



ONTARIO  
DEPARTMENT OF HIGHWAYS

Bridge Division

Memo to	Mr. A. Stermac Principal Foundation Eng. Room 107, Lab. Bldg.	Date	June 4, 1962.
		Subject	W.P. 43-61 Head Lake Narrows Bridge Hwy. #121, Dist. #11
From	S. McCombie		

Attached please find print of preliminary plan D 5064-P1 for the above bridge. The bridge is founded on steel "H" piles driven to bedrock as recommended in your report.

SMCC/m

*S. McCombie*

S. McCombie,  
Bridge Planning Engineer



ONTARIO  
DEPARTMENT OF HIGHWAYS

61-564  
Bridge Division

Memo to	Mr. A. G. Stermac	Date	June 1, 1962
	Principal Foundation Eng.		
	Room 107, Lab. Bldg	Subject	W.P. 43-61
			Head Lake Narrows Bridge
From	S. McCombie		Hwy. #121, Dist. #11

Attached please find print of preliminary plan D 5064-P 1, for the above bridge. The bridge is founded on steel "H" piles driven to bedrock as recommended in your report.

SMcC/m

S. McCombie  
S. McCombie,  
Bridge Planning Engineer

acc  
no comments

OFFICE LOCATION -  
DOWNSVIEW AVE.,  
KEELE ST. - HIGHWAY 401  
TORONTO, ONTARIO.



ONTARIO  
DEPARTMENT OF HIGHWAYS

POSTAL ADDRESS -  
DEPARTMENT OF HIGHWAYS  
PARLIAMENT BUILDINGS,  
TORONTO 5, ONTARIO.

Bridge Division,  
September 11, 1961.

*File with report*

MEMORANDUM TO:

*61 F-64*

Mr. A. Stermac,  
Principal Foundation Eng.,  
Department of Highways,  
Room 107,  
Downsview, Ontario.

RE: W.P. 43-61  
Head Lake Narrows Br.  
Hwy. #121 - Dist. #11

The Foundation Section carried out a foundation investigation for a new structure at the above crossing.

Because of poor alignment and the high cost the proposed line has been abandoned.

It has now been decided to widen the existing structure to accomodate modern loads and traffic.

*J. C. McAllister*

JCMcA/bm

J. C. McAllister,  
for S. McCombie,  
Bridge Planning Engineer.

c.c. N.D. Smith

*File  
App  
Sept 12, 1961.*

*Gen. files.*  
*62-62-321.*  
*D-5118-2*  
*62-321*  
*121 41-1*

Mr. A. M. Toye,  
Bridge Engineer.  
Materials & Research Division,  
(Foundation Section)  
Attention: Mr. S. McCombie.

March 30, 1962.  
D.H.O. FOUNDATION INVESTIGATION  
W.J. 61-F-64 -- W.P. 43-61. <sup>REPORT</sup>

Re: Proposed Bridge Structure on Hwy. #121,  
over Head Lake, Township of Dysart,  
County of Haliburton. District No. 11.

Attached, we are forwarding to you, our detailed  
report on subsoil conditions existing at the above-mentioned  
structure location.

We believe you will find the factual data and  
recommendations contained therein, adequate for your future  
design. work. If additional information is required, please  
feel free to contact our Office.

AGS/MdeF  
Attach.

cc: Messrs. A. M. Toye (2)  
E. A. Tregaskes  
H. D. McMillan  
G. K. Hunter  
H. C. Dernier  
T. J. Kovich  
J. Roy  
J. E. Gruspier  
E. R. Saint  
F. Norman  
A. Watt  
Foundations Office ✓  
Gen. Files.

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

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# FOUNDATION INVESTIGATION

For

Proposed Bridge Structure on Hwy. #121,  
over Head Lake, Township of Dysart,  
County of Haliburton, District No. 11.  
W.J. 61-F-64      --      W.P. 43-61.

## 1. INTRODUCTION:

A foundation investigation for the proposed new bridge at Head Lake Narrows in Haliburton, was requested by the Bridge Planning Engineer in a memo dated June 26, 1961. An investigation was carried out at the site of this structure along the revised Line 'G' in July, 1961.

This report contains the field and laboratory findings and recommendations for the foundations of the proposed structure.

## 2. DESCRIPTION OF SITE AND GEOLOGY:

The existing bridge is a wooden structure of 150' span supported by timber piles. It appears to be in a stable condition. Hwy. 121 is a two lane road and part of it is carried through a rock cutting, just northwest of the structure. The entire area is undulating, picturesque, and was fairly heavy with traffic during the period of this investigation.

Geologically, the site under consideration is located in the area of the Precambrian Shield. A large mass of granite gneiss about 8 to 10 miles wide, occupies the area north and west of the existing bridge. To the east, lies a narrow band of about 1 to 2 miles in width, of metamorphic sediments which are mainly composed of crystalline limestones, hornblende gneiss, and micaceous schist. The contact of these two rock masses occurs about a quarter

cont'd. /2 ...

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

of a mile south-east of the location and runs parallel to the C.N.R. tracks.

To the north, in the immediate vicinity of the boreholes, metamorphic sediments can be found dipping gently to the east. These include hornblende gneiss and hornblende micaceous schists with numerous pink coloured pegmatite dike intrusions. In the borings, the same type of rock assembly was encountered.

The bedrock overburden suggests that the area was glaciated during the last stage of the Pleistocene period.

3. DESCRIPTION OF FIELD AND LABORATORY WORK:

Field work consisted of six sampled boreholes with dynamic cone penetration tests adjacent to each borehole.

The exploration programme was carried out by a standard core drill machine adapted for soil sampling. It was mounted on a 18' x 18' wooden raft, for working on the water. A conventional wash boring procedure was followed. Samples were recovered at required depths, by means of a 2-inch I.D. Shelby tube and by a 2-inch O.D. split spoon sampler. The dimensions of this spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test.

Wherever possible, in-situ vane tests were carried out to determine the shear strength of the subsoil deposits. An AXT core barrel was employed to obtain bedrock core samples.

Drawing No. 61-F-64A shows the borehole locations, their respective elevations and the estimated subsoil stratigraphy.

cont'd. /3 ...

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

Samples were visually examined and identified in the field before being transported to the laboratory. Upon receipt in the laboratory, necessary tests were carried out on a selection of both disturbed and undisturbed samples for the determination of moisture content, grain size distribution curves, Atterberg limits and undrained triaxial compression tests.

Laboratory and field test results have been summarized and are included in this report under Appendix I.

4. SUBSOIL CONDITIONS:

4.1) General:

The investigation has shown that in general, the subsoil stratification can be considered as quite regular and uniform. Apart from a thin layer of topsoil, three distinct layers were encountered in the following succession:-

Clayey silt with occasional thin sand seams,  
Sand and gravel,  
Bedrock.

A detailed description of these three main layers is given below:-

4.2) Clayey Silt:

A layer of clayey silt was encountered in all borings. It is slightly organic at its upper surface. The thickness of this layer is approximately 15 feet in borings 1 and 2; 11 feet in borings 3, 4 and 5, and 4 feet in boring 6. A few thin sand seams are present in this layer, at random. In boring 4, the layer



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

4.2) Clavey Silt: (cont'd.) ...

consists of thin varves of silt and clay. The consistency of the material is very soft, becoming stiff with increasing depth. The minimum and maximum values of shear strength were found to be 120 p.s.f. and 1500 p.s.f., respectively, with an average value of 600 p.s.f. The material in this layer is of low plasticity and is grey in colour. The average values of the liquid and plastic limits are 28% and 23%, respectively, and the average moisture content is 30.5%.

4.3) Silty Sand and Gravel:

This layer of granular material was encountered below the above-mentioned layer of cohesive silt. During the investigation, an artesian water pressure was encountered in this layer, causing loosening of the material. In such a case, the Standard Penetration Test does not give a correct idea of the material's denseness. However, it is considered to be in a medium dense to very dense state of compaction. In boring 1, a 3-foot thick boulder of the hornblende gneiss variety was encountered near the surface of the deposit (elev. 1029'). The thickness of the layer is 24 feet in boring 1; 15 feet in boring 2, 20 feet in boring 3, 17 feet in borings 4 and 6, and 19 feet in boring 5. On the average, it contains 52% sand, 32% gravel and 16% silt.

cont'd. /5 ...

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

4.4) Bedrock:

Below the above-mentioned layer of sand and gravel, hornblende gneiss and micaceous schist bedrock was encountered in all the borings. It contains thin layers of pink-coloured pegmatite intrusions.

Following, are the elevations at which the bedrock was encountered:-

<u>Borehole No.</u>	<u>Bedrock Elevations (in feet)</u>
1	1005.7
2	1006.5
3	1001.5
4	1007.4
5	1003.5
6	1010.3

5. GROUND WATER CONDITIONS:

The elevation of the water in the lake was observed to be approximately 1043.0' during the period of this investigation. The water level in boring 1, which was drilled from the ground surface on dry land, was also found to be at elevation 1043'.

An artesian water condition was observed in all the borings. Given below, are the elevations of depths at which the artesian condition was observed and the heights to which the water rose in the casing:-

5. GROUND WATER CONDITIONS: (cont'd.) ...

<u>Borehole No.</u>	<u>Elevation at which Encountered</u>	<u>Elevation of Water Level</u>
1	1023'	1048.3'
2	1014'	1046.8'
3	1011'	1044.8'
4	1014'	1043.7'
5	1010'	1043.5'
6	1022'	1045.0'

The disparity in artesian water elevations is probably due to certain permeability differences of the material and possible leakages through the casing joints.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new bridge to carry Hwy. 121 over Head Lake Narrows. At present, Hwy. 121 which follows a winding course, is carried over a wooden structure, 12' wide. It is located between Lots 13 and 14, and Con. VIII, in the County of Haliburton.

It has been found necessary to realign the highway and originally, Line 'F' was proposed. This Line 'F' had since been revised (Plan E 3988-1) and a new line referred to as Line 'G' was finally adopted.

In the preceding paragraphs, the different layers and their respective properties have been described in detail. The soil stratification can be considered as regular. It can be seen from the strength and compressibility characteristics of the upper

cont'd. /7 ...

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

clayey silt layer, that it is not competent to support spread footings economically. Therefore, the possibility of providing spread footings is ruled out.

A piled foundation is recommended. The structure may be supported on timber piles driven to practical refusal in the sand and gravel layer, or on steel 'H'-piles driven to refusal at bedrock contact.

Timber piles 12" in diameter, can take a safe load of 20 tons per pile, if driven to practical refusal in the layer of silty sand and gravel, or possibly to the bedrock. It is advisable to protect the pile tips against breakage by providing steel shoes. The possibility of encountering an occasional boulder should not be overlooked. Finally, the safe load on the piles should be verified in the field by the use of the Hiley Formula. The piles should be treated to prevent deterioration of the timber by rotting.

Steel 'H'-piles are recommended for their high load bearing capacity. A safe load of 70 tons per pile may be used in the case of 12 BP at 74 'H' piles driven to refusal on bedrock.

No slope stability problems are anticipated with the standard 2:1 slopes, as the approach fills will be of the order of 15' or less. However, all compressible organic material should be removed before placing the fill material.

7. SUMMARY:

A field investigation consisting of six boreholes was carried out for the proposed new structure at Head Lake Narrows in Haliburton.

Subsoil at the site consists of about 20' of clayey silt, followed by about 15' of silty sand and gravel with occasional boulders, followed by bedrock of metamorphic origin.

The level of water in the lake was observed to be at an approx. elev. 1043'. Artesian pressure conditions were encountered in all the borings in the layer of sand and gravel.

Subsoil conditions are such that spread footings are not an economical proposition. A piled foundation is therefore recommended. Treated timber piles of 12" in diameter, driven to practical refusal in the layer of sand and gravel, or to bedrock, can provide a safe load of 20 tons per pile. For higher load bearing capacity, steel 'H'-piles are recommended. A safe load up to 70 tons per pile can be used, for 'H'-piles driven to refusal on the bedrock.

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

8. MISCELLANEOUS:

Field work was commenced on July 5, 1961, and was completed by July 26, 1961, using D.H.O. equipment and crew.

Field work was supervised by Mr. B. M. Ghadiali of the Foundation Section.

March 1962

REPORT PREPARED BY: *for B. M. Ghadiali*  
B. M. Ghadiali,  
PROJECT FOUNDATION ENGINEER.

REPORT APPROVED BY: *K. G. Selby*  
K. G. Selby,  
SR. PROJECT FOUNDATION ENGR.

APPENDIX I.

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-64

W.P. 43-61

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	3'-4.5'	Clayey silt & organic decayed material. Br. grey. Soft.	3	-	-	-	-	-	
	VANE	6'		-	-	-	-	1200	-	Sens: 4.3
	T2	6'-7.5'	Silty clay & clayey silt. Med. stiff. Grey.	Pushed	37.4	23.6	31.6	760	111.0	
	VANE	9'		-	-	-	-	1440	-	Sens: 3.4
	T3	10'-11.5'	Clayey silt & fine sand in trace. Stiff. Grey.	12	-	-	-	-	-	
	S4	15'-16.5'	" " " "	4	29.7	21.8	25.5	-	-	EM 6-6779
	S5	22'-23.5'	Silty sand and gravel (Max. 1" size) Med. dense. Grey.	16	-	-	-	-	-	
	S6	25'-26.5'	Sand and gravel. Dense.	40	-	-	-	-	-	
	S7	31.3'-32.8'	Fine gravel.	34	-	-	-	-	-	Lost.
	S8	35'-36'	Silty sand & gravel. V. dense. Grey.	170	15.3	-	-	-	-	
	S9	39'-40'	" " "	103	-	-	-	-	-	
	RC10	40.3'-42'	Bedrock. Metamorphic, hornblende gneiss with pigmatite intrusions and micaceous schist.	-	-	-	-	-	-	
	RC11	42'-47'	" " "	-	-	-	-	-	-	

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-64

W.P. 43-61

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	S1	5'-6.5'	Clayey silt and organic material. Soft. Grey.	6	-	-	-	-	-	
	VANE	8'		-	-	-	-	120	-	Sens: 3.0
	T2	10'-11.5'	" " "	5	-	-	-	-	-	Lost
	VANE	13'		-	-	-	-	520	-	Sens: 2.4
	T3	15'-16.5'	Clayey silt and trace of fine sand. V. stiff. Grey.	Pushed	24.6	-	-	2460	127.0	
	S4	20'-21.5'	Silty sand and gravel up to 1" size. Med. dense. Grey.	18	-	-	-	-	-	
	S5	25'-26.5'	Silty sand and gravel up to 1" size. V. dense. Grey.	63	10.5	-	-	-	-	
	S6	30'-30.3'	Decomposed micaceous gneiss. Grey and reddish.	100-3"	-	-	-	-	-	
3	RC7	30.3'-35.3'	Bedrock. Metamorphic, hornblende gneiss with pignatite intrusions and micaceous schist.	-	-	-	-	-	-	
	RC8	35.3'-40.3'	" " "	-	-	-	-	-	-	
	S1	5'-6.5'	Clayey silt and organic material. Soft. Grey.	5	-	-	-	-	-	
	VANE	8'		-	-	-	-	340	-	Sens: 4.2
	T2	10'-11.5'	" " "	Pushed	32.3	20.6 23.5 21.8	28.8 28.9 30.2	505	117.0	



## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-64W.P. 43-61

SOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/F1	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
3	VANE	13'		-	-	-	-	720	-	Sens: 3.3
	T3	15'-16.5'	Silty sand and gravel, up to 1" size. Med. dense. Grey.	21	-	-	-	-	-	
	S4	20'-21.5'	Silty sand and gravel (Pigmatite) V. dense. Grey.	56	-	-	-	-	-	
	S5	25'-26.5'	" " "	68	-	-	-	-	-	
	S6	31'-32.5'	" " "	71	14.2	-	-	-	-	
	RC7	35.5'-40.5'	Bedrock. Hornblende gneiss and schist.	-	-	-	-	-	-	
4	S1	5'-6.5'	Clayey silt, fine sand and organic matter. Soft. Grey.	5	-	-	-	-	-	
	VANE	8'		-	-	-	-	240	-	Sens: 3.4
	T2	10'-11.5'	" " " Stiff. Grey.	Pushed	84.4 29.0	- 24.1	- 27.1	- 1130	- 119.9	
	VANE	13'		-	-	-	-	840	-	Sens: 3.8
	T3	15'-16'	Silty sand and gravel. Med. dense. Grey.	18	-	-	-	-	-	
	S4	20'-21.5'	Silty sand and gravel. V. dense. Grey.	56	5.9	-	-	-	-	
	S5	25'-26.5'	" " "	49	-	-	-	-	-	

# SUMMARY OF FIELD & LABORATORY TESTS

JOB 61-F-64

W.P. 43-61

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
4	S6	30'-31.5'	Silty sand. Med. dense.	32	12.6	-	-	-	-	
	RC7	33'-38'	Bedrock. Metamorphic, hornblende gneiss and schist.	-	-	-	-	-	-	
5	S1	3'-4.5'	Clayey silt and organic material. V. soft. Grey.	Pushed	-	-	-	-	-	Sens: 5.8  Sens: 4.0  Sens: 2.5  Lost.
	VANE	6'		-	-	-	-	520	-	
	T2	6'-7.5'	" " "	Pushed	-	-	-	-	-	
	VANE	9'		-	-	-	-	240	-	
	T3	10'-11.5'	Clayey silt and fine sand. Stiff. Grey.	Pushed	-	22.7 22.6 22.2	28.1 24.1 25.4	1520	122.9	
	VANE	13'		-	-	-	-	400	-	
	T4	13'-14.5'	Clayey silt and fine sand. Soft and loose.	Pushed	26.6	-	-	-	-	
	S5	18'-19.5'	Silty sand. Med. dense.	20	-	-	-	-	-	
	S6	23'-24.5'	Silty sand and gravel. Dense. Grey.	33	-	-	-	-	-	
	S7	28'-29.5'	Silty sand and fine gravel. V. dense. Grey.	53	-	-	-	-	-	
	RC8	33'-38'	Metamorphic, hornblende gneiss and schist with pignatite intrusions.	-	-	-	-	-	-	

## SUMMARY OF FIELD &amp; LABORATORY TESTS

JOB 61-F-64

W.P. 43-61

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
6	S1	3'-4.5'	Silty sand-sea shells and organic material. Loose.	6	-	-	-	-	-	Lost.
	T2	8'-9.5'	Clayey silt and fine sand. Loose. Grey.	Pushed	29.3	-	-	-	-	
	S3	13'-14.5'	Silty sand and gravel up to 1' size. Dense. Grey.	32	-	-	-	-	-	
	S4	18'-19.5'	" " " "	41	-	-	-	-	-	
	S5	23'-24.5'	Silty sand and fine gravel. V. dense. Grey and pink.	63	-	-	-	-	-	
	RC6	27'-31'	Bedrock. Metamorphic, hornblende gneiss and schist with pygmite intrusions.	-	-	-	-	-	-	
	RC7	31'-36'	" " " "	-	-	-	-	-	-	
			S denotes split spoon sample. T " shelly tube " RC " rock core.							

# DEPARTMENT OF HIGHWAYS - ONTARIO

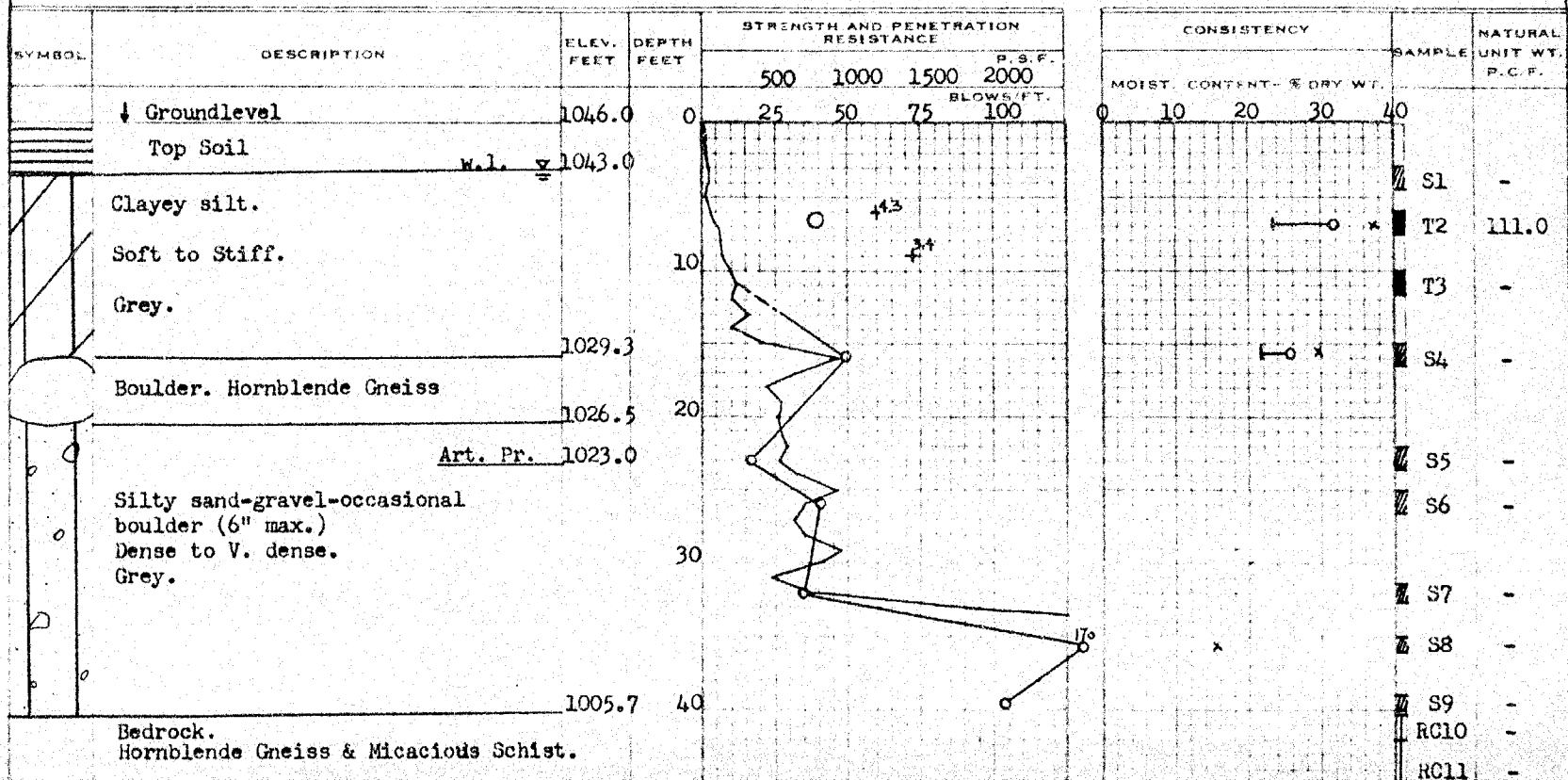
## MATERIALS AND RESEARCH SECTION

W.P. 43-61 BORE HOLE NO. 1  
 JOB 61-F-64 STATION 214+10 (6' Rt. E.)  
 DATUM 1046.0' COMPILED BY B.K.  
 BORING DATE July 6/61 CHECKED BY B.M.G.

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

### LEGEND

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



# DEPARTMENT OF HIGHWAYS - ONTARIO

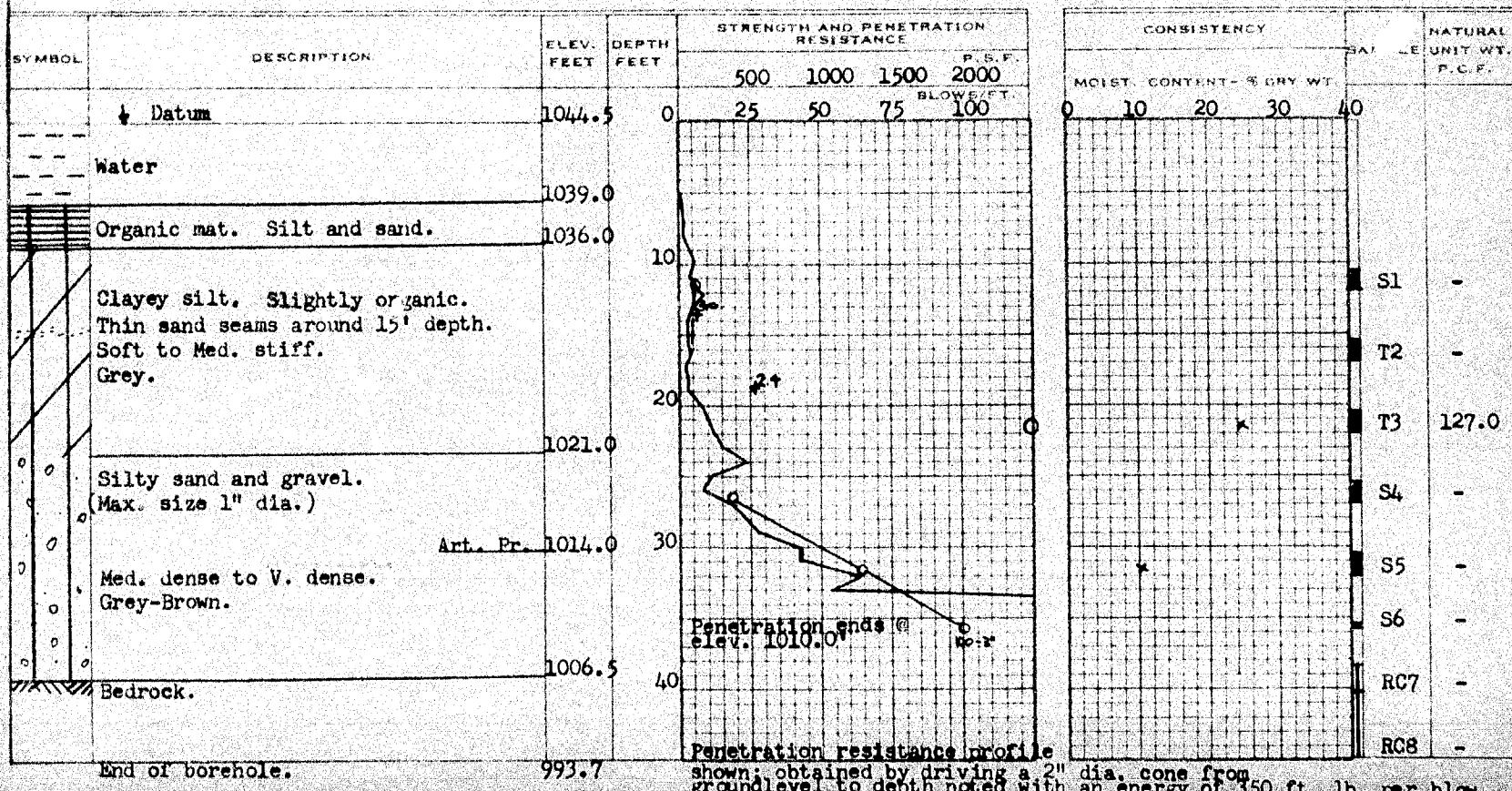
## MATERIALS AND RESEARCH SECTION

W.P. 43-61 BORE HOLE NO. 2  
 JOB 61-F-64 STATION 214/60 (20' Rt. E.)  
 DATUM 1044.5' COMPILED BY B.K.  
 BORING DATE July 13/61 CHECKED BY B.M.G.

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



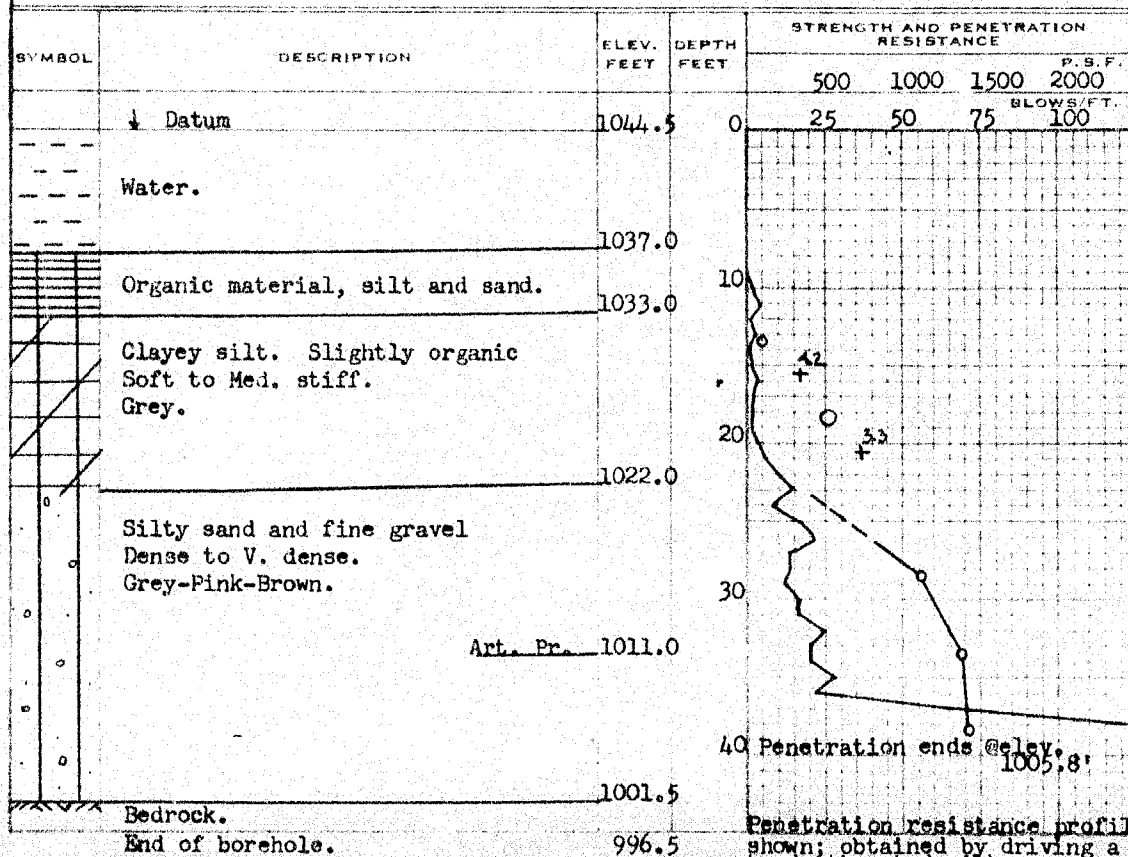
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 43-61 BORE HOLE NO. 3  
JOB 61-F-64 STATION 215+45 (30' Rt.)  
DATUM 1044.5' COMPILED BY B.K.  
BORING DATE July 17/61. CHECKED BY B.M.G.

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

## LEGEND

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



CONSISTENCY	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.	
0 10 20 30 40	
	S1 -
	T2 117.0
	T3 -
	S4 -
	S5 -
	S6 -
	RC7 -

W.P. 43-61 BORE HOLE NO. 4  
JOB 61-F-64 STATION 21540 (30' It.)  
DATUM 1044.5' COMPILED BY B.K.  
BORING DATE July 19/61. CHECKED BY B.M.G.

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

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

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				500	1000	1500	2000
				P.S.F. BLOWS/FT.			
	↓ Datum	1044.5	0	25	50	75	100
	Waterlevel	1043.0					
	Water	1040.4					
	Organic material-silt and sand.	1036.5					
	Clayey silt with thin varves. Soft to med. stiff. Grey.	1025.2	10				
	Silty sand & gravel Med. dense to V. dense. Grey-Brown.		20				
	Art. Pr.	1014.5	30				
		1007.4					
	Bedrock.		40				
	End of borehole.	1002.4					

Penetration ends @ elev. 1006.3'

CONSISTENCY				SAMPLE	NATURAL	
MOIST. CONTENT - % DRY WT.					UNIT WT. P. C. F.	
0	10	20	30	40		
					S1	-
					T2	119.9
					T3	-
					S4	-
					S5	-
					S6	-
					RC7	-

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.



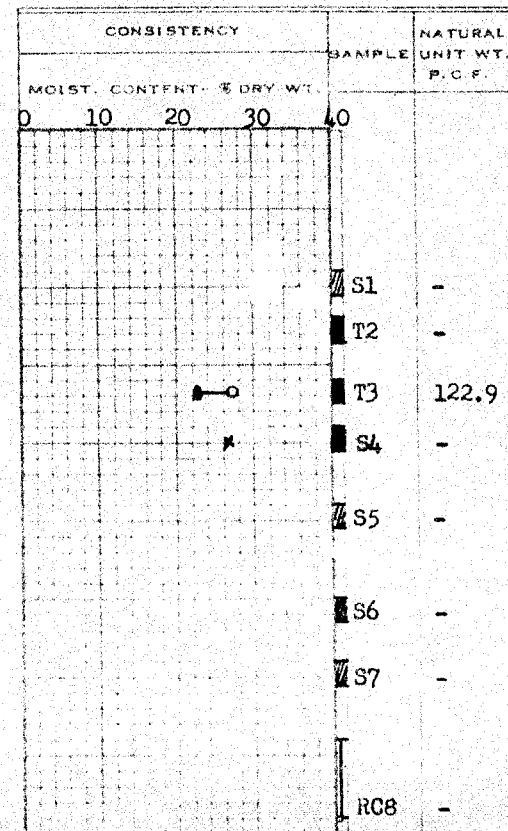
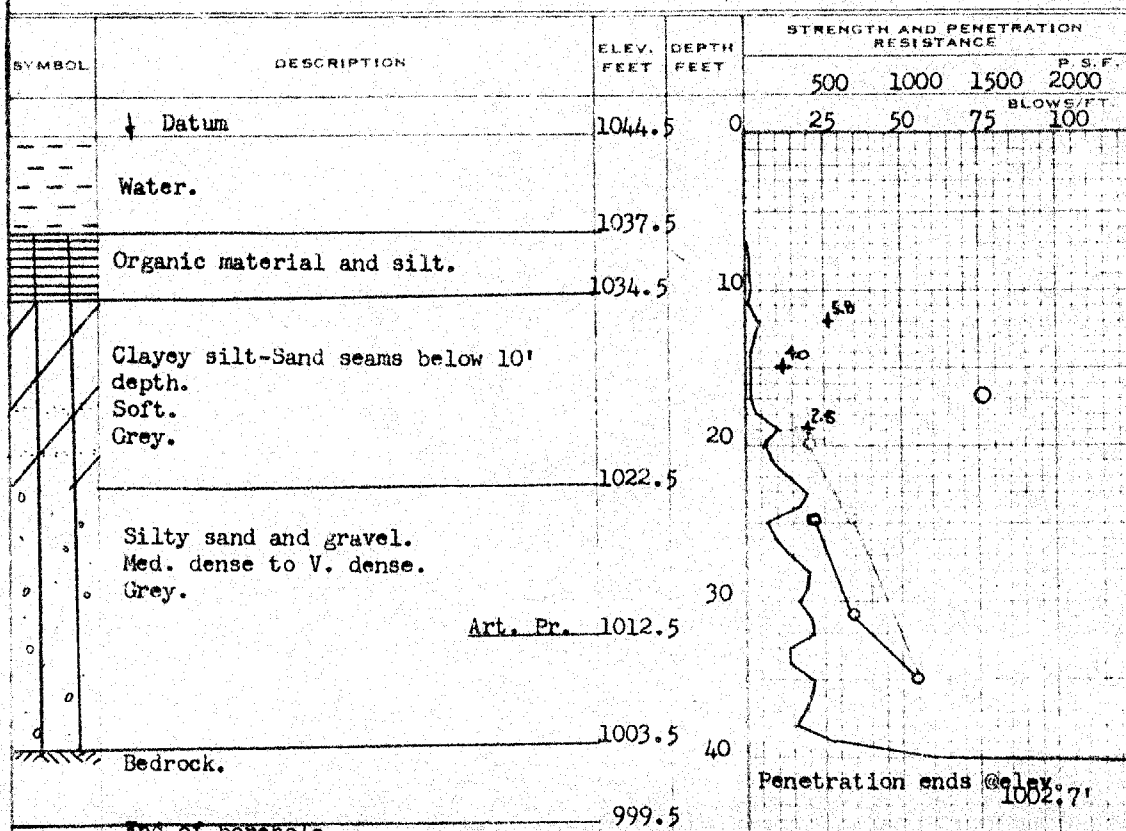
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 43-61 BORE HOLE NO. 5  
JOB 61-F-64 STATION 216+60 E  
DATUM 1044.5' COMPILED BY B.K.  
BORING DATE July 21/61. CHECKED BY B.M.G.

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

## LEGEND

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



End of borehole.

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.



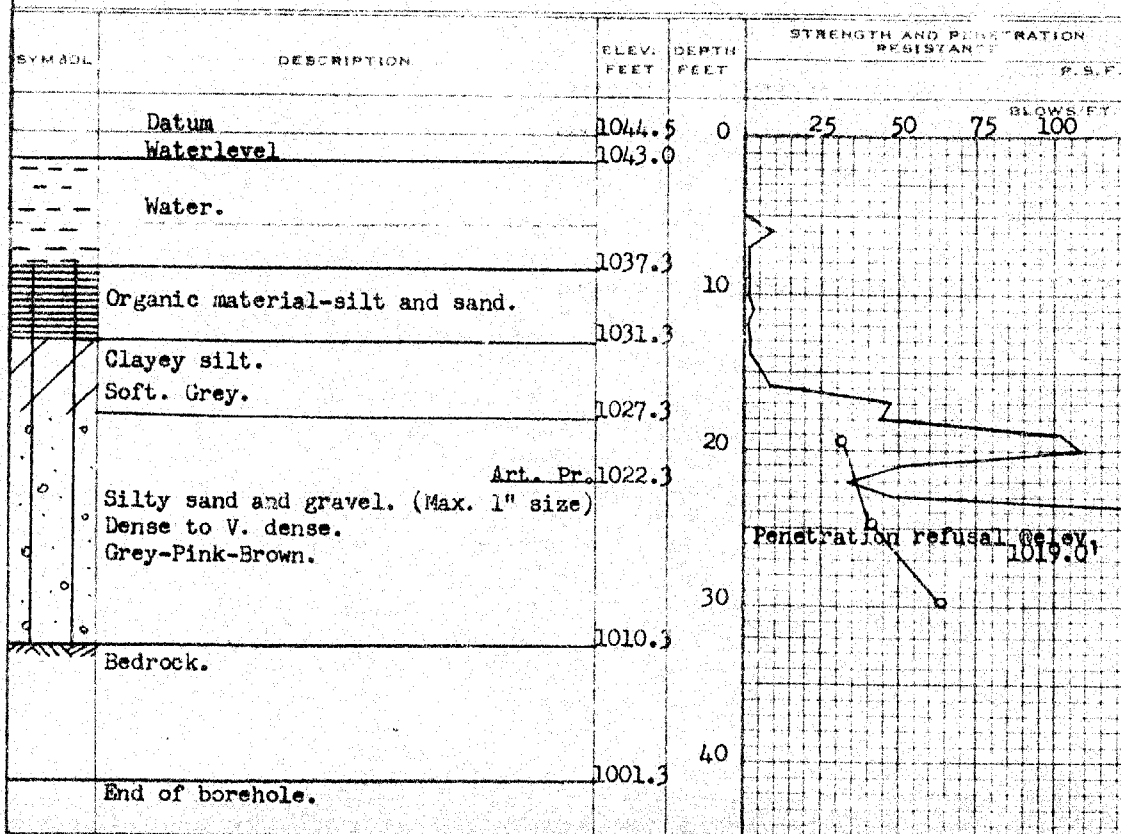
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 43-61 BORE HOLE NO. 6  
JOB 61-F-64 STATION 216+18 (20' Lt.)  
DATUM 1044.5' COMPILED BY B.K.  
BORING DATE July 25/61. CHECKED BY B.M.G.

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

## LEGEND

1/2 UNCONFINED COMPRESSION ( $Q_u$ ) — O  
VANE TEST (C) AND SENSITIVITY (S) — +  
NATURAL MOISTURE AND LIQUIDITY INDEX — X  
LIQUID LIMIT — 0  
PLASTIC LIMIT —



CONSISTENCY				SAMPLE	NATURAL UNIT WT P.C.F.
MOIST. CONTENT - % DRY WT.					
0	10	20	30	40	
				S1	-
				T2	-
				S3	-
				S4	-
				S5	-
				RC6	-
				RC7	-

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

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

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL 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
s	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
$I_C$	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$
$C_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR $= \frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ 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
$\bar{\sigma}$	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

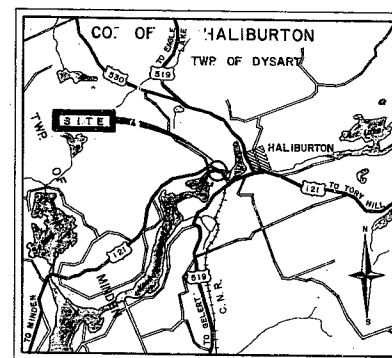
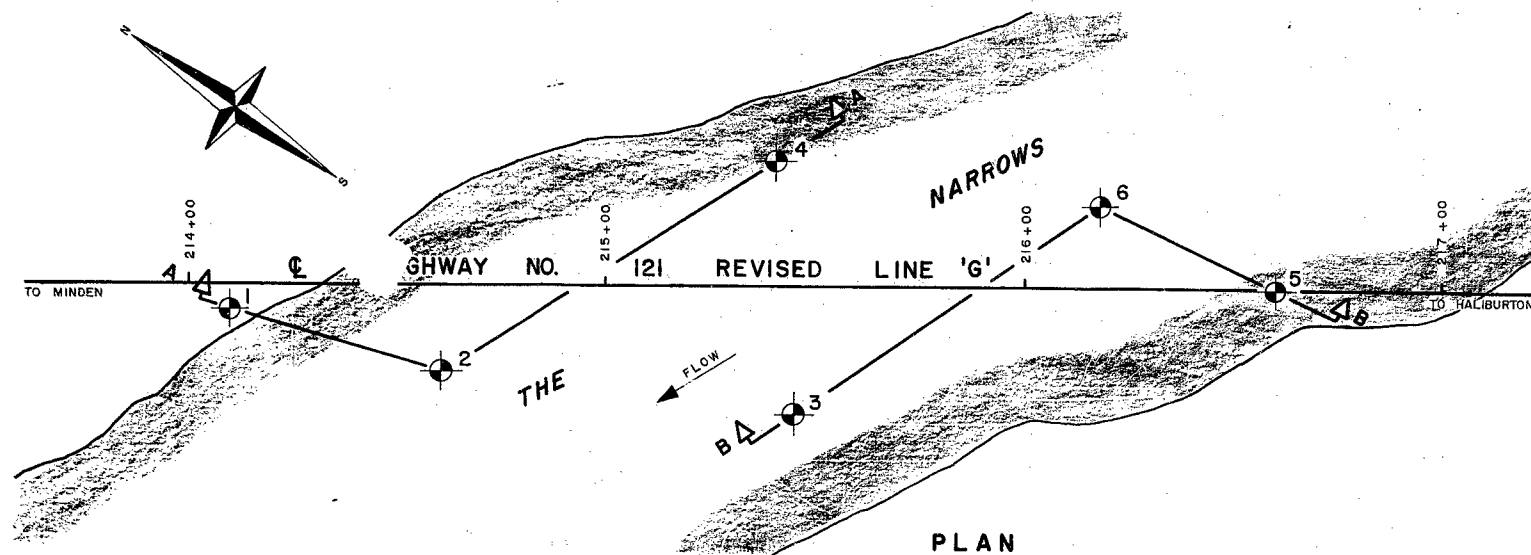
#61-F-64

W.P. # 43-61

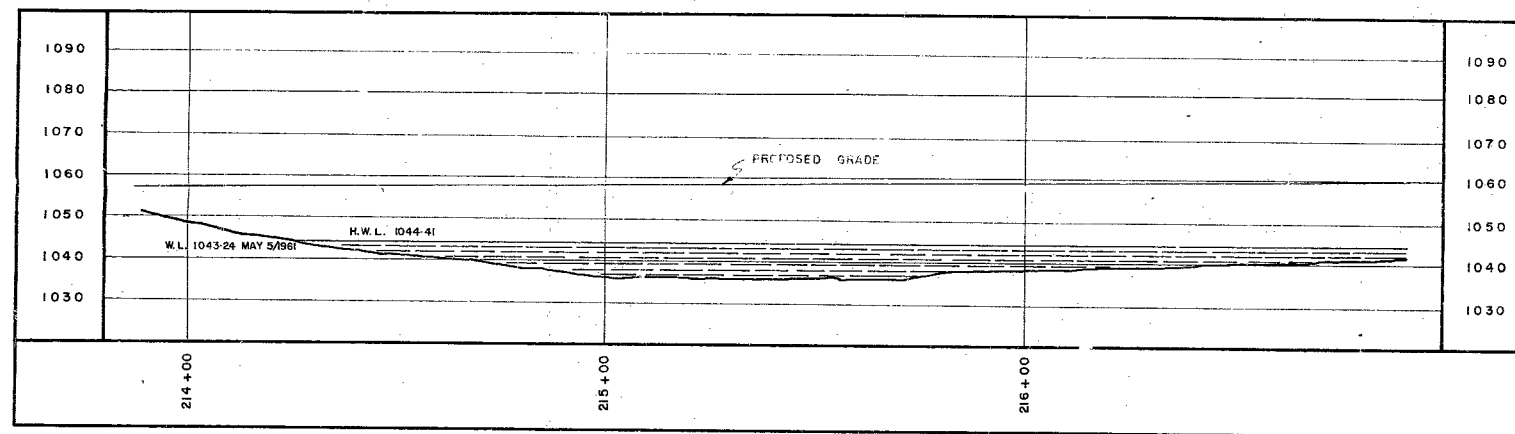
Hwy. # 121

HEAD LAKE

NARROWS

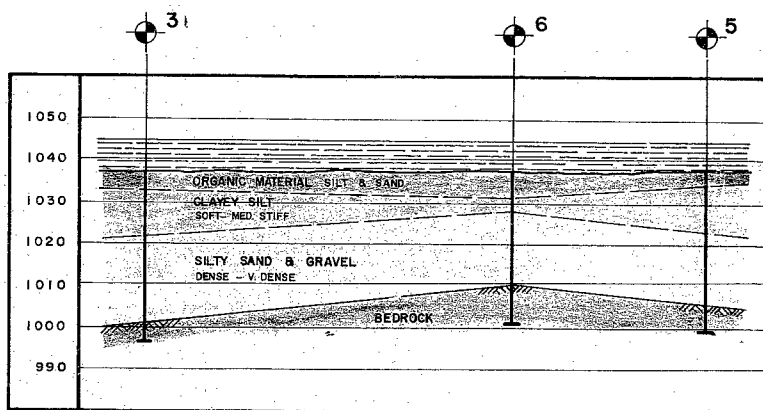
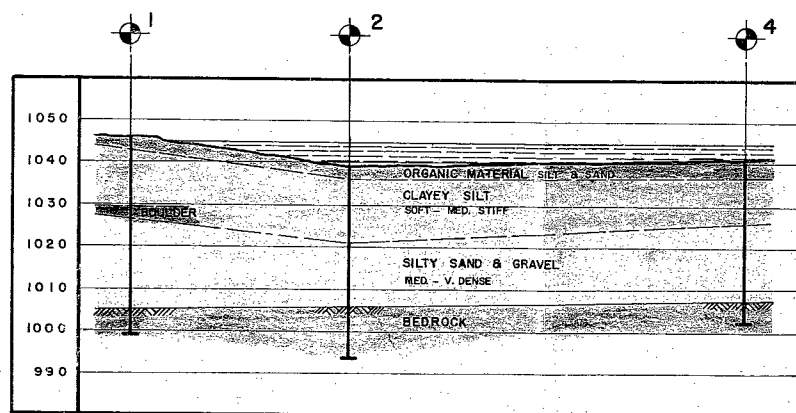


SCALE: 1 in. = 2 mi.



LEGEND			
BORE & PENETRATION HOLE			
HOLE	STATION	ELEVATION	OFFSET
1	214+10	1046.0	6' RT.
2	214+60	1039.0	20' RT.
3	215+45	1037.0	30' RT.
4	215+40	1040.4	30' LT.
5	216+60	1037.5	£
6	216+18	1037.3	20' LT.

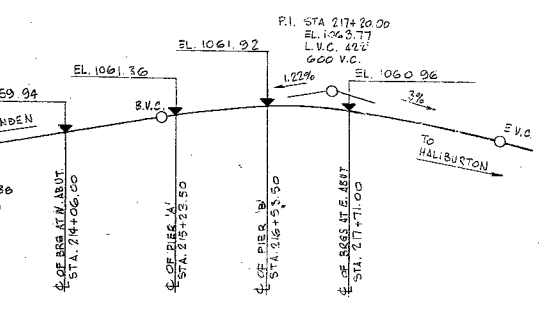
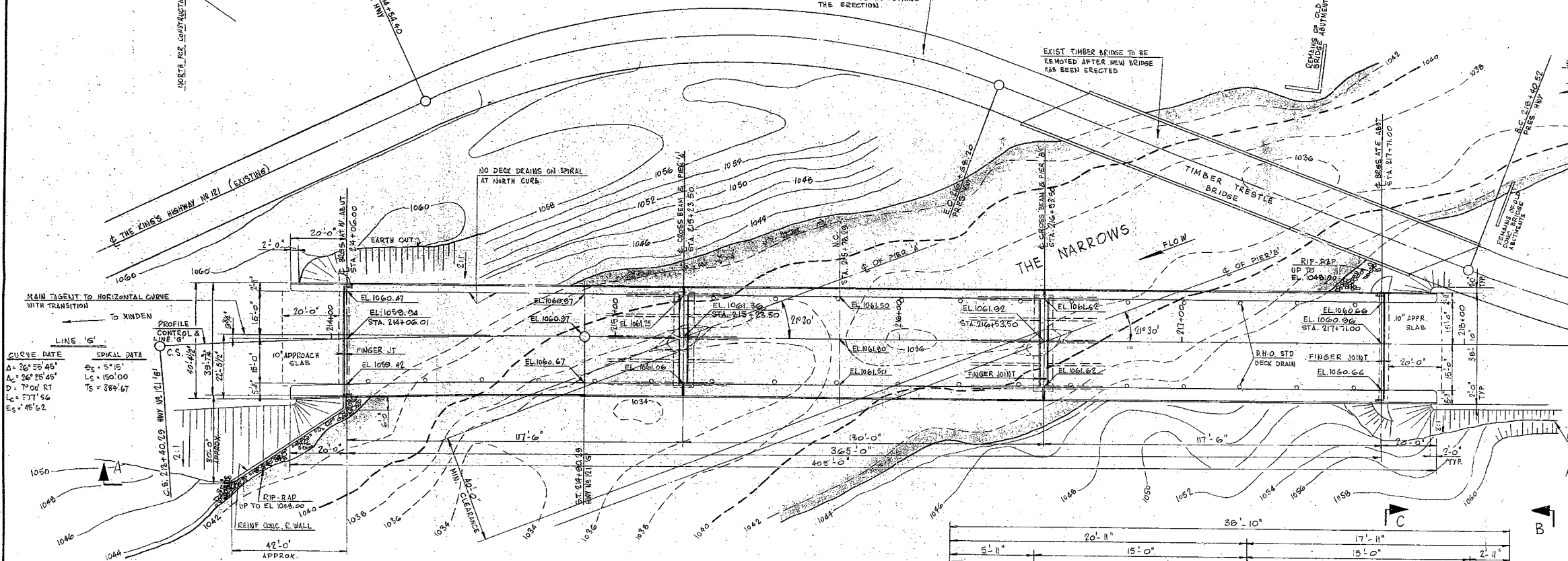
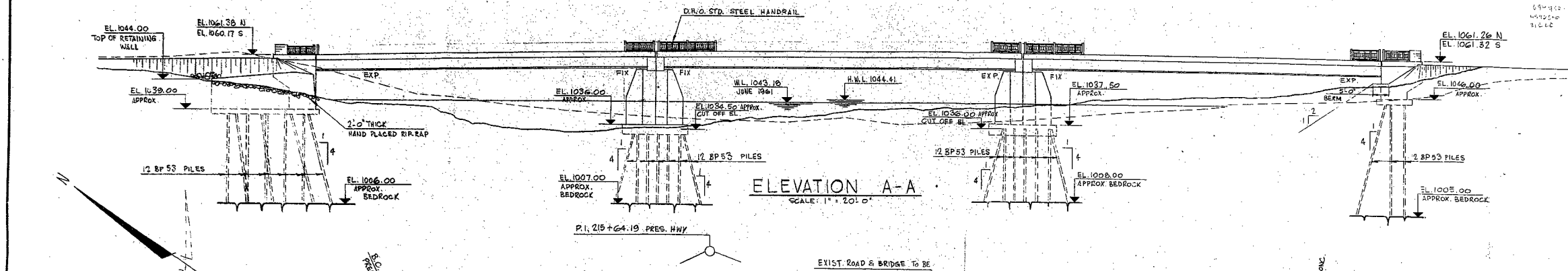
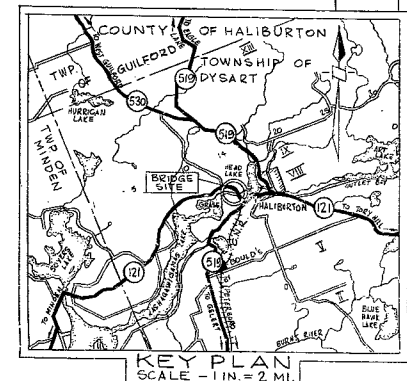
— NOTE —  
THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**THE NARROWS HEAD LAKE  
AND  
HIGHWAY NO. 121  
REVISION LINE 'G'**

ORIGINATED BY: GRADALI	DISTRICT NO. 8	DATE: 4 AUGUST 1961
DRAWN BY: MUMFORD	W.P. NO. 43-61	JOB NO. 61-F-64
CHECKED BY: [Signature]	SCALE	DRAWING NO.
APPROVED BY: [Signature]	1 INCH = 20 FEET	61-F-64 A

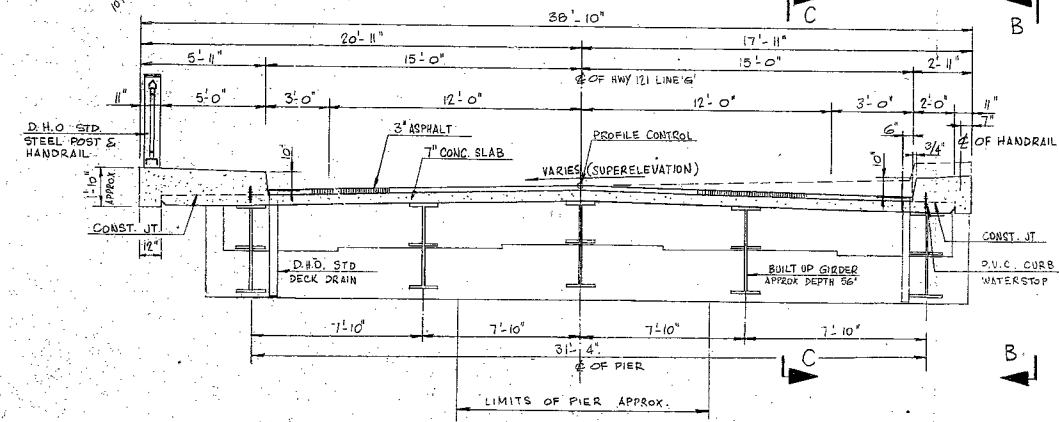
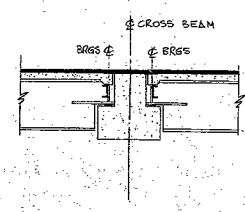
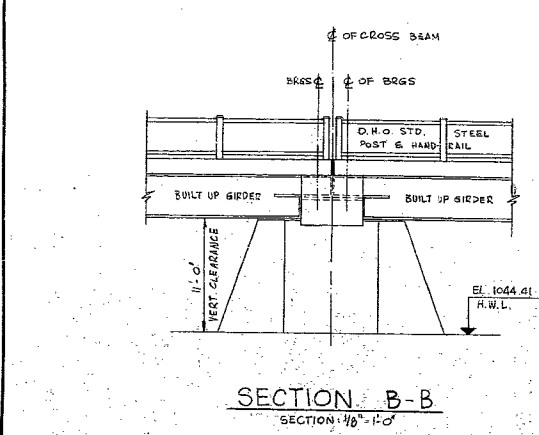


PROFILE OF FINISHED ROADWAY ON  
PROFILE CONTROL OF THE KING'S  
HIGHWAY NO. 121 LINE 'G'

NOTE:  
ORIGINAL PROFILE HAS BEEN RAISED 10"  
PROFILE GRADE IS 0.25' BELOW FINISHED PAVEMENT

GEODETIC S.M. NO. 326-S, ELEV. 1030.46  
HALIBURTON, ROCK LEDGE AT THE BASE OF A STEEP ROCKY HILL BESIDE  
MINDEN - HALIBURTON ROAD, HALF A MILE SOUTHWEST OF C.M.R. STATION AND  
400 FEET NORTHWEST OF CROSSING OF C.N.R. TRAIL IN WEST FACE OF ROCK,  
35 FT. SOUTHEAST OF CENTRE LINE OF ROAD AND 5 FEET ABOVE SAME.

PRINT RECORD		
No.	FOR	DATE



REVISIONS		DESCRIPTION
DATE	BY	

A. M. LOUNT AND ASSOCIATES  
164 EGLINTON AVE. E. CONSULTING ENGINEERS TORONTO

DEPARTMENT OF HIGHWAYS ONTARIO  
BRIDGE DIVISION

HEAD LAKE NARROWS BRIDGE  
TOWN OF HALIBURTON

KING'S HIGHWAY No. 121 DIST. No. 11  
CO. OF HALIBURTON  
TWP. OF DYSART LOT 14 CON. VIII

PRELIMINARY GENERAL ARRANGEMENT

APPROVED \_\_\_\_\_ SITE No. \_\_\_\_\_ W.P. No. 43-61

DESIGN \_\_\_\_\_ CHECK \_\_\_\_\_ CONTRACT \_\_\_\_\_  
DRAWING K-A CHECK \_\_\_\_\_ No. \_\_\_\_\_  
DATE MAY 15 1962 LOADING H20-S16 DRAWING No. D-5064 - P1