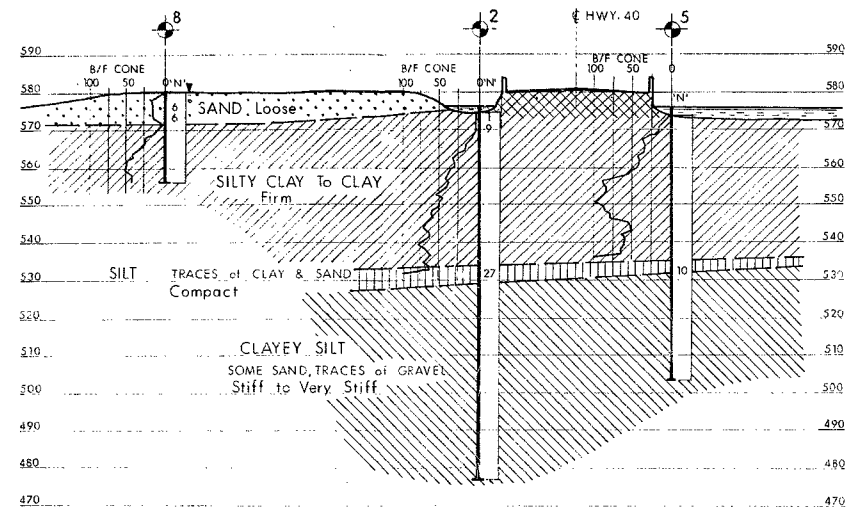


#68-F-42

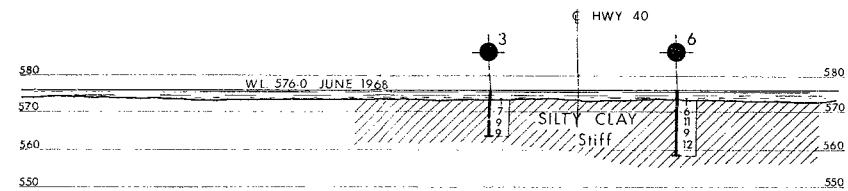
W.P. #155-67-01

HWY #40

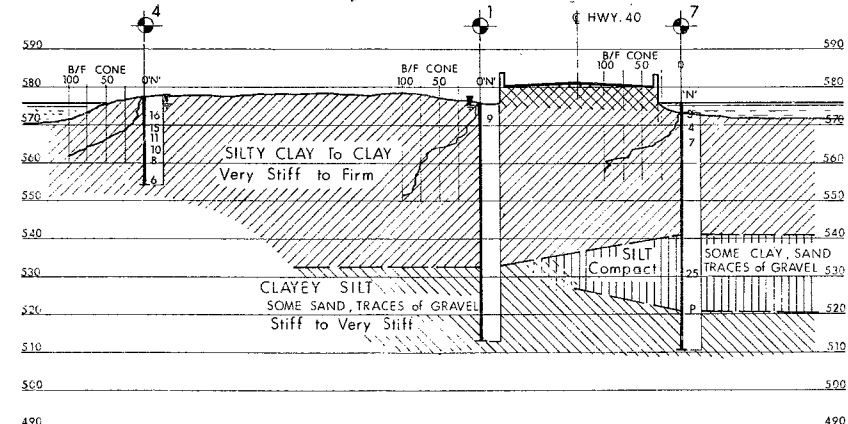
BOWEN CREEK



A-A



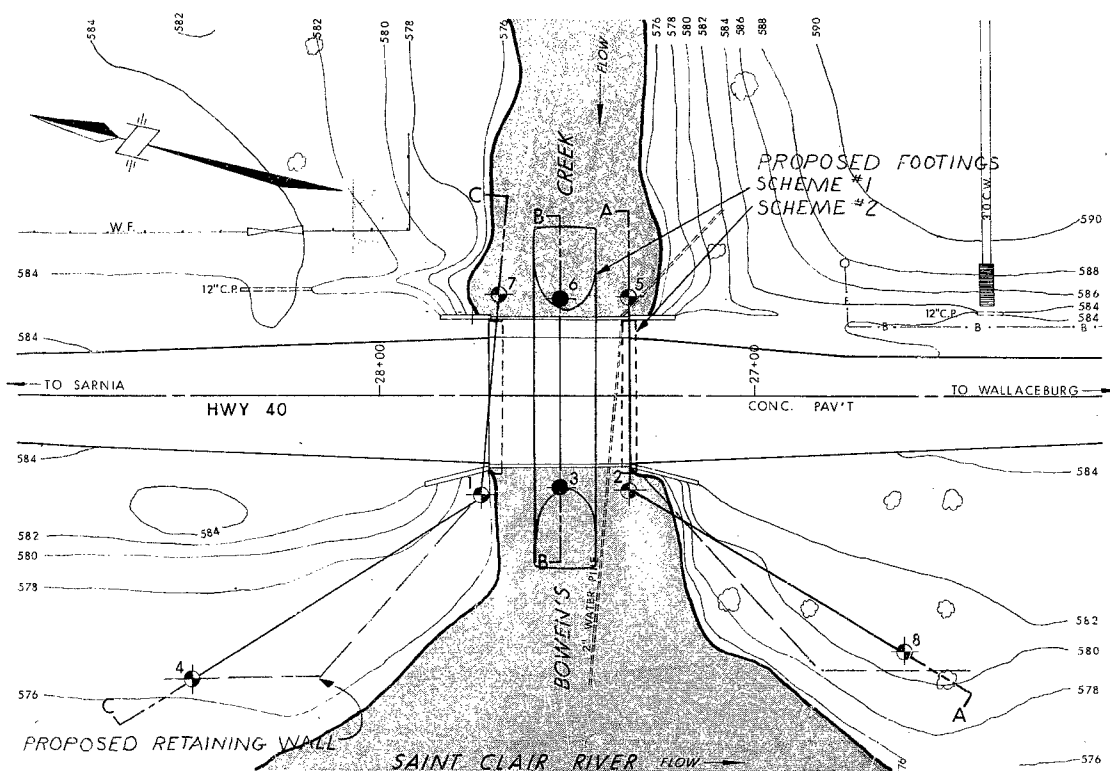
B-B



C-C

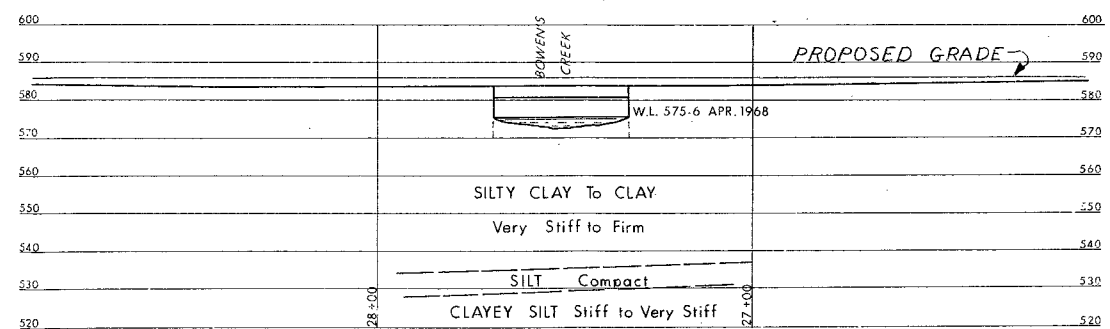
SECTIONS

SCALE 20 10 0 20 40 FT.



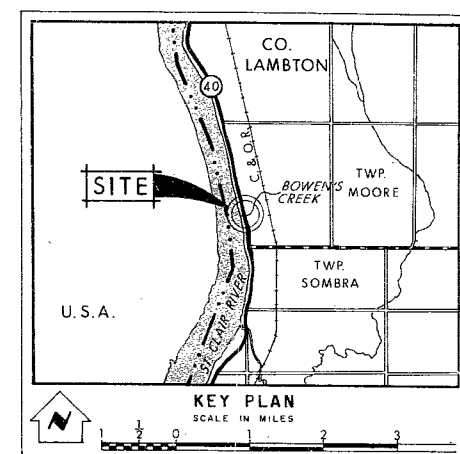
PLAN

SCALE 20 10 0 20 40 FT.



PROFILE

SCALE 20 10 0 20 40 FT.



LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊙ Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, JUNE, 1968

NO.	ELEVATION	STATION	OFFSET
1	576.4	27+73	26' LT.
2	576.0	27+33	25' LT.
3	576.0	27+52	25' LT.
4	576.4	28+50	75' LT.
5	576.0	27+33	26' RT.
6	576.0	27+52	26' RT.
7	576.0	27+68	26' RT.
8	580.5	26+69	68' LT.

NOTE

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

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

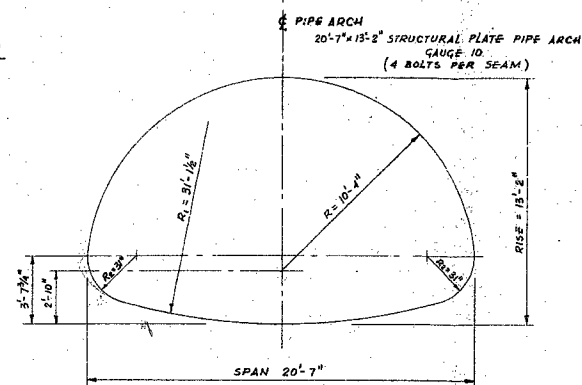
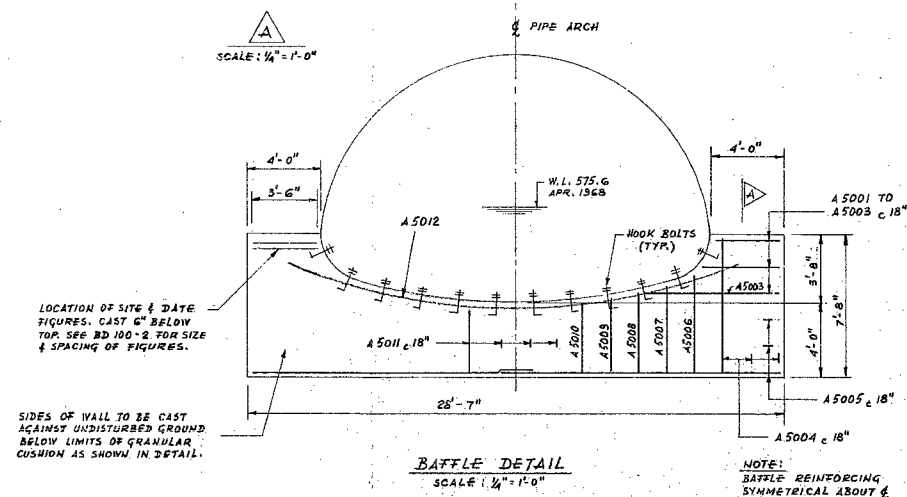
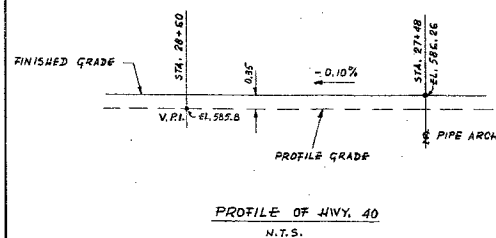
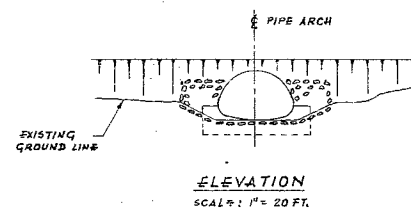
BOWEN'S CREEK

KING'S HIGHWAY NO. 40 DIST. NO. 1
CO. LAMBTON
TWP. MOORE LOT 4 CON. FRONT

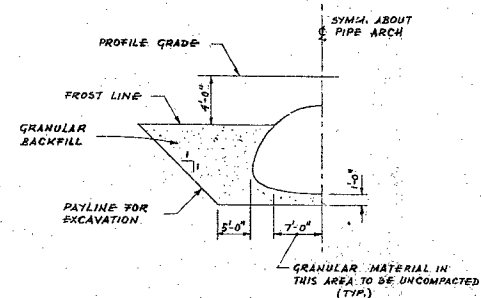
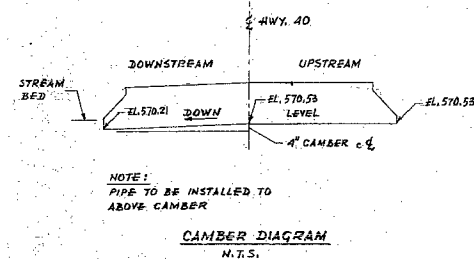
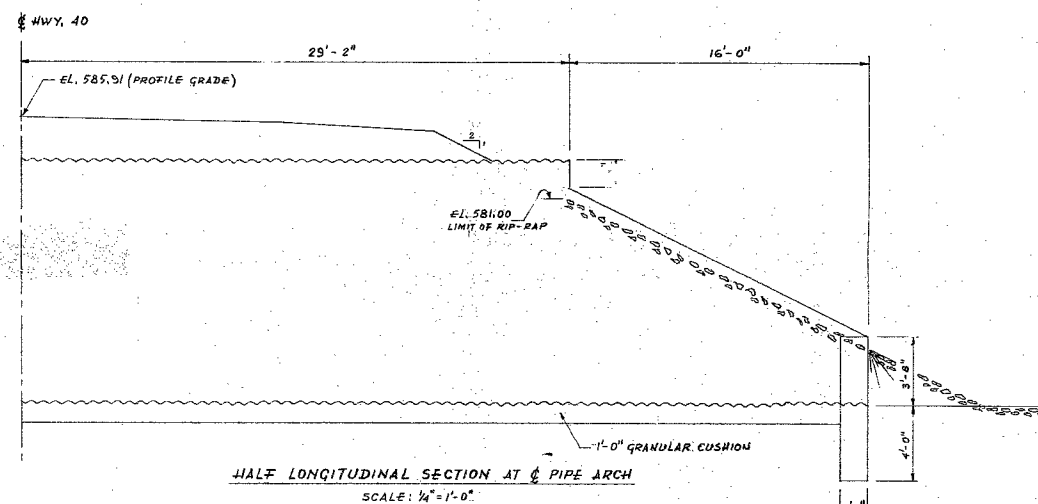
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. A.P. CHECKED <i>[initials]</i>	W.P. NO. 155-67-01	M.B.T. DRAWING NO.
DRAWN D.M. CHECKED <i>[initials]</i>	JOB NO. 68-F-42	68-F-42A
DATE JULY 25, 1968	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[signature]</i>	CONT. NO.	

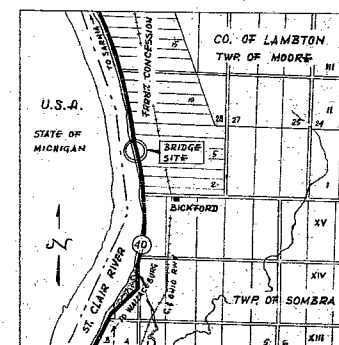
REF. No. E-4820-1



TYP. CROSS SECTION
SCALE: $\frac{1}{8}" = 1'-0"$



DETAIL OF GRANULAR BACKFILL
N.T.S.



KEY PLAN
SCALE: 1" = 1 MI.

G.B.M. N° MMMCCLXII ELEV. 590.388
INTERNATIONAL BOUNDARY COMMISSION CONC. REFERENCE
MONUMENT N° 35, 30 FEET WEST OF Q RIVER ROAD, 4 MILES
NORTH OF SOMBERA FERRY LANDING AND ABOUT 1500 FEET
SOUTH OF SOMBERA - MOORE TOWNSHIP LINE, BOLT SET
HORIZONTALLY FACING SOUTH.

NOTES:

CLASS OF CONCRETE

3000 P.S.I.

CLEAR COVER ON REINFORCING STEEL

3¹ EXCEPT AS NOTED.

LIST OF DRAWINGS

D-6541-1 PLAN AND DETAILS

-2 BORE HOLE LOCATIONS & SOIL STRATA.

ESTIMATED TENDER	15,660
" MATERIAL	7,590
(10%)	<u>2,325</u>
	25,575.00

[illegible]

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

BOWEN CREEK STRUCTURE
4.5 MI. NORTH OF SOMBRA

KING'S HIGHWAY No. 40		DIST. No. 1
CO. LAMBTON	STA. 27+48	
TWP. MOORE	LOT 4	CON. FRONT

PLAN AND DETAILS

APPROVED _____				SITE No. 14-173		W.P. No. 155-67-0	
BRIDGE ENGINEER				CONTRACT No.			
DESIGN	ADAPTED	CHECK	W.T.H				
DRAWING	P.K.	CHECK	W.T.H.	DRAWING No.		D-6541-1	
DATE	JUN. 1963	LOADING	MS-20-44				



MEMORANDUM

TO: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division,
Admin. Bldg.

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: July 30, 1968

OUR FILE REF.

IN REPLY TO 68-1-1958

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at Bowen Creek
And Hwy. #40, Township of Moore
Lot 4, Front Con., County of Lambton
District No. 1 (Chatham)
W.J. 68-F-42 -- W.P. 155-67-01

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/MdeF
Attach.

A. G. Sternac
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
W. Zonnenberg
F. C. Brown
A. P. Watt
J. Roy
B. A. Singh

Foundations Files
Gen. Files

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 2. DESCRIPTION OF SITE.
 3. FIELD AND LABORATORY WORK.
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 - 4.3) Silt, some Sand and Clay.
 - 4.4) Clayey Silt, some Sand, Traces of Gravel.
 - 4.5) Sand, some Gravel, Traces of Silt and Clay.
 5. GROUNDWATER.
 6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) Corrugated Steel Pipe Arch.
 - 6.2) Bridge.
 - 6.3) Retaining Walls.
 7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at Bowen Creek
And Hwy. #40, Township of Moore
Lot 4, Front Con., County of Lambton
District No. 1 (Chatham)
W.J. 68-F-42 -- W.P. 155-67-01

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed new bridge to carry Hwy. #40 over Bowen Creek, was received from Mr. A. P. Watt, Regional Bridge Location Engineer, in memos dated May 6, 1968, and May 25, 1968.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed bridge and retaining walls.

This report contains the results of our field and laboratory investigation, together with our recommendations for the foundations of the new structure and the proposed retaining walls.

2. DESCRIPTION OF SITE:

The new structure is proposed to be located at the same site as the existing one. The site is located 4.5 miles north of Sombra on Hwy. #40. The existing bridge is a 36.0 ft. clear span concrete rigid frame slab bridge. The two halves of the bridge were constructed at two different times. The western half, which is the older one, is in a bad condition. It has needed extensive repairs in the past and understandably, new measures have been proposed for strengthening this portion. Apparently, there was another still older bridge at the same site, the piles for which can be seen protruding out of the water.

cont'd. /2 ...

2. DESCRIPTION OF SITE: (cont'd.) ...

At the bridge site, Bowen Creek meets the St. Clair River which is a very busy waterway. Whenever ships pass the point, water is forced up Bowen Creek by the backwash.

The land on both sides of the creek is gently sloping and covered with vegetation.

The site of the crossing is situated in the physiographical region known as the 'St. Clair Clay Plains'.

3. FIELD AND LABORATORY WORK:

The field work at the site consisted of eight sampled boreholes and six dynamic cone penetration tests. All holes were advanced using conventional diamond drilling equipment adapted for soil sampling purposes. A driving energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

Disturbed samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration Test. Undisturbed samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil manually.

In-situ vane tests were carried out wherever possible, at elevations 12 inches below various soil samples.

Samples were visually examined in the field and subsequently in the laboratory. The following tests were carried out on selected samples:

- 1) Grain-Size Distribution.
- 2) Atterberg Limits.
- 3) Natural Moisture Content.
- 4) Bulk Density.
- 5) Unconfined Compression Tests.
- 6) Laboratory Vane Tests.

cont'd. /3 ...

3. FIELD AND LABORATORY WORK: (cont'd.) ...

The results of field and laboratory tests are summarized in the Record of Borehole sheets, which are contained in the Appendix to the report.

The locations and the elevations of boreholes are given on Drawing No. 68-P-42A, which is also contained in the Appendix to this report.

The borehole elevations were surveyed by the Chatham District Office of the D.H.O.

4. SUBSOIL CONDITIONS:

4.1) General:

In general, the subsoil consists of a deposit of silty clay underlain by a layer of silt, which in turn overlies a clayey silt stratum.

The boundaries between the different deposits are shown on the attached Record of Borehole sheets. The estimated stratigraphical profiles shown on Drawing No. 68-P-42A, are based upon this information.

From ground level downwards, the different soil deposits are described as follows:

4.2) Silty Clay to Clay:

This deposit was encountered in all boreholes from the ground level downwards, except in borehole 8, where it was overlain by 9.0 ft. of sand. It is mainly silty clay to clay. Boreholes 3, 4, 6 and 8 were terminated in this deposit. The thickness of the deposit is 42.0 - 44.0 ft., except in borehole 7, where it is 36.0 ft. The ranges of Atterberg Limits are as follows:

Liquid Limit	:	39.0	-	57.1%
Plastic Limit	:	18.7	-	28.4%
Natural Moisture Content	:	26.5	-	47.9%

cont'd. /4 ...

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

4.2) Silty Clay to Clay:

The undrained shear strength as determined in the field by vane tests, is about 800 lbs./sq.ft., indicating a firm consistency, except for the top few feet, where it is much higher because of desiccation. The shear strength as obtained from unconfined compression tests, is slightly lower. The laboratory vane tests give much lower values still and have been disregarded.

4.3) Silt, some Sand and Clay:

This deposit occurred in boreholes 2, 5 and 7, and its thickness in these boreholes was 5.0, 3.0 and 20.0 ft., respectively. It is mainly silt with varying amounts of sand and clay. The grain-size distribution curves show the following ranges:

Sand	:	1	-	18%
Silt	:	51	-	96%
Clay	:	4	-	22%

The 'N' values indicate a compact denseness.

4.4) Clayey Silt, some Sand, Traces of Gravel:

This material was found in boreholes 1, 2, 5 and 7 and these boreholes were terminated in this stratum. The soil can be classified as clayey silt, some sand and traces of gravel. The ranges of grain sizes and Atterberg Limits are as follows:

Liquid Limit	:	31.8	-	36.3%
Plastic Limit	:	17.5	-	20.1%
Natural Moisture Content	:	19.4	-	22.4%

Gravel	:	2	-	5%
Sand	:	13	-	19%
Silt	:	45	-	53%
Clay	:	30	-	39%

The field vane and the unconfined compression tests show shear strength values increasing steadily with depth from 1100 p.s.f. to 3500 p.s.f.

cont'd. /5 ...

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

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

This material was found only in borehole 8 from ground level to a depth of 9.0 ft. The only grain-size analysis showed:

Gravel	16%
Sand	73%
Silt and Clay	11%

The Standard Penetration Test gave 'N' values of 6 blows/ft., indicating a loose denseness.

5. GROUNDWATER:

The water level in the river at the time of investigation was at elevation 576.0. It may be assumed that the groundwater level in the vicinity of the river is equal to or slightly higher than the prevailing river water level.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to replace the existing bridge with a new structure. Two alternative structure types have been suggested:

- 1) Corrugated steel pipe arch.
- 2) Single-span concrete bridge.

The proposed grade is 2.0 ft. above the existing grade.

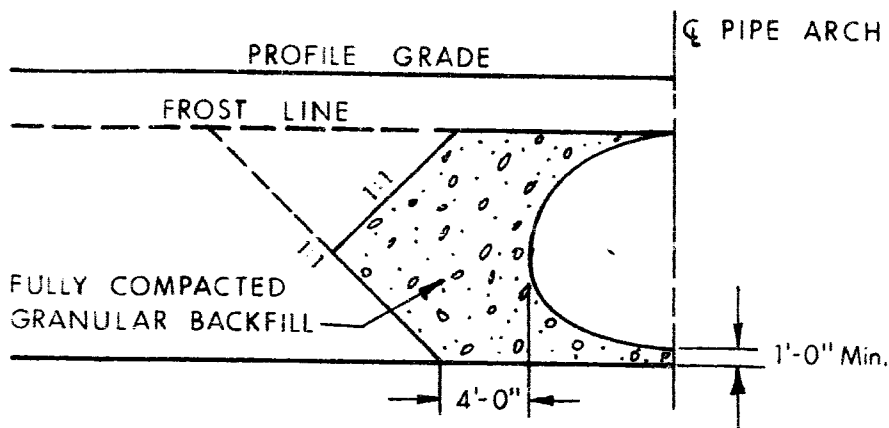
6.1) Corrugated Steel Pipe Arch:

It is recommended that the loose material down to elevation 570.0 be removed and replaced with at least 1 ft. thick granular pad. The pipe should be founded on this pad. The granular backfill should be placed against the sides as shown on the following page:

cont'd. /6 ...

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

6.1) Corrugated Steel Pipe Arch: (cont'd.) ...



6.2) Bridge:

It is proposed to replace the existing bridge with another bridge of the same dimensions. Since the clay layer is relatively soft and the thickness of the crust is small, it is not suitable for spread footings. It is recommended that the structure be supported on No. 14 timber piles with an embedded length of 45.0 ft. or more. These will be friction piles, and the safe load for 45 ft. penetration may be assumed to be 22.0 tons/pile.

6.3) Retaining Walls:

It is recommended that the retaining walls be supported on No. 14 timber piles. The safe load may be assumed to be 0.4 tons per ft. of penetration into the soil for the first 30 ft. and 0.75 tons per ft. beyond 30 ft. of embedment. Thus, the safe load for various lengths should be assumed as follows:

cont'd. /7 ...

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

6.3) Retaining Walls: (cont'd.) ...

<u>Length in Ft.</u>	<u>Safe Load in Tons</u>
30.0	12.0
35.0	15.0
40.0	19.0
45.0	23.0

Granular backfill behind the retaining walls may be placed as per D.H.O. Standards SD-4-58 and SD-4-74. For calculating the earth pressure a coefficient of earth pressure of 0.40 may be used.

No stability problems are anticipated for 2:1 slopes.

No major dewatering problem is foreseen.

7. MISCELLANEOUS:

The field work for this project was carried out during the period June 10 to June 21, 1968, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by Canadian Longyear Co. Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

July, 1968.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-42 LOCATION Sta. 27 + 33 25' Lt.

ORIGINATED BY AP

W P 155-67-01 BORING DATE June 13 - 14, 1968

COMPILED BY AP

DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing & Cone

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-42

LOCATION Sta. 28 + 50 75' Lt. of g

ORIGINATED BY AP

W. P. 155-67-01

BORING DATE June 17, 1968

COMPILED BY **WB**

DATUM Geodetic

Washboring, BX Casing

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P S F	PLASTIC LIMIT ——— WP	WATER CONTENT ——— WL		
							20 40 60 80 100					
576.4	Ground Level							+ Field Vane				Gr. Sa. S1. C1
0.0	Silty clay. Very stiff to firm.		1	SS	16	570		5.5 +				
			2	SS	15			e.4				
			3	SS	11			+2.7				
			4	SS	10			1.9				
			5	SS	8	560		+ 2.0				
553.4			6	SS	6			+2.3				
23.0	End of Borehole					550						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB	68-F-42	LOCATION	Sta. 27 + 33 26' Rt.	ORIGINATED BY	AP
W. P.	155-67-01	BORING DATE	June 18, 1968	COMPILED BY	WB
DATUM	Geodetic	BOREHOLE TYPE	Washboring, BX Casing	CHECKED BY	✓

SOIL PROFILE			SAMPLES			ELEV SCALE ELEV	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	Liquid Limit ——— W _L Plastic Limit ——— W _P	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P S F + Field Vane × Lab Vane o Unconfined	WATER CONTENT % WP ———— WL	
577.0	Top of Raft								
1.0	Water								
574.0	Ground Level								
3.0									
	Stiff		1	TW	PM	570	2.8 +	3290	
			2	TW	PM		+ 3.6	5.9	
	Silty clay Firm traces of clay		3	TW	PM	560	2.7 x 1.9 +		120 0 1 49 50
			4	TW	PM		3.7+		
			5	TW	PM	550	ot 3.3 + 2.7		119
			6	TW	PM		1.8+		
			7	TW	PM	540	1.8 x x 6.1 + 3.3		110
535.0	Silt, traces of clay and sand. Compact		8	TW	PM		x 6		109 0 1 96 3
532.0			9	SS	10	530	+ 1.3		0 2 42 56
45.0	Clayey silt, some sand and traces of gravel.		10	TW	PM		1.6		
	Stiff to very stiff.		11	TW	PM	520	x 8.3	2.4	4 13 53 30
			12	TW	PM	510		> +	
504.0								2.2	
73.0	End of Borehole					500			
							0 15-0-5 10	% Strain at Failure	

DEPARTMENT OF HIGHWAYS - ONTARIO						RECORD OF BOREHOLE NO. 6							FOUNDATION SECTION		
MATERIALS & TESTING DIVISION															
JOB 68-F-42						LOCATION Sta. 27 + 52 26' Rt.							ORIGINATED BY AP		
W.P. 155-67-01						BORING DATE June 19, 1968							COMPILED BY WB		
DATUM Geodetic						BOREHOLE TYPE Washboring, BX Casing							CHECKED BY		
SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F. + Field Vane					WATER CONTENT % WP ——— WL			
577.0	Top of Raft					500	1000	1500	2000	2500					
0.0															
1.0	Water														
573.5	Ground Level		1	SS	1										
3.5	Silty clay.		2	SS	6	570	+ 2.7								
			3	SS	11			+ 2.0							
			4	SS	9			+ 5.0							
	Stiff		5	SS	12	560		+ 3.2							
559.0							4.0 +								
18.0	End of Borehole					550									

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.7

FOUNDATION SECTION

JOB 68-F-42 LOCATION Sta. 27 + 68 26' Rt. ORIGINATED BY AP
W P 155-67-01 BORING DATE June 20/68 COMPILED BY WB
DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY LL

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BORE DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P S F + Field Vane x Lab Vane o Unconfined	500 1000 1500 2000 2500	WATER CONTENT % 0 40 60	W P	W	WL		
577.0	Top of Raft														Gr.Sa.Si.Cl
0.0															
574.0	Water														
3.0	Ground Level		1	SS	3	570			+10.0						
			2	SS	4				+2.8						
	Very Stiff		3	SS	7				+2.7						1 3 43 53
			4	TW	PM	560			+2.1						
	Silty clay, traces of sand. Firm		5	TW	PM			9.0 x 6	+3.7					115	
			6	TW	PM	550			+4.3						
			7	TW	PM			10.0	3.0					107	
541.0						540									
36.0	Silt, some clay, sand, traces of gravel.		8	TW	Lost										
	Compact														
			9	SS	25	530								0 5 85 10	
521.0			10	SS	PM	520									1 26 51 22
56.0	Clayey silt, some sand, traces of gravel.														
510.5	Stiff to very stiff.		11	TW	Drive	510			7.36					131.5	5 18 47 30
66.5	End of Borehole														
								15 0 5 10	% Strain at Failure						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

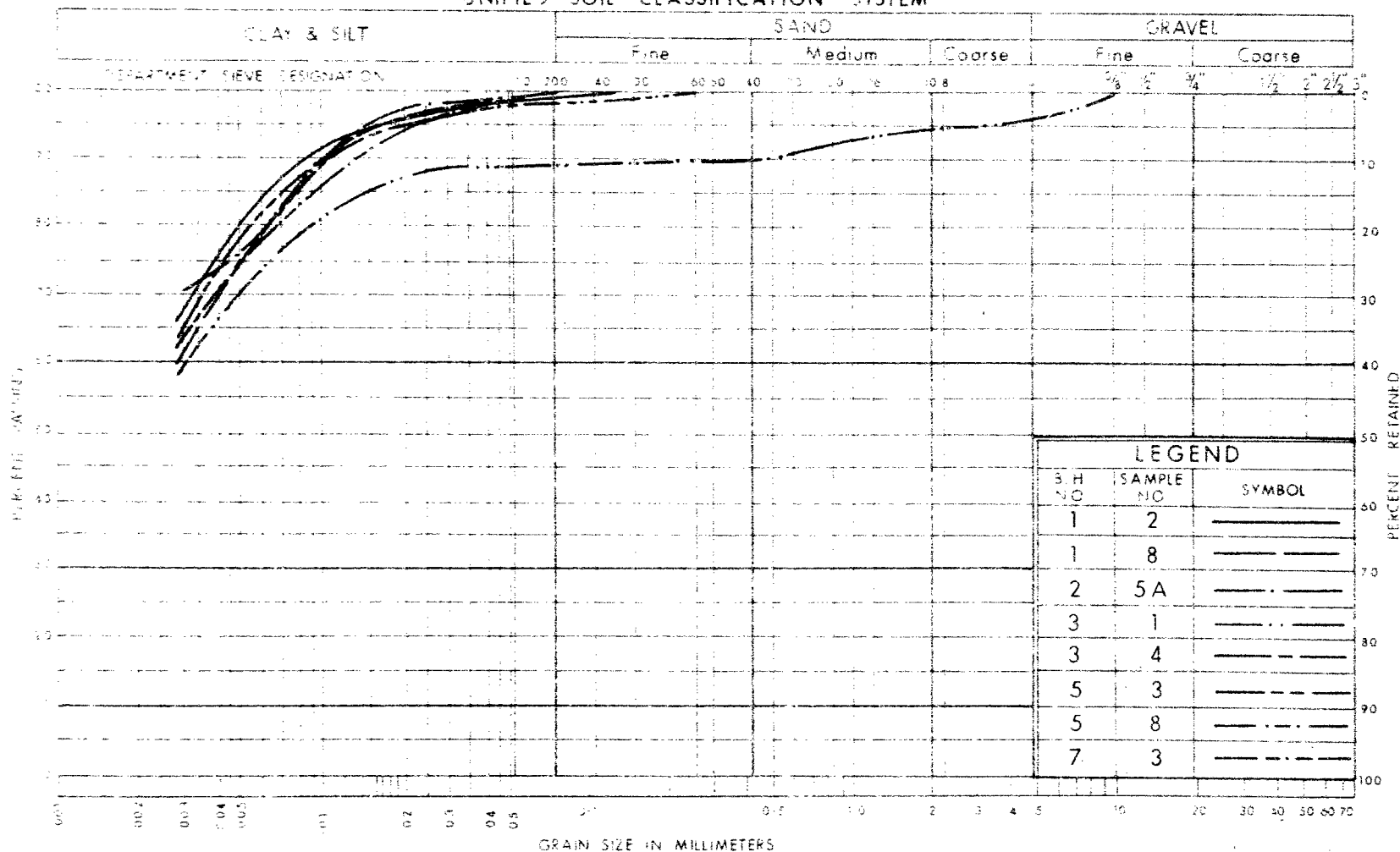
RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 68-F-42 LOCATION Sta. 26 + 69 68' Lt. ORIGINATED BY AP
W P 155-67-01 BORING DATE June 21, 1968 COMPILED BY WB
DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY LL

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P C F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P S F + Field Vane x Lab Vane o Unconfined	500 1000 1500 2000 2500	WATER CONTENT % 20 40 60	WL WP WL	WATER CONTENT % 20 40 60			
580.5	Ground Level														580.5
0.0	Sand, some gravel, traces of silt & clay		1	SS	6	580									Gr.Sa.Si.Cl.
571.5	Loose		2	SS	6										6 73 (11)
9.0	Silty clay. Firm to stiff.		3	TW	PM	570		9.5	2.1						
			4	TW	PM			+ 2.3							
			5	TW	PM			2.1							
556.0			6	TW	PM	560		2.3							
								x 11.0							
24.5	End of Borehole					550		0 15-0-5 10	% Strain at Failure						

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION SILTY CLAY TO CLAY

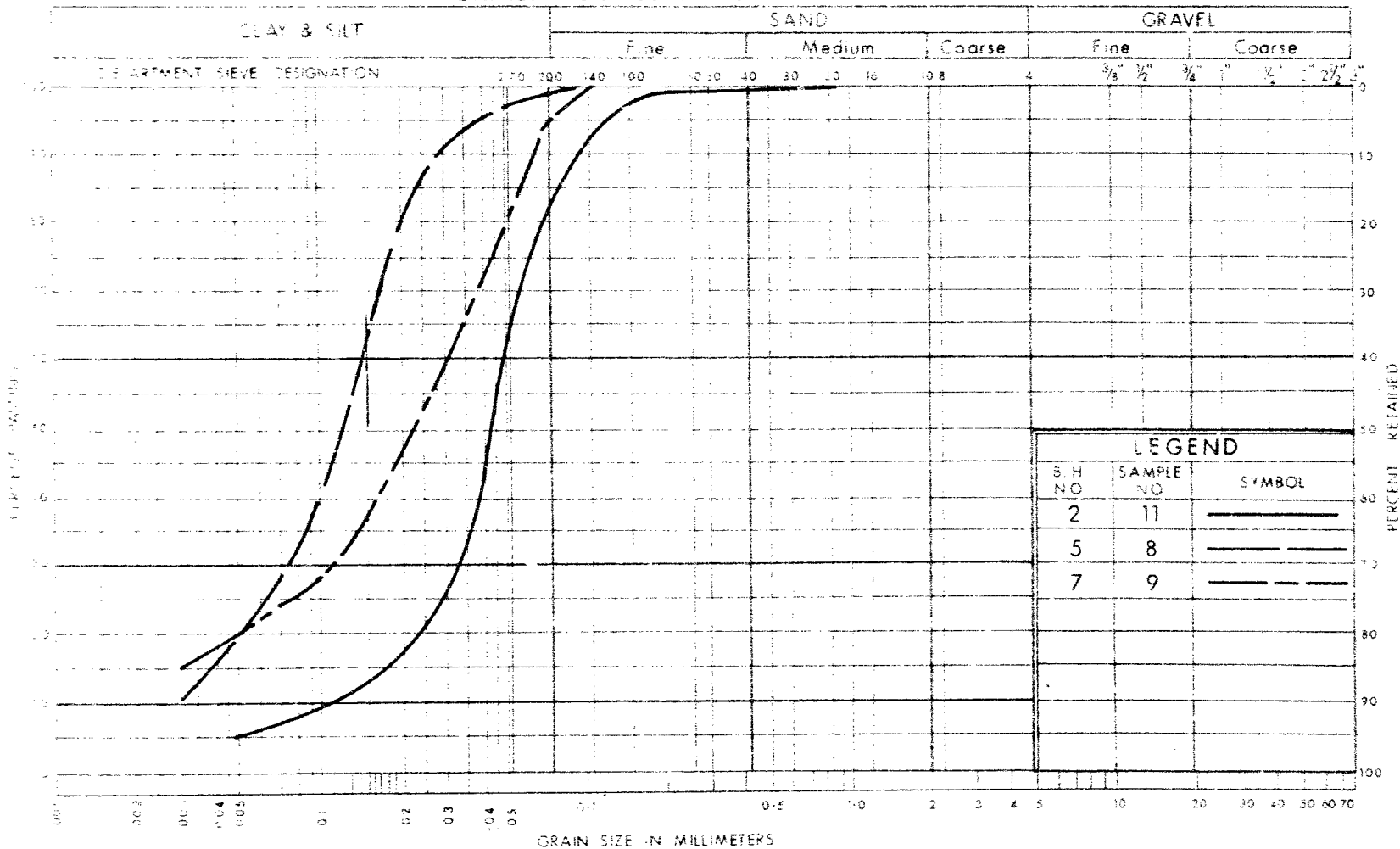
DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

W.P. No. 155-67-01

JOB No. 68-F-42

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION SILT

SOME SAND TRACES OF CLAY

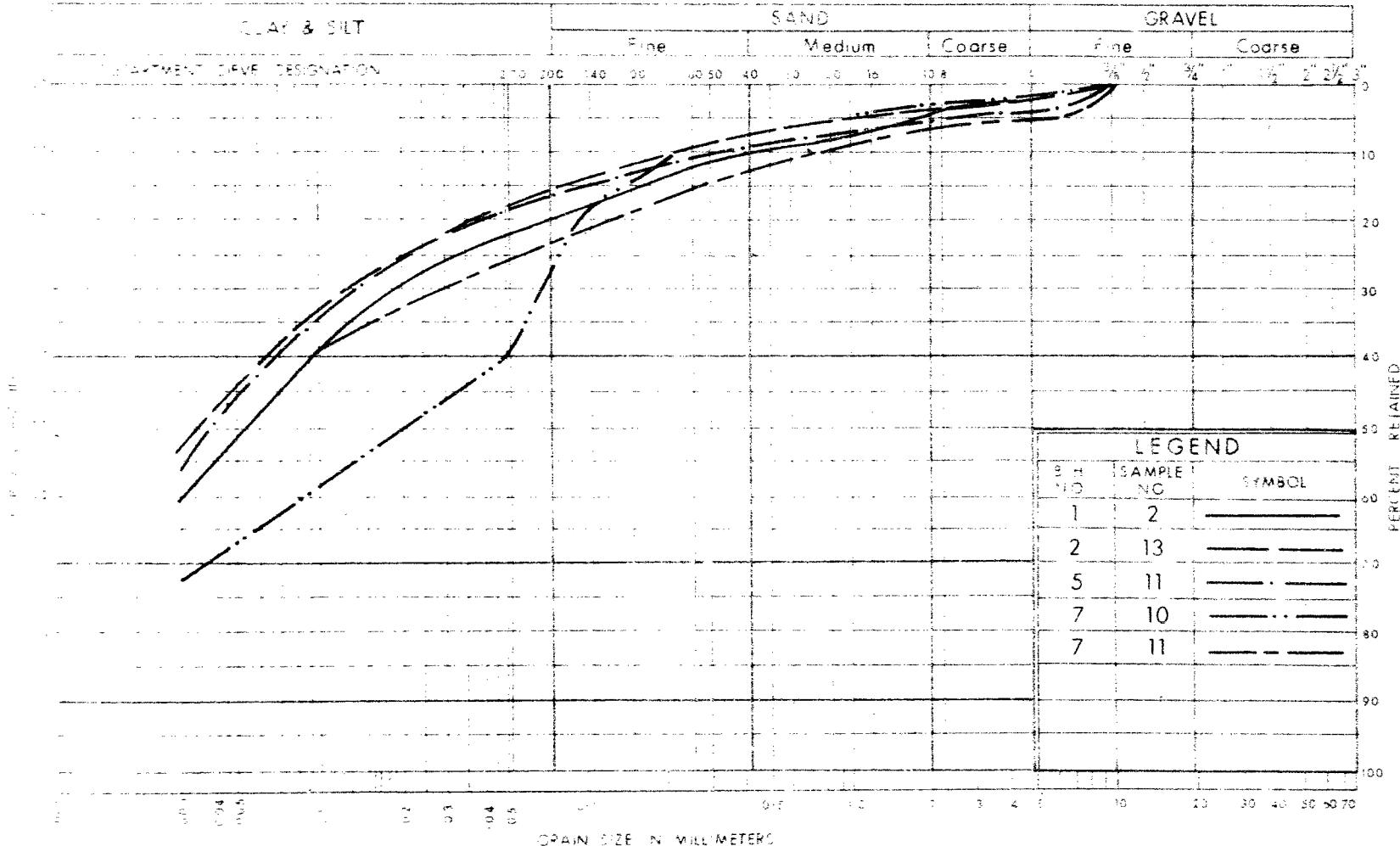
WP No. 155-67-01

JOB No. 68-F-42

FIG. 2

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT
SOME SAND TRACES OF GRAVEL

WP No. 155-67-01

JOB No. 68-F-42

FIG. 3

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

SHEAR STRENGTH VS. ELEVATION

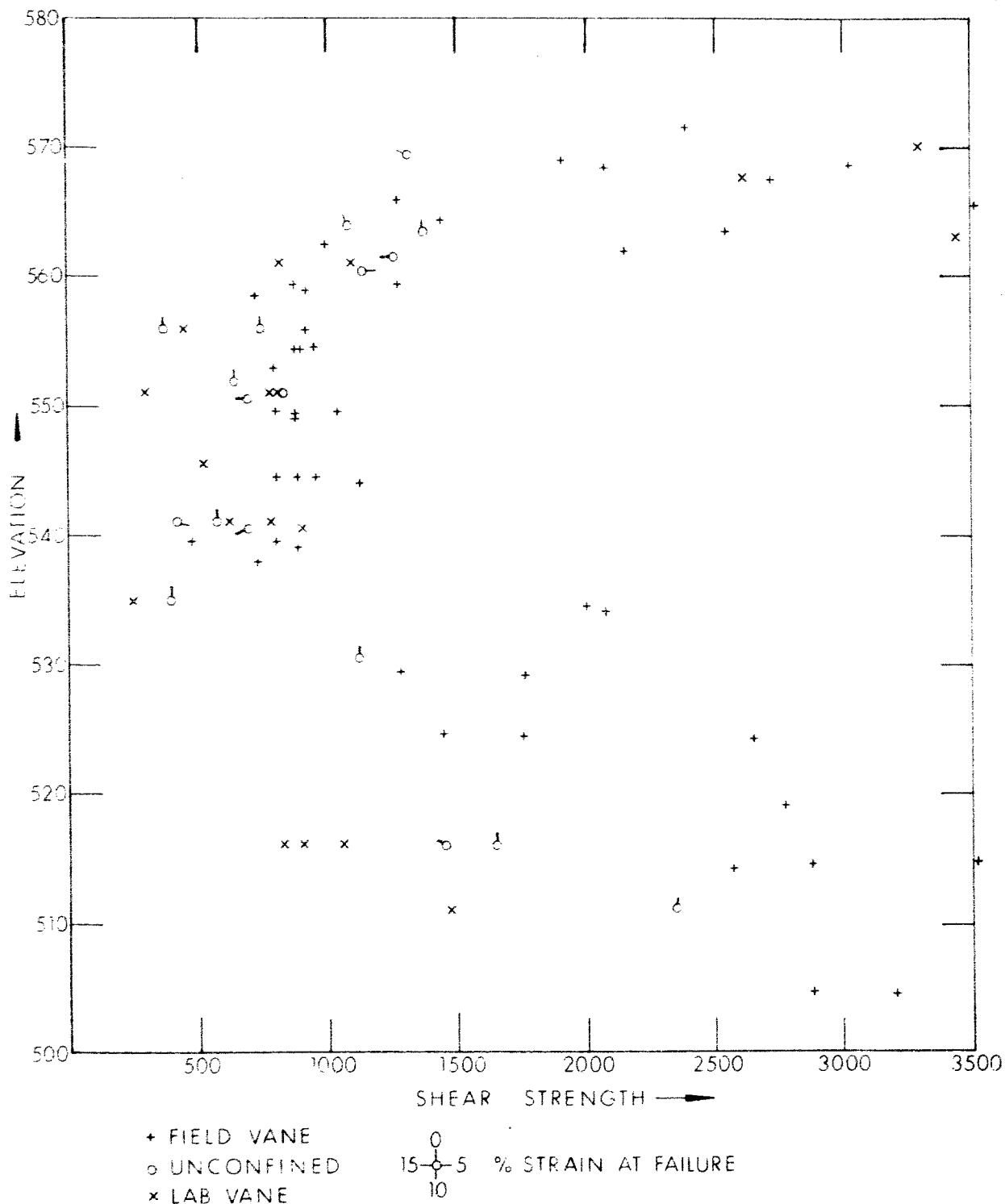


FIG. 4

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

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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_i	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

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: Bridge Office,
Downsview

ATTENTION:

DATE: January 27, 1969

OUR FILE REF.

IN REPLY TO

SUBJECT: Bowen Creek Structure
4.5 Mi. North of Sombra
W.P. 155-67-01, Site 14-173
Highway 40, District 1

68-F-42


Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest con-
venience.

CSG:rd

Attach.

c.c. J. Andersen


C.S. Grebski,
Bridge Design Engineer

no other comments
OK
2/1/69
NLS