

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Design Engr.,
Bridge Division.

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

Attention: Mr. F. Gormek,
Bridge Proj. Engr.

DATE: January 12, 1965

OUR FILE REF.

IN REPLY TO

SUBJECT:

Joseph River Bridge, Hwy. 632,
District #11, Huntsville, Ont.
W.J. 64-F-47 -- W.P. 272-63

Further to your request on December 29, 1964,
regarding the adoption of caissons for pier foundations
at the above-mentioned project, we have reviewed this problem
with various drilling specialists.

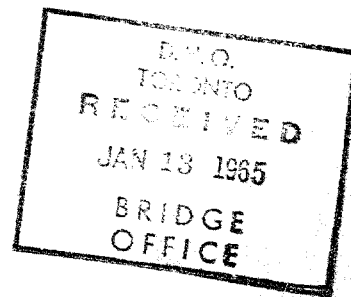
We have obtained quotations for the above-mentioned
work from three organizations in Toronto. The information
obtained from the drilling organizations is enclosed along with
this memo.

If you have any further queries regarding this
matter, please contact this Office.

MD/MdeF
Attach. (3)

for M. Divata
for A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office
Gen. Files



FRANKI

CANADA LIMITED

TELEX NO
02 7159
CABEGRAMS
"FRANKI LEE"
TELEPHONE
HU 6426



214 MERTON STREET,

TORONTO,

January 6, 1965.

Department of Highways,
Materials & Research Section,
Downsview, Ontario.

Attention: Mr. M. Devata, P. Eng.

Re: Joseph River Bridge,
Huntsville District

Dear Sirs:

In accordance with your request we have prepared a rough estimate on the above job.

It is understood that 3 piers will be founded on a total of 12 - 16 inch diameter by 0.250 wall concrete filled caissons, socketed 7 feet into hard metamorphic bedrock. The rock is understood to be overlain by 10 to 20 feet of silty sand, of which the lower few feet are very dense, probably containing boulders. The depth of the river is of the order of 12 feet. The caissons will extend above the river approximately 15 feet, giving therefore a maximum caisson length of the order of 55 feet.

Employing the churn drilling method to penetrate the bedrock, it is estimated that the cost per caisson could be of the order of \$ 6,000.00. Or for 12 caissons \$ 72,000.00. To this should be added the cost of installation and dismantling of equipment, which could amount to about \$3,000.00, as well as the rental of a raft, or the cost of some form of platform.

It should be emphasized that projects such as this, are very much subject to local site and soil conditions; the estimate given therefore should only be used as a rough guide.

The churn drilling process normally implies heavy equipment. It should be noted that the size of equipment on this project is limited by the size of the 16 inch caissons, thereby almost certainly affecting the production and therefore cost, adversely. Consideration may be given to employing larger caissons, socketed to a lesser depth into the rock. For instance, if the pier load, understood to be 766 kips, is divided over 3 caissons, each would carry about 130 ton and require a caisson diameter of about 30 inches. This diameter would enable the use of larger and more efficient equipment and would facilitate inspection of and possibly work at the bottom of the caisson.

Yours very truly,

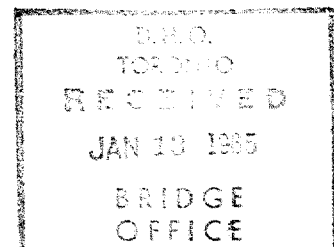
FRANKI CANADA LIMITED



A. Prior, P. Eng.
CHIEF ENGINEER

AP/b

Ref: x2-65



F. E. JOHNSTON DRILLING CO. LTD.
DRILLING CONTRACTORS

HEAD OFFICE

1181 CECIL AVE., OTTAWA 1, ONT.



January 9, 1965.

Ontario Department of Highways,
Downsview,
Ontario.
Attention: Mr. T. Sternac, Principal Engineer.

Re: Joseph River Structure, Job No. 63-F-47

Dear Sir:

The following is a run down of our methods and prices for the pre-boring, installation and grouting of tubular steel piles on the above project.

It is understood that three groups of 16" tubular piles are required with four in each group for a total of twelve piles. All these piles are to be inserted seven feet into bed-rock.

According to your soils report, the material in the vicinity of these piles would be: Water depth—10' to 12'. Overburden—10' to 20' which would be composed of material ranging from silty clay to sand and gravel containing some boulders and, a thin layer of hard-pan on top of bed-rock. The seven feet of bed-rock would be in a Metamorphic Schist.

Our method of undertaking this work would be to mount a churn drill on a sectionalised barge of suitable dimensions. Drill and drive 26" casing to bed-rock or as close as possible. Drill and drive 24" casing a short distance into bed-rock to acquire a suitable seal. Drill the remaining 7' of bed-rock with a 22" bit. Insert the 16" tubular steel piling, grout the annular space between the pile and bed-rock with 2" grout pipes, and grout up into the over-burden if required, as our outer casings are withdrawn.

Our price to undertake this work would be at the rate of \$150.00 per lineal foot for the combined depths of overburden and bed-rock encountered.

(con't)

F. E. JOHNSTON DRILLING CO. LTD.

DRILLING CONTRACTORS

HEAD OFFICE

1181 CECIL AVE., OTTAWA 1, ONT.



SOIL
INVESTIGATIONS

□ □

EARTH
AUGERING

HORIZONTAL
AND
VERTICAL

□ □

WELL
DRILLING
DOMESTIC
AND
COMMERCIAL

□ □

CONCRETE
CORING

□ □

EXPLORATION
DIAMOND
DRILLING

□ □

DIAMOND
SAWING

□ □

POLE
SETTING

-2-

This rate would include the supplying of labour, barge, transportation to and from the site, outer casings, percussion drill and necessary equipment. It would not include the 16" tubular piling, specialized grout or the surveying of locations.

It would appear that the cost of inserting the piles could be in the range of \$40,000.00. However, with the issuance of detailed specifications, there could be factors which would alter this price either upward or downward.

We sincerely hope that the foregoing information may be of some value to your Department.

Yours truly,

F. E. JOHNSTON DRILLING CO. LTD.

FB/jl

Per: F. Blackburn

WCL

WESTERN CAISSONS LIMITED

"Cast-in-Place Concrete Caissons"

R.R. NO. 1
MAPLE, ONTARIO
PHONE 226-7383

Jan. 4th, 1965.
File No. 65-29

Materials & Research Division,
Department of Highways,
DOWNSVIEW, Ontario.

ATTENTION: Mr. Devata

Dear Mr. Devata:

RE: Pile Installation
Joseph River Crossing

We are pleased to acknowledge your enquiry regarding the installation of piles for the above project, and would like to submit the following proposal:

We will install a 16-inch diameter pipe pile a distance of 7 feet into schist bedrock. The steel pipe column to extend up through the overburden silty sand and water, so that the top of each pile is at least 2 feet above high water level. The steel pipe pile will then be filled with concrete. The piles will be driven into the bedrock as the rock is churn drilled out, and will therefore fit tightly against the rock.

Our price to install a total of 12 piles in this manner will be:

TWENTY THREE THOUSAND NINE HUNDRED DOLLARS (\$23,900.00)

The above price includes the provision of heavy duty churn drilling equipment, personnel and concrete. It does not include the supply of the 16-inch pipe, nor does it include the cost of a barge for floating our equipment into position for the piles. Our proposal has also assumed that electrical power will be available at the site, and that the survey layout of pile locations will be the responsibility of others.

.....2

Department of Highways

-2-

Jan. 4th, 1965.

An additional charge of \$2500.00 will be made for moving our equipment onto the site, and removing it when the job has been completed.

We trust that this information will be sufficient to meet your present requirements, and we will be pleased to provide additional information should you care to call on us.

Hoping to be of service, we remain,

Yours very truly,

WESTERN CAISSONS LIMITED



A. Demetrick

AD:bt

D.H.O.
TORONTO
RECEIVED

JAN 10 1965

MEMORANDUM

3282

Tom level 3273

BA1927

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

FROM: Foundation Section,
Materials and Research Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: October 13, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed new structure over Joseph
River and Hwy #632 (Line 'F')
Dist. #11
Twp: Medora Lot: 19 Con 1X
W.J. 64-F-47 W.P. 272-63

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

We believe that you will find the factual data and
recommendations contained therein, adequate for your future
design work. Should you require additional information,
please do not hesitate to contact our Office.

AGS/PB
Attach.

cc: Messrs. A. M. Toye (2) ✓
H. A. Tregaskes
H. D. McMillan
H. McArthur
E. H. Jones
T. J. Kovich
A. Watt

[Signature]
J. A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

Foundations Office
Gen. Files

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-

FOUNDATION INVESTIGATION REPORT

For

Proposed new structure over Joseph River
and Hwy #632 (Line 'F') - Dist #11
Twp: Medora Lot: 19 Con IX
W.J. 64-F-47 W.P. 272-63

1. INTRODUCTION:

A foundation investigation at the site of the proposed Hwy #632 (Line 'F') and Joseph River crossing was requested in a memo dated June 17th, 1964 from Mr. J. McAllister of the Bridge Planning section.

Two field investigations were subsequently carried out by this section to determine the subsoil conditions at the site. This report contains the results of these investigations together with our recommendations pertaining to the design of the proposed structure foundations.

2. DESCRIPTION OF SITE:

The site of the proposed Hwy #632 and Joseph river crossing is about 5 miles north of Port Sandfield. Joseph river is one of the waterways which links lake Joseph with lake Rousseau in Muskoka county. The area is characterized by forest covered hills which surround the lakes. The bedrock outcrop is exposed extensively at the slopes. The area is in the physiographic region known as the "Canadian Shield".

cont'd /2...

3. DESCRIPTION OF THE FIELD WORK:

The field investigations were carried out by means of a diamond drill machine mounted on a raft. The work consisted of drilling some 26 boreholes in order to establish a sectional profile of the subsoil at the proposed pier and abutment locations with reference to line "F". In granular material sampling was carried out by means of a 2" O.D. split spoon sampler and the energy used to drive it conforms with the requirements of the Standard Penetration Test. The bedrock was drilled and AXT core samples were recovered.

The locations and elevations of the boreholes are shown on the attached drawing no. 64-F-47A.

4. SUBSOIL CONDITIONS:

The investigations show that the bedrock is overlain by a deposit of silty sand with occasional gravel. In B.H. 6 the overburden material was clayey silt at the top changing to silty clay with occasional pieces of gravel.

4.1) Silty Sand:

This material overlying the bedrock is basically silty sand which varies in thickness from 2.5 ft. in B.H. 22 to 22.5 ft. in B.H. 27. The upper portion of the layer has traces of organic matter. The remainder of the layer contains occasional gravel. The layer is in loose to very dense state of compaction, having an 'N' value range of 2 to over 100 blows per foot.

In B.H. 6 a deposit of silty clay was observed. This material is about 16 ft. thick and overlies the silty sand layer. The upper 8-10 ft. is very soft. During dynamic cone penetration

4.1) Silty Sand: (Cont'd)

test the A-rod went through the upper 8-10 ft. with a single blow of the hammer. The lower 6 ft. of the material is firm and contains occasional pieces of gravel.

4.2) Bedrock: (Metamorphic Schist)

The bedrock underlying the silty sand layer was drilled and AXI core samples were recovered. In all the boreholes the core recovery was 100%. The bedrock is similar in all the holes and was identified as Metamorphic Schist .

5. DISCUSSION & RECOMMENDATIONS:

It is proposed to construct a three span structure (45'-75'-45') where the relocated Hwy No. 632 (Line F) crosses the Joseph River. The new structure will replace the existing single lane three span Bailey bridge located some 60 ft. south of the Q of Hwy 632 (Line 'F'). The existing Bailey bridge is supported on rock filled timber cribs.

The subsoil at the site generally consists of 3 to 22 ft. of loose to very dense silty sand followed by schist bedrock. In view of the variable depth of bedrock below the river bottom, detailed bedrock profiles were established at the proposed piers and abutments locations and are shown on Dwg. 64-F-47A.

5.1) Structure Foundations:

Abutments:

The proposed abutments may be founded directly on to the rock fill on spread footing provided that there is no danger of scouring out of the fill material or of

cont'd /4...

5.1) Structure Foundations: (cont'd)

the subsoil below the fill material. A safe load of 2 t.s.f. may be used for design purposes in this case. Concrete working slab of 6" should be provided underneath the footings.

As an alternative the abutments may be supported on piled foundations driven through the fill material. In this case the fill below the footings must consist of a material other than rock fill to allow penetration by the piles. This fill material should be blanketed by rock fill to provide some protection against scour. The most suitable type of piles would be steel 'H' piles driven to bedrock. The maximum allowable load for the pile section may be used.

Piers:

The proposed west pier may be founded directly on the bedrock surface with a safe net pressure of 10 t.s.f. A dewatering scheme will be required as excavations will be carried out below river water levels.

The proposed east pier should be founded directly on to the bedrock as for the west pier, or on steel 'H' piles driven to the bedrock. The maximum allowable load for the pile section should be used. The most economical solution should be adopted..

Consideration should be given to shifting the proposed line some 25 ft. south. This would facilitate the construction of the west pier since the bedrock is shallower and has a more even surface than at the present location.

cont'd /5....

5.2) Approach Fills:

The profile grade of the new highway at the proposed structure location varies from elev. 760 to elev. 765. This indicates that the maximum height approach embankments will be in the order of some 35 feet. No stability problems are anticipated and the following standard slopes may be used.

Rock Fill: $1\frac{1}{4}$ horizontal to 1 vertical.

Earth Fill: 2 horizontal to 1 vertical.

6. SUMMARY:

A three span structure is proposed at the crossing of Joseph River and relocated Hwy 632 (Line F) to replace the existing single lane Bailey bridge.

The subsoil at the site generally consists of 3 to 22 feet of loose to very dense silty sand followed by bedrock. In B.H. #6 a deposit of 16 ft of soft to firm silty clay was encountered above the sand stratum.

The structure can be supported directly on bedrock or on steel 'H' end bearing piles as discussed in chapter 5.

No approach fill stability problems are anticipated.

7. MISCELLANEOUS:

The field work was carried out during July 2 to July 15, 1964 under the supervision of Mr. V. Korlu, Proj. Found. Eng., who also wrote this report. The report was reviewed by Mr. M. Devata, Senior Found. Eng.

The drilling equipment was provided by Longyear Co. of Toronto.

October 13, 1964.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - INTERIOR
MATERIALS RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 32/36; 15' to left of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE July 6, 1964.

COMPILED BY V.K.

METHOD Geodetic

BOREHOLE TYPE Washboring; BX casing.

CHECKED BY M.D.

SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		FLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — % WATER CONTENT %	BULK DENSITY pcf	REMARKS
		NUMBER	TYPE			20	40	60	80	100			
741.0 Waterlevel					740								
0.0													
Water													
729.0					730								
12.0													
Silty sand, (trace of gravel)		1	SS 6										
Loose to v. dense.		2	SS 17		720								
		3	SS 27										
		4	SS 151		710								
34.0 Bedrock		5	RC 100%										
Metamorphic Schist			Rec										
39.0 End of borehole.					700								

DEPARTMENT OF HIGHWAY CONSTRUCTION
MATERIALS RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

64-F-47

LOCATION Sta. 32+36; 15' to Rt. of Line "F"

ORIGINATED BY V.K.

272-63

BORING DATE July 7, 1964.

COMPILED BY V.K.

METHOD Geodetic

BORING TYPE Washboring, BX Casing.

CHECKED BY M.D.

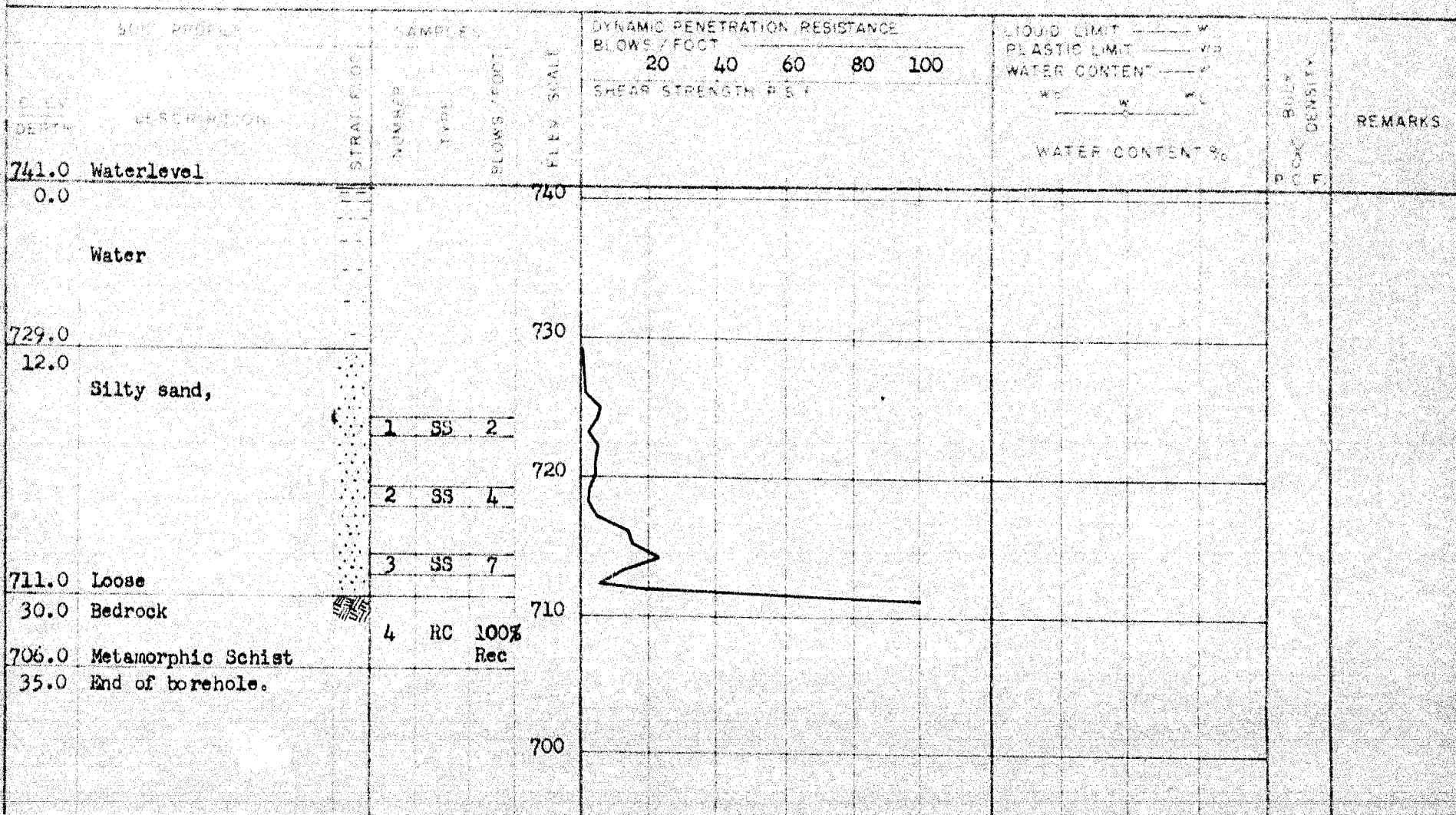
DEPTH	STRAT. PLT	SAMPLE		BLWS. FT.	ELEV. FEET	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _p			SOIL DENSITY P.C.F.	REMARKS
		NUMBER	TYPE			20	40	60	80	100	PLASTIC LIMIT — W _p				
						SHEAR STRENGTH P.S.F.					WATER CONTENT — W _p				
											W _p — W _L				
											WATER CONTENT %				
741.0					740										
728.5					730										
12.5															
721.0		1	SS 10												
20.0		2	RC 100% Rec.		720										
716.0															
25.0															

DEPARTMENT OF HIGHWAYS, DISTRICT
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB NO. 64-F-47 LOCATION Sta. 31+88; 15' to Rt. of Line "F" ORIGINATED BY V.K.
 W.P. 272-63 BORING DATE July 7, 1964. COMPILED BY V.K.
 METHOD Geodetic BOREHOLE TYPE Washboring, BX casing. CHECKED BY M.D.

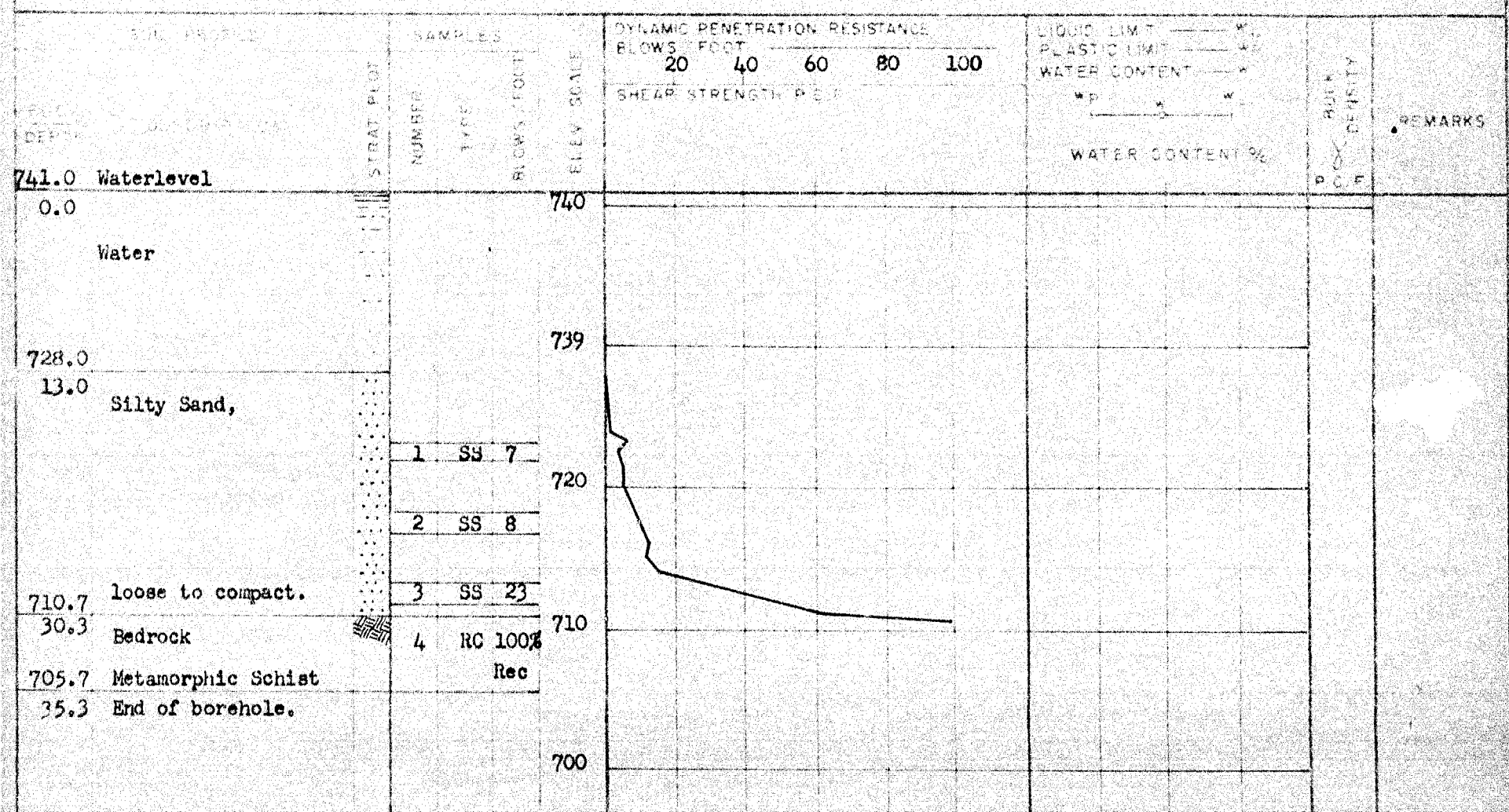


DEPARTMENT OF HIGHWAYS & CONCRETE
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

BOREHOLE NO. 64-F-47 LOCATION Sta. 31+88; 15' Lt. of Line "F" ORIGINATED BY V.K.
 V.P. NO. 272-63 BORING DATE July 8, 1964. COMPILED BY V.K.
 DATA TYPE Geodetic BOREHOLE TYPE Washboring; BX casing. CHECKED BY M.D.



DEPARTMENT OF HIGHWAYS - CENTRAL
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+13; 15' to Lt. of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE July 9, 1964.

COMPILED BY V.K.

DATE Geodetic

BOREHOLE TYPE Wash and boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE

SAMPLES

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT

20 40 60 80 100

SHEAR STRENGTH P.S.F.

LIQUID LIMIT ——— W_LPLASTIC LIMIT ——— W_P

WATER CONTENT ——— W

W_P ——— W_L

WATER CONTENT %

BULK
DENSITY
P.C.F.

REMARKS

741.0 Waterlevel

0.0 Water

740

730.0

11.0 Silty clay
occasional pieces of
gravel.

Soft to firm.

730

1 SS 2

720

2 SS 6

714.0

27.0 Sand and gravel.
Very dense.

710

30.5 Bedrock

3 SS 66

4 RC 100%

Metamorphic Schist

Rec

35.5 End of borehole.

700

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+13; 15' to Rt. of Line "F"

ORIGINATED BY V.K.

W. O. 272-63

BORING DATE July 9, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash and boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W _L			ALIGNED BULK DENSITY PCF	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLT.	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT							PLASTIC LIMIT — W _P		
							20	40	60	80	100			WATER CONTENT — W		
							SHEAR STRENGTH P.S.F.							W _P	W _L	W _U
WATER CONTENT %																
741.0	Waterlevel															
0.0	Water					740										
731.0																
10.0	Silty sand					730										
15.5	Bedrock															
	Metamorphic Schist		1	RC 100% Rec		720										
20.5	End of borehole.					710										

DEPARTMENT OF HIGHWAYS - MATERIALS
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

WELL NO. 64-F-47 LOCATION Sta. 30+67; 15' to Rt. of Line "F" ORIGINATED BY V.K.
 W.D. NO. 272-63 BORING DATE July 10, 1964. COMPILED BY V.K.
 METHOD Geodetic BOREHOLE TYPE Wash and boring; BX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	FLUID LIMIT — WL PLASTIC LIMIT — PL WATER CONTENT — W SHEAR STRENGTH — P.S.F.	WATER CONTENT % WL PL	UNIT WEIGHT P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE					
741.0	Waterlevel							
0.0	Water							
732.0								
9.0	Silty sand (trace of gravel) Compact	1	SS 17					
723.5								
17.5	Bedrock	2	RC 100% Rec					
718.5	Metamorphic Schist							
22.5	End of borehole.							

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 30+67; 15' to Lt. of Line "F" ORIGINATED BY V.K.
 W. # 272-63 BORING DATE July 13, 1964. COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Wash and boring; BX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ——— W _L			P. C. F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE			BLOWS / FOOT 20 40 60 80 100	PLASTIC LIMIT ——— W _P	WATER CONTENT ——— W	WATER CONTENT %		
741.0	Waterlevel				740						
0.0	Water										
730.0					730						
11.0	Silty sand,	1	SS	16							
		2	SS	25	720						
717.0	Compact										
24.0	Bedrock	3	RC	100%							
712.0	Metamorphic Schist			Rec	710						
29.0	End of borehole.				700						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 30+26; E of Line "P" ORIGINATED BY V.K.
W. B. 272-63 BORING DATE July 14, 1964. COMPILED BY V.K.
DATUM Geodetic BOREHOLE TYPE Wash and boring BX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W _c		BULK DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLUG	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100		
741.0	Waterlevel												
0.0	Water					740							
731.0													
10.0	Silty sand					730							
	(trace of gravel)		1	SS	19								
	loose to v. dense.		2	SS	76	720							
718.0													
23.0	Bedrock		3	FC	100%								
713.0	Metamorphic Schist				Rec								
28.0	End of borehole.					710							
						700							

FOUNDATION SECTION

LOG	64-F-47	LOCATION	Sta. 29+86; E of Line "P"	ORIGINATED BY	V.K.
WELL	272-63	BORING DATE	July 14, 1964	COMPILED BY	V.K.
TEST	Geodetic	BORING TYPE	Wash and boring; BX casing.	CHECKED BY	M.D.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 30+67; 30' to Rt. of Line "F"
 W.P. 272-63 BORING DATE Aug. 14, 1964.
 METHOD Geodetic BOREHOLE TYPE Wash and boring; BX casing.
 ORIGINATED BY V.K.
 COMPILED BY V.K.
 CHECKED BY M.D.

SOIL PROFILE	DISCUSSION	DEPTH	STRAT. PLCT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — % WATER CONTENT %	ROCK DENSITY	REMARKS
				NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100			
741.0	Waterlevel	0.0					740								
	Water														
730.5							730								
10.5	Silty sand (trace of gravel) compact.			1	SS	20									
				2	SS	18									
719.0							720								
22.0	Bedrock			3	RC	100%									
714.0	Metamorphic Schist					Rec									
27.0	End of borehole.						710								
							700								

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF MINERAL INVESTIGATION
MATERIALS RESEARCH DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 30467; E of Line "F" ORIGINATED BY V.K.
272-63 BORING DATE Aug. 16, 1964. COMPILED BY V.K.
CATAL Geodetic BOREHOLE TYPE Wash and boring; BX casing. CHECKED BY M.D.

DEPTH FEET	SOIL PROFILE	SAMPLE NUMBER	TYPE	BLOW FEET	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT % PLASTIC LIMIT % WATER CONTENT % WATER CONTENT %	BULK DENSITY PCF	REMARKS
						20	40	60	80	100			
741.0	Waterlevel												
0.0					740								
	Water												
729.0					730								
12.0	Silty sand, (trace of gravel),	1	SS	14									
720.0	Compact	2	SS	19									
21.0		3	RC	100%	720								
715.0	Metamorphic Schist			Rec.									
26.0	End of borehole.												
					710								
					700								

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 15

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31/12, E of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

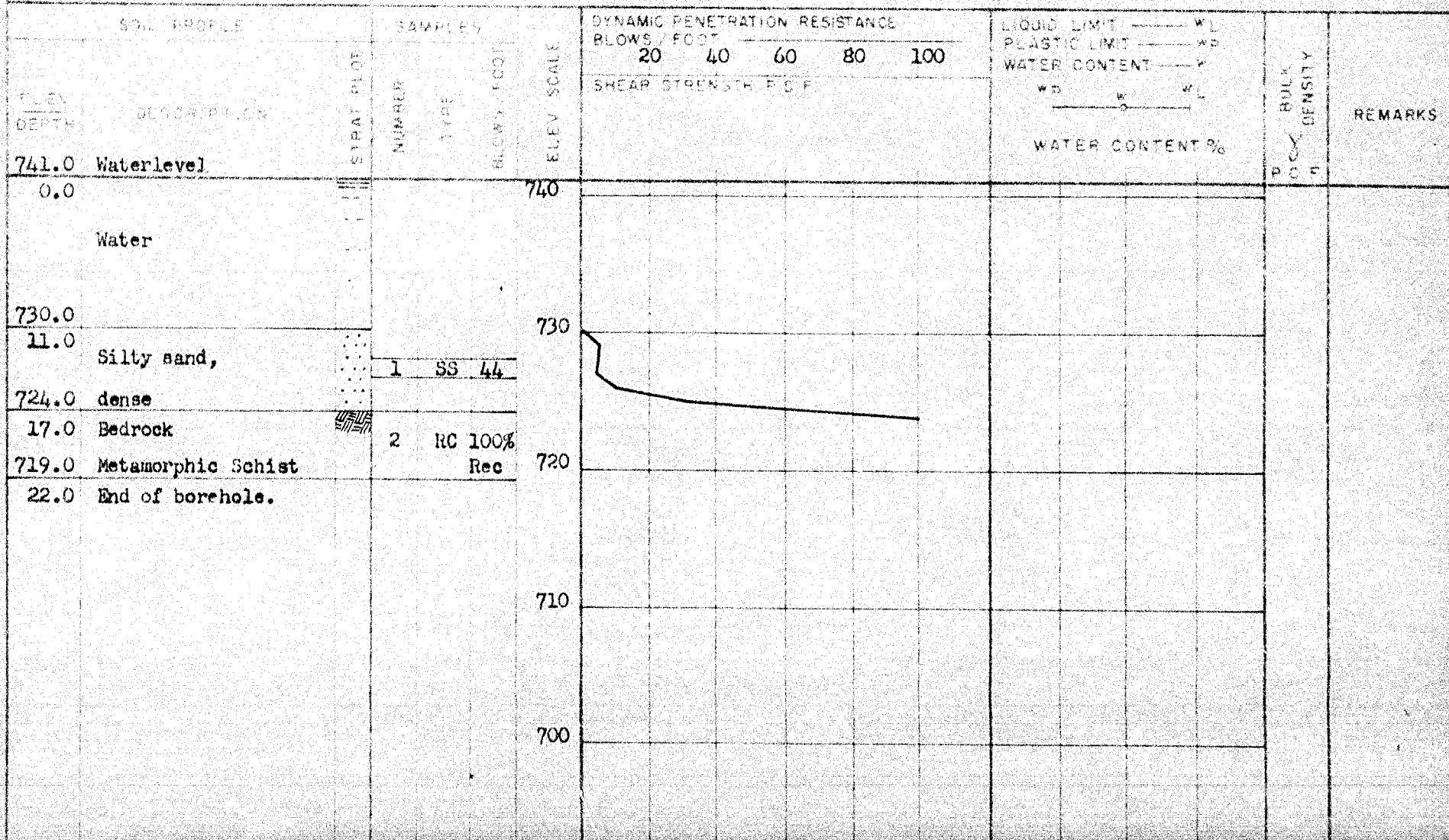
BORING DATE Aug. 16, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash and boring; BK casing.

CHECKED BY H.D.



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 16

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 31+13; 29' to Rt. of Line "F" ORIGINATED BY V.K.
W.P. 272-63 BORING DATE Aug. 17, 1964. COMPILED BY V.K.
DATUM Geodetic BOREHOLE CASE Wash and boring BX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL			REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT						PLASTIC LIMIT ——— WP
							20	40	60	80	100		WATER CONTENT ——— W
							SHEAR STRENGTH P.S.F.						WD
										WATER CONTENT %			
741.0	Waterlevel												
0.0	water					740							
731.0													
10.0	Silty sand (trace of gravel)					730							
725.0	Compact		1	SS	25								
16.0	Bedrock		2	RC	100%								
720.0	Metamorphic Schist				Rec	720							
21.0	End of borehole.												
						710							
						700							

DEPARTMENT OF HIGHWAYS, OFFICE OF
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 17

FOUNDATION SECTION

64-F-47 LOCATION Sta. 31+50; 29' to Rt. of Line "F" ORIGINATED BY V.K.
 272-63 BORING DATE Aug. 17, 1964. COMPILED BY V.K.
 Geodetic BOREHOLE TYPE Wash boring; BX casing. CHECKED BY M.D.

SOIL PROFILE	DEPTH FEET	STRAT. UNIT	SAMPLES		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W _c W _D ——— W _c ——— W _L WATER CONTENT %	BULK DENSITY PC F.	REMARKS
			NUMBER	TYPE			20	40	60	80	100			
741.0 Waterlevel	0.0	Water				740								
732.0	9.0	Silty sand,				730								
718.5 loose			1	SS	5	720								
22.5 Bedrock			2	RC	100%									
713.5 Metamorphic Schist					Rec									
27.5 End of borehole.						710								
						700								

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 19

FOUNDATION SECTION

NO. 64-F-47 LOCATION Sta. 31+50; 15' to Lt. of Line "F" ORIGINATED BY V.K.
 W.P. 272-63 BORING DATE Aug. 17, 1964. COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration. CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100		
741.0	Waterlevel				740							
	Water											
731.0					730							
10.0												
712.5					720							
28.5	End of Cone Penetration				710							
					700							

DEPARTMENT OF HIGHWAYS AND
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 20

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+88; 27' to Rt. of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE Aug. 19, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %		ROCK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100		
741.0	Waterlevel											
0.0	Water				740							
730.0					730							
11.0	Silty sand,											
			1 SS	13								
			2 SS	17	720							
714.0	compact.											
27.0	Bedrock		3 RC	100%								
				Rec	710							
709.0	Metamorphic Schist											
32.0	End of borehole.				700							

FOUNDATION SECTION

ORIGINATED BY V.K.

CONFIDENTIAL V.K.

THE CREDIT M.D.

SOIL PROFILE		SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LQUID LIMIT ——— %	BULK DENSITY	REMARKS
DEPTH	DESCRIPTION	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT 20 40 60 80 100		
					SHEAR STRENGTH P.S.F.	WATER CONTENT ——— % * * *		
741.0	Waterlevel			740				
0.0	Water							
731.5								
9.5	Silty sand,			730				
728.5	loose							
12.5	Bedrock							
		1	HC 100%					
			Rec					
718.5	Metamorphic Schist			720				
22.5	End of borehole.							
				710				
				700				

DEPARTMENT OF HIGHWAYS - CIVIL
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 23

FOUNDATION SECTION

64-F-47

LOCATION Sta. 32+36; E of Line "F"

ORIGINATED BY V.K.

272-63

Aug. 20, 1964.

COMPILED BY V.K.

Geodetic

Wash boring; BX casing.

CHECKED BY _____ M.D.

DEPTH		DESCRIPTION	STRAT. FLO.	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT	LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	WATER CONTENT %	BULK DENSITY	REMARKS
								20 40 60 80 100						
741.0	0.0	Waterlevel					740							
		Water												
730.5	10.5	Silty sand, compact.		1	SS	13	730							
				2	SS	18	720							
23.0		Bedrock Metamorphic Schist		3	RC	100% Rec								
28.0		End of borehole.					710							
							700							

ORIGINATED BY V.K.

COMPILED BY Y.K.

SIGNED BY _____ M.D.

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT

20	40	60	80	100
SHEAR STRENGTH, P.S.F.				

DEPARTMENT OF HIGHWAYS - MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 26

FOUNDATION SECTION

64-F-47

LOCATION Sta. 31+88; 92' Rt. of Line "P"

ORIGINATED BY V.K.

W.P. 272-63

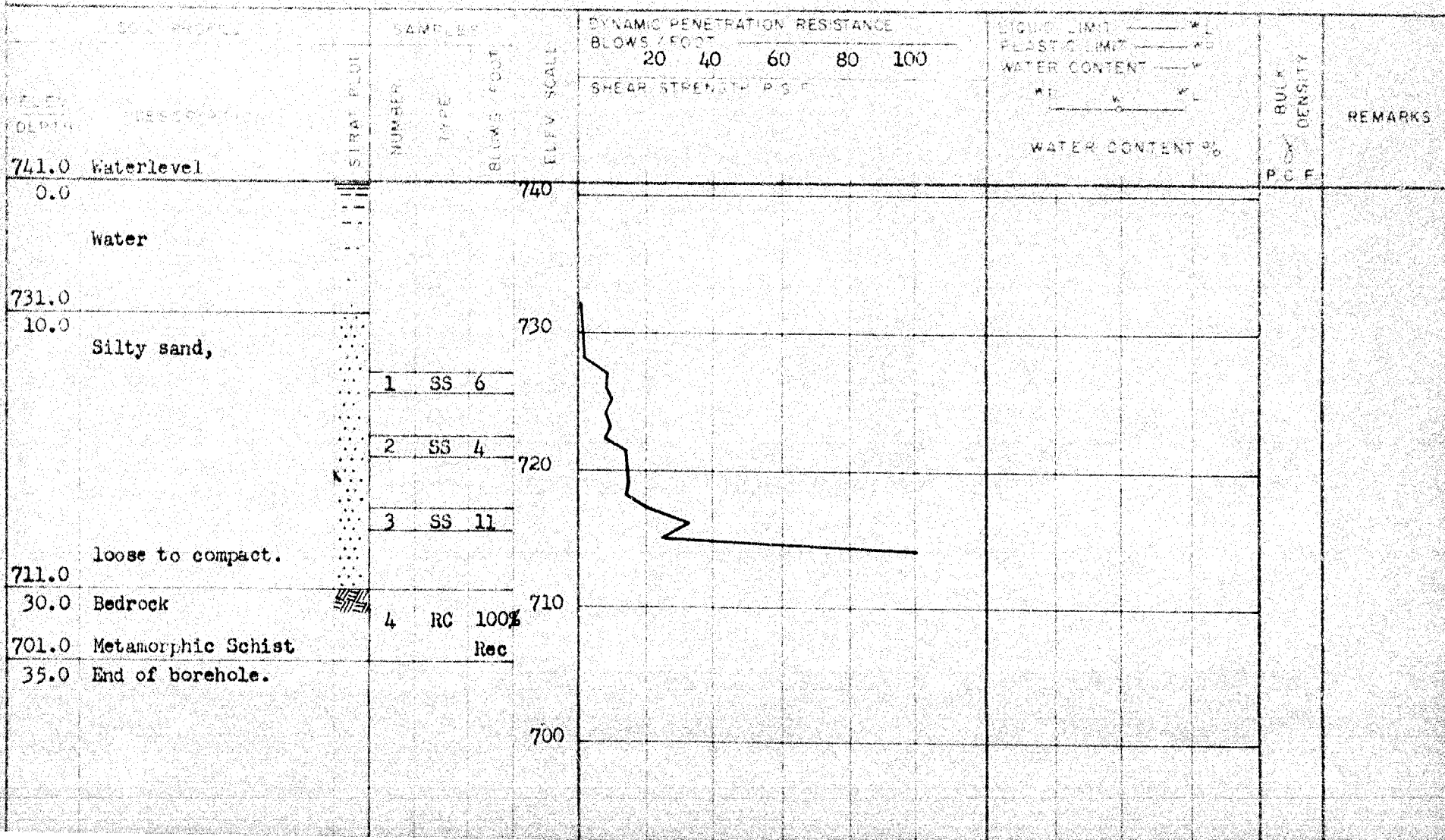
BORING DATE Aug. 24, 1964.

COMPILED BY V.K.

CATEGORY Geodetic

BOREHOLE TYPE Wash boring; BX casing.

CHECKED BY M.D.



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 27

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+50; 92' Rt. of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

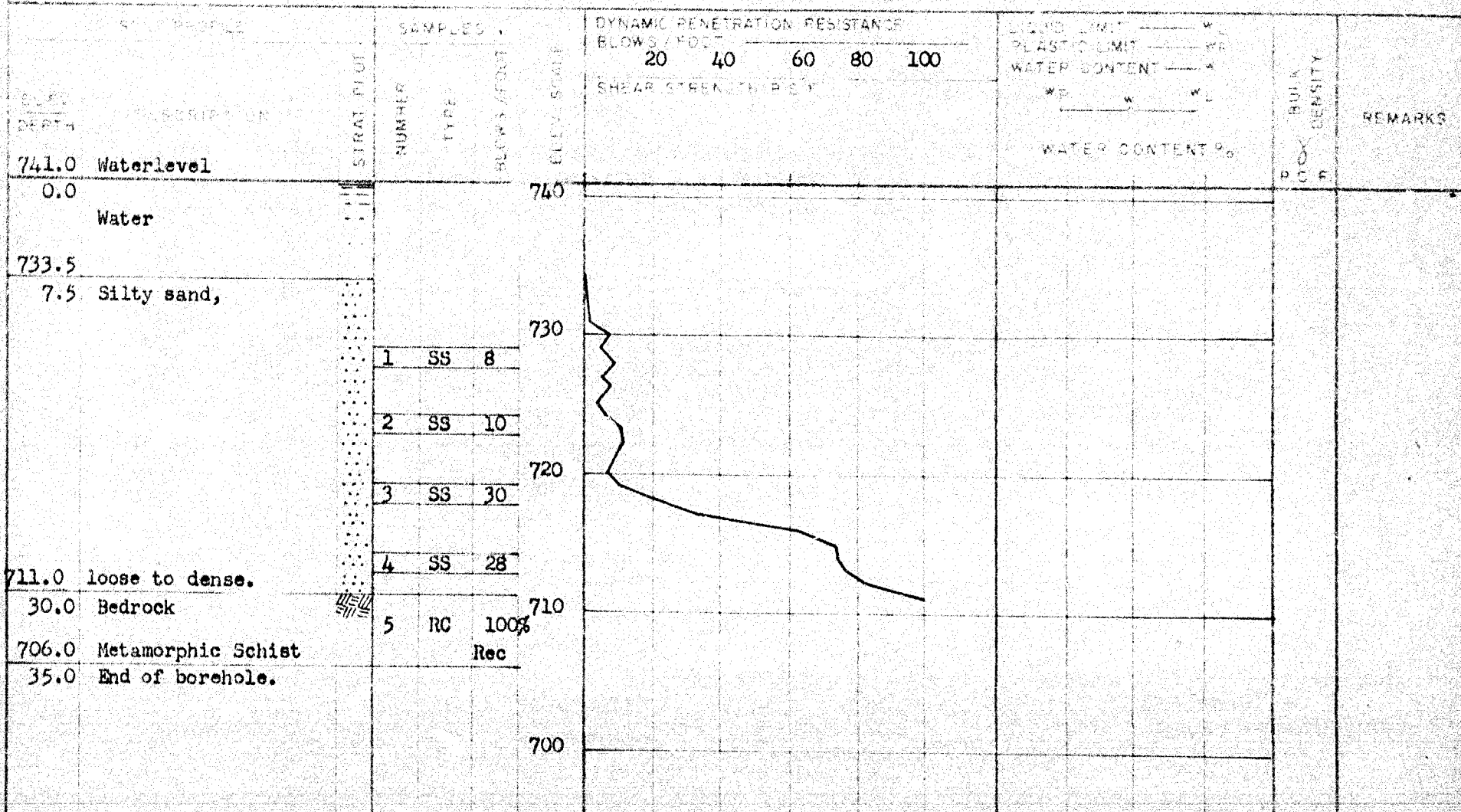
BORING DATE Aug. 25, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash boring; BX casing.

CHECKED BY M.D.



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 28

FOUNDATION SECTION

64-F-47

LOCATION Sta. 31/13; 90' Rt. of Line "F"

ORIGINATED BY V.K.

272-63

BOILING DATE AUG. 26, 1964.

COMPILED BY V.K.

DATA Geodetic

Wash and boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— W _L		BULK DENSITY P.C.F.	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT							PLASTIC LIMIT ——— W _P	
							20	40	60	80	100			WATER CONTENT ——— W	
							SHEAR STRENGTH P.S.F.					WATER CONTENT %			
741.0	Waterlevel														
0.0	Water					740									
733.5															
7.5	Silty sand,					730									
			1	SS	8										
			2	SS	14										
						720									
721.0	loose to compact.														
20.0	Bedrock														
716.0	Metamorphic Schist		3	RC	100% Rec										
25.0	End of borehole.					710									
						700									

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

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
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
$\bar{\sigma}$	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 (YOUNG'S 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_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
θ	ANGLE OF SLOPE TO HORIZONTAL

MEMORANDUM

23-66-47

W.P. 272-63

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

FROM: Foundation Section,
Materials and Research Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: October 13, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed new structure over Joseph
River and Hwy #632 (Line 'F')
Dist. #11
Twp: Medora Lot: 19 Con 1X
W.J. 64-F-47 W.P. 272-63

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

We believe that you will find the factual data and
recommendations contained therein, adequate for your future
design work. Should you require additional information,
please do not hesitate to contact our Office.

AGS/PB
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
H. McArthur
E. H. Jones
T. J. Kovich
A. Watt

[Signature]
J. A. C. Stermac,
PRINCIPAL FOUNDATION ENGINEER

Foundations Office
Gen. Files

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 2. DESCRIPTION OF SITE
 3. DESCRIPTION OF THE FIELD WORK
 4. SUBSOIL CONDITIONS
 - 4.1) Silty Sand
 - 4.2) Bedrock (Metamorphic Schist)
 5. DISCUSSION & RECOMMENDATIONS.
 - 5.1) Structure Foundations
 - 5.2) Approach Fills
 6. SUMMARY.
 7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT

For

Proposed new structure over Joseph River
and Hwy #632 (Line 'F') - Dist #11
Twp: Medora Lot: 19 Con IX
W.J. 64-F -47 W.P. 272-63

1. INTRODUCTION:

A foundation investigation at the site of the proposed Hwy #632 (Line 'F') and Joseph River crossing was requested in a memo dated June 17th, 1964 from Mr. J. McAllister of the Bridge Planning section.

Two field investigations were subsequently carried out by this section to determine the subsoil conditions at the site. This report contains the results of these investigations together with our recommendations pertaining to the design of the proposed structure foundations.

2. DESCRIPTION OF SITE:

The site of the proposed Hwy #632 and Joseph river crossing is about 5 miles north of Port Sandfield. Joseph river is one of the waterways which links lake Joseph with lake Rousseau in Lake of the Woods county. The area is characterized by forest covered hills which surround the lakes. The bedrock outcrop is exposed extensively at the slopes. The area is in the physiographic region known as the "Canadian Shield".

cont'd /2...

3. DESCRIPTION OF THE FIELD WORK:

The field investigations were carried out by means of a diamond drill machine mounted on a raft. The work consisted of drilling some 26 boreholes in order to establish a sectional profile of the subsoil at the proposed pier and abutment locations with reference to line "F". In granular material sampling was carried out by means of a 2" O.D. split spoon sampler and the energy used to drive it conforms with the requirements of the Standard Penetration Test. The bedrock was drilled and AXT core samples were recovered.

The locations and elevations of the boreholes are shown on the attached drawing no. 64-F-47A.

4. SUBSOIL CONDITIONS:

The investigations show that the bedrock is overlain by a deposit of silty sand with occasional gravel. In B.H. 6 the overburden material was clayey silt at the top changing to silty clay with occasional pieces of gravel.

4.1) Silty Sand:

This material overlying the bedrock is basically silty sand which varies in thickness from 2.5 ft. in B.H. 22 to 22.5 ft. in B.H. 27. The upper portion of the layer has traces of organic matter. The remainder of the layer contains occasional gravel. The layer is in loose to very dense state of compaction, having an 'N' value range of 2 to over 100 blows per foot.

In B.H. 6 a deposit of silty clay was observed. This material is about 16 ft. thick and overlies the silty sand layer. The upper 8-10 ft. is very soft. During dynamic cone penetration

4.1) Silty Sand: (Cont'd)

test the A-rod went through the upper 8-10 ft. with a single blow of the hammer. The lower 6 ft. of the material is firm and contains occasional pieces of gravel.

4.2) Bedrock: (Metamorphic Schist)

The bedrock underlying the silty sand layer was drilled and AXT core samples were recovered. In all the boreholes the core recovery was 100%. The bedrock is similar in all the holes and was identified as Metamorphic Schist .

5. DISCUSSION & RECOMMENDATIONS:

It is proposed to construct a three span structure (45'-75'-45') where the relocated Hwy No. 632 (Line F) crosses the Joseph River. The new structure will replace the existing single lane three span Bailey bridge located some 60 ft. south of the Q of Hwy 632 (Line 'F'). The existing Bailey bridge is supported on rock filled timber cribs.

The subsoil at the site generally consists of 3 to 22 ft. of loose to very dense silty sand followed by schist bedrock. In view of the variable depth of bedrock below the river bottom, detailed bedrock profiles were established at the proposed piers and abutments locations and are shown on Dwg. 64-F-47A.

5.1) Structure Foundations:

Abutments:

The proposed abutments may be founded directly on to the rock fill on spread footing provided that there is no danger of scouring out of the fill material or of

cont'd /4...

5.1) Structure Foundations: (cont'd)

the subsoil below the fill material. A safe load of 2 t.s.f. may be used for design purposes in this case. Concrete working slab of 6" should be provided underneath the footings.

As an alternative the abutments may be supported on piled foundations driven through the fill material. In this case the fill below the footings must consist of a material other than rock fill to allow penetration by the piles. This fill material should be blanketed by rock fill to provide some protection against scour. The most suitable type of piles would be steel 'H' piles driven to bedrock. The maximum allowable load for the pile section may be used.

Piers:

The proposed west pier may be founded directly on the bedrock surface with a safe net pressure of 10 t.s.f. A dewatering scheme will be required as excavations will be carried out below river water levels.

The proposed east pier should be founded directly on to the bedrock as for the west pier, or on steel 'H' piles driven to the bedrock. The maximum allowable load for the pile section should be used. The most economical solution should be adopted..

Consideration should be given to shifting the proposed line some 25 ft. south. This would facilitate the construction of the west pier since the bedrock is shallower and has a more even surface than at the present location.

cont'd /5....

5.2) Approach Fills:

The profile grade of the new highway at the proposed structure location varies from elev. 760 to elev. 765. This indicates that the maximum height approach embankments will be in the order of some 35 feet. No stability problems are anticipated and the following standard slopes may be used.

Rock Fill: 1 $\frac{1}{2}$ horizontal to 1 vertical.

Earth Fill: 2 horizontal to 1 vertical.

6. SUMMARY:

A three span structure is proposed at the crossing of Joseph River and relocated Hwy 632 (Line F) to replace the existing single lane Bailey bridge.

The subsoil at the site generally consists of 3 to 22 feet of loose to very dense silty sand followed by bedrock. In B.H. #6 a deposit of 16 ft of soft to firm silty clay was encountered above the sand stratum.

The structure can be supported directly on bedrock or on steel 'H' end bearing piles as discussed in chapter 5.

No approach fill stability problems are anticipated.

7. MISCELLANEOUS:

The field work was carried out during July 2 to July 15, 1964 under the supervision of Mr. V. Korlu, Proj. Found. Eng., who also wrote this report. The report was reviewed by Mr. M. Devata, Senior Found. Eng.

The drilling equipment was provided by LongyearCo. of Toronto.

October 13, 1964.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 32+76; on E of Line "P"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE July 3, 1964.

COMPILED BY V.K.

CATUM Geodetic

BORING TYPE Wash and boring; BX Casing.

CHECKED BY M.D.

SOIL SAMPLES		SAMPLER		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %		BULK DENSITY pcf	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100		
741.0	Waterlevel				740							
0.0	Water											
735.0	6.0 Silty sand (trace of gravel)				730							
	Loose to v. dense.		1 SS 9									
723.0			2 SS 64									
18.0	Bedrock		3 RC 100% Rec		720							
718.0	Metamorphic Schist											
23.0	End of borehole.				710							
					700							

DEPARTMENT OF HIGHWAYS
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

64-F-47

Sta. 32/36; 15' to left of Line "F"

ORIGINATED BY V.K.

272-63

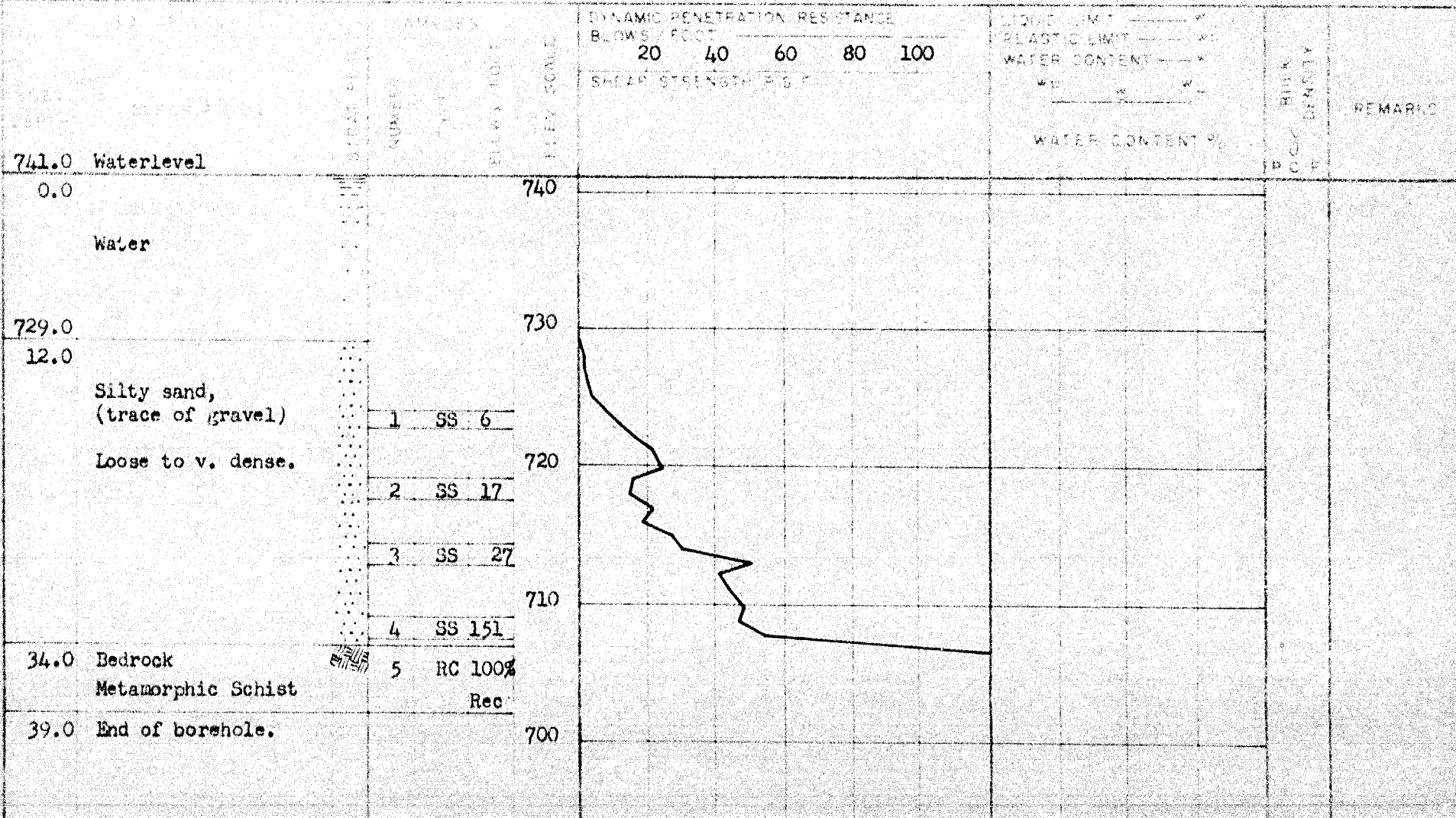
July 6, 1964.

COMPILED BY V.K.

Geodetic

Washboring; BX casing.

CHECKED BY M.D.



DEPARTMENT OF HIGHWAYS - TECHNICAL MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

64-F-47	LOCATION	Sta. 31+88; 15' to Rt. of Line "E"	ORIGINATED BY	V.K.
272-63	BOREHOLE DATE	July 7, 1964.	COMPILED BY	V.K.
Geodetic	BOREHOLE TYPE	Washboring, BX casing.	CHECKED BY	M.D.

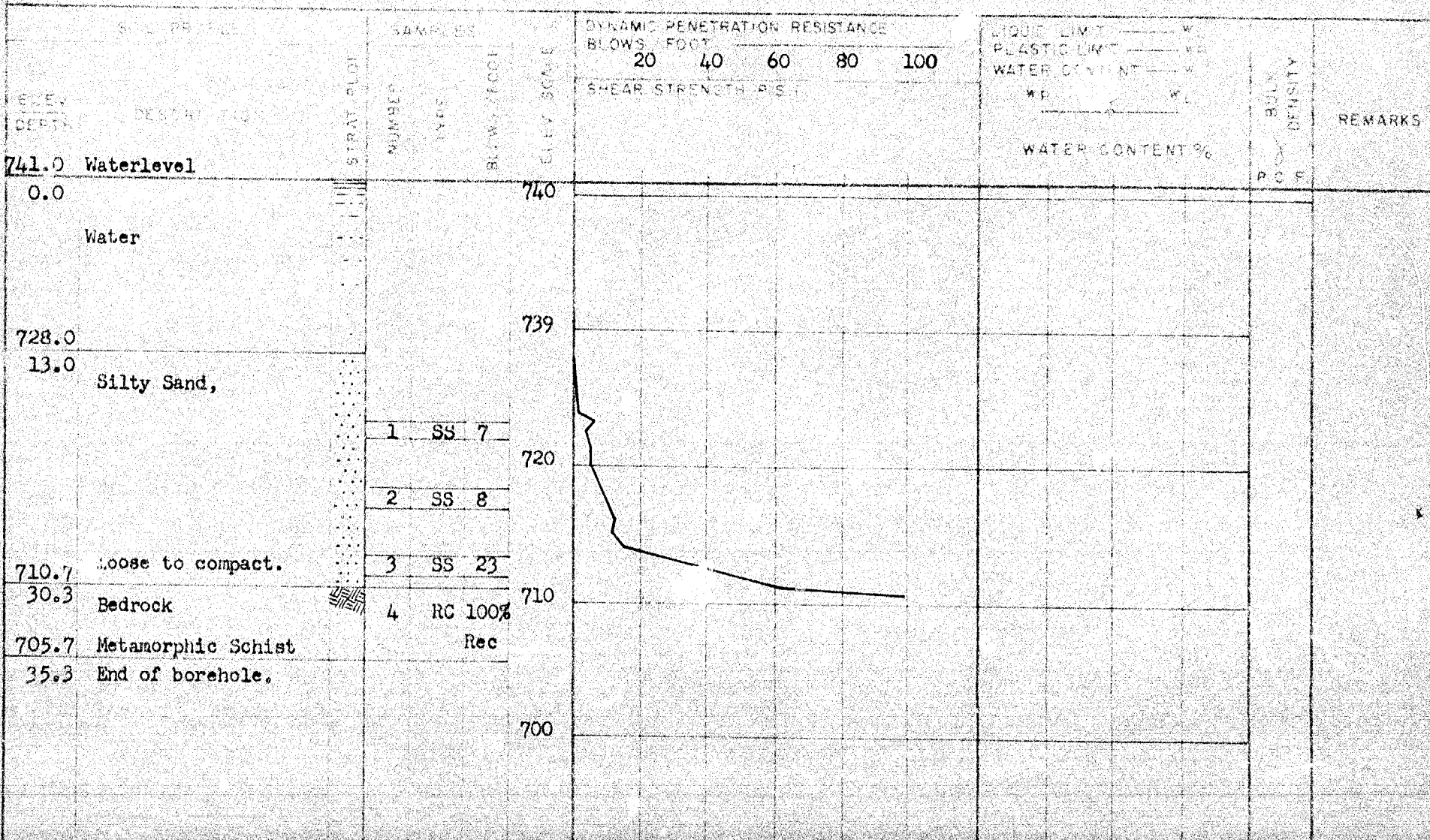
SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT _____ % PLASTIC LIMIT _____ % WATER CONTENT _____ %	BULK DENSITY P C F	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. FLAG	NUMBER TYPE	BLOWS / FOOT	SHEAR STRENGTH P S Y		
741.0	Waterlevel						
0.0				740			
	Water						
729.0				730			
12.0	Silty sand,						
			1 SS 2				
			2 SS 4	720			
			3 SS 7				
711.0	Loose						
30.0	Bedrock			710			
			4 RC 100% Rec				
706.0	Metamorphic Schist						
35.0	End of borehole.			700			

DEPARTMENT OF HIGHWAYS
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 31+88; 15' Lt. of Line "F" ORIGINATED BY V.K.
 W.C. 272-63 STARTING DATE July 8, 1964. COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Washboring; BX casing. CHECKED BY M.D.



DEPARTMENT OF HIGHWAYS - CONTRACT
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+13; 15' to Lt. of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE July 9, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash and boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE

SAMPLES

DYNAMIC PENETRATION RESISTANCE

BLOWS / FOOT

20 40 60 80 100

SHEAR STRENGTH P.S.F.

LIQUID LIMIT ——— WL

PLASTIC LIMIT ——— PL

WATER CONTENT ——— W

W ——— W ——— WL

WATER CONTENT %

BULK
DENSITY

P.C.F.

REMARKS

741.0 Waterlevel

0.0 Water

730.0

11.0 Silty clay
occasional pieces of
gravel.

Soft to firm.

714.0

27.0 Sand and gravel.
Very dense.

30.5 Bedrock

Metamorphic Schist

35.5 End of borehole.

1 SS 2

2 SS 6

3 SS 66

4 RC 100%

Rec

740

730

720

710

700

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+13; 15' to Rt. of Line "F"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE July 9, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash and boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY pcf	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100		
741.0	Waterlevel				740							
0.0	Water											
731.0					730							
10.0	Silty sand											
15.5	Bedrock		1	RC 100%	720							
	Metamorphic Schist			Rec								
20.5	End of borehole.				710							

DEPARTMENT OF THE ARMY
 MATERIAL & RESEARCH CENTER

RECORD OF BOREHOLE NO 8

FOUNDATION SECTION

64-F-47

LOCATION Sta. 30/67; 15' to Rt. of Line "F"

ORIGINATED BY V.K.

272-63

BORING DATE July 10, 1964.

COMPILED BY V.K.

METHOD Geodetic

BOREHOLE TYPE Wash and boring; BX casing.

CHECKED BY M.D.

DEPTH FEET	SOIL TYPE	SAMPLE NUMBER	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQ. LIMIT PLAST. LIMIT WATER CONTENT W _p W _L W _u	BULK DENSITY P.C.F.	REMARKS
					20	40	60	80	100			
741.0	Waterlevel			740								
0.0	Water											
732.0												
9.0	Silty sand (trace of gravel) Compact	1 SS 17		730								
723.5												
17.5	Bedrock	2 RC 100% Rec		720								
718.5	Metamorphic Schist											
22.5	End of borehole.											
				710								
				700								

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 9

FOUNDATION SECTION

JOE 64-F-47 LOCATION Sta. 30+67; 15' to Lt. of Line "F" ORIGINATED BY V.K.
 W.P. 272-63 BORING DATE July 13, 1964. COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Wash and boring; BX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— *L PLASTIC LIMIT ——— *P WATER CONTENT ——— *W		BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100		
741.0	Waterlevel											
0.0	Water				740							
730.0					730							
11.0	Silty sand,	1	SS	16								
717.0	Compact	2	SS	25	720							
24.0	Bedrock	3	RC	100%								
712.0	Metamorphic Schist			Rec								
29.0	End of borehole.				710							
					700							

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 10

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 30+26; E of Line "P"

W.P. 272-63 BORING DATE July 14, 1964.

DATUM Geodetic BOREHOLE TYPE Wash and boring BX Casing.

ORIGINATED BY V.K.

COMPILED BY V.K.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT _____ W _L		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT 20 40 60 80 100						
						SHEAR STRENGTH P.S.F.					WATER CONTENT _____ W	P.C.F.
											W _P W W _L	
											WATER CONTENT %	
741.0	Waterlevel											
0.0	Water				740							
731.0												
10.0	Silty sand				730							
	(trace of gravel)	1	SS	19								
	loose to v. dense.	2	SS	76	720							
718.0												
23.0	Bedrock	3	RC	100%								
713.0	Metamorphic Schist			Rec								
28.0	End of borehole.				710							
					700							

DEPARTMENT OF HIGHWAYS
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 11

FOUNDATION SECTION

OF 64-F-47 LOCATION Sta. 29+86; E of Line "F" ORIGINATED BY V.K.
 # 272-63 BORING DATE July 14, 1964 COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Wash and boring; EX casing. CHECKED BY M.D.

ELEV. DEPTH	DESCRIPTION	SAMPLING ALSO	SAMPLES		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE			20	40	60	80	100			
741.0	Waterlevel													
0.0	Water					740								
736.0														
5.0	Silty sand													
730.0														
11.0	Bedrock					730								
725.0	Metamorphic Schist		1	RC 100%										
16.0	End of borehole.			Rec										
						720								
						710								
						700								

DEPARTMENT OF HIGHWAYS & MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 30+67; 85' Rt. of Line "P"

ORIGINATED BY V.K.

W.P. 272-63

BORING DATE Aug. 13, 1964.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Wash and boring; BX casing.

CHECKED BY M.D.

ELEV. DEPTH	DESCRIPTION	STRAT. PLT	SAMPLES		BLOW COUNT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQ. LIMIT PLAST. LIMIT WATER CONTENT %	BULK DENSITY POUND PER CUBIC FOOT	REMARKS
			NUMBER	TYPE			BLOWS / FOOT	20	40	60	80	100		
741.0	Waterlevel													
0.0	Water					740								
735.5														
5.5	Silty sand, (trace of gravel)		1	SS	38	730								
	dense		2	SS	45									
725.0														
16.0	Bedrock		3	RC	100%									
					Rec									
720.0	Metamorphic Schist					720								
21.0	End of borehole.													
						710								
						700								

FOUNDATION SECTION

ORIGINAL V.K.

... V.K.

H.D.

ELEV DEPTH	DESCRIPTION	SAMPLING METHOD	CORRECTION TYPE	BLOW COUNT	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	WATER CONTENT % PLASTIC LIMIT % SHRINKAGE %	UNIT WEIGHT pcf	REMARKS
741.0	Waterlevel							
0.0	Water							
730.5								
10.5	Silty sand (trace of gravel) compact.	1	SS	20				
719.0		2	SS	18				
22.0	Bedrock	3	RC	100%				
714.0	Metamorphic Schist		Rec					
27.0	End of borehole.							

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 15

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 31+12, E of Line "F" ORIGINATED BY V.K.
 W.P. 272-63 BORING DATE Aug. 16, 1964. COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Wash and boring; BX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WD — W — WL WATER CONTENT %		BULK DENSITY pcf	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER TYPE	BLOWS / FOOT	ELEV SCALE	20	40	60	80	100		
741.0	Waterlevel				740							
0.0	Water											
730.0					730							
11.0	Silty sand,		1 SS 44									
724.0	dense											
17.0	Bedrock		2 RC 100% Rec		720							
719.0	Metamorphic Schist											
22.0	End of borehole.				710							
					700							

DEPARTMENT OF HIGHWAYS - DISTRICT
 MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 16

FOUNDATION SECTION

JOB 64-F-47 LOCATION Sta. 31+13; 29' to Rt. of Line "F" ORIGINATED BY V.K.
 W.P. 272-63 BORING DATE Aug. 17, 1964. COMPILED BY V.K.
 DATUM Geodetic BOREHOLE TYPE Wash and boring BX casing. CHECKED BY M.D.

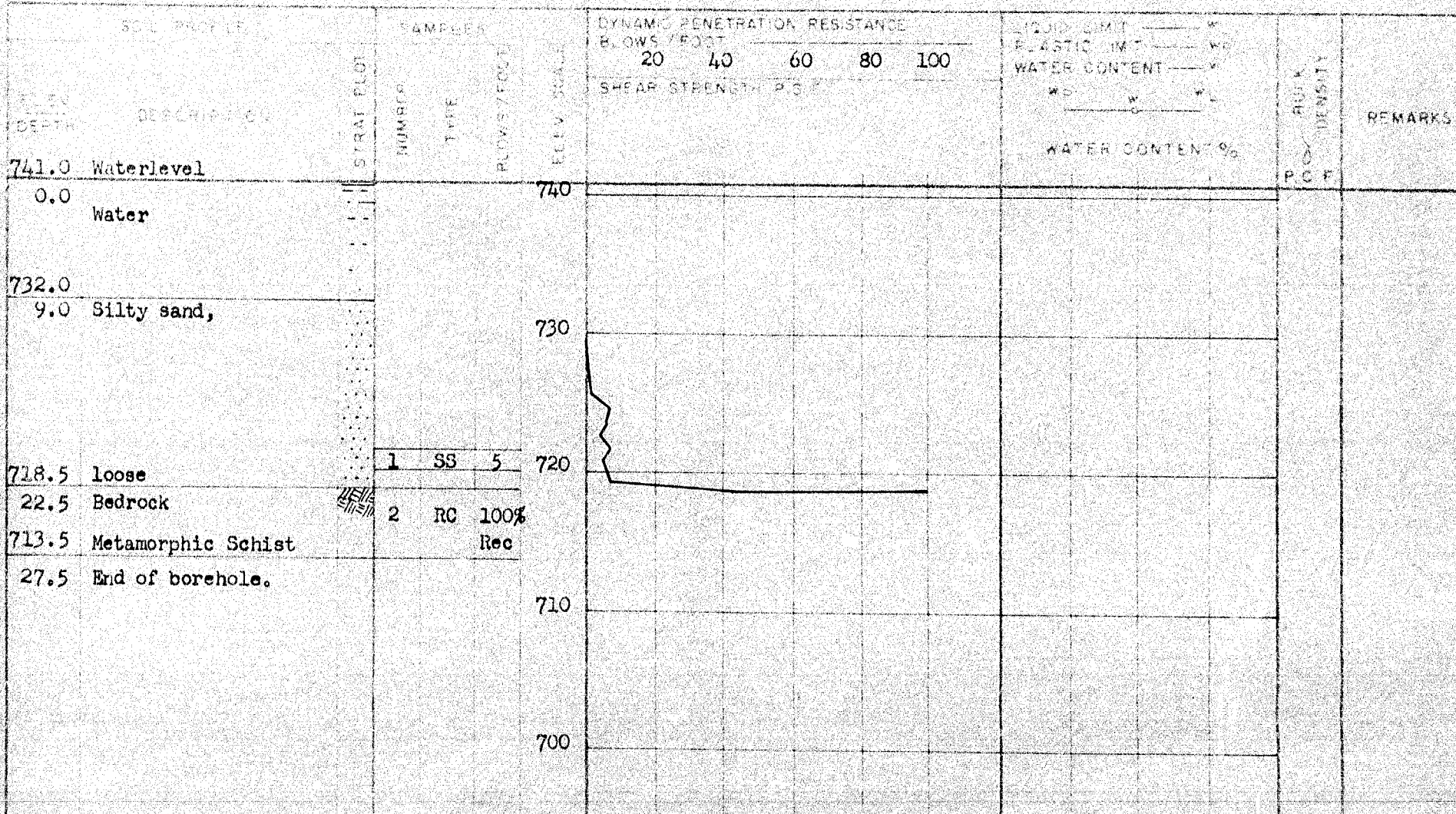
SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %		BULK DENSITY pcf	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80		
741.0	Waterlevel											
0.0	Water					740						
731.0												
10.0	Silty sand (trace of gravel)		1	SS	25	730						
725.0	Compact											
16.0	Bedrock		2	RC	100%							
720.0	Metamorphic Schist				Rec	720						
21.0	End of borehole.											
						710						
						700						

DEPARTMENT OF HIGHWAYS - DIVISION
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 17

FOUNDATION SECTION

64-F-47 LOCATION Sta. 31+50; 29' to Rt. of Line "F"
272-63 BORING DATE Aug. 17, 1964.
Geodetic BORE HOLE TYPE Wash boring; BX casing.
ORIGINATED BY V.K.
COMPILED BY V.K.
CHECKED BY M.D.



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 18

FOUNDATION SECTION

JOB 64-F-47

LOCATION Sta. 31+80; E of Line "F"

ORIGINATED BY V.K.

W.D. 272-63

BORING DATE Aug. 17, 1964.

COMPILED BY V.K.

DATA Geodetic

BOREHOLE TYPE Wash boring; BX casing.

CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT _____ W _L		BULK DENSITY P.C.F.	REMARKS					
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT										
							20	40	60	80	100						
							SHEAR STRENGTH P.C.F.										
										WATER CONTENT _____ W _P							
										WATER CONTENT %							
741.0	Waterlevel																
0.0	Water					740											
731.0																	
10.0	Silty sand,					730											
			1	SS	14												
718.0	Compact					720											
23.0	Bedrock		2	RC	100% Rec												
713.0	Metamorphic Schist																
28.0	End of borehole.					710											
						700											

DEPARTMENT OF AGRICULTURE
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 19

FOUNDATION SECTION

JOB: 64-F-47 LOCATION: Sta. 31+50; 15' to Lt. of Line "F"
 W.P.: 272-63 BORING DATE: Aug. 17, 1964.
 METHOD: Geodetic BOREHOLE TYPE: Dynamic Cone Penetration.
 ORIGINATED BY: V.K.
 COMPILED BY: V.K.
 CHECKED BY: M.D.

ELEV. DEPTH	SOIL PROFILE	SAMPLING NUMBER TYPE	BLOW'S / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK PORE DENSITY	REMARKS
					20	40	60	80	100			
741.0	Waterlevel			740								
	Water											
731.0				730								
10.0												
712.5				720								
28.5	End of Cone Penetration			710								
				700								

COUNT OF SECTION

DECEMBER 1954 V.K.

V.K.

DATE: M.D.

1 RC 100%
Rec

DEPARTMENT OF HIGHWAYS - INTER
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 23

FOUNDATION SECTION

ICE 64-F-47 LOCATION Sta. 32736; E of Line "P"
W 272-63 BORING DATE Aug. 20, 1964.
CAUTION Geodetic BOREHOLE TYPE Wash boring; BX casing.
ORIGINATED BY V.K.
COMPILED BY V.K.
CHECKED BY M.D.

ELEV DEPTH	DESCRIPTION	STRAT. POS.	SAMPLED		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					WATER CONTENT %	WATER CONTENT %	REMARKS
			NUMBER	TYPE			20	40	60	80	100			
741.0	Waterlevel					740								
0.0	Water													
730.5						730								
10.5	Silty sand, compact.		1	SS	13									
			2	SS	18	720								
23.0	Bedrock Metamorphic Schist		3	RC	100% Rec									
28.0	End of borehole.					710								
						700								

FOUNDATION SECTION

Sta. 32+36; 92' to Rt. of Line "F"

Aug. 24, 1964.

Wash boring; BX Casing.

ORIGINATED BY V.K.

COMPILED BY V.K.

MADE BY _____ M.D. _____

[illegible]

FOUNDATION SECTION

64-F-47	LOCATION	Sta. 32736; 117' to Rt. of Line "F"	ORIGINATED BY	V.K.
272-63	BOHRING DATE	Aug. 24, 1964.	COMPILED BY	V.K.
Geodetic	BOHRING TYPE	Dynamic Cone Penetration	CHECKED BY	M.D.

[illegible]

DEPARTMENT OF AGRICULTURE, ONCE
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 26

FOUNDATION SECTION

64-R-47

Loc. on Sta. 31/83; 92' Rt. of Line "F"

ORIGINATED BY V.K.

W. 272-63

DATE OF TEST Aug. 24, 1964.

COMPILED BY V.K.

METHOD Geodetic

BOREHOLE TYPE Wash boring; BX casing.

CHECKED BY M.D.

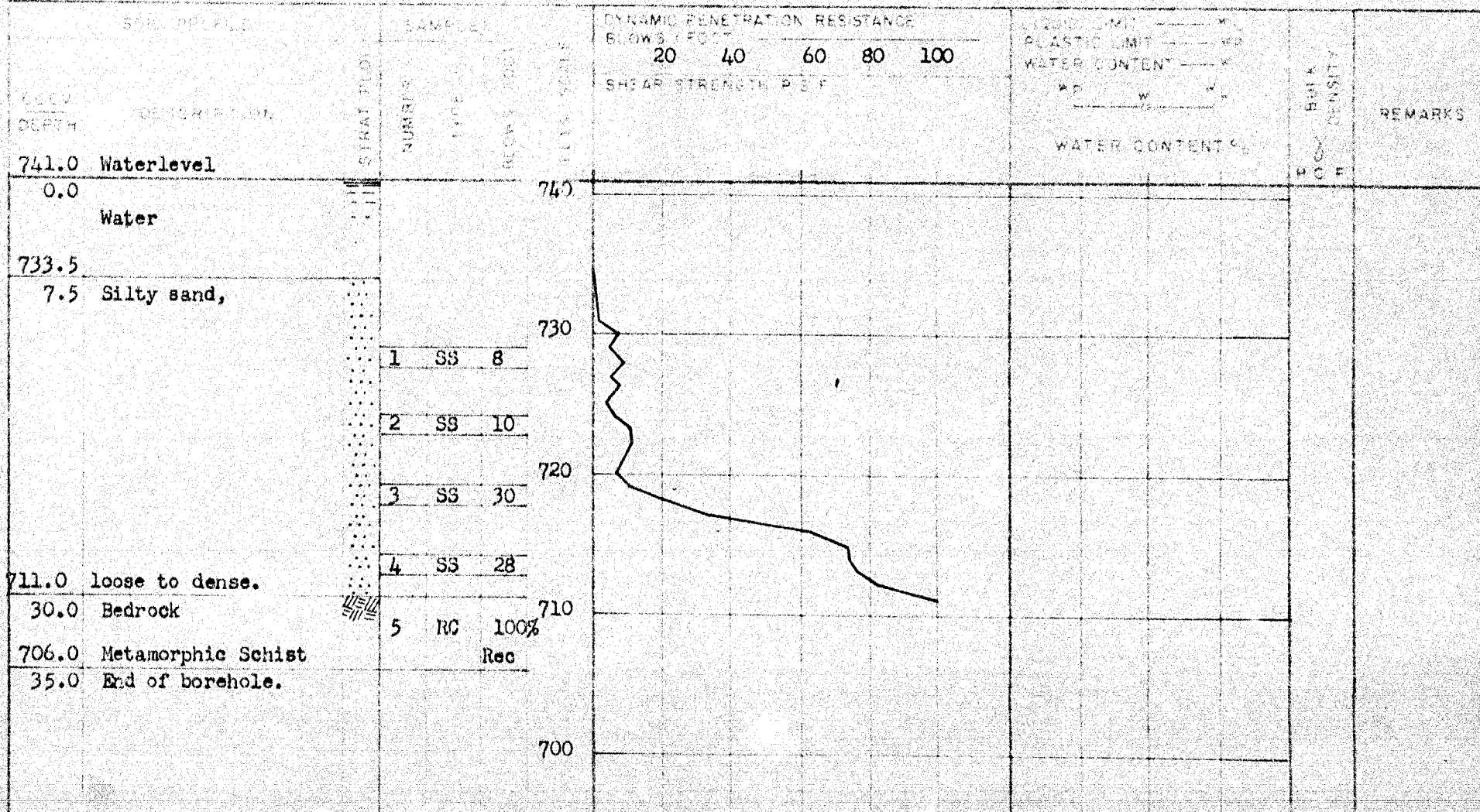
SOIL PROFILE DEPTH DESCRIPTION	STRAT. PLOT	SAMPLER		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT PLASTICITY INDEX WATER CONTENT	WATER CONTENT %	UNIT WEIGHT PCF	REMARKS
		NUMBER	TYPE					
741.0 Waterlevel				20 40 60 80 100				
0.0								
Water								
731.0								
10.0								
Silty sand,		1	SS	6				
		2	SS	4				
		3	SS	11				
loose to compact.								
711.0								
30.0 Bedrock		4	RC	100%				
701.0 Metamorphic Schist				Rec				
35.0 End of borehole.								

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO 27

FOUNDATION SECTION

JOB NO. 64-F-47 LOCATION Sta. 31+50; 92' Rt. of Line "F" ORIGINATED BY V.K.
 DRAWING NO. 272-63 BORING DATE Aug. 25, 1964. COMPILED BY V.K.
 METHOD Geodetic BORING TYPE Wash boring; BX casing. CHECKED BY M.D.



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

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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_i	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 (YOUNG'S 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_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
β	ANGLE OF SLOPE TO HORIZONTAL

64-F-47

0115

JUN 26 AM 10:49

V

HUNT DOWN 5 JUNE 26/64 1033A VP

E M JONES DIST ENCR

ATTN S A CANT MTCF ENCR

RE JOSEPH RIVER BRIDGE SEC RD 632 DIST 11 WPC70-67

WJ64-F-41

THE FOUNDATION INVESTIGATION WORK FOR THE ABOVE MENTIONED JOB

WILL COMMENCE ON JULY 2ND/64

M DEVATA SR FOUND ENCR FOR A C STEPMAC PRINC FOUND ENCR

MATS & RES DIV

SP

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

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DEPARTMENT OF HIGHWAYS ONTARIO
MEMORANDUM

Amarty
June 22
64-F-47

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

FROM: Bridge Division,
Department of Highways.

DATE: June 17, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: Joseph River Bridge,
Sec. Rd. #632,
District #11, WP 272-63.

The proposed bridge at the above location will require a foundation investigation. Attached are two prints of site plan E-4401-1 showing suggested locations for boreholes

The structure proposed will probably be three spans of approximately 47', 75', 47' with the abutments placed on rock fill approaches, providing the clay over the bedrock can take the load of the approach fill or can be excavated. The final choice of design will be dependent on your findings. The grade shown on the profile will be used for design and any possible change will be minor.

J. C. McAllister

JCA/lb

cc. N. D. Smith
R. Fitzgibbon

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

Mr. B. R. Davis,
Bridge Design Engr.,
Bridge Division.

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

Attention: Mr. F. Gormek,
Bridge Proj. Engr.

January 12, 1965

Joseph River Bridge, Hwy. 632,
District #11, Huntsville, Ont.
W.J. 64-F-47 -- W.P. 272-63

Further to your request on December 29, 1964,
regarding the adoption of caissons for pier foundations
at the above-mentioned project, we have reviewed this problem
with various drilling specialists.

We have obtained quotations for the above-mentioned
work from three organizations in Toronto. The information
obtained from the drilling organizations is enclosed along with
this memo.

If you have any further queries regarding this
matter, please contact this Office.

MD/MdeF
Attach. (3)

M. Levata
for A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office ✓
Gen. Files



FRANKI

CANADA LIMITED

214 MERTON STREET,

TORONTO,

January 6, 1965.

TELEX NO.
02-2159
CABLEGRAMS
"FRANKIPILE"
TELEPHONE:
HU. 1-6426

Department of Highways,
Materials & Research Section,
Downsview, Ontario.

Attention: Mr. M. Devata, P. Eng.

Re: Joseph River Bridge,
Huntsville District

Dear Sirs:

In accordance with your request we have prepared a rough estimate on the above job.

It is understood that 3 piers will be founded on a total of 12 - 16 inch diameter by 0.250 wall concrete filled caissons, socketed 7 feet into hard metamorphic bedrock. The rock is understood to be overlain by 10 to 20 feet of silty sand, of which the lower few feet are very dense, probably containing boulders. The depth of the river is of the order of 12 feet. The caissons will extend above the river approximately 15 feet, giving therefore a maximum caisson length of the order of 55 feet.

Employing the churn drilling method to penetrate the bedrock, it is estimated that the cost per caisson could be of the order of \$ 6,000.00. Or for 12 caissons \$ 72,000.00. To this should be added the cost of installation and dismantling of equipment, which could amount to about \$3,000.00, as well as the rental of a raft, or the cost of some form of platform.


It should be emphasized that projects such as this, are very much subject to local site and soil conditions; the estimate given therefore should only be used as a rough guide.

.....(2)

The churn drilling process normally implies heavy equipment. It should be noted that the size of equipment on this project is limited by the size of the 16 inch caissons, thereby almost certainly affecting the production and therefore cost, adversely. Consideration may be given to employing larger caissons, socketed to a lesser depth into the rock. For instance, if the pier load, understood to be 766 kips, is divided over 3 caissons, each would carry about 130 ton and require a caisson diameter of about 30 inches. This diameter would enable the use of larger and more efficient equipment and would facilitate inspection of and possibly work at the bottom of the caisson.

Yours very truly,

FRANKI CANADA LIMITED

A handwritten signature in dark ink, appearing to be 'A. Prior', written over a horizontal line.

A. Prior, P. Eng.
CHIEF ENGINEER

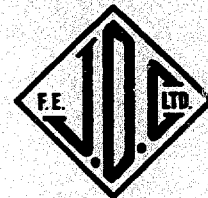
AP/b

Ref: x2-65

F. E. JOHNSTON DRILLING CO. LTD.
DRILLING CONTRACTORS

HEAD OFFICE

1181 CECIL AVE., OTTAWA 1, ONT.



January 9, 1965.

Ontario Department of Highways,
Downsview,
Ontario.
Attention: Mr. T. Stermac, Principal Engineer.

Re: Joseph River Structure, Job No. 63-F-47

Dear Sir:

The following is a run down of our methods and prices for the pre-boring, installation and grouting of tubular steel piles on the above project.

It is understood that three groups of 16" tubular piles are required with four in each group for a total of twelve piles. All these piles are to be inserted seven feet into bed-rock.

According to your soils report, the material in the vicinity of these piles would be: Water depth--10' to 12'. Overburden--10' to 20' which would be composed of material ranging from silty clay to sand and gravel containing some boulders and, a thin layer of hard-pan on top of bed-rock. The seven feet of bed-rock would be in a Metamorphic Schist.

Our method of undertaking this work would be to mount a churn drill on a sectionalized barge of suitable dimensions. Drill and drive 26" casing to bed-rock or as close as possible. Drill and drive 24" casing a short distance into bed-rock to acquire a suitable seal. Drill the remaining 7' of bed-rock with a 22" bit. Insert the 16" tubular steel piling, grout the annular space between the pile and bed-rock with 2" grout pipes, and grout up into the over-burden if required, as our outer casings are withdrawn.

Our price to undertake this work would be at the rate of \$150.00 per lineal foot for the combined depths of overburden and bed-rock encountered.

(con't)

SOIL
ESTIGATIONS

□ □

EARTH
AUGERING

HORIZONTAL
AND
VERTICAL

□ □

WELL
DRILLING

DOMESTIC
AND
COMMERCIAL

□ □

CONCRETE
CORING

□ □

EXPLORATION
DIAMOND
DRILLING

□ □

DIAMOND
SAWING

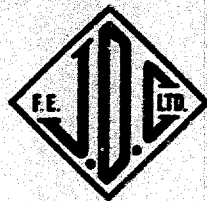
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POLE
SETTING

F. E. JOHNSTON DRILLING CO. LTD.
DRILLING CONTRACTORS

HEAD OFFICE

1181 CECIL AVE., OTTAWA 1, ONT.



-2-

This rate would include the supplying of labour, barge, transportation to and from the site, outer casings, percussion drill and necessary equipment. It would not include the 16" tubular piling, specialized grout or the surveying of locations.

It would appear that the cost of inserting the piles could be in the range of \$40,000.00. However, with the issuance of detailed specifications, there could be factors which would alter this price either upward or downward.

We sincerely hope that the foregoing information may be of some value to your Department.

Yours truly,

F. E. JOHNSTON DRILLING CO. LTD.

Per: F. Blackburn

FB/jl

SOIL
INVESTIGATIONS

□ □

EARTH
AUGERING

HORIZONTAL
AND
VERTICAL

□ □

WELL
DRILLING
DOMESTIC
AND
COMMERCIAL

□ □

CONCRETE
CORING

□ □

EXPLORATION
DIAMOND
DRILLING

□ □

DIAMOND
SAWING

□ □

POLE
SETTING

WCL

WESTERN CAISSONS LIMITED

"Cast-in-Place Concrete Caissons"

R.R. NO. 1
MAPLE, ONTARIO
PHONE 222-7383
683-

Jan. 4th, 1965.
File No. 65-29

Materials & Research Division,
Department of Highways,
DOWNSVIEW, Ontario.

ATTENTION: Mr. Devata

Dear Mr. Devata:

RE: Pile Installation
Joseph River Crossing

We are pleased to acknowledge your enquiry regarding the installation of piles for the above project, and would like to submit the following proposal:

We will install a 16-inch diameter pipe pile a distance of 7 feet into schist bedrock. The steel pipe column to extend up through the overburden silty sand and water, so that the top of each pile is at least 2 feet above high water level. The steel pipe pile will then be filled with concrete. The piles will be driven into the bedrock as the rock is churn drilled out, and will therefore fit tightly against the rock.

Our price to install a total of 12 piles in this manner will be:

TWENTY THREE THOUSAND NINE HUNDRED DOLLARS (\$23,900.00)

The above price includes the provision of heavy duty churn drilling equipment, personnel and concrete. It does not include the supply of the 16-inch pipe, nor does it include the cost of a barge for floating our equipment into position for the piles. Our proposal has also assumed that electrical power will be available at the site, and that the survey layout of pile locations will be the responsibility of others.

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WESTERN CAISSONS LIMITED

Department of Highways

-2-

Jan. 4th, 1965.

An additional charge of \$2500.00 will be made for moving our equipment onto the site, and removing it when the job has been completed.

We trust that this information will be sufficient to meet your present requirements, and we will be pleased to provide additional information should you care to call on us.

Hoping to be of service, we remain,

Yours very truly,

WESTERN CAISSONS LIMITED



A. Demetrick

AD:bt

WCL

WESTERN CAISSONS LIMITED

"Cast-in-Place Concrete Caissons"

July 13th, 1965.

R.R. NO. 1
MAPLE, ONTARIO
PHONE 285-7383

889-

Department of Highways of Ontario,
Material and Research Division,
Foundation Section,
DOWNSVIEW, Ontario.

Attention: Mr. DeVata

Dear Sir:

Re: Caisson Specification for
Proposed Joseph River Crossing

As requested during our recent telephone conversation, we are herewith submitting for your information a general caisson specification together with a typical section prior to concreting which we hope you will find useful in clarifying any construction procedures which may be involved in connection with the above work.

1. SCOPE

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment and materials to perform all operations in connection with the installation of drilled-in caissons or piles complete in strict accordance with this section of the specifications, the applicable drawings, and subject to the terms and conditions of the contract.

2. CAISSON TYPE AND EQUIPMENT

Caissons shall be what is known as drilled-in caissons or piles, formed by means of a churn drill and socketed into the bedrock as shown on the drawings. Installation equipment shall be in first class condition and shall be so maintained and operated at all times.

3. CAISSON INSTALLATION

a) All caissons or piles shall be installed from a barge to be provided by the Department. Caissons shall be accurately centered at the ground surface and shall be installed as specified. The 18" diameter pipe will be supplied on the site by the Department and all welding shall be performed in accordance with the

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Department of Highways of Ontario

July 13th, 1965.

latest American Welding Institute specifications. Any caisson out of centre or plumb beyond the tolerances noted shall be corrected as directed by the Engineer. The maximum variation of the center of any caisson or pile at the cut-off elevation shall be 4" and no caisson shall be out of plumb more than 2% of its depth. This contractor shall bear cost of correction.

b) No concrete shall be placed until the shaft has been inspected and approved. All extraneous material must be removed from inside the casing by either mud pumps or bailing buckets prior to depositing of concrete.

c) When the excavation of any caisson or pile is completed and approved, reinforcing steel shall be placed immediately and the concrete poured without delay. Where any inflow of water from the bottom of the casing is encountered, the concrete shall be placed through still water by means of a tremie or bottom dump bucket to heights sufficient to perfect the seal. All other concrete shall be placed continuously utilizing the free fall method.

d) Should obstructions be encountered during the caisson or piling operation which cannot be removed within the normal churn drilling equipment, the contractor will proceed on a time and material basis to remove such obstructions. Obstructions shall be construed to mean rock, boulders, other such material which would necessitate the use of hand or rock tools, core barrels, etc. to penetrate. Before proceeding in any such work, arrange for equipment, etc. and percentages for overhead and profit will be agreed upon in writing.

4. TEST

a) When the caisson or pile has been drilled to the depth specified, it shall be inspected with respect to dimensions and plumbness and to ascertain the materials suitable for bearing.

b) The testing of bearing materials shall be performed in accordance with the Department of Highway's requirements.

5. REPORT

a) A complete report of each caisson and pile installed shall be made for the engineer. The report shall contain all dimensions, locations of caissons or piles, shaft diameter, elevations of bottom and top as actually poured and any other pertinent data. The Soils Engineer shall submit a complete report of each caisson or pile tested to substantiate his approval of the bearing material.

Department of Highways of Ontario

July 13th, 1965.

b) A daily work sheet shall be prepared and signed by the authorized representative for the architect for work performed under Article 3, Paragraph F of this specification.

6. UNIT PRICE

Amount to be added or deducted for each lineal foot of caisson or pile shaft in event actual foundation bearings are below or above elevations established on the drawings. The unit shall cover excavating, concrete and other items involved in the work. Final computations shall be submitted at the conclusion of the caisson installation on a net add or deduct basis.

Should additional information be required, please feel free to contact us.

Yours very truly,

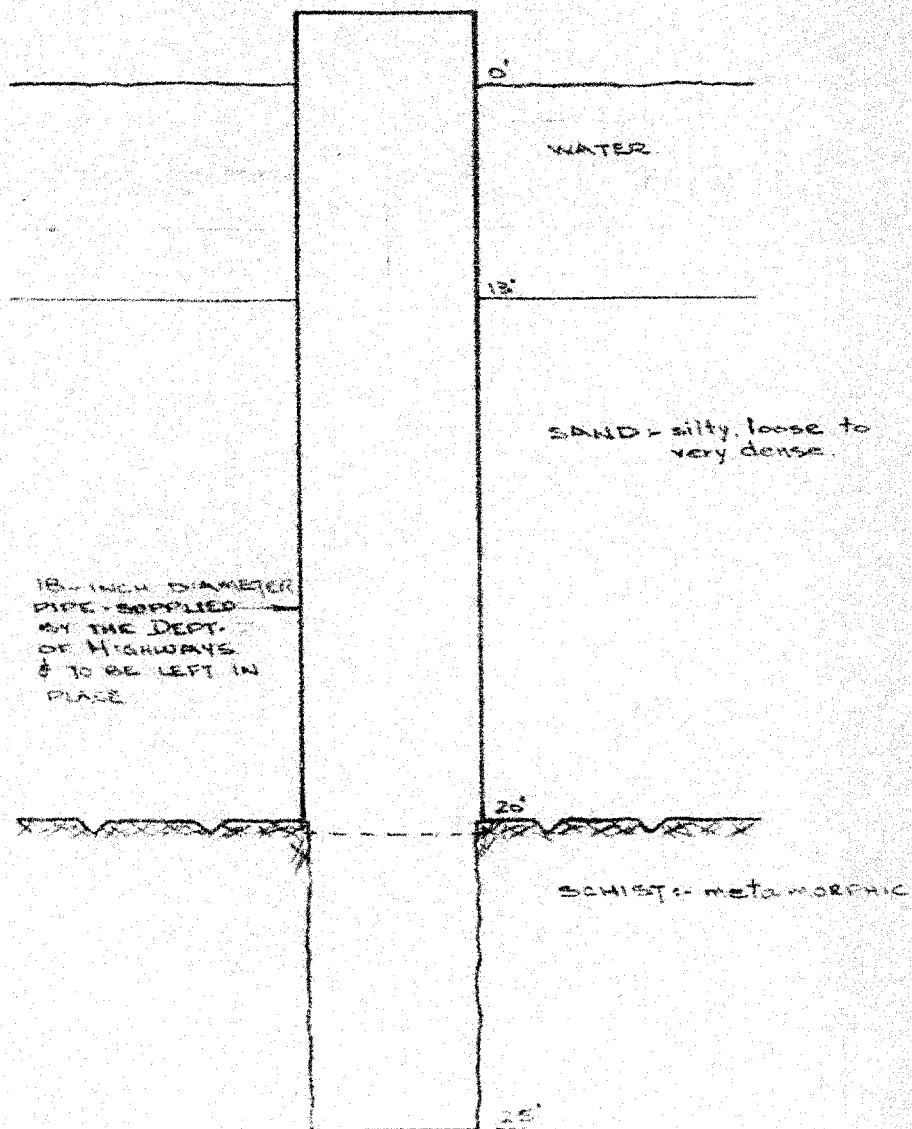
WESTERN CAISSONS LIMITED



P. Kozicki, P. Eng.

PK/bt

Encl.



TYPICAL SECTION OF CAISSON PRIOR TO CONCRETING
PROPOSED JOSEPH RIVER CROSSING

PREPARED BY:-
WESTERN CAISSONS LTD.,
46 CREDITON ROAD,
MAPLE - ONTARIO.

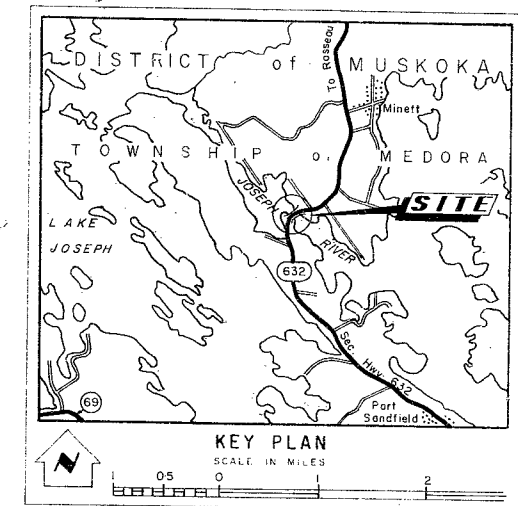
SCALE:- NOT TO SCALE
DRAWN BY:- P.K.
DATE:- JULY 20th 1968

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



W.P.# 272-63

HWY# 632

JOSEPH RIVER



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 error.

LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation.		
B.H.	1 - 11	JULY 3 - JULY 14, 1954	
B.H.	12 - 28	AUG 13 - AUG 25, 1954	
NO.	GROUND ELEVATION	LINE P' STATION	OFFSET
1	735.0	32 + 76	6
2	729.5	32 + 76	15' RT.
3	729.5	31 + 26	15' RT.
4	729.0	31 + 88	15' RT.
5	728.0	31 + 88	15' LT.
6	730.0	31 + 13	15' LT.
7	731.0	31 + 13	15' RT.
8	732.0	30 + 67	15 RT.
9	730.0	30 + 67	15' LT.
10	731.0	30 + 26	6
11	736.0	29 + 86	6
12	735.5	30 + 67	85' RT.
13	730.5	30 + 67	30' RT.
14	729.0	30 + 67	6
15	730.0	31 + 13	6
16	731.0	31 + 13	30' RT.
17	732.0	31 + 50	20' RT.
18	731.0	31 + 50	6
19	731.0	31 + 50	15' LT.
20	730.0	31 + 88	27' RT.
21	730.0	31 + 88	6
22	731.5	32 + 36	27' RT.
23	730.5	32 + 36	6
24	732.5	32 + 36	92' RT.
25	730.0	32 + 36	117' RT.
26	731.0	31 + 88	92' RT.
27	733.5	31 + 50	92' RT.
28	733.5	31 + 13	90' RT.

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

JOSEPH RIVER

KING'S HIGHWAY NO. 632 - PROP. REV'N DIST. NO. 11
DIST. MUSKOGA
TWP. MEDORA LOT 19 CON. IX

BORE HOLE LOCATIONS & SOIL STRATA

SUBNO. V. K.	CHECKED <i>HR</i>	W.P. NO. 272-63	M.B.R. DRAWING NO.
DRAWN <i>SC</i>	CHECKED <i>HR</i>	JOB NO. 64-F-47	64-F-47A
DATE AUG 31 1964	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>U. S. Thomas</i>	CONT. NO.		

[illegible]