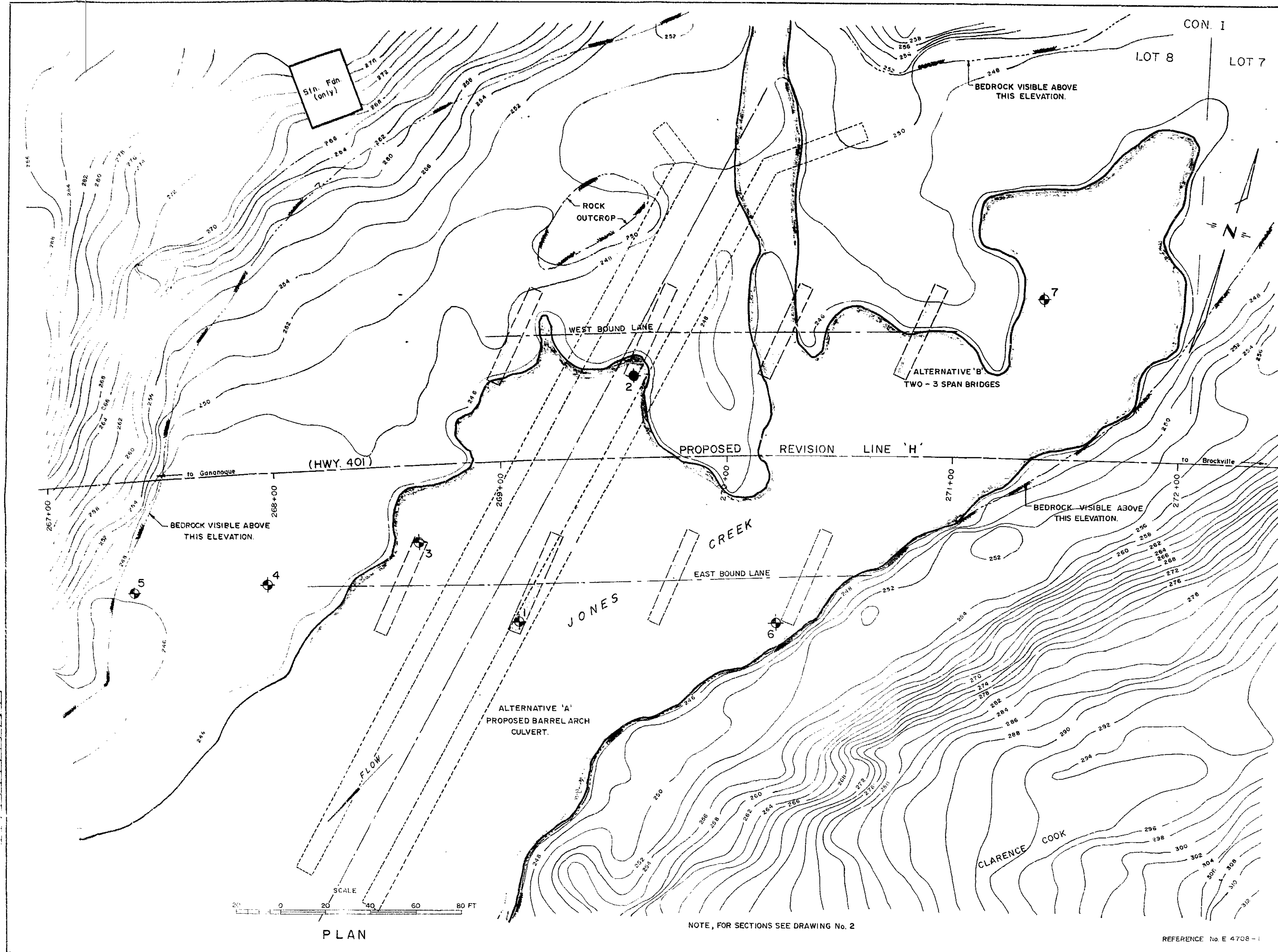
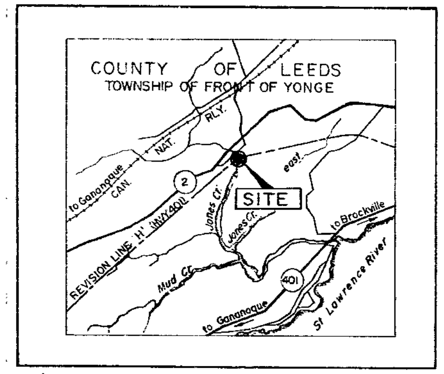
#65-F-233
W.P. #178-61
Hwy. #401
JONES
CREEK



NOTE, FOR SECTIONS SEE DRAWING No. 2

REFERENCE No. E 4708 - I



KEY PLAN

SCALE IN MILES

LEGEND

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

NO.	ELEVATION	STATION	OFFSET
1	242.8	269+06	71' RIGHT
2	245.6	269+59	36' LEFT
3	244.3	268+63	34' RIGHT
4	246.3	267+95	49' RIGHT
5	246.3	267+35	49' RIGHT
6	243.7	270+21	74' RIGHT
7	244.9	271+40	70' LEFT

- NOTE -

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
DATE	BY	DESCRIPTION

H.Q.GOLDER & ASSOCIATES LIMITED

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

JONES CREEK

REVISION LINE 'H'

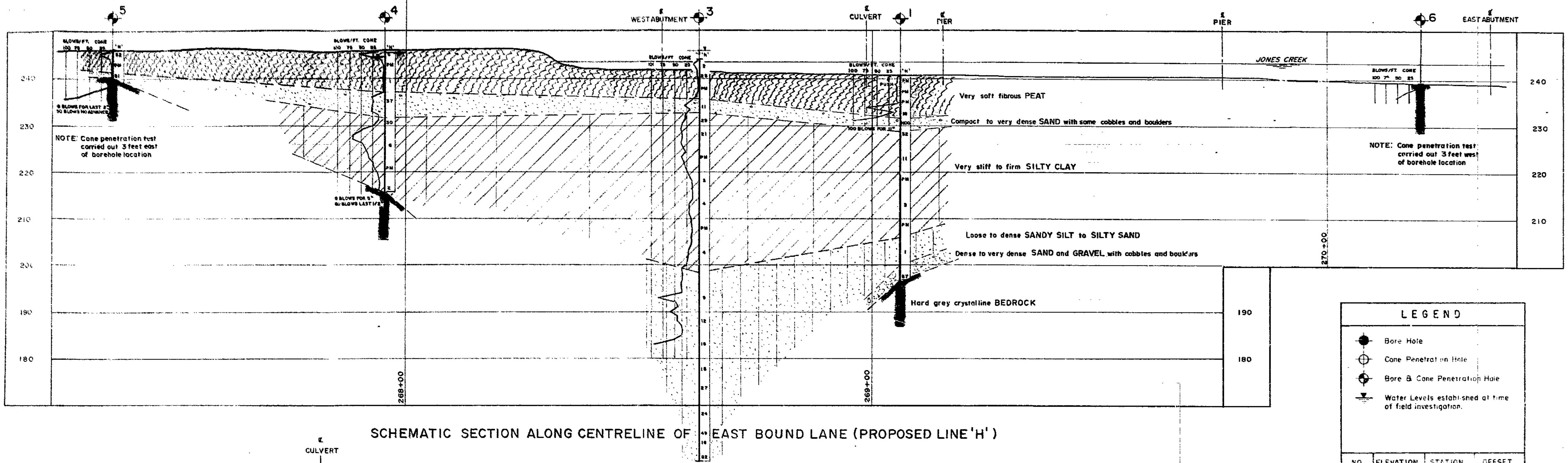
KING'S HIGHWAY NO. 401 DIST NO 8

CO. OF LEEDS

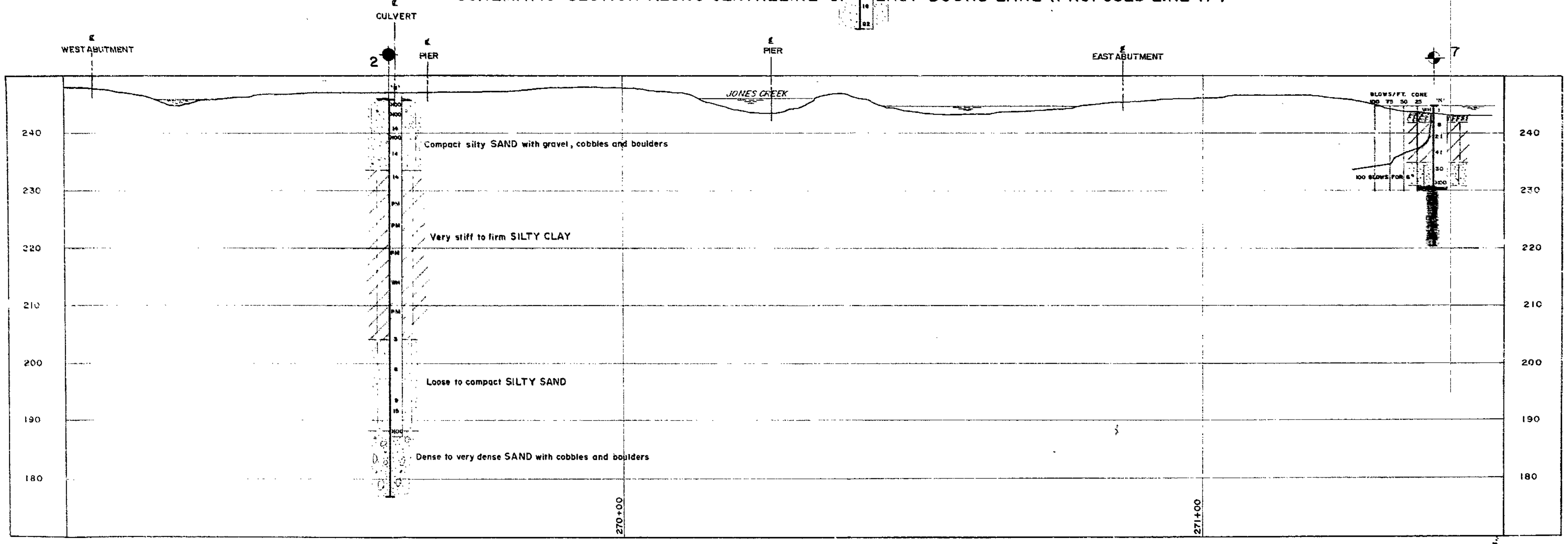
TWP OF FRONT OF YONGE LOTS 7 & 8 CON I

SITE AND BORING PLAN

	CHECKED	W.P. NO 178 - 61	DRAWING NO. 1
DRAWN M.W.	CHECKED	JOB NO 65028	
DATE MAY 3, 1965		SITE NO	BRIDGE DRAWING NO
APPROVED		CONT NO	



SCHEMATIC SECTION ALONG CENTRELINE OF EAST BOUND LANE (PROPOSED LINE 'H')



SCHEMATIC SECTION ALONG CENTRELINE OF WEST BOUND LANE (PROPOSED LINE 'H')

SCALE 10 0 10 20 30 40 50 60 FT.

NOTE, FOR LOCATIONS OF SECTIONS SEE DRAWING No. 1

REFERENCE No. E4708-1

LEGEND

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

NO.	ELEVATION	STATION	OFFSET
1	242.8	269+06	71' RIGHT
2	245.6	263+59	36' LEFT
3	244.3	268+63	34' RIGHT
4	246.3	267+95	49' RIGHT
5	246.3	267+35	49' RIGHT
6	243.7	270+21	74' RIGHT
7	244.9	271+40	70' LEFT

– NOTE –
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
DATE	BY	DESCRIPTION

PRINT RECORD

NO	FOR	DATE

H.Q. GOLDER & ASSOCIATES LIMITED

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

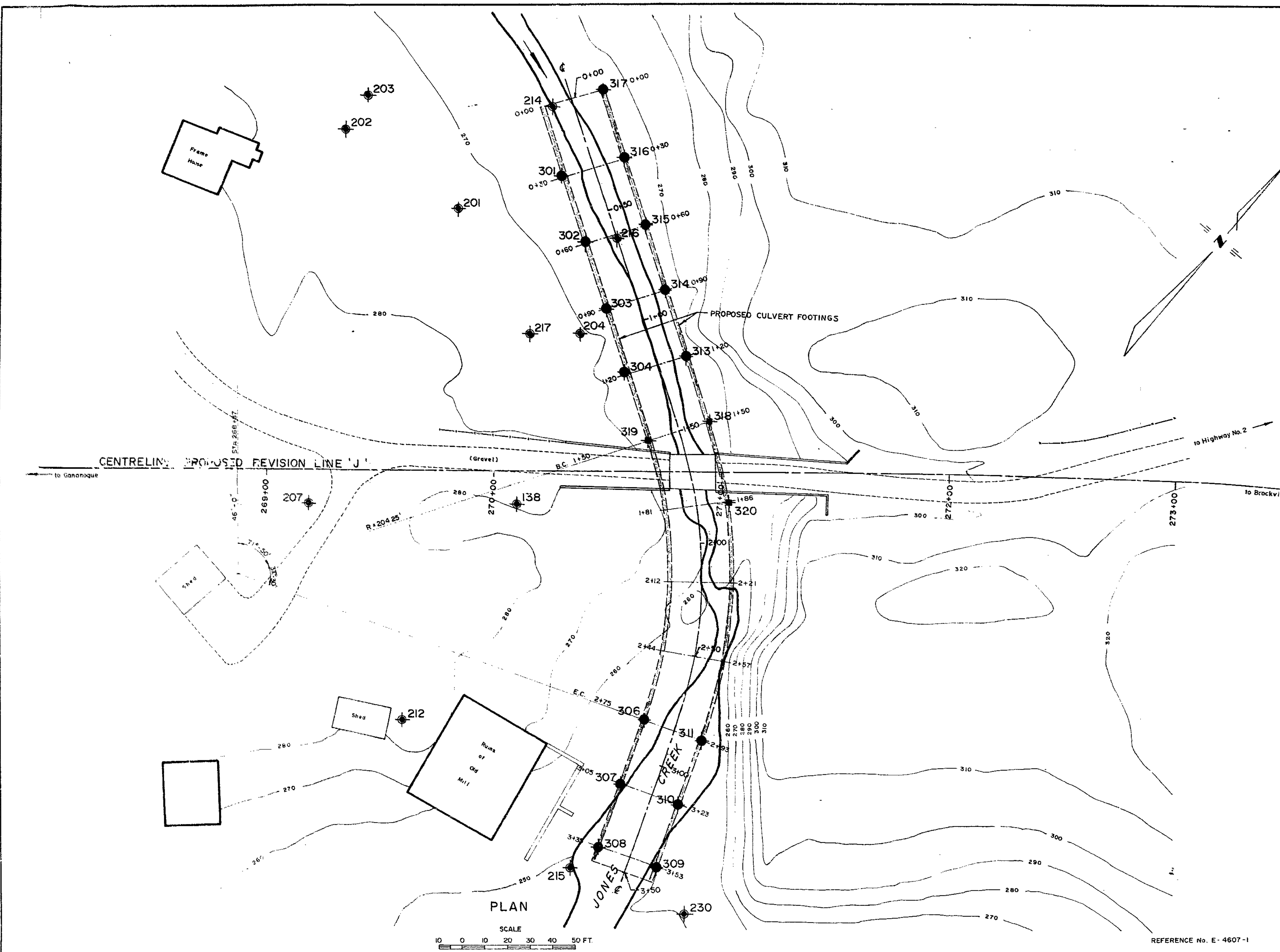
JONES CREEK

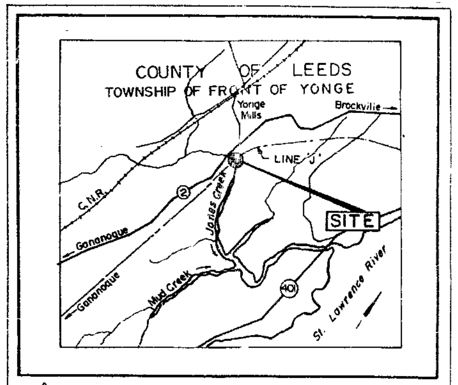
REVISION LINE 'H'

KING'S HIGHWAY NO. 401 DIST NO 8
CO. OF LEEDS
TWP. OF FRONT OF YONGE LOTS 7 & 8 CON I

SOIL STRATIGRAPHY SECTIONS

SUBM'D	CHECKED	W.P. NO 178 - 61	DRAWING NO 2
DRAWN M.W.	CHECKED	JOB NO. 65028	
DATE MAY 6, 1965		SITE NO	BRIDGE DRAWING NO
APPROVED		CONT NO	





KEY PLAN

SCALE IN MILES

1.0 0 1.0 2.0 3.0

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation.
- Test Pit
- Previous Borings in area.

NO.	ELEVATION	STATION	OFFSET
301	2664	0+30	13.5' RIGHT
302	266.8	0+60	"
303	267.7	0+90	"
304	2680	1+20	"
306	2516	2+84	"
307	251.3	3+14	"
308	2492	3+44	"
309	2506	3+44	13.5' LEFT
310	250.6	3+14	"
311	251.3	2+84	"
313	2643	1+20	
314	263.1	0+90	"
315	263.7	0+60	"
316	264.7	0+30	"
317	266.1	0+00	"
318	264.7	1+50	"
319	268.3	1+50	13.5' RIGHT
320	2689	1+83	13.5' LEFT

Note, Stations and Offset refer to Centreline Culvert Chainage.

– NOTE –

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

H. Q. GOLDER AND ASSOCIATES LIMITED

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION – FOUNDATION SECTION

JONES CREEK

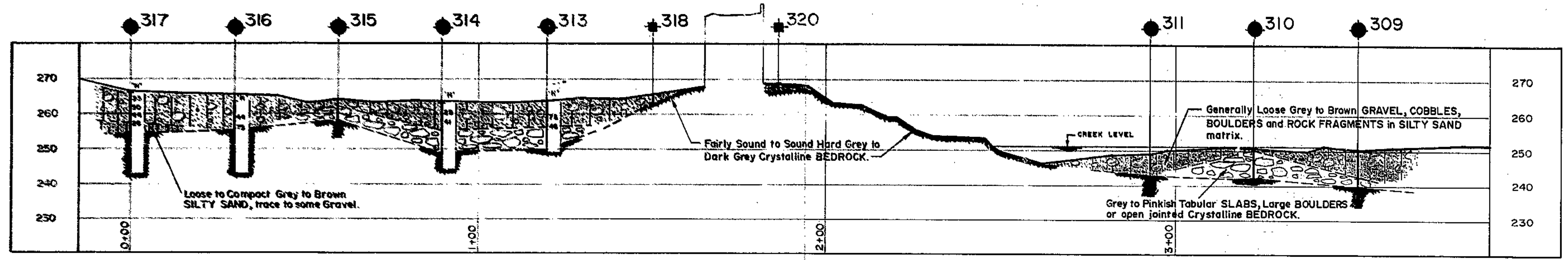
KING'S HIGHWAY NO. 401, PROPOSED REVISION LINE 'J' DIST. NO. 8

CO. LEEDS

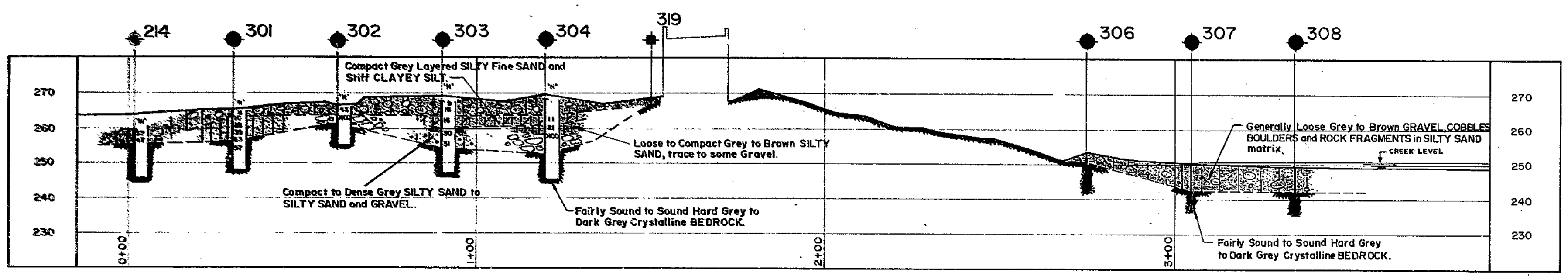
TWP. OF FRONT OF YONGE LOT 8 CON. I

SITE AND BORING PLAN

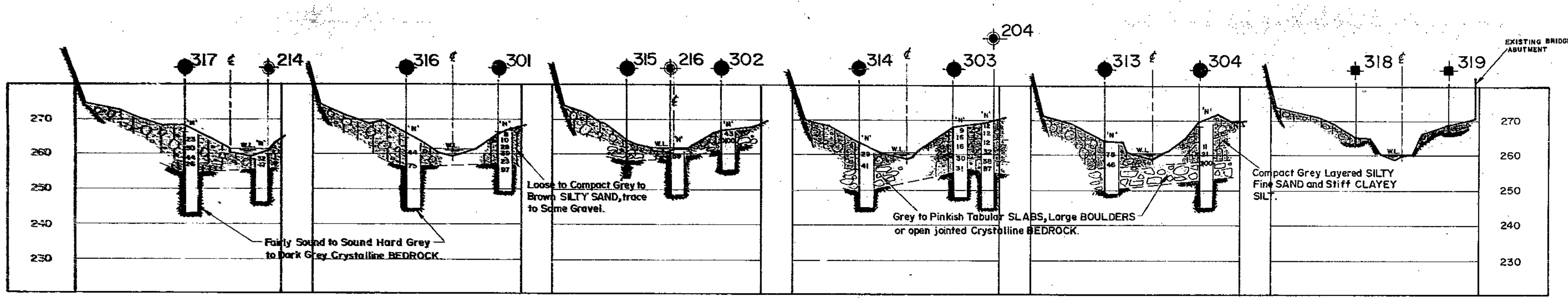
SUBM'D	CHECKED	W.P. NO. 178-61	M.&T. DRAWING NO. 1
DRAWN M.W.	CHECKED	JOB NO. 65111	
DATE OCT. 15, 1965		SITE NO	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT NO.	



SECTION ALONG PROPOSED EAST FOOTING LINE

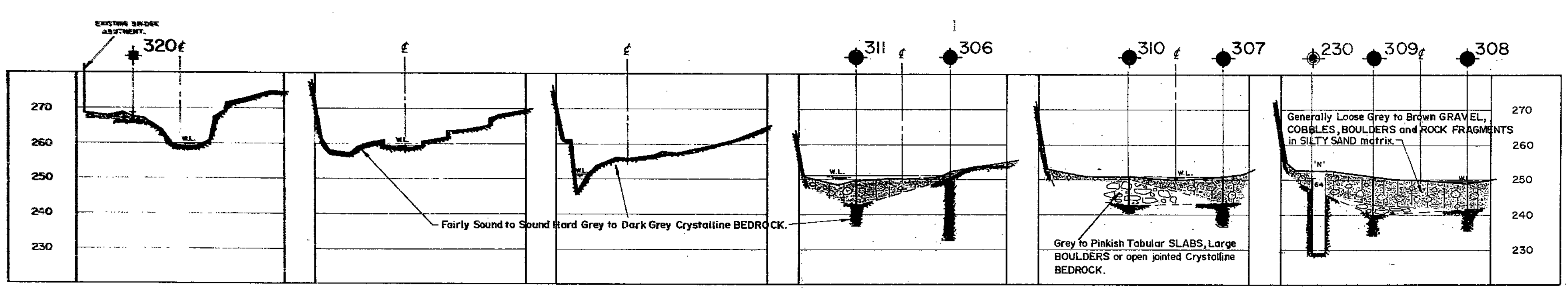


SECTION ALONG PROPOSED WEST FOOTING LINE



SECTION AT CENTRELINE STATION

0+00 | 0+30 | 0+60 | 0+90 | 1+20 | 1+50



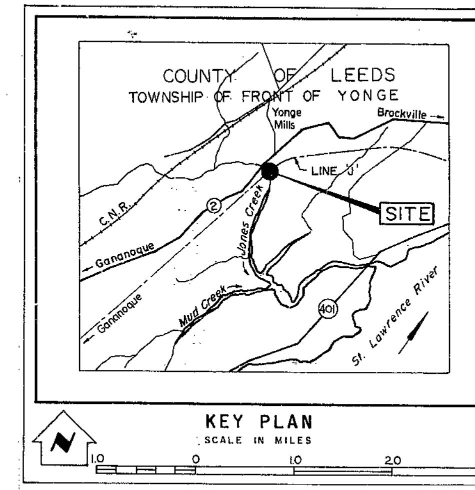
SECTION AT CENTRELINE STATION

1+83 | 2+17 | 2+30 | 2+84 | 3+14 | 3+44

SCALE IN FEET

20 0 20 40 60 80 100

REFERENCE No. E-4607-1



KEY PLAN

SCALE IN MILES

10 0 10 20 30

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. (OCT. 7, 1965).
- Test Pit
- Previous Borings in area

NO.	ELEVATION	STATION	OFFSET
301	266.4	0+30	13.5' RIGHT
302	266.6	0+60	"
303	267.7	0+90	"
304	268.0	1+20	"
306	251.6	2+84	"
307	251.3	3+14	"
308	249.2	3+44	"
309	250.6	3+44	13.5' LEFT
310	250.6	3+14	"
311	251.3	2+84	"
313	264.3	1+20	"
314	263.1	0+90	"
315	263.7	0+60	"
316	264.7	0+30	"
317	266.1	0+00	"
318	264.7	1+50	"
319	268.3	1+50	13.5' RIGHT
320	268.9	1+83	13.5' LEFT

Note, Stations and Offset refer to Centreline Culvert Chainage.

- NOTE -

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

H. Q. GOLDER AND ASSOCIATES LIMITED

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION - FOUNDATION SECTION

JONES CREEK

KING'S HIGHWAY NO. 401, PROPOSED REVISION LINE 'J' DIST NO. 8

CO. OF LEEDS

TWP. OF FRONT OF YONGE LOT 8 CON. I

SOIL STRATIGRAPHY SECTIONS

SUBM'D.	CHECKED	W.P. NO. 178-61	DRAWING NO. 2
DRAWN M.W.	CHECKED	JOB NO. 65111	
DATE OCT. 19, 1965		SITE NO	DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

SOME DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENTS

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

W.P. 178-61

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SITE INVESTIGATION

PROPOSED JONES CREEK (WEST BRANCH) CROSSING

HIGHWAY 401 - LINE H

TOWNSHIP OF FRONT OF YONGE ONTARIO

Distribution:

11 copies - Department of Highways, Ontario, Toronto, Ontario.

2 copies - H. Q. Golder & Associates Ltd., Toronto, Ontario.

June, 1965 65028

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SITE AND GEOLOGY	3
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RECORDS OF BOREHOLES	

FIGURE 1 - Site and Boring Plan

2 - Soil Stratigraphy Sections

3 - Penetration Resistance and Shear Strength for Silty Clay Stratum

ABSTRACT

The results of an investigation to determine the sub-surface conditions along the proposed Highway 401 - Line "H" crossing of the west branch of Jones Creek near Mallorytown, Ontario, are reported.

It was found that the site is generally covered by up to 9 feet of very soft compressible peat overlying a thin deposit of sand and gravel. Underlying the sand and gravel in the central portion of the creek valley is a stratum of very stiff to firm silty clay up to 35 feet in thickness. The clay stratum is underlain by loose to compact sandy silt to silty sand becoming dense sand and gravel with cobbles and boulders resting on hard grey crystalline bedrock. The bedrock elevation varies considerably across the site, being over 80 feet higher at the edges of the valley floor than it is at the central portion.

Preliminary computations carried out during the course of the field work indicate that the proposed 55 foot high embankments placed across the valley floor, after removal of the peat, would not be sufficiently stable due to the presence of the underlying firm clay stratum. To provide stable approach embankments at this crossing it would be necessary to lengthen the proposed 3 span structures considerably. Based on economics, it was decided at this stage to abandon the line "H" crossing entirely and to investigate a crossing to the north in the proximity of line "X" as detailed in our report 65046, dated June, 1965.

INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by the Department of Highways, Ontario, to carry out a soil investigation for the proposed Jones Creek (West Branch) crossing of the Highway 401 realignment designated as line "H" near Mallorytown, Ontario. The purpose of the investigation was to determine the subsoil conditions at the site and, based on this information, to make recommendations regarding the foundation design of the proposed structures and approach embankments at this crossing.

PROCEDURE

The field work for this investigation was carried out during the period April 2 to 23, 1965. A total of seven boreholes were put down by the wash boring method using a diamond machine drillrig supplied and operated by the F.E. Johnston Drilling Co. Limited under the supervision of an engineer from our staff. Dynamic penetration tests were carried out adjacent to six of the borehole locations. Five of the boreholes were put down on land while the remaining two were carried out from a raft. The borings were advanced in NX and BX casing size to depths ranging from about 15 to 86 feet below ground surface. In several of the holes the presence of cobbles and boulders necessitated diamond drilling to advance the casing through the overburden. Bedrock was cored in AXT size in borings 1, 4, 5, 6 and 7. Either a sealed piezometer or a standpipe was installed in 6 of the borings to determine the groundwater level.

Detailed logs of each boring are given on the Records of Boreholes following the text of this report. The locations of the borings are shown on Figure 1 and sections of the inferred soil stratigraphy along the centrelines of the eastbound and westbound lanes are shown on Figure 2. These figures are located in a pocket following the Records of Boreholes.

The samples obtained during the investigation were brought to our laboratory but no testing was carried out.

The elevations in this report were provided by the Department of Highways, Ontario, and it is understood that they are referred to Geodetic datum.

SITE & GEOLOGY

The site of the proposed Highway 401 - Line "H" crossing over the west branch of Jones Creek is located some 800 feet south of the existing Highway 2 in the Township of Front of Yonge in the County of Leeds near the site of the original Yonge Mills. At the site of the proposed crossing the creek is about 120 feet wide and up to 8 feet deep. The creek flows in a southwesterly direction, but slightly north of the site where the creek narrows to about 10 feet in width it flows in a northwesterly direction. The creek valley is about 250 feet wide and is bounded on both sides by fairly steep rock slopes some 60 feet high. The creek valley extends north of the site along approximately the axis on which it crosses the site but the valley floor becomes considerably narrower.

The proposed revision line "H" runs in a generally east-west direction and crosses the creek valley at a skew of about 30° necessitating a crossing of some 750 feet in length at the proposed highway grade. The valley slopes show extensive bedrock outcrops and some outcrops exist on the valley floor.

Based on previous experience and geological knowledge, the bedrock in the area of the proposed crossing consists generally of hard grey and red quartzite with some biotite and augite. Examination of rock outcrops indicate that the bedrock at the site is characterized by beds about 6 inches thick with a dip of about 55° generally towards the west.

SUBSURFACE CONDITIONS

The detailed stratigraphy encountered in each borehole is given on the Records of Boreholes. Following is a summary account of the inferred soil conditions at the site.

The surface deposit in all boreholes, except number 6, is a brown fibrous peat with varying amounts of sand and small pieces of wood throughout. The thickness of this deposit ranges from less than 1 foot at boring 2 to 9 feet at borings 1 and 4. Several field vane tests carried out within the peat, the results of which are shown on the Records of Boreholes, gave undrained shear strength values of from 200 to 400 lb/sq.ft. Based on these strength values, together with the standard penetration test results, the overall consistency of the peat is estimated to be very soft to soft.

Below the peat in boreholes 1 to 5, inclusive, is a layer of brown to grey silty sand to sand with gravel, cobbles and boulders. This granular deposit varies in thickness from less than 1 foot at boring 5 to about 11 feet at boring 2. Standard penetration tests carried out within the sand and gravel gave "N" values ranging from 11 blows/ft. to values in excess of 100 blows/ft. indicating that the relative density is compact to very dense and generally dense to very dense.

Underlying the sand and gravel in boreholes 1 to 4, inclusive, and the peat in borehole 7, is a stratum of grey silty clay with a trace of sand and gravel throughout and with occasional layers of silt and sand up to 2 inches thick. The silty clay stratum is from about 7 to 34 feet in thickness. The undrained shear strength of the silty clay was determined by field vane tests, the results of which are given on the Records of Boreholes and are summarized on Figure 3. As shown by the plot on Figure 3, the shear strength ranges from about 500 lb/sq.ft. to greater than 3000 lb/sq.ft. with an average value of about 1,000 lb/sq.ft. The sensitivity of the silty clay, as determined by the remoulded field vane tests, varies generally from about 4 to 8. Based on the strength results together with the standard penetration test results which are also summarized on Figure 3, the consistency of the clay is very stiff to firm.

A deposit of grey sandy silt, ranging from 4 feet to a thickness in excess of 40 feet in borehole 3, with some gravel and occasional clayey silt seams up to about 1 foot thick, was encountered below the silty clay in boreholes 1, 2, 3 and 7. Standard penetration tests carried out within the sandy silt to silty sand deposit indicate that the relative density is loose to dense and generally compact

In boreholes 1 and 2, the silty sand is underlain by a deposit of dense to very dense sand and gravel with cobbles and boulders throughout. This deposit has a thickness of about 3 feet in borehole 1. Borehole 2 was terminated at a depth of about 11 feet in the sand, cobbles and boulders.

Hard grey crystalline bedrock, with occasional horizontal and inclined fractures, was encountered beneath the sand

and gravel in boreholes 1 and 5, the silty sand in borehole 7 and the silty clay in borehole 4. At borehole 6 bedrock forms the creek bed. The bedrock elevation varies considerably across the site, being at about elevation 240 at the locations of boreholes 5 and 6, while at borehole 3 bedrock was not encountered within the depth of exploration which extended down to elevation 158.

GROUNDWATER CONDITIONS

Sealed piezometers or standpipes were installed in all boreholes, except number 6, following completion of drilling to determine the piezometric groundwater level at the site. Details of these installations are given on the Records of Boreholes. Periodic water level readings were taken during the course of the field work and the latest results obtained are given on the Records of Boreholes and on Figure 2.

The piezometric groundwater level, as measured in the borings on June 9, 1965, was found to range between about elevation 244 and 246, that is, up to about 2 feet above the water level in Jones Creek which varied from about elevation 243 to 244 during the period of the investigation.

DISCUSSION

It is understood that a barrel arch culvert or twin bridge structures have been proposed for this crossing at the locations shown on Figure 1. The choice of the culvert or the 3 span bridge structures would be dependent on the subsoil conditions encountered. The proposed roadway grade along line "H" over Jones Creek has been established at about elevation 300 thus necessitating approach embankments of the order of 55 feet in height above the valley floor.

During the course of the field investigation which disclosed a very stiff to firm silty clay stratum underlying the valley floor, preliminary computations were carried out to check on the overall stability of the proposed 55 foot high embankment. These computations showed that the stability of the proposed fill was not adequate. This eliminated the use of the culvert and necessitated increasing the length of the proposed 3 span bridge structures considerably in order to reduce the height of the proposed approach fills to prevent a stability problem.

The above information was communicated to the Department of Highways, Ontario, and based on relative economics, it was decided on April 23, 1965, during the course of the field work to abandon line "H" and proceed with an investigation of a crossing to the north where a previous preliminary investigation indicated more favourable foundation conditions. The results of this subsequent investigation are presented in our report 65046, dated June, 1965.

for L. R. Lahti, P.Eng.

J. L. Seychuk, P.Eng.

LRL:HJB
65028
June, 1965

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS	auger sample
CS	chunk sample
DO	drive open
DS	Denison type sample
FS	foil sample
RC	rock core
ST	slotted tube
TO	thin-walled, open
TP	thin-walled, piston
WS	wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, N: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*N, blows/ft.*
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	c_u, *lb./sq. ft.*
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	combined analysis, sieve and hydrometer[1]
Q	undrained triaxial[2]
R	consolidated undrained triaxial[2]
S	drained triaxial
U	unconfined compression
V	field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

LIST OF SYMBOLS

I. GENERAL

$\pi = 3.1416$
e = base of natural logarithms 2.7183
$\log_e a$ or $\ln a$, natural logarithm of a
$\log_{10} a$ or $\log a$, logarithm of a to base 10

t	time
g	acceleration due to gravity
V	volume
W	weight
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	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

III. SOIL PROPERTIES

(a) *Unit weight*

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_s	specific gravity of solid particles $G_s = \gamma_s/\gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) *Consistency*

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_S	shrinkage limit
I_L	liquidity index $= (w - w_P)/I_P$
I_C	consistency index $= (w_L - w)/I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

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

(d) *Consolidation (one-dimensional)*

m_v	coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$
C_c	compression index $= -\Delta e/\Delta \log_{10} \sigma'$
c_v	coefficient of consolidation
T_v	time factor $= c_v t/d^2$ (d, drainage path)
U	degree of consolidation

(e) *Shear strength*

τ_f	shear strength	
c'	effective cohesion intercept	in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	effective angle of shearing resistance, or friction	
c_u	apparent cohesion*	in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$
ϕ_u	apparent angle of shearing resistance, or friction	
μ	coefficient of friction	
S_t	sensitivity	

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

RECORD OF BOREHOLE 1

LOCATION See Figure 1 BORING DATE APRIL 2-6, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX-BX CASINGS

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLES: NUMBER	TYPE	BLOWS / FT.
242.8	ICE LEVEL			
0.0 / 240.6	CREEK BED			
2.2	VERY SOFT TO SOFT DARK BROWN FIBROUS **PEAT** WITH PIECES OF WOOD AND SOME SAND AND GRAVEL BELOW EL. 234	1	2" DO	PM
		2	2" TO	PM
		3	2" TP	PM
		4	2" DO	18
231.6 / 11.2	VERY DENSE GREY **SAND** WITH SOME GRAVEL	5		>100
		6	AXT RC	–
228.3 / 14.0	VERY STIFF TO FIRM GREY **SILTY CLAY** WITH OCCASIONAL LAYERS OF SAND AND GRAVEL, BECOMING LAYERED BELOW ABOUT EL. 217 WITH 3" THICK SILTY CLAY LAYERS & 2" THICK CLAYEY SILT AND SAND LAYERS	7	2" DO	32
		8	2" TO	11
		9	"	PM
		10	2" DO	3
		11	2" TO	PM
205.8 / 37.0	LOOSE GREY **SILT** WITH SOME FINE SAND	12	2" DO	1
200.6 / 41.8	VERY DENSE GREY **SAND AND GRAVEL** WITH SOME SILT	13	"	87
196.8 / 46.0	HARD LIGHT GREY METAMORPHOSED CRYSTALLINE **BEDROCK** WITH OCCASIONAL FRA[C]TURES BELOW EL 193	14	AXT RC	–
		15	"	–
		16	"	–
186.9 / 55.9	END OF HOLE			

ELEVATION SCALE: 250, 240, 230, 220, 210, 200, 190, 180

DYNAMIC PENETRATION RESISTANCE BLOWS/FT. (20, 40, 60, 80, 100)

SHEAR STRENGTH C_u, LB./SQ.FT. VANE + FIELD, ⊕ REM. (500, 1000, 1500, 2000, 2500)

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT W_P W W_L

ADDITIONAL LAB. TESTING

PUSHED BY HAND

END OF PEN. TEST @ELEV. 230.0 100 BLOWS FOR LAST 11 INCHES

% CORE RECOVERY: 90, 88, 79

15-○-5 Percent axial strain at failure

PIEZOMETER OR STANDPIPE INSTALLATION: ICE LEVEL; PLASTIC TUBING; CAVE-IN; SAND FILL; BENTONITE SEAL; BX.CA. HOLE; AXT CORE HOLE; PIEZOMETER

W.L. IN PIEZOMETER @ EL. 244.3 ON JUNE 9, 1965

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN RH & MW

CHECKED [illegible]

PROJECT No. 65028

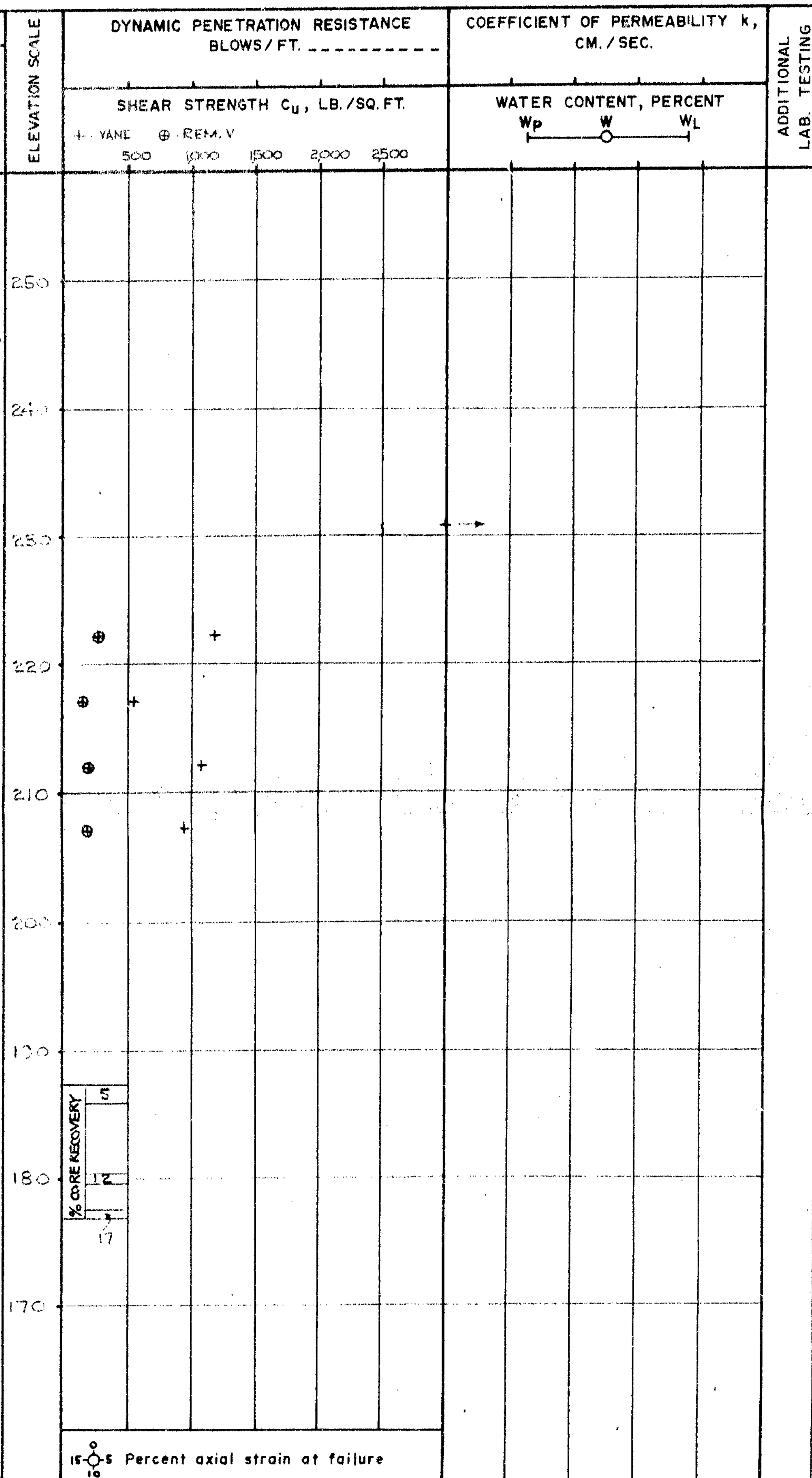
RECORD OF BOREHOLE 2

LOCATION See Figure 1 BORING DATE APRIL 6-9, 1965 DATUM GEODETIC

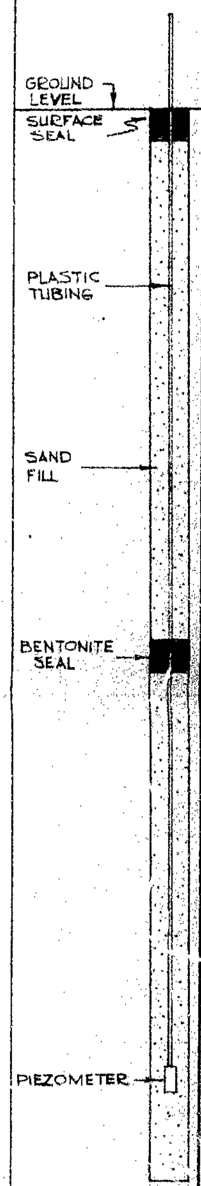
BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT – LB. DROP – INCHES

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
245.6	GROUND LEVEL	1	2" DO	>100
0.5	FIBROUS PEAT	2	AX RC	
	COMPACT BROWN **SILTY SAND** WITH SOME GRAVEL, COBBLES & BOULDERS THROUGHOUT AND WITH OCCASIONAL POCKETS OF ORGANIC MATTER	3	2" DO	>100
		4	AX RC	
		5	2" DO	14
		6	AX RC	>100
		7		
		8	AX RC	
		9	2" DO	14
233.6 / 12.0	VERY STIFF BECOMING STIFF TO FIRM, GREY FAINTLY LAYERED **SILTY CLAY** WITH THIN SILT LAYERS AND WITH A TRACE TO SOME SAND	10	"	14
		11	2" TO	PM
		12	2" DO	PM
		13	2" TO	PM
		14	2" DO	Wh
		15	2" TO	PM
204.1 / 41.5	LOOSE TO COMPACT GREY **SILTY SAND** WITH A TRACE OF CLAY, BECOMING SAND WITH A TRACE TO SOME SILT AND GRAVEL	16	2" DO	3
		17	"	8
		18	2" DO	9
		19	"	15
188.1 / 57.5	DENSE TO VERY DENSE **SAND** WITH COBBLES AND BOULDERS THROUGHOUT	20	"	>100
		21	AXT RC	–
		22	WS	–
		23	WS	–
		24	AXT RC	–
		25	WS	–
		26	AXT RC	–
176.8 / 68.8	END OF HOLE			



15 -○- 5 Percent axial strain at failure (10)



W.L. ROSE IN CASING DURING DRILLING OPERATIONS TO EL. 207. PIEZOMETER INSTALLATION DESTROYED - UNABLE TO TAKE FURTHER READINGS

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN RH & M.V.

CHECKED [illegible]

PROJECT No. 65028

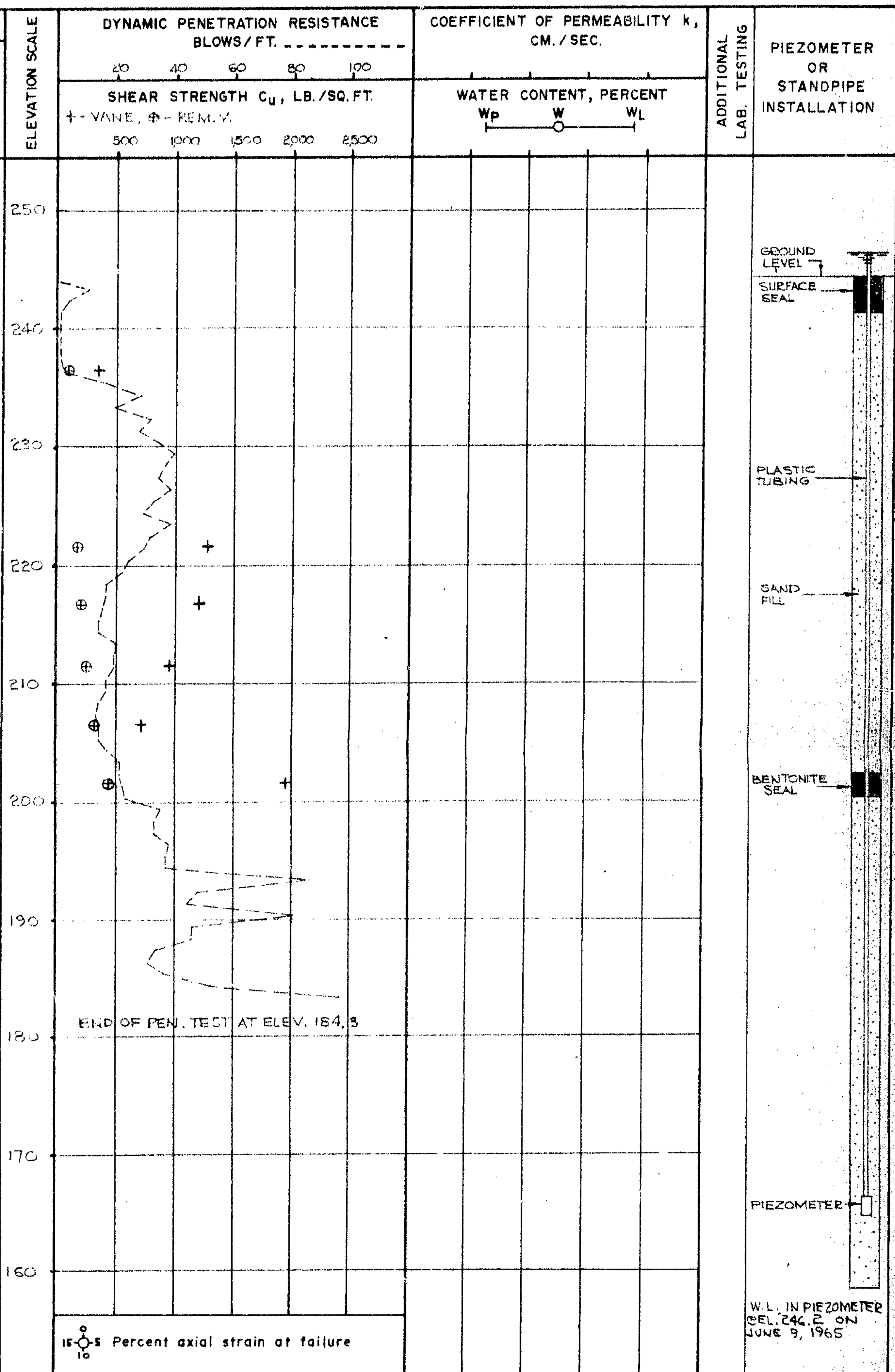
RECORD OF BOREHOLE 3

LOCATION See Figure 1 BORING DATE APRIL 12-15, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX-BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEV'N. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.
244.3	GROUND LEVEL			
0.0	VERY SOFT TO SOFT DARK BROWN FIBROUS PEAT WITH SOME SAND ABOVE EL. 242 AND WITH PIECES OF WOOD THROUGHOUT	1	2" DO	2
		2	2" TO	25
		3	"	PM
235.8 / 8.5	COMPACT GREY SAND WITH SOME GRAVEL	4	2" DO	11
232.8 / 11.5	STIFF TO FIRM GREY SILTY CLAY WITH A TRACE TO SOME SAND AND A TRACE OF GRAVEL BECOMING FAINTLY LAYERED SILTY CLAY TO CLAYEY SILT BELOW EL. 204	5	"	29
		6	2" TO	21
		7	2" DO	PM
		8	2" TO	3
		9	2" DO	4
		10	2" TO	PM
		11	2" DO	4
198.5 / 45.8	COMPACT, BECOMING DENSE WITH DEPTH GREY SANDY SILT WITH A TRACE OF CLAY AND GRAVEL TO SILTY SAND WITH SOME GRAVEL, SCATTERED COBBLES THROUGHOUT AND WITH A 1 FOOT SEAM OF CLAYEY SILT AT EL. 168	12	2" TO	8
		13	2" DO	9
		14	"	12
		15	"	16
		16	"	15
		17/18	"	27
		19	"	24
		20	"	49
		21	"	16
		22	"	72
158.3 / 86.0	END OF HOLE			



15 -○- 5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN RH & MW

CHECKED

PROJECT No. 65928

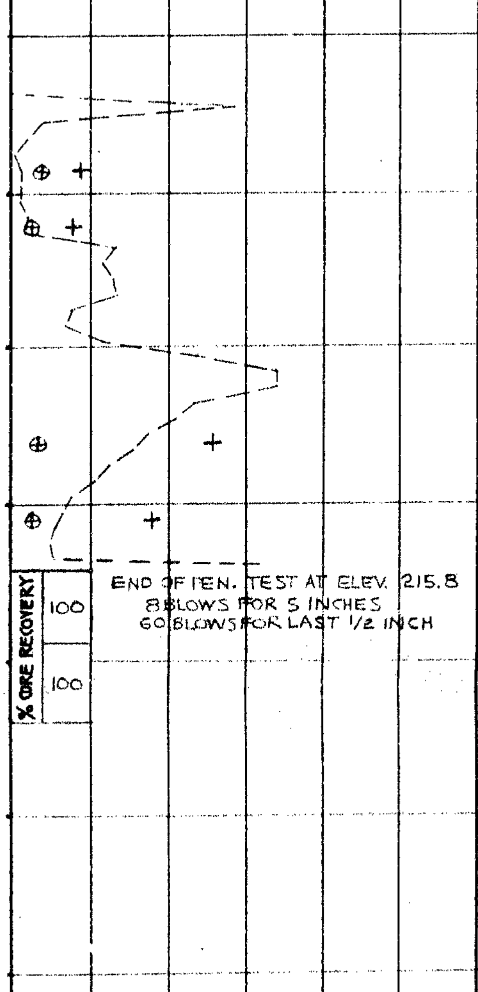
RECORD OF BOREHOLE 4

LOCATION See Figure 1 BORING DATE APRIL 15-20, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX - BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
246.3	GROUND LEVEL			
0.0	SOFT BROWN FIBROUS **PEAT** WITH PIECES OF WOOD THROUGHOUT	1	2" D.O.	6
		2	2" T.O.	Pm
		3	"	1
237.3 / 9.0	DENSE GREY **SAND** WITH SOME GRAVEL AND COBBLES	4	2" D.O.	37
231.8 / 14.5	STIFF TO FIRM WITH DEPTH GREY **SILTY CLAY** WITH A TRACE TO SOME SAND AND GRAVEL	5	"	30
		6	"	6
		7	2" T.O.	Pm
		8	2" D.O.	2
215.8 / 30.5	HARD GREY METAMORPHOSED CRYSTALLINE **BEDROCK** WITH NUMEROUS HORIZONTAL FRACTURES	9	AXT RC	–
		10	"	–
205.8 / 40.5	END OF HOLE			

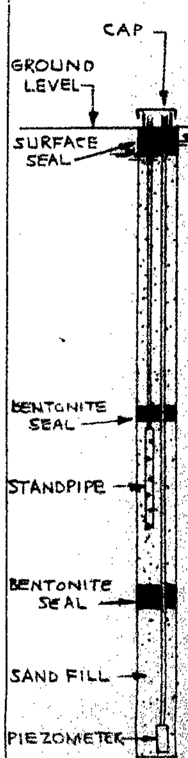


COEFFICIENT OF PERMEABILITY k, CM. / SEC.

WATER CONTENT, PERCENT W_P W W_L

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 244.8 ON JUNE 9, 1965

W.L. IN PIEZOMETER @ EL. 245.5 ON JUNE 9, 1965

15-O-5 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN RH EMW

CHECKED [signature]

PROJECT No. 65028

RECORD OF BOREHOLES 5, 6 & 7

LOCATION: See Figure 1 | BORING DATE: APRIL 20-23, 1965 | DATUM: GEODETIC

BOREHOLE TYPE: WASH BORING | BOREHOLE DIAMETER: NX - BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

Column headings: SOIL PROFILE (ELEVN. / DEPTH, DESCRIPTION, STRAT. PLOT); SAMPLES (NUMBER, TYPE, BLOWS / FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS / FT. (20, 40, 60, 80, 100); SHEAR STRENGTH C_u, LB./SQ.FT.; COEFFICIENT OF PERMEABILITY k, CM./SEC.; WATER CONTENT, PERCENT (W_P, W, W_L); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

5/

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT.
246.3	GROUND LEVEL			
0.0	SOFT BROWN FIBROUS PEAT WITH SOME SAND AND PIECES OF WOOD	1	2" D.O.	52
		2	2" T.O.	Pm
241.6		3	2" D.O.	51
240.3 / 6.0	VERY DENSE GREY SAND AND GRAVEL	4	AX,RC	–
	HARD GREY METAMORPHOSED CRYSTALLINE BEDROCK WITH NUMEROUS FRACTURES	5	"	–
			"	–
		8	"	–
231.4 / 14.9	END OF HOLE			

Elevation scale: 250, 240, 230. % CORE RECOVERY: 38, 38, 82. Penetration plot values: 57, 100.

END OF PEN. TEST AT ELEV. 236.1
18 BLOWS FOR LAST 2 INCHES
50 BLOWS FOR NO ADVANCE

Installation: CAP; GROUND LEVEL; SURFACE SEAL; SAND FILL; STANDPIPE

W.L. IN STANDPIPE @EL. 245.3 ON JUNE 9, 1965

6/

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT.
243.7 / 0.0	WATER LEVEL			
239.5 / 4.2	CREEK BED	1	AXT RC	–
	HARD GREY METAMORPHOSED CRYSTALLINE BEDROCK WITH SOME FRACTURES INCLINED UP TO 60° TO THE HORIZONTAL	2	"	–
		3	"	–
228.8 / 14.9	END OF HOLE			

Elevation scale: 240, 230. % CORE RECOVERY: 47, 100, 92.

END OF PEN. TEST AT ELEV. 235.7

7/

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT.
244.9	GROUND LEVEL			
0.0	VERY SOFT DARK BROWN FIBROUS PEAT	1	2" D.O.	1
241.9 / 3.0	STIFF TO VERY STIFF GREY SILTY CLAY WITH A TRACE TO SOME SAND AND GRAVEL	2	2" T.O.	8
		3	2" D.O.	21
234.9		4	"	41
10.0	DENSE GREY SILT WITH SOME SAND AND TRACE OF CLAY	5	"	30
230.9			"	>100
14.0	HARD GREY METAMORPHOSED CRYSTALLINE BEDROCK WITH OCCASIONAL INCLINED FRACTURES	7	AXT RC	–
		8	"	–
220.6 / 24.3	END OF HOLE			

Elevation scale: 250, 240, 230, 220. Penetration plot values: WH, 139. % CORE RECOVERY: 70, 50.

END OF PEN. TEST AT ELEV. 233.4
100 BLOWS FOR LAST 6 INCHES

Installation: CAP; GROUND LEVEL; SURFACE SEAL; BENTONITE SEAL; SAND FILL; PIEZOMETER

W.L. IN PIEZOMETER @EL. 245.8 ON JUNE 9, 1965

15 ○ 5 (10) Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN ____
CHECKED ____

Department of Highways Ontario

Copy for the information of

Mr. A. G. Stermac, Principal Foundation Engineer,
~~Room 107, Lab. Bldg.~~

Mr. A. G. Boucher,
Supt. of Engineering Surveys,
Kingston Regional Office,
KINGSTON, Ontario.

Bridge Division,
Downsview, Ontario.

September 22, 1965.

W.P. 178-61 - Site #16-167
Jones Creek Structure - West Branch
3.1 miles westof County Road to Mallorytown
Hwy. 401 - District 8

In order to proceed with the design of a 25'-0 arch culvert for the above location, the designer feels that additional information along the proposed footings of the culvert is required.

Attached please find one copy of the site plan E-4607-1 with the location where the designer wishes bedrock elevations confirmed marked by a green circle and one copy of the General Plan D-5774-1 which shows the location of the 25'-0 arch culvert.

Mr. A. G. Stermac, Principal Foundation Engineer, has retained H. Q. Golder and Associates Limited to do this work.

Would you kindly aid Mr. J. L. Seychuk, P. Eng., or his field representative in the location of the proposed culvert or areas interested. Mr. Seychuk is expected on the site on September 27, 1965.

A. P. Watt,
Regional Bridge Location Engineer.

APW/im
cc. A. G. Stermac

cc: Foundations Office (Rm. 110)

Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

Attention: Mr. A. McCombie

Foundation Section,
Materials and Testing Div.,
Room 107, Lab. Bldg.

July 27, 1965

FOUNDATION INVESTIGATION REPORT BY:
H. G. Golder and Associates, Limited.
Proposed Jones Creek (West Branch) Crossing,
Highway 401, Line 'H', Township of Front
of Yonge, Ontario. -- W.P. 178-61, District 8.

The report on the foundation investigation of the above site has been reviewed.

It may be noted that this line has been abandoned for reasons discussed in the report which, therefore, serves as a record of factual information only. Line 'J' was adopted subsequently, and reports on both the East and West Branch of Jones Creek on this alignment have been sent to you previously.

Should there be any queries in connection with this project, please feel free to contact our Office.

K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

KYL/MdeP
Attach.
cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
W. R. Farren
J. Ford
A. A. Cash
J. W. Gruspier
A. Watt

Foundations Office
Gen. Files

H. Q. GOLDER & ASSOCIATES LTD.
CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

July 19, 1965

Department of Highways, Ontario,
Materials & Testing Division,
Hwy. 401 & Keele Street,
Downsview, Ontario.

Attention: ~~Mr. A. Rutka~~, P.Eng. A. Stermac

RE: W.P. 178-61,
SITE INVESTIGATION,
JONES CREEK WEST BRANCH,
HWY. 401 - LINE H,
NEAR MALLORYTOWN, ONTARIO.

Dear Sirs:

We have forwarded to you today, by messenger, 11 copies of our report for the above investigation. A Cronaflex copy of Figures 1 and 2 from our report was also sent.

This report covers the field work along the line "H" portion of the route which was abandoned in favour of a line to the north in close proximity to line "X". The investigation along this new line, referred to as line "J", is presented in our report 65046, dated June, 1965 and submitted to you on June 25, 1965.

Yours truly,

H. Q. GOLDER & ASSOCIATES LTD.

J. L. Seychuk

J. L. Seychuk, P.Eng.

JLS:HJB
65028

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

November 8, 1965

Department of Highways, Ontario,
Foundation Section,
Hwy. 401 & Keele Street,
DOWNSVIEW, Ontario.

Attention: Mr. A. G. Stermac, P.Eng.,
Principal Foundation Engineer.

RE: BEDROCK INVESTIGATION,
PROPOSED CULVERT STRUCTURE,
WEST BRANCH JONES CREEK CROSSING,
HIGHWAY 401 - LINE "J",
NEAR GANANOQUE, ONTARIO.

Dear Sirs:

At your request we have carried out a detailed bedrock investigation at the above site. The purpose of this investigation was to determine the elevation of bedrock surface at selected locations along the footing lines of the proposed rigid arch culvert.

The results of a subsurface investigation which we carried out at this crossing last spring are presented in our report 65046, dated June, 1965. This letter accompanies the factual results obtained during this, the most recent investigation and should be read in conjunction with our previous report which it compliments.

The field work for this investigation was carried out between September 27 and October 15, 1965. A total of 15 boreholes (numbered 301 to 317, inclusive but excluding 305 and 312) were put down into the bedrock using a standard skid-mounted machine drill-rig supplied and operated by the F. E. Johnston Drilling Co. Ltd. of Ottawa, Ontario. Bedrock was cored in AXT size for generally a minimum depth of 5 feet in each borehole. In addition to the boreholes, three test pits (numbered 318, 319 and 320) were put down manually. The field work was supervised throughout by a member of our engineering staff who also directed the surveying and bedrock outcrop mapping operations.

A detailed log of each boring and test pit is given on the Record of Borehole sheets following this letter. The locations of the boreholes and test pits are shown on Figure 1 located in a pocket following the Records of Boreholes. Sections showing the subsurface stratigraphy and the elevation of bedrock surface at the proposed culvert location are given on Figure 2.

The elevations used in this report are referred to Geodetic datum. All the surveying work associated with this investigation was carried out by Department of Highways, Ontario, personnel.

We trust that the factual information presented on the Records of Boreholes and drawings is sufficient for your requirements. If you require additional information or if you have any questions, please call us.

Yours truly,
H. Q. GOLDER & ASSOCIATES LTD.,

J. L. Seychuk, P.Eng.

JLS:HDG
65111
November 8, 1965.

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS	auger sample
CS	chunk sample
DO	drive open
DS	Denison type sample
FS	foil sample
RC	rock core
ST	slotted tube
TO	thin-walled, open
TP	thin-walled, piston
WS	wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*N, blows/ft.*
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	c_u, *lb./sq. ft.*
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	combined analysis, sieve and hydrometer[1]
Q	undrained triaxial[2]
R	consolidated undrained triaxial[2]
S	drained triaxial
U	unconfined compression
V	field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

LIST OF SYMBOLS

I. GENERAL

$\pi = 3.1416$

e = base of natural logarithms 2.7183

$\log_e a$ or $\ln a$, natural logarithm of a

$\log_{10} a$ or $\log a$, logarithm of a to base 10

t time

g acceleration due to gravity

V volume

W weight

M moment

F factor of safety

II. STRESS AND STRAIN

u pore pressure

σ normal stress

σ' normal effective stress ($\bar{\sigma}$ is also used)

τ shear stress

ϵ linear strain

ϵ_{xy} 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

III. SOIL PROPERTIES

(a) *Unit weight*

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_s specific gravity of solid particles $G_s = \gamma_s/\gamma_w$

e void ratio

n porosity

w water content

S_r degree of saturation

(b) *Consistency*

w_L liquid limit

w_P plastic limit

I_P plasticity index

w_S shrinkage limit

I_L liquidity index $= (w - w_P)/I_P$

I_C consistency index $= (w_L - w)/I_P$

e_{max} void ratio in loosest state

e_{min} void ratio in densest state

D_r relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

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

(d) *Consolidation (one-dimensional)*

m_v coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$

C_c compression index $= -\Delta e/\Delta \log_{10} \sigma'$

c_v coefficient of consolidation

T_v time factor $= c_v t/d^2$ (d, drainage path)

U degree of consolidation

(e) *Shear strength*

τ_f shear strength

c' effective cohesion intercept; ϕ' effective angle of shearing resistance, or friction — in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$

c_u apparent cohesion*; ϕ_u apparent angle of shearing resistance, or friction — in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$

μ coefficient of friction

S_t sensitivity

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

RECORD OF BOREHOLES 301 & 302

LOCATION See Figure 1 BORING DATE SEPT. 28 - 29, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX & AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. / DEPTH, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS/FT.) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS/FT. — SHEAR STRENGTH C_u, LB./SQ.FT. | COEFFICIENT OF PERMEABILITY k, CM./SEC. — WATER CONTENT, PERCENT W_P W W_L | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

301

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
266.4	GROUND SURFACE				
0.0	GRAVEL, COBBLES, BOULDERS AND ROCK SLABS IN SILTY SAND MATRIX.	1	2" D.O.	8	
263.9 / 2.5	LOOSE TO COMPACT GREY SILTY SAND.	2	"	10	
		3	"	28	
		4	"	39	
		5	"	33	
257.3 / 9.1	FAIRLY SOUND GREY TO PINKISH CRYSTALLINE BEDROCK SOUND BELOW EL. 251.5	6	AXT RC	–	70
		7	"	–	70
		8	"	–	100
249.4 / 17.0	END OF HOLE				

302

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
266.8	GROUND SURFACE				
0.0	COBBLES, BOULDERS, ROCK CHIPS AND FRAGMENTS IN SILTY SAND MATRIX, TRACE OF ROOTS IN UPPER PORTION.	1	2" D.O.	43	
		2	"	>100	
263.6 / 3.2	GREY CRYSTALLINE BEDROCK WITH OXIDIZED VERTICAL FRACTURES OR TABULAR SLABS.	3	AXT RC	–	50
		4	"	–	88
261.3 / 5.5	FAIRLY SOUND TO SOUND GREY CRYSTALLINE BEDROCK WITH NEAR VERTICAL FRACTURES THROUGHOUT.	5	"	–	81
		6	"	–	98
255.4 / 11.4	END OF HOLE				

Elevation scale: 270, 265, 260, 255, 250

15-○-5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN ____ CHECKED ____

PROJECT No. 65111

RECORD OF BOREHOLE 303

LOCATION See Figure 1 BORING DATE SEPT. 29-30, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
267.7	GROUND SURFACE				
0.0	LOOSE TO COMPACT GREY BROWN SILTY SAND WITH GRAVEL, COBBLES, BOULDERS AND ROCK FRAGMENTS	1	2" D.O.	9	
		2	"	16	
263.4 / 4.3	COMPACT GREY LAYERED SILTY FINE SAND AND STIFF CLAYEY SILT.	3	"	16	
260.2 / 7.5	QUARTZITE BOULDER	4	AXT R.C.	—	
8.4	COMPACT TO DENSE GREY SILTY SAND TO SILTY SAND AND GRAVEL.	5	2" D.O.	30	
		6	"	31	
254.7 / 13.0	FAIRLY SOUND TO SOUND DARK GREY CRYSTALLINE BEDROCK, BEDDING PLANES INCLINED 70° to HORIZ.	7	AXT R.C.	—	98
		8	"	—	100
		9	"	—	80
247.6 / 20.1	END OF HOLE				

Column headings: SOIL PROFILE (ELEVN./DEPTH, DESCRIPTION, STRAT. PLOT); SAMPLES (NUMBER, TYPE, BLOWS/FT.); ELEVATION SCALE (270, 265, 260, 255, 250, 245, 240); DYNAMIC PENETRATION RESISTANCE BLOWS/FT.; SHEAR STRENGTH C_u, LB./SQ.FT.; COEFFICIENT OF PERMEABILITY k, CM./SEC.; WATER CONTENT, PERCENT W_P W W_L; ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

303

15-○-5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN ______ CHECKED ______

PROJECT No. 6511

RECORD OF BOREHOLE 304

LOCATION See Figure 1 BORING DATE SEPT. 30 - OCT. 2, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	ELEVATION SCALE	PERCENT CORE RECOVERY
					270	
268.0	GROUND SURFACE					
0.0	DARK GREY CRYSTALLINE **BOULDERS** IN **SAND** AND **GRAVEL** MATRIX.	1	AXT CORE	—	265	
		2	"	—		
263.5 / 4.5	LOOSE GREY LAYERED **SILTY** FINE **SAND**, TRACE OF CLAY AND **CLAYEY SILT**.	3	2" D.C.	11		
260.5 / 7.5	COMPACT GREY-BROWN **SAND**, TRACE TO SOME SILT WITH ROCK FRAGMENTS	4	"	21	260	
		5	"	100		
258.0 / 10.0	DARK GREY HARD CRYSTALLINE **TABULAR SLABS** OR OPEN JOINTED **BEDROCK**	6	AXT KC	—		95
		7	"	—	255	10
252.4 / 15.6	SOUND HARD DARK GREY CRYSTALLINE **BEDROCK**	8	"	—		80
		9	"	—	250	100
		10	"	—		95
245.0 / 23.0	END OF HOLE				245	
					240	

DYNAMIC PENETRATION RESISTANCE BLOWS/FT.

SHEAR STRENGTH C_u, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT W_P W W_L

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

304

15 5 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN [signature]

CHECKED [signature]

PROJECT No. 65111

RECORD OF BOREHOLES 306 & 307

LOCATION See Figure 1 — BORING DATE OCT. 8 & 12, 1965 — DATUM GEODETIC

BOREHOLE TYPE WASH BORING — BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. DEPTH, DESCRIPTION, STRAT. PLOT); SAMPLES (NUMBER, TYPE, BLOWS/FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FT.; SHEAR STRENGTH C_u, LB./SQ.FT.; COEFFICIENT OF PERMEABILITY k, CM./SEC.; WATER CONTENT, PERCENT (W_P, W, W_L); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

306

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
251.6	GROUND SURFACE				
0.0	COBBLES & BOULDERS IN SAND MATRIX.	1	BX CORE	—	
1.0	FAIRLY SOUND TO SOUND GREY CRYSTALLINE BEDROCK, OCCASIONAL OPEN JOINTS AND VERTICAL FRACTURES.	2	AXT RC	—	80
		3	"	—	90
		4	"	—	100
		5	"	—	100
		6	"	—	100
242.6 / 9.0	END OF HOLE				

Elevation scale: 255, 250, 245, 240

307

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
251.3	GROUND SURFACE				
0.0	BADLY FRACTURED AND OXIDIZED CRYSTALLINE TABULAR SLABS AND BOULDERS IN SILTY SAND MATRIX.	1	AXT RC	—	75
		2	"	—	50
		3	"	—	30
		4	"	—	35
		5	"	—	50
243.2 / 8.1	SOUND HARD DARK GREY CRYSTALLINE BEDROCK	6	"	—	100
		7	"	—	100
		8	"	—	100
236.4 / 14.9	END OF HOLE				

Elevation scale: 255, 250, 245, 240, 235, 230

15-○-5 Percent axial strain at failure (10)

VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED [signature]

PROJECT No. 65111

RECORD OF BOREHOLES 308 & 309

LOCATION: See Figure 1 | BORING DATE: OCT. 14-15, 1965 | DATUM: GEODETIC

BOREHOLE TYPE: WASH BORING | BOREHOLE DIAMETER: BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. / DEPTH, DESCRIPTION, STRAT. PLOT); SAMPLES (NUMBER, TYPE, BLOWS/FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FT.; SHEAR STRENGTH C_u, LB./SQ.FT.; COEFFICIENT OF PERMEABILITY k, CM./SEC.; WATER CONTENT, PERCENT W_P W W_L; ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

308

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
249.2	GROUND SURFACE				
0.0	HARD GREY OXIDIZED CRYSTALLINE BOULDERS IN SAND MATRIX.	1	AXT RC	—	95
		2	"	—	35
		3	"	—	80
241.4 / 7.8	GREY CRYSTALLINE BEDROCK WITH NUMEROUS OXIDIZED SEAMS AND JOINTS.	4	"	—	80
		5	"	—	78
		6	"	—	100
235.4 / 13.8	END OF HOLE				

309

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
250.6	GROUND LEVEL				
0.0	OXIDIZED GREY CRYSTALLINE BOULDERS IN SAND MATRIX	1	AXT RC	—	5
		2	"	—	5
		3	"	—	90
242.6 / 8.0	BADLY FRACTURED CRYSTALLINE BEDROCK	4	"	—	40
239.8 / 10.8	FAIRLY SOUND TO SOUND GREY CRYSTALLINE BEDROCK.	5	"	—	100
		6	"	—	85
234.1 / 16.5	END OF HOLE				

Elevation scale: 250, 245, 240, 235, 230

15-O-5 (10) Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN ____ CHECKED ____

PROJECT No. 65111

RECORD OF BOREHOLES 310 & 311

LOCATION See Figure 1 BORING DATE OCT. 13-14, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. DEPTH; DESCRIPTION; STRAT. PLOT) | SAMPLES (NUMBER; TYPE; BLOWS/FT.) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS/FT. / SHEAR STRENGTH C_u, LB./SQ.FT. | COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT W_P W W_L | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

310

ELEVN. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
250.6	GROUND SURFACE				
0.2	BOULDER	1	BX CORE	—	
	OPEN JOINTED GREY CRYSTALLINE TABULAR SLABS OR BEDROCK WITH VOIDS BETWEEN ELEV. 246.3-246.4 AND ELEV. 242.4-242.0.	2	AXT RC	—	100
		3	"	—	100
		4	"	—	80
242.0 / 8.6	FAIRLY SOUND TO SOUND GREY CRYSTALLINE BEDROCK.	5	"	—	50
240.1 / 10.5	END OF HOLE				

311

ELEVN. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
251.3	CREEK LEVEL				
0.0	WATER				
248.5 / 2.8	CREEK BOTTOM				
	OXIDIZED GREY CRYSTALLINE BOULDERS WITH OCCASIONAL SAND AND ROCK FRAGMENTS IN VOIDS.	1	AXT RC	—	30
		2	"	—	40
243.2 / 8.1	SOUND HARD GREY TO DARK GREY CRYSTALLINE BEDROCK.	3	"	—	60
		4	"	—	100
		5	"	—	100
237.0 / 14.3	END OF HOLE				

Elevation scale: 255, 250, 245, 240 (310); 255, 250, 245, 240, 235 (311)

15-○-5 / 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN MM
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PROJECT No. 6511

RECORD OF BOREHOLES 313 & 314

LOCATION See Figure 1 BORING DATE OCT. 6-7, 1955 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. DEPTH; DESCRIPTION; STRAT. PLOT) | SAMPLES (NUMBER; TYPE; BLOWS/FT.) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS/FT. / SHEAR STRENGTH C_u, LB./SQ.FT. | COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT (W_P, W, W_L) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

313

ELEVN. / DEPTH	DESCRIPTION
264.3	GROUND SURFACE
0.0	LOOSE TO COMPACT GREY BROWN **COBBLES & BOULDERS** IN **SILTY SAND** AND **GRAVEL** MATRIX.
256.4 / 7.9	FRACTURED TO FAIRLY SOUND GREY CRYSTALLINE **BEDROCK** OR **SLABS**
249.8	
249.3 / 15.0	END OF HOLE
	SOUND GREY CRYSTALLINE **BEDROCK**

NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
1	AXT CORE	—	45
2	2" D.O.	75	
3	AXT CORE	—	90
4	2" D.O.	46	
5	AXT RC	—	100
6	"	—	95
7	"	—	100

Elevation scale: 265, 260, 255, 250

314

ELEVN. / DEPTH	DESCRIPTION
263.1	GROUND SURFACE
0.0	LOOSE TO COMPACT GREY BROWN **GRAVEL, COBBLES** AND **BOULDERS** IN **SILTY SAND**.
255.2 / 7.9	FRACTURED AND BROKEN DARK GREY TO PINKISH CRYSTALLINE **TABULAR SLABS** AND **BOULDERS**.
248.9 / 14.2	SOUND HARD LIGHT TO DARK GREY CRYSTALLINE **BEDROCK**.
244.2 / 18.9	END OF HOLE

NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
1	AX CA.	—	
2	2" D.O.	29	
3	"	41	
4	AXT RC	—	50
5	"	—	60
6	"	—	98
7	"	—	100

Elevation scale: 265, 260, 255, 250, 245, 240

15-O-5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

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PROJECT No. 65111

RECORD OF BOREHOLES 315 & 316

LOCATION See Figure 1 | BORING DATE OCT. 2-3, 1965 | DATUM GEODETIC

BOREHOLE TYPE WASH BORING | BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. DEPTH, DESCRIPTION, STRAT. PLOT); SAMPLES (NUMBER, TYPE, BLOWS/FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FT.; SHEAR STRENGTH C_u, LB./SQ.FT.; COEFFICIENT OF PERMEABILITY k, CM./SEC.; WATER CONTENT, PERCENT W_P W W_L; ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

315

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
263.7	GROUND SURFACE				
0.0	GREY CRYSTALLINE COBBLES AND BOULDERS IN SAND AND GRAVEL MATRIX	1	AX CA.	—	50
261.6 / 2.1	GREY VERTICALLY FRACTURED CRYSTALLINE BEDROCK OR LARGE SLABS.	2	AXT RC	—	98
		3	"	—	99
257.7 / 6.0	SOUND HARD GREY CRYSTALLINE BEDROCK.	4	"	—	100
252.9 / 10.8	END OF HOLE				

316

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.	PERCENT CORE RECOVERY
264.7	GROUND SURFACE				
0.0	GREY CRYSTALLINE COBBLES AND BOULDERS IN SILTY SAND TO GREY SANDY SILT MATRIX.	1	2" D.O.	45	
		2	AX C.S.	—	
		3	2" D.O.	75	
256.1 / 8.6	FRACTURED CRYSTALLINE BEDROCK BECOMING SOUND HARD GREY CRYSTALLINE BEDROCK BELOW ABOUT EL. 250.	4	AXT RC	—	40
		5	"	—	70
		6	"	—	100
244.2 / 20.5	END OF HOLE				

Elevation scale: 265, 260, 255, 250 (315); 265, 260, 255, 250, 245, 240 (316)

15-O-5 / 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

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CHECKED [signature]

PROJECT No. 65111

RECORD OF BOREHOLE 317

LOCATION See Figure 1 BORING DATE OCT. 4-5, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	PERCENT CORE RECOVERY
						270	
266.1	GROUND SURFACE						
0.0	LOOSE TO COMPACT GREY BROWN COBBLES AND BOULDERS IN SAND AND SILTY SAND MATRIX.		1	2" D.C.	23	265	
			2	"	50		
			3	"	44	260	
257.6 / 8.5	COMPACT BROWN SILTY SAND AND GRAVEL.		4	"	26		
254.6 / 11.5	FRACTURED CRYSTALLINE BEDROCK WITH VOID BETWEEN ABOUT EL. 250.5 AND 250.0 BECOMING SOUND BEDROCK BELOW EL. 250.0.		5	AXT D.C.	—	255	100
			6	"	—		75
			7	"	—	250	100
			8	"	—		100
			9	"	—		83
			10	"	—	245	100
243.1 / 23.0	END OF HOLE						
						240	

DYNAMIC PENETRATION RESISTANCE BLOWS/FT. ----------

SHEAR STRENGTH C_u, LB./SQ.FT.

317

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT W_P W W_L

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

15-○-5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN MWA

CHECKED [signature]

PROJECT No. 6511

RECORD OF TEST PITS 318, 319 & 320

LOCATION See Figure 1 BORING DATE OCT. 4, 1965 DATUM GEODETIC

BOREHOLE TYPE TEST PITS BOREHOLE DIAMETER 2' x 2' APPROX.

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FT. / SHEAR STRENGTH C_u, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
ELEVN. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FT.					
	318									
264.7	GROUND SURFACE					265				
0.0	GREY COBBLES & BOULDERS IN SAND AND GRAVEL MATRIX									
263.3 / 1.4	END OF HOLE FRACTURED TO SOUND GREY CRYSTALLINE BEDROCK									
						260				
	319									
						270				
268.3	GROUND SURFACE									
0.0	GREY COBBLES & BOULDERS IN SAND AND GRAVEL MATRIX									
266.7 / 1.6	END OF HOLE FRACTURED TO SOUND GREY CRYSTALLINE BEDROCK									
						265				
	320									
						270				
268.9	GROUND SURFACE									
0.0	ANGULAR BOULDERS AND BOULDER FRAGMENTS IN SAND AND GRAVEL MATRIX									
266.5 / 2.4	END OF HOLE FRACTURED TO SOUND GREY CRYSTALLINE BEDROCK					265				

15-○-5 Percent axial strain at failure (10 below)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN MW

CHECKED [signature]

cc: Foundations Office (Rm. 110)

Mr. B. R. Davis,
Bridge Engineer,
Bridge Division

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

Attention: Mr. S. McCombie

November 16, 1965

NOV 16 1965

FOUNDATION INVESTIGATION REPORT BY:
H. Q. Golder and Associates, Limited -
(Detailed Bedrock Investigation)
Proposed Rigid Culvert - West Branch
Jones Creek Crossing, Hwy. 401, Line 'J',
Township of Front of Yonge, Ontario.
W.P. 178-61 - District 8 (Kingston)

Attached, please find the above-mentioned report submitted by H. Q. Golder and Associates, Ltd.

We have reviewed the report and believe that it contains all the requested information. It is believed that the data of the report will suffice for your further design work. However, should you need some additional information, please do not hesitate to contact this Office.

AGS/MdeF
Attach.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

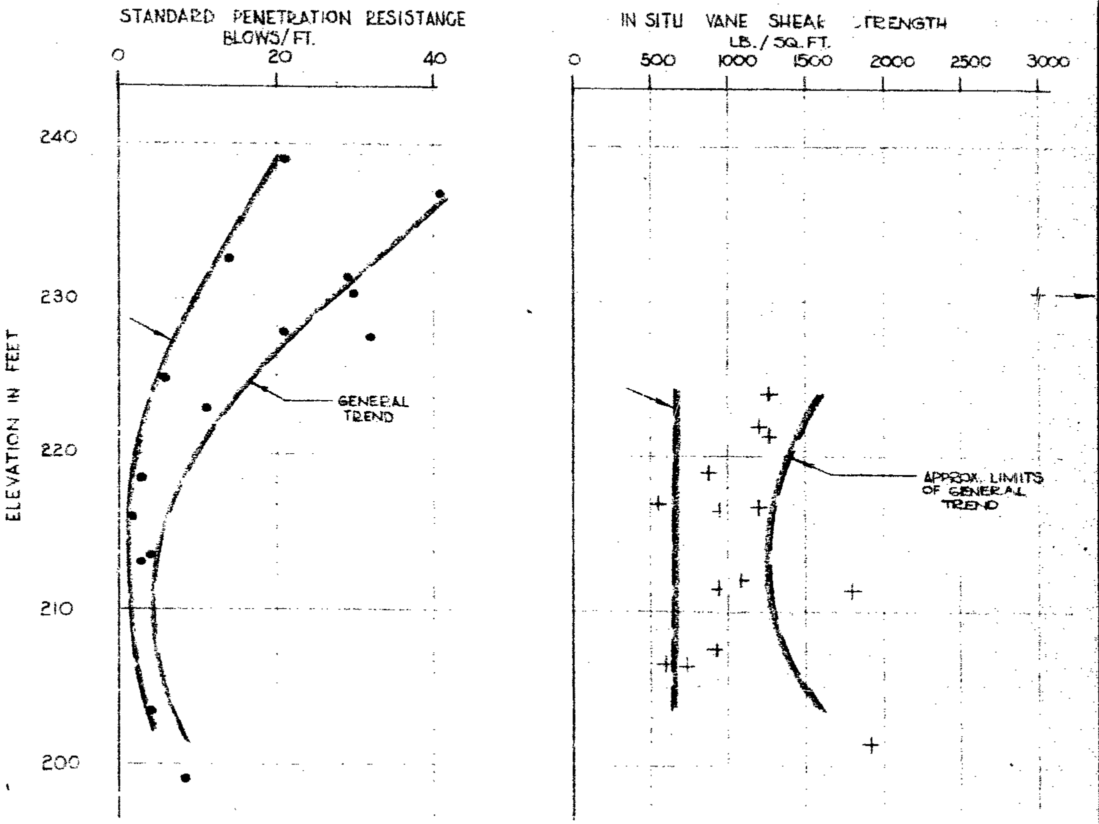
cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
R. A. Millar
L. A. Cash
J. E. Gruspier
A. Watt

Foundations Office
Gen. Files

PROJECT No. 65028

'N' VALUES & UNDRAINED SHEAR STRENGTH RESULTS vs ELEVATION SILTY CLAY STRATUM

FIGURE 3



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CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
767-9201
763-4103

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

31B-8
GEOCRES No.

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED JONES CREEK (WEST BRANCH) BRIDGE

HIGHWAY 401 - LINE G

WP 178-61

GANANOQUE ONTARIO

Distribution:

11 copies - Department of Highways, Ontario,
Toronto, Ontario.

2 copies - H. Q. Golder & Associates Ltd.,
Toronto, Ontario.

March, 1963 6264

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Figure 1 - Boring Plan

Figure 2 - Schematic Soil Section

Figure 3 - Inferred Soil Stratigraphy - Sections A-A and B-B

Figures 4 to 17 - Results of Laboratory Testing

Figures 18 to 20 - Engineering Analyses

ABSTRACT

The results of an investigation to determine the soil conditions at the site of the proposed Jones Creek (West Branch) crossing on the proposed revision of Highway 401, Line G, near Gananoque, Ontario are reported and recommendations are made for the foundation design of the proposed structures and embankments.

Jones Creek is underlain by about 13 to 28 feet of fibrous muskeg which overlies a stratum of layered silty clay and clayey silt up to about 33 feet in thickness. The layered silty clay and clayey silt rests on bedrock which has a very irregular upper surface.

The embankment portions of the proposed crossing may be constructed by excavating the muskeg and replacing it with sand and gravel on rockfill, as discussed in the report.

The proposed structures should be founded on specially tipped steel H- piles which are driven to bedrock. Alternate types of structures are discussed in the report.

Settlement of the recommended embankments due to consolidation of the underlying clayey stratum could be about 1 to 4 inches and some additional settlement could occur due to compaction of the sand and gravel or rockfill, as discussed in the report. Settlement of the proposed structures, if founded as recommended, will be negligible.

INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by the Department of Highways, Ontario by letter dated November 15, 1962 to carry out a soil investigation for the proposed Jones Creek (West Branch) crossing for the proposed revision of Highway 401, Line G, near Gananoque, Ontario.

The purpose of the investigation was to determine the soil conditions at the site and to make recommendations concerning the foundation design of the proposed structures and approach embankments.

PROCEDURE

An attempt was made to start the field work for the investigation on November 27th and 28th, 1962, however, a thin ice formation on Jones Creek necessitated postponing the work until the ice was thick enough to support a drillrig.

The field work was commenced on January 7, 1963 and completed on January 18, 1963. Six borings, each with an accompanying dynamic penetration test and 12 additional dynamic penetration tests were put down by means of a machine drillrig working from the ice. It was not possible to put down any borings among the bullrushes between about stations 252+30 and 253+80 as the ice was very poor in this area and would not support the drillrig.

The locations of all borings and dynamic penetration tests put down during the investigation are shown on Figure 1 and sections of the inferred soil stratigraphy on Figures 2 and 3. Detailed logs of each boring and dynamic penetration test are given on the Records of Boreholes.

The soil samples obtained during the investigation were returned to our laboratory for examination and testing. The results of the laboratory testing are plotted on the Records of Boreholes and on the figures.

All borings were located with reference to the centreline of proposed Highway 401, Line G, as staked by others in the field. The borehole elevations are referred to two bench marks. One bench mark is located in the east root of a 1.8 feet diameter pine 76 feet right of station 250+65 while the other is in the south root of a 2.0 feet diameter oak 41 feet left of station 258+92. The elevations of these bench marks are given as 279.99 and 259.51, respectively on Department of Highways, Ontario Plan E-4139-1, dated September, 1962. The datum is Geodetic.

SITE TOPOGRAPHY AND GEOLOGY

The proposed site is located approximately 9 miles southwest of Brockville, Ontario within the physiographic region known as the "Leeds Knobs and Flats" (Chapman and Putnam, 1951).

This region consists primarily of scattered knobs of rock between which lie clay deposits laid down by the Champlain sea. The clay plains are typically gently undulating farmed land. Jones Creek flows between two rock outcrops at the site of the proposed crossing.

Bedrock in this area consists of various types of altered sedimentary rocks, crystalline limestones and dolomites, gneisses and quartzites if the Grenville series of Precambrian Age, which are intruded, metamorphosed and deformed by bodies of granite, syenite and other igneous rocks (Wilson, 1946). The surface elevation of bedrock can vary appreciably within small areas.

SOIL CONDITIONS

Jones Creek is underlain by a deposit of muskeg which ranges in depth from about 13 feet in borehole 6 to about 28 feet in borehole 5. The muskeg has a fine fibrous structure, the individual fibres generally being less than 3/4 inches in length except close to the surface of the deposit were some coarser fibres were noted. The structure of the muskeg appears to become less fibrous with depth and some layers on lenses of sand up to about 1 inch in thickness were noted in the deposit. One grain size distribution curve for the material from one of the sand layers is shown on Figure 4. Occasional small twigs or wood fragments were encountered in the muskeg. The properties of the muskeg are summarized on Figure 8.

A stratum of loose to compact sand with occasional gravel size particles and some shells was encountered below the muskeg in boreholes 5 and 6. There were some layers of muskeg in this stratum in borehole 6. The sand was about 4 feet in thickness in both boreholes. One grain size distribution curve for the material in borehole 5 is shown on Figure 4.

Underlying the muskeg in boreholes 1 to 3 and the sand in boreholes 5 and 6 is a layered silty clay and clayey silt which rests on a very irregularly shaped bedrock surface. In borehole 4 the muskeg rests directly on bedrock. The layered silty clay and clayey silt was found to range in thickness from about 16 feet in borehole 3 to about 33 feet in borehole 5. The individual silty clay layers, which usually exhibit a fissured structure, are generally 1/8 to 1/2 inches in thickness. The clayey silt layers are generally less than 1/2 inches in thickness but may be up to 2 inches in thickness. An occasional fine sand layer generally less than 1/8 inch in thickness occurs in the deposit. One grain size distribution curve for each layer is shown on Figure 5. The properties of the layered silty clay and clayey silt are summarized on Figure 9. From the measured liquidity indices and from further laboratory testing the sensitivity, S_t, of the coarser layers within the clay is high. ($S_t > 10$).

Bedrock, which underlies the clayey stratum, has a very irregular upper surface. The rock has been tentatively identified as a generally sound crystalline limestone in borehole 4. In boreholes 2 and 3 it is a hard grey-green metamorphosed crystalline rock.

WATER CONDITIONS

The ice level in Jones Creek was at elevation 244.2 on January 18, 1963. The maximum depth of water encountered in the creek during the investigation was about 8 feet. No noticeable movement of the ice on the creek occurred during the field investigation.

SHEAR STRENGTH OF MUSKEG AND CLAYEY STRATUM

The undrained shear strength of the muskeg was determined by undrained triaxial compression tests on samples of the muskeg and by in situ vane shear tests. The results of these tests are plotted on Figure 8. The vane shear tests gave higher shear strength values than the triaxial compression tests. The higher vane values are probably due to the fibrous structure of the muskeg.

Undrained triaxial compression tests on samples of the sensitive layered silty clay and clayey silt gave widely varying undrained shear strength values ranging generally from about 150 to 2,000 lb/sq.ft. with two values in excess of 3,500 lb/sq.ft.

The results of these tests are plotted on Figure 9.

It is inferred from the results of consolidation tests, Figures 15 to 17, that the clayey stratum has been preconsolidated to some extent. Figures 15 and 16, which show the results of consolidation tests on samples from the middle and lower portions of the clayey stratum, indicate that the preconsolidation pressure could be about 2.0 to 2.5 tons/sq.ft. in excess of the present overburden pressure, however, the results of a consolidation test carried out on a sample from the upper portion of the clayey stratum, Figure 17, indicate that this sample has been preconsolidated by about 5 to 6 tons/sq.ft. in excess of the present overburden pressure. It is probable that the upper surface of the stratum has been desiccated.

Based primarily on the consolidation test data, we infer that the pattern of undrained shear strength versus elevation could approximate to that indicated on Figure 9. The lower range in estimated shear strength has been used for design.

DISCUSSION

General

It is proposed to construct a causeway across Jones Creek (West Branch) on the proposed revision of Highway 401, Line G. The causeway, which will have a crest width of about 140 feet, is understood to be of earth or rockfill construction with a short structural section near the centre of the creek to permit the flow of water down the creek. The total length of the causeway is to be about 500 feet. The proposed grade across the creek varies from 13 to 15 feet above present ice level (elevation 244.2).

Initially it was proposed that the structural portion of the causeway would consist of two skew bridge structures, one to carry the eastbound lanes and one to carry the westbound lanes, each structure having three spans of 33, 35 and 33 feet. We were informed on March 20th, 1963 that it is now proposed to utilize two structures each having one skew span of 50 feet.

Construction of Embankment

The proposed earth or rockfill portions of the causeway could possibly be constructed by several different methods. These include stage construction with surcharging, end dumping on top of the muskeg, end dumping combined with blasting and excavating the muskeg. These methods are discussed separately below.

(i) Stage Construction and Surcharging. Based on the undrained shear strength of the muskeg, as measured by undrained triaxial compression tests on samples of the muskeg, the maximum height of embankment that the muskeg could support is about 8 feet. Thus, in order to construct an embankment up to about 18 feet in height above the present surface of the muskeg even if it were feasible, would require building it in at least three stages with an adequate period of time between each stage of the loading for the muskeg to compress and so gain strength to support additional weight of fill. It is extremely doubtful if sufficient shearing resistance could be mobilized for the muskeg to support 18 feet of fill even with stage construction. Further, previous experience with this type of construction (Brawner, 1961) indicates that although the first stage of loading compresses the muskeg quite rapidly, compression during the second stage is much slower due to large decreases in the permeability of the muskeg as it is compressed. Consolidation tests carried out on samples of the muskeg, Figures 10 to 14, indicate that the settlement of the fill due to consolidation of the muskeg under the additional weight of the fill could approach half the thickness of the muskeg. Obviously then, stage construction is not a practical solution to this problem.

(ii) End Dumping. The proposed embankment could be built by end dumping fill on top of the muskeg, overloading the muskeg by increasing the height of the fill, advancing the fill on a vee-shaped front and thus causing the muskeg below the fill to fail and flow laterally. The fill would then move down and occupy the space where the muskeg has been displaced. The principal objections to this method are the great depth of muskeg to be displaced and the fact that very little control of construction is possible. Consequently pockets of muskeg and/or clay may be trapped within the new fill giving rise to later failures in local sections of the fill and very irregular settlements within the fill. These results are undesirable in a high class highway of the type proposed.

(iii) End Dumping combined with Blasting. In this method the fill is end dumped as in (ii) above but the height of fill is limited so that no failure occurs in the underlying muskeg. Blasting is then used to displace the muskeg below the fill which drops down into the space previously occupied by the muskeg. Alternatively, the fill may be advanced as in (ii) above and blasting is carried out at the toe of the fill to facilitate displacement of the muskeg. This method has been used with some success in soft clay deposits, (Milligan, Soderman, Rutka, 1962). While these methods are more certain than (ii) above, in reducing the danger of local failures some remoulding of the lower sensitive layered silty clay and clayey silt would probably occur. This remoulding will partially reduce the undrained shearing resistance at the upper surface of the clay, thus reducing the factor of safety of the embankment against a sliding block or circular arc type failure for the arcs passing through partially remoulded portions of the clay. In addition, the settlement of end-dumped fill is generally quite large and for coarse-grained sand or dumped rockfill can be as high as 1 to 2 percent of the fill thickness. This means that for end-dumped fill approaching 40 to 50 feet in thickness, settlement due to compaction of the fill could be of the order of 6 to 12 inches. Further, total and differential settlements caused by consolidation of the clay under the additional weight of the embankment (approximately 3,500 to 4,000 lb/sq.ft. in the deeper sections of muskeg) would tend to be increased by the partial remoulding induced by blasting close to the sensitive clayey stratum. This method of construction cannot be considered as a positive solution to the problem.

(iv) Excavation of the Muskeg. Excavation of the muskeg and its replacement by more competent material appears to be the most suitable method of producing an embankment fill with adequate stability. Typical suggested cross-sections at stations 253+80 and 256+50, which approximate to the maximum and minimum depths of muskeg encountered by the borings, respectively, are shown on Figure 18. The stability of the sections has been checked by total stress circular arc and sliding block analyses assuming that the placed earthfill can mobilize an angle of internal friction, Ø, of 30 degrees and that the pattern of undrained shear strength of the layered silty clay and clayey silt is approximately as indicated on Figure 9. A minimum factor of safety of 1.3 against a circular arc type failure in the embankment has been set for design.

The suggested embankment will settle due to compaction of granular fill placed below water and due to consolidation of the underlying clayey stratum under the additional weight of the fill. (It is assumed that the fill placed above water will be rolled and compacted in shallow lifts.) Settlement of the embankment due to consolidation of the underlying overconsolidated clayey stratum is computed to be about 1 to 4 inches, depending on the thickness of clay. Due to the variable thickness of clay at the site total differential settlements as much as 4 to 5 inches may take place. However, this settlement should occur largely in the first year after construction.

It is recommended that final paving of the highway be left until the major portion of the settlement of the embankment is complete. This can readily be monitored using settlement plates set in the upper fill.

If the embankment is to be constructed of rockfill it is essential that a sand and gravel layer, about 5 feet in thickness, is laid down on top of the clayey stratum and the muskeg in the benched areas prior to any rockfill being placed in order to prevent loss of large rock sizes in the clay or muskeg.

In view of the quantity of muskeg to be removed, approximately 140,000 cubic yards, consideration should be given to dredging rather than dragline operations.

Bridge Structures

It is now proposed to construct two structures, each having a single skew span of about 50 feet, near the mid-point of the proposed causeway. Very little detailed information on the proposed structures is available at this time, however, in order to check the stability of a small single span structure several assumptions have been made. These assumptions are given on Figure 19 which illustrates proposed Scheme A. A total stress circular arc stability analysis was carried out for Scheme A to check the overall stability of the abutments of the structure. The results of the analysis are presented on Figure 19 as a plot of factor of safety, F, versus the undrained shear strength, c, of the clayey stratum. Factor of safety, F, is at least 1.4 for c values ranging from 750 to 1,000 lb/sq.ft., which is within the lower range of estimated undrained shear strength.

Suggested stages in the construction of structures similar to that illustrated on Figure 19 are given on this figure.

An alternate scheme, Scheme B, is shown on Figure 20. It is suggested that consideration be given to this type of structure as it will provide a structure less sensitive to settlement of the approach embankments. The factor of safety, F, against a circular arc type failure for this structure is plotted against the undrained shear strength of the clayey stratum, c, on Figure 20. F should be at least 1.4 for the assumed conditions. It may be noted that a longer span structure is required in Scheme B; however, the abutments for this type of structure can be constructed in the dry above river level using normal construction practice whereas the abutments for the structure in Scheme A would have to be constructed below river level in sheeted excavation.

Whichever type of structure is adopted it should be supported on end-bearing piles driven to refusal on bedrock. Due to the large variations in the elevation of the bedrock surface at the site steel H-piles would probably be the most suitable pile type as they can be readily altered in length. The piles should be fitted with special steel tips so that they can bite into a steeply sloping rock face and so reduce the risk of the pile slipping down the rock face. In addition, a special tip will minimize the danger of local overstress in the pile section.

Settlement of the proposed structures, if founded as recommended above, will be negligible.

Rip-rap should be placed in the bottom of the proposed river channel and on the side and end slopes of the proposed causeway to prevent scour.

McC/jb
6264

N. R. McCammon, P. Eng.

for V. Milligan, P. Eng.

GOLDER & ASSOCIATES

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MILLIGAN, V., SODERMAN, L.G., AND RUTKA, A., "Experience with Canadian Varved Clays," Journal of the Soil Mechanics and Foundation Division of the American Society of Civil Engineers, No. SM4, Vol. 88, August 1962.

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LIST OF STANDARD ABBREVIATIONS

The standard abbreviations commonly employed on each "Record of Borehole", on the figures, and in the text of the report are as follows:

SAMPLE TYPES

A.S. – Auger Sample
C.S. – Chunk Sample
D.O. – Drive Open
D.S. – Denison Type Sample
F.S. – Foil Sample
R.C. – Rock Core
S.T. – Slotted Tube
T.O. – Thin-walled, Open
T.P. – Thin-walled, Piston
W.S. – Wash Sample

PENETRATION RESISTANCES

Dynamic Penetration Resistance – The energy required to drive a 2 inch diameter, 60 degree cone attached to the end of the drilling rods into the ground: expressed in blows per foot, where each blow represents 4,200 inch-pounds of energy.

Standard Penetration Resistance, N – The number of blows by a 140 pound hammer dropped 30 inches required to drive a 2 inch drive open sampler one foot into the ground.

Sampler advanced by static weight – weight, hammer – Wh
Sampler advanced by pressure – pressure,hydraulic – Ph
Sampler advanced by pressure – pressure,manual – Pm

SOIL DESCRIPTION

The standard terminology for the descriptions of the relative density of cohesionless soils and the consistency of cohesive soils is as follows:

Relative Density	N, Blows/ft.	Consistency	c, lb/sq. ft.
Very Loose	0 to 4	Very Soft	Less than 250
Loose	4 to 10	Soft	250 to 500
Compact	10 to 30	Firm	500 to 1,000
Dense	30 to 50	Stiff	1,000 to 2,000
Very Dense	over 50	Very Stiff	2,000 to 4,000
		Hard	over 4,000

SOIL TESTS

C – Consolidation Test
H – Hydrometer Analysis
M – Sieve Analysis
MH – Combined Analysis, Sieve and Hydrometer
Q – Undrained Triaxial
Qc – Consolidated Undrained Triaxial
S – Drained Triaxial
U – Unconfined Compression
V – Field Vane Test

Note: Undrained triaxial tests in which pore pressures are measured are shown as Q' or Q'c.

SOIL PROPERTIES

γ – Total Unit Weight
γ_d – Dry Unit Weight
γ_b – Submerged Unit Weight
L_L – Liquid Limit
P_L – Plastic Limit
W – Natural Water Content
G – Specific Gravity
e – Void Ratio
K – Coefficient of Permeability
c – Undrained Shear Strength (½ Compressive Strength)
St – Sensitivity
Ø' – Effective Angle of Shearing Resistance
c' – Effective Cohesion Intercept
Cc – Compression Index
Cv – Coefficient of Consolidation

PROJECT No. 6264

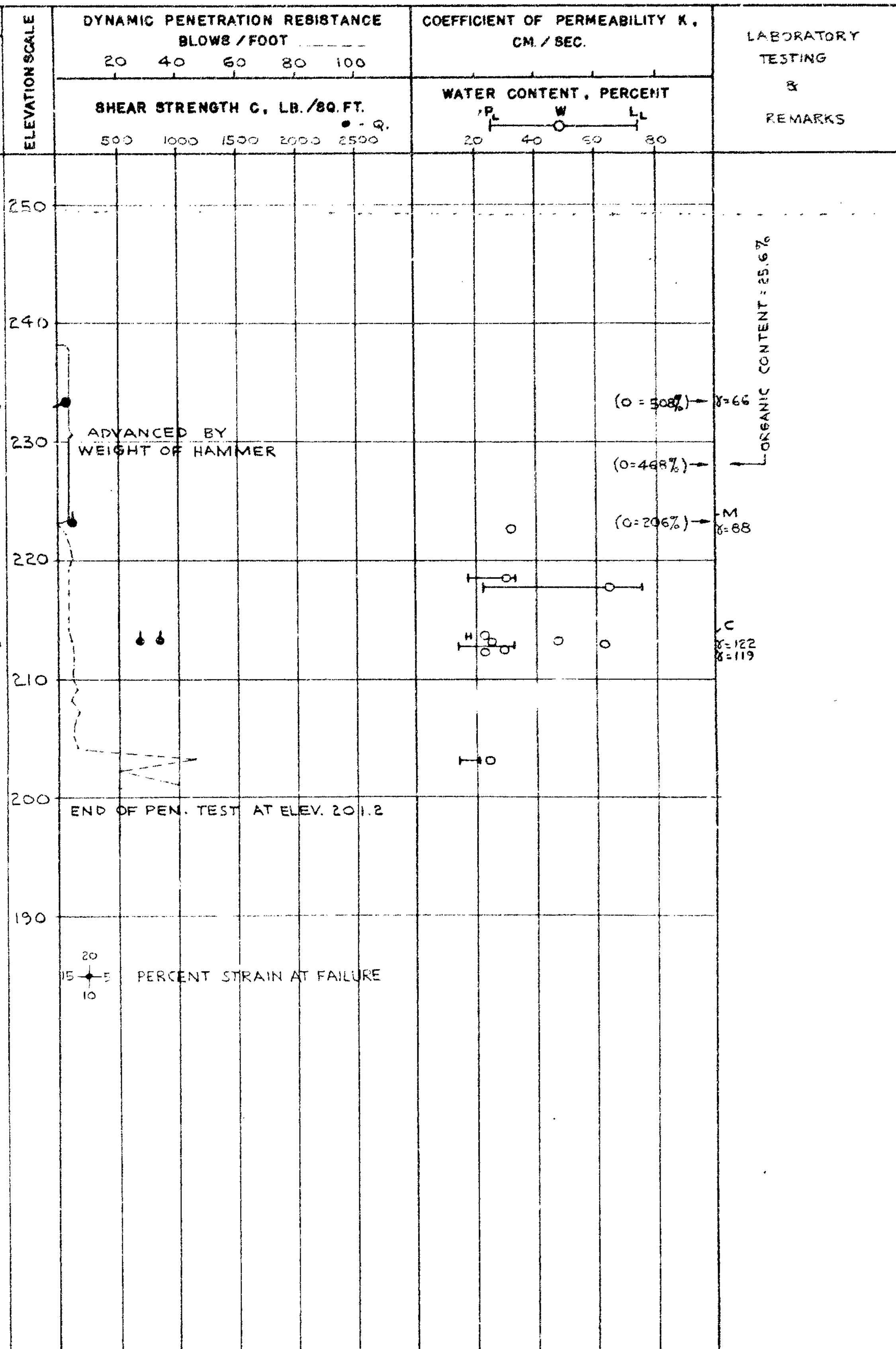
RECORD OF BOREHOLE 1

LOCATION SEE FIGURE 1 BORING DATE JAN. 17 1963 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
244.2	ICE LEVEL			
0.0	WATER			
238.2 / 6.0	RIVER BOTTOM			
	BROWN **FIBROUS MUSKEG**, WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES GENERALLY LESS THAN 1 INCH IN THICKNESS WITH INCREASING DEPTH	1	2" TO	Pm
		2	"	Pm
223.2 / 21.0		3	"	Pm
	FIRM GREY LAYERED **SILTY CLAY AND CLAYEY SILT** OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH SAND LAYERS GENERALLY LESS THAN 1/8 INCHES IN THICKNESS	4	2" DO	2
		5	2" TO	Pm
		6	2" DO	2
		7	"	16
201.2 / 43.0	END OF HOLE **REFUSAL**, PROBABLY BOULDER OR BEDROCK			



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED M.M.S.

PROJECT No. 6264

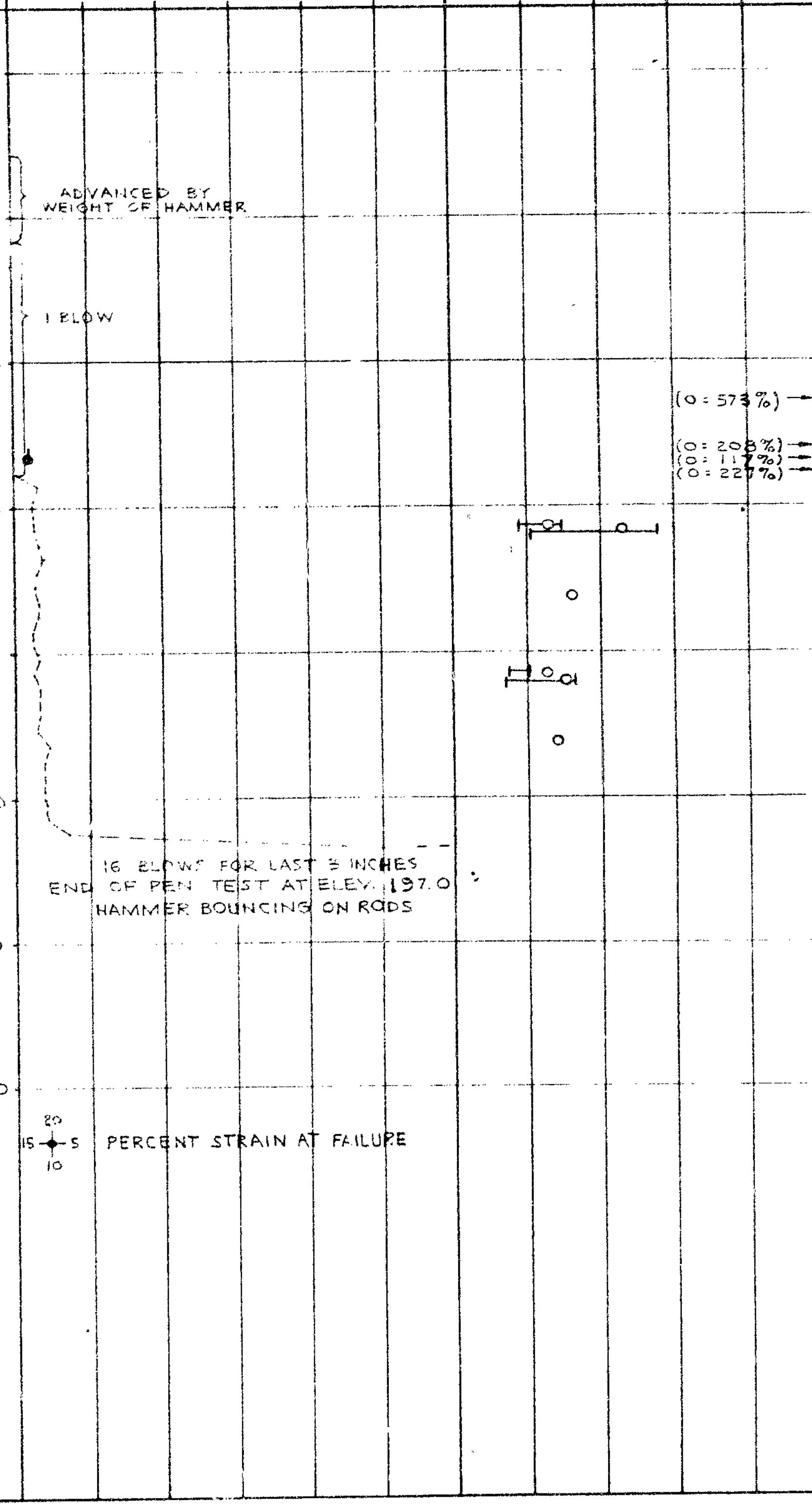
RECORD OF BOREHOLE 2

LOCATION SEE FIGURE 1 BORING DATE JAN. 10, 1963 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	BLOWS / FT.
244.2	ICE LEVEL			
0.0	WATER			
240.7 / 3.5	RIVER BOTTOM			
	BROWN FIBROUS **MUSKEG**, WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES GENERALLY LESS THAN 1 INCH IN THICKNESS) WITH INCREASING DEPTH	1	2" TO	Pm
		2	"	Pm
		3	"	Pm
220.7 / 23.5	GREY LAYERED **SILTY CLAY AND CLAYEY SILT** OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH PROBABLY FIRM	4	2" DO	2
		5	"	2
		6	"	3
		7	"	3
199.2 / 45.0	HARD GREY-GREEN METAMORPHOSED CRYSTALLINE ROCK FAIRLY NUMEROUS FRACTURES IN UPPER 4 FEET, OCCASIONAL FRACTURES [illegible] 4 FT. **(BEDROCK)**	8	AXT RC	–
		9	"	–
		10	"	–
188.2 / 56.0	END OF HOLE			



LABORATORY TESTING & REMARKS

SPECIFIC GRAVITY = 2.16
ORGANIC CONTENT = 34.1%
C
γ=78

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED [illegible]

PROJECT No. 6264

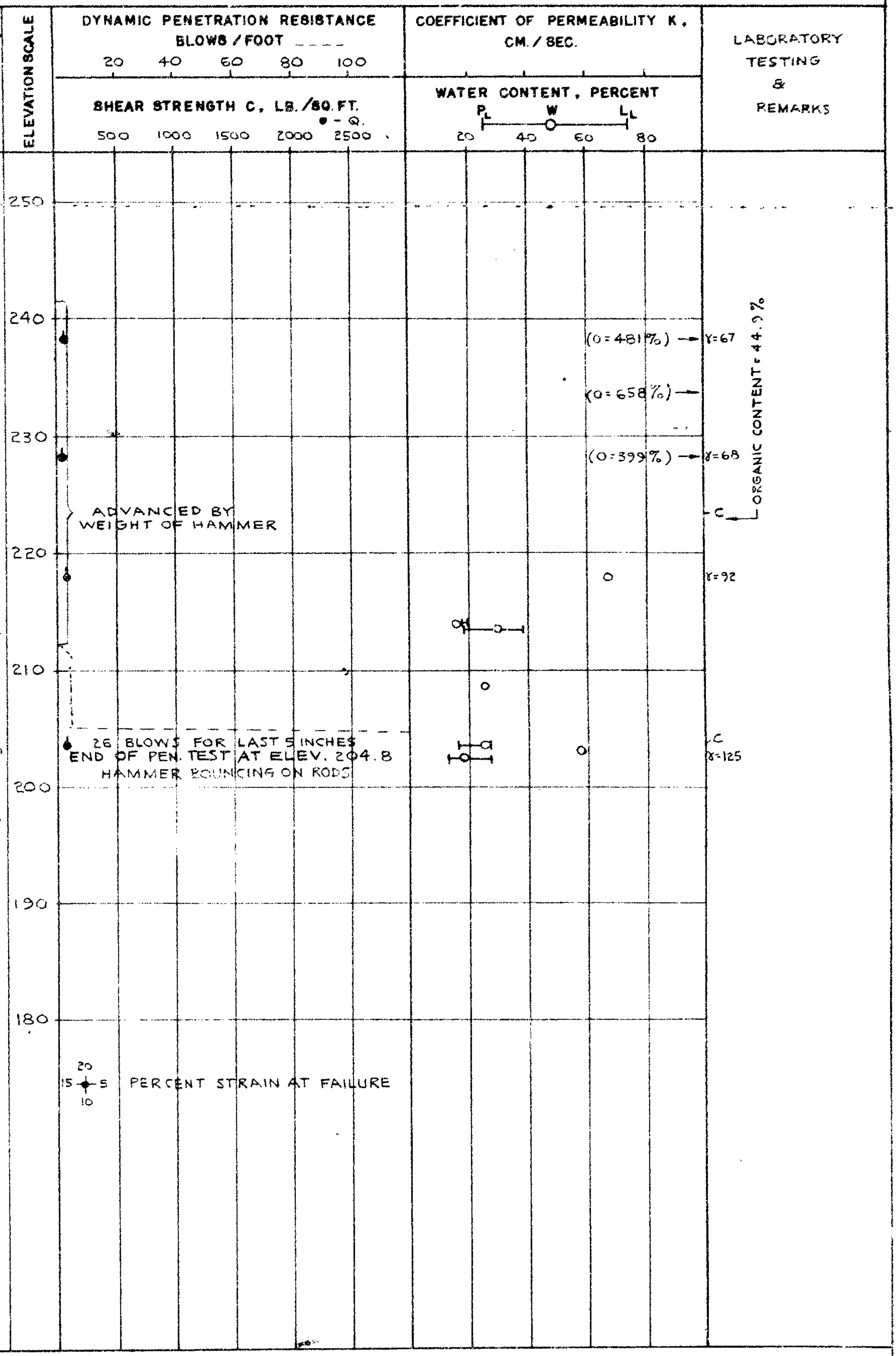
RECORD OF BOREHOLE 3

LOCATION: SEE FIGURE 1 — BORING DATE: JAN. 16, 1963 — DATUM: GEODETIC

BOREHOLE TYPE: WASH BORING — BOREHOLE DIAMETER: EX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	BLOWS / FT.
244.2	WATER ICE LEVEL			
241.7 / 0.0	RIVER BOTTOM			
2.5	BROWN FIBROUS **MUSKEG** WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES (GENERALLY LESS THAN 1 INCH IN THICKNESS) WITH INCREASING DEPTH	1	2" TO	Pm
		2	"	Pm
		3	"	Pm
		4	"	Pm
		5	"	Pm
215.7 / 28.5	VERY SOFT GREY LAYERED **SILTY CLAY AND CLAYEY SILT** OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH. SAND LAYERS GENERALLY LESS THAN 1/8 INCHES IN THICKNESS	6	2" DO	42
		7	"	19
		8	2" TO	Pm
199.7 / 44.5	HARD GREY - GREEN METAMORPHOSED CRYSTALLINE ROCK **(BEDROCK)** CONTAINS A FEW FRACTURES	9	AXT RC	–
		10	"	–
189.7 / 54.5	END OF HOLE			



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED M.M.C.

PROJECT No. 6264

RECORD OF BOREHOLE 4

LOCATION SEE FIGURE 1 | BORING DATE JAN. 14, 1963 | DATUM GEODETIC

BOREHOLE TYPE WASH BORING | BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	DYNAMIC PENETRATION / SHEAR STRENGTH	WATER CONTENT, PERCENT	LABORATORY TESTING & REMARKS
244.2	WATER ICE LEVEL						
0.0	RIVER BOTTOM				ADVANCED BY WEIGHT OF HAMMER		
2.0	BROWN FIBROUS **MUSKEG** WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES (GENERALLY LESS THAN 1 INCH IN THICKNESS) WITH INCREASING DEPTH	1	2" TO			(ω = 601%)	ORGANIC CONTENT = 56.4%
		2	"			(ω = 370%)	γ = 69
		3	"			(ω = 503%)	γ = 66
225.2 / 19.0	GENERALLY SOUND LIGHT GREY CRYSTALLINE LIMESTONE **(BEDROCK)** FRACTURES AT 1.8 AND 2.2 FEET BELOW UPPER SURFACE BOTH AT 70 DEGREES TO HORIZONTAL	4	AXT RC	-	END OF PEN. TEST AT ELEV. 226.2 HAMMER BOUNCING ON RODS		
		5	"	-			
215.2 / 29.0	END OF HOLE						

Chart scales: Dynamic penetration resistance, blows/foot: 20, 40, 60, 80, 100. Shear strength C, lb./sq.ft. (● - Q): 500, 1000, 1500, 2000, 2500. Coefficient of permeability K, cm./sec. Water content, percent (P_L — W — L_L): 20, 40, 60, 80. Elevation scale: 250, 240, 230, 220, 210.

Percent strain at failure: 20 / 15 — 5 / 10

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED [illegible]

PROJECT No. 6264

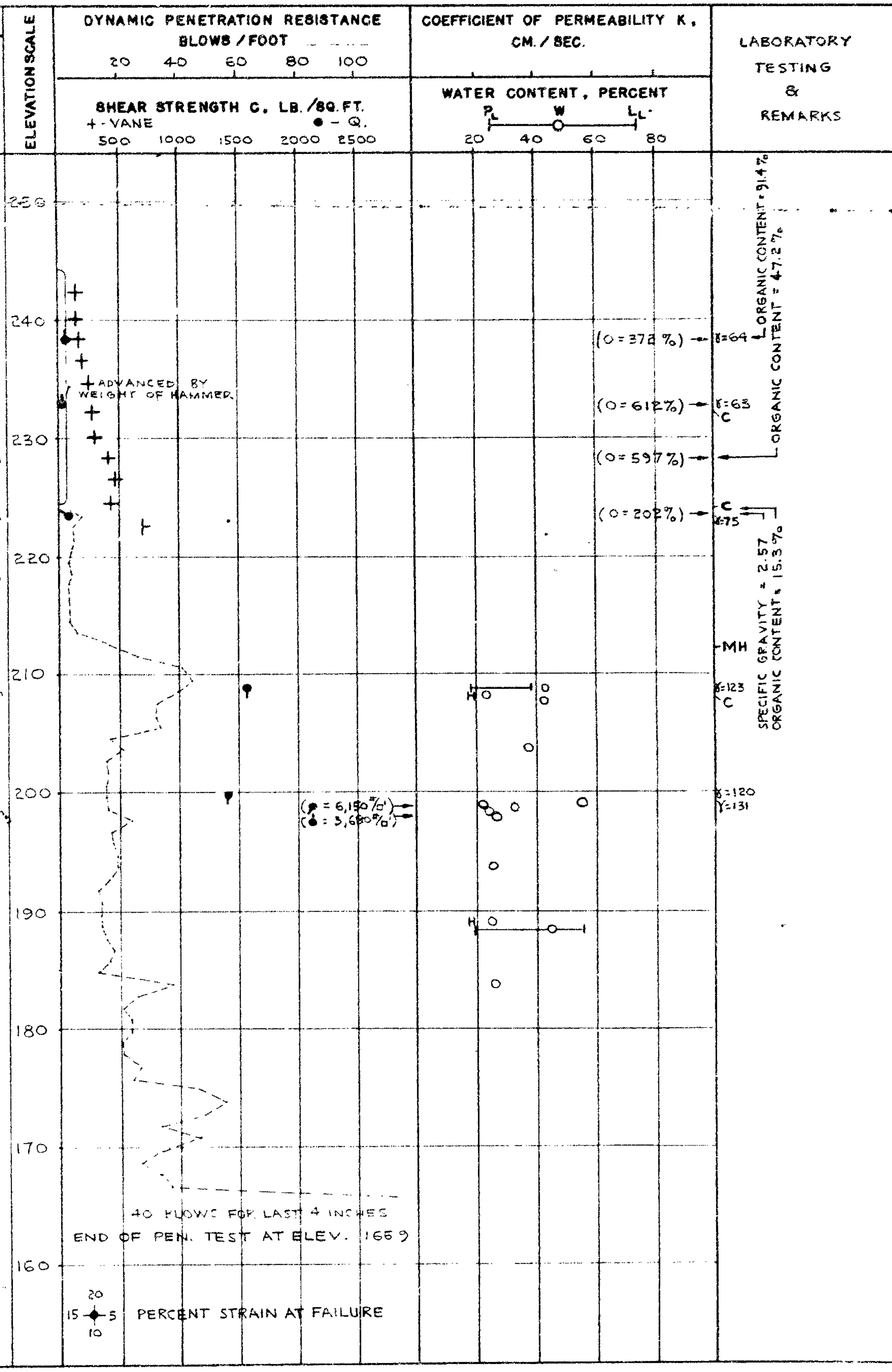
RECORD OF BOREHOLE 5

LOCATION: SEE FIGURE 1 — BORING DATE: JAN. 8, 1963 — DATUM: GEODETIC

BOREHOLE TYPE: WASH BORING — BOREHOLE DIAMETER: BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
244.2 / 0.0	WATER LEVEL – ICE			
1.0	BROWN FIBROUS **MUSKEG** WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES GENERALLY LESS THAN 1 INCH IN THICKNESS) WITH INCREASING DEPTH	1	2" TO	Pm
		2	"	Pm
		3	"	Pm
		4	"	Pm
		5	"	Pm
215.2 / 29.0	COMPACT **SAND** WITH SOME GRAVEL AND SHELLS	6	2" DO	13
211.6 / 32.6	STIFF TO HARD GREY LAYERED **SILTY CLAY** AND **CLAYEY SILT** OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH	7	2" TO	Pm
		8	2" DO	3
		9	2" TO	Pm
		10	2" DO	4
		11	"	3
		12	"	5
179.3 / 64.9	END OF HOLE **REFUSAL**, PROBABLY BOULDER OR BEDROCK			



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED

PROJECT No. 6264

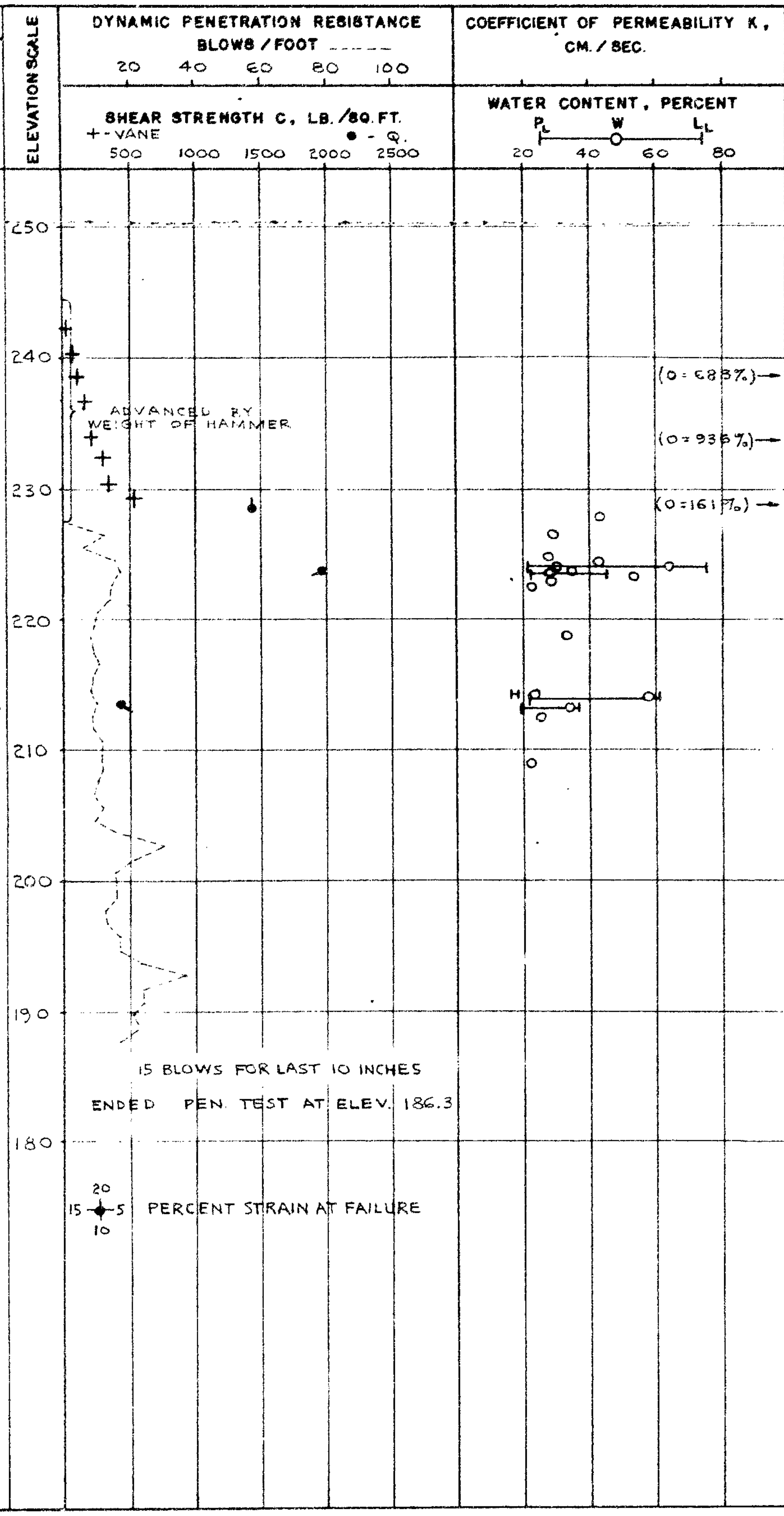
RECORD OF BOREHOLE 6

LOCATION SEE FIGURE 1 BORING DATE JAN. 2, [illegible] DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
244.2	ICE LEVEL			
0.0	WATER			
1.5	BROWN FIBROUS **MUSKEG** WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES GENERALLY LESS THAN 1 INCH IN THICKNESS) WITH INCREASING DEPTH	1	2" TO	Pm
		2	"	Pm
230.2 / 14.0	LOOSE GREY **SAND** OCCASIONAL LAYERS (TO 1/2 INCH) OF MUSKEG	3	"	Pm
226.0 / 18.2		4	2" DO	7
	STIFF TO SOFT GREY LAYERED **SILTY CLAY** AND **CLAYEY SILT** OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH	5	2" TO	Pm
		6	2" DO	2
		7	2" TO	Pm
		8	2" DO	2
202.7 / 41.5	END OF HOLE **REFUSAL**, PROBABLY BOULDER OR BEDROCK	9	"	4



LABORATORY TESTING & REMARKS

C
γ=84
γ=116
MH
γ=123
MH
ORGANIC CONTENT = 62.6%

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED [illegible]

RECORD OF BOREHOLE 7

LOCATION SEE FIGURE 1 BORING DATE JAN 11, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB DROP 30 INCHES

ELEVN. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / SHEAR STRENGTH C, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT (P_L W L_L)
						250		
244.2 / 0.0	ICE LEVEL							
	WATER					240		
236.2 / 8.0	RIVER BOTTOM							
						230	ADVANCED BY WEIGHT OF HAMMER	
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					220		
						210		
						200		
195.9 / 48.3	END OF PEN. TEST PROBABLY BOULDER OR BEDROCK						30 BLOWS FOR LAST 3 INCHES HAMMER BOUNCING ON RODS	
						190		

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED [illegible signature]

PROJECT No. 6267

RECORD OF BOREHOLE 8

LOCATION SEE FIGURE 1 BORING DATE JAN. 11, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT – LB. DROP – INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE: ELEVN. / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20, 40, 60, 80, 100) / SHEAR STRENGTH C, LB. / SQ. FT.	COEFFICIENT OF PERMEABILITY K, CM. / SEC. / WATER CONTENT, PERCENT (P_L, W, L_L)
						250		
244.2	ICE LEVEL							
0.0	WATER					240		
236.2 / 8.0	RIVER BOTTOM							
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					230	ADVANCED BY WEIGHT OF HAMMER	
						220		
						210		
204.9 / 39.3	END OF PEN. TEST						20 BLOWS FOR LAST 3 INCHES HAMMER BOUNCING ON RODS	
	PROBABLY BOULDER OR BEDROCK					200		

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED M.M.C.

PROJECT No. 6264

RECORD OF BOREHOLE 9

LOCATION SEE FIGURE 1 BORING DATE JAN 11, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE			SAMPLES		
ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.
244.2	ICE LEVEL				
0.0	WATER				
1.5	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN				
195.7 / 48.5	END OF PEN. TEST PROBABLY BOULDER OR BEDROCK				

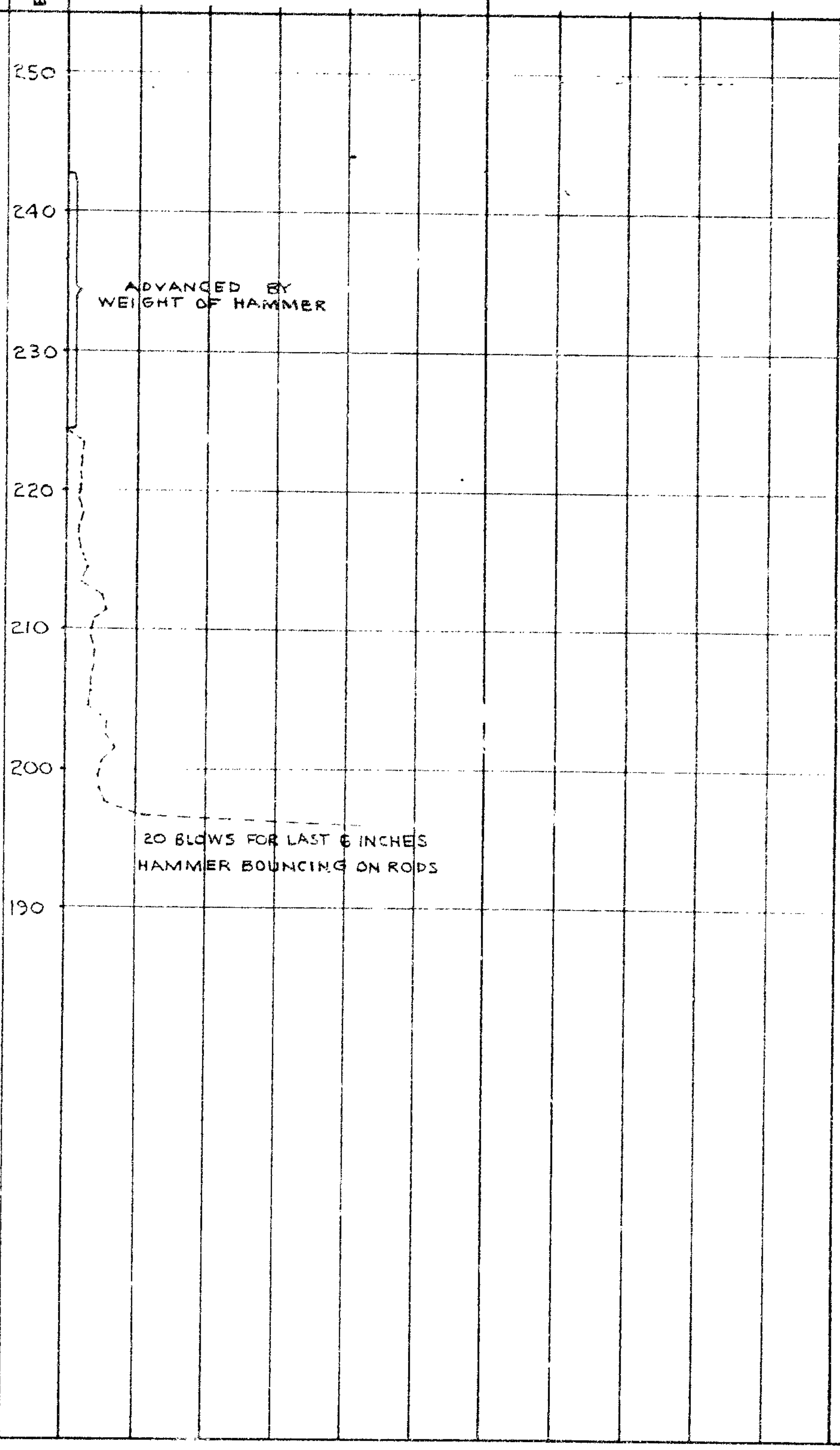
ELEVATION SCALE

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY K, CM./SEC.

WATER CONTENT, PERCENT
P_L W L_L



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED

PROJECT No. 6264

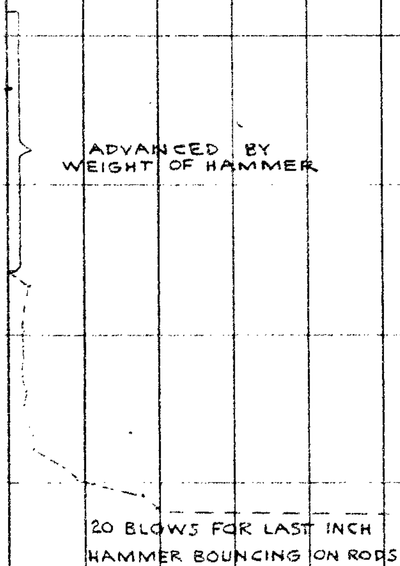
RECORD OF BOREHOLE 10

LOCATION SEE FIGURE 1 BORING DATE JAN 15, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE: ELEVN. / DEPTH	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20, 40, 60, 80, 100) / SHEAR STRENGTH C. LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT (P_L, W, L_L)
						250		
244.2	ICE LEVEL							
0.0	WATER							
241.7 / 2.5	RIVER BOTTOM					240		
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					230		
						220		
						210		
208.1 / 36.1	END OF PEN. TEST PROBABLY BOULDER OR BEDROCK							
						200		



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M. W.

CHECKED M.M.G.

PROJECT No. 6264

RECORD OF BOREHOLE 11

LOCATION SEE FIGURE 1 BORING DATE JAN. 15, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20, 40, 60, 80, 100) / SHEAR STRENGTH C, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT (P_L — W — L_L)
						250		
244.2 / 0.0	ICE LEVEL							
	WATER					240		
237.2 / 7.0	RIVER BOTTOM							
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					230		
						220		
212.9 / 31.3	END OF PEN. TEST PROBABLY BOULDER OR BEDROCK					210	20 BLOWS FOR LAST 4 INCHES HAMMER BOUNCING ON RODS	

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED M. McG.

PROJECT No. [illegible]

RECORD OF BOREHOLE 12

LOCATION SEE FIGURE 1 BORING DATE JAN. 15, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / SHEAR STRENGTH C, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT (P_L — W — L_L)
						250		
244.2	ICE LEVEL							
0.0	WATER					240		
236.4 / 7.8	RIVER BOTTOM							
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					230	ADVANCED BY WEIGHT OF HAMMER	
						220		
210.2 / 34.0	END OF PEN. TEST					210	30 BLOWS FOR LAST 12 INCHES HAMMER BOUNCING ON RODS AT 34' DEPTH	
	PROBABLY BOULDER OR BEDROCK							
						200		

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M. W.

CHECKED [illegible]

PROJECT No. 6264

RECORD OF BOREHOLE 13

LOCATION SEE FIGURE 1 BORING DATE JAN. 15, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HA MER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20, 40, 60, 80, 100) / SHEAR STRENGTH C, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT (P_L W L_L)
ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.			
						250		
244.2	ICE LEVEL							
0.0	WATER					240		
236.2 / 8.0	RIVER BOTTOM							
	DYNAMIC PENETRATION TEST ONLY- NO SAMPLES TAKEN					230	ADVANCED BY WEIGHT OF HAMMER	
						220		
213.4 / 30.8	END OF PEN. TEST						40 BLOWS FOR LAST 10 INCHES	
						210		

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED M.M.B.

PROJECT No. 6264

RECORD OF BOREHOLE 14

LOCATION SEE FIGURE 1 BORING DATE JAN. 15, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT – LB. DROP – INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / SHEAR STRENGTH C, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT P_L W L_L
						250		
244.2	ICE LEVEL							
0.0	WATER					240		
237.9 / 6.3	RIVER BOTTOM							
	DYNAMIC PENETRATION TEST ONLY – NO SAMPLES TAKEN					230	ADVANCED BY WEIGHT OF HAMMER	
						220		
216.2 / 28.0	END OF PEN. TEST						ENDED PEN. TEST AT ELEV. 216.2 AS RODS APPEARED TO BE GLANCING OFF A BOULDER OR ROCK.	
						210	NOTE: RODS BENT BY DRIVING. PROBABLY BOULDER OR BEDROCK AT ABOUT EL. 216	

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED A.M.B.

PROJECT No. 6264

RECORD OF BOREHOLE 15

LOCATION SEE FIGURE 1 BORING DATE JAN. 15, 1963 DATUM GEODETIC

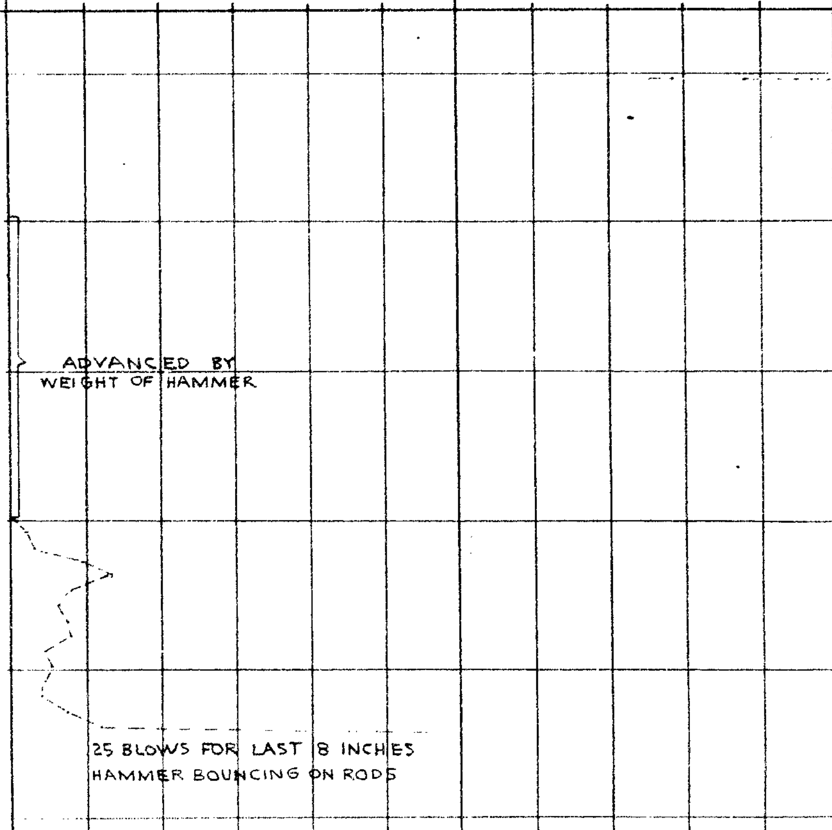
BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE: ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE
						250
244.2	ICE LEVEL					
0.0	WATER					
240.4 / 3.8	RIVER BOTTOM					240
						230
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					220
						210
205.5 / 38.7	END OF PEN. TEST PROBABLY BOULDER OR BEDROCK					
						200

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20, 40, 60, 80, 100) — SHEAR STRENGTH C, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY K, CM. / SEC. — WATER CONTENT, PERCENT (P_L, W, L_L)



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED [illegible]

PROJECT No. 6264

RECORD OF BOREHOLE 16

LOCATION SEE FIGURE 1 BORING DATE JAN. 11, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT -- LB. DROP -- INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.
244.2	ICE LEVEL				
0.0	WATER				
235.9 / 8.3	RIVER BOTTOM				
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN				
205.7 / 38.5	END OF PEN. TEST				

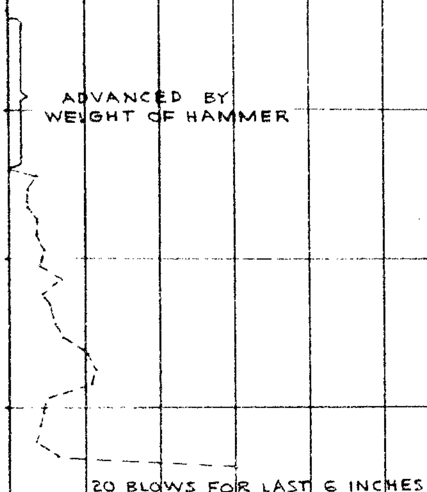
ELEVATION SCALE: 250, 240, 230, 220, 210, 200

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20, 40, 60, 80, 100)

SHEAR STRENGTH C, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY K, CM./SEC.

WATER CONTENT, PERCENT (P_L, W, L_L)



NOTE: THE BOTTOM 7 FEET OF THE TEST ROD WAS BENT BY DRIVING, INDICATING THAT THE CONE COULD HAVE BEEN DEFLECTED BY A BOULDER OR BEDROCK AT ABOUT ELEV. 213.

VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.

CHECKED M.M.S.

PROJECT No. 6264

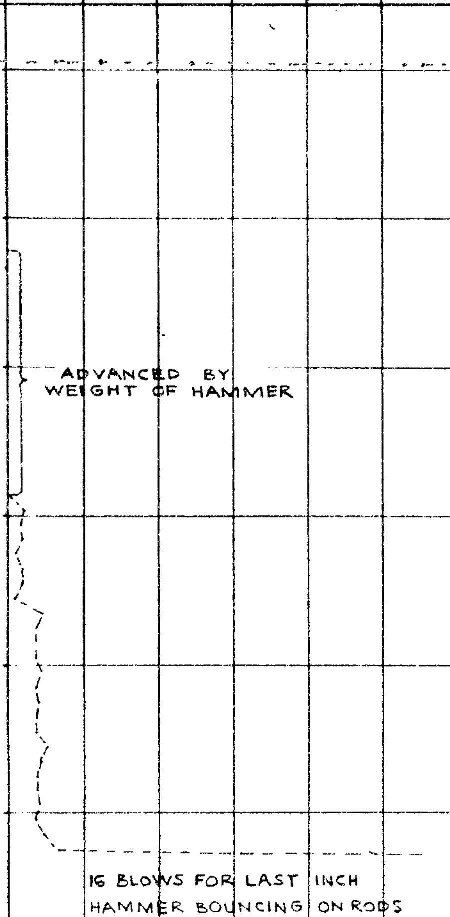
RECORD OF BOREHOLE 17

LOCATION SEE FIGURE 1   BORING DATE JAN. 11, 1963   DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST   BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES   PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / SHEAR STRENGTH C, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY K, CM./SEC. / WATER CONTENT, PERCENT (P_L — W — L_L)
ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE		
						250		
244.2	ICE LEVEL							
0.0	WATER					240		
237.7 / 6.5	RIVER BOTTOM							
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					230 / 220 / 210 / 200		
197.1 / 47.1	END OF PEN. TEST PROBABLY BOULDER OR BEDROCK					190		



VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED 1/1/58.

PROJECT No. 6264

RECORD OF BOREHOLE 18

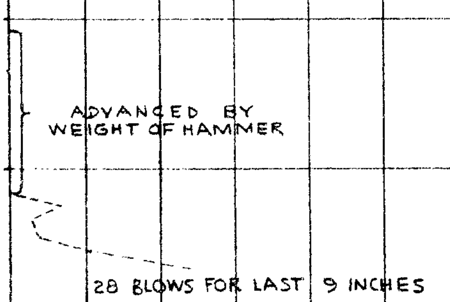
LOCATION SEE FIGURE 1 BORING DATE JAN. 11, 1963 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE
						250
244.2	ICE LEVEL					
0.0	WATER					
239.2 / 5.0	RIVER BOTTOM					240
	DYNAMIC PENETRATION TEST ONLY - NO SAMPLES TAKEN					230
223.4 / 20.8	END OF PEN. TEST					220

DYNAMIC PENETRATION RESISTANCE, BLOWS / FOOT ---- (20, 40, 60, 80, 100); SHEAR STRENGTH C, LB./SQ.FT.



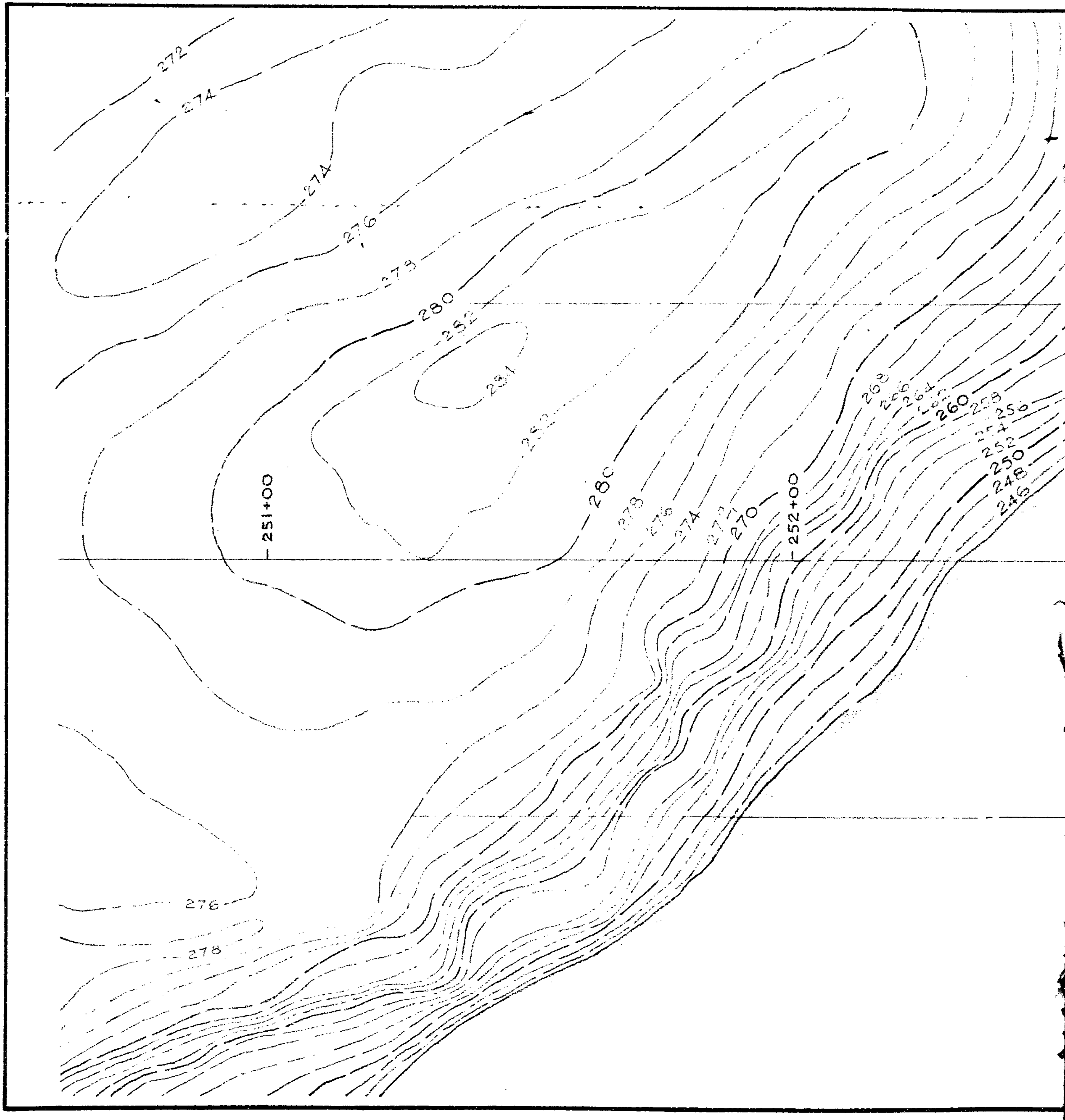
NOTE: TEST RODS APPEARED TO BE DEFLECTING OFF A HARD OBJECT (PROBABLY A BOULDER OR INCLINED BEDROCK) AT ABOUT ELEV. 224.

COEFFICIENT OF PERMEABILITY K, CM./SEC.; WATER CONTENT, PERCENT P_L — W — L_L

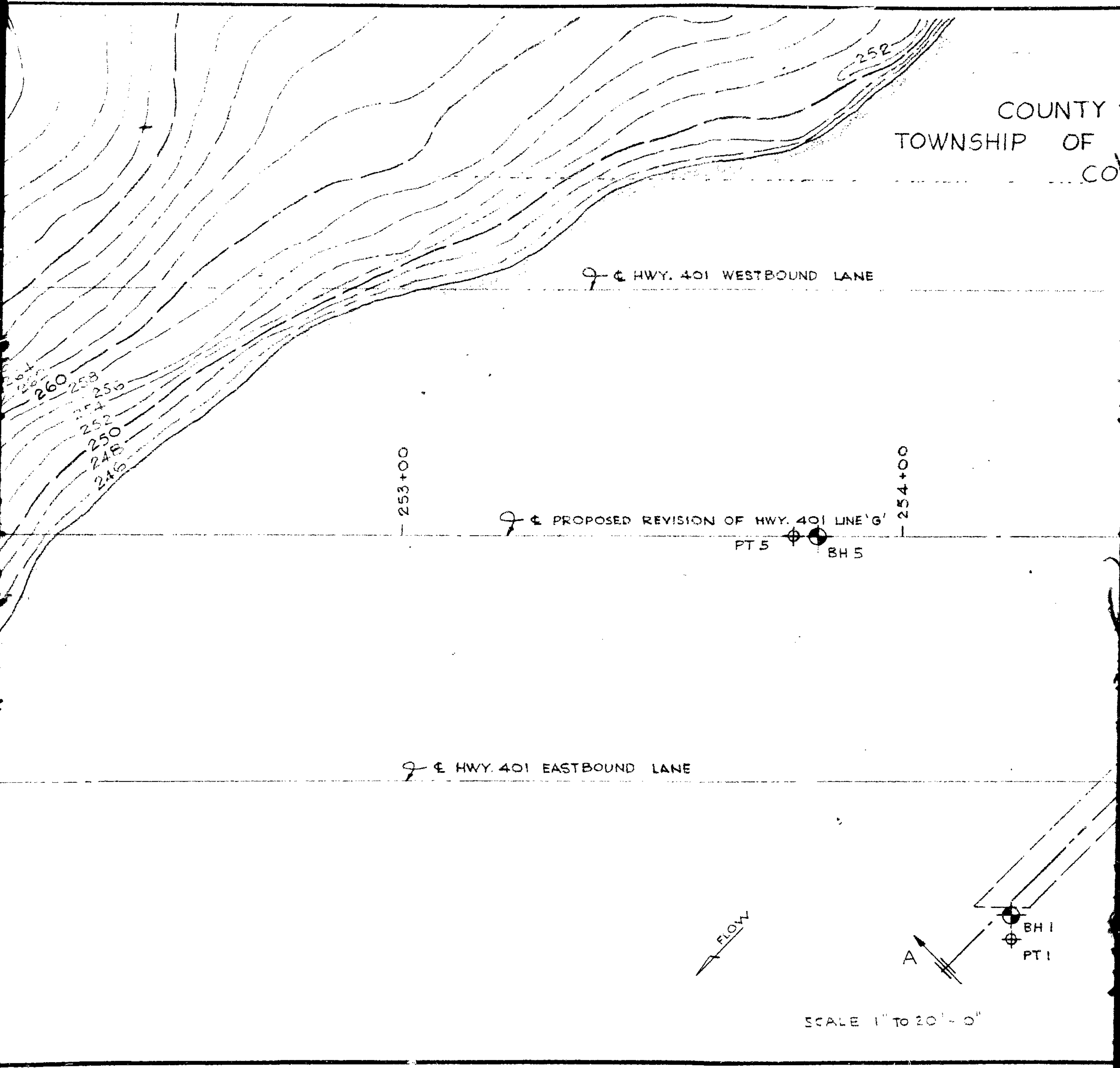
VERTICAL SCALE 1 INCH TO 10'-0"

GOLDER & ASSOCIATES

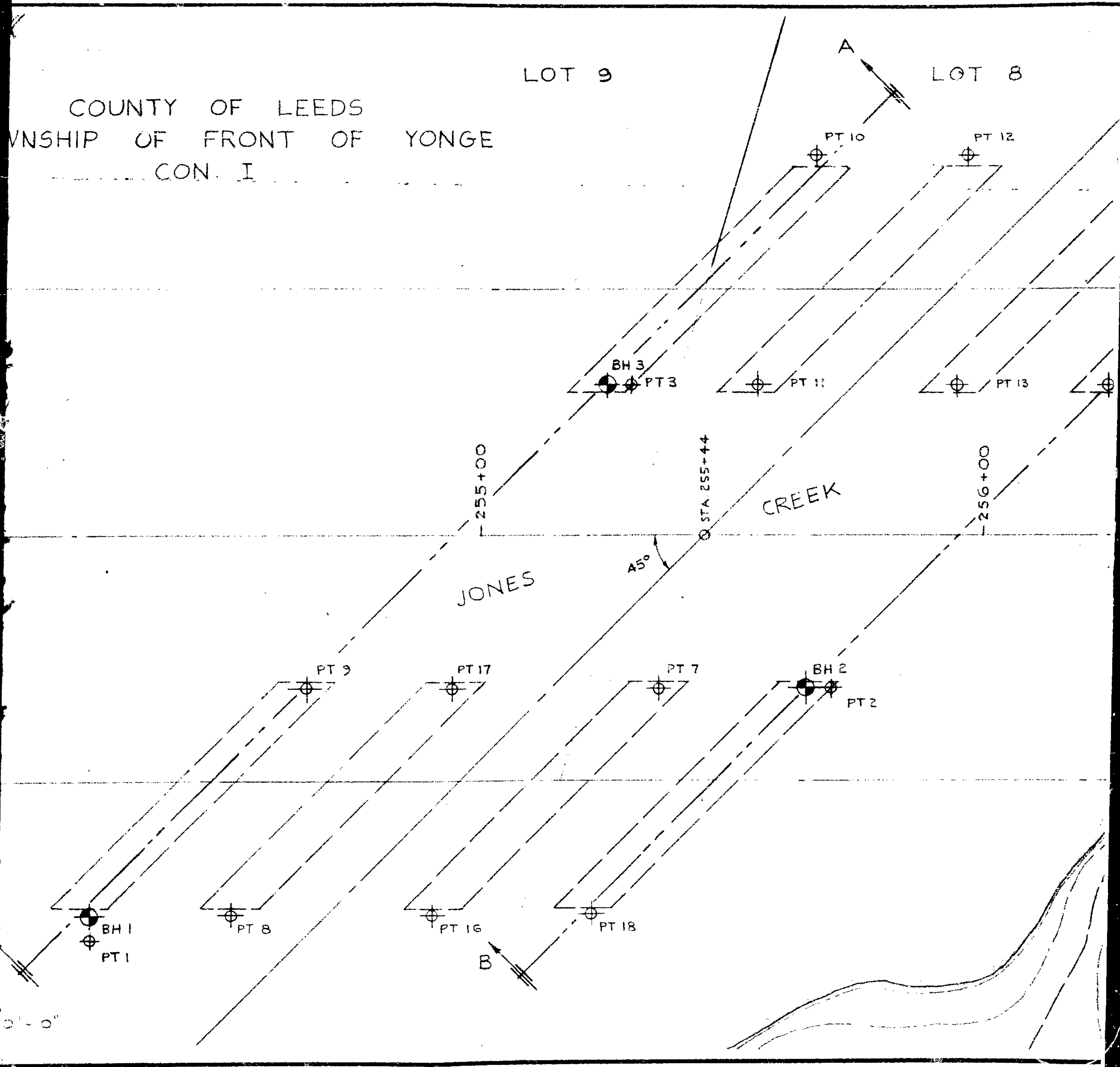
DRAWN M.W.
CHECKED M.McL.

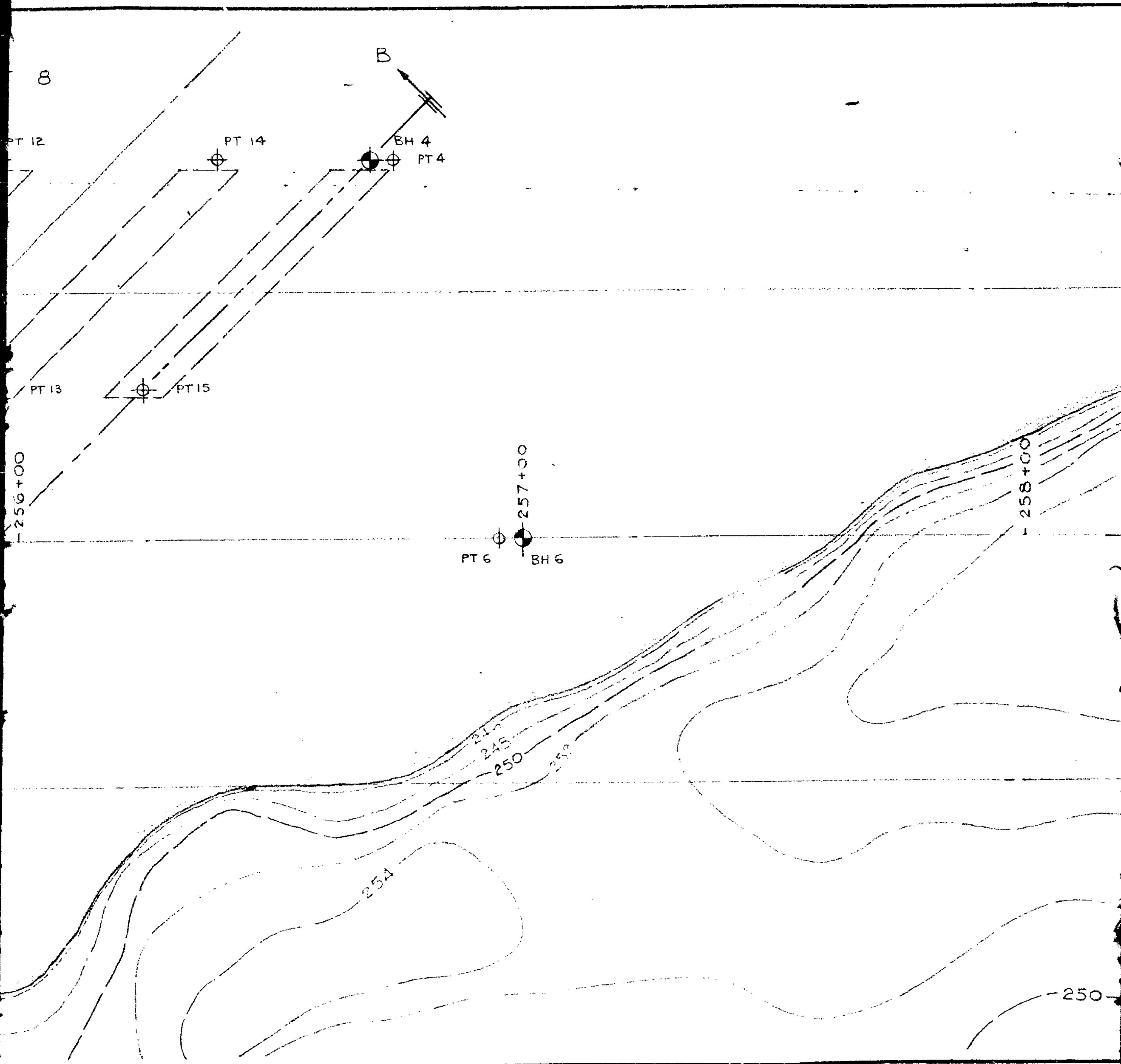


272
274
274
276
278
280
282
281
282
251+00
280
278
276
274
272
270
252+00
268
266
264
260
258
256
252
250
248
246
276
278

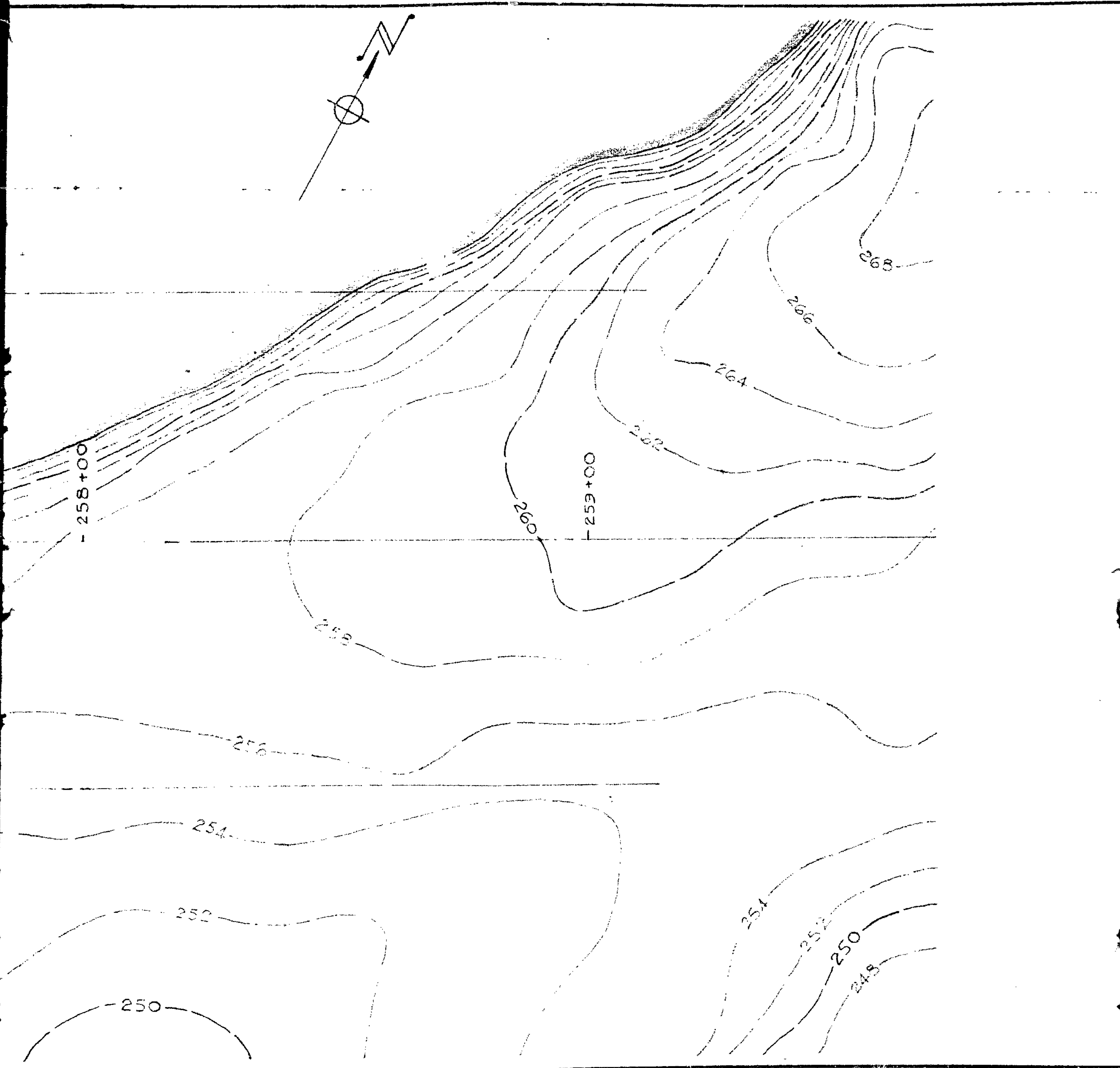


COUNTY
TOWNSHIP OF
CO
252
260
258
256
252
250
248
246
℄ HWY. 401 WESTBOUND LANE
253+00
254+00
℄ PROPOSED REVISION OF HWY. 401 LINE 'G'
PT 5
BH 5
℄ HWY. 401 EASTBOUND LANE
FLOW
A
BH 1
PT 1
SCALE 1" TO 20'-0"


LOT 9
LOT 8
COUNTY OF LEEDS
VNSHIP OF FRONT OF YONGE
CON. I
A
PT 10
PT 12
BH 3
PT 3
PT 13
255+00
STA. 255+44
256+00
CREEK
45°
JONES
PT 9
PT 17
PT 7
BH 2
PT 2
BH 1
PT 1
PT 8
PT 16
PT 18
B



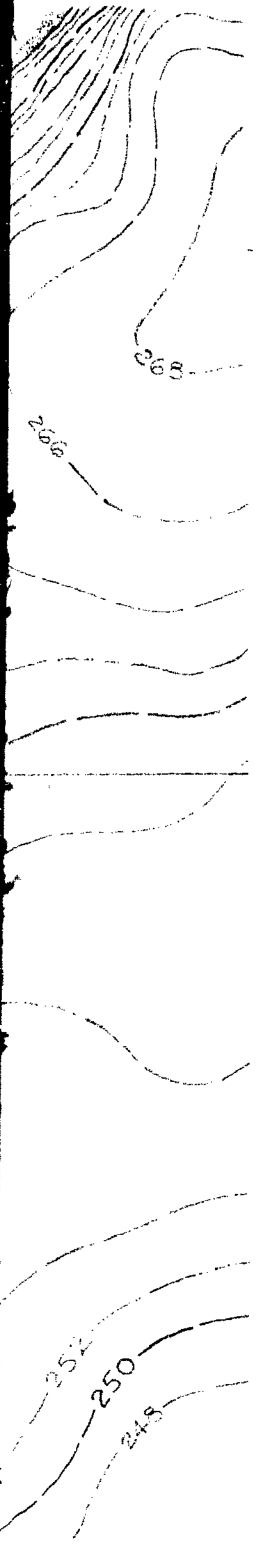
8
B
PT 12
PT 14
BH 4
PT 4
PT 13
PT 15
256+00
257+00
258+00
PT 6
BH 6
245
250
254
250

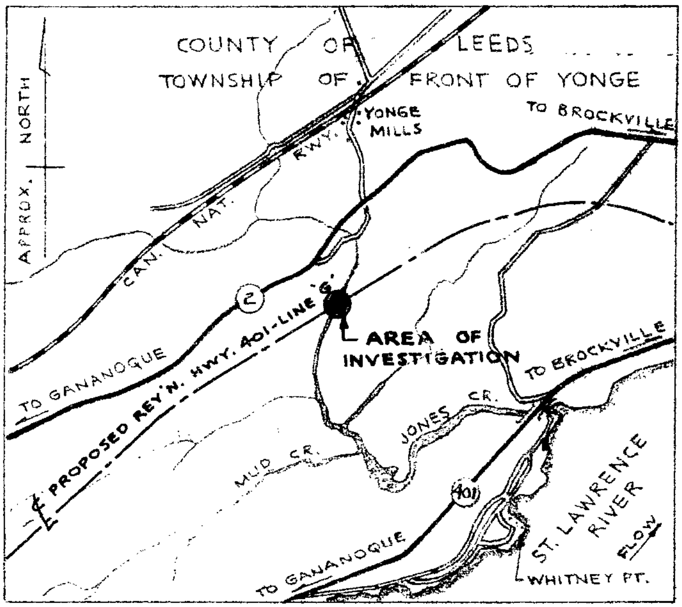


N
268
266
264
262
260
258+00
253+00
258
256
254
252
250
254
252
250
248

BORING PLAN

FIGURE 1





KEY PLAN

SCALE 1" TO 0.8 MILES

LEGEND

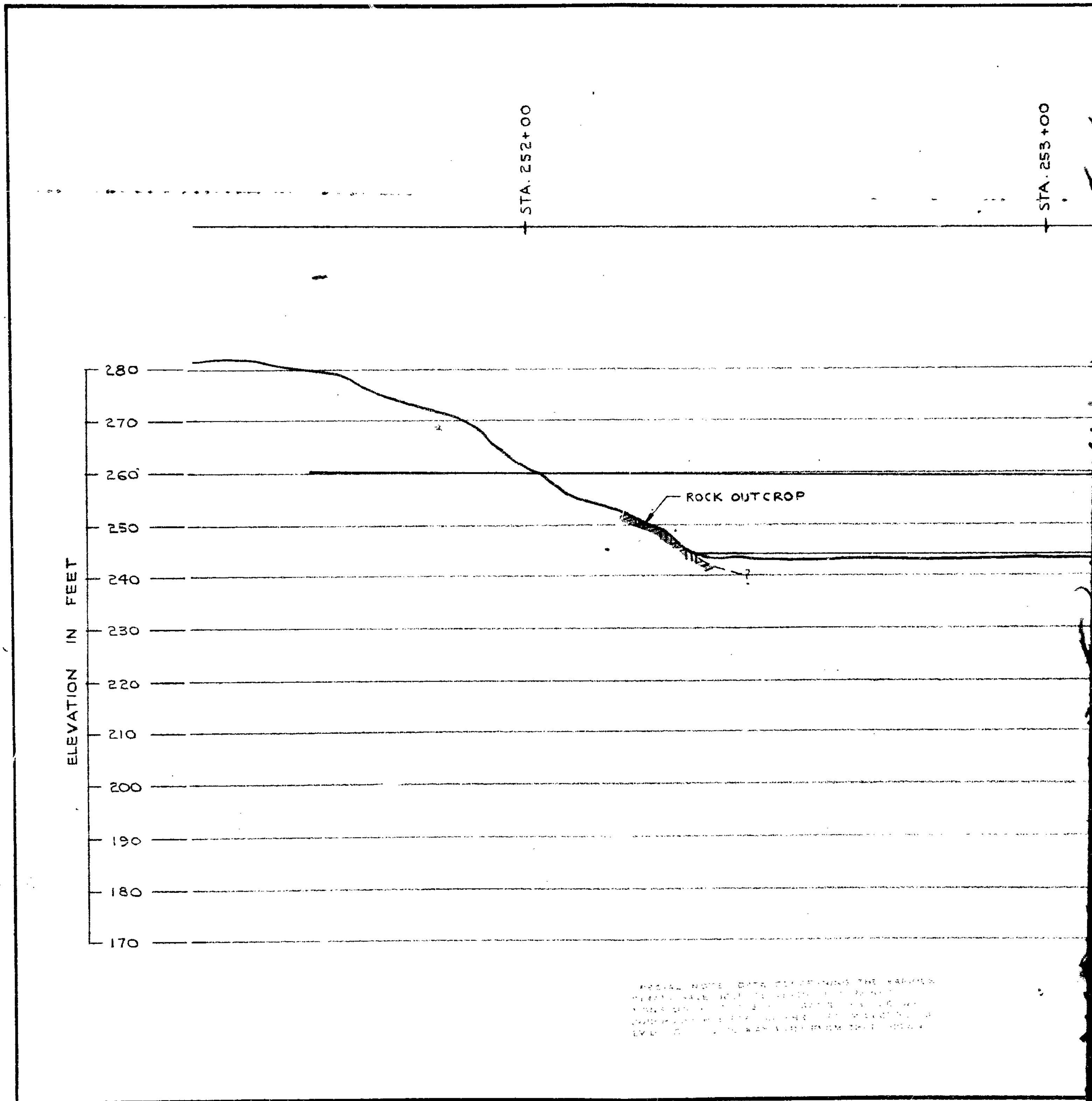
BH 6	BOREHOLE IN PLAN
PT 2	PENETRATION TEST IN PLAN
	PROPOSED FOOTING LOCATIONS (REC'D. OCTOBER 1962)

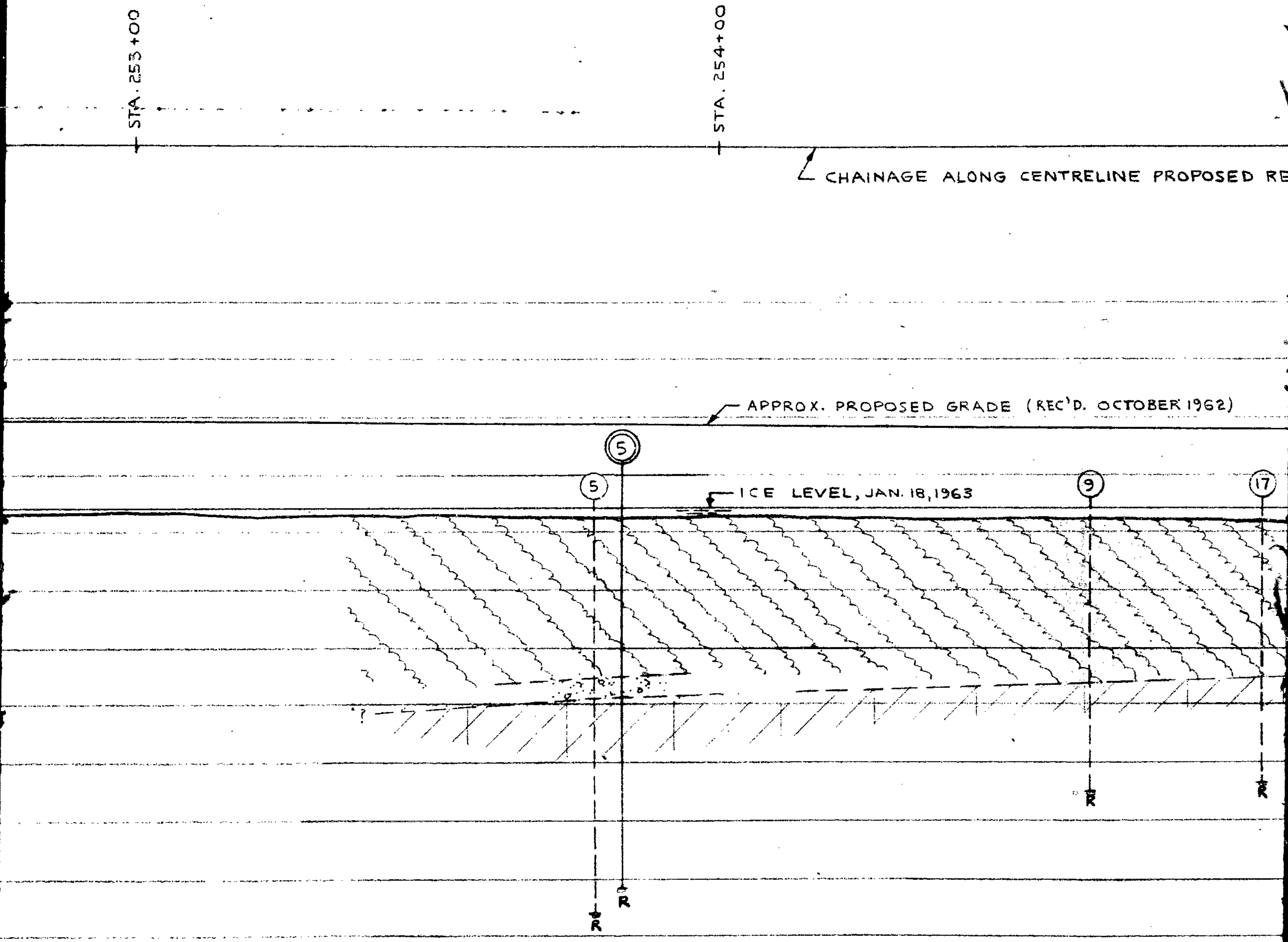
REFERENCE DRWG. No. E-4139-1, DEPARTMENT OF HIGHWAYS, ONTARIO DRWG. OF PROPOSED CROSSING AT JONES CR. & PROPOSED REV'N. OF HWY. 401- LINE 'G' - TWP. OF FRONT OF YONGE, COUNTY OF LEEDS - DATED: SEPT. 1962.

31B-8
GEOCRES No.

GOLDER & ASSOCIATES

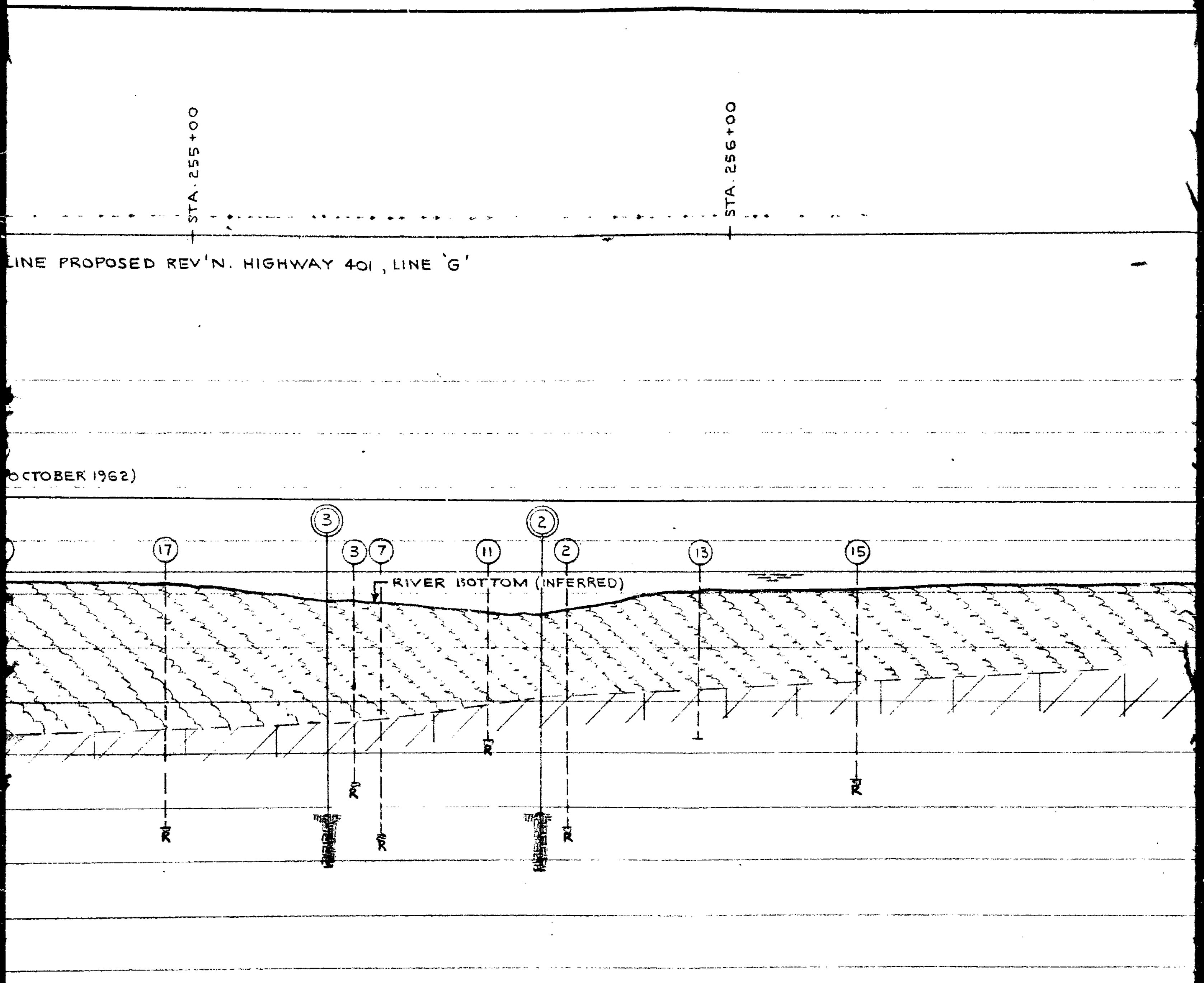
Made P.C.
Chkd. [illegible]
Appd. [illegible]


STA. 252+00
STA. 253+00
280
270
260
250
240
230
220
210
200
190
180
170
ELEVATION IN FEET
ROCK OUTCROP



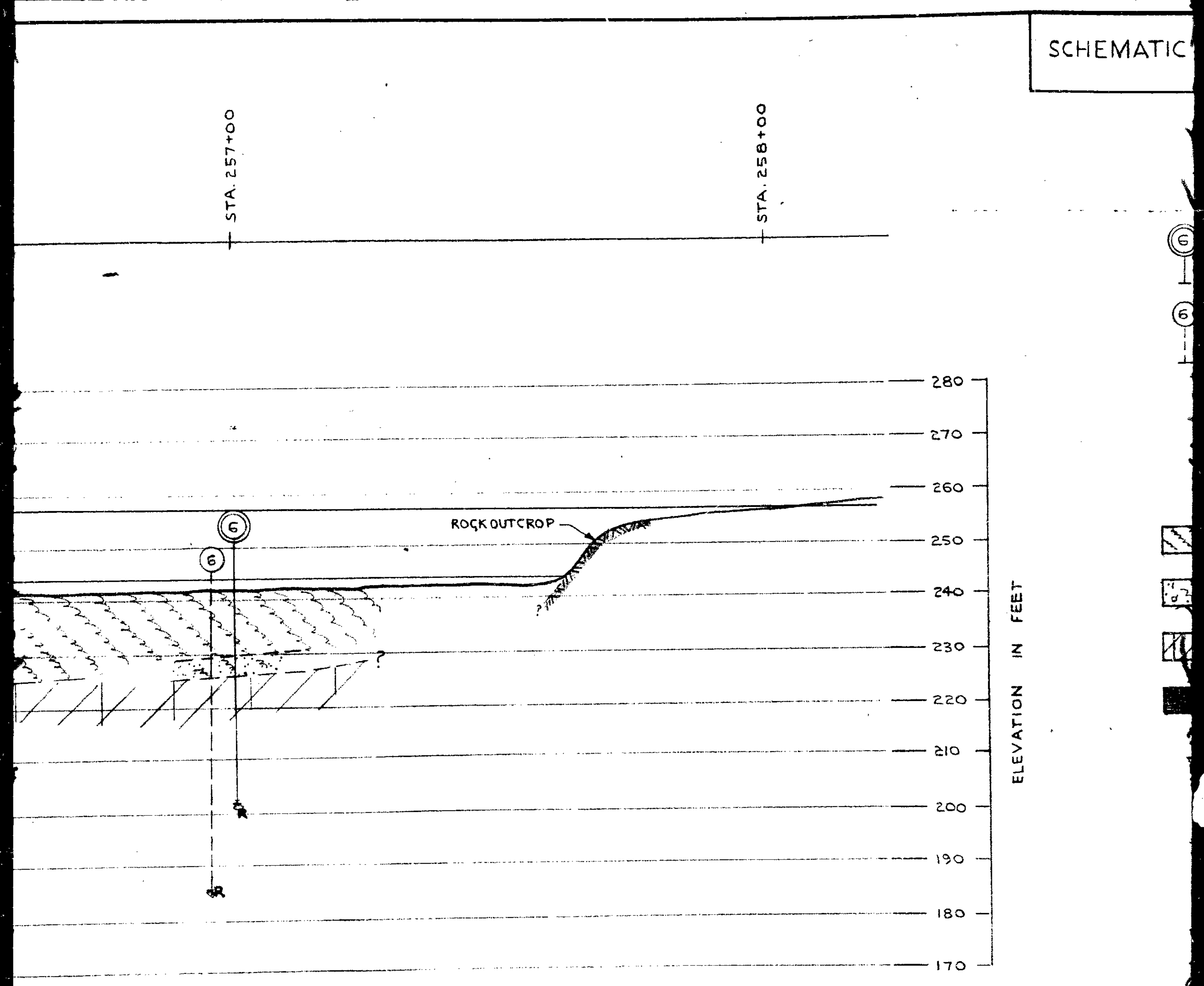
SCHEMATIC SOIL SECTION ALONG CENTR

SCALE 1" TO 20'



ONG CENTRELINE OF HIGHWAY 401 - LINE G

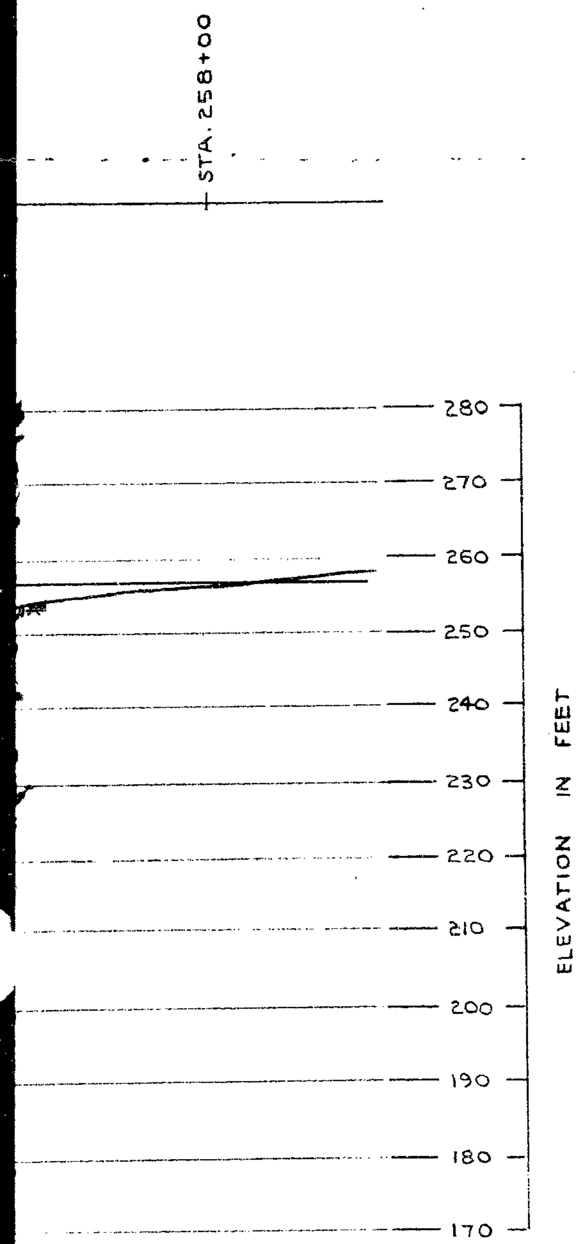
SCALE 1" TO 20'-0"



REFERENCE. DEPARTMENT OF HIGHWAYS, ONTARIO PLAN - E - 4139 - 1
PROPOSED CROSSING AT JONES CR. & PROPOSED REV'N.
OF HIGHWAY 401 - LINE G - TWP. OF FRONT OF YONGE,
COUNTY OF LEEDS - DATED: SEPT. 1962.

SCHEMATIC SOIL SECTION

FIGURE 2



LEGEND

(6) BOREHOLE IN ELEVATION

(6) PENETRATION TEST IN ELEVATION

STRATIGRAPHY

BROWN FIBROUS **MUSKEG** WITH SOME PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH

LOOSE TO COMPACT GREY **SAND**. SOME GRAVEL & SHELLS IN BOREHOLE 5, SOME LAYERS OF MUSKEG IN BOREHOLE 6.

LAYERED **SILTY CLAY AND CLAYEY SILT**. OCCASIONAL THIN (GENERALLY LESS THAN 1/8 INCHES) SAND LAYERS OR LENSES WITH INCREASING DEPTH. STRATUM GENERALLY SOFT TO STIFF

BEDROCK. GENERALLY SOUND LIGHT GREY CRYSTALLINE LIMESTONE IN BOREHOLE 4. HARD GREY-GREEN METAMORPHOSED CRYSTALLINE ROCK IN BOREHOLES 2 AND 3.

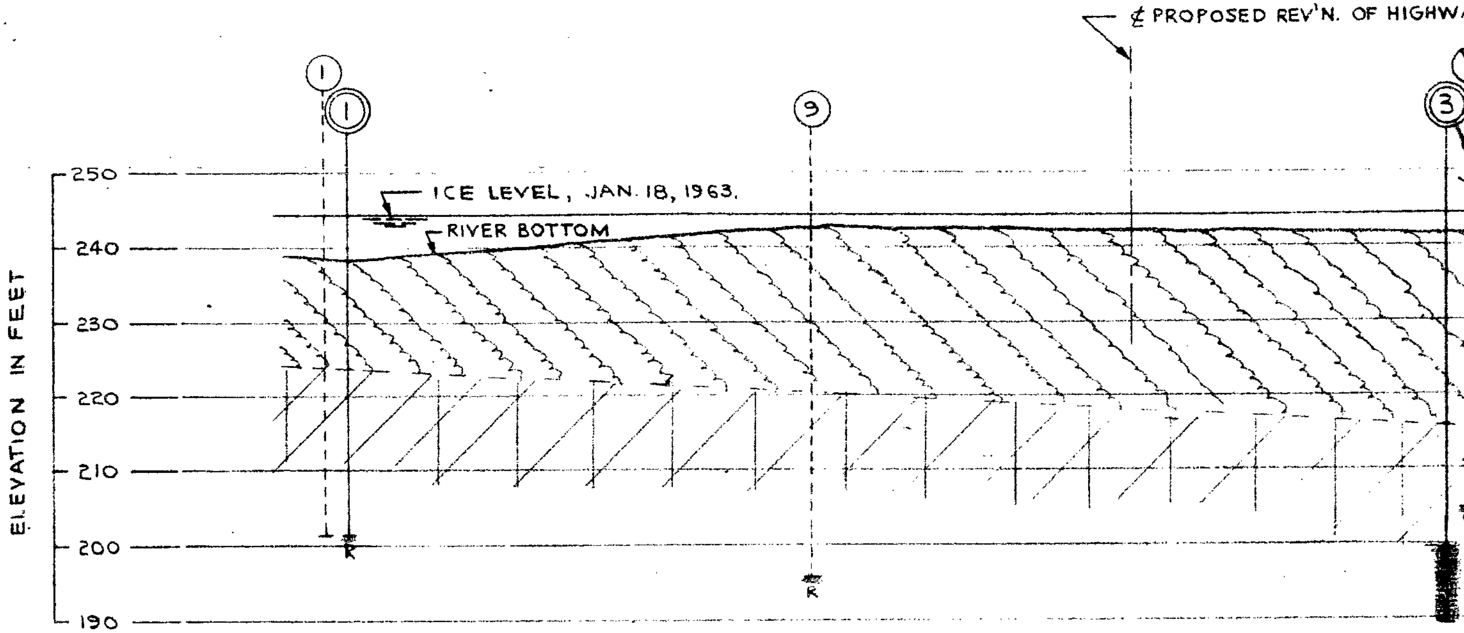
R **REFUSAL**, PROBABLY BOULDE OR BEDROCK

YS, ONTARIO PLAN-E-4139-1
ONES CR & PROPOSED REV'N.
TWP. OF FRONT OF YONGE,
: SEPT. 1962.

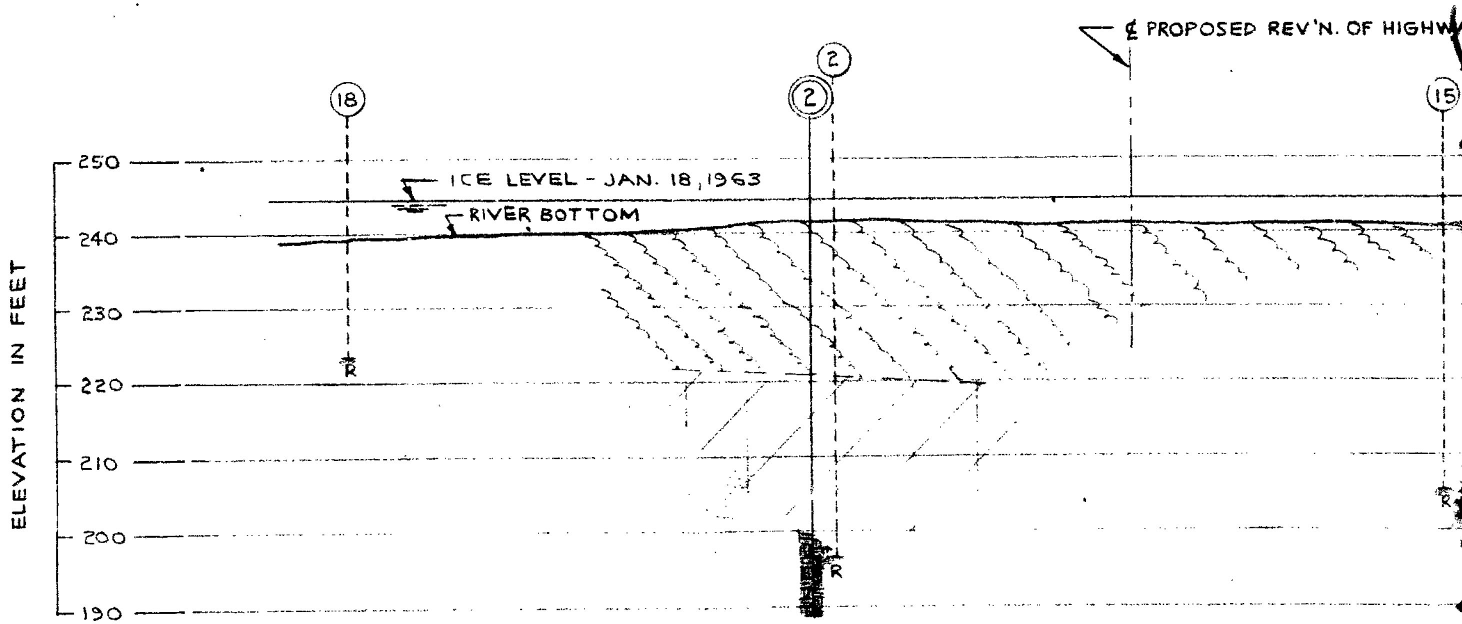
31B - 8
GEOCRES No.

GOLDER & ASSOCIATES

Made M.W.
Chkd.
Appd.



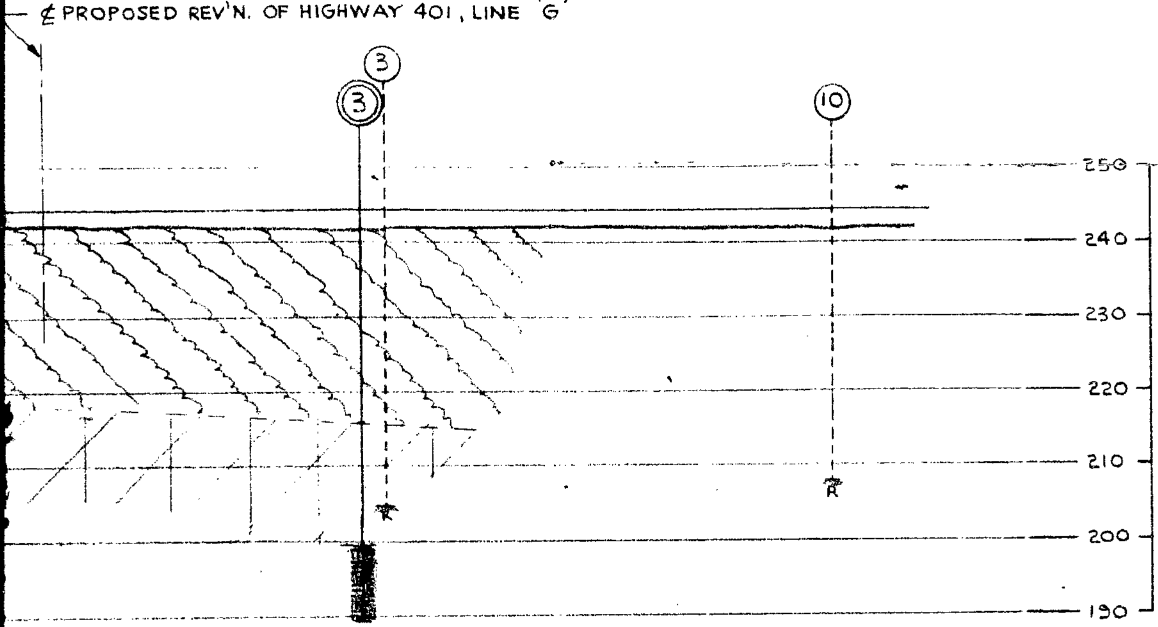
SECTION A-A



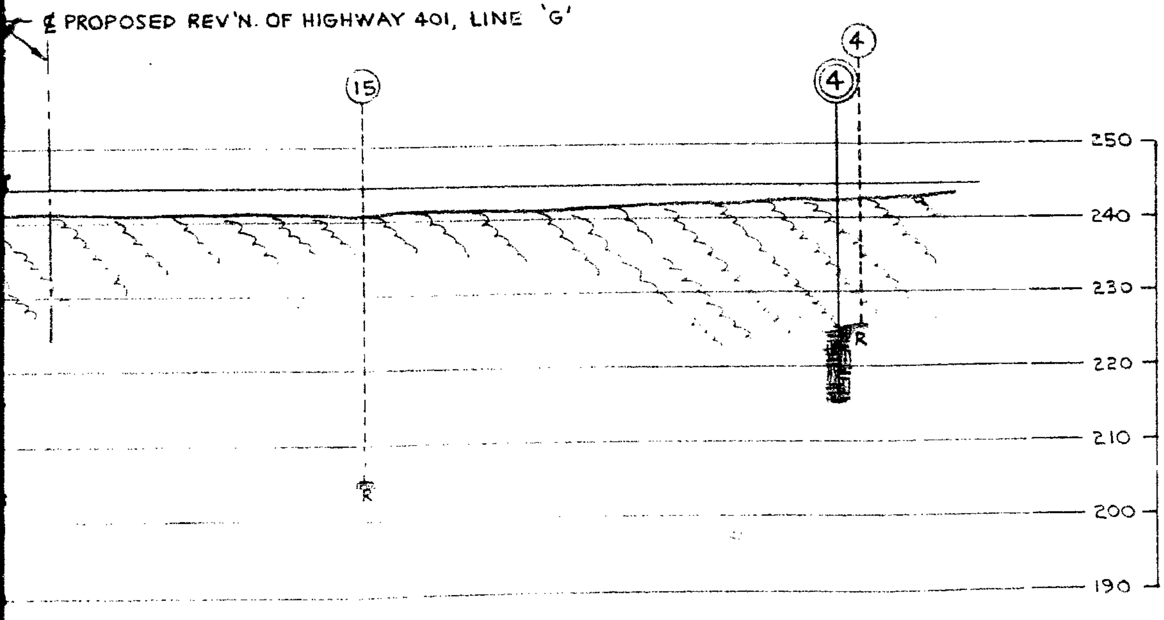
SECTION B-B

INFERRED S

SECTIO



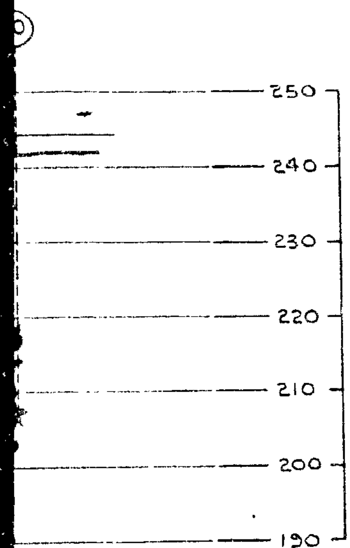
ON A-A

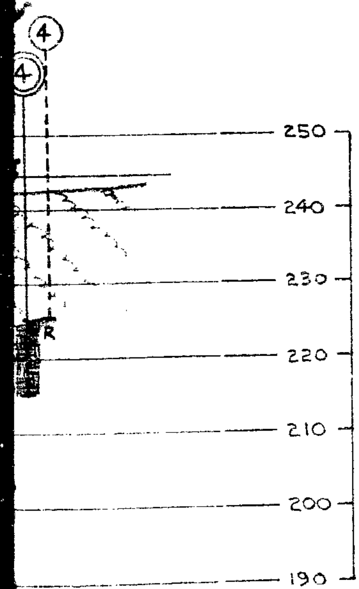


ON B-B

INFERRED SOIL STRATIGRAPHY
SECTIONS A-A & B-B

FIGURE 3





LEGEND

BOREHOLE IN ELEVATION

PENETRATION TEST IN ELEVATION

STRATIGRAPHY

BROWN FIBROUS **MUSKEG** WITH PIECES OF WOOD AND OCCASIONAL SAND LAYERS OR LENSES WITH INCREASING DEPTH

LAYERED **SILTY CLAY AND CLAYEY SILT**. OCCASIONAL THIN (GENERALLY LESS THAN 1/8 INCHES) SAND LAYERS OR LENSES WITH INCREASING DEPTH. STRATUM GENERALLY SOFT TO STIFF

BEDROCK - GENERALLY SOUND LIGHT GREY CRYSTALLINE LIMESTONE IN BOREHOLE 4. HARD GREY-GREEN METAMORPHOSED CRYSTALLINE ROCK IN BOREHOLES 2 AND 3.

REFUSAL, PROBABLY BOULDER OR BEDROCK.

SPECIAL NOTE: DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDANCE AND SO MAY VARY FROM THAT SHOWN.

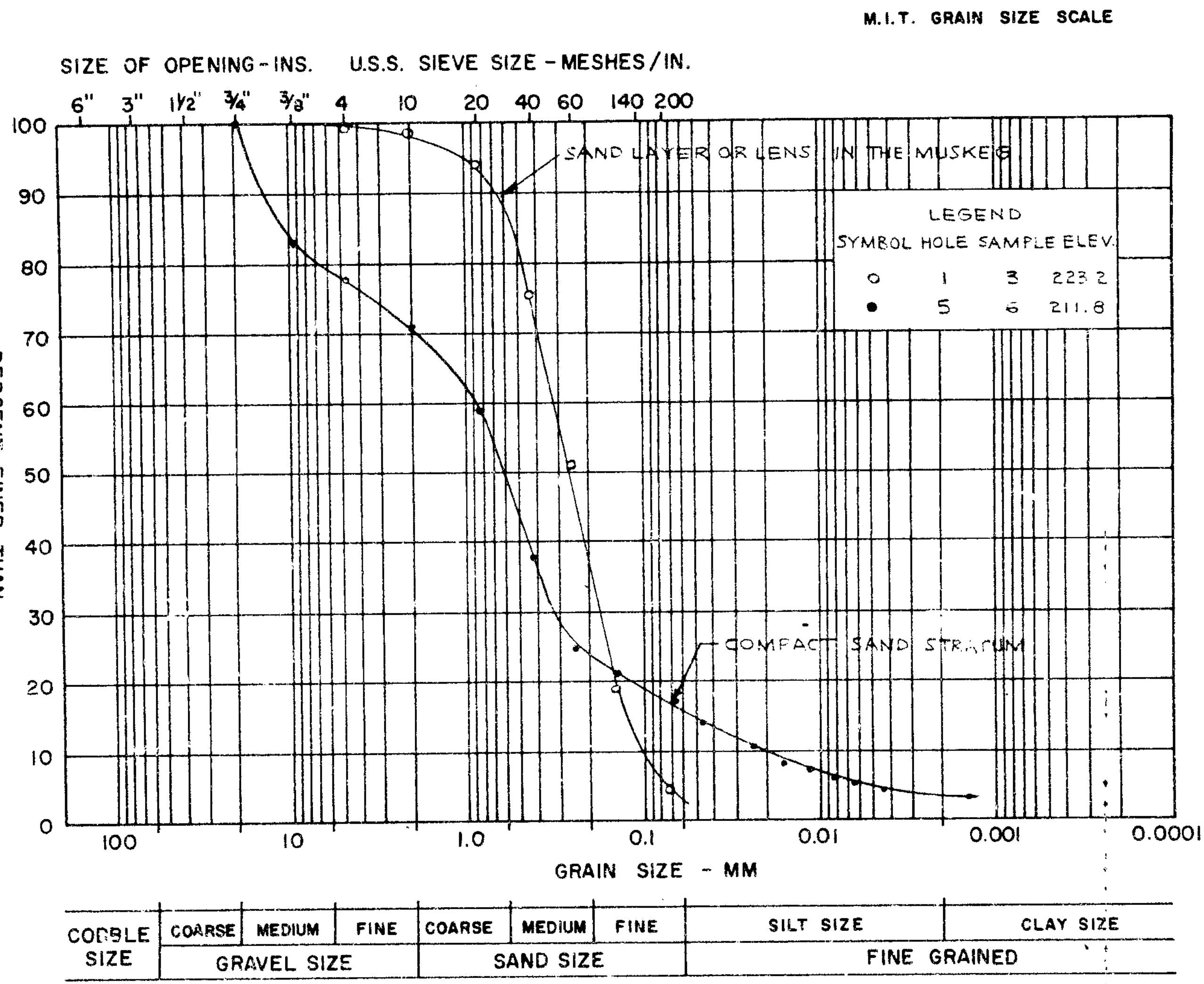
31B-8
GEOCRES No.

SCALE 1" TO 20'-0"

GOLDER & ASSOCIATES

Made M.W.
Chkd. [illegible]
Appd. [illegible]

PROJECT No. 6264



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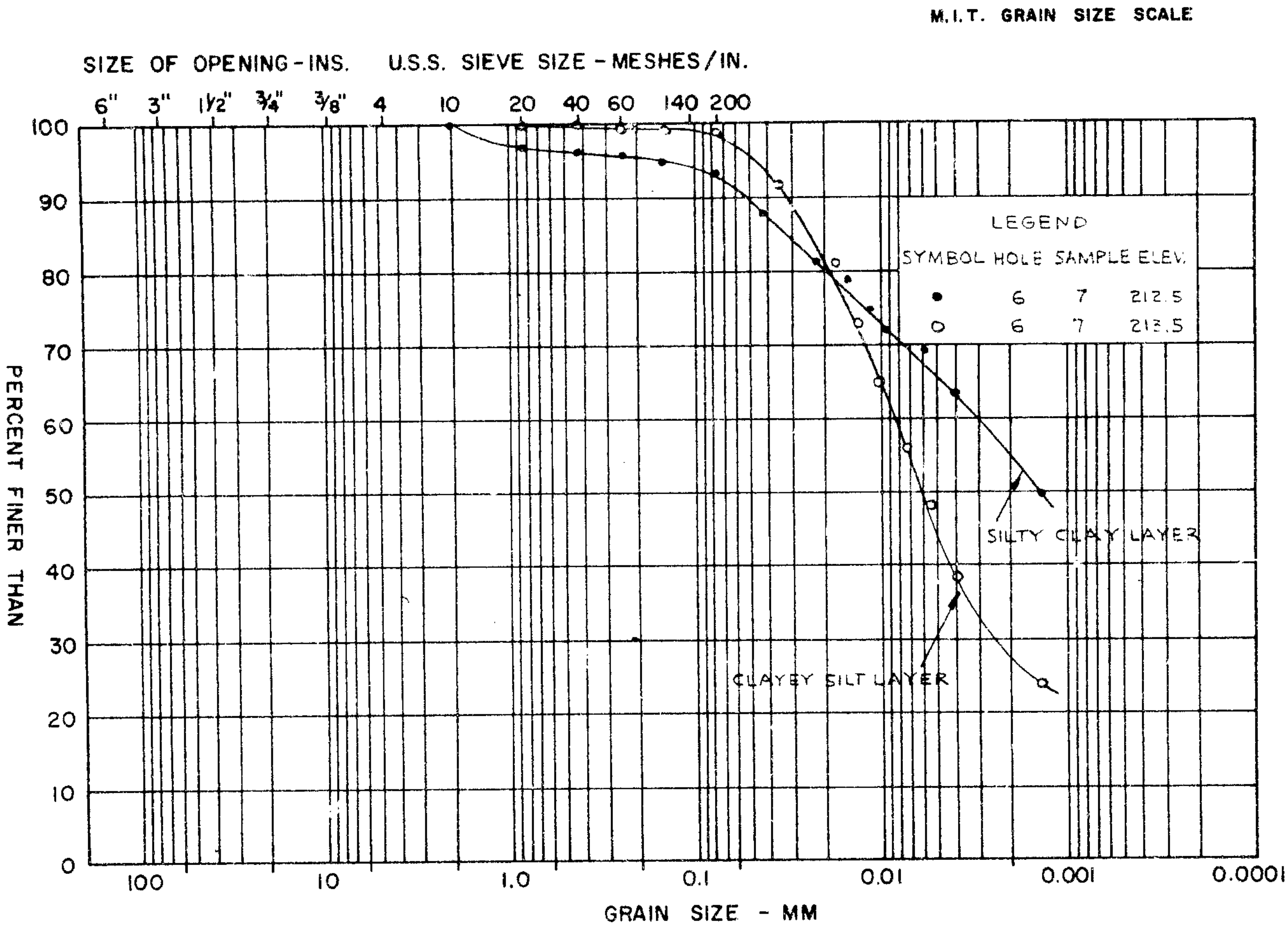
GRAIN SIZE DISTRIBUTION

FIGURE 4

PROJECT No. 6264

GRAIN SIZE DISTRIBUTION

LAYERED SILTY CLAY & CLAYEY SILT



COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

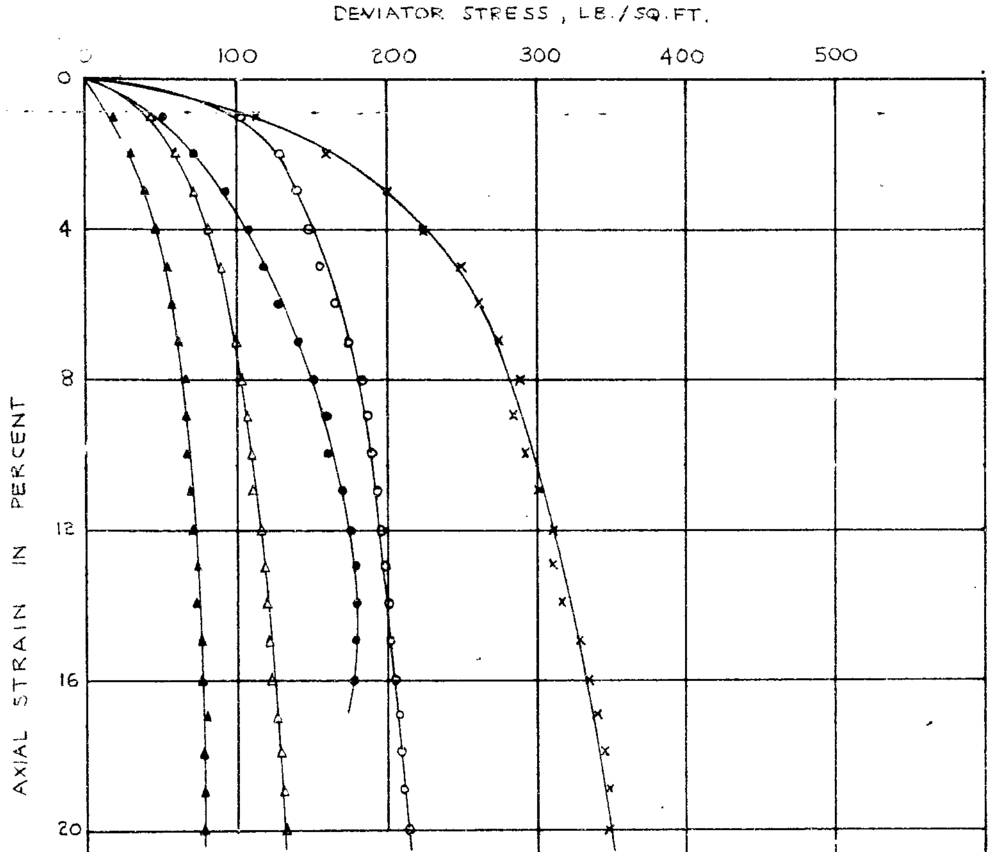
GOLDER & ASSOCIATES

FIGURE 5

PROJECT No. 6264

UNDRAINED TRIAXIAL COMPRESSION TESTS
TYPICAL STRESS - STRAIN CURVES
MUSKEG

FIGURE 6



LEGEND

SYMBOL	HOLE	SAMPLE	DEPTH	ELEVATION
●	1	1	11.2	233.0
○	1	3	21.2	223.0
×	2	3	21.7	222.5
▲	4	2	10.7	233.5
△	5	2	10.7	233.5

GOLDER & ASSOCIATES

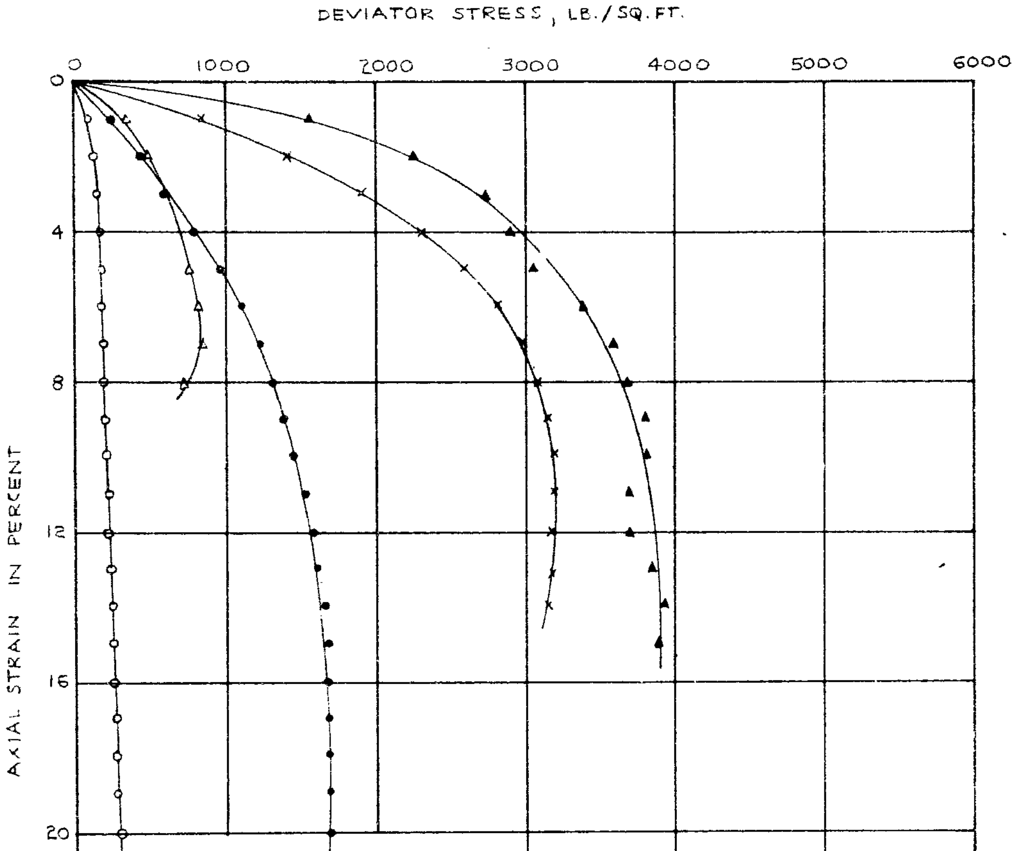
PROJECT No. 6264

UNDRAINED TRIAXIAL COMPRESSION TESTS

TYPICAL STRESS - STRAIN CURVES

LAYERED SILTY CLAY & CLAYEY SILT

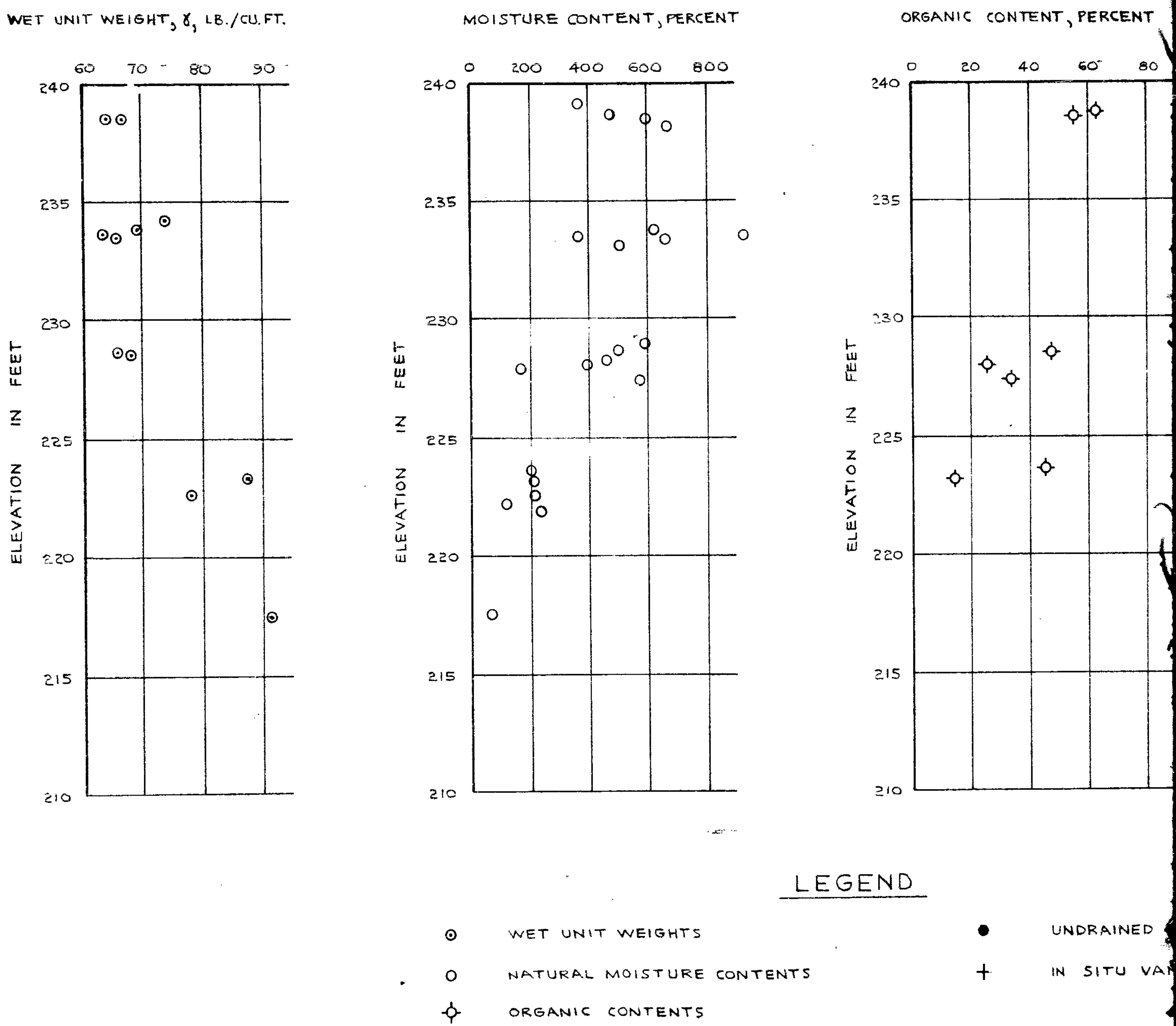
FIGURE 1



LEGEND

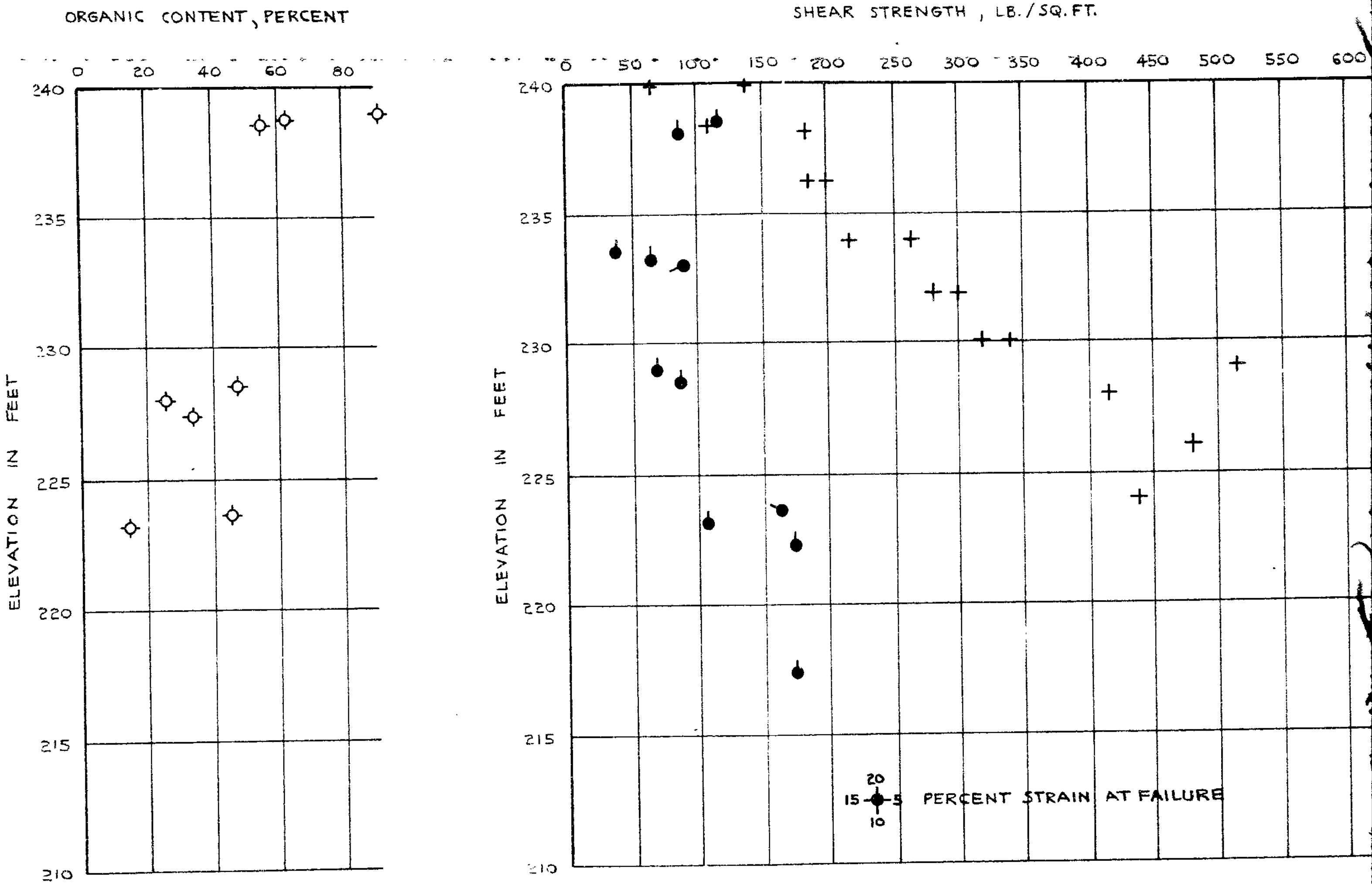
SYMBOL	HOLE	SAMPLE	DEPTH	ELEVATION
●	1	5	31.2	213.0
○	3	8	41.7	202.5
×	5	7	36.2	208.0
▲	6	5	20.7	223.5
△	6	7	30.7	213.5

GOLDER & ASSOCIATES



WET UNIT WEIGHT, γ, LB./CU.FT.
60 70 80 90
MOISTURE CONTENT, PERCENT
0 200 400 600 800
ORGANIC CONTENT, PERCENT
0 20 40 60 80
ELEVATION IN FEET
240 235 230 225 220 215 210
LEGEND
WET UNIT WEIGHTS
NATURAL MOISTURE CONTENTS
ORGANIC CONTENTS
UNDRAINED
IN SITU VA

SUMMARY OF MUSKEG PROPERTIES



LEGEND

ENTS

● UNDRAINED TRIAXIAL TESTS

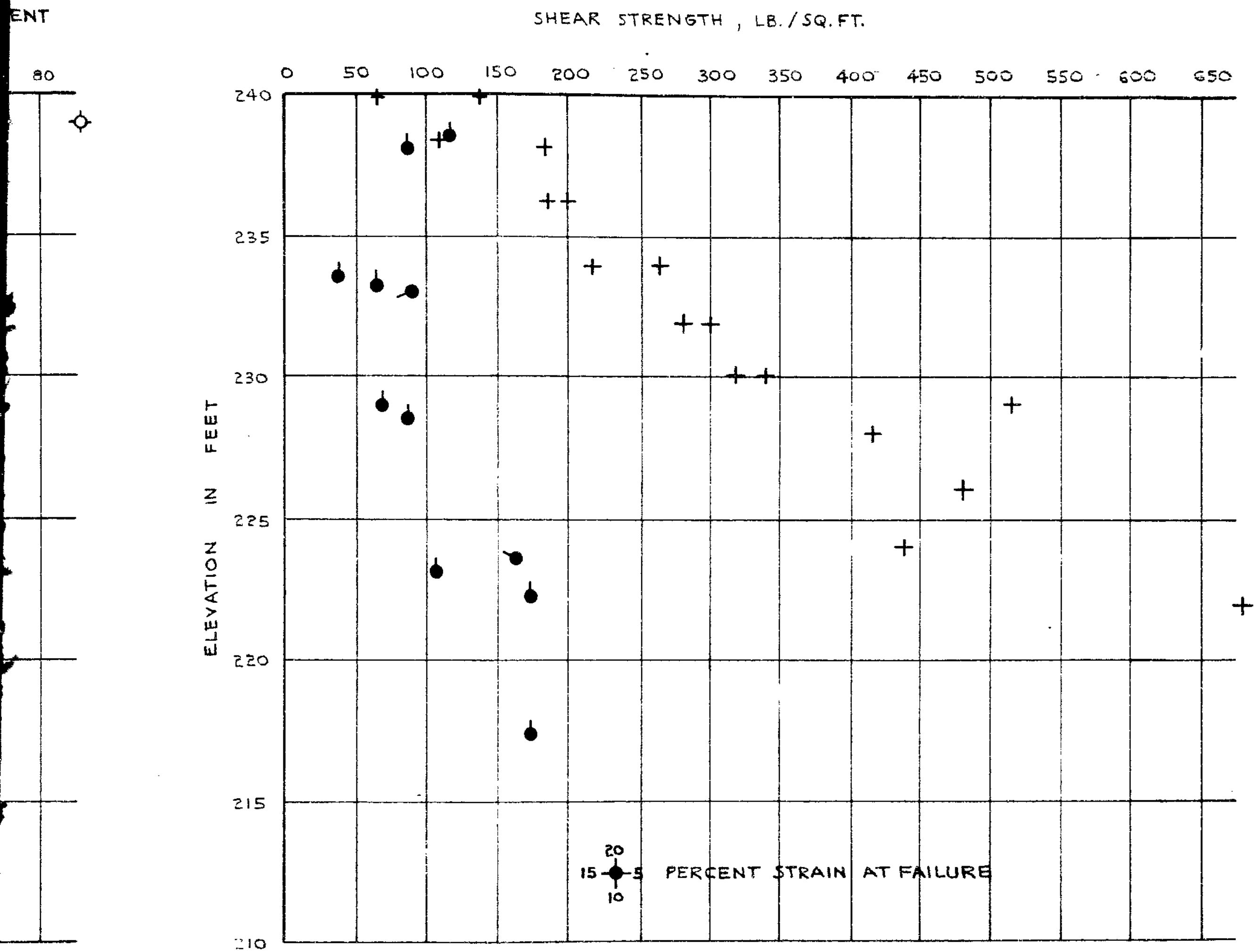
+ IN SITU VANE TESTS

NOTE: IN SITU VANE SHEAR VALUES ARE CO
TO BE HIGH DUE TO THE FIBROUS STR
THE MUSKEG.

GOLDER & ASSOCIATES

SUMMARY OF MUSKEG PROPERTIES

FIGURE 8



NOTE: IN SITU VANE SHEAR VALUES ARE CONSIDERED TO BE HIGH DUE TO THE FIBROUS STRUCTURE OF THE MUSKEG.

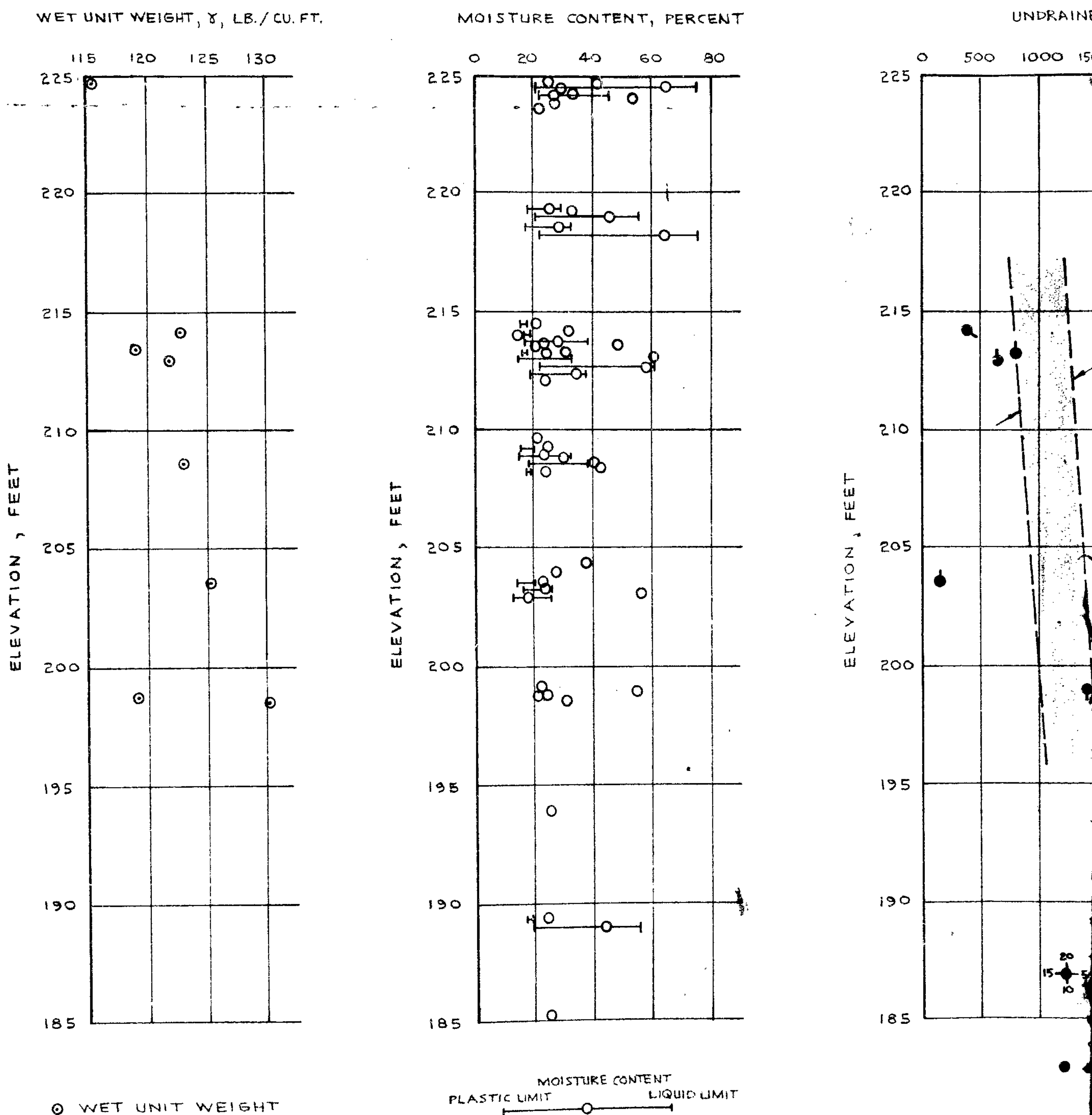
NED TRIAXIAL TESTS

U VANE TESTS

GOLDER & ASSOCIATES

Made M.W.
Chkd
Appd

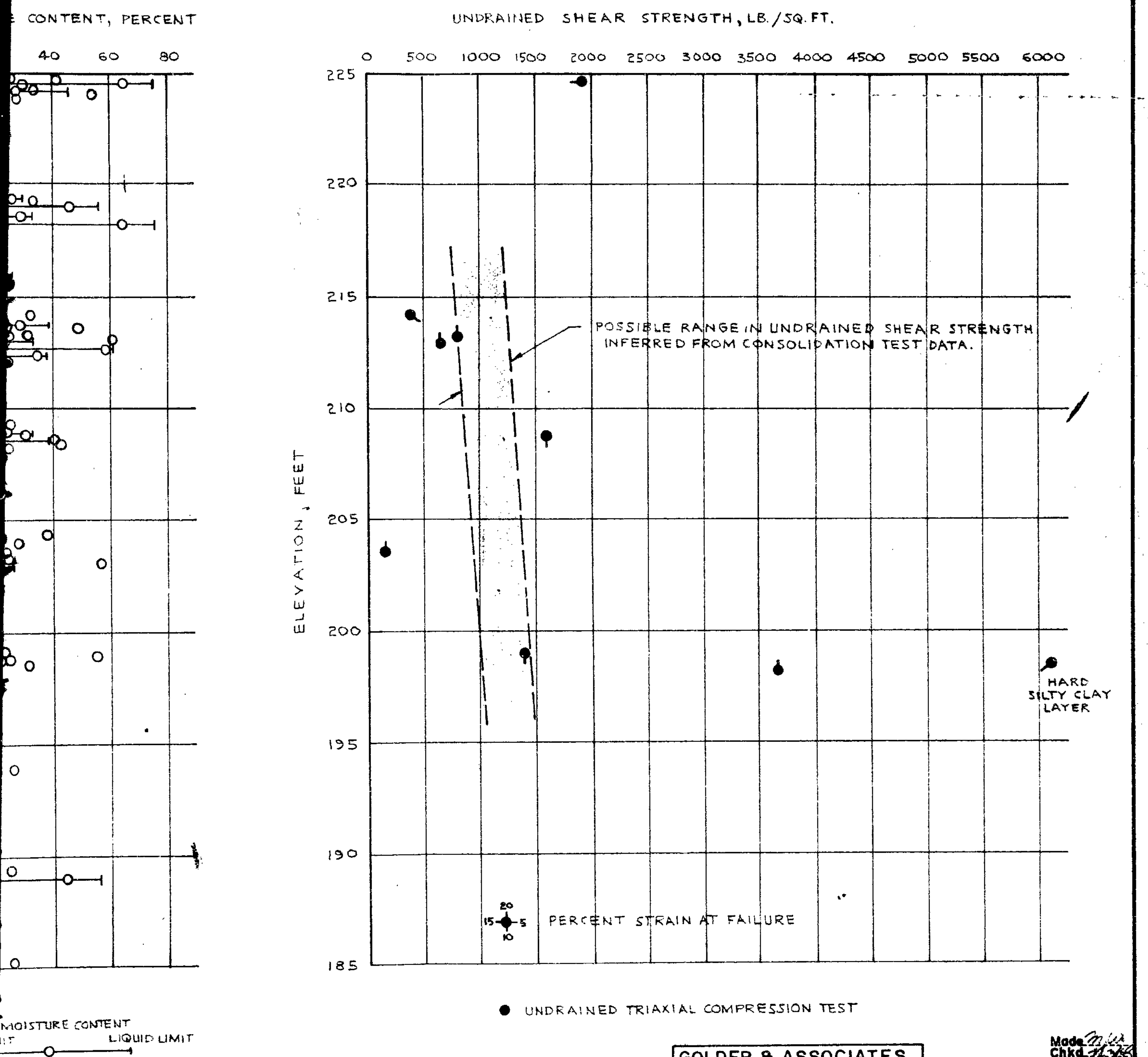
SUM
LAY


WET UNIT WEIGHT, γ, LB./CU. FT.
115 120 125 130
225 220 215 210 205 200 195 190 185
ELEVATION, FEET
⊙ WET UNIT WEIGHT
MOISTURE CONTENT, PERCENT
0 20 40 60 80
ELEVATION, FEET
MOISTURE CONTENT
PLASTIC LIMIT
LIQUID LIMIT
UNDRAINE
0 500 1000
ELEVATION, FEET

SUMMARY OF PROPERTIES

LAYERED SILTY CLAY & CLAYEY SILT

FIGURE 9



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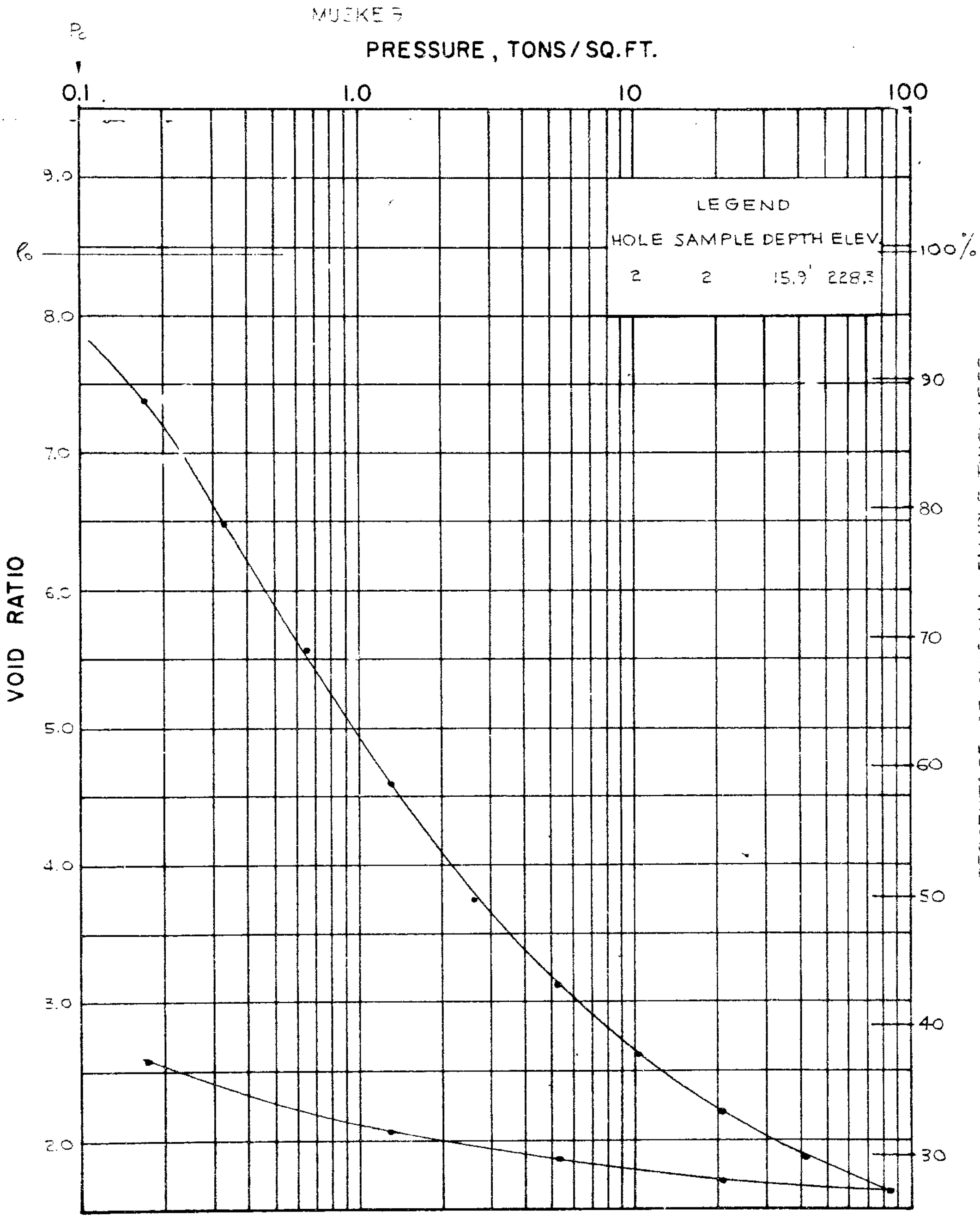
Made
Chkd.
Appd.

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 10



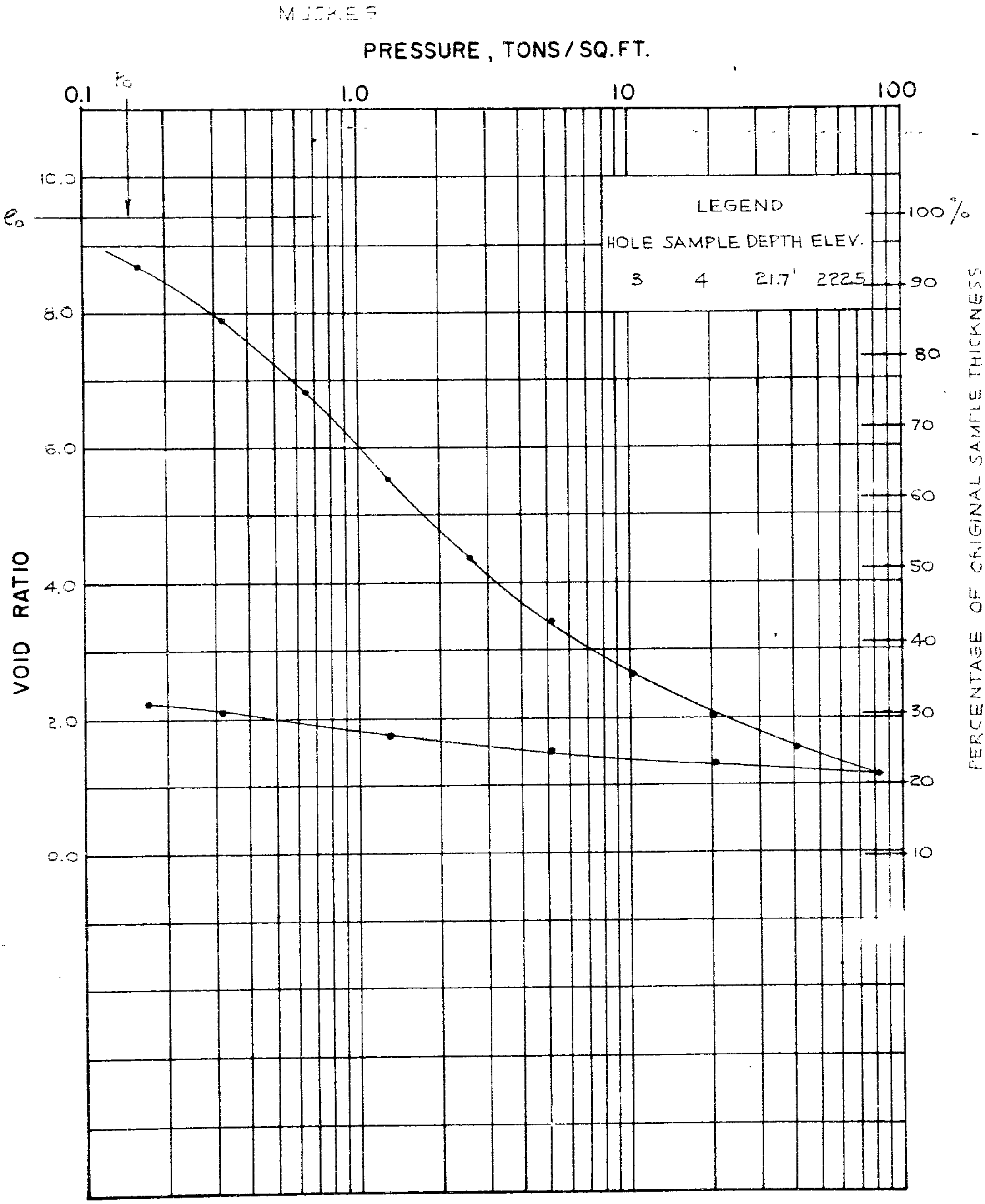
GOLDER & ASSOCIATES

PROJECT No.

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 11

PROJECT No. 6264

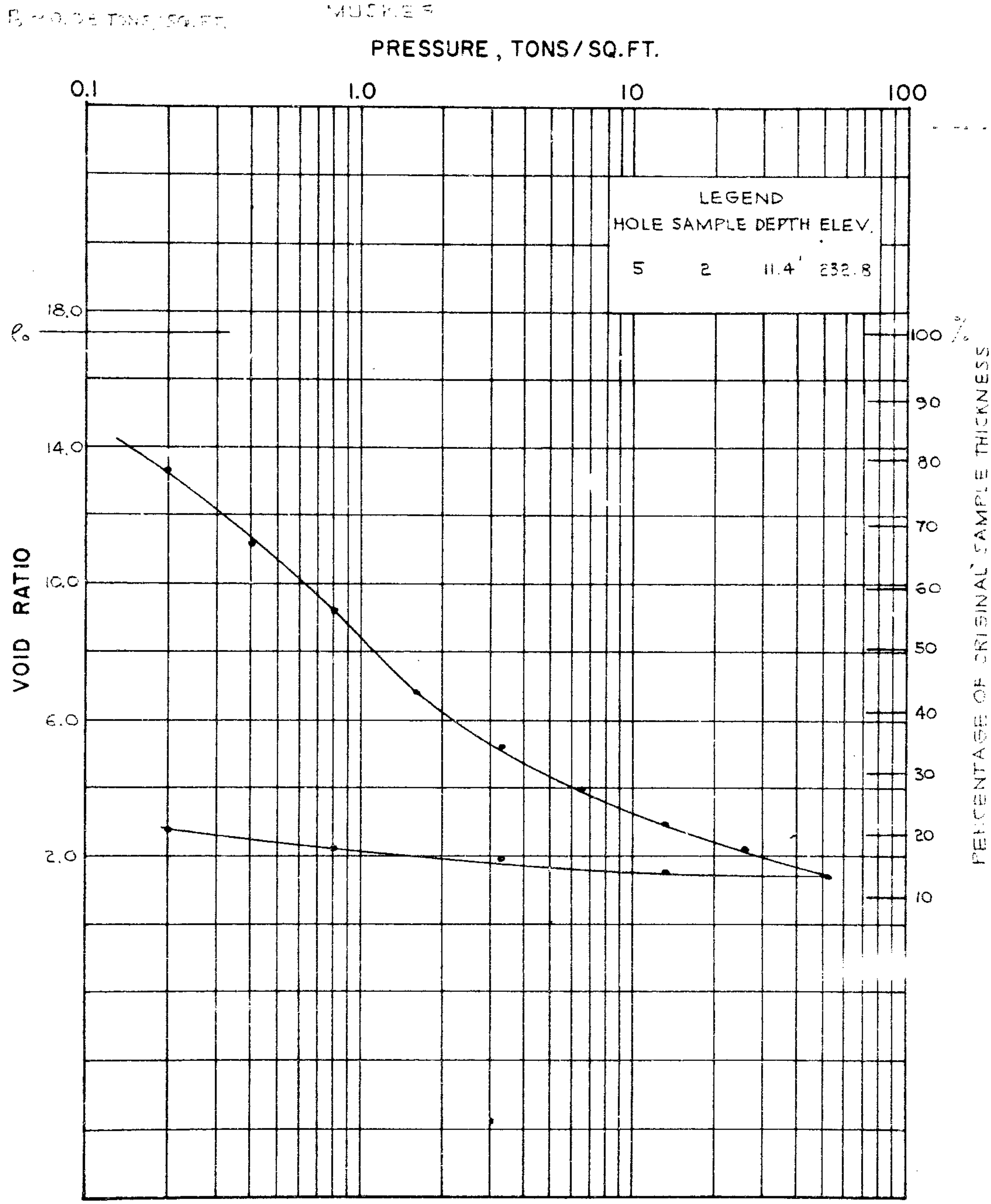


GOLDER & ASSOCIATES

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 12

PROJECT No. ....



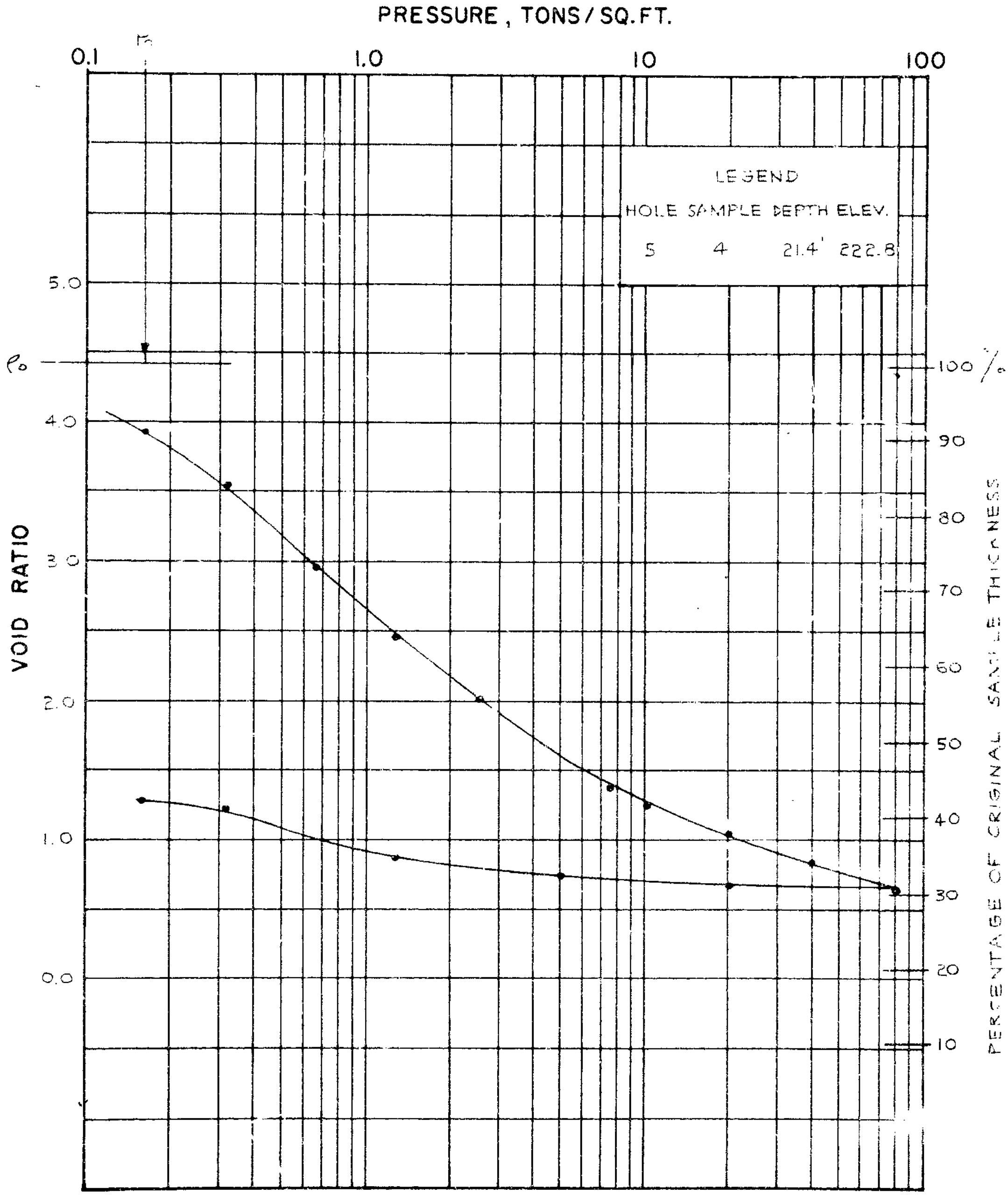
GOLDER & ASSOCIATES

PROJECT No. 6264

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 13

MUSKEG

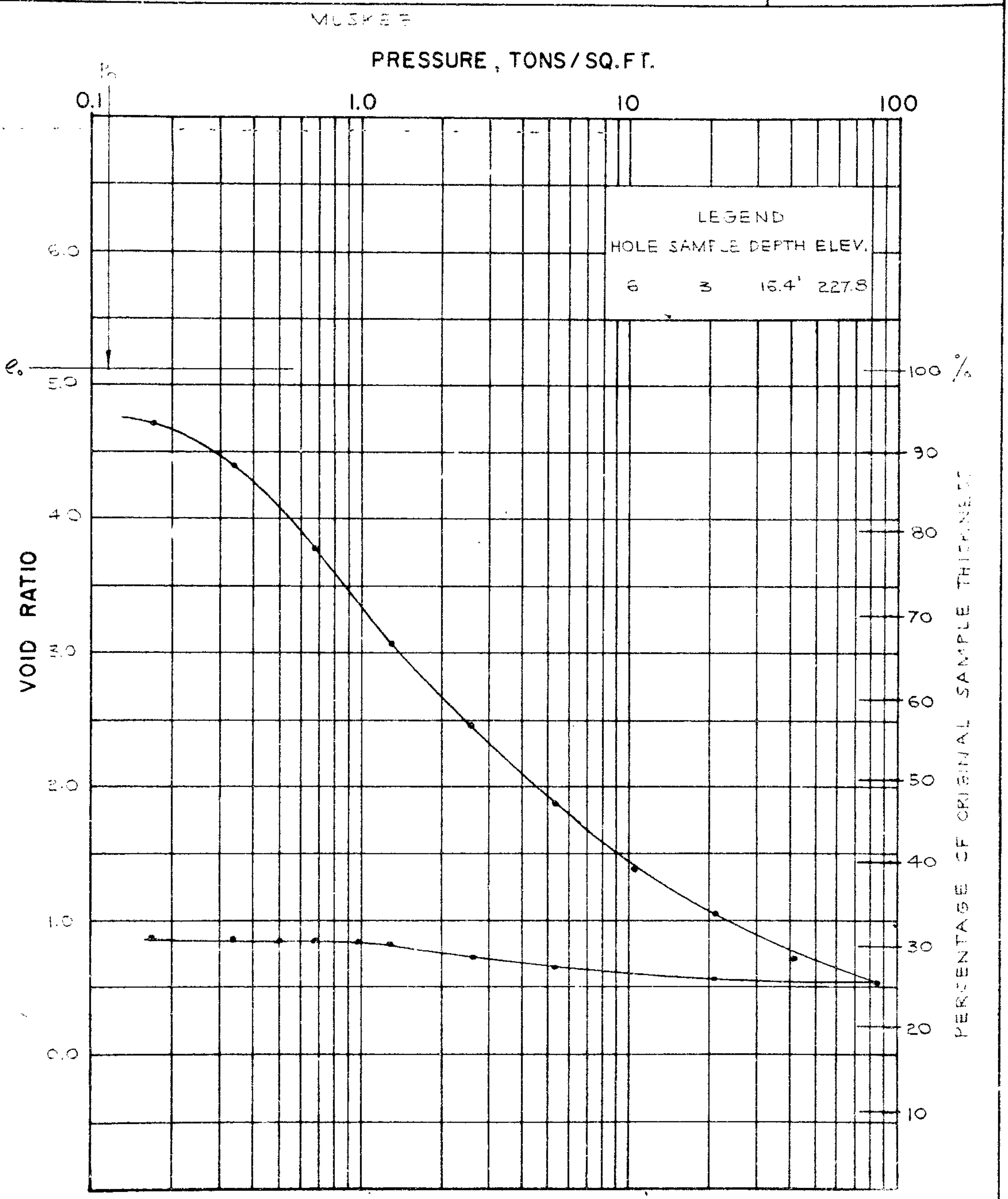


GOLDER & ASSOCIATES

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 14

PROJECT No. 6051

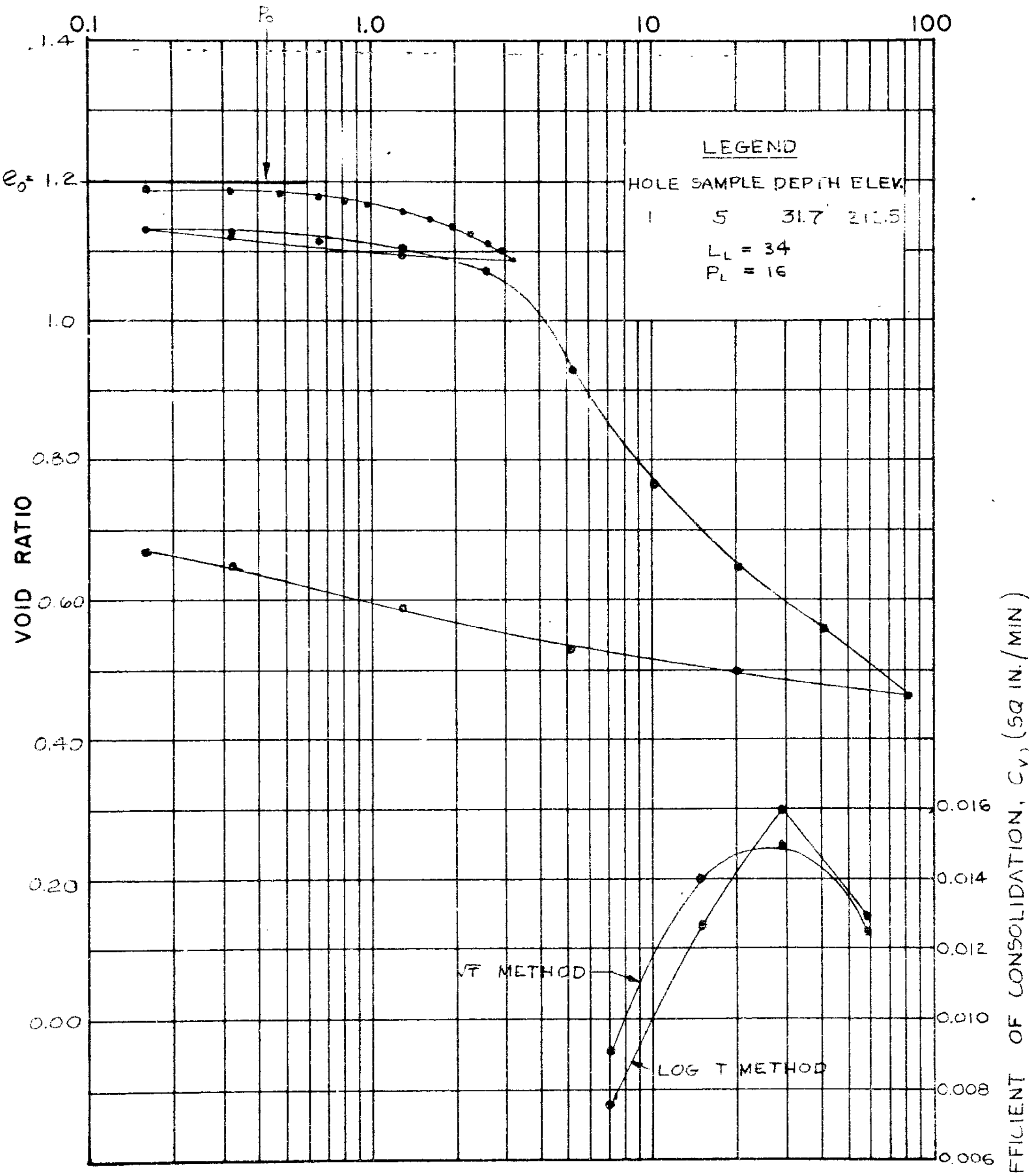


GOLDER & ASSOCIATES

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 15

PROJECT No. 6264



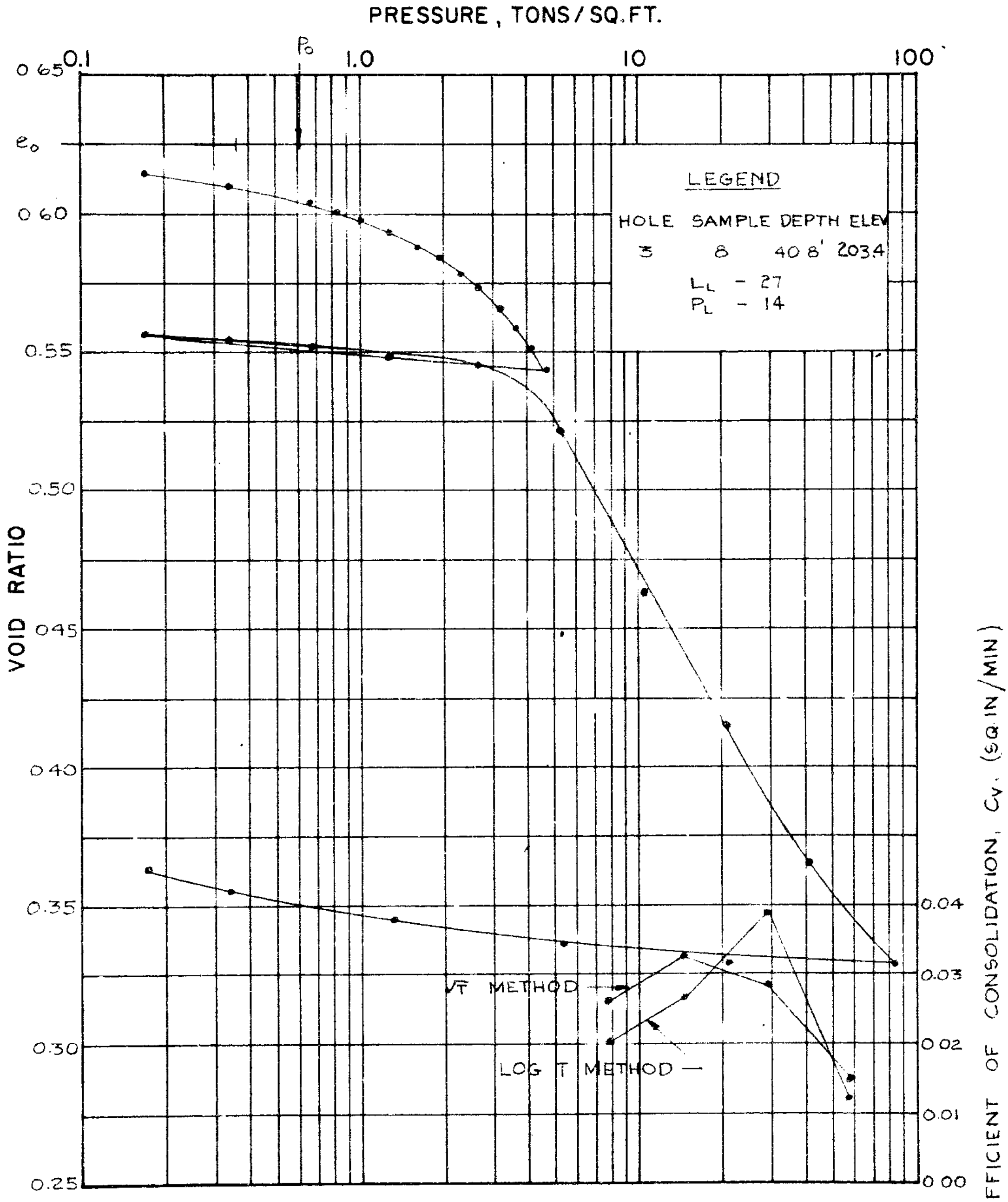
NOTE: SAMPLE AT MID THICKNESS OF CLAYEY STRATUM.

GOLDER & ASSOCIATES

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 16

LAYERED SILTY CLAY & CLAYEY SILT STRATUM - CLAYEY SILT LAYER



NOTE: SAMPLE FROM LOWER PORTION OF CLAYEY STRATUM.

GOLDER & ASSOCIATES

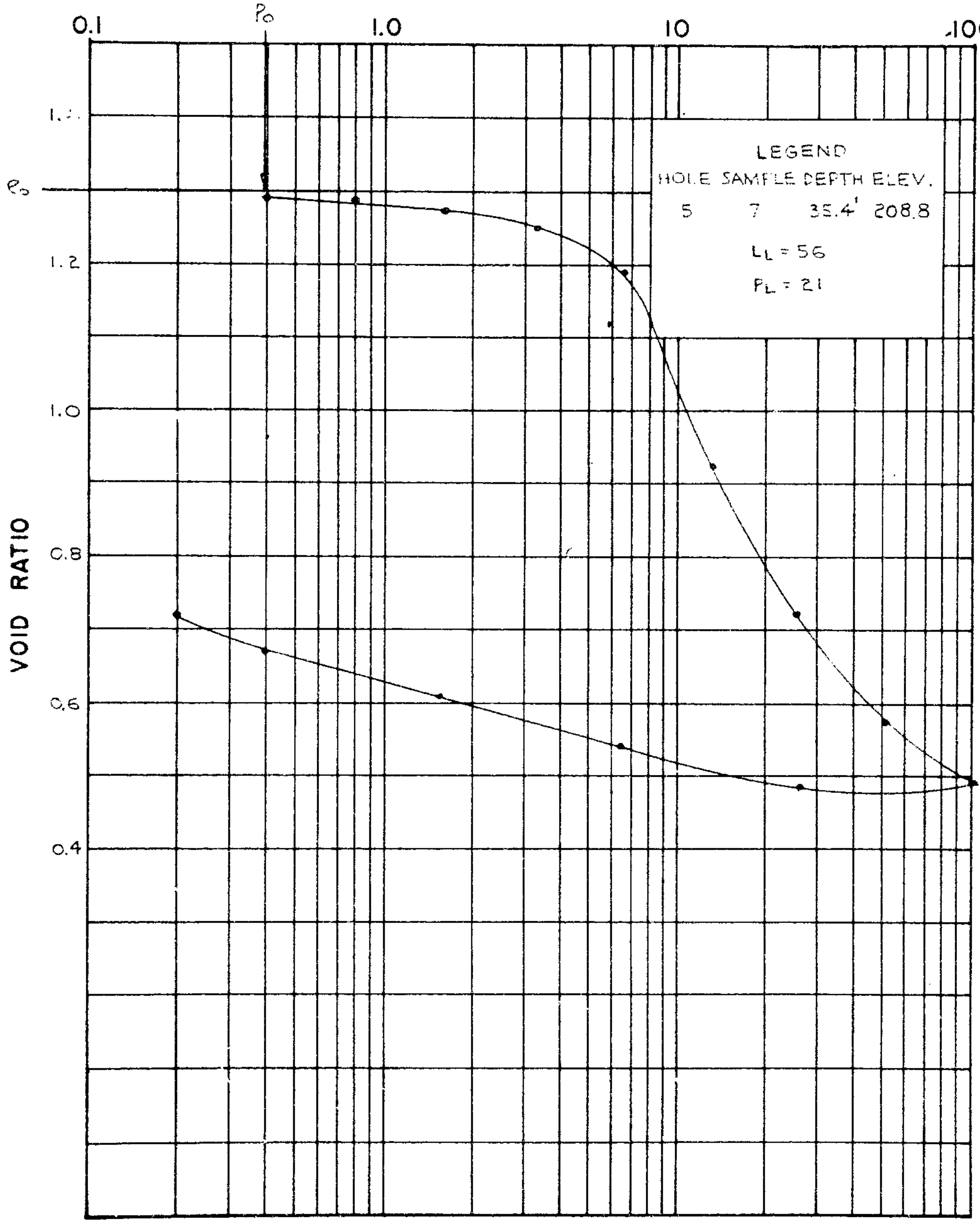
PROJECT No. 6264

VOID RATIO - PRESSURE CURVES
CONSOLIDATION TEST

FIGURE 17

LAYERED SILTY CLAY & CLAYEY SILT STRATUM - SILTY CLAY LAYER

PRESSURE, TONS / SQ.FT.



NOTE: SAMPLE CLOSE TO UPPER SURFACE OF CLAYEY STRATUM.

GOLDER & ASSOCIATES

GOLDER & ASSOCIATES

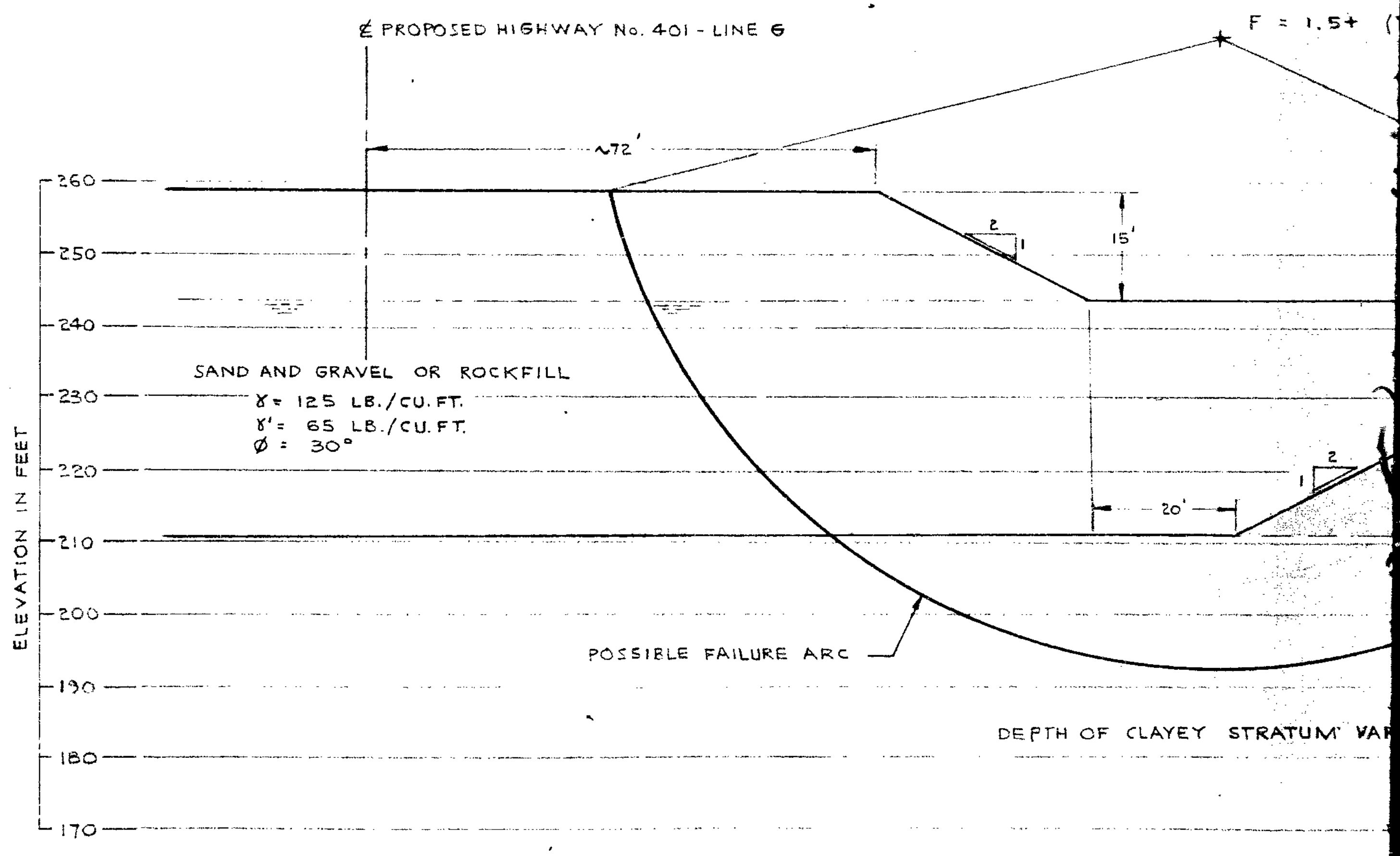
CONSOLIDATION TESTS - SUMMARY OF RESULTS

Layered Silty Clay and Clayey Silt

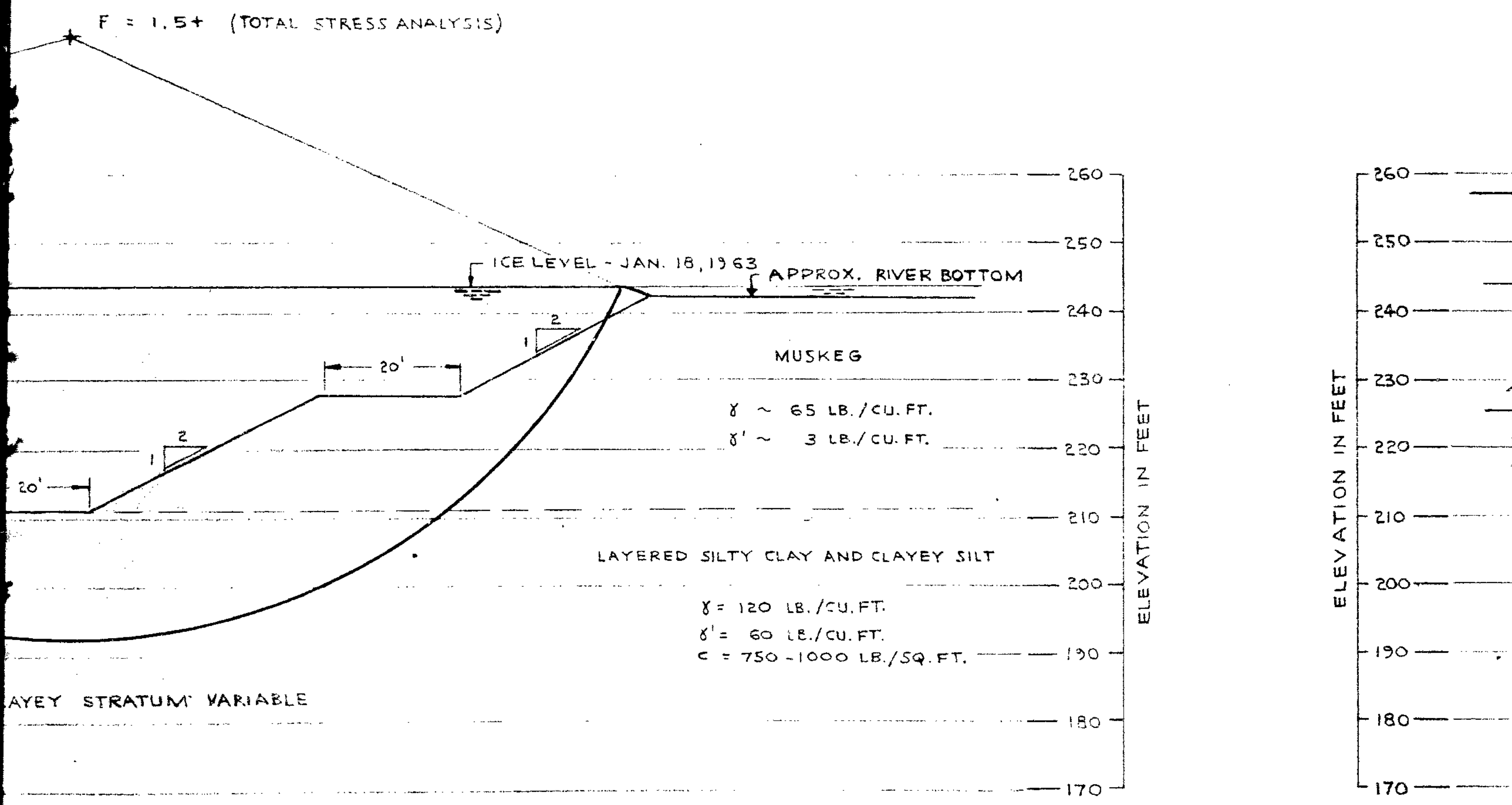
	BH	SA	Depth, ft.	Elevation	L_L	P_L	e_o	C_c	C_{cr}
Silty Clay Layer	1	5	31.7	212.5	34	16	1.20	0.62	0.04
Clayey Silt Layer	3	8	40.8	203.4	27	14	0.62	0.20	0.01
Silty Clay Layer	5	7	35.4	208.8	56	21	1.30	0.95	-

In the above table:

L_L = Liquid Limit
P_L = Plastic Limit
e_o = Initial void ratio
C_c = Laboratory compression index
C_{cr} = Laboratory rebound compression index
Depth - Depth in feet below present ice level in Jones Creek (Elevation 244.2).

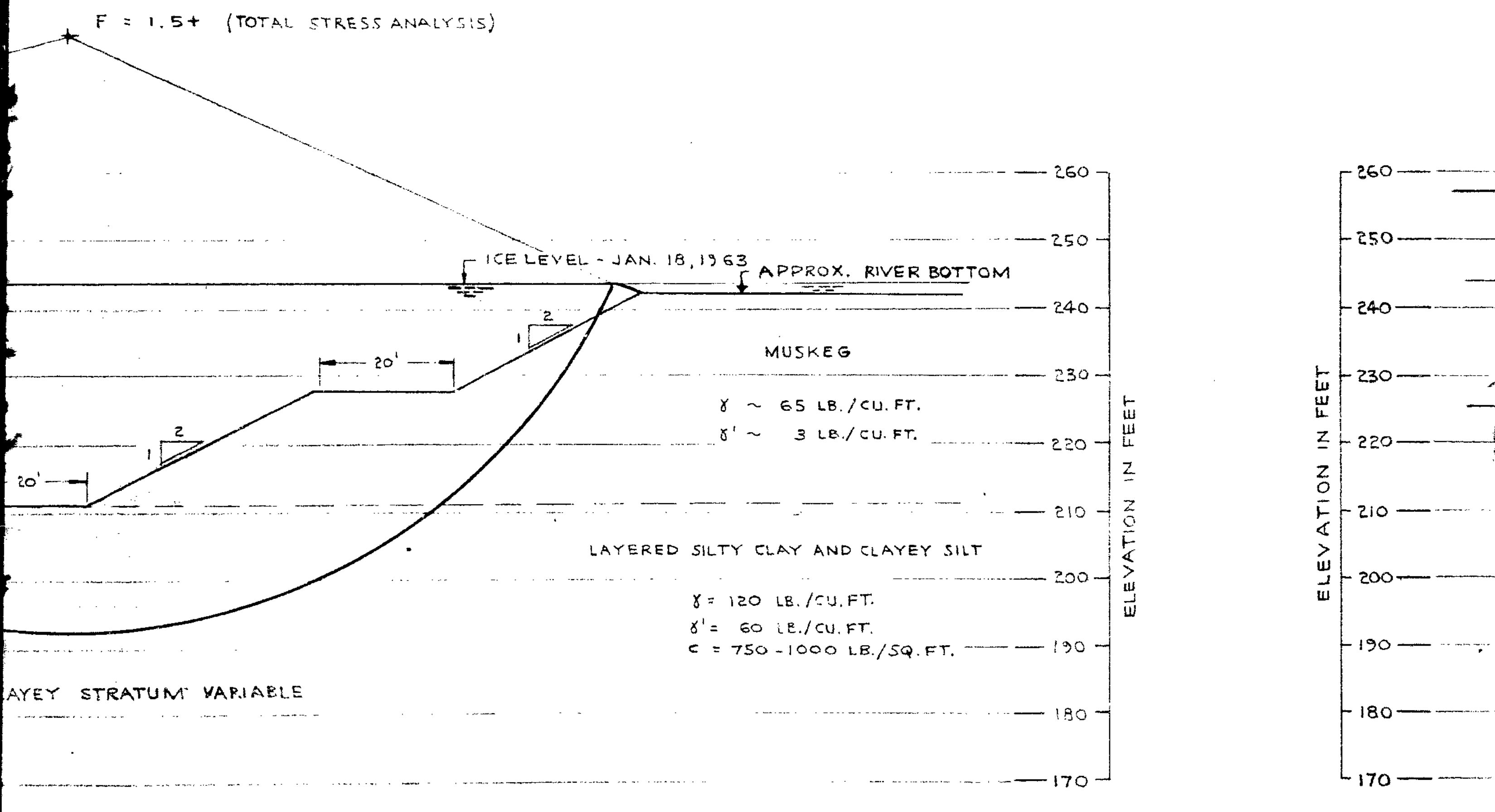


SECTION AT STATION 253+80



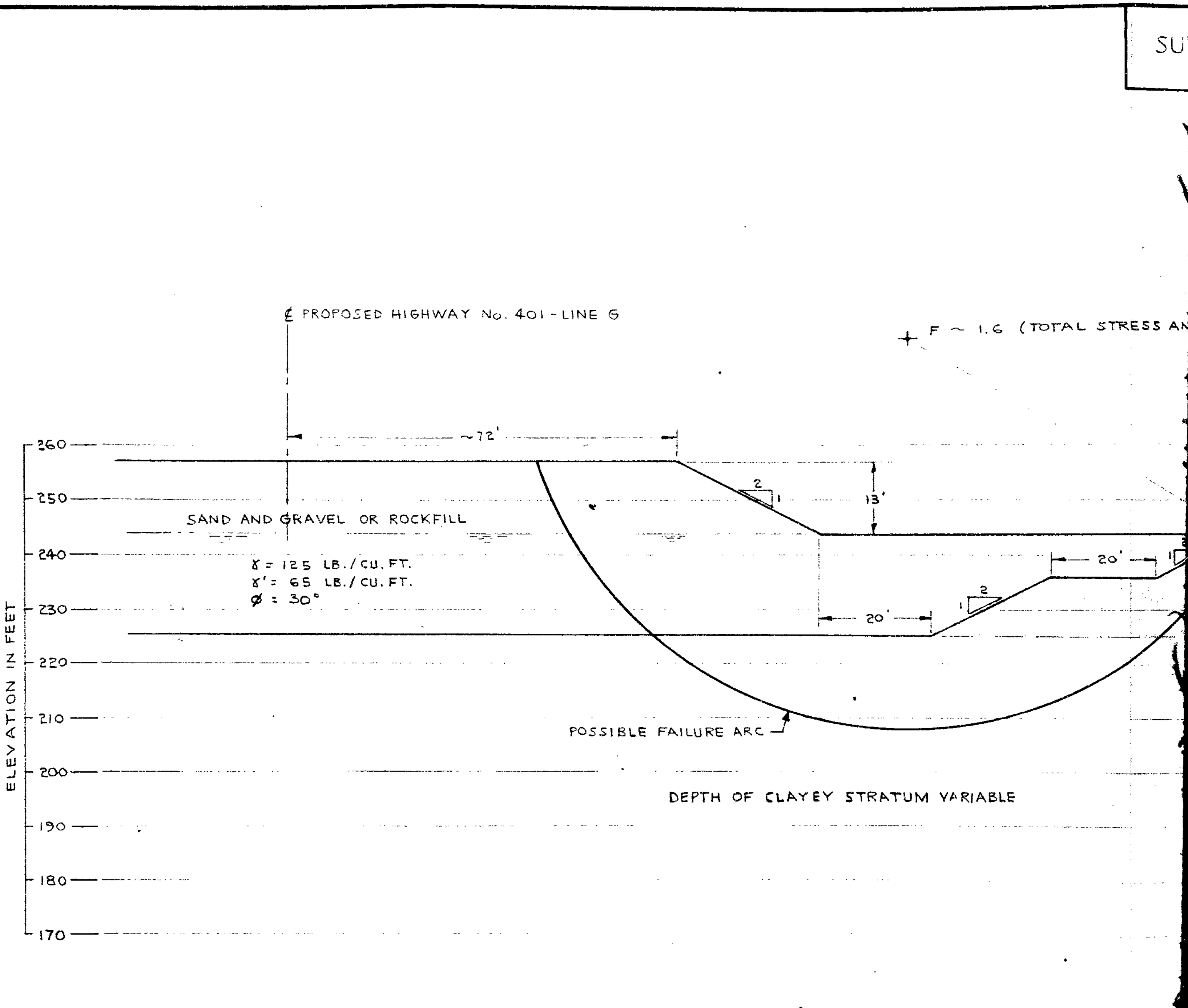
ON 253+80

SCALE 1" TO 20'-0"



ON 253+80

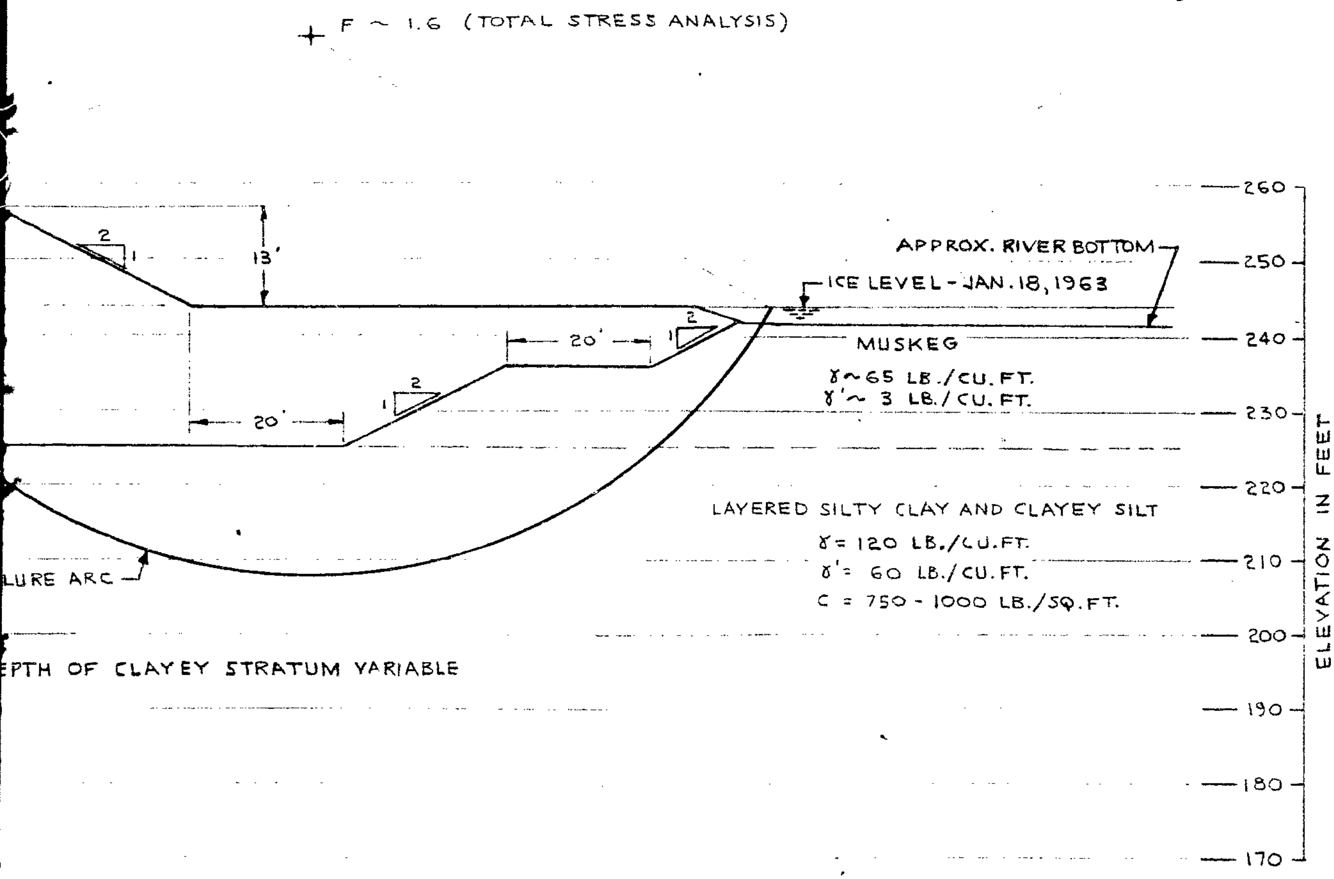
SCALE 1" TO 20'-0"



SECTION AT STATION 256+50

SUGGESTED CROSS-SECTIONS
PROPOSED CAUSEWAY

FIGURE 18



ECTION AT STATION 256+50

31B-8
GEOCRES No.

GOLDER & ASSOCIATES

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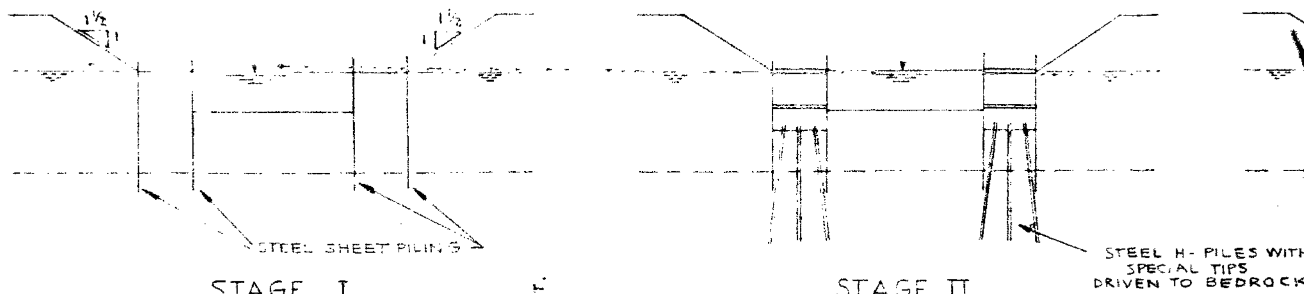
Chkd.
Appd.

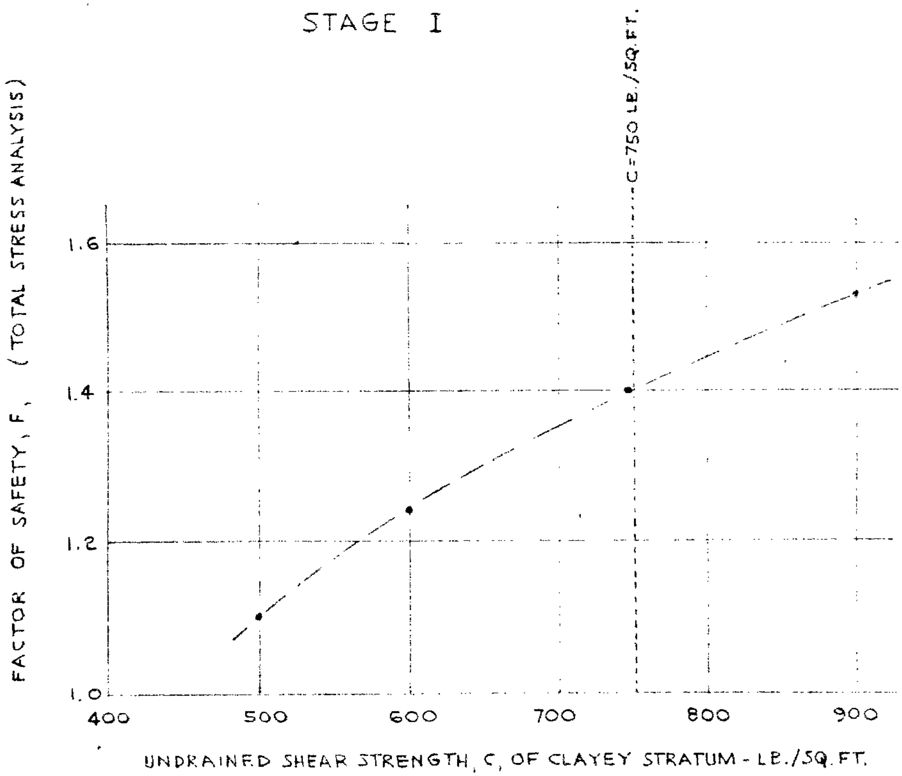
NOTE: WATER LEVEL TO BE DRAWN DOWN INSIDE
STEEL SHEET PILING DURING
CONSTRUCTION OF FOOTINGS

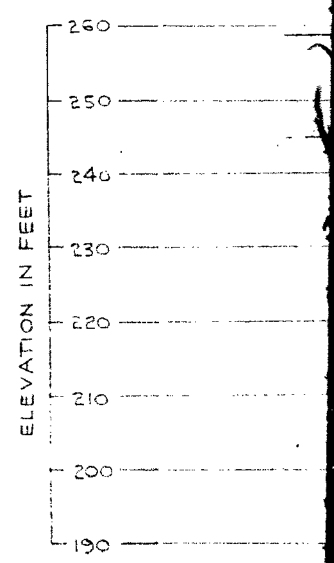


STAGE I

STAGE II

SUGGESTED CONSTRUCT





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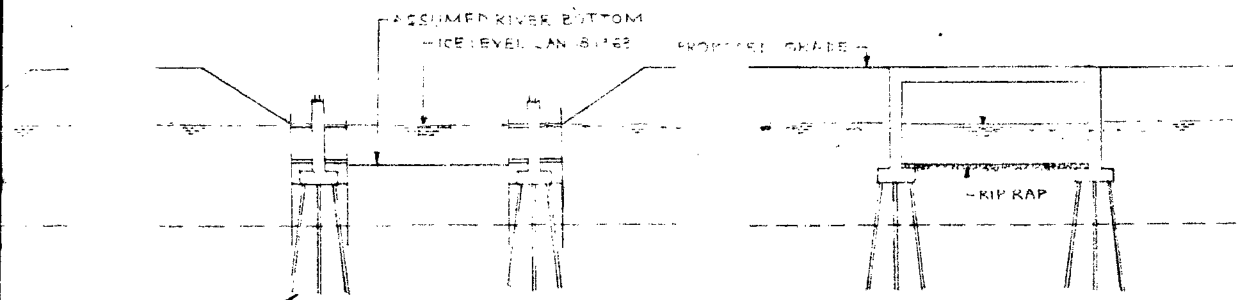
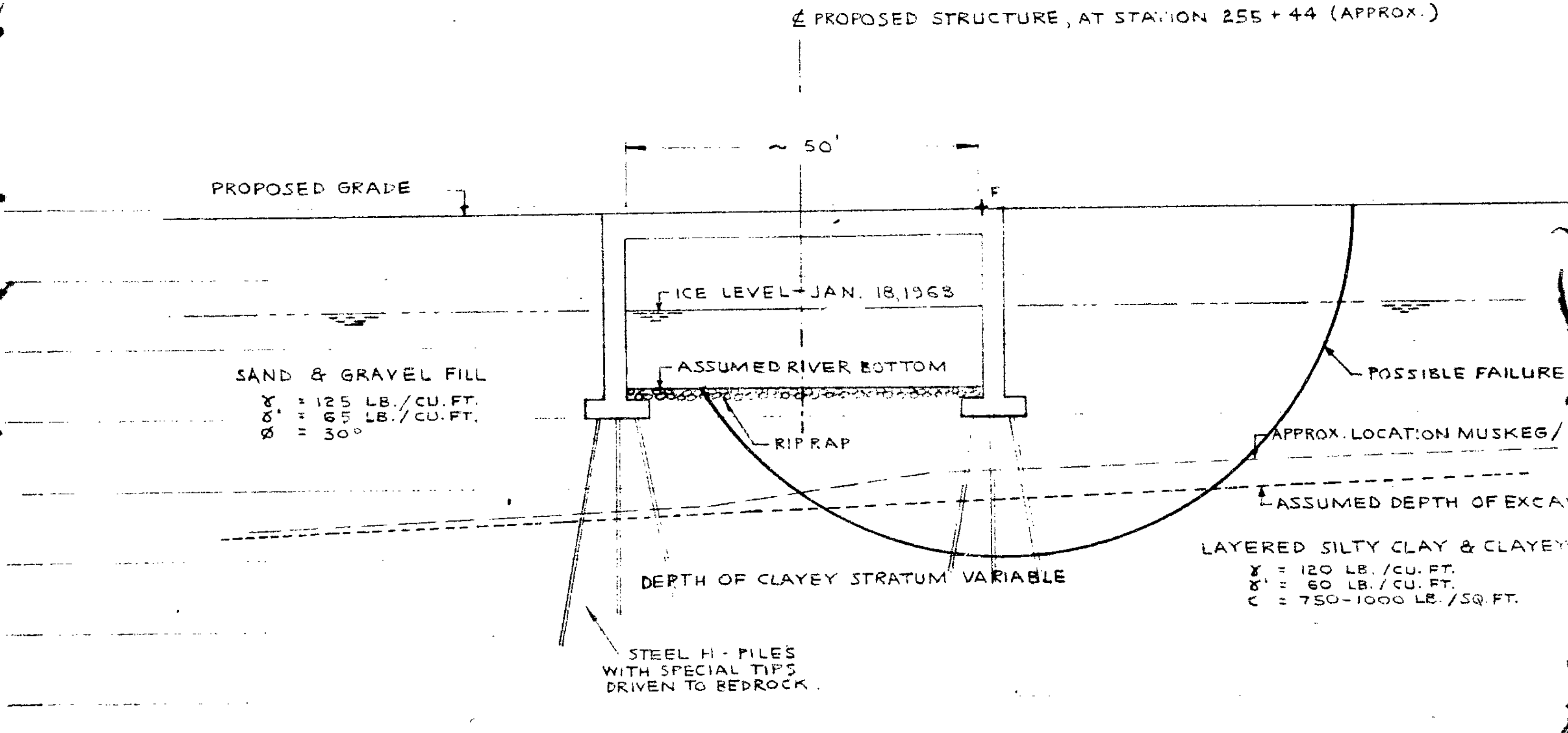


STAGE III

STAGE IV

CONSTRUCTION PROCEDURE



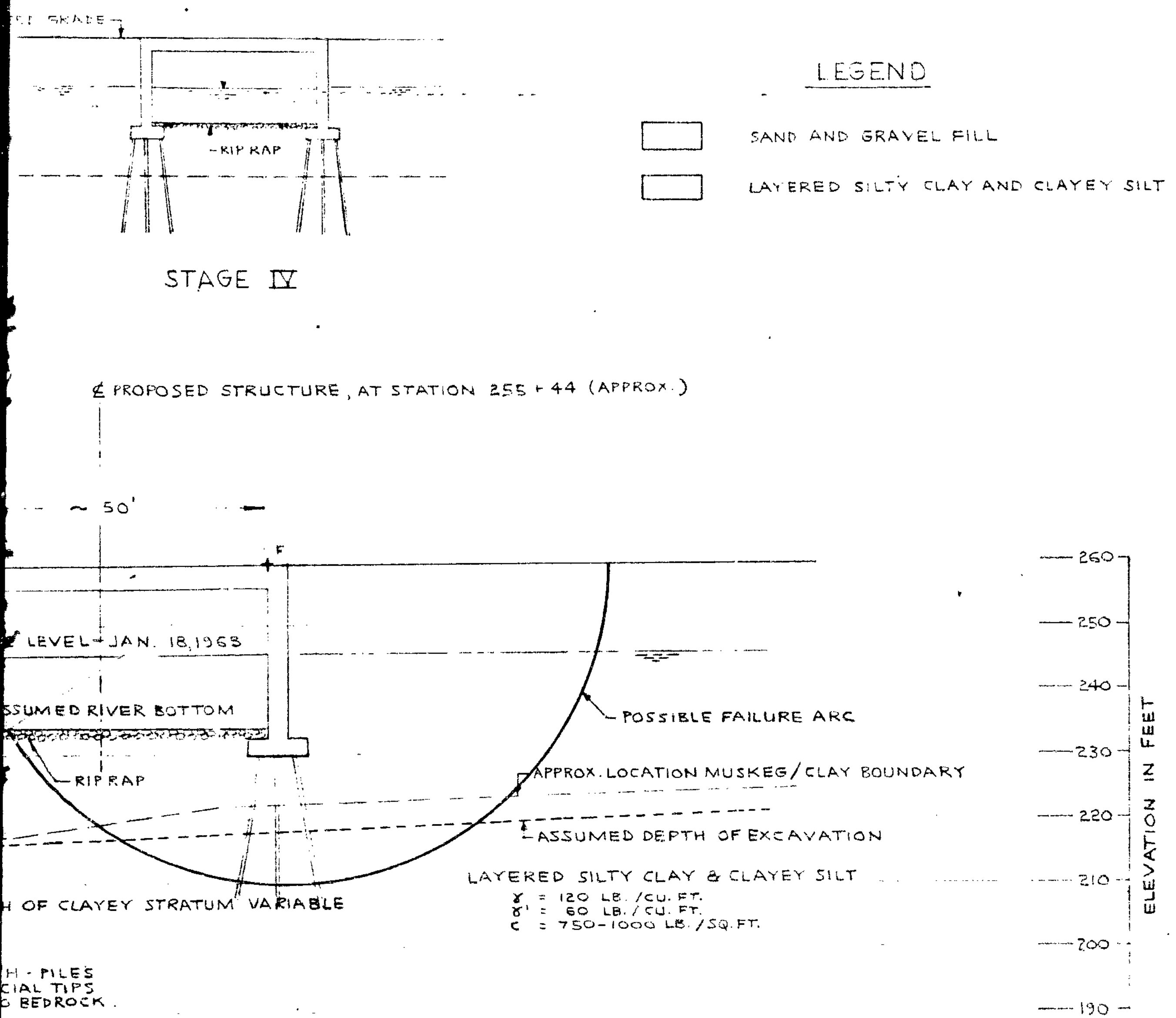
PROPOSED STRUCTURE — SCHEME A

APPROX. SCALE 1" TO 20'-0"

NOTE: THE PROPOSED RIVER BOTTOM ELEVATION IS NOT KNOWN, IT HAS BEEN ASSUMED TO BE AT ELEV. 234 FOR THE PRESENT COMPUTATIONS.

PROPOSED STRUCTURE - SCHEME A

FIGURE 19



OSED STRUCTURE — SCHEME A

APPROX. SCALE 1" TO 20'-0"

OWN.

31 B - 8

GEOCRES No.

GOLDER & ASSOCIATES

Made M.W.
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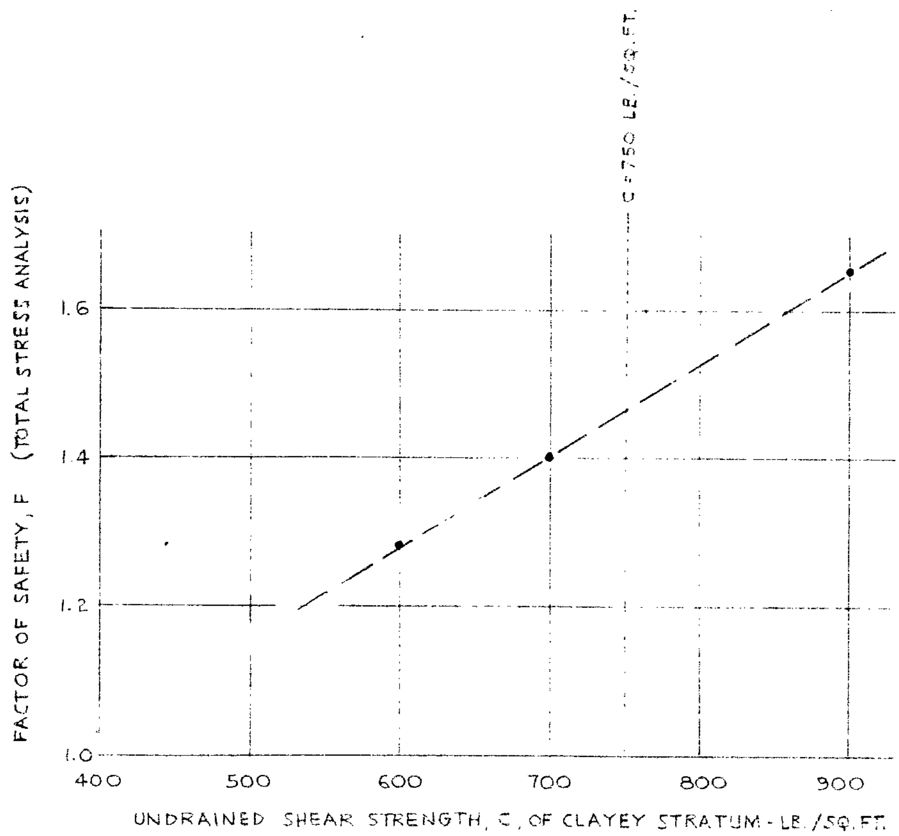
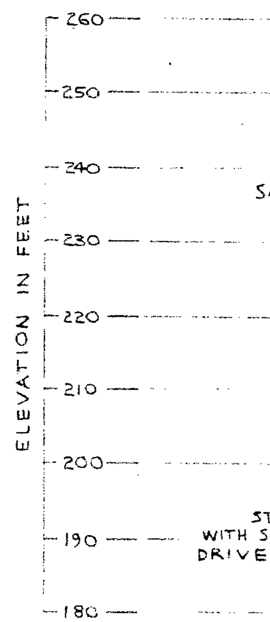
Appd. [illegible]





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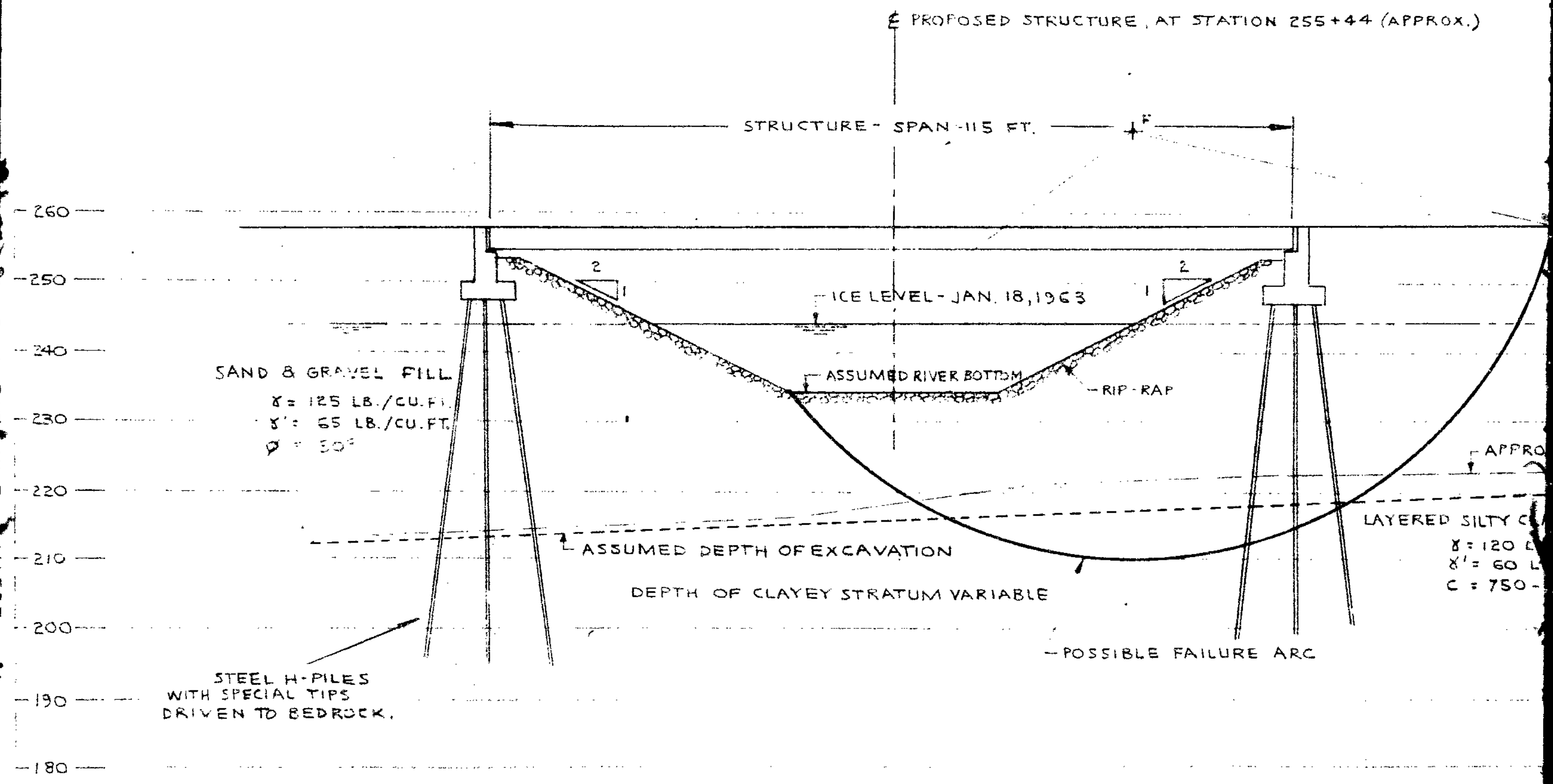


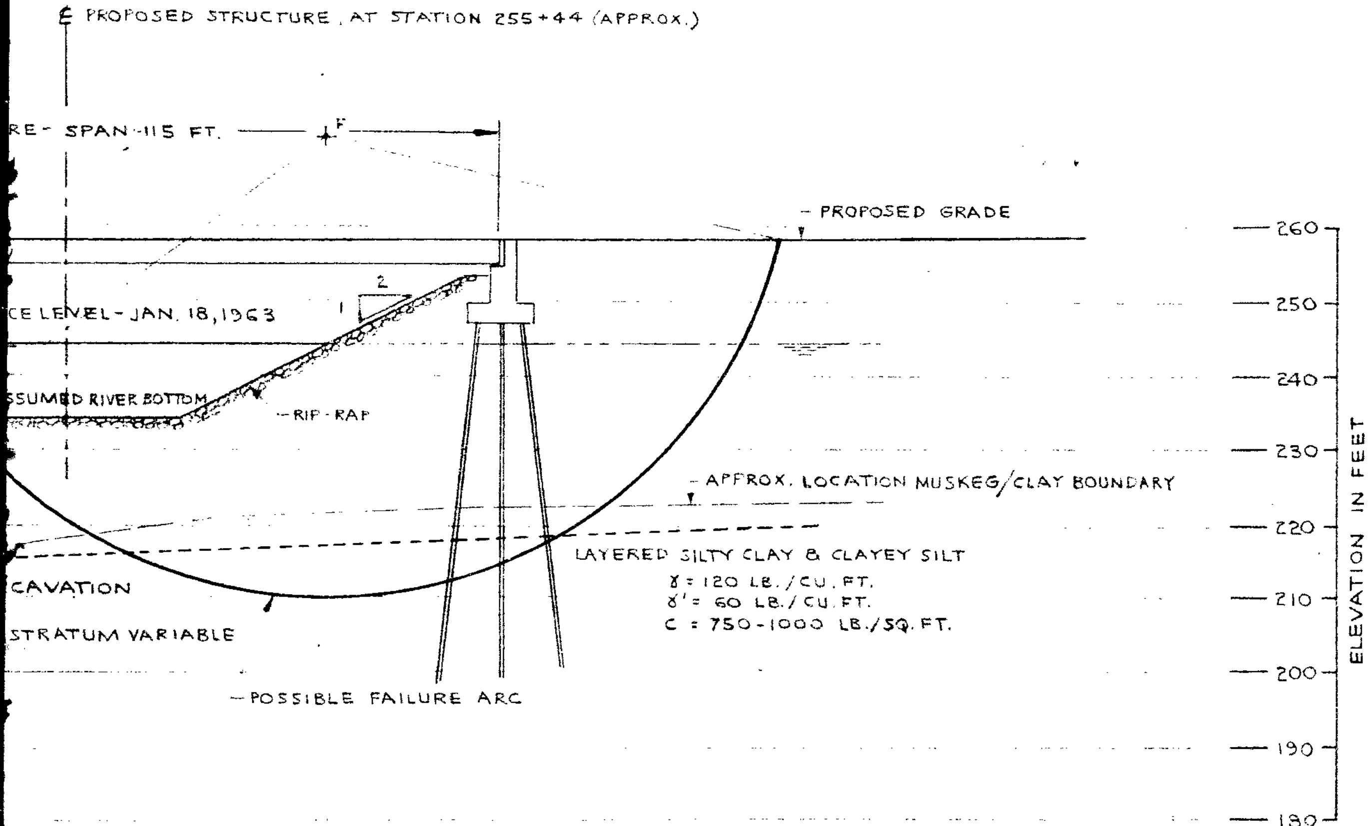
PROPOSED STRUCTURE - SUGGESTED SCHEME B

APPROX. SCALE 1" TO 20'-0"

NOTE: THE PROPOSED RIVER BOTTOM ELEVATION IS NOT KNOWN.
IT HAS BEEN ASSUMED TO BE AT ELEV. 234
FOR THE PRESENT COMPUTATIONS.

PROPOSED STRUCTURE - SUGGESTED SCHEME B

FIGURE 20



D STRUCTURE - SUGGESTED SCHEME B

APPROX. SCALE 1" TO 20'-0"

GOLDER & ASSOCIATES

Made M.W.
Chkd. M.M.C.
Appd. [illegible]