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GEOCRES No. 40P2-26A

DIST. 4 REGION

W.P. No. 163-60-00

CONT. No. 83-10

W. O. No.

STR. SITE No. 1-148

HWY. No. 403

LOCATION Horner Creek and Kings
Bridge

No. of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

G.I.-30 SEPT. 1976

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: A. P. Watt, (2)
Regional Structural Planning Eng.,
Southwestern Region,
London, Ontario.

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

ATTENTION:

DATE:

September 14, 1972.

OUR FILE REF.

IN REPLY TO

SEP 21 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed Bridge Site 1-148
Horner Creek and
King's Hwy. #403, Line 'E'
District #4, Hamilton
W.O. 72-11036 -- W.P. 163-60 - 01



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.

A handwritten signature in cursive script, appearing to read 'A. G. Stermac'.

A. G. Stermac,

PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attach.

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

Foundations Files
Documents

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elevations of 950 to 1000 feet, are moraines of pale brown calcareous clay or silty clay while in the vales, between elevations of 800 to 900 feet, it is common to find alluvium of gravel, sand, and silt. This job is situated in one of these vales at elevations of approximately 850 to 860 feet.

3. FIELD AND LABORATORY INVESTIGATIONS:

The field investigation consisted of 10 sampled boreholes and 20 dynamic cone penetration tests, 10 of the cone tests being adjacent to the boreholes. B.H.'s #10 to 20 were advanced by a hollow stem auger and B.H. #1 to 9 were advanced by a conventional diamond drilling rig adapted for soil sampling. Soil samples were taken by means of a split-spoon sampler and Standard Penetration 'N' valves (blows/ft.) were recorded with each split-spoon sample. The boreholes were surveyed by personnel from the Southwestern Region. All the field and laboratory test results are recorded on the accompanying borelog sheets.

Soil samples were identified in the field and again upon arrival in the laboratory. Laboratory testing for moisture content, grains size distribution, and Atterberg Limits were carried out on representative samples.

The locations and elevations of the Boreholes as well as stratigraphical profiles are plotted on Drawing #72-11036A, attached at the end of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil encountered with the boreholes can be divided into 4 main classifications. The first subsoil encountered after the topsoil was sand with silt and traces of gravel and clay, followed by silt with sand and clay and traces of gravel, then silty sand with some gravel and traces of clay, and finally silt with some sand and clay and traces of gravel. A detailed description of each layer is given in the following paragraphs.

4.2) Sand with Silt and Traces of Gravel and Clay:

This layer was encountered in all the boreholes except B.H.'s #1 and 5. It varies in thickness from 7 to 18 feet and was found between the elevations of 861.2 and 843.8 feet to a maximum of 18 feet below the ground surface. Grain size analyses indicate that the composition of this deposit is 0 to 16% gravel, 49 to 91% sand, 25 to 46% silt, and 4 to 6% clay. A typical grain size curve envelope is included in the Appendix as Fig. 1. Standard Penetration 'N' values for this material varied from 4 to more than a 100 blows per foot indicating a loose to very dense relative density. The majority of the sand falls into the loose category. The material moisture content was measured to be between 8.5 and 57%.

4.3) Silt with Sand and Clay and Traces of Gravel:

Beneath the sand with silt is a layer of silt with sand and clay and traces of gravel. This is a silt till and was encountered in each of the 10 boreholes. It varies in thickness from 5 to 13 feet and ranges between elevations 851.1 feet and 833.8 feet to a maximum of 28 feet below the ground surface. Standard Penetration 'N' values for this material range from 8 to more than 100 blows per foot corresponding to a relative density of loose to very dense. Grain size analyses indicate that the silt with sand and clay is made up of 0 to 20% gravel, 4 to 37% sand, 40 to 78% silt, and 2 to 29% clay. A typical grain size curve envelope is included in the Appendix as Fig. 2. The natural moisture content was found to be between 7 and 21%.

4.4) Silty Sand with some Gravel and Traces of Clay:

This deposit is very similar to the first and was sampled in all the boreholes. The average thickness encountered in the boreholes was between 3 and 14 feet. This strata was found between the elevations of 845.5 and 826.0 feet and extended to a maximum depth of 34 feet below the ground surface.

Properties of the material found in this layer that were investigated are given as follows:

	<u>Gravel</u>	<u>Sand</u>	<u>Silt</u>	<u>Clay</u>
Grain Size	0 to 22%	63 to 93%	7	to 36%
Moisture Content	5 to 24%			

Standard Penetration 'N' valves within this layer vary from 18 to more than 100 blows per foot indicating a compact to very dense relative density. A typical grain size curve envelope is included in the Appendix as Fig. 3. Boreholes 9, 12, 17 and 20 were terminated within this deposit as the material was considered to have favourable properties to support the bridge foundation. Borehole 1 was also terminated within this layer because of the desire to avoid penetrating the layer which was found to contain artesian water.

4.5) Silt with some Sand and Clay and Traces of Gravel:

Boreholes 4, 5, 8, 13, and 16 were terminated within this strata. This layer was also described as a silt till. The deepest penetration occurred in B.H. #8 which was washbored some 42 feet below the ground surface to elevation 819.7 feet. This deposit was encountered between elevations 842.4 ft. and 819.7 ft. Soil properties of the silt with some sand and clay are as given below:

	<u>Gravel</u>	<u>Sand</u>	<u>Silt</u>	<u>Clay</u>
Grain Size	0 to 8%	9 to 32%	49 to 78%	2 to 21%
Moisture Content	5 to 19.5%			

Standard Penetration 'N' valves within this strata vary from 26 to more than 100 blows per foot indicating a compact to very dense relative density. A typical grain size envelope for this material appears in the Appendix as Fig. 4. Artesian water was encountered within the layer in boreholes 4, 5, 8 and 9 between elevations 825 feet and 835 feet.

4.6) Groundwater:

No artesian water was encountered in the West Bound Lane crossing. The water levels after several days of observation were recorded as follows:

B.H. 12	-	847.0 ft.
B.H. 13	-	846.7 ft.
B.H. 16	-	851.6 ft.
B.H. 17	-	850.4 ft.
B.H. 20	-	848.1 ft.

During the investigation of the East Bound Lane structure foundation, artesian water was encountered in 4 of the 5 boreholes. The ground elevation of B.H.'s #8 and 9 is above the maximum artesian head elevation and therefore it was not realized that artesian pressure was hit until B.H. #4 was put down. As a result it is not known at what elevation the artesian water was met in B.H.'s #8 and 9. The artesian water came up to approximate el 859 feet in the boreholes in which it was encountered. In B.H. #4 and 5 the artesian water was encountered at el 825 ft. and 835 ft. respectively. The elevation of the river at the time of the investigation was 851.2 feet.

5. DISCUSSION AND RECOMMENDATIONS:

5.1) General:

There are two proposals for the C.A.H. 403 and Horner Creek crossing, ie. a two span and three span structure. The two span structure will have two spans of 61 feet each. The three span structure will have spans of 30 ft., 60 ft., and 30 ft. for a total of 122 ft. The proposed footings are 52 ft. wide. The grade of C.A.H. 403 over Horner Creek is 872 feet. The distance between the two bridges is 116 ft. It is proposed that Horner Creek will be diverted to a course running almost perpendicular to the C.A.H. 403 center-line through sta. 279 + 70.

FOUNDATION INVESTIGATION REPORT
For
The Proposed Bridge Site 1-148
Horner Creek and
King's Hwy. #403, Line 'E'
District #4, Hamilton
W.O. 72-11036 --- W.P. 163-60

1. INTRODUCTION:

The Foundation Office was requested to conduct a Foundation Investigation for the proposed C.A.H. #403 and Horner Creek Crossing. The request was contained in a memo from Mr. S. Jants, Bridge Planning Technician, Southwestern Region dated February 15, 1972. There are two proposals for this Crossing, a two span and a three span structure. Subsequently, field and laboratory investigations were carried out by this Office in order to determine subsoil and groundwater conditions at the proposed site. In this report are presented the results of the above investigations along with recommendations concerning the structure foundations.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site is located some 3 miles south of Princeton in Brant County. At the crossing Horner Creek is about 40 feet wide and had a maximum depth of about 3.5 feet. The river banks have a slope of about 2:1. The land slopes gradually towards the creek from both the east and the west. The immediate area is covered with undergrowth and trees. The land use of the general area is agriculture with tobacco being the main crop.

The site is situated in the Mount Elgin Ridges Physiographic Region. The Mount Elgin Ridges are a succession of ridges and vales with a local relief of about 100 feet, few slopes being greater than 10 per cent. The ridges, between

5.2) Foundations:

5.2.1) Abutments

The approach fills for the east and west abutments of the west bound lanes have proposed fills of about 20 feet and 10 feet respectively. The proposed fills for the east bound lane abutments are both about 12 feet in height. If it is desired to place abutment footings within the approach fills, they may be supported on steel H-piles driven through the fills. Piles should be driven to approximate elevations given below:

West Bound Lanes

West Abutment	253 254.5 el. 830 to 835 ft.
East Abutment	el. 830 to 835 ft.

East Bound Lanes

West Abutment	254.8 256.6 el. 836 to 842 ft.
East Abutment	251.5 253 el. 825 to 830 ft.

It is anticipated, that piles driven to the quoted elevations will support safe loads equal to the structural strength of the particular pile section. No bouldery material should be placed within the embankments at the locations where the piles are to be driven. No stability problems are foreseen for the approach fills provided they are built with slopes of two horizontal to one vertical.

5.3) Two Span Structure:

5.3.1) Piers

According to the proposal the two span structure would require the center pier to be located within the stream diversion. As a result and assuming that the elevation of the bottom of stream diversion and the existing river bed will be the same, it is recommended that the center pier footing excavation should not exceed 4 feet below the bottom of the stream diversion. Design loads of 3.0 tons/ft.² and 4.0 tons/ft.² may be used for the west bound lane center pier footing and the east bound lane center pier footing respectively. The footing excavation for the west bound lane center pier should not go below el. 840

due to the presence of artesian water which may cause some piping and blow out. Care should be taken to protect the footings against scour by the placing of rip-rap. The depth of scour should be checked with the Hydrology Office. During construction ground water may cause problems and a dewatering scheme may be necessary.

5.4) Three Span Structure:

5.4.1) Piers

Two alternatives for the pier footings may be considered. For the west bound lanes spread footings may be established at the east and west piers at elevations 847 ft. and 853 ft. respectively using a design load of 4 tons/ft.². Below elevation 851 ft. ground water may present a problem. Some seepage into the footing excavation may be encountered but it is believed that an oversize excavation and open pumping from a shallow sump will take care of it.

For the east bound lanes spread footings can be established for the east and west piers at elevations 845 ft. and 851 ft. respectively with a design load of 4 tons/ft. As the ground water condition is similar for both bridge sites comments in the previous paragraph concerning dewatering below approximate elevation 851 ft. apply here as well. No artesian water was encountered in the boreholes for this structure.

The second alternative for the three span structure is to place the pier footings at higher elevations upon pile foundations. Since the abutment footings are recommended to be on piles and also because of the rather deep excavation for the spread footings, it might be more economical to drive piles for all the footings. The piles should be driven into the very dense silt till. It is anticipated that the piles if so driven will support loads equal to the full structural strength of the piles used. Elevations where pile refusal might occur are listed as follows:

West Bound Lanes

West Pier

Elevation 820 to 825 ft.

East Pier

Elevation 820 to 825 ft.

East Bound Lanes

West Pier

Elevation 830 to 835 ft.

East Pier

Elevation 825 to 830 ft.

5.5) Stream Diversion:

No major problems are foreseen for the stream diversion other than that the sand and silt can easily be eroded. It is suggested that rip-rap or some other means of protection should be provided.

6. MISCELLANEOUS:

The field work was carried out during March 13 to 17, 1972 under the supervision of Mr. J. Bangs, Project Engineer, and during May 23 to June 3, 1972, under the supervision of Mr. E. A. Wood and Mr. P. Korgemagi, Project Foundations Engineers.

The equipment used from March 13 to 17 was owned and operated by P.V.K. Drilling Company, Burford, Ontario and from May 23 to June 3 by Canadian Longyear Ltd., Toronto.

This report was prepared by Mr. P. Korgemagi, Project Foundations Engineer, and reviewed by Mr. A. K. Barsvary, Senior Foundations Engineer.

P. Korgemagi

P. Korgemagi, P. Eng.

A. K. Barsvary

A. K. Barsvary, P. Eng.



PK/fn

September 8, 1972.

... APPENDIX I

FOUNDATION SECTION

JOB <u>72-11036</u>	LOCATION <u>Sta. 279 + 16 90' Rt. C Line 'B'</u>	ORIGINATED BY <u>PK</u>
W.P. <u>163-60-01</u>	BORING DATE <u>June 1, 1972</u>	COMPILED BY <u>TW</u>
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Washboring</u>	CHECKED BY <u>SR</u>

[illegible]

FOUNDATION SECTION

ORIGINATED BY TW

COMPILED BY T.W.

CHECKED BY AK

[illegible]

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY JB

COMPILED BY PK

CHECKED BY

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		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
0.0	Ground Level					860										
13.5	End of Cone Test					850										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 72-11036

LOCATION Sta. 280 + 04 60' Rt. 6 Line 'E'

ORIGINATED BY TW

W.P. 163-60

BORING DATE May 23, 1972

COMPILED BY TW

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY TW

COMPILED BY PK.

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 72-11036 LOCATION Sta. 279 + 04 60' Lt C Line 'E' ORIGINATED BY JB
 W.P. 163-60 BORING DATE March 13, 1972 COMPILED BY FK
 DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY [Signature]

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 72-11036 LOCATION Sta. 279 + 00 108' Lt. Ø Line 'E' ORIGINATED BY JB
W.P. 163-60 BORING DATE March 16, 1972 COMPILED BY FK
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY [Signature]

[illegible]

FOUNDATION SECTION

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

OB 72-37036

LOCATION Sta. 279 + 31 108' Lt. Ø Line 'E'

ORIGINATED BY JB

W.P. 163-60

BORING DATE March 13, 1972

COMPILED BY PK

DATUM Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY

[illegible]

FOUNDATION SECTION

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 16

FOUNDATION SECTION

JOB 72-11036

LOCATION Sta. 279 + 61 108' Lt. \emptyset Line 'E'

ORIGINATED BY JB

W.P. 163-60

BORING DATE March 15, 1972

COMPILED BY FK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY JB

COMPILED BY PK

CHECKED BY AK

[illegible]

FOUNDATION SECTION

ORIGINATED BY JB

COMPILED BY PK

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY JB

COMPILED BY PK

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY JB

COMPILED BY PK

CHECKED BY

[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

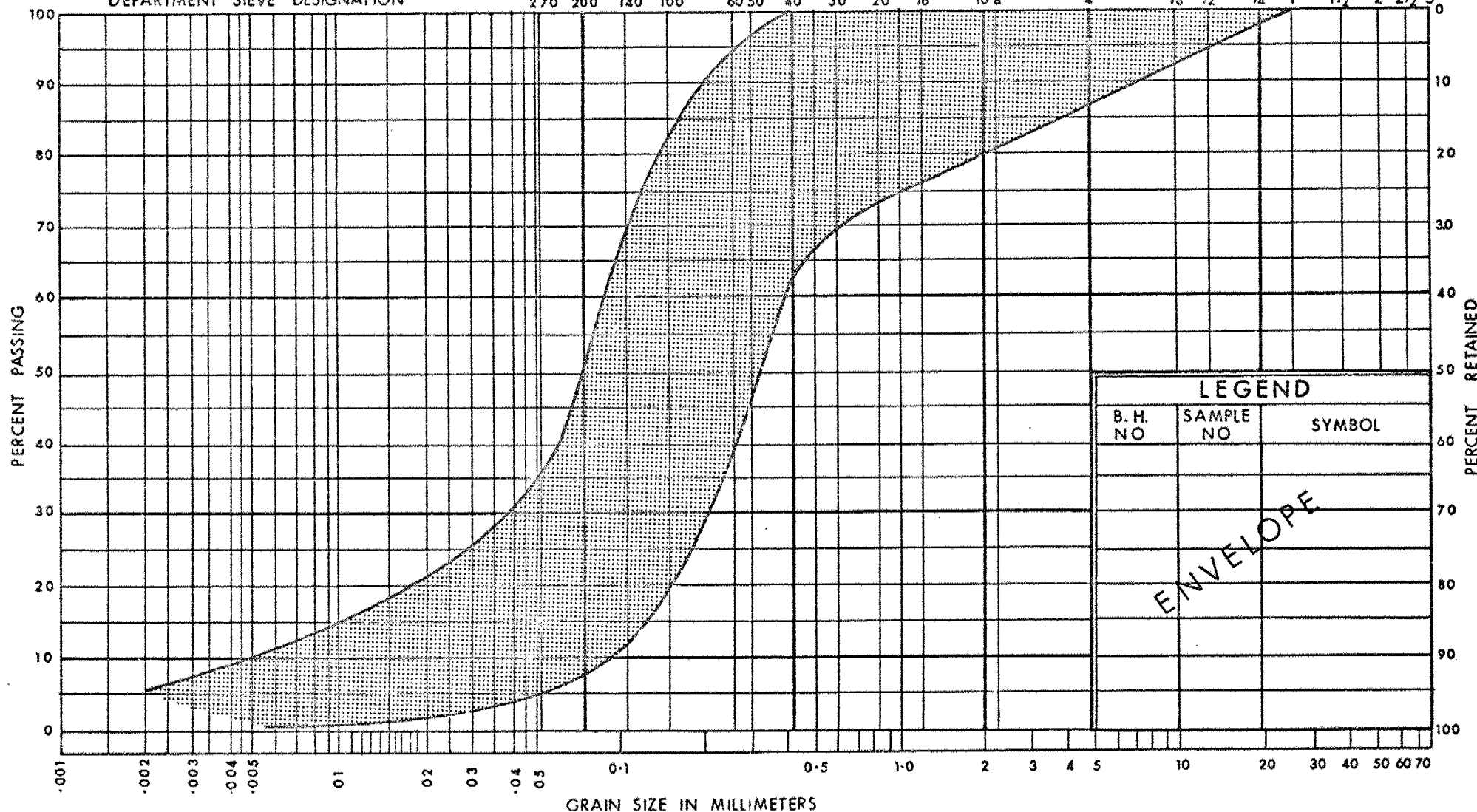
Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION

270 200 140 100 60 50 40 30 20 16 10 8 4 $\frac{3}{8}$ " $\frac{1}{2}$ " $\frac{3}{4}$ " 1" $1\frac{1}{2}$ " 2" $2\frac{1}{2}$ " 3"



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



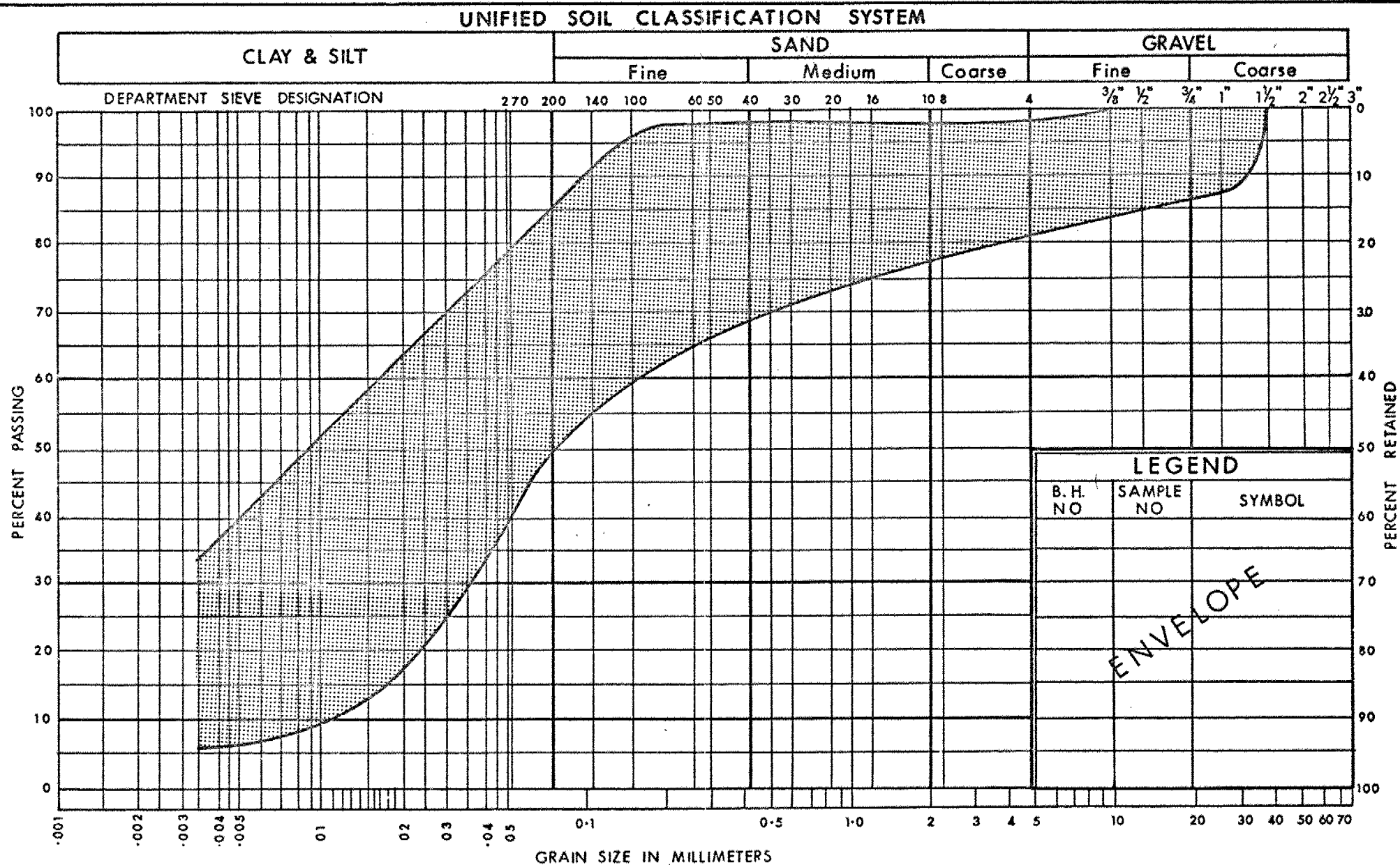
DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION
SAND
WITH SILT AND TRACES OF GRAVEL

W.P. No. 163-60

JOB No. 72-11036

FIG. NO. 1



ONTARIO

DESIGN SERVICES
BRANCH

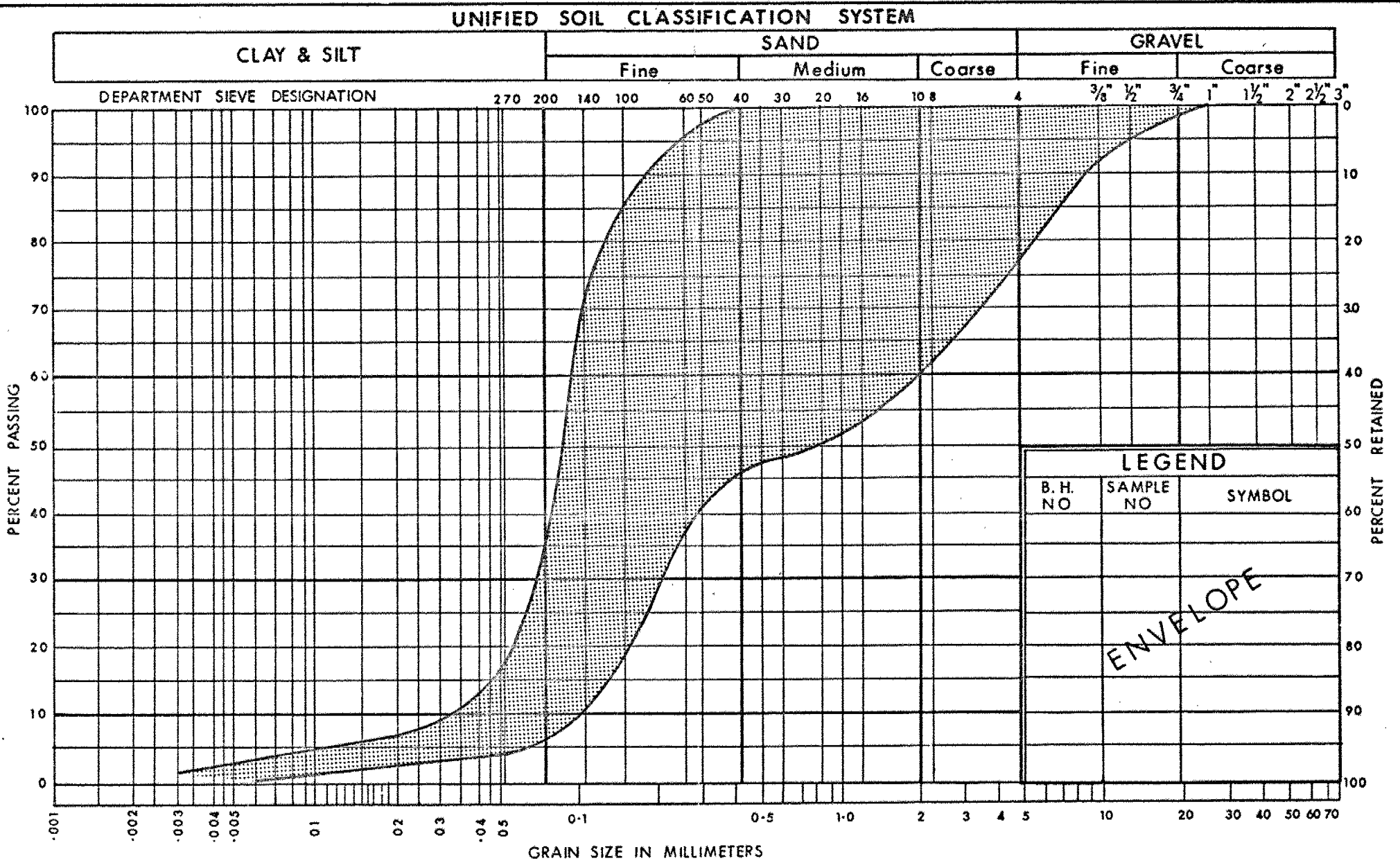
GRAIN SIZE DISTRIBUTION

SILT
WITH SAND AND CLAY, TRACES OF GRAVEL

W.P. No. 163-60

JOB No. 72-11036

FIG. NO. 2



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

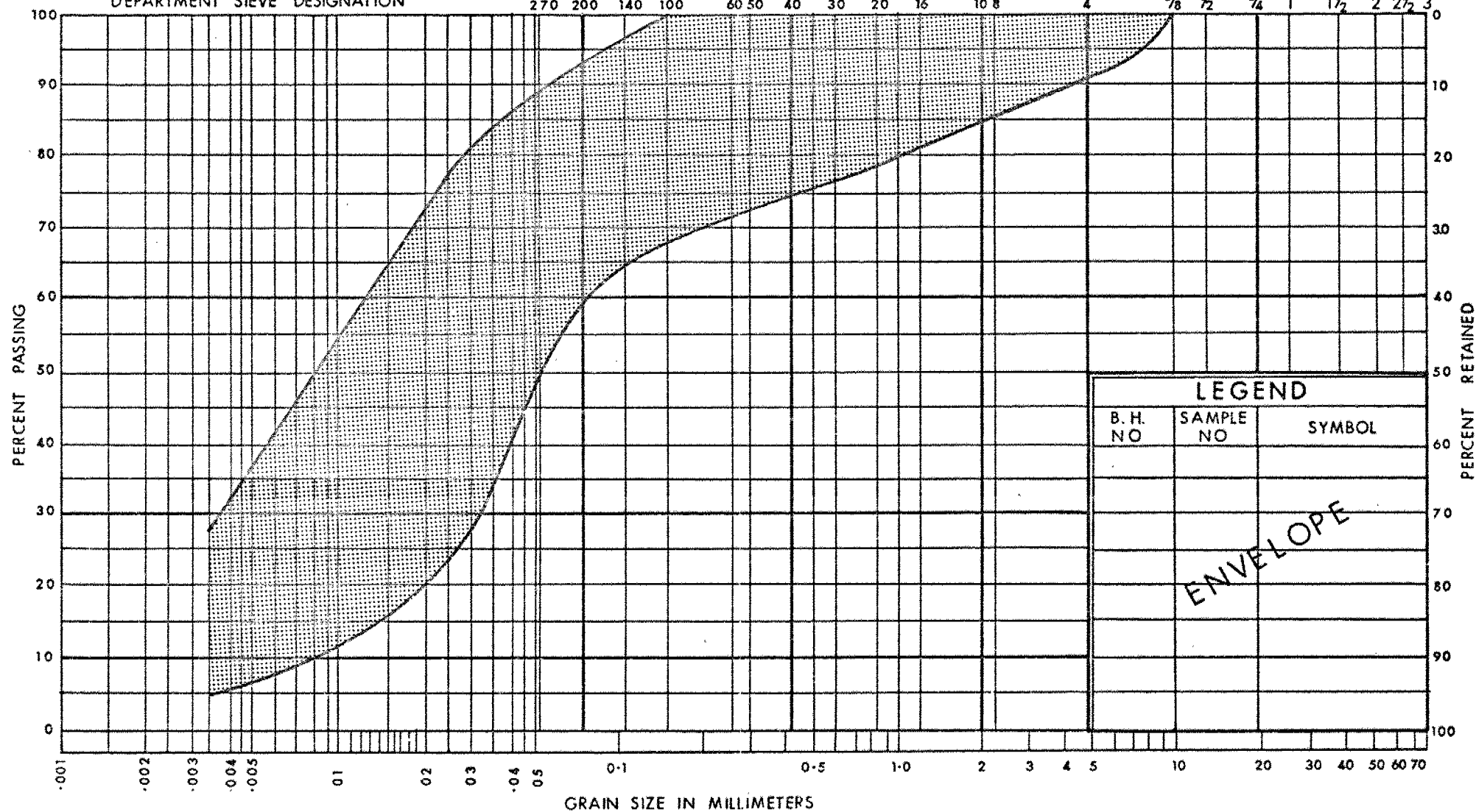
Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION

270	200	140	100	60	50	40	30	20	16	10	8	4	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{3}{4}$ "	1"	$1\frac{1}{2}$ "	2"	$2\frac{1}{2}$ "	3"
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DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION
SILT

WITH SOME SAND AND CLAY, TRACES OF GRAVEL

W.P. No. 163-60

JOB No. 72-11036

FIG. NO. 4

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

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

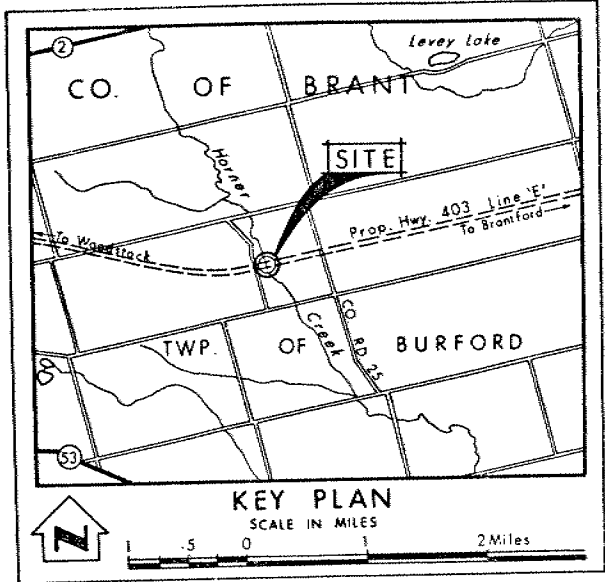
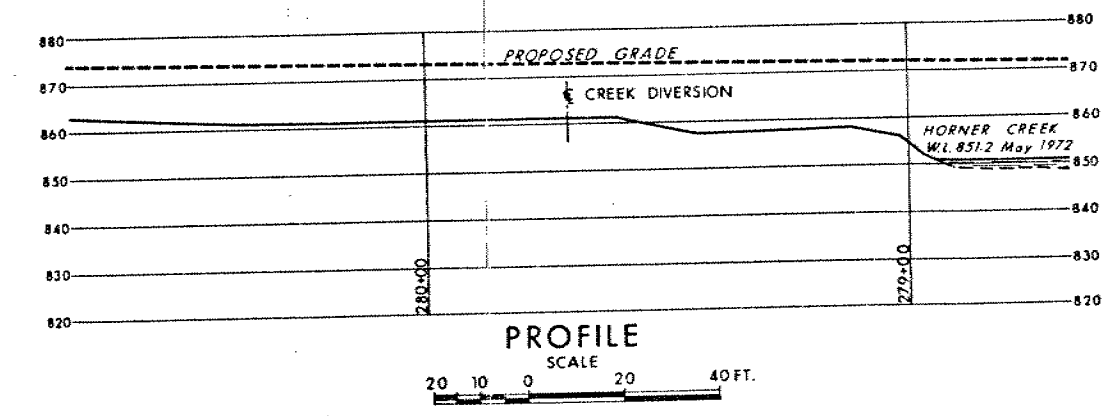
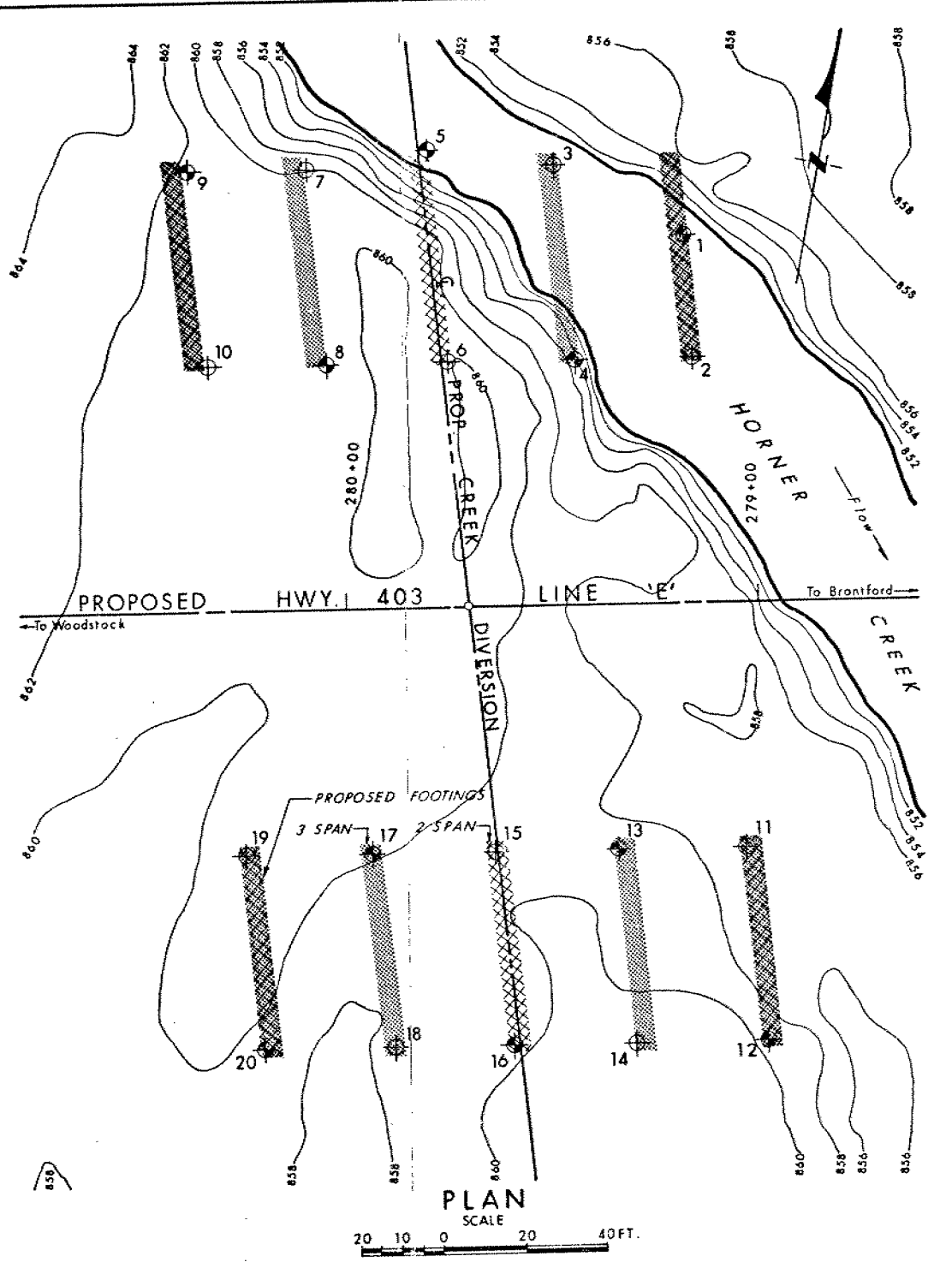
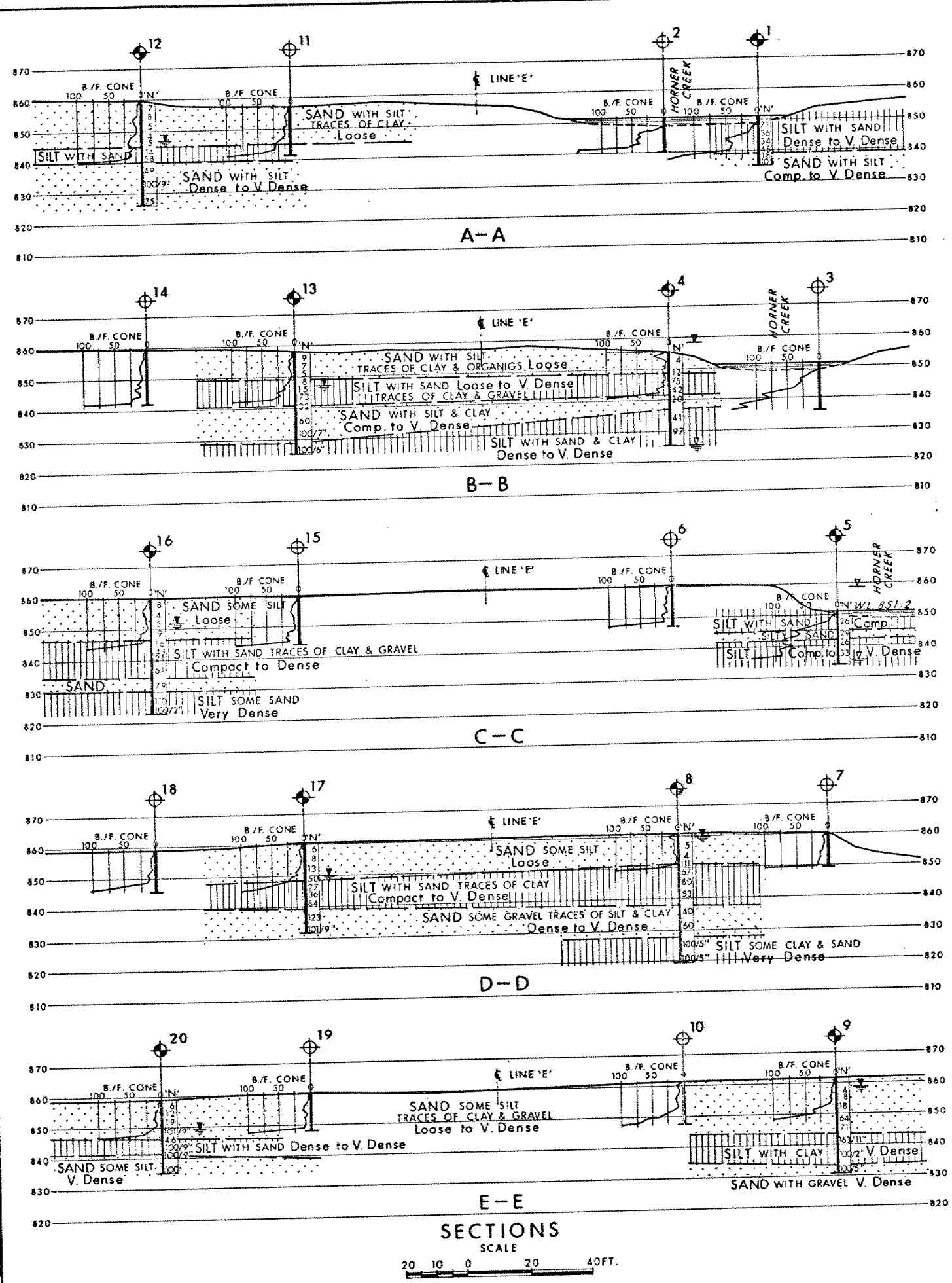
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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



LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, March, May Head and June, 1972		
	Artesian Condition Encountered		
NO.	ELEVATION	STATION	OFFSET
1	851.2	279+16	90' RT.
2	851.2	279+15	60' RT.
3	851.2	279+47	108' RT.
4	855.5	279+43	60' RT.
5	851.2	279+78	113' RT.
6	861.0	279+74	60' RT.
7	860.4	280+08	108' RT.
8	861.2	280+04	60' RT.
9	861.8	280+37	108' RT.
10	861.7	280+33	60' RT.
11	857.1	279+04	60' LT.
12	860.0	279+00	108' LT.
13	858.7	279+35	60' LT.
14	860.1	279+31	108' LT.
15	859.8	279+65	60' LT.
16	859.9	279+61	108' LT.
17	860.4	279+94	60' LT.
18	858.5	279+90	108' LT.
19	860.6	280+24	60' LT.
20	859.6	280+22	108' 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.

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

HORNER CREEK

HIGHWAY NO. Prop. 403 Line 'E' DIST. NO. 4
CO. BRANT
TWP. BURFORD LOT 14 CON. III

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD P.K.	CHECKED <input checked="" type="checkbox"/>	WP NO. 163-60	DRAWING NO.
DRAWN <input checked="" type="checkbox"/>	CHECKED <input checked="" type="checkbox"/>	WO NO. 72-11036	72-11036A
DATE <u>Sept. 12, 1972</u>	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <u>[Signature]</u>	CONT. NO.	PRINCIPAL FOUNDATION ENGINEER	

REF. NO. E-4895-1

RECORD OF BOREHOLE No 1

W P 163-60-01 LOCATION Sta. 16 + 609.6 28.2 Lt. C/L 403 MED. ORIGINATED BY PK
DIST 4 HWY 403 BOREHOLE TYPE Washboring COMPILED BY TW
DATUM Geodetic DATE 72 06 01 CHECKED BY HR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W		
259.4	Water Level											
258.8	Creek Bottom											
	Silt with Sand Very Dense		1	SS	71		258					
	— Grey —		2	SS	56							
	Brown		3	SS	34							
255.8	Dense to Very Dense		4	SS	48							
3.0	Sand with Silt		5	SS	18		256					1 32 60 7
254.7	Compact to Very Dense		6	SS	105							1 63 35 1
4.1	End of Borehole						254					

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Ministry of
Transportation and
Communications
Ontario

RECORD OF CONE HOLE No 2, 6, 10, 11

W P 163-60-01 LOCATION Sta. 16+610.0, 18.3 m Lt. # 403 ORIGINATED BY P.R.
DIST 4 HWY 403 BOREHOLE TYPE Cone Tests Only COMPILED BY _____
DATUM Geodetic DATE _____ CHECKED BY _____

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 _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								
259.0	Water Level											
0.0	Creek Bottom											
258.3												
0.7												
255.6												
3.4	End of Cone Test											
262.4	Ground Level											
0.0												
258.3												
4.1	End of Cone Test											
262.6	Ground Level											
0.0												
258.4												
4.2	End of Cone Test											
261.2	Ground Level											
0.0												
256.4												
4.8	End of Cone Test											

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



Ministry of
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Communications
Ontario

RECORD OF BOREHOLE No 4

W P 163-60-01 LOCATION Sta. 16+601.0, 18.3 m Lt. E 403 ORIGINATED BY T.W.
DIST 4 HWY 403 BOREHOLE TYPE Washboring & Cone Test COMPILED BY _____
DATUM Geodetic DATE 72 05 26 CHECKED BY _____

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 _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								
260.8	Ground Level											
0.0	Sand With Silt Traces of Organics Loose		1	SS	4	260						2 69 25 4
258.6			2	SS	12							4 49 42 5
2.0	Silt Some Sand Compact to Very Dense		3	SS	75	258						2 21 62 15
256.5			4	SS	42							
4.3	Silty Sand Compact to Dense		5	SS	20	256						5 20 70 5
255.3												
5.5	Silt Some Sand & Clay Loose to Very Dense		6	SS	41	254						8 32 49 11
			7	SS	97							1 9 74 16
251.6						252						
9.1	End of Borehole											

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Ministry of
Transportation and
Communications
Ontario

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 8

W P 163-60-01 LOCATION Sta. 16+582.2, 18.3 m Lt. 403 ORIGINATED BY T.W.
DIST 4 HWY 403 BOREHOLE TYPE Washboring & Cone Test COMPILED BY
DATUM Geodetic DATE 72 05 23 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100						
262.5	Ground Level													
0.0	Sand With Some Silt		1	SS	5		262							0 84 (16)
	Loose		2	SS	4		260							
259.4			3	SS	111									
3.0	Silt With Sand, Trace of Clay		4	SS	67		258							1 25 64 10
	Very Dense		5	SS	80		256							
255.5			6	SS	53		254							
7.0	Sand With Some Gravel		7	SS	40		252							11 70 (19)
	Traces of Silt & Clay		8	SS	60		250							
252.4	Dense to Very Dense		9	SS	100/	13 cm								
10.0	Silt With Some Clay and Sand		10	SS	100/	13 cm								2 10 67 21
249.8	Very Dense													
12.6	End of Borehole													

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



W P 163-60-01 LOCATION Sta. 16+604.1, 18.3 m Rt. of 403 ORIGINATED BY J.B.
DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY O.J.
DATUM Geodetic DATE 72 03 15 CHECKED BY _____

+3, x5: Numbers refer to Sensitivity

OFFICE REPORT ON SOIL EXPLORATION

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION SAND WITH SILT & TRACES OF GRAVEL

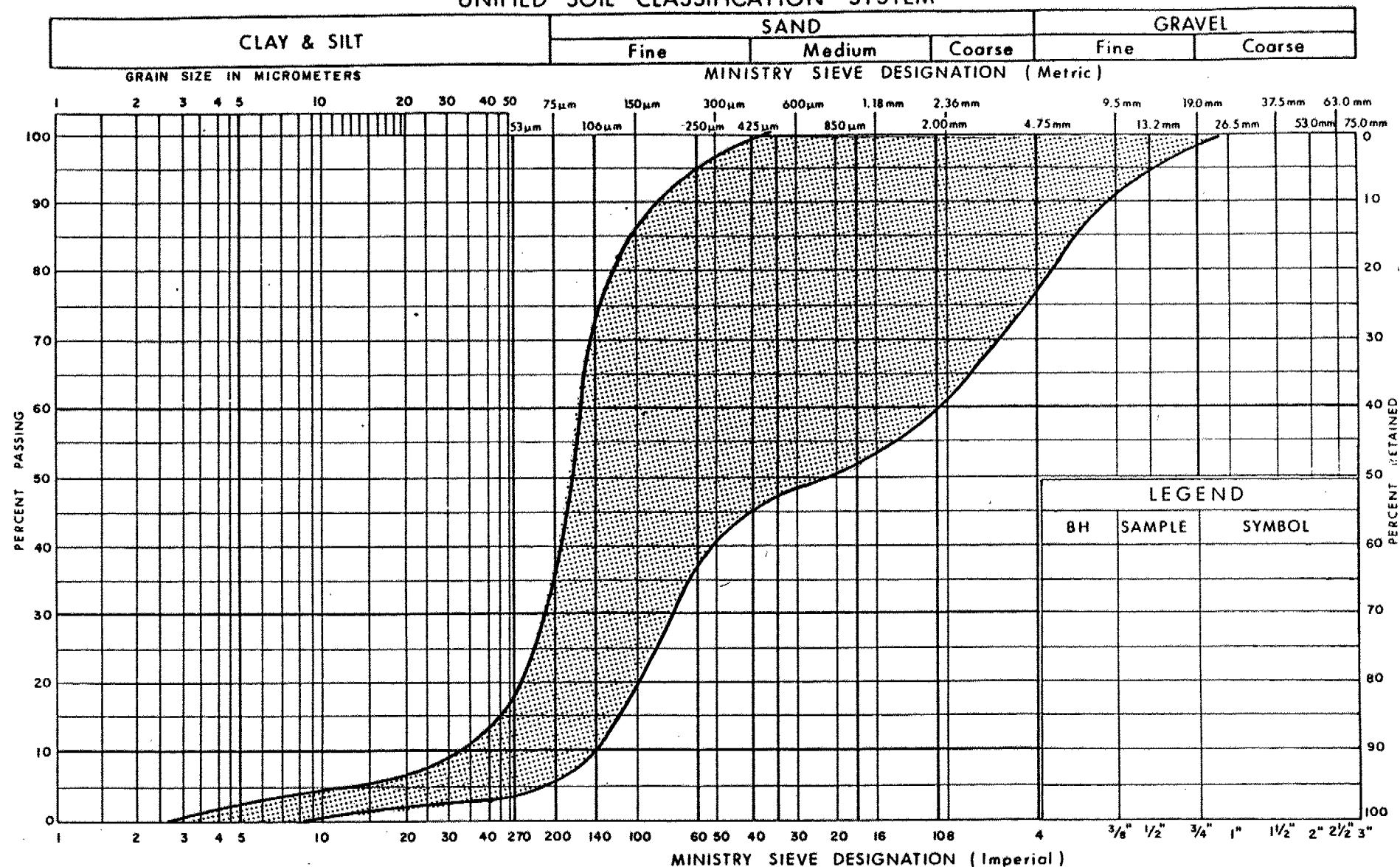
FIG No 1

W P 163-60-01



W P 163-60-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION

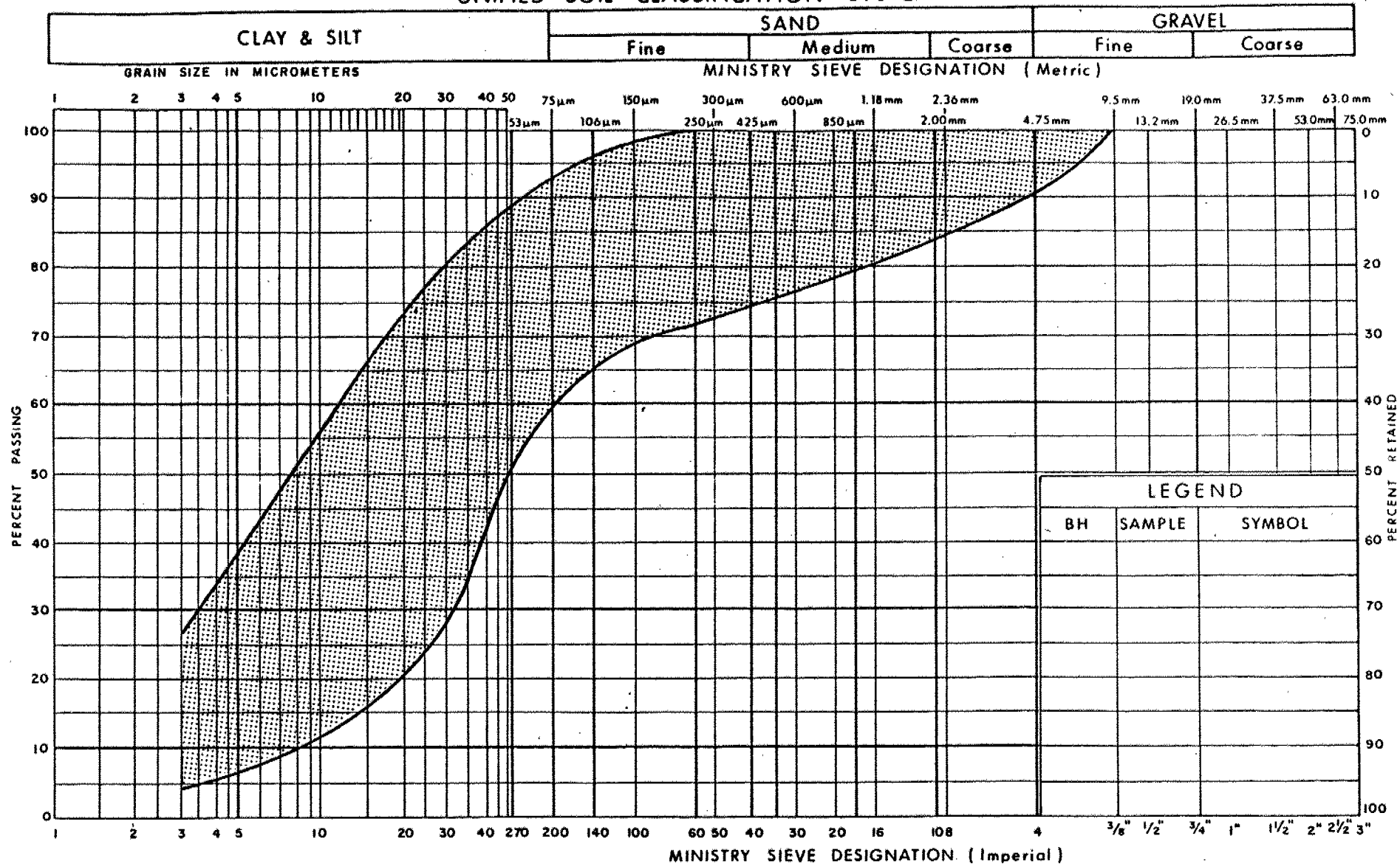
SAND

WITH SOME SILT & GRAVEL

FIG No 3

W P 163-60-01

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILT

WITH SOME SAND & CLAY TRACES OF GRAVEL

FIG No 4

W P 163-60-01

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_r	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

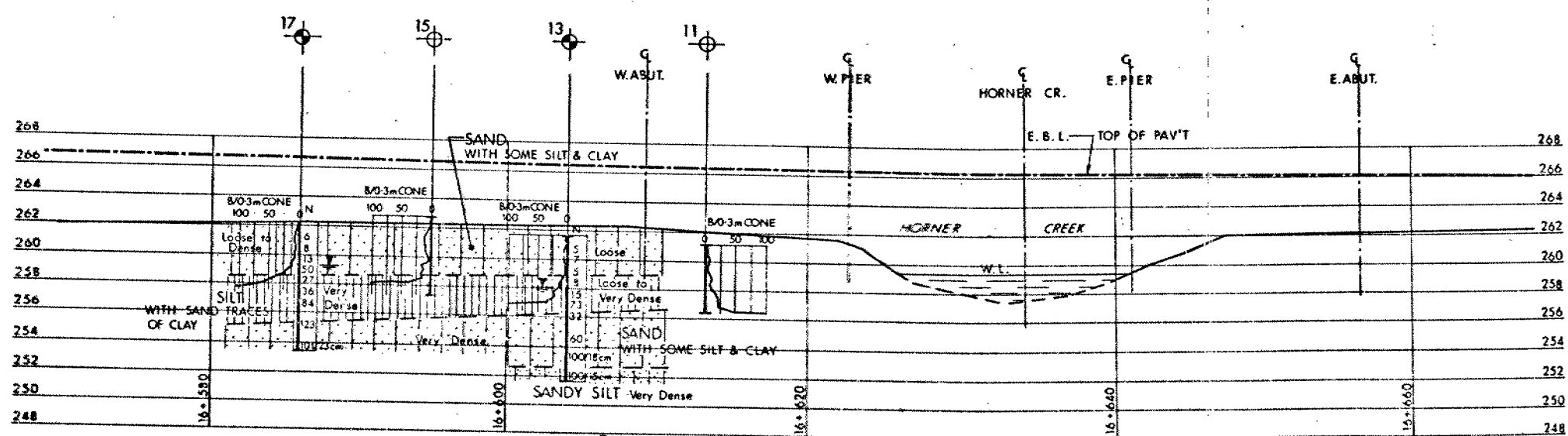
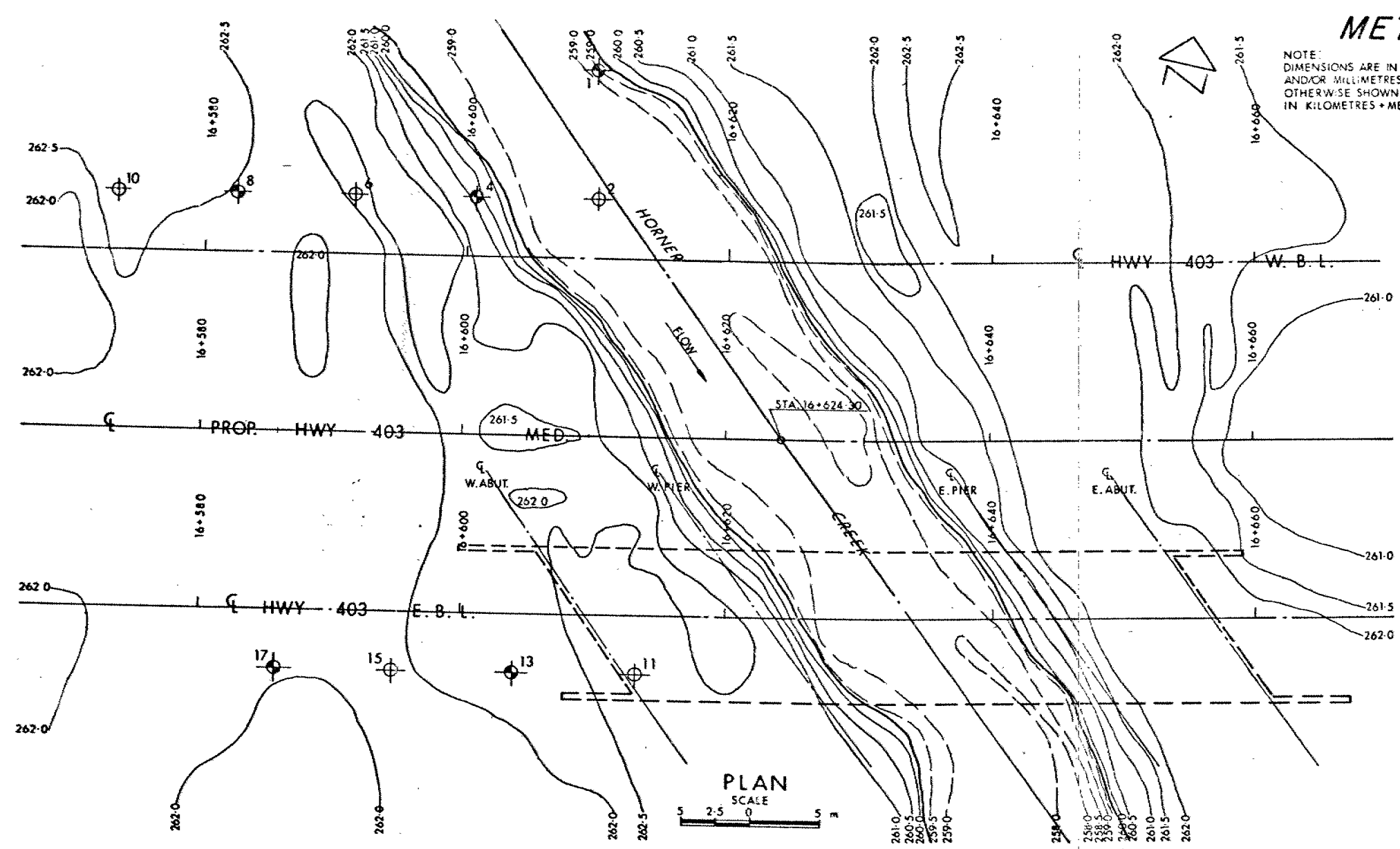
STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{\min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
P	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kn/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{\max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m^2	SEEPAGE FORCE
γ'	kn/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, OTTAWA, ONTARIO, CANADA



PROFILE PROPOSED HWY 403 E.B.L.

METRIC

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

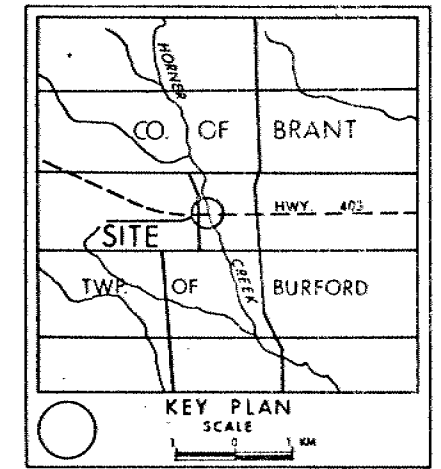
CONT No
WP No 163-60-01

HORNER CREEK BRIDGE E.B.L.

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- ◆ Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 72 03 16

No	ELEVATION	STATION	OFFSET CL MED.
11	261.2	16+613.3	18.3 RT.
13	261.7	16+604.1	18.3 RT.
15	262.8	16+595.0	18.3 RT.
17	262.2	16+585.0	18.3 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 40P2-26A

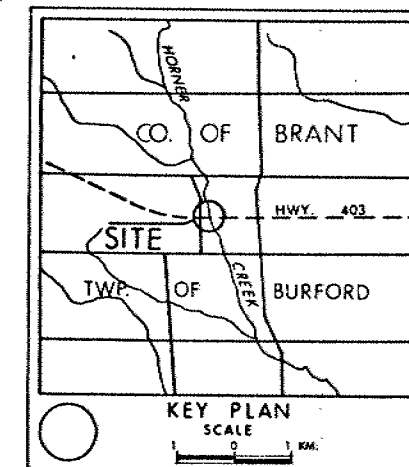
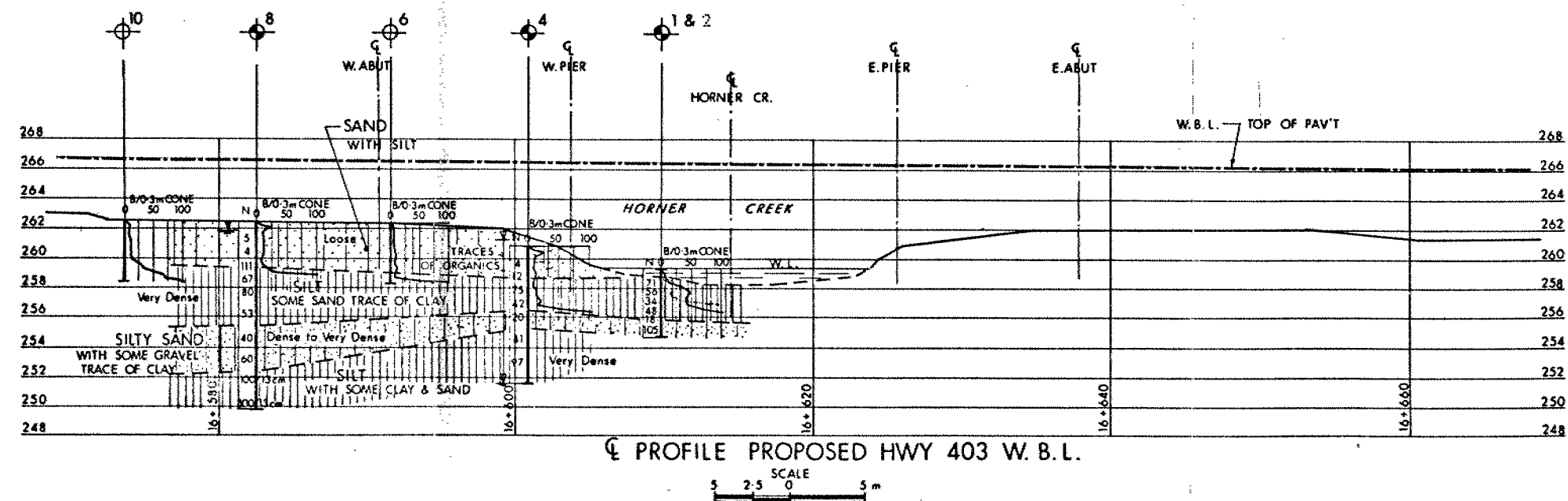
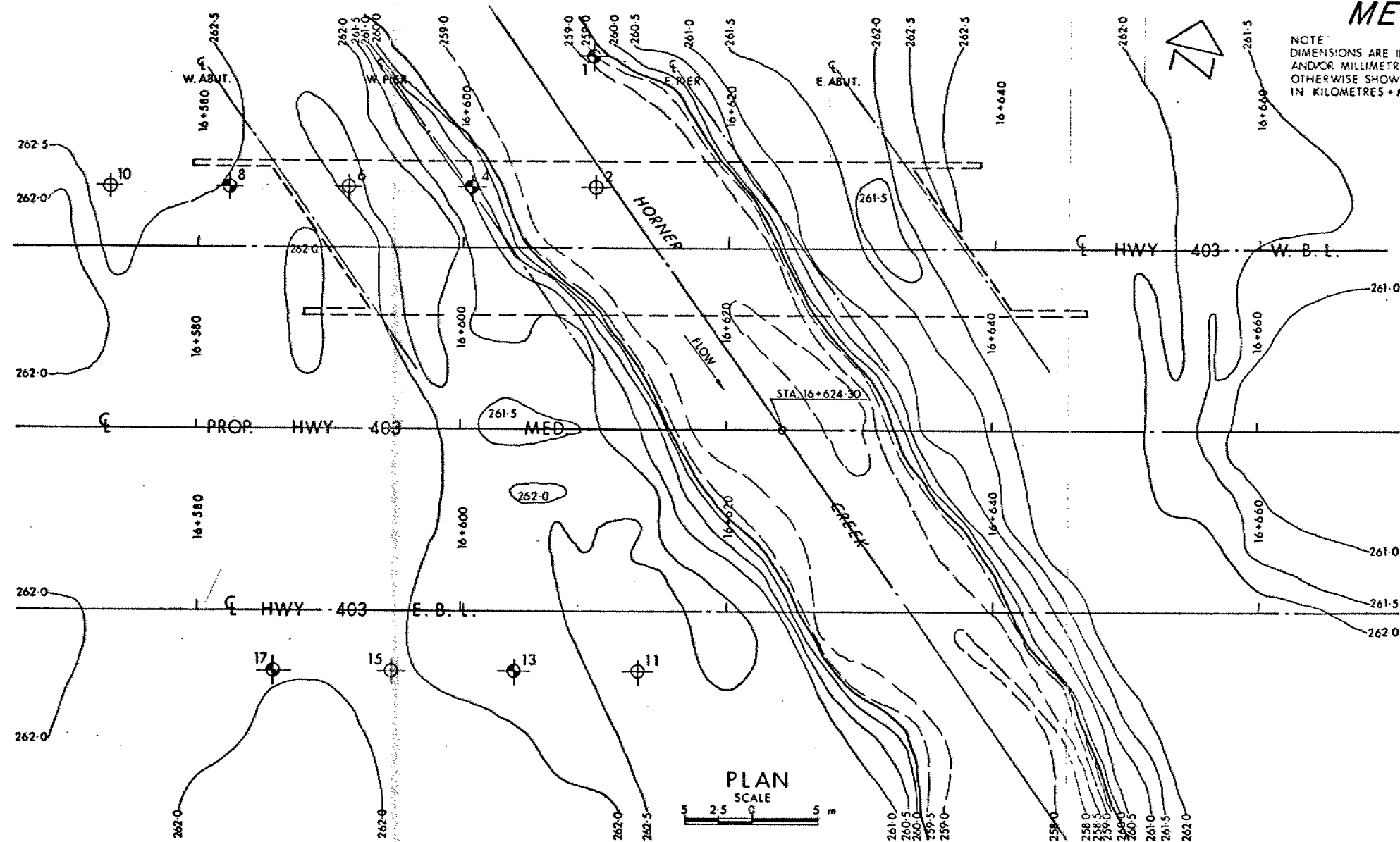
HWY No	403	DIS	4
SUBMITTAL CHECKED	DATE 82 03 11	SHEET	1-148A
DRAWN/LOI CHECKED	DATE 82 03 11	REV	2A










SHEET

METRIC

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) |
|  | WL at time of investigation 72 05 23 |
|  | Head |
|  | ARTESIAN CONDITION |
|  | Encountered |

No	ELEVATION	STATION	OFFSET C/L MED.
1	259.4	16+609.6	28.2 LT
2	259.0	16+610.0	18.3 LT
4	260.8	16+601.0	18.3 LT
6	262.4	16+591.2	18.3 LT
8	262.5	16+582.2	18.3 LT
10	262.6	16+573.2	18.3 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.

[illegible]

Geocres No 40P2-26A

HWY No 403		DIST 4	
SUBMIT P.P.	CHECKED	DATE 82 03 10	SITE 1-1486
DRAWNOL J	CHECKED	APPROVED	DWG 28

DIST. No. 4 HWY. 403 W.B.
CONT No
WP No 163-60-01



HORNER CREEK BRIDGE
8.5 KM. E. OF HWY. 53
GENERAL ARRANGEMENT

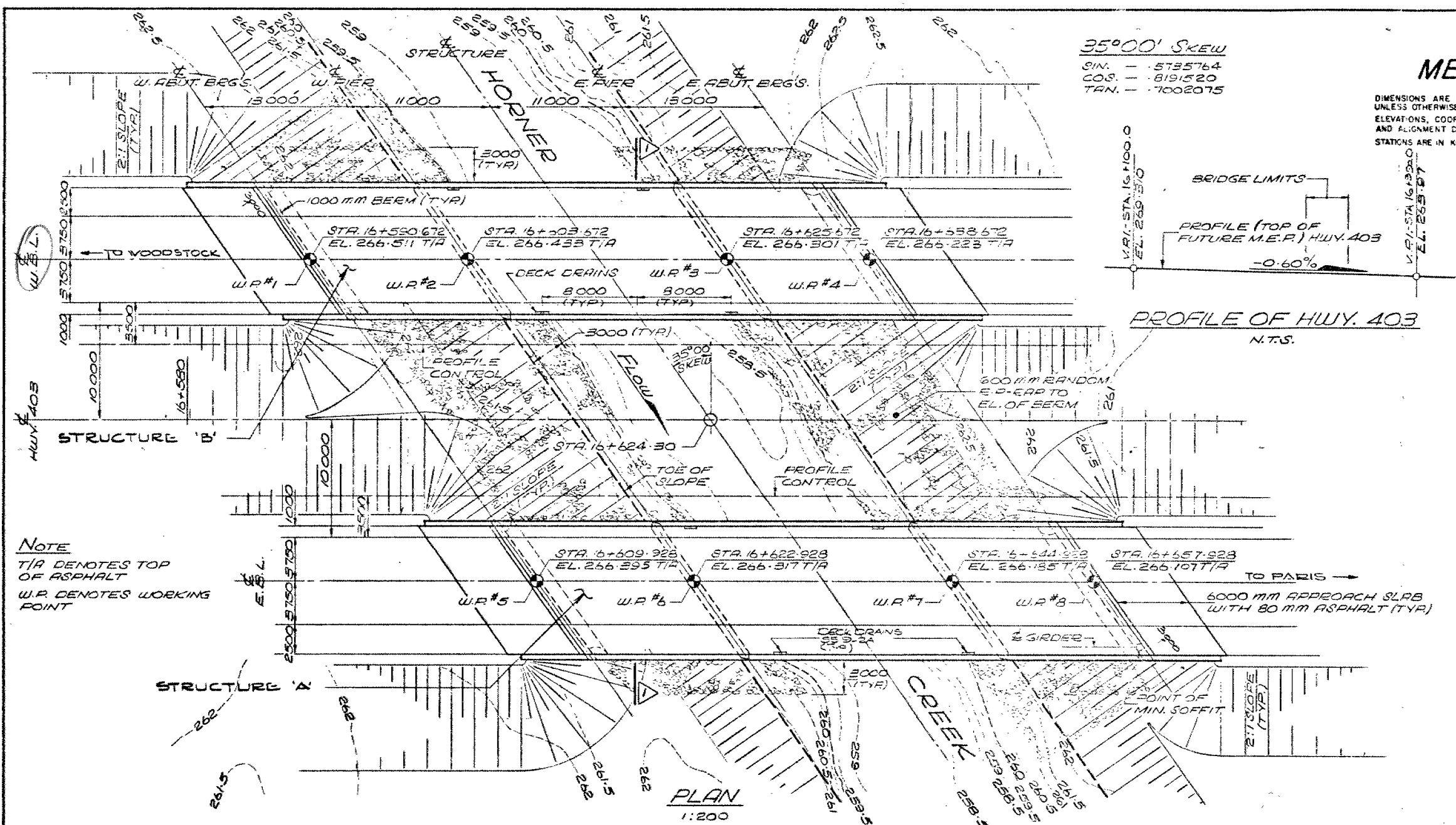
SHEET

FENCO
FENCO CONSULTANTS LTD.

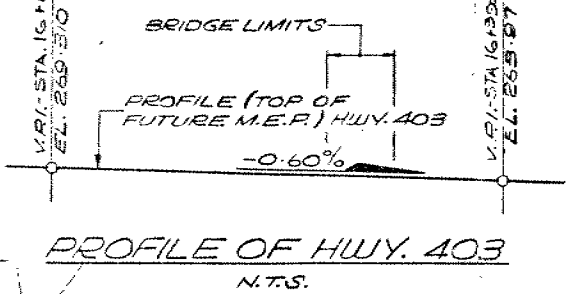
METRIC

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

35°00' SKEW
SIN. = .5735764
COS. = .8191520
TAN. = .7002075



NOTE
T/A DENOTES TOP
OF ASPHALT
W.P. DENOTES WORKING
POINT



NOTES:

CLASS OF CONCRETE:

PRESTRESSED GIRDERS	35 MPa
DECK, ABUTMENTS, PIERS & BARRIER WALL	30 MPa
REMAINDER	20 MPa
OR AS NOTED ON DRAWINGS	

REINFORCING STEEL

GRADE 400
BAR MARKS WITH SUFFIX 'C' DENOTE COATED BARS

CLEAR COVER TO REINF. STEEL

FOOTING	100±25
DECK TOP	70±20
DECK BOT	40±10
ABUTMENTS, FRONT & FACE OF WINGWALLS	80±20
ABUTMENTS, REAR FACES	70±20
PIERS	80±20
REMAINDER, UNLESS OTHERWISE NOTED ON DRAWINGS	70±20

CONSTRUCTION NOTES:

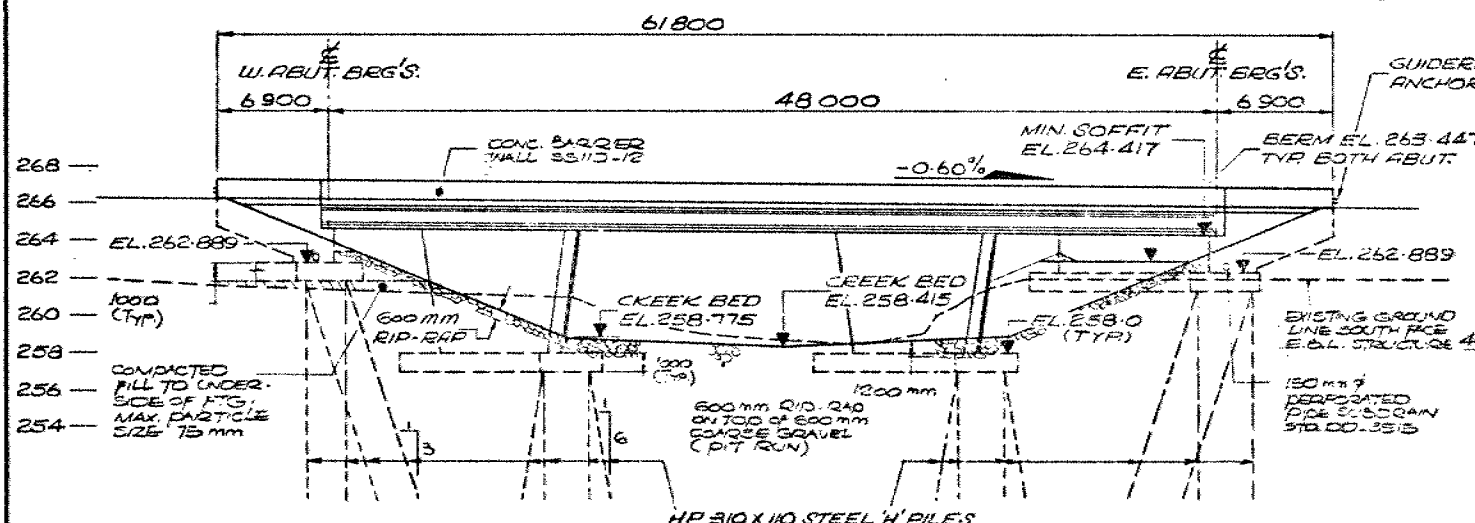
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ±3mm

CONCRETE QUANTITIES LISTED BELOW FOR THE APPLICABLE LUMP SUM TENDER ITEMS.

CONCRETE IN PIERS, ABUTMENTS & WINGWALLS	259 m³ (30 MPa)
CONCRETE IN DECK	171 m³ (30 MPa)
CONCRETE IN BARRIER WALLS	32 m³ (30 MPa)
CONCRETE IN APPROACH SLABS	33 m³ (20 MPa)

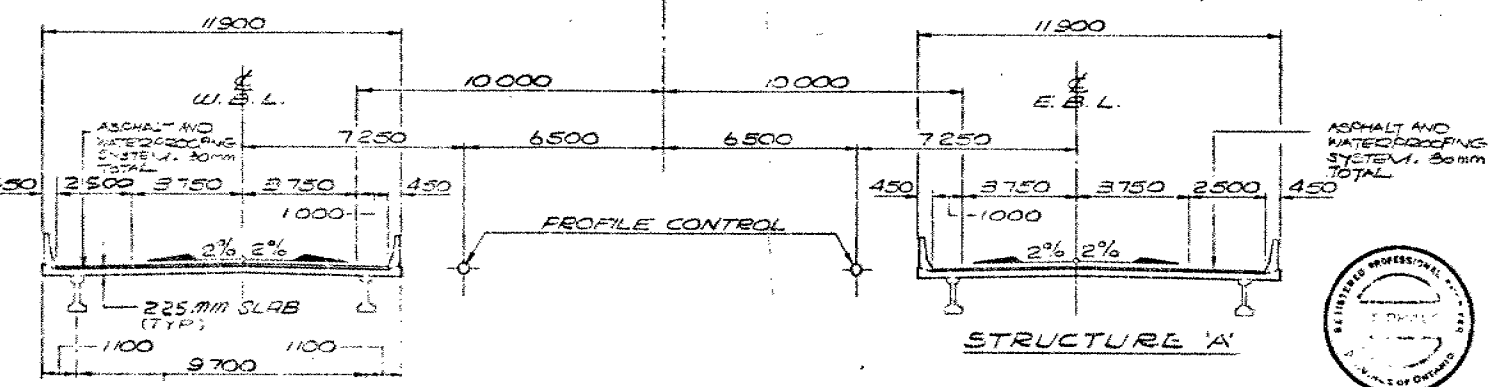
LIST OF DRAWINGS - STRUCTURE 'B'

1. GENERAL ARRANGEMENT
2. BORE HOLE LOCATIONS & SOIL STRATA
3. FOUNDATION LAYOUT
4. WEST ABUTMENT
5. EAST ABUTMENT
6. PIERS
7. PRESTRESSED GIRDERS AND BEARINGS
8. DECK
9. SCREED ELEVATIONS & MISCELLANEOUS DETAILS
10. BARRIER WALL
11. 6000mm APPROACH SLAB
12. STANDARD DETAILS
13. BRIDGE DATE & SITE NUMBER DATA
14. AS CONSTRUCTED ELEV. & DIM.
15. PILE DRIVING - DEEP HAMMERS
16. PILE DRIVING - STEAM & DIESEL HAMMERS



B.M. 264.405
N. & W. IN S.W. ROOT 0.76 CHERRY
55-B LT. 16+562.6

ELEVATION E.B.L. STRUCTURE
1:200



C.P.C. 1200 PRETENSIONED
CONCRETE GIRDERS E.B.L.
STRUCTURE SIMILAR

1:125

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN: R.V.H. CHECK: J.C.D. LOADING: CHBUC-A-79 DATE: AUG 91
DRAWING: M.F.Y. SITE: 163-60-01 EWS: 18

FENCO No 35849-1K-12

PILE DATA

LOCATION	PILES REQUIRED	TYPE	LENGTH EA. PILE	LENGTH EA. TYPE
WEST ABUT.	12	BATTER 3:1	7.50	88.00
DO DO	4	VERTICAL	7.50	32.00
EAST PIER	12	BATTER 6:1	7.50	88.00
DO DO	4	VERTICAL	7.50	32.00
WEST ABUTMENT	9	BATTER 3:1	12.50	112.50
DO DO	11	VERTICAL	12.50	137.50
EAST ABUTMENT	9	BATTER 3:1	12.50	112.50
DO DO	11	VERTICAL	12.50	137.50
TOTAL LENGTH				740.00



METRIC

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

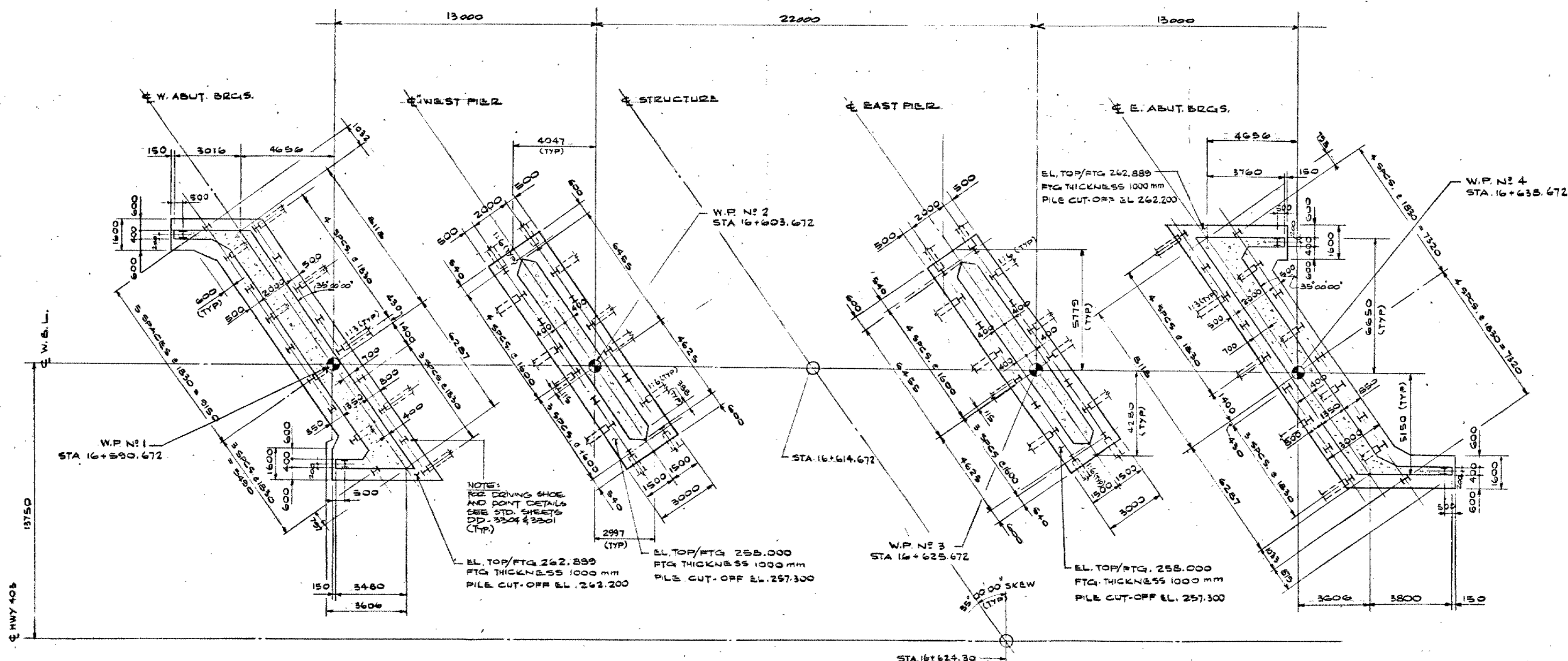
DIST. No. 4 HWY. 403 W.B.
CONT No
WP No 163-60-01

HORNER CREEK BRIDGE-B
8.5 KM E. OF HWY. 53
FOUNDATION LAYOUT
WEST-BOUND STRUCTURE

SHEET

FENCO

FENCO CONSULTANTS LTD



FOUNDATION LAYOUT

WEST-BOUND STRUCTURE
SCALE 1:100

PILE DESIGN DATA:

- DESIGN LOAD AT SLS TYPE II — 800 KN
- FACTORED CAPACITY AT ULS — 1600 KN

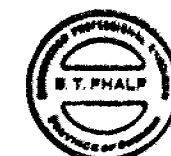
PILE CONSTRUCTION DATA:

- ULTIMATE CAPACITY — 2700 KN
- PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARDS SS103-10 OR SS103-11 USING AN ULTIMATE CAPACITY OF 2700 KN PER PILE BUT MUST BE DRIVEN BELOW ELEVATION 252.000
- LEGEND — INDICATES BATTER PILE, I INDICATES VERTICAL PILE
- ALL PILES TO BE HP310X110
- PILE LENGTHS SHOWN ON DRAWINGS ARE THEORETICAL LENGTHS BELOW CUT-OFF

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN RYM	CHECK JCD	LOADING Q:300-A-79	DATE AUG. 81
DRAWING HBM	CHECK JCD	SITE No 1-488	DWG 38

FENCO N° 33849-1K-38



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

DESTRESSED ORDERS
DECK, ABUTMENTS, DECS & BARRIER WALL
REMAINDER
OR AS NOTED ON DRAWINGS

GRADE 400
BAR MARKS WITH SUFFIX 'C' DENOTE COATED BARS

CLEAR COVER TO REIN. STEEL

FEET/INGS	MM
DEAL TO	100 ± 20
DEAL BOT	70 ± 20
ABUTMENT, FRONT FACE OF KINGPINS	40 ± 10
ABUTMENT, REAR FACE	80 ± 20
PIERS-RT	70 ± 20
DEMANDER UNLESS OTHERWISE	80 ± 20
NOTED ON DRAWINGS	70 ± 20

CONSTRUCTION NOTES:

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BLAZING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF 13 mm.

CONCRETE QUANTITIES LISTED BELOW FOR THE APPLICABLE LUMP SUM TENDER ITEMS.

CONCRETE IN PILLARS, ABUTMENTS & WINGWALLS	250 m ³ 30 MPa
CONCRETE IN DECK	171 m ³ 30 MPa
CONCRETE IN BARRIER WALLS	32 m ³ 30 MPa
CONCRETE IN APPROACH SLABS	23 m ³ 30 MPa

LIST OF DRAWINGS - STRUCTURE 'A'

- 1A. GENERAL ARRANGEMENT
- 2A. BORE HOLE LOCATIONS & SOIL STRATA
- 3A. FOUNDATION LAYOUT
- 4A. WEST ABUTMENT
- 5A. EAST ABUTMENT
- 6A. PIERS
- 7A. PRESTRESSED GIRDERS AND BEARINGS
- 8A. DECK
- 9A. SCREED ELEVATIONS & MISCELLANEOUS DETAILS
- 10A. BARRIER WALL
- 11A. 6000mm APPROACH SLABS
- 12A. STANDARD DETAILS
- 13A. BRIDGE DATE & SITE NUMBER DATA
- 14A. AS CONSTRUCTED ELEV. & DIM.
- 15A. PILE DRIVING - DROP HAMMERS
- 16A. PILE DRIVING - STEAM & DIESEL HAMMERS

NOTE
T/R DENOTES TOP
OF ASPHALT
W/P DENOTES WORKING
JOINT

61800

W. ABUT. BRG'S. 6900

48000

E. ABUT. BRG'S. 6900

CONCRETE BARRIER WALL SS10-12

MIN SOFFIT EL. 264.417

GUIDERAIL (CHANNEL ANCHORAGE (TYR))

BEEN EL. 263.447 TYR BOTH ABUT.

EL. 263.839

EL. 262.859

EL. 262.415

EL. 259.0

EL. 258.0

EL. 254.0

1000 (TYR)

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3000 (TYR)

4000 (TYR)

5000 (TYR)

6000 (TYR)

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263000 (TYR)

B.M. 264-405
N. J. WIN & W. SCOT 0-76 CHERRY
55-B LT 16+562-6

ELEVATION E.S.L. STRUCTURE

STRUCTURE B

1
112

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

[illegible]

PENCON: 32849-K-1A



METRIC

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STATIONS ARE IN KILOMETRES + METRES.

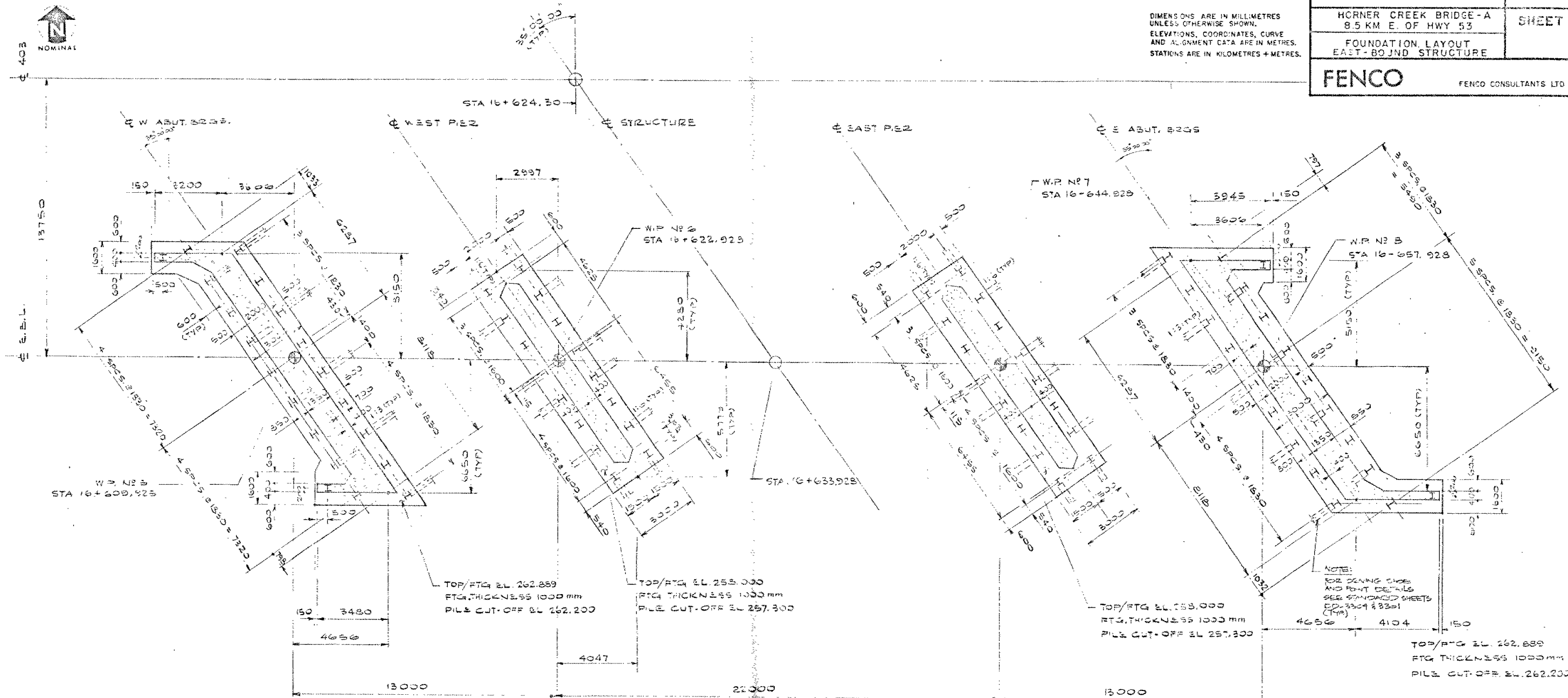
DIST. No. 4 HWY. 403 E.B.
CONT No
WP No 163-60-01

HORNER CREEK BRIDGE-A
8.5 KM E. OF HWY 53
FOUNDATION LAYOUT
EAST-BOUND STRUCTURE

SHEET

FENCO

FENCO CONSULTANTS LTD



FOUNDATION LAYOUT

EAST-BOUND STRUCTURE
SCALE 1:100

PILE DATA

LOCATION	PILES NO.	TYPE	LENGTH EA. PILE	LENGTH EA. TYPE
WEST PIER	12	BATER 3/11	7.50	88.00
DO DO	4	VERTICAL	7.50	32.00
EAST PIER	12	BATER 3/11	7.50	88.00
DO DO	4	VERTICAL	7.50	32.00
WEST ABUTMENT	9	BATER 3/11	12.50	112.50
DO DO	11	VERTICAL	12.50	137.50
EAST ABUTMENT	9	BATER 3/11	12.50	112.50
DO DO	11	VERTICAL	12.50	137.50
TOTAL LENGTH				700.00

PILE DESIGN DATA:

DESIGN LOAD AT SLAB-TIE 1: 900 KN
REDUCED CAPACITY AT ULS: 600 KN

PILE CONSTRUCTION DATA:

ULTIMATE CAPACITY: 2700 KN
PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARDS
EN103-10 OR BS 5933-11. USES AN ULTIMATE CAPACITY
OF 2700 KN PER PILE BUT MUST BE DRIVEN BELOW
ELEVATION 252.000
LE AND L INDICATES BATER PILE, V INDICATES VERTICAL PILE
ALL PILES TO BE HORIZONTAL
PILE LENGTH SHOWN ON DRAWING ARE THEORETICAL
LENGTHS BELOW CUT-OFF

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

FENCO No. 5354 J-K-DA



SEND
TO

Mr. H. GREENLY
CONSTRUCTION OFFICE
S-W REGION LONDON

FROM A. MA STRUCTURAL SECTION S-W REGION

DATE

84-04-25

SUBJECT

SNOWMOBILE PATH @ HORNER CREEK BRIDGE - W/P 163-60-01, CONT. 83-10

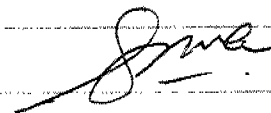
WE HAVE NOW OBTAINED AGREEMENT FROM BOTH MR. K. G. SELBY OF FOUNDATION OFFICE AND MR. J. L. KEEN OF STRUCTURAL OFFICE REGARDING THE DESIGN OF THE ABOVE MENTIONED SNOWMOBILE PATH UNDER THE EAST SPAN OF HORNER CREEK BRIDGES (SITE 1-88-148A & B).

C.C. MR. K. G. SELBY
MR. J. L. KEEN

RECEIVED

APR 26 1984

ment and Foundation Design Section



REPLY

REPLY FROM

REPLY DATE



Ontario

TO WRITE: HANDWRITE IN TYPE REMOVE AND RETAIN YELLOW COPY FORWARD BALANCE OF SET

TO REPLY: WRITE REPLY IN BOTTOM AREA SNAP SET APART

FOLD AT DASHED LINE TO OPEN TO WINDOW ENVELOPE

RETAIN ORIGINAL AND RETURN PINK COPY

memorandum



To: ~~M/~~ K. G. Selby
Chief Foundation Engineer
Pavement and Foundation Design Section
Central Building
Downsview

Date: 1984 04 02


Re: Snowmobile Path
Horner Creek Bridge, Site 1-88-148
W.P. 163-60-01
Highway 403, District 4

With reference to our memo of 84 02 27, the width of the snowmobile path has been changed from 6' to 4' but the 7' vertical clearance remains unchanged. We have revised our design/scheme for this snowmobile path, and this memo is to confirm my telephone conversation with you 84 03 26 regarding design recommendations as follows:

- (1) The forward slope under easterly end span is to be changed from 2:1 to 1 3/4:1, and 1 3/4:1 slope is stable.
- (2) Granular "A" pad is not required; the bedding material for the gabion mat should be granular and shall be compacted to 100%.
- (3) Styrofoam on top of the footing, for frost protection, can be omitted if the gabion mat above the footing is covered with granular fill (sand). Styrofoam placed in front of the footing should be extended deep enough to provide minimum frost protection of 1.2m.
- (4) In view of the bedding material is granular (sand), geotextile (filter cloth) can be omitted.

Attached are two prints showing cross-section A-A (off the structure) and cross-section B-B (under the structure). Cross-section C-C and D-D shown on the general arrangement drawing sent to you on 84 02 27 should be deleted.

We would appreciate receiving your comments by 84 04 06.


A. S. P. Ma
Sr. Structural Engineer
For: V. H. Boehnke, Head
Structural Section

ASPM/854

c.c.: H. Greenly
J. L. Keen



No comments

K. G. Selby
84-04-17

memorandum



Mr. K. Selby
To: Sr. Foundation Engineer
Pavement & Foundation Design Section
Central Building, Downsview

Date:

84 02 27

Re: Snowmobile Path
Horner Creek Bridge, Site 1-88-148
W.P. 163-60-01
Hwy. 403, District 4



We have been requested to provide a snowmobile path (6' wide and 7' vertical clearance) under the easterly end span of the above structure, by Mr. H. Greenly of our Regional Construction office in 84-02-09.

We proposed to cut a path on the easterly forward slope under the end span, and the path is protected by gabion mats and the fill on the upper side is retained by gabion baskets.

The design of the gabion retaining structure has been completed as per your foundation recommendations which are as follows:

1. Excavate 500 mm below the base of gabion retaining wall and compact the excavated area to 95%.
2. Fill up the excavated area with granular 'A' and compact to 100%.
3. Net safe bearing pressure is 100 kPa.
4. Use approximately 1 meter thick granular 'B' for backfill
5. Angle of internal friction is 30 degrees and unit weight of backfill is 21.5 KN/m³.
6. Minimum frost protection is 1.2 metres.
7. Styrofoam used for frost protection is 1-1/2" (38 mm) thick expanded polystyrene extruded type HI-40.

For your review and comments, attached are the following:

1. General Arrangement Drawing 1A for Horner Creek Bridges.
2. Plan View of snowmobile path and gabion structure under easterly end span.
3. Cross-section A, B, C. D.

We would appreciate receiving your comments by 84-03-09,
especially regarding the use of styrofoam as shown on
Cross-section B-B.



A.S.P. Ma
Sr. Structural Engineer
For: V.F. Boehnke
Head, Structural Section

ASPM/431

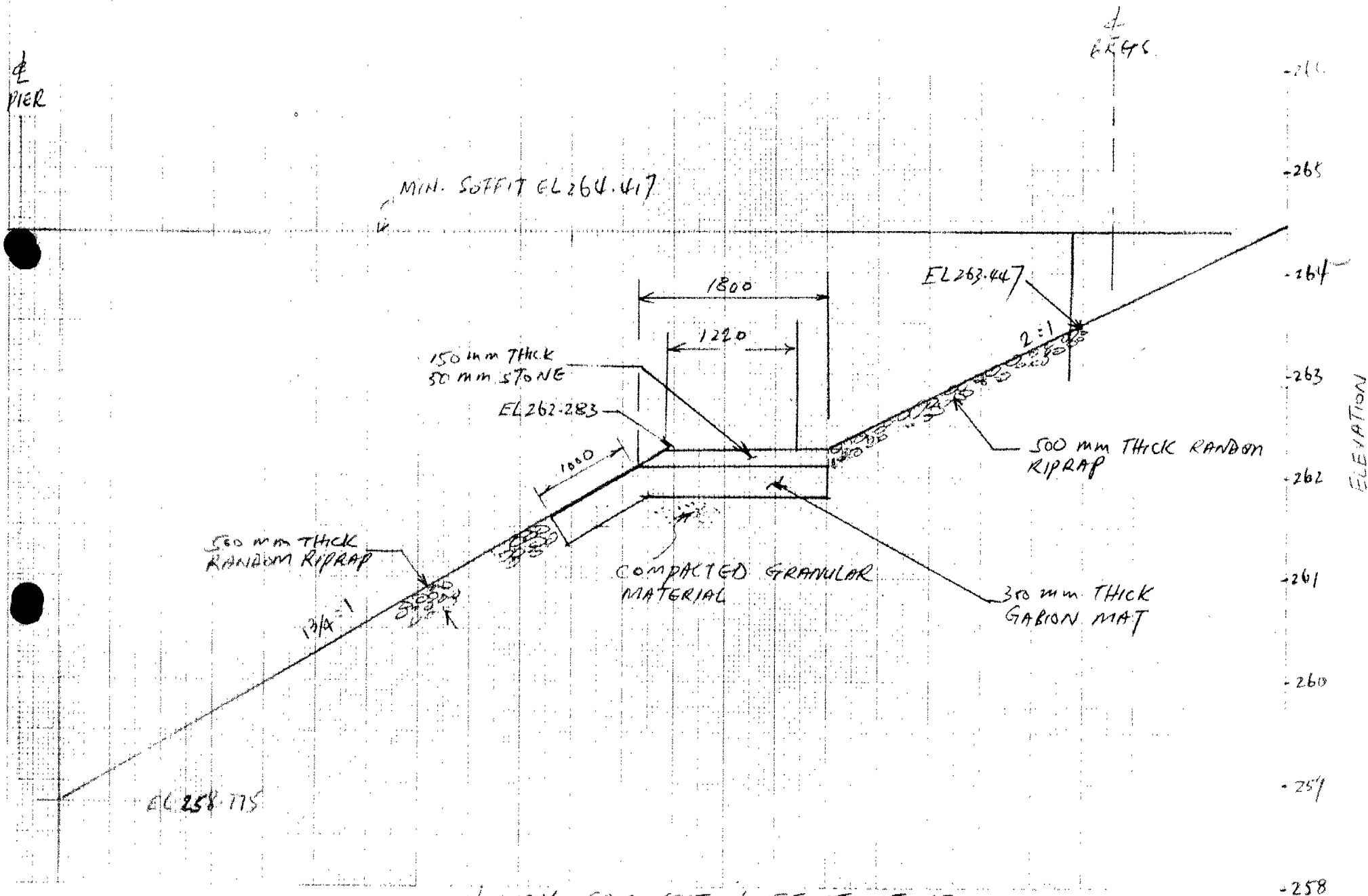
cc: Mr. J.L. Keen
Mr. H. Greenly
Mr. E. Stevenson

84-03-26

11



SCALE 1:70



NORMAL CROSS-SECTION OFF STRUCTURE
SECTION A-A

SCALE 1:50

memorandum



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

Date: 82 05 03

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

Re: W.P. 163-60-01, Site 1-148
Horner Creek Bridge - A & B
Hwy. 403, District 4

This Section has reviewed the submitted final drawings and provisions for this proposed twin structure. Our comments are as follows:

If the piles penetrate the strata of artesian water pressure, water flowing up along the piles may have to be accommodated by a filter beneath the pile caps. The need for this treatment will have to be determined during construction.

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

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

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

DHD:syc

memorandum



To: Mr. R. Carney
Head, Planning and Design Section
Southwestern Region
London

Date: 1981 11 20

Re: Horner Creek Bridges - A & B
8.5 km E. of Hwy. 53
W.P. 163-60-01
Site #1-148A, Structure A, E.B. Lanes
Site #1-148B, Structure B, W.B. Lanes
Dist. No. 4, Hwy. 403

Subsequent to recommendations received from the Specifications and Standards Office, we have revised the proposed special provision, "Operational Constraints - Environmental Protection of Horner Creek". Please replace the version contained in the Special Provisions sent to you 81 10 22 with the enclosed copies for Structure A and Structure B.

JLK:ac
Encl.

J.L. Keen
Design Engineer
Southwestern Section

cc: J. Blevins
V. Boehnke
G. Martens
B. Giroux
G. Wrong
R. Dorton
C.S. Grebski
W. McFarlane
B. Phalp (Fenco, Toronto)



memorandum



To: Mr. V.F. Boehnke
Head, Structural Section
Southwestern Region
London

Date: 81 04 08

Attention: Mr. S. Jants

From: Pavement & Foundation Design Section
Room 313, Central Building

Re: Proposed Twin Structures at Horner Creek
Hwy. #403, Site 1-148, W.P. 163-60-01,
District #4

As per your request, we have reviewed the recently issued Site Plan (E-5546-1) for the above structures and our comments and recommendations are as follows:

- 1) A foundation investigation was carried out at this location in 1972 and consequent report was issued on 72 09 21 (W.O. 72-11036).
- 2) It is noted that the centre of the structures was moved about 17 metres towards the east along Hwy. #403 E.
- 3) The east and southbound lanes were moved some 10 metres closer to Hwy. #403 E.
- 4) No borings were carried out east of Horner Creek.
- 5) It is believed that the subsoil conditions on the east side of Horner Creek are similar to those encountered on the west side.
- 6) We recommend that the abutments and piers of the proposed structures be founded on end-bearing steel 'H' piles driven into the very dense silt stratum. For HP310x110 steel 'H' piles with reinforced tips the permissible load is 900 kN. The pile driving should be in accordance with Standards SS103-11 or SS103-10 with the provision that the piles must be driven below El. 252.0. The driving energy should not be less than 50,000 joules per blow.
- 7) The frost penetration requirement in this area is 1.25 m of earth cover.
- 8) The fill material at the pile driving locations should be boulder free, the maximum aggregate size should not be over 75 mm.
- 9) The footings should be protected against scour. The scour depth will be determined by the Hydrology Section.
- 10) The approach fills should be constructed with 2:1 forward and side slopes.

cont'd..../2

For purposes of O.H.B.D. Code the following recommendations are also provided:

- a) HP310x110 steel 'H' piles driven in accordance with Standards SS103C-11 or SS103C-10;

Factored Capacity at U.L.S. 1600 kN
Capacity at S.L.S. Type II 900 kN

For 'H' piles at different size the capacities may be assumed to be directly proportional to the cross sectional area and calculated accordingly from the values given for HP310x110 piles.

- b) Earth pressures should be computed as per Section 6.6.1.2.2. of the O.H.B.D. Code.

A new metric foundation drawing will be issued for contract purposes after receipt by us of the final structure design drawings.

A revised foundation investigation report will also be prepared for contract purposes at the appropriate time (4 weeks prior to advertising). We believe, the proposed structure design can now proceed without any delay.

Should further information be required, please contact our Office.



P. Payer
Foundations Engineer

PP:ea

cc: J. Keen