

54-F-6

Hwy. #85

St. JACOB's

TA 150
54-90

MATERIALS LABORATORY - DEPARTMENT OF HIGHWAYS - ONTARIO
OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG No. 4
CASING BX (STANDARD SAMPLERS TO FIT UNLESS NOTED)
SAMPLER HAMMER WT 250 * DROP 21 INCHES

JOB F54-6 St Jacobs
DATE REPORT BORING DATE 23-7-54 - 11-8-54
COMPILED BY G.B.H. CHECKED BY G.M.

SAMPLE CONDITION
DISTURBED
GOOD
LOST

SAMPLE TYPES
CS - CHUNK
DO - DRIVE OPEN
DF - DRIVE FOOT VALVE
WS - WASHED SAMPLE
RC - ROCK CORE
TO - THIN WALLED OPEN

ABBREVIATIONS
V - INSITU VANE SHEAR TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
Qc - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW
γ - UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION
CA - CASING
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

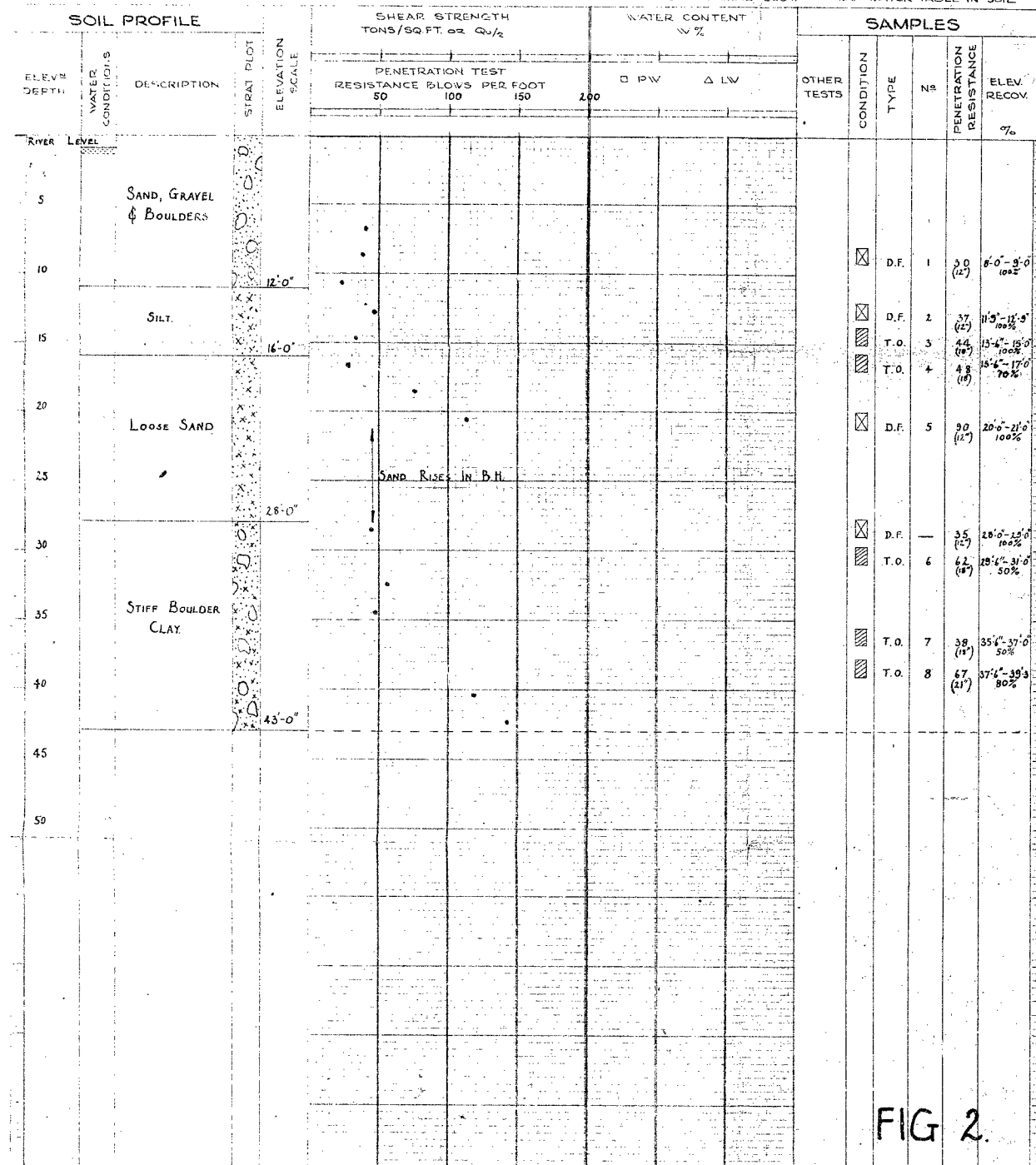


FIG 2.

TL 150
54-90

MATERIALS LABORATORY - DEPARTMENT OF HIGHWAYS - ONTARIO
OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG No. 4
CASING BX (STANDARD SAMPLERS TO FIT UNLESS NOTED)
SAMPLER HAMMER WT 250 * DROP 21 INCHES

JOB F54-6 St Jacobs
DATE REPORT BORING DATE 23-7-54 - 11-8-54
COMPILED BY G.B.H. CHECKED BY G.M.

SAMPLE CONDITION
DISTURBED
GOOD
LOST

SAMPLE TYPES
CS - CHUNK
DO - DRIVE OPEN
DF - DRIVE FOOT VALVE
WS - WASHED SAMPLE
RC - ROCK CORE
TO - THIN WALLED OPEN

ABBREVIATIONS
V - INSITU VANE SHEAR TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
Qc - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL QUICK
S - TRIAXIAL SLOW
γ - UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION
CA - CASING
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

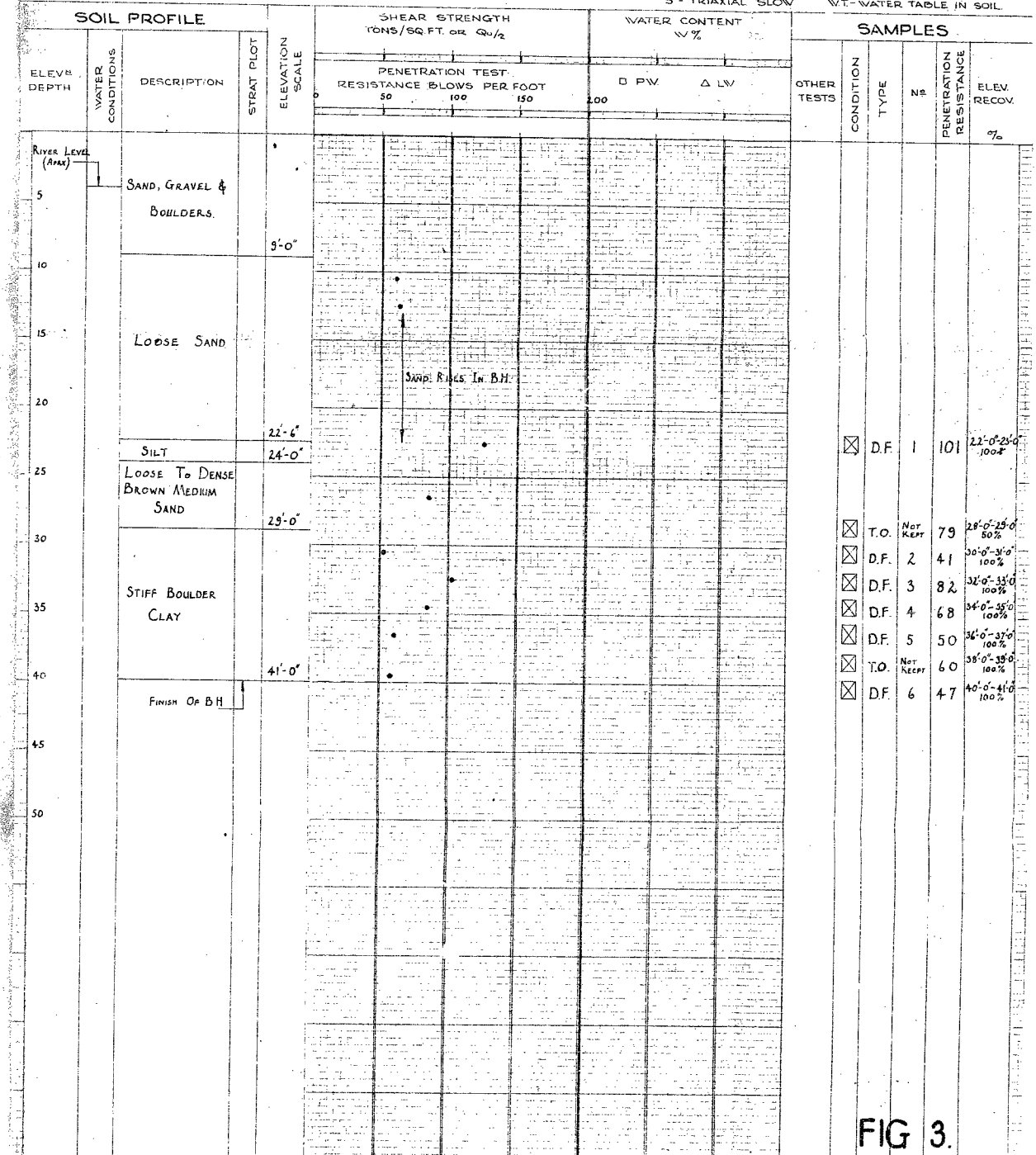
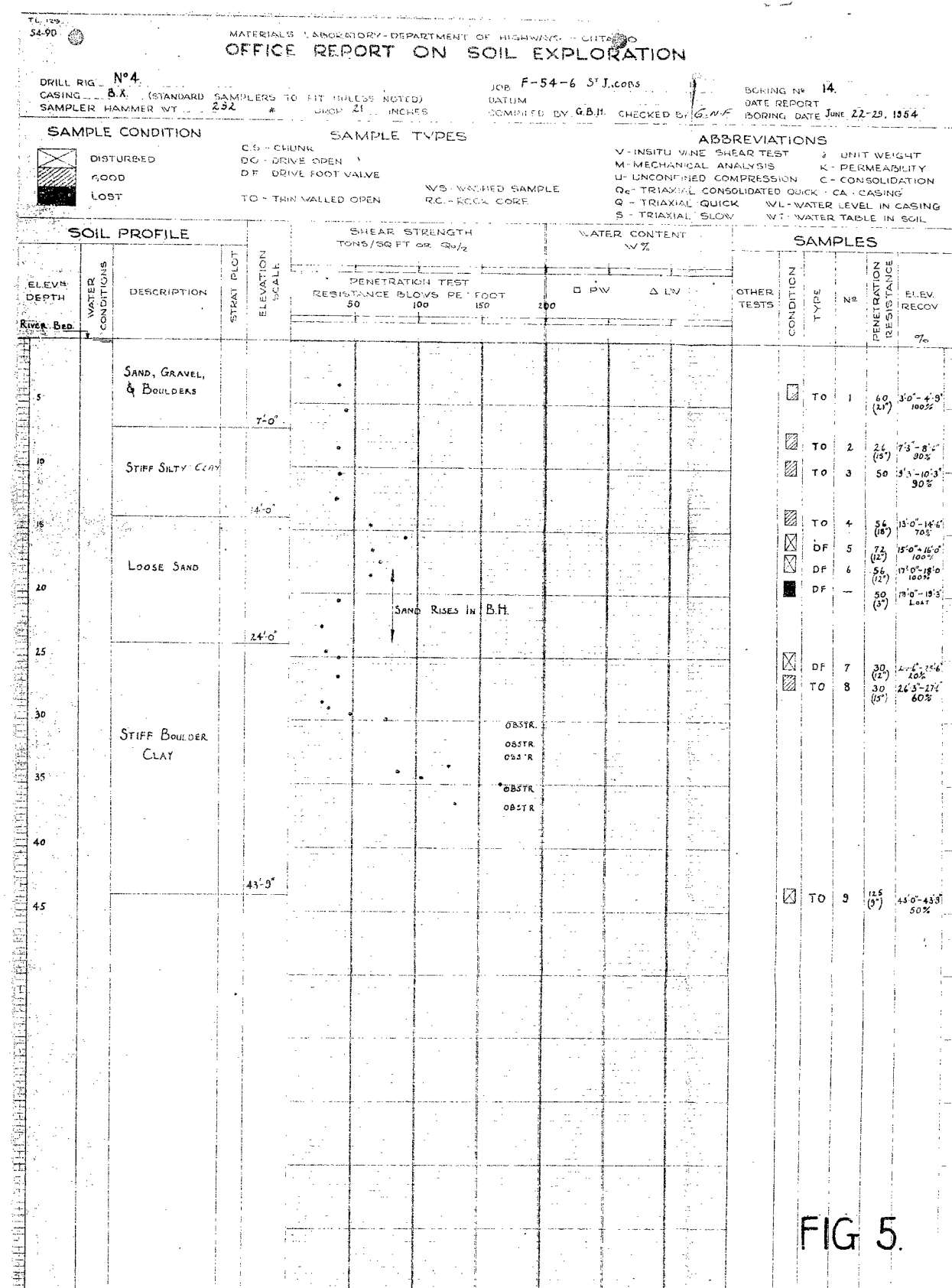
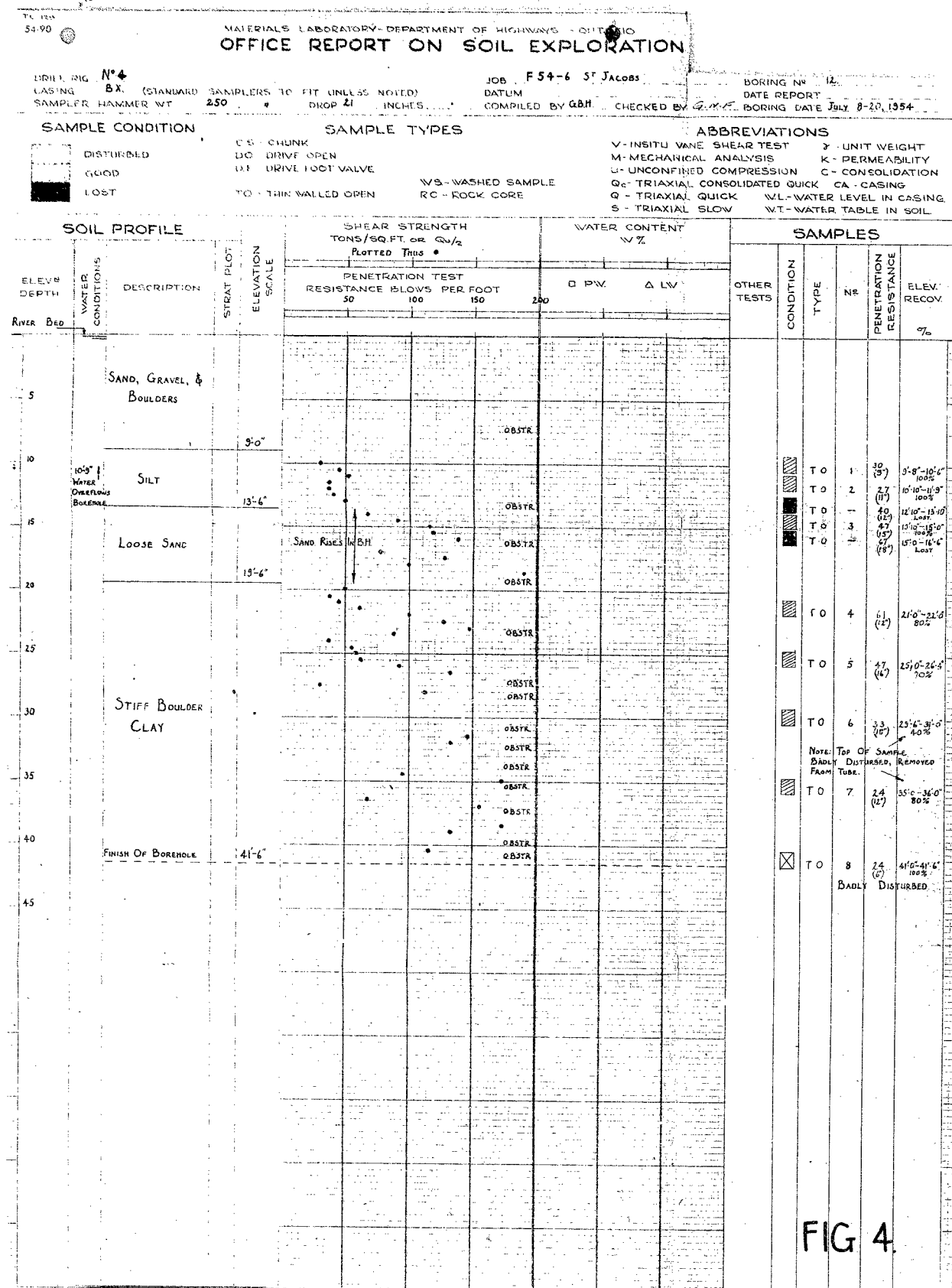


FIG 3.






DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

TL 1155
54-90

MATERIALS LABORATORY - DEPARTMENT OF HIGHWAYS - CHICAGO
OFFICE REPORT ON

DRILL RIG LONGYEAR N° 4
CASING BX (STANDARD SAMPLERS TO FIT UNLESS NOTED)
SAMPLER HAMMER WT 250 # DROP 22 INCHES

SAMPLE CONDITION

 DISTURBED
 GOOD
 LOST

C.S. - CHUNK
D.O. - DRIVE OPEN
D.F. - DRIVE FOOT VALVE
T.O. - THIN WALLED OPEN

SAMPLE TYPES

SOIL PROFILE

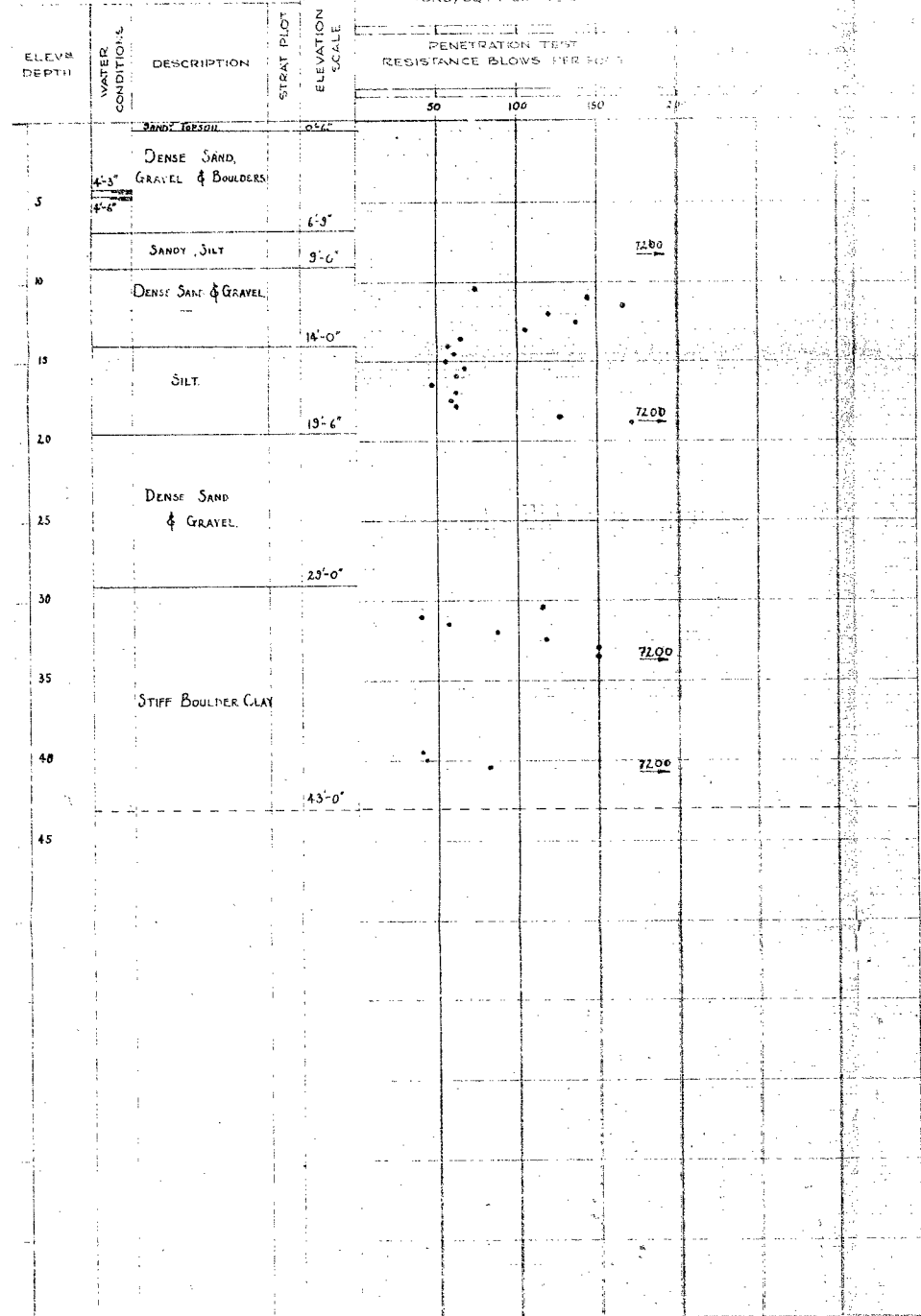


FIG 6.

TL 1155
54-90

MATERIALS LABORATORY - DEPARTMENT OF HIGHWAYS - CHICAGO
OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG N° 4
CASING BX (STANDARD SAMPLERS TO FIT UNLESS NOTED)
SAMPLER HAMMER WT 250 # DROP 22 INCHES

JOB F54-6

DATUM




COMPILED BY G.B.M. CHECKED BY G.M.F.

BORING N° 17

DATE REPORT

BORING DATE JUNE 23-24, 1954

SAMPLE CONDITION

 DISTURBED
 GOOD
 LOST

SAMPLE TYPES

C.S. - CHUNK
D.O. - DRIVE OPEN
D.F. - DRIVE FOOT VALVE
T.O. - THIN WALLED OPEN

W.S. - WASHED SAMPLE
R.C. - ROCK CORE

ABBREVIATIONS

V - INSITU VANE SHEAR TEST
M - MECHANICAL ANALYSIS
U - UNCONFINED COMPRESSION
 Q_c - TRIAXIAL CONSOLIDATED QUICK
Q - TRIAXIAL SLOW
S - TRIAXIAL SLOW
γ - UNIT WEIGHT
K - PERMEABILITY
C - CONSOLIDATION
CA - CASING
WL - WATER LEVEL IN CASING
WT - WATER TABLE IN SOIL

SOIL PROFILE

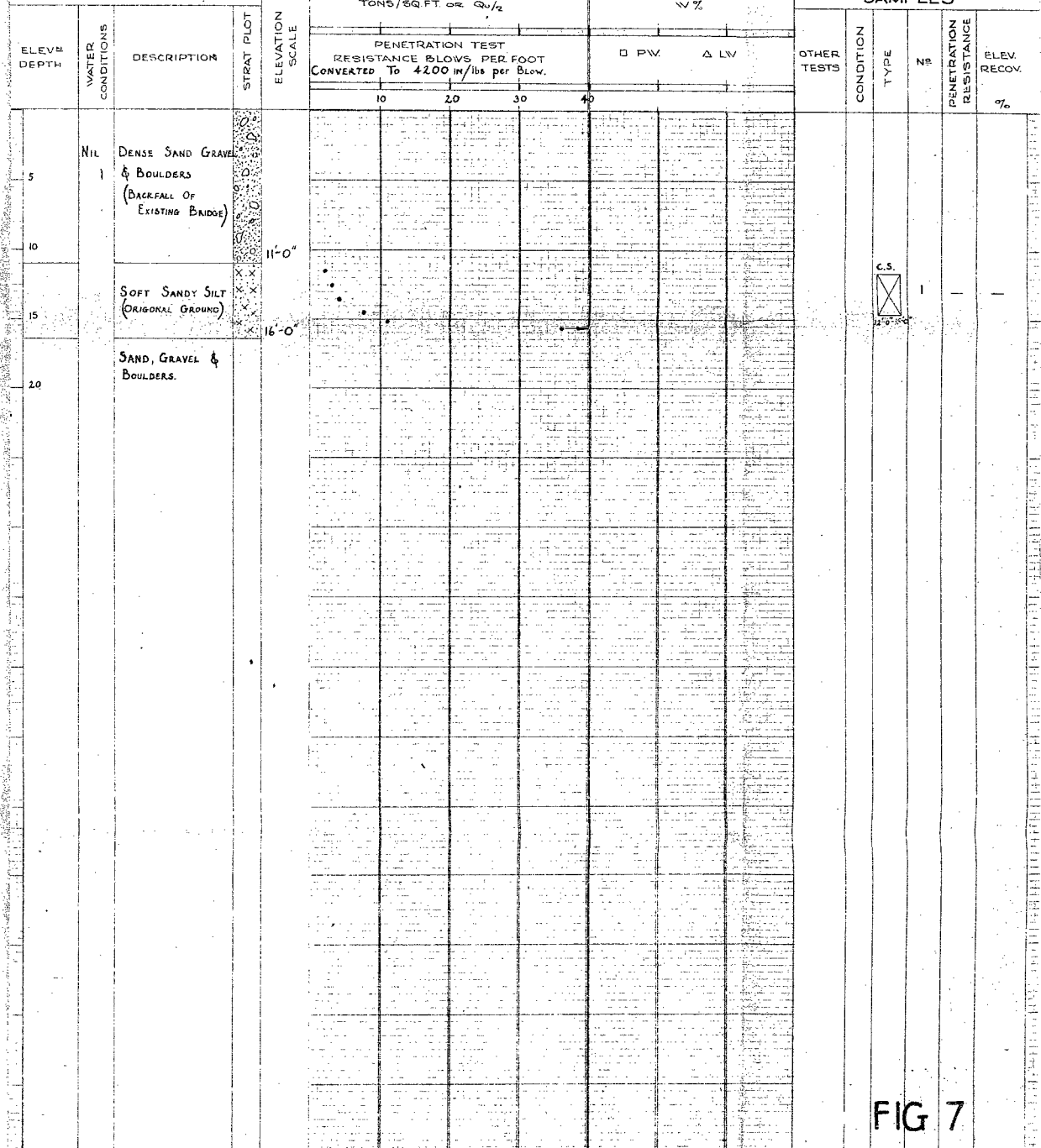


FIG 7

MATERIALS LABORATORY-DEPARTMENT OF HIGHWAYS - ONTARIO
OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG LONGYEAR N° 4
CASING DX (STANDARD SAMPLERS TO FIT UNLESS NOTED)
SAMPLER HAMMER WT 250 * DROP 22 INCHES

JOB F54-6 ST JACOB'S BRIDGE BORING NO 18
 DATUM DATE REPORT
 COMPILED BY G.B.M. CHECKED BY G.B.M. BORING DATE 16-23 JUNE 1954

SAMPLE CONDITION



SAMPLE TYPES

CS - CHUCK
DO - DRIVE OPEN
DF - DRIVE FOOT VALVE
TO - THIN WALLED OPEN
WS - WASHED SAMPLE
RC - ROCK CORE

ABBREVIATIONS

V-INSITU VANE SHEAR TEST > -UNIT WEIGHT
M-MECHANICAL ANALYSIS K- PERMEABILITY
U- UNCONFINED COMPRESSION C- CONSOLIDATION
Qc- TRIAXIAL CONSOLIDATED QUICK CA.- CASING
Q- TRIAXIAL QUICK WL- WATER LEVEL IN CASING
S- TRIAXIAL SLOW WT- WATER TABLE IN SOIL

SOIL PROFILE

[illegible]

FIG 8

MATERIALS LABORATORY-DEPARTMENT OF HIGHWAYS - ONTARIO
OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG N° 4
CASING BX (STANDARD SAMPLERS TO FIT UNLESS NOTED)
SAMPLER HAMMER WT 250 # DROP 21 INCHES

JOB F 54-6 BORING NO. 19
 DATUM _____ DATE REPORT _____
 COMPILED BY G.B.H. CHECKED BY G.B.H. BORING DATE Aug. 19-26 1954

SAMPLE CONDITION



SAMPLE TYPES

CS - CHUCK
DO - DRIVE OPEN
DF - DRIVE FOOT VALVE
TO - THIN WALLED OPEN
WS - WASHED SAMPLE
RC - ROCK CORE

ABBREVIATIONS

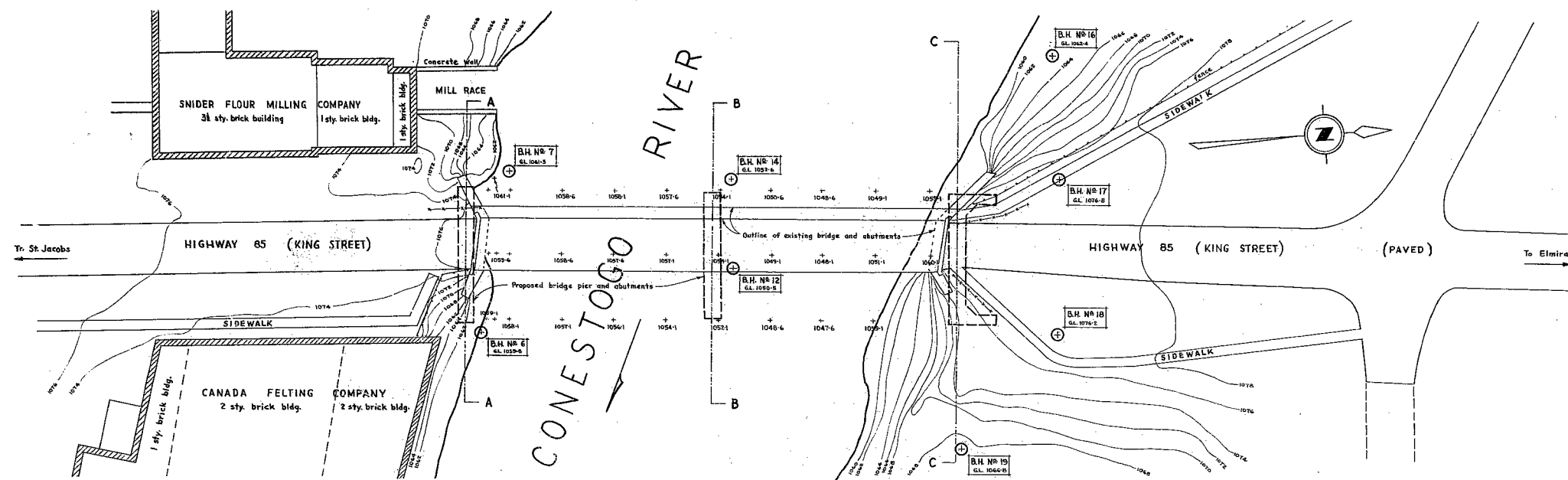
V - INSITU VANE SHEAR TEST γ - UNIT WEIGHT
 M - MECHANICAL ANALYSIS K - PERMEABILITY
 U - UNCONFINED COMPRESSION C - CONSOLIDATION
 Q_c - TRIAXIAL CONSOLIDATED QUICK CA - CASING
 Q - TRIAXIAL QUICK WL - WATER LEVEL IN CASING
 S - TRIAXIAL SLOW WT - WATER TABLE IN SOIL

SOIL PROFILE

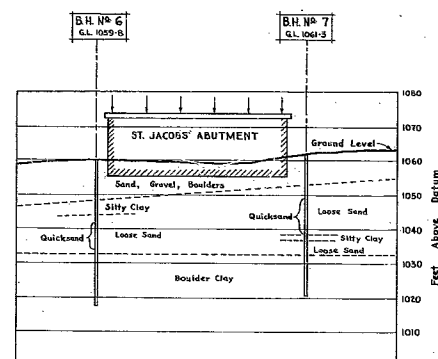
SOIL PROFILE				SHEAR STRENGTH TONS/SQ.FT OR $Q_{u/2}$		WATER CONTENT W %		SAMPLES								
ELEV# DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT ELEVATION SCALE	PENETRATION TEST RESISTANCE BLOWS PER FOOT				□ PW	△ LW	OTHER TESTS	CONDITION	T TYPE	N#	PENETRATION RESISTANCE % 70	ELEV. RECOV	
				50	100	150	200									
5		SAND, GRAVEL & BOULDERS.	12'-0"													
10		—														
15		DENSE SILTY SAND	21'-0"								■	DF	—	49 (12')	13'-0"-14'-0" Lost	
20												☒	DF	1	33 (12')	18'-0"-19'-0" 100%
25		SAND & GRAVEL	27'-0"								☒	DF	2	89 (12')	22'-0"-23'-0"	
												☒	DF	3	84 (12')	24'-0"-25'-0"
											☒	DF	4	84 (12')	26'-0"-27'-0"	
30											☒	DF	5	37 (12')	28'-0"-29'-0"	
											☒	DF	6	29 (12')	30'-0"-31'-0"	
35											☒	DF	7	31 (12')	32'-0"-33'-0"	
											☒	DF	8	33 (12')	34'-0"-35'-0"	
40																
											☒	DF	9	39 (12')	38'-0"-39'-0"	
45		STIFF BOULDER CLAY.	73'-0"								☒	DF	10	40 (12')	40'-0"-41'-0"	
50																
											☒	DF	11	94 (12')	50'-0"-51'-0"	
55																
60																
											☒	DF	12	120 (12')	60'-0"-61'-0"	
65																
70																
75		LIMESTONE ROCK														

FIG 9.

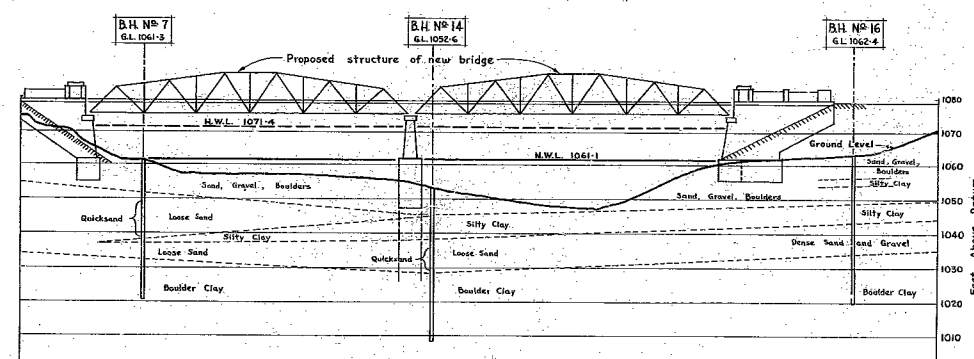
FIG. 9.



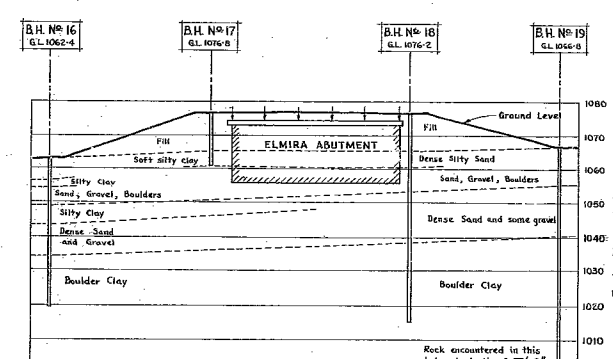
SITE PLAN



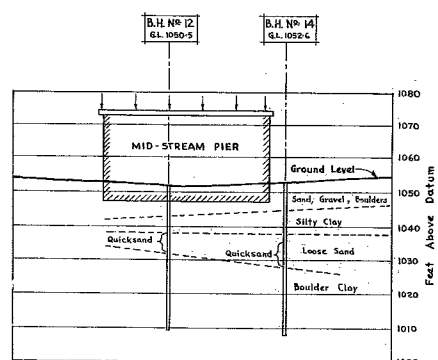
SECTION A-A



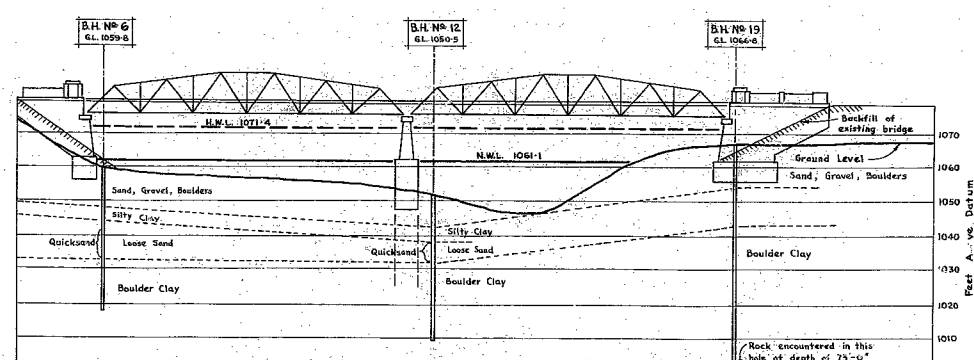
APPROXIMATE X-SECTION WEST OF BRIDGE



SECTION C-C



SECTION B-B



APPROXIMATE X-SECTION EAST OF BRIDGE

ST. JACOBS' Site Plan and
Cross-Sections of Strata Encountered
in Bore Holes for Proposed Bridge

DEPARTMENT OF HIGHWAYS - ONTARIO		
MATERIALS & RESEARCH BRANCH		
CONESTOGO RIVER		
SCALE 1 inch = 20 feet	SUBMITTED BY:	DATE Sept. 9/54
TRACED BY: H.D. Reed	APPROVED BY: <i>[Signature]</i>	DRAWING NO. F-54-6A

40P 2-1
GEORGE W.

Report of
Subsurface Exploration
for Proposed Bridge Site
Highway 55 - St. Jacob's

Copies to: Mr. H. Leont
Bridge Engineer (2)

Mr. J. Walter
Construction Engineer (1)

Project F-54-6

Mr. C. Fraser
Division Engineer, Division #6 (1)

INDEX

	<u>Page</u>
Introduction	1
Procedure	1
Soil Conditions	1
<u>Analysis of Sampling and Testing</u>	2
Water Conditions	3
<u>Analysis and Recommendations</u>	3
Widening the Footings	4
Pile Foundation	4
<u>Conclusion</u>	5
Appendix I	
Drawing at back of book - 7-14-6A	

Introduction

It is proposed to construct a new highway bridge, larger than the present one, over the Conestogo River.

A site investigation was therefore carried out to determine the nature and characteristics of the subsurface material at the location of the proposed pier and abutments, and to determine the maximum safe bearing capacity of the soil, and the most suitable founding method for the bridge.

Procedure

Eight boreholes were put down in the neighborhood of the proposed bridge with a diamond drill between June 15 and August 23, 1954. Most of the boreholes consisted of two holes drilled about 4 feet apart, in one of which undisturbed samples of the soil were taken, and in the other continuous penetration records were kept, wherever possible.

Generally, two holes on each bank were drilled close to the existing river edge on each side of the proposed bridge. Another two holes were drilled from a raft anchored at the position of the proposed pier in mid-stream. Two more holes were drilled through the backfill of the existing bridge. One hole was continued to bedrock at a total depth of 75 feet. The positions of all the holes and relative ground levels, etc. are shown on the site plan, Fig. 1.

Details of the strata encountered are shown on the borehole records Figs. 2 to 8.

Soil Conditions

Generally 7 feet to 11 feet of sandy gravel and boulders overlies loose to very dense sand which in turn was underlain by very stiff till (bouldery clay). A wedge shaped layer of silty clay was encountered in the sandy stratum as shown on the cross-sections and profile - Fig. 1.

Analysis of Sampling and Testing

Sandy Gravel with Boulders

For this stratum occurring near the surface, it was difficult to conduct any recognised penetration test or take any undisturbed samples.

The evaluation of this stratum was estimated where necessary by inspection and using accepted codes of practice.

Silty Clay Stratum

This stratum occurring in most of the boreholes immediately below the bouldery stratum was generally stiff to very stiff in consistency, and undisturbed samples were obtained for classification and testing.

Sand

This stratum in all the boreholes was tested in the field by means of the standard penetration test, or Dynamic Cone Method.

In the holes on the Elmhurst side of the river, the sand appeared to be stable, well graded, and containing little gravel. In midstream and on the St. Jacobs side, however, the sand was found to rise in the boreholes, and the indication is that the Standard Penetration number may not exceed 10 (loose) in the area.

Boulder Clay (Till)

This stratum encountered in all the boreholes was generally stiff to hard in consistency. Undisturbed samples were obtained for classification and testing.

The position and nature of all samples and the results of the penetration tests are shown in the borehole records, Figs. 2 to 8.

Water Conditions

During the period of the investigation, the water level in the river remained almost constant at the level of minimum flow. At this time, almost the entire flow is provided by the mill race from the local flour mill. At certain times of the year, however, the water level has been known to rise by as much as 10 feet and to reach a considerable velocity. The question of scour of the material adjacent to the foundations must therefore be taken into consideration. The ground water table in the surrounding soil will naturally depend on the river level.

In borehole 12, in midstream, water was observed to overflow the casing at depth 10 feet 9 inches under slight artesian head. The same occurrence was observed when boring through the sandy stratum at positions where the sand rises in the borehole.

Analysis and Recommendations

The preliminary drawings for the proposed bridge indicate strip footings for the abutments and pier about 7 feet wide and 40 feet long. The footings for the abutments are situated about 5 feet below low water level; and for the pier about 6 feet below river bottom as shown on the plan.

The estimated bearing pressure exerted by the footings on the soil under these conditions is $2\frac{1}{2}$ tons per square foot.

Analysis of the vertical pressure exerted at different horizons below the footing indicates that in the vicinity of the foundation on the St. Jacobs side, a factor of safety of 2.2 is provided against general shear failure of the foundation. In midstream and on the Elmira side the factor is 2.9 and 3.0 respectively. These factors are based on an assessed angle of internal friction for the quicksand encountered in the boreholes, and subsequent analysis following the methods of Dr. G. G. Meyerhof as published in Geotechnique, December 1951.

4.

In midstream and on the Elaira side, the presence of a band of stiff silty clay further reduces the factor of safety at these points to 1.3. This was calculated from the cohesive strength and angle of internal friction of this stratum derived from triaxial compression tests on undisturbed samples.

A factor of safety of 3 against general shear failure is normally considered the minimum requirement for safety, and consequently other types of foundation should be investigated, such as widening the footings, or piles.

(a) Widening the footings.

A maximum bearing value of 1.1 ton per square foot for all footings would effectively avoid overstressing the silty stratum on the Elaira side and in midstream, and the quicksand deposit on the St. Jacobs side. The above would require considerable widening of the proposed footings to a point where it might become more economical to use piles. If spread footings are used, it should be kept in mind that where soft patches of silt were encountered during excavation it would be necessary to remove them.

(b) Pile Foundation.

The ultimate bearing capacity of a single pile driven into the stiff boulder clay encountered in all the boreholes has been estimated. Assuming a minimum shear strength of 2000 lbs. per square foot for the boulder clay, a one-foot square pile driven about 5 feet into this stratum would be expected to develop an ultimate point resistance, plus skin friction, of the order of 43 tons. To this a safety factor of 2 should be provided. The above estimated load per pile, that is, 21 tons, should be checked on the field with load test on a pile and by pile formulae. The undersigned will direct and evaluate on request the result of a load test on a pile.

Conclusion

(1) Spread footings can be used if the allowable load does not exceed 1.1 tons per square foot. The footings should be founded 4 to 5 feet below ground elevation. Sheet piling should be provided to prevent erosions of the soil around the abutments.

(2) Piles about 34 feet could be used. Estimated load per one foot square pile is about 21 tons. This figure should be checked by actual load tests on a pile and from Hiley or Engineering News pile formulae.

F. C. Brownridge
Materials and Research Engineer

Per:



(G. Farantatos)

APPENDIX I