

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: August 31, 1966

File Ref.

IN REPLY TO

SEP - 6 1966

Subject:

FOUNDATION INVESTIGATION REPORT
For
Proposed Seventh Street Underpass
and Q.E.W., Twp. of Louth, County of
Lincoln, District #4 (Hamilton)
W.J. 66-F-65 -- W.P. 212-63

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

We believe that you will find the factual data and recommendations contained therein, adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

ASB/XdeP
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. J. Farren
G. K. Hunter (2)
H. Greenland
T. J. Kovich
W. S. Melinyshyn
A. Watt

A. G. Sternac,
PRINCIPAL FOUNDATION ENGINEER

Foundations Office
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Proposed Seventh Street Underpass
and Q.E.W., Twp. of Louth, County of
Lincoln, District #4 (Hamilton)
W.J. 66-F-65 -- W.P. 212-63

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed underpass at the crossing of the Q.E.W. and Seventh Street, was received from Mr. W. S. Melinyshyn, Regional Bridge Location Engineer, to the Foundation Section in a memorandum dated May 26, 1966. An investigation was subsequently carried out by this Section to determine the subsoil conditions at the site of the proposed structure. Presented in this report are the results of our investigation, together with recommendations pertaining to the foundations for the structure and the stability of the proposed approach embankments.

2. DESCRIPTION OF THE SITE:

The site is located in the Niagara Peninsula between the Niagara Escarpment and Lake Ontario, approximately 2 miles west of St. Catharines. In particular, it is located in Lots 6 & 7, Con. I, Township of Louth, County of Lincoln. The surrounding topography is flat, and the area is generally in use for orchards or vineyards.

Physiographically, the region is known as the Iroquois Plain. The plain is built on shallow silt and sand soils underlain by clayey deposits of low permeability which in turn, overlie red-coloured layers, derived from the underlying Queenston shale bedrock.

cont'd. /2 ...

3. FIELD AND LABORATORY WORK:

The field work consisted of 11 sampled boreholes and 11 dynamic cone penetration tests. Samples were recovered at the required depths by means of a 2-in. O.D. split-spoon sampler and by a 2-in. I.D. Shelby tube sampler. The dimensions of the split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. In-situ vane tests were carried out, wherever possible, in order to determine the undrained shear strength of the cohesive material. A 60-degree 2-in. O.D. cone was used in the dynamic penetration test, and the energy used in the test was 350 ft.-lbs. per blow.

The field test results, locations and elevations of the boreholes, have been summarized and are presented in Appendix I of this report.

Samples were visually examined and identified in the laboratory as well as in the field. Tests were carried out in the laboratory, on a selection of samples to determine:

- 1) Natural Moisture Contents
- 2) Bulk Densities
- 3) Grain-size Distribution
- 4) Atterberg Limits
- 5) Undrained Shear Strengths
- 6) Consolidation Tests

Laboratory test results have been summarized and are included under the Appendix of this report.

4. SOIL TYPES AND SUBSOIL CONDITIONS:

4.1) General:

Eleven borings, together with dynamic cone penetration tests, were carried out during the course of the field work, revealing the following subsoil conditions.

cont'd. /3 ...

4. SOIL TYPES AND SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Silt to Clayey Silt and Sand with Organics:

This surface deposit was encountered in all boreholes immediately below ground level, except in B.H. #8. Thickness of the stratum ranged in depth from 4.5 feet in B.H. #1 to 9.0 feet in B.H. #2 and #9.

Physical properties of the material as determined in the laboratory, are summarized as follows:

Liquid Limit	(W _L %)	--	19% - 27%
Plastic Limit	(W _p %)	--	15% - 18%
Moisture Content	(W%)	--	17% - 20%

Grain-size distribution curves indicate the following average results: gravel 2%, sand 44%, silt 41%, and clay 13%. An organic test indicated an organic content of 3.5% in this layer. Standard Penetration Test (N) results in the layer vary generally, from 4 to 10 blows/ft., while boreholes #2, #3, and #11 showed higher 'N' values, from 17 to 60 blows/ft.

4.3) Clayey Silt with some Sand and Traces of Gravel:

This deposit was encountered immediately below the silt to clayey silt stratum. The thickness of the stratum varies from 38 ft. in B.H. #1 to 50 ft. in B.H. #4.

Physical properties of the material as determined in the laboratory, are summarized as follows:

Liquid Limit	(W _L %)	--	19% - 37%
Plastic Limit	(W _p %)	--	12% - 23%
Moisture Content	(W%)	--	11% - 35%

cont'd. /4 ...

4. SOIL TYPES AND SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Clayey Silt with some Sand and Traces of Gravel: (cont'd.) ...

Grain-size distribution curves indicate the following:

Gravel	0% - 3%	Silt	46% - 82%
Sand	0% - 42%	Clay	9% - 54%

Field and laboratory results gave the following values:

Standard Penetration Test	5 blows/ft.	-	85 blows/ft.
Field Vane	1000 p.s.f.	-	> 2000 p.s.f.
Unconfined Compression	390 p.s.f.	-	5820 p.s.f.
Quick Triaxial	700 p.s.f.	-	5205 p.s.f.

The shear strength profile exhibits a typical decrease from a maximum at the top of the deposit to a minimum at about the elevation of the water table (approx. elev. 800) with a further increase with depth below this point. The consistency may be termed as firm to hard, according to the above results.

4.4) Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till):

This grey deposit was found immediately below the clayey silt in boreholes #1 to #7 inclusive.

Boreholes #8 to #11 inclusive, were terminated within the clayey silt stratum at 30 feet depth.

The thickness of this deposit ranged from 5.5 ft. in B.H. #2 to 27.5 ft. in B.H. #6.

From laboratory tests the physical properties are as follows:

cont'd. /5 ...

4. SOIL TYPES AND SUBSOIL CONDITIONS: (cont'd.) ...

4.4) Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till): (cont'd.) ...

Liquid Limit (W_L%) -- 15% - 20%

Plastic Limit (W_P%) -- 12% - 14%

Moisture Content (W%) -- 5% - 12%

Grain-size distribution curves showed the following compositions:

Gravel 18% - 36% Silt 13% - 33%

Sand 42% - 53% Clay 3% - 7%

The 'N' values varied from 79 blows/ft. to 100 blows/2 inches.

4.5) Bedrock (Shale):

This was encountered below the glacial till (heterogeneous mixture of clayey silt, sand and gravel), in boreholes #1 to #7 inclusive.

Sound bedrock is indicated as occurring between elev. 217.0 to 235.5 ft., or 57.5 feet to 70.5 feet below ground level. This elevation was determined as the point at which the drilling augers met refusal. The material for approximately one foot above this elevation, appeared to be very extensively weathered shale.

5. WATER CONDITIONS:

From field measurements taken during the investigation, the water level varied from elevation 280 to 288. The exact water level elevations are recorded in the borelog sheets of the Appendix.

cont'd. /6 ...

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to reconstruct the existing Q.E.W. as a controlled access highway from Stoney Creek traffic circle to St. Catharines. In addition, two-lane service roads are proposed to be built on both sides of the Q.E.W. The reconstruction program necessitates the construction of several underpass structures.

At the crossing of Seventh Street (County Sub-Road #18) and the Q.E.W., an underpass structure is proposed. Present proposals call for a six-span (35.5' - 70.5' - 77.5' - 77.5' - 70.5' - 35.5') structure with approach fills having a maximum height of about 25 ft. above existing ground surface.

Subsoil at the site consists mainly of 4.5 to 9 ft. of firm clayey silt to silt and sand with organics, followed by 38 to 50 ft. of stiff to hard clayey silt with some sand and traces of gravel. Underlying the clayey silt stratum and above the bedrock is a deposit of glacial till (heterogeneous mixture of clayey silt, sand and gravel). The depth to bedrock was observed to be 57 to 70 ft. below the ground surface.

The subsoil conditions are not favourable to provide an adequate bearing capacity for an economical spread footing design. The new structure should, therefore, be supported on end-bearing piles driven to practical refusal into the glacial till stratum, or to the shale bedrock. For estimating purposes, it can be assumed that the piles may penetrate a maximum depth of ten feet into the dense glacial till stratum. Design loads to be used are dependent on the pile section selected and may be 80 tons per pile in the case of 12 BP 73 steel H-piles. Care should be taken to ensure that no bouldery fill is placed at the abutment locations through which piles have to be driven.

No stability problems are anticipated for the proposed approach fills, using standard 2:1 slopes.

cont'd. /7 ...

7. SUMMARY:

A foundation investigation at the site of a proposed structure at the crossing of Seventh Street and Q.E.W. in the Twp. of Louth and County of Lincoln is reported.

Subsoil at the site consists of deposits of silt to clayey silt with organics, clayey silt with sand and traces of gravel, glacial till and shale bedrock.

It is recommended that the proposed structure be founded on end-bearing piles driven to practical refusal into the glacial fill stratum or down to shale bedrock, as discussed in the main body of the report.

No stability problems are anticipated for standard 2:1 slopes.

8. MISCELLANEOUS:

The field work for this project was carried out during the period June 21 to July 6, 1966, under the supervision of Mr. V. Korlu, Project Foundation Engineer.

Equipment used (Penn. drill) was owned and operated by Canadian Longyear Ltd. The survey work was carried out by a survey crew from Central Region.

The preparation of the report was undertaken by Mr. V. Korlu, and reviewed by Mr. M. Devata, Supervising Foundation Engineer.

August 1966

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 1

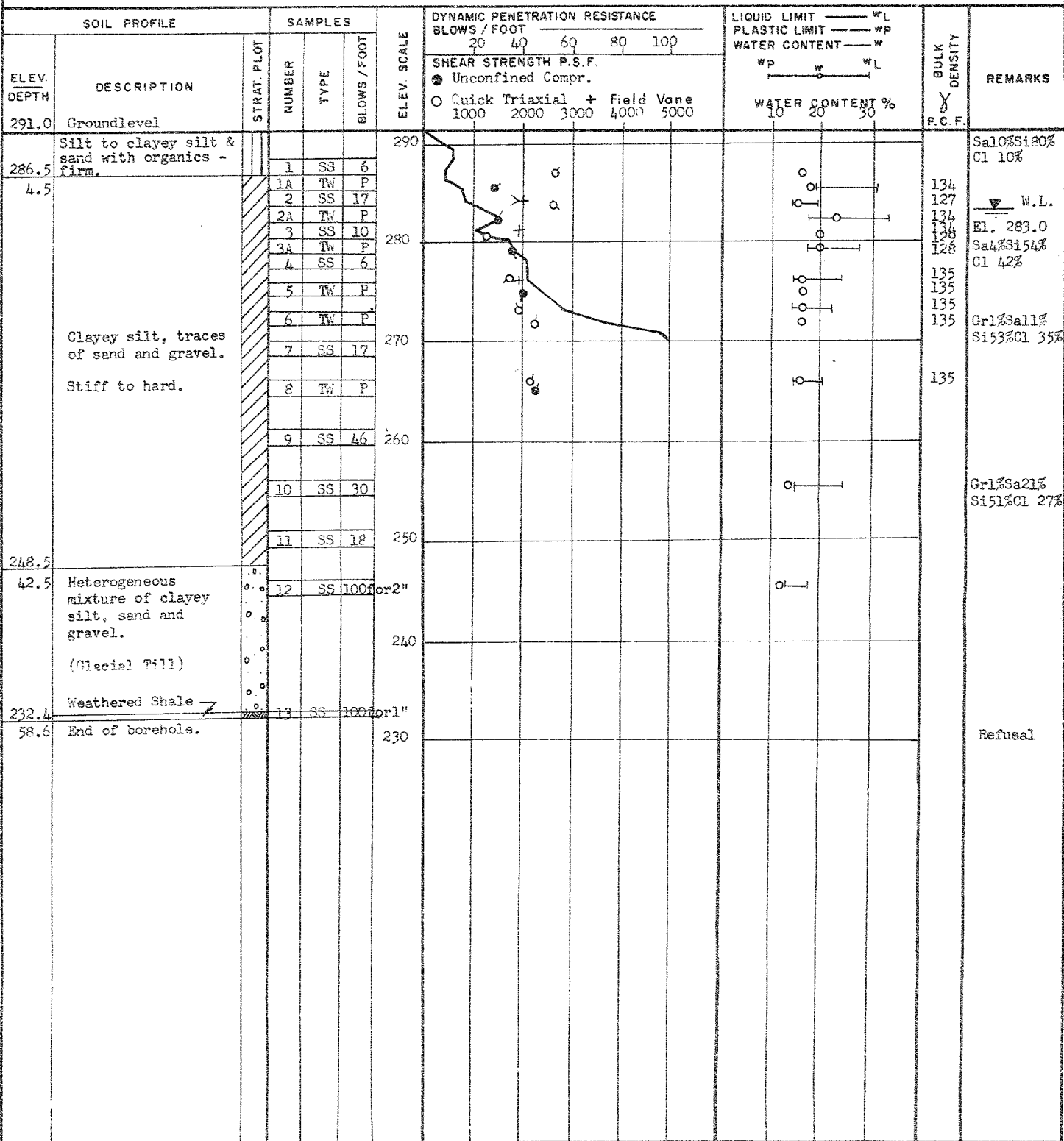
FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-65

LOCATION QEW - 7th St. Sta. 30+90, O/S 33' Lt.ORIGINATED BY V.K.

W.P. 212-63

BORING DATE June 21, 1966COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE PenndrillCHECKED BY M.D.

CHECKED BY M.D. AL

Refusal

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

LOCATION QEW - 7th St. Sta. 31+47, O/S 30.5' Rt.

ORIGINATED BY V.K.

BORING DATE June 23, 1966

COMPILED BY V.K.

BOREHOLE TYPE Penndrill

CHECKED BY _____ M.D.

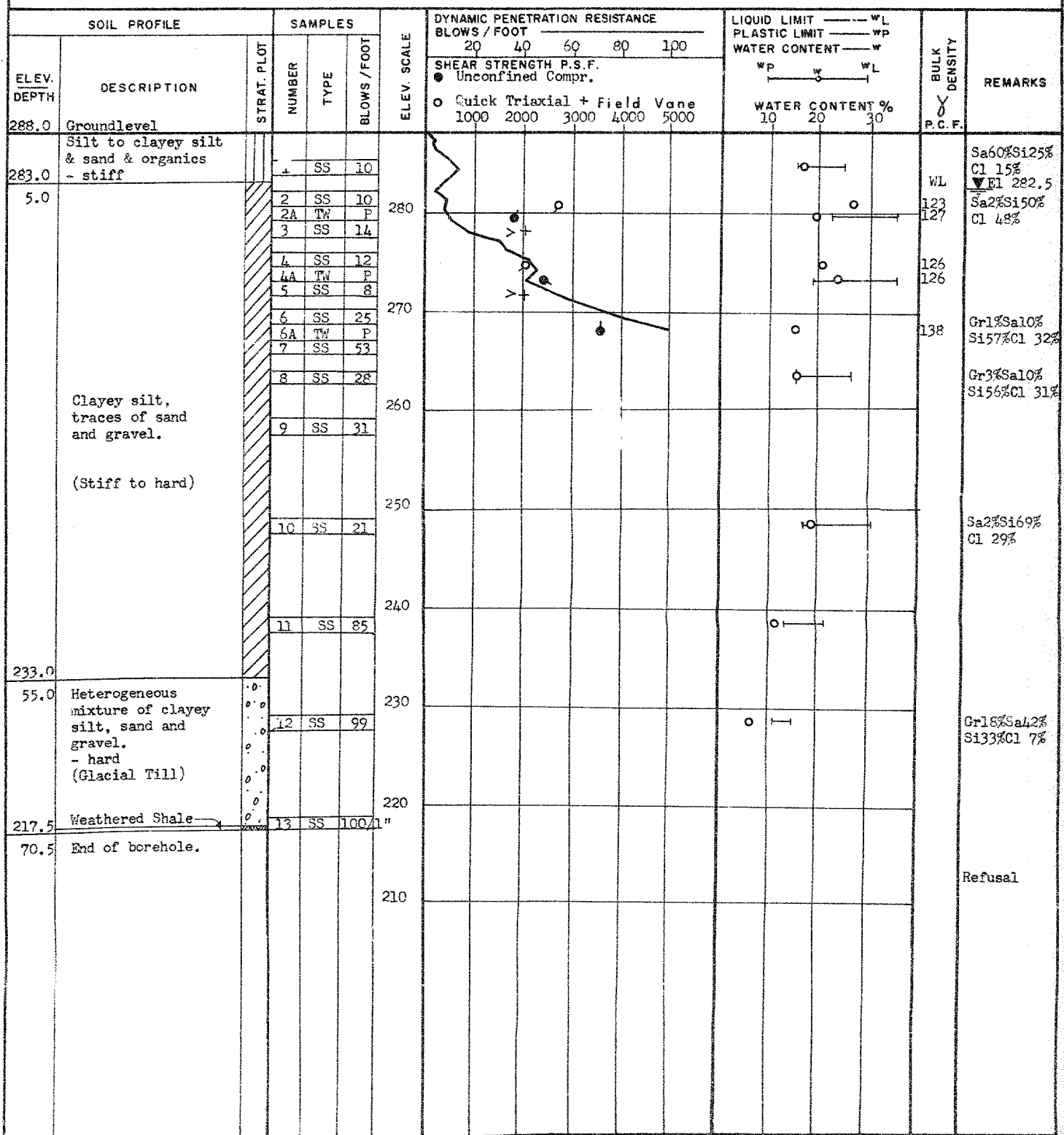
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DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 66-F-65LOCATION QJW - 7th St. Sta. 28+09, O/S 35' Lt.ORIGINATED BY V.K.W.P. 212-63BORING DATE June 24, 1966.COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE PenndrillCHECKED BY M.D. *ML*

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 66-F-55

LOCATION CEW - 7th St. Sta. 29+37, O/S 41.5' Lt.

FOUNDATION SECTION

ORIGINATED BY V.K.

W.P. 212-63

BORING DATE June 28, 1966

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Penndrill

CHECKED BY M.D.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS						
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F. ● Unconfined Compr. ○ Quick Triaxial + Field Vane					WATER CONTENT % WP — W — WL										
						20	40	60	80	100	1000	2000	3000	4000	5000	10	20	30			
287.5	Groundlevel																				
282.5	Silt to clayey silt & sand with organics - firm		1	SS	6															Gr2%Sa68% Si&Cl 30%	
5.0	Clayey silt, traces of sand and gravel. (V. stiff to hard)		2	SS	5	280														El. 282.0 Org. 3.5%	
			3	TW	P																
			4	TW	P																
			5	SS	31	270															Gr1%Sa13% Si54%Cl 32%
			6	SS	21																
			7	SS	28																
			8	SS	21	260															
			9	SS	49																Sa25%Si56% Cl 19%
			10	SS	25	250															
			11	SS	16																
			12	TW	P																
		241.5	Heterogeneous mixture of clayey silt, sand and gravel - hard (Glacial Till)		13	SS	100	240													
46.0				for 4"																Gr29%Sa45% Si20%Cl 6%	
			14	SS	100																
				for 5"		230															
219.5	Weathered Shale		15	SS	100	220															
68.0	End of borehole.			for 1"																	Refusal
						210															

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 66-P-65

LOCATION QEW - 7th St. Sta. 28+51 O/S 19' Rt.

ORIGINATED BY V.K.

W.P. 212-63

BORING DATE June 29, 1966.

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Penndrill

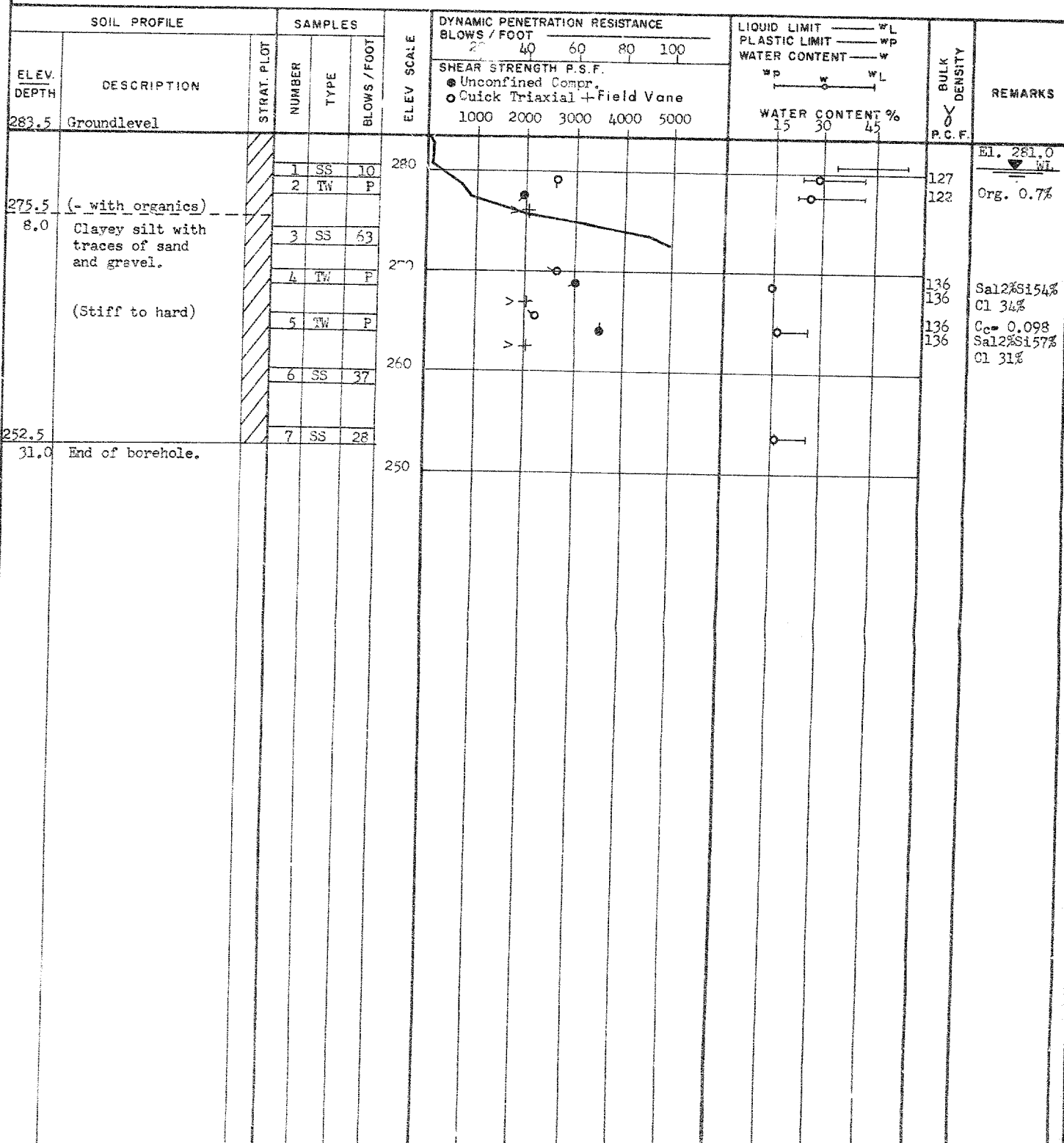
CHECKED BY M.D. *HL*

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. + Field Vane	WATER CONTENT %		
286.5	Groundlevel									
0.0	Silt to clayey silt and sand, with organics - firm.		1	SS	5	280				Sa26%Si58% Cl 16% W.L. El. 280.5
278.5			2	SS	17					
8.0			3	TW	P					
	Clayey silt and sand, traces of gravel.		4	SS	30					Sa18%Si60% Cl 22%
	(V. stiff to hard)		5	SS	33					
			6	SS	39					Grl%Sa42% Si47%Cl 10%
			7	SS	35					
			8	SS	26					
244.5			9	SS	150					
42.0	Heterogeneous mixture of clayey silt, sand and gravel.		10	SS	103					
	Glacial Till									
217.0	Weathered Shale		11	SS	100					
69.5	End of borehole.				for 1"					Refusal

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 66-F-65LOCATION CEW - 7th St, Sta. 28+60 o/s 48' Lt.ORIGINATED BY V.K.W.P. 212-63BORING DATE June 30, 1966COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE PenndrillCHECKED BY M.D.

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-65

LOCATION QEW - 7th St. Sta. 29+20, O/S 22' Rt.ORIGINATED BY V.K.

W.P. 212-63

BORING DATE July 4, 1966COMPILED BY V.K.DATUM GeodeticBOREHOLE TYPE Penn-drillCHECKED BY M.D. AR

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WATER CONTENT % 10 20 30			
288.0	Groundlevel														
279.0	Silt to clayey silt & sand with organics - firm		1	SS	6										
			2	TW	P										
9.0	Clayey silt, some sand and gravel. (V. stiff)		3	TW	P										
			4	TW	P										
			5	SS	43										
			6	SS	25										
			7	SS	27										
258.0			8	SS	25										
30.0	End of borehole.														

SHEAR STRENGTH P.S.F.
 • Unconfined Compr.
 • Quick Triaxial + Field Vane
 1000 2000 3000 4000 5000

C_c = 0.216
 > +

118
 118
 131
 119
 133
 133

Gr2%Sa29%
 Si60%Cl 9%
 W.L.
 EL. 281.0
 Sa35%Si48%
 Cl 17%
 Sa19%Si65%
 Cl 16%
 Sa7%Si60%
 Cl 33%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 66-F-65

LOCATION QEW - 7th St. Sta. 30+71, O/S 42' Rt.

ORIGINATED BY V.K.

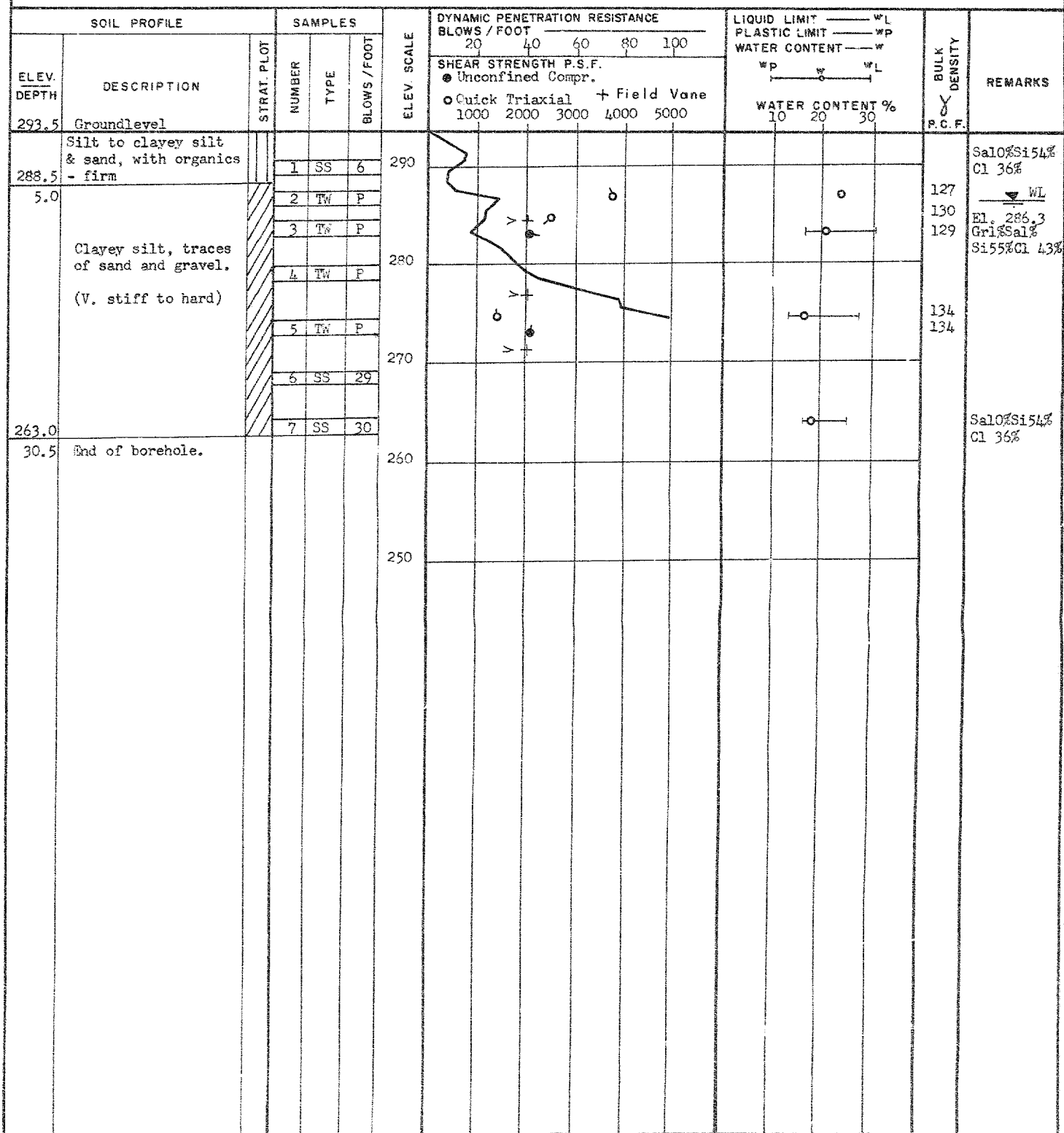
W.P. 212-63

BORING DATE July 4, 1966

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE Penndrill

CHECKED BY M.D. *MD*

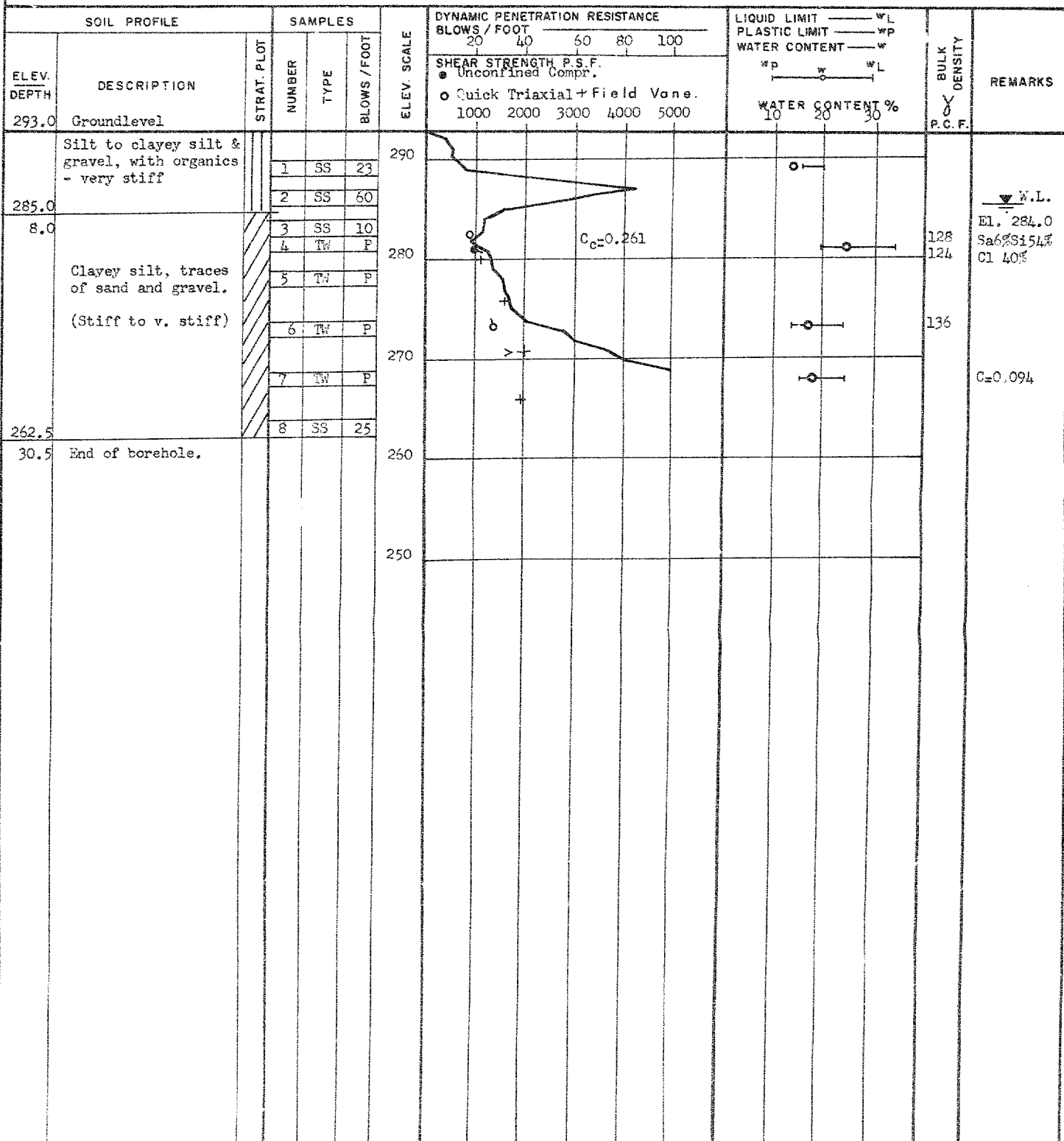
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 66-F-65 LOCATION CEW - 7th St. Sta. 45' Lt. ORIGINATED BY V.K.
W.P. 212-63 BORING DATE July 6, 1966 COMPILED BY V.K.
DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY M.D. *HL*



ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H.	SAMPLE ADVANCED HYDRAULICALLY	
	P.M.	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

Mr. C. S. Grebski
Bridge Design Engineer
Bridge Division
Admin. Bldg.

Foundation Section
Room 107
Lab. Bldg.

September 21, 1967

Seventh Street Underpass
1.7 Miles West of St. Catharines
W.P. 212-63, Site 18-102
Q.E.S., District No. 4

66-8-65

The Preliminary Bridge Plan Drawing D-6058-P1
for the above-mentioned structure has been
reviewed.

We have no comments pertaining to the structure
foundations.

MD:mt

M. Devata
Supervising Foundation Engineer
for: A. C. Stermac
Principal Foundation Engineer

cc: S. McCombie
A. Melnyshyn
Foundation File
General File

Department of Highways Ontario

Copy for the information of
Mr. A. Stermac,
Principal Foundation Engineer

Mr. W. Melinyshyn,
Reg. Bridge Location Engineer,
Central Region,
Administration Building

Bridge Division,
Downsview, Ontario

September 14, 1967

Seventh Street Underpass
1.7 Miles West of St. Catharines
W.P. 212-63, Site 18-102
Q.E.W., District No. 4

66-F-65

Attached herewith are prints of the Preliminary Bridge Plan
Drawing D-6058-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$330,000.
This cost includes tender, materials, engineering and sundry
construction.

Any comments or revisions you may have should be submitted
within three weeks.

CSG:rd

C.S. Grebski,
Bridge Design Engineer

Attach.

c.c. S. McCombie
A. Stermac
W. Wigle
R. Forrest
E. Cross

MEMORANDUM

66-F-65

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

From: Bridge Division,
Downsview, Ontario.

Date: May 26th, 1966.

Our File Ref.

In Reply To:

Subject: W.P. #212-63, Site #18-102,
Seventh Street Underpass,
W.P. #213-63, Site #18-23,
Fifteen Mile Creek,
Q.E.W. District #4.

Herewith is one print each of the following bridge site plans for the above structures: E-4733-1 and E-4734-1. The probable location of the footings have been marked in red. Four extra holes have been marked in green on the Fifteen Mile Creek drawing, these will be required in the future for the widening of the existing east-bound structure. The preliminary structure site report sheets are also enclosed.

These structures are part of the grading W.P. #211-63. Two other structures for Sixteen Mile Creek and Eighteen Mile Creek are also included under this W.P. The E-plans are expected in this office by June 7th and will be forwarded to you immediately.

JFW/cew
Encl.

cc. R. Forrest
A. Crowley

W. S. Melnyshyn
W. S. Melnyshyn,
Regional Bridge Location Engineer.

EXPIRATION DATE:
JULY 27, 1966

* ALSO SEE: 66-114

MM

#66-F-65

W.P. #212-63

Q.E.W. &

SEVENTH ST.

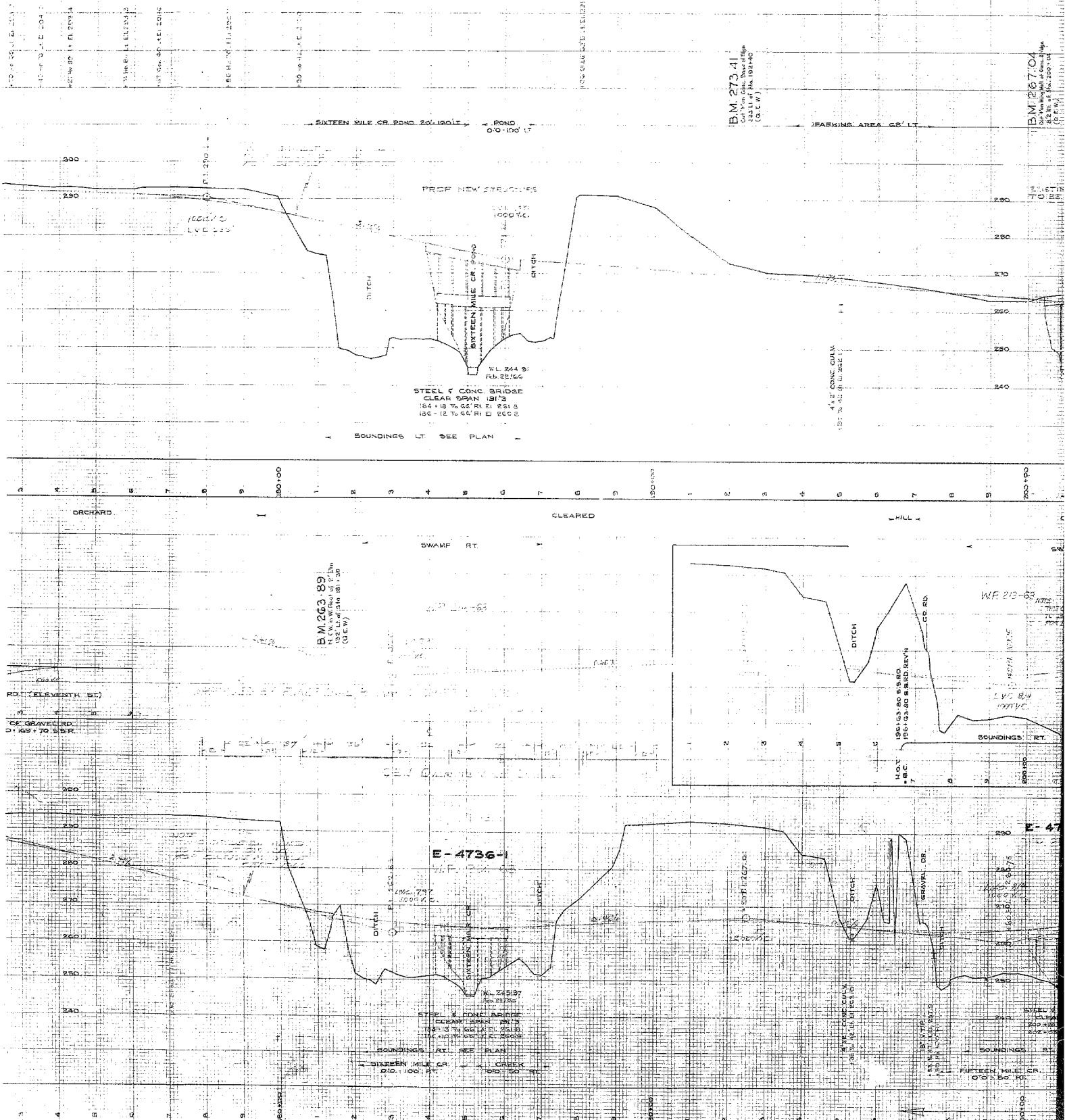
UNDERPASS

10' B-12 APPLE ORCHARD

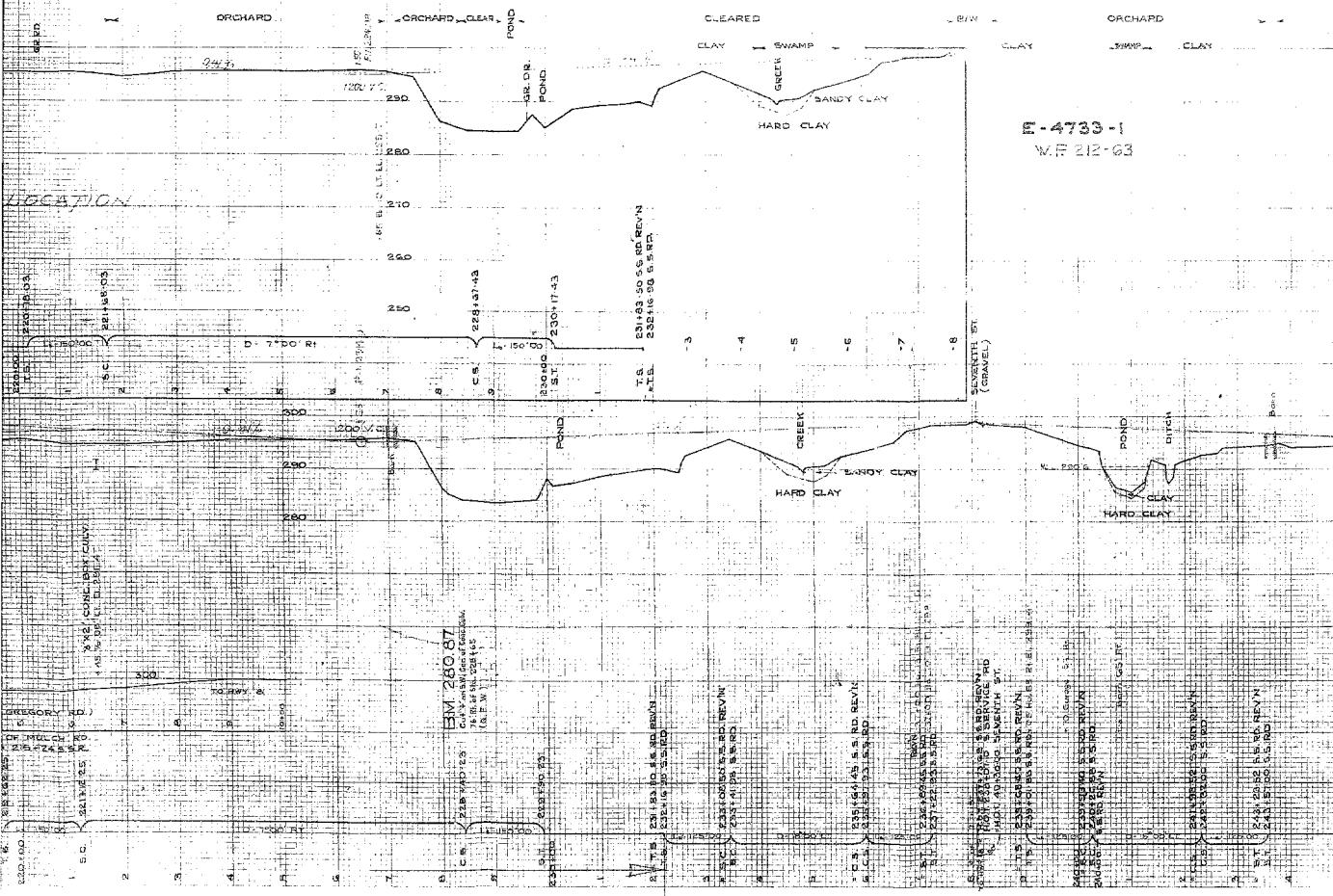
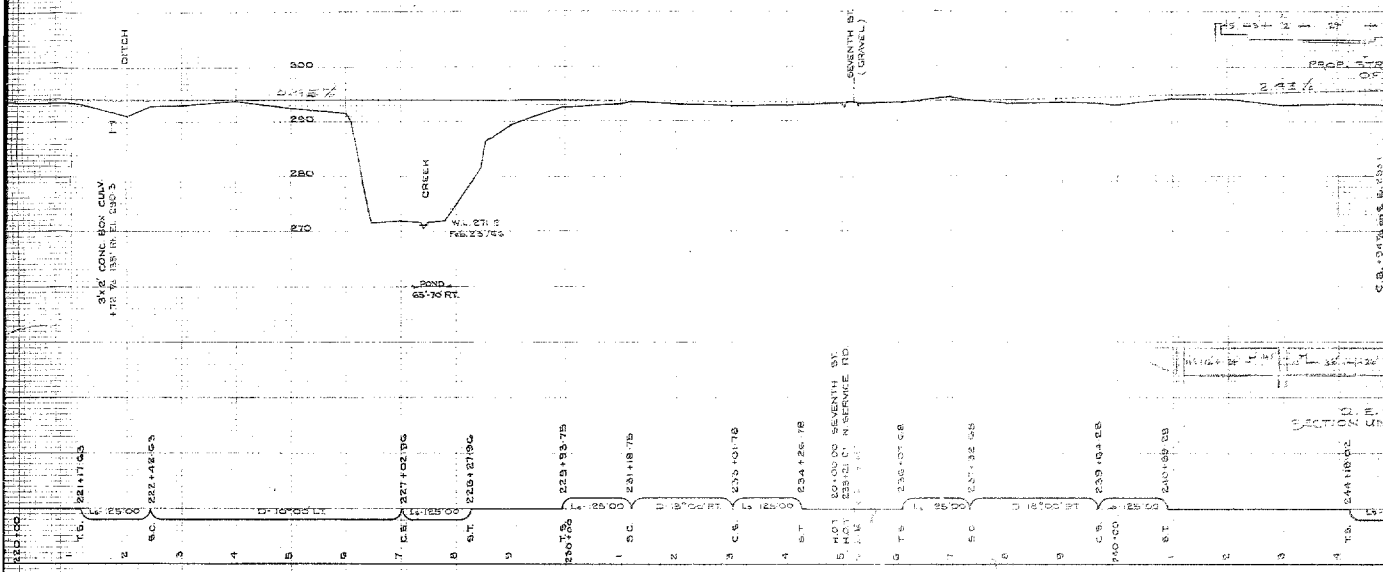
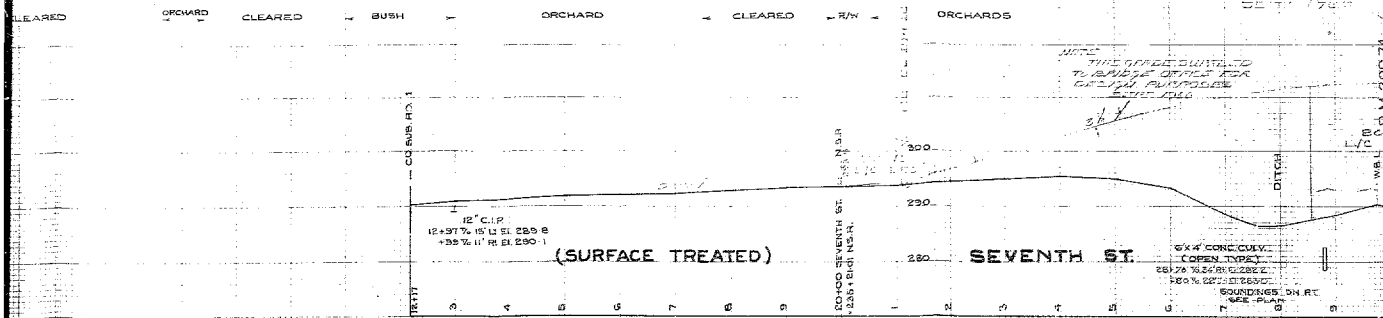
WITHIN RIGHT OF WAY & CLEARED SWAMP LT.

ON PRESENT NO

LOUTH TWP







M-4733-1
W.R. 212-63