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G.I.-30 SEPT. 1976

GEOCRES No. 31F-32

DIST. 9 REGION

W.P. No. 7-67-04

CONT. No.

W. O. No.

STR. SITE No. 29-195

HWY. No. 17N

LOCATION CPR (0.2 MILES EAST
OF SEC Hwy 653)

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ontario
Department of Transportation and Communications
~~DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS~~

MEMORANDUM

TO: Mr. T. C. Kingsland, (2)
Regional Bridge Planning Eng.,
Eastern Region,
Kingston, Ontario.

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

ATTENTION:

DATE: November 3, 1971.

OUR FILE REF.

IN REPLY TO **NOV 17 1971**

SUBJECT:

31F-32

FOUNDATION INVESTIGATION REPORT

For

The Proposed Structure at the
Crossing of Hwy. 17 'N' E.B.L. and
Canadian Pacific Railway Spur Line
Twp. of Ross - Co. of Renfrew
District No. 9 (Ottawa)
W.O. 71-11088 -- W.P. 7-67-04

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure 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
Attach.

cc: Messrs. B. R. Davis
A. Rutka
D. W. Farren
S. J. Markiewicz
J. E. Callaghan
B. J. Giroux
E. R. Saint
G. A. Wrong
B. A. Singh

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER.

Foundations Office ✓
Documents

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FOUNDATION INVESTIGATION REPORT

For

The Proposed Structure at the
Crossing of Hwy. 17 'N' E.B.L. and
Canadian Pacific Railway Spur Line
Twp. of Ross - Co. of Renfrew
District No. 9 (Ottawa)
W.O. 71-11083 -- W.P. 6-67-01

1. INTRODUCTION:

A request to carry out a foundation investigation at the above-mentioned site was contained in a memo dated August 17, 1971, from the Eastern Regional Bridge Section (Mr. T. C. Kingsland, Regional Bridge Planning Engineer). The site is located about 1 mile north of the Village of Haley Station.

At this location the C.P.R. tracks are on a very low embankment (1' high). The surrounding area is rolling with bedrock outcrops a few hundred ft. south-west of the site.

An investigation was subsequently carried out by this section to determine the subsoil conditions at the site of the proposed structure. Presented in this report are the results of our investigation, together with the recommendations pertaining to the foundations for the structure and the stability of the proposed approach embankments.

2. SUBSOIL CONDITIONS:

2.1) General:

Seven borings, each with an accompanying dynamic cone penetration test, were carried out during the field investigation. These borings revealed the subsoil conditions to be generally uniform over the site consisting of a surficial deposit of silty sand, followed by an extensive deposit of glacial till (heterogeneous mixture of clayey silt, sand & gravel) which in turn is underlain by sound crystalline dolomite bedrock.

The boundaries between the different deposits together with detailed descriptions of the material in the deposits are shown on the borelog sheets attached to this report. The estimated stratigraphical profile, shown on Drawing 71-11088A, is based on this information. From ground level downwards, the different soil types are described in detail as follows:

2.2) Silty Sand - Trace of Clay & Gravel:

This deposit was observed over the entire site beneath a thin layer of sandy top soil, except in B.H. #7 which was carried out at the bottom of the creek east of the proposed structure. This surficial deposit varies from 6 to 8 ft. in thickness and generally consists of a brown fine silty sand with traces of clay and gravel. Occasional pockets (up to 1" in size) of clayey silt were encountered within this stratum. Typical grain-size distribution curves for samples of the silty sand are plotted on Figure #1, included in the Appendix of this report.

Standard penetration resistance values, carried out within the deposit, gave 'N' values ranging from 4 to 29 blows per foot indicating a relative density of loose increasing to compact with depth.

2.3) Glacial Till (Heterogeneous Mixture of Clayey Silt, Sand and Gravel):

Underlying the surficial layer, and immediately beneath the creek bed, an extensive deposit of glacial till from 43 to 56 ft. thick was encountered.

2. SUBSOIL CONDITIONS: (cont'd) ...

2.3) Glacial Till (Heterogeneous Mixture of Clayey Silt, Sand and Gravel: (cont'd) ..

This material was generally composed of a heterogeneous mixture of clayey silt, sand and gravel; i.e., it is relatively cohesive in nature. Occasional boulders up to 11 inches in size were encountered throughout the deposit. In B.H.'s 2 & 5 a layer (12" thick) of sand and gravel was encountered in the upper 2 to 3 ft. of the deposit. In the lower portion of the stratum random zones were encountered in which the glacial till is basically granular in nature; in these areas the till is a heterogeneous mixture of silt, sand and gravel with traces of clay.

Grain-size distribution curves for samples of the overall deposit, are plotted on Figure 3 in the Appendix.

Atterberg limit tests were carried out on representative samples of the glacial till; these results indicate that the matrix of the till deposit is generally of low plasticity (Ref. to Figure 2).

The standard penetration resistance tests, carried out within the deposit, are plotted on the borelog sheets. These tests gave 'N' values ranging from 17 to greater than 100 blows per ft. indicating a consistency ranging from very stiff to hard, being generally hard. Within the lower granular zones the relative density is very dense.

2.4) Bedrock:

The glacial till stratum is underlain by bedrock which was proven in four of the boreholes by obtaining from 6 to 12 ft. of either AXT or BX size rock core. The bedrock was encountered at elevations ranging from 459 to 470, or some 65 to 49 feet below existing ground surface. The bedrock consists of white crystalline dolomite with dark bands of fine grained gneiss, and is sound as evidenced by the high percentage of core recovery.

2.5) Groundwater Conditions:

Groundwater elevations, observed in the open boreholes at the close of operations, were found to be between elevation 518 and elevation 521 (Ref. Borelog Sheets).

3. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a three-span structure (36'-40'-36') to carry the eastbound lane of proposed Hwy. 17 'New' over a spur line of the Canadian Pacific Railway. The profile grade of Hwy. 17 'N' will be about elevation 552, i.e. some 32 ft. above the natural ground level at the site and some 40' above the bottom of the creek located about 150 feet east of the C.P.R. crossing.

The proposed piers can be supported on spread footings located within the competent glacial till deposit, at or below elevation 513. In all cases, four feet of earth cover should be provided to the underside of the footings for frost protection purposes. An allowable bearing pressure of 3.0 t.s.f. may be used in footing design. The settlements induced by the footing pressure will be negligible. The footings will be located below the groundwater level recorded during the period of the investigation. Dewatering of the pier excavations should present no special problems due to the relatively impervious nature of the glacial till stratum. Any seepage from the upper silty sand stratum could be controlled by ordinary pumping methods. It is recommended that a working slab should be placed immediately after the completion of the pier footing excavations to prevent softening of the foundation subsoil by groundwater seepage or surface runoff.

The proposed abutments may be supported on spread footings placed within the approach fills. The fill material below the tops of the footings should consist of well compacted G.B.C. Class 'A' material and should extend for a horizontal distance of at least 10 ft. from the footing edges in the plane of the footing tops. This portion of the fill should be constructed with side slopes of 2:1. The remainder of the fill should be completed to above profile grade for a distance of about 50 feet behind the abutment before re-excavating for the abutment footings. A design load of 2.5 t.s.f. may be used for the abutment foundations.

3. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

Alternatively, the abutments may be supported on end bearing piles driven either to the bedrock surface or into the glacial till. The maximum allowable loads may be used in the design for the pile section chosen, e.g., a 14 BP 73 steel H pile may be designed for a safe load of 95 tons per pile. For estimating purposes the following tie elevations may be used for the respective abutment locations.

East Abutment - Elev. 470 (Bedrock)

West Abutment - Elev. 470-478 (Glacial Till)

During construction the pile driving within the glacial till stratum should be controlled by use of the Hiley Formula as per current Departmental Standards. No bouldery fill material should be placed in areas where piles are to be driven.

If a scheme consisting of spread footings for both the piers and the abutments is adopted the differential settlements between the piers and abutments should be of the order of 1". If the alternate scheme is chosen, the differential settlements between the piers on spread footings and the abutments on end bearing piles should not exceed 1/2".

No stability problems are anticipated for the approach fills provided standard slopes of 2:1 are used.

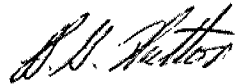
4. MISCELLANEOUS:

The field work was carried out during the period of Sept. 29 to Oct. 18, 1971, under the supervision of Mr. R. Davis, (Technician from Golder Associates) and Mr. W. G. Hutton, Project Foundation Engineer, who also prepared this report.

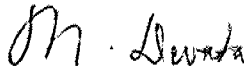
The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

4. MISCELLANEOUS: (cont'd) ...

The equipment used was owned and operated by Johnston Drilling Co. Ltd.



W. G. Hutton, P. Eng.



M. Devata, P. Eng.

WGH/ao
November 4, 1971.

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11088

LOCATION Sta. 593 + 97 22' Rt.

ORIGINATED BY RBD

W.P. 7-67-04

BORING DATE Sept. 29, 1971

COMPILED BY ED

DATUM Geodetic

BOREHOLE TYPE Diamond Drill Washboring

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					PLASTIC LIMIT — w_p				
							20	40	60	80	100	WATER CONTENT — w				
SHEAR STRENGTH P.S.F.												WATER CONTENT %				
○ UNCONFINED + FIELD VANE												w_p — w — w_L				
● QUICK TRIAXIAL x LAB. VANE												10 20 30				
523.4	Ground Level		1	SS	7											
	Sandy silt, trace of clay.		2	SS	9	520									521.3	
	Loose to compact.		3	SS	22										0 39 52 9	
515.4	Brown		4	SS	17											
8.0	Glacial Till		5A	RC	30%										11 43 36 10	
	Het. mix. of clayey		5	SS	19	5100										
	silt, sand & gravel		6	SS	33											
			7A	RC	50%											
			7	SS	37										3 50 36 11	
	Boulders up to 11" in size throughout		8	SS	12	500										
			9	SS	98											
	Very Stiff to Hard		10A	RC	28%	490										
			10	SS	75										3 45 41 11	
			11	SS	50											
	Grey		12	SS	41 1/3"	480										
			13	SS	70 5/8"	470										
			14	SS	96 7/8"											
			15	SS	90 5/8"											
458.7						460										
64.7	Bedrock		16	RC	75%											
	Crystalline dolomite with bands of gneiss															
	Sound		17	RC	100%	450										
448.8	White with dark bands															
74.6	End of Borehole															

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-11088

LOCATION Sta. 594 + 38 22' Rt.

ORIGINATED BY WH

W.P. 7-67-04

BORING DATE Oct. 12, 1971

COMPILED BY ED

DATUM Geodetic

BOREHOLE TYPE Diamond Drill Washboring

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		BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
524.1	Ground Level															
516.2	Silty sand, trace of clay & gravel. Loose to Compact. Brown		1	SS	8	520										521. 6 47 34 13 2 49 35 14
			2	SS	7											
			3	SS	23											
7.9	Sand and gravel Glacial Till Het. mix. of clayey silt, sand & gravel. Very Stiff to Hard Grey		4	SS	68	510										
			5	SS	26											
			6	SS	51											
			7	SS	39											
			8	SS	44											
493.8			9	SS	100/1.1"											
30.3	End of Borehole					490										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11088

LOCATION Sta. 594 + 45 22' Lt.

ORIGINATED BY RBD

W.P. 7-67-04

BORING DATE Oct. 12, 1971

COMPILED BY ED

DATUM Geodetic

BOREHOLE TYPE Diamond Drill Washboring

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		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	P.S.F.					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					w_p ——— w ——— w_L					
520.7	Ground Level																
514.7 6.0	Silty sand, some gravel, trace of clay. Loose to Compact. Brown		1	SS	8	520									GR SA SI CL 520.2 16 56 21 4 <		

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 71-11088

LOCATION Sta. 594 + 78 22' Rt.

ORIGINATED BY WH

W.P. 7-67-01

BORING DATE Oct. 12, 1971

COMPILED BY ED

DATUM Geodetic

BOREHOLE TYPE Diamond Drill Washboring

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		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					
521.3	Ground Level																
0.0	Silty sand, trace of clay. Loose to Compact. Brown		1	SS	9	520									517.9		
514.3			2	SS	17												
7.0	Glacial Till		3	SS	38	510									8 42 40 10		
	Het. mix. of clayey silt, sand & gravel.		4	SS	69												
			5	SS	38										4 48 33 15		
			6	SS	48	500											
	Hard		7	SS	87												
			8	SS	127	490											
	Grey		9	SS	83												
			10	SS	43	480									1 52 37 10		
			11	SS	88												
469.6			12	SS	129	470											
51.7	Bedrock Crystalline dolomite with bands of gneiss Sound.		13	RC	97%												
			14	RC	77%												
457.6	White with dark bands		15	RC	65%	460											
63.7	End of Borehole					450											

FOUNDATION SECTION

CHECKED BY

20
15 — 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 71-11088 LOCATION Sta. 595 + 16 22' Lt.

ORIGINATED BY WH

W.P. 7-67-04 BORING DATE Oct. 14, 1971

COMPILED BY ED

DATUM Geodetic BOREHOLE TYPE Diamond Drill Washboring

CHECKED BY

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				
519.2	Ground Level															
0.0	Silty sand, trace of gravel & clay.		1	SS	9											
513.2	Loose to Compact. Brown.		2	SS	15											
5.0	Glacial Till		3	SS	14											
			4A	RC	33											
			4	SS	50											
	Het. mix. of clayey silt sand and gravel.		5	SS	37											
			6	SS	33											
			7	SS	58											
	Hard		8	SS	60											
			9	SS	45											
	Grey		10	SS	43											
			11	SS	96											
			12	SS	137											
470.2	Bedrock		13	AXT	98%											
49.0	Crystalline dolomite with bands of gneiss		14	AXT	100%											
464.0	Sound White															
55.2	End of Borehole															

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 71-11088

LOCATION Sta. 596 + 08 Ø

ORIGINATED BY WE

W.P. 7-67-04

BORING DATE Oct. 14, 1971

COMPILED BY ED

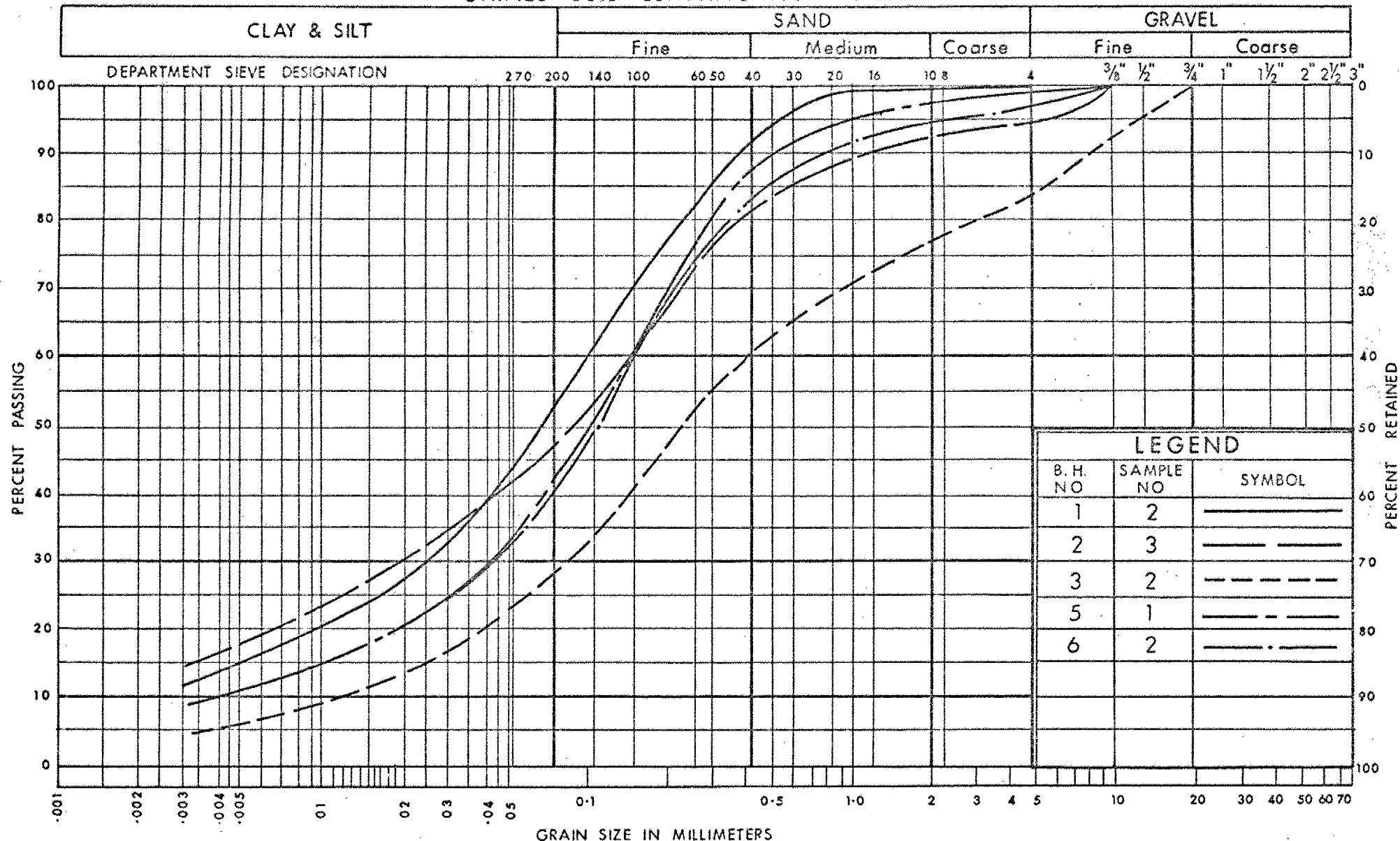
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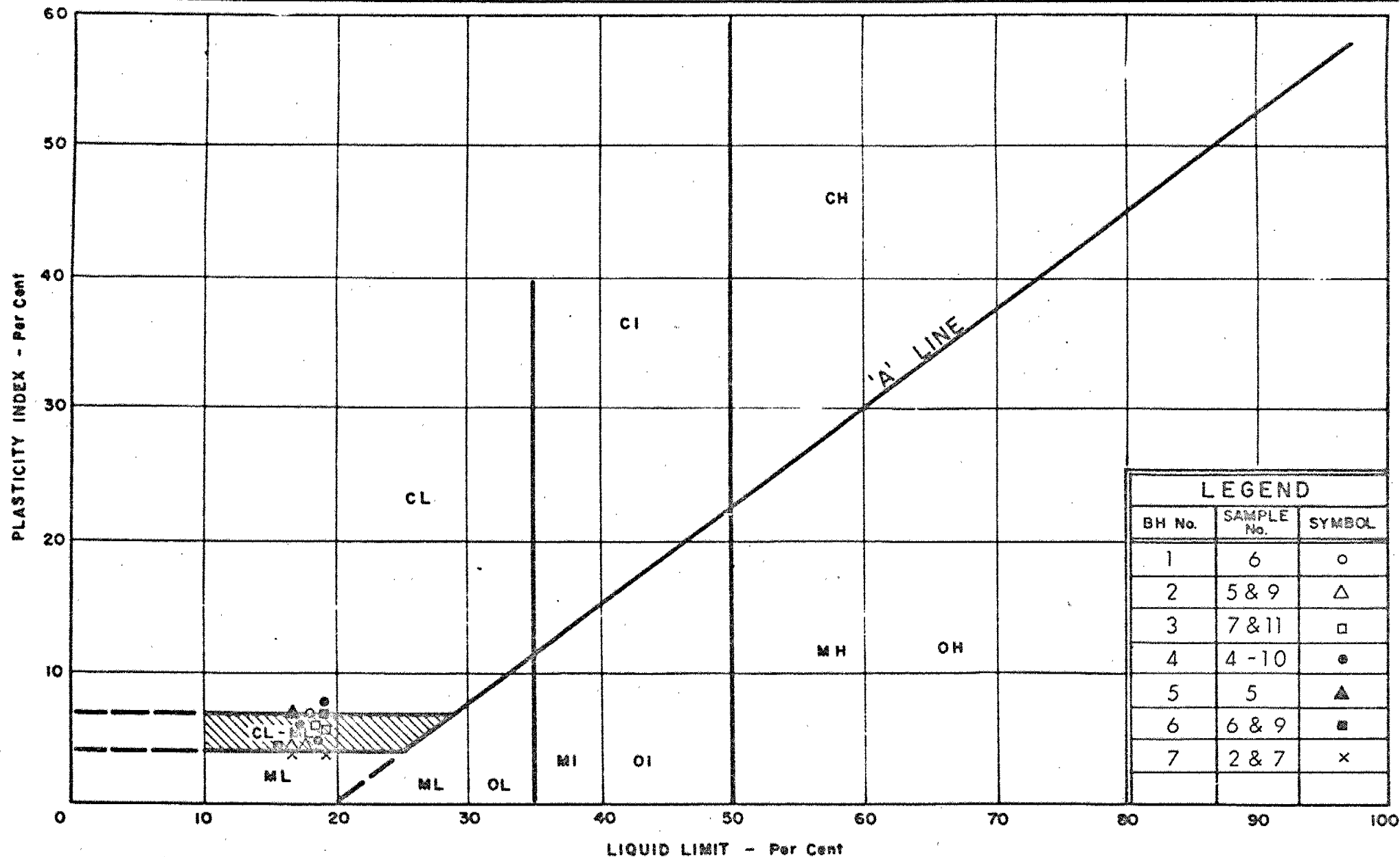
BOREHOLE TYPE Diamond Drill Washboring

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. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100					WATER CONTENT % 10 20 30				
510.8	Water Level Ground Level														
	Glacial Till	1	SS	11	510										3 49 38 10
	Het. mix. of clayey silt sand and gravel	2	SS	22											
		3	SS	23											
		4	SS	53	500										
		5	SS	37											
	Stiff to Hard	6	SS	43											
499.3	Grey	7	SS	45	490										15 44 32 9
21.5	End of Borehole														

UNIFIED SOIL CLASSIFICATION SYSTEM





DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

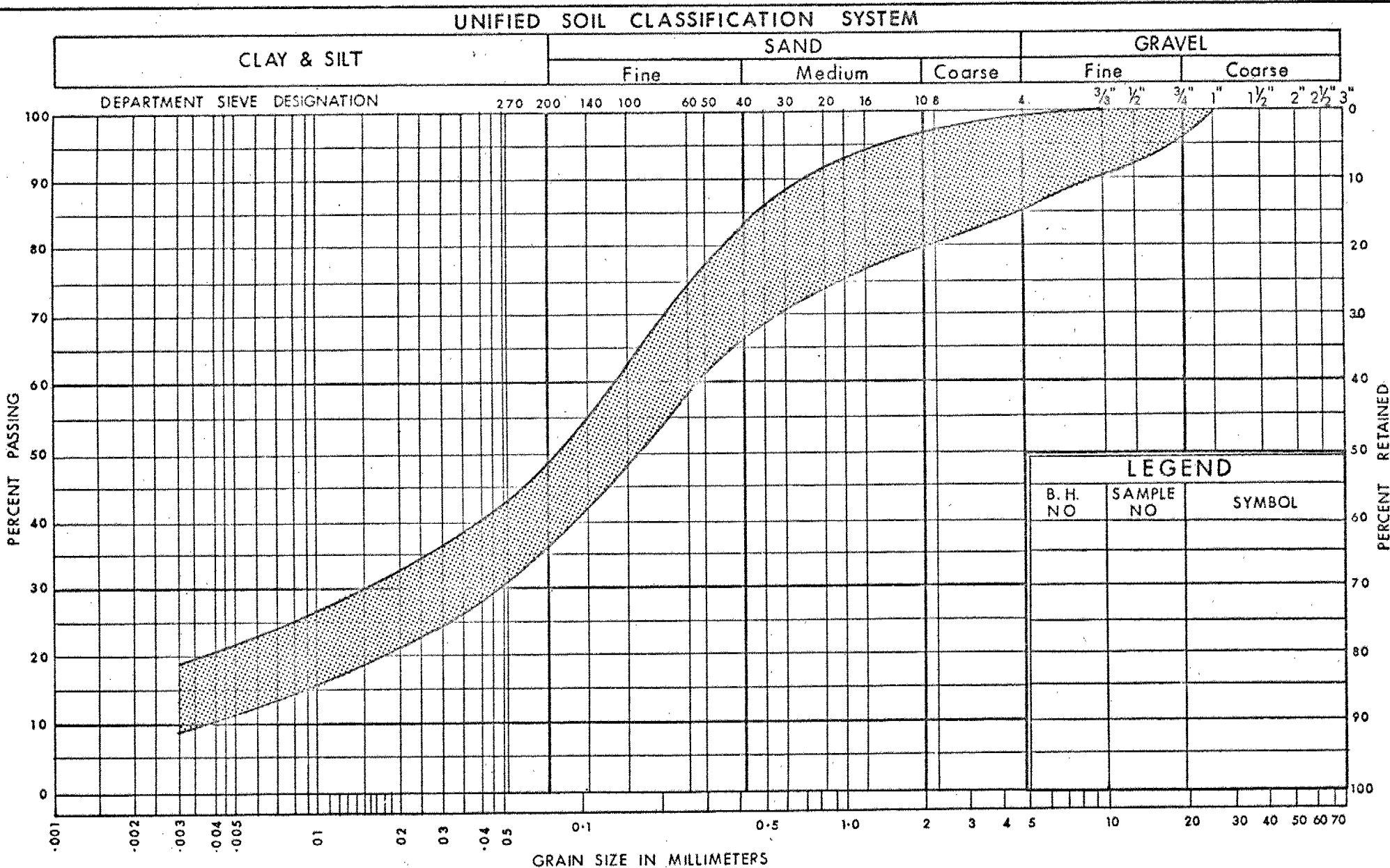
PLASTICITY CHART GLACIAL TILL

HET. MIXTURE OF CLAYEY SILT, SAND & GRAVEL

W.P. No. 6 - 67 - 04

JOB No. 71-11088

FIG. 2



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION GLACIAL TILL

HET. MIXTURE OF CLAYEY SILT, SAND & GRAVEL

W.P. No. 6 - 67 - 04

JOB No. 71 - 11088

FIG. 3

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:-

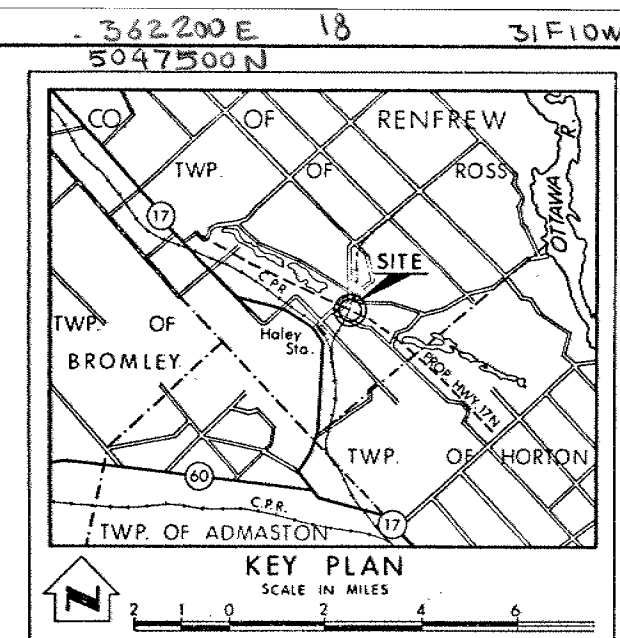
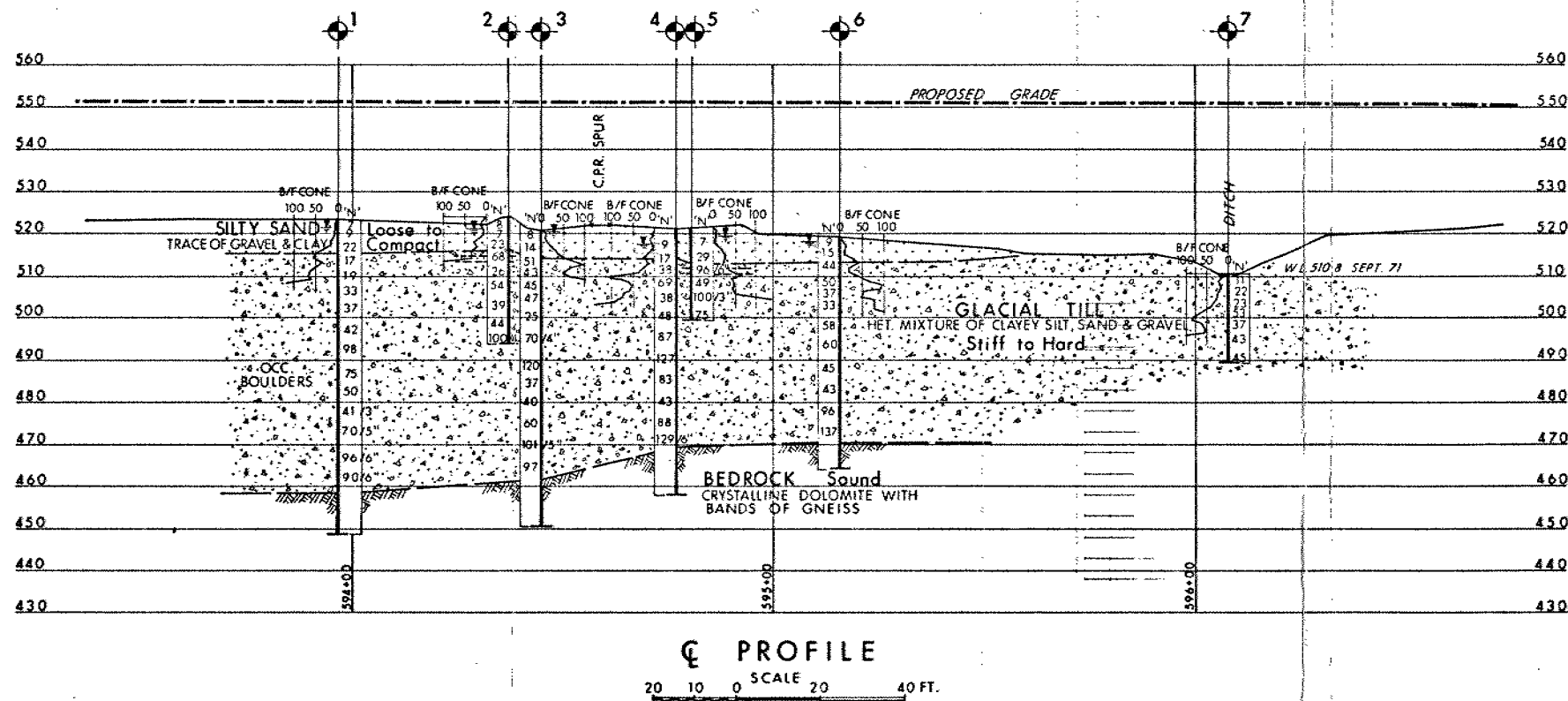
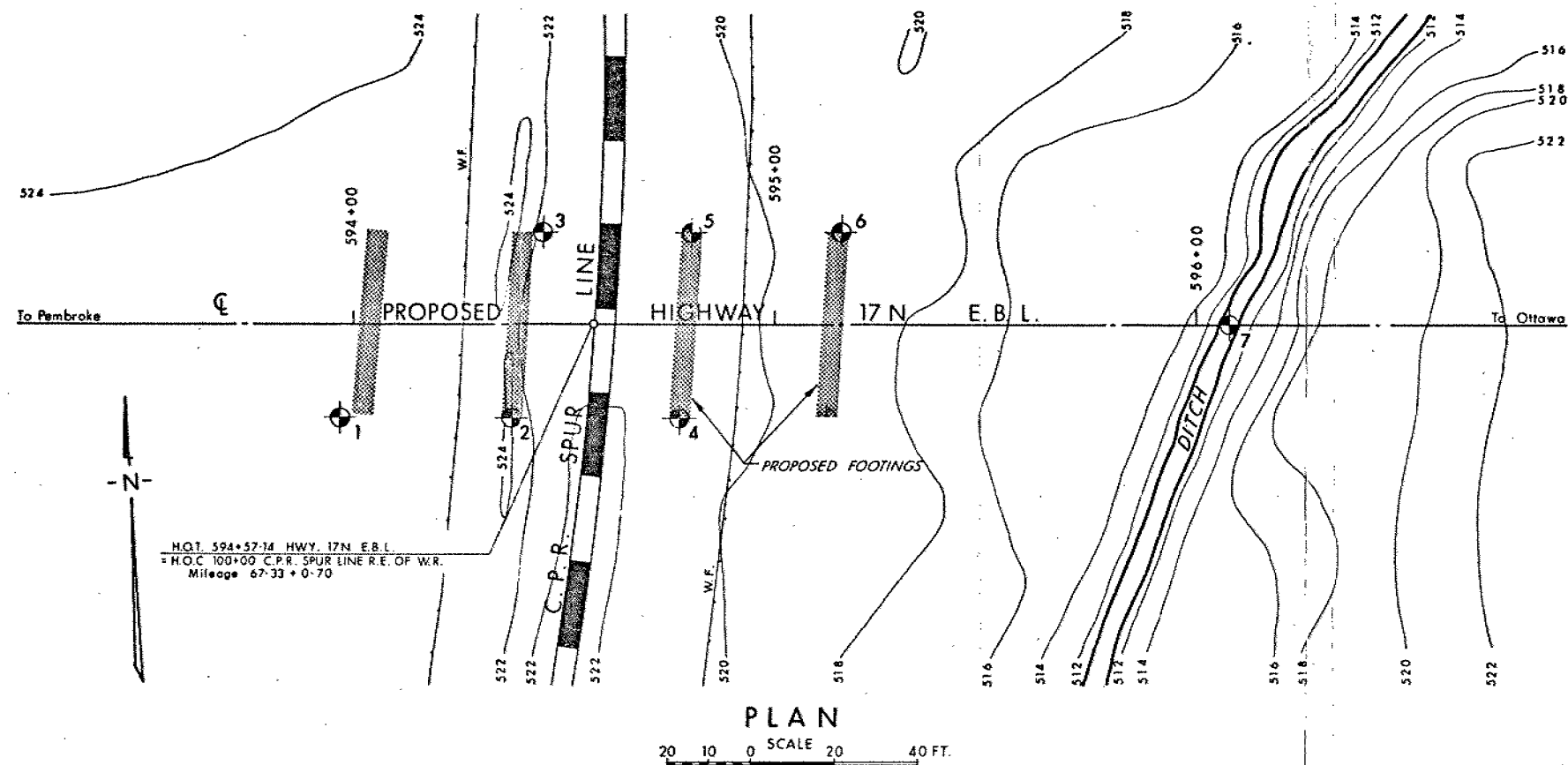
<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 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, SEPT. 1971		

NO.	ELEVATION	STATION	OFFSET
1	523.4	593+97	22' RT.
2	524.1	594+38	22' RT.
3	520.7	594+45	22' LT.
4	521.3	594+78	22' RT.
5	520.8	594+80	22' LT.
6	519.2	595+16	22' LT.
7	510.8	596+08	CL

— 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

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH - FOUNDATION OFFICE

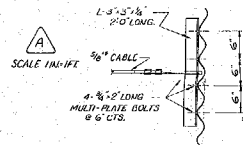
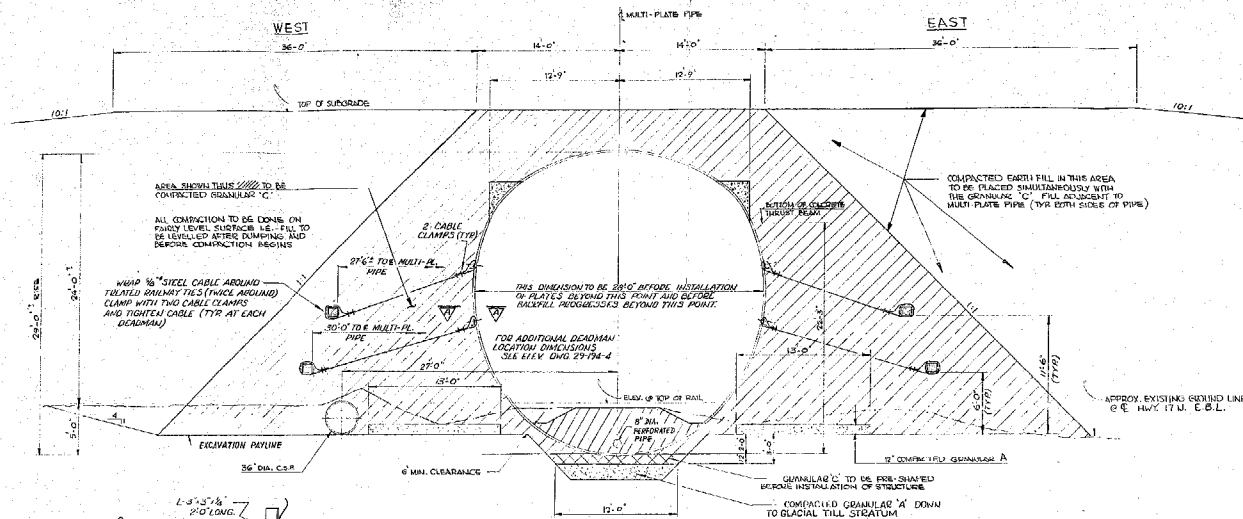
C.P.R. SPUR LINE

HIGHWAY NO. 17N E.B.L. DIST. NO. 9
CO. RENFREW
TWP. ROSS LOT 23 CON. 3

BORE HOLE LOCATIONS & SOIL STRATA

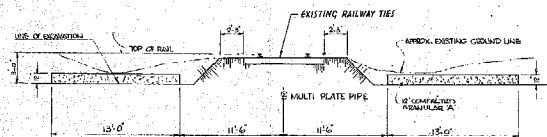
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DRAWN S.O. CHECKED <input checked="" type="checkbox"/>	JOB NO. <u>71-11088</u>	BRIDGE DRAWING NO. <u> </u>
DATE <u>NOV. 1, 1971</u>	SITE NO. <u> </u>	
APPROVED <u> </u>	CONT. NO. <u> </u>	

PRINCIPAL FOUNDATION ENGINEER



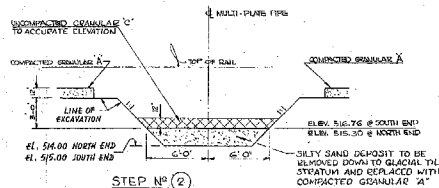
STRUCTURE BACKFILL DETAILS
SCALE: 3/16\"/>

FOUNDATION PREPARATION



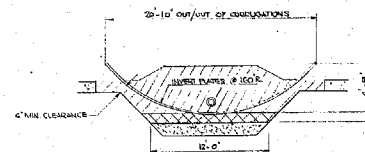
STEP N° 1

- EXCAVATE SITE TO PROFILES SHOWN ABOVE.
- INSTALL 12\"/>



STEP N° 2

- REMOVE RAILWAY TRACK (BY OTHERS)
- REMOVE EXISTING RAILWAY BALLAST AND EXCAVATE TRENCH AND TIE IN SLOPES
- REMOVE LOOSE SOIL FROM TRENCH AND PLACE COMPACTED GRANULAR 'A' UP TO INDICATED ELEVATIONS
- PLACE 12\"/>



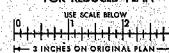
STEP N° 3

- SHAPE CUSHION INVERSE TO SUIT INVERT PLATES
- INSTALL INVERT PLATES FOR STRUCTURE AND OTHER DRAINAGE DRAINAGE
- SEAL CUSHION WITH 1/4\"/>



NOTE:
CERTAIN ASPECTS OF THIS DESIGN
ARE PATENTED BY ARMCO
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ARMCO IS A TRADEMARK OF THE
ARMCO COMPANY

FOR REDUCED PLAN



INSTALLATION INSTRUCTIONS

ERECTION OF STRUCTURE

- THE STRUCTURAL STEEL PLATE SHALL BE ASSEMBLED IN ACCORDANCE WITH ARMCO'S STANDARD PROCEDURES AND WITH THE FOLLOWING ADDITIONAL REQUIREMENTS.
- PLATE ARRANGEMENT TO BE IN ACCORDANCE WITH THE ARMCO ERECTION DRAWING.
- ALL BOLTS TO BE 3/4\"/>

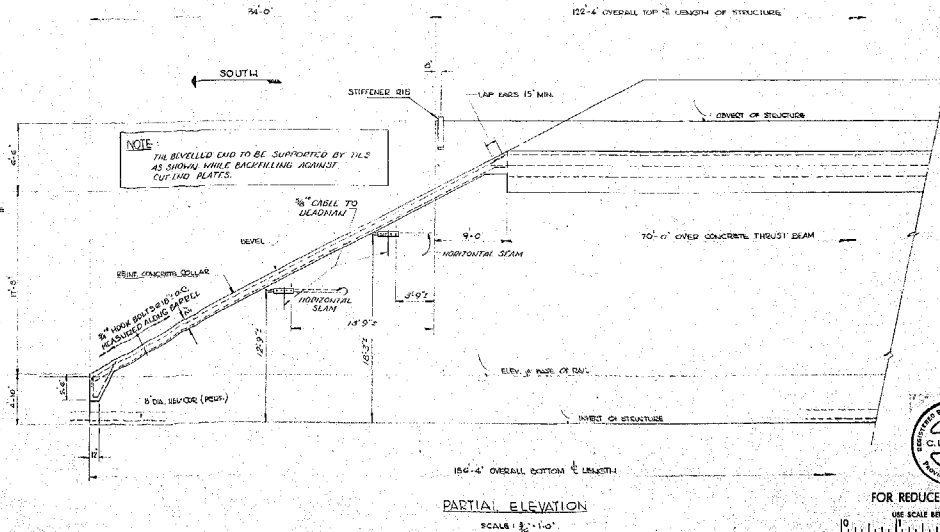
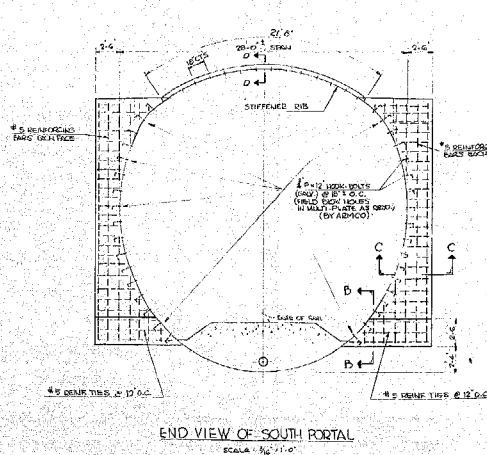
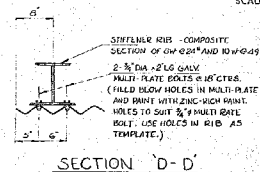
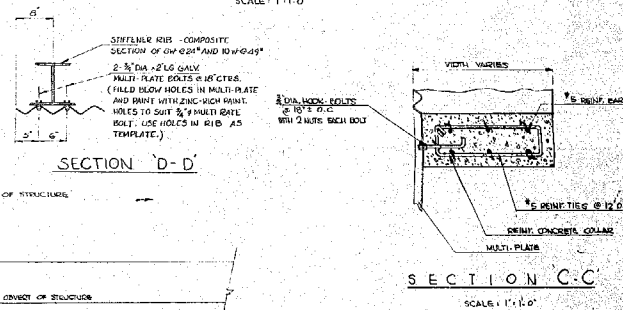
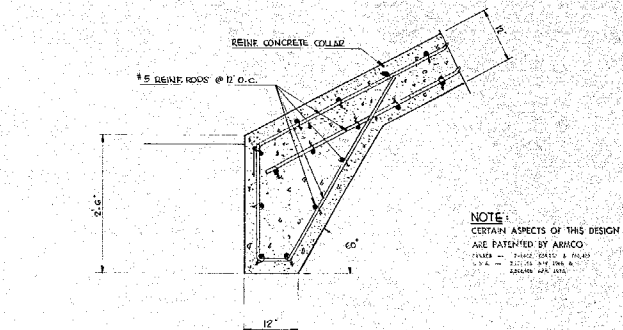
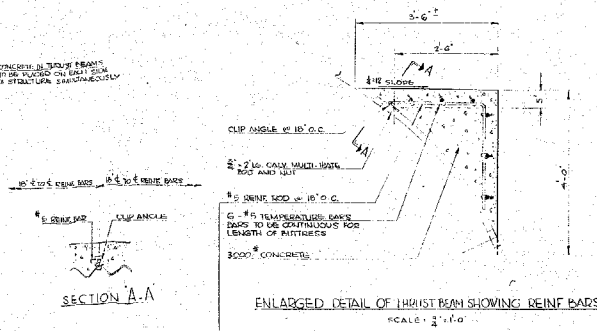
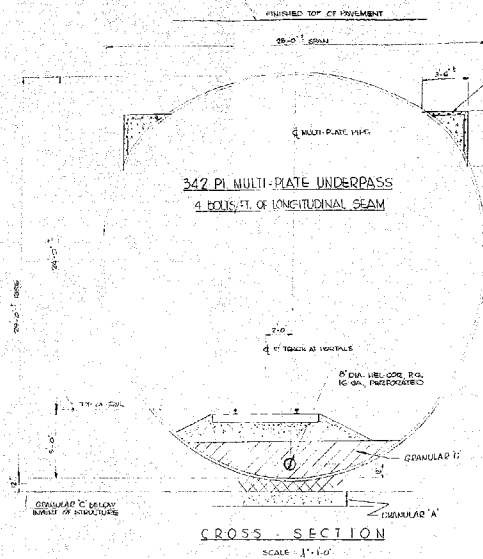
BACKFILLING

- THE BED UNDER THE PIPE SHALL CONSIST OF A MINIMUM 12\"/>

W 0 71-11088

DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS ONTARIO			
ARMCO CANADA LTD.			
CANADIAN PACIFIC RAILWAY OVERHEAD 0.2 MI. EAST OF SECONDARY HWY. 653			
KING'S HIGHWAY No. 17 N.E.B.L.		DIST. No. 9	
CO. BENTON		TYP. NO. 208	
DATE: 09-19-95		COM. 111	
ERECTION AND BACKFILL DETAILS			
APPROVED:	DESIGN:	CHECK:	DATE:
C.L. FISHER	C.L. FISHER	C.L. FISHER	09-19-95
DRAWING: 208	CHECK: 208	CHECK: 208	DATE: 09-19-95

[illegible]

REVISIONS			
	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS			
ONTARIO			
ARMCO CANADA LTD.			
CANADIAN PACIFIC RAILWAY OVERHEAD			
0.2 MI EAST OF SECONDARY HWY. 653			
KING'S HIGHWAY No. 17 N.E.B.L.		DIST. No. 9	
CO. REHEARSE		JOB No.	
TWP. ROSS	LOT 23	CON. III	
CONCRETE THRUST BEAM AND COLLAR DETAILS			
APPROVED <i>[Signature]</i>		SHEET No. 97-199	S.P. No. 7-107
DESIGNED BY <i>[Signature]</i>		CONTRACT	
BRUSH	CHECKED		
SEAWING	CHECKED		
DATE OCT/78	ISSUED	DRAWING No.	29-195-4

VISUAL CLASSIFICATION SHEET

PROJECT 71-11085 SITE Hwy 17'N' - C.D.R. BOREHOLE No. 128 GROUND ELEVATION _____

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	0.0 2.0														organic silt	
4	3.8 5.3														clayey silt, seams of silty sand	
8	15.0 17.0														glacial till, 1st. mix. of silty sand, trace of clay	
9	18.0 20.0														till, ditto	
10	20.0 22.0														ditto	
11	24.0 26.0														ditto	
12	27.5 29.0														ditto	
13	29.5 31.0														ditto	
17	32.0 34.0														silty sand, trace of gra	

NOTES:— VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:—

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING OFFICE
VISUAL CLASSIFICATION SHEET

PROJECT 71-11085 SITE Hwy 17N - C.P.R. BOREHOLE No. S GROUND ELEVATION _____

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	31.0 32.1														fill, heterogen. mix. of sil. sand & gra. trace of clay	
2	35.0 36.2														silty	
3	40.0 40.5														fine sand, silty & gravelly	
4	45.0 46.5														" no marble	

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING OFFICE
VISUAL CLASSIFICATION SHEET

PROJECT 71-11085 SITE Howy 17N - C.P.R. BOREHOLE No. BV GROUND ELEVATION _____

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION			DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE										
				GRAVEL SAND SILT & CLAY										
1	0.0 2.0									brown			clayey silt, some sand	Cl
2	3.0 4.5									grey			layered clayey silt, thin layers of silt & sand	Cl
3	6.0 7.5									grey			clayey silt, thin layers of sa. silt	Cl
4	12.0 13.5									grey			sands, trace of gravel	
5	15.0 16.5												fine sand, some gravel	
6	20.0 21.5												glacial till, bot. part of si, sa + gra. trace of clay	
7	25.0 26.5												ditto	
8	30.0 31.5												ditto	
9	41.9 42.5												pieces of gra	

NOTES:- VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING OFFICE
VISUAL CLASSIFICATION SHEET

PROJECT <u>71-11085</u>		SITE <u>Hwy 17N - C.P.R.</u>		BOREHOLE No. <u>86</u>		GROUND ELEVATION _____											
SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL	
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE													
				GRAVEL	SAND	SILT & CLAY											
13	45.0 46.5																
14	50.1 50.9																

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING OFFICE
VISUAL CLASSIFICATION SHEET

PROJECT 71-11085 SITE Highway 17N - C.D.R. BOREHOLE No. 5 GROUND ELEVATION _____

SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION			DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE										
		GRAVEL	SAND	SILT & CLAY										
1	0.0 2.0								Organic	Black			Organic silt & peat	
2	3.7 5.2						None		Earthy	Grey			silty clayey silt with layers of sandy silt up to 1/4" thick	CL
3	6.0 7.5						"		"	"			clayey silt with " " "	CL
4	9.0 10.5												layered silty sand & silty clay. layers up to 3/4" thick	
5	12.0 13.5												layered silty clay, silt & silty sand - thin layers	
6	15.0 17.0									Grey			sand; some gravel	
7	20.0 22.0									dark grey			fill heterogeneous mix of silt, sa. & gra. trace of cla	
8	25.0 26.5												Sand wash, some gravel	
9	30.0 30.6													

NOTES:- VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. A. G. Stermac,
Principal Foundation Engineer,
Downsview, Ontario.

FROM: Bridge Section,
Kingston, Ontario.

ATTENTION: Mr. M. Devata

DATE: August 10, 1971.

OUR FILE REF

IN REPLY TO

SUBJECT: W.P. 6-67-02, Site 29-192, Bonnechere River Bridge 71-11084
→ W.P. 7-67-03, Site 29-194, C.P.R. Overhead 71-11-085
Highway 17N, Renfrew By-pass, District 9 - Ottawa

Enclosed please find two partial prints each of Plan 9-FP-174 and Profile 9-FP-175 on which we have marked the proposed locations of the above structures.

We have tied in the stations for piers and abutments with the line as run in the field and shown the corrected stations in blue. These stations may have to be adjusted slightly when site plans for these structures become available.

As field survey parties have not reached the site of W.P. 7-67-04, Site 29-195, C.P.R. Overhead east of Highway 653, we were not able at this time to tie in the run line stations to the ones shown on the plans available. Railway requirements for W.P. 7-67-02, Site 29-193, C.N.R. Overhead, are not available at this time. Plans and profiles for these structures will be forwarded to you when the required information is received.

We will be pleased if you will make arrangements for the necessary foundation investigation for W.P. 6-67-02, Bonnechere River Bridge, and W.P. 7-67-03, C.P.R. Overhead, and to have your report, the scheduled date for which is September 8, 1971.



For: A. Van Dalen
T. O. Kingsland
Regional Bridge Planning Engineer

AV/h1

Encls.

c.c.

Mr. R. Forrest

Mr. S. McCombie

MEMORANDUM

TO: Mr. T. C. Kingsland (2)
Regional Bridge Planning Eng.
Eastern Region
Kingston, Ontario

FROM: Foundations Office
Design Services Branch
Downsview, Ontario

ATTENTION:

DATE: December 8, 1971

OUR FILE REF.

IN REPLY TO

Dec 17/71

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Overhead Structure at the
Crossing of Proposed Hwy. 17 'New' (WBL)
And Canadian Pacific Railway
Twp. of Horton - Co. of Renfrew
District No. 9 (Ottawa)
W.O. 71-11085 -- W.P. ~~5-67-01~~
7-67-03

31F-321

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure 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
Attach.

cc: Messrs. D. W. Farren
B. R. Davis
A. Rutka
S. J. Markiewicz
J. E. Callaghan
B. J. Giroux
E. R. Saint
G. A. Wrong
B. A. Singh

Foundation Files
Documents

A. G. Stermac
A. G. Stermac,
Principal Foundation Engineer

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1. INTRODUCTION.
 2. DESCRIPTION OF THE SITE AND GEOLOGY.
 3. FIELD AND LABORATORY WORK.
 4. SUBSOIL AND BEDROCK CONDITIONS.
 - 4.1) General.
 - 4.2) Surficial Deposits.
 - 4.3) Clayey Silt.
 - 4.4) Heterogeneous Mixture of Silt, Sand and Gravel, Trace of Clay (Glacial Till).
 - 4.5) Crystalline Dolomite Bedrock.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS.
 - 6.1) General.
 - 6.2) Approach Embankments.
 - 6.3) Structure Foundations.
 7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT
For
The Overhead Structure at the
Crossing of Proposed Hwy. 17 'New' (W.B.L.)
And Canadian Pacific Railway
Twp. of Horton - Co. of Renfrew
District No. 9 (Ottawa)
W.O. 71-11085 -- W.P. 5-67-01

1. INTRODUCTION:

The Foundation Office was requested to carry out a subsurface investigation at the site of the proposed overhead structure at the crossing of Hwy. #17 'N' (W.B.L.) and the C.P.R. at Lot 7, Con. 4, Township of Horton, County of Renfrew. The request was contained in a memo from Mr. T. C. Kingsland, Regional Bridge Planning Engineer, Eastern Region, dated August 10, 1971. An investigation was subsequently carried out by this Office to determine the subsoil, bedrock and ground-water conditions at this site.

This report contains the factual results obtained from the investigation, together with recommendations pertaining to the foundations of the proposed structure as well as the stability and settlement considerations associated with the approach fills.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about 3 miles west of the Town of Renfrew. At the location of the site the C.P.R. track is raised on an embankment about 4 ft. above the surrounding ground. The terrain in this area is flat and low lying with poor drainage. South of the track the area is swampy and was covered by

3 to 6 inches of water at the time of the field investigation. The surrounding land is cultivated and being used for farming purposes.

This area is situated in the physiographic region known as the 'Ottawa-Valley Clay Plains'. In this region clay deposits are interrupted by ridges of rock and sand. The sensitive marine clay, which was deposited in the geologic past in the Champlain Sea, varies in thickness over the region. The clay is underlain by glacial till.

The overburden deposits are underlain by Precambrian rock.

3. FIELD AND LABORATORY WORK:

Eight sampled boreholes, seven of which were accompanied by a dynamic cone penetration test, were put down at this site using conventional diamond drill rigs adapted for soil sampling purposes.

Samples of the cohesive stratum, as well as the glacial till deposit were obtained, at specified intervals, in a 2-inch O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. In the softer portions of the cohesive stratum the testing programme was supplemented by taking 2-inch I.D. Shelby tubes, which were manually pushed into the soil. In addition, field vanes were carried out, where possible, to determine the undrained shear strength of the clay stratum. Bedrock was proven in 6 of the boreholes by obtaining BX size rock core samples.

Groundwater level observations were carried out, during the period of the investigation, in the open boreholes.

The soil, bedrock and groundwater conditions, encountered at the boring locations, are presented on the Record of Borelog sheets appended to this report. The location and elevation of

the various boreholes were provided by personnel from the Eastern Region Engineering Surveys Section. The elevations in this report are referenced to a Geodetic datum. The boring locations and elevations are shown on Drawing No. W.O. 71-11085A.

All the samples were subjected to a careful visual examination in the field, and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following engineering properties of the overburden:

- Bulk Density
- Natural Moisture Content
- Atterberg Limits
- Grain-Size Distribution
- Undrained Shear Strength
- Consolidation Characteristics

The results of this testing are plotted on the Record of Borelog sheets and summarized on Figures No. 1 to 5, inclusive, all contained in the Appendix of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

Subsoil over the site consists of surficial deposits of sandy topsoil and organic silt up to 2 ft. thick, followed by a cohesive stratum composed of a very stiff to firm grey clayey silt. The thickness of this stratum varies from 10 to 14 feet. The cohesive subsoil is underlain by a 26 to 40 feet thick compact to very dense glacial till deposit, consisting of a heterogeneous mixture of silt, sand and gravel, trace of clay. The glacial till is, in turn, underlain by crystalline dolomite bedrock.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying borehole sheets. The stratigraphical section, shown on Drawing No. W.O. 71-11085A, has been inferred from this data.

From ground surface downward, the various soil types encountered, are as follows:

4.2) Surficial Deposits:

The surficial deposit across the site consists of a 6 inch to a 2 foot thick deposit of loose sandy topsoil intermixed with organic silt. In the swampy area, south of the tracks, this deposit also contains organic material and peat.

4.3) Clayey Silt:

Directly beneath the surficial deposit is a cohesive stratum, composed of a grey clayey silt with silty sand seams throughout. The overall thickness of the cohesive soil varies from 10 to 14 feet. Generally the silty sand seams increase in thickness with depth, ranging from very thin partings in the upper portion of the deposit to distinct seams up to 3 inches thick below elevation 420. In the lower 2 to 3 ft. of the stratum, just above the underlying glacial till deposit, there is a transitional zone with alternate layers of silty sand, sand and clayey silt; the individual layers are up to 3 inches thick. Grain-size distribution curves for samples of the cohesive subsoil are shown on Figure #2, located in Appendix 1 of the report.

The properties of the stratum, as determined by field and laboratory testing, are presented in tabular form below:

Identity Tests

		<u>Range</u>	<u>Average</u>
Bulk Density (p.c.f.)	(γ)	117 - 133	126
Liquid Limit (%)	(W_L)	20 - 32	25
Plastic Limit (%)	(W_P)	14 - 18	16
Natural Moisture Content (%)	(W)	19 - 37	24

Consolidation Characteristics

Initial Void Ratio	(e_0)	0.6 to 1.0
Compression Index	(C_c)	0.21 to 0.69
Degree of Preconsolidation (t.s.f.)	($P_c - P'_0$)	2.3 to 3.6

<u>Undrained Shear Strength</u> (p.s.f.)	(C _u)	<u>Range</u>	<u>Average</u>
1) Field Tests		1,280 - >2,000	
2) Lab Tests		500 - >2,000	
<u>Standard Penetration</u> <u>Resistance Testing</u> (Blows/ft.)		2 - 27	

The Atterberg limit tests are also plotted on the Plasticity Chart, Figure #1. These results indicate that the cohesive subsoil is essentially inorganic with a plasticity in the low range. The natural water content is at or slightly above the liquid limit.

The results of the undrained shear strength testing carried out indicates that the consistency of the deposit varies from firm to very stiff.

The consolidation characteristics of the stratum were determined by carrying out two laboratory tests, the results of which are shown as Void Ratio vs. Pressure plots on Figure #5. The results of these tests indicate that the clay stratum is preconsolidated by about 2.3 to 3.6 t.s.f. in excess of existing overburden pressure.

4.4) Heterogeneous Mixture of Silt, Sand and Gravel, Trace of Clay (Glacial Till):

The clayey silt stratum is underlain by a non-cohesive glacial till deposit composed of a heterogeneous mixture of silt, sand and gravel with a trace of clay. The overall thickness of this deposit ranges from 26 to 40 feet. In certain borings (B.H. #1, 3, 5, 6 and 8), the upper 4 to 6 ft. of the glacial till consists of a layer of silty sand with some gravel. Occasional boulders up to 12 inches in size were encountered throughout the deposit. The boulders became more numerous with depth. Grain-size distribution curves for samples of the glacial till, as well as the upper silty sand layer, are plotted on Figure #4. Atterberg

limit tests were attempted on the more cohesive portions of the glacial till. These tests, which are plotted on Figure #3 indicate a low plasticity.

The Standard Penetration Tests, carried out within the glacial till deposit, are plotted on the Record of Borelog sheets. This testing gave 'N' values which ranged from 16 to 36 blows/ft. in the upper silty sand zone, and from 5 to greater than 100 blows/ft. in the remaining portion of the glacial till deposit. Based on these values it is estimated that the relative density of the upper 'silty sand' zone varies from compact to dense and the remainder ranges from loose to very dense.

4.5) Crystalline Dolomite Bedrock:

The glacial till is directly underlain by bedrock which was proven in 6 of the boreholes by obtaining 12 to 25 ft. of either BX or AXT size rock core samples. Over the site the bedrock surface was found to vary between elevations 376 and 385, which corresponds to depths below ground surface of from 52 to 40 feet, respectively.

The bedrock is composed of a crystalline dolomite. Generally the upper 7 to 18 feet of the bedrock is in a fractured condition. Occasional vertical seams were encountered within this upper fractured zone, and in some cases the bedrock was highly weathered along these seams. In B.H.#2 a cavity, some 4 ft. thick, was encountered within the bedrock. This cavity was filled with a deposit of silty sand with occasional layers of clayey silt up to 1 inch thick. Below this fractured zone the bedrock is in a sound condition as evidenced by the high percentage of core recovery.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out, during the period of the investigation, in the open boreholes. The observations are presented on the individual borelog sheets as well as on Drawing No. W.O. 71-11085A. The results indicate

that the water level, across the site, varies between elevations 424 and 426. These water levels correspond to depths below ground surface of from 0.5 to 1.5 feet.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a 44 ft. wide three-span (71'-60'-62') overhead structure at the crossing of the C.P.R. and Hwy. 17 'N' (W.B.L.). It is understood that the profile grade of Hwy. #17 'N' (W.B.L.), in the vicinity of the crossing, will be about elevation 459. The profile grade of the C.P.R. track is about elevation 430. It is proposed to extend the C.P.R. embankment about 20 ft. to the west to provide room for a second track. The associated approach fills will, therefore, have a maximum height of the order of 29 ft. in the longitudinal direction and 33 ft., above the existing ground surface, in the transverse direction.

The subsoil across the site is composed of a thin surficial organic deposit followed by a very stiff to firm grey clayey silt, which varies from 10 to 14 ft. in thickness. The cohesive stratum is underlain by a 26 to 40 feet thick generally non-cohesive glacial till deposit, which, in turn, is underlain by crystalline dolomite bedrock.

6.2) Approach Embankments:

No stability problems are anticipated for the height of fills contemplated, provided 1) standard 2:1 slopes are employed and ii) all organic silt and peat is sub-excavated to its full depth from within the plan limits of the embankments. The sub-excavation should be backfilled with granular material to a level at least 1 foot above the prevailing groundwater level in the area.

The underlying clayey silt stratum will settle due to the loading of the approach fills, over a long-term period. In addition, some settlement will take place in the underlying

granular glacial till deposit. This settlement will be elastic in nature and negligible in magnitude. The estimated consolidation settlement due to the embankment loading, will be in the order of 3 to 4 inches. The total predicted consolidation settlement will take place in a relatively short period of time, e.g. approximately 50 percent within 12 months.

6.3) Structure Foundations:

The presence of the very stiff to firm compressible clay at a shallow depth below the ground surface will dictate the necessity of supporting the structure abutments and piers on piles.

The piers and abutments can be supported on end-bearing piles driven to their design load either within i) the competent glacial till stratum or ii) the upper fractured portion of the bedrock. For estimating purposes the pile tips can be assumed to be at the following elevations.

<u>Location</u>	<u>Estimated Pile Tip Elev.</u>	
West Abutment (B.H.'s #1 and 2)	385	Within Bedrock
West Pier (B.H.'s #3 and 4)	390	} Within Glacial Till
East Pier (B.H. #5)	393 to 398	
East Abutment (B.H. #6)	385 to 390	

Allowable loads will depend on the pile section chosen (e.g. 14BP74 steel H piles may be designed for 95 tons per pile).

At those locations where the pile tips will be located within the glacial till stratum the pile driving during construction, should be controlled by employing the Hiley Dynamic Pile Driving Formula, in accordance with current Department Standards, in order to attain the loads specified.

At least 4 feet of earth cover should be provided to the underside of the pile caps for frost protection purposes.

The base of the pier pile cap excavations will be below the groundwater level recorded during the period of the investigation. However, no major dewatering problems are anticipated due to the relatively impervious nature of the subsoil. Any groundwater seepage or surface runoff occurring in the excavation could be handled using standard techniques such as pumping from sumps.

No bouldery or rock fill should be placed in areas where piles are to be driven.

7. MISCELLANEOUS:

The field work for this project was carried out during the period of September 7 to October 22, 1971, under the supervision of Mr. W. G. Hutton, Project Foundation Engineer, who also prepared this report.

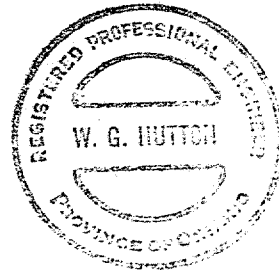
The project was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed the report.

The equipment used was owned and operated by the F. E. Johnston Drilling Co. Ltd., Ottawa, Ontario.

W. G. Hutton
W. G. Hutton, P. Eng.

M. Devata
M. Devata, P. Eng.

WGH/ao
December 2, 1971.



APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11085

LOCATION Sta. 508 + 16 20' Rt.

ORIGINATED BY WH

W.P. 7-67-03

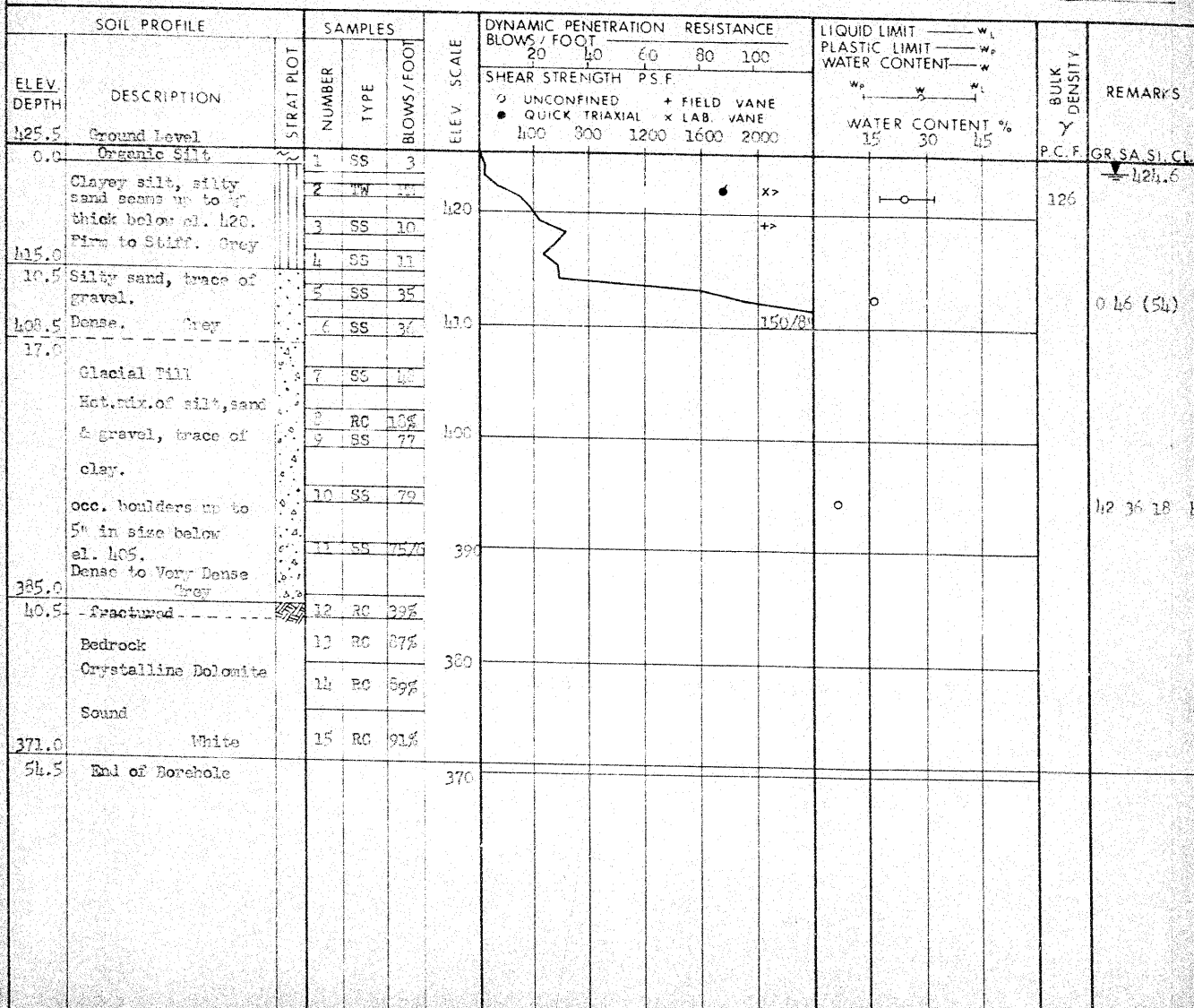
BORING DATE Sept. 16 & 21, 1971

COMPILED BY SO

DATUM Geodetic

BOREHOLE TYPE Diamond Drill - Washboring

CHECKED BY R.D.



FOUNDATION SECTION

ORIGINATED BY WH

COMPILED BY SO

CHECKED BY E.A.

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11035

LOCATION Sta. 508 + 75 20' Rt.

ORIGINATED BY WE

W.P. 7-67-03

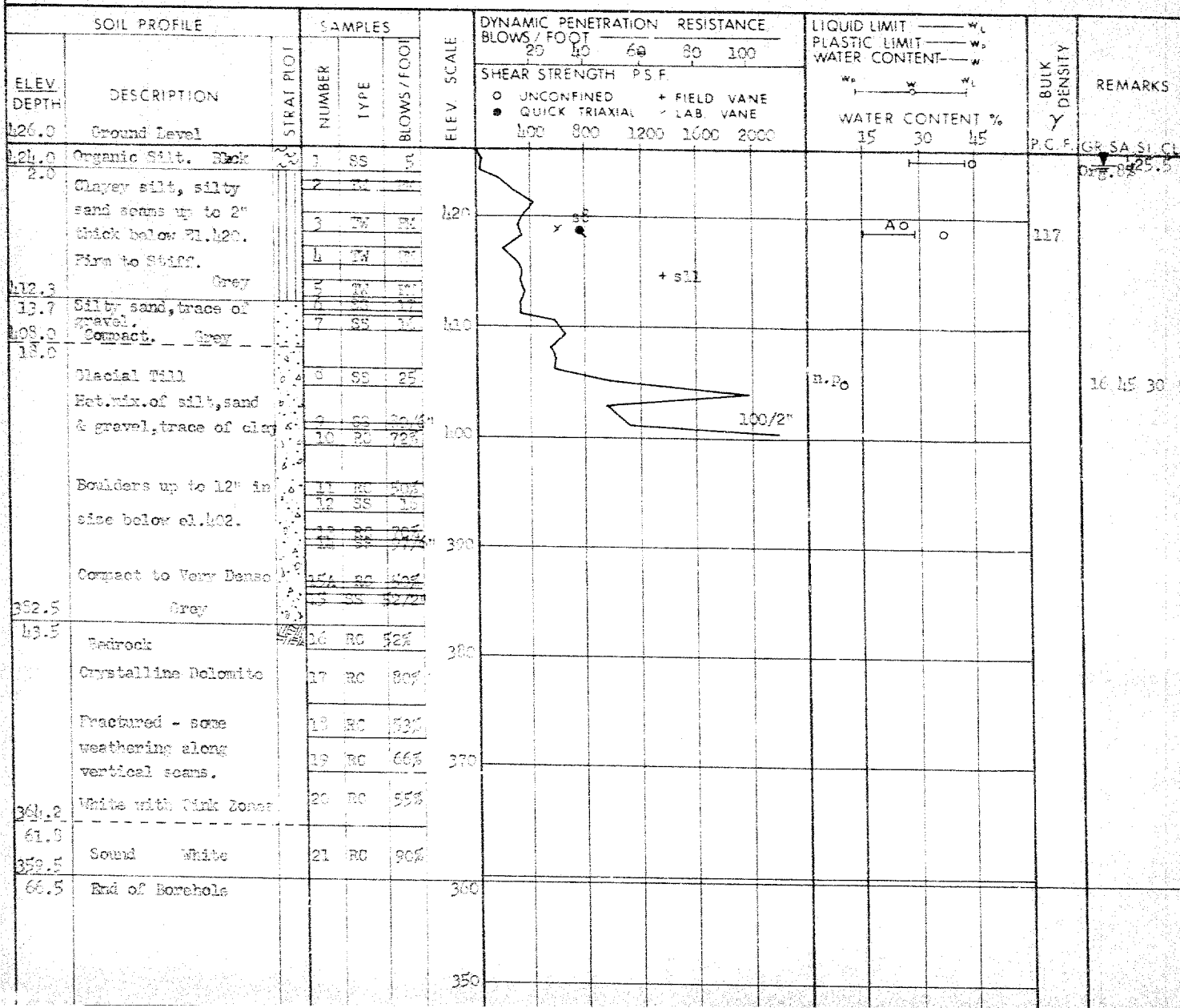
BORING DATE Sept. 24, 25 & 27, 1971

COMPILED BY SD

DATUM Geodetic

BOREHOLE TYPE Diamond Drill, Washboring

CHECKED BY EV



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 72-11085 LOCATION Sta. 509 + 16 20' Lt.
W.P. 7-27-03 BORING DATE Sept. 7, 8, 9, 10 & 15, 1971
DATUM Geodetic BOREHOLE TYPE Diamond Drill Washcoring

ORIGINATED BY WJ
COMPILED BY SO
CHECKED BY JD

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 71-11085 LOCATION Sta. 507 + 40 2 ORIGINATED BY WH
W.P. 7-67-03 BORING DATE Sept. 28, 1971 COMPILED BY SO
DATUM Geodetic BOREHOLE TYPE Diamond Drill Washboring CHECKED BY E.D.

[illegible]

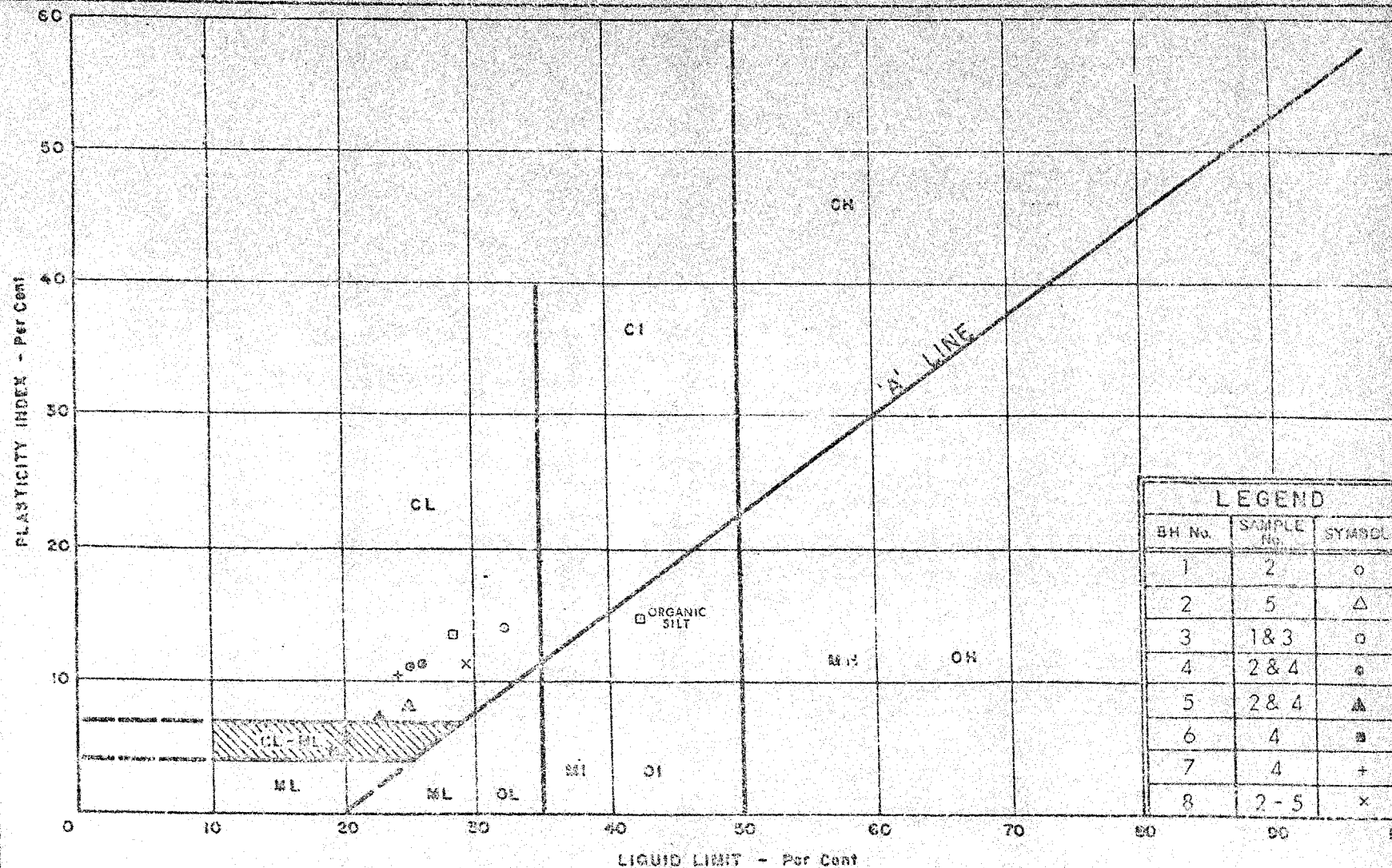
FOUNDATION SECTION

ORIGINATED BY WJH

COMPILED BY SO

CHECKED BY *THE ID*

[illegible]



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

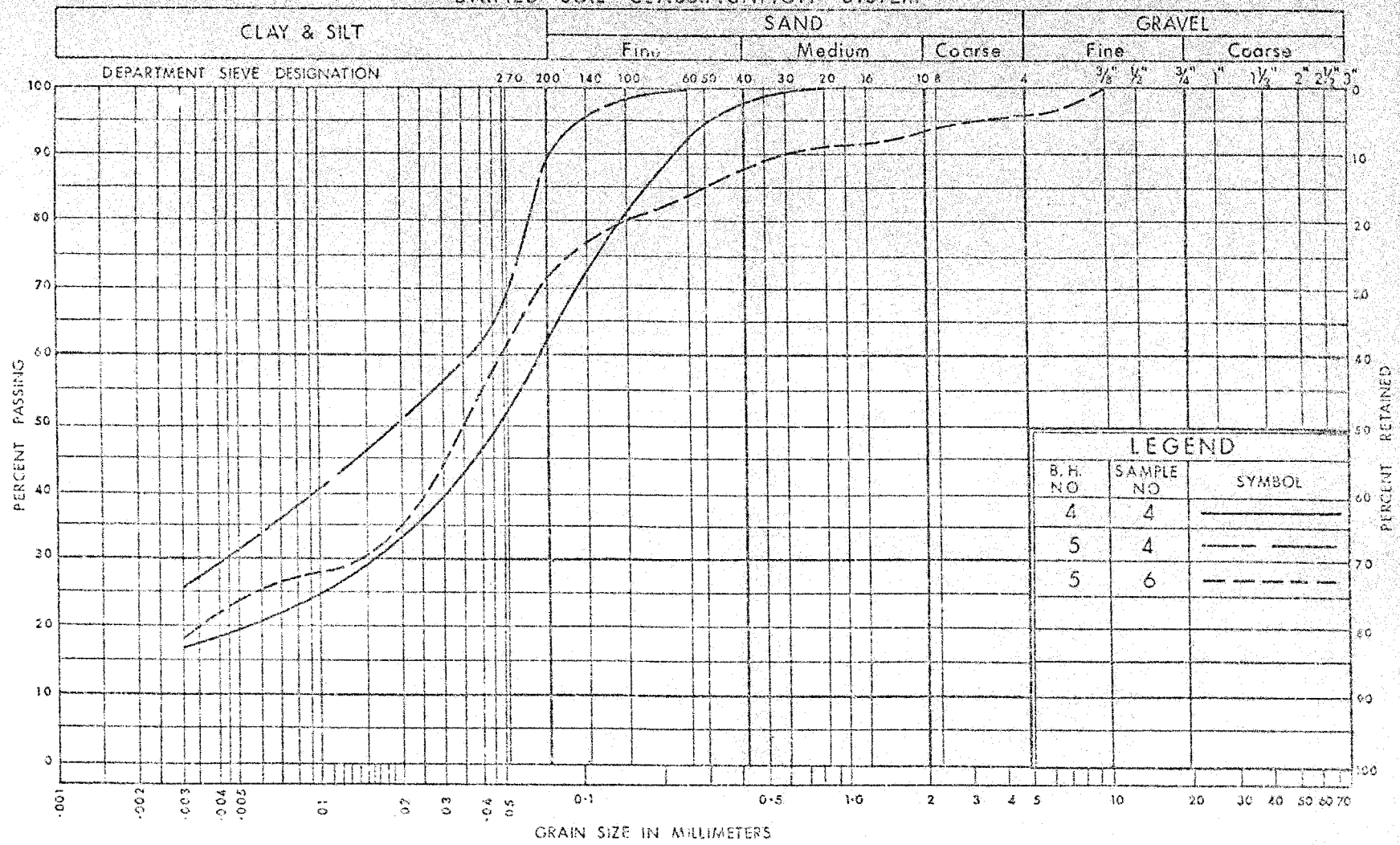
PLASTICITY CHART CLAYEY SILT THIN SILTY SAND SEAMS

WP No. 7-67-03

JOB No. 71-11085

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION

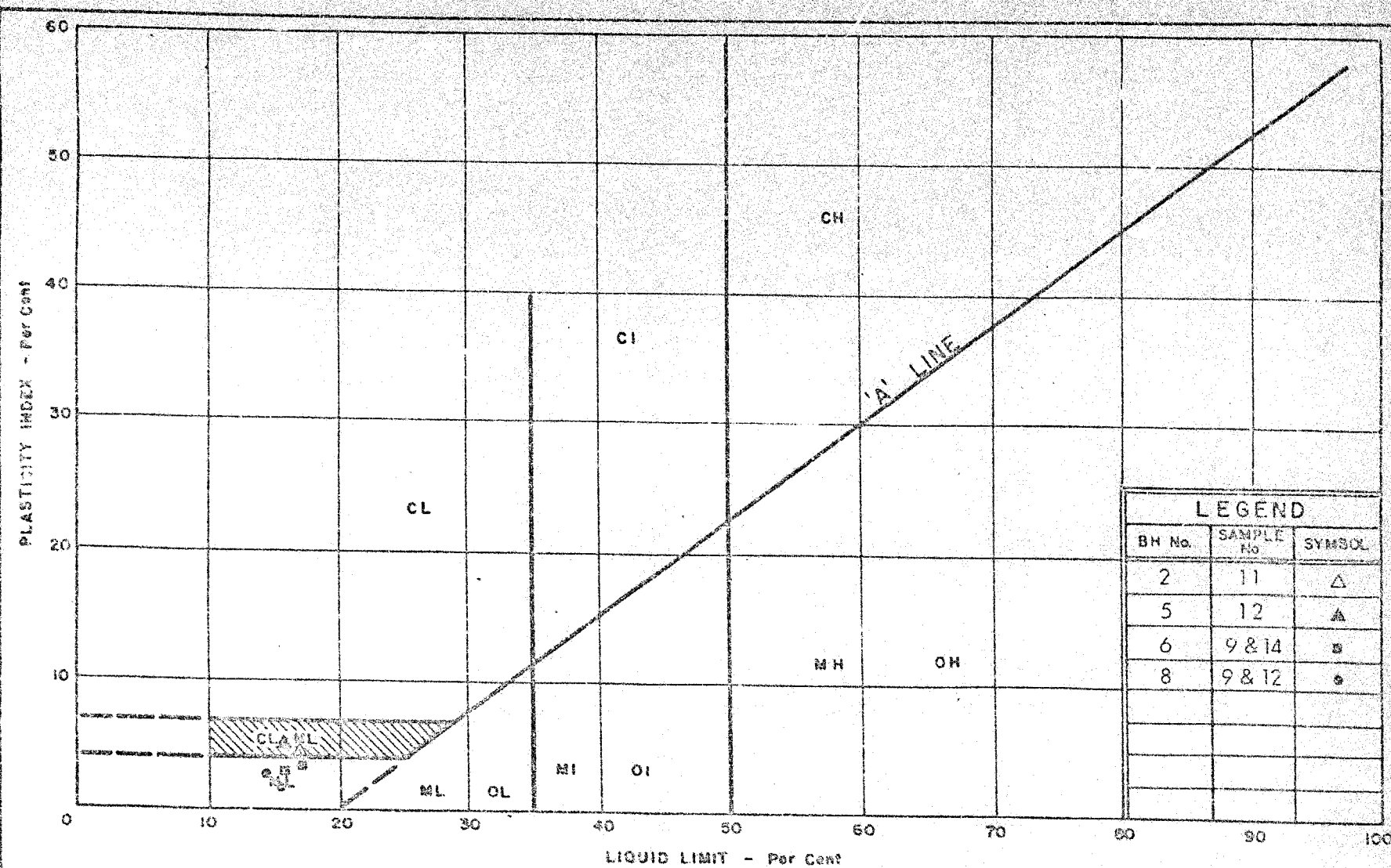
CLAYEY SILT

WITH SILTY SAND SEAMS

W.P. No. 7 - 67 - 03

JOB No. 71-11085

FIG. 2



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

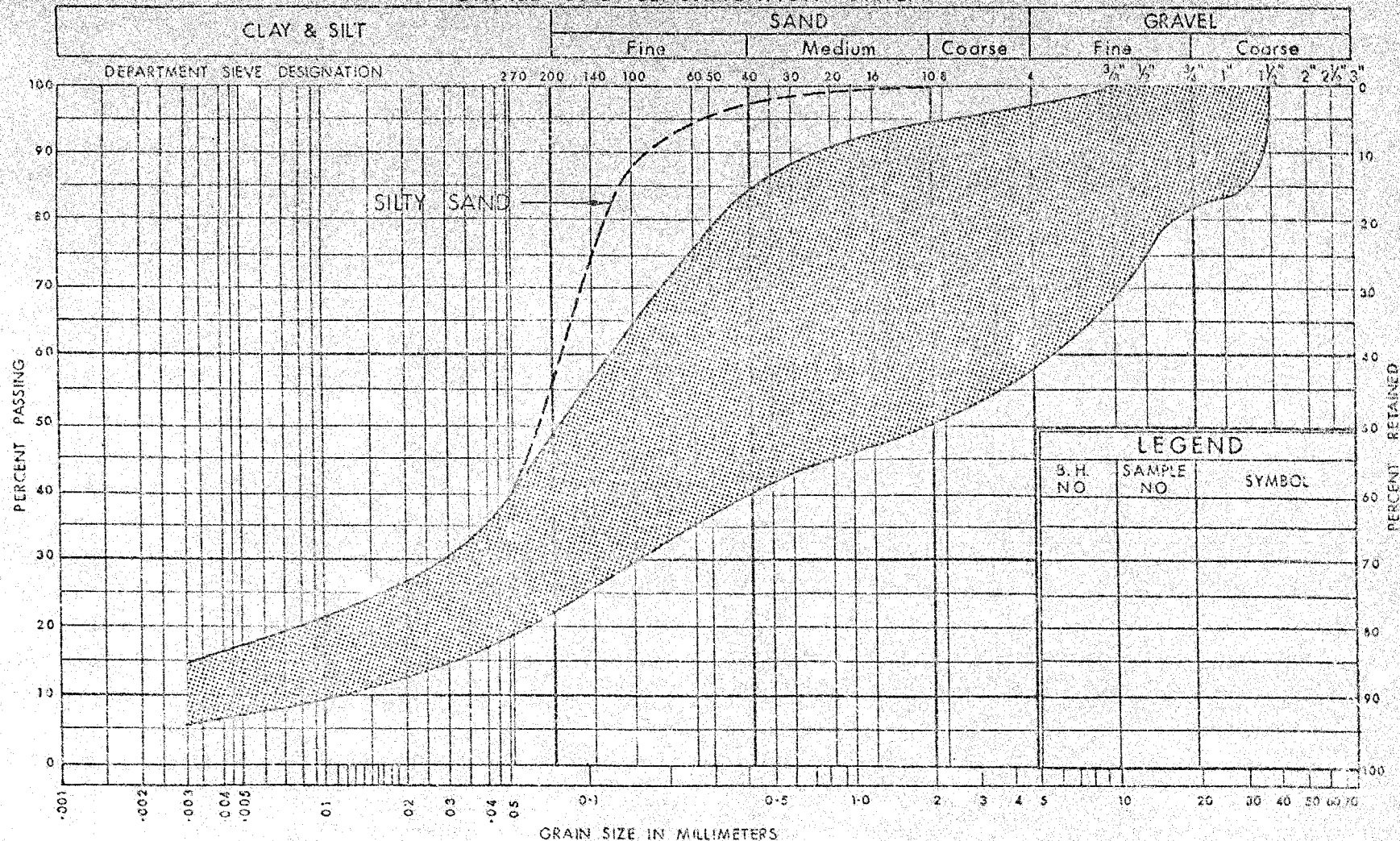
PLASTICITY CHART
GLACIAL TILL
HET. MIXTURE OF SILT, SAND & GRAVEL, TRACE OF CLAY

WR No. 7-67-03

JOB No. 71-11085

FIG. 3

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND

S.H. NO	SAMPLE NO	SYMBOL

DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION GLACIAL TILL

HET. MIXTURE OF SILT, SAND & GRAVEL, TRACE OF CLAY

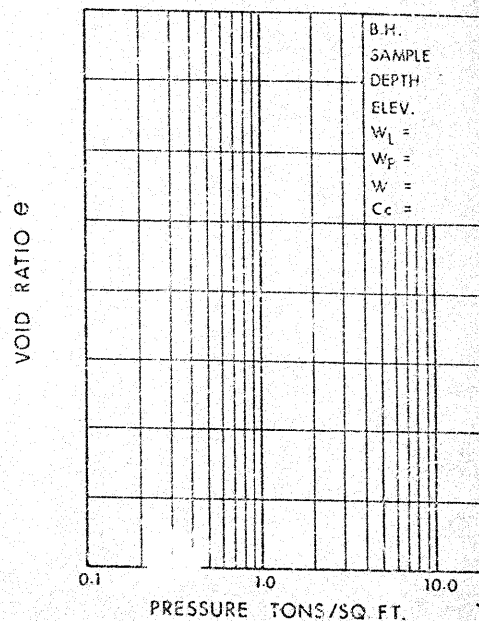
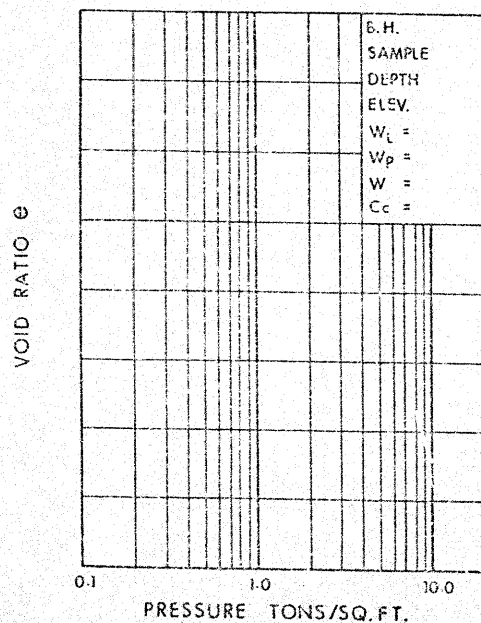
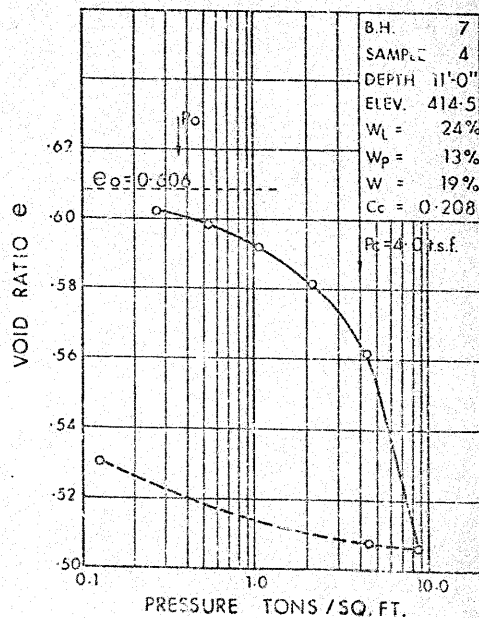
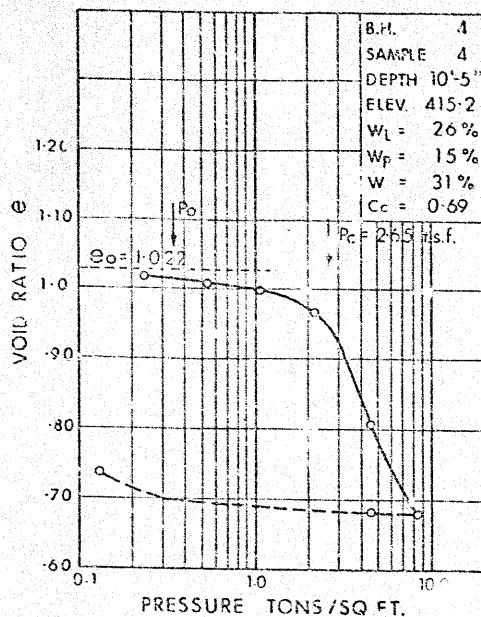
W.P. No. 7-67-03

JOB 1.. 71-11085

FIG. 4

VOID RATIO-PRESSURE CURVES

JOB NO. 71-11085



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 300 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>G. LB. / 50 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 - 6	500 - 1000	COMPACT	10 - 30
STIFF	6 - 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.	OERTERBERG 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
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

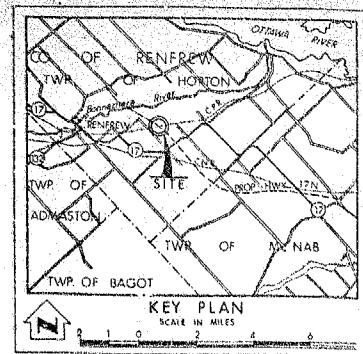
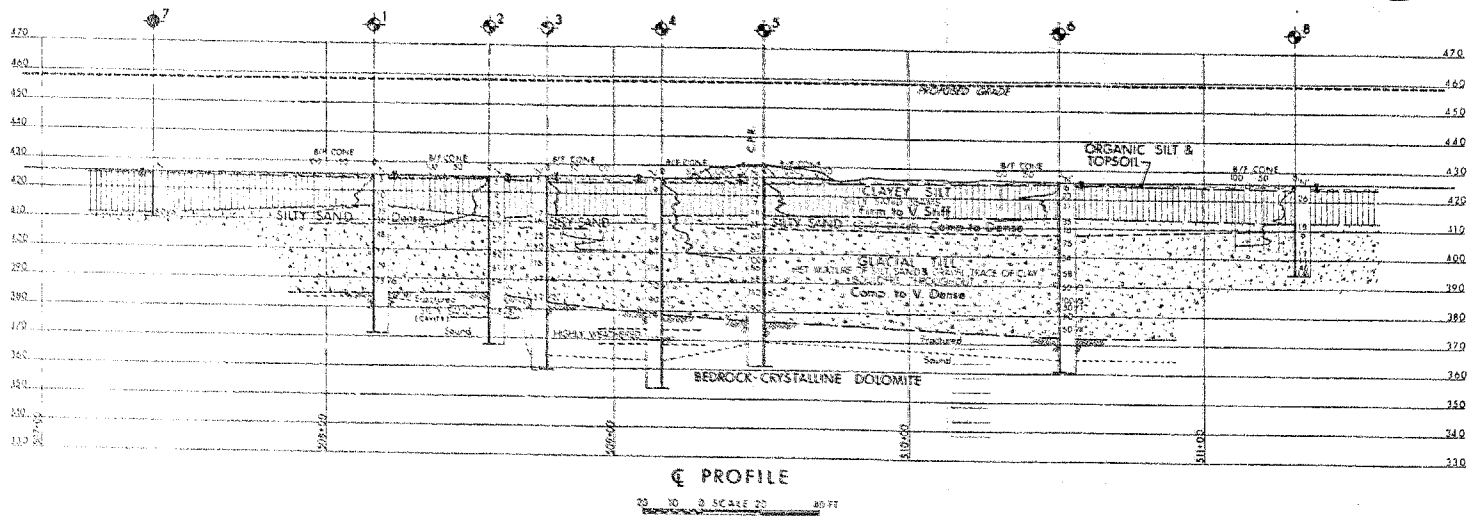
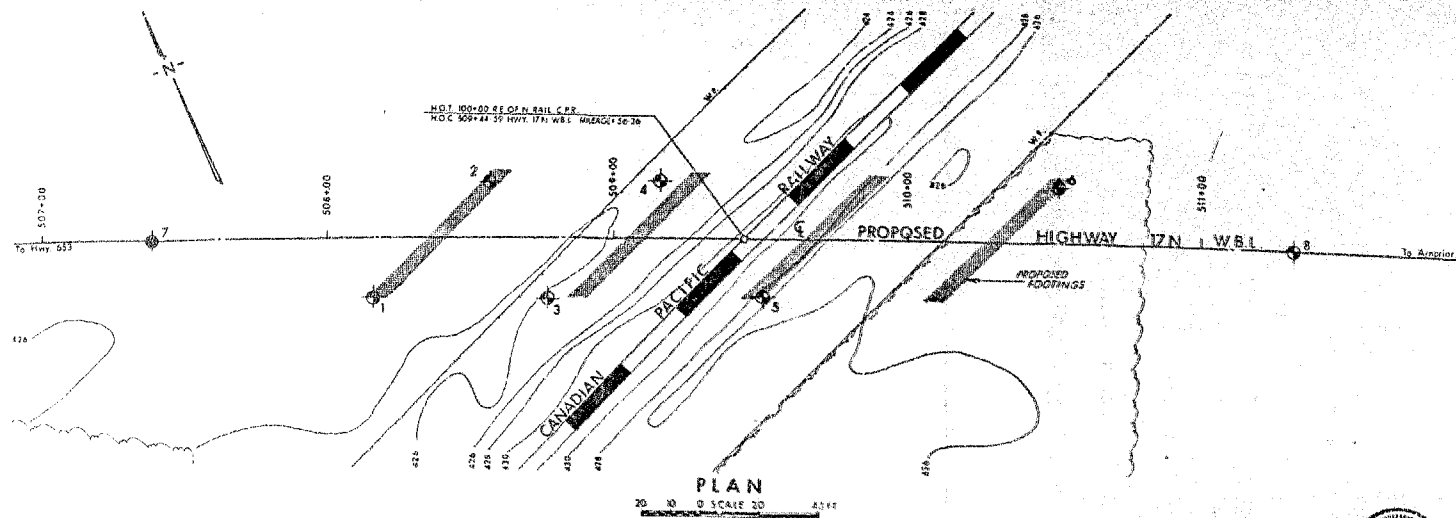
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

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, SEPT. & OCT. 71

NO.	ELEVATION	STATION	OFFSET
1	425.5	508+16	20' RT.
2	425.3	508+56	20' LT.
3	426.0	508+76	20' RT.
4	425.7	509+16	20' LT.
5	426.6	509+51	20' RT.
6	425.5	510+51	20' LT.
7	425.5	507+40	⊕
8	425.5	511+31	⊕

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

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH - FOUNDATION DIVISION

CANADIAN PACIFIC RAILWAY

HIGHWAY NO. 17N W.B.I. DIST NO. 9
CO. RENFREW
TWP. HORTON LOT 7 CON. 4

BORE HOLE LOCATIONS & SOIL STRATA

DRAWN BY: [Signature] CHECKED BY: [Signature] DATE: 16 NOV 1971
JOB NO. 71-11055
SHEET NO. 1
PROJECT NO. 71-11085A

January 27, 1972

memo to fills:

re: Overhead Structure at the
Crossing of Proposed Hwy 17' N.E.W.
and Canadian Pacific Railway
Twp. Horton Co. of Kenora
W.O. 71-11085' W.P. ~~5-67-03~~

7-67-03

Jan 30/72

Murray Batten informed the ~~re~~ writer
that the fill along the approaches will be
composed of rock fill with ~~the~~ a bulk
unit weight of 115 p.c.f.

the fills will be approx. 34' high and stand
with side slopes of $1\frac{1}{4}$ to $1\frac{1}{2}$: 1.

In the report we discussed the following

fill - earth borrow $\gamma = 120$ p.c.f.

Slopes 2:1 - Fill height 33'
this condition was computed to be stable.

Comments: the rock fill will be lighter and
will be placed with steeper side slopes than
the scheme discussed in the report. The
proposed rock fill scheme will, however, be
stable.

Barry T. Dorch

Mr. E. R. Saint,
Regional Materials Engineer,
Kingston, Ontario.

01128
Feb 2/72
Bridge Section,
Kingston, Ontario.

Mr. A. M. Batten

January 31, 1972.

W.P. 7-67-02, C.N.R. Overhead, Site 29-193
W.P. 7-67-03, C.P.R. Overhead, Site 29-194
Highway 17N, District 9 - Ottawa

71-11-085

I understand that there is a possibility that you will be recommending the use of rock fill in the vicinity of these two structures.

Will you please confirm or otherwise as soon as possible and advise the rock fill slope to be used, if applicable. In the meantime, all design work on these structures has been suspended.

T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl

c.c. -

✓ A. G. Stermac - Att. M. Devata
S. J. Markiewicz - Att. A. E. Iring
C. S. Grebski - Att. K. Bassi

DOCUMENT MICROFILMING IDENTIFICATION

GEOCREs No. 31F-32

DIST. 9 REGION Eastern

W.P. No. 7-67-03

CONT. No. 73-126

W. O. No. 71-11085

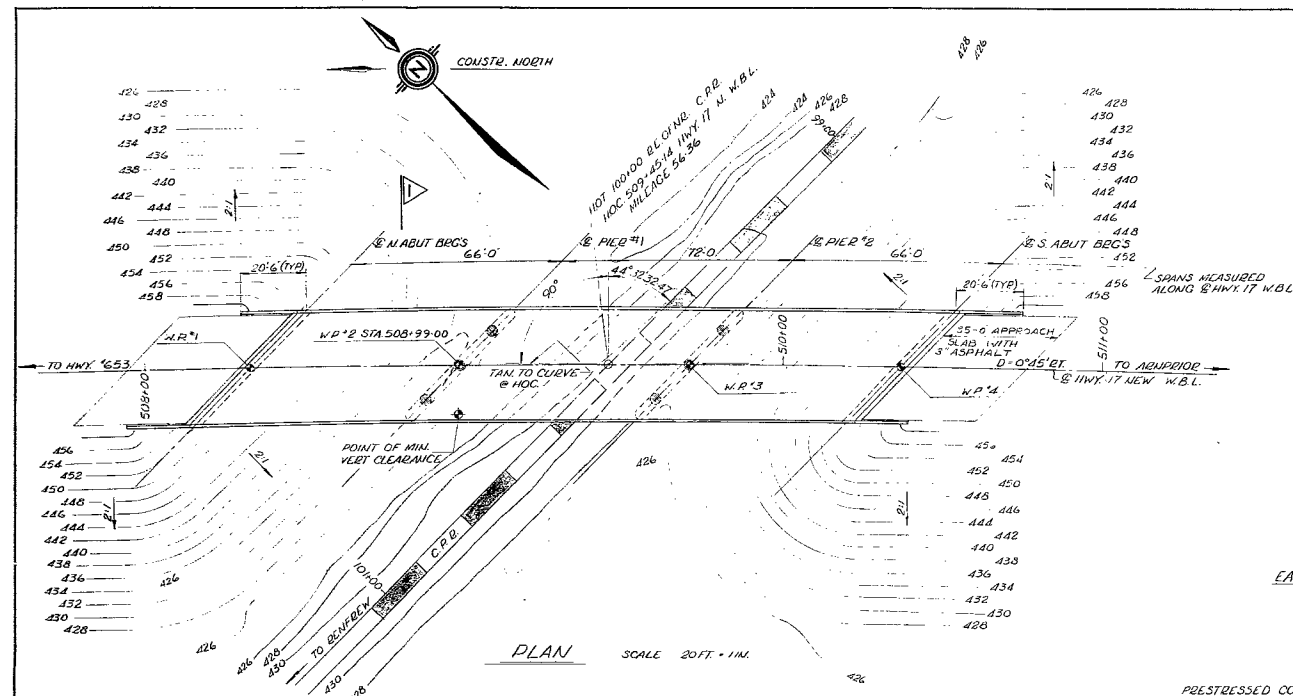
STR. SITE No. 29-194

HWY. No. 17N

LOCATION EBB X-ing (From 9.3 M.W.
of Arnprior W.Lts. N'ly to Renfrew
City Rd 14) G.D.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 2

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE
MICROFILMED

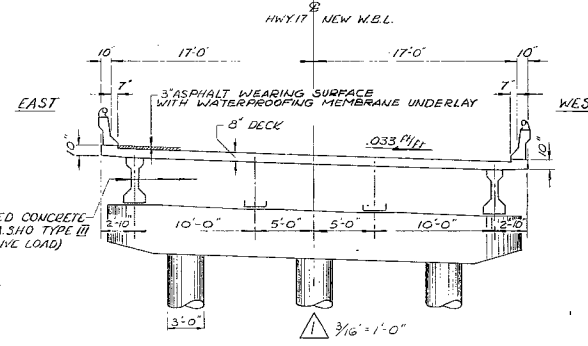
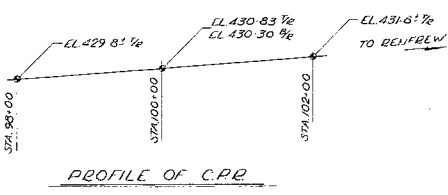
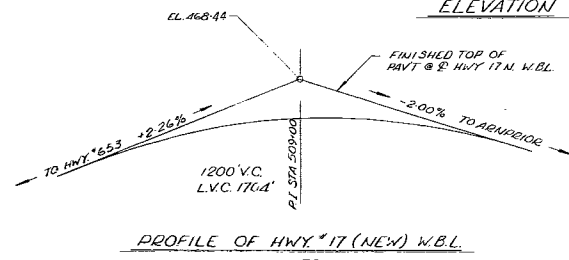
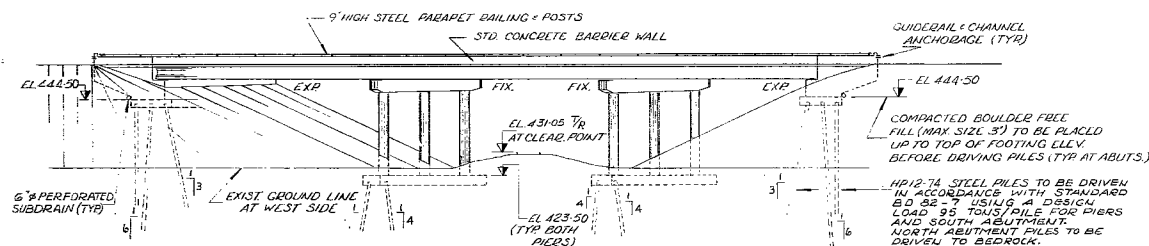


CURVE DATA
 Δ 10° 49' 58" 17"
 D 0° 45' 48"
 E 7639' 44"
 T 784' 35"
 L 1444' 38"
 E 54' 26"

44° 32' 32" 41" SKEW FUNCTIONS

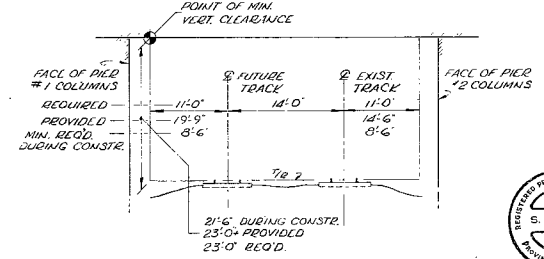
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 COS. 0.7127321
 TAN. 0.9841515

NOTE - W.P. DENOTES WORKING POINT



LIST OF DRAWINGS

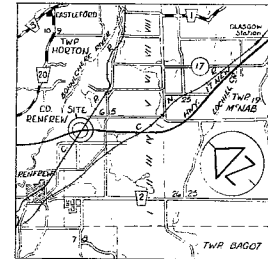
- 29-194-1 - GENERAL PLAN
- 2 - BORE HOLE LOCATIONS & SOIL STRATA
- 3 - FOOTINGS-DIMENSIONS & REINFORCING
- 4 - ABUTMENTS-DIMENSIONS & REINFORCING
- 5 - PIERS
- 6 - PRESTRESSED GIRDERS & BEARINGS
- 7 - DECK DETAILS
- 8 - 38 FT. APPROACH SLAB FOR BARRIER WALL
- 9 - CONCRETE BARRIER WALL (2'-8" HIGH)
- 10 - DETAILS OF 8" HIGH STEEL PARAPET RAIL
- 11 - STANDARD DETAILS I
- 12 - STANDARD DETAILS II



RAILWAY CLEARANCE DIAGRAM

(CLEARANCES SHOWN ARE PERPENDICULAR TO & TRACK)

FOR REDUCED PLAN
 USE SCALE BELOW
 1" = 3' ON ORIGINAL PLAN



GENERAL NOTES

1. CLASS OF CONCRETE
 DECK, DIAPHRAGMS, PIERS, PIER CAPS & APPRO. SLABS 5000 P.S.I.
 BARRIER WALLS 4000 P.S.I.
 REMAINDER 3000 P.S.I.
 2. CLEAR COVER ON REINFORCING STEEL
 FOOTINGS, ABUTMENTS & PIERS 3"
 PIER CAPS, CURBS & APPROACH SLABS 2"
 BARRIER WALLS & DIAPHRAGMS 1 1/2"
 DECK TOP - 2" BOTTOM - 1 1/2"
 3. CONSTRUCTION NOTES
 THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8".

31F. 32

B.M. ELEV 428.21 GEODETIC DATUM
 N 1/4 IN 200' OF 2 1/2" ELM 102' EX. STA. 507+58

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS			
ONTARIO			
71-11-035			
CANADIAN PACIFIC RAILWAY OVERHEAD			
APPROX. 2.6 MILES EAST OF BENEFREW			
KING'S HIGHWAY No. 17 (NEW) W.B.L.	DIST. No. 9		
CO. BENEFREW	TWP. HORTON		
GENERAL PLAN		CON. IV	
APPROVED	DATE	W.P. No.	7-67-03
DESIGN	CHECK	CONTRACT	
DRAWING	CHECK	DRAWING	
DATE	LOADING	DRAWING	

