

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Section.

September 26, 1960.

FOUNDATION INVESTIGATION REPORT
By: Dominion Soil Investigation, Ltd.

Attention: Mr. E. McCombie.

Re: Proposed Crossing C.P.E. Overhead and
Grindstone Creek at Watertown, Ontario.
Hwy. No. 5, District No. 4, (W.P. 272-60.)

Attached, we are forwarding to you the foundation investigation report for the above structure, submitted by Dominion Soil Investigation, Ltd.

We have reviewed the report, and on the basis of the presented factual data, agree with the recommendations contained therein, except that we believe that the settlements will be smaller than indicated in the report. It is therefore our recommendation that spread footings be used - the North abutment's footing at Elev. 711.0', and the South abutment's footing at Elev. 703.0', respectively. The allowable bearing capacity of 3.0 T/sq.ft. should be used.

Should there be any further queries in connection with the contents of this report, or our comments, please contact our Office.

AS/MGF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. C. Ramsay
I. Campbell
G. E. Richardson
T. J. Kovich
A. Watt

Foundations Office
Gen. Files.

L. G. Soderman,
PRINCIPAL FOUNDATIONS ENGR.
Per:

(A. Sternac,
FOUNDATIONS OFFICE ENGR.)

ONTARIO
DEPARTMENT OF HIGHWAYS
MATERIALS & RESEARCH SECTION
DOWNSVIEW AVE. TORONTO

REPORT ON
FOUNDATION INVESTIGATION
FOR
PROPOSED CROSSING
C.P.R. OVERHEAD AND GRINDSTONE CREEK
AT
WATERDOWN, ONTARIO
HWY. #5, DISTRICT #4 - WP 272-60

Submitted by
Dominion Soil Investigation Ltd.
88 Eglinton Ave. East
Toronto 12 Ontario

Our Reference Number: C-8-1

August 19, 1960

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DOMINION SOIL INVESTIGATION LTD.

SOIL MECHANICS • FOUNDATION ENGINEERING

TORONTO 12, ONTARIO

INTRODUCTION

..... Authorization was received on July 20, 1960, from the Ontario Department of Highways, Downsview Avenue, Toronto, to carry out foundation investigation for Proposed Crossing C.P.R. Overhead and Grindstone Creek at Waterdown, Ontario - Hwy. #5, District #4 - W.P. 272-60. The proposed structure will replace the existing old one. It will most likely be a multi-span, four lane bridge.

A location plan and profile was provided by the client. Number and location of boreholes were in accordance with the client's requirements.

The purpose of the investigation is to determine the subsoil condition at the site for the design of the above mentioned project.

This Report presents the results of our field investigation, laboratory testing and recommendations.

I. THE SITE

Waterdown is a small village (pop. 1800) about six miles north of Hamilton. The village is cut into two halves by a deep valley in which Grindstone Creek is flowing in a south direction. At the location of the Overhead, parallel to the Creek, runs the railway line of the C.P.R. on a rock fill. Several hundred feet north of the bridge is WATERDOWN SOUTH - railway station. (For Key Plan see Encl. #1.)

The stream is fast running but it is not too deep. The side of the railway fill underneath the bridge and the western piers are protected against erosion by a concrete retaining wall.

The valley is an ancient spillway formed as the Pleistocene ice melted away. The area is underlain by stratified grey shale deposited in the Silurian Age. (Grindstone Creek most likely owes its name to this shale deposit.)

10 miles west from the site there is a limestone mine, and this limestone can be found as crushed stone or boulder fill at the bridge site also. Angular limestone gravel and cobbles (crushed and broken by the moving ice) can be recognized in the subsoil.

At present, there is a 3 span bridge above the valley. The center span is a steel truss, the end spans steel girders, the bridge deck is timber. The structure is statically determinate. It is very old, probably 40 years of age. The pier and abutments may be even older. The whole bridge is in a very bad condition.

II. FIELD WORK

The boreholes and dynamic core penetration tests were set out with the help of the location plan. Elevations were taken using the Benchmark and marked on the profile: nail in Maple at Sta. 89 + 42, Elevation 731.00. (For location of boreholes and core tests see Encl. #2.)

Wash boring method was used. Casing: Bx. Bx core was obtained of the bedrock. Samples were taken with a 2" diameter split spoon and 2" diameter Shelby Tube. Hammer weight: 140 lbs, fall 30". Vane tests were carried out with a 2" x 5" vane. Both in situ and remolded shear resistance were measured, where it seemed to be suitable.

The drilling operations were carried out from July 20 to 26 inclusive, in the following order: C₁ - BH₁ - C₂ -

BH₂ - C₄ - BH₄ - C_{4A} - C₃ - C_{3A} - BH₃ - C₅.

A dynamic core penetration test was suggested close to the western pier. However, this was omitted because of the rock fill and the evidence of the fact that the pier is founded right on the bedrock. C₃ met refusal at 22'-3" depth, C₄ at 12'-10" depth. Both tests were repeated (C_{3A} and C_{4A} respectively) close to the original spot. The refusals at the previous, higher levels were due to boulders. The penetration curves for C₃ and C₄ are not shown in this report.

Recovery of samples taken with split spoon was generally fair to good, except in cases where the subsoil was too gravelly. Core recovery was good.

For detailed information regarding the results of standard penetration tests, core tests, see Enclosures #3 to 6 inclusive.

III. LABORATORY TEST RESULTS

Several split spoon samples were tested in the laboratory to determine their Index Properties. Here are the results:

BH:	Sa:	Elevation:	LL%	PL%	PI%	W%	CI
1	2	719.05	28.4	16.9	11.5	20.0	0.73
	5	709.85	37.2	21.7	15.5	30.2	0.45
	9	701.85	35.8	20.0	15.8	17.0	1.19
4	6	714.7	23.5	14.3	9.2	19.4	0.45
	7	712.2	30.9	17.5	13.4	15.8	1.13
	8	710.2	34.1	19.7	14.4	14.0	1.40
	10	701.2	33.1	18.8	14.3	13.0	1.40

In the very stiff, red, damp, medium plastic clay with traces of silt and shale particles, no Shelby Tube sample could be obtained. Thus there is no undisturbed sample of this layer on which consolidation, etc., test could have been performed.

IV. SUBSURFACE CONDITIONS

The subsoil at the site can be classified as follows:

WET, BROWN-GREY, LOOSE SILTY SAND AND GRAVEL FILL occupies the first 12-14 ft (to elevations 721 to 724) at BHs #1 and #4.

WET, BROWN-GREY MEDIUM STIFF SILT AND CLAY MIXED WITH GRAVELS AND SOME SAND. This is the natural overburden and extends down to elevation 710 - 712. The higher penetration values in BH #4 are due to the gravel and crushed stone content of the

layer. In BH #1 between elevation 704 - 710, cobbles and a 1" diameter limestone boulder was encountered. Diamond drilling through it became necessary.

RED, DAMP, MEDIUM PLASTIC CLAY, TRACES OF SILT AND SHALE PARTICLES in VERY STIFF consistency. This fill material starts at about elevation 704.0 in BH #1 and about 712.0 in BH #4. It extends down to the bedrock.

The BEDROCK starts at between elevation 695 - 700. It is soft grey shale, horizontally bedded, sloping towards the middle of the valley.

The subsoil is somewhat different at the two piers. These are founded directly on the bedrock. After the footings had been built, they were backfilled with the red fill (for description see above) and with rockfill above it. But this also proves the existence (or better, the past existence) of the red clay fill.

V. RECOMMENDATIONS

When consideration is given to the type of foundation to be used for the new bridge, it has to be kept in mind that the existing structure will be demolished. Whether this includes the footings of abutments or not, is not known, but the wingwalls, abutment itself, will definitely be broken down. This means that material has to be excavated down to the bottom of the old footing regardless of type of foundation that will be built. Most likely the existing bridge abutments are founded on spread footings which rest on the red, very stiff, medium plastic clay.

The new abutments are recommended to be built on spread footings on this red, very stiff clay, and the safe bearing pressure is 6000 p.s.f. plus. Assuming that the north abutment is founded at elevation 712, and the south abutment at elevation 704, the settlements will be in the order of 2" and 1" respectively.

As an alternative, short point bearing piles may also be used, their tips reaching the bedrock. In this case, the settlements are negligible.

The piers should be founded directly on the shale bedrock. They will not settle noticeably. Safe bearing pressure on the soft shale is 10,000 p.s.f.

Differential settlements between piers and abutments will be the above values.

Scour protection is recommended in the creekbed and at the pier and abutment on the south side. Dewatering will be no problem.

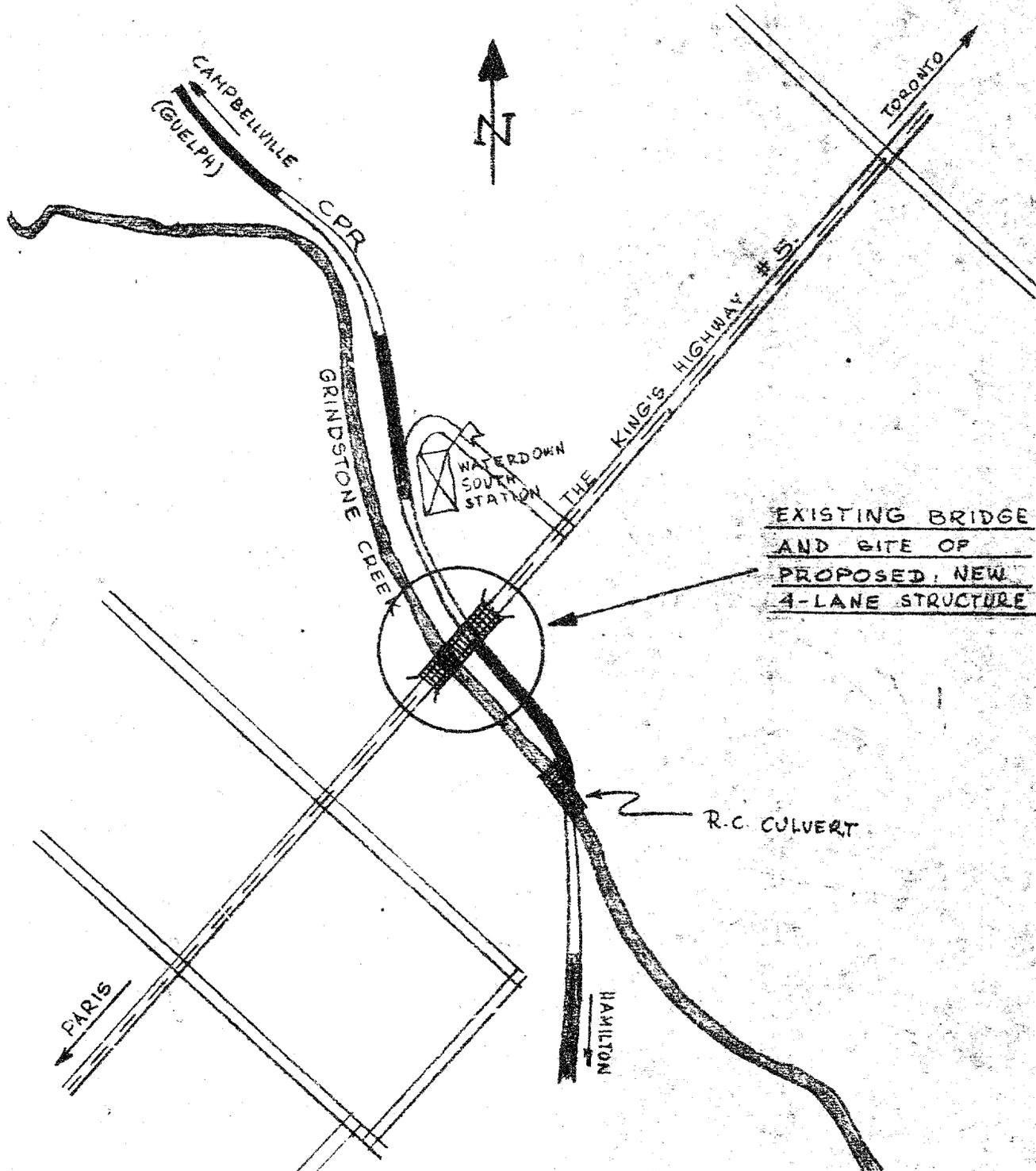
DOMINION SOIL INVESTIGATION LTD.



L. R. Szatlatkay
L. R. Szatlatkay, P. Eng.

Toronto, Ontario
August 19, 1960.

Enclosures



KEY PLAN

SCALE: 3 INGS ~ 1 MILE

Dominion Soil Investigation Ltd.

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 1 OF 4 &

Engineering Data Sheet for Borehole:

Date:

Project: PROPOSED CROSSING C.P.R.
 OVERHEAD & GRINDSTONE CREEK
 Location: WATERDOWN, ONT.
 Hole Location: STA. 88+635 LEFT 15.4'
 Hole Elevation and Datum: 732.35
 Field Supervisor: LRS
 Driller: E-H

LEGEND
 Shear Strength (C)
 Unconfined compression
 Vane test and sensitivity (S)
 Penetration Resistance (P)
 2" Split tube
 2" Dia. Cone
 Casing

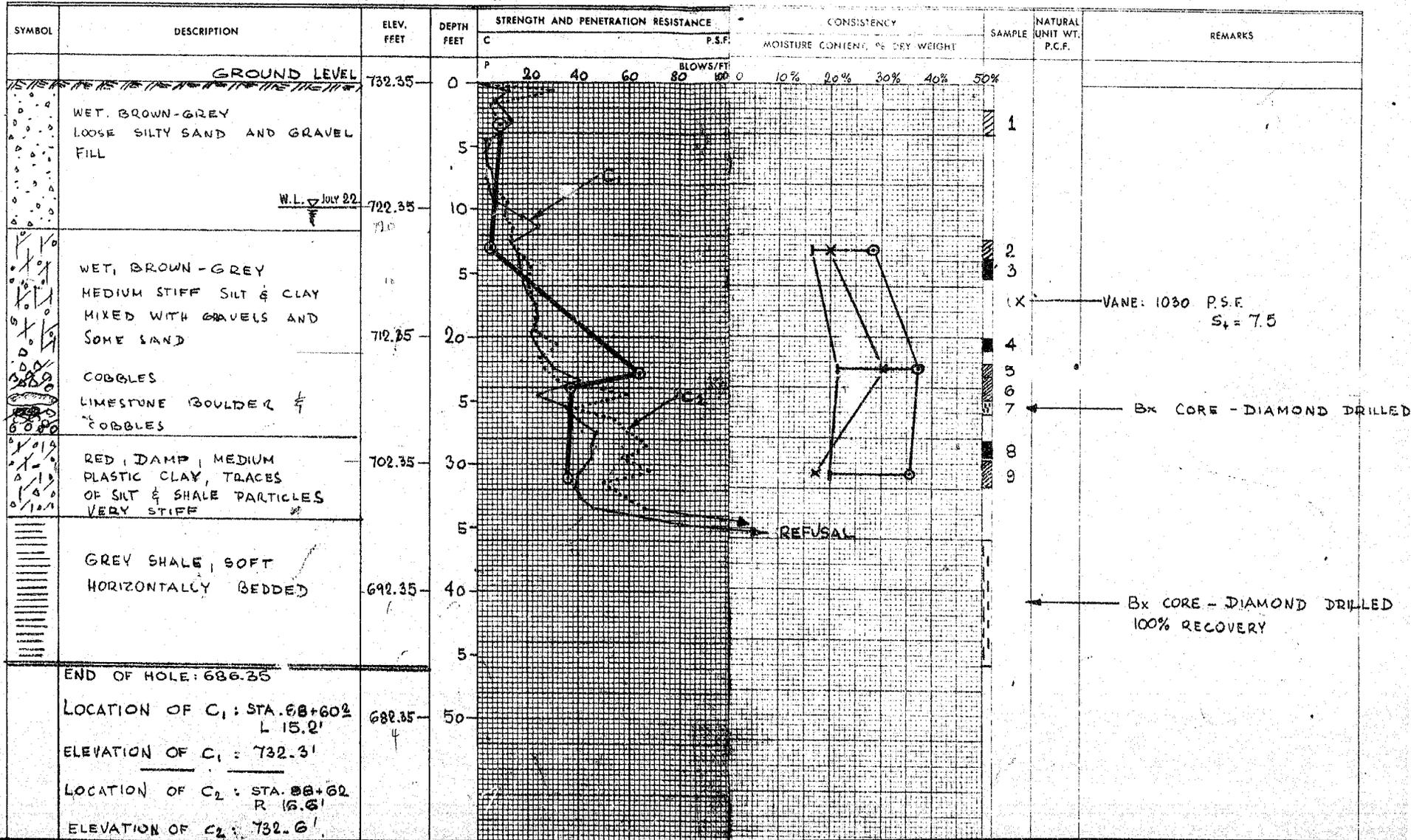
DYN. CONE PEN. TESTS
 # 1 & 2 OF 5

Date: JULY 20, 21, 1960.

Sampling Method
 2" Dia. split tube
 2" Shelby tube

LEGEND
 Consistency
 Natural moisture and
 Liquidity Index (LI)
 Liquid limit
 Plastic limit

Sampling Method
 2" Dia. split tube
 2" Shelby tube



Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 2 OF 4

Date: JULY 22, 1960.

Project: PROPOSED CROSSING - CPR
 Location: OVERHEAD & GRINDSTONE CREEK
 Location: WATERDOWN, ONT.
 Hole Location: STA. 88+075 R 15.5'
 Hole Elevation and Datum: 733.4'
 Field Supervisor: LRS Prep.: LRS
 Driller: E.H Checked: LRS

LEGEND
 Shear Strength (C) \oplus
 Unconfined compression Vane test and sensitivity (S) \oplus^s
 Penetration Resistance (P)
 2" Split tube $\ominus \ominus$
 2" Dia. Cone \ominus
 Casing $---$

Sampling Method
 2" Dia. split tube 
 2" Shelby tube 

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				C	P.S.F.
	BRIDGE DECK	733.4	0	P	BLOWS/FT.
		723.4	10		
		713.4	20		
		703.4	30		
	GROUND LEVEL 701.1'				
	RED SILTY CLAY - BACKFILL				
	CONCRETE FOOTING	694.4			
	GREY SHALE, SOFT HORIZONTALLY BEDDED	693.4	40		
	END OF HOLE 688.4	688.4	50		

BX CORE
 ← DIAMOND DRILLED
 60% RECOVERY

Dominion Soil Investigation Ltd.

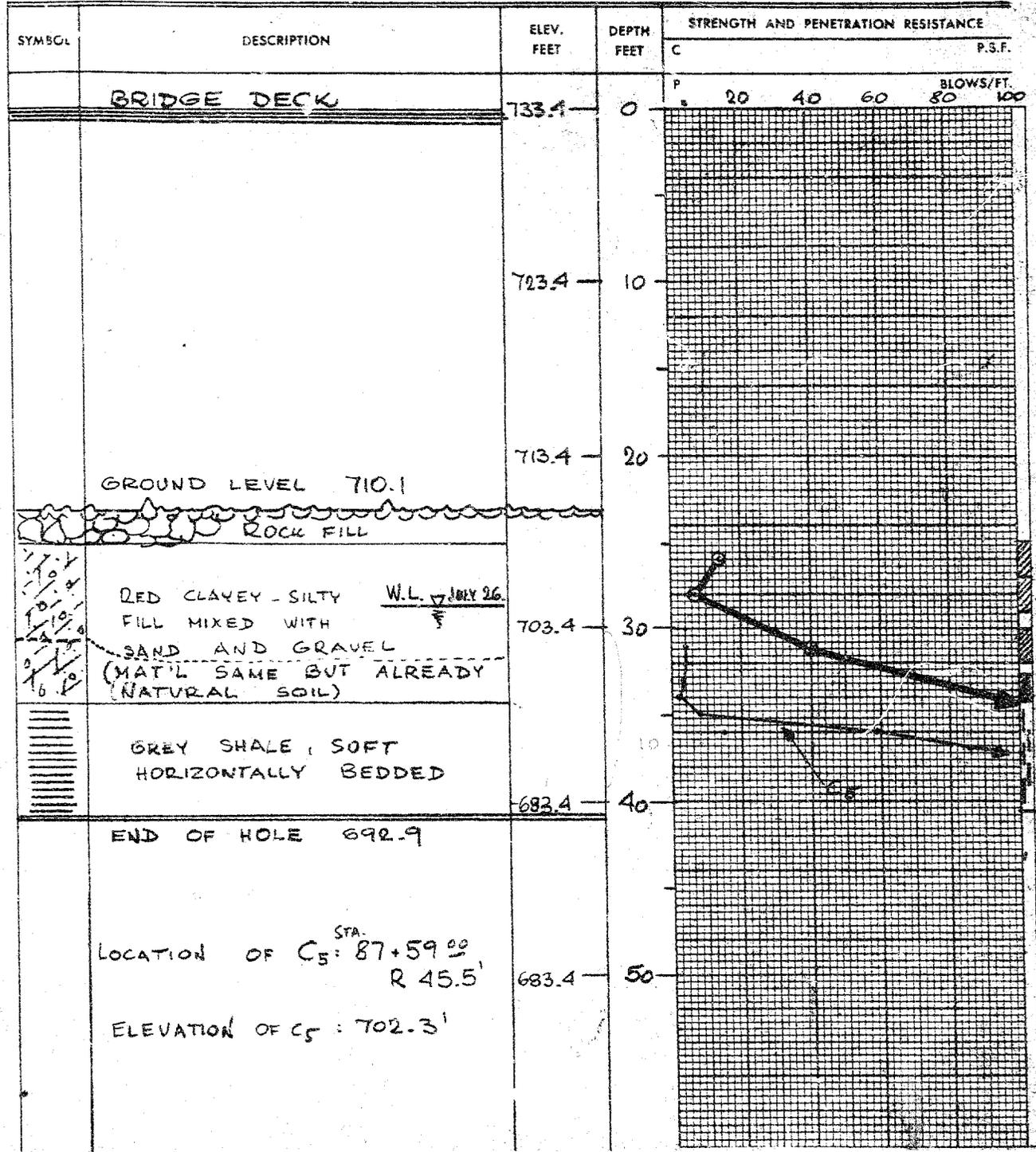
Engineering Data Sheet for Borehole: 3 of 5

DYN. CONE PEN. TEST #5 of Date: JULY 25, 1960.
5 & 26.

Project: PROPOSED CROSSING - CPR OVERHEAD & GRINDSTONE CREEK
 Location: WATERDOWN, ONT.
 Hole Location: STA. 87+44 L 14.5'
 Hole Elevation and Datum: 733.4
 Field Supervisor: Prep.:
 Driller: Checked:

LEGEND
 Shear Strength (C) ⊕
 Unconfined compression Vane test and sensitivity (S) ⊕
 Penetration Resistance (P) •
 2" Split tube ⊕
 2" Dia. Cone ⊕
 Casing ⊕

Sampling Method
 2" Dia. split tube
 2" Shelby tube



Dominion Soil Investigation Ltd.

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 4 &

Engineering Data Sheet for Borehole:

Date:

PROPOSED CROSSING - CPR

DYN. CONE PEN. TESTS

Date: JULY 22, 23, 25 1960

Project: OVERHEAD & GRINDSTONE CREEK

LEGEND
Shear Strength (C) #3A & 4A

Location: WATERDOWN, ONT.

Unconfined compression
Vane test and sensitivity (S) ⊕
+³

Hole Location: STA. 87+075 R 16.0'

Penetration Resistance (P)

Hole Elevation and Datum: 732.7

2" Split tube
2" Dia. Cone
Casing

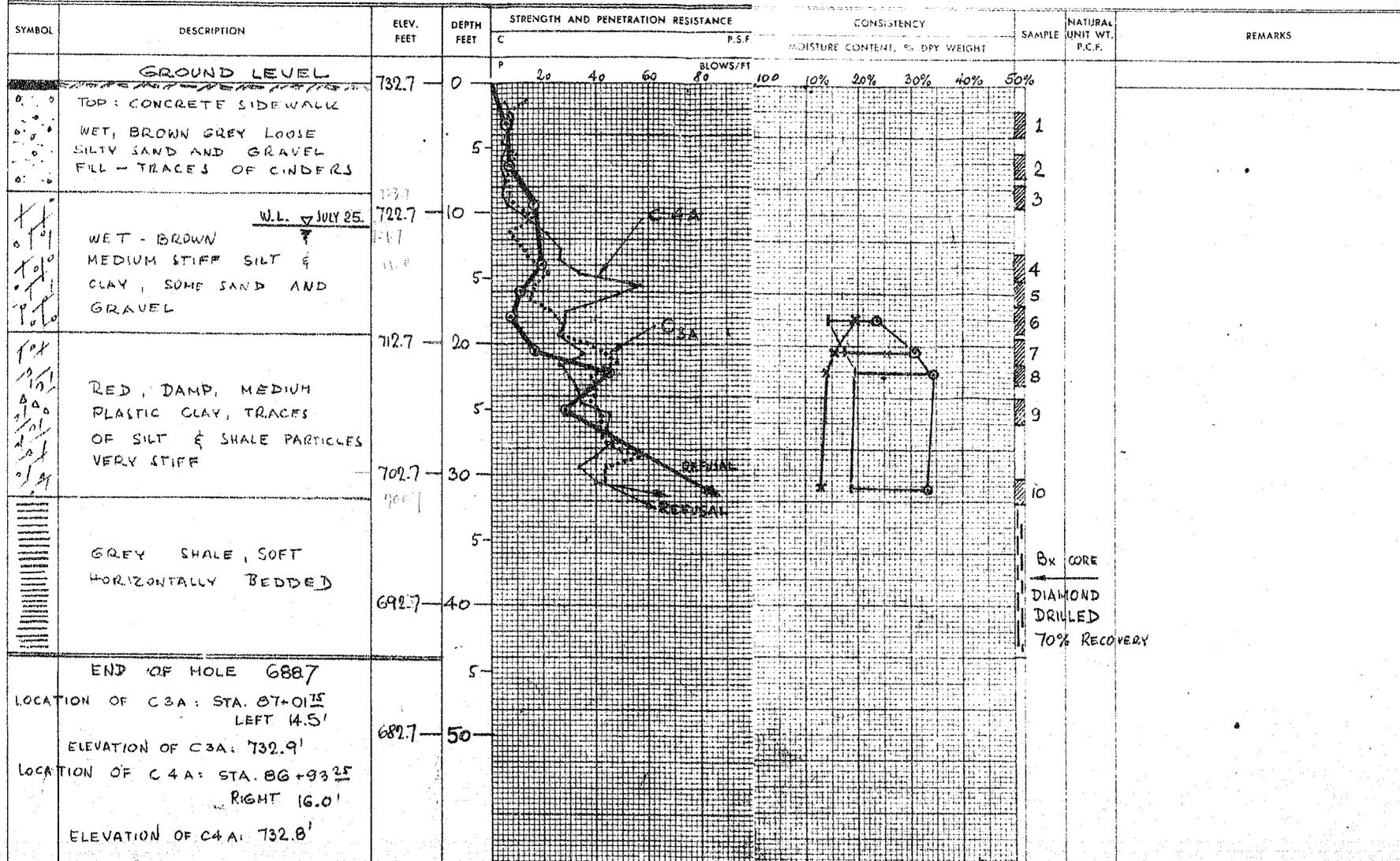
Sampling Method
2" Dia. split tube
2" Shelby tube

LEGEND
Consistency
Natural moisture and
Liquidity index (LI)
Liquid limit
Plastic limit

Sampling Method
2" Dia. split tube
2" Shelby tube

Field Supervisor: LRS Prep.: LRS

Driller: E-H Checked: LRS



DISCUSSION OF FOUNDATION CONDITIONS

I. SAFE BEARING PRESSURE [q_a]

SPLIT SPOON SAMPLES WITH RESULTS OF STANDARD PENETRATION TESTS ARE AVAILABLE OF THE RED, DAMP MEDIUM PLASTIC CLAY. THE "N" VALUE IS BETWEEN 30 & 40. THUS IT COULD BE CLASSIFIED AS "HARD". HOWEVER - DUE TO PRESENCE OF COARSE PARTICLES, IT IS BELIEVED, THAT THE "VERY STIFF" NOTATION IS MORE CORRECT. LABORATORY TESTS INDICATED THAT THE CONSISTENCY IS VERY STIFF TO HARD. [SEE LAB. TEST RESULTS]

IN PARAGRAPH 1.4.15 OF THE A.A.S.H.O "STANDARD SPECIFICATIONS" THE "SAFE BEARING POWER" FOR CLAYS IS 1 TO 4 TONS/SQ. FT. REGARDING THE CONSISTENCY OF THE AFORESAID CLAY, A q_a VALUE OF 3 TONS/SQ. FT. + IS REASONABLE, FOR A FOOTING 6 TO 10 FT WIDE.

THE SAFE BEARING PRESSURE ON THE SHALE IS 5 TONS/SQ. FT. [THE AASHO SPEC'S GIVE 5 TONS/SQ. FT. AS A MINIMUM VALUE ^{ON ROCK}. THE NAT'L BUILDING CODE ALLOWS 5 T/SQ. FT. FOR SOFT SHALE - ALSO.]

II. SETTLEMENT

THE PREDICTION OF SETTLEMENT IS VERY DIFFICULT IN THIS CASE. HOWEVER, AN ATTEMPT IS MADE TO ESTIMATE THE MODULUS OF COMPRESSIBILITY (K) FOR THE RED CLAY. FOR THIS CONSISTENCY OF CLAY, THE "K" VALUE IS AROUND 150 TONS/SQ. FT.* TAKING AN AVERAGE VALUE OF FOOTING WIDTH OF 8 FT, AND TAKING AS ELEVATION OF BOTTOM OF FOOTING

	AT SOUTH —	AT NORTH —	
	704.0	712.0	<u>ABUTMENT</u>
TOP OF ROCK:	~ 697.0	~ 700.5	
THICKNESS OF CLAY LAYER	~ <u>7.0 FT</u>	~ <u>11.5 FT.</u>	

THIS IS THE THICKNESS OF THE COMPRESSIBLE CLAY LAYER, FOR WHICH THE "K" VALUE IS ASSUMED TO BE 150 T.S.F.

Prep. By LRSZALATKAY

DISCUSSION - CONT'D
SETTLEMENT - CONT'D

USING THE GROSS SOIL PRESSURE AS ACTING AT THE BOTTOM OF FOOTING, THE STRESS AT THE TOP OF ROCK IS APPROX.

SOUTH ABUTMENT

1.72 T.S.F.

NORTH ABUTMENT

1.29 T.S.F.

ASSUMING LINEAR STRESS DISTRIBUTION, THE AVERAGE STRESSES ARE:

2.36 T.S.F.

2.15 T.S.F.

$$\text{SETTLEMENT } \rho = \frac{2.36}{150} \times 7.0 = 0.11'$$

$$\approx \underline{\underline{1\frac{1}{4}''}} \quad (\text{SAY } 1'')$$

$$= \frac{2.15}{150} \times 11.5 = 0.165'$$

$$\approx \underline{\underline{2''}}$$

THESE VALUES ARE DIFFERENTIAL SETTLEMENTS BETWEEN PIERS AND ABUTMENTS. THEIR ACCURACY IS QUESTIONABLE, THEY ARE MORE OR LESS OF QUALITATIVE VALUE [SHOWING THAT THERE WILL BE DIFFERENTIAL SETTLEMENT] AND THEY SHOW THE ORDER OF FIGURE ONLY.

OVER

Prep. By LRSZALATKAY

DISCUSSION - CONT'D
SETTLEMENT - CONT'D

USING THE GROSS SOIL PRESSURE AS ACTING AT THE BOTTOM OF FOOTING, THE STRESS AT THE TOP OF ROCK IS APPROX.

SOUTH ABUTMENT
1.72 T.S.F.

NORTH ABUTMENT
1.29 T.S.F.

ASSUMING LINEAR STRESS DISTRIBUTION, THE AVERAGE STRESSES ARE.

2.36 T.S.F.

2.15 T.S.F.

SETTLEMENT $s = \frac{2.36}{150} \times 7.0 = 0.11'$
 $\cong \underline{\underline{1\frac{1}{4}''}}$ (SAY 1")

$= \frac{2.15}{150} \times 11.5 = 0.165'$
 $\cong \underline{\underline{2''}}$

THESE VALUES ARE DIFFERENTIAL SETTLEMENTS BETWEEN PIERS AND ABUTMENTS. THEIR ACCURACY IS QUESTIONABLE, THEY ARE MORE OR LESS OF QUALITATIVE VALUE [SHOWING THAT THERE WILL BE DIFFERENTIAL SETTLEMENT] AND THEY SHOW THE ORDER OF FIGURE ONLY.

DATE - 10/20/50
PROJECT - T-100-100

1 INTRODUCTION

2 DESCOR OF SITE AND GEOLOGY

3 FIELD AND LABOR. WORK

4 SUBSOIL CONDITION

4.1 GENERAL

4.2 SILTY CLAY

4.3 WELL SAND GRAVEL

5 WATER COND.

6. DISCUSSION & RECOMMENATION

7. SUMMARY

N

Mr. A. M. Teye,

September 26, 1960.

Bridge Engineer.

FOUNDATION INVESTIGATION REPORT

Materials & Research Section.

by: Dominion Soil Investigation, Ltd.

Attention: Mr. S. McCombie.

Re: Proposed Crossing C.P.R. Overhead and
Grindstone Creek at Waterdown, Ontario.
Hwy. No. 5, District No. 4, W.P. 272-60.

Attached, we are forwarding to you the foundation investigation report for the above structure, submitted by Dominion Soil Investigation, Ltd.

We have reviewed the report, and on the basis of the presented factual data, agree with the recommendations contained therein, except that we believe that the settlements will be smaller than indicated in the report. It is therefore our recommendation that spread footings be used - the North abutment's footing at Elev. 711.0', and the South abutment's footing at Elev. 703.0', respectively. The allowable bearing capacity of 3.0 T/sq.ft. should be used.

Should there be any further queries in connection with the contents of this report, or our comments, please contact our Office.

AS/M&R
Attach.

E. G. Soderman,
PRINCIPAL FOUNDATIONS ENGR.
Per:

cc: Messrs. A. M. Teye (2)
M. A. Tregaskes
D. G. Ramsay
I. Campbell
S. E. Richardson
T. J. Kovich
A. Watt

(A. Stermac,
FOUNDATIONS OFFICE ENGR.)

Foundations Office
Gen. Files.

DOMINION SOIL INVESTIGATION LTD.

SOIL MECHANICS • FOUNDATION ENGINEERING

TORONTO 12, ONTARIO

Date AUGUST 30th 196⁰

Our File No: 0 --8 - 1
Your File No: -

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS AND RESEARCH SECTION
DOWNSVIEW AVE
TORONTO, ONT.

Re: Foundation Investigation for
Proposed Crossing C.P.R. Overhead
and Grindstone Creek at Waterdown
Ont. HWY # 5, District # 4.
WP 272 - 60

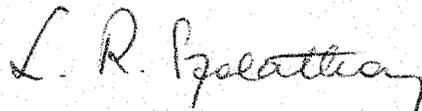
Dear Sir,

Enclosed are ^{TEN} copies of our Report on the SUBSOIL
INVESTIGATION on the above project.

We thank you for this opportunity of being of service
to you. Please feel free to contact the undersigned should you
have any questions regarding this Report.

Yours very truly,

DOMINION SOIL INVESTIGATION LTD.


L. R. Szalatka, P. Eng.

LRS/s
Encl.

#60-F-226-C

W.P. #272-60

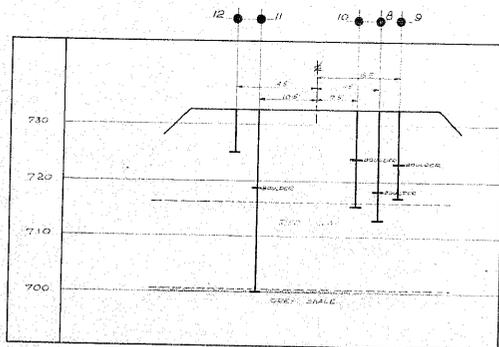
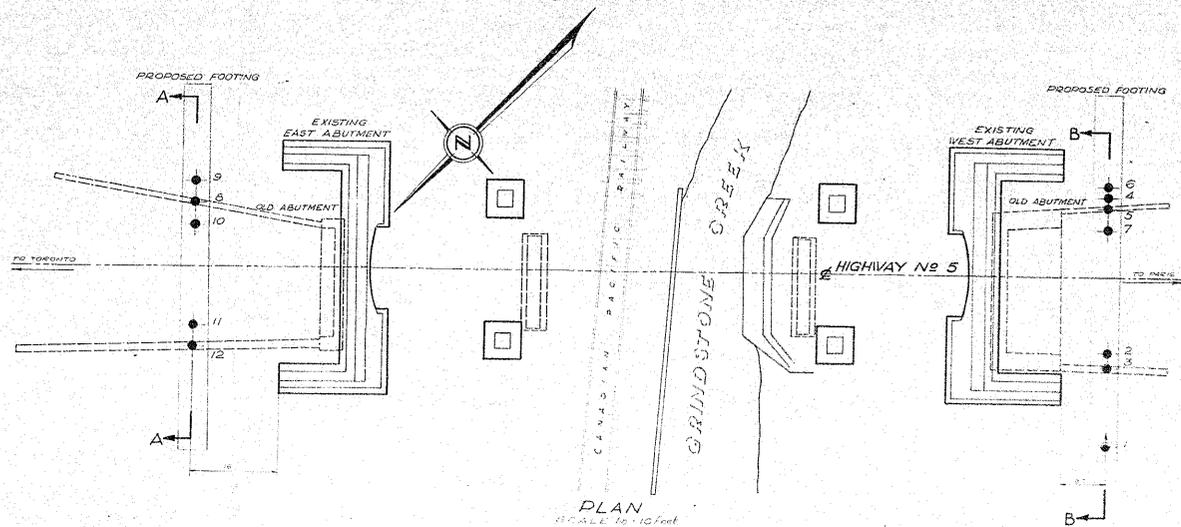
PROP. C. P. R.

OVERHEAD

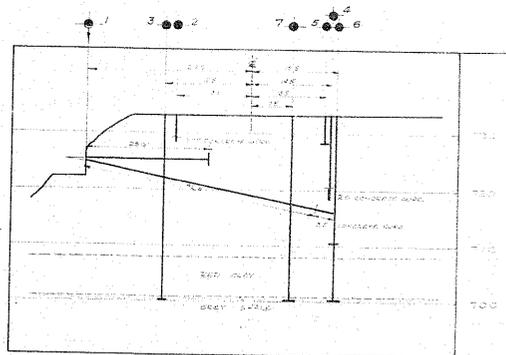
CROSSING

GRINDSTONE CR.

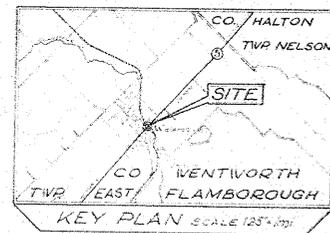
WATER DOWN



A - A



B - B



NOTE
BORE HOLE NO. HAS BORED OVERWAY
AT 90 DEGREES IN AN ATTEMPT TO
LOCATE OLD CONCRETE ABUTMENTS

MINISTRY OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

PROPOSED NEW BRIDGE
GRINDSTONE CREEK @ C.P.R.
ON
HIGHWAY No 5 IN WATERDOWN

DESIGNED BY: J. J. ...	DRAWING NO. 4	DATE: 25. 08. 1967
CHECKED BY: J. J. ...	P.R. NO. 274-000	JOB NO. 61-F-28
APPROVED BY: J. J. ...	SCALE	DRAWING NO.
DATE: 04/0	TITLE: 10 feet	61-F-28A

60-F-236 C

