DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. S. McCombie

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

DATE: June 26, 1960

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed New Structure at Crossing
Of Shadow River and Hwy. #532
District No. 11 (Huntsville)
W.J. 68-F-18 -- W.P. 109-67-1

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeP
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
H. McArthur
W. S. Aitken
J. B. Curtis
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Proposed New Structure at Crossing
Of Shadow River and Hwy. #532
District No. 11 (Huntsville)
W.J. 68-F-18 -- W.P. 109-67-1

1. INTRODUCTION:

The Foundation Section was requested to carry out a foundation investigation at the above site. The request was contained in a memorandum dated February 27, 1968, from Mr. J. B. Curtis, Regional Bridge Location Engineer.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed crossing.

Presented in this report are the results of our field and laboratory investigations, together with our recommendations pertaining to the foundations of the new structure.

2. DESCRIPTION OF SITE:

The site is located about two miles west of the town of Rosseau on Hwy. #532, at the crossing of the Shadow River. The site is located in a valley with rock visible at each end. The river flows in a southerly direction with an average depth of five feet. No houses are located in the valley and land is not used at the present time. In the spring the water covers most of the low-lying valley.

Physiographically, the site is located in the region referred to as the "Precambrian Shield".

3. FIELD WORK:

A total of eleven sampled boreholes and sixteen dynamic cone tests was carried out during the course of the field work.

cont'd. /2 ...

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

Drilling equipment consisted of a conventional diamond drill adapted for soil sampling purposes. 'Disturbed' samples were recovered at required depths by means of a 2-inch O.D. split-spoon driven into the soil with a 140-lb. hammer imparting an energy of 350 ft.-lbs. per blow according to the specifications of the Standard Penetration test. 'Undisturbed' samples were obtained by pushing 2-inch I.D. Shelby tubes manually into the soil. In-situ shear strengths were measured by field vane tests. All samples were visually examined in the field before being transported to the laboratory.

The locations and elevations of all boreholes were surveyed by personnel from the North Bay Region Engineering Surveys Section, and are shown on Drawing 68-F-19A together with the estimated stratigraphical profiles in the Appendix of this report.

4. LABORATORY TESTING:

All samples were subjected to a careful visual inspection in the laboratory. Laboratory tests were then carried out on selected representative samples to determine:

i) Natural Moisture Contents
ii) Atterberg Limits
iii) Grain-Size Distribution
iv) Consolidation Characteristics

The results of these tests are summarized and plotted on the Record of Borelog sheets and on Fig's 1 - 16 which are contained in the Appendix of this report.

cont'd. /3 ...

5. SOIL TYPES AND SOIL CONDITIONS:

5.1) General:

Subsoil conditions over most of the site area were found to be generally uniform. Five main soil types were encountered, namely: silty clay, layered clay, clayey silt, silty sand to sand, and silt.

5.2) Silty Clay:

This deposit was situated immediately below the ground surface. This soil type was encountered in all the sampled boreholes except in boreholes 4 and 16. The thickness varied from 5.0 feet to 10.0 feet. The 'N' values from the Standard Penetration Test gave values ranging from 1 to 4 blows per foot, indicating a very soft to soft consistency. The moisture content varied from 33% to 73%. Atterberg Limit tests gave the following results:

Liquid Limit	.....	35% - 49%
Plastic Limit	.....	16% - 27%

The above results are plotted on Fig. 1 of the Appendix of this report.

The undrained shear strength test results were as follows:

	Min.	Max.
Field Vane Test	400 p.s.f.	440 p.s.f.
Unconfined Compression Test ...	324 p.s.f.	340 p.s.f.
Triaxial Compression Test	281 p.s.f.	
Sensitivity	6.6	11.0

From the above results the average shear strength is estimated to be in the order of 350 p.s.f. as shown on Figure 2 of the Appendix of this report. The average grain-size distribution is as follows: gravel 1%, sand 5%, silt 58%, and clay 36%, which are plotted on Figure 3 of the Appendix.

cont'd. /4 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.3) Clay:

This deposit of clay of high plasticity (CH) was encountered in all of the sampled boreholes except in borehole 16. This deposit was grey at the top and changed to a grey and brown layered clay farther down. The thickness of this stratum ranged from 30.5 feet to 42.0 feet. The moisture content varied between 41% and 97%. Atterberg Limit tests gave the following results:

Liquid Limit	50% - 93%
Plastic Limit	18% - 30%

The undrained shear strength test results were as follows:

	Min.	Max.
Field Vane Test	140 p.s.f.	840 p.s.f.
Lab. Vane Test	308 p.s.f.	658 p.s.f.
Unconfined Compression Test ..	174 p.s.f.	478 p.s.f.
Triaxial Compression Test	205 p.s.f.	541 p.s.f.
Sensitivity	2.7	10.0
Density	91 p.c.f.	103 p.c.f.

From the above results the average shear strength is estimated to be in the order of 350 p.s.f. to 500 p.s.f. as shown on Figure 2 of the Appendix. The Atterberg Limit tests are plotted on Figure 4 of the Appendix.

Consolidation tests using conventional laboratory techniques, were carried out on 5 soil samples recovered from different elevations. The results of these tests are plotted on Fig's 10 to 14 of the Appendix. The main conclusion which can be drawn from these tests is that the deposit is preconsolidated by about 0.925 t.s.f. in excess of existing effective overburden pressure. Fig. 15 shows a plot of existing overburden pressure versus elevation: on the same figure the estimated preconsolidation pressure line is also shown. Fig. 15 also shows a plot of undrained

cont'd. /5 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.3) Clay (cont'd.) ...

shear strength versus elevation. This plot shows a C/p ratio of 0.16, and it is of interest to note that when this line is extended it cuts the elevation ordinate at 800.0 at the same point as does the extension of the preconsolidation line. Elevation 800.0 is the level of the high ground immediately adjacent to the valley.

Typical stress vs. strain curves are plotted on Fig. 16.

5.4) Clayey Silt:

This deposit was encountered in boreholes 12 and 16 near the ground surface. The average thickness was 5 feet. The moisture content ranged between 23% and 50%. 'N' values ranged from 4 to 15 blows per foot, indicating a firm to stiff consistency. Atterberg Limit tests gave the following results:

	Min.	Max.
Liquid Limit	32%	33%
Plastic Limit	16%	18%

5.5) Silty Sand to Sand:

This deposit consisted mainly of sand with some silt and traces of gravel and clay. The layer was encountered either at the top of the borehole or immediately above bedrock. The thickness ranged from 4.0 feet to 28.5 feet. The moisture content varied from 10% to 19%. The average grain-size distribution from several mechanical analyses, was found to be as follows: gravel 8%, sand 71%, silt 17%, and clay 4%; these are plotted on Figure 5 of the Appendix. 'N' values from Standard Penetration tests ranged from 1 to 29 blows per foot, indicating a very loose to compact relative density near the top of the layer to 'N' values ranging from 52 blows per foot to 100 blows per 3 inches at the bottom, indicating a very dense relative density. The cone tests substantiate this increase.

cont'd. /6 ...

5. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

5.6) Silt:

This deposit consisted of silt with some sand and a trace of clay. The thickness varied from 17 to 22 feet and was encountered only in boreholes 4 and 11. The moisture content ranged between 15% and 30%. 'N' values varied from 4 to 8 blows per foot, indicating a loose relative density. The average grain-size distribution obtained from mechanical analyses gave the following: gravel 1%, sand 13%, silt 79%, and clay 7%. These are plotted on Figure 6 of the Appendix.

5.7) Bedrock:

Bedrock was proven in only borehole 5 to 5 feet which yielded a 100% recovery. The bedrock is a granite gneiss bedrock. In other boreholes bedrock was assumed at refusal to farther penetration of the drilling equipment.

6. GROUNDWATER:

The groundwater level ranged between elevation 742.8 and 744.8, which is slightly higher than the prevailing creek level.

7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

It is proposed to construct a new bridge at this site to replace the existing 27-ft. single-span concrete structure. Crossings on two lines have been considered and are discussed below. These lines are, Line 'L' which is approximately 40 ft. south of the existing bridge, and Projected Revision Line which is about 5 ft. south of the existing centre-line of Hwy. 532.

7.2) Crossing on Line 'L':

As can be seen from the foregoing sections of this report, subsoil along the entire length of the valley floor consists of about 40 feet of soft clay followed by varying depths of loose to very dense sand followed by granite bedrock. The presence of the soft clay

cont'd. /7 ...

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

7.2) Crossing on Line 'L': (cont'd.) ...

deposits gives rise to problems for the structure approaches insofar as stability and settlements are concerned. The type and length of a suitable bridge structure is therefore governed to a large extent by the measures necessary to stabilize the embankments and by the future performance of the embankments. Stability analyses, in terms of total stresses, have been carried out for various heights of fill with the following assumptions:

Subsoil -

Undrained Shear Strength	C = 315 - 515 p.s.f.
Bulk Density	δ = 95 p.c.f.
Groundwater Level	At surface.

Fill -

Undrained Shear Strength	C = 400 p.s.f. (Partial Mobilization)
Bulk Density	δ = 135 p.c.f.

The results of the analyses show that fill heights of more than 10 ft. above the toe of the slope require half-height berms ranging in length from zero for fill heights of 10 ft. to 100 ft. for fill heights of 20 ft. Fig. 7 of the Appendix shows a typical bermed section, together with a graph of Height of Embankment versus Berm Length. It should be noted that the fill height is defined as the difference in elevation between the top of the embankment and the finished ground level at the toe ofthe slope. It can be seen that the maximum height of fill occurs at the bridge abutments where it is referred to the elevation of the stream bed. Depending on the level of the future stream bed, therefore, berms will be required in the forward direction and will consequently increase the length of the structure required.

cont'd. /8 ...

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

7.2) Crossing on Line 'L': (cont'd.) ...

Long-term settlements will occur under the new embankments due to consolidation of the underlying soft clay layers. For various fill heights, settlements have been computed using conventional techniques: the results have been illustrated graphically on Fig. 8. Fig. 9 shows a plot of Degree of Consolidation Settlement versus Time. It will be noted that the settlement under a 12-ft. high embankment is estimated to be 22.5 inches, 50% of which should occur in a period of 7 months. No estimates of elastic settlements have been made. These will occur instantaneously and, in consequence, should not affect the final product. In considering the validity of the consolidation settlement calculations, experience in the past has shown that theoretical values are often much larger than the actual settlements. In this case, however, the computed results appear to be reasonable, and it is believed that they can be taken at face value.

The proposed structure should be supported on piled foundations since the subsoil cannot provide sufficient support for an economically designed spread footing. The most suitable type of structure would be a trestle design with tube piles or timber piles driven to end bearing either on rock or within the very dense zone of the sand stratum. Drawing 68-F-18A shows the estimated rock profile where encountered in borings. Between Stations 150+67 and 153+25, where rock was not encountered, estimated pile tip elevations range from el. 685 to el. 670, respectively. Design loads on the piles may be the maximum allowable from a structural point of view.

If Line 'L' is constructed the following recommendations and comments should be noted:

(1) The structure site should be chosen so that the minimum height of approach fill is required. This will result in the minimum of settlements and the minimum length of stabilizing berm.

cont'd. /9 ...

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

7.2) Crossing on Line 'L': (cont'd.) ...

(2) It would be extremely advantageous to construct the embankments about 12 months ahead of the structure since the bulk of the anticipated settlements should occur within this period.

(3) In order to ensure permanent stability of the embankments and berms adjacent to the creek, sufficient rip-rap must be placed within the stream bed to prevent future erosion. If erosion of the stream bed does occur below the depth assumed in the stability analyses, unstable conditions will be created with serious consequences for the structure.

(4) As an alternative to a bridge structure, a pipe arch culvert placed on a 2-ft. thick granular pad may be considered. The length of the pipe will depend on the berm lengths necessary for embankment stability. The pipe should be cambered to accommodate settlements, which may be obtained from Fig. 8.

7.3) Crossing on Projected Revision Line:

All of the previous discussion referring to Line 'L' is generally valid for this line also, with the following additional comments:

(1) Since this line closely follows the existing road, future settlements under an increased height of fill would be somewhat less than for new fill placed along Line 'L'.

(2) From a stability point of view, conditions under the existing road should be slightly better than along Line 'L'. It is believed, however, that this effect cannot be assessed accurately.

cont'd. /10 ...

8. MISCELLANEOUS:

The field work for this report was carried out during the period May 14 to May 28, 1968, under the supervision of Mr. A. M. Seppala, Project Foundation Engineer, who prepared this report.

Equipment used was owned and operated by Johnston Drilling Company Limited.

Mr. K. G. Selby, Supervising Foundation Engineer, reviewed this report.

June, 1968.

FORM OB-MT-1
56-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 151 + 00 38' Lt. of ℄ ORIGINATED BY AMS
W.P. 109-67-1 BORING DATE May 14 & 15, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing & Cone Test CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
744.3	Ground Level					
0.0	Silty clay					
	Very soft		1	SS	1	
737.3						
7.0			2	TW	PM	
	Grey and brown					
	layered clay		3	TW	PM	
			4	TW	PM	
			5	TW	PM	
	soft		6	TW	PM	
			7	TW	PM	
705.3						
703.3	Silty clay		8A	SS	-	
41.0						
	Sand, some silt and		9	SS	52	
	gravel.					
	Very dense.		10	SS	100/3"	
674.8			11	SS	100/5"	
69.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F.
+ Field Vane o Unconfined Comp.
x Lab. Vane • Triaxial
500 1000 1500 2000 2500

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT % 25 50 75

BULK DENSITY
P.C.F.

REMARKS
▼ 743.3
Gr.Sa.Si.Cl
3 4 51 42
17 67 14 2

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 151 + 34 40' Lt. of ℄ ORIGINATED BY AMS

W.P. 109-67-1 BORING DATE May 15, 1968 COMPILED BY WB

DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
744.7	Ground Level									
0.0						740				
						730				
						720				
						710				
						700				
688.1						690				
56.6	End of Cone test						120/6"			

FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.3

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 151 + 06 10' Rt. of ℄ ORIGINATED BY AMS
W.P. 109-67-1 BORING DATE May 16, 1968 COMPILED BY WB
DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
745.6	Ground Level									
0.0						740				
						730				
						720				
						710				
						700				
692.8							100/10"			
52.8	End of Cone Test									

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 151 + 75 5' Rt. of ℄ ORIGINATED BY AMS
W.P. 109-67-1 BORING DATE May 16, 1968 COMPILED BY WB
DATUM Geodetic BOREHOLE TYPE NX Casing & Cone Test CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
744.0	Ground Level					
0.0	Silty sand, organics, trace of clay. Very loose		1A	SS	1	740
736.0						
8.0	Grey and brown layered clay. Soft.		2	TW	PM	
			3	TW	PM	730
			4	TW	PM	
			5	TW	PM	720
			6	TW	PM	
			7	TW	PM	710
			8	TW	PM	
694.0						700
50.0	Silt, some sand. Loose		9A	SS	-	
			10	SS	7	690
684.0						
60.0	Sand, trace of gravel. Loose to very dense.		11	SS	100/6"	680
672.4			12	SS	100/2"	
71.6	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
+ Field Vane o Unconfined Comp.
x Lab. Vane • Triaxial
500 1000 1500 2000 2500

+3.5
+10
+4.0
+6.0
+6.0
+6.5
+5.8

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT % 25 50 75

BULK DENSITY γ P.C.F.

103
91.5
95.5
94
96
97
99

REMARKS
Gr.Sa.Si.Cl
743.5
2 12 85 1

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 154 + 82 12' Lt. of ℄ ORIGINATED BY AMS
W P 109-67-1 BORING DATE May 21, 1968 COMPILED BY WB
DATUM Geodetic BOREHOLE TYPE NX Casing & Cone Test CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT
747.0	Ground Level				
0.0 / 743.0	Fine sand, some clay. Loose		1	SS	5
4.0	Silty clay.		2	SS	2
	Soft.		3	TW	PM
734.0					
13.0			4	TW	PM
	Grey and brown layered clay.		5	TW	PM
			6	TW	PM
	Soft.		7	TW	PM
			8	TW	PM
			9	TW	PM
699.5					
697.5	Sand				
49.5 / 692.5	Granite gneiss Bedrock		10	AXT RC	Rec. 100%
54.5	End of Borehole				

ELEV SCALE: 740, 730, 720, 710, 700, 690

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100
SHEAR STRENGTH P S F: + Field Vane ○ Unconfined Comp. × Lab. Vane ● Triaxial
500 1000 1500 2000 2500

+11.0
+4.4
+5.2
+5.0
+7.5
+4.7
120/6"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 25 50 75

BULK DENSITY γ PCF: 105, 95, 92, 100.5, 99, 97, 98, 99

REMARKS: ▼ 744.3

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 68-P-18 LOCATION Sta. 155 + 50 22' Rt. of ℄ ORIGINATED BY AMS

W P 109-67-1 BORING DATE May 23, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE NX Casing CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F + Field Vane o Unconfined Comp x Lab. Vane • Triaxial 500 1000 1500 2000 2500	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT % 25 50 75	BULK DENSITY γ PCF	REMARKS
747.7	Ground Level									
0.0	Mottled silty clay (Fill)									▼744.7
741.7			1	SS	12	740				
6.0	Grey and brown layered clay. Soft.		2	TW	PM		+4.5		112	
			3	TW	PM		x +4.4		93	
			4	TW	PM	730	• +4.0		95 95	
						720				
711.2			5	TW	PM		+4.7		99	
36.5	Sand, some silt, traces of gravel and clay. Compact		6	SS	29	710				2 82 11 5
703.7										
44.0	Probable Bedrock End of Borehole									

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 156 + 00 12' Lt. of ℄ ORIGINATED BY AMS

W P 109-67-1 BORING DATE May 23, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE Cone only. CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT %	BULK DENSITY γ P C F	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT					
747.8	Ground Level									
0.0						740				
						730				
717.3						720				
30.5	Probable Bedrock End of cone test					710	67/6" refusal			

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7A

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 156 + 00 16' Rt. of ℄ ORIGINATED BY AMS
W P 09-67-1 BORING DATE May 24, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT %	HULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE				
748.2	Ground Level									
0.0						740				
						730				
						720				
714.4										
33.8	Probable Bedrock End of Cone Test					710	114/9" refusal			

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 156 + 50 13' Rt. of ℄ ORIGINATED BY AMS

W P 109-67-1 BORING DATE May 23, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE Cone Only CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P S F.	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_P WATER CONTENT ——— w w_P w w_L WATER CONTENT %	BULK DENSITY γ P C F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT					
749.3	Ground Level									
0.0						740				
728.6						730				
20.7	Probable Bedrock End of cone test						55/8" refusal			

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 156 + 50 15' Lt. of ℄ ORIGINATED BY AMS

W.P. 109-67-1 BORING DATE May 24, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / w_P w w_L / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
748.8	Ground Level									
0.0						740				
733.2										
15.6	Probable Bedrock End of cone test					730	25/7" refusal			

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 154 + 25 15' Lt. of ℄ ORIGINATED BY AMS
W P 109-67-1 BORING DATE May 23 & 24, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F. + Field Vane o Unconfined Comp. x Lab Vane • Triaxial 500 1000 1500 2000 2500	LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w WATER CONTENT % 25 50 75	BULK DENSITY γ PCF	REMARKS
746.5	Ground Level									Gr.Sa.Si.Cl
0.0	Silty clay. Soft.									▼ 743.5
739.5			1	SS	2	740				
7.0	Grey and brown layered clay. Soft.		2	TW	PM		o + 5.2	o	110	
			3	TW	PM	730	o + 7.2	o	94	
			4	TW	PM		+ 2.8	o	91	
			5	TW	PM	720	• + 8.6	o	97 96	
			6A	SS	-	710	+ 6.0	o		
701.5										
45.0	Silty sand, traces of gravel and clay. Compact.		7	SS	13	700		o		5 62 28 5
693.2										
53.3	Probable Bedrock End of borehole									

FORM DB-MT-12
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 11

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 153 + 75 on ℄ ORIGINATED BY AMS
W.P. 109-67-1 BORING DATE May 23 & 24, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing - Washbore CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT; SHEAR STRENGTH P.S.F + Field Vane o Unconfined Comp x Lab Vane (500 1000 1500 2000 2500)	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w (WATER CONTENT % 25 50 75)	BULK DENSITY ℄ P.C.F.	REMARKS
747.0	Ground Level									Gr.Sa.Si.Cl
0.0	Silty clay. Soft		1	SS	4	740				▼ 743.8
740.0										
7.0	Grey and brown layered clay. Soft.		2	TW	PM		+9.0		93	
						730				
			3	TW	PM		x + 4.8			
						720				
			4	TW	PM		+7.3			
						710				
			5	TW	PM		+3.5		97.3	
699.0						700				
48.0	Silt, some sand and some clay Loose		6	SS	8					1 14 72 13
						690				
			7	SS	4					
682.0										
65.0	Probable Bedrock End of Borehole					680				

FORM GS-MT-124
68-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 153 + 25 34' Lt. of ℄ ORIGINATED BY AMS
W.P. 109-67-1 BORING DATE May 24 & 27, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing - Washbore CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F. + Field Vane o Uncon. Comp. • Triaxial (500 1000 1500 2000 2500)	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w (25 50 75 %)	BULK DENSITY P.C.F.	REMARKS
746.3	Ground Level									
0.0	Silty clay									▼ 743.3
	Soft		1	SS	2	740				
736.3										
10.0	Clayey silt.		2B	SS	-		+ 7.3			
731.3						730				
15.0	Grey and brown layered clay.		3	TW	PM		o + 5.5		97	
						720				
			4	TW	PM		o + 4.7		92.1	
	Soft.					710				
			5	TW	PM		o • + 6.2		95 98	
698.3						700				
48.0	Fine sand. Very loose to compact		6	SS	1					
						690				
			7	SS	1					
						680				
673.7			8	SS	14					
72.6	Probable Bedrock End of Borehole									

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 152 + 75 12' Rt. of ℄ ORIGINATED BY AMS
W.P 109-67-1 BORING DATE May 24, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
747.8	Ground Level									
0.0						740				
						730				
						720				
						710				
						700				
						690				
						680				
674.3							100/6"			
73.5	End of Cone Test					670				

FORM DS-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 152 + 32 10' Lt. of ℄ ORIGINATED BY AMS
W P 109-67-1 BORING DATE May 28, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing - Washbore CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P S F: + Field Vane, o Uncon Comp, • Triaxial (500 1000 1500 2000 2500)	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT % (25 50 75)	BULK DENSITY PCF	REMARKS
743.6	Ground Level									Gr.Sa.Si.Cl
0.0	Silty sand, trace of clay.					740				▽ 742.8
735.6	Very loose		1	SS	1					
8.0	Silty clay		2	TW	PM		+6.6		98.2 / 107.5	0 5 65 30
730.6						730				
13.0	Grey and Brown layered clay.		3	TW	PM		+9.5		96	
						720				
	Soft		4	TW	PM		+6.2		100	
						710				
			5	TW	PM		+6.0		97.5 / 97.2	
695.6						700				
48.0	Silty sand to sand.		6	SS	2					
	Very loose					690				
682.1			7	SS	4					
61.5	End of Borehole									

FORM OB-MT-12
66-4548

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 15

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 148 + 40 on Ø ORIGINATED BY AMS

W P 109-67-1 BORING DATE May 24, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY X P C F	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE				
744.2	Ground Level									
0.0										
740.2										
4.0	Probable Bedrock End of Cone test					740	refusal			

FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 16

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 142 + 05 5' Lt. of ℄ ORIGINATED BY AMS
W P 109-67-1 BORING DATE May 27, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing & Cone Test CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT
748.0	Ground Level				
0.0 / 744.0	Fine Sand. Compact.		1	SS	15
4.0 / 739.0	Clayey silt. Stiff		2	SS	13
9.0	Sand, some silt, traces of gravel and clay. Loose to compact.		3	SS	23
			4	SS	5
723.8			5	SS	23
24.2	Probable Bedrock				
	End of Borehole				

ELEV SCALE: 740, 730, 720

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P S F 500 1000 1500 2000 2500

44/2" refusal

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT % 25 50 75

BULK DENSITY P C F

REMARKS: Gr.Sa.Si.Cl

▼ 744.8

9 73 14 4

FORM DB-MT-12
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 17 & 20

FOUNDATION SECTION

JOB 8-F-18 LOCATION Sta. 149 + 75 6' Lt. of ℄ ORIGINATED BY AMS
W P 109-67-1 BORING DATE May 27 & 28, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing - Washbore & Cone Test CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
745.7	Ground Level					
0.0	Silty clay to clayey silt. Firm to stiff		1	SS	16	740
737.7			2	SS	6	
8.0	Grey and brown layered clay.		3	TW	PM	
727.7			4	TW	PM	730
18.0	Sand, trace of gravel. Compact		5	SS	-	
			6	SS	23	720
						710
699.4						700
46.3	Probable Bedrock End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P S F
+ Field Vane o Uncon Comp
500 1000 1500 2000 2500

+40
60
+6.6

62/4" refusal

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %
25 50 75

BULK DENSITY γ
P C F
99
97

REMARKS
744.3

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 18

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 150 + 40 27' Lt. of ℄ ORIGINATED BY AMS
W.P. 109-67-1 BORING DATE May 28, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE NX Casing - Washbore CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. + Field Vane o Uncon Comp ● Triaxial (500 1000 1500 2000 2500)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (WATER CONTENT % 25 50 75)	BULK DENSITY γ P.C.F.	REMARKS
745.0	Ground Level									
0.0	Grey and brown silty clay to clay. Soft.		1	SS	4	740				▽ 744.0
			2	TW	PM		+ 6.6		103 92	
						730				
			3	TW	PM		+ 10.0		99	
						720				
			4	TW	PM		+ 7.3		97	
711.0										
34.0	Silty sand.					710				
707.4										
37.6	Probable Bedrock End of Borehole									

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 19

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 150 + 67 22' Lt. of ℄ ORIGINATED BY AMS

W P 109-67-1 BORING DA May 28, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE T PE Cone only CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY γ P C F	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE				
744.8	Ground Level									
0 0						740				
						730				
						720				
						710				
						700				
693.1										
51.7	Probable Bedrock End of cone test					690	51/8" refusal			

FORM MB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 21

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 150 + 45 115' Rt. of ℄ ORIGINATED BY AMS
W P 109-67-1 BORING DATE May 28, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W WP W WL WATER CONTENT %	BULK DENSITY P C F	REMARKS
ELEV / DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT					
744.3	Ground Level									
0.0						740				
						730				
						720				
						710				
						700				
693.1										
51.2	Probable Bedrock Encd of cone test					690	6773# refusal			

FORM 58-MT-124
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

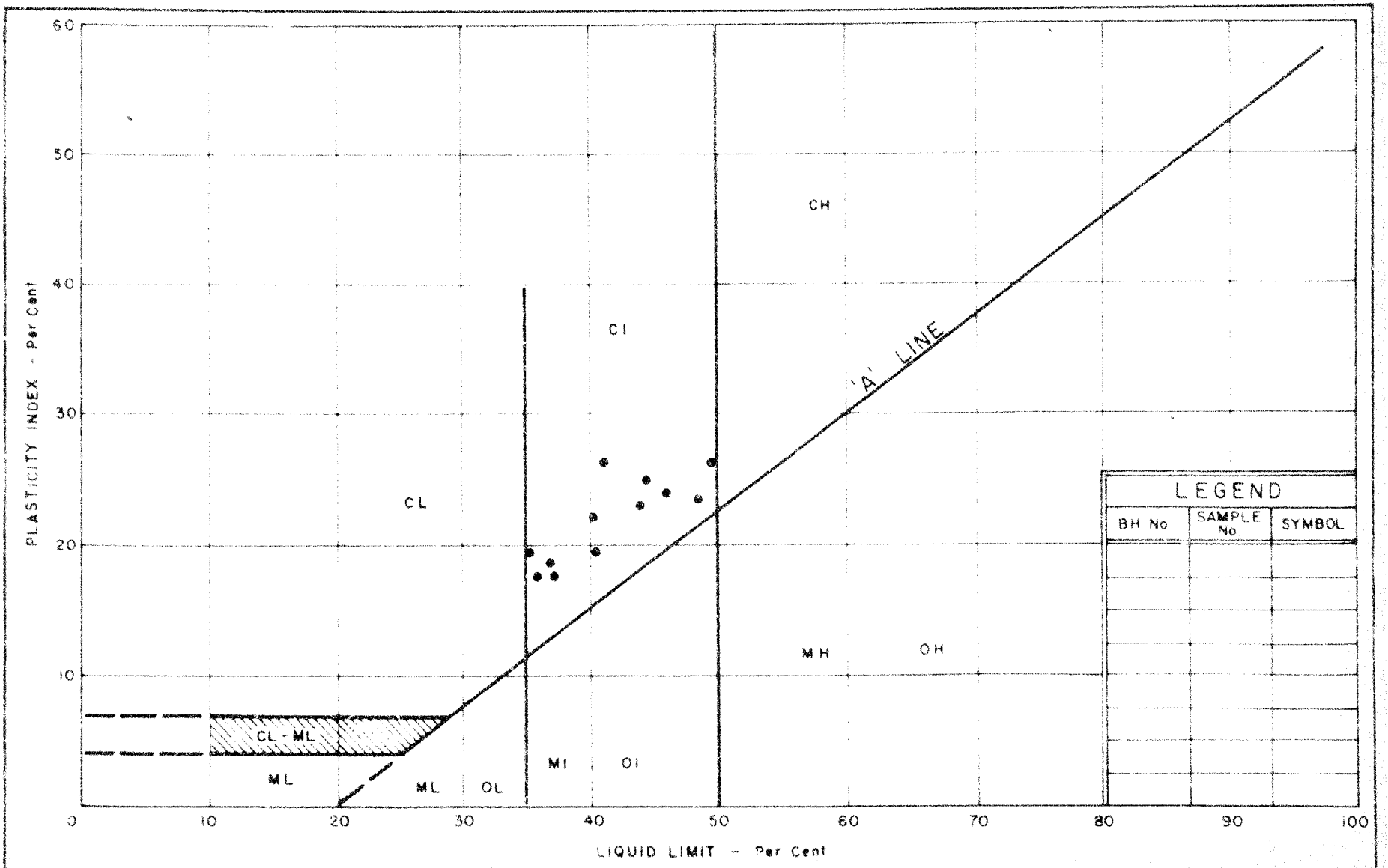
RECORD OF BOREHOLE NO. 22

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 151 + 86 63' Rt. of ℄ ORIGINATED BY AMS
W.P 109-67-1 BORING DATE May 28, 1968 COMPILED BY AMS
DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY P C F	REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE				
743.0 0.0	Ground Level					740 730 720 710 700 690 680				
678.8 64.2	Probable Bedrock End of Cone Test					670	65/3" refusal			

FORM OB-MT-252
REVISED JULY [illegible] 966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART
SILTY CLAY

W.P. No. 109 - 67 - 1
JOB No. 68 - F - 18
FIG. 1

ELEVATION VS. UNDRAINED SHEAR STRENGTH

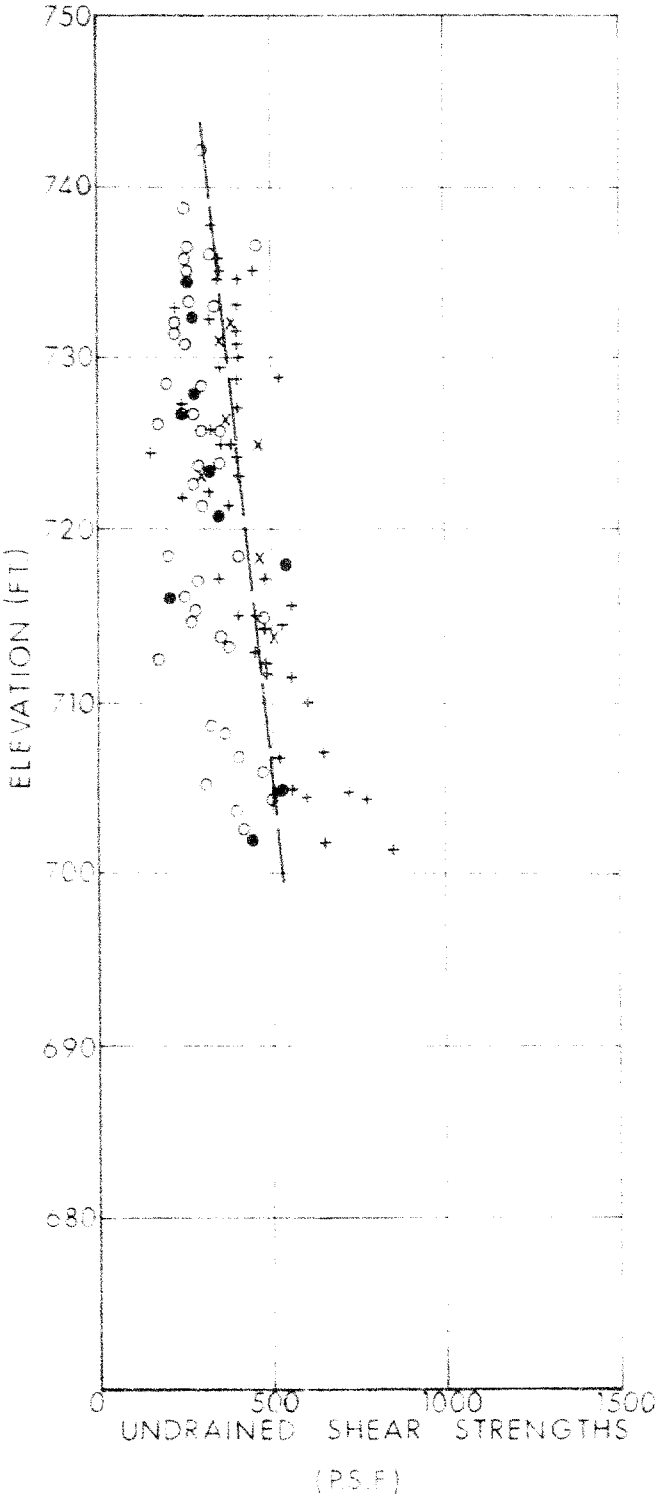
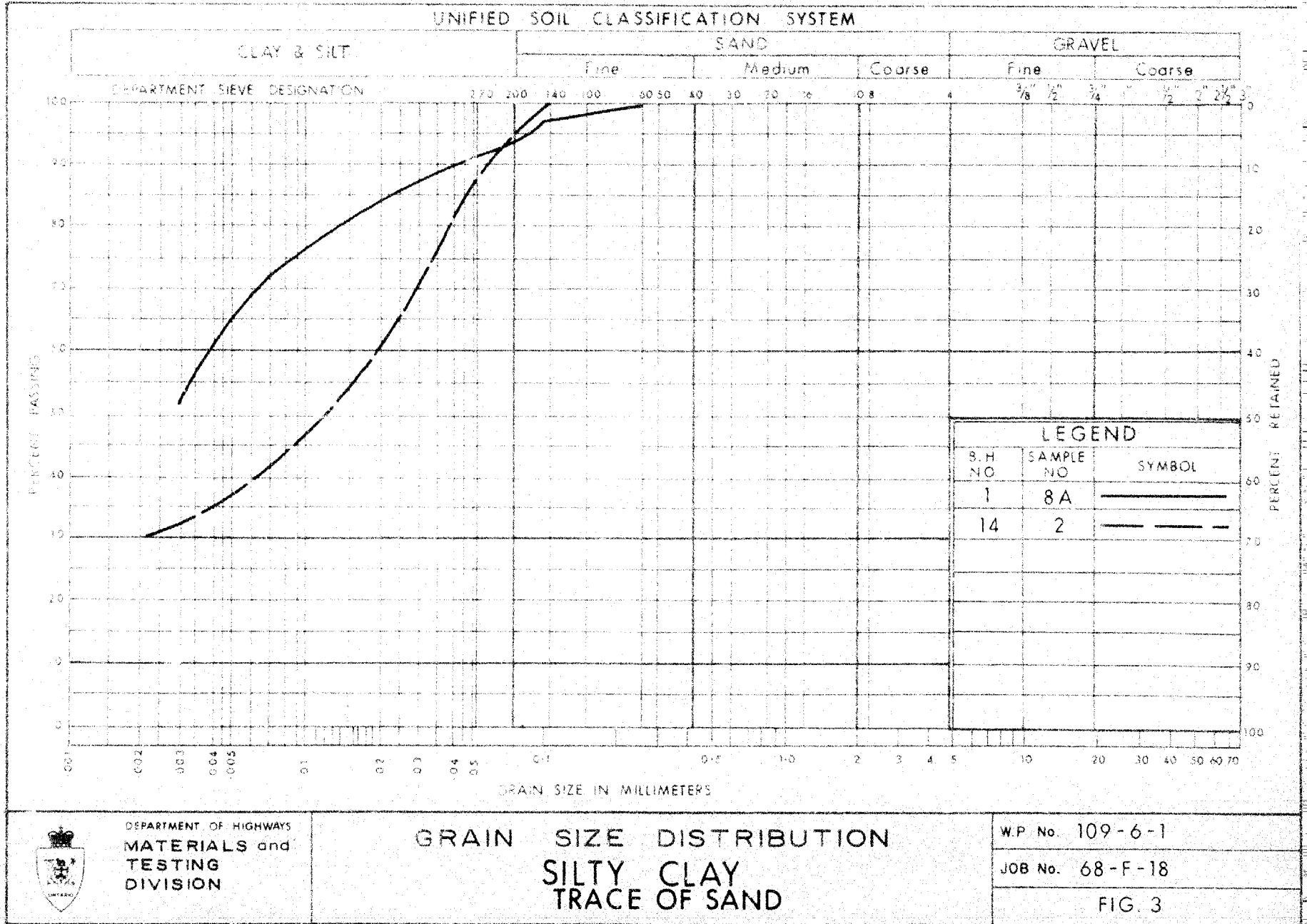


FIG. 2

FORM OB MT - 17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

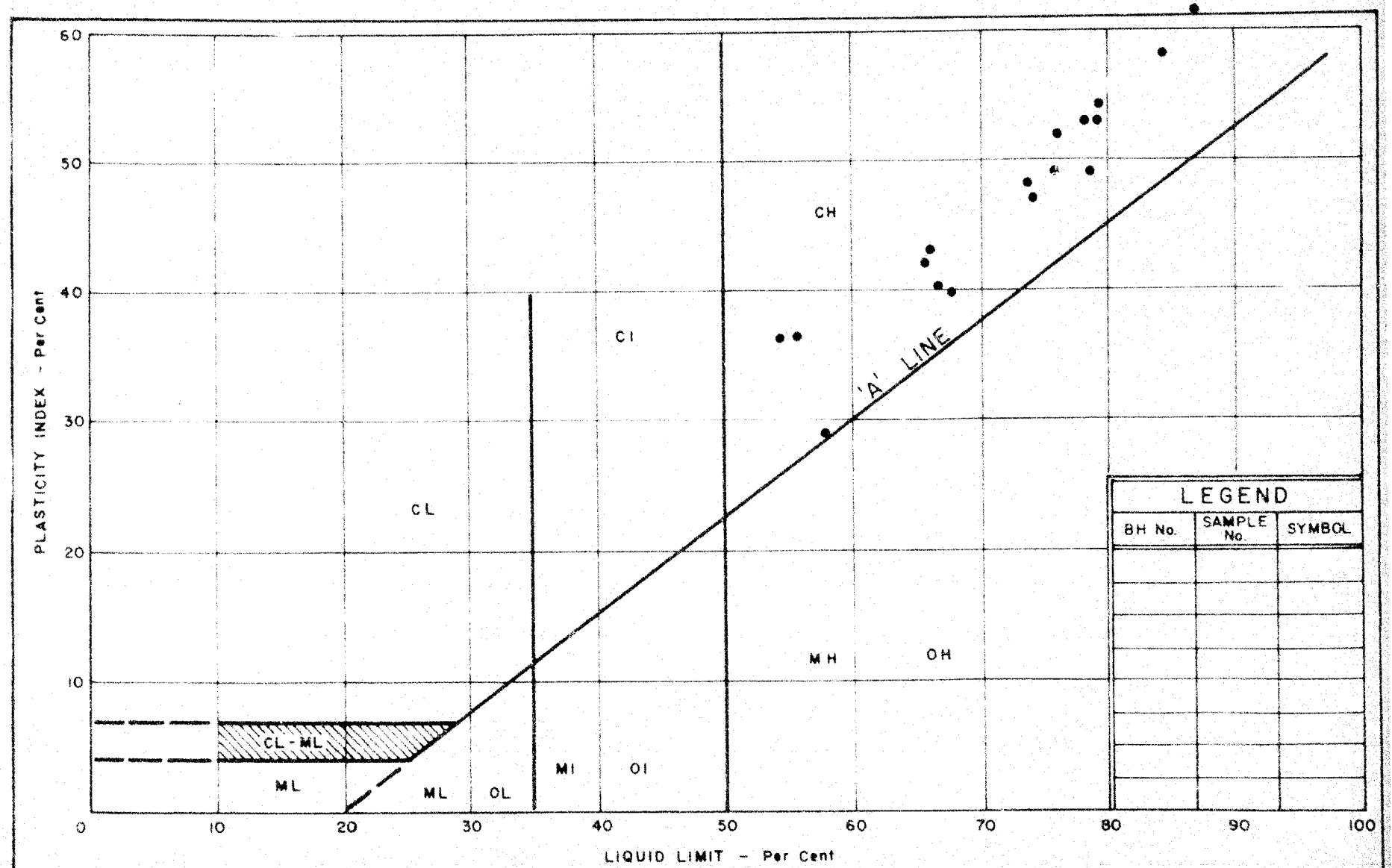
SILTY CLAY
TRACE OF SAND

W.P. No. 109-6-1

JOB No. 68-F-18

FIG. 3

FORM OB-MT-252
REVISED JUL 1966



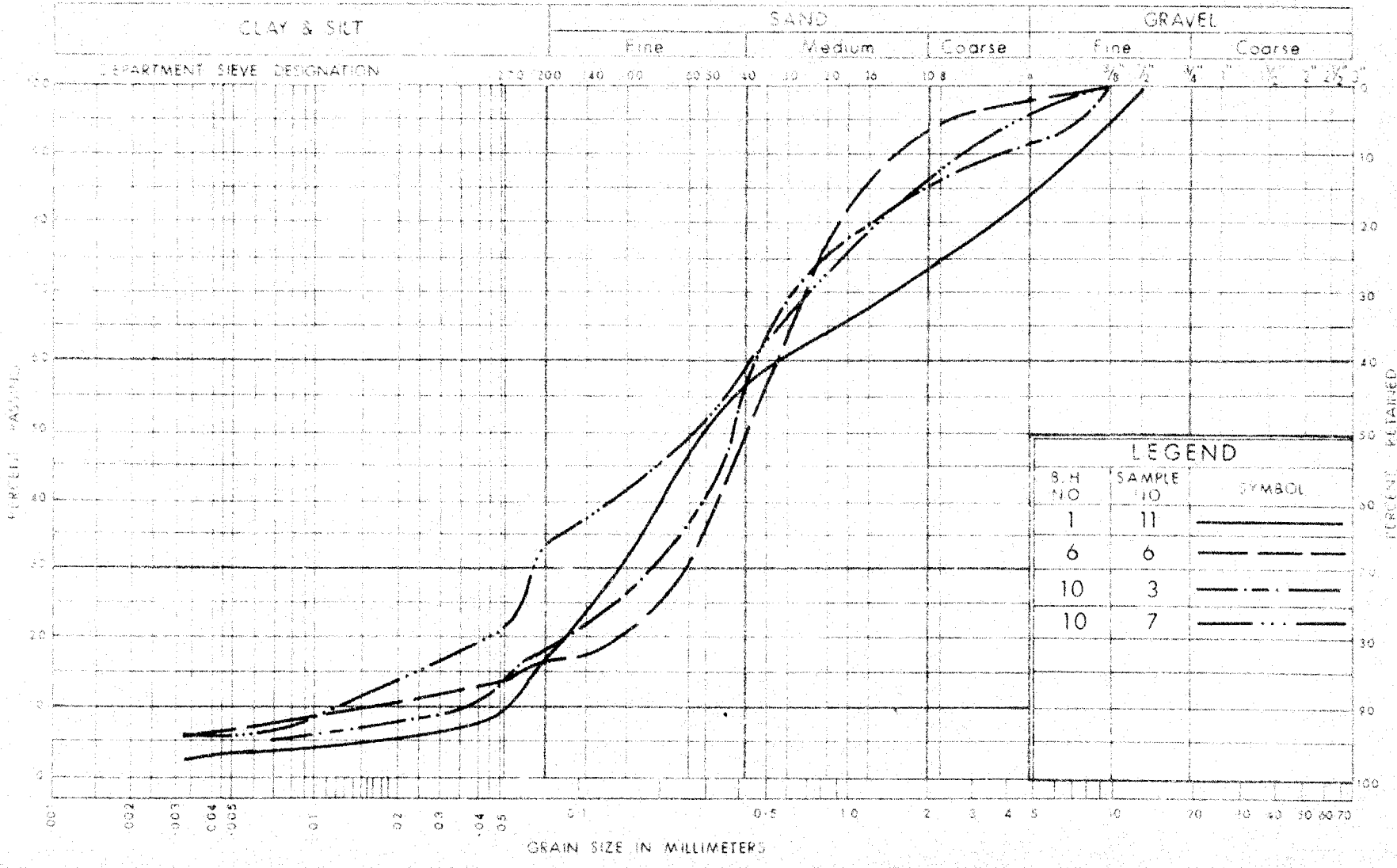
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART
CLAY

W.P. No. 109-6-1
JOB No. 68-F-18
FIG 4

FORM OB MT-
REV APR 1965

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION
SAND SOME SILT
TRACES OF GRAVEL & CLAY

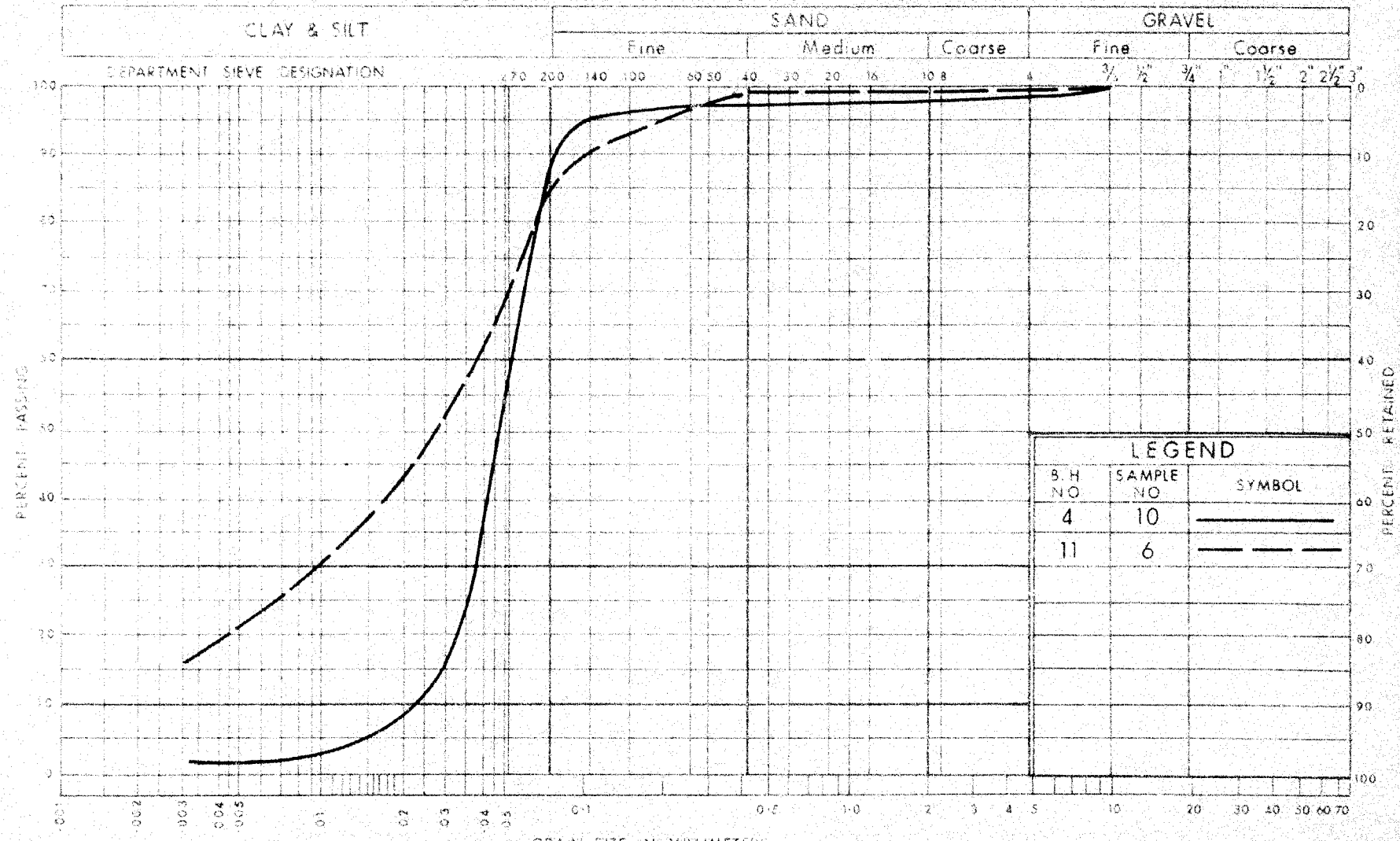
W.P No. 109-6-1

JOB No. 68-F-18

FIG. 5

FORM OB MT-17
REV APR 1965

UNIFIED SOIL CLASSIFICATION SYSTEM

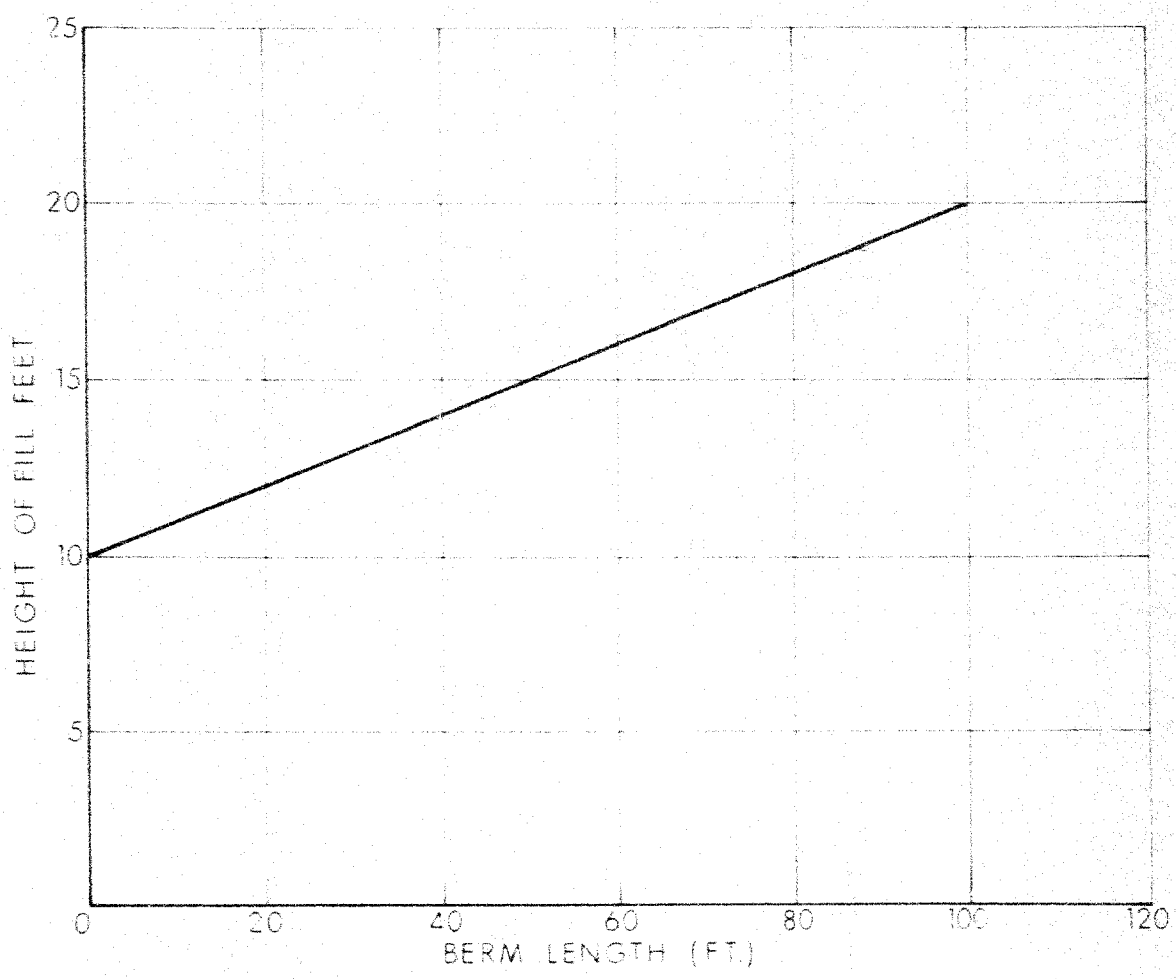


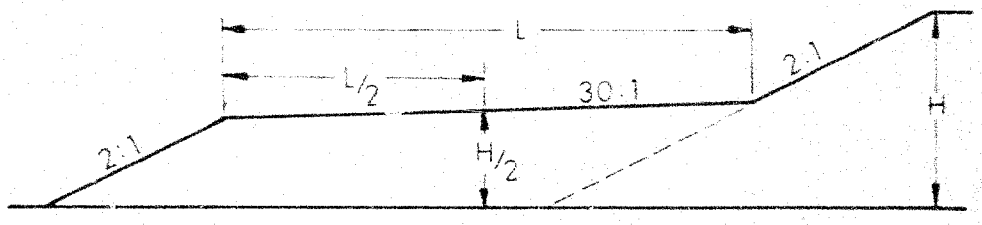
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION
SILT SOME SAND
TRACE OF CLAY

W.P No. 109-6-1
JOB No. 68-F-18
FIG. 6

HEIGHT OF FILL VS. BERM LENGTH

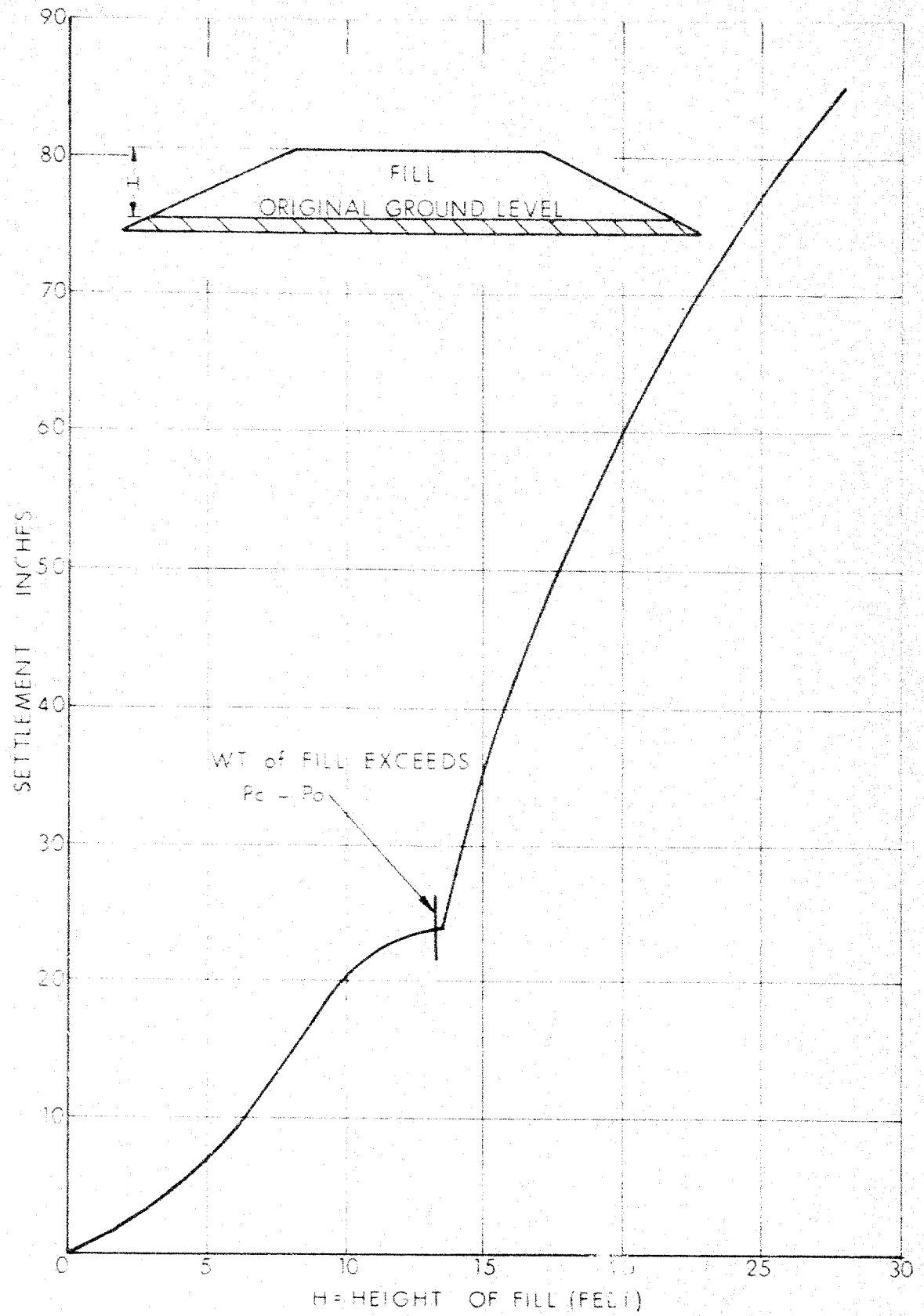




TYPICAL BERM SECTION

NOTE: H= ELEVATION AT TOP OF EMBANKMENT MINUS ELEVATION OF FINISHED GROUNDLEVEL AT TOE OF SLOPE.

FIG. 7



SETTLEMENT VS. HEIGHT OF FILL

FIG. 8

DEGREE OF CONSOLIDATION SETTELMENT
VS.
TIME

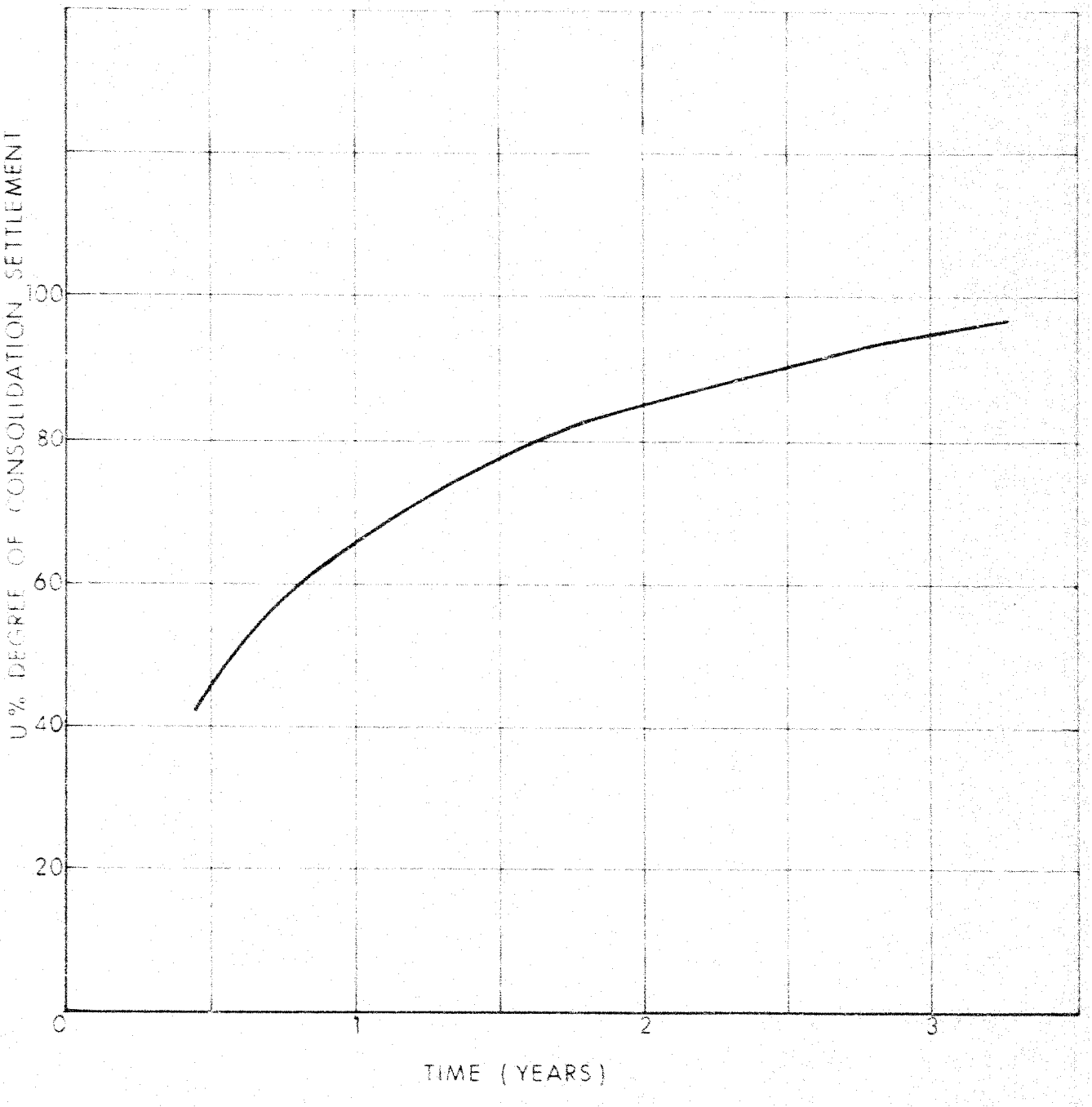


FIG. 9

VOID RATIO vs PRESSURE

W_L = 36%
W_P = 18%
W = 57%
C_c = .74

BORE HOLE 14
SAMPLE 2
DEPTH 10' 11"
ELEV. 732.7

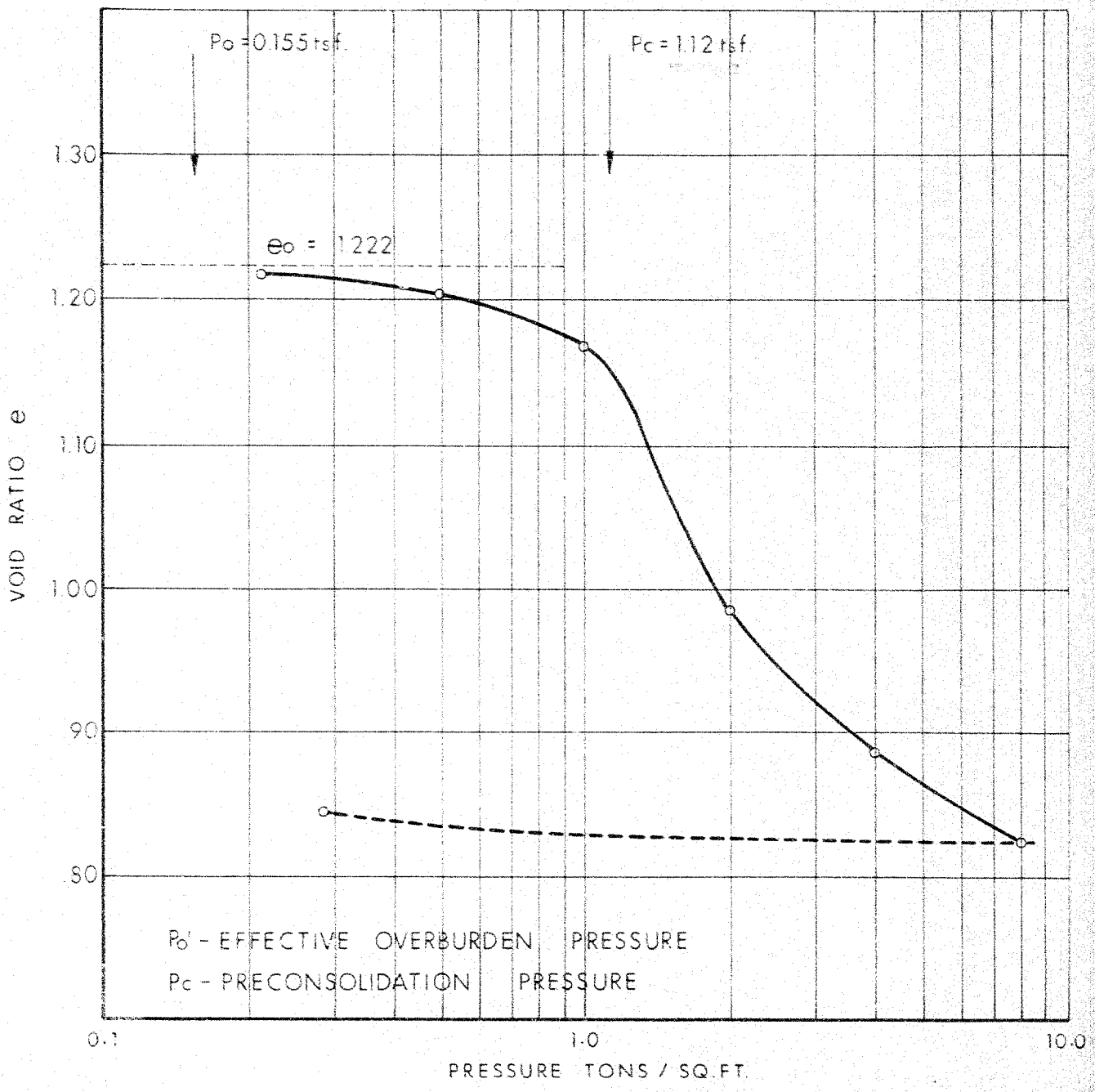


FIG 10

VOID RATIO vs PRESSURE

W_L = 79 %
W_P = 25 %
W = 87 %
C_c = 2.90

BORE HOLE 4
SAMPLE 5
DEPTH 25' 11"
ELEV. 718.1

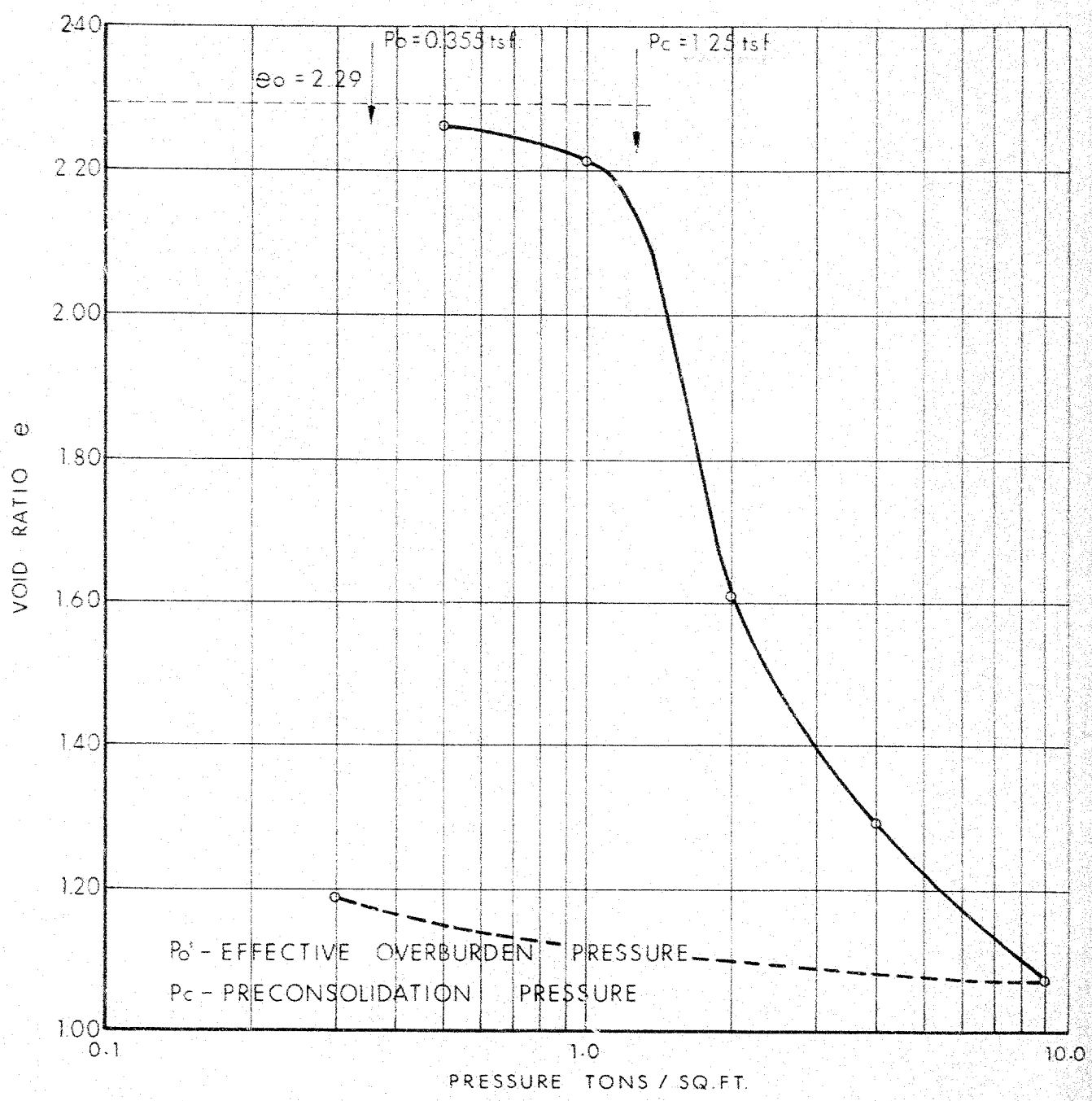


FIG. 11

VOID RATIO vs PRESSURE

W_L = 49 %
W_P = 23 %
W = 80 %
C_c = 2·100

BORE HOLE 18
SAMPLE 3
DEPTH 30' 11"
ELEV. 714·1

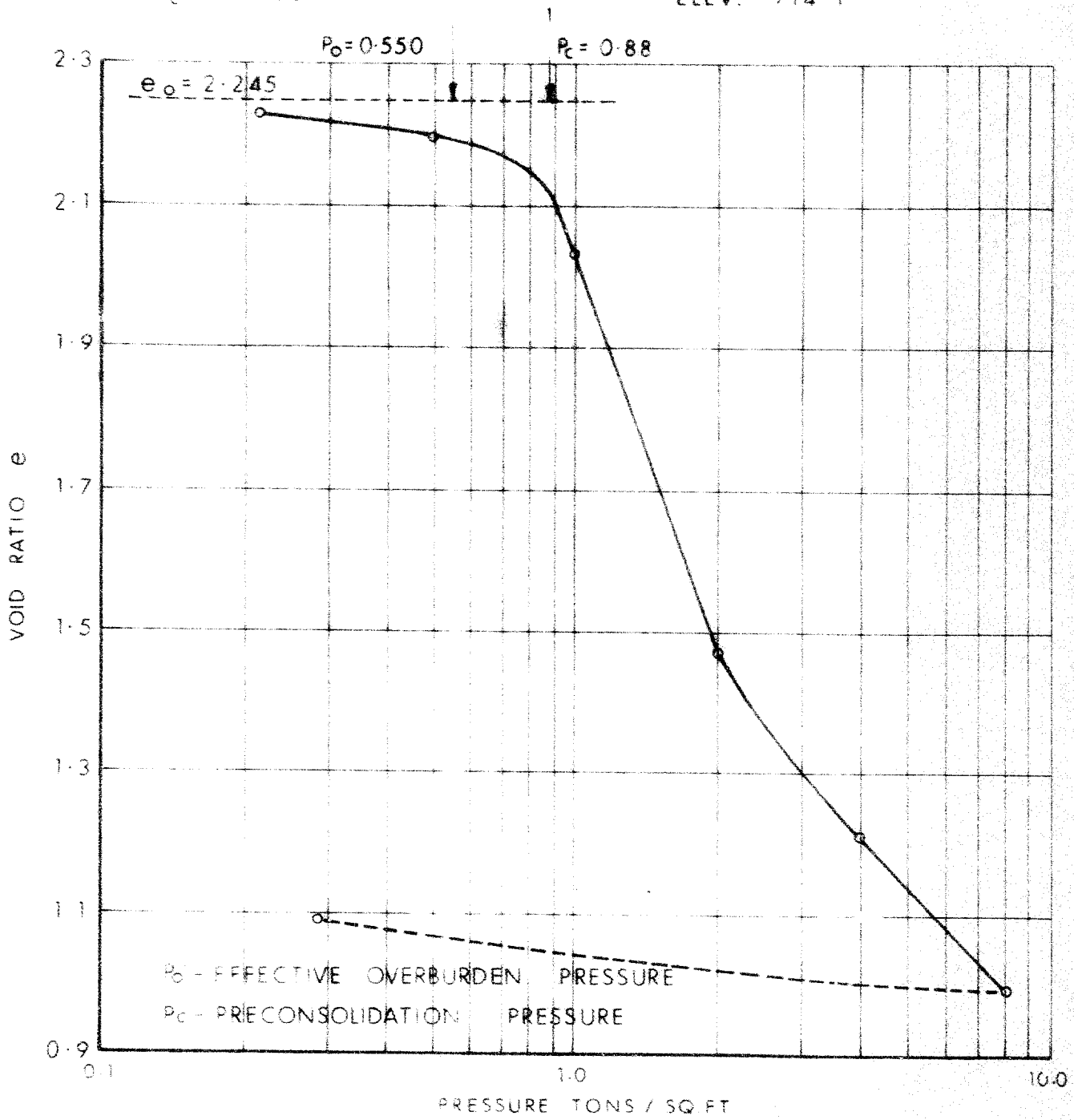


FIG 12

VOID RATIO VS PRESSURE

W_L = 76%
W_P = 27%
W = 71%
C_c = 1.5900

BORE HOLE 1
SAMPLE 7
DEPTH 35' 11"
ELEV. 708.4

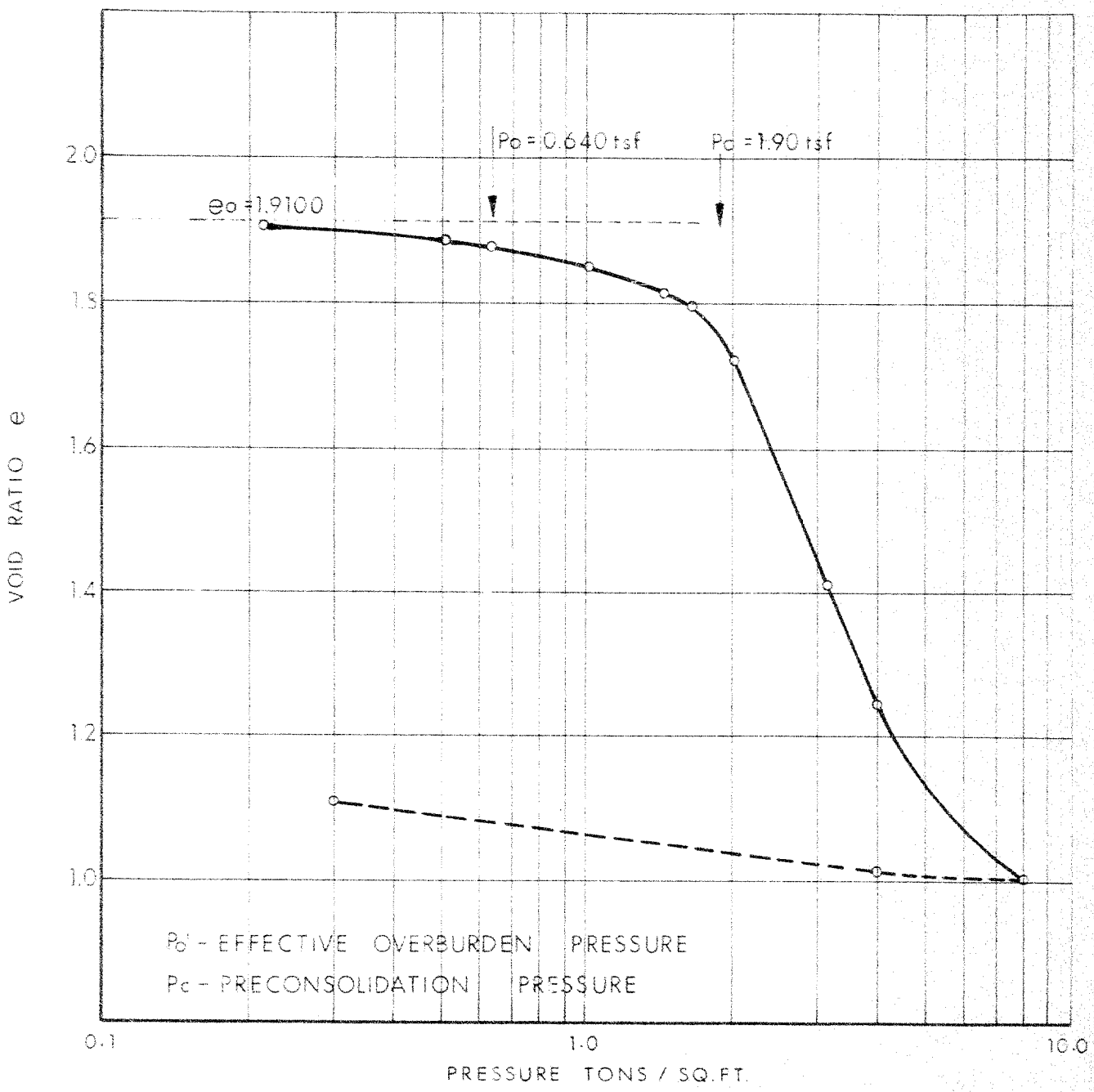


FIG. 13

VOID RATIO vs PRESSURE

W_L = 68 %
W_P = 27 %
W = 69 %
C 1.33

BORE HOLE 5
SAMPLE 9
DEPTH 40'11"
ELEV. 706.1

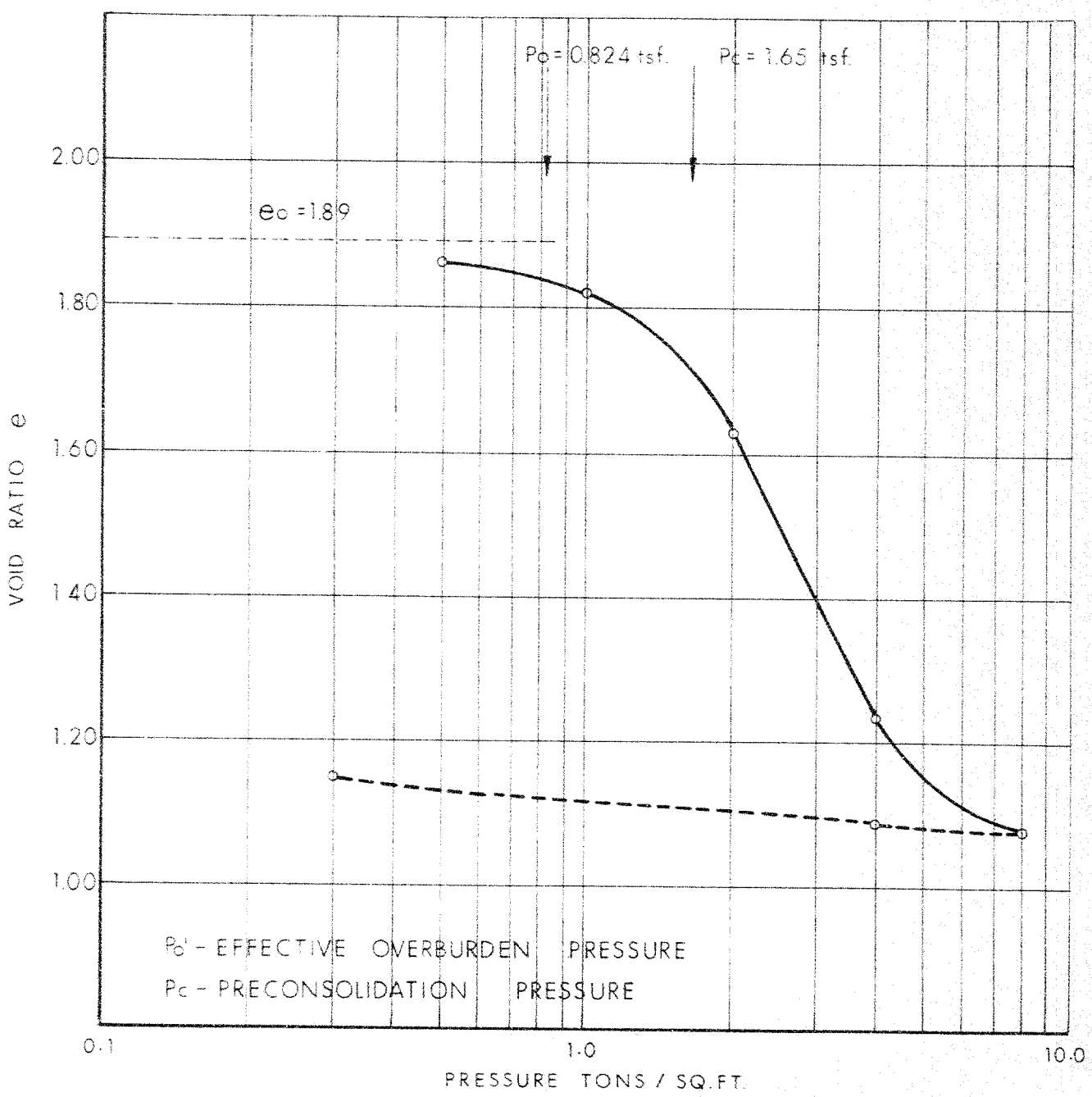


FIG. 14

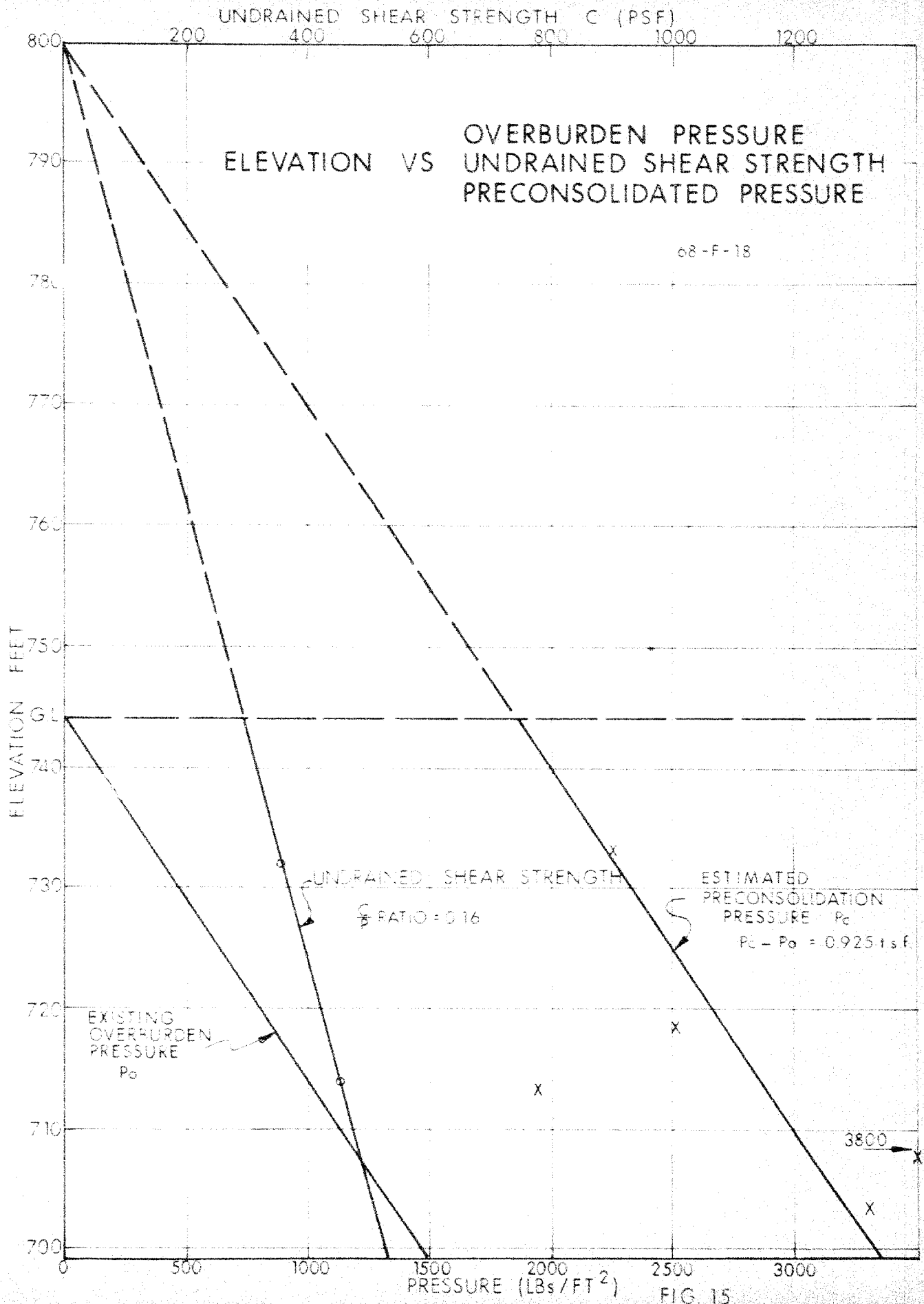
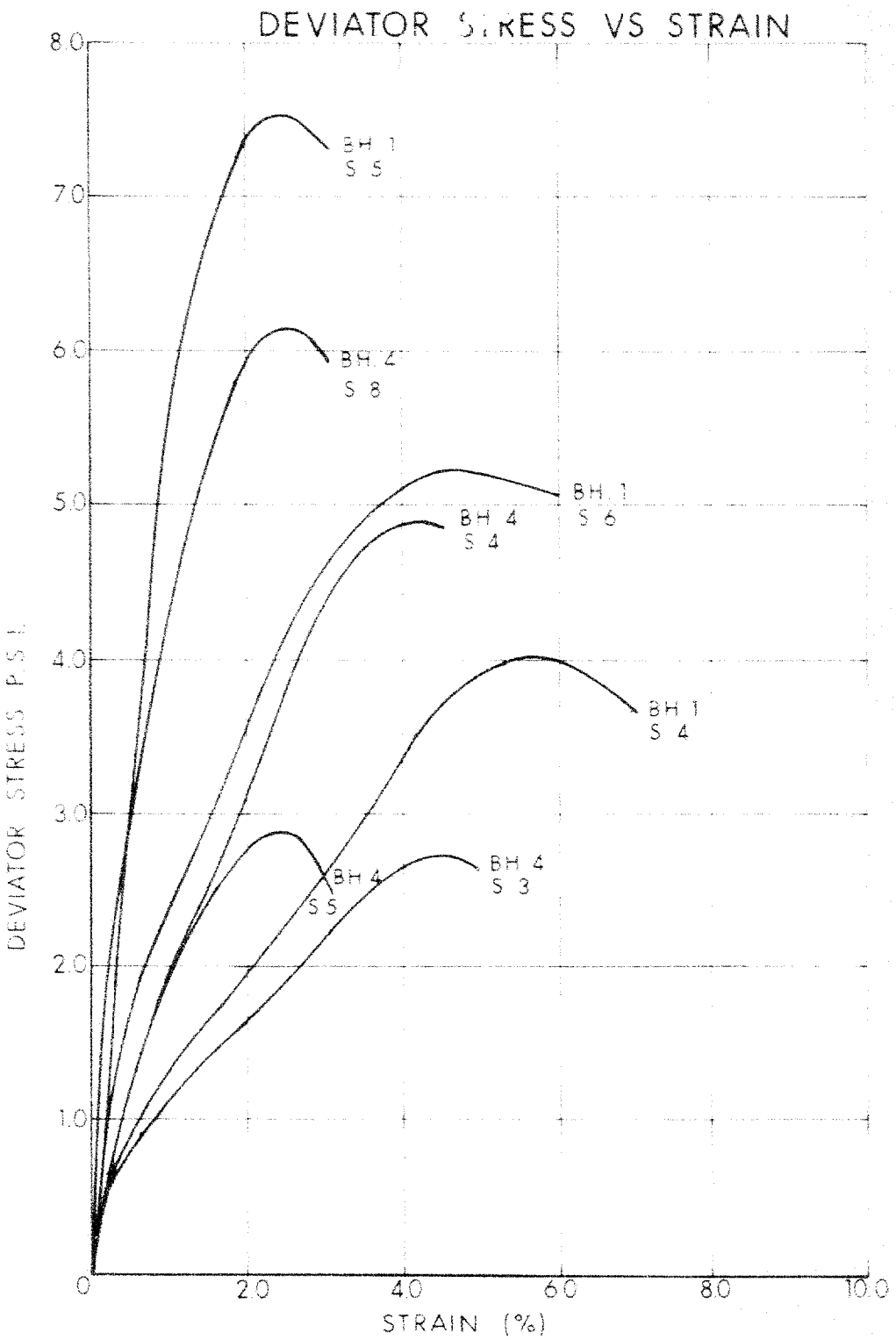

UNDRAINED SHEAR STRENGTH C (PSF)
200
400
600
800
1000
1200
800
790
780
770
760
750
G.L.
740
730
720
710
700
ELEVATION FEET
ELEVATION VS OVERBURDEN PRESSURE
UNDRAINED SHEAR STRENGTH
PRECONSOLIDATED PRESSURE
68-F-18
UNDRAINED SHEAR STRENGTH
$\frac{C}{P}$ RATIO = 0.16
ESTIMATED
PRECONSOLIDATION
PRESSURE Pc
Pc – Po = 0.925 t s f
EXISTING
OVERBURDEN
PRESSURE
Po
3800
0
500
1000
1500
2000
2500
3000
PRESSURE (LBs/FT²)

FIG. 15



TYPICAL STRESS STRAIN CURVES

FIG. 16

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 :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
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

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

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

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

68-F-18

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. G. Stermac
Principal Foundations Engr.
Materials & Testing

From: Bridge Planning Section
Northern Region

Date: February 27, 1968

Our File Ref.

In reply to

Subject:

Shadow River Bridge On Hwy. 532
W. P. 109-67; Bridge Site 44-159

Enclosed find one marked up copy of site plan No. E4476-1 indicating the probable footing locations in the vicinity of the re-located highway.

Hand augers taken by Mr. Peter Arkima at the time of the Functional Planning Field [illegible]ting indicated a considerable depth of soft material, possibly granular, over the entire length of the valley which this road crosses. Assuming then that the conditions across the entire valley are uniform fro[illegible] foundations point of view, the structure will likely be located at Sta[illegible]n 151 + 16 as indicated on the site plan. Should the foundation conditions at a location 400 ft to the west prove to [illegible] considerably more favourable then a structure location at this chainage would appear feasible. Should this condition actually exist in the field further borings should be made in the area of the stream div[illegible]sion required by the placement of the cross[illegible] in the area of Sta[illegible] 155. I have indicated three locati[illegible]s where [illegible] might make these borings in the vicinity of the stream diversion to ensure that there would be no excavation problems down to elevation 739 which would be the stream bed elevation in the stream diversion.

In order to obviate any flooding of the new road the grade is to be raised as indicated on the site plan. It would, therefore, appear that you might check the area for stability on the basis of this grade.

Food and accommodation should be readily available in the Town of Rosseau immediately to the east of the crossing.

As mentioned above the road alignment crosses a valley of approximately 2,000 ft in width at this location, the soil in which appears to be of a soft nature. Rock outcrops, however, occur at either side of th valley. It is reported that at least part of the existing bridge is founded o

[illegible] Cont'd...

piles. An examination of the structure abutments would tend to indicate a settlement of the southern portion of the structure relative to the old (and stable) northern section.

Would you kindly arrange to have the necessary foundation investigation carried out. If we can be of any assistance whatever kindly advise.

Within the next few weeks I will be issuing a further foundation request for the Magnetewan River and Highway 520 overpass at Burk's Falls, approximately 40 miles distant from this crossing.

J. B. Curtis
Regional Bridge Location Engineer

cc: Mr. A. Crowley
Program Division

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To:

Mr. A.G. Stermac,
Principal Foundation Eng.,
Room 107, Lab. Building,
Downsview, Ontario.
Att'n: Mr. K.G. Selby.

From:

Bridge Planning Section,
Northern Region.

Date:

June 14, 1968.

Our File Ref.

In reply to

Subject:

Shadow River Bridge,
Highway 532, W.P. 109-67,
B.S. 44-159.

62 F-8

Enclosed find a plan and profile indicating the revised projected alignment in the vicinity of the above crossing. The alignment has been revised in the light of the poor soils which you have reported.

Would you kindly then complete your report both on the basis of the original design and finalize it on the basis of the design as now projected as indicated on these plans. I have spoken to Mr. Crowley, the regional expeditor who is currently in North Bay, regarding your completion date of same. He suggests that you complete your report as soon as possible, however, he will discuss the matter further with you upon his return to Toronto.

If you have any questions on this matter, kindly advise.

J.B. CURTIS,
REGIONAL BRIDGE LOCATION ENGINEER.

JBC/jmc
encls.

c.c. A. Crowley.

cc: Foundations Files (Rm. 110)

Mr. J. C. McAllister,
Regional Bridge Location Engr.,
Northern Region,
NORTH BAY, Ontario.

Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

April 3, 1969

Your Memo April 1, 1969

Re: W.P. 109-67-1; Bridge Site 44-159;
Sec. Rd. #532; Shadow River Bridge
Line 'M' Revision; District #11.

Since subsoil conditions are similar at both proposed locations of the S.P.P.A., the height of fill should govern the decision.

In our report numbered 68-F-18, the heights of the fill versus the required berm lengths, are given. From the graph, the length of the berm required at both proposed pipe locations may be scaled off. Your attention is called to the fact that, at the site of the pipe, the height of the embankment is the distance between the culvert bottom and the finished grade of the highway.

A.K.B. Sterman
PRINCIPAL FOUNDATION ENGINEER

AKB/MdeP

cc: Foundations Files
Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac
Principal Foundation Eng.
Foundations Section, Downsview

From: Bridge Planning
Northern Region

Date: April 1, 1969

Our File Ref.

In reply to

Subject:

W. P. 109-67-1; Bridge Site 44-159;
Sec. Rd. #532; Shadow Ri. Bridge
Line 'M' Revision; District #11

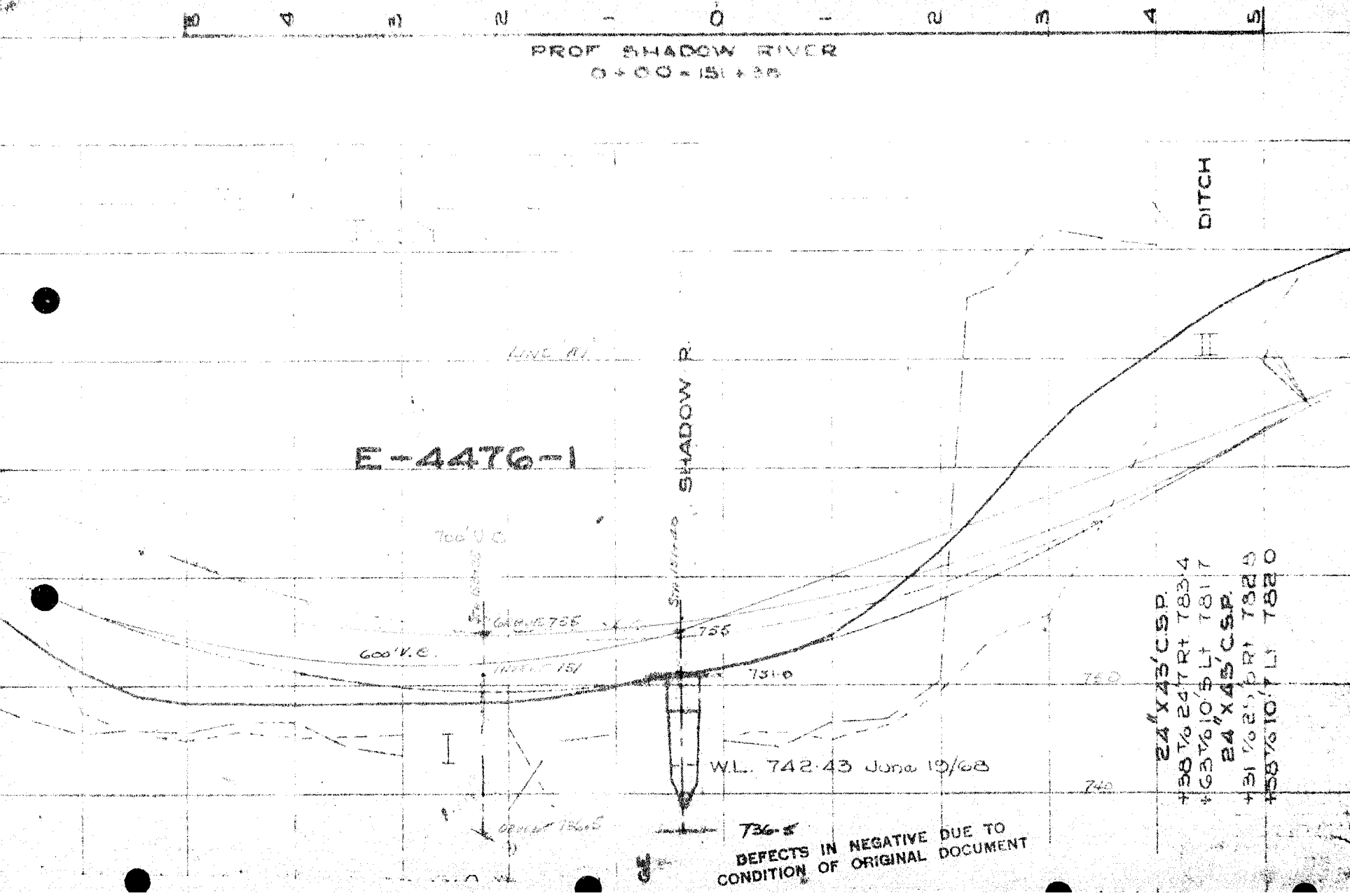
Consideration is being given to the use of a 22' x 14.7' S. P. P. A. placed either at Sta. 153 + 25 on 30° Lt skew or at Sta. 151 + 40 on 0° skew. In both cases the pipe will have an invert elev. of 751 with the grade at elev. 755 over the pipe. The alternative grades are shown on the attached profile and you have already received the projected revision line 'M'.

Would you please evaluate these two locations and their respective revised grades in the light of the foundation material and the berms required.

An early reply would be greatly appreciated.

J. C. McAllister
Regional Bridge
Location Supervisor

PROF SHADOW RIVER
0+00 - 151+35



DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: C.S. Grebski,
Bridge Office

Attention:

Date: October 8, 1969

Our File Ref.

In reply to

Subject: Shadow River Bridge
Approx. 1.4 Mi. W. of Rosseau
W.P. 109-67-1, Site No. 44-159
Sec. Rd. No. 532, District 11

68-F-18

Attached herewith we are submitting the final General Plan Drawing for the above-mentioned structure.

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Section

Timber piles are proposed 58 - 75 long Allowable load 18T/pile Forward and side slopes 2:1. Beam length 48'

No comments

APS
14/10/69

Mylar to Bridge Office 11 July 68

Design Services Branch,
1201 Wilson Avenue,
Downsview, Ontario.
M3M 1J8

November 27, 1973.

Master Soil Investigation,
104 Kenhar Drive,
Weston, Ontario.
M9L 1N4

Dear Sirs:

This letter confirms our request of November 23, 1973, for the supply of a diamond drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at Rosseau, Ontario, on or about Nov. 26, 1973.

Mobilization will be from Junction of Hwys. 516 and 11.

Our Project Number is W.O. 73-11094.

Yours truly,

ORIGINAL SIGNED BY
A. G. STERMAC

RGS/ao

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

c.c. W. W. Fry
(Attn: Mrs. M. Porter)

Foundations Files
Documents

additional work to 68-F-018

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. J. C. McAllister,
Regional Structural Supervisor,
Northern Region,
North Bay, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: December 20, 1973.

OUR FILE REF.

IN REPLY TO JAN - 7 1974

SUBJECT: Shadow River Bridge, Approx. 1.4 Mi. W. of Rosseau, Sec. Rd. No. 532, District #11, Site No. 44-159 W.P. 109-67-1 W.O. 68-11018 (73-11-094)

We have recently completed further investigations at the above site in order to determine the pile lengths for the Shadow River Bridge. The investigation consisted of sixteen cone penetration tests. A cone was driven at each end of each proposed Bent.

The bedrock profile along both sides of the bridge is shown in Drawing 68-11018B. Bedrock was encountered in eleven boreholes and a very dense stratum was encountered in Boreholes #23, 24, 26, 29 and 36. While driving the cone at Borehole 29 the rods were deflected at 58 ft. below the surface, elevation 690 ft. The cone then encountered a very dense stratum at elevation 685. This would indicate the presence of a boulder or a localized very steep slope in the bedrock.

Listed below are the elevations of the estimated refusal of the timber piles.

	South End (Left)	North End (Right)
Bent 1	Elev. 674	Elev. 667
2	674	672
3	680	680
4	680	685
5	692	690
6	694	692
7	696	694
8	696	695

Please attach this memorandum along with Drawing 68-11018B to Foundation Report W.O. 68-11018.

.....2

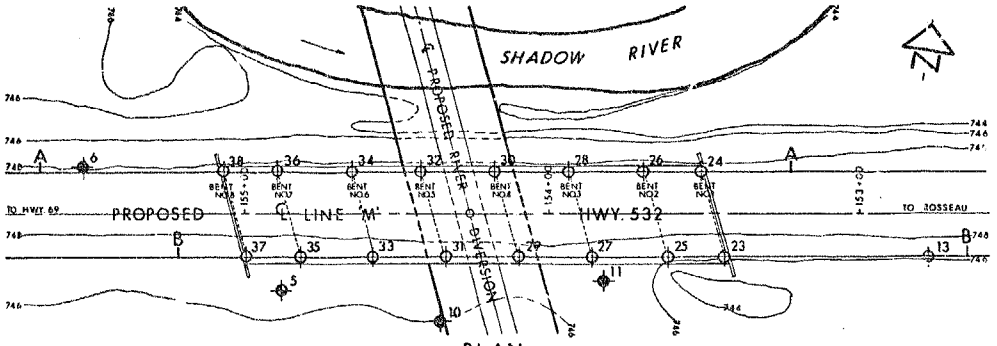
We hope that this information will meet your requirements for the bridge design. If there are any questions please contact our Office.

P. Korgemagi

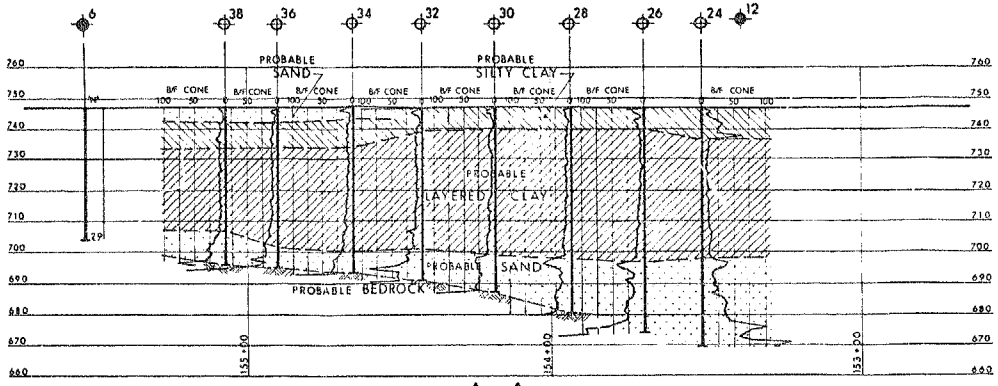
PK/ao
Attch.
c.c. E. J. Orr
B. R. Davis
A. Rutka
H. McArthur
R. S. Chapman
B. J. Giroux
J. E. Gruspier
G. A. Wrong
B. A. Singh
S. McCombie

Foundations Files
Documents

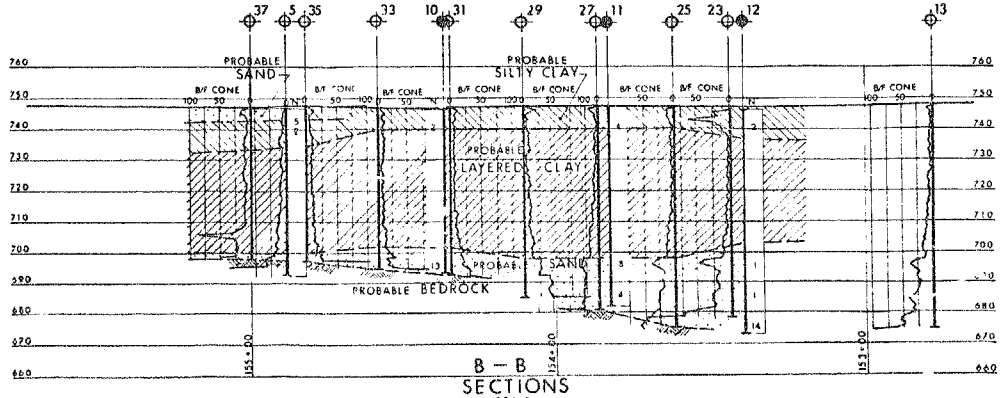
P. Korgemagi,
Project Foundations Engineer,
For: K. G. Selby,
Supervising Foundations Engineer.



PLAN



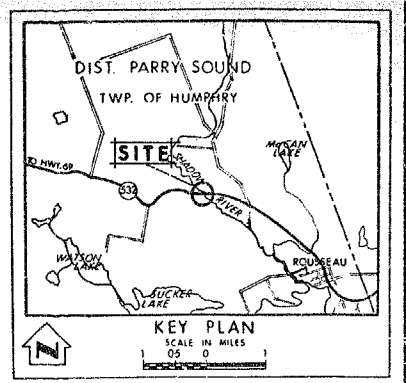
A – A



B – B

SECTIONS

SCALE
20 10 0 20 FT.



KEY PLAN
SCALE IN MILES
1 0.5 0 1

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Level Established at time of Field Investigation NOT

NOTE:
BORE HOLE NO'S 5, 6, 10, 11, 12, 13
SEE DRAWING NO. 68-F-18A

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

NO.	ELEVATION	STATION	OFFSET
23	747·7	153+43	14'LT.
24	747·6	153+50	14'RT.
25	747·6	153+61	14'LT.
26	747·4	153+69	14'RT.
27	747·7	153+86	14'LT.
28	747·6	153+93	14'RT.
29	747·9	154+09	14'LT.
30	747·7	154+17	14'RT.
31	747·7	154+33	14'LT.
32	747·7	154+41	14'RT.
33	747·6	154+57	14'LT.
34	747·8	154+64	14'RT.
35	747·9	154+81	14'LT.
36	747·9	154+88	14'RT.
37	747·8	154+99	14'LT.
38	747·7	155+07	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

REVISIONS

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

SHADOW RIVER BRIDGE

HIGHWAY NO. 532 LINE 'M' DIST. NO. 11
DIST. PARRY SOUND
TWP. HUMPHRY LOT 78 CON. A

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD P. K.	CHECKED	W.P. NO. 109-67-1	DRAWING NO. 68-11018 B
DRAWN O. J.	CHECKED	W.O. NO. 73-11094	
DATE 19 DEC. 1972		SITE NO.	BRIDGE DRAWING NO. D-6529-2
APPROVED		CONT. NO.	

1 Sepia copy - Hughes (73-11-094)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. J. C. McAllister,
Regional Structural Supervisor,
Northern Region,
North Bay, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: December 20, 1973.

OUR FILE REF.

IN REPLY TO JAN 7 1974

SUBJECT: Shadow River Bridge, Approx. 1.4 Mi. W. of Rosseau, Sec. Rd. No. 532, District #11, Site No. 44-159 W.P. 109-67-1 W.O. 68-11018 (73-11-094)

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.....2

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P. Korgemagi

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G. A. Wrong
B. A. Singh
S. McCombie

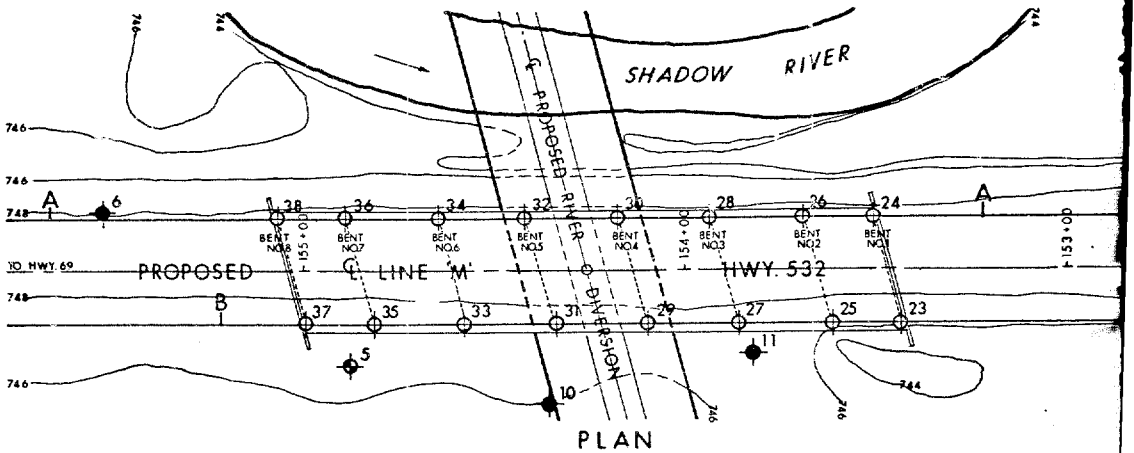
Foundations Files
Documents

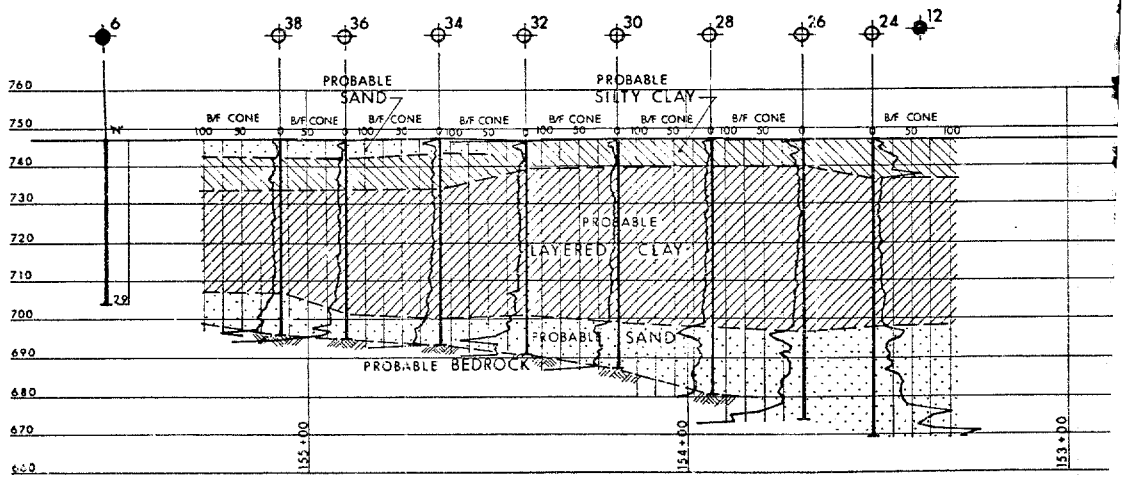
For: P. Korgemagi,
Project Foundations Engineer,
K. G. Selby,
Supervising Foundations Engineer.

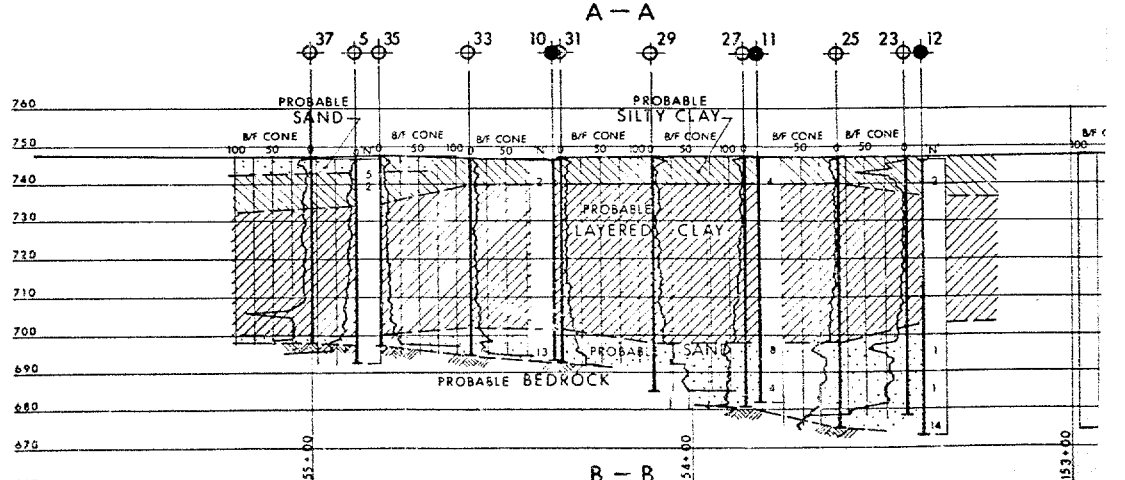
Oversized drawings:

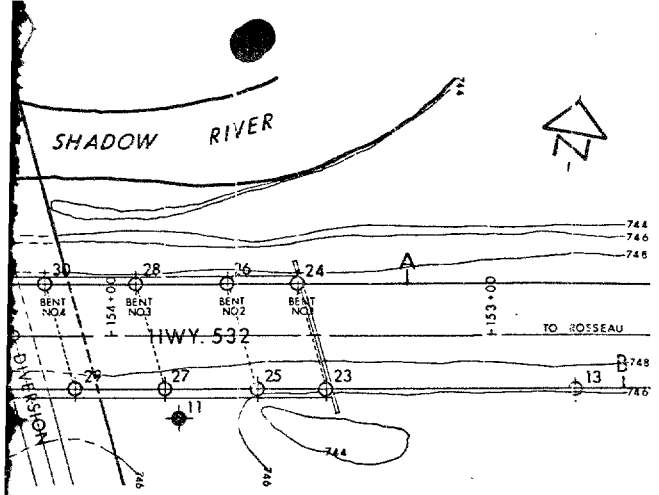
Record of Borehole No 5
" " " " 6
" " " 10
" " " " 11
" " " " 12
" " " " 13

Bore Hole Locations & Soil Strata M & T. Drawing No. 68-F-18A

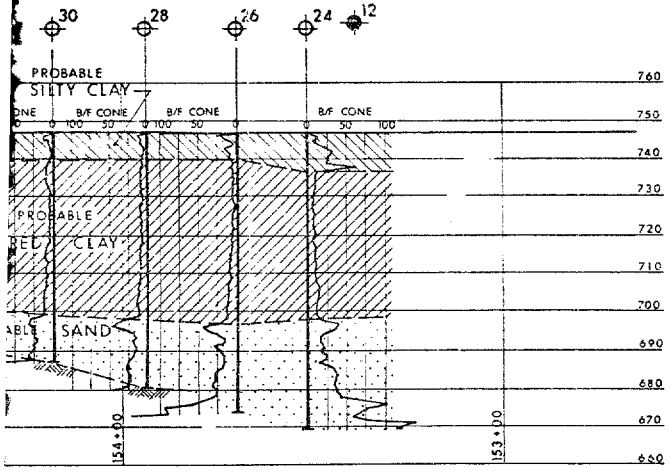

SHADOW RIVER
PROPOSED ALIGNMENT
PROPOSED
℄ LINE 'M'
HWY. 532
TO HWY. 69
BENT NO.8
BENT NO.7
BENT NO.6
BENT NO.5
BENT NO.4
BENT NO.3
BENT NO.2
BENT NO.1
155+00
154+00
153+00
A
B
PLAN


PROBABLE SAND
PROBABLE SILTY CLAY
B/F CONE
PROBABLE LAYERED CLAY
PROBABLE SAND
PROBABLE BEDROCK
155+00
154+00
153+00
A — A

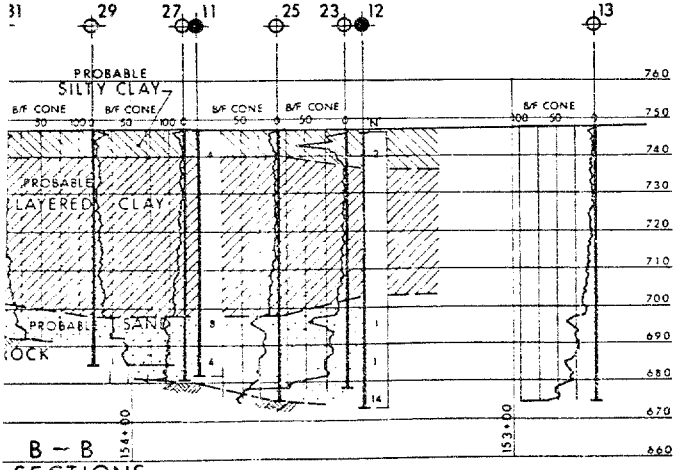

PROBABLE SAND
PROBABLE SILTY CLAY
B/F CONE
PROBABLE LAYERED CLAY
PROBABLE SAND
PROBABLE BEDROCK
155+00
154+00
153+00
B — B
SECTIONS
SCALE
20 10 0 20 FT.



PLAN



A — A

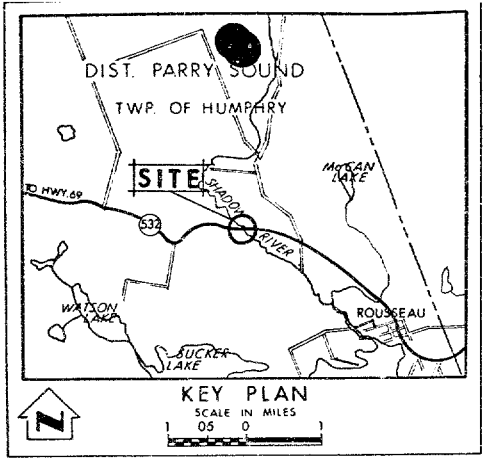


B — B

SECTIONS

SCALE

10 0 20 FT



KEY PLAN

SCALE IN MILES

1 0.5 0 1

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels NOT established at time of field investigation.

NO.	ELEVATION	STATION	OFFSET
23	747·7	153+43	14'LT.
24	747·6	153+50	14'RT.
25	747·6	153+61	14'LT.
26	747·4	153+69	14'RT.
27	747·7	153+86	14'LT.
28	747·6	153+93	14'RT.
29	747·9	154+09	14'LT.
30	747·7	154+17	14'RT.
31	747·7	154+33	14'LT.
32	747·7	154+41	14'RT.
33	747·6	154+57	14'LT.
34	747·8	154+64	14'RT.
35	747·9	154+81	14'LT.
36	747·9	154+88	14'RT.
37	747·8	154+99	14'LT.
38	747·7	155+07	14'RT.

NOTE:

BORE HOLE NO'S 5, 6, 10, 11, 12, 13
SEE DRAWING NO. 68-F-18A

NOTE:

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

— 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
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

SHADOW RIVER BRIDGE

HIGHWAY NO 532 LINE 'M' DIST. NO. 11
DIST. PARRY SOUND
TWP HUMPHRY LOT 78 CON A

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D P. K.	CHECKED JF	W.P. NO 109-67-1	DRAWING NO 68-11018 B
DRAWN O. J.	CHECKED	W.O. NO 73-11094	
DATE 19 DEC 1972		SITE NO	BRIDGE DRAWING NO D-6529-2
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT NO	

Bore copy - Hydro (78-11-094)

REQUESTS FOR
SERVICES OF THE FOUNDATIONS OFFICE

W.O. 73-11094

W.P. Nº 109-67-1 CONT. Nº _____ SITE Nº _____

LOCATION : ROSSEAU

SERVICES REQUESTED : ADDITIONAL FIELD INVESTIGATION (68-F-18)

REQUESTED BY : DECIDED BY THIS OFFICE AFTER DISCUSSION WITH A RADKOWSKI

DATE OF REQUEST : Nov. 9/73

DUE DATE JAN 9/74

Oversized Drawing

General Plan

Drawing No. D-6529-1

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31 E-20

DIST. 11 REGION NORTHERN

W.P. No. 109-67-4

CONT. No. 74-174

W. O. No. 68-11018

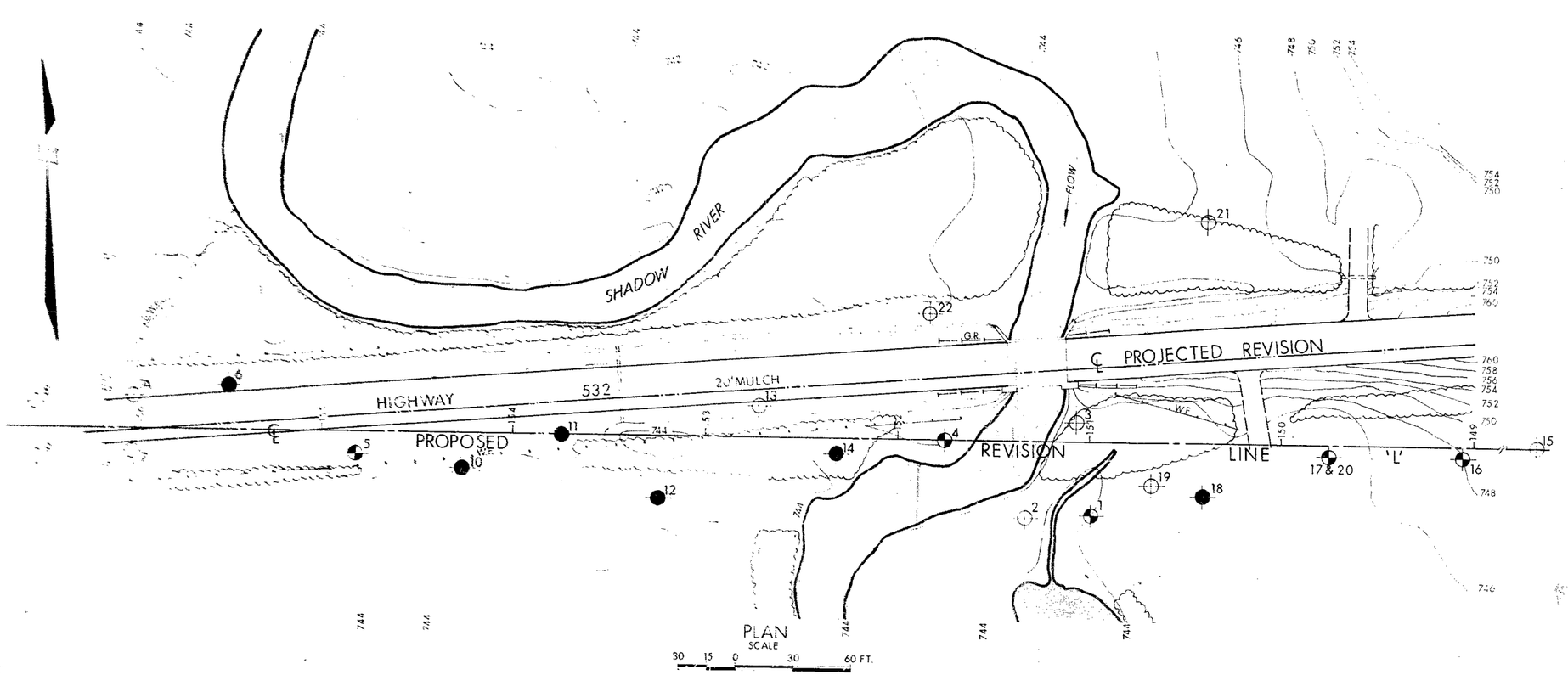
STR. SITE No. 44-159

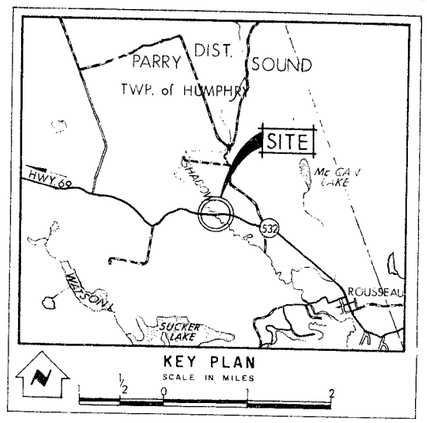
HWY. No.

LOCATION HWY. 532 : SHADOW RIVER

C.E.-SIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 8

REMARKS: TO BE ADDED TO ALREADY EXISTING MICROFICHE DOCUMENTS TO BE UNFOLDED BEFORE MICROFILMED.





LEGEND

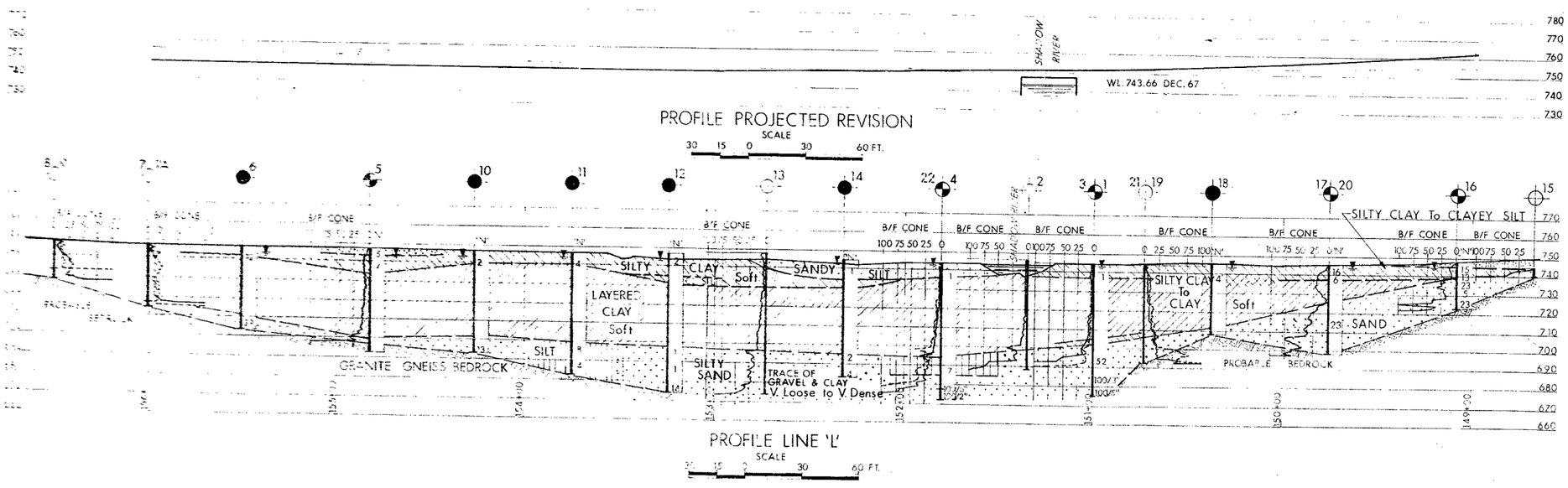
- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. MAY. 1968.

NO.	ELEVATION	STATION	OFFSET
1	744.3	151+00	38' LT.
2	744.7	151+34	40' LT.
3	745.6	151+06	10' RT.
4	744.0	151+75	5' RT.
5	747.0	154+82	12' LT.
6	747.7	155+50	22' RT.
7	747.8	156+00	12' LT.
7A	748.2	156+00	16' RT.
8	749.3	156+50	13' RT.
9	748.8	156+50	15' LT.
10	746.5	154+25	15' LT.
11	747.0	153+75	ON ℄
12	746.3	153+25	34' LT.
13	747.8	152+75	12' RT.
14	743.6	152+32	10' LT.
15	744.2	148+40	ON ℄
16	748.0	149+05	5' LT.
17	745.7	149+75	6' LT.
18	745.0	150+40	27' LT.
19	744.8	150+67	22' LT.
20	745.7	149+75	8' LT.
21	744.3	150+45	115' RT.
22	743.0	151+86	63' RT.

— NOTE —

The boundaries between soil strata have been Bore Hole locations. Between Bore Holes the ' from geological evidence and may be subje

d only at re assumed able error.



REVISIONS			
DATE	BY	DESCRIPTION	

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

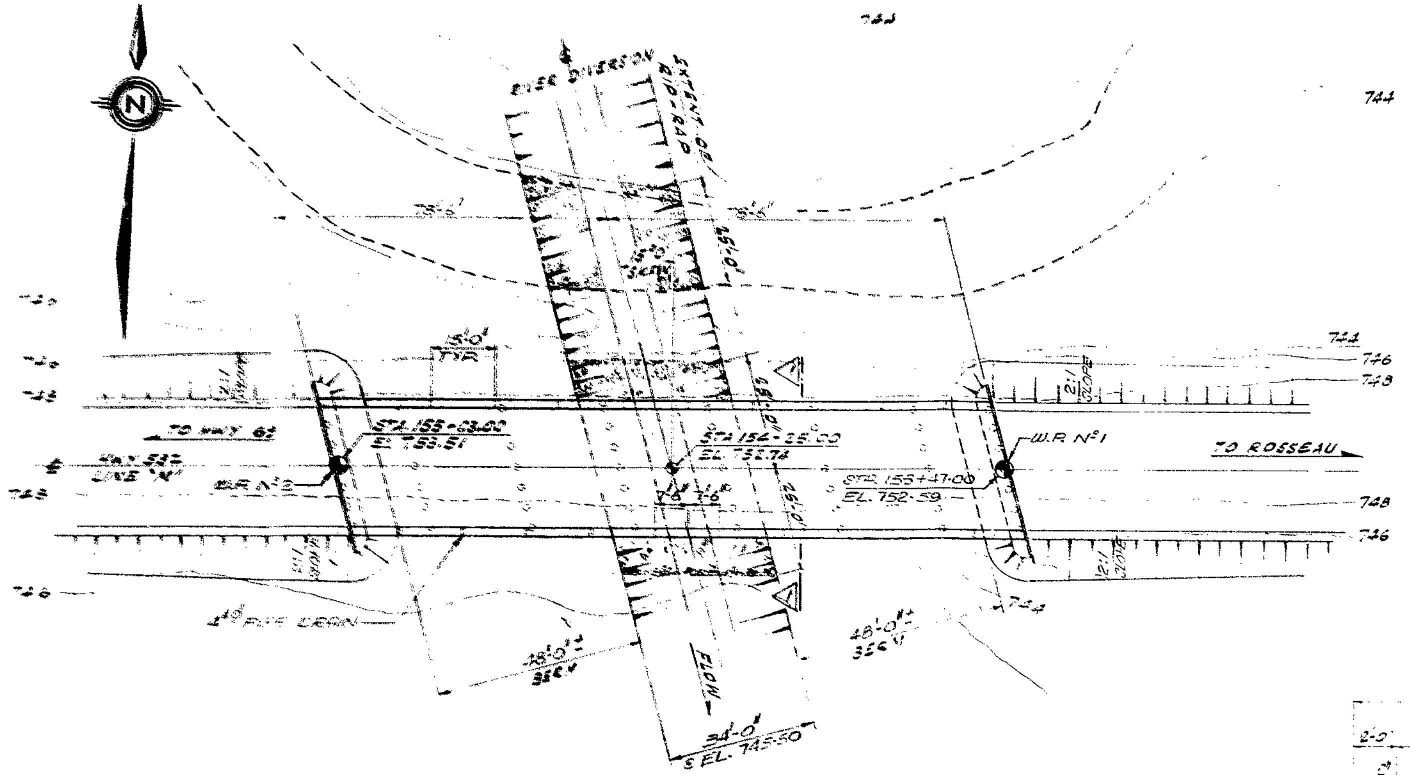
SHADOW RIVER

KING'S HIGHWAY NO. 532 LINE 'L' & PROJ. REV. DIST. NO. 11
DIST. PARRY SOUND
TWP. HUMPHRY LOT 78 CON. A

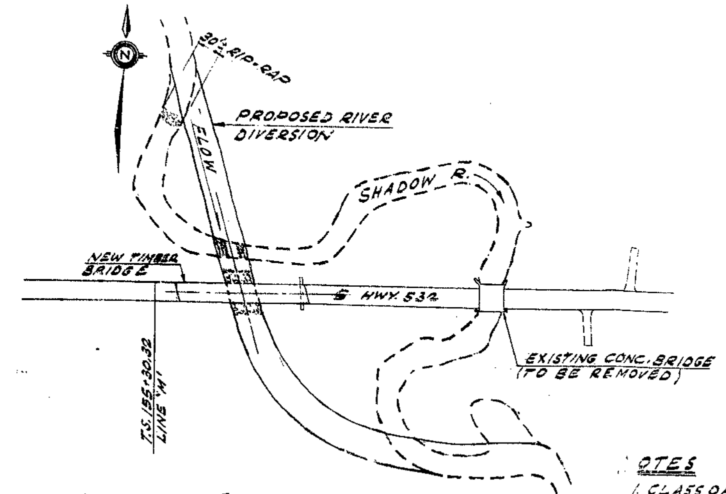
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D A.S.	CHECKED D.L.	W.P. NO. 109-67-1	M.B.T. DRAWING NO. 68-F-18 A
DRAWN D.M.	CHECKED	JOB NO. 68-F-18	
DATE JUNE 27/68		SITE NO	BRIDGE DRAWING NO.
APPROVED (PRINCIPAL FOUNDATION ENGINEER)		CONT. NO	

REF. NO. E-4476-1

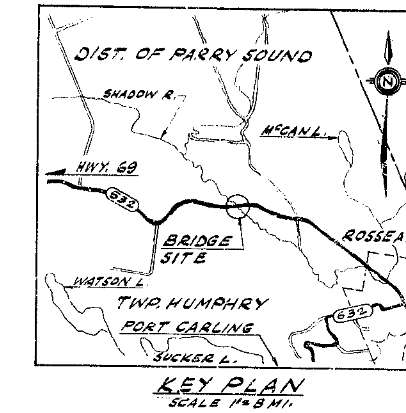


PLAN



SITE PLAN

SCALE: 1"=100'

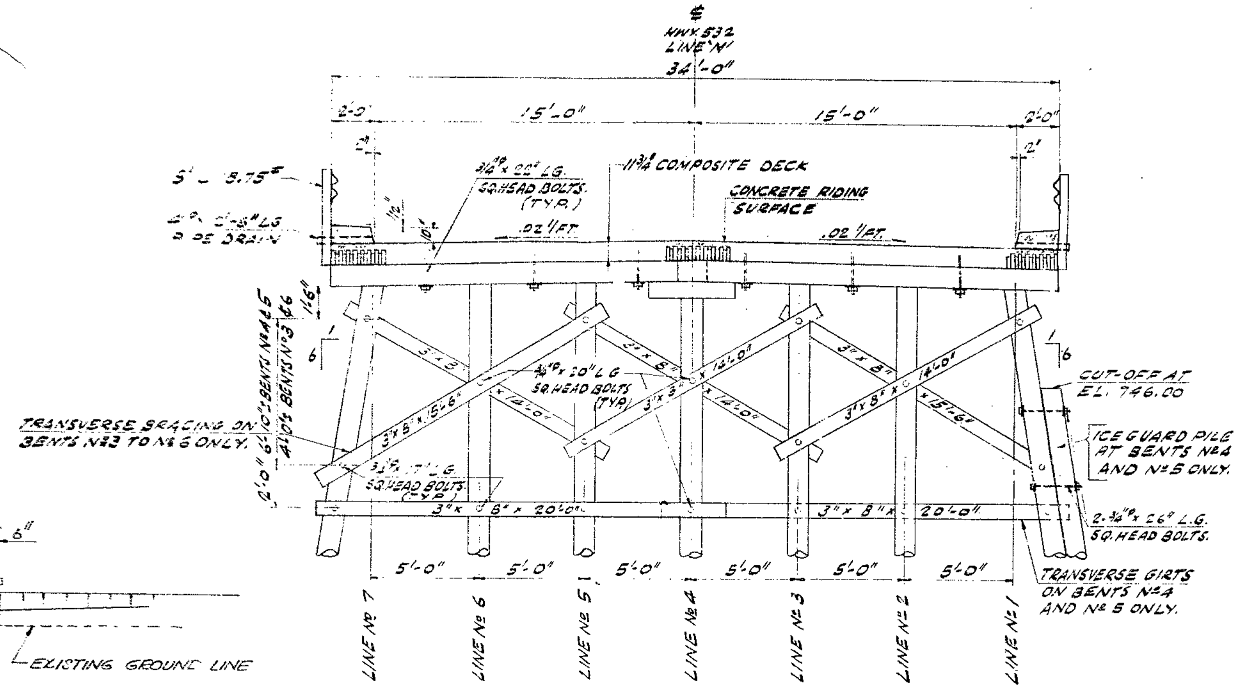


KEY PLAN

SCALE 1"=8 MI.

NOTES

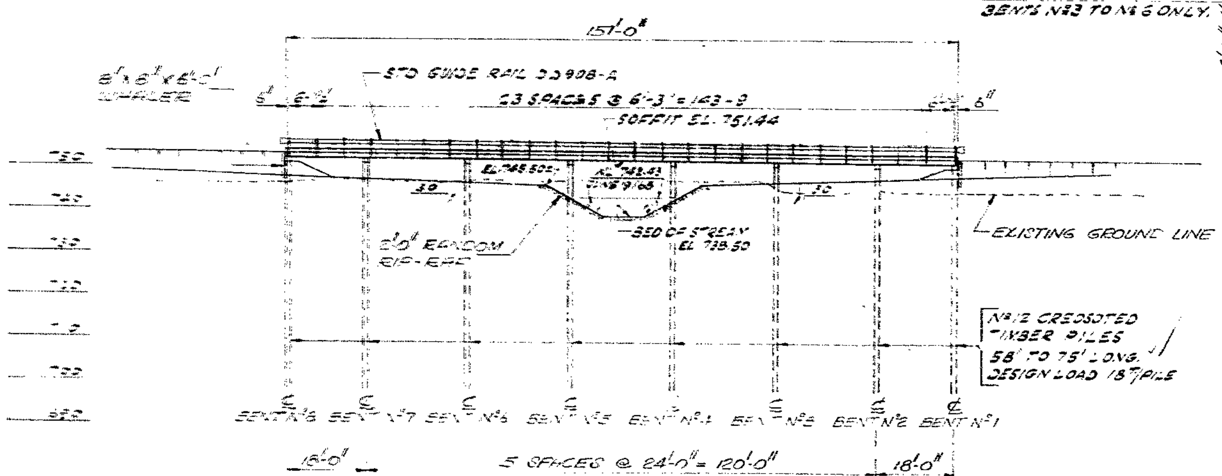
1. CLASS OF CONCRETE-3000 P.S.I. AT 28 DAYS.
2. CLEAR COVER ON REINFORCING STEEL-2" OR AS NOTED.
3. APPROVED ADMIXTURES SUPPLIED BY THE CONTRACTOR WILL BE ADDED TO ALL CONCRETE AS SPECIFIED BY THE ENGINEER.
4. ALL HOLES FOR DRIFT PINS SHALL BE DRILLED IN THE FIELD AND SHALL BE 3/4"φ. ALL HOLES FOR BOLTS SHALL BE DRILLED IN THE FIELD AND SHALL BE 1/16" LARGER THAN THE BOLT DIAMETER.
5. BEFORE CUTTING OFF PILES, THE CUT-OFF ELEVATIONS WILL BE CHECKED BY THE ENGINEER IN THE FIELD TO ENSURE A TRUE GRADE ACROSS THE STRUCTURE.



SCALE: 1/4"=1'-0"

LIST OF DRAWINGS

D-6529-1 GENERAL PLAN
" " -2 BORE HOLE LOCATIONS & SOIL STRATA
" " -3 DECK & DETAILS
" " -4 BILLS OF MATERIALS
" " -5 STANDARD DETAILS

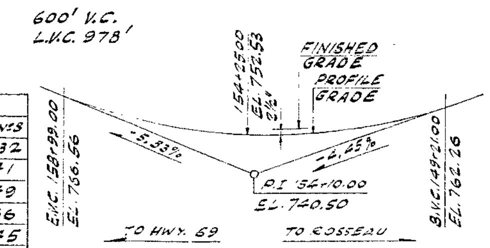


ELEVATION

SCALE: 1"=20'

B.M. ELEVATION 755.56
GEODETIC DATUM: CUT X ON ROCK 165' RT. AT STA. 149+68.00

TABLE OF PILE CUT-OFF ELEVATIONS								
	BENT Nº1	BENT Nº2	BENT Nº3	BENT Nº4	BENT Nº5	BENT Nº6	BENT Nº7	BENT Nº8
LINE Nº1	750.34	750.33	750.37	750.46	750.61	750.82	751.09	751.32
LINE Nº2	750.44	750.43	750.46	750.55	750.70	750.91	751.17	751.41
LINE Nº3	750.55	750.53	750.56	750.65	750.79	750.99	751.25	751.49
LINE Nº4	749.94	749.90	749.95	750.03	750.17	750.37	750.63	750.86
LINE Nº5	750.55	750.53	750.55	750.63	750.77	750.97	751.22	751.45
LINE Nº6	750.45	750.43	750.45	750.53	750.66	750.86	751.11	751.33
LINE Nº7	750.36	750.33	750.35	750.42	750.55	750.74	750.99	751.21



PROFILE @ ℄ HWY. 532 LINE 'M'

N.T.S.

FOR REDUCED PLAN
USE SCALE BELOW
3 INCHES ON ORIGINAL PLAN

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

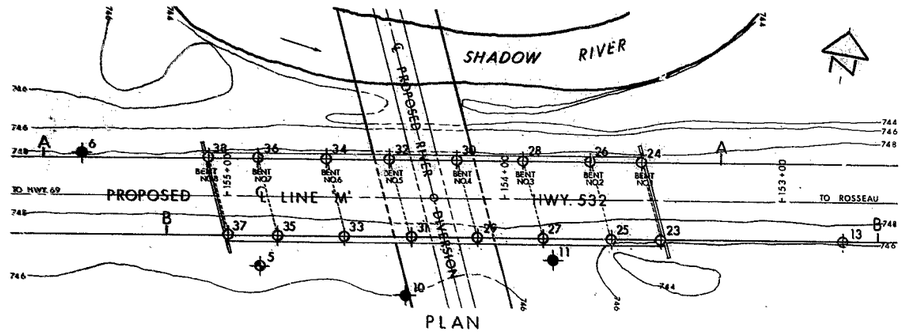
68? F-18

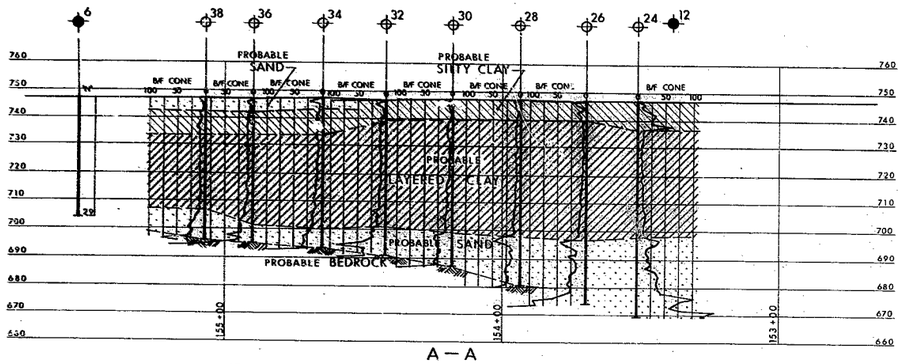
SHADOW RIVER BRIDGE
APPROX. 1.4 MI. W. OF ROSSEAU

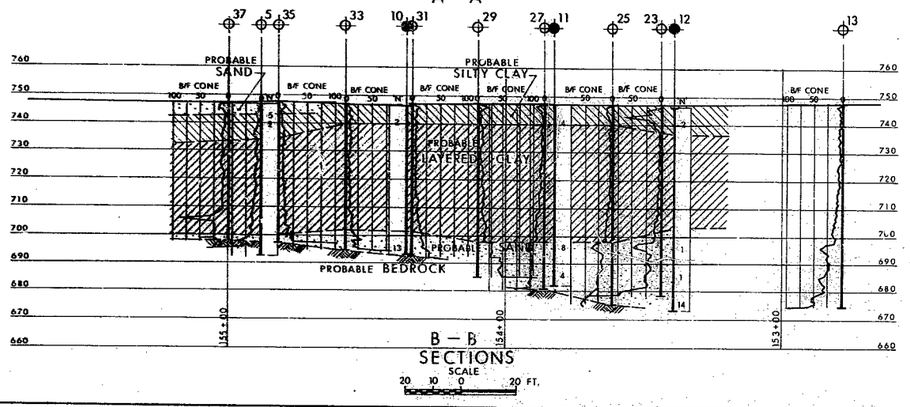
KING'S HIGHWAY No. SEC. RD. No. 532 DIST. No. 11
DIST. OF PARRY SOUND
TWP. HUMPHREY LOT 78 CON. A

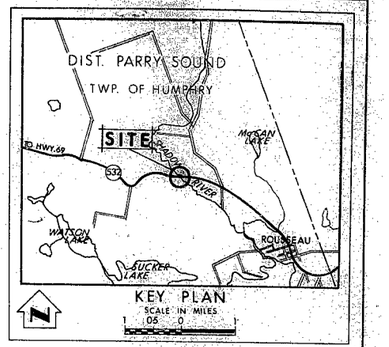
GENERAL PLAN

APPROVED	BRIDGE ENGINEER			SITE No. 44-159	W.P. No. 109-67-1
DESIGN	V.F.B.	CHECK	[illegible]	CONTRACT Nos.	
DRAWING	A.V.	CHECK	V.F.B.	DRAWING No.	D-6529-1
DATE	SEPT/69	LOADING	HS 20-44		









LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. NOT

NOTE:
BORE HOLE NOs 5, 6, 10, 11, 12, 13
SEE DRAWING NO. 68-F-18A

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

NO.	ELEVATION	STATION	OFFSET
23	747·7	153+43	14'LT.
24	747·6	153+50	14'RT.
25	747·6	153+61	14'LT.
26	747·4	153+69	14'RT.
27	747·7	153+86	14'LT.
28	747·6	153+93	14'RT.
29	747·9	154+09	14'LT.
30	747·7	154+17	14'RT.
31	747·7	154+33	14'LT.
32	747·7	154+41	14'RT.
33	747·6	154+57	14'LT.
34	747·8	154+64	14'RT.
35	747·9	154+81	14'LT.
36	747·9	154+88	14'RT.
37	747·8	154+99	14'LT.
38	747·7	155+07	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.

REVISIONS		
DATE	BY	DESCRIPTION

31E-20
GLOCRES No.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

SHADOW RIVER BRIDGE

HIGHWAY NO. 532 LINE 'M' DIST. NO. 11
DIST. PARRY SOUND
TWP. HUMPHRY LOT 78 CON. A

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD P. K.	CHECKED R	W.P. NO. 109-67-1	DRAWING NO. 68-1018 B
DRAWN O. L. J.	CHECKED	W.O. NO. 73-11094	
DATE 19 DEC 1972		SITE NO.	BRIDGE DRAWING NO. D-6529-2
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

SMD-TRACING 300-8-70

Additional Info on Dwg 68-1018A. 1 Extra copy – Mylar

OFFICE REPORT ON SOIL EXPLORATION

GEOCRES No.

DEPARTMENT OF HIGHWAYS ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 154 + 82 12' Lt. of ℄ ORIGINATED BY AMS

W P 109-67-1 BORING DATE May 21, 1968 COMPILED BY WB

DATUM Geodetic BOREHOLE TYPE NX Casing & Cone Test CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
747.0	Ground Level					
0.0	Fine sand, some clay.					
743.0	Loose		1	SS	5	
4.0	Silty clay.		2	SS	2	740
	Soft.		3	TW	PM	
734.0						
13.0			4	TW	PM	730
	Grey and brown		5	TW	PM	
	layered clay.		6	TW	PM	720
	Soft.		7	TW	PM	
			8	TW	PM	710
			9	TW	PM	
699.5						
697.5	Sand					
49.5	Granite gneiss		10	AXT RC	Rec. 100%	
692.5	Bedrock					
54.5	End of Borehole					690

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F + Field Vane ○ Unconfined Comp. × Lab. Vane ● Triaxial 500 1000 1500 2000 2500

+11.0 +1.4 +5.2 +5.0 +7.5 +4.7 120/6"

LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_P WATER CONTENT ——— w

w_P w w_L

WATER CONTENT % 25 50 75

BULK DENSITY γ P.C.F.	REMARKS
	▽ 744.3
105	
95	
92	
100.5	
99	
97	
98	
99	

OFFICE REPORT ON SOIL EXPLORATION

GEOCRES No. 31E-20

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 69-F-38 LOCATION Sta. 155 + 50 22' Rt. of ℄ ORIGINATED BY AMS

W P 109-67-1 BORING DATE May 23, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE NX Casing CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F + Field Vane o Unconfined Comp x Lab Vane • Triaxial 500 1000 1500 2000 2500	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % 25 50 75	BULK DENSITY P C F	REMARKS
717.7	Ground Level									Gr.Sa.Si.Cl
0.0	Mottled silty clay (Fill)									±714.7
714.7 6.0			1	SS	12	740				
	Grey and brown layered clay. Soft.		2	TW	PM		+4.5		112	
			3	TW	PM		x +4.4		93	
			4	TW	PM	730	• +4.0		95 95	
			5	TW	PM	720	+4.7		99	
711.2										
36.5	Sand, some silt, traces of gravel and clay. Compact		6	SS	29	710				2 82 11 5
703.7										
44.0	Probable Bedrock End of Borehole									

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 68-F-18 LOCATION Sta. 15+ 25 15' lt. of ℄ ORIGINATED BY AMS

W P 102-67-1 BORING DATE May 23 & 24, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE NX Casing CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (+ Field Vane, o Unconfined Comp, x Lab Vane, ● Triaxial) 500 1000 1500 2000 2500	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 25 50 75	BULK DENSITY γ P.C.F.	REMARKS
746.5	Ground Level									
0.0	Silty clay.									
739.5	Soft.		1	SS	2	740				▼ 743.5
7.0			2	TW	PH		o + 5.2	o	110	
			3	TW	PH	730	o + 7.2	o	94	
	Grey and brown		4	TW	PH		+ 2.8		91	
	layered clay.					720				
			5	TW	PH		● + 8.6	o	97	
	Soft.					710			85	
701.5			6A	SS	-		+ 6.0	o		
45.0	Silty sand, traces of gravel and clay.					700				
693.2	Compact.		7	SS	13			o		5 62 28 5
53.3	Probable Bedrock End of borehole									

OFFICE REPORT ON SOIL EXPLORATION

GEOCRES No. 31C-30

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 68-F-18 | LOCATION Sta. 153 + 75 on ℄ | ORIGINATED BY AMS
W P 109-67-1 | BORING DATE May 23 & 24, 1968 | COMPILED BY AMS
DATUM Geodetic | BOREHOLE TYPE NX Casing - Washbore | CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT; SHEAR STRENGTH P.S.F + Field Vane o Unconfined Comp x Lab Vane (500 1000 1500 2000 2500)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (WATER CONTENT % 25 50 75)	UNIT DENSITY γ PCF	REMARKS
747.0	Ground Level									Gr.Sa.Si.Cl
0.0	Silty clay. Soft		1	SS	4	740				▼ 743.8
740.0 7.0			2	TW	PM		o +9.0	o	93	
	Grey and brown layered clay.		3	TW	PM	730	x + 4.8	o		
	Soft.		4	TW	PM	720	+7.3	o		
			5	TW	PM	710	o +3.5	o	97.3	
699.0						700				
48.0	Silt, some sand and some clay Loose		6	SS	8			o		1 14 72 13
			7	SS	4	690				
682.0 65.0	Probable Bedrock End of Borehole					680				

66-434A

312-20
GEOCRES No.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 68-F-18 | LOCATION Sta. 153 + 25 34' Lt. of ℄ | ORIGINATED BY AMS
W.P 109-67-1 | BORING DATE May 24 & 27, 1968 | COMPILED BY AMS
DATUM Geodetic | BOREHOLE TYPE NX Casing - Washbore | CHECKED BY [illegible]

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. + Field Vane o Uncon. Comp. ⊕ Triaxial (500 1000 1500 2000 2500)	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT % (25 50 75)	BULK DENSITY γ P.C.F.	REMARKS
746.3	Ground Level									
0.0	Silty clay									▼ 743.3
	Soft		1	SS	2	740				
736.3										
10.0	Clayey silt.		2B	SS	-		+ 7.3			
731.3						730				
15.0	Grey and brown layered clay.		3	TW	PM		o + 5.5		97	
						720				
			4	TW	PM		o + 4.7		92.1	
	Soft.					710				
			5	TW	PM		o + 6.2		95 98	
698.3						700				
48.0	Fine sand.		6	SS	1					
	Very loose to compact					690		o		
			7	SS	1					
						680				
673.7			8	SS	1			o		
72.6	Probable Bedrock End of Borehole									

31C-30

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 13

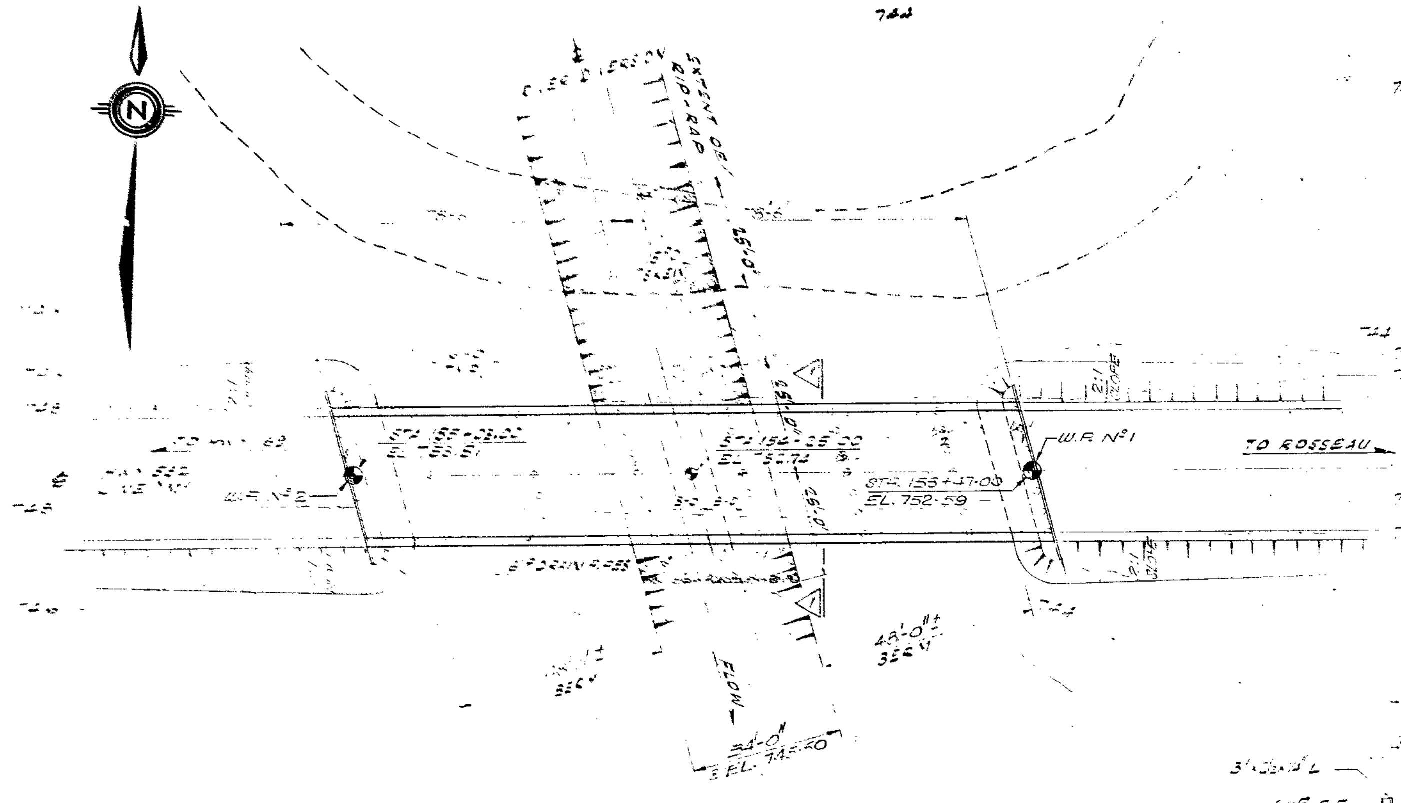
FOUNDATION SECTION

JOB 68-F-16 LOCATION Sta. 152 + 75 12' Rt. of ℄ ORIGINATED BY AMS

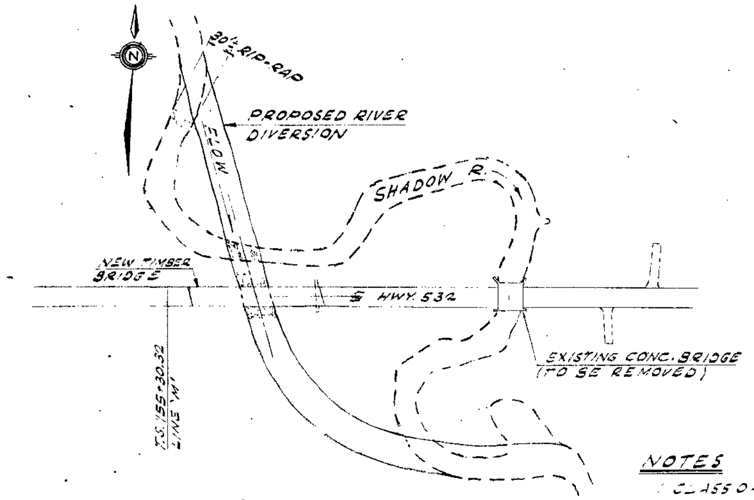
W P 109-67-1 BORING DATE May 24, 1968 COMPILED BY AMS

DATUM Geodetic BOREHOLE TYPE Cone only CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_P WATER CONTENT ——— w w_P w w_L WATER CONTENT %	BULK DENSITY γ P.C.F	REMARKS
747.8	Ground Level									
0.0						740				
						730				
						720				
						710				
						700				
						690				
						680				
674.3							100/6"			
73.5	End of Cone Test					670				

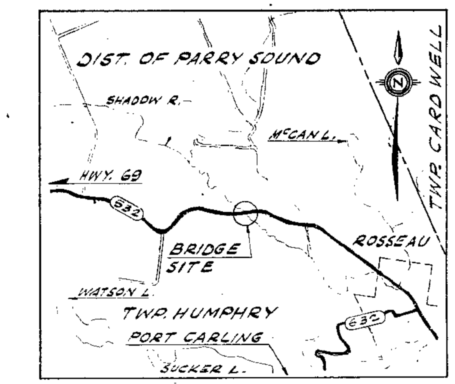


PLAN



SITE PLAN

SCALE: 1"=100'

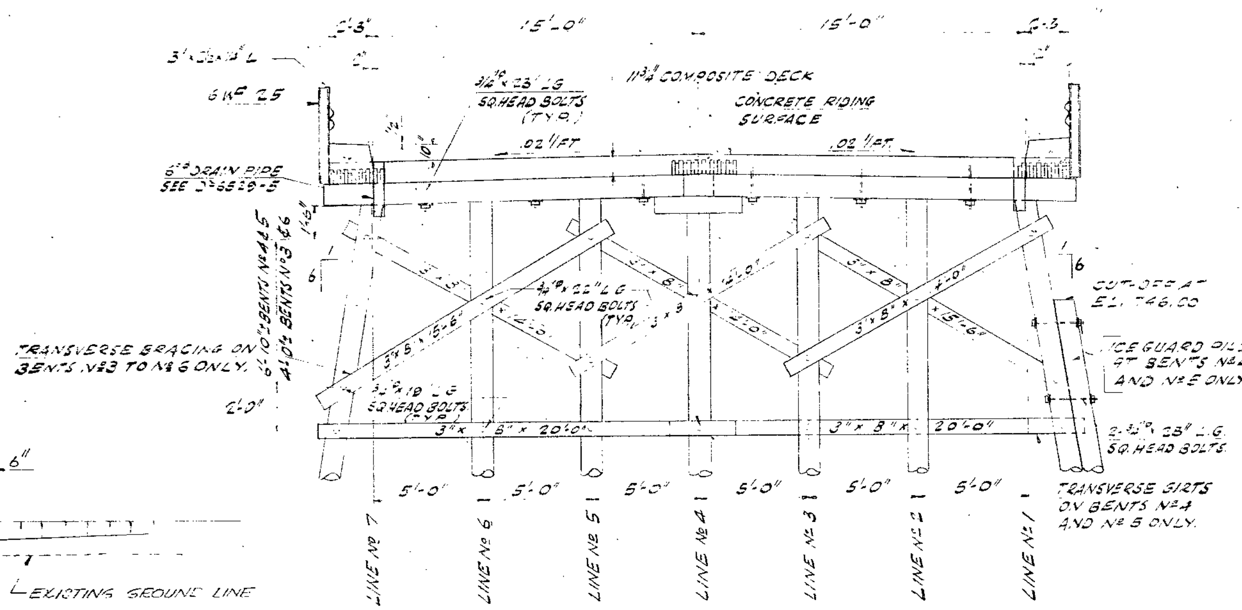


KEY PLAN

SCALE 1"=8 MI.

NOTES

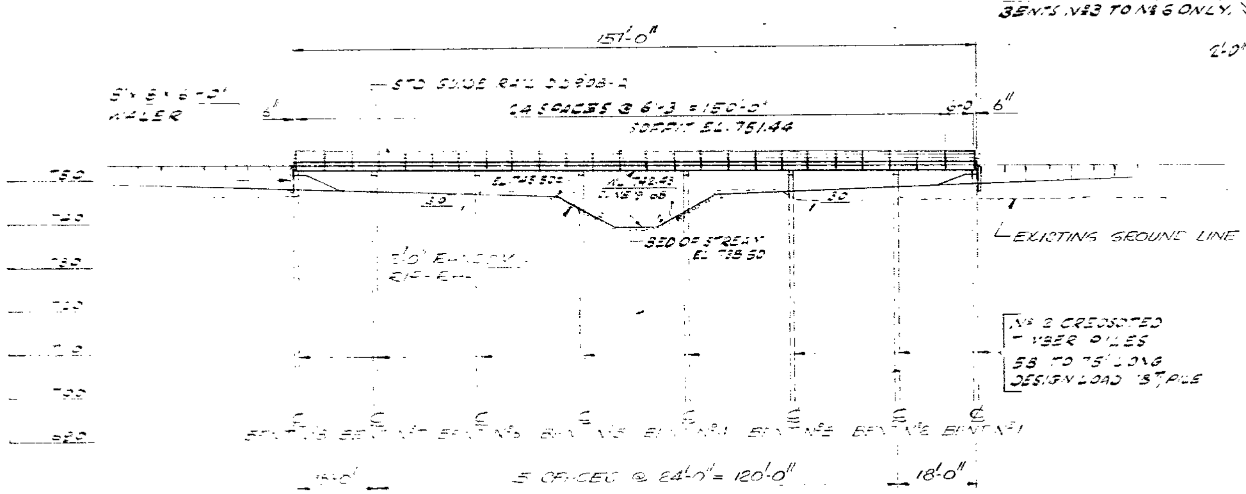
1. CLASS OF CONCRETE–3000 P.S.I. AT 28 DAYS.
2. CLEAR COVER ON REINFORCING STEEL–2" OR AS NOTED.
3. APPROVED ADMIXTURES SUPPLIED BY THE CONTRACTOR WILL BE ADDED TO ALL CONCRETE AS SPECIFIED BY THE ENGINEER.
4. ALL HOLES FOR DRIFT PINS SHALL BE DRILLED IN THE FIELD AND SHALL BE 3/4"Ø. ALL HOLES FOR BOLTS SHALL BE DRILLED IN THE FIELD AND SHALL BE 1/16" LARGER THAN THE BOLT DIAMETER.
5. BEFORE CUTTING OFF PILES, THE CUT-OFF ELEVATIONS WILL BE CHECKED BY THE ENGINEER IN THE FIELD TO ENSURE A TRUE GRADE ACROSS THE STRUCTURE.



LIST OF DRAWINGS

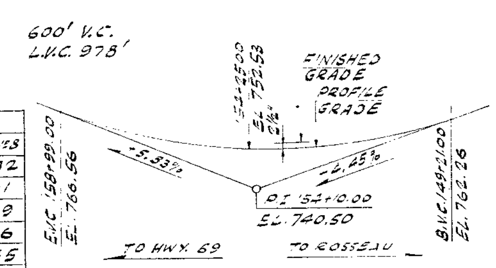
D-6529-1 GENERAL PLAN
" " -2 BORE HOLE LOCATIONS & SOIL STRATA
" " -3 DECK & DETAILS
" " -4 BILLS OF MATERIALS
" " -5 STANDARD DETAILS

W.O. 73-11094



ELEVATION

B.M. ELEVATION 755.56
GEODETIC DATUM - CUT X ON ROCK 165' RT. AT STA 149+68.00



PROFILE @ ℄ HWY. 532 LINE 'M'

N.T.S.

TABLE OF PILE CUT-OFF ELEVATIONS

	BENT Nº1	BENT Nº2	BENT Nº3	BENT Nº4	BENT Nº5	BENT Nº6	BENT Nº7	BENT Nº8
LINE Nº1	750.34	750.33	750.37	750.46	750.61	750.82	751.09	751.32
LINE Nº2	750.44	750.43	750.46	750.55	750.70	750.91	751.17	751.41
LINE Nº3	750.55	750.53	750.56	750.65	750.79	750.99	751.25	751.49
LINE Nº4	749.94	749.92	749.95	750.03	750.17	750.37	750.63	750.86
LINE Nº5	750.55	750.53	750.55	750.63	750.77	750.97	751.22	751.45
LINE Nº6	750.45	750.43	750.45	750.53	750.66	750.86	751.11	751.33
LINE Nº7	750.36	750.33	750.35	750.42	750.55	750.74	750.99	751.21

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

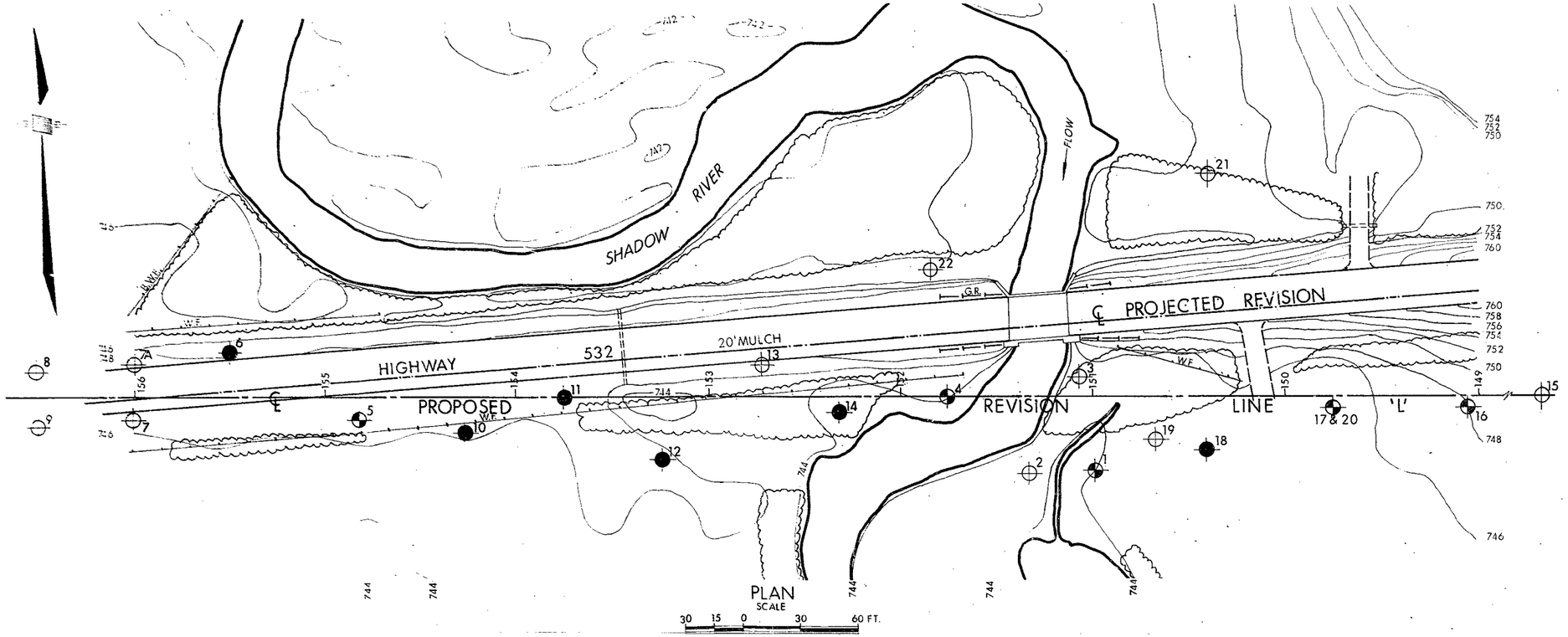
SHADOW RIVER BRIDGE
APPROX. 1.4 MI. W. OF ROSSEAU

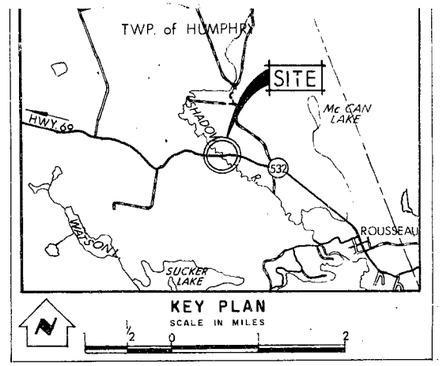
GEOCRES No. 31E-20

KING'S HIGHWAY No. SEC. RD. No. 532 DIST. No. 11
DIST. OF PARRY SOUND
TWP. HUMPHREY LOT 78 CON. A

GENERAL PLAN

APPROVED	BRIDGE ENGINEER	SITE No. 44-159	W.P. No. 109-67-1
DESIGN V.F.B.	CHECK	CONTRACT Nos.	
DRAWING A.V.	CHECK V.F.B.	DRAWING No.	D-6529-1
DATE SEPT. 69	LOADING HS 20-44		

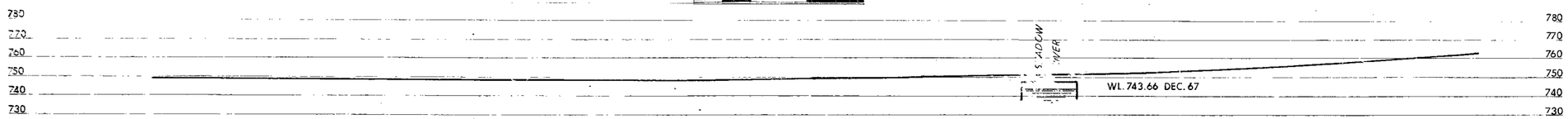




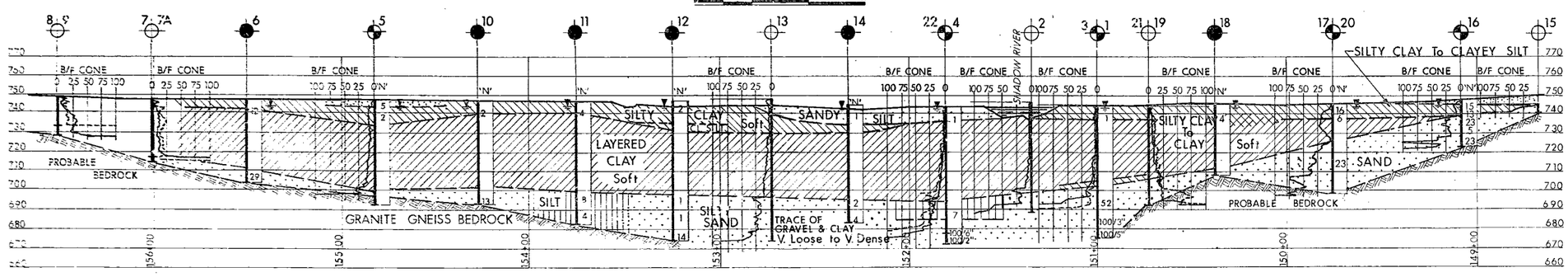
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. MAY. 1968.

NO.	ELEVATION	STATION	OFFSET
1	744.3	151+00	38'LT.
2	744.7	151+34	40'LT.
3	745.6	151+06	10'RT.
4	744.0	151+75	5'RT.
5	747.0	154+82	12'LT.
6	747.7	155+50	22'RT.
7	747.8	156+00	12'LT.
7A	748.2	156+00	16'RT.
8	749.3	156+50	13'RT.
9	748.8	156+50	15'LT.
10	746.5	154+25	15'LT.
11	747.0	153+75	ON ℄
12	746.3	153+25	34'LT.
13	747.8	152+75	12'RT.
14	743.6	152+32	10'LT.
15	744.2	148+40	ON ℄
16	748.0	149+05	5'LT.
17	745.7	149+75	6'LT.
18	745.0	150+40	27'LT.
19	744.8	150+67	22'LT.
20	745.7	149+75	8'LT.
21	744.3	150+45	115'RT.
22	743.0	151+86	63'RT.



PROFILE PROJECTED REVISION
SCALE
30 15 0 30 60 FT.



PROFILE LINE 'L'
SCALE
30 15 0 30 60 FT.

- 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.

REVISIONS	DATE	BY	DESCRIPTION

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

SHADOW RIVER

BILL 20
CLERKS No.

KING'S HIGHWAY NO. 532 LINE 'L' & PROJ. REV. DIST. NO. 11
DIST. PARRY SOUND
TWP. HUMPHRY LOT 78 CON. A

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. A.S.	CHECKED	W.P. NO. 109-67-1	M.&T. DRAWING NO. 68-F-18 A
DRAWN D.M.	CHECKED	JOB NO. 68-F-18	
DATE JUNE 27/68		SITE NO.	BRIDGE DRAWING NO.
APPROVED A.G. Thomas PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

REF. NO. E-4476-1