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W. O. No.

STR. SITE No. 1-149

HWY. No. 403

LOCATION Barford Twp Rd. Underpass

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. A. P. Watt, (4)
Regional Structural Planning Eng.,
Southwestern Region,
London, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION: Mr. B. J. McKenna.

DATE: July 4, 1972.

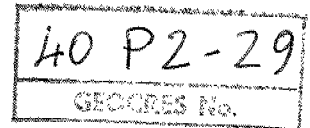
OUR FILE REF.

IN REPLY TO JUL 10 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Burford Twp. Road Underpass
of Proposed Hwy. #403, 13.3 Mi. West
of Brantford West Limits, District #4
W.O. 72-11045 -- W.P. 73-62-00



Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ao
Attch.

cc: Messrs. D. W. Farren
B. R. Davis
A. Rutka
W. A. Zonnenberg
C. R. Robertson
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

Foundations Files
Documents

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FOUNDATION INVESTIGATION REPORT
For
Burford Twp. Road Underpass
of Proposed Hwy. #403, 13.3 Mi. West
of Brantford West Limits, District #4
W.O. 72-11045 -- W.P. 73-62-00

1. INTRODUCTION:

The results of a foundation investigation, conducted at the site of the proposed Burford Twp. Road Underpass of Hwy. #403 are reported. The investigation was requested by Mr. B. J. McKenna, Bridge Location Engineer, Southwestern Region, in a memo dated February 29, 1972.

Subsequent to the request a field investigation was carried out under the supervision of the Foundations Office. Boreholes were located and surveyed by personnel of the Engineering Survey Office, Southwestern Region.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The existing Twp. Road at the future crossing is proposed to be shifted westerly. The site of the structure is wooded, fairly level ground, with considerable stagnant water partially covering the surface. The general land use is agricultural, tobacco being the main produce. There are a few oil wells in the vicinity.

Geologically the area belongs to the physiographic region known as the "Mount Elgin Ridges," consisting of a succession of ridges and vales. The ridges are moraines of pale brown calcareous clay or silty clay, while in the vales it is common to find alluvium of gravel, sand or silt. The ridges are well drained, while poor drainage prevails in hallows.

3. FIELD AND LABORATORY INVESTIGATIONS:

Some seven boreholes, and adjacent to the holes six dynamic cone penetration tests were implemented during the course of the field work. Borings were carried out by means of a continuous hollow stem flight auger (CME 55) taking frequent samples in accordance with the Standard Penetration Tests. Penetration resistancies measured by the number of hammer blows applied for 1 ft. penetration are recorded on the accompanying borelogs, together with the results of the laboratory testing. On account of the very stiff to hard consistencies of the cohesive layers, no undisturbed soil samples were taken.

Upon recovery samples were identified, recorded and stored in glass jars. Visual classifications of all the samples were carried out in the laboratory, and representative samples were subjected to laboratory testing in order to determine Atterberg limits, natural moisture contents and grain size distributions. On attached Drawing #72-11045A the locations and elevations of the borings as well as the estimated soil profile are shown.

4. SUBSOIL CONDITIONS:

4.1) General:

A somewhat complex soil stratigraphy was encountered in the borings, layers alternating between cohesive and granular deposits. The cohesive layers were identified to be clayey silts with traces of sand and gravel and silty clays. The granular deposits were found to be stratified, consisting of sandy silts, silty sands, gravelly sands and sandy gravels. A brief description of the various strata is given as follows.

4.2) Clayey Silt, Traces of Sand and Gravel:

This is the uppermost material at the south portion of the proposed structure. Under the north half, however, it

was found to be overlain by a 4 - 5 ft. deep surficial sandy silt layer. The depth of the clayey silts is about 22 - 28 ft. terminating at elevation 880 ft. - 891 ft. Within the upper 5 - 10 ft. penetration 'N' values ranging from 8 blows/ft. to 17 blows/ft. were recorded, below which depth 'N' values increase up to 85 blows/ft. The stratum exhibits some cohesion; plastic limits were measured to fall between 12% and 19%, liquid limits between 19% and 32%. The average natural moisture content was estimated to be 15%. Grain size distributions indicate a fairly heterogeneous deposit, the range of gravel particles being 0 - 5%, the sand 2 - 5%, silt 52% - 65% and clay 30 - 43%.

4.3) Silty Clay:

A second cohesive deposit was found in the deeper boreholes (B.H.'s #1, #3 and #7) intercepting the granular layers at around elevation 874-876 ft. The thickness of this stratum is some 10 - 11 ft., extending to elevation 863 ft.- 866 ft. On account of its medium plasticity the material was classified to be silty clay of stiff to hard consistency. Penetration resistances obtained within this layer vary between 14 blows/ft. to 70 blows/ft. Plastic limits of the clays average 18%, liquid limits 36 - 39%, with natural moisture contents around 28%.

4.4) Layers of Silt, Sand and Gravel:

Around elevation 881 ft. - 891 ft. the cohesive material was found to be underlain by layers and seams of granular deposits, intercepted by a 10 - 11 ft. thick clay layer as discussed above. The granular layers were identified to be silty sands, sandy gravels and sandy silts. Traces of clay size particles were usually found in every soil sample, occasionally the clay content being sufficient to render the sample very slightly plastic. The measured penetration 'N' values are considered to be unreliable, since in several

locations quick conditions developed at the bottom of holes in view of the unbalanced hydrostatic head. It appears reasonable to assume that the relative density of the granular layers varies between dense and very dense. The results of grain size analyses of the individual samples are marked on the borelogs.

4.5) Groundwater Conditions:

Groundwater levels were established at each borehole location and they were found to be very high, usually around 1.5-2.0 ft. below ground level. In certain boreholes the water level has risen up to the ground surface. It is surmised that the observed water levels were at or near the yearly high water table.

5. DISCUSSION AND RECOMMENDATIONS:

5.1) General:

Two alternative schemes are submitted for this crossing. The first scheme calls for a five span underpass structure, while the second proposal utilizes a two span bridge. The overall length of the structure will be some 273 ft. The elevation of the top of pavement of Hwy. #403 is designed to be 915 ft.; the proposed grade of the Twp. Road at the Crossing being elevation 937 ft. with some 20 ft. high approach fills.

Subsoils were found to consist of deposits of clayey silt and silty clay of stiff to hard consistency and stratified sandy silts, silty sands and gravelly sands of compact to very dense relative density.

5.2) Foundations:

Beneath the surficial 5-8 ft. thick deposit, the very stiff to hard clayey silts are considered to be competent load bearing soils. As a consequence spread footings appear

to be the most economical for both the five span as well as the two span structures, footing being placed at or below elevation 905 ft. At this elevation safe design loads up to 3 t.s.f. may be used on the footing bases. A minimum cover of 4 ft. should be provided for the footings for frost protection.

Perched abutments or the entire structure may also be supported on piles. If piled foundations are chosen by the designer, the use of 12-3/4 O.D. steel tubes are recommended. Piles ought to be driven according to Standard BD-82-7, using 60 ton/pile design loads. It is estimated that above loads will be achieved by driving the tubes to approximate elevation 880 ft. - 885 ft. Care should be taken not to place bouldery material within the embankments at the locations of the abutments, if piled foundations are adopted.

5.3) Dewatering and Approach Fill Stability:

The uppermost 4-5 ft. deep sandy silts were noted to lack cohesive strength; thus these soils are susceptible to conditions of unbalanced hydrostatic head. It is, however, believed that at the recommended footing levels of elevation 905 ft. or below the base of the excavations will be within the underlying cohesive clayey silts. No quick conditions are anticipated to occur, therefore, at the bottom of the excavations. Some seepage will take place along the sides of the excavations, but open pumping from shallow sumps, dug at the perimeter of the oversize excavations will likely handle the water.

No stability problems are foreseen for the approach fills, provided that they are constructed with 2 horizontal to 1 vertical slopes.

6. MISCELLANEOUS:

The field work carried out during April 5 - 20, 1972, was supervised by Mr. W. V. Urie, Field Technician. The

equipment used was owned and operated by P.V.K. Drilling Company, Burford, Ontario.

This report was written by Mr. A. K. Barsvary, Senior Foundations Engineer, and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

A. K. Barsvary

A. K. Barsvary, P. Eng.



K. G. Selby

K. G. Selby, P. Eng.

AKB/ao

June 30/72

APPENDIX I

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 101 + 02, 13th Rt. & Twp. Rd. Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 13, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w				BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT %					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				w_p — w — w_L					
913.7	Ground level.															
0.0	Fine to medium sand.															
908.7	Compact.		1	SS	12	910										
			2	SS	20											
5.0	Clayey silt, traces of sand.		3	SS	51											
			4	SS	28											
	Very stiff to hard.		5	SS	54	900										
			6	SS	57											
	Brown.		7	SS	80											
887.7			8	SS	85	890									0 5 52 43	
26.0	Layers of silty sand and sandy gravel.		9	SS	55											
			10	SS	73	880										
875.7	Very dense.		11	SS	39											
38.0	Silty clay.		12	SS	21	870										
	Very stiff to hard.		13	SS	70											
864.7			14	SS	1	860										
49.0	Layers of sandy silt, Silty sand and clayey silt.		15	SS	2179"										0 14 80 6	
			16	SS	23	850										
	Hard and loose to very dense.		17	SS	19											
			18	SS	17	840									0 5 71 24	
	Greyish brown.		19	SS	7	830									2 75 17 6	
			20	SS	81	820									5 49 41 5	
814.7																
99.0	End of borehole.															

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 101 + 44, 13' Lt. 7 Twp. Rd. Revision

ORIGINATED BY W.V.U.

W.P. 73- 62-00

BORING DATE April 18, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.P.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L		BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS/FOOT	20 40 60 80 100	PLASTIC LIMIT — w_p	WATER CONTENT — w		
913.4	Ground level.											
0.0	Sandy silt, traces of clay & gravel.		1	SS	16	910						9 29 50 12
4.0	Clayey silt, traces of sand.		2	SS	18							
			3	SS	17							
	Very stiff to hard.		4	SS	33							
			5	SS	46	900						
	Brown.		6	SS	32							
			7	SS	43							5 2 58 35
887.9			8	SS	62	890						
25.5	Silty sand to sand.		9	SS	66							0 60 34 6
884.4			10	SS	69							8 81 (11)
29.0	End of borehole.											

RECORD OF BOREHOLE No. 3

JOB 72-11045

LOCATION Sta. 100 + 45, O/S 13' Lt. & Twp. Rd. Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 14, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.K.

SOIL PROFILE		STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS / FOOT	RESISTANCE	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
911.4	Ground level.										
0.0	Silty sand, some organics.										
906.4	Compact.		1	SS	18						0 81 (19)
5.0	Clayey silt, traces of sand.		2	SS	9						
	Stiff to hard.		3	SS	26						
	Brown.		4	SS	28						
			5	SS	44						
			6	SS	40						0 2 63 35
			7	SS	42						
883.4			8	SS	76						
			9	SS	87						0 20 71 9
28.0	Layers of sandy silt and gravelly sand.										
873.9	Very dense.		10	SS	100/7"						19 61 (20)
37.5	Silty clay. Stiff to very stiff.		11	SS	24						
			12	SS	14						0 1 33 66
863.4			13	SS	63						
48.0	Sandy silt, irregular layers of clayey silt.		14	SS	14						
	Loose to compact.		15	SS	17						0 13 85 2
	Very stiff.		16	SS	44						
	Greyish brown.		17	SS	17						
			18	SS	6						
832.4			19	SS	22						0 7 69 24
79.0	End of borehole.										

RECORD OF BOREHOLE No. 4

JOB 72-11045

LOCATION Sta. 100 + 03 O/S 13' Rt. & Twp. Road Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 5, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY C.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	w_p	w	w_L		
912.3	Ground level.															
0.0	Sandy silt, some organics. Compact.		1	SS	15	910										
907.8			2	SS	27											
4.5	Clayey silt, traces of sand and gravel.		3	SS	35											
	Very stiff to hard.		4	SS	21											
	Brown.		5	SS	34	900										
			6	SS	34											
			7	SS	34											
			8	SS	39	890										
884.3			9	SS	35											
28.0	Silty sand to gravelly sand.															
878.3	Dense to very dense.		10	SS	100	880										
34.0	End of borehole.															

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 72-11045 LOCATION Sta. 99 + 74 O/S 10' Lt. 1/2 Twp. Road Revision ORIGINATED BY W.V.U.
 W.P. 73-62-00 BORING DATE April 24, 1972 COMPILED BY A.K.B.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY J.R.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L		BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	20 40 60 80 100	PLASTIC LIMIT — w_p	WATER CONTENT — w		
909.4	Ground level.										
	Clayey silt, traces of sand and gravel.		1	SS	14						
			2	SS	29						
	Stiff to hard.		3	SS	26						
			4	SS	48						
	Brown.		5	SS	42						
			6	SS	36						
			7	SS	68						
			8	SS	44						
880.9			9	SS	39						
28.5	Layers of sandy silt & clayey silt.										
875.4			10	SS	57						
34.0	End of borehole.										

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 98 + 92 O/S 13' Rt. 1/2 Twp. Road Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 20, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % 10 20 30				
912.3	Ground level.															
0.0	Clayey silt, traces of sand.		1	SS	13	910									6 23 50 21	
			2	SS	24											
			3	SS	62											
	Stiff to hard.		4	SS	67											
			5	SS	42	900										
	Brown.		6	SS	34											
			7	SS	40										1 3 60 36	
890.3																
22.0	Layers of sandy silt, clayey silt and sandy gravel.		8	SS	30	890									0 38 53 9	
			9	SS	50											
	Very dense.															
878.3			10	SS	49	880									18 79 (3)	
34.0	End of borehole.															

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 72-11045

LOCATION Sta. 98 + 61 O/S 13' Lt. & Twp. Rd. Revision

ORIGINATED BY W.V.U.

W.P. 73-62-00

BORING DATE April 20-21, 1972

COMPILED BY A.K.B.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	w_p	w	w_L		
914.3	Ground level.															
0.0	Clayey silt, traces of sand. Stiff to hard. Brown.		1	SS	13	910	100/7"									
			2	SS	8											
			3	SS	55											
			4	SS	66											
			5	SS	54											
			6	SS	35											
			7	SS	29											
891.3	Fine sandy silt and sandy gravel. Dense to very dense.		8	SS	26	890										0 39 53 8
23.0			9	SS	32											
			10	SS	52	880										
876.3	Silty clay. Very stiff.		11	SS	18											0 1 69 30
38.0						870										
866.3	Sandy silt and silty sand. Traces of clay and gravel. Compact to very dense. Greyish brown.		12	SS	19											0 10 79 11
48.0			13	SS	32	860										
			14	SS	17											
			15	SS	100	850										
			16	SS	100/5"	840										
						830										
			17	SS	100/4"											
825.3	End of borehole.															11 40 39 10
89.0																

20
15-5 % STRAIN AT FAILURE
10

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

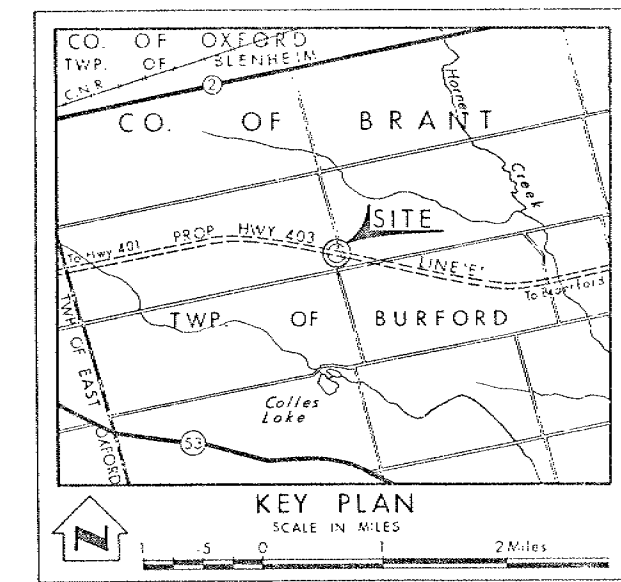
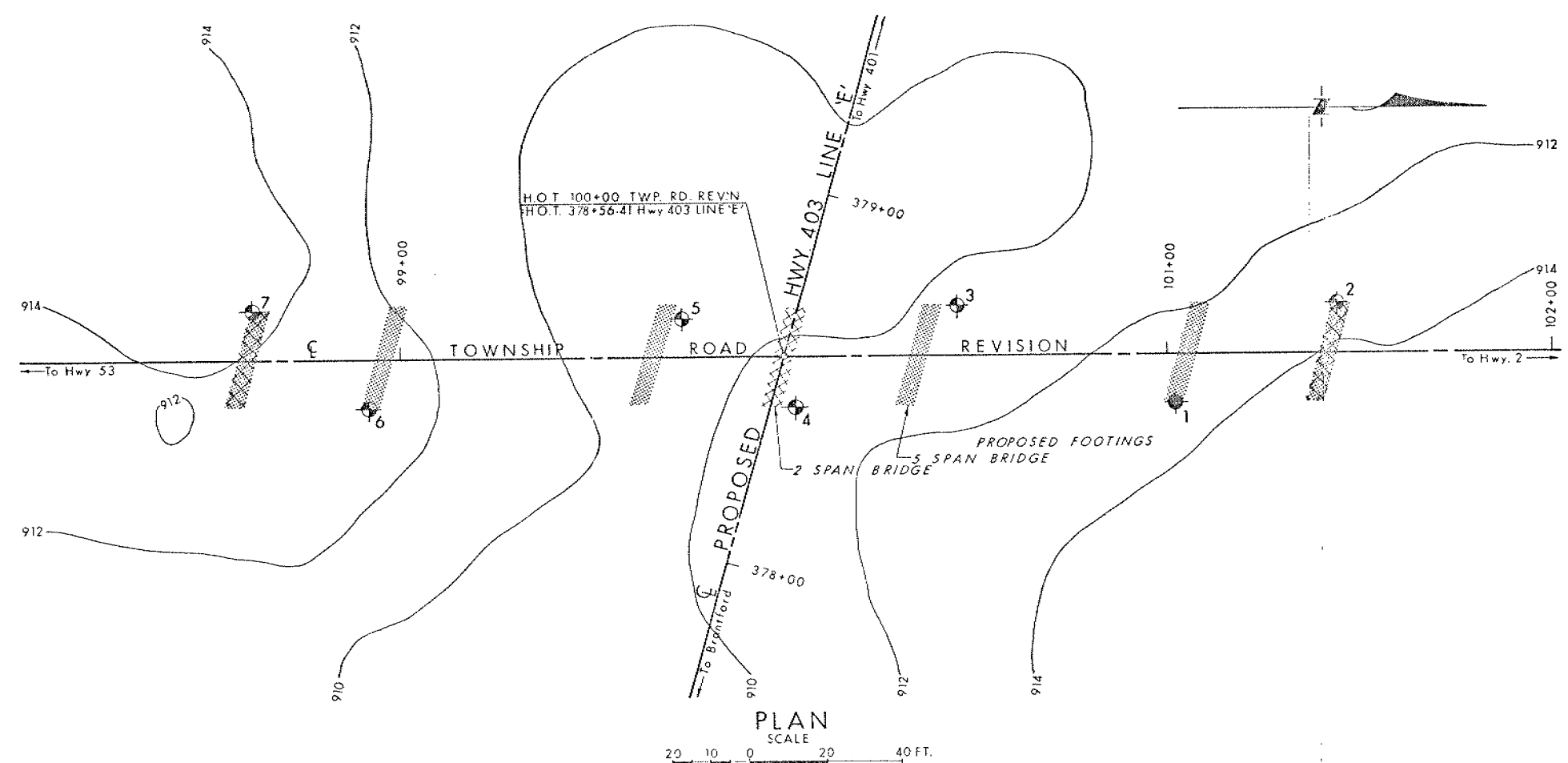
<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

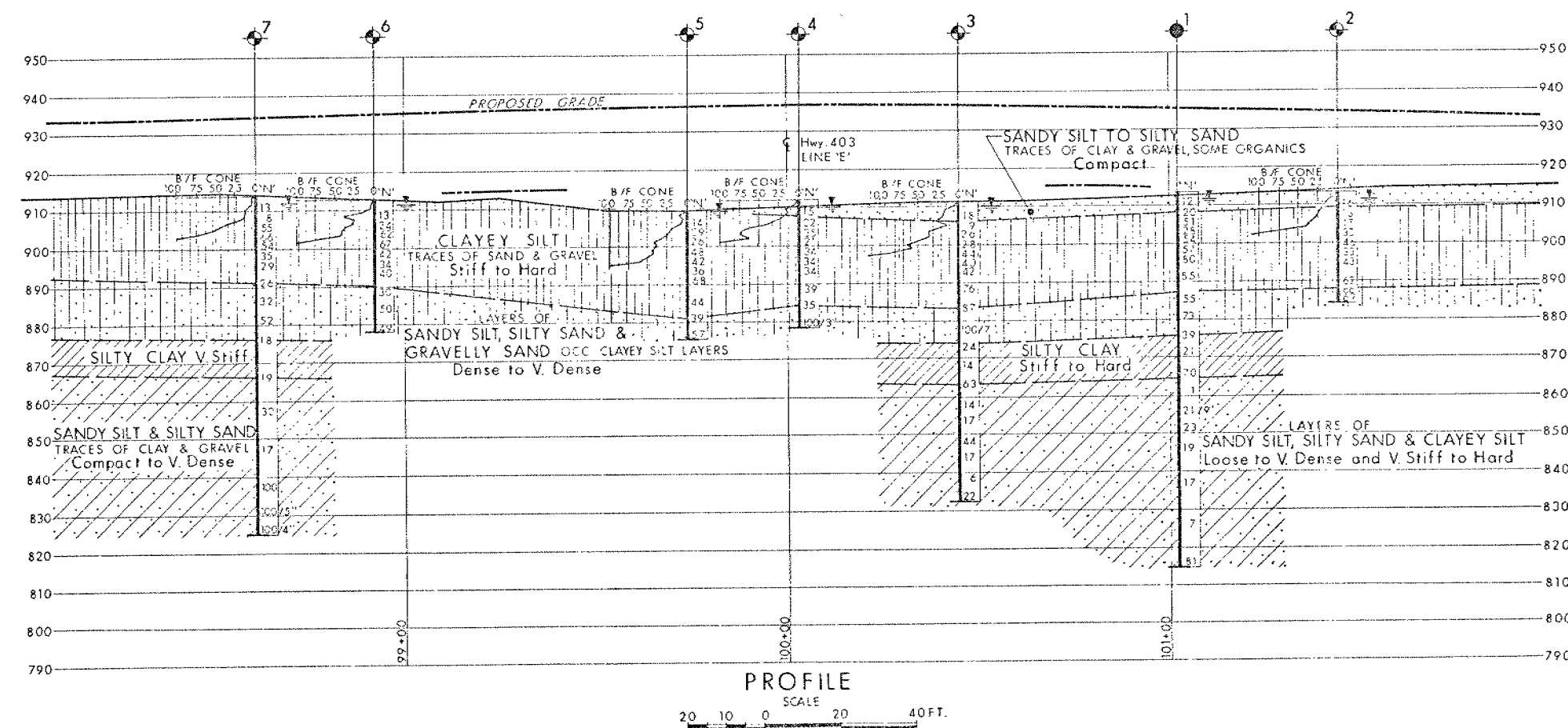
Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY



LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation April 1972		

NO.	ELEVATION	STATION	OFFSET
1	913.7	101+02	13' RT.
2	913.4	101+44	13' LT.
3	911.4	100+45	13' LT.
4	912.3	100+03	13' RT.
5	909.4	99+74	10' LT.
6	912.3	98+92	13' RT.
7	914.3	98+61	13' LT.

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.



REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

TOWNSHIP ROAD REVISION

HIGHWAY NO. Prop. 403 LINE 'E' DIST. NO. 4
CO. BRANT
TWP. BURFORD LOT 19 CON. II

BORE HOLE LOCATIONS & SOIL STRATA

SUBWD. A B	CHECKED BY	WP NO. 73-62-02	DRAWING NO.
DRAWN BY	CHECKED BY	JCB NO. 72-11045	72-11045A
DATE <u>June 15, 1972</u>	SITE NO.	BRIDGE DRAWING NO.	
APPROVED BY	CONT. NO.		

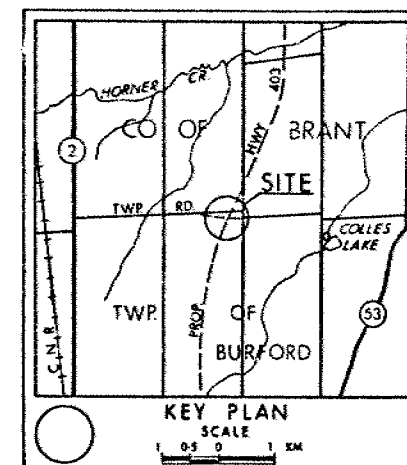
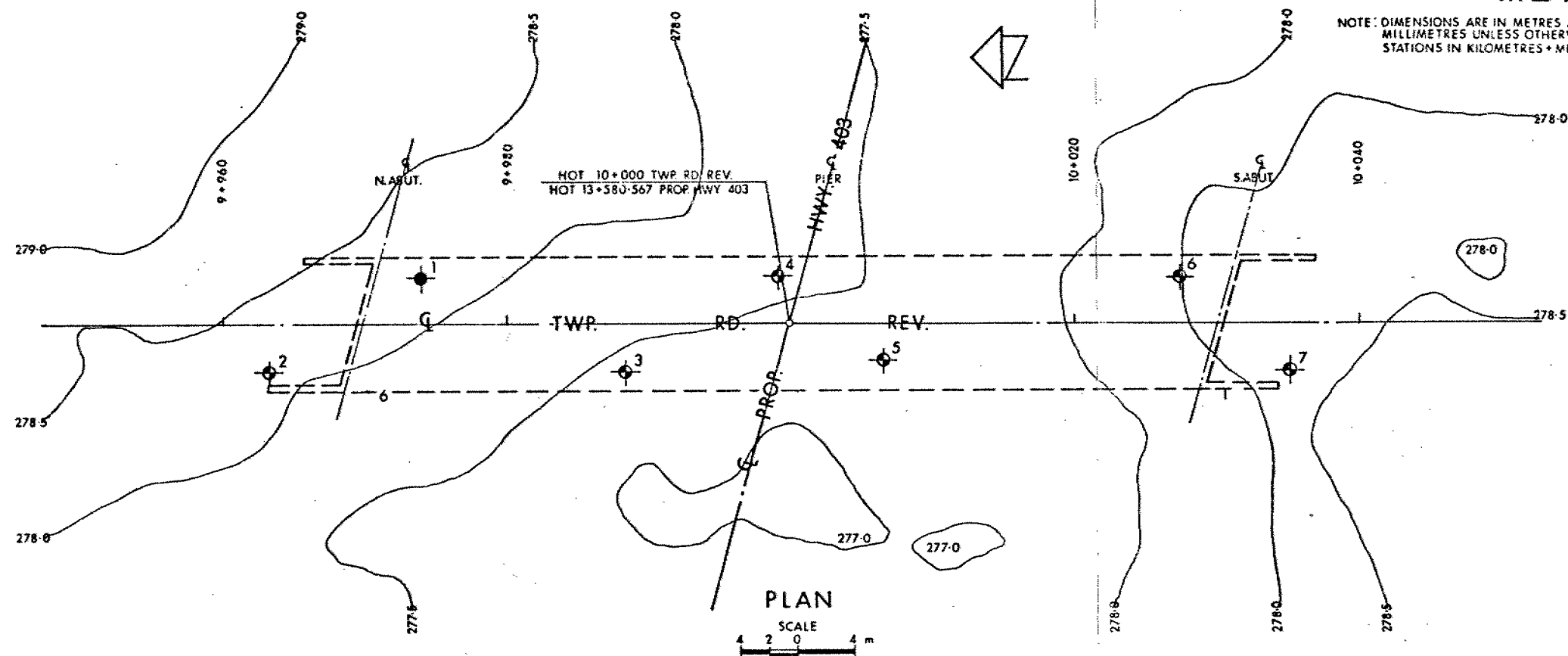
METRICCONT No
WP No 73-62-01

TWP. RD. REV. CROSSING AT HWY 403

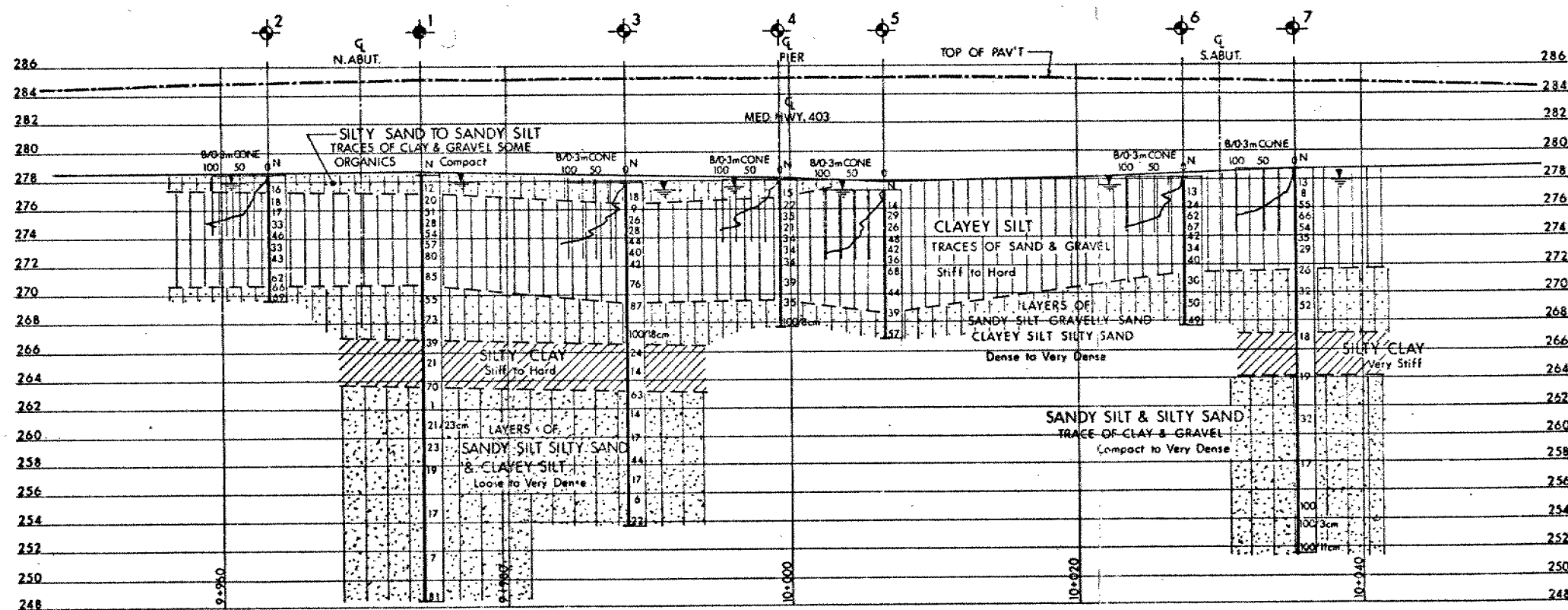
BORE HOLE LOCATIONS & SOIL STRATA



SHEET

NOTE: DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN
STATIONS IN KILOMETRES + METRES**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 72 04 14



No	ELEVATION	STATION	OFFSET
1	278.5	9+974.1	3.1 LT.
2	278.4	9+963.1	3.1 RT.
3	277.8	9+988.2	3.2 RT.
4	278.1	9+999.1	3.1 LT.
5	277.2	10+006.3	2.2 RT.
6	278.1	10+027.2	3.1 LT.
7	278.7	10+035.0	3.1 RT.

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 40P2-29

HWY No	403	DIST	4
SUBM'D BY	CHECKED	DATE	81 11 10
DRAWN BY	J. CHECKED	APPROVED	

SITE 1-149
DWG 736201-A

RECORD OF BOREHOLE No 1

W P 73-62-00 LOCATION Sta. 9+974.1 3.1 m Lt. ORIGINATED BY W.V.U.
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY O. J.
 DATUM Geodetic DATE 72 04 13 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH						
								WATER CONTENT (%)						
278.5	Ground Level						20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L				
								WATER CONTENT (%)						
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30.2 End of Borehole

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

W P 73-62-00 LOCATION Sta. 9+963.1 3.1 m Rt. ORIGINATED BY W.V.U.
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY W.V.U.
 DATUM Geodetic DATE 72 04 18 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
278.4	Ground Level												
277.2	Sandy silt, traces of clay and gravel		1	SS	16		278						9 29 50 12
1.2	Clayey Silt		2	SS	18		276						
	Traces of sand		3	SS	17								
	Very stiff to		4	SS	33								
	Hard		5	SS	46		274						
	Brown		6	SS	33								
			7	SS	43		272						5 2 58 35
270.6	Silty sand to sand		8	SS	62								
7.8			9	SS	66		270						0 60 34 6
269.6			10	SS	69								8 81 (11)
8.8	End of Borehole						268						

+3, x5 : Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

W P 73-62-00 LOCATION Sta. 9+988.2 3.2 m Rt. ORIGINATED BY W.V.U.
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY el.j.
 DATUM Geodetic DATE 72 04 14 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE						10	20	30
277.8	Ground Level																		
276.3	Silty sand, some organics Compact		1	SS	18											0 81 (19)			
1.5	Clayey silt Traces of sand Stiff to Hard Brown		2	SS	9											0 2 63 35			
			3	SS	26														
			4	SS	28														
			5	SS	44														
			6	SS	40														
			7	SS	42														
			8	SS	76														
269.3			9	SS	87										0 20 71 9				
8.5	Layers of sandy silt and gravelly sand Very dense		10	SS	100/18 cm											19 61 (20)			
			11	SS	24														
11.4	Silty clay Stiff to very Stiff		12	SS	14											0 1 33 66			
263.2			13	SS	63														
14.6	Sandy silt irregular layers of clayey silt Loose to compact Grayish Brown		14	SS	14											0 13 85 2			
			15	SS	17														
			16	SS	44														
			17	SS	17														
			18	SS	6														
			19	SS	22													0 7 69 24	
253.7																			
24.1	End of Borehole																		

+³, x⁵: Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 4

W P 73-62-00 LOCATION Sta 9+999.1 3.1 m Lt. ORIGINATED BY W.V.U.
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY W.J.
DATUM Geodetic DATE 72 04 05 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE						
278.1	Ground Level							20	40	60	80	100	10	20	30		
276.7	Sandy silt, some organics Compact		1	SS	15												
1.4	Clayey silt Traces of Sand and Gravel Very Stiff to Hard		2	SS	22												
			3	SS	35												
			4	SS	21												
			5	SS	34												
			6	SS	34												
			7	SS	34												
			8	SS	39												
269.5		9	SS	35													
8.5	Layers of silty sand to gravelly sand Dense to very dense																
267.7		10	SS	100	8cm												
10.4	End of Borehole																

RECORD OF BOREHOLE No 5

W P 73-62-00 LOCATION Sta. -10+006.3 2.2 m Rt. ORIGINATED BY H. V. U.
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY R. J.
 DATUM Geodetic DATE 72 04 24 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE											
277.2	Ground Level																		
0.0	Clayey Silt Traces of sand and gravel Stiff to Hard Brown		1	SS	14		276												
			2	SS	29														
			3	SS	26														
			4	SS	48			274										0 4 65 31	
			5	SS	42														
			6	SS	36			272											
			7	SS	68														
			8	SS	44			270										2 4 60 34	
268.5	Layers Sandy Silt and Clayey Silt		9	SS	39			268											
8.7																			
266.8			10	SS	57											8 11 60 21			
10.4	End of Borehole						266												

+3, x5 : Numbers refer to Sensitivity

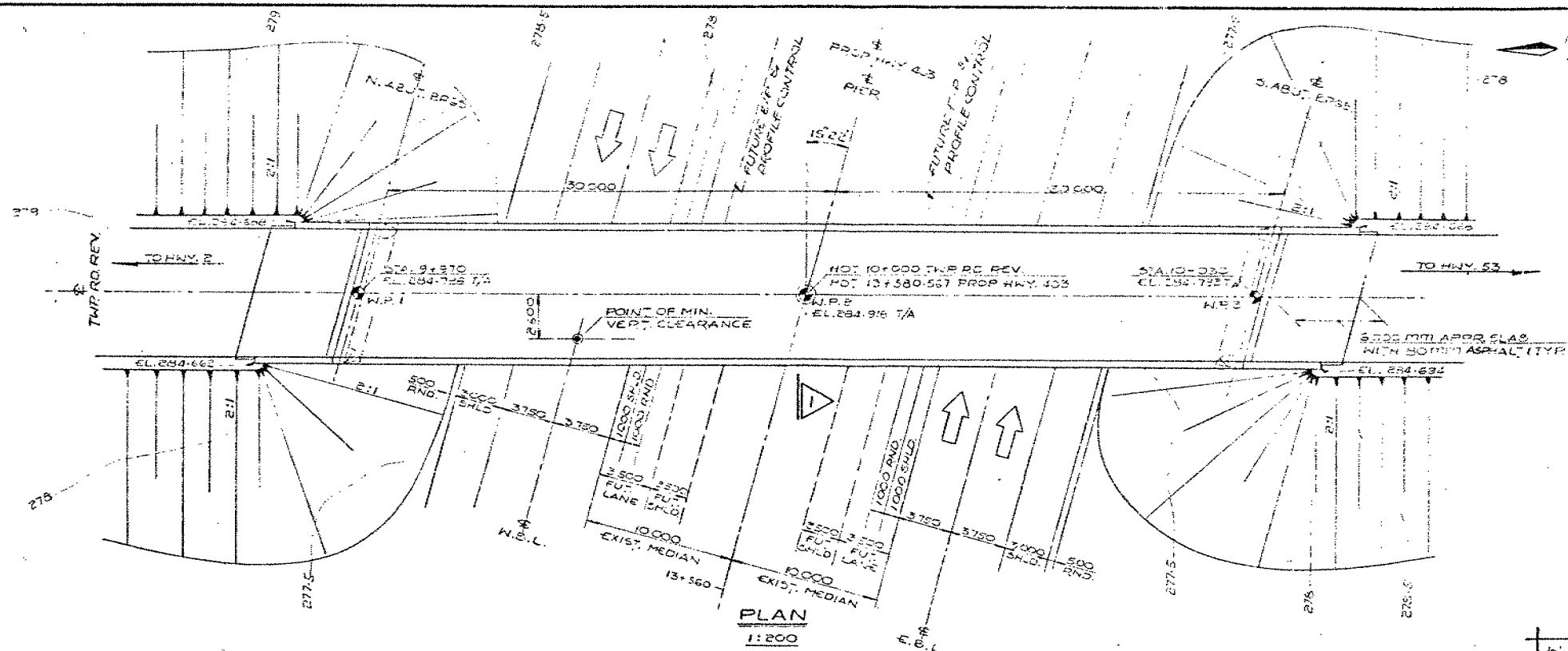
20
15
10
5 (%) STRAIN AT FAILURE

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 7

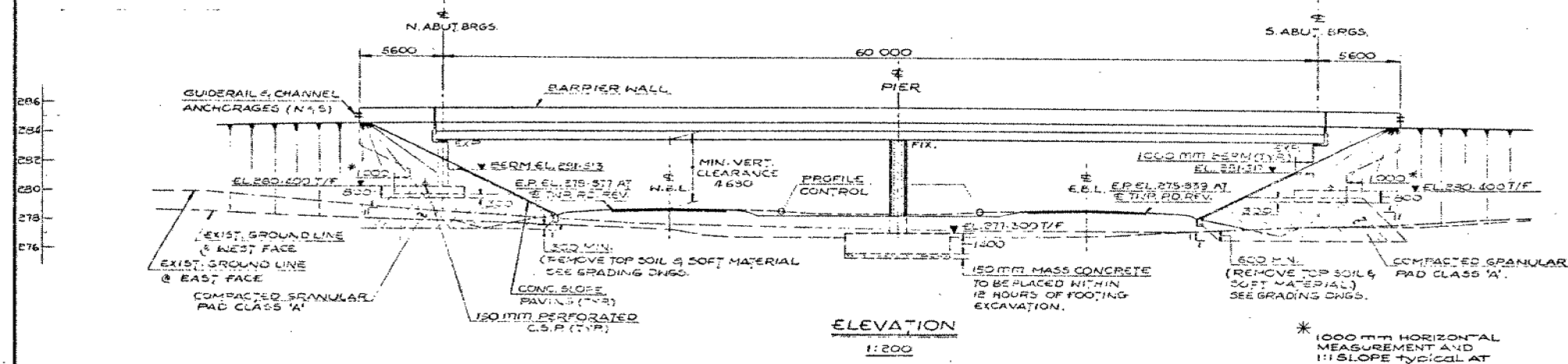
W P 73-62-00 LOCATION Sta 10+035.0 *3.1 m Rt. ORIGINATED BY W.V.U.
 DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Augers COMPILED BY W.V.U.
 DATUM Geodetic DATE 72 04 20, 21 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
278.7	Ground Level							20 40 60 80 100							
271.7	Clayey silt Traces of Sand Stiff to Hard		1	SS	13										
			2	SS	8										
			3	SS	55										
			4	SS	66										
			5	SS	54										
			6	SS	35										
			7	SS	29										
7.0	Sandy silt and Sandy gravel Dense to Very Dense		8	SS	26										
			9	SS	32										
			10	SS	52										
267.1			11	SS	18										
11.6	Silty clay Very Stiff														
264.0			12	SS	19										
14.7	Sandy Silt and Silty Sand Traces of Clay and Gravel Compact to Very Dense														
			13	SS	32										
			14	SS	17										
			15	SS	100										
251.6			16	SS	100	13 cm									
			17	SS	100	11 cm									
227.1	End of Borehole														

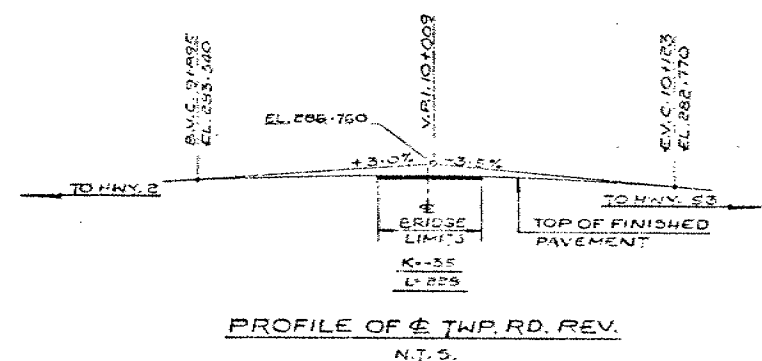
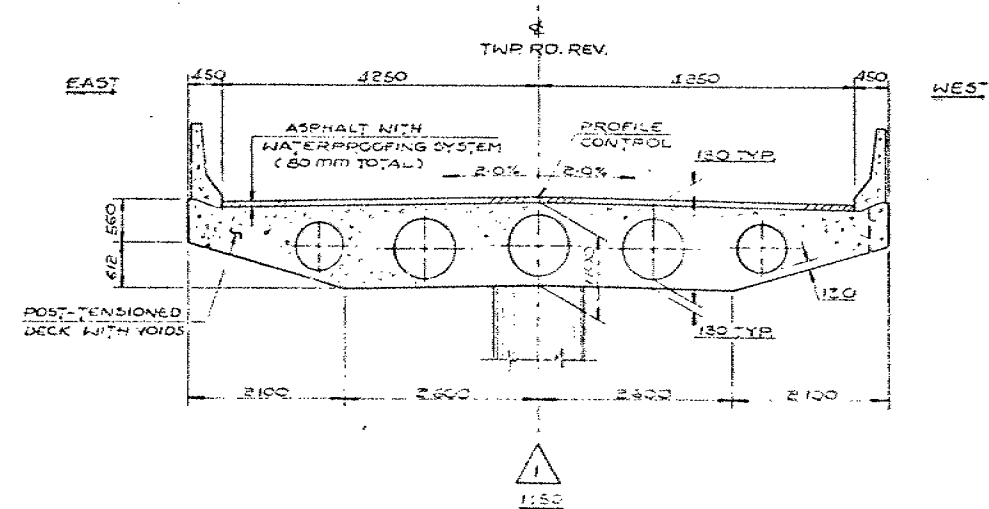


PLAN
1:200

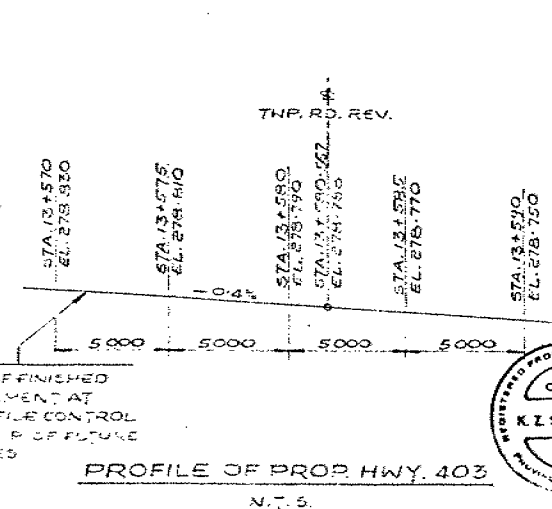
W.P. = WORKING POINT
T/A = TOP OF ASPHALT
T/F = TOP OF FOOTING



ELEVATION
1:200



PROFILE OF TWP RD. REV.
N.T.S.



PROFILE OF PROP. HWY. 403
N.T.S.

METRIC
DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

DIST. No 4		SHEET
CONT No WP No 73-62-01		
TWP RD. REV. U'PASS 6.3 KM EAST OF HWY 403		GENERAL ARRANGEMENT

NOTES

CLASS OF CONCRETE

DECK & PIER COLUMN	35 MPa
ABUTMENTS, WING WALLS & BARRIER WALLS	30 MPa
REMAINDER	20 MPa

REINFORCING STEEL

GRADE 400	
BAR MARK WITH SUFFIX 'C' DENOTES COATED BAR.	

NOMINAL CLEAR COVER AND TOLERANCE TO REINF. STEEL

	mm
FOOTINGS	100 ± 25
ABUTMENTS	70 ± 20
PIER COLUMN	80 ± 20
DECK TOP	70 ± 20
DECK BOT. AND SIDES	50 ± 10
REMAINDER UNLESS OTHERWISE NOTED	70 ± 20

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 3 mm.

CONCRETE QUANTITIES
CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:

CONCRETE IN PIER, ABUTS. & WINGWALLS	35 MPa	105 m³
PRESTRESSED CONCRETE BRIDGE DECK	35 MPa	447 m³
CONCRETE IN BARRIER WALLS	30 MPa	36 m³
CONCRETE IN APPROACH SLABS	30 MPa	26 m³
CONCRETE IN SLOPE PAVING	20 MPa	24 m³

- LIST OF DRAWINGS**
- H-149-1 GENERAL ARRANGEMENT
 - 2 BOREHOLE LOCATION & SOIL STRATA
 - 3 FOOTING LAYOUT & REINFORCING
 - 4 NORTH & SOUTH ABUTMENTS
 - 5 PIER & PIER FOOTING
 - 6 DECK DETAILS & ABUT. BEARINGS
 - 7 LONGITUDINAL CABLE DETAILS
 - 8 TRANSVERSE CABLE DETAILS I
 - 9 TRANSVERSE CABLE DETAILS II
 - 10 DECK REINFORCING I
 - 11 DECK REINFORCING II
 - 12 BARRIER WALL
 - 13 6000 MM APPROACH SLAB
 - 14 DETAILS OF CONC. SLOPE PAVING
 - 15 AS CONSTRUCTED ELEV. & DIM.
 - 16 BRIDGE DATE & SITE NUMBER DATA
 - 17 STANDARD DETAILS.



Finalized

REVISIONS	DATE	BY	DESCRIPTION

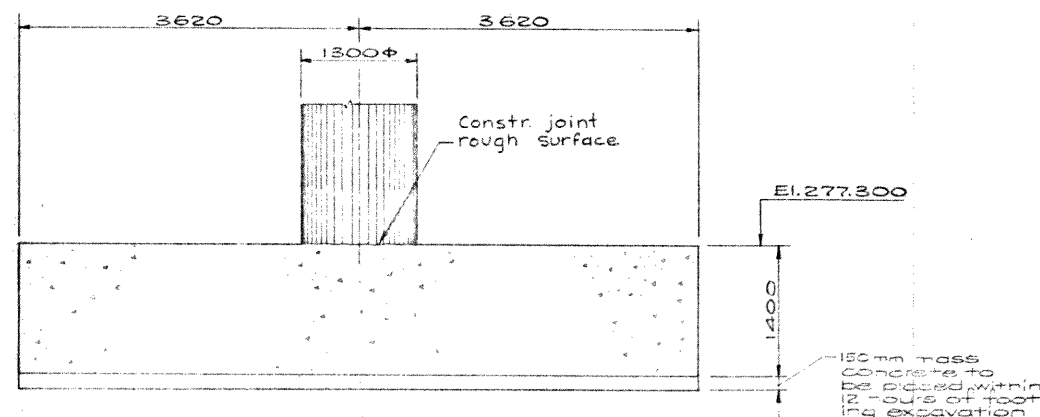
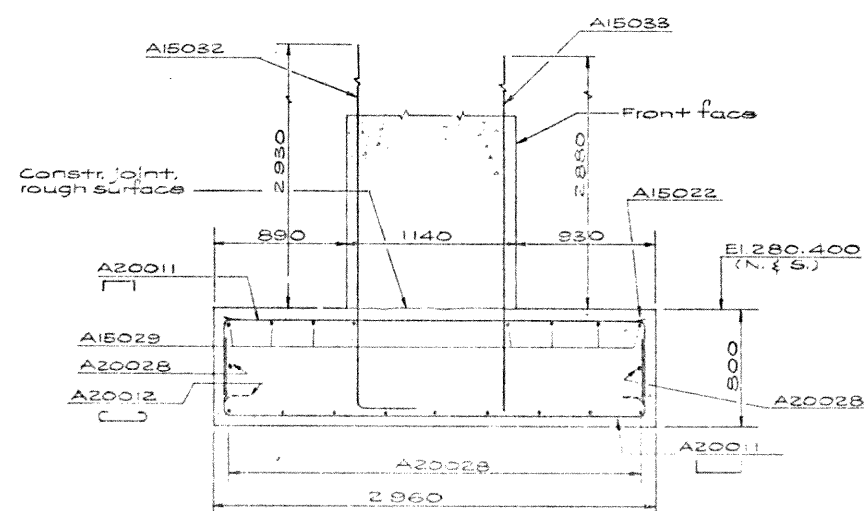
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE
AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

FOOTING LAYOUT & REINFORCING



North and South abutment footings are similar, north footing showing dimensions and south footing showing reinforcing.



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISES									
	DATE	BY	DESCRIPTION						
DESIGN	11/1/82	CHECK	LOADING - CHECKED						
DRAWING	11/1/82	CHECKED	SITE No. 11/1/82 DWG 11/1/82						

memorandum



To: Mr. C.S. Grebski
Head, Operating Section
Structural Office
4th Floor, 3501 Dufferin St.

Date: 82 04 29

From: Pavement & Foundation Design Section
Room 315, Central Bldg.
Downsview

Re: W.P. 73-62-01, Site 1-149
Hwy. 403 Underpass at Township Rd.
6.3 km East of Hwy. 53
Hwy. 403, District 4, Hamilton

The submitted final drawings and provisions have been reviewed by this section. There are no comments.

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

for: K.G. Selby, P. Eng.
Senior Foundations Engineer

DHD:syc

W.P. 73-62-00, Site 1-149
Twp. Road Underpass
Hwy. 403
District 4, Hamilton



View S. along Twp. Road Revision Line



View of proposed intersection of 403
Sta. 378 + 56.41 Line 'E' and Twp. Road
Revision, Sta. 100 + 00.

October, 1971

W.P. 73-62-00, Site 1-149
Twp. Road Underpass
Hwy. 403
District 4, Hamilton



View N. along Twp. Road Revision Line