

#69-F-53R

CHAPLEAU

C.P.R.

MEMORANDUM

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

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

ATTENTION: Mr. S. McCombie

DATE: October 2, 1969

OUR FILE REF.

IN REPLY TO

OCT 14 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed C.P.R. Crossing  
Town of Chapleau  
District #18 (Sault Ste. Marie)  
W.J. 69-F-53R -- W.P. (Nil)

Enclosed, please find our detailed foundation investigation report on subsoil conditions existing at the above site.

It is pointed out that the report contains information deemed to be sufficient for functional planning purposes only, and that additional field work will be necessary for actual design purposes when the project reaches that stage.

Should any points in our report require clarification or should additional information be required, please contact this Office.

AGS/KdeF  
Attach.

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
H. W. Hurrell  
R. G. Gascoyne  
S. B. Davidson  
R. Morgenroth  
B. A. Singh  
Foundations Files ✓  
Gen. Files

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

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FOUNDATION INVESTIGATION REPORT  
For

Proposed C.P.R. Crossing  
Town of Chapleau  
District #18 (Sault Ste. Marie)

W.J. 69-F-53R -- W.P. (Nil)

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed new crossing of the C.P.R. in the Town of Chapleau, was contained in a memo from Mr. J. H. Blevins, District Engineer, dated June 23, 1969.

An investigation was subsequently carried out by this Section to determine subsoil conditions existing at a number of locations suggested by McCormick, Rankin & Associates, Consulting Engineers, who have been retained by the Town of Chapleau to prepare a functional planning report. At the time of the field work, 4 schemes had been proposed by the Consultant, and the boring programme was based on these 4 schemes. These schemes have since been modified, but the main purpose of the original boring programme has nevertheless been achieved, as the intent was to obtain information of a general nature only, sufficient for preliminary design purposes.

This report contains the results of our field and laboratory investigations, together with recommendations of a general nature, pertaining to the future structure foundations.

2. DESCRIPTION OF SITE:

The sites are located in the Town of Chapleau and are adjacent to and east of the existing and only bridge crossing of the C.P.R. tracks. The existing bridge is U-shaped, having very steep approaches which run parallel to the railway. The curve of

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

the bridge is such that traffic has only one lane. This bridge is founded directly on bedrock which outcrops at this location. At the locations of the alternative crossings of the C.P.R., the area on both sides of the tracks is built up residential. At the east end of the town is Kepsquasheshing Lake, which is also known as Chapleau River. The terrain at the locations of all alternative crossings is, in general, flat to gently undulating, though at a number of places, small hillocks (which are probably rock knobs covered with a thin layer of overburden), can be observed. At many locations bedrock outcrops are in evidence.

3. FIELD WORK:

Field work consisted of 7 sampled boreholes and 11 dynamic cone penetration tests. A visual inspection was also carried out to locate bedrock outcrops. Boring was achieved by means of conventional diamond drilling equipment adapted for soil sampling purposes. Samples were recovered by means of 2-inch O.D. split-spoon samplers driven into the soil by means of a 140-lb. hammer falling freely so as to impart an energy of 350 ft.-lbs. per blow. The dynamic cones were advanced into the soil in the same manner. Bedrock was proved by recovering rock core samples in some holes, whereas in other holes, it was assumed that bedrock had been reached on meeting practical refusal to advancing the boring by means other than diamond drilling.

Samples were visually examined on recovery from the sampler, in the field and subsequently again in the laboratory. Tests were then carried out in the laboratory to determine the following physical properties:

Grain-Size Distribution

Organic Content

Moisture Content

The results of these tests, together with those of the field tests - dynamic cone penetration and standard penetration tests -

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

are plotted on the Record of Borelog sheets which are contained in the Appendix of the report.

The locations and elevations of the borings were established in the field by the Project Foundation Engineer. These are shown on Drawings #69-F-53A and B, which form part of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists of various granular type strata ranging in particle size from silt to gravel overlying bedrock. Depth to bedrock is highly variable. The boundaries between the various deposits are shown on the Record of Borehole sheets in the Appendix. The estimated stratigraphical profiles, shown on Drawings #69-F-53A and B, are based upon this information. From ground level downwards, the various soil types are described in detail as follows:

4.2) Medium Sand:

This material was found in boreholes 2, 3, 6, 7 and 11. In all boreholes, it was found from ground level downwards to depths varying from 4.8 ft. (B.H. 2) to 24.0 ft. (B.H. 6). In addition, an 8-ft. thick layer, mixed with some gravel, was found to overlie bedrock in B.H. 6. In borehole 2, it overlies bedrock. The denseness of the material is loose to compact. The composition of material varies from fine to medium sand to medium to coarse sand with small amounts of gravel, silt and clay.

Grain-size analyses indicate the following distribution, and are plotted on Fig. 1 of the Appendix:

Gravel	:	2	-	17%
Sand	:	58	-	91%
Silt and Clay	:	4	-	30%

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

4.3) Fine Sand:

This material was encountered in boreholes 1, 3 and 6. In boreholes 3 and 6, it was overlain by a medium sand deposit, but in borehole 1 it was found from ground level downwards. The thickness of the deposit varies from 5.5 ft. in borehole 1 to 19.0 ft. in borehole 3. The 'N' values range from 7 to more than 100 blows/ft., indicating a loose to very dense relative density. The higher 'N' values were recorded in B.H. 3. This may be, in part, due to plugging of the bottom of the borehole due to 'unbalanced' hydrostatic head in the borehole. Therefore, it is believed that, in general, the relative density ranges from loose to compact. The material is essentially fine sand with varying amounts of silt and clay. The grain-size analyses carried out, indicate the following ranges of distribution, and are plotted on Fig. 2 of the Appendix:

Sand -			
Medium to Coarse	:	0 - 11%	
Fine	:	64 - 94%	
Silt and Clay	:	3 - 36%	

4.4) Silt:

This material was found in boreholes 1, 3, 7 and 8. In borehole 8, it was the surface deposit, but in other boreholes, it was overlain by sand layers. In borehole 1 underlying this material, was a 2-ft. layer of sand and gravel, which in turn, was underlain by bedrock. In other boreholes this deposit was underlain by bedrock. The thickness of the layer varied from 6.5 ft. in borehole 1, to 43.5 ft. in borehole 3. The denseness of the material, as indicated by 'N' values, is loose to compact. The material essentially consists of silt with traces of sand and clay, except in borehole 7, in which case, some gravel was mixed with the silt.

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

4.4) Silt: (cont'd.) ...

Grain-size analysis indicates the following distribution, and is plotted on Fig. 3 of the Appendix:

Gravel	:	0 - 22%
Sand	:	0 - 18%
Silt and Clay	:	78 - 100% (Clay <10%)

4.5) Sand and Silt:

A 1.4-ft. thick layer of sand and silt was found in borehole 11. It was overlain by sand and underlain by bedrock. The relative density is compact; the 'N' values are high because of proximity of bedrock. The material consists of sand and silt with traces of gravel and clay. Grain-size analysis indicates the following distribution, and is plotted on Fig. 4 of the Appendix:

Gravel	:	8%
Sand	:	47%
Silt and Clay	:	45%

4.6) Sand and Gravel:

A 1.7 ft. thick layer of very dense sand and gravel with traces of silt and clay, was found in borehole 1, immediately overlying the bedrock. Grain-size analysis indicates the following distribution, and is plotted on Fig. 4.

Gravel	:	41%
Sand	:	44%
Silt and Clay	:	15%

4.7) Bedrock:

Bedrock was proven in boreholes 1, 6 and 8 by obtaining 4.0 to 5.0 ft. of AXT rock core. In other boreholes the bedrock surface was assumed to be the level at which refusal to further drilling, by means of a chopping bit, or to driving the split-spoon,



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

4.7) Bedrock: (cont'd.) ...

or the cone, was reached. At many places bedrock is exposed, as shown on Drawing #69-F-53A. The bedrock is granite and sound in nature, as indicated by nearly 100% recovery.

5. GROUNDWATER:

The water level in the lake, at the time of the investigation, was at approximate elevation 1403.0. The highest water level recorded was at elevation 1407.5 in borehole 7. Other boreholes caved in soon after withdrawing the casing. It is estimated that the water level in other boreholes lies between these two limits.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to replace the existing crossing of the C.P.R. tracks in the Town of Chapleau. At present, 4 alternative schemes have been proposed by the Consultant. These schemes are shown on Drawing #69-F-53A and, as mentioned earlier, differ somewhat from the schemes proposed at the time of the field investigation. Nevertheless, certain conclusions can be drawn and recommendations of a general nature can be made based on the field information obtained.

Subsoil at all sites consists of generally loose to compact granular type strata overlying bedrock. Depth to bedrock varies greatly. The groundwater level was found to be fairly close to the level of the nearby lake.

With regard to the type of structure to be constructed, it would seem that a subway can be ruled out on the basis of difficulty of construction below the groundwater in highly permeable granular subsoil and the cost of a permanent drainage system, since the future grade would be well below the groundwater level. This type of structure would be feasible from an economic

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

viewpoint, only if the entire subway and approaches would be fully within bedrock or an impermeable soil. Since this is not the case at any of the proposed sites, an overhead structure is recommended.

The proposed structure can be supported on spread footings placed on sound bedrock, or on piles driven to bedrock. Spread footings within the overburden are not recommended due to the low relative density of the subsoil and the high groundwater. For spread footings placed on sound bedrock, design loads of up to 20 t.s.f. may be assumed. For piled foundations, steel H-piles are recommended. These should be driven to bedrock, in which case, the maximum allowable load for the particular steel section adopted, may be assumed. In certain cases where the piles are short and the bedrock known to be sloping steeply or erratically, it would be advisable to key the piles into the rock after fitting Oslo Points. Information regarding these may be obtained from this Section, or from the N.G.I. Publication #23, or Geotechnique Vol. VII, Page 73, 1957.

Excavations carried out below the groundwater level, will be subject to 'boiling' conditions since the subsoil is of a granular nature. A dewatering scheme will therefore be necessary to ensure stable and safe conditions in excavations. Pile caps should be at a sufficient depth to ensure frost protection.

The decision to design piled foundations or spread footings should be based on economical reasons and will, of course, be dependent on the depth to the bedrock. For the present purposes, this decision can be based on the soil information contained in this report. It is pointed out, however, that when the locations of the footings are finally decided upon, new borings must be carried out to determine the exact conditions at these locations. This is considered to be absolutely necessary because of the great variation in depth to bedrock over short distances.

7. MISCELLANEOUS:

The field work for this project was carried out during the period July 1 - 5, 1969, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by Master Soil Investigations Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

September 1969

APPENDIX I.

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FOUNDATION SECTION

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-53(R)

LOCATION As shown on plan

ORIGINATED BY AP

W.P.

BORING DATE July 2, 1969

COMPILED BY PT

DATUM Geodetic

BOREHOLE TYPE Washboring, BX Casing &amp; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % $w_p$ ——— $w$ ——— $w_L$
							20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					
1408.0	Ground Level																
0.6	Fine to med. sand, some gravel & silt.														GR, SA, SI, CL		
1403.2	Dense		1	SS	37						100/9"				13 57 (30)		
4.8	Probable Bedrock End of Borehole					1400					Hammer bouncing						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-53 (R)

LOCATION As shown on plan

ORIGINATED BY AP

W.P.

BORING DATE July 2, 1969

COMPILED BY PT

DATUM Geodetic

BOREHOLE TYPE Washboring, BX Casing &amp; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
1413.0	Ground Level															
0.0	Fine to med. sand, some gravel. Loose		1	SS	7	1410										13 83 (4)
1404.0			2	SS	10											
9.0	Fine sand with silt Compact to very dense		3	SS	13	1400										Caved in at 5.5 ft. Probable WL 1405.±
			4	SS	36											
			5	SS	125	1390										0 65 (35)
1385.0			6	SS	100/7"											
28.0	Silt, traces of sand Compact		7	SS	16	1380										
			8	SS	21											0 10 85 5
			9	SS	26	1370										
						1360										
						1350										
1341.5			10	SS	150/3"											Blows on cone at 71.5 ft. 150/1" Hammer Bouncing
71.5	Probable Bedrock End of Borehole					1340										





DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No.5

FOUNDATION SECTION

JOB 69-F-53(R)

LOCATION As shown on plan

ORIGINATED BY AP

W.P.

BORING DATE July 3, 1969

COMPILED BY PT

DATUM Gzodetic

BOREHOLE TYPE Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % $w_p$ ——— $w$ ——— $w_L$
							20	40	60	80	100						
												○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			
110.5	Ground Level					1110											
0.0	Probable Fine to med. sand  Loose					1100											
1389.0						1390											
21.5	Probable  Silt  Compact					1380											
1365.4						1370											
45.1	Probable Bedrock End of Cone Test														50/2" Hammer bouncing		

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-53(R) LOCATION As shown on plan ORIGINATED BY AP  
 W.P. \_\_\_\_\_ BORING DATE July 3, 1969 COMPILED BY PT  
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing, AX Core & Cone CHECKED BY LL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				
1412.0	Ground Level					1410										GR. SA. SI. CL.
0.0																
	Medium Sand		1	SS	12											4 92 ( 4 )
	Loose to compact		2	SS	5	1400										caved in at 4.4 ft. Probable WL 1406.±
1397.0			3	SS	7											
15.0																
	Fine Sand		4	SS	12	1390										0 98 ( 2 )
	Compact		5	SS	12											
			6	SS	11	1380										
1379.0																
33.0	Sand, some gravel and silt.		7	SS	38											17 58 (25)
1371.9	Dense		8	SS	50/1"											
40.1	Bedrock															
1367.9	Granite		9	AXT	100%	1370										
44.1	End of Borehole															

80/4"  
Hammer bouncing

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-53(R)

LOCATION As shown on plan

ORIGINATED BY AP

W.P.

BORING DATE July 4, 1969

COMPILED BY PT

DATUM Geodetic

BOREHOLE TYPE Washboring, BX Casing &amp; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % $w_p$ — $w$ — $w_L$			
1413.0	Ground Level														
1411.0	Topsoil														
2.0	Med. to coarse sand  Compact		1	SS	16	1410									7 88 ( 5) Caved in at 3.0 ft. Probable WL 1407.±
			2	SS	11	1400									
			3	SS	14										
			4	SS	12	1390									
1389.0	Silt, some gravel Compact		5	SS	14								21 2 74 3		
24.0			6	SS	13	1380									
1381.2	Probable Bedrock End of Borehole														
31.8															

100/3"  
Hammer bouncing

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-53(R) LOCATION As shown on Plan ORIGINATED BY AP  
 W.P. \_\_\_\_\_ BORING DATE July 4, 1969 COMPILED BY PT  
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing & Cone CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %
							20	40	60	80	100	PS.F.					
1413.5	Ground Level																
1411.5	Topsoil																
2.0	Silt, some fine sand					1410											
	Compact		1	SS	20												
1402.2			2	SS	50/9"												
11.3	Bedrock Granite		3	AXT	100%	1400											
1397.2																	
16.3	End of Borehole																
						1390											

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 69-F-53(R)

LOCATION As shown on plan

ORIGINATED BY AP

W.P.

BORING DATE July 4, 1969

COMPILED BY PT

DATUM

Geodetic

BOREHOLE TYPE Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20    40    60    80    100					SHEAR STRENGTH P.S.F. ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    x LAB. VANE				
1113.0	Ground Level															
1111.0	Top Soil					1110										
2.0	Probable silt, some fine sand. Loose.															
1107.5																
5.5	Probable Bedrock End of Cone Test					1100										

100/6"

Hammer bouncing

FOUNDATION SECTION

JOB 69-F-53 (R) LOCATION As shown on plan ORIGINATED BY AP  
W.P.  BORING DATE July 4, 1969 COMPILED BY PT  
DATUM Geodetic BOREHOLE TYPE Cone Test CHECKED BY ✓

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT — $w_L$		BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20 40 60 80 100	PLASTIC LIMIT — $w_p$	WATER CONTENT — $w$		
113.5	Ground Level											
111.5	Topsoil											
2.0	Probable silt, some fine sand.					1110						
105.2	Loose											
8.3	Probable Bedrock End of Cone Test					1100						

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 69-F-53(R)

LOCATION As shown on plan

ORIGINATED BY AP

W. P.

BORING DATE July 5, 1969

COMPILED BY PT

DATUM      Geodetic

BOREHOLE TYPE Washboring, BX Casing & Cone

CHECKED BY

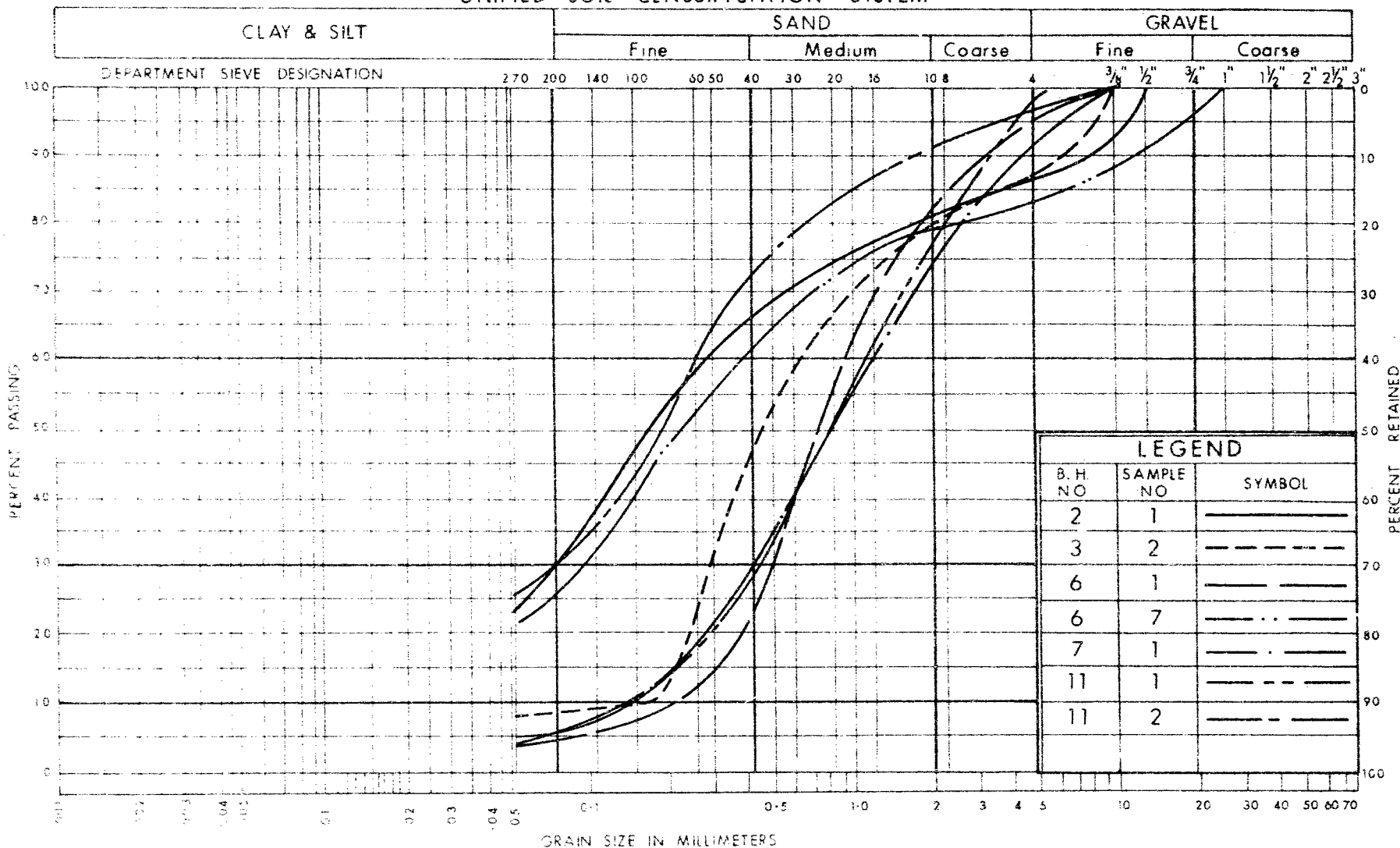
SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % $w_p$ ——— $w$ ——— $w_L$				
							SHEAR STRENGTH P.S.F.									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
0+03.0	Ground Level					1400										
0+01.0	Medium coarse sand.	•••	1	SS	11									Org. 14.6%	GR. SA. SI. CL.	
2.0	Fine to med. sand with silt. Compact	•••	2	SS	16										0 94 (6)	
1399.0	Sand & silt. Compact	•••	3	SS	>100										3 67 (30)	
1397.6	Probable Bedrock End of Borehole														9 44 45 2	
5.4																

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$		BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60			80
							SHEAR STRENGTH P.S.F.		$w_p$ — $w$ — $w_L$				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE						
11.14.0	Ground Level												
11.12.0	Topsoil												
2.0	Probable Fine Sand					1110							
11.05.2	Loose to compact												
8.8	Probable Bedrock End of Cone Test					11400							



# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

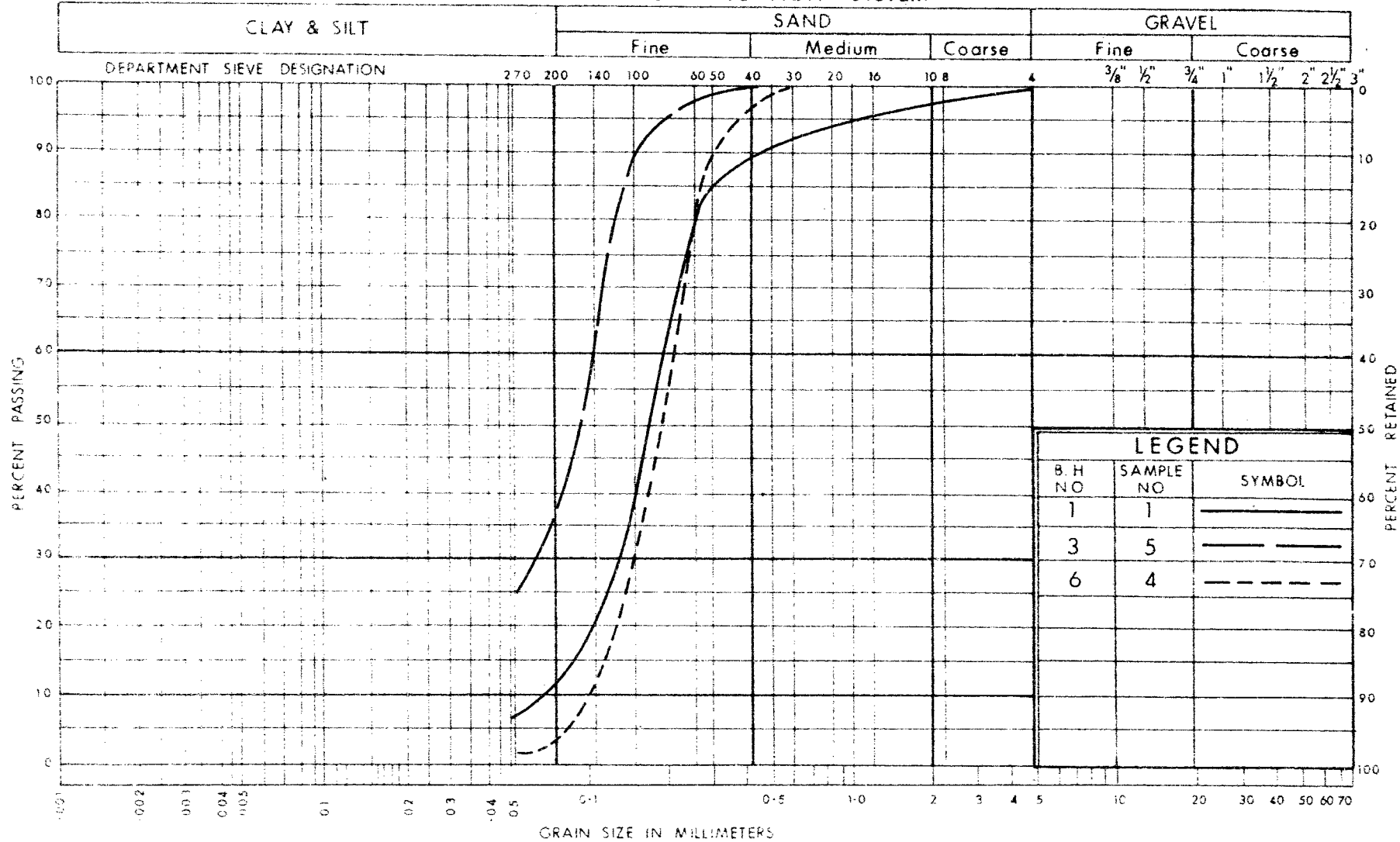
GRAIN SIZE DISTRIBUTION  
FINE TO MEDIUM SAND  
MEDIUM TO COARSE SAND

W.P. No.

JOB No. 69 - F - 53 (R)

FIG. 1

# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
B. H. NO.	SAMPLE NO.	SYMBOL
1	1	—————
3	5	—————
6	4	- - - - -



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

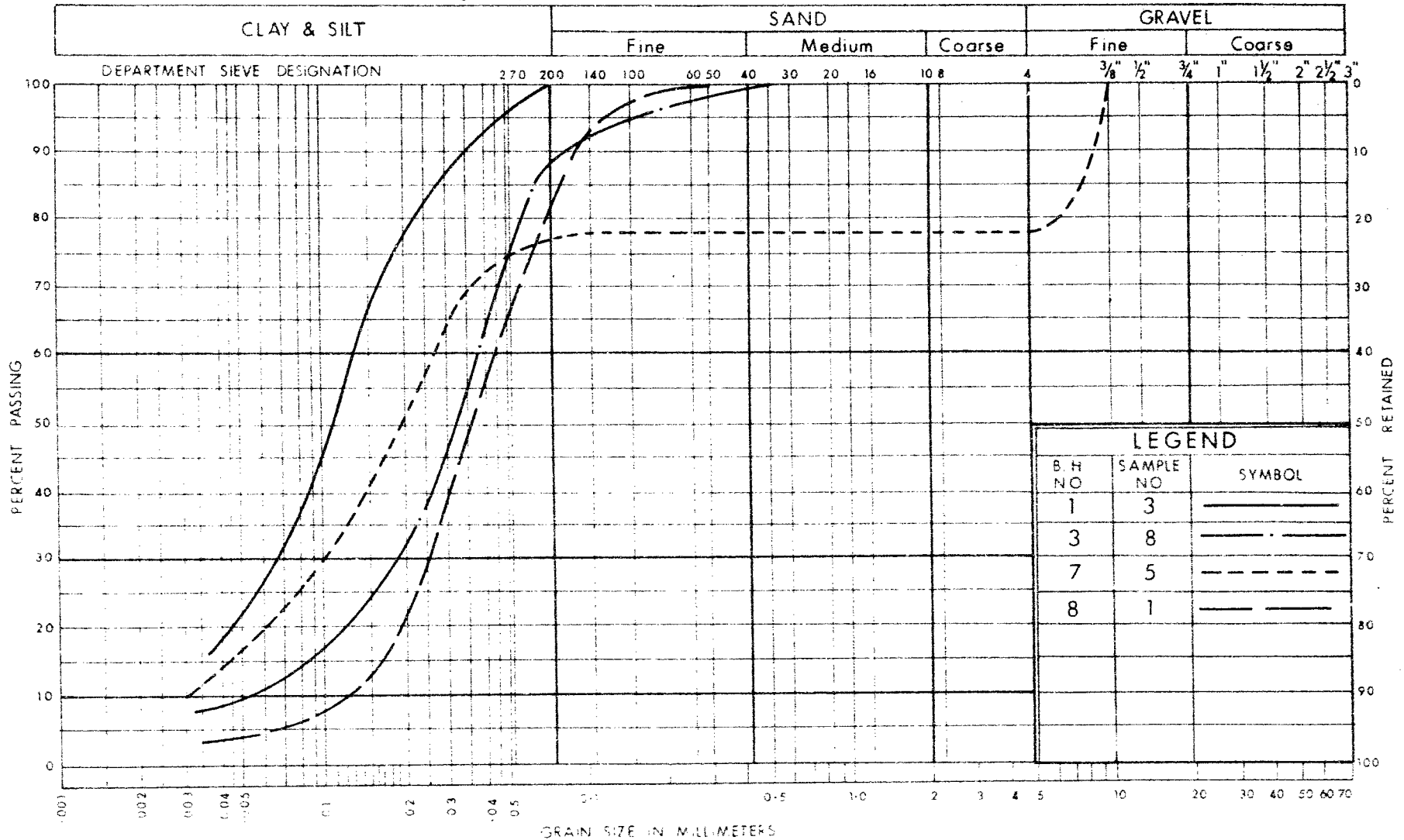
## GRAIN SIZE DISTRIBUTION FINE SAND

W. P. No.

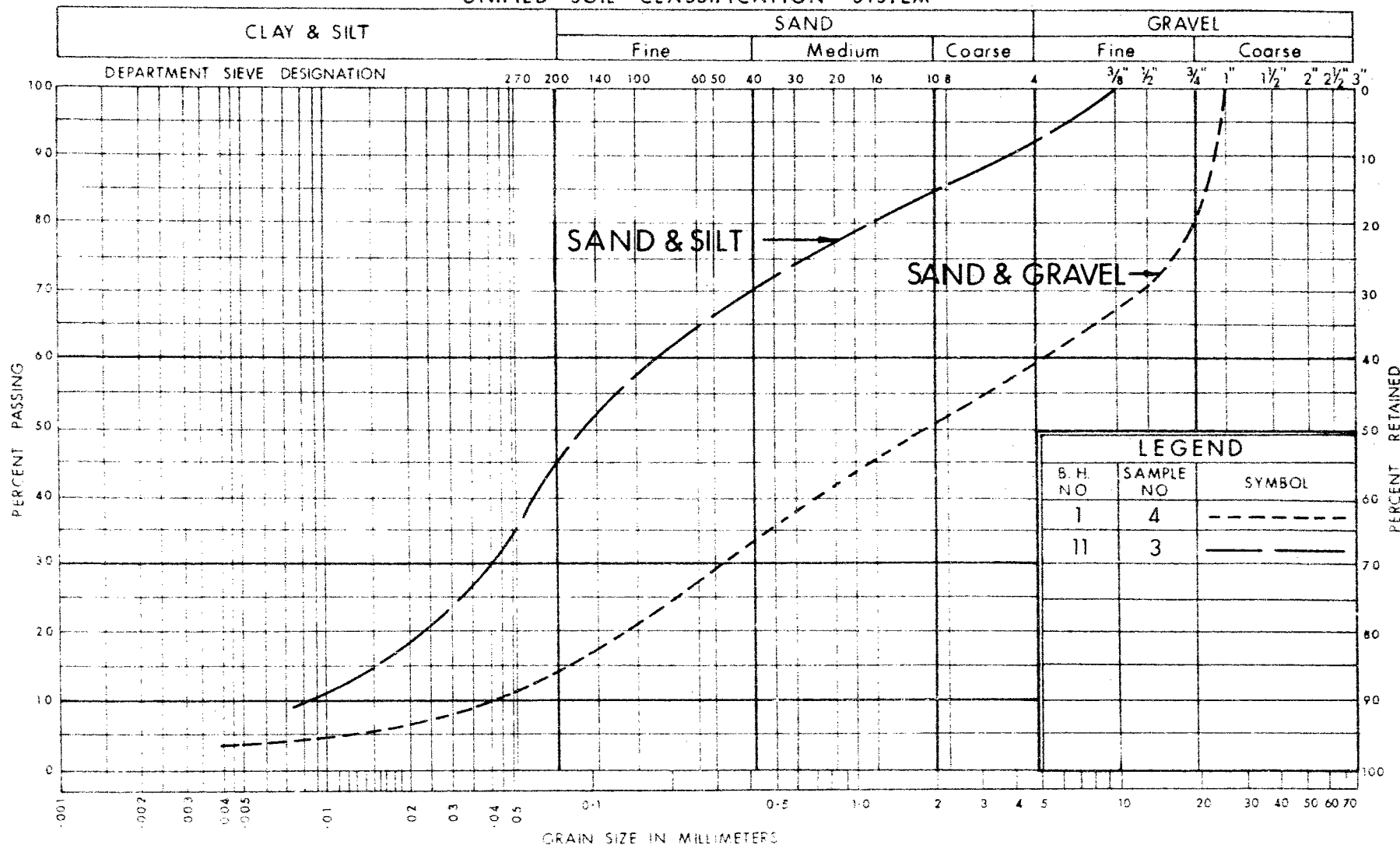
JOB No. 69-F-53 (R)

FIG. 2

# UNIFIED SOIL CLASSIFICATION SYSTEM



# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION

W.P. No.

JOB No. 69-F-53 (R)

FIG. 4

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

## STRESS AND STRAIN

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

## EARTH PRESSURE

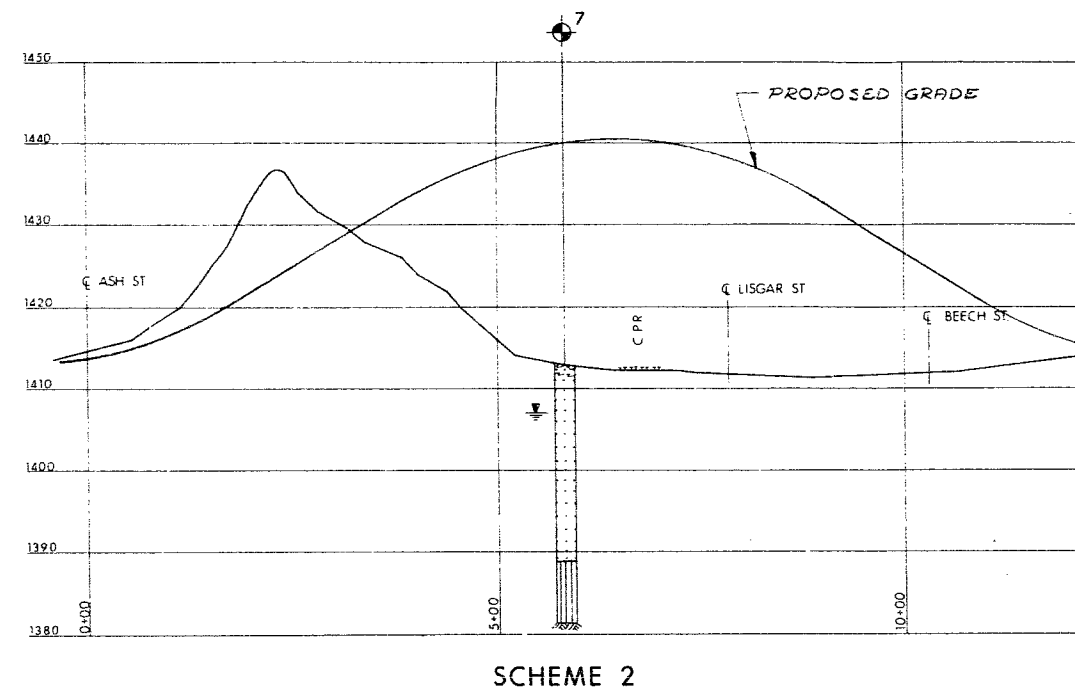
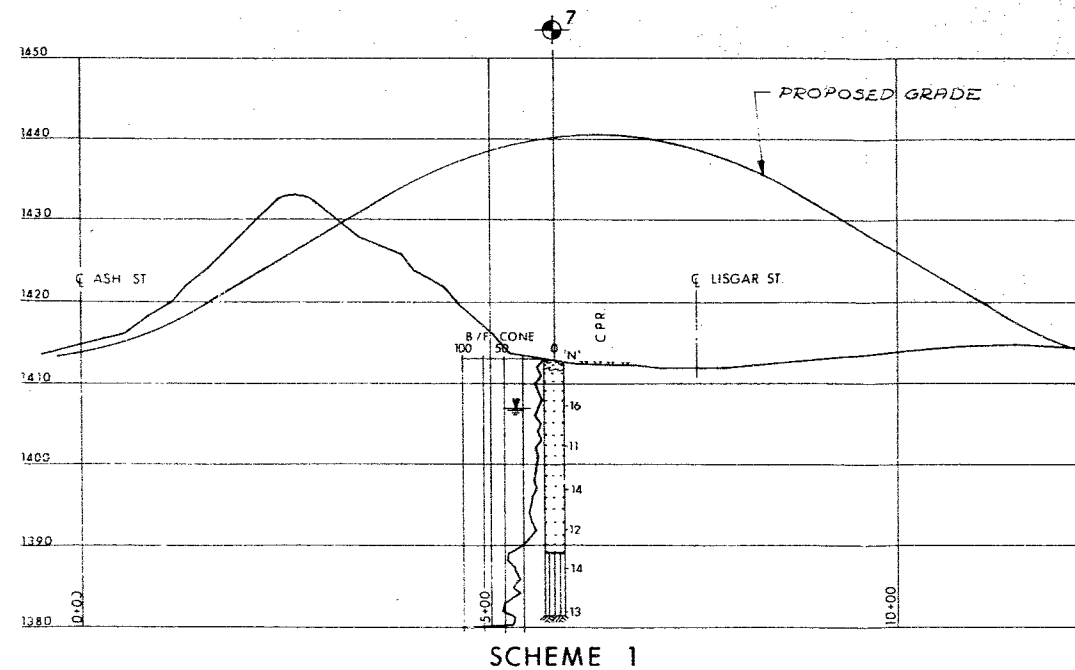
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

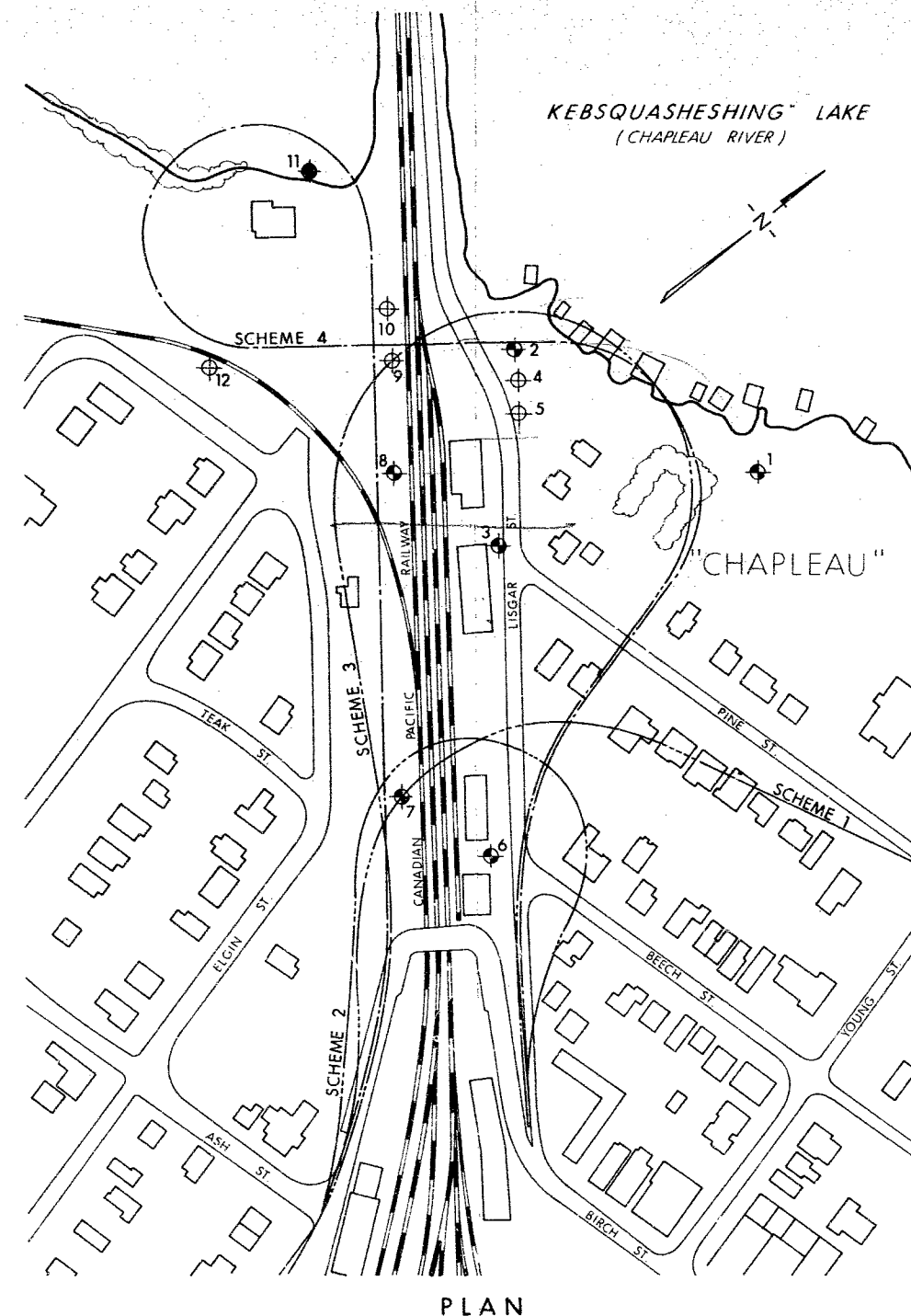
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

## SLOPES

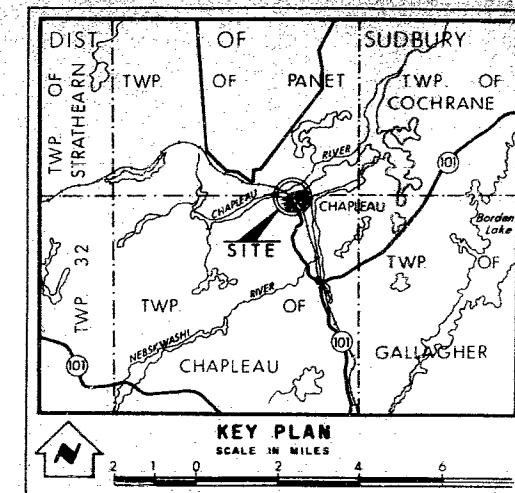
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



SCALE  
VERT. 10 5 0 10 20  
HORIZ. 100 50 0 100 200 FT.



100 50 0 SCALE 100 200 FT



#### LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊗ Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. JULY 1969

SOIL LEGEND SEE DWG. 69-F-53B

NO.	ELEVATION	STATION	OFFSET
1	1405.0	AS SHOWN	
2	1408.0		
3	1413.0		
4	1408.5		
5	1410.5		
6	1412.0		
7	1413.0		
8	1413.5		
9	1413.0		
10	1413.5		
11	1403.0		
12	1414.0		

#### 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

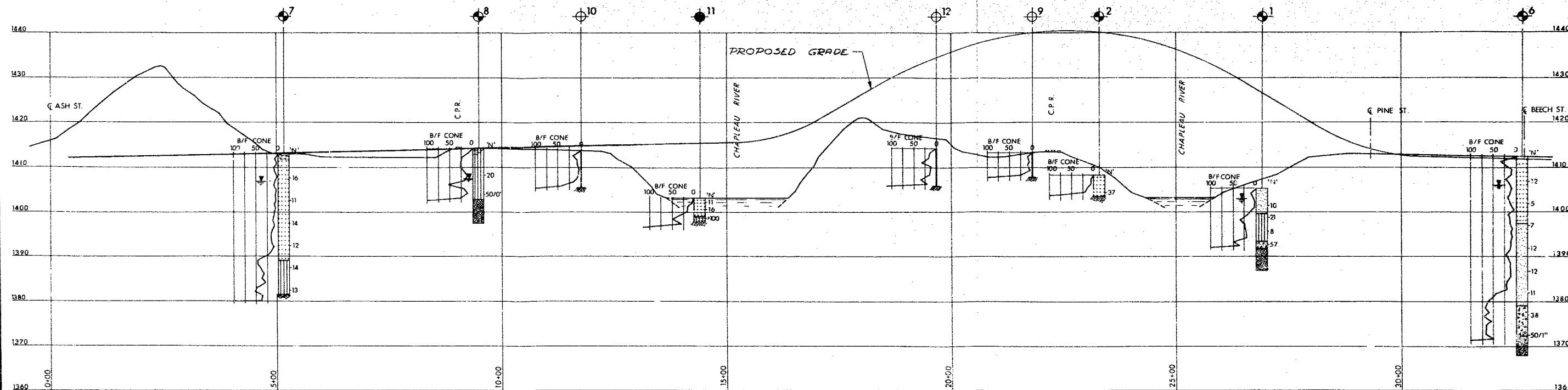
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

CANADIAN PACIFIC RAILWAY  
(CHAPLEAU)

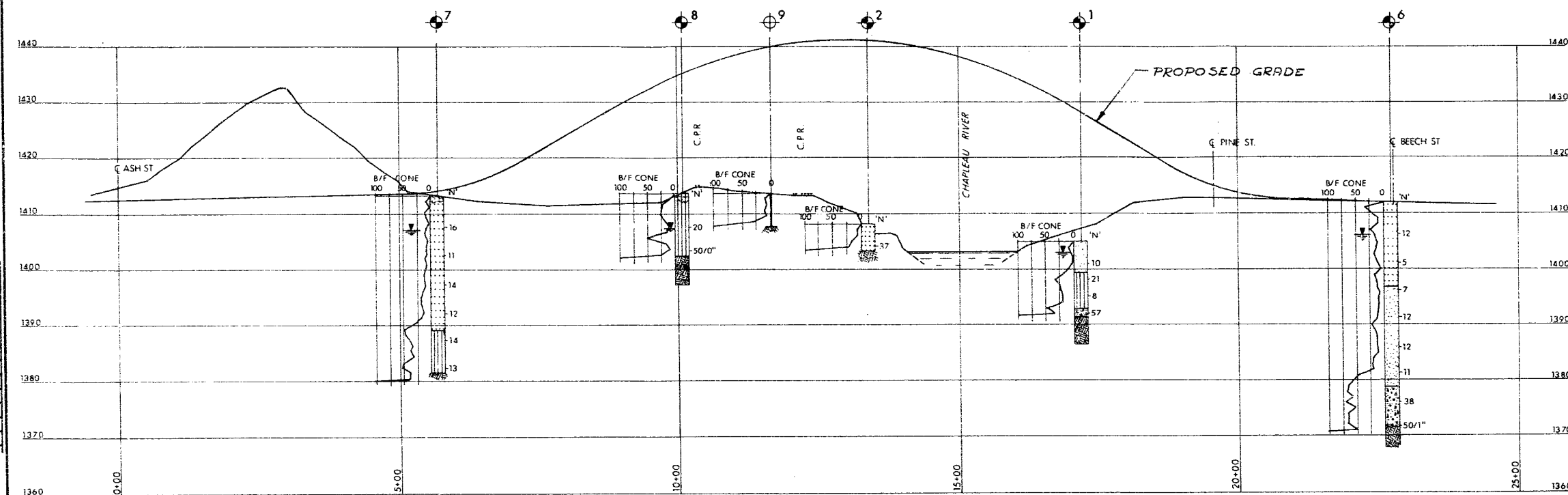
KING'S HIGHWAY NO. \_\_\_\_\_ DIST. NO. 18  
TWP. CHAPLEAU LOT \_\_\_\_\_ CON. \_\_\_\_\_

BORE HOLE LOCATIONS & SOIL STRATA

SUBMITT. A.P. CHECKED <input checked="" type="checkbox"/>	W.P. NO. _____	M.B.T. DRAWING NO. _____
DRAWN S.O. CHECKED <input checked="" type="checkbox"/>	JOB NO. 69-F-53	69-F-53A(R)
DATE 15 SEPT 1969	SITE NO. _____	BRIDGE DRAWING NO. _____
APPROVED <i>[Signature]</i>	CONT. NO. _____	



SCHEME 4



SCHEME 3

VERT. 10 5 0 SCALE 10 20 FT.  
HORIZ. 100 50 0 100 200

LEGEND

- Med. SAND SOME GRAVEL Loose to Comp.
- Fine SAND SOME SILT Comp.
- SILT trace of SAND Comp.
- SAND & GRAVEL Dense
- GRANITE BEDROCK

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 OFFICE - FOUNDATION SECTION

CANADIAN PACIFIC RAILWAY  
(CHAPLEAU)

KING'S HIGHWAY NO. DIST. NO. 18  
DIST. OF SUDBURY  
TWP. CHAPLEAU LOT CON.

PROFILES & SOIL STRATA

SUBM'D. A.P.	CHECKED <i>[Signature]</i>	W.P. NO.	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED <i>[Signature]</i>	JOB NO. 69-F-53	69-F-53B(R)
DATE 15 SEPT. 1969	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		