



ONTARIO
DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, **Date** November 15, 1960.
Bridge Engineer. **Subject** D.H.O. FOUNDATION INVESTIGATION
From Materials & Research Section. W.J. 60-F-86 -- W.P. 190-60.

Attention: Mr. S. McCombie.

Re: Proposed Structure for the South Service Road
of Hwy. #401 at Wesley Creek, 3.0 Miles East
of Lancaster, Ontario, District # 9.

Attached hereto, we are forwarding to you, the soil investigation report for the above mentioned location.

The summary and recommendations contained in this report are self-explanatory, and we trust they will prove sufficient for your future design work.

Should you require any further assistance in connection with this project, please feel free to call on our Office.

L. G. Soderman,
PRINCIPAL FOUNDATIONS ENGR.

Per:

A. G. Stermac
(A. G. Stermac,
FOUNDATIONS OFFICE ENGR.)

AGS/MdeP
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. G. Ramsay
J. Ford
L. E. Walker
J. E. Graspier
A. Watt

Foundations Office
Gen. Files.

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FOUNDATION INVESTIGATION

For

Proposed Structure for the South Service Road
of Hwy. #401 at Wesley Creek, 3.0 Miles East
of Lancaster, Ontario, District # 9.

W.J. 60-F-86 -- W.P. 190-60.

1. INTRODUCTION:

Approximately 3.0 miles East of Lancaster, Wesley Creek crosses Hwy. #2 and flows South to the St. Lawrence River. At the time of the investigation, the creek was about eight feet wide and about 2.0' deep. The centre line of proposed new Hwy. #401 is located 150' South of Hwy. #2. It is proposed to construct a service road on the South side of Hwy. #401. In conjunction with the above proposal, it is also proposed to construct a diversion for Wesley Creek, which will have the effect of straightening a short section of the creek in the vicinity of the proposed crossings, which will be required for the new roads.

A field investigation for the proposed crossing of Hwy. #401 and Wesley Creek was carried out by Racey, MacCallum and Associates, Ltd., during the summer of 1960 under W.P. #115-59.

The present investigation was carried out to determine the subsoil conditions existing at the site of the proposed crossing of the South Service Road and Wesley Creek.

2. DESCRIPTION OF THE SITE:

The topography in this area consists mostly of flat open farmland on the North bank of the St. Lawrence River. The site of the proposed crossing of the South Service Road and Wesley Creek, however, is located in a small wooded area of about two or three acres in size. The trees are mostly small; maple, birch, and alders.

According to Chapman-Putman in "The Physiography of Southern Ontario", the clay subsoil in this area represents a marine deposit from the Champlain Sea period, which overlies a very stoney till.

cont'd. /2 ...

3. FIELD INVESTIGATION PROCEDURE:

A total of four dynamic cone penetration tests and one borehole was carried out using conventional diamond drill equipment adapted for soil sampling purposes. The borehole was cased with 4-inch diameter steel casing to the bottom of the clay deposit, and from then on, BX casing was drilled into the stoney till.

Samples were recovered in the disturbed state using a 2-inch O.D. split spoon which was driven into the soil by a 140 lb. hammer with an energy of 350 ft. lbs. per blow. Undisturbed samples were recovered using 2-inch I.D. Shelby Tubes. These were pushed into the soil by hand. Wherever possible, vane tests were carried out to determine the in-situ shear strength of the clay layer at a distance of 12 inches below the bottom of the various samples.

Four dynamic cone penetration tests were carried out: driving energy to advance the cone was 350 ft. lbs. per blow.

All elevations were established from the original ground profile (#P-4067-1), taking the ground elevation at Sta. 174 + 40.0 as 154.0'.

Locations of all boreholes were established prior to boring operations by the Field Engineer. These are shown on Drawing - #60-P-86A which forms part of this report.

4. LABORATORY INVESTIGATIONS:

Laboratory tests were carried out on a selection of undisturbed samples to determine the following properties of the clay deposits:-

1. Liquid Limit.
2. Plastic Limit.
3. Moisture Content.
4. Undrained Shear Strength (Triaxial).
5. Bulk Density.

From the information thus obtained, it was possible to produce curves showing variation of the above properties with depth. These, together with detailed test results, are shown in Appendix #1 of this report.

cont'd. /3 ...

5. DESCRIPTION OF SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Detailed descriptions of the various soil types are given below and are also shown in Appendix #1 of this report. The estimated stratigraphical profiles shown in Drawing #60-F-86A are based upon this information.

From ground level downward, the various soil types are as follows:-

5.2) Soft Marine Clay:

This material extends from ground level to a depth of about 50 feet. It consists of a soft highly sensitive silty clay, blue-grey in colour. The upper 5 - 7 feet of the stratum have become desiccated and, as a consequence, have a higher shear strength than that of the material below which is of the order of 400 - 600 p.s.f. The shear strength of the desiccated layer is greater than 2000 p.s.f. at 4.5 feet dropping to 1000 p.s.f. at 7.0 feet.

Bulk density of the material varies from 116 p.c.f. in the upper layers to 90 p.c.f. in the lower, and the natural moisture content varies from 44% at the surface to 74% at 40.0'.

5.3) Coarse Sand Gravel and Boulder Till:

This material was observed at 54.0' in B.H. #1 and underlies the soft clay layers. It consists of a very dense mixture of coarse sand, gravel and boulders. Adjacent to B.H. #1, it was not possible to drive the dynamic cone farther than 58.0', and subsequent drilling indicated the presence of a large boulder. In the three other penetration tests, absolute refusal was reached at depths from 49 - 54 feet. In no case, was the dense stratum penetrated by the cone more than four feet.

5.4) Ground Water Conditions:

The natural water table over the whole site is about 3.0 feet below ground level. Because of the impermeable nature of the clay subsoil, no major dewatering problems are to be anticipated in excavations carried out in this material.

cont'd. /4 ...

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a single-span bridge at this location to span the proposed diversion of Wesley Creek. The span of the bridge will be about 25.0' and the skew angle about 20°. The normal water level in the creek diversion will be at elevation, 152.0' and it is assumed that the creek bed will be at elevation 150.0'.

Particular problems dealt with in this report are discussed under the appropriate headings.

6.2) Structure Foundations:

The presence of a soft clay layer relatively close to the ground excludes the possibility of the structure being supported by spread footings. In view of this, it is recommended that the structure be supported on piles driven into the dense till stratum below the clay layer. It is estimated that 'H' piles would attain practical refusal at depths within four to five feet below the surface of the dense stratum. A design load of 60 tons per pile would be suitable in this case. Displacement piles are not recommended in view of the fact that they are likely to create disturbances in the sensitive clay thus causing serious stability problems for the bridge approaches.

6.3) Structure Approaches:

With the above comments in mind, it is felt that the proposed 7 - 8 ft. high bridge approaches will not present any problems with regard to stability. Settlements will occur but in view of the presence of the stiff crust in the clay material, these are likely to be small.

7. SUMMARY:

The investigation findings and resulting recommendations are summarized in the following paragraphs:-

cont'd. /5 ...

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

Subsoil in this area consists of a soft sensitive marine clay, underlain by a dense till stratum of sand gravel and boulders. The upper 7.0' of the clay layer are desiccated and have a consequent higher shear strength than the lower layers.

It is recommended that the structure be founded on 'H' piles driven to refusal in the dense boulder till stratum shown on Drawing #60-F-86A. A safe load of 60 tons can be attributed to each pile.

No problems are anticipated during or after construction of the proposed bridge approaches.

No major problems are anticipated with regard to the dewatering of excavations carried out for the proposed footings.

8. MISCELLANEOUS:

The field investigation was carried out during the period October 19th to October 21st, 1960, under the supervision of Mr. K. G. Selby. Equipment used was owned and operated by Johnston Drilling Co., Ottawa.

October, 1960.

REPORT PREPARED BY:

K. G. Selby
.....
K. G. Selby,
Project Foundations Engr.

REPORT APPROVED BY:

A. G. Stermac
.....
A. G. Stermac,
Foundations Office Engr.

APPENDIX I

SUMMARY OF FIELD & LABORATORY TESTS

JOB 60-F-86

W.P. 190-60

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	T1	3'-4'	Stiff oxidized silty clay	P	44.4	31.0	68.0	-	116.5	
	VANE	5.5'		-	-	-	-	>2000	-	
	T2	6'-7.5'	"	P	74.5	25.0	74.4	610	101	
	VANE	9'		-	-	-	-	1000	-	Sens: 12.5
	T3	10'-11.5'	Soft, sensitive, silty clay	P	-	-	-	-	-	
	VANE	13'		-	-	-	-	400	-	Sens: 13.3
	T4	15'-16.5'	"	P	103.0	27.6	67.0	340	90.5	
	VANE	18'		-	-	-	-	340	-	Sens: 8.8
	T5	20'-21.5'	"	P	-	-	-	-	-	
	VANE	23'		-	-	-	-	480	-	Sens: 16.0
	T6	30'-31.5'	"	P	-	-	-	-	-	
	VANE	33'		-	-	-	-	540	-	Sens: 18.0

SUMMARY OF FIELD & LABORATORY TESTS

JOB 60-F-86

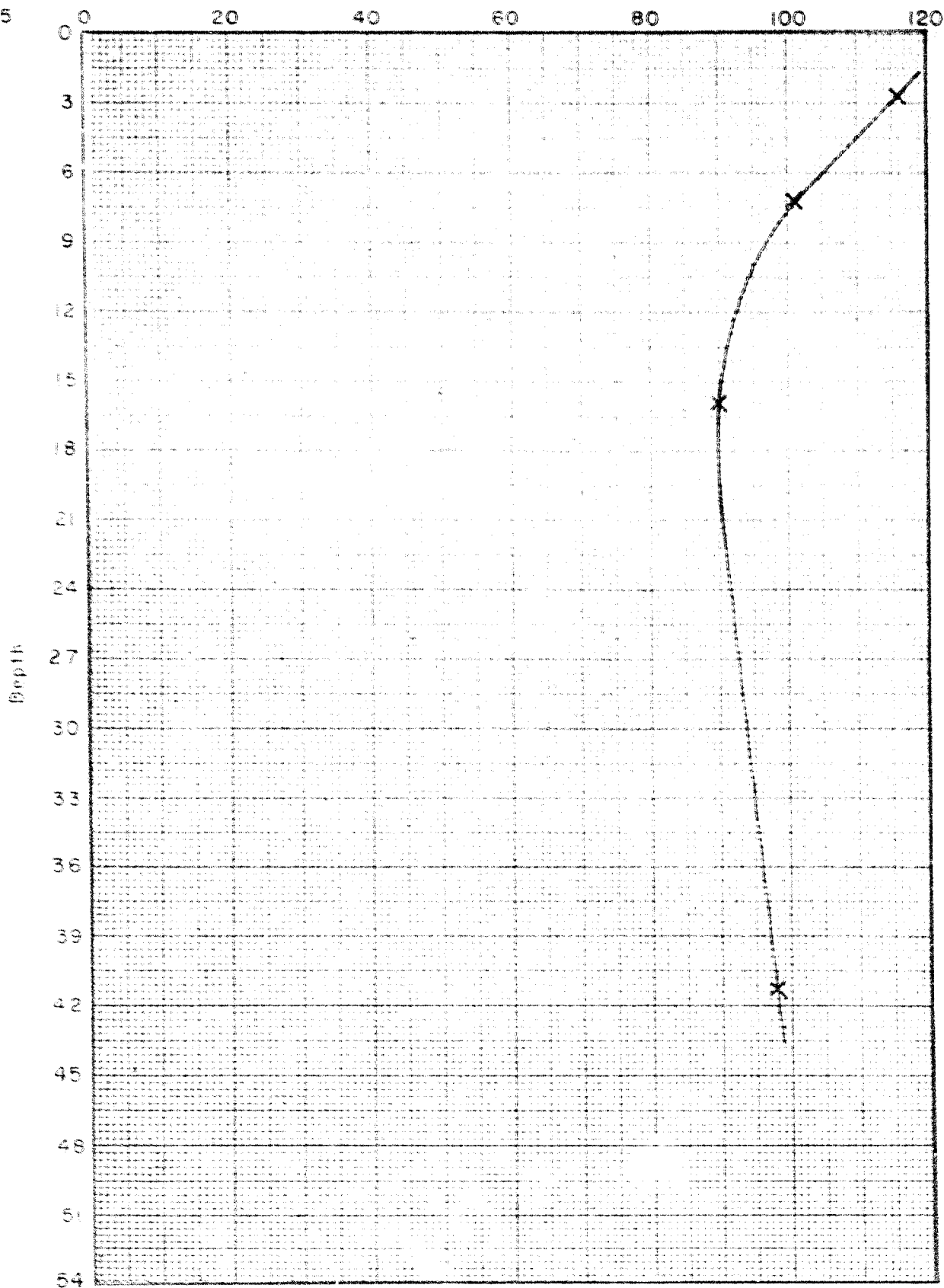
W.P. 190-60

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	T7	40'-41.5'	Soft, sensitive, silty clay	P	74.0	25.8	75.7	500	98.5	
	VANE	43'		-	-	-	-	600	-	St 0.0
	T8	50'-51.5'	"	P	-	-	-	-	-	
	VANE	53'		-	-	-	-	600	-	Sens: 15.0
	S9	55'-56.5'	Dense sand, gravel & boulders	57	-	-	-	-	-	
2	cone	penetration	only							
3	"	"	"							
4	"	"	"							
			S denotes split spoon							
			T " shelby tube							

Variation in Bulk Density with Depth

pcf.

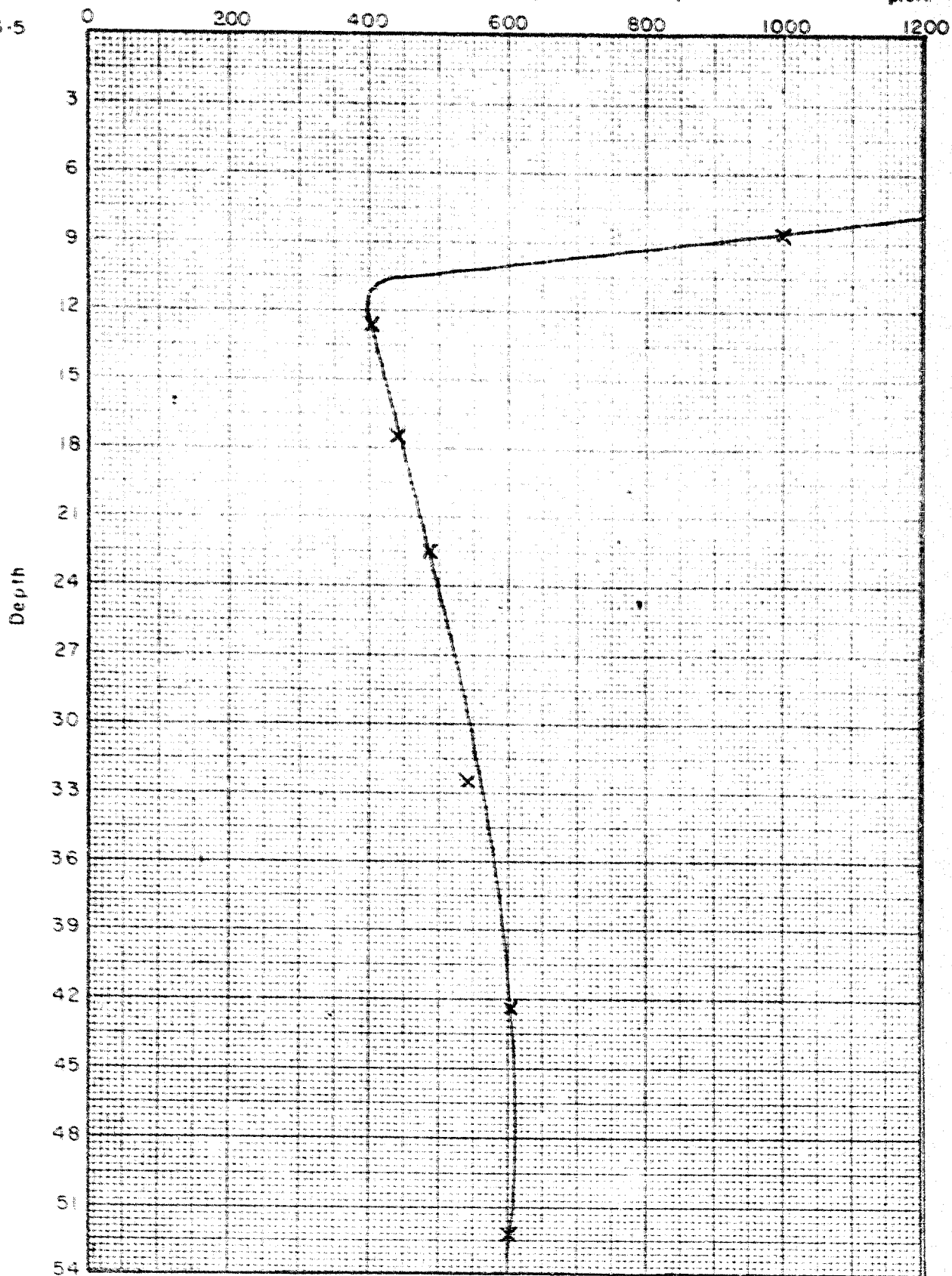
71.153.5



Variation in Shear Strength with Depth

p.s.f.

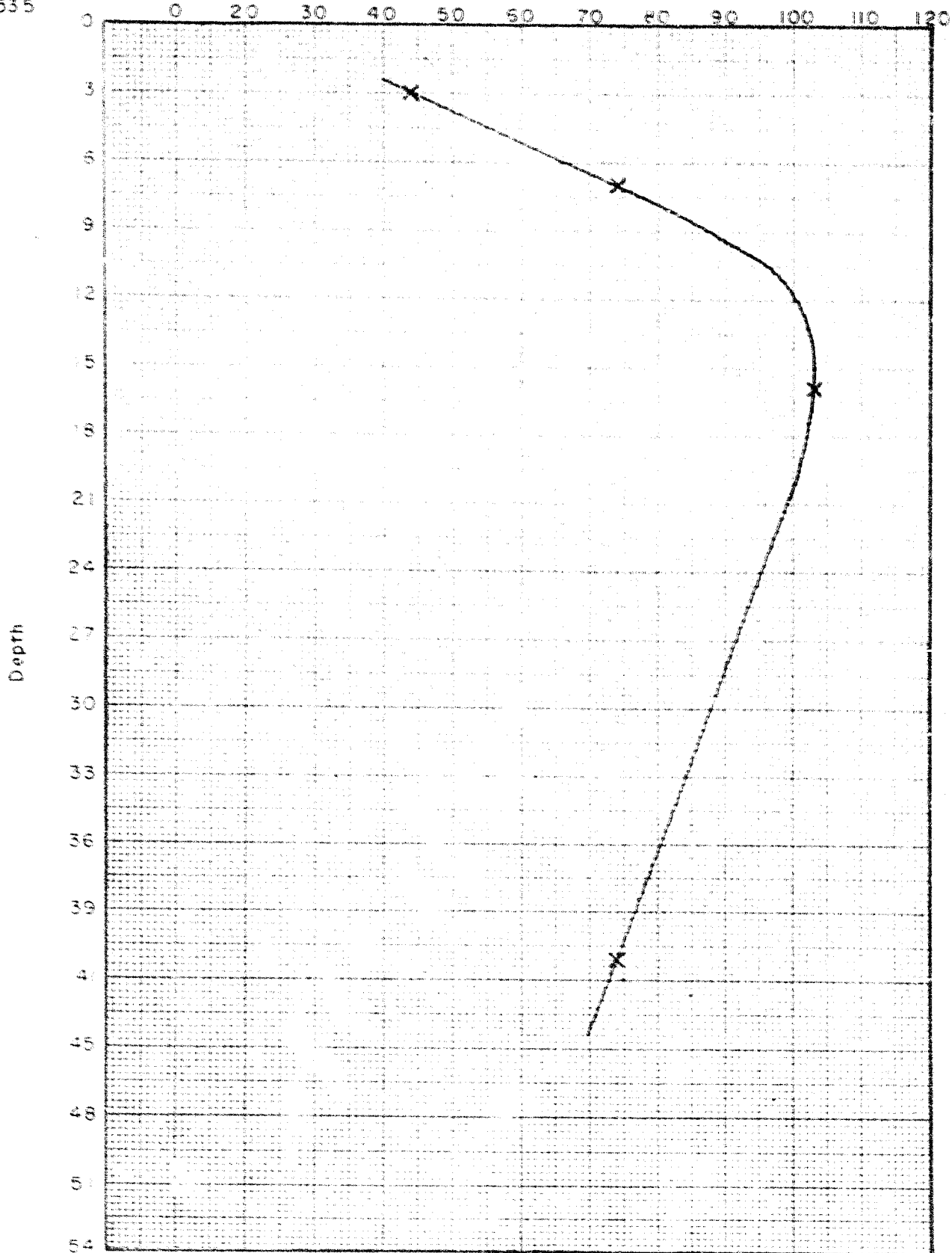
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Variation in moisture content with depth

%

L 1535



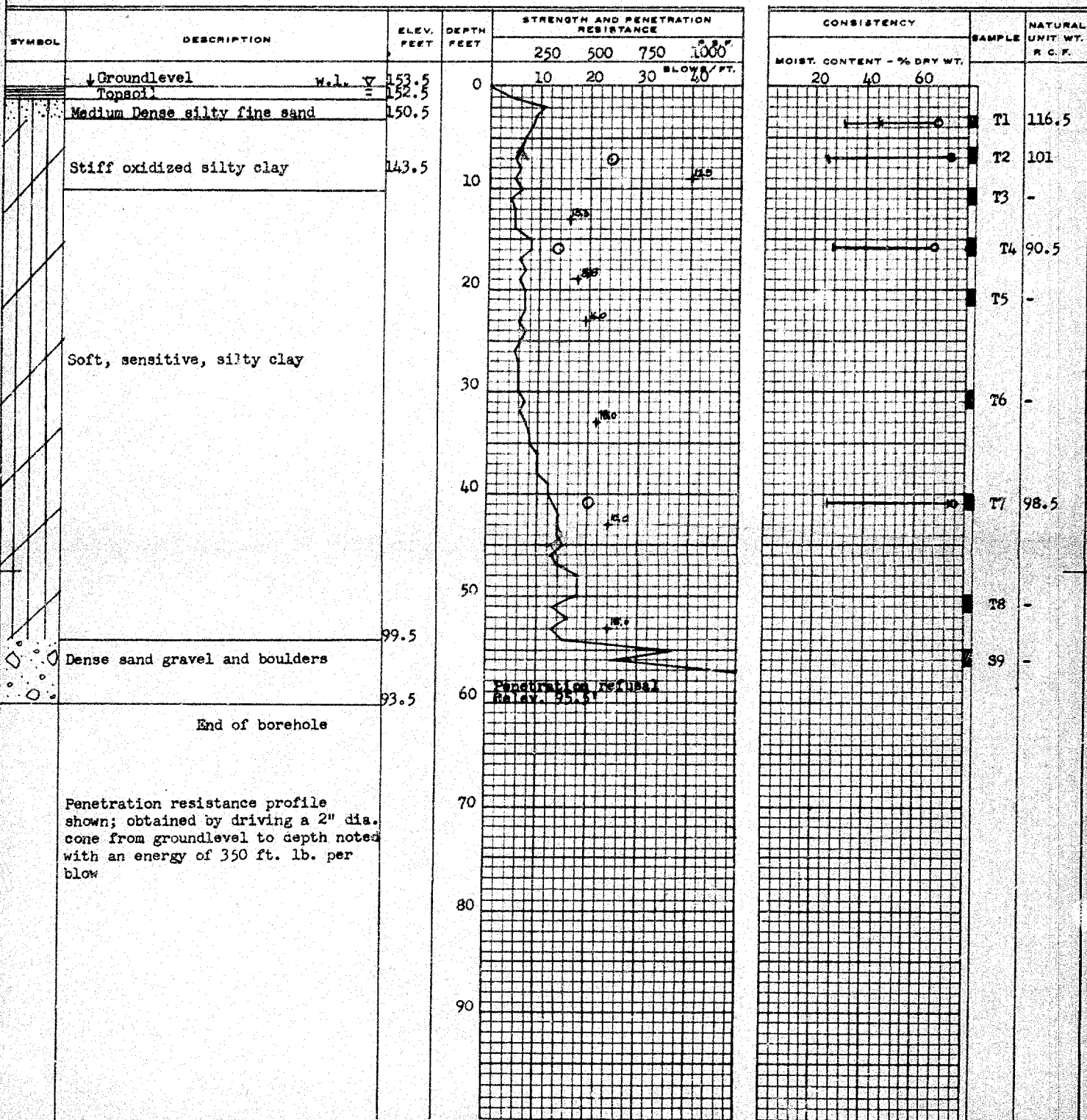
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 190-60 BORE HOLE NO. 1
 JOB 60-F-86 STATION 174+58 14' Left
 DATUM G.S.C. COMPILED BY B.K.
 BORING DATE 20/10/60 CHECKED BY K.S.

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

LEGEND

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



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 190-60

BORE HOLE NO. 2 (Cone Test Only)

JOB 60-F-86

STATION 174/27 14' Left

DATUM G.S.C.

COMPILED BY B.K.

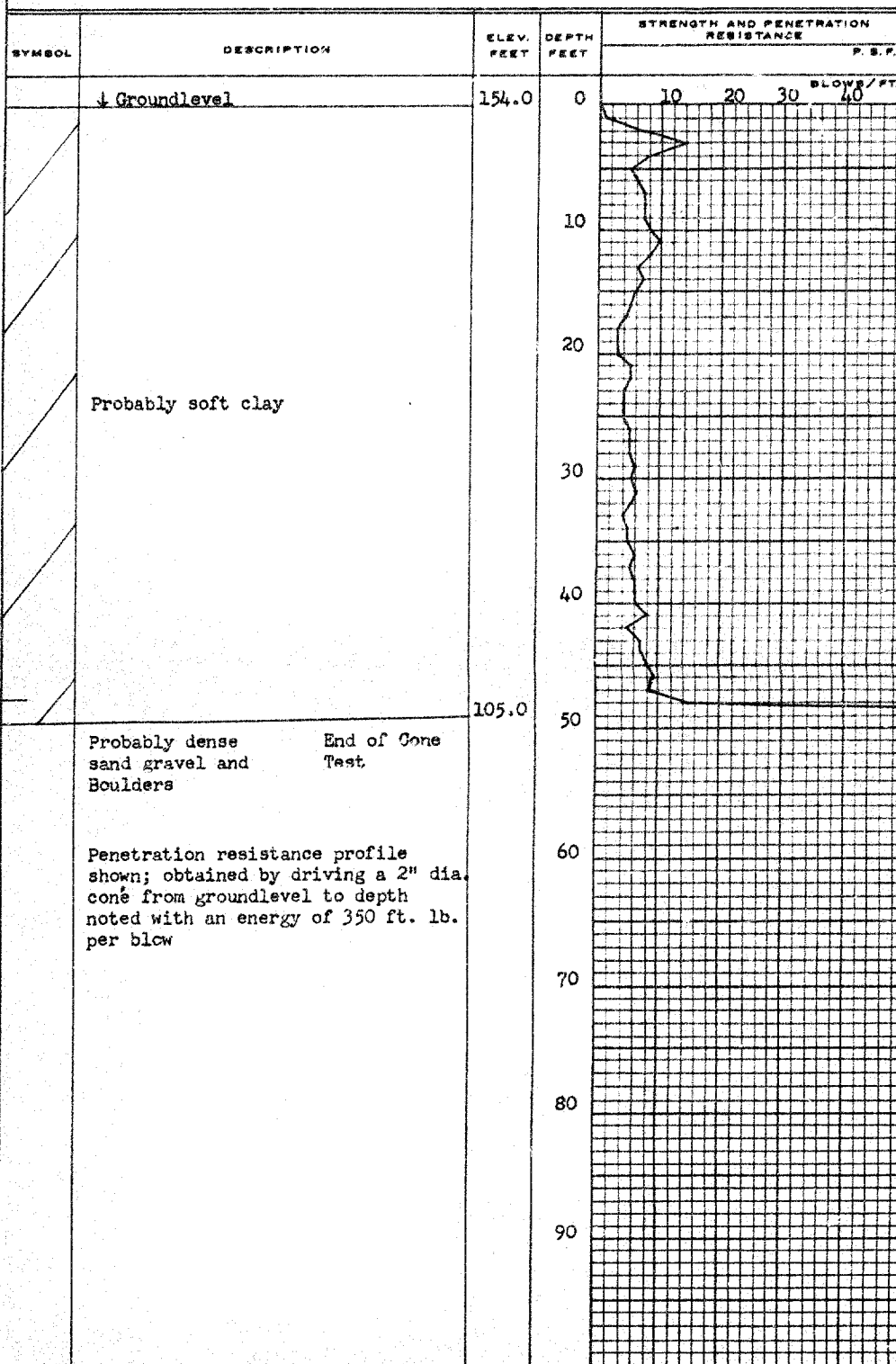
BORING DATE 21/10/60

CHECKED BY K.S.

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
C' SING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu)	0
VANE TEST (C) AND SENSITIVITY (S)-----	4 ^s
NATURAL MOISTURE AND	
LIQUIDITY INDEX -----	LI
LIQUID LIMIT -----	X
PLASTIC LIMIT -----	0

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 190-60 BORE HOLE NO. 3 (Cone Test Only)

JOB 60-F-86 STATION 174+21 14' Rt.

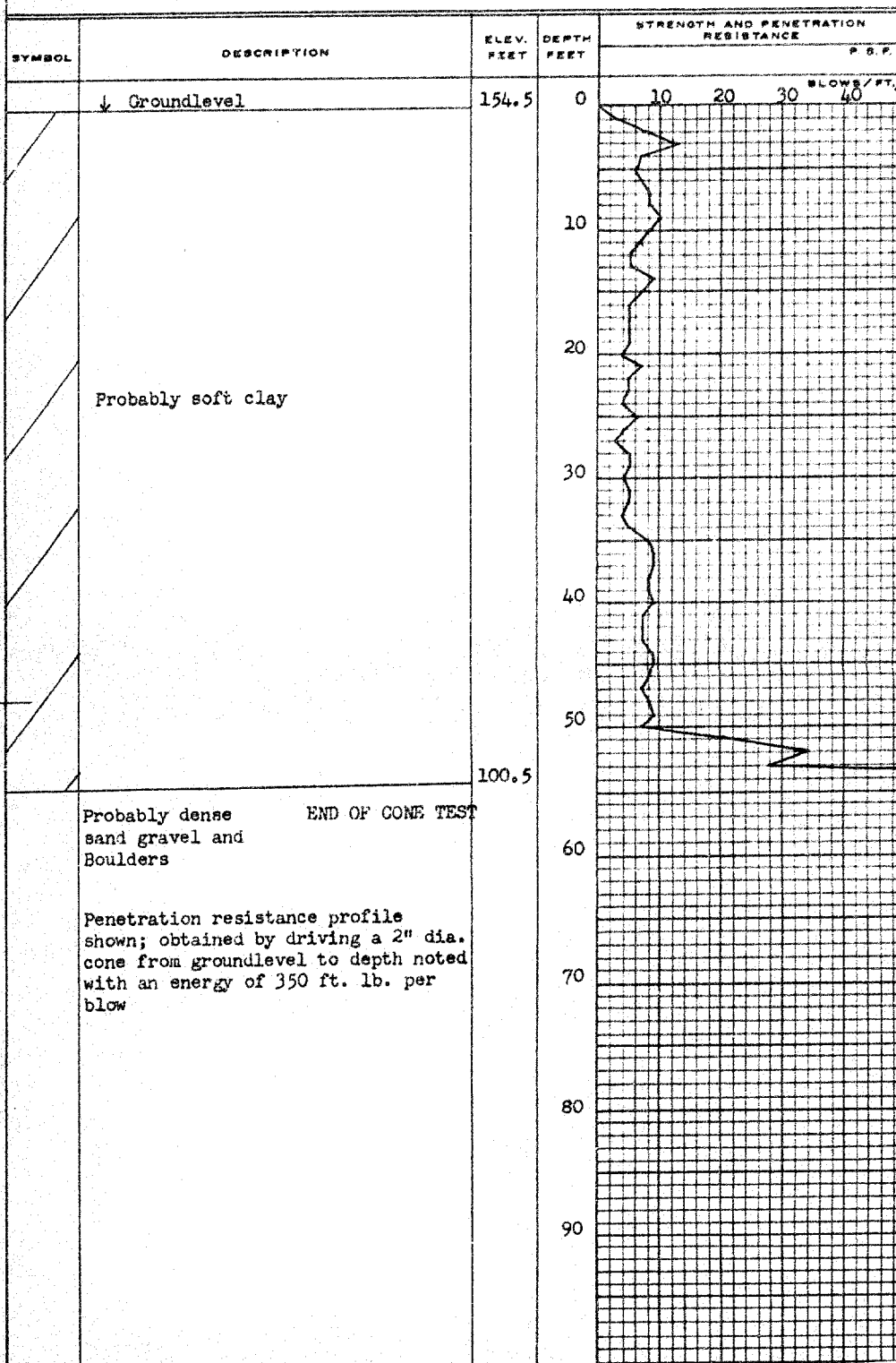
DATUM G.S.C. _____ COMPILED BY _____ B.K. _____

BORING DATE 21/10/60 CHECKED BY K.S.

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 -----	0



CONSISTENCY		SAMPLE	NATURAL UNIT WT. R.C.F.
MOIST. CONTENT - % DRY WT.			

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 190-60

BORE HOLE NO. 4 (Cone Test Only)

JOB 60-F-86

STATION 174+52 14.0' Ht.

DATUM G.S.C.

COMPILED BY B.K.

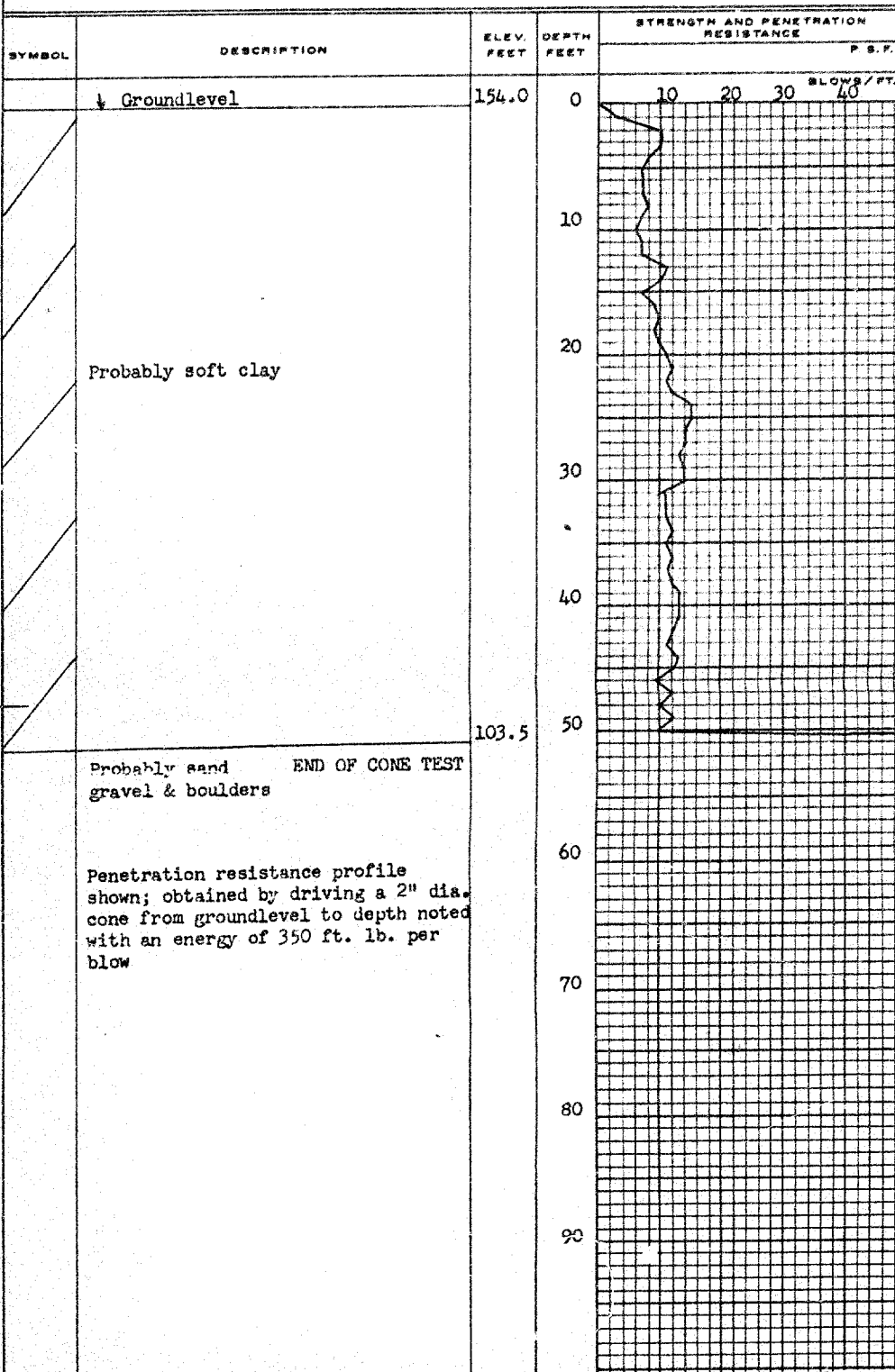
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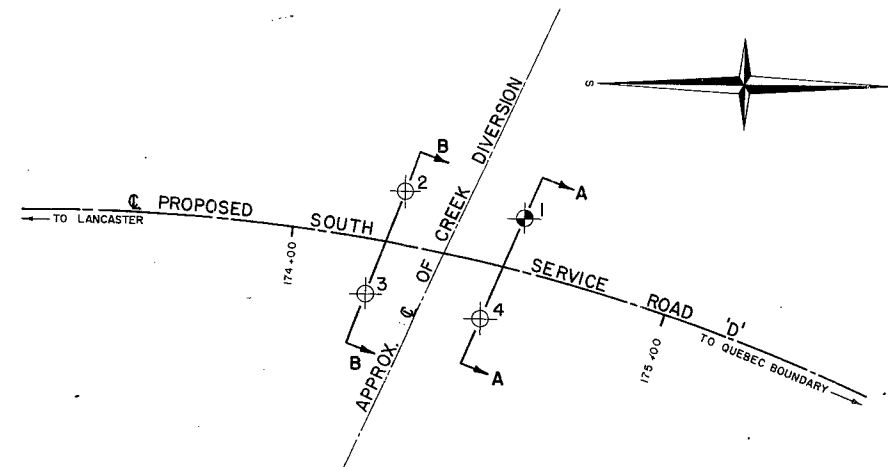
2" DIA. SPLIT TUBE	1/2"	3/4"	1"	1 1/4"	1 1/2"	1 3/4"	2"	2 1/4"	2 1/2"	2 3/4"	3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"	5 1/4"	5 1/2"	5 3/4"	6"	6 1/4"	6 1/2"	6 3/4"	7"	7 1/4"	7 1/2"	7 3/4"	8"	8 1/4"	8 1/2"	8 3/4"	9"	9 1/4"	9 1/2"	9 3/4"	10"	10 1/4"	10 1/2"	10 3/4"	11"	11 1/4"	11 1/2"	11 3/4"	12"	12 1/4"	12 1/2"	12 3/4"	13"	13 1/4"	13 1/2"	13 3/4"	14"	14 1/4"	14 1/2"	14 3/4"	15"	15 1/4"	15 1/2"	15 3/4"	16"	16 1/4"	16 1/2"	16 3/4"	17"	17 1/4"	17 1/2"	17 3/4"	18"	18 1/4"	18 1/2"	18 3/4"	19"	19 1/4"	19 1/2"	19 3/4"	20"	20 1/4"	20 1/2"	20 3/4"	21"	21 1/4"	21 1/2"	21 3/4"	22"	22 1/4"	22 1/2"	22 3/4"	23"	23 1/4"	23 1/2"	23 3/4"	24"	24 1/4"	24 1/2"	24 3/4"	25"	25 1/4"	25 1/2"	25 3/4"	26"	26 1/4"	26 1/2"	26 3/4"	27"	27 1/4"	27 1/2"	27 3/4"	28"	28 1/4"	28 1/2"	28 3/4"	29"	29 1/4"	29 1/2"	29 3/4"	30"	30 1/4"	30 1/2"	30 3/4"	31"	31 1/4"	31 1/2"	31 3/4"	32"	32 1/4"	32 1/2"	32 3/4"	33"	33 1/4"	33 1/2"	33 3/4"	34"	34 1/4"	34 1/2"	34 3/4"	35"	35 1/4"	35 1/2"	35 3/4"	36"	36 1/4"	36 1/2"	36 3/4"	37"	37 1/4"	37 1/2"	37 3/4"	38"	38 1/4"	38 1/2"	38 3/4"	39"	39 1/4"	39 1/2"	39 3/4"	40"	40 1/4"	40 1/2"	40 3/4"	41"	41 1/4"	41 1/2"	41 3/4"	42"	42 1/4"	42 1/2"	42 3/4"	43"	43 1/4"	43 1/2"	43 3/4"	44"	44 1/4"	44 1/2"	44 3/4"	45"	45 1/4"	45 1/2"	45 3/4"	46"	46 1/4"	46 1/2"	46 3/4"	47"	47 1/4"	47 1/2"	47 3/4"	48"	48 1/4"	48 1/2"	48 3/4"	49"	49 1/4"	49 1/2"	49 3/4"	50"	50 1/4"	50 1/2"	50 3/4"	51"	51 1/4"	51 1/2"	51 3/4"	52"	52 1/4"	52 1/2"	52 3/4"	53"	53 1/4"	53 1/2"	53 3/4"	54"	54 1/4"	54 1/2"	54 3/4"	55"	55 1/4"	55 1/2"	55 3/4"	56"	56 1/4"	56 1/2"	56 3/4"	57"	57 1/4"	57 1/2"	57 3/4"	58"	58 1/4"	58 1/2"	58 3/4"	59"	59 1/4"	59 1/2"	59 3/4"	60"	60 1/4"	60 1/2"	60 3/4"	61"	61 1/4"	61 1/2"	61 3/4"	62"	62 1/4"	62 1/2"	62 3/4"	63"	63 1/4"	63 1/2"	63 3/4"	64"	64 1/4"	64 1/2"	64 3/4"	65"	65 1/4"	65 1/2"	65 3/4"	66"	66 1/4"	66 1/2"	66 3/4"	67"	67 1/4"	67 1/2"	67 3/4"	68"	68 1/4"	68 1/2"	68 3/4"	69"	69 1/4"	69 1/2"	69 3/4"	70"	70 1/4"	70 1/2"	70 3/4"	71"	71 1/4"	71 1/2"	71 3/4"	72"	72 1/4"	72 1/2"	72 3/4"	73"	73 1/4"	73 1/2"	73 3/4"	74"	74 1/4"	74 1/2"	74 3/4"	75"	75 1/4"	75 1/2"	75 3/4"	76"	76 1/4"	76 1/2"	76 3/4"	77"	77 1/4"	77 1/2"	77 3/4"	78"	78 1/4"	78 1/2"	78 3/4"	79"	79 1/4"	79 1/2"	79 3/4"	80"	80 1/4"	80 1/2"	80 3/4"	81"	81 1/4"	81 1/2"	81 3/4"	82"	82 1/4"	82 1/2"	82 3/4"	83"	83 1/4"	83 1/2"	83 3/4"	84"	84 1/4"	84 1/2"	84 3/4"	85"	85 1/4"	85 1/2"	85 3/4"	86"	86 1/4"	86 1/2"	86 3/4"	87"	87 1/4"	87 1/2"	87 3/4"	88"	88 1/4"	88 1/2"	88 3/4"	89"	89 1/4"	89 1/2"	89 3/4"	90"	90 1/4"	90 1/2"	90 3/4"	91"	91 1/4"	91 1/2"	91 3/4"	92"	92 1/4"	92 1/2"	92 3/4"	93"	93 1/4"	93 1/2"	93 3/4"
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LEGEND

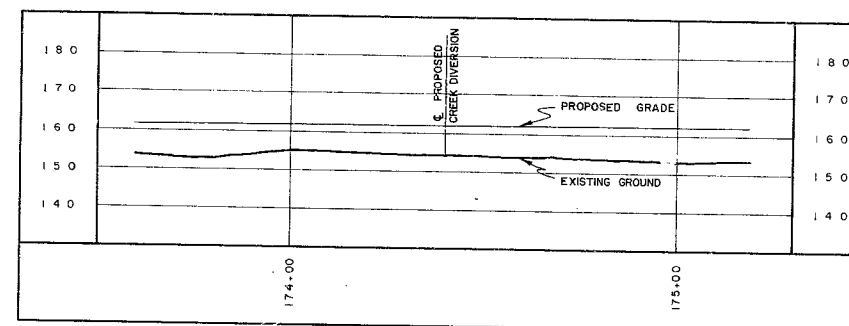
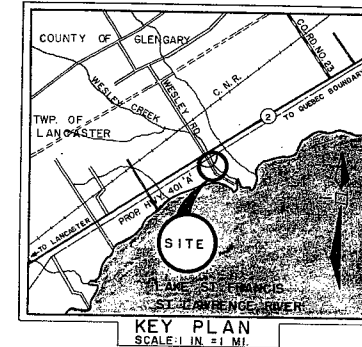
1/2 UNCONFINED COMPRESSION (QU)	0
VANE TEST (C) AND SENSITIVITY (S)---	+ ^s
NATURAL MOISTURE AND	LI
LIQUIDITY INDEX -----	X
LIQUID LIMIT -----	0
PLASTIC LIMIT -----	1

[illegible]

#60-F-86
W.P.# 190-60
Hwy. # 401
S. SERVICE RD.
AT WESLEY CR.
3 MILES E. OF
LANCASTER



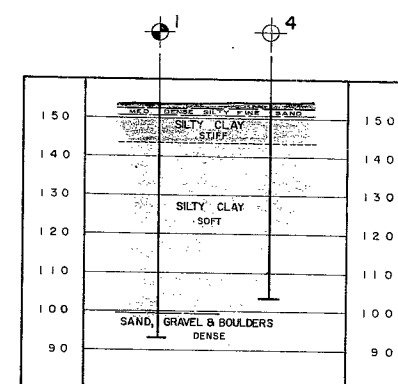
PLAN



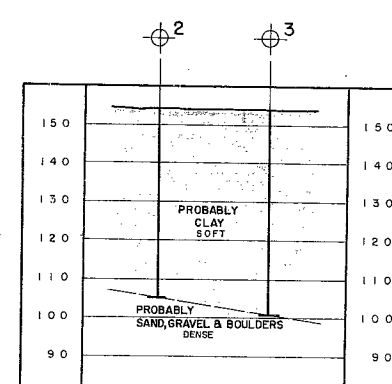
PROFILE

LEGEND			
	BORE & PENETRATION HOLE		
	PENETRATION HOLE		
HOLE	ELEVATION	STATION	DISTANCE FROM C
1	153.5	174+58	14' LT.
2	154.0	174+27	14' LT.
3	154.5	174+21	14' RT.
4	154.0	174+52	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.



A-A



B-B

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

WESLEY CREEK DIVERSION
AND
PROPOSED SOUTH SERVICE ROAD LINE 'D'
SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 SERVICE RD. DISTRICT... 9... COUNTY, GLENGARRY...
TOWNSHIP LANCASTER... LOT 24 & 25 CON. I...
LOCATION 3 MILES EAST OF LANCASTER

DRAWN BY: D. MUMFORD CHECKED BY: *[Signature]* W.P. 190-60
DATE 10 NOV. 1960 APPROVED BY: *[Signature]* DRAWING NO.
SCALE 1 inch = 20 feet 60-F-86 A