravel trace sand Hard		11	SS	67									
182.6														
17.2	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 10

METRIC

W P 74-70-05 LOCATION Co-ords. N 4 896 327.5; E 389 060.9  
 DIST 7 HWY 115 BOREHOLE TYPE Hollow-Stem Augers, Cone Test  
 DATUM Geodetic DATE 85 05 28  
 ORIGINATED BY IR  
 COMPILED BY IR  
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)				
200.2	Ground Surface													
0.0	Organics Silty Sand trace gravel, trace clay Loose to Compact		1	SS	12		200							
197.8			2	SS	29		198							
2.4			3	SS	11		196							
			4	SS	15		194							
	Silty Clay (CL to CI) trace gravel trace sand Soft to Very Stiff		5	TW	PH		192							
			6	SS	5		190							
			7	TW	PH		188							
			8	SS	4		186							
			9	SS	11									
	occasional sandy zones		10	SS	5									
186.2			11	SS	24									
14.0	Sandy Silt to Silt trace clay very dense		12	SS	58									
184.5														
15.7	End of Borehole													

+3, x5: Numbers refer to Sensitivity  
 20  
 15 5 (%) STRAIN AT FAILURE  
 10

# RECORD OF BOREHOLE No 11

METRIC

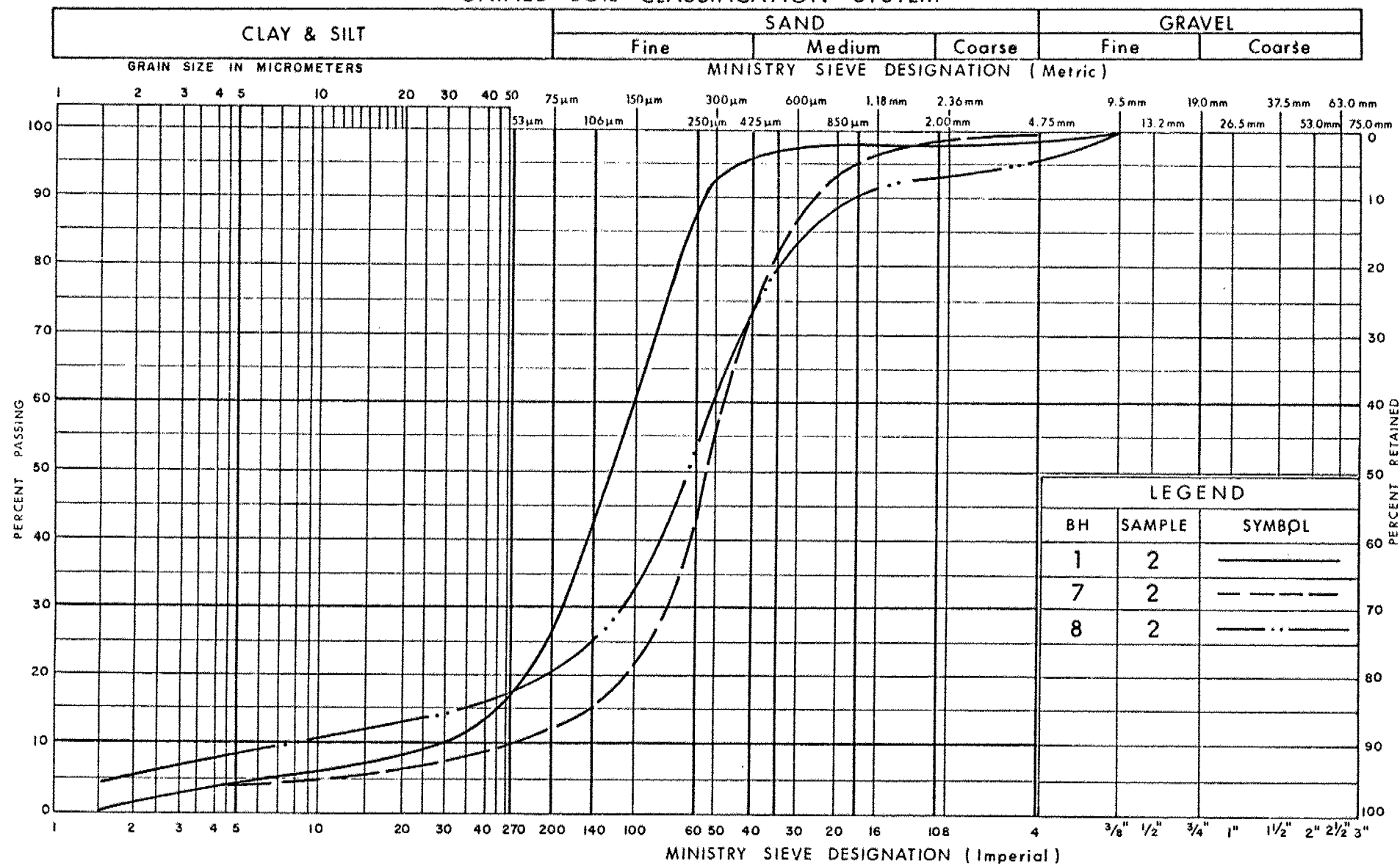
W P 74-70-05 LOCATION Co-ords. N 4 896 353.5; E 388 886.5 ORIGINATED BY FS  
 DIST 7 HWY 115 BOREHOLE TYPE Hollow Stem Augers, Cone Test COMPILED BY IR  
 DATUM Geodetic DATE 85 05 29 CHECKED BY [Signature]

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	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	W <sub>p</sub> W W <sub>L</sub>					
198.4	Ground Surface														
0.0	Silty Clay (CL to CI) trace gravel trace sand Soft to Very Stiff		1	SS	3		198								
			2	SS	5		196								
			3	SS	3		194								
			4	SS	5		192								
191.1	Sandy Silt to Silty Sand trace clay Compact to Very Dense						190								
7.3															
189.3	Silty Clay (CL to CI) trace sand Firm to Very Stiff		5	SS	17		188							0 63 34 3	
9.1															0 3 47 50
			6	SS	4		186								
185.9	Sandy Silt to Silt trace clay Compact to Very Dense		7	SW	PH		184							0 1 81 18	
12.5															
184.4	Silty Clay (CL) *		8	SS	5										
14.0															
183.8	End of Borehole		9	SS	32										
14.6															
	* trace/some gravel trace sand Hard														

+3, x5: Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

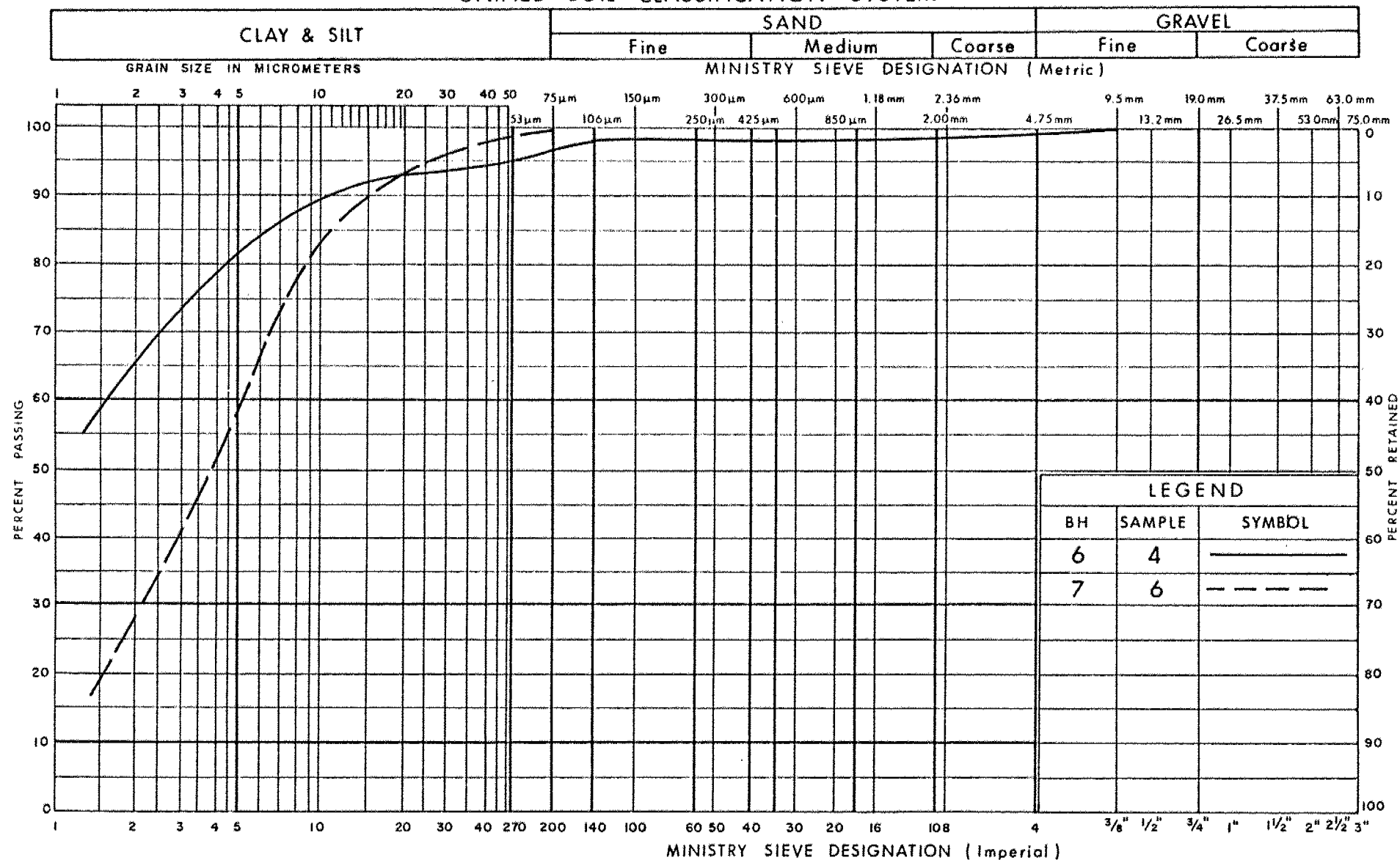
**GRAIN SIZE DISTRIBUTION**  
**SILTY SAND**  
TRACE GRAVEL, TRACE CLAY

FIG No 1

W P 74 - 70-05



## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
UPPER SILTY CLAY TRACE  
GRAVEL, TRACE SAND

FIG No 2

W P 74-70-05

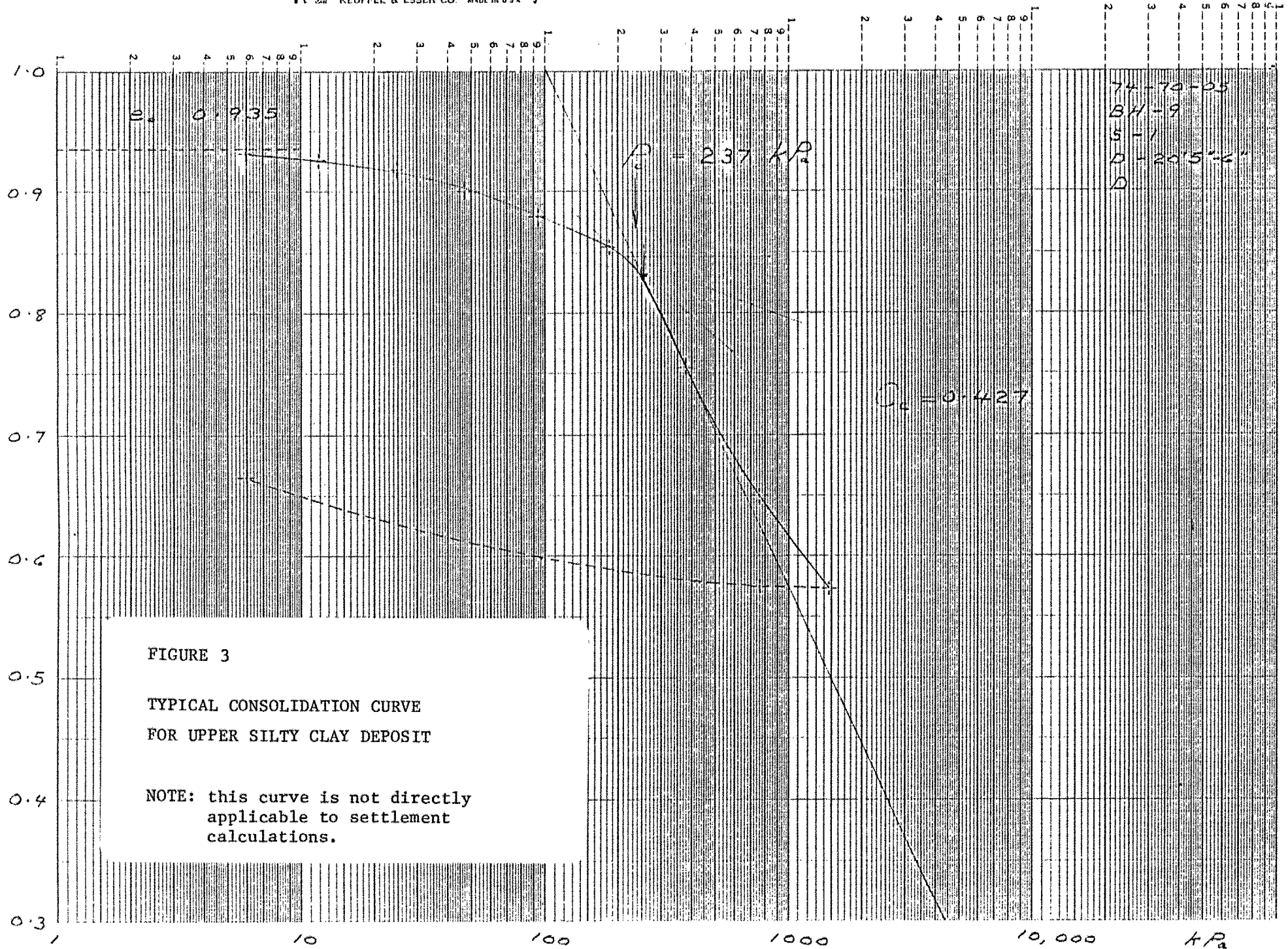


TABLE 1

DESCRIPTION OF ROCK CORE - W.P. 74-70-05

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR *	% RQD *	DEPTH (m)	DESCRIPTION
1	25.30-26.04	100	41	25.30-26.69	Limestone (80%), unweathered, closely spaced joints, with shale layers (20%), unweathered
	26.04-26.95	89	50		
	26.95-27.13	86	57	26.69-28.35	Limestone (100%), unweathered, medium to widely spaced joint
	27.13-28.35	98	98		
-----					

\* CR= CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

TABLE 2

## SLOPE STABILITY ASSUMPTIONS

W.P. 74-70-05

WEST APPROACH EMBANKMENT						EAST APPROACH EMBANKMENT					
DEPTH (m)	SOIL TYPE	C (kPa)	$\phi$ (°)	(kN/m <sup>3</sup> )	(kN/m <sup>3</sup> )	DEPTH (m)	SOIL TYPE	C (kPa)	$\phi$ (°)	(kN/m <sup>3</sup> )	(kN/m <sup>3</sup> )
N/A	FILL	20	0	20.4	10.7	N/A	FILL	20	0	20.4	10.7
0	Silty Sand	0	30	20.4	10.7	0	Silty Sand	0	30	20.4	10.7
1.5	Silty Clay	100	0	19.6	9.9	2.4	Silty Clay	100	0	19.6	9.9
3.0	Silty Clay	60	0	19.6	9.9	4.6	Silty Clay	60	0	19.6	9.9
4.6	Silty Clay	40	0	19.6	9.9	7.6	Silty Clay	25	0	19.6	9.9
7.6	Silty Clay	100	0	19.6	9.9	9.1	Silty Clay	40	0	19.6	9.9
9.1	Silty Clay	25	0	19.6	9.9	10.7	Silty Clay	20	0	19.6	9.9
12.2	Silty Clay	50	0	19.6	9.9	12.2	Silty Clay	100	0	19.6	9.9
13.7	Silty Clay	100	0	19.6	9.9	14.0	Silty Sand	0	27	19.6	9.9

TABLE 3

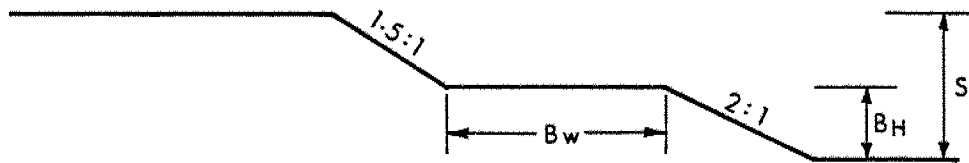
EMBANKMENT GEOMETRY  
(WEST & EAST APPROACHES)

W.P. 74-70-05

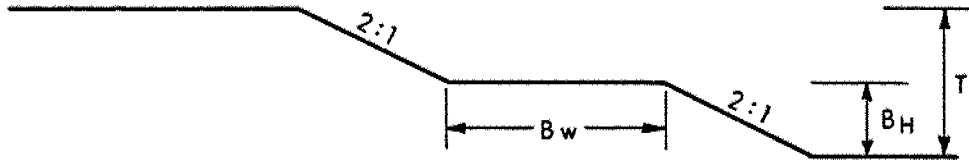
FINAL EMBANKMENT HEIGHT	EMBANKMENT HEIGHT INCLUDING SURCHARGE	BERM HEIGHT	FINAL TRANSVERSE & SURCHARGE GEOMETRY BERM WIDTH	FINAL FORWARD BERM WIDTH
(T)	(S)	(B ) H	(B ) W	(B ) F
6m	7m	N/A	N/A	N/A
7m	8m	3.5m	6m	<del>N/A</del> 6m
8m	9m	4.0m	12m	12m
9m	10m	4.5m	18m	18m

# EMBANKMENT GEOMETRY

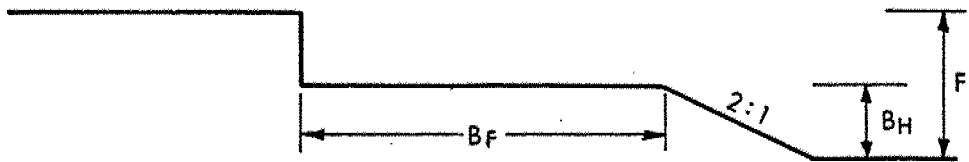
## SURCHARGE GEOMETRY



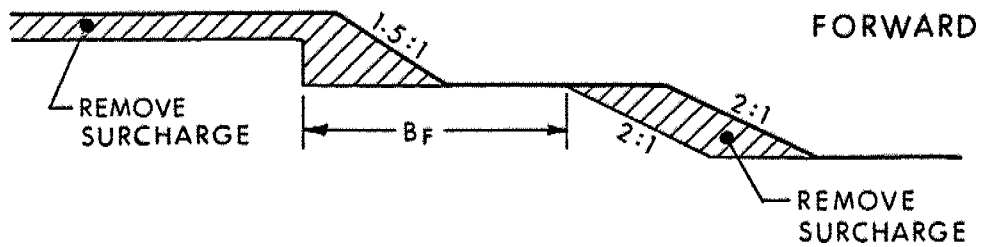
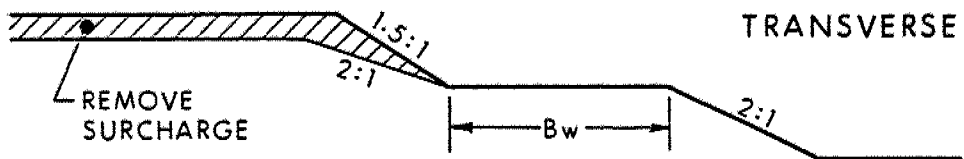
## FINAL TRANSVERSE GEOMETRY



## FINAL FORWARD GEOMETRY



## RE-GRADING - SURCHARGE TO FINAL GEOMETRY



N. T. S.

Fig 4

WP 74-70-05

**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
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	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
$\alpha$	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
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

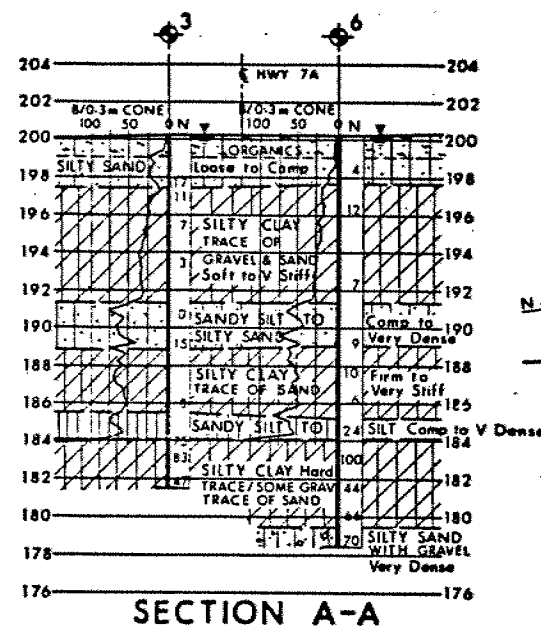
$P_s$	$kg/m^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$kN/m^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	$kg/m^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$kN/m^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$kg/m^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$kN/m^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$kg/m^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$m^3/s$	RATE OF DISCHARGE
$\gamma_d$	$kN/m^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	$kg/m^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	$kN/m^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$kg/m^3$	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$kN/m^3$	SEEPAGE FORCE
$\gamma'$	$kN/m^3$	UNIT WEIGHT OF SUBMERGED SOIL						

CONT No  
WP No 74-70-05

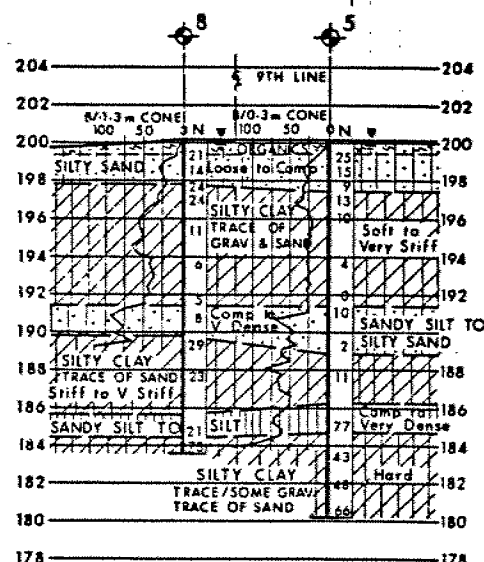


HWY 7A UNDERPASS  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

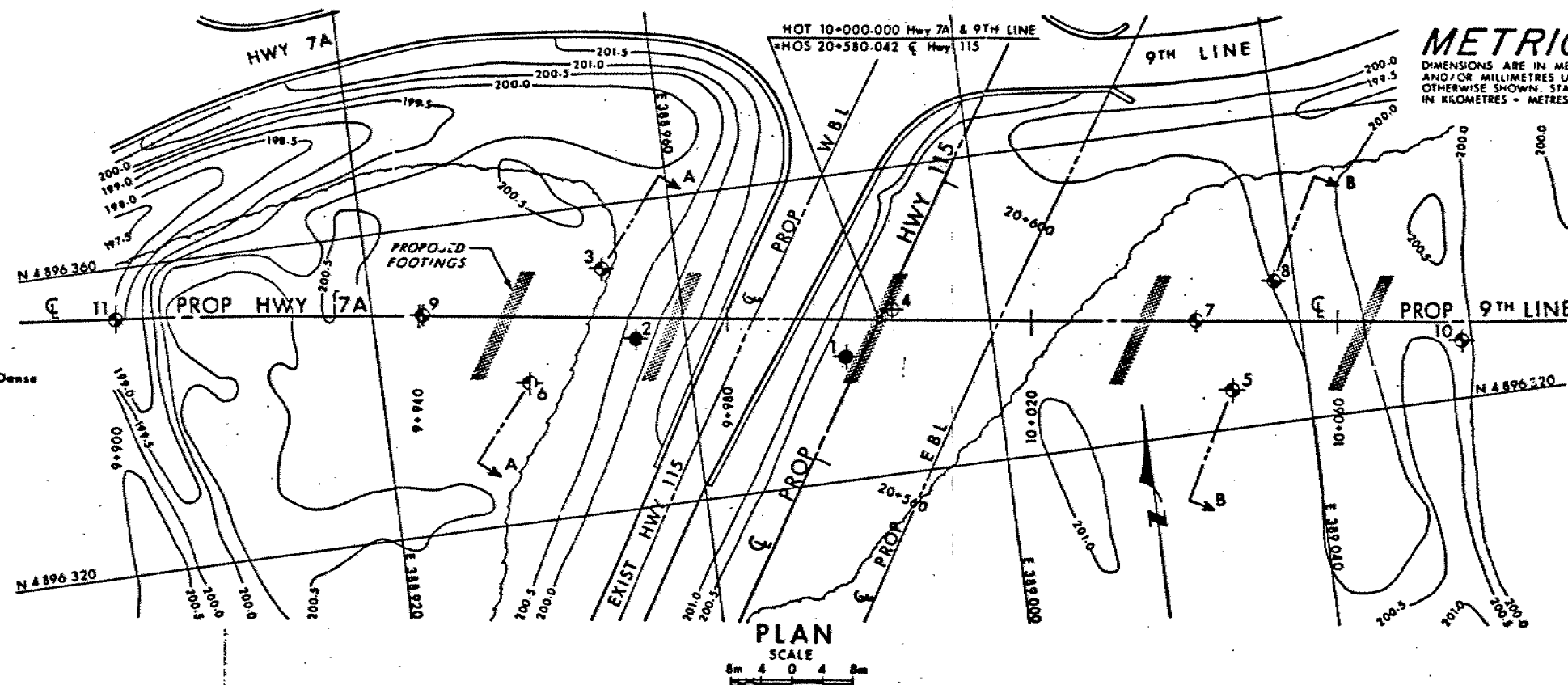


SECTION A-A

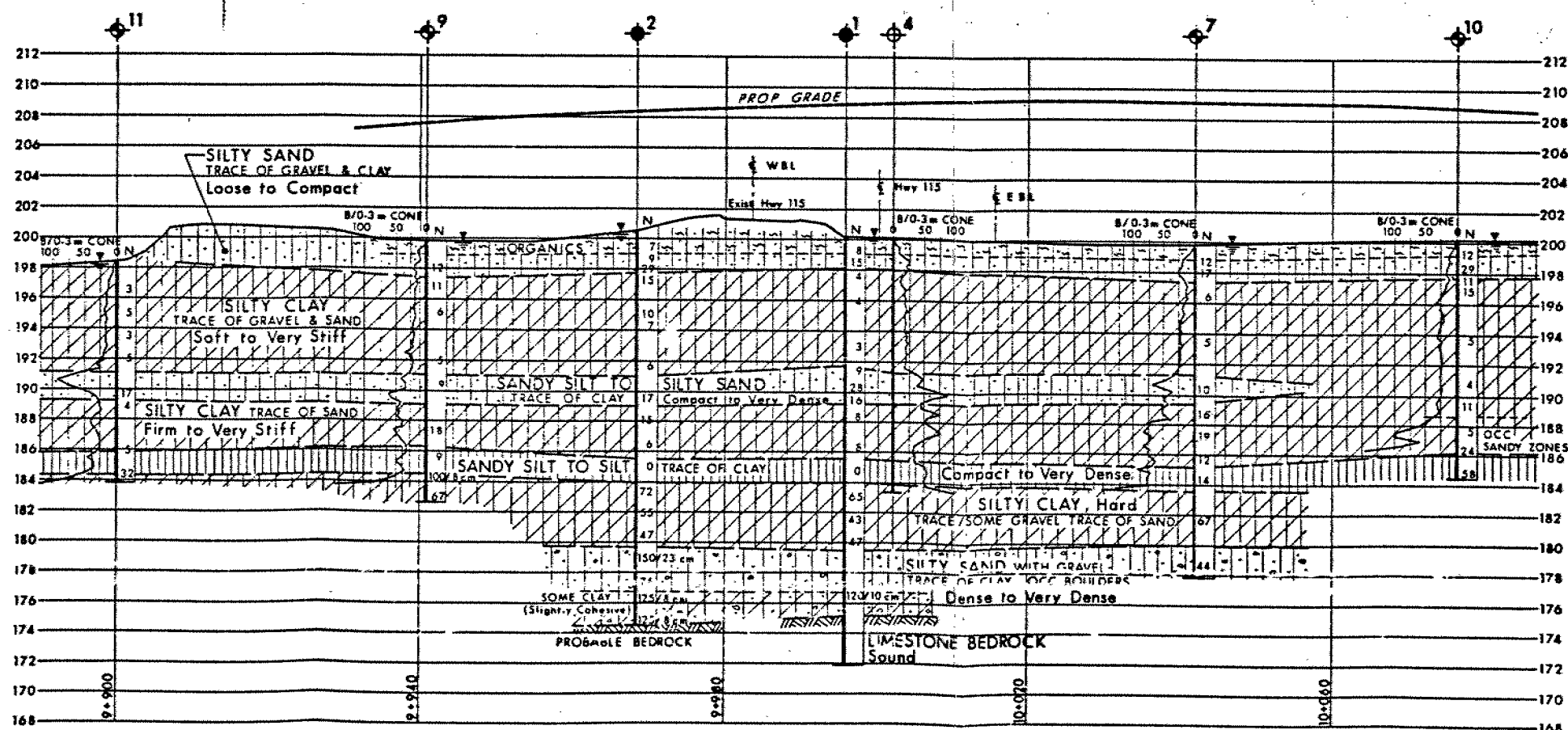


SECTION B-B

NOTE:  
For detailed soil conditions  
refer to Record of Borehole Sheets



PLAN



PROFILE PROP HWY 7A & 9TH LINE

- 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 85 05

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	200.2	4 896 336.2	388 980.4
2	200.5	4 896 342.0	388 953.3
3	200.2	4 896 351.7	388 950.0
4	200.1	4 896 341.5	388 987.2
5	200.2	4 896 325.0	389 030.3
6	200.2	4 896 338.2	388 939.0
7	199.8	4 896 334.5	389 026.7
8	200.2	4 896 335.5	389 037.5
9	199.8	4 896 348.8	388 926.5
10	200.2	4 896 327.5	389 060.9
11	198.4	4 896 353.5	388 886.5

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

DATE	BY	DESCRIPTION

Geocres No 310-310

HWY No 115

SUBMD DDCHECKED DATE 1985 28 27 SITE 21-39-446

DRAWN DDCHECKED DATE 1985 28 27 SITE 21-39-446

DWG 747005-A

# memorandum



To: S. Gwartz  
Area Construction Engineer  
Port Hope

Date: 1989 12 05

From: Foundation Design Section  
Room 315, Central Building

Re: Hwy. 115/7A IC  
Contract 89-57  
W.P. 74-70-05, Site 21-39-446  
District 7, Port Hope

Further to your request for our assessment of the stability of the pier excavation immediately east of Hwy. 115, and our subsequent site inspection of Nov. 30, 1989.

In our opinion, road protection is required along Hwy. 115 due to the proximity of the pier excavation and the unstable material at the face of the excavation.

This shoring could consist of sheet piles or soldier piles and lagging. The existing excavation may require backfilling to facilitate installation of the shoring. In any case, the contractor should submit his proposed shoring scheme for review.

The subsurface conditions at this location are illustrated in BH#1 of the contract documents (attached). For design purposes, it may be assumed that the properties of the subsurface materials are as follows:

<u>Elevation (m)</u>		$\phi$ ( $^{\circ}$ )	C (kPa)	$\gamma$ (kN/m <sup>3</sup> )
<u>From</u>	<u>To</u>			
201± (Road Surface)	200	30	---	20.5
200	198	28	---	20
198	192	--	20	19
192	189	20	---	--
189	186	--	40	19
186	184	30	---	20
184	179	--	300	20
179	175	35	---	20

The groundwater can be assumed to be at elev. 200m.


.../2



- 2 -

If there are any questions, please advise.

DH/jb

  
D.H. Dundas, P. Eng.  
Sr. Foundation Engineer

memo

To: File

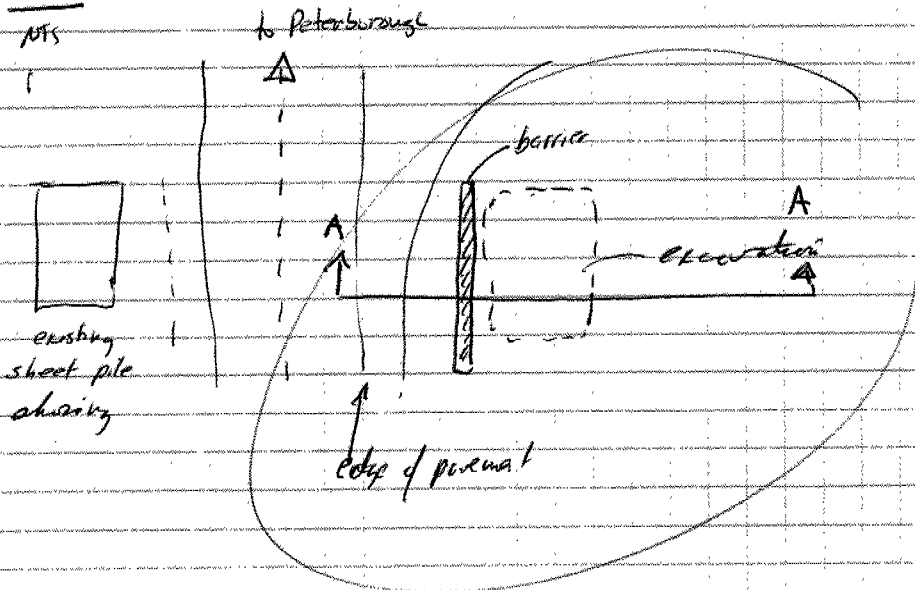
Date: Dec 4/89

Re: Contract 89-57  
WP 74-70-05  
 Hwy 115/7A

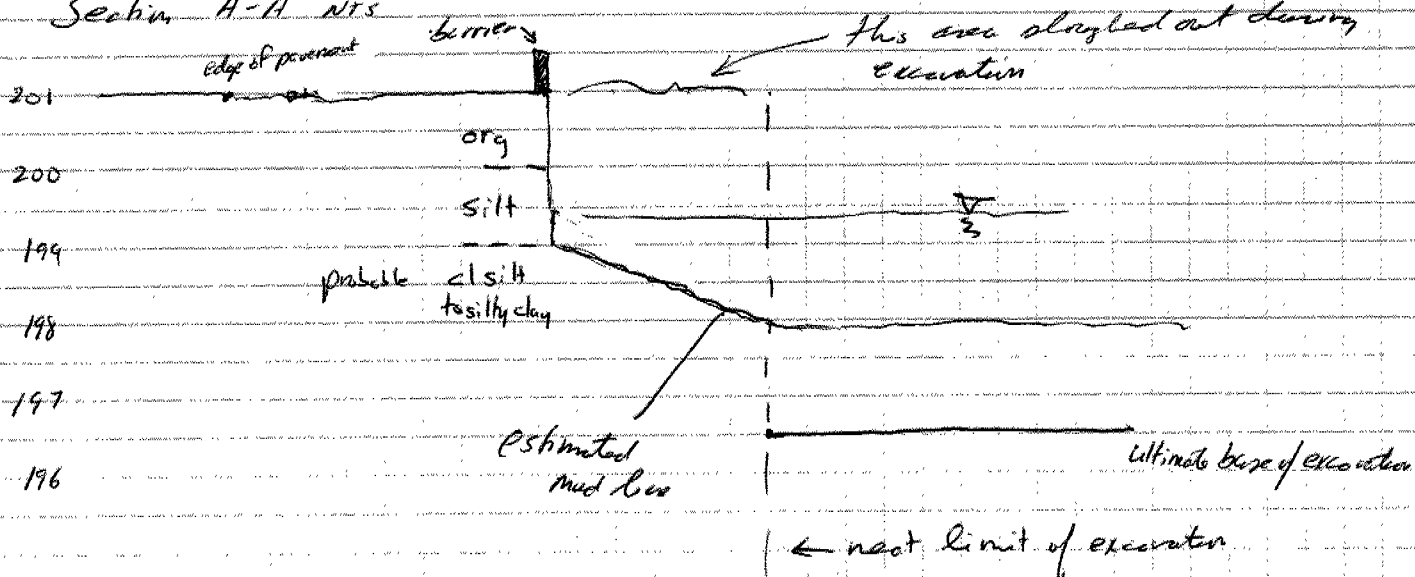
On Nov. 30 I visited the site with  
Shael Sharady to inspect the pre-  
excavation immediately east of Hwy 115.

The excavation is as per following sketch.

Plan  
NTS



Section A-A NTS



- the contractor felt that road protection required and halted his operation pending a decision from MDV

- the contractor proposed moving his sheet pile box caisson from west side of road to east side

- for all schemes involving piling the excavation would have to be backfilled first

- the cost of the contractor's proposal would be at bid price of \$72 k

- in my opinion roadway protection required along Hwy 115 due to undercutting and long term open of excavation. Although it is stable when frozen I believe we can not rely on it when thawed or during vibrations from pile driving

- Also in my opinion roadway protection is required only along Hwy 115. The other 3 sides as proposed by the contractor are really to his advantage in order to access his pile driver

- if retention is needed to support shoring it could be casters or reaction piles

- the shoring could be driven H piles & lagging or alternatively sheet piles

Nov. 27/89

Cont 89-57

LR 74-70-05

May 115/77

Shael Stewart of CR Construction advised that the contractor was concerned about soft conditions at the pier location and the impact on his pile driving operations and access of his equipment.

We reviewed the soil conditions & I advised that the soil report indicated soft conditions and it was up to the contractor to design a solution to do the job & that we should not put ourselves in position of liability by making recommendations.

Told him my only concerns were

1) is it a boiling problem?

- if so the excavation is probably in soil

- the problem could be improved by substituting

the clay layer, even, sanding, sand or

steel piles, well points or vacuum dewatering

2) is it soft conditions in clay

- the contractor could build working pier

provided he keeps 2' away from road

- I told him freezing would help structure

Shael will respond if it is problem correct

D. Dwyer

# memorandum

235-3731



To: Mr. P. Verok  
Senior Project Manager  
Planning & Design Section  
Central Region

From: Foundation Design Section  
Room 315, Central Building

RE: Contract 89-57  
Highway 7A Underpass  
W.P. 74-70-05, Site 21-39-446  
Hwy. 115, District #7, Port Hope

Date: 1989 04 06

As requested by the Estimating Office, we have reviewed the requirements for pre-loading at this project.

The present requirement for 1 year pre-loading would extend to November 30, 1989. In our opinion, this can be relaxed to October 1, 1989 in order to facilitate your scheduling for this project.

If there are any questions, please advise.

*D.H. Dundas*  
D.H. Dundas, P. Eng.  
Senior Foundation Engineer

DHD/ms

cc: D. Aspinwall

M E M O R A N D U M

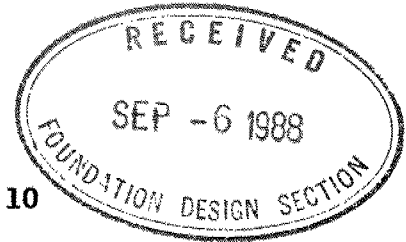
Geotechnical Section, Central Region

Telephone: 224-7676

To: Mr. G. Jewell  
Area Construction Engineer  
District 7, Port Hope  
Construction Office  
Central Region

Date: 88-08-30

Attention: C. Collins



Re: Contract 88-39, Hwys. 115, 7A and Co. Rd. 10  
Removal of Organic Material at Hwy. 7A  
Removal of Asphalt at Hwy. 7A and Co. Rd. 10

On August 9, 1988, D. Smith and D. Mullett reviewed the excavated area for the advance fills at Hwy. 7A, north of Hwy. 115.

Construction was concerned that they would be removing competent material and that the amount of organic material shown on the contract drawings was not a true indication of the field conditions.

Construction removed the organic material and exposed the underlying sandy silt. At this time, the Geotechnical Section was called out to determine whether this material should remain or continue to be excavated per contract drawings.

In reviewing the depths of excavation shown on the contract drawings and the competency of the sandy silt, it was decided that the material should remain under the advance fills and that further excavation was not required. This was discussed with B. Stanley, Project Supervisor, at the contract site.

During this visit, B. Stanley requested that the asphalt to be removed under the advance fills at Hwy. 7 and Co. Rd. 10 be left in place. This was reviewed by the Geotechnical Section and it was decided that where the asphalt was a minimum of 1.5 m below the future top of pavement grade, within the confines of the advance fill, it could be left in place.

Refer to the attached drawings for the limits of the asphalt to remain under the advance fills.

Please contact this office should you require clarification or further assistance.

A handwritten signature in dark ink, appearing to read "David Smith".

David Smith  
for:  
G. Cautillo  
Head, Geotechnical Section

DS/GC/rb  
Attach.

c.c. J. Smrcka  
B. Lamb  
D. Dundas

MEMO

To: File

Date 88 06 21

Re: Cont. 88-39

Hwy 7A Underpass

WP 74-70-05, Site 21-446

Hwy. 115, Dist. 7, Port Hope

---

Cherie Collins called to advise that installation of settlement plates would be in approximately 2 weeks. We agreed that the plates should be installed at approximately the level of existing ground after subexcavation of organics and replacement with selected granular. We agreed the only practical way to install plates is above groundwater level. I left out for Mr. Devito re: scheduling requirements.

D. Dunder  
Sr. Feas. Eng.

M E M O R A N D U M

Geotechnical Section, Central Region

Telephone: 224-7676

To: Mr. G. Jewell  
Area Construction Engineer  
District 7, Port Hope  
Construction Office  
Central Region

Date: 88-06-27

Attention: C. Collins



Re: Contract 88-39, Hwys. 115, 7A  
Ramps and Approaches at Hwy. 7A  
Interchange and Peterborough Co. Rd. 10  
Interchange Including Commuter Parking  
District 7, Port Hope

On June 16, 1988, this office was contacted regarding the excavation of materials for the advance fills for the Hwy. 7A/Hwy. 115 interchange. The area in question was to the south of Highway 115. Construction was concerned that they would be removing competent material and that the amount of organic material shown on the contract drawings was not a true indication of the field conditions.

On June 23, 1988, D. Smith and D. Mullett visited the site to determine the extent of the organic material. Two test pits were dug by dragline at locations which showed deep organic deposits. Both test pits verified the depth of organics shown on the contract drawings.

Two test pits were dug in the knolls adjacent to the low lying organic deposits. The materials encountered consist of silty sand over sandy silt over silty clay with a firm consistency.

In reviewing the proposal to excavate this material, it was determined that the material is competent and should remain under the advance fills.

As discussed with Bev Stanley, Project Supervisor, all organic materials, organic topsoil and vegetation should be removed prior to placing the uncompacted S.S.M.

It was discussed that similar conditions may exist at this interchange on the north side of Highway 115. This office should be contacted when excavation begins so that field soil conditions can be reviewed.

A handwritten signature in dark ink, appearing to read "David Smith".

DS/GC/rb

David Smith  
for:

c.c. J. Smrcka  
B. Lamb  
D. Dundas

G. Cautillo  
Head, Geotechnical Section



# memorandum



Tel: (416) 235-3731

To: C. Collins, Construction Supervisor      Date: 1988 06 21  
139 George St. North  
Peterborough, Ontario  
K9J 3G6

From: Foundation Design Section  
Rm. 315, Central Building  
Downsview

RE: Hwy. 7A Interchange  
Contract 88-39  
W.P. 74-70-05, Site 21-39-446  
Hwy. 115, District 7, Port Hope

As discussed in our telephone conversation of 1988 06 20, we have investigated the subexcavation requirements detailed on Sheet 24 of the Contract Drawings, and determined that they did not originate in the Foundation Design Section. Based on Point 2C of the Minutes of Progress Meeting No. 85-09 (enclosed), we refer your inquiries to the Central Region Geotechnical Section.

However, embankment construction is critical to slope stability at this site, and our input will be available, upon request, should it be required for this or any other concern you may encounter.

A handwritten signature in cursive script that reads "D. H. Dundas".

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

DHD/mj

c.c. - G. Cautillo  
P. Verok  
D. Woods

Encl.

# memorandum



To: G. Al-Bazi  
Design Engineer  
Structural Office  
3501 Dufferin Street

Date: 1988 06 20

From: Foundation Design Section  
Room 315, Central Building  
Downsview, Ontario

RE: Final Review  
Hwy. 7A Underpass  
W.P. 74-70-05, Site 21-446  
Hwy. 115, District 7, Port Hope

We have reviewed the contract package and final design drawings for this project.

Our comments are as follows:

- 1) Due to the soft clay deposits at this site, slope stability of the approach embankments is critical. The recommended design is based on the unit weight of fill not exceeding  $20.4 \text{ kN/m}^3$ .
- 2) The bases of pile caps at Piers #1 and #3 are on silty sand at elev.  $198.8\pm$  and  $197.8\pm$  respectively. At the time of the foundation investigation the groundwater elevation was at elev.  $200\pm$ . If these pile caps are to be formed in-the-dry, dewatering will be required at these locations. Dewatering requirements could be reduced to sump pumping if the bases of pile caps were in cohesive soils (below elev.  $197.8$  at Pier 1, below elev.  $197.4$  at Pier 3).
- 3) No foundation investigations have been completed, and no foundation recommendations have been provided for ramps in the NW quadrant of this site due to property clearance problems.
- 4) The required berms should be constructed before the height of the approach embankments is increased above the design berm heights.
- 5) The approach embankments should be pre-loaded for a period of 1 year before the abutment piles are installed.
- 6) All soft or loose surficial material and all surficial organic material below the plan limits of the embankments should be removed before the embankment is constructed. The depth of required sub-excavation under the approach embankments between Sta.  $9+900\pm$  and  $10+100\pm$  is estimated at  $1.5 \text{ m}$ . Over the remainder of the site, the depth of required sub-excavation is estimated at  $1.0 \text{ m}$ . It is understood that the Central Region Geotechnical Section has provided detailed recommendations for subexcavation.

*Note. 880621  
Don Glavin called  
to advise that  
sheet piling was  
being used.  
D.O.*

- 7) Backfill placed below the prevailing groundwater level should consist of non-cohesive (free-draining) material.

If there are any questions, please contact this office.

*D. H. Dundas*

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

DHD/mj

WP 128-86-00

87 09 28

Hwy 115/7A

Review of Bell Conduit Report

Discussed at Oct. 1 / 87  
mtg in the Val Mitrani

### General Comments

If MTC follows spec's does Bell take responsibility for performance of conduit

Alternatively they (Bell) could specify tolerable settlement and leave design & responsibility to MTC.

What are consequences if conduit fails?

What are estimated costs for Bell proposal?

Who commissioned this report?

Does the report reflect Bell policy?

### Specific Comments

- Floor strength and consolidation tests weren't carried out

- pg 6 "A further assumption is that the concrete conduit can tolerate minor movement and cracking without disrupting the internal cables"  
- is this statement Bell policy

- pg 9 48

insufficient information is being considered  
why not string temporary aerial wires  
and relocate conduit after embankment  
has been placed.

D.H. Dunder  
Sr. Foundation Engineer

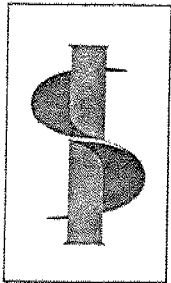
REPORT ON SOIL CONDITIONS  
BURIED CONCRETE ENCASED CONDUIT  
HIGHWAY NOS. 115 & 7A INTERSECTION  
CAVAN TOWNSHIP

Prepared for:

Bell Canada  
253 George Street, N.  
PETERBOROUGH, Ontario.  
K9J 3G9

SISL PROJECT NO. 3325

SEPTEMBER, 1987



SITE INVESTIGATION SERVICES  
LIMITED

785 THE KINGSWAY PETERBOROUGH, ONTARIO, CANADA K9J 6W7 TELEPHONE (705) 743-6850

September 9, 1987

Bell Canada  
253 George Street, N.  
PETERBOROUGH, Ontario.  
K9J 3G9

ATTENTION: MR. G. BILTON

RE: REPORT ON SOIL CONDITIONS: BURIED CONCRETE ENCASED  
CONDUIT, HIGHWAY NOS. 115 & 7A INTERSECTION  
TOWNSHIP OF CAVAN  
OUR PROJECT NO. 3325

---

Dear Sirs,

We are pleased to submit four copies of our soils report for the above project.

I trust that the information provided is adequate for your requirements. Should you have any queries, however, or should you require further assistance, please do not hesitate to contact me.

Yours very truly,

*R. Marttila*

ROBERT E. MARTTILA, B.Sc., M.A. Sc., P. Eng.  
Consulting Geotechnical Engineer for:

SITE INVESTIGATION SERVICES LIMITED

# HIGHWAY NOS. 115 & 7A INTERSECTION - CAVAN TOWNSHIP

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EXPLANATION OF SYMBOLS & TEST DATA -----	APPENDIX 'A'

## HIGHWAY 115 & 7A INTERSECTION

### 1.0 INTRODUCTION

---

An evaluation of soil conditions has been completed along sections of an existing buried concrete encased telephone cable conduit that will be affected by a proposed new interchange at the intersection of Highway No. 115 and Highway No. 7A in the Township of Cavan.

This report describes the site conditions and discusses some considerations for protecting the conduit from damage during and after construction.

Recommendations and discussions included in this report are provided for the guidance of the owner and consultants for preparing design drawings and cost estimates. In no case should they be construed as specific instructions for contractors. Interpretations of soil profiles have been completed for similar reasons. While these interpretations are believed to be a good representation of soil conditions, some irregularities should be expected. Tender documents and project cost allowances should allow for such irregularities and actual soil strata limits should be confirmed by observations during construction.



## HIGHWAY 115 & 7A INTERSECTION

### 2.0 FIELD WORK AND LABORATORY WORK

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Borings were drilled at 28 locations along the conduit length on July 6 and August 14 and 18, 1987 using a Bombardier-mounted CME-55 drill equipped with continuous flight augers. Auger cuttings were observed for strata changes. Soil samples were obtained with 50mm diameter "split spoon" samplers driven in accordance with standard penetration test procedures. The open boreholes were checked for groundwater during, and after, drilling. The borings generally were located within 3 feet of the conduit location indicated by the Bell Canada technician.

The top of the concrete in the existing buried, concrete encased conduit was determined by driving an 18mm steel rod to the concrete surface with a steel pipe section closed at one end. This indirect determination is believed to have defined the top of concrete level accurately adjacent to most borings where the concrete surface level is indicated on the summary profiles or logs.

Elevations of the borings were related to the existing geodetic datum survey of the site.

Selected samples of soil were tested for moisture content and particle size distribution.

## HIGHWAY 115 & 7A INTERSECTION

### 3.0 SITE CONDITIONS

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- 3.1 General - The locations of borings are shown on Figures 1, 2 and 3 and soil profile and test data at each of the borehole locations are summarized on Figures 7 to 34. Summary soil profiles are provided on Figures 4, 5 and 6 and particle sizes of typical samples are presented on Figures 35 to 42.
- 3.2 West End Area (Boreholes 1 to 8) - Boreholes 1 to 8, near the west end of the project, are all located within a flat marshy area and all 8 holes encountered peat and organic silt for depths of 0.91 to 1.68 metres. Soils immediately below the organic deposits consist of non-plastic soils within the range of silt to gravelly sand.

At Boreholes 4 and 5, the organic soils are underlain directly or almost directly by silt or sandy silt and similar silt soils are found below sand soils at Boreholes 1 and 2. Relatively clean sand and gravelly sand exists immediately below the organic soils at Boreholes 1, 2, 3 and 6.

The organic soils generally are soft with standard penetration resistances of 1 to 2 blows per 305mm. Penetration resistance of 9 to 19 blows in the inorganic sand and silt soils are indicative of compact relative density. (A resistance of 1 1/2 at 5 metres depth in Borehole 3 is attributed to sampling disturbance).

The groundwater table on July 6, 1987 was 0.7 to 0.9 metres below the ground surface. Conditions were relatively dry prior to this date. Consequently, we expect that the groundwater table will be higher during most times. During seasonally wet periods, the groundwater table will be at or above the ground surface.

The indicated top of the concrete encased conduit is relatively flat within the range of elevation 194.04 to 194.35 metres.

## HIGHWAY 115 & 7A INTERSECTION

- 3.3 Central and East Area (Boreholes 101 to 113) - Silty clay is the predominant native soil type through this section. All thirteen of the 3.1 to 4.6 metre deep borings were terminated in clay soils.

West of Highway No. 115 (Boreholes 101 to 108), the clay soils generally are covered with an irregular thickness of fine sand and silty sand that extends to depths of 0.51 to 3.35 metres. Some of this material appears to be fill, probably related to excavations for the conduit. An exception to this normal profile occurs at Borehole 107 where the clay soils are overlain directly by 1.88 metres of organic soils and soft clayey silt.

East of the existing Highway No. 115 embankment, the ground level has been raised by the addition of 1 to 1.5 metres of sandy fill that contain some lenses of topsoil. At Boreholes 109 to 110, the fill is underlain by 1 to 1.5 metres of native sand and silty sand which in turn is underlain by silty clay. In the more easterly boreholes (Boreholes 111, 112 and 113), the fill and the underlying sandy native soils are separated by 0.45 to 0.76 metres of organic soil.

The sand and silty sand is loose to compact as indicated by penetration resistances of 4 to 14 blows per 305mm. At shallow depths the silty clay soils are classified as firm on the basis of penetration resistances of 2 to 4. Most of the deeper clay soils are stiff to very stiff with resistances of 5 to 15 blows.

On August 14, 1987, the relatively flat groundwater table in Boreholes 109 to 113 was 1 to 1.5 metres below the ground surface. West of Highway No. 115, at Borehole 101 to 108, the groundwater level generally was more than 2 metres below the ground surface and the water table sloped to the west. These groundwater levels reflect the very dry summer conditions that have occurred this year. Consequently, higher water levels should be expected at most times and significantly higher water levels will occur during seasonally wet periods.

The inferred top of the concrete conduit is 0.91 to 1.17 metres below the ground surface in most areas.

## HIGHWAY 115 & 7A INTERSECTION

- 3.4 Concession Road 9 Area - Boreholes 114 to 120 - The soil profile in this area consists of a sequence of topsoil or peat underlain by sand and silty sand which in turn is underlain by silty clay. The topsoil/peat layer generally is thin with maximum thicknesses of 0.76 and 1.07 metres occurring at Boreholes 116 and 117.

The transition from sandy (occasionally silt) soils to clay occurs near elevation 197 metres at Boreholes 117 to 120. The transition level is deeper to the west.

Penetration resistance of 5 to 9 in the sandy soils are indicative of loose to compact material. The silty clay is classified as stiff to very stiff.

The groundwater table was 0.56 to 1.22 metres below the ground surface on August 18, 1987. Higher water levels should be expected at most times, particularly during seasonally wet periods.

- 3.5 Soils at Depth - Ministry of Transportation and Communication studies for the interchange structures and embankments indicate that deep deposits of interlensed clay, silt and silty sand exist below the depth range sampled by borings described in this report. Much of the clay soil is relatively soft and compressible. Bedrock occurs near elevation 175 metres which is about 25 metres below current road grades.

#### 4.0 CONDUIT PROTECTION CONSIDERATIONS

---

- 4.1 General - We understand that much of the conduit length studied will be covered with fill for interchange and temporary diversion embankments.

This section of the report discusses procedures and designs to ensure that the concrete encased conduit is adequately protected from damage by construction activity and forces and movements caused by the embankment loading.

The report only deals with the behaviour of soils in the immediate vicinity of the conduit. It is assumed that the overall embankment stability has been assured by the Ministry of Transportation and Communications design which includes stabilizing berms adjacent to the higher embankment sections. We also assume that all organic soils, not necessarily including a thin covering of topsoil, will be sub-excavated from below embankments.

A further assumption is that the concrete conduit can tolerate minor movement and cracking without disrupting the internal cables.

- 4.2 General Precautions - There are several general precautions that should be adhered to for all conduit sections affected by the highway construction. These include the following:

- (a) Special care and procedures should be used when working within 2 metres of the conduit.
- (b) Hand excavation and backfilling procedures should be used within 0.7 metres vertically and 1 metre horizontally from the conduit. Hand procedures include the use of small hand operated compactors.

It should be assumed that the surface of concrete encasement is irregular on the sides and the bottom.

- (c) Dewatering procedures should ensure that the sand soils adjacent to the conduit do not get disturbed during excavation. The extent of dewatering will depend on the groundwater levels that exist during construction and on construction procedures.

## HIGHWAY 115 & 7A INTERSECTION

### 4.2 General Precautions - (Continued)

- (d) Fill should be brought up equally on both sides of the conduit to ensure that there is no lateral thrust produced against the conduit. This comment applies to the full height of the embankment.
- (e) Any sections where the conduit is underlain by organic soils will require special treatment on an individual case basis. We should be contacted if any such occurrences are found.

### 4.3 Westerly Area - Boreholes 1 to 8 - Part of the existing conduit is near the toe of the new entrance road to the railway station and most of it will be covered with the stabilizing berm that forms part of the east-west ramp embankment.

The top of the concrete conduit is at or above the contact between the upper organic soils and the underlying sand or silt soils. Where the projection above the organic-sand contact is minor, it should be feasible to remove the organics and then place fill directly over the conduit. Where the projection is appreciable (more than 0.15 metres), it will be necessary to hand place fill or lean concrete on both sides of the conduit to provide lateral stability before covering fill is placed.

The organic soil-sand contact is below the groundwater table, even during dry periods. Consequently, some form of groundwater control may be required to prevent disturbance of the sand soils. The need for dewatering increases as the width of excavation adjacent to the conduit decreases.

## HIGHWAY 115 & 7A INTERSECTION

- 4.4 Borehole No. 101 to 110 Area - Except near Borehole 107, the conduit appears to be in firm soil and there is no need to expose the conduit. Care should of course be used until there is at least 3 feet of cover over the conduit.

Near Borehole 107 the organic soils should be removed and hand compacted fill or lean concrete should be placed beside the exposed conduit section to stabilize it prior to placement of the covering fill.

Subsoils below the organic soils probably will consist of clayey material. However, the soil lensing is relatively erratic and allowance should be made for sand soils and related dewatering along part of this section.

- 4.5 Borehole No. 111 to 113 Area - This area will be covered partly by the new north bound lanes of the highway. The area between Boreholes 112 and 113 will be the east side ditch location and to get adequate soil cover, the conduit will have to be lowered.

The conduit lowering should ensure that the entire conduit length has its base set on or in the compact sand below the organic soils.

Some form of dewatering will be required to prevent extensive soil disturbance and facilitate existing conduit removal, if the work that is done is a relatively narrow excavation. The dewatering system must lower the groundwater table below the proposed bottom level of the new conduit. A number of sumps extending to the underlying clay layer may suffice if groundwater levels are relatively low at the time of construction.

If the organic soils near the culvert are not going to be sub-excavated as part of the highway construction, it will be necessary to construct transitions on either side of the culvert to minimize differential settlements, caused by compression of the soils under the weight of the road embankment fill. A transition slope of at least 5 horizontal to 1 vertical should be provided through the organic soil zone.

## HIGHWAY 115 & 7A INTERSECTION

- 4.6 Concession Road 9 Area (Boreholes 114 to 120) - At Boreholes 115, 116, 118, 119 and 120 the conduit is embedded in competent soils and no special precautions are required. At Boreholes 114 and 117, however, part of the conduit extends above the organic soil-sand contact and the upper conduit section will have to be exposed and backfilled as described in Section 4.3 of this report.

The final road grade appears to be at least 1.2 metres above the highest top of the conduit section encountered. This is considered adequate to distribute traffic loads.

- 4.7 Settlement Considerations - Major settlements are not expected from compression of the inorganic subsoils encountered in the shallow borings completed for this study. However, some compression of underlying soft to firm clay soils encountered in Ministry of Transportation and Communications borings will occur under the load from the road embankments. The existing conduit will move downward with the surrounding soil as this settlement occurs.

Ministry of Transportation and Communications reports indicate that settlements in excess of 15 centimetres can be expected below the highest embankment sections and that the total settlement could take several years to occur. Based on proportional heights, a corresponding settlement below the ramp embankment fill should be less than 10 centimetres.

The settlement source is deep seated and the compressible clay layer is relatively uniform in thickness. Under these circumstances, no large differential settlements are expected and stresses and deformations induced in the conduit should be within tolerable ranges.

- 4.8 Conduit Access - The conduit west of the existing Highway No. 115 embankment will be covered with several metres of fill. This will make access for inspection or repair extremely difficult. Consequently, a conduit relocation to a higher level, after the embankments are in place, may be advisable.

Submitted by:



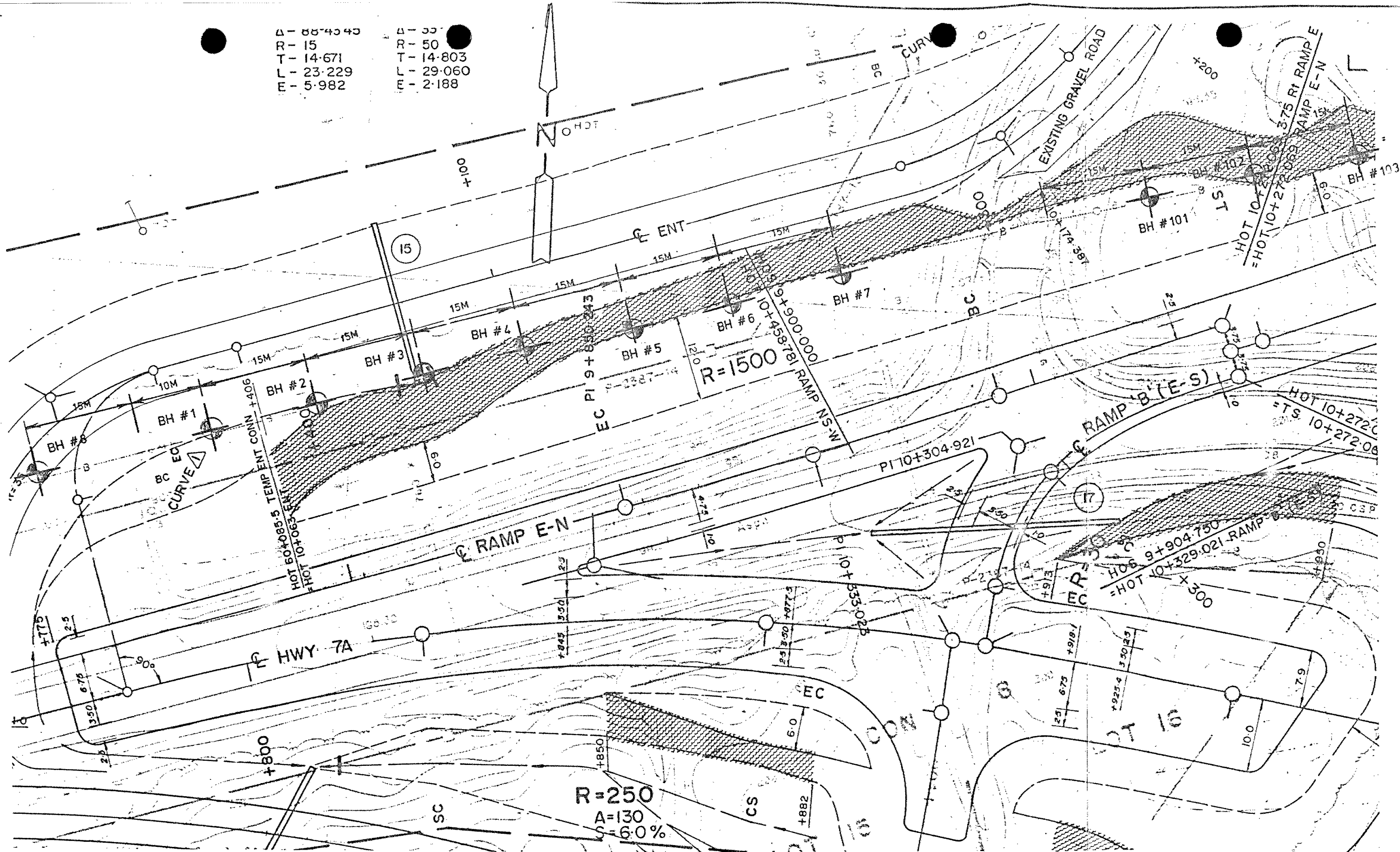
ROBERT E. MARTTILA, B.Sc., M.A.Sc., P. Eng.,  
Consulting Geotechnical Engineer for:

SITE INVESTIGATION SERVICES LIMITED

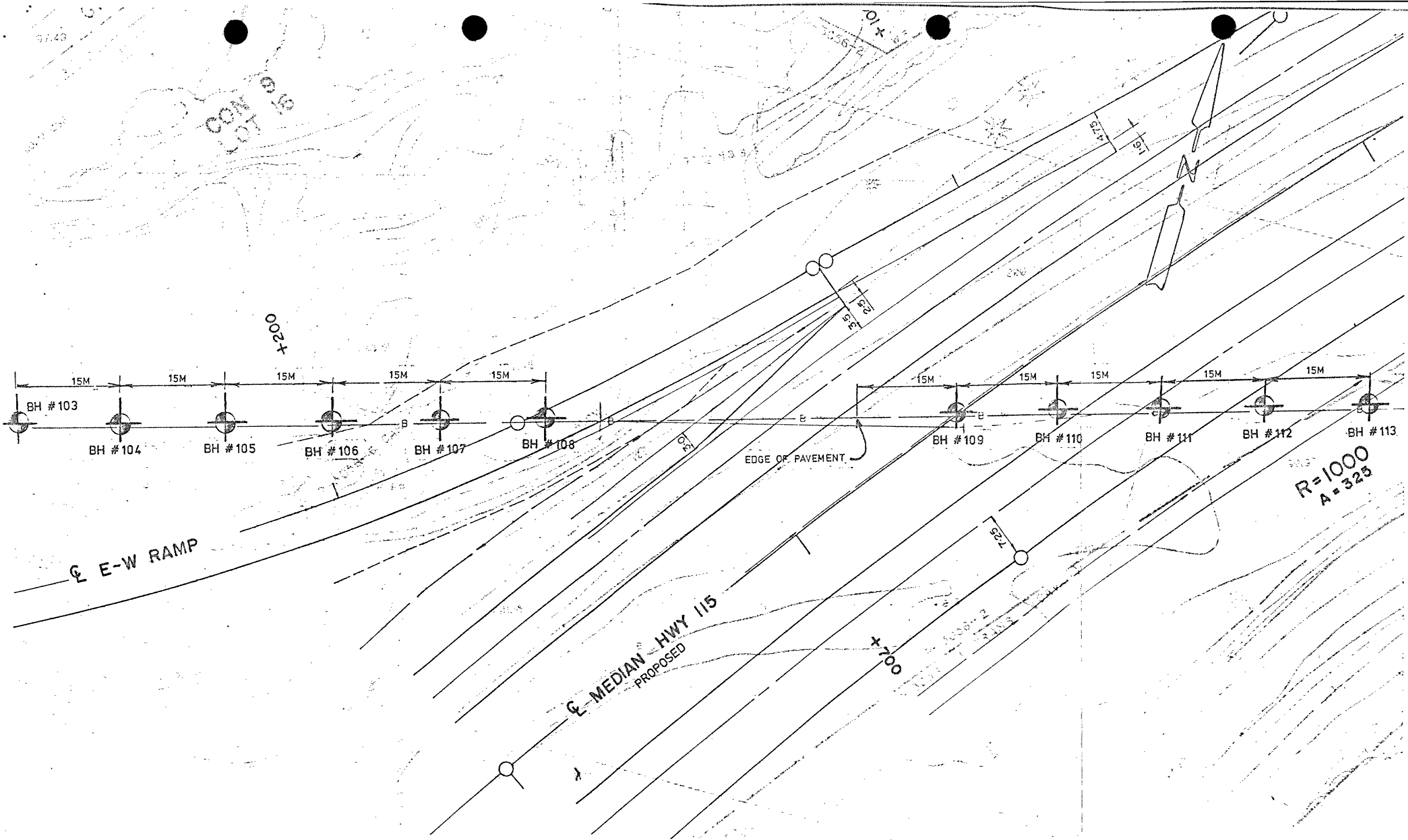


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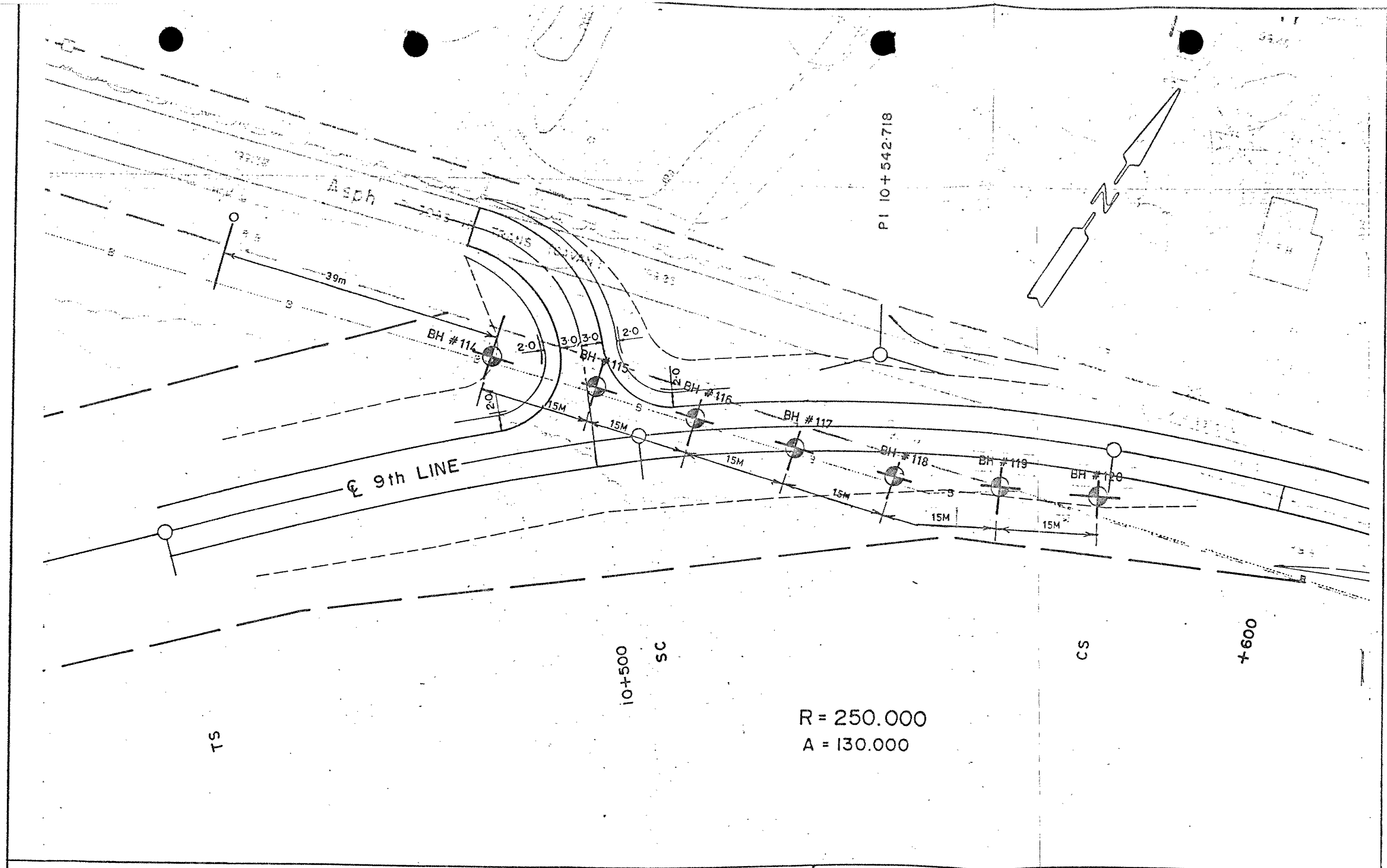
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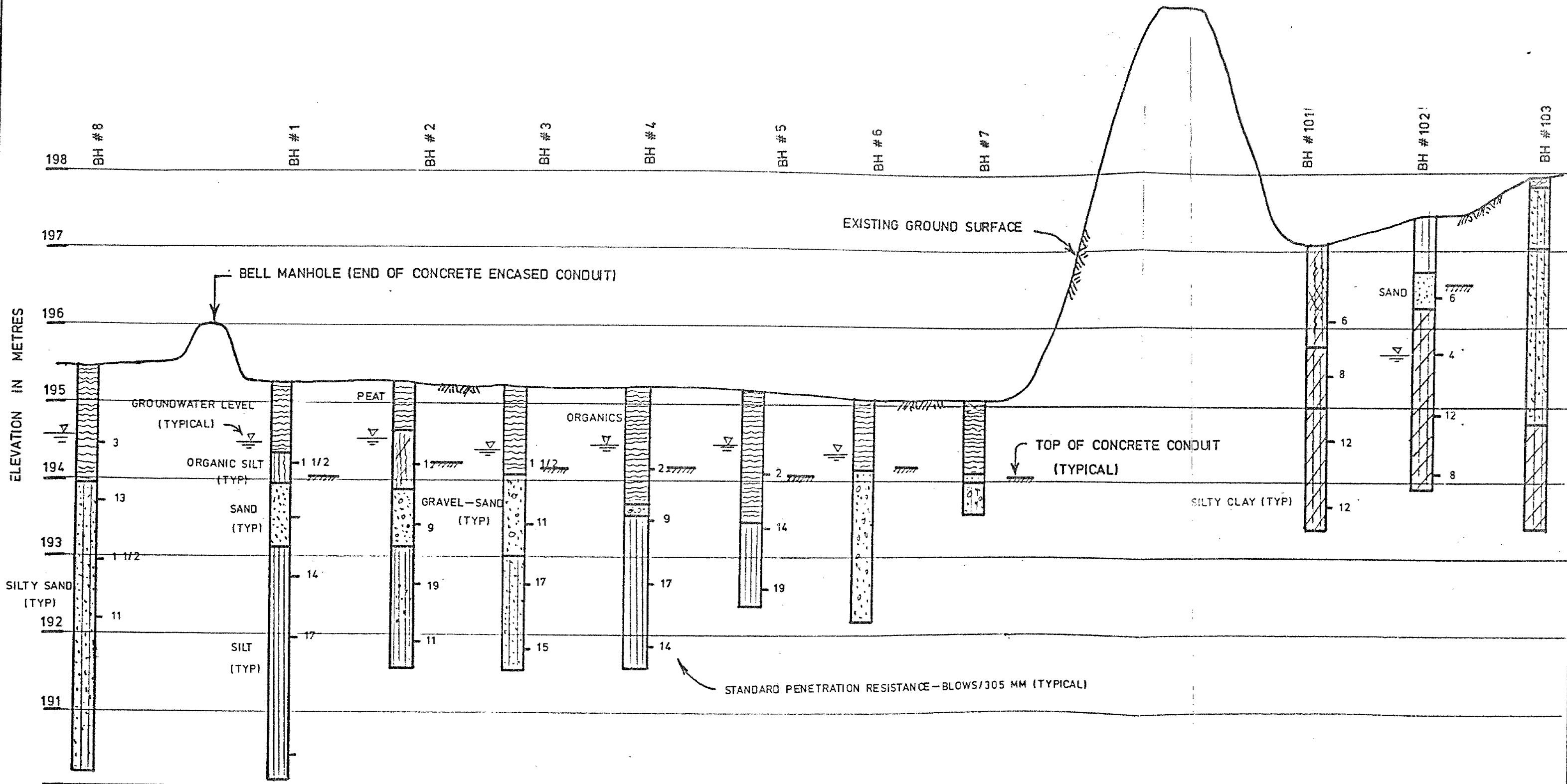
JOB NO.	3325	SCALE	SITE INVESTIGATION SERVICES LIMITED		FIGURE  1
DATE	SEPTEMBER, 1987	HORIZ. 1:500 VERT.	BELL CANADA CONDUIT HIGHWAYS #115 AND #7A INTERCHANGE LOCATION PLAN - WEST END		
APP'D BY	<i>[Signature]</i>	DRAWN BY L.M.			



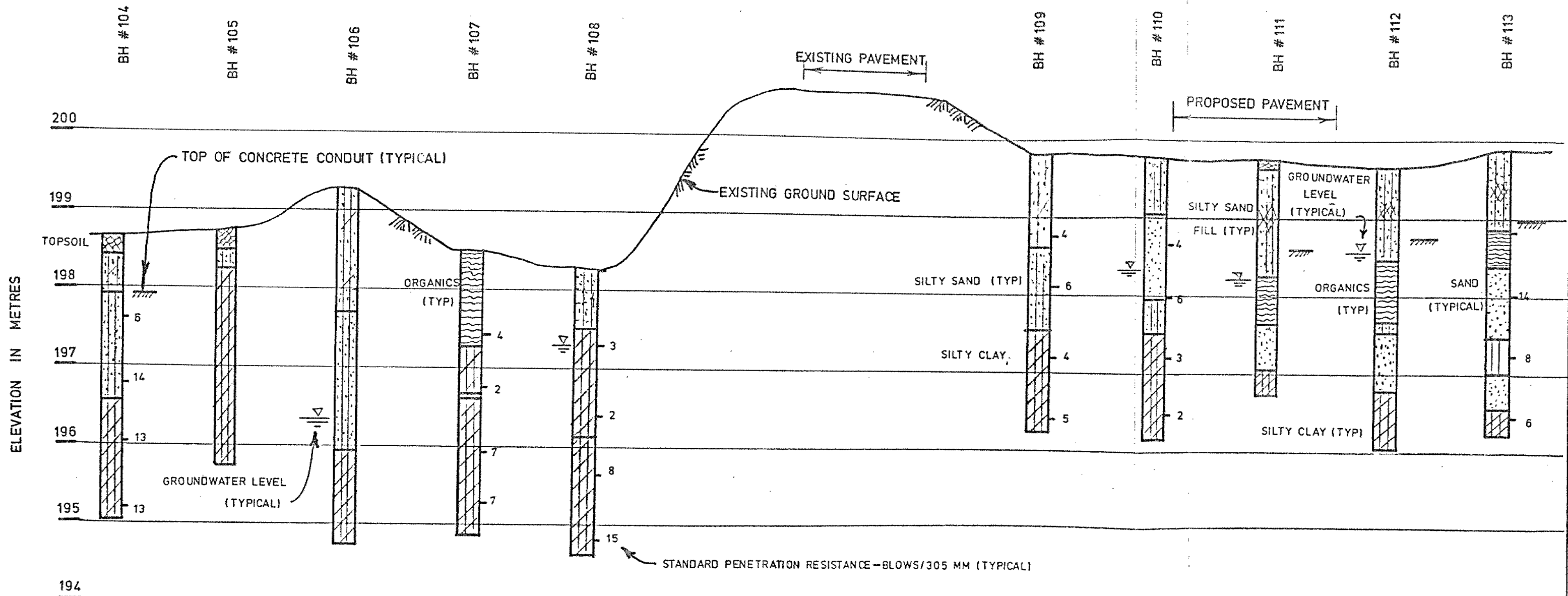
JOB NO. 3325	SCALE	SITE INVESTIGATION SERVICES LIMITED BELL CANADA CONDUIT HIGHWAYS #115 AND #7A INTERCHANGE LOCATION PLAN - EAST END	FIGURE 2
DATE SEPTEMBER, 1987	HORIZ. 1:500 VERT.		
APP'D BY P.E.M.	DRAWN BY L.M.		



	JOB NO. 3325	SCALE HORIZ. 1:500 VERT.	SITE INVESTIGATION SERVICES LIMITED		FIGURE 3
	DATE SEPTEMBER, 1987		BELL CANADA CONDUIT HIGHWAY #115 & 7A INTERSECTION		
	APP'D BY R Em	DRAWN BY L.M.	LOCATION PLAN - 9TH LINE		



JOB NO.	3325	SCALE	SITE INVESTIGATION SERVICES LIMITED		FIGURE
	DATE				
	SEPTEMBER, 1987				
APP'D BY	R. E. A.	DRAWN BY	BELL CANADA CONDUIT		4
		L.M.	HIGHWAYS #115 AND #7A INTERCHANGE		
			SOIL PROFILE - WEST END		

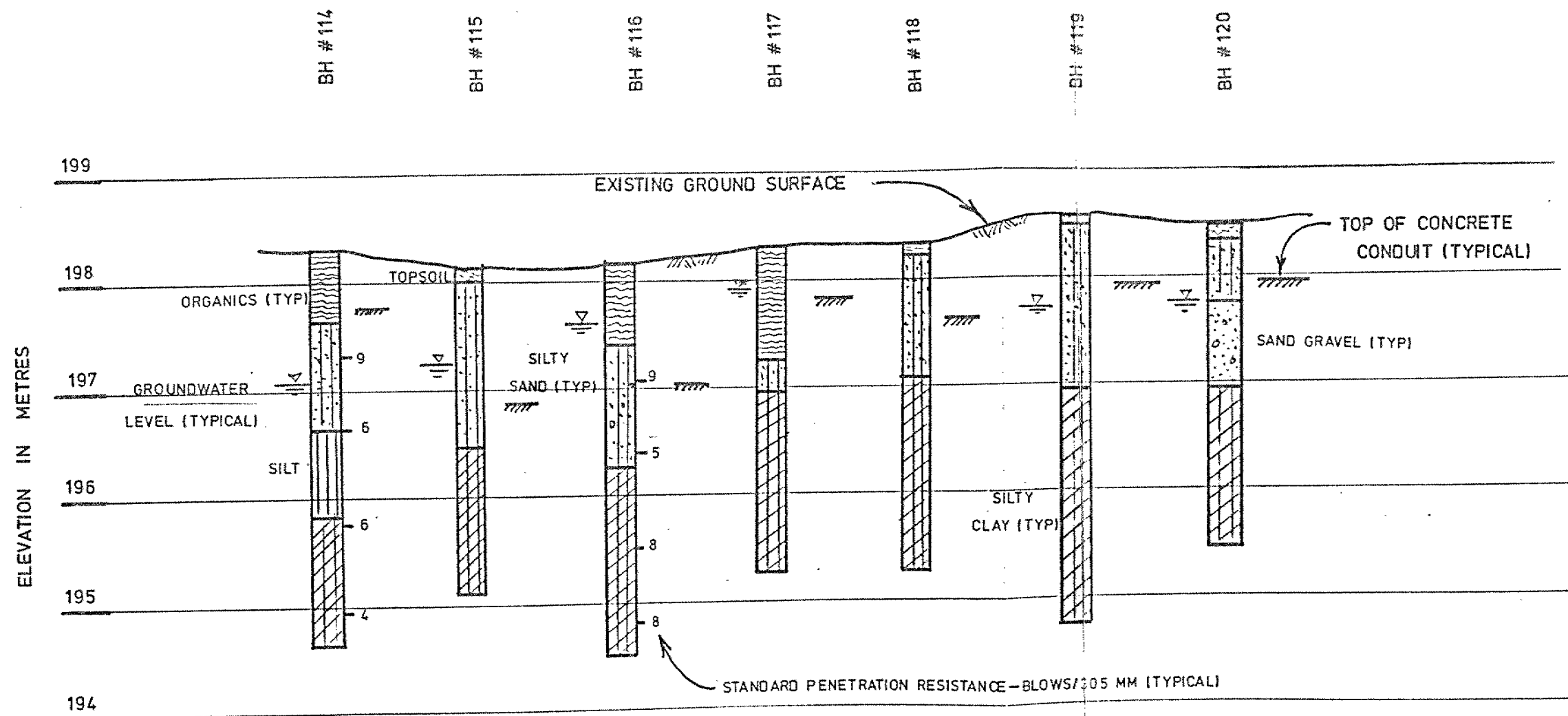


JOB NO. 3325  
DATE SEPTEMBER, 1987  
APP'D BY *REM*

SCALE  
HORIZ. 1:500  
VERT. 1:50  
DRAWN BY L.M.

SITE INVESTIGATION SERVICES LIMITED  
BELL CANADA CONDUIT  
HIGHWAYS #115 AND #7A INTERCHANGE  
SOIL PROFILE — EAST END

FIGURE  
**5**



	JOB NO. 3325	SCALE HORIZ. 1:500 VERT. 1:50	SITE INVESTIGATION SERVICES LIMITED BELL CANADA CONDUIT HIGHWAYS #115 AND #7A INTERCHANGE SOIL PROFILE - 9TH LINE	FIGURE 6
	DATE SEPTEMBER 1987			
	APP'D BY <i>R.G.</i>			
		DRAWN BY L.M.		

# memorandum



To: V. Mitranic  
Senior Project Manager  
Planning & Design Section  
Central Region  
5000 Yonge Street  
Willowdale

From: Foundation Design Section  
Rm 315, Central Building  
Downsview, Ontario

RE: County Rd. 10 & Hwy. 7A  
W.P. 128-86-00  
Hwy. 115, Dist. 7, Port Hope

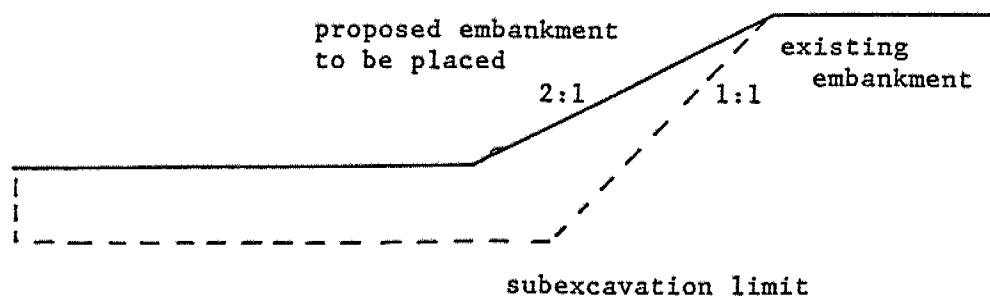
Tel: (416) 235-3731  
Date: 1987 08 07

Further to your memo of 1987 07 29, we have considered the proposal to designate SSM as embankment fill for the above noted projects.

In our opinion, this material is acceptable for fills above the prevailing groundwater level. However, for those portions of embankments below the groundwater level, there are potential construction problems if the clay/cohesive silt component exceeds approximately 10% and it would be advantageous to incorporate this restriction, if possible.

I have enclosed a copy of a previous memo which will clarify that we have always proposed that the most economical fill should be used, and that recommendations restricting the fill to Granular B originated with the Central Region Geotechnical Section.

Further to our meeting of 1987 08 06, this will confirm that we agree to the following subexcavation geometry provided that the subexcavation/backfilling operations are carried out in a continuous operation and no more than 5 m of subexcavation is exposed at any time.



If there are any questions, please contact this office.

DHD/pb

c.c.: D. Woods  
G. Green

Enclosed

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



# memorandum



To: V. Mitranic  
Senior Project Manager  
Planning & Design Section  
Central Region  
5000 Yonge Street  
Willowdale

Tel: (416) 235-3731  
Date: 1987 07 24

From: Foundation Design Section  
Rm 315, Central Building  
Downsview, Ontario

RE: County Rd. 10 & Hwy. 7A  
W.P. 128-86-00  
Hwy. 115, Dist. 7, Port Hope

We have reviewed the minutes to the mini-tech review meeting of 87 07 14 and wish to draw your attention to a possible misconception regarding the requirement for Granular B for embankment fills at these sites.

In point 1.1, the minutes imply that the Central Region Geotechnical Section recommends Granular B in order to meet the requirements of the Foundation Design Section.

I refer you to our memo to Totten Sims Hubick dated 87 03 16 in which we have indicated that our requirements are for a non-cohesive fill, preferably similar to, but not necessarily Granular B. Less than optimum material may be salvageable if drainage measures are incorporated in the design, and we recommend that the most economical alternative should be adopted. Our only other requirement is that the unit weight of in place compacted fill at Hwy. 7A does not exceed  $20.4 \text{ kN/m}^3$  as recommended in the Foundation Report for the Hwy. 7A Underpass.

It is our understanding that the recommendations for Granular B originate from the Central Region Geotechnical Section, as indicated at the above-noted meeting and on page 2 of the minutes for Progress Meeting No. 85-08 (85 10 09).

If there are any questions, please contact this office.

DHD/pb

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

# memorandum



To: V Mitranic  
Senior Project Manager  
Planning & Design Section  
Central Region  
5000 Yonge Street  
Willowdale

Tel: (416) 235-3731  
Date: 1987 07 17

From: Foundation Design Section  
Rm 315, Central Building  
Downsview, Ontario

RE: W.P. 128-86-00  
Hwy. 115/Co. Rd. 10 & Hwy. 115/Hwy. 7A  
Contract Package Review

We have reviewed the contract drawings and related documents for the above-noted projects. Our comments are as follows:

## Co. Rd. 10

- 1) The SP for settlement plates should include the details and sketch (attached) provided in M.L. Pauly's memo dated April 28, 1987.
- 2) The SP for the granular blanket over the pile locations can be changed to require HL4 instead of HL3.

## Hwy. 7A

- 1) Based on the available drawings, it is difficult to review the berm design. It is our understanding that additional X-sections will be available for the contract. When these become available, please provide us with representative X-sections for review. Preferably, the representative X-sections should consist of the highest and lowest grades, where berms are required, for each ramp/approach.
- 2) Concerning the subexcavation detail in the typical sections, we are concerned
  - a) that the vertical subexcavation indicated will not be attainable due to the soft organic soil.and
  - b) that a vertical cut adjacent to the existing toe of the slope may adversely affect the stability of the existing embankment.

Consequently we recommend

- a) that the subexcavation geometry should be modified as illustrated in the attached sketch. If any distress to the existing embankment results, the subexcavation should be backfilled to 2H:1V and this office should be immediately advised.

If there are any questions, please contact this office.

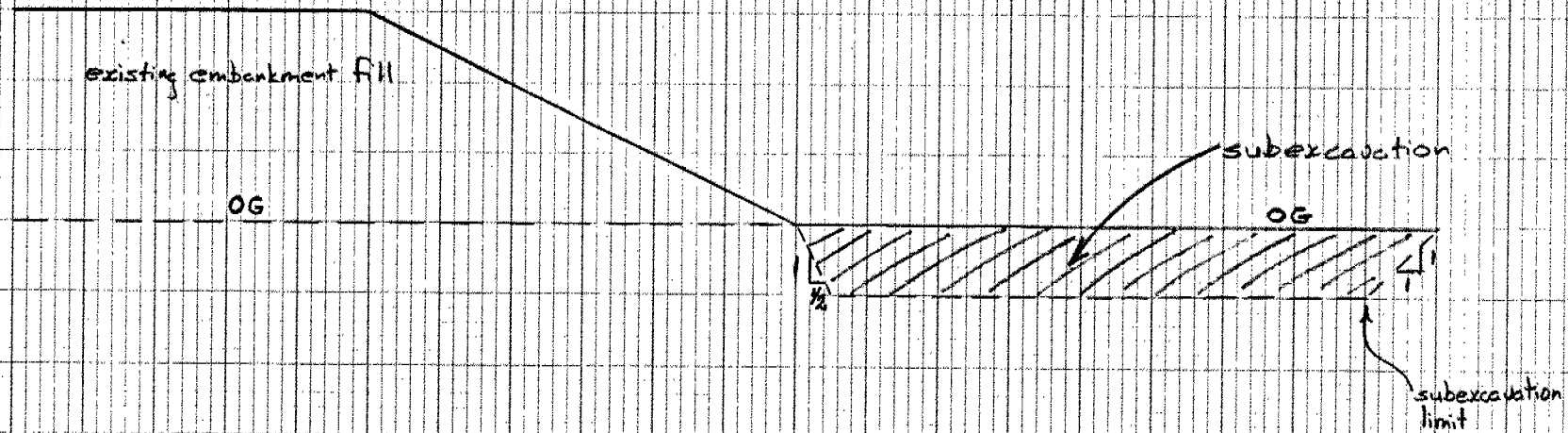
*D.H. Dundas*

D.H. Dundas  
Sr. Foundations Engineer

DHD/pb

Attachment

# RECOMMENDED SUBEXCAVATION DETAIL



X-SECTION

NTS

# memorandum



M. Devata

To: V. Mitranic  
Sr. Project Manager,  
Planning & Design Section,  
Central Region,  
5000 Yonge Street,  
Willowdale, Ontario.

Date: 87 06 22

Tel. No: 235-3661

Our File No: 7-84-03

From: Maintenance Branch,  
Room 230, Central Bldg.,  
1201 Wilson Avenue,  
Downsview, Ontario.

Re: W.P. 14-86-00  
W.P. 15-86-01  
W.P. 128-86-00  
Hwy. 115, Hwy. 7A Interchange Preloading,  
County Road 10 Advanced Grading,  
Commuter Parking Lot

This is an outline of the landscape concerns that arose during the progress meeting of 87 06 17. I have discussed these matters with R.M. Dell, Supervisor, Landscape Operations Unit.

- (1) We will not use muck as a topsoil substitute in the ditches in the parking area due to the conflict of this treatment with MNR's recommendations, with respect to fishery concerns:
  - (a) The main ditch draining the parking lot is basically a stream diversion of the existing Cavan Creek tributary. MNR wants a V-ditch instead of a wide flat-bottom ditch.
  - (b) MNR recommends that the lower most 1.0 m of the ditch be lined with fine gravel to facilitate spawning activity.

In consideration of the extra expense of building a gravel bottom, the MTC standard seeding and mulching for the 2:1 ditch slope is best to be replaced with Seeding and Erosion Control Blanket per S.P. 515. This applies to the slopes from the edge of the gravel bottom up to 1.0 m beyond the top of the ditch. This will help prevent the silting-up of the gravel lining during the turf establishment period.

- (2) The proposed Granular 'B' permanent embankments of County Road 10, if not treated, will remain as an eyesore in this rural/natural setting. In order to mitigate the visual impact of this high structure approach fill, I have recommended that a 450 mm earth cap plus 50 mm topsoil be applied to the permanent slopes. This will allow the establishment of a healthy vegetative cover.

.. /2

(2) Continued....

In light of a possibility that the Foundation Office may object to this treatment, I have conferred with J. Gruspier, Research Engineer of the Research and Development Branch to develop a viable alternative, satisfactory both from the Environmental as well as the Engineering points of views.

J. Gruspier stated that 100 mm - 150 mm of topsoil can be applied directly onto the free-draining material with no adverse effect. I believe this alternative is acceptable to the Foundation Office. He, however did not see the need for Granular 'B' more than 0.5 m above the ground-water level, unless there is an over-abundance of this material. He added that alternative materials such as sand, granular borrow or earth type SSM can be use over Granular 'B' even without geotextile separation. The interfusing will take place, with frictional strength established, in the first 100 mm.

- (3) In the Hwy. 7A interchange preloading contract, my previous recommendation towards temporary seeding and mulching of the surcharged embankment slopes is still applicable, barring full height Granular 'B'.

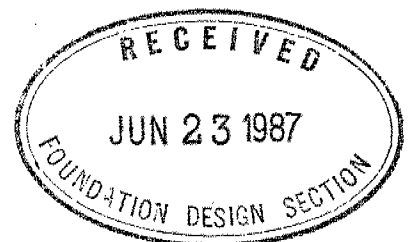
Since the embankments will be regraded under a future contract, the establishment of permanent vegetative cover will be discussed during detail design of the interchange.

I trust the above clarifies our position on these outstanding landscape issues. Thank you for your cooperation.



S. Ng,  
Landscape Planner,  
Landscape Planning Unit.

cc: R.M. Dell  
J. Gruspier  
H. McNeely (Attn: J. Foster)  
D. Gunter (Attn: G. Shibuya)  
T. Zander (Attn: C. Collins)  
W.J. Peck (Attn: D. Ficko)  
M. Devata  
Totten Sims Hubicki (D. Woods)



# memorandum



Tel: 3731

To: V. Mitranic  
Senior Project Manager  
Planning & Design Section  
5000 Yonge Street

From: Foundation Design Section  
Room 315, Central Building

RE: W.P. 74-70-05 (W.P. 74-70-01)  
Hwy. 7A/Hwy. 115 Interchange  
Hwy. 115, District 7, Port Hope

Date: 1987 03 16

Further to our telephone conversation of 87 03 13, we have reviewed the plan you submitted, showing the revised geometry for this interchange. Our comments are as follows:

- 1) The revised geometry involves additional ramps in the area of - Sta. 10 + 120 to 10 + 220 (Hwy. 7A alignment)  
and - Sta. 9 + 900± (Hwy. 7A alignment)
- 2) Sufficient field work has already been carried out to provide foundation recommendations for the revised geometry.
- 3) The recommendations provided in the Foundation Design Reports for W.P. 74-70-05 and W.P. 74-70-01 (Hwy. 7A interchange) should be followed.

If there are any questions, please contact this office.

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

DHD/mmj

c.c. - D. Woods



Ontario

Ministry of  
Transportation and  
Communications

Tel: (416) 235-3731

Engineering Materials Office  
Foundation Design Section  
Room 315, Central Building  
1201 Wilson Avenue  
Downsview, Ontario  
M3M 1J8

1987 03 16

Totten Sims Hubicki & Assoc. Ltd.  
1500 Hopkins Street  
P.O. Box 149  
Whitby, Ontario  
L1N 2C3

Atten: Mr. D.R. Woods, P. Eng.

RE: W.P. 74-70-01/05  
Hwy. 7A/115 Crossing  
District 7, Port Hope

Dear Sir,

Further to Progress Meeting No. 87-14, following are our responses to your queries:

1) Concerning the fill material for the embankment:

Free-draining non-cohesive material is required for any fill below the prevailing groundwater level. For the remainder of an embankment of this magnitude, a non-cohesive type of fill is preferable, although not necessarily material that strictly meets the criteria for M.T.C. Granular B. Less than optimum material may be salvageable if drainage measures are incorporated in the design. We suggest that you submit the grain size characteristics of the intended fill material at which time we could provide you with recommendations.

2) Concerning the SP for settlement plates and settlement monitoring:

Basically, a series of 1 m square steel plates will be placed at O.G. and at locations within the fill and the original locations of the plates will be surveyed. After completion of the embankment, the plates will be located by drilling techniques and their elevations will be periodically monitored. In order to schedule installation we will require a reasonable notice (3 to 4 weeks) of the start of embankment construction. We will also require assistance from the contractor and M.T.C. surveying staff to install and monitor the settlement plates. Full details for the SP could be provided by this office but in order to specify the location of the settlement plates we would require drawings showing the extent and survey details of the proposed fill.



- 3) Concerning the requirements for erosion protection of the preload:

Erosion protection is not required for temporary slopes provided that the minimum required preload geometry can be maintained. However, please note that since the geometry of this embankment is critical to its stability, the recommended fill heights should not be exceeded, and the recommended berm lengths must be maintained.

- 4) Concerning the existing pavement:

The existing pavement under the plan limits of the proposed embankment should be removed.

- 5) Concerning the disposal of organic material on the berm slopes:

The stability of this embankment is critical and the geometry recommended in the Foundation Design Report should be strictly followed. Organic material should not be placed on the berm slopes as it may create drainage related instabilities.

If there are any questions, please contact this office.

*D. H. Dundas*

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

DHD/mmj

c.c. - V. Mitranic



Ontario

Telephone: (416) 248-3282

Ministry of  
Transportation and  
Communications

Engineering Materials Office  
Foundation Design Section  
Central Building, Room 315  
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1986 03 20

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1500 Hopkins Street  
P.O. Box 149  
Whitby, Ontario  
L1N 2C3

Attention: Mr. D. R. Woods, P. Eng.

Dear Sirs:

Re: WP 74-70-01, (WP 74-70-05 vicinity)  
Hwy 7A, District 7, Port Hope

Further to your letter dated March 13, 1986, we have reviewed your queries and our comments are as follows:

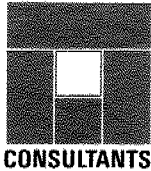
1. Surface drainage would be facilitated by a slope on the lateral berms. A slope of less than 5% is suggested.
2. No stability problems are anticipated for your proposal to grade the upper final slopes (above the berms) to 3H:1V provided that half the surcharge depth is removed prior to the regrading of the slopes.

If there are any questions, please contact this office.

Yours truly,

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

DHD:gp



## totten sims hubicki associates

G. L. TOTTEN B.Sc., P.Eng.  
R. E. SIMS B.A.Sc., P.Eng.  
J. M. HUBICKI B.A.Sc., P.Eng.  
R. L. WINDOVER M.Sc., P.Eng.  
P. C. EBERLEE B.A.Sc., P.Eng.

TOTTEN SIMS HUBICKI ASSOCIATES (1981) LIMITED  
1500 HOPKINS STREET, WHITBY, ONTARIO  
L1N 2C3 (416) 668-9363

March 13th, 1986

Foundation Design Section  
Ministry of Transportation  
and Communications  
1201 Wilson Avenue  
Downsview, Ontario  
M3M 1J8

Attention: Mr. D. Dundas, P. Eng.

Re: Highway 115, Highway 28 to County Road 10  
7.7 km, W.P. 74-70-01, District 7, Port Hope  
Hwy. 7A Interchange

Dear Sir:

May we please have your comments on the following matters, illustrated on the attached sketch:

- a) The need for a slope on the lateral berms and if required, your recommended %.
- b) Would it be acceptable to grade off the surcharge fill at a 3:1 fill slope on top of the berm to eliminate the need for guiderail.

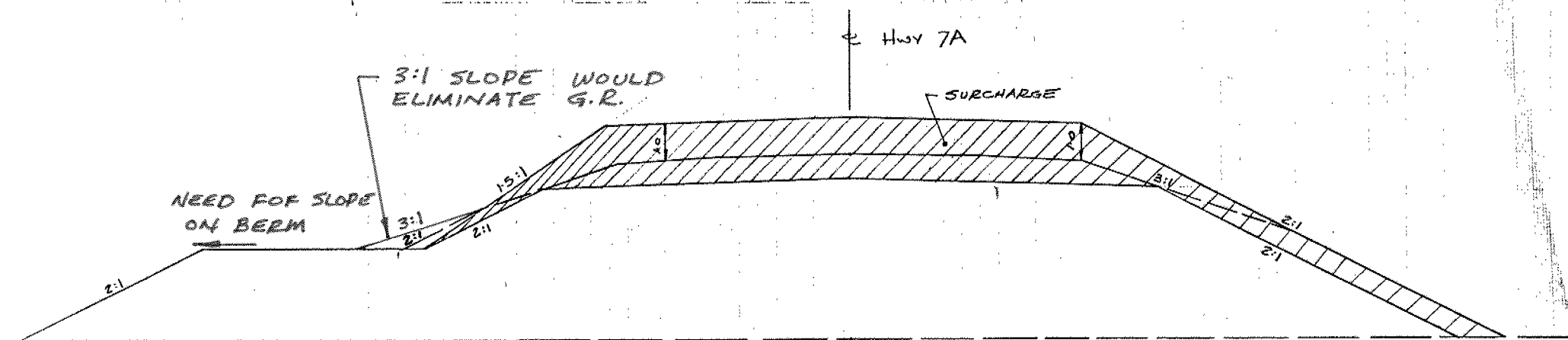
If you require further clarification of these two matters please contact the undersigned.

Yours very truly,

D. R. Woods, P. Eng.  
Project Manager

DRW/dh  
Encl.





PRELOADING & SURCHARGE  
HWY 7A

# memorandum



To: G.C.E. Burkhardt  
Head, Structural Section  
Central Region

Date: 1985 12 02

Attn: P.K. Roy

From: Foundation Design Section  
Rm 315, Central Building

Re: Preliminary Review  
W.P. 74-70-05; Site 21-39-446  
Hwy. 115, District 7, Port Hope

---

This Section has reviewed the General Arrangement Drawing 21-39-446-PI dated Nov/85, showing a 10 m forward berm at the west abutment and a 15 m forward berm at the east abutment. Assuming that the west abutment is 7.66 m high, and the east abutment is 8.57 m high, we have no further comments.

If there are questions, please contact this office.

*D. H. Dundas*

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

DHD/ta

# memorandum



To: W. L. Lin,  
Design Engineer,  
Structural Office,  
4th floor,  
3501 Dufferin Street

Date: 85 11 21

From: Foundation Design Section,  
Engineering Materials Office,  
Central Building, Room 315

Re: W. P. 74-70-05; Site: 21-39-446  
Hwy. 7A Underpass  
Hwy. 115, District #7, Port Hope

This section has reviewed the preliminary General Arrangement drawing 21-39-446-PI for the above-noted structure.

Our comments are as follows:

- 1) Our recommended final forward geometry is indicated in Table 3, Appendix, of the Foundation Investigation and Design Report. Please note that for a final abutment height of 7 m, a 6 m berm will be required. This change is shown on the attached photocopy of Table 3.
- 2) Required berm lengths may be interpolated between the values given.
- 3) D. Gluppe of the Structural Office has advised us that the top of grade elevations at the abutment locations will be as follows:
  - west abutment 207.66 m
  - east abutment 208.57 m

It is assumed that the ground elevation will be 200.0 m at the abutments at the time of construction of embankments. This implies that the site will be backfilled to this level subsequent to any subexcavation of soft or loose or organic materials.

In this case, we would recommend that the minimum forward berm lengths at the abutments should be:

- west abutment 10.0 m
- east abutment 15.0 m

If there are any questions, please contact this office.

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

DHD/ta

## WEST APPROACH EMBANKMENT

## EAST APPROACH EMBANKMENT

PTH (m)	SOIL TYPE	C (kPa)	$\phi$ (°)	(kN/m <sup>3</sup> )	(kN/m <sup>3</sup> )	DEPTH (m)	SOIL TYPE	C (kPa)	$\phi$ (°)	(kN/m <sup>3</sup> )	(kN/m <sup>3</sup> )
0	FILL	20	0	20.4	10.7	N/A	FILL	20	0	20.4	10.7
1.5	Silty Sand	0	30	20.4	10.7	0	Silty Sand	0	30	20.4	10.7
3.0	Silty Clay	100	0	19.6	9.9	2.4	Silty Clay	100	0	19.6	9.9
4.6	Silty Clay	60	0	19.6	9.9	4.6	Silty Clay	60	0	19.6	9.9
7.6	Silty Clay	40	0	19.6	9.9	7.6	Silty Clay	25	0	19.6	9.9
9.1	Silty Clay	100	0	19.6	9.9	9.1	Silty Clay	40	0	19.6	9.9
2.2	Silty Clay	25	0	19.6	9.9	10.7	Silty Clay	20	0	19.6	9.9
3.7	Silty Clay	50	0	19.6	9.9	12.2	Silty Clay	100	0	19.6	9.9
	Silty Clay	100	0	19.6	9.9	14.0	Silty Sand	0	27	19.6	9.9

EMBANKMENT GEOMETRY  
(WEST & EAST APPROACHES)

W.P. 74-70-05

TABLE 3

FINAL EMBANKMENT HEIGHT	EMBANKMENT HEIGHT INCLUDING SURCHARGE	BERM HEIGHT	FINAL TRANSVERSE & SURCHARGE GEOMETRY BERM WIDTH	FINAL FORWARD BERM WIDTH
(T)	(S)	(B ) H	(B ) W	(B ) F
6m	7m	N/A	N/A	N/A
7m	8m	3.5m	6m	<del>N/A</del> 6m
8m	9m	4.0m	12m	12m
9m	10m	4.5m	18m	18m



Ontario

Ministry of  
Transportation and  
Communications

Foundation Design Section  
Room 315, Central Building  
1201 Wilson Avenue  
Downsview Ontario  
M3M 1J8

Tel: (416) 248-3282

1985 11 20

MEMORANDUM TO:

Totten Sims Hubicki Associates  
1500 Hapkins Street  
Whitby, Ontario  
L1N 2C3

Attention: D. Woods

Re: Grading Design  
W.P. 74-70-01  
Hwy. 115/Hwy. 7A Interchange (W.P. 74-70-05)  
Hwy. 115, District 7, Port Hope

Further to the review meeting of 85 11 13 and our subsequent telephone conversations:

- 1) For design of berms, embankment heights should be calculated from toe of slope to top of embankment.
- 2) We have been advised by D. Gluppe of the MTC Structural Office that the top of grade at the abutment will be;

West abutment	207.66 m
East abutment	208.57 m

We have assumed that the existing ground level at the abutment will be 200 m at the time of embankment construction. This implies that the site will be backfilled to this level following any subexcavation. In this case, we recommend that the minimum length of the forward berms at the abutment should be;

West abutment	10 m
East abutment	15 m

- 3) We have reviewed the plan and X-sections detailing embankment geometry and have no comments other than noting that at present the proposed forward berm at the west abutment is 12 m.
- 4) To clarify the requirements for subexcavation, please refer to pg. 3 of the memo to A. Wittenberg dated 1985 09 23. All soft or loose surficial material and all surficial organic material below the plan limits of the embankments should be removed before the embankment is constructed.



If there any questions please contact this office.

*D. H. Dundas*

D.H. Dundas  
Senior Foundations Engineer

cc: V. Mitranec (Planning & Design)  
P. Roy (Structural Section)

DHD/ta

HWY. 7A10+675      2.4 m Lt. ¢

0	-	40 mm	mulch
40	-	540	gr. GP
540	-	700	dk.br.si.sa.tps.
700	-	1.2 m	br.si.sa. wet
1.2	-	1.7	gry.si. wet

10+625      5.0 m Lt. ¢

0	-	30 mm	mulch
30	-	380	gr. GP
380	-	750	br.si.sa. moist
750	-	1.5 m	br.si. wet

9+750      3.0 m Lt. ¢

0	-	150 mm	asph.
150	-	1.5 m	gr. GP

9+700      3.0 m Lt. ¢

0	-	140 mm	asph.
140	-	300	cr.gr.
300	-	1.3 m	gr. GP

9+700      5.0 m Lt. ¢

0	-	200 mm	cr.gr.
200	-	1.3 m	gr. GP

9+650      3.0 m Lt. ¢

0	-	100 mm	asph.
100	-	300	cr.gr.
300	-	1.5 m	gr. GP

10+020	¢		
0	-	100 mm	dk.br.cl.sa.tps.
100	-	500	br.sa.si. wet
500	-	1.2 m	br.si.sa. wet
10+032	¢		
0	-	500 mm	dk.br.org.
500	-	1.2 m	br.si.sa. wet
10+032	¢		
0	-	750 mm	dk.br.org.
500	-	1.2 m	br.sa.si. wet
10+032	7.0 m Rt. ¢		
0	-		
2.1	-	2.1 m	dk.br.org.
2.1	-	2.3	gry.sa.si. wet
10+082	¢		
0	-		
2.1	-	2.1 m	dk.br.org.
2.1	-	2.3	gry.sa.si. wet
10+082	10.0 m Rt. ¢		
0	-		
2.1	-	2.1 m	dk.br.org.
2.1	-	2.3	gry.sa.si. wet
10+082	15.0 m Rt. ¢		
0	-		
2.1	-	2.1 m	dk.br.org.
2.1	-	2.3	gry.sa.si. wet
10+082	10.0 m Lt. ¢		
0	-	850 mm	dk.br.org.
850	-	1.2 m	gry.sa.si. wet
10+082	15.0 m Lt. ¢		
0	-	800 mm	dk.br.org.
800	-	1.2 m	br.sa.si. wet

HWY 7A

10+090	±		
0	-	100 mm	water
100	-	3.0 m	dk.br.org.
3.0	-	3.2	gry.sa.si. wet

10+090	10.0 m Rt. ±		
0	-	4.2 m	dk.br.org.
4.2	-	4.5	gry.sa.si. wet

10+090	15.0 m Rt. ±		
0	-	5.1 m	dk.br.org.
5.1	-	5.3	gry.si.cl. (MP) moist

NOTE: Sta. 10+078 to 10+095  
Low area 15.0 m Lt. and Rt. ±

10+090	5.0 m Lt. ±		
0	-	150 mm	water
150	-	750	dk.br.org.
750	-	1.6 m	br.sa.si. wet (soft 1.0 - 1.4 m)

10+090	10.0 m Lt. ±		
0	-	150 mm	water
150	-	750	dk.br.org.
750	-	1.6 m	br.sa.si. wet (soft 1.0 - 1.4 m)

10+118	±		
0	-	500 mm	water
500	-	2.3 m	dk.br.org.
2.3	-	2.5	gry.si.cl. (MP) (moist, firm)

10+118	10.0 m Lt. ±		
0	-	400 mm	water
400	-	3.0 m	dk.br.org.
3.0	-	3.2	gry.cl.si. (moist, firm)

10+150	±		
0	-	250 mm	water
250	-	5.4 m	dk.br.org.
5.4	-	5.6	gry.si.cl. (MP) moist firm

10+140	15.0 m Lt. ±		
0	-	4.5 m	dk.br.org.
4.5	-	4.9	gry.si.cl. (MP) (soft 4.5 - 4.7 m)

10+140	10.0 m Lt. ±		
0	-	200 mm	water
200	-	3.9 m	dk.br.org.
3.9	-	4.4	gry.si.cl. (MP) (soft 3.9 - 4.2 m)

10+140	10.0 m Rt. ±		
0	-	500 mm	dk.br.org.
500	-	1.2 m	br.sa.si.

10+140	±		
0	-	200 mm	water
200	-	3.2 m	dk.br.org.
3.2	-	3.5	gry.si.cl. (MP) moist firm

NOTE: Sta. 10+107 to 10+123  
Low area 15.0 m + Lt. and Rt. ±  
NOTE: Sta. 10+135 to 10+165  
Low area 15.0 m + Lt. and Rt. ±

10+118	7.0 m Rt. ±		
0	-	600 mm	dk.br.org.
600	-	1.2 m	gry.si.cl. (MP) moist

10+118	15.0 m Lt. ±		
0	-	200 mm	water
200	-	2.8 m	gry.si.cl. (firm)

10+185	Φ			
0	-	500 mm	water	
500	-	1.3 m	dk.br.org.	
1.3	-	1.6	gry.si.cl. (MP) moist firm	

10+185	10.0 m Lt. Φ			
0	-	200 mm	water	
200	-	1.2 m	dk.br.org.	
1.2	-	1.6	gry.si.cl. (MP) moist firm	

10+185	10.0 m Rt. Φ			
450	-	450 mm	water	
1.2	-	1.2 m	dk.br.org.	
1.2	-	1.4	gry.si.cl. (MP) moist	

10+189	Φ			
0	-	200 mm	water	
200	-	800	dk.br.org.	
800	-	1.2 m	gry.si.cl. (MP) firm	

NOTE: Sta. 10+220 to 10+230  
Low area 15.0 + Lt. and Rt. Φ

10+221	Φ			
100	-	100 mm	water	
1.2	-	1.2 m	dk.br.org.	
1.2	-	1.4	br.si.sa. wet	

10+225	Φ			
0	-	300 mm	water	
300	-	1.6 m	dk.br.org.	
1.6	-	1.8	gry.br.si.sa. wet	

10+225	10.0 m Lt. Φ			
0	-	300 mm	water	
300	-	3.3 m	dk.br.org.	
3.3	-	3.6	gry.br.si.sa. wet firm	

NOTE: Sta. 10+180 to 10+190  
Low area 15.0 m Lt. and Rt. Φ

10+181	Φ			
0	-	200 mm	water	
200	-	1.2 m	dk.br.org.	
1.2	-	1.4	gry.br.cl.si. moist-wet firm	

### 10+160 10.0 m Lt. Φ

0	-	150 mm	water	
150	-	1.2 m	dk.br.org.	
1.2	-	1.4	gry.si.sa. wet	

### 10+160 10.0 m Rt. Φ

0	-	300 mm	water	
300	-	2.4 m	dk.br.org.	
2.4	-	2.6	gry.br.si.sa. wet	

### 10+160 Φ

0	-	200 mm	water	
200	-	2.3 m	dk.br.org.	
2.3	-	2.6	gry.br.si.sa. wet	

### 10+150 10.0 m Lt. Φ

0	-	200 mm	water	
200	-	4.8 m	dk.br.org.	
4.8	-	5.2	gry.si.cl. (MP) moist	

### 10+150 11.0 m Rt. Φ

0	-	3.6 m	dk.br.org.	
3.6	-	4.2	gry.si.cl. (MP) (soft 3.6 - 3.9 m)	

## HWY 7A

10+225 10.0 m Rt.  $\Phi$

0	-	200 mm	water
200	-	2.1 m	dk.br.org.
2.1	-	2.3	gry.sa.si. wet firm

10+229  $\Phi$

0	-	100 mm	water
100	-	1.0 m	dk.br.org.
1.0	-	1.2	gry.br.si.sa. wet

NOTE: Sta. 10+165 to 10+290  
Low area 15.0 m Lt. and Rt.  $\Phi$

10+275  $\Phi$

0	-	100 mm	water
100	-	4.1 m	dk.br.org.
4.1	-	4.3	gry.si.cl. (MP) moist firm

10+275 10.0 m Lt.  $\Phi$

0	-	250 mm	water
250	-	4.9 m	dk.br.org.
4.9	-	5.2	gry.si.cl. (MP) moist, firm

10+275 10.0 m Rt.  $\Phi$

0	-	200 mm	water
200	-	4.0 m	dk.br.org.
4.0	-	4.3	gry.si.cl. (MP) moist firm

10+288  $\Phi$

0	-	200 mm	water
200	-	1.5 m	dk.br.org.
1.5	-	1.7	gry.br.si.sa. wet

NOTE: Sta. 10+303 to 10+311  
Low area 5.0 m Lt. and Rt.  $\Phi$

450	-	600	br.cl.sa. moist firm
0	-	450 mm	dk.br.org.

10+351 5.0 m Lt.  $\Phi$

1.2	-	1.6	gry.br.si.sa. wet firm
0	-	1.2 m	dk.br.org.

10+346  $\Phi$

200	-	3.0 m	dk.br.org.
0	-	200 mm	water
200	-	3.2	gry.cl.si. wet firm

10+351 10.0 m Rt.  $\Phi$

2.1	-	2.4	gry.cl.si. wet firm
0	-	2.1 m	dk.br.org.

10+351  $\Phi$

NOTE: Sta. 10+345 to 10+357  
Low area 5.0 m Lt.  $\Phi$  And 15.0 m + Rt.  $\Phi$

100	-	1.8 m	dk.br.org.
1.8	-	2.0	gry.br.cl.si. moist
0	-	100 mm	water

10+307 4.0 m Rt.  $\Phi$

100	-	1.3 m	dk.br.org.
1.3	-	1.5	gry.br.cl.si. moist
0	-	100 mm	water

10+307 4.0 m Lt.  $\Phi$

300	-	1.7 m	dk.br.org.
1.7	-	2.5	gry.br.cl.si. moist-wet (soft to 2.3 m)
0	-	300 mm	water

10+307  $\Phi$

HWY.7A

10+355      ₣

0      -      750 mm      dk.br.org.  
750      -      1.0 m      br.cl.sa. moist firm

NOTE: Sta. 10+383 to 10+394

Low area 15.0 m + Lt. and Rt. ₣

10+384      ₣

0      -      100 mm      water  
100      -      700      dk.br.org.  
700      -      1.2 m      br.si.sa. wet firm

10+389      ₣

0      -      350 mm      water  
350      -      800      dk.br.org.  
800      -      1.2 m      gry.si.cl. (MP) moist

10+389      10.0 m Lt. ₣

0      -      350 mm      water  
350      -      1.9 m      dk.br.org.  
1.9      -      2.1      gry.cl.si. moist-wet firm

10+389      10.0 m Rt. ₣

0      -      750 mm      dk.br.org.  
750      -      1.2 m      br.si.cl. (MP) moist

10+393      ₣

0      -      50 mm      water  
50      -      500      dk.br.org.  
500      -      1.0 m      br.si.sa. wet

NOTE: Sta. 10+425 to 10+436

Low area 15.0 m+ Lt. and Rt. ₣

10+426      ₣  
0      -      100 mm      water  
100      -      350      dk.br.org.  
350      -      1.2 m      br.si.sa. wet firm

10+431      ₣  
0      -      400 mm      water  
400      -      700      dk.br.org.  
700      -      1.2 m      br.sa.si. wet firm

10+431      10.0 m Rt. ₣  
0      -      400 mm      water  
400      -      700      dk.br.org.  
700      -      1.2 m      br.sa.si. wet firm

10+431      10.0 m Lt. ₣  
0      -      250 mm      dk.br.org.  
250      -      1.0 m      br.cl.sa. moist-wet firm

NOTE: Sta. 10+445 to 10+455  
Low area from 5.0 m + Lt. ₣  
10+450      10.0 m Lt. ₣

0      -      350 mm      water  
350      -      650      dk.br.org.  
650      -      1.2 m      gry.sa.si. wet firm

NOTE: Sta. 10+460 to 10+525  
Low area 15.0 m + Lt. and Rt. ₣

10+462      ₣  
0      -      100 mm      water  
100      -      300      dk.br.org.  
300      -      1.0 m      br.sa.si. wet

10+475      ₣  
0      -      400 mm      water  
400      -      600      dk.br.org.

# HWY. 7A

10+475		10.0 m Rt. ₪	
0	-	430 mm	water
430	-	550	dk.br.org.
550	-	1.2 m	br.si.sa. wet firm

10+475		10.0 m Lt. ₪	
0	-	450 mm	water
450	-	650	dk.br.org.
650	-	1.2 m	br.si.sa. wet firm

10+500		₪	
0	-	450 mm	water
450	-	650	dk.br.org.
650	-	1.2 m	gry.br.si.sa. wet

10+500		10.0 m Rt. ₪	
0	-	400 mm	water
400	-	700	dk.br.org.
700	-	1.2 m	gry.br.si.sa. wet

10+500		10.0 m Lt. ₪	
0	-	250 mm	water
250	-	800	dk.br.org.
800	-	1.2 m	br.si.sa. wet firm

10+525		₪	
0	-	300 mm	water
300	-	500	dk.br.org.
500	-	1.2 m	br.si.sa. wet firm

10+525		10.0 m Rt. ₪	
0	-	400 mm	water
400	-	850	dk.br.org.
850	-	1.2 m	br.si.sa. wet

0	-	100 mm	water
100	-	400	dk.br.org.
400	-	1.2 m	br.si.cl. (MP) moist
10+462		₪	

NOTE: Sta. 10+465 to 10+460  
Low area 15.0 m + Lt. and Rt. ₪

## RAMP W-E (7A)

0	-	500 mm	dk.br.org.tps.
500	-	1.2 m	br.si.sa. wet firm
10+600		10.0 m Rt. ₪	
0	-	40 mm	water
40	-	400	dk.br.org.
400	-	1.2 m	gry.br.si.sa. wet firm

10+575		10.0 m Rt. ₪	
0	-	150 mm	dk.br.si.sa.tps.
150	-	1.2 m	br.sa.si. wet firm
10+550		10.0 m Rt. ₪	

0	-	50 mm	water
50	-	400	dk.br.org.
400	-	600	br.si. w/s cl. moist
600	-	1.2 m	br.si.cl. (MP) moist
10+550		₪	

NOTE: Sta. 10+525 to 10+550  
Low area 15.0 m + Rt. ₪ and  
10.0 m and decreasing to Lt. ₪

10+525		10.0 m Lt. ₪	
0	-	340 mm	water
340	-	600	dk.br.org.
600	-	1.2 m	br.sa.si. wet firm

10+462 10.0 m Lt.  $\Phi$

0	-	60 mm	water
60	-	400	dk.br.org.
400	-	1.2 m	br.si.cl. (MP) moist

10+462 10.0 m Rt.  $\Phi$

0	-	100 mm	water
100	-	400	dk.br.org.
400	-	1.2 m	gry.br.si.cl. (MP) moist

NOTE: Sta. 10+445 to 10+400

Low area 15.0 + m Lt. and Rt.  $\Phi$

10+442  $\Phi$

0	-	150 mm	water
150	-	2.0 m	dk.br.org.
2.0	-	2.3	gry.br.si.sa. wet firm

10+425  $\Phi$

0	-	5.2 m	dk.br.org.
5.2	-	5.4	gry.si.cl. (MP) moist

10+524 10.0 m Lt.  $\Phi$

0	-	5.2 m	dk.br.org.
5.2	-	5.4	gry.si.sa. wet

10+425 10.0 m Rt.  $\Phi$

0	-	300 mm	water
300	-	2.8 m	dk.br.org.
2.8	-	3.0	gry.si.sa. wet

NOTE: Sta. 0+305 to 0+295  
Low area 10.0 m Lt.  $\Phi$  and 15.0 + m Rt.  $\Phi$

0	-	2.4 m	dk.br.org.
2.4	-	2.6	br.si.sa. wet
10+335	10.0 m Rt. $\Phi$		
0	-	150 mm	water
150	-	2.7 m	dk.br.org.
2.7	-	3.0	gry.si.sa. wet
10+335	$\Phi$		

NOTE: Sta. 10+340 to 10+330  
Low area 15.0 m + Lt. and Rt.  $\Phi$

0	-	250 mm	water
250	-	2.0 m	dk.br.org.
2.0	-	2.3	gry.si.sa. wet
10+350	10.0 m Lt. $\Phi$		

NOTE: Sta. 30+360 to 30+340  
Low area 5.0 - 15.0 m Lt.  $\Phi$

0	-	4.6 m	dk.br.org.
4.6	-	5.0	gry.si.sa. wet
10+400	10.0 m Lt. $\Phi$		
0	-	300 mm	water
300	-	3.1 m	dk.br.org.
3.1	-	3.3	gry.si.sa. wet
10+400	$\Phi$		



HWY. 7A

10+300		¢	
0	-	100 mm	water
100	-	700	dk.br.org.
700	-	1.2 m	gry.cl.si. wet firm

10+300 10.0 m Rt. ¢

0	-	400 mm	water
400	-	1.5 m	dk.br.org.
1.5	-	1.7	gry.si.wet firm

10+300 5.0 m Lt. ¢

0	-	300 mm	dk.br.org.
300	-	1.2 m	gry.sa.si. wet firm

NOTE: Sta. 10+275 to 10+265  
Low area 15.0 m + Lt. and Rt. ¢

10+260 ¢

0	-	300 mm	water
300	-	850	dk.br.org.
850	-	1.2 m	gry.cl.si. wet firm

10+260 10.0 m Rt. ¢

0	-	150 mm	water
150	-	1.5 m	dk.br.org.
1.5	-	1.7	gry.cl.si. wet firm

10+260 10.0 m Lt. ¢

0	-	200 mm	water
200	-	1.4 m	dk.br.org.
1.4	-	1.6	gry.sa.si. wet firm

NOTE: Sta. 10+220 to 10+205  
Low area Lt. ¢

0	-	100 mm	water
100	-	1.1 m	dk.br.org.
1.1	-	1.4	gry.cl.sa. wet firm
10+450		10.0 m Rt. ¢	

RAMP N-W (7A)

0	-	700 mm	dk.br.org.
700	-	1.0 m	br.sa.si. wet firm
10+175		5.0 m Lt. ¢	

0	-	200 mm	water
200	-	2.0 m	dk.br.org.
2.0	-	2.2	gry.sa.si. wet firm
10+175		¢	

0	-	150 mm	water
150	-	4.0 m	dk.br.org.
4.0	-	4.2 m	gry.si.cl. (MP) firm
10+200		10.0 m Lt. ¢	

0	-	100 mm	water
100	-	2.4 m	dk.br.org.
2.4	-	2.6	gry.br.sa.si. wet firm
10+200		¢	

NOTE: Sta. 30+205 to 30+170  
Low area 5.0 to 15.0 m Rt. ¢  
and 15.0 m Lt. ¢

0	-	800 mm	dk.br.org.
800	-	1.0 m	br.si.cl. (MP) moist firm
10+220		10.0 m Lt. ¢	

HWY. 7A

- 9 -

10+400      10.0 m Rt.  $\phi$ 

0	-	100 mm	water
100	-	950	dk.br.org.
950	-	1.2 m	gry.si.sa. wet firm

10+350      15.0 m Rt.  $\phi$ 

0	-	100 mm	water
100	-	1.3 m	dk.br.org.
1.3	-	1.5	gry.si.sa. wet firm

# memorandum



To: Phil Gray  
Program Officer  
Central Region

Date: August 12, 1985

Re: Hwy. 74-70-01 Hwy. 115 Reconstruction  
Hwy. 28 to and including County Rd. 10  
Proposed Revision to Contract Package

Interchanges are proposed at Hwy. 7A and County Rd. 10.

1. Hwy. 7A/115 Interchange Foundation Office has identified a need for one year pre-loading of earth fill at this location.
2. County Rd. 10/115 Interchange Foundation recommendation will be available in September 1985, and Structure Report in October 1985.

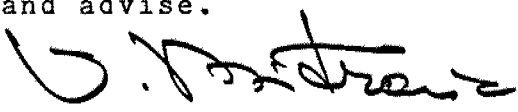
We may assume that pre-loading of earth fill at Structure approaches will be required at this location as well.

We, therefore, recommend that a separate pre-loading contract is prepared with delivery date of April 1, 1986, in order to maintain current schedule.

Property Request shall be issued and priority for property purchase identified to facilitate pre-loading contract.

Please review the enclosed and advise.

VM/MW  
Encl.

  
V. Mitranic,  
Senior Project Manager

cc: L.C. Poste  
A. Wittenberg  
R. Fitzgibbon  
Pradib Roy  
✓ Lou Politano  
D.J. Zander



# memorandum



To: Mr. M. Devata  
Chief Foundation Engineer  
Foundation Design Section  
Central Building, Room 315

Date: 85 06 21

File No.: 3162-2-4-113

Attn: Mr. D. Dundas

From: Soils & Aggregates Section  
Engineering Materials Office  
Central Building, Room 311



Re: Borehole Core Descriptions  
Bridge Foundations,  
Hwy. 115 and 7A  
Peterborough  
W.P. 74-70-05

As requested by your section, core from one (1) borehole was logged, and description is appended. Depth to top of bedrock and depth to top of sound rock are shown below:

<u>BOREHOLE NUMBER</u>	<u>DEPTH TO BEDROCK (in metres below ground surface)</u>	<u>DEPTH TO SOUND ROCK (in metres below ground surface)</u>
1	25.30	25.30

Bedrock is limestone and some shale of the Trenton and Black River Group.

If you have any questions, please contact me.

A handwritten signature in dark ink, appearing to read "E.R. Magni".  
E.R. Magni,  
Geologist.

ERM/jlo  
Attachment

DESCRIPTION OF ROCK CORE - W.P. 74-70-05

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	25.30-26.04	100	41	25.30-26.69	Limestone (80%), unweathered, closely spaced joints, with shale layers (20%), unweathered
	26.04-26.95	89	50		
	26.95-27.13	86	57		
	27.13-28.35	98	98	26.69-28.35	Limestone (100%), unweathered, medium to widely spaced joints

\* CR= CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

# memorandum



To: G.C.E. Burkhardt  
Head, Structural Section  
Central Region  
5000 Yonge Street

Date: 1985 06 13

ATTEN: P.K. Roy

From: Foundation Design Section  
Room 315, Central Building

RE: Foundation Investigation  
Preliminary Recommendations  
W.P. 74-70-05, Site 21-39-446  
Highway 7A Underpass  
Hwy. 115, District 7, Port Hope

Fieldwork for the structure portion of this project has been completed.

This memo contains recommendations pertaining to the design and construction of the foundations for the proposed structure and its immediate approaches (St. 9 + 900 to St. 10 + 100, but not including ramp). These recommendations are intended to be sufficient to allow the design of this structure to proceed to completion. Our complete foundation investigation and design report will be submitted in the near future. If there are any questions, please contact this office.

## SUBSURFACE CONDITIONS

At this site, the overburden thickness is approximately 25 m.

A simplified sequence of materials from the surface (elev. 200<sup>+</sup> m) downwards is summarized below:

### Elevation (m)

200.0 - 198.5	Organics (soft)
198.5 - 197.5	Silty Sand (loose to compact)
197.5 - 191.0	Silty Clay (soft to very stiff)
191.0 - 189.0	Sandy Silt to Silty Sand (Compact)
189.0 - 185.5	Silty Clay (firm to very stiff)
185.5 - 184.0	Sandy Silt to Silty Sand (compact)
184.0 - 179.5	Silty Clay (hard)
179.5 - 175.0	Silty Sand, Occ.boulders (very dense)
175.0	Bedrock

At the time of the field investigation, groundwater level was essentially at the existing ground surface.

.....2

### DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a two-span bridge (span lengths approx. 32 m and 41 m) to carry re-aligned Hwy. 7A over Hwy. 115 at a grade of 209<sup>±</sup> m. The proposed grade for Hwy. 115 is 201<sup>±</sup> m. This proposal will involve approach fills in the order of 8 m at the north abutment (Sta. 9 + 970) and 9 m at the south abutment (Sta. 10 + 040).

A number of foundation alternatives, especially in the embankment design are recommended. The alternatives which lead to the least expensive design should be adopted.

### DESIGN DETAILS

The proposed structure may be supported on steel H piles, equipped with reinforced tips (to facilitate pile driving) and driven to bedrock.

The following design values are recommended:

<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
310 HP 79	1150 kN per pile	830 kN per pile

The heavier pile section may be more appropriate at this site, due to the presence of boulders in the soil stratum immediately above the bedrock.

If desired, the abutment footings (supported on Steel H-Piles) may be perched within the embankment fill. In this case, to facilitate pile driving, particle sizes in the fill immediately beneath the pile locations should not exceed 75 mm.

### 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:

<u>Material</u>	<u><math>\phi</math></u>	<u><math>\gamma</math></u>
Granular 'A'	35°	22.0 kN/m <sup>3</sup>
Granular 'B'	30°	21.2 kN/m <sup>3</sup>

From a geotechnical viewpoint the foundation is considered to be non-yielding as the piles will be driven to bedrock and the at-rest condition applies insofar as lateral earth pressures are concerned. However, from a structural viewpoint, the active condition may control the earth pressure design due to the lengths of the piles.

### FROST PROTECTION

For frost protection, earth cover of 1.6 m, or equivalent is required.

### SETTLEMENT CONSIDERATIONS

Differential settlements of the proposed abutments and piers will be negligible if they are constructed in accordance with the recommendations provided in this report.

However, appreciable settlements of the approach embankments are expected. Details regarding amount and rate of settlement have not yet been determined and will be provided in the final Foundation Investigation and Design Report. It is anticipated, that pre-loading of the approach embankments will be recommended, in order to reduce the effects on the finished embankments. Also, lightweight fill should be considered as an alternative, in order to reduce settlement.

### FINAL SLOPE STABILITY:

For the purposes of these preliminary recommendations, only the forward embankment stability at the abutments has been addressed. It is proposed that the transverse stability recommendation be postponed pending further investigations along the high approach embankments and ramp, so that the embankment geometry can be better co-ordinated.

However, the forward embankment geometry may be assumed to apply to the transverse geometry within 10 m of the abutments.

At the north abutment the 8 m approach embankment will require a 5 m wide midheight berm if normal fill is used to construct the embankment. If lightweight fill is used, 2H:1V slopes will be stable.

At the south abutment, the 9 m approach embankments will require a 9 m wide mid-height berm if normal fill is used. If lightweight fill is used, 2H:1V slopes will be stable.

### DE-WATERING

De-watering will be required for pile caps founded in non-cohesive (silty sand) material, below the prevailing groundwater elevation. The need for de-watering might be reduced if the pile caps were founded in the underlying cohesive (silty clay) material (below elev. 198<sup>+</sup> m).

*D.H. Dundas*

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

DHD/mmj



HWY. 7A U'PASS AT HWY. 115  
SITE 21-39-446, W.P. 74-70-05  
DISTRICT 7, PORT HOPE

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VIEW OF THE SITE (LOOKING NORTH)



VIEW OF THE SITE (LOOKING SOUTH)

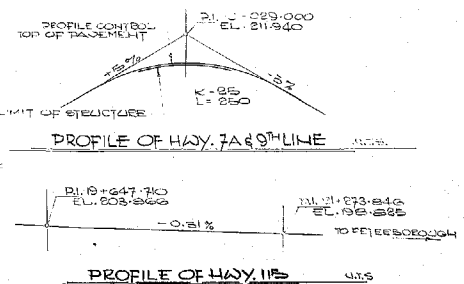
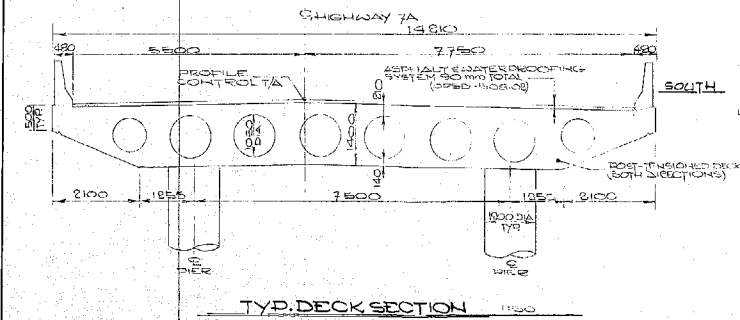
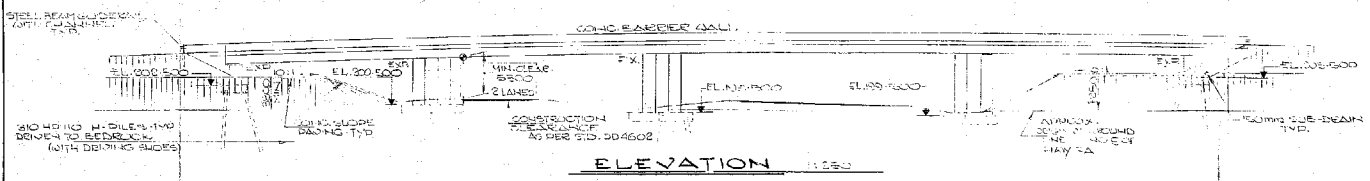
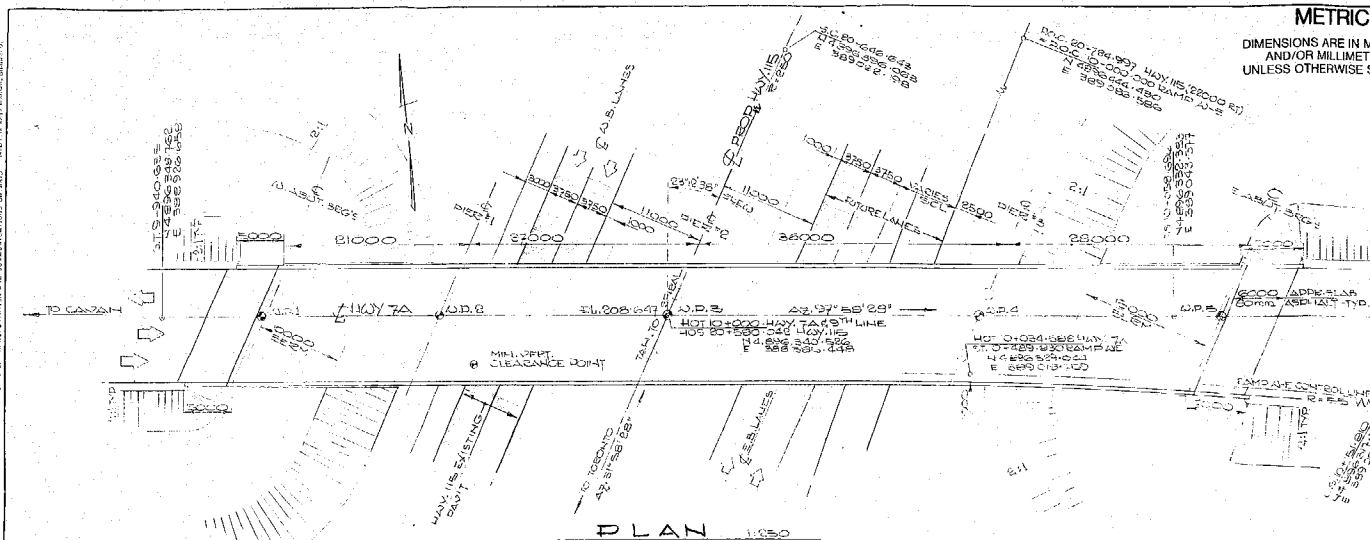
# METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

DIST. 7  
CONT No  
WP No 74-70-05

HIGHWAY 7A UNDERPASS  
GENERAL LAYOUT

SHEET



- ## GENERAL NOTES
- | CLASS OF CONCRETE       |        |
|-------------------------|--------|
| FOOTINGS                | 30 MPa |
| PIER COLUMNS            | 35 MPa |
| ABUTMENTS & WINGS WALLS | 30 MPa |
| DECK                    | 35 MPa |
| BARRIER WALLS           | 30 MPa |
| APPROACH SLABS          | 30 MPa |
- 
- | CLEAR COVER TO REINFORCING STEEL |          |
|----------------------------------|----------|
| FOOTINGS                         | 100 ± 3% |
| ABUTMENTS AND WINGS WALLS        | 80 ± 20  |
| DECK FACE                        | 70 ± 20  |
| BACK FACE                        | 70 ± 20  |
| PIER COLUMNS                     | 80 ± 20  |
| DECK                             | 70 ± 20  |
| TOP                              | 50 ± 10  |
| BOTTOM                           | 50 ± 10  |
| BARRIER WALLS                    | 70 ± 20  |
| APPROACH SLABS                   | 70 ± 20  |
| AND AS NOTED                     | 70 ± 20  |
- 
- ## REINFORCING STEEL
- REINFORCING STEEL SHALL BE GRADE 400  
UNLESS OTHERWISE SPECIFIED  
BARS SHALL BE COATED WITH EPOXY  
UNLESS OTHERWISE SPECIFIED
- 
- ## CONSTRUCTION NOTES
- THE CONTRACTOR SHALL FINISH THE  
SEALING BEATS TO A TOLERANCE OF ± 3mm

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING OF HWY. 7A
DRAWING	CHECK	SITE No 71-30-446