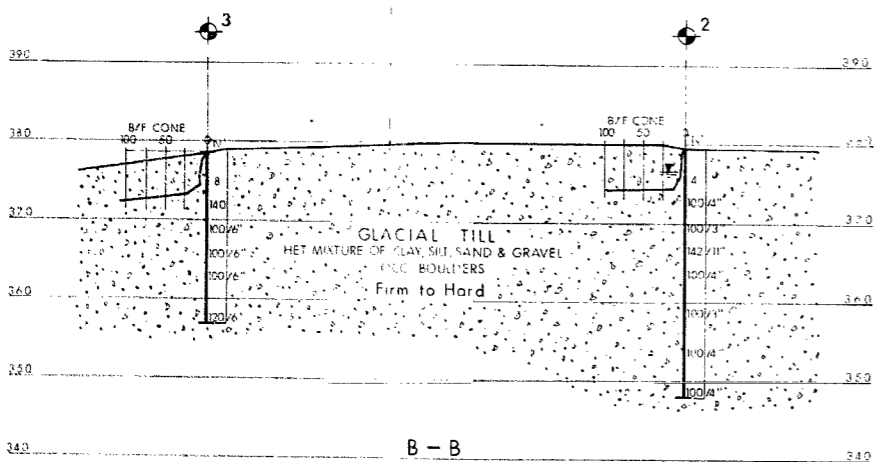
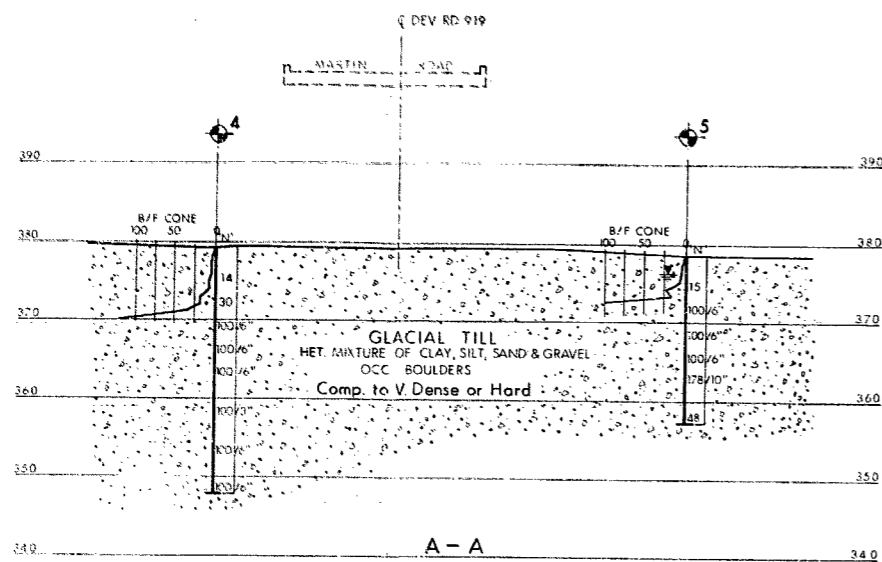


#68-F-47

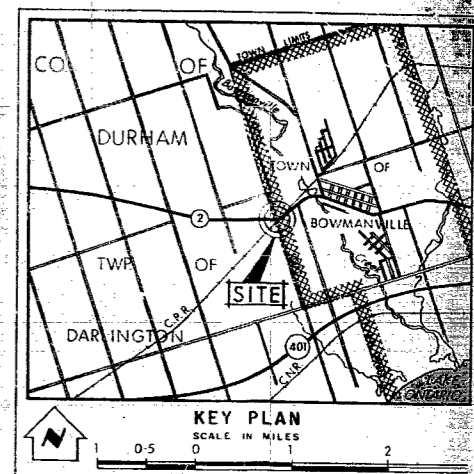
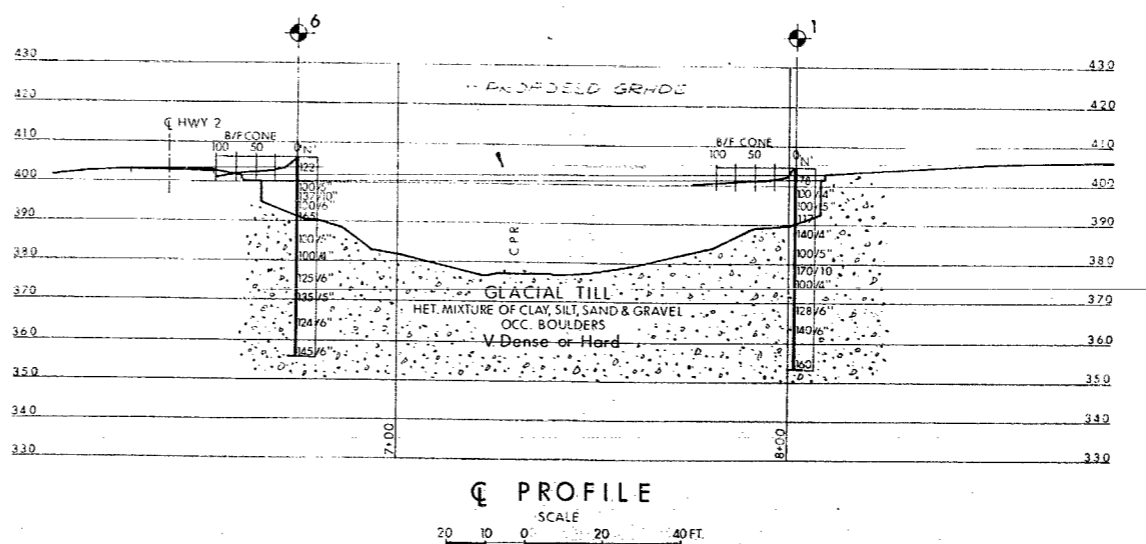
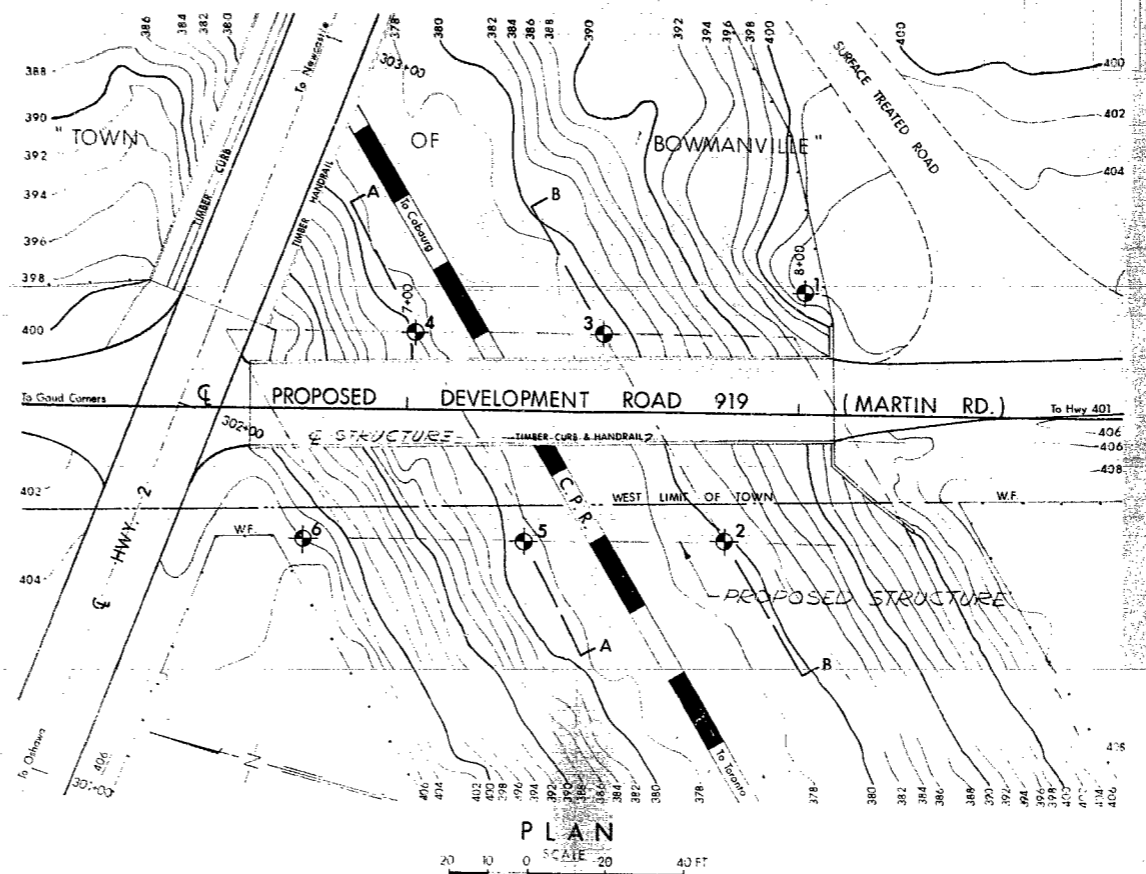
WP. #149-67-1

DEV. RD. #919

C.P.R. OVERHEAD



SECTIONS
10 5 0 SCALE 10 20 FT



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, JUNE 1966		
NO.	ELEVATION	STATION	OFFSET
1	404.9	8+01	32' LT.
2	378.4	7+21	32' RT.
3	378.2	7+50	20' LT.
4	379.3	7+02	20' LT.
5	378.7	7+30	32' RT.
6	406.1	6+74	32' RT.

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.

DATE	BY	DESCRIPTION

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

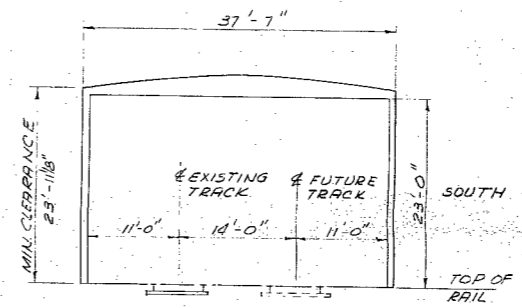
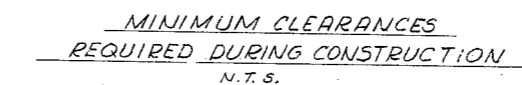
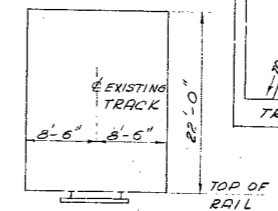
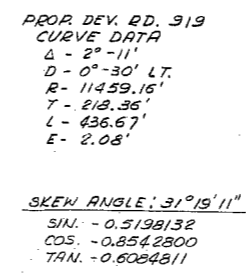
CANADIAN PACIFIC RAILWAY

KING'S HIGHWAY NO. PROP. DEV. ROAD 919 DIST. NO. 7
CO. DURHAM TOWN OF BOWMANVILLE
TWP. DARLINGTON LOT CON.

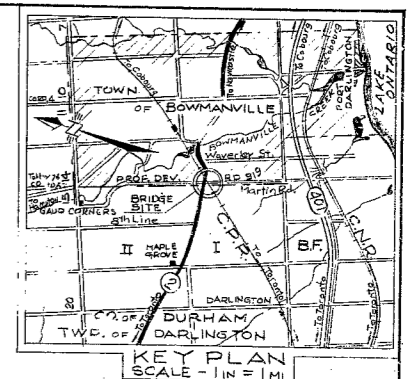
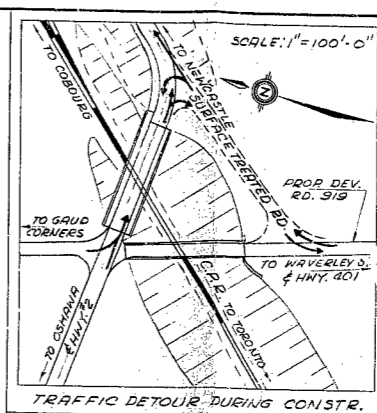
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. V. K.	CHECKED	W.P. NO. 149-67-1	M.S.T. DRAWING NO.
DRAWN S.O.	CHECKED	JOB NO. 68-F-47	68-F-47A
DATE 24 JULY 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CONT. NO.		

REF NO E-4914-1



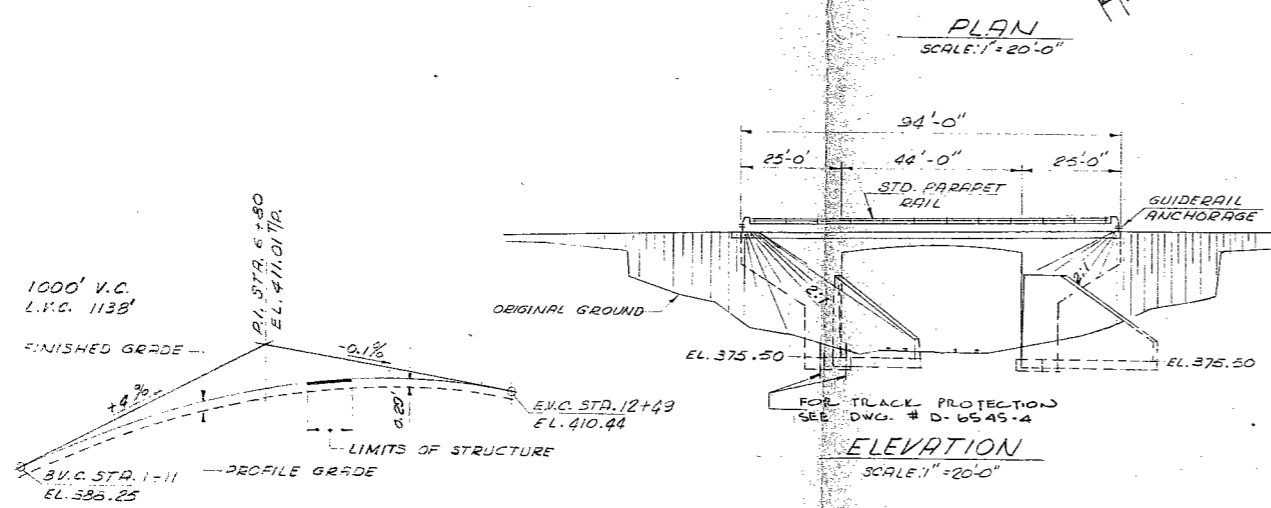
RAILWAY CLEARANCE DIAGRAM
N. T. S.



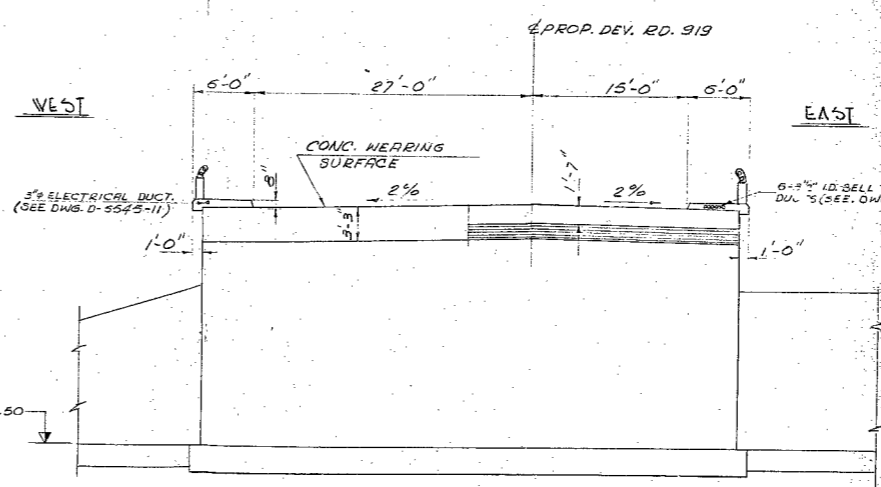
CLASS OF CONCRETE:
DECK, CURBS & PARAPET WALLS - 4000 P.S.I.
REMAINDER - 3000 P.S.I.

CLEAR COVER ON REINFORCING STEEL
FOOTINGS & ABUTMENTS - 3"

- 1 GENERAL PLAN.
- 2 BORE HOLE LOCATION & SOIL STRATA.
- 3 FOOTING LAYOUT.
- 4 FOOTING DETAILS & REINFORCEMENT.
- 5 FRAME DIMENSIONS & REINFORCEMENT.
- 6 VINING WALL DIMENSIONS & REINFORCEMENT
- 7 RETAINING WALLS.
- 8 PARAPET WALL DETAILS.
- 9 STANDARD STEEL PARAPET RAIL.
- 10 APPROACH SLABS.
- 11 BRIDGE ELECTRICAL DETAILS.
- 12 STANDARD DETAILS.



PROFILE OF DEV. RD. 919
N. T. S.



AT ABUTMENT AT CENTRE

B.M. - 408.79
GEODETIC DATUM
N. & W. IN N. ROOT OF 1' MAPLE
225' RT. OF STA. 302+79 HWY. 2

REVISIONS			
	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

68-5-47

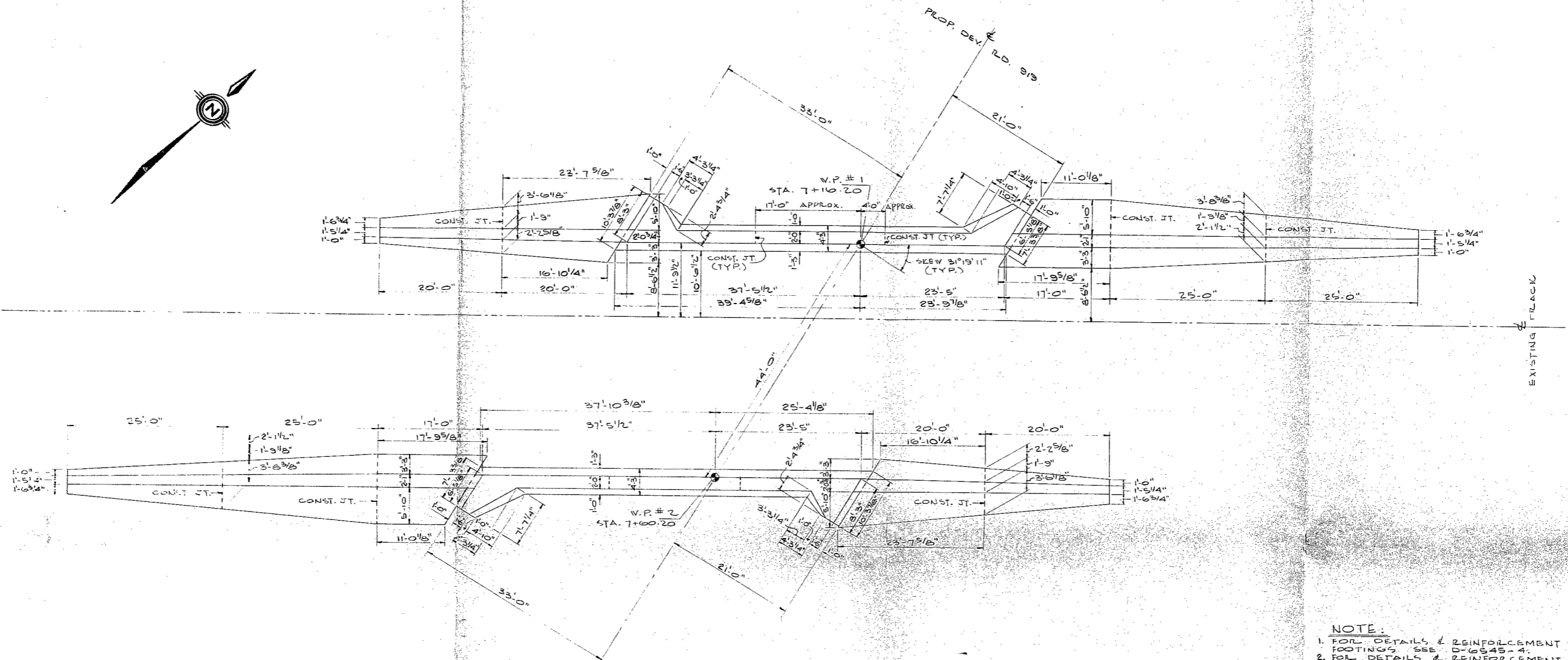
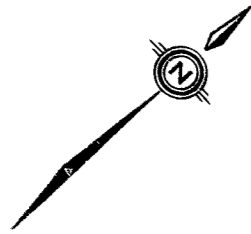
C.P.R. OVERHEAD

TOWN OF BOWMANVILLE WEST LIMITS

KING'S HIGHWAY No. PROP. DEV. RD. 919 DIST. No. 7
CO. DURHAM

GENERAL PLAN

APPROVED _____				SITE No. <u>21-168</u>		V.P. No. <u>149-67-1</u>	
BRIDGE ENGINEER				CONTRACT			
DESIGN	<u>S.B.O</u>	CHECK	<u>J.S.</u>	Nat.			
DRAWING	<u>B.S.</u>	CHECK	<u>J.S.</u>				
DATE	<u>MAR 1969</u>	LOADING	<u>4520-42</u>	DRAWING No.	<u>D-6545-1</u>		



FOOTING LAYOUT
SCALE: 1/8" = 1'-0"

- NOTE:
1. FOR DETAILS & REINFORCEMENT OF FOOTINGS SEE D-6545-4.
 2. FOR DETAILS & REINFORCEMENT OF RETAINING WALLS SEE D-6545-7.

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION



DEPARTMENT OF HIGHWAYS ONTARIO			
BRIDGE DIVISION			
68-15-47			
C.P.R. OVERHEAD			
TOWN OF BOVMANVILLE WEST LIMITS			
KING'S HIGHWAY No. PROG. DEV. RD 919		DIST. No. 7	
CO. DURHAM			
TWP. DARLINGTON		LOT 15 CON. 1	
FOOTING LAYOUT			
APPROVED		SITE No. 21-108 W.P. No. 149-67-1	
DESIGN J.S.		CONTRACT No.	
DRAWING P		DRAWING No. D-6545-3	
DATE MAR. / 69		LOADING HS20-44	

MEMORANDUM

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

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: May 1, 1969

OUR FILE REF.

IN REPLY TO

SUBJECT: C.P.R. Overhead
Town of Bowmanville West Limits
W.P. 149-67-01, Site 21-168
Highway 2, District No. 7

68-F-47

Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.



C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Section

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division,
Admin. Bldg.

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

Attention: Mr. S. McCombie

DATE: July 31, 1968

OUR FILE REF.

IN REPLY TO

AUG 1 1968

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For the
Proposed Crossing at Canadian Pacific
Railway and Development Road 919
Town of Bowmanville, County of Durham
District No. 7 (Port Hope)
W.J. 68-F-47 -- W.P. 149-67-1

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

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

AGS/SF
Attach.

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

Foundations Files ✓
Gen. Files.

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

FOUNDATION INVESTIGATION REPORT
For the
Proposed Crossing at Canadian Pacific
Railway and Development Road 919
Town of Bowmanville, County of Durham
District No. 7 (Port Hope)
W.J. 68-F-47 -- W.P. 149-67-1

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation at the site of the existing crossing of the Canadian Pacific Railway and Martin Road in the Town of Bowmanville, County of Durham. The request was contained in a memo from the Bridge Division (Mr. W.S. Melinyshyn, Regional Bridge Location Engineer) dated May 24th 1968.

At this location the existing overhead structure will be demolished and replaced with a new wider structure. The existing Martin Road will be realigned and called Development Road #919.

An investigation was subsequently carried out by this Section to determine the subsoil conditions at the site.

This report contains the results of the investigation together with recommendations pertaining to the foundations of the proposed structure.

2. DESCRIPTION OF THE SITE AND GEOLOGY

The site is located at the western boundary of the Town of Bowmanville where Martin Road crosses the C.P.R. track. About 70 ft. north of the site Hwy #2 also crosses the C.P.R. track. Both crossings are bridged by timber structure, the one on Martin Road being 145' in length with a 20 ft. road width.

The C.P.R. track at the site is in a 27' cut section with side slopes of about 2 horizontal to 1 vertical.

The general area of the site is on a large hill raised about 30 ft. above the surrounding terrain. The immediate area in the vicinity of the site is open and grass covered.

Physiographically the site is situated in the "Iroquois Sand Plain". Based on available geological information it is known that the site is situated on a "drumlin" formed during the movement of the last continental glacier. The overburden consists of glacial till sheets; lacustrine clay deposited in glacial Lake Iroquois, is however, often encountered between till sheets, particularly in the upper 30 to 40 feet. The bedrock is limestone of the Trenton formation.

3. FIELD AND LABORATORY WORK

Six boreholes, each with an accompanying dynamic cone penetration test, were carried out during the course of the field investigation. The borings were advanced by means of a conventional diamond drill rig adapted for soil sampling purposes.

Samples were obtained at required depths in a 2-inch O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. During sampling operations detailed logs of the borings were made. These logs contain a record of the sampling techniques used, together with the soil types encountered.

The locations and elevations of all the borings were surveyed in the field by personnel from the Central Region, Engineering Surveys Section and are shown on Drawing 68-F-47A, together with estimated stratigraphic sections across the site. All elevations in the report are referenced to a Geodetic datum.

All samples were visually examined and identified in the field and later in the laboratory. Laboratory tests were carried out on

selected representative samples to determine the physical properties of the overburden, namely.

Natural Moisture Contents

Atterberg Limits

Grain Size Distributions

On completion of these tests, the various soil samples were classified as to type and consistency in accordance with the Unified Soil Classification System (October 1963). The results of the laboratory tests are plotted on the Record of Borelog sheets contained in the Appendix of the report.

4. SUBSOIL CONDITIONS

4.1) General

Subsoil at the site generally consists of a thin (6") surface layer of topsoil followed by a glacial till deposit consisting of a heterogeneous mixture of clay, silt, sand and gravel, with occasional boulders.

The soil strata is shown on the Record of Borelog sheets contained in the Appendix of the report; the stratigraphic sections shown on Drawing 68-F-47A are based on this information.

4.2) Glacial Till - Heterogeneous Mixture of Clay, Silt, Sand and Gravel.

Underlying the topsoil is an extensive glacial till deposit, which was not fully penetrated at any of the boring locations. It was proven to extend down to at least elevation 348 i.e. 52 feet below ground surface. This material is generally composed of a heterogeneous mixture of clay, silt, sand and gravel, with occasional boulders up to 8 inches in diameter throughout. In general the matrix of the glacial till is a clayey silt and as such the deposit is cohesive in nature.

cont'd /4 ...

However, random zones in which the matrix of the glacial till is granular in nature i.e. composed of sand and silt, were encountered within the deposit, particularly in the upper 15 to 20 feet. In B.H's #2, 3 and 5 the upper 4 feet of the deposit contains a trace of organic matter. Grain-size distribution curves for samples of the non-cohesive and cohesive portions of the glacial till are plotted on Figures 1 and 2, respectively.

Atterberg limit tests carried out on representative samples of the cohesive portion of the glacial till are plotted on the Record of Borelog sheets and summarized on Figure 3. The results indicate that the liquid and plastic limit of this portion of the deposit varies from 14 to 26 and 10 to 14, respectively. The corresponding natural water content was at, or a few percent, below the plastic limit. Based on these results it is estimated that the cohesive portions are inorganic and of low plasticity.

The standard penetration resistance tests carried out within the deposit are plotted on the borelog sheets. These tests gave "N" values ranging from 14 blows/ft. to 140 blows/6 inches, with the exception of the upper organic zone where the values range from 4 to 15 blows/ft. Based on these values it is estimated that the consistency of the cohesive portion of the glacial till varies from stiff to hard with the organic zone in the firm to stiff range. The relative density of the granular zones within the glacial till vary from compact to very dense.

5. GROUND WATER CONDITIONS.

Ground water level observations, carried out during the period of the field investigation in the open boreholes, indicate that the water level in general was at elev. 377. This is some 2 to 3 feet

below the bottom of the railway cut section. These observations are summarized on Drawing No. 68-F-47A.

6. DISCUSSION AND RECOMMENDATIONS.

6.1) General

It is proposed to construct a new three span (42'-40'-42') overhead structure to replace the existing timber overhead structure at the crossing of Martin Road (Dev. Road #919) and the C.P.R. track in the Town of Bowmanville. The new structure will be 52 ft. wide with the centre line about 10 ft. west of the centre line of the existing roadway. The grade of the new overhead structure will be about 3 ft. above the elevation of the existing structure.

The subsoil at the site consists of a glacial till deposit at least 52 ft. thick. The matrix of this deposit is basically composed of clayey silt; the consistency of the glacial till ranges from firm to hard. Granular zones were encountered within the deposit, in these zones the matrix of the glacial till was composed of sand and silt. The ground water level across the site, during the period of the investigation, was about 27 to 29 feet below ground surface, or 2 to 3 ft. below the bottom of the railway cut.

6.2) Structure Foundations

The proposed pier and abutment footings can be founded on spread footings placed within the hard (or very dense) portion of the glacial till deposit, using an allowable bearing pressure of 4.0 tsf. in design. The pier footings should be placed at or below elev. 374 to satisfy this requirement. In any event, all footings should be located at least 4 ft. below the existing ground surface for frost protection. Settlement of the pier and abutment footings will be negligible, providing the foundation soil at and below footing level is not softening due to surface run-off or construction traffic. In

this regard it is recommended that as soon as the excavations reach footing level a working mat of lean concrete or, alternatively, a granular blanket be placed on the base.

The pier footing excavations are to extend down to below elevation 374, which is some 3 feet below the recorded ground water level. Ground water seepage into the excavation should be minor due to the impermeable nature of the basically cohesive glacial till. If, however, a more granular portion of the glacial till is encountered, a dewatering scheme will be required.

There will be no stability problems for any fill that may have to be placed provided standard slopes of 2 horizontal to 1 vertical are used.

7. SUMMARY.

The results of a foundation investigation for the proposed overhead structure at the crossing of Development Road #919 and the C.P.R. in the Town of Bowmanville are presented.

Subsoil at the site consists of a glacial till deposit composed of a heterogeneous mixture of clay, silt, sand and gravel with occasional boulders.

Both the pier and abutment footings can be founded on spread footings located within the hard (very dense) glacial till deposit using a safe bearing pressure of 4 tsf. in design. Settlement of the footings will be negligible as discussed in the report.

Ground water seepage into the pier footing excavations which are to be carried out below the recorded ground water level, should be minor and readily controlled as discussed in the report.

No stability problems are anticipated.

8. MISCELLANEOUS

The field work carried out during June 21st to July 8th 1968 was supervised by Mr. V. Korlu, Project Foundation Engineer. The report was prepared by Mr. W. Hutton, Project Foundation Engineer.

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

The equipment used was owned and operated by Johnston Drilling Co. Ltd.

July, 1968.

APPENDIX I

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 2

FOUNDATION SECTION

JOB 68-F-47 LOCATION Sta. 7 + 81 @ Dev. Rd, 919 o/s 32' Rt. ORIGINATED BY VK
W P 149-67-1 BORING DATE July 3, 1968 COMPILED BY TC
DATUM Geodetic BOREHOLE TYPE Washboring Diamond Drill CHECKED BY /

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— W L PLASTIC LIMIT ——— W P WATER CONTENT ——— W			BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	* P ——— * L WATER CONTENT %				
							SHEAR STRENGTH P S F					400	800	1200		
379.4	Ground Level															Gr.Sa.Si.Cl
0.0	Glacial Till															▼ 376.6
	Het. mixture of clay, silt, sand & gravel		1	SS	100/1"											
	occ. boulders up to 8" in diam.throughout		2	SS	100/4"											9 28 53 10
	Trace of organics about elev. 375		3	SS	100/3"	370										
			4	SS	112/11"											
			5	SS	100/4"											
	Firm to Hard		6	SS	100/3"	360										
			7	SS	100/4"											
	Brown to grey		8	SS	100/4"	350										2 18 60 20
347.9																
31.5	End of Borehole															

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 68-F-47

LOCATION Sta. 7 + 50 @ Dev. Rd. 919 o/s 20' Lt.

ORIGINATED BY VK

W P 149-67-1

BORING DATE July 4, 1968

COMPILED BY TC

DATUM Geodetic

BOREHOLE TYPE Washboring Diamond Drill

CHECKED BY LL

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.				
378.2	Ground Level						20	40	60	80	100					
0.0	Glacial Till						400	800	1200	1600	2000					
	Heterogeneous mixture of clay, silt, sand & gravel.		1	SS	8											
			2	SS	140											
			3	SS	100/6"											
			4	SS	100/6"											
	Trace of orgs. about elev. 374.		5	SS	100/6"											
356.7	Stiff to hard Brown to grey		6	SS	120/6"											
21.5	End of Borehole															

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 68-F-47

LOCATION Sta. 7 + 02 @ Dev. Rd. 919 o/s 20' Lt.

ORIGINATED BY VK

W P 149-67-1

BORING DATE July 5, 1968

COMPILED BY TC

DATUM Geodetic

BOREHOLE TYPE Washboring Diamond Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	WATER CONTENT % 10 20 30			
379.3	Ground Level						400	800	1200	1600	2000				Gr. Sa. Sl. Cl.	
0.0	Glacial Till															
	Het. mixture of clay, silt, sand & gravel		1	SS	14										6 90 (4)	
			2	SS	30											
	Occ. boulders up to 8" in diam. throughout		3	SS	100/6"	370										
			4	SS	100/6"										44 46 (10)	
	Compact to very dense or hard		5	SS	100/6"											
			6	SS	100/3"	360										
			7	SS	100/6"											
347.8			8	SS	100/6"	350									5 36 42 17	
31.5	End of Borehole					340										

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 5

FOUNDATION SECTION

JOB 68-F-47

LOCATION Sta. 7 + 30 @ Dev. Rd. 919 o/s 32' Rt.

ORIGINATED BY VK

W P 149-67-1

BORING DATE June 28, 1968

COMPILED BY TC

DATUM Geodetic

BOREHOLE TYPE Washboring Diamond Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	WL	W		
378.7	Ground Level						400	800	1200	1600	2000	10	20	30		Gr. Sa. St. Cl
370.0	Glacial Till Het. mix. of clay, silt sand & gravel. Occ. boulders up to 6" in diam. throughout Trace of organics about elev. 374.2 Very stiff to hard or very dense. Grey		1	SS	15											376.2
			2	SS	100/6"											43 (24)
			3	SS	100/6"											
			4	SS	100/6"											
			5	SS	178/10"											
357.2			6	SS	48											1 16 43 40
21.5	End of Borehole															

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-47 LOCATION Sta. 6 + 74 Ø Dev. Rd. 919 o/s 32' Rt. ORIGINATED BY VK

W P 149-67-1 BORING DATE June 25, 1968 COMPILED BY TG

DATUM Geodetic BOREHOLE TYPE Washboring Diamond Drill CHECKED BY ✓

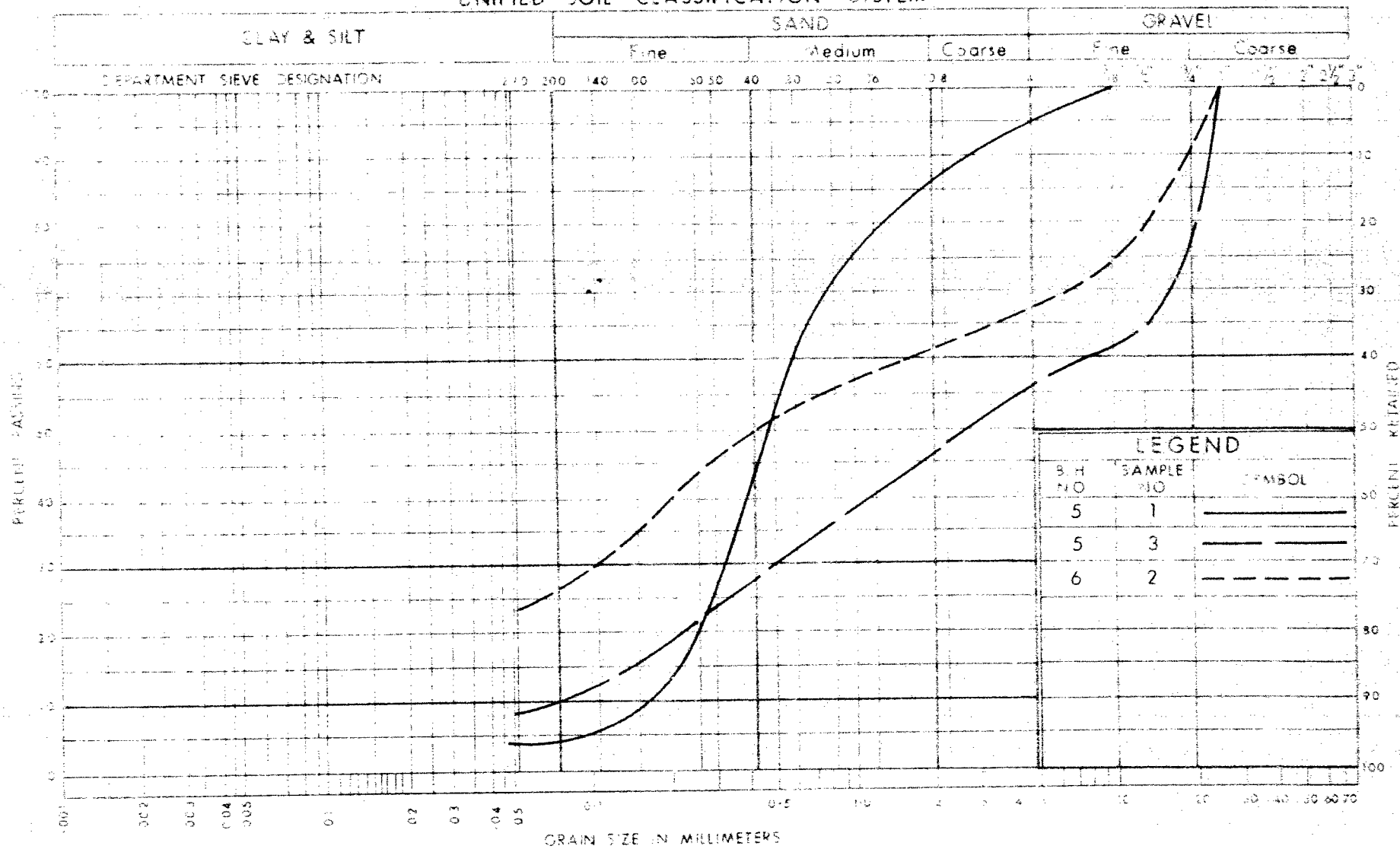
SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL			BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT ——— WP	WATER CONTENT ——— WL		
406.1	Ground Level						400	800	1200	1600	2000	WP	WL		
0.0	Glacial Till														
	Net mix. of clay, silt, sand & gravel		1	SS	122										
	Occ. boulders up to 8" in diam. throughout.		2	SS	100/5"	400									
	Hard or very dense.		3	SS	137/10"										
			4	SS	100/6"										
			5	SS	165	390									
			6	SS	100/5"										
	Brown to grey		7	SS	100/4"	380									
			8	SS	125/6"										
			9	SS	135/5"	370									
			10	SS	124/6"										
						360									
355.6			11	SS	145/6"										
50.5	End of Borehole														

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

No water

Hole
caved to
elev. 379.6

UNIFIED SOIL CLASSIFICATION SYSTEM

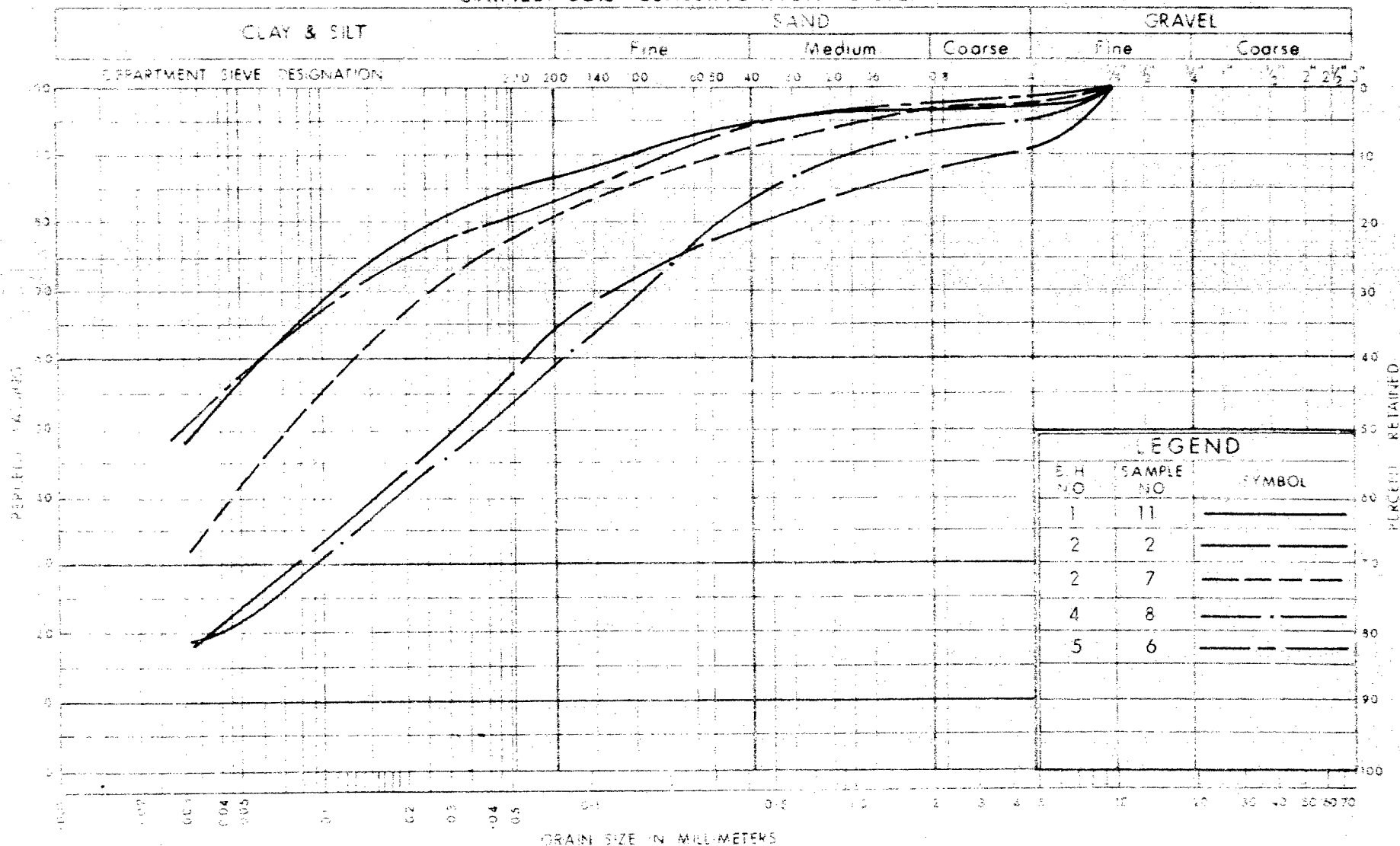


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION GLACIAL TILL (NON COHESIVE)

W.P. No. 142-67-1
JOB No. 68-F-47
FIG 1

UNIFIED SOIL CLASSIFICATION SYSTEM

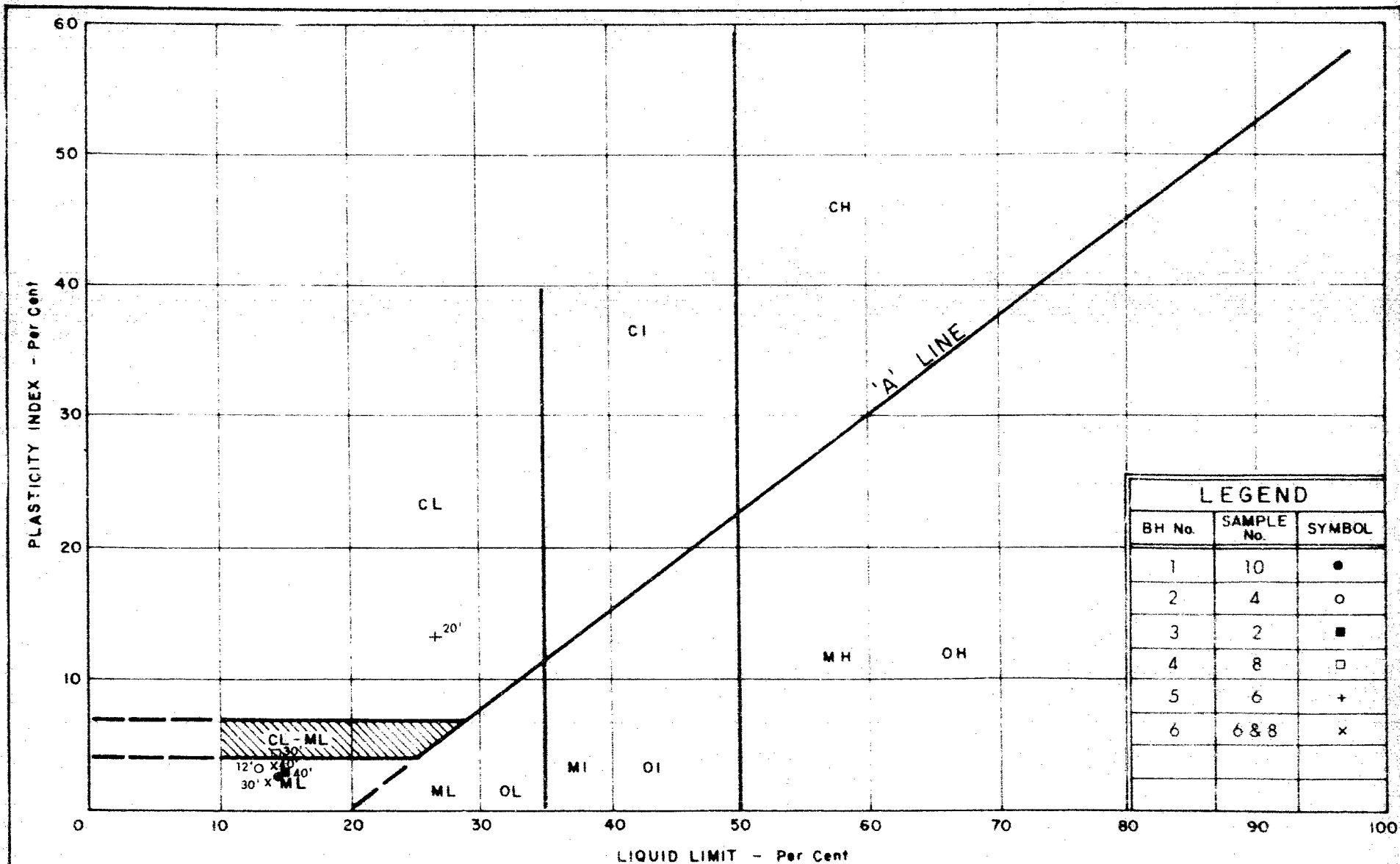


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FIG 2

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT



DEPARTMENT OF HIGHWAYS
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DEFECTS IN
CONDITION OF ORIGINAL DOCUMENT

PLASTICITY CHART GLACIAL TILL

WP No. 149-67-1

JOB No. 68-F-47

FIG. 3

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

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	OS	OESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	PH SAMPLE ADVANCED HYDRAULICALLY		
	PM SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	LV	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	FV	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 INTERCEPT
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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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