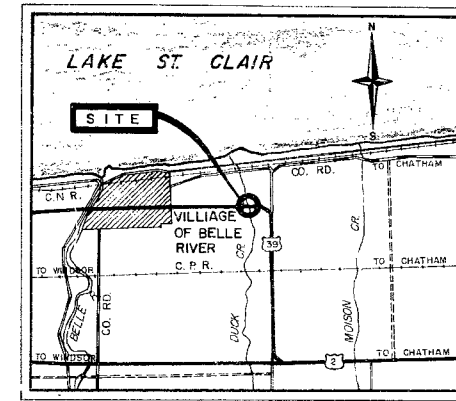
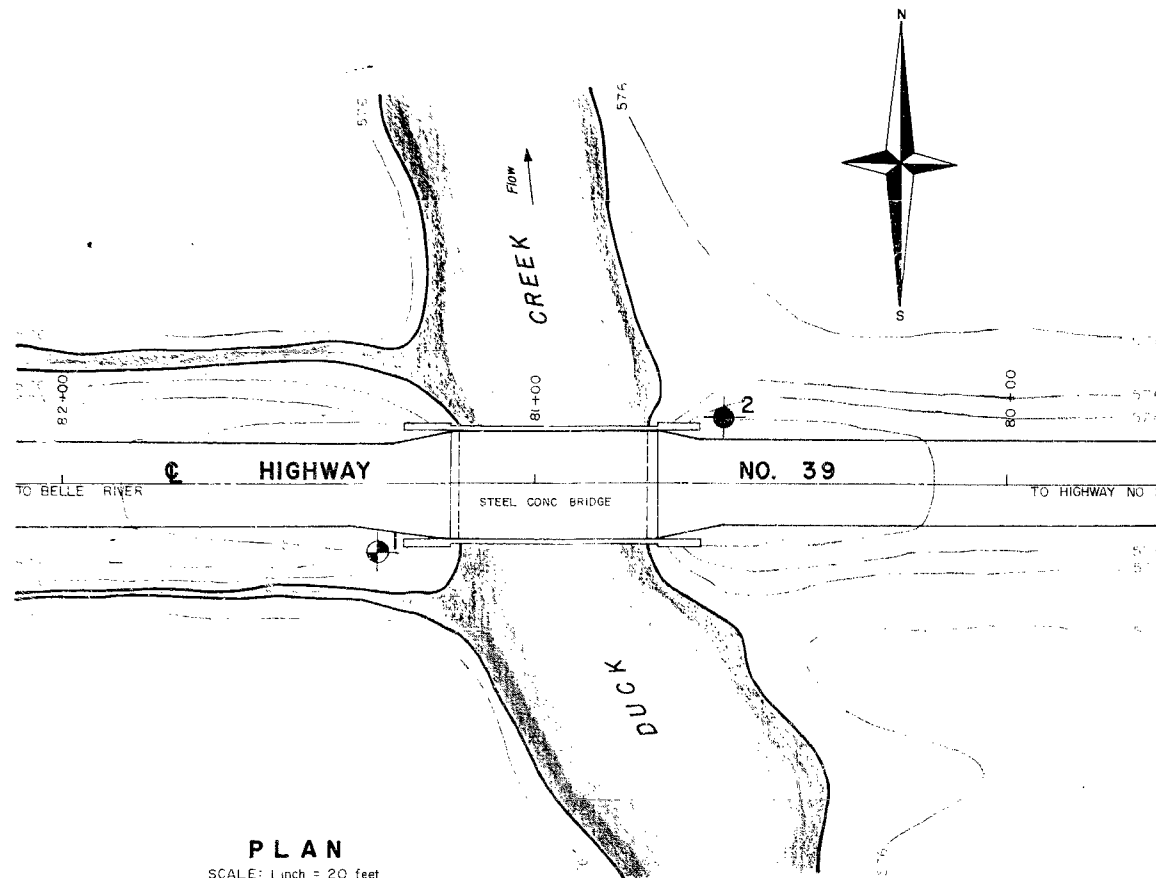
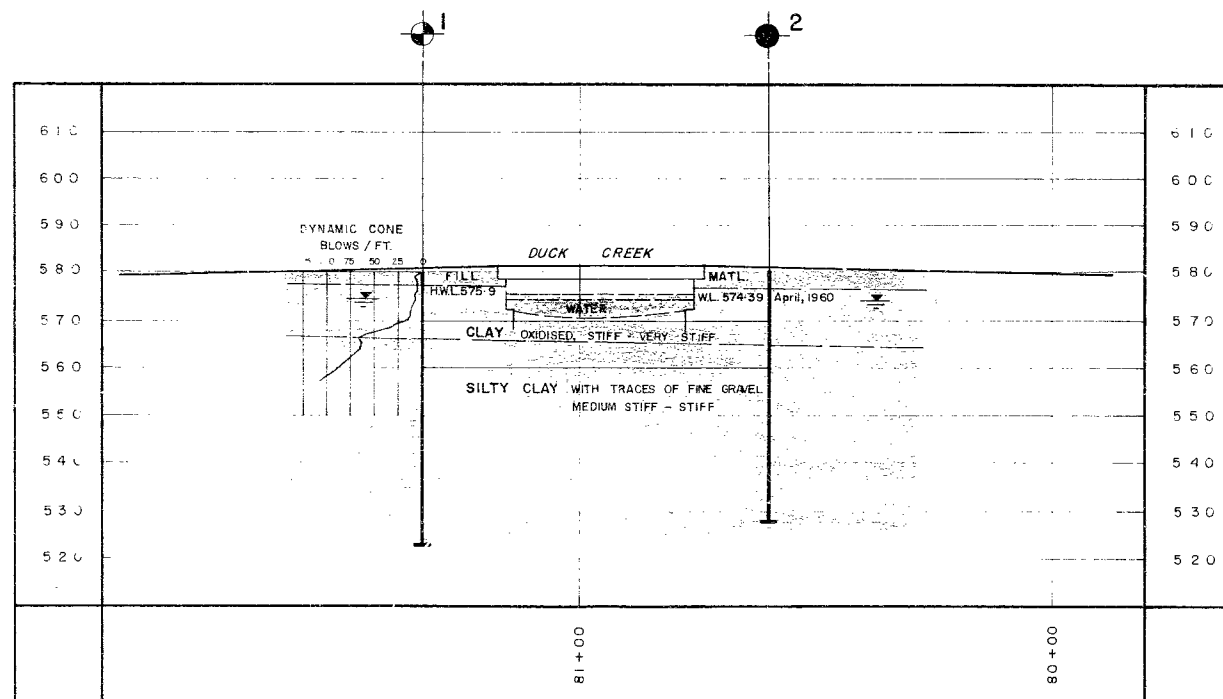


#  
61-F-103  
W.P.#  
143-61  
Hwy #  
39  
DUCK CREEK

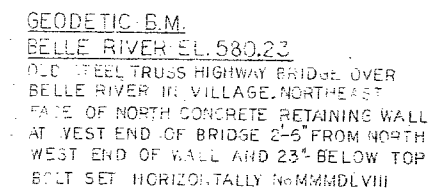
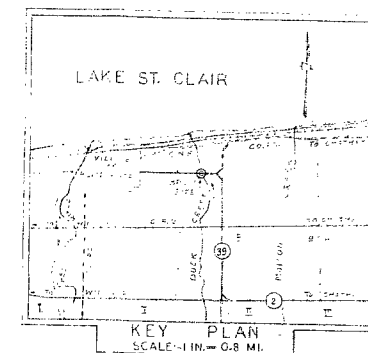
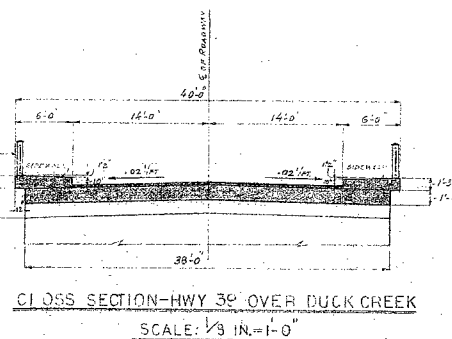
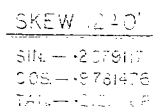


LEGEND			
	BORE HOLE		
	BORE & PENETRATION HOLE		
	WATER LEVELS ESTABLISHED AT TIME OF FIELD INVESTIGATION (OCT. 1961)		
HOLE	ELEVATION	STATION	OFFSET
1	580.0	81+33	14' LT.
2	580.0	80+60	14' RT.



**NOTE**  
THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

DEPARTMENT OF HIGHWAYS - ONTARIO		
MATERIALS & RESEARCH SECTION		
<b>DUCK CREEK AND HIGHWAY NO. 39</b>		
ORIGINATED M. DEVATA	DISTRICT NO. 1	DATE 11 OCT. 1961
DRAWN D. MUMFORD	W.P. NO. 143-61	JOB NO. 61-F-103
CHECKED <i>[Signature]</i>	SCALE	DRAWING NO.
APPROVED <i>[Signature]</i>	AS SHOWN	<b>61-F-103A</b>



<u>W.P. 143-61</u> <b>DEPARTMENT OF HIGHWAYS-ONTARIO</b> <b>BRIDGE OFFICE-TORONTO</b>																
<u>DUCK CREEK BRIDGE</u> <u>(AT BELLE RIVER EAST LIMITS)</u>																
THE KING'S HIGHWAY No. 39 CO. ESSEY TWP. ROCHESTER	S. No. 1 LOT 6-1 CON. I & II BRIDGE 1928															
<u>PRELIMINARY PLAN</u>																
<u>APPROVED</u>																
BRIDGE ENGINEER	DESIGN ENGINEER															
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">DESIGN</td> <td style="width: 15%;">A.R.B.</td> <td style="width: 15%;">CHECK</td> <td style="width: 15%;">M.M.</td> <td rowspan="3" style="width: 30%; text-align: center; vertical-align: middle;">           CONTRACT            NUMBERS              LOADING            H-20            S-16         </td> </tr> <tr> <td>DRAWING</td> <td>A.R.B.</td> <td>CHECK</td> <td>M.M.</td> </tr> <tr> <td>TRACING</td> <td></td> <td>CHECK</td> <td></td> </tr> </table>	DESIGN	A.R.B.	CHECK	M.M.	CONTRACT NUMBERS  LOADING H-20 S-16	DRAWING	A.R.B.	CHECK	M.M.	TRACING		CHECK		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; text-align: center;">DATE</td> <td style="width: 75%;">DECEMBER 1961</td> </tr> </table>	DATE	DECEMBER 1961
DESIGN	A.R.B.	CHECK	M.M.	CONTRACT NUMBERS  LOADING H-20 S-16												
DRAWING	A.R.B.	CHECK	M.M.													
TRACING		CHECK														
DATE	DECEMBER 1961															
DRAWING NUMBER <u>D-4984-P</u>																

DOCUMENT NUMBER IDENTIFICATION

GEOCRES No. 40J 7-3A

DIST. 1 REGION SOUTHWESTERN

W.P. No. 143-61-01

CONT. No. 78-01

W. O. No. \_\_\_\_\_

STR. SITE No. 6-34

HWY. No. \_\_\_\_\_

LOCATION DUCK CREEK BRIDGE AT  
HWY. 2

OVERALL DRAWING IS TO BE USED FOR THE REPORT 4

REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



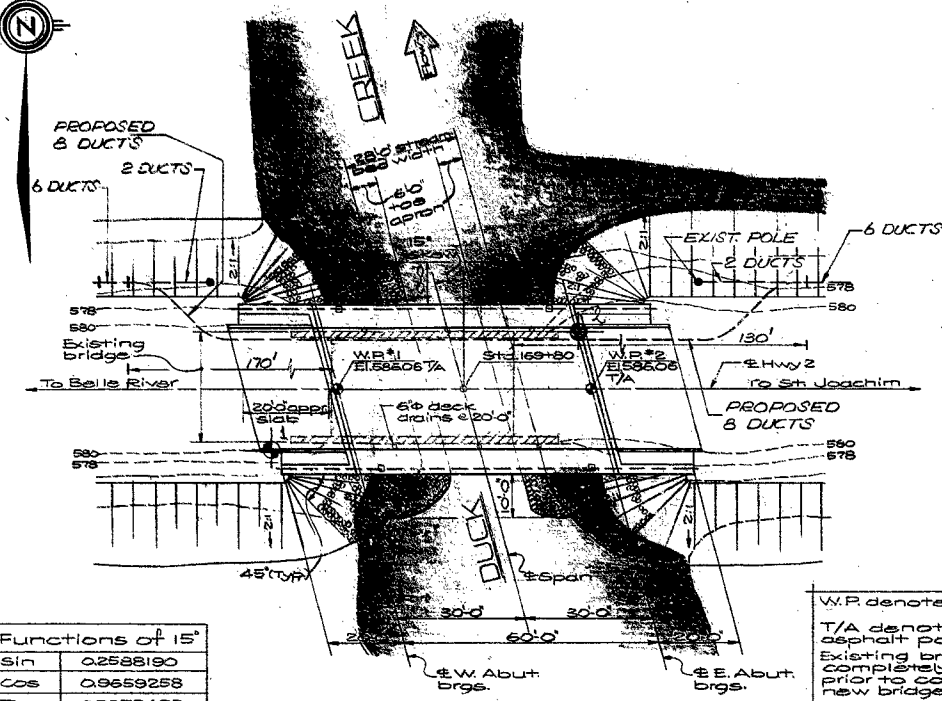
REVISIONS			
	DATE	BY	DESCRIPTION

APPROVED _____				CONTRACT No. _____	
STRUCTURAL ENGINEER					
DESIGN	C.F.F.	CHECK	J. S.	W.P. No.	143-61-01
DRAWING	E.O'N.	CHECK	C.F.F.		
DATE	APR. 75	LOADING	HS-20-44	SITE No. 6-34	SHEET 3

USE SCALE BELOW

0 1 2

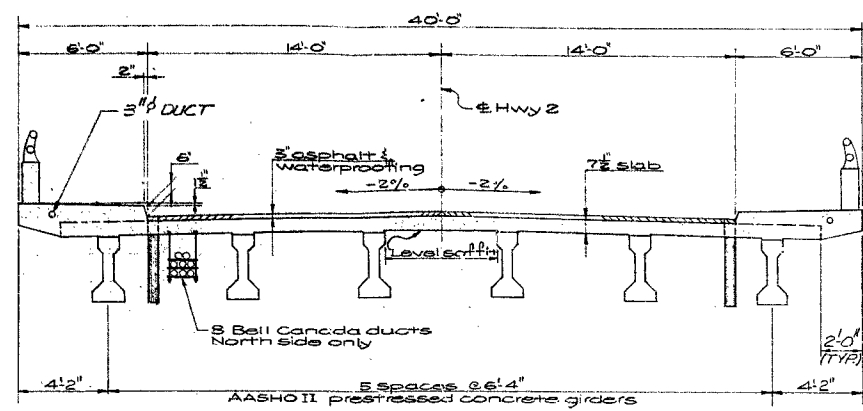
3 INCHES ON ORIGINAL PLAN



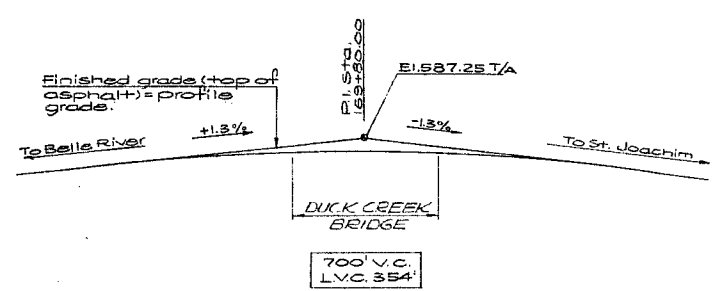
Functions of 15'	
Sin	0.2588190
Cos	0.9659258
Tan	0.2679492
Sec	1.0352762

W.P. denotes working point  
T/A denotes top of asphalt pavement.  
Existing bridge to be completely removed prior to construction of new bridge.

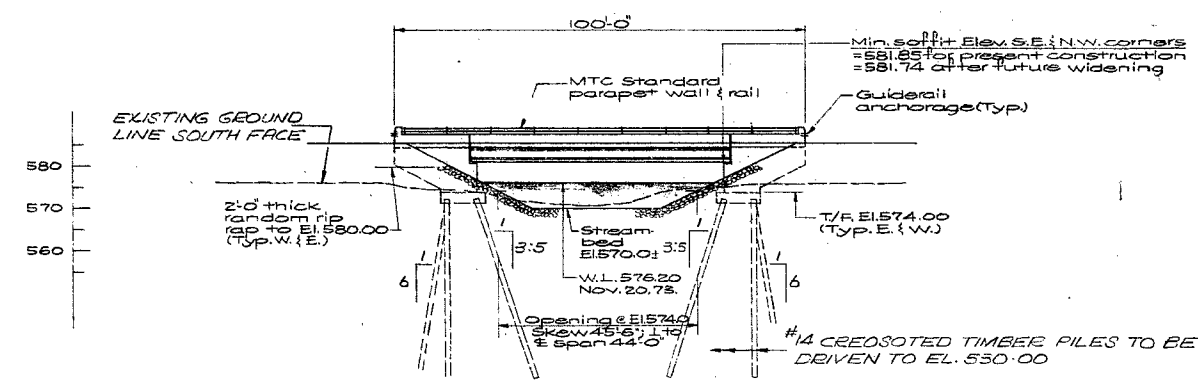
PLAN  
1"=20'-0"



DECK CROSS SECTION  
1"=1'-0"



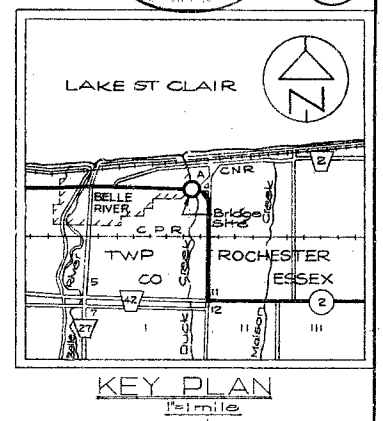
E PROFILE OF HWY. 2  
N.T.S.



ELEVATION  
1"=20'-0"

NOTE  
FOR DETAILS OF STREAM EXCAVATION SEE GRADING DRAWINGS.

RECEIVED  
APR 1 1975



NOTES

- CLASS OF CONCRETE  
ABUTMENTS & APPROACH SLABS 3,000 P.S.I.  
GIRDERS 5,000 P.S.I.  
DECK, SIDEWALKS & PARAPET WALLS 4,000 P.S.I.
- CLEAR COVER ON REINFORCING STEEL  
ABUTMENTS — 3"  
DECK — TOP 2" BOTTOM 1 1/2" (SEE NOTE DWG. 6)  
PARAPET WALLS — 1 1/2"  
AND/OR AS NOTED ON DRAWINGS.
- CONSTRUCTION NOTES  
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF 1/8".  
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

LIST OF DRAWINGS

- 6-34-1 GENERAL PLAN  
- 2 BORE HOLE LOCATIONS & SOIL STRATA  
- 3 FOOTINGS  
- 4 ABUTMENTS  
- 5 PRESTRESSED GIRDERS & BEARINGS  
- 6 DECK  
- 7 PARAPET WALL DETAILS  
- 8 STEEL PARAPET RAILING  
- 9 20 FOOT APPROACH SLAB  
- 10 BRIDGE ELECTRICAL DETAILS - TYPE A  
- 11 STANDARD DETAILS I  
- 12 STANDARD DETAILS II

B.M. 581.29

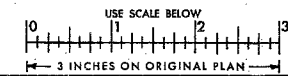
GEODETIC DATUM

TOP S.E. COR. N.W. CONC. ABUTMENT OF BRIDGE  
12-2' LT. 169 + 39.

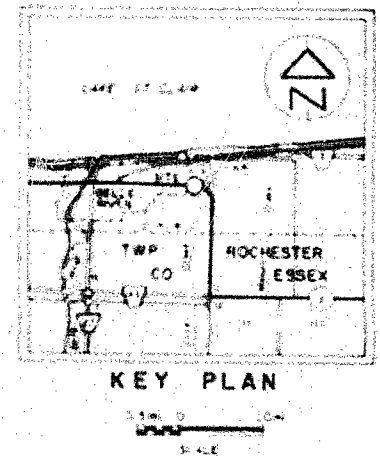
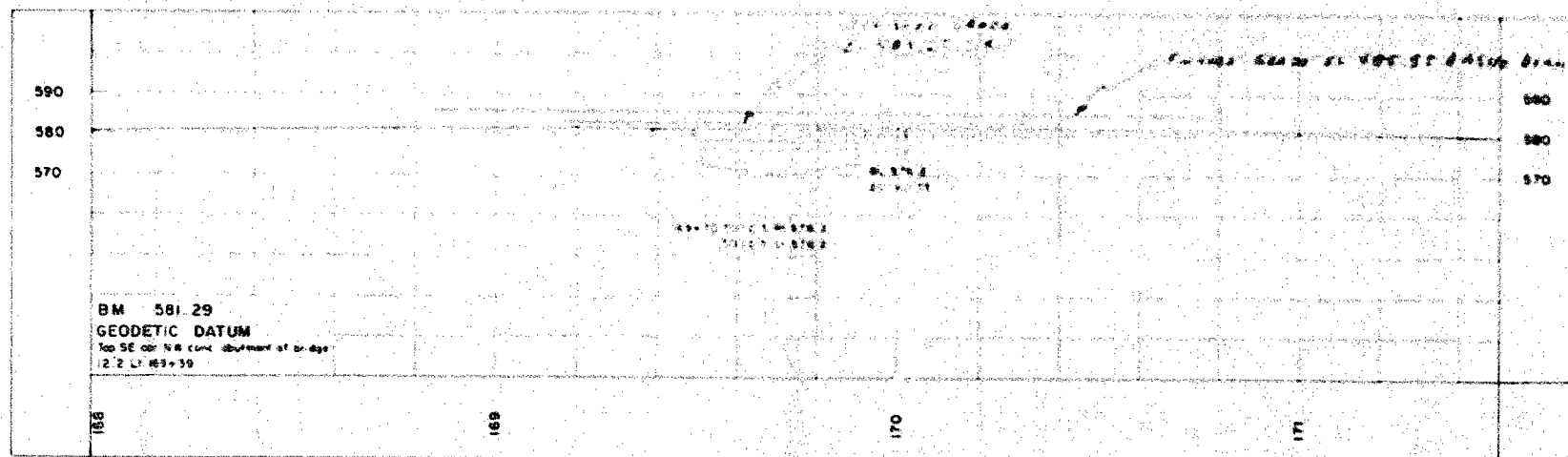
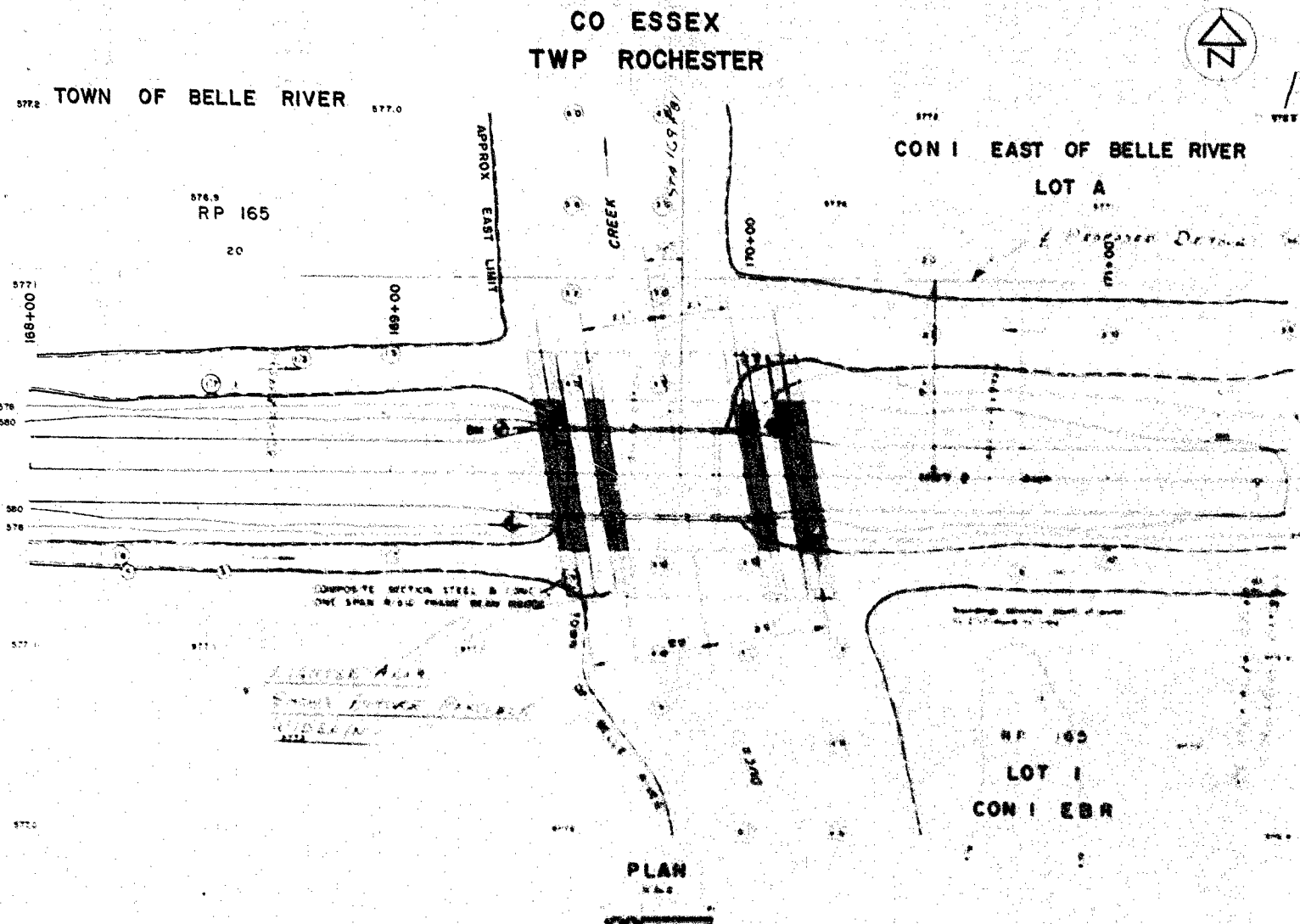
REVISIONS	DATE	BY	DESCRIPTION



FOR REDUCED PLAN

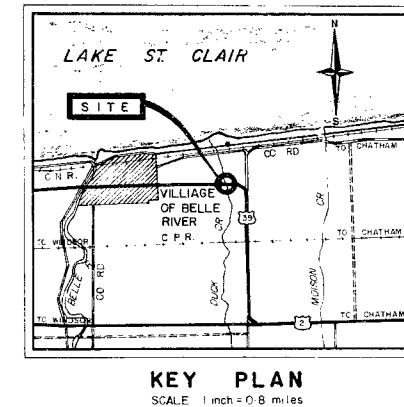
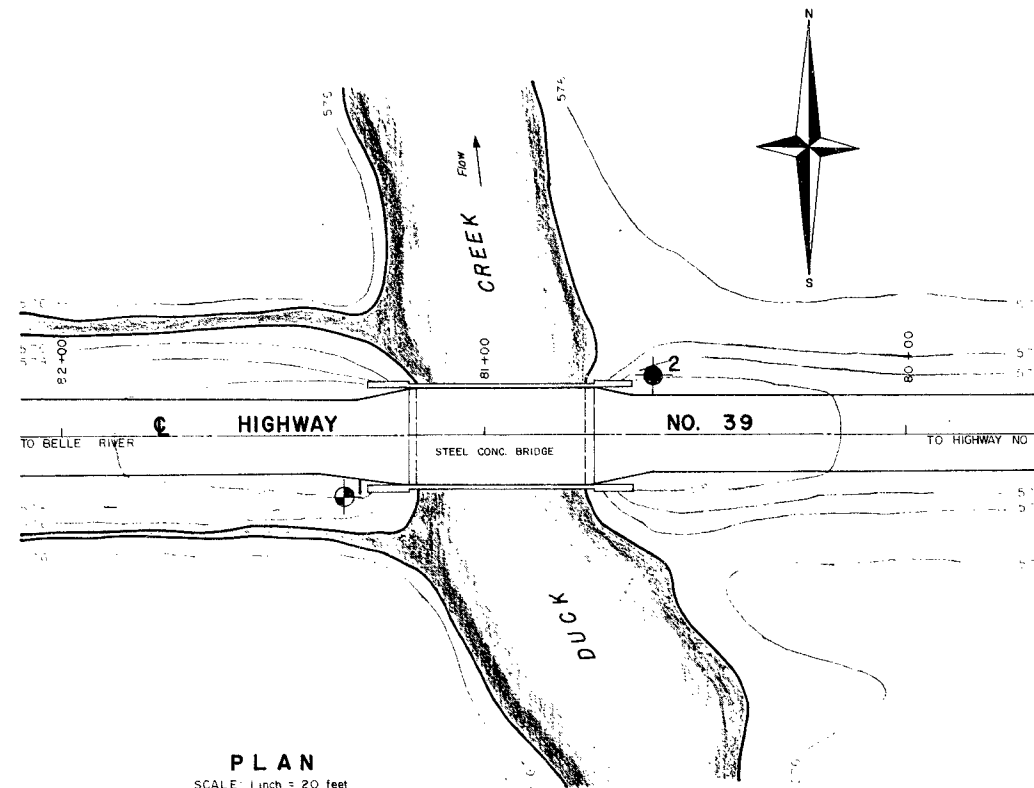


MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO	
40J7-3A	
DUCK CREEK BRIDGE At Belle River East Limits	
KING'S HIGHWAY No. 2	DIST. No. 1
CO. Essex	
TWP. Rochester	LOT 111A CON. 1 E.B.R.
GENERAL PLAN	
APPROVED	CONTRACT No.
DESIGN C.F.F. CHECK J.P.	W.P. No. 143-61-01
DRAWING G.C. CHECK G.B.	
DATE APR 75	LOADING 152044 SITE No. 6-34 SHEET 1

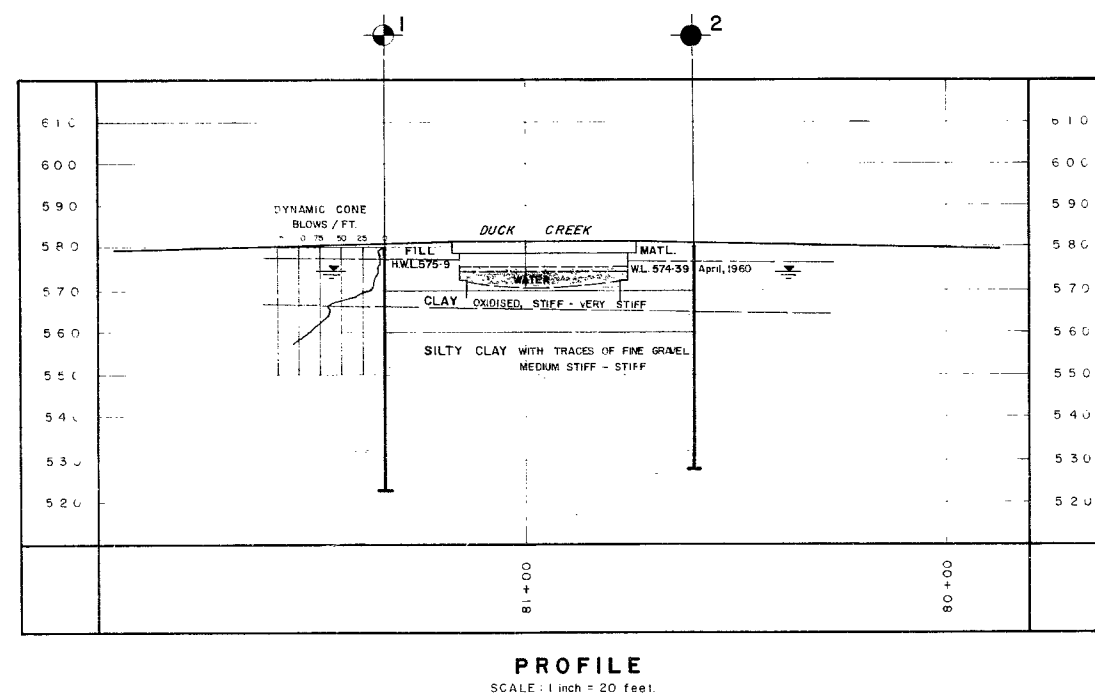


WP 143-61-01

DATE	REVISIONS & ADDITIONS	BY	CHK'D
4037-3A			
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS DESIGN DIVISION - DESIGN SERVICES BRANCH ENGINEERING SURVEYS OFFICE SOUTHWESTERN REGION			
BRIDGE SITE			
EXISTING CROSSING AT HWY 2 AND DUCK CREEK APPROX 0.1 MI WEST OF CO ROAD 25			
LOT 18 1A TWP ROCHESTER		CON 1 EBR CO ESSEX	
SCALE AS SHOWN	DISTRICT CHATHAM	REGION SOUTHWESTERN	
W.O. 93-631-71	Date of Survey Nov '73 Plan Nov '73	SITE	
SURVEY BY Chief of Party B FOX Supervisor R AGNEW		DRAWN BY Draftsman J VORDING & J TAYLOR Supervisor J SALVATORI	
CHECKED BY Draftsman J SALVATORI Supervisor J SALVATORI		PLAN E-5348-1	



LEGEND			
	BORE HOLE		
	BORE & PENETRATION HOLE		
	WATER LEVELS ESTABLISHED AT TIME OF FIELD INVESTIGATION (OCT. 1961)		
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4057-3A

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**DUCK CREEK  
AND  
HIGHWAY NO. 39**

ORIGINATED M. DEVATA	DISTRICT NO. 1	DATE 11 OCT 1961
DRAWN D. MUMFORD	W.P. NO. 143-61	JOB NO. 61-F-103
CHECKED <i>HL</i>	SCALE	DRAWING NO.
APPROVED <i>W. H. H. H. H.</i>	AS SHOWN	<b>61-F-103A</b>

REF. NO. E-3953



Mr. A. M. Teye,  
Bridge Engineer.  
Materials & Research Division,  
(Foundations Office).  
Attention: Mr. E. McCosbie.

October 23, 1961.

D.E.O. FOUNDATION INVESTIGATION  
REPORT.  
W.J. 61-1-13 -- W.P. 143-61.

Re: Duck Creek and Hwy. 39, (Approx. 1 Mile E.  
of Belle River) Twp. of Rochester, County  
of Essex. Lots 12 - 13, District No. 1.

Accompanying this memo, is our detailed foundation  
report on the subsoil conditions existing at the above site.

We believe you will find the conclusions and recom-  
mendations summarized in the report, self-explanatory and adequate  
for your future design work.

If further assistance is required in connection with  
the above project, please do not hesitate to contact our Office.

AGS/Mief  
attach.

cc: Messrs. A. M. Teye (2)  
H. A. Fregaskes  
H. D. McMillan  
A. Gater  
C. U. Howell  
J. Roy  
T. J. Kovich  
J. E. Graspier  
E. H. Saint  
F. Norman  
A. Watt  
Foundations Office  
Gen. Files.

*A. G. Sterns*  
A. G. Sterns,  
PRINCIPAL FOUNDATION ENGINEER

## FOUNDATION INVESTIGATION

at

Duck Creek and Hwy. 39, (Approx. 1 Mile E.  
of Belle River) Twp. of Rochester, County  
of Essex, Lots 17 - 18, District No. 1,  
W.J. 61-F-103 -- W.P. 143-61.

---

### 1. INTRODUCTION:

It is proposed to construct a new bridge to carry Hwy. #39 over Duck Creek at the above-mentioned location. The existing structure is a steel girder bridge having a 40.0' span. The new structure is to be re-positioned for hydrological reasons and will be slightly wider than the existing structure. The new span will be 40 ft.

A field investigation was carried out by this Section in order to determine the subsoil conditions at the site. The results and discussion of the field work and laboratory testing, together with conclusions and recommendations, are presented in this report.

### 2. DESCRIPTION OF THE SITE & GEOLOGY:

The site is located on the south shore of Lake St. Clair. The site and its surrounding area is generally flat, open farmland at present under cultivation.

Physiographically, the site under consideration, is located on the Essex Clay Plain of the St. Clair Clay Plains, inundated by glacial Lakes Whittlesey and Warren. According to available geological information, these extensive plains covering a large

cont'd. /2 ...

## TABLE OF CONTENTS

1. INTRODUCTION.
  2. DESCRIPTION OF THE SITE & GEOLOGY.
  3. FIELD & LABORATORY WORK.
  4. SUBSOIL CONDITIONS.
  5. WATER CONDITIONS.
  6. DISCUSSION AND RECOMMENDATIONS.
  7. SUMMARY.
  8. MISCELLANEOUS.
-

2. DESCRIPTION OF THE SITE & GEOLOGY: (cont'd.) ...

area of South-Western Ontario, are covered by deep deposits of clay, underlain by limestone or shale bedrock. At this site, the upper zone of the clay stratus was found to be desiccated and in a very stiff condition for a depth approximately 10 to 12 ft.

3. FIELD & LABORATORY WORK:

Two sampled boreholes and one dynamic cone penetration test were carried out at the site. Disturbed samples were recovered by means of 2" O.D. split spoon. Driving energy to advance the split spoon, and the dynamic cone, was 350 ft. lbs. per blow. Wherever possible in cohesive materials, undisturbed samples were obtained by means of 2" I.D. thin-walled Shelby tube sampler. In addition, in-situ vane tests were carried out in the field to determine the shear strength of the cohesive materials. Laboratory tests were carried out on selected representative samples to determine the following physical properties:-

- 1) Natural Moisture Content.
- 2) Atterberg Limits.
- 3) Bulk Density.
- 4) Undrained Shear Strengths.

Results of the above tests, as well as field test results, are presented in Appendix I of this report.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

Subsoil at the site consists mainly of cohesive deposits. Reference to the borehole logs indicates that the site is underlain by a shallow layer of fill material approximately 3 ft. thick, followed by a deep deposit of lacustrine silty clay containing a minor percentage of fine gravel. The upper 12 ft. of the desiccated crust was found to be in a stiff to very stiff preconsolidated state. Average values of Unit weight, Atterberg Limits and undrained Shear Strength of the desiccated crust are as follows:-

Natural Moisture Content ...	22%
Liquid Limit .....	57%
Plastic Limit .....	25%
Unit Weight (Bulk) .....	120 p.c.f.
Undrained Shear Strength ...	2500 p.s.f.

Immediately below the desiccated crust, the non-oxidized stratum of silty clay was encountered. The silty clay extends to the full depth of the exploration and was penetrated to a maximum depth of 57.0' in B.H. #1.

Atterberg limit determinations on the non-oxidized clay stratum indicate that the liquid limit ranges from 27% to 36%, whereas the plastic limit ranges from 14% to 18%. The average values for the liquid and plastic limits are 33% and 17%, respectively.

The results of the Atterberg limits are plotted on the Casagrande plasticity chart and indicate that the stratum is predominantly an 'inorganic silty clay of intermediate plasticity.

cont'd. /4 ...

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

Wet unit weight determinations on samples from the stratum gave values ranging from 127 to 130 p.s.f. with the corresponding natural moisture contents ranging from 19% to 22%. This indicates that the moisture content is slightly higher than the plastic limit of the non-oxidized stratum.

Triaxial compression tests carried out on selected samples gave shear strength values ranging from 965 to 1490 p.s.f. The shear strength increases with depth, with an average value of 1000 p.s.f. at the surface of this layer, to about 1400 p.s.f. at 55 ft. below the ground surface. From the results of the triaxial tests, together with the in-situ field vane tests, it can be concluded that the consistency of this stratum ranges from med. stiff to stiff.

5. WATER CONDITIONS:

Due to the impermeable nature of the subsoil strata, it was not possible to establish too accurately the elevation of the ground water table during the boring programme. Therefore, it has been assumed that the ground water table will be approximately at the same elevation as the water level in the creek. During the time of the investigation, the water level in the creek was at approx. elev. 574.5'.

6. DISCUSSION AND RECOMMENDATIONS:

The upper stiff clay crust is competent to provide adequate foundation support for the proposed structure. Laboratory and field vane test results indicate that spread footing support can be obtained

cont'd. /5 ...

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

at elev. 568.0' with an allowable bearing pressure of 2 T.S.F. Footings founded at elev. 568.0' should have sufficient protection from frost action. In view of the relatively uniform subsoil conditions at the site, differential settlements will be negligible in the case of a single span structure, since each abutment will virtually settle the same amount.

For all practical purposes, the subsoil can be considered as relatively impermeable, hence, dewatering of the excavations should present no special problems. Before beginning the excavation, it is suggested that a cofferdam be built to such a height so as to prevent water from the creek entering the excavation. Any seepage water that may enter the cutting may be removed by the use of pumps.

The excavation may be made with vertical sides and brought down to the required elevation; a working slab should be poured immediately to prevent softening of the clay material.

Approach fill slopes of 2:1 should not present any stability problems. It is recommended that the latter be protected by rock rip-rap to the H.W.L.

7. SUMMARY:

The subsoil at the site consists of a deep deposit of lacustrine clay containing a minor percentage of fine gravel. The upper 10 to 12 ft. of the clay deposit has been subjected to oxidation and desiccation.

Spread footing support can be obtained at a shallow depth at this site. A safe permissible bearing capacity of 2 T.S.F. can be applied at elev. 568.0'.

cont'd. /6 ...

7. SUMMARY: (cont'd.) ...

In view of the relatively uniform subsoil conditions at the site, differential settlements of any consequence, are not anticipated for a single-span structure.

Due to the highly impermeable nature of the subsoil, dewatering for the excavation should present no special problems.

The creek water may be prevented from entering the footing excavation by using a cofferdam. Low capacity pumps may be used to keep the excavation free from seepage.

No stability problems are anticipated with regard to the approach fills. Rip-rap should be provided for the slopes below H.W.L.

8. MISCELLANEOUS:

The field work was carried out during the period Oct. 5th and 6th, 1961. Equipment used was owned and operated by Johnston Drilling Co., under the supervision of Mr. M. Devata of the Foundation Section of the Department of Highways.

October 1961. REPORT PREPARED BY: *B.M. Handa*  
for M. Devata,  
JR. PROJECT FOUNDATION ENGR.

REPORT APPROVED BY: *Afternoon*  
A. G. Sternac,  
PRINCIPAL FOUNDATION ENGR.



APPENDIX I.

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-103W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	2'-3.5'	2-2.5 Fill material (clay & gravel) 2-5-3.5 Oxidized stiff brown clay.	12	22.8	27.9	55.4	-	-	
	S2	3.5'-5'	Oxidized stiff brown clay with occasional fine gravel.	14	23.4	25.4	63.4	-	115.0	
	T3	5'-6.5'	Oxidized brown clay-V. stiff.	Pushed	-	-	-	-	-	
	T4	6.5'-8'	" " "	Pushed	22.8	26.1	61.8	2680	127.8	
	S5	8'-9.5'	" " "	20	23.5	-	-	-	-	
	T6	10'-11.5'	" " "	Pushed	22.5	-	-	4460	133.9	
	T7	11.5'-13'	" " "	"	-	-	-	-	-	
	S8	13'-14.5'	" " "	19	27.5	-	-	-	-	
	S9	15'-16.5'	Grey silty clay with traces of fine gravel. Med. stiff.	7	17.4	14.9	27.1	-	127.1	
	T10	16.5'-18'	" " "	Pushed	19.5	-	-	990	130.6	
	VANE	19.5'		-	-	-	-	1520	-	Sens: 1.7
	T11	21'-22.5'	" " " - stiff	Pushed	-	-	-	-	-	
	T12	22.5'-24'	Grey silty clay with traces of occasional fine gravel-stiff.	Pushed	-	16.3	32.8	-	-	
	VANE	25.5'		-	-	-	-	1600	-	Sens: 1.3
	T13	27'-28.5'	" " "	Pushed	-	17.2	35.9	-	-	

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-103

W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	VANE	30'		-	-	-	-	1760	-	Sens: 1.4
	T14	31'-32'	Grey silty clay with traces of occasional fine gravel-stiff.	Pushed	-	-	-	-	-	
	S15	32'-32.5'	" " "	14	21.3	17.0	33.6	-	125.0	
	T16	35'-36.5'	" " "	Pushed	21.2	18.3	35.4	1320	128.6	
	VANE	38'		-	-	-	-	1840	-	Sens: 1.4
	G17	40'	" " "	-	21.5	-	-	-	-	
	T18	44'-45.5'	" " "	Pushed	21.0	-	-	1490	128.9	
	VANE	47'		-	-	-	-	1920	-	Sens: 1.2
	G19	50'	Grey silty clay with traces of occasional fine gravel-Stiff	-	21.8	-	-	-	-	
	T20	54'-55.5'	" " "	Pushed	-	-	-	-	-	
2	VANE	57'		-	-	-	-	1760	-	Sens: 1.6
	S1	2'-3.5'	2-3.0 Fill material (clay & gravel) 3.0-3.5 Oxidized brown clay.	10	21.0	21.8	54.6	-	-	
	S2	4'-5.5'	Oxidized brown clay-V. stiff.	7	23.0	27.2	60.0	-	118.2	
	S3	7'-8.5'	" " "	9	19.2	20.5	43.6	-	-	
	T4	8.5'-10'	" " "	Pushed	-	-	-	-	-	
	T5	10'-11.5'	" " "	"	-	-	-	-	-	

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-103W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
2	T6	14'-15.5'	Grey silty clay with traces of occasional fine gravel-Stiff.	Pushed	-	-	-	-	-	
	VANE	17'		-	-	-	-	1040	-	Sens: 1.7
	T7	20'-21.5'	" " " " - Med. stiff.	Pushed	21.6	17.3	33.2	965	127.3	
	VANE	23'		-	-	-	-	1280	-	Sens: 1.9
	G7B	23'	Grey silty clay with occasional fine gravel. Stiff.	-	-	-	-	-	-	
	T8	24'-25.5'	" " "	Pushed	-	-	-	-	-	
	VANE	27'		-	-	-	-	1160	-	Sens: 1.7
	G9A	29'	" " "	-	21.8	-	-	-	-	
	T9	29'-30.5'	" " "	Pushed	-	-	-	-	-	
	VANE	31.5		-	-	-	-	1120	-	Sens: 1.3
	T10	34'-35.5'	" " "	Pushed	-	-	-	-	-	
	VANE	37'		-	-	-	-	1600	-	Sens: 2.0
	G11	39'	" " "	-	-	-	-	-	-	
	G12	47'	" " "	-	-	-	-	-	-	

JOB 61-F-103

W.P. 143-61

[illegible]

W.P. 143-61 BORE HOLE NO. 1  
JOB 61-F-103 STATION 81+33 (14' Lt.)  
DATUM 580.0' COMPILED BY B.K.  
BORING DATE Oct. 5/61. CHECKED BY M.D.

1/2 UNCONFINED COMPRESSION (Qu)	0
VANE TEST (C) AND SENSITIVITY (S)---	+ <sup>s</sup>
NATURAL MOISTURE AND	LI
LIQUIDITY INDEX -----	X
LIQUID LIMIT -----	0
PLASTIC LIMIT -----	1

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE						CONSISTENCY				SAMPLE	NATURAL UNIT WT.
				P.S.F.											R C F.
				500	1000	1500	2000	2500							
				BLOW / FT.											
				25	50	75	100	125		MOIST. CONTENT - % DRY WT.	20	40	60	80	
	↓ Groundlevel	580.0	0							XI				S1	-
/ \	Fill material (clay & gravel)	577.5		O						XII				S2	115.0
	Oxidized stiff to v. stiff brown clay. W.L.	574.5								XIII				T3	-
			10							XIV				T4	127.8
										*				S5	-
										* X				T6	133.9
		566.5								XV				T7	-
										XVI				S8	129.1
			20							XVII				T10	130.6
	Silty clay with traces of fine gravel med. stiff to stiff grey.									XVIII				T11	-
										XIX				T12	-
			30							X				T13	-
										XI				T14	125.0
										XII				G15	128.6
			40							XIII				G17	-
										XIV				T18	128.9
			50							XV				G19	-
										XVI				T20	-
		523.0	60							XVII					
	End of borehole.									XVIII					

Penetration resistance profile shown; obtained by driving a 2" dia. cone from groundlevel to depth noted with an energy of 350 ft. lb. per blow.

# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 143-61 BORE HOLE NO. 2  
 JOB 61-F-103 STATION 80+60 (14' Est.)  
 DATUM 580.0' COMPILED BY B.K.  
 BORING DATE Oct. 6/61. CHECKED BY M.D.

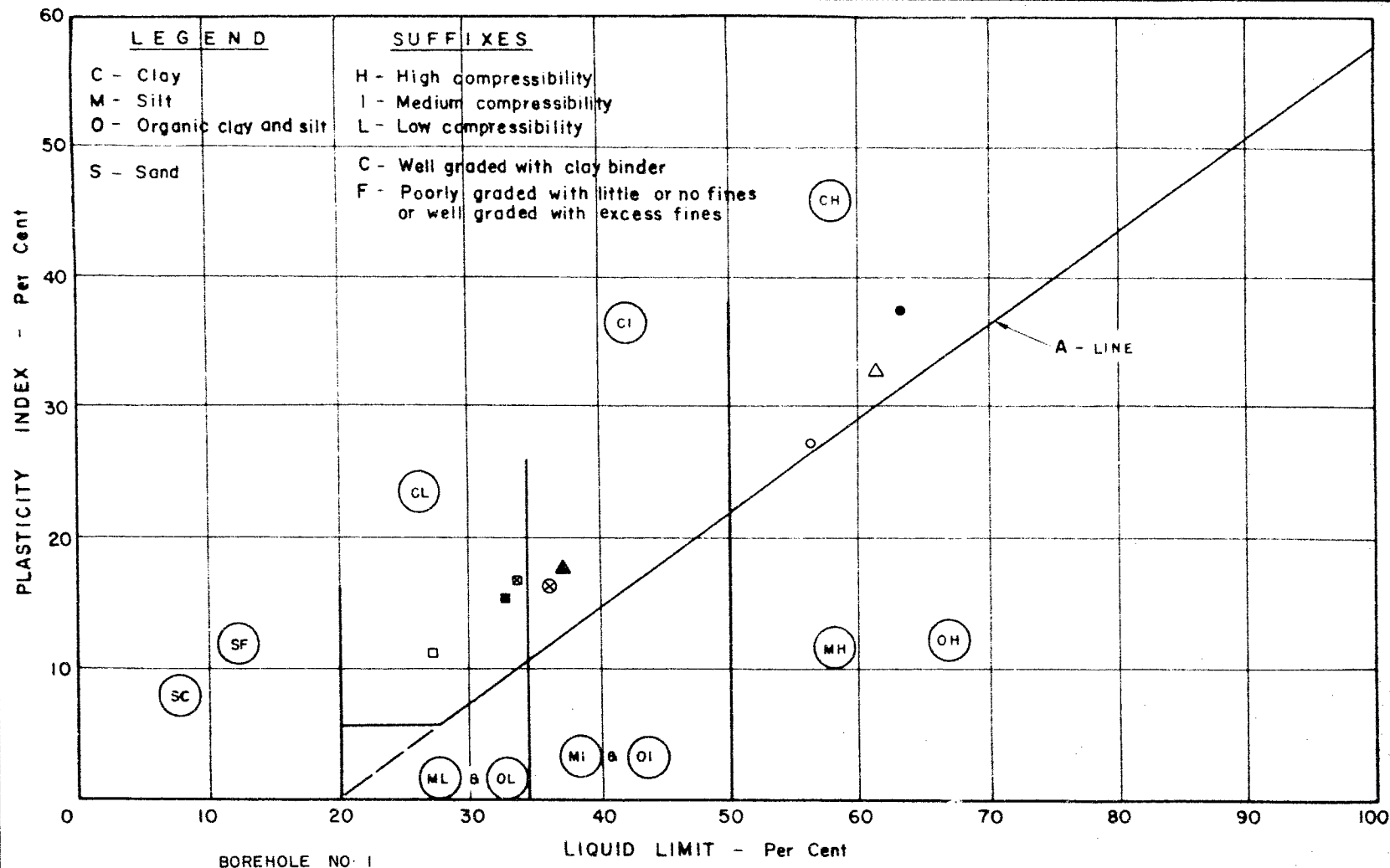
2" DIA. SPLIT TUBE -----  
 2" SHELBY TUBE -----  
 2" SPLIT TUBE -----  
 2" DIA. CONE -----  
 2" SHELBY -----  
 CASING -----

## LEGEND

1/2 UNCONFINED COMPRESSION (Qu) -----  
 VANE TEST (C) AND SENSITIVITY (S) -----  
 NATURAL MOISTURE AND LIQUIDITY INDEX -----  
 LIQUID LIMIT -----  
 PLASTIC LIMIT -----

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				500	1000	1500	2000
				P.S.F.			
				BLKS./FT.			
	↓ Groundlevel	580.0	0	25	50	75	100
	Fill material (clay & gravel)	577.0					
	Oxidized stiff to v. stiff brown clay.	574.0					
		567.0	10				
	Silty clay with traces of fine gravel med. stiff to stiff, grey.		20				
			30				
			40				
			50				
	End of borehole.	528.0	60				
			70				

CONSISTENCY				SAMPLE	NATURAL UNIT WT. R C F.
MOIST. CONTENT - % DRY WT.					
0	20	40	60		
				S1	-
				S2	118.2
				S3	-
				T4	-
				T5	-
				T6	-
				T7	127.3
				G7B	-
				T8	-
				G9A	-
				T9	-
				T10	-
				G11	-
				G12	-
				T13	-



## NOTES

- |                             |                              |
|-----------------------------|------------------------------|
| ○ SAMPLE NO. 1, 2'-3.5'     | ■ SAMPLE NO. 12, 22.5' - 24' |
| ● SAMPLE NO. 2, 3.5' - 5'   | ▲ SAMPLE NO. 13, 27' - 28.5' |
| △ SAMPLE NO. 4, 6.5' - 8'   | ⊠ SAMPLE NO. 15, 32' - 32.5' |
| □ SAMPLE NO. 9, 15' - 16.5' | ⊗ SAMPLE NO. 16, 35' - 36.5' |

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
PLASTICITY CHART

Job No.

61-F-103

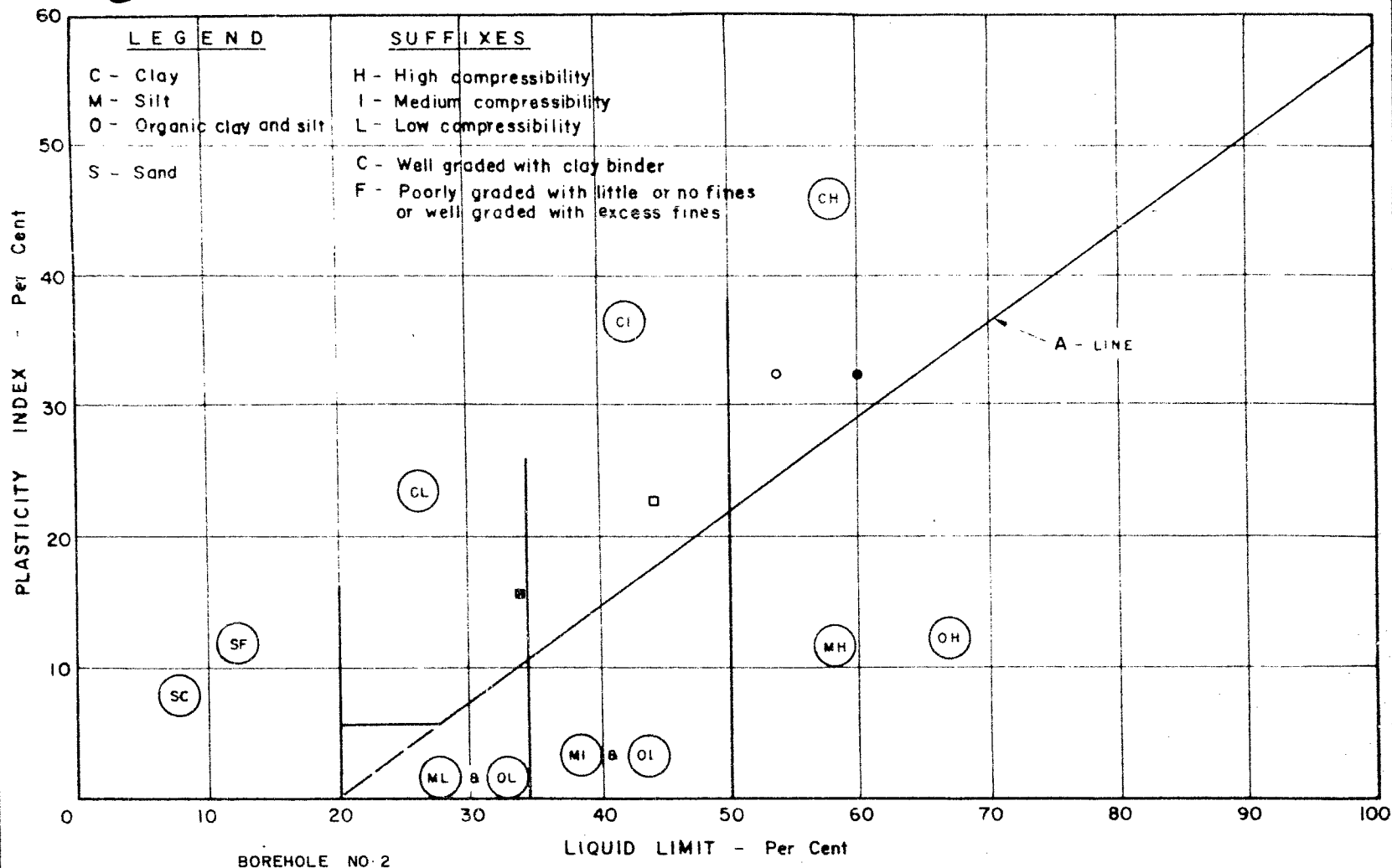
W.P. No.

143-61

Location

DUCK CREEK AT BELLE RIVER





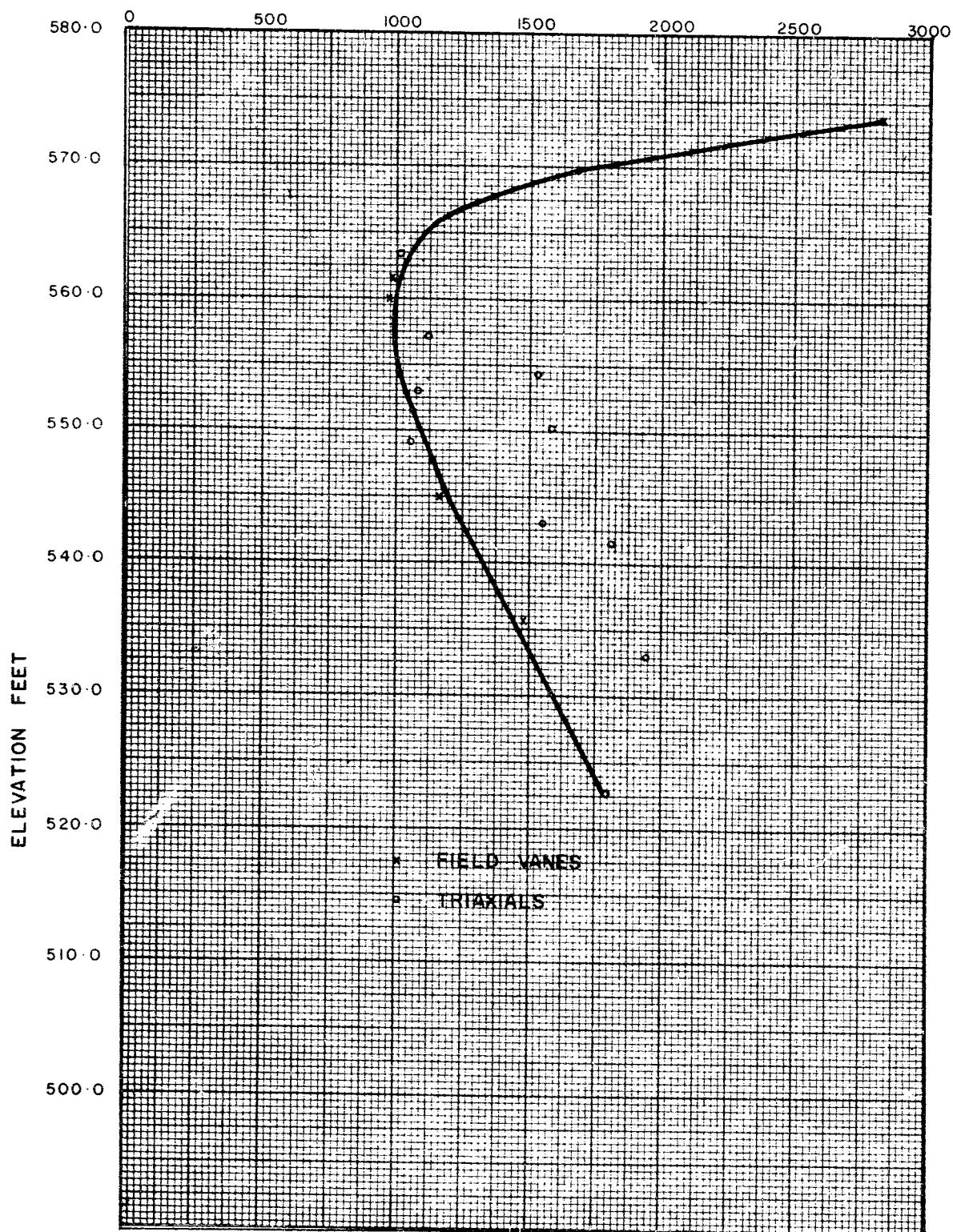
## NOTES

- SAMPLE NO. 1, 2'-3.5'
- SAMPLE NO. 2, 4'-5.5'
- SAMPLE NO. 3, 7'-8.5'
- SAMPLE NO. 7, 20'-21.5'

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
PLASTICITY CHART

Job No. 61-F-103 W.P. No. 143-61  
Location DUCK CREEK AT BELLE RIVER

## SHEAR STRENGTH P.S.F.



DOCUMENT MICROFILMING IDENTIFICATION

G.I-30 SEPT. 1976

GEOGRS No. 40J7-3A  
DIST. 1 REGION Southwestern  
W.P. No. 143-61-01

CONT. No. 78-01

W. O. No. \_\_\_\_\_

STR. SITE No. 6-34

HWY. No. \_\_\_\_\_

LOCATION Duck Creek Bridge  
at Hwy. 2

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 4

REMARKS: @ photos enclosed  
@ documents to be unfolded  
before microfilming



ONTARIO  
DEPARTMENT OF HIGHWAYS

**Memo to** Mr. A. M. Toye, **Date** October 23, 1961.  
Bridge Engineer. **Subject** D.H.O. FOUNDATION INVESTIGATION  
**From** Materials & Research Division, W.J. 61-F-103 -- W.P. 143-61.  
(Foundations Office).  
**Attention:** Mr. S. McCombie.

Re: Duck Creek and Hwy. 39, (Approx. 1 Mile E.  
of Belle River) Twp. of Rochester, County  
of Essex, Lots 17 - 18, District No. 1.

Accompanying this memo, is our detailed foundation report on the subsoil conditions existing at the above site.

We believe you will find the conclusions and recommendations summarized in the report, self-explanatory and adequate for your future design work.

If further assistance is required in connection with the above project, please do not hesitate to contact our Office.

AGS/MdeF  
Attach.

cc: Messrs. A. M. Toye (2)  
H. A. Tregaskes  
H. D. McMillan  
A. Gater  
G. U. Howell  
J. Roy  
T. J. Kovich  
J. E. Gruspier  
E. R. Saint  
F. Norman  
A. Watt  
Foundations Office  
Gen. Files.

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

# FOUNDATION INVESTIGATION

At

Duck Creek and Hwy. 39, (Approx. 1 Mile E.  
of Belle River) Twp. of Rochester, County  
of Essex, Lots 17 - 18, District No. 1,  
W.J. 61-F-103 -- W.P. 143-61.

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## 1. INTRODUCTION:

It is proposed to construct a new bridge to carry Hwy. #39 over Duck Creek at the above-mentioned location. The existing structure is a steel girder bridge having a 40.0' span. The new structure is to be re-positioned for hydrological reasons and will be slightly wider than the existing structure. The new span will be 40 ft.

A field investigation was carried out by this Section in order to determine the subsoil conditions at the site. The results and discussion of the field work and laboratory testing, together with conclusions and recommendations, are presented in this report.

## 2. DESCRIPTION OF THE SITE & GEOLOGY:

The site is located on the south shore of Lake St. Clair. The site and its surrounding area is generally flat, open farmland at present under cultivation.

Physiographically, the site under consideration, is located on the Essex Clay Plain of the St. Clair Clay Plains, inundated by glacial Lakes Whittlesey and Warren. According to available geological information, these extensive plains covering a large

cont'd. /2 ...

2. DESCRIPTION OF THE SITE & GEOLOGY: (cont'd.) ...

area of South-Western Ontario, are covered by deep deposits of clay, underlain by limestone or shale bedrock. At this site, the upper zone of the clay stratum was found to be desiccated and in a very stiff condition for a depth approximately 10 to 12 ft.

3. FIELD & LABORATORY WORK:

Two sampled boreholes and one dynamic cone penetration test were carried out at the site. Disturbed samples were recovered by means of 2" O.D. split spoon. Driving energy to advance the split spoon, and the dynamic one, was 350 ft. lbs. per blow. Wherever possible in cohesive materials, undisturbed samples were obtained by means of 2" I.D. thin-walled Shelby tube sampler. In addition, in-situ vane tests were carried out in the field to determine the shear strength of the cohesive materials. Laboratory tests were carried out on selected representative samples to determine the following physical properties:-

- 1) Natural Moisture Content.
- 2) Atterberg Limits.
- 3) Bulk Density.
- 4) Undrained Shear Strengths.

Results of the above tests, as well as field test results, are presented in Appendix I of this report.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

Subsoil at the site consists mainly of cohesive deposits. Reference to the borehole logs indicates that the site is underlain by a shallow layer of fill material approximately 3 ft. thick, followed by a deep deposit of lacustrine silty clay containing a minor percentage of fine gravel. The upper 12 ft. of the desiccated crust was found to be in a stiff to very stiff preconsolidated state. Average values of Unit weight, Atterberg Limits and undrained Shear Strength of the desiccated crust are as follows:-

Natural Moisture Content ...	22%
Liquid Limit .....	57%
Plastic Limit .....	25%
Unit Weight (Bulk) .....	120 p.c.f.
Undrained Shear Strength ...	2500 p.s.f.

Immediately below the desiccated crust, the non-oxidized stratum of silty clay was encountered. The silty clay extends to the full depth of the exploration and was penetrated to a maximum depth of 57.0' in B.H. #1.

Atterberg limit determinations on the non-oxidized clay stratum indicate that the liquid limit ranges from 27% to 36%, whereas the plastic limit ranges from 14% to 18%. The average values for the liquid and plastic limits are 33% and 17%, respectively.

The results of the Atterberg limits are plotted on the Casagrande plasticity chart and indicate that the stratum is predominantly an inorganic silty clay of intermediate plasticity.

cont'd. /4 ...

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

Wet unit weight determinations on samples from the stratum gave values ranging from 127 to 130 p.c.f. with the corresponding natural moisture contents ranging from 19% to 22%. This indicates that the moisture content is slightly higher than the plastic limit of the non-oxidized stratum.

Triaxial compression tests carried out on selected samples gave shear strength values ranging from 965 to 1490 p.s.f. The shear strength increases with depth, with an average value of 1000 p.s.f. at the surface of this layer, to about 1400 p.s.f. at 55 ft. below the ground surface. From the results of the triaxial tests, together with the in-situ field vane tests, it can be concluded that the consistency of this stratum ranges from med. stiff to stiff.

5. WATER CONDITIONS:

Due to the impermeable nature of the subsoil strata, it was not possible to establish too accurately the elevation of the ground water table during the boring programme. Therefore, it has been assumed that the ground water table will be approximately at the same elevation as the water level in the creek. During the time of the investigation, the water level in the creek was at approx. elev. 574.5'.

6. DISCUSSION AND RECOMMENDATIONS:

The upper stiff clay crust is competent to provide adequate foundation support for the proposed structure. Laboratory and field vane test results indicate that spread footing support can be obtained

cont'd. /5 ...



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

at elev. 568.0' with an allowable bearing pressure of 2 T.S.F. Footings founded at elev. 568.0' should have sufficient protection from frost action. In view of the relatively uniform subsoil conditions at the site, differential settlements will be negligible in the case of a single span structure, since each abutment will virtually settle the same amount.

For all practical purposes, the subsoil can be considered as relatively impermeable, hence, dewatering of the excavations should present no special problems. Before beginning the excavation, it is suggested that a cofferdam be built to such a height so as to prevent water from the creek entering the excavation. Any seepage water that may enter the cutting may be removed by the use of pumps.

The excavation may be made with vertical sides and brought down to the required elevation; a working slab should be poured immediately to prevent softening of the clay material.

Approach fill slopes of 2:1 should not present any stability problems. It is recommended that the latter be protected by rock rip-rap to the H.W.L.

7. SUMMARY:

The subsoil at the site consists of a deep deposit of lacustrine clay containing a minor percentage of fine gravel. The upper 10 to 12 ft. of the clay deposit has been subjected to oxidation and desiccation.

Spread footing support can be obtained at a shallow depth at this site. A safe permissible bearing capacity of 2 T.S.F. can be applied at elev. 568.0'.

cont'd. /6 ...

7. SUMMARY: (cont'd.) ...

In view of the relatively uniform subsoil conditions at the site, differential settlements of any consequence, are not anticipated for a single-span structure.

Due to the highly impermeable nature of the subsoil, dewatering for the excavation should present no special problems.

The creek water may be prevented from entering the footing excavation by using a cofferdam. Low capacity pumps may be used to keep the excavation free from seepage.

No stability problems are anticipated with regard to the approach fills. Rip-rap should be provided for the slopes below H.W.L.

8. MISCELLANEOUS:

The field work was carried out during the period Oct. 5th and 6th, 1961. Equipment used was owned and operated by Johnston Drilling Co., under the supervision of Mr. M. Devata of the Foundation Section of the Department of Highways.

October 1961. REPORT PREPARED BY: B.M. Shadiali  
for M. Devata,  
SR. PROJECT FOUNDATION ENGR.

REPORT APPROVED BY: A.G. Stermac  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-103

W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	2'-3.5'	2-2.5 Fill material (clay & gravel) 2.5-3.5 Oxidized stiff brown clay.	12	22.8	27.9	55.4	-	-	
	S2	3.5'-5'	Oxidized stiff brown clay with occasional fine gravel.	14	23.4	25.4	63.4	-	115.0	
	T3	5'-6.5'	Oxidized brown clay-V. stiff.	Pushed	-	-	-	-	-	
	T4	6.5'-8'	" " "	Pushed	22.8	26.1	61.8	2680	127.8	
	S5	8'-9.5'	" " "	20	23.5	-	-	-	-	
	T6	10'-11.5'	" " "	Pushed	22.5	-	-	4460	133.9	
	T7	11.5'-13'	" " "	"	-	-	-	-	-	
	S8	13'-14.5'	" " "	19	27.5	-	-	-	-	
	S9	15'-16.5'	Grey silty clay with traces of fine gravel. Med. stiff.	7	17.4	14.9	27.1	-	127.1	
	T10	16.5'-18'	" " "	Pushed	19.5	-	-	990	130.6	
	VANE	19.5'		-	-	-	-	1520	-	Sens: 1.7
	T11	21'-22.5'	" " " - stiff	Pushed	-	-	-	-	-	
	T12	22.5'-24'	Grey silty clay with traces of occasional fine gravel-stiff.	Pushed	-	16.3	32.8	-	-	
	VANE	25.5'		-	-	-	-	1600	-	Sens: 1.3
	T13	27'-28.5'	" " "	Pushed	-	17.2	35.9	-	-	

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-103W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	VANE	30'		-	-	-	-	1760	-	Sens: 1.4
	TL4	31'-32'	Grey silty clay with traces of occasional fine gravel-stiff.	Pushed	-	-	-	-	-	
	SL5	32'-32.5'	" " "	14	21.3	17.0	33.6	-	125.0	
	TL6	35'-36.5'	" " "	Pushed	21.2	18.3	35.4	1320	128.6	
	VANE	38'		-	-	-	-	1840	-	Sens: 1.4
	GL7	40'	" " "	-	21.5	-	-	-	-	
	TL8	44'-45.5'	" " "	Pushed	21.0	-	-	1490	128.9	
	VANE	47'		-	-	-	-	1920	-	Sens: 1.2
	GL9	50'	Grey silty clay with traces of occasional fine gravel-Stiff	-	21.8	-	-	-	-	
	T20	54'-55.5'	" " "	Pushed	-	-	-	-	-	
2	VANE	57'		-	-	-	-	1760	-	Sens: 1.6
	S1	2'-3.5'	2-3.0 Fill material (clay & gravel) 3.0-3.5 Oxidized brown clay.	10	21.0	21.8	54.6	-	-	
	S2	4'-5.5'	Oxidized brown clay-V. stiff.	7	23.0	27.2	60.0	-	118.2	
	S3	7'-8.5'	" " "	9	19.2	20.5	43.6	-	-	
	T4	8.5'-10'	" " "	Pushed	-	-	-	-	-	
	T5	10'-11.5'	" " "	"	-	-	-	-	-	

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-103W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
2	T6	14'-15.5'	Grey silty clay with traces of occasional fine gravel-Stiff.	Pushed	-	-	-	-	-	
	VANE	17'		-	-	-	-	1040	-	Sens: 1.7
	T7	20'-21.5'	" " " " - Med. stiff.	Pushed	21.6	17.3	33.2	965	127.3	
	VANE	23'		-	-	-	-	1280	-	Sens: 1.9
	G7B	23'	Grey silty clay with occasional fine gravel. Stiff.	-	-	-	-	-	-	
	T8	24'-25.5'	" " "	Pushed	-	-	-	-	-	
	VANE	27'		-	-	-	-	1150	-	Sens: 1.7
	G9A	29'	" " "	-	21.8	-	-	-	-	
	T9	29'-30.5'	" " "	Pushed	-	-	-	-	-	
	VANE	31.5		-	-	-	-	1120	-	Sens: 1.3
	T10	34'-35.5'	" " "	Pushed	-	-	-	-	-	
	VANE	37'		-	-	-	-	1600	-	Sens: 2.0
	G11	39'	" " "	-	-	-	-	-	-	
	G12	47'	" " "	-	-	-	-	-	-	

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-103

W.P. 143-61

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT.	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
2	T13	49'-50.5'	Grey silty clay with occasional fine gravel. Stiff.	Pushed	-	-	-	-	-	Sens: 2.0
	VANE	52'		-	-	-	-	1280	-	
			S denotes split spoon sample T " shelby tube " G " grab sample							

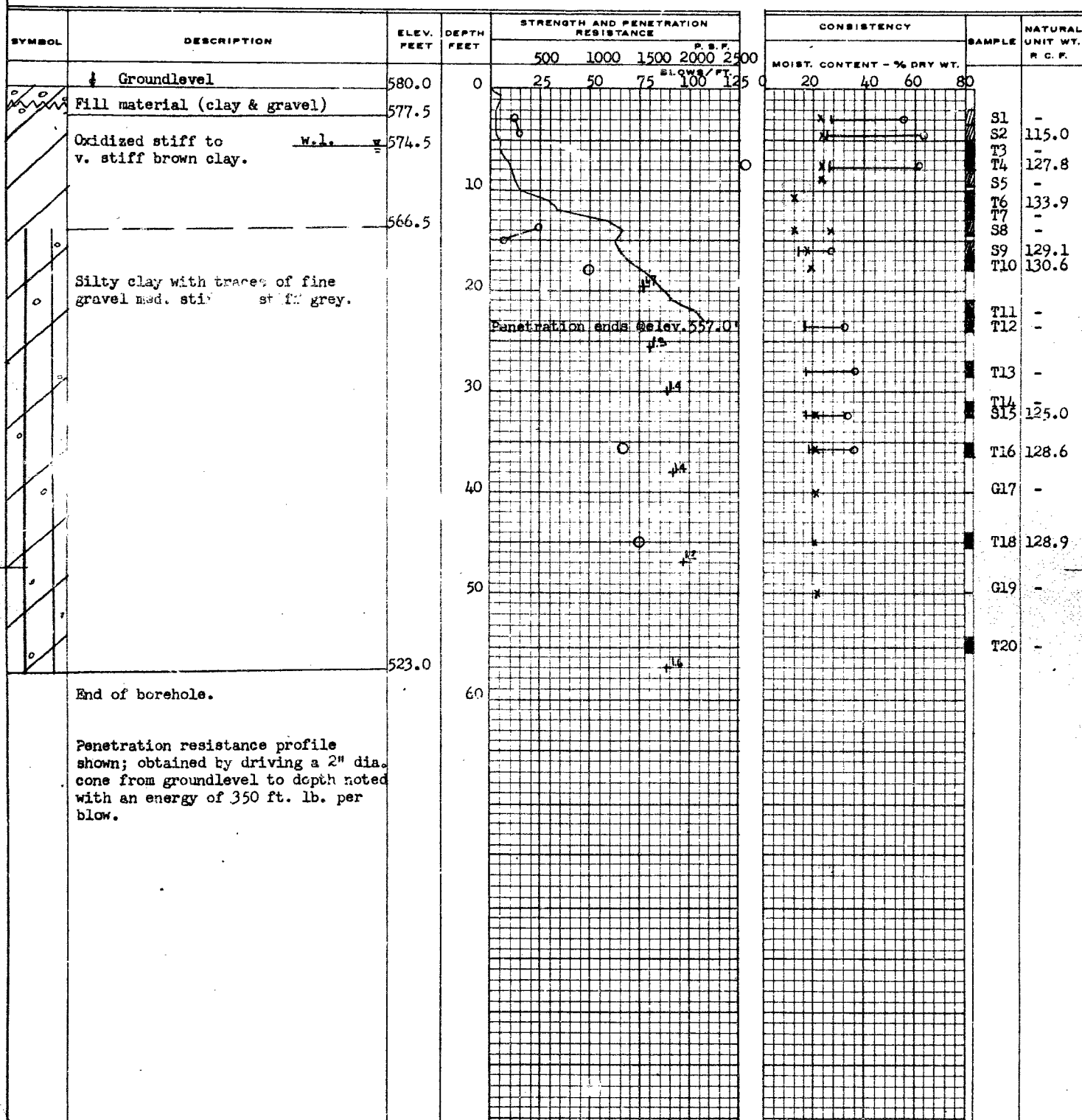
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. 143-61 BORE HOLE NO. 1  
JOB 61-F-103 STATION 81+33 (14' Lt.)  
DATUM 580.0' COMPILED BY B.K.  
BORING DATE Oct. 5/61. CHECKED BY M.D.

2" DIA. SPLIT TUBE -----  
2" SHELBY TUBE -----  
2" SPLIT TUBE -----  
2" DIA. CONE -----  
2" SHELBY -----  
CASING -----

### LEGEND

1/2 UNCONFINED COMPRESSION (Qu)	0
VANE TEST (C) AND SENSITIVITY (S)---	+s
NATURAL MOISTURE AND	LI
LIQUIDITY INDEX -----	X
LIQUID LIMIT -----	0
PLASTIC LIMIT -----	



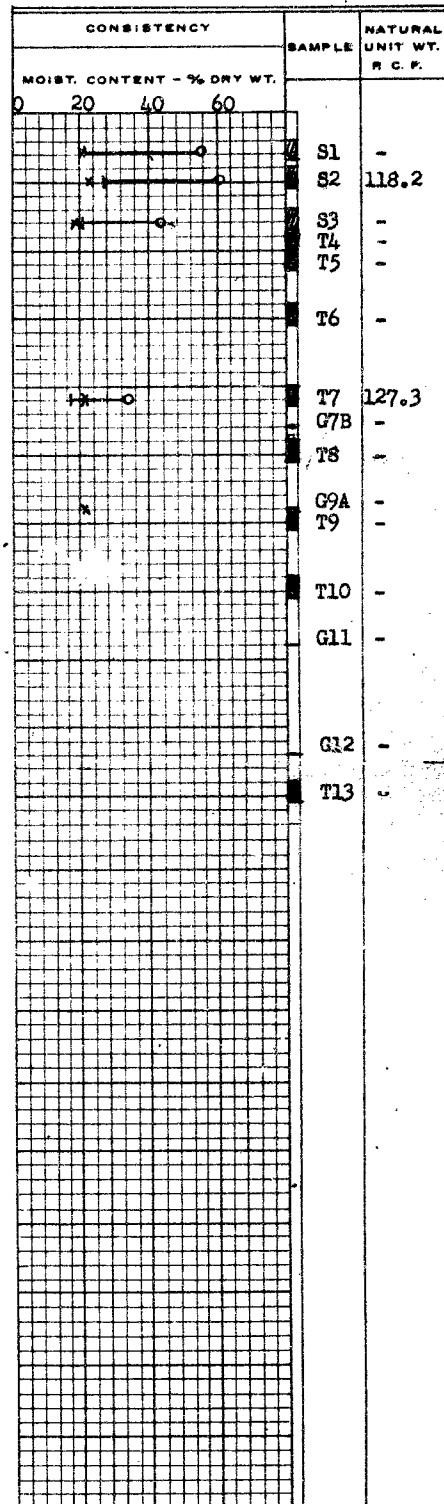
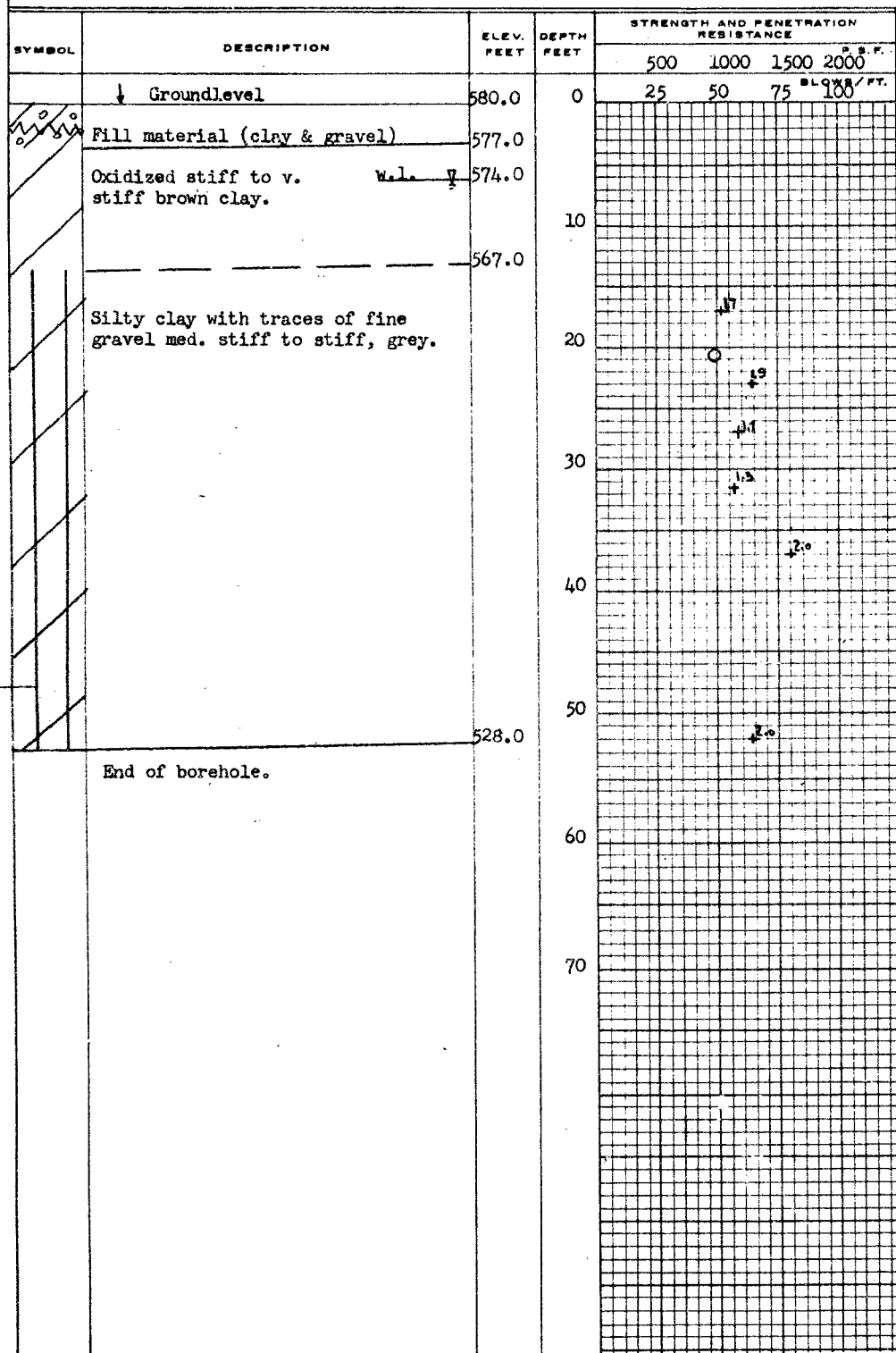
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 143-61 BORE HOLE NO. 2  
 JOB 61-F-103 STATION 80+60 (14' Lt.)  
 DATUM 580.0' COMPILED BY B.K.  
 BORING DATE Oct. 6/61. CHECKED BY M.D.

2" DIA. SPLIT TUBE -----  
 2" SHELBY TUBE -----  
 2" SPLIT TUBE -----  
 2" DIA. CONE -----  
 2" SHELBY -----  
 CASING -----

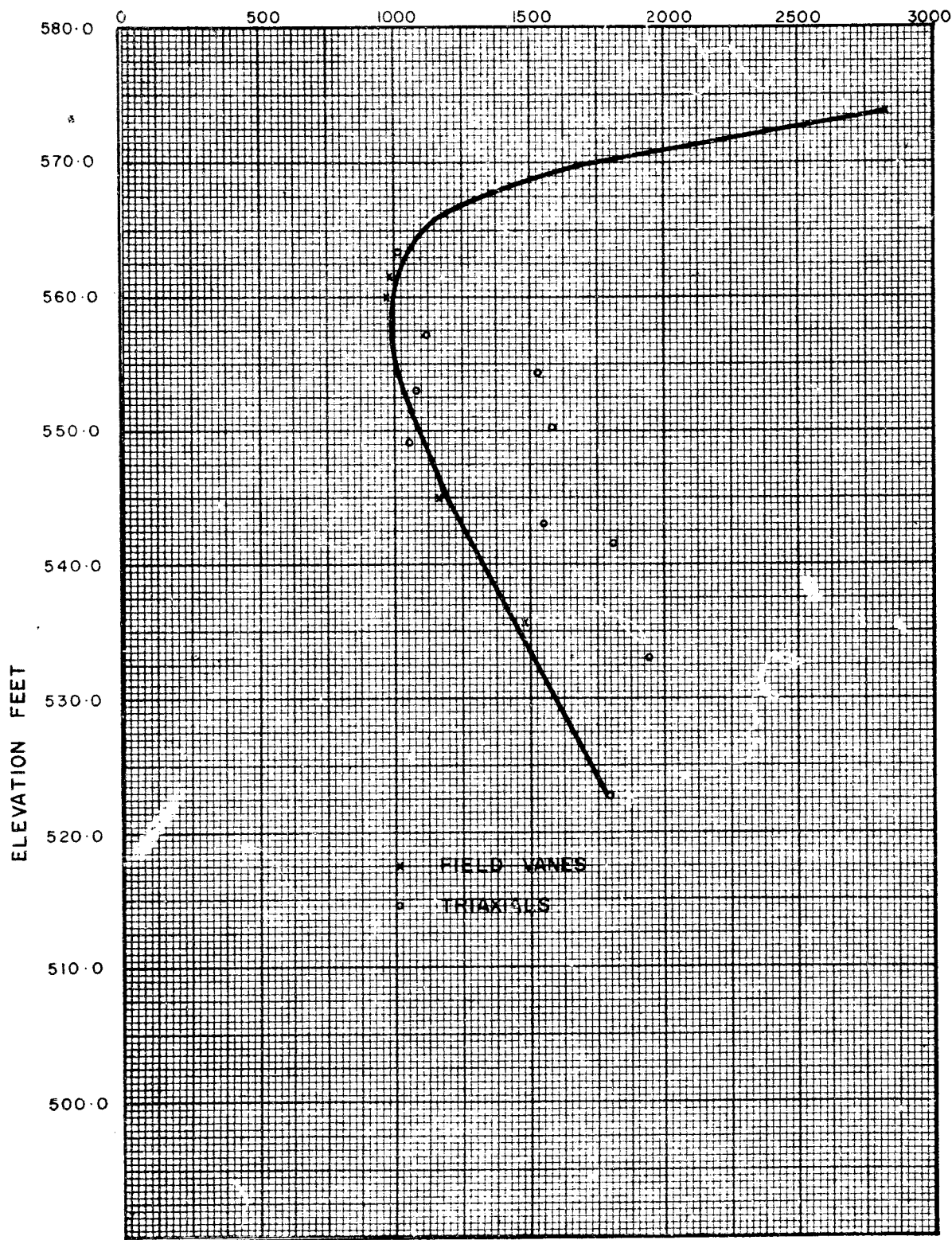
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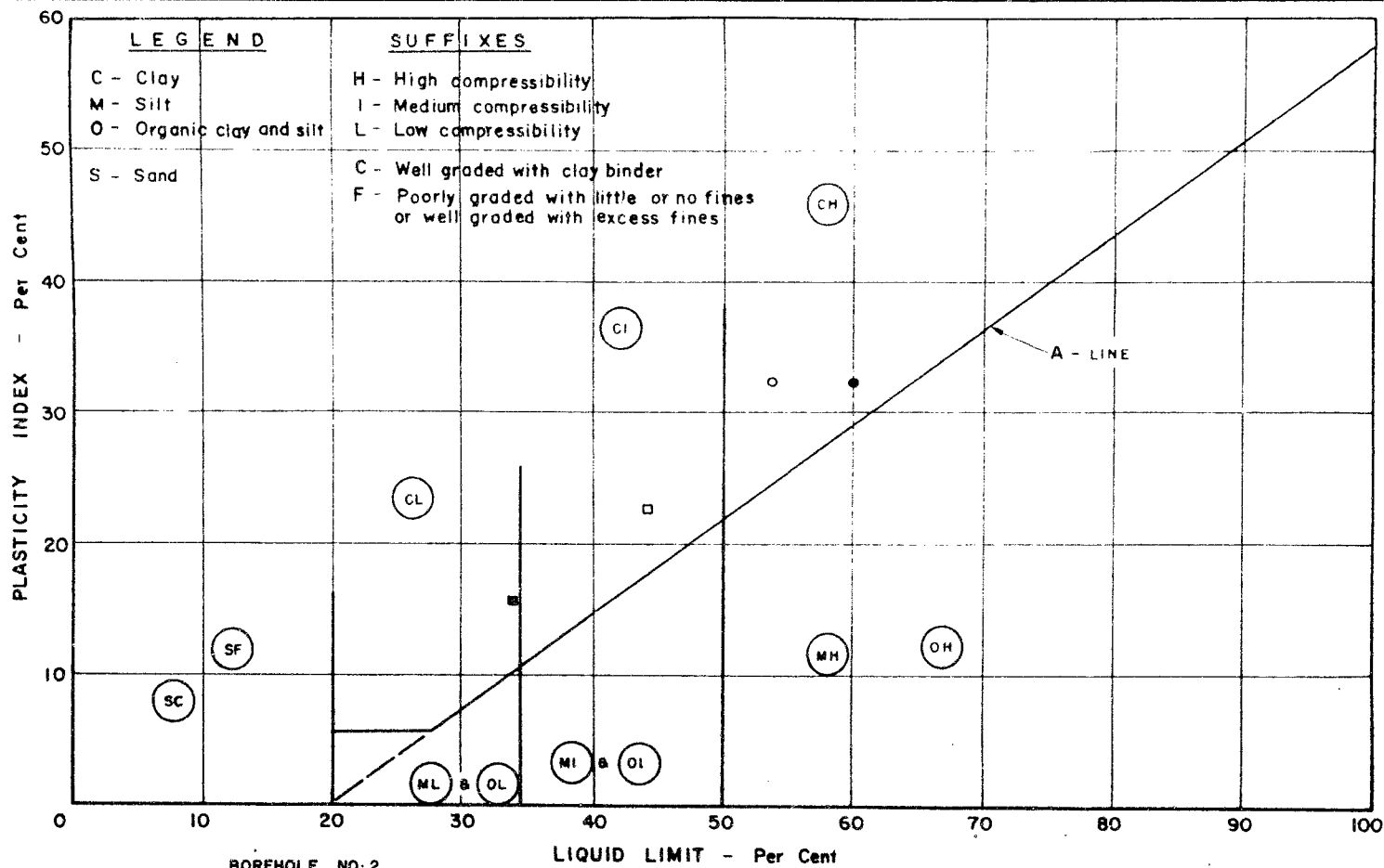
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 VANE TEST (C) AND SENSITIVITY (S) -----  
 NATURAL MOISTURE AND LIQUIDITY INDEX -----  
 LIQUID LIMIT -----  
 PLASTIC LIMIT -----





## SHEAR STRENGTH P.S.F.





BOREHOLE NO. 2

## NOTES

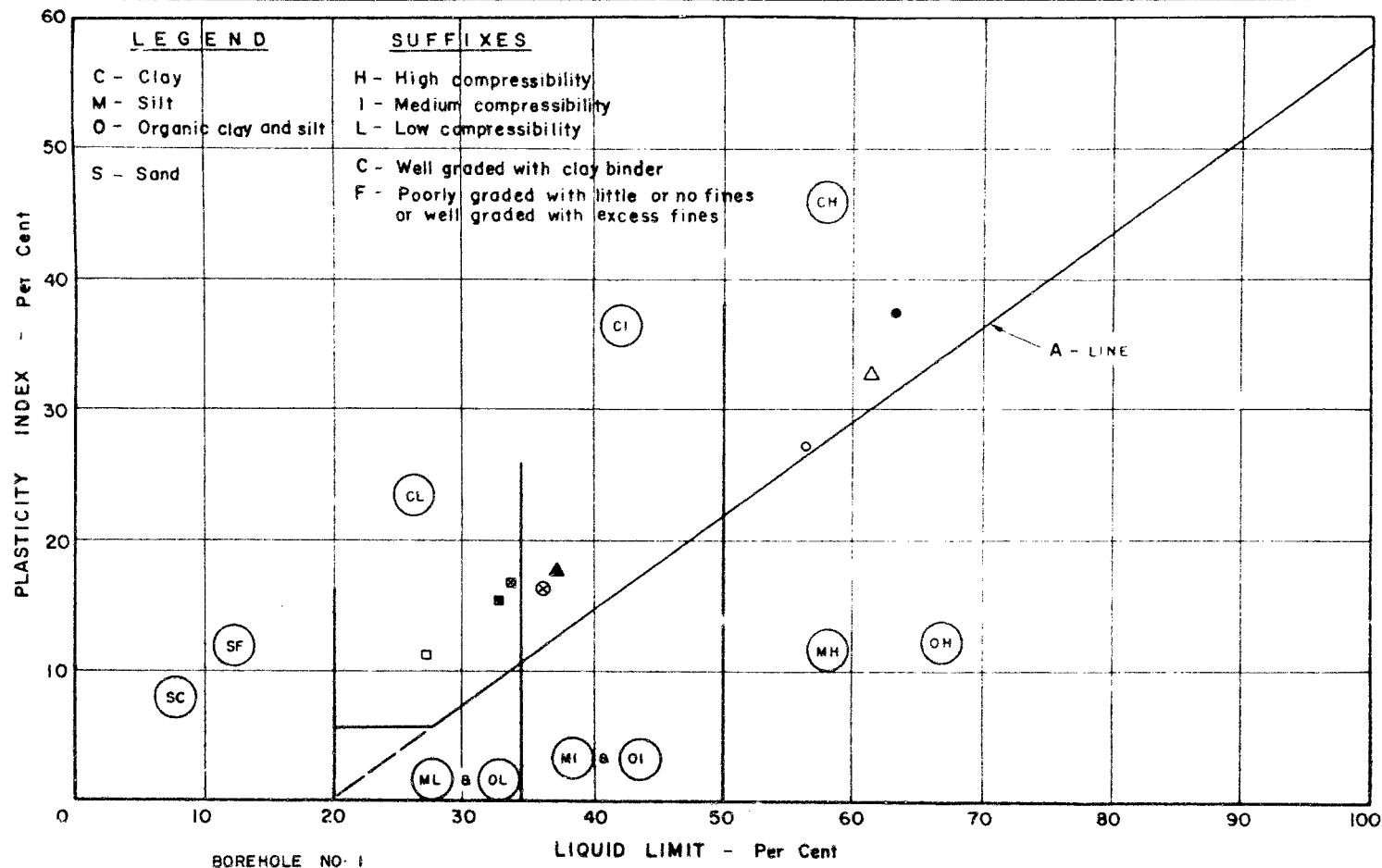
- SAMPLE NO. 1, 2'-3.5'
- SAMPLE NO. 2, 4'-5.5'
- SAMPLE NO. 3, 7'-8.5'
- SAMPLE NO. 7, 20'-21.5'

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
PLASTICITY CHART

Job No. 61-F-103

W. No. 143-61

Location DUCK CREEK AT BELLE RIVER



NOTES	○ SAMPLE NO. 1, 2'-3.5'	■ SAMPLE NO. 12, 22.5'-24'
	● SAMPLE NO. 2, 3.5'-5'	▲ SAMPLE NO. 13, 27'-28.5'
	△ SAMPLE NO. 4, 6.5'-8'	⊠ SAMPLE NO. 15, 32'-32.5'
	□ SAMPLE NO. 9, 15'-16.5'	⊗ SAMPLE NO. 16, 35'-36.5'

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
**PLASTICITY CHART**

Job No. 61-F-103 W.P. No. 143-61  
Location DUCK CREEK AT BELLE RIVER

# FOUNDATION INVESTIGATION REPORT

For

Proposed Duck Creek Bridge at Hwy. #2,  
Site #6-34, Town of Belle River,  
County of Essex, District #1 (Chatham).

W.O. 74-11005

W.P. 143-61-01

## 1) INTRODUCTION:

The Soil Mechanics Section carried out a subsurface investigation at the site of the proposed Duck Creek Bridge, during October of 1961. The result of this investigation was reported under W.O. 61-F-103 in October 23rd, 1961. Very recently, the Geotechnical Office was requested by Mr. A.P. Watt, Regional Structural Planning Engineer, Southwestern Region, to conduct a subsurface investigation at the new footing locations. The borings put down in 1961 were reasonably close to the proposed footings and they revealed relatively uniform subsoil conditions across the site. In view of these, we feel that no additional field investigation is necessary.

This report will contain all the information and recommendations given in the previous report W.O. 61-F-103, with necessary revisions to meet current M.T.C. standards, as well as our recommendations pertaining to the design and construction of the Bailey Bridge for the detour.

## 2) DESCRIPTION OF THE SITE & GEOLOGY:

The site is located on the south shore of Lake St. Clair. The site and its surrounding area is generally flat, open farmland at present under cultivation.

Physiographically, the site under consideration, is located on the Essex Clay Plain of the St. Clair Clay Plains, inundated by glacial Lakes Whittlesey and Warren. According to available geological information, these extensive plains covering

a large area of South-western Ontario, are covered by deep deposits of clay, underlain by limestone or shale bedrock. At this site, the upper zone of the clay stratum was found to be desiccated and in a very stiff condition for a depth approximately 10 to 12 ft. (3 to 3.7 m).

3) FIELD & LABORATORY WORK:

Two sampled boreholes, one of which was accompanied by a dynamic cone penetration test, were carried out at the site. Disturbed samples were recovered by means of 2" O.D. split spoon. Driving energy to advance the split spoon, and the dynamic cone, was 350 ft. lbs. (475 J.) per blow. Wherever possible in cohesive materials, undisturbed samples were obtained by means of 2" I.D. thin-walled Shelby tube sampler. In addition, in-situ vane tests were carried out in the field to determine the shear strength of the cohesive materials. Laboratory tests were carried out on selected representative samples to determine the following physical properties:-

- 1) Natural Moisture Content.
- 2) Atterberg Limits.
- 3) Bulk Density.
- 4) Undrained Shear Strengths.

Results on the above tests, as well as field test results, are plotted on the Record of Borehole Sheets, contained in the Appendix.

..... /3

4) SUBSOIL CONDITIONS:

Subsoil at the site consists mainly of cohesive deposits. Reference to the borehole logs indicates that the site is underlain by a shallow layer of fill material approximately 3 ft. (0.9 m) thick, followed by a deep deposit of lacustrine silty clay containing a minor percentage of fine gravel. The upper 12 ft. (3.7 m) of this deposit is believed to have been desiccated, was found to be in a state of very low preconsolidated state. Average unit weight, Atterberg Limits and undrained Shear Strength of the desiccated crust are as follows:-

Natural Moisture Content (W)	22%
Liquid Limit ( $W_L$ )	57%
Plastic Limit ( $W_P$ )	25%
Bulk Unit Weight	120 p.c.f. (1.92 T/m <sup>3</sup> )
Undrained Shear Strength (Cu)	2500 p.s.f. (120 kN/m <sup>2</sup> )

Immediately below the desiccated crust, the non-oxidized stratum of silty clay was encountered. The silty clay extends to the full depth of the exploration and was penetrated to a maximum depth of 57 feet (17.4 m) in B.H.#1.

Atterberg Limit determinations on the non-oxidized cohesive stratum indicate that the liquid limit ranges from 27% to 36%, whereas the plastic limit ranges from 14% to 18%. The average values for the liquid and plastic limits are 33% and 17%, respectively.

The results of the Atterberg Limits are plotted on the Casagrande plasticity chart (Fig. #1) and indicate that the stratum is predominantly inorganic and of low to intermediate plasticity.

Wet unit weight determinations on samples from the stratum gave values ranging from 127 to 130 p.c.f. (2.03 to 2.08 T/m<sup>3</sup>) with the corresponding natural moisture contents ranging from 19% to 22%. This indicates that the moisture content is slightly higher than the plastic limit of the non-oxidized stratum.

Triaxial compression tests carried out on selected samples gave shear strength values ranging from 965 to 1490 p.s.f. (46 to 72 KN/m<sup>2</sup>). The shear strength increases with depth, with an average value of 1000 p.s.f. (48 KN/m<sup>2</sup>) at the surface of this layer, to about 1400 p.s.f. (67 KN/m<sup>2</sup>) at 55 ft. (16.8 m) below the ground surface. From the results of the triaxial tests, together with the in-situ field vane tests, it can be concluded that the consistency of this stratum ranges from firm to stiff.

5) WATER CONDITIONS:

Due to the impermeable nature of the subsoil strata, it was not possible to establish too accurately the elevation of the groundwater table during the boring programme. Therefore, it has been assumed that the groundwater table will be approximately at the same elevation as the water level in the creek. During the time of the investigation, the water level in the creek was at approx. elev. 574.5(175.1 m).

..... /5

6) DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to replace the existing single span (40 ft. or 12.2 m) steel girder bridge with a new one at the crossing of Hwy. 2 and Duck Creek at the eastern limits of Belle River, County of Essex. The proposed bridge will be 40 feet wide (12.2 m). Ultimately it will be widened to 67 feet (20.5 m). At the present time, two types of structures were being considered; namely

- i) Rigid Frame structure (span length 42 feet or 12.8 m).
- ii) AASHO Beam Structure (span length 66 feet or 20.1 m).

The proposed grades of Hwy. #2 in the vicinity of the structure will be at elevations 583.2 and 585.5 for schemes #1 and #2 respectively. The existing grade of Hwy. #2 is at elevation 581.5, while the surrounding terrain is at approximate elevation 576. The maximum heights of the additional fill will therefore be 7 and 10 feet (2.1 and 3.1 m) respectively for the two schemes.

6.2) Approaches:

As mentioned previously, the maximum height of the approach will be in the order of 10 feet (3.1 m). No stability problems are anticipated provided:-

..... /6



- i) 2:1 slopes are employed,
- ii) any localized softened zones within the plan limits of the new approaches are removed and replaced with compacted non-cohesive type of fill material, this is particularly true at the ditches located at the toe of the existing embankments.
- and iii) the new fill is properly keyed to the slopes of the existing embankments in accordance with current M.T.C. Standard #DD-414.

In addition, it is recommended that the side slopes be sodded and the forward slopes be protected against erosion with, for instance, rip-rap.

### 6.3) Structure Foundations:

#### 6.3.1) Rigid Frame Structure:

The abutments may be supported on spread footings founded at a level at least 4 feet (1.2 m) below the creek bottom. That would place the footings at the lower portion of the desiccated zone of the cohesive stratum. Spread footings so founded may be designed using an allowable bearing pressure of up to 1.5 t.s.f. In computing the lateral resistance of the footings, an adhesion value of 1,000 p.s.f. may be used.

In view of the relatively uniform subsoil conditions at the site, differential settlements will be negligible in the case of a single span structure, since each abutment will virtually settle the same amount.

For all practical purposes, the subsoil can be considered as relatively impermeable, hence dewatering of the excavations should present no special problems. Before beginning the excavation, it is suggested that a cofferdam be built to such a height so as to prevent water from the creek entering the excavation. Any seepage water that may enter the cutting may be removed by the use of pumps.

The excavation may be made with vertical sides and brought down to the required elevation; a working slab should be poured immediately to prevent softening of the clay material.

The structure will be designed as a rigid frame, therefore, it is recommended that a coefficient of earth pressure at rest ( $K_0$ ) of 0.5 should be assumed for the granular backfill behind the abutment walls. In order to avoid buildup of water pressure behind the abutment walls, suitable drainage should be provided within the backfill in accordance with current M.T.C. practices.

If the allowable bearing pressure quoted above is insufficient, the abutments may be supported on friction piles. The capacity of the pile will depend on the size and type of pile and length of embedment. For example, #14 Timber Pile may be designed using the following quotation:

$$Q = 0.6 L$$

where Q = Safe capacity of pile (tons/pile)

L = Embedded length in original ground (feet)

#### 6.3.2) AASHO Beam Structure:

The abutments may be perched within the approaches and be supported on spread footings founded on the upper portion of the desiccated crust, in order to take full advantage of the higher shear strength of the clay within the crust. The front face of the footing should be at least 10 feet (3.1 m) behind the face of the forward slope. Any localized softened zones or fill material encountered at founding level should be completely removed and backfilled with mass concrete. Footings so founded may be designed using an allowable bearing pressure of up to 2 t.s.f. An adhesion value of 1,250 p.s.f. may be used to compute the lateral resistance of the footings.

The excavations will be carried out within the relatively impervious clay deposit and above the creek level. No dewatering problems are anticipated.

Other recommendations pertaining to the design and construction details discussed in Subsection 6.3.1) will be applicable here.

#### 6.4) Bailey Bridge at Detour:

It is understood that a detour is being proposed to the north of the existing alignment some 55 feet (16.8 m). A one-way bailey bridge approximately 70 to 90 feet (21.3 to 27.4 m) long is contemplated. The bailey bridge will be supported on rock filled cribs.

No borings were put down at the proposed location of the cribs. However, based on past experience and geological evidences, it may be inferred that the subsoil conditions at these locations will be similar to those encountered at the proposed structure site. The cribs may be founded on the desiccated portion of the cohesive stratum using an allowable bearing value of up to 1.5 t.s.f. No major problems are anticipated during the construction of the bailey bridge from a foundation point of view.

7) - MISCELLANEOUS:

The field work was carried out between October 5th and 6th, 1961, under the supervision of Mr. M. Devata, then Senior Project Foundation Engineer. The drilling equipment used was owned and operated by Johnston Drilling Co.

This report was originally prepared by Mr. M. Devata and updated by Mr. C.S. Poon, Project Engineer.



CSP/mj  
April, 1974.

*C.S. Poon*  
C.S. Poon, P. Eng.

*M. Devata*  
M. Devata, P. Eng.

ORIGINATED BY M.D.  
COMPILED BY C.S.P.  
CHECKED BY 40

ORIGINATED BY C.S.P.  
COMPILED BY

COMPILED BY XXXXXXXXXXXXXXXXXXXX

CHECKED BY ED

15  $\pm$  5 % STRAIN AT FAILURE

DESIGN SERVICES BRANCH

## RECORD OF BOREHOLE No 2

FOUNDATIONS OFFICE

JOB 74-11005

LOCATION Hwy. 2, Sta. 170 + 07; 14' LT

W.P. 143-61-01

BORING DATE October 6, 1961

ORIGINATED BY M.D.

COMPILED BY C.S.P.

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *So*

SOIL PROFILE		SAMPLES			ELEV. SCALE ft/m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m)					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			BULK DENSITY $\gamma$	REMARKS	
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		SHEAR STRENGTH P.S.F.					WATER CONTENT %					
						O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					20 40 60			P.C.F.	GR.SA.SI.C	
176.8	580.0		1	SS	10											
0.0	0.0		2	SS	7											
175.9	577.0		3	SS	9											
0.9	3.0		4	TW	PM	570										
			5	TW	PM	173.7										
			6	TW	PM											
			7	TW	PM	560										
			8	TW	PM	170.7										
			9	TW	PM	550										
			10	TW	PM	167.6										
			11	AS	-	540										
			12	AS	-	164.6										
160.9	528.0		13	TW	PM	530										
15.9	52.0				161.5											
					520											
					158.5											

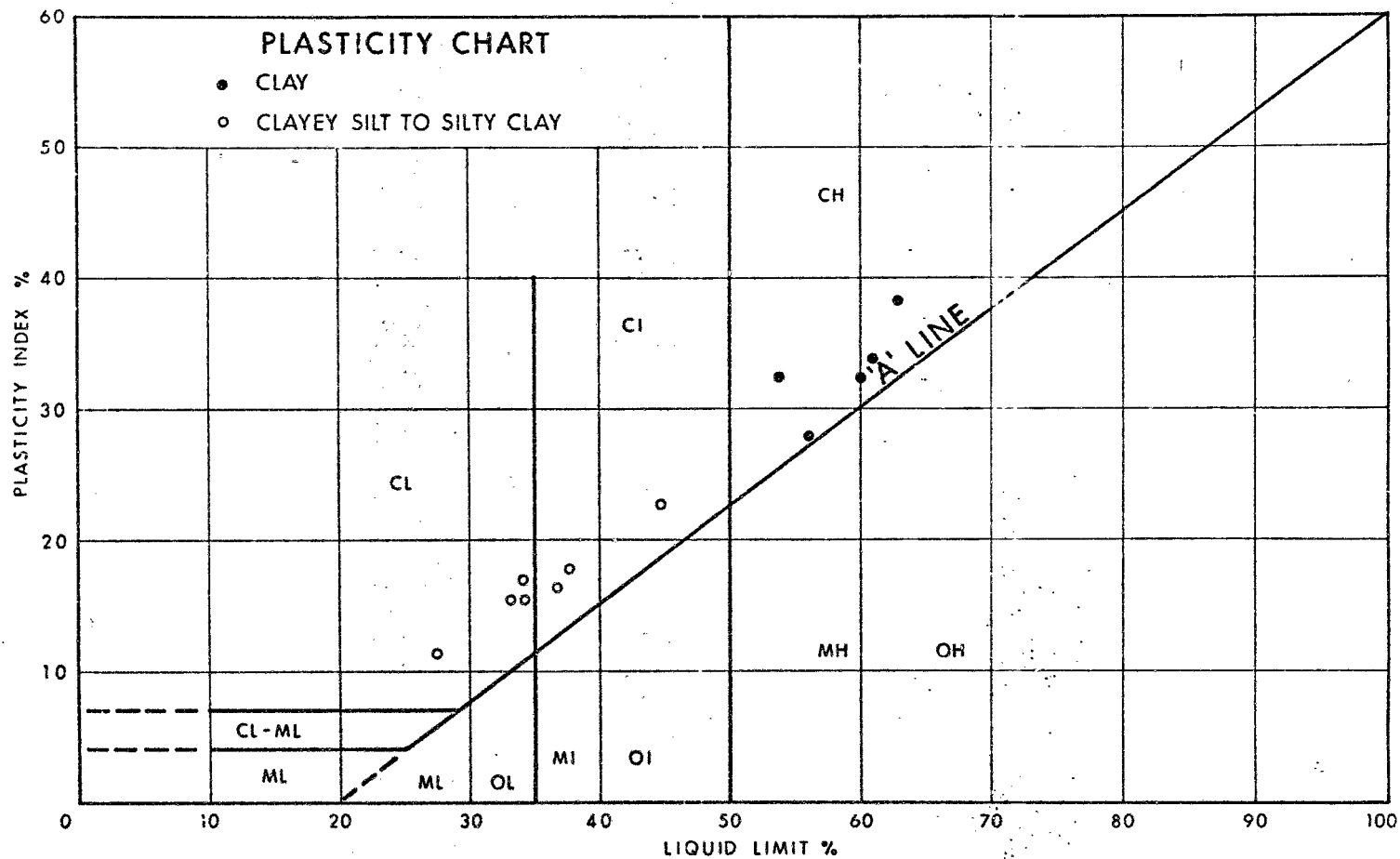


FIG. 1

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE : - 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>c LB/50 FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

FINES < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" " ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		



ABBREVIATIONS & SYMBOLS USED IN THIS REPORTSOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$w_s$	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
$I_c$	CONSISTENCY INDEX $= \frac{w_p - w}{I_p}$
$e_{max}$	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
$\tau_f$	SHEAR STRENGTH
c	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

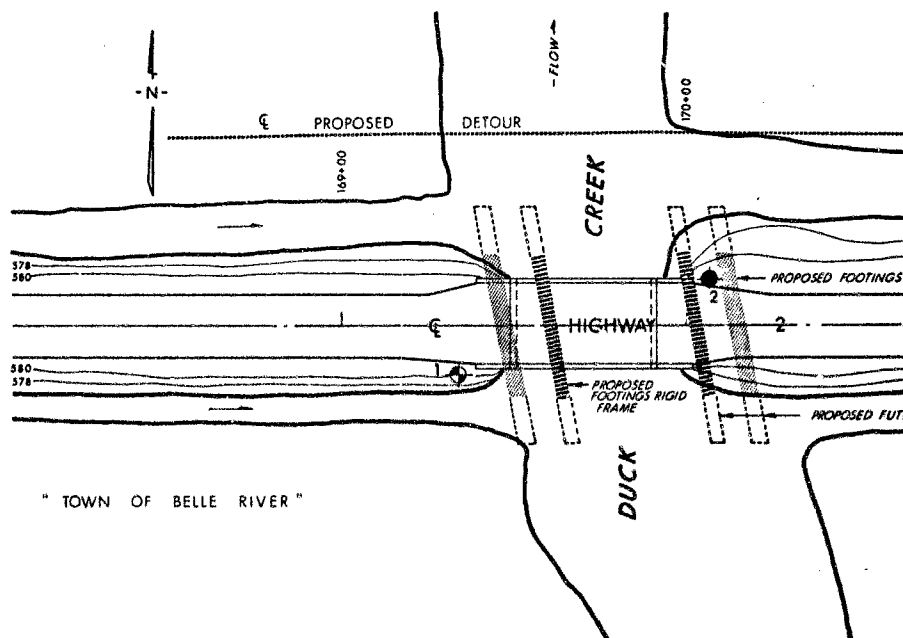
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

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

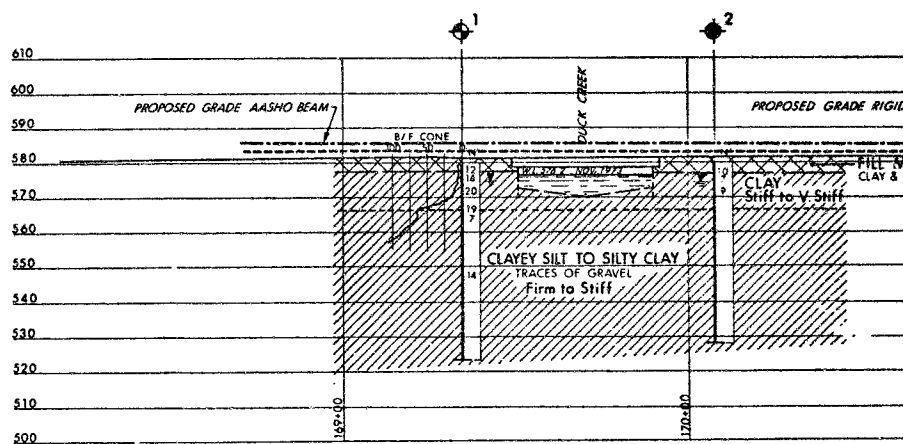
SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



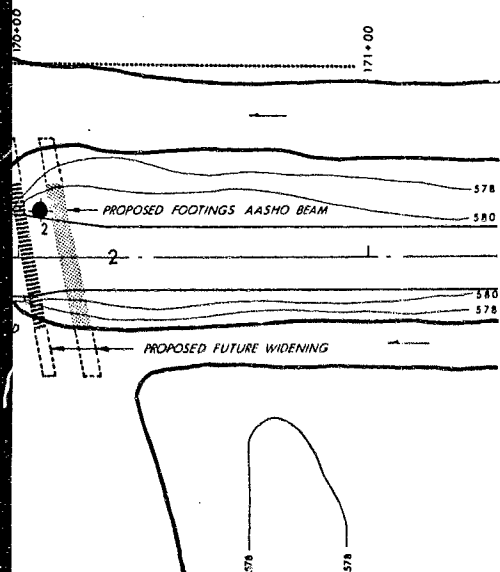
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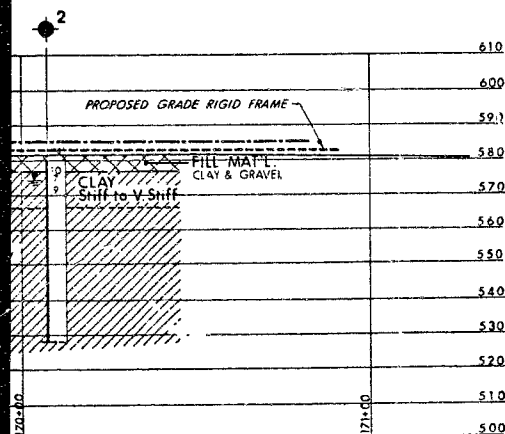


PROFILE

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40 FT.



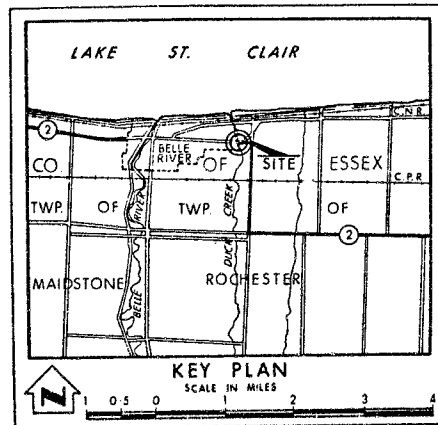
40 FT

#### NOTE FOR CONTRACT DOCUMENT

The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the CHESHAM District Office.

#### NOTE

SUB-SOIL INVESTIGATION CARRIED OUT IN OCT. 1961



#### LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- ↓ Water Levels established at time of field investigation OCT. 1961

NO.	ELEVATION	STATION	OFFSET
1	580.0	169+34	14' RT.
2	580.0	170+07	14' 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.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE

#### DUCK CREEK

HIGHWAY NO. 2 DIST. NO. 1  
CO. ESSEX  
TWP. ROCHESTER LOT. CON.

#### BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. C.P.	CHECKED ✓	WP NO. 143-61-01	DRAWING NO.
DRAWN S.O.	CHECKED ✓	WO NO. 74-11005	74-11005A
DATE 11 APR. 1974	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CONT. NO.		

REF. NO. E-5348-1

28 840-TRACE 40-4-71

74-11005

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A. Rutka  
Manager  
Geotechnical Office  
West Bldg., Downsview  
ATTENTION: Mr. M. Devata

FROM: Structural Planning Office  
Southwestern Region

DATE: March 22, 1974

Supervising Foundation Engineer

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 143-61-01, Bridge Site 6-34  
Duck Creek Bridge  
At Belle River East Limits  
Hwy. 2  
District 1, Chatham

Would you kindly arrange to have a foundation investigation conducted at the above location or the previous foundation investigation report W.J. 61-F-103 under W.P. 143-61 reported on October 23, 1961, evaluated and updated.

I have enclosed two copies of the new bridge site plan E-5348-1 showing the probable footing locations for two schemes (a) a concrete rigid frame shown in red and (b) an AASHO beam shown in blue. The darker areas show the footings that will be required in the initial stage while the lighter area shows the possible future widening.

A detour is being proposed to the north of the existing alignment some 55 feet. A one way bailey bridge is contemplated. Would you kindly comment on the suitability of the sub-soil for rock filled cribs for a 70 to 90 foot bailey bridge.

Pictures of the site and a field reconnaissance report is enclosed for your use.

Please note the chainage equation at the T.S. of Sta. 171 + 41.94, E-5348-1 = Sta. 79 + 25.24, E-3953-1. Also note that the increasing chainage on bridge site E-5348-1 runs apposite to the bridge site E-3953-1. Bridge Site Plan E-3953-1 was used for the Foundation Investigation Report W.J. 61-F-103.

An early reply would be appreciated.

*A. P. Watt*

A. P. Watt  
Regional Structural Planning Engineer

APW:sz  
Enc.

cc A. Crowley  
J. Forster



*Office due date: April 1974  
no field work required*



Ontario

61-F-103

Ministry of  
Transportation  
and  
Communications

July 17, 1973

Memorandum to: Mr. A. G. Stermac  
Principal Foundation Engineer  
Foundation Office, DOWNSVIEW

Subject: W.P. 143-61-01, Bridge Site 6-34  
Duck Creek Bridge  
at Belle River East Limits  
Hwy 2  
District 1, Chatham

At present, the above structure is on the 1975 program. Systems Design, Southwestern Region, is taking the necessary steps to prepare the contract for 1975.

Would you kindly advise me if the Foundation Report W.J. 61-F-103 under W.P. 143-61 can be used for the replacement of the above structure.

A designed replacement structure prepared by the Structural Office does exist under drawing number D-4984-1 to 7, filed in Documents, Downsview, Ontario.

Attached please find a copy of the Bridge Site Plan E-3953-1 prepared in 1960 which should be updated if you require to do additional work. I have two copies of the Foundation Report W.J. 61-F-103.

An early reply would be appreciated.

A. P. Watt  
Regional Structural Planning Eng.

APW/pw  
Enc.

c.c. J. D. Harris  
J. L. Keen  
T. A. Hickey

Discussed with Mr. A. Watt on the phone immediately upon the arrival of this memo and Mr. Watt agreed that he will submit a revised preliminary drawing in due course.

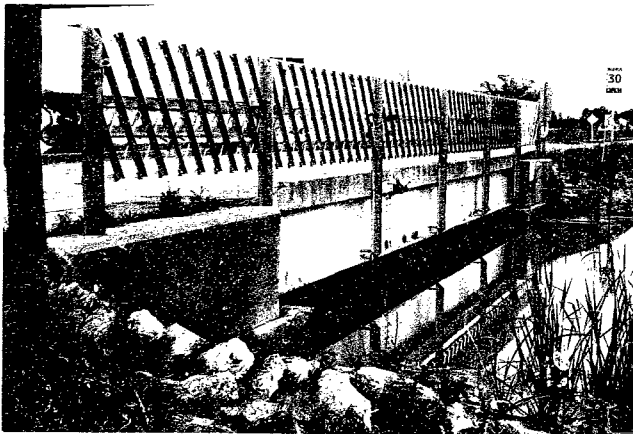
M. Derrada  
July 25th 1973.

W.P. ~~631-71-01~~ 143-61-01

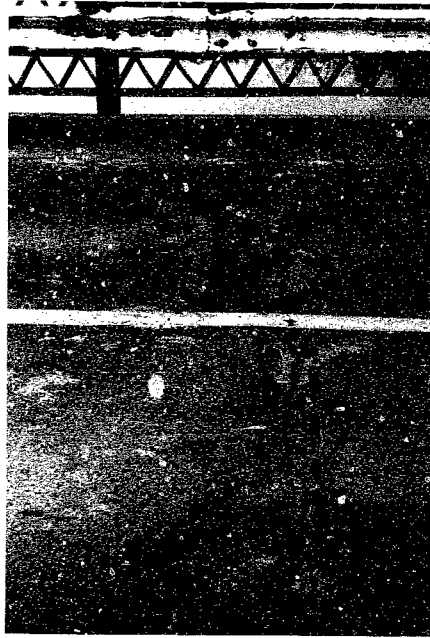
Hwy #2 - DUCK CREEK BRIDGE  
AND APPROACHES  
BRIDGE SITE 6-34



View Looking West over Deck



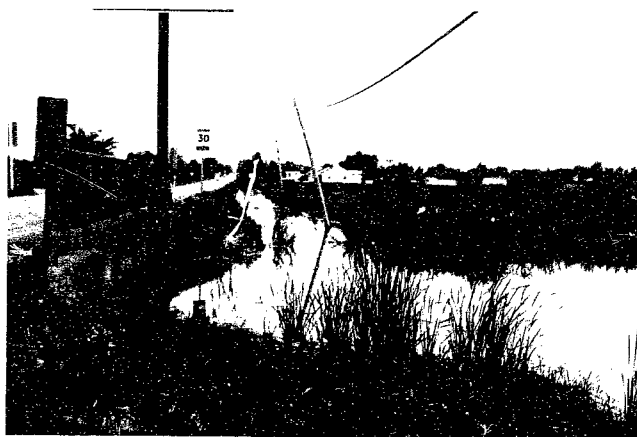
North Elevation



View Showing Crack in Deck at  
Intermediate Floor Beams due to  
Impacted Loads



View Looking East Along South Ditch Line



View Looking East Along North Ditch