

## MEMORANDUM

To: Mr. S. B. Davis,  
Bridge Engineer,  
Bridge Office,  
Admin. Bldg.

From: Foundation Section,  
Materials & Testing Office,  
Room 107, Lab. Bldg.

Attention: Mr. S. McConbie

Date: July 28, 1969

Our File Ref.

IN REPLY TO

Subject:

## FOUNDATION INVESTIGATION REPORT

For

Proposed Underpass Structure at the  
Crossing of Co. Rd. #24 (Reloc.) and  
Hwy. #417 (E.B.L. & W.B.L.)  
Twp. of E. Hawkesbury, Co. of Prescott  
District No. 9 (Ottawa)  
W.J. 69-F-31 -- W.P. 37-66-15 (Str.)

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 do not hesitate to contact our Office.

AGS/MBF  
Attach.

cc: Messrs. B. B. Davis (2)  
H. A. Tregaskes  
D. W. Ferren  
S. J. Markiewicz  
C. R. Robertson  
T. C. Kingsland  
J. E. Gruspier  
B. A. Singh

Foundations Files  
Gen. Files

*A. G. Sternac*  
A. G. Sternac  
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Underpass Structure at the  
Crossing of Co. Rd. #24 (Reloc.) and  
Hwy. #417 (E.B.L. & W.B.L.)  
Twp. of E. Hawkesbury, Co. of Prescott  
District No. 9 (Ottawa)  
W.J. 69-F-31 -- W.P. 37-66-15 (Str.)

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation at the proposed crossing of Co. Rd. #24 (Reloc.) and Hwy. #417, in the Township of E. Hawkesbury, County of Prescott. The request was contained in a memo from the Kingston Bridge Location Section (Mr. G. Scott, Regional Bridge Location Engineer), dated May 7, 1969. An investigation was subsequently carried out by this Section to determine the subsoil and ground-water conditions at this site.

This report contains the results of the investigation, together with the recommendations pertaining to the foundations of the proposed structure as well as the stability and settlement of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is situated on existing Hwy. #17, approximately 0.1 miles west of the Quebec Border. Highway #17 is a 2-lane, paved roadway about 22 feet wide, with the grade at about elevation 154. The surrounding terrain slopes gently from elevation 167, in the south; towards the north, the flat land in the northern portion is at about elevation 135. South of the proposed crossing the terrain is being utilized as pasture land, while to the north, it is covered with light brush growth, behind which a swamp exists. The major drainage in the region is provided by the Ottawa River, which is located approximately one mile to the north.

2. DESCRIPTION OF THE SITE AND GEOLOGY: (cont'd.) ...

Geographically the site is situated in an isolated pocket which is part of the physiographic region known as the "Glengarry Till Plains". This area is characterized by drumlinized ridges with the intervening flats floored with clays, and in some cases, swamp deposits. The glacial till is stoney in texture and generally less than 25 feet in thickness. The overburden is underlain by limestone and shale bedrock of the Chazy Group, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Eight sampled boreholes, one of which was accompanied by a dynamic cone penetration test, were put down during the course of the field investigation. The borings were advanced by means of a conventional diamond drill rig adapted for soil sampling purposes. In addition, 6 hand probe holes were manually advanced in an area occupied by a swamp. The purpose of these probes was to delineate the vertical and lateral extent of the surficial organic material encountered in this area.

Samples of the overburden were obtained, at specified intervals, in a 2" O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration test.

The groundwater level conditions across the site were determined by installing sealed piezometers in two of the boreholes. This information was supplemented by recording the water level in the open holes at some of the other boring locations.

The locations and elevations of all the borings and hand probes were surveyed in the field by personnel from the Kingston Regional Engineering Surveys Section, and are shown on Drawing No. 69-F-31A, together with the estimated stratigraphical profile across the site.

3. FIELD AND LABORATORY WORK: (cont'd.) ...

All the samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this inspection, laboratory tests were carried out on certain samples to determine the engineering properties of the various soil types, namely:

Natural Moisture Contents  
Grain-Size Distributions  
Atterberg Limits  
Organic Matter Contents

The results of the laboratory tests are plotted on the Record of Borelog sheets and are summarized in the Figures, contained in Appendix I of this report,

4. SUBSOIL CONDITIONS:

4.1) General:

The subsoil at the site consists of a thin surficial cover of topsoil followed by a granular deposit of silty sand to sand with occasional boulders. The thickness of the granular deposit ranges between 16 and 44 ft. across the site. The granular deposit is underlain by a cohesive stratum of clayey silt to silty clay having a thickness of 12 to greater than 25 ft. In certain locations the cohesive stratum is underlain by an extensive deposit of boulders in a sand and gravel matrix. In the area of the existing swamp at the north end of the site, the granular deposit is overlain by 4.5 to 11 ft. of a very soft peat.

The boundaries between the various deposits, as determined in the boreholes, are shown on the accompanying borelog sheets. The stratigraphical profile, shown on Drawing 69-F-31A, is based on this information.

From ground surface downwards, the various soil types encountered are described as follows:

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Organic Material (Peat) - Swamp Deposit:

A swamp is present in an area bounded between Stations 33+77 and 35+16. The surficial material in this area consists of a black fibrous peat with some silt having a thickness ranging from 4.5 to 11 ft. Moisture contents of typical samples ranged between 418 and 905 per cent. The organic matter content averaged about 22 per cent, by weight. Standard Penetration Resistance 'N' values were 1 blow/ft. or less in this deposit, indicating a very soft consistency for the fibrous peat.

4.3) Silty Sand to Sand (with Bouldery Zones):

Underlying topsoil, or the peat in the swamp area, is an extensive complexly stratified granular deposit. The thickness of this deposit varies from 16 feet at B.H. #8 to 44 feet at B.H.'s #1 and #2 - i.e., it increases in thickness towards the south as the elevation of the terrain increases. The upper 8 to 14 feet of the deposit, in those areas where it is most extensive, is composed of a silty sand, with a trace of gravel. With depth, however, the stratum transitionally changes to a uniform sand with a trace of gravel. At B.H.'s #1 to #4 inclusive, boulders up to 9 inches in size, were encountered within the upper 8 to 23 ft. of the sandy deposit. In addition to the boulders, occasional random pockets of clayey silt are present throughout the deposit.

Grain-size curves, for samples obtained using a 2" O.D. split-spoon sampler, are plotted on Figures 1 and 2, contained in the Appendix of this report. Figure #1 contains the grain-size curves for the upper silty sand zone, while Figure #2 shows the curves for the lower uniform sand. The natural moisture content of the granular material, as determined by laboratory testing, ranges from 9 to 23 per cent, being typically about 12 per cent.

Standard penetration tests, carried out within the deposit, are plotted on the borelog sheets. The results of this testing gave 'N' values which generally vary in a random fashion between 18 blows/ft. to 90 blows for 2 inches, being

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Silty Sand to Sand (with Bouldery Zones): (cont'd.) ...

typically greater than 75 blows/ft. Based on these values, it is estimated that the relative density of the deposit varies from compact to very dense, being generally very dense.

4.4) Clayey Silt to Silty Clay:

Directly underlying the dense granular deposit is a stratum composed of grey clayey silt to silty clay with a trace of sand. The surface of this cohesive stratum was encountered between elevations 111 and 123; it was penetrated fully only at B.H. #2, where the thickness was 12 feet. It was, however, proven to extend for a depth of at least 25 feet at B.H. #6.

Atterberg limit tests, carried out on representative samples of the cohesive stratum, are summarized on the Plasticity Chart, Figure #3. The results indicate that the soil is inorganic and of low to intermediate plasticity. The average natural moisture content is approximately 25 per cent.

The Standard Penetration Tests carried out in this deposit, gave 'N' values ranging from 20 to 160 blows/ft., being typically about 45 blows/ft. Based on these results, it is estimated that the consistency of the deposit varies from very stiff to hard, being generally in the hard range.

4.5) Boulders in Sand and Gravel Matrix:

At B.H. #2, the only borehole which fully penetrated the silty clay stratum, a very dense deposit composed of boulders up to 9 inches in size embedded in a sand and gravel matrix, was encountered. Diamond drilling techniques were required in order to advance the borehole. This bouldery deposit was penetrated for a depth of 36 feet without encountering bedrock.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out, during the period of the investigation, in 1) sealed piezometers installed in B.H.'s #4 and #8, and 11) open holes at some of the remaining locations. The observations are recorded on the borelog sheets and summarized on Drawing 69-F-31A. The results of the measurements indicate that the piezometric groundwater level within the granular deposit and the underlying silty clay stratum is between elevations 130 and 134 - i.e., some 5 to 20 feet below ground surface.

A piezometer installed in the lower portion of the soft peat in the swamp area (refer to B.H. #8) indicated a slight artesian head of about 2 feet above ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an underpass structure to carry County Road #24 (Reloc.) over the East and Westbound lanes of proposed Hwy. #417, in the Twp. of E. Hawkesbury, County of Prescott. Present proposals call for a five-span structure (37'-77'-76'-77'-37'). The maximum profile grade of County Rd. #24 (Reloc.), in the vicinity of the crossing, is elevation 173. At this grade the south and north approach embankments will have maximum heights of about 12 and 27 feet above ground surface, respectively. The embankments will have a crest width of 36 feet.

The East and Westbound lanes of Hwy. #417 will initially have three 12-foot wide paved lanes (one of which will be a collector lane) with provision for a fourth lane; the roadway cross-section will also incorporate shoulders and a median. The existing Hwy. #17 will be incorporated into the E.B.L. The finished grade of the W.B.L. and E.B.L. will be at elevations 150 and 154, respectively.

Within the plan limits of the proposed structure, the surficial topsoil is underlain by a dense to very dense granular



6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.1) General: (cont'd.) ...

deposit ranging from silty sand, in the upper portion, to sand with a trace of gravel in the lower extremities. Boulders are often encountered in the upper portion of the stratum. The thickness of this deposit varies from 16 feet to 44 feet. This deposit is underlain by a very stiff to hard silty clay, which, in turn, is followed by boulders interbedded in a sand and gravel matrix.

North of the structure, between Stations 33+77 and 35+16, a swamp exists. Between 4.5 and 11 feet of very soft peat is present within this area. The north approach embankment will have to traverse this swamp.

6.2) Structure Foundations:

6.2.1) Pier Foundations -

As mentioned in the previous paragraphs the subsoil, immediately below the topsoil, is composed of a competent granular deposit. It is recommended, therefore, that the piers be founded on spread footings located within this deposit, at as high an elevation as possible. It should be noted, however, that 5 feet of earth cover should be provided, to the underside of the footings, for frost protection purposes. The respective footings could be founded at or below the following elevations:

<u>Pier Location</u>	<u>Station</u>	<u>Recommended Footing Level (at or below)</u>
South	29 + 70	Elev. 150
South Intermediate	30 + 47	" 150
North Intermediate	31 + 23	" 146
North	32 + 00	" 139

For footings founded at the above elevations, an allowable bearing value of up to 5.0 t.s.f. can be used in design.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Structure Foundations: (cont'd.) ...

6.2.1) Pier Foundations - (cont'd.) ...

At these elevations the footing excavations will extend some 4 to 5 feet below existing ground surface. The groundwater level, at the time of the investigation, was at a lower elevation. Therefore, no major dewatering problems are anticipated. If, however, the excavations are carried out during a period of heavy precipitation, some seepage may occur. This could readily be handled by pumping from properly maintained sumps.

Settlement of the foundation subsoil will take place due to the applied footing loading. For the size of footings contemplated (approximately 6 to 8 feet in width), imposing the above loading, it is estimated that the settlement will be negligible and may be of the order of 1/2 inch. This settlement will be realized during, or immediately following, the construction period.

6.2.2) Abutment Foundations -

The proposed abutments may be constructed within the approach fills; two alternate methods are given for the foundation support of the abutments:

1) The abutments may be supported on spread footings placed within the approach fills. The fill material, below the tops of the footings, should consist of well compacted G.B.C. Class 'A' material, and should extend to a horizontal distance of at least 10 feet from the footing edges in the plane of the footing tops. This portion of the fill should be constructed with side slopes no steeper than 2:1. The remainder of the fill should be completed to about profile grade for a distance of 50 feet behind the abutments before re-excavation for the abutment footings. An allowable bearing pressure of 2.0 t.s.f. may be used in design.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Structure Foundations: (cont'd.) ...

6.2.2) Abutment Foundations: (cont'd.) ...

11) The abutments for the structure may be supported on steel H-piles driven to practical refusal into the dense granular deposit. In any case, attempts should be made to penetrate the piles a minimum of 10 feet into natural ground. For estimating purposes, the pile tips may meet refusal at the following elevations:

South Abutment	--	Elev. 145
North Abutment	--	Elev. 125

The aforementioned piles could be designed for the ultimate capacity of the section chosen - e.g., 12 BP 74 steel H-piles could be designed for 90 tons/pile.

6.3) Approach Embankments:

As discussed previously, the maximum heights of fill will be 27 and 12 feet along the north and south approaches, respectively. Between Stations 33+77 and 35+16, along the north approach, up to 11 feet of soft peat is present. This organic deposit should be completely sub-excavated in accordance with D.H.O. Standard DD-406 prior to placing of fill. The excavation so formed, should be backfilled with suitable non-cohesive type of material. In order to properly define the amount of sub-excavation necessary, it is suggested that additional borings should be carried out by the Eastern Region - Materials and Testing Section.

Provided the peat is sub-excavated beneath the north approach, no stability problems are anticipated for embankments constructed of properly compacted fill with standard 2:1 slopes.

7. SUMMARY:

A foundation investigation at the site of the proposed underpass structure to carry County Rd. #24 (Reloc.) over the East and Westbound lanes of proposed Hwy. #417, in the Twp. of S. Hawkesbury, County of Prescott, is reported.

7. SUMMARY: (cont'd.) ...

Within the plan limits of the proposed structure, topsoil is underlain by a dense to very dense granular deposit ranging from silty sand in the upper portion, to sand in the lower extremities; bouldery zones were often encountered in the upper part of the stratum. The overall thickness of this deposit varies from 16 to 44 feet. This granular subsoil is underlain by a very stiff to hard silty clay, which, in turn, is followed by boulders interbedded in a sand and gravel matrix.

North of the structure, however, (between Stations 33+77 to 35+16), a swamp exists. Between 4.5 and 11 feet of soft peat is present in this swampy area.

The piers can be supported on spread footings located within the upper competent granular deposit, using an allowable bearing pressure of up to 5.0 t.s.f. in design. Recommended founding elevations for the various proposed footing locations are given in this report.

The abutments can be founded with the approach fills either: i) within a zone composed of properly compacted granular fill (G.B.C. 'A') using an allowable bearing pressure of 2.0 t.s.f., or ii) on steel H-piles driven to practical refusal into the upper natural granular deposit, as discussed in the report.

The approach embankments will be stable provided the organic deposit, located beneath the north approach, is completely sub-excavated and backfilled with granular fill in accordance with standard D.H.O. practices.

8. MISCELLANEOUS:

The field work, performed during the period of June 13 to 24, 1969, was supervised jointly by Messrs. D. Phelps and K. K. Kwan, Project Foundation Engineers.

This project was carried out under the general supervision of Mr. E. T. Darch, Senior Foundation Engineer, who also wrote this report.

8. MISCELLANEOUS: (cont'd.) ...

This report was reviewed by Mr. M. Devata, Supervising Foundation Engineer.

Equipment used was owned and operated by the P. E. Johnston Diamond Drilling Co. Ltd.

July 1969.

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-31 LOCATION Sta. 29+24 E Co. Rd. No. 24 Reloc'n O/S 16' Lt.

ORIGINATED BY K.K.

W.P. 37-66-05 BORING DATE June 16-19, 1969

COMPILED BY C.M.

DATUM Geodetic BOREHOLE TYPE Washboring -NX Casing; Cone

CHECKED BY *AK*

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — $w_L$	PLASTIC LIMIT — $w_p$	WATER CONTENT — $w$	BULK DENSITY Y P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F.	WATER CONTENT %			
160.7	Ground Level											
158.7 2.0	Top Soil		1	SS	28	160						0-75-18-7
	Silty Sand		2	SS	93							
	Tr. Gravel & Clay		3	SS	60	150						7-68-17-8
144.7 16.0	V. Dense Brown		4	SS	152							
	With Occasional Boulders		5	SS	20/2"	140						No Recovery
135.7 25.0	Sand		6	SS	214							0-94-6-
	( iformaly graded)		7	SS	175	130						
	Tr. Silt & Clay		8	SS	122	120						
	V. Dense Brown to Grey		9	SS	114							0-88-12
114.2 46.5	Clayey Silt to Silty Clay		10	SS	106	110						
	Hard Grey		11	SS	78							
			12	SS	94	100						
			13	SS	92							
92.7 68.0	End of Borehole					90						Probably Boulder

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-31

LOCATION Sta. 29 + 80½ Co. Rd. No. 24 Reloc'n, O/S 16' Rt.

ORIGINATED BY K.K.

W.P. 37-66-05

BORING DATE June 13-23, 1969

COMPILED BY C.M.

DATUM Geodetic

BOREHOLE TYPE Washboring - NX, BX &amp; AX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE	SHEAR STRENGTH P.S.F.			WATER CONTENT %				
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
151.6	Ground Level													
149.6	Topsoil		1	SS	22	150								
2.0	Silty Sand		2	SS	111									
	Tr. Gravel		3	SS	111									
	V. Dense, Brown		4	SS	129									
141.6	Occ. Boulders		5	SS	136									
10.0						140								No recover
	Sand		6	SS	177									
	(uniformly graded)													
	Tr. Silt & Clay		7	SS	165/10"									
	V. Dense		8	SS	114	130								0-82-18
	Brown - Grey		9	SS	129									
	Occ. Gravel Pockets		10	SS	151									0-86-14
			11	SS	171	120								21-70-9
			12	SS	106									
			13	SS	122/7"									
			14	SS	96									
109.6			15	SS	90	110								
42.0	Clayey Silt to Silty Clay		16	SS	68									
	Hard		17	SS	47									
	Grey		18	SS	37									
97.6			19	SS	45	100								
54.0	Boulders up to 9" in size in sand & gravel matrix with Tr. Clay.		20	BX RC	-									Core drilling was necessary to advance borehole through boulders below elev. 97.6
			21	BX RC	-	90								
			22	BX RC	-									
			23	AXT RC AXT	-	80								
			24	RC	-	70								
			25	AXT	-									
			26	RC	-									
			27	AXT RC	-									
71.6														
90.0	End of Borehole					60								



## MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 3

## FOUNDATION SECTION

108 69-F-31

LOCATION Sta. 30+39 Ç Co. Rd. No. 24 Reloc'n, O/S 16' lt.

ORIGINATED BY D.P.


W.P 37-66-05

BORING DATE **June 18-19, 1969**

COMPILED BY C.M.

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY 

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %			BULK DENSITY pcf	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT % 15 30 45				
154.4	Ground Level											
152.4	Topsoil		1	SS	17							5-55-30-10
2.0	Silty Sand-Sandy Silt Tr. Gravel & Clay V. Dense Brown		2	SS	47	150						
144.4			3	SS	81							8-37-51-4 Boulder
10.0	Occ. Boulders up to 6" & random		3A	NX RC	-							
139.4	clayey silt-silt seams		4	SS	94	140						13-3838-11
15.0			5	SS	169							
	Sand (uniformly graded)		6	SS	143							W.L. Elev 134.4
	Tr. clay, silt & gravel		7	SS	175	130						
	V. Dense		8	SS	165							0-89-11
	Brown - Grey		9	SS	107	120						
111.4			10	SS	47							0-93-7
43.0	Silty Clay V. stiff to Hard Grey		11	SS	25	110						
103.4												
51.0	End of Borehole		12	SS	41							

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-F-31 LOCATION Sta. 31+33 & Co. Rd. No. 24 Reloc'n, O/S 16' Rt ORIGINATED BY K.K.  
W.P. 37-66-D5 BORING DATE June 20-23, 1969 COMPILED BY C.M.  
DATUM G BOREHOLE TYPE Washboring - NY Casing CHECKED BY *AK*



SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	W <sub>p</sub>	W	W <sub>L</sub>		
146.6	Ground Level		1	SS	98/6"				15	30	45		GR. SA. SIL. CL.
144.6	Topsoil		2	SS	103				○				10-57-29-4
2.0	Silty Sand with some Gravel Tr. Clay V. Dense Brown		3	SS	91	140							
137.6			4	SS	1100/6"								
9.0	Occ. Boulders up to 8" in size random clayey silt-silt zones		5	SS	142	130							W.L. Elev. 134.6
124.6			6	SS	141								Tip Elev 124.6 No Recovery
22.0	Sand (Uniformly Graded) V. Dense		7	SS	116	120			○				099-1 Tip Elev. 109.6 Piezometers Read June 26/69
116.0	Brown		8	SS	52								
30.6	Silty Clay Hard		9	SS	94	110							
109.6	Gray												
37.0	End of Borehole												
						100							

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 5

FOUNDATION SECTION


JOB 69-F-31 LOCATION Sta. 31+91 C Co. Rd. No. 24 Reloc'n O/S 16' Lt. ORIGINATED BY D.P.  
 W.P. 37-66-05 BORING DATE June 23-24, 1969 COMPILED BY C.M.  
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY Y P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %				
142.6	Ground Level						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE						
140.6	Topsoil		1	SS	11	140							GR, SA, SI, CL
2.0	Silty Sand Tr. Clay Occ. Boulders Upto 8"		2	SS	100/6"								No recovery (Boulder)
130.0			3	SS	154								0-77-23
121.6	Sand (Uniformly Graded) Tr. Silt V. Dense		4	SS	86	130							
21.0			5	SS	26	120							0-97+3
110.6	Clayey Silt to Silty Clay V. Stiff - Hard Grey		6	SS	30								
32.0	End of Borehole		7	SS	30	110							
						100							

## FOUNDATION SECTION

ORIGINATED BY D.P.

COMPILED BY **Q. M.**

CHECKED BY 

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %	BULK DENSITY  Y P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W <sub>p</sub> — W <sub>L</sub> — W <sub>n</sub> WATER CONTENT % 15 30 45		
140.9	Ground Level								
0.0 138.8 2.0	Topsoil	1	SS	8	140		○		
	Sand (uniformly, graded) Tr. Silt & Clay Compact - V. Dense Brown	2	SS	18					
		3	SS	64	130		○		
	Occ. Gravel Pockets	4	SS	97			○		
122.9 18.0	Silty Clay  V. Stiff - Hard  Grey	5	SS	31	120		○—		
		6	SS	26					
		7	SS	33	110		○		
		8	SS	25			○—		
97.9		9	SS	53	100				
43.0	End of Borehole								Encountered Boulders

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-31

LOCATION Sta. 34+00.6 Co. Rd. No 2½ Reloc'n

ORIGINATED BY

D.P.

W/P 37-66-05

BORING DATE June 17-18, 1969

COMPILED BY

C.M.

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — %		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT		PLASTIC LIMIT — %	WATER CONTENT — %		
135.2	Ground Level					SHEAR STRENGTH — P.S.F.		* — %			
						○ UNCONFINED * FIELD VANE		* — %			
						● QUICK TRIAXIAL * LAB VANE		WATER CONTENT %			
								15	30	45	
0.0	Organic Soil- Feat Brown - Black V. Soft.	1	SS	1	130			○ — 418 %			22% org. matter
126.7 8.5	Sand (uniformly graded) Tr. Silt Compact to Dense Brown	2	SS	1							Artesian Water encounter at elev. 125.2 0-91-2
117.2 18.0	Silty Clay V. Stiff to Hard Grey	3	SS	12	120						
		4	SS	42							
		5	SS	20	110						
		6	SS	21							
		7	SS	42							
98.2		8	SS	15 1/2	100						water lost in Borehole below elev. 100
37.0	End of Borehole				90						Practical refusal to casing penetration probably boulders.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-31

LOCATION Sta 24+41 of Co. Rd. No 24 Reloc'n

ORIGINATED BY D.P.

W.P. 37-66-05

BORING DATE June 18, 1969

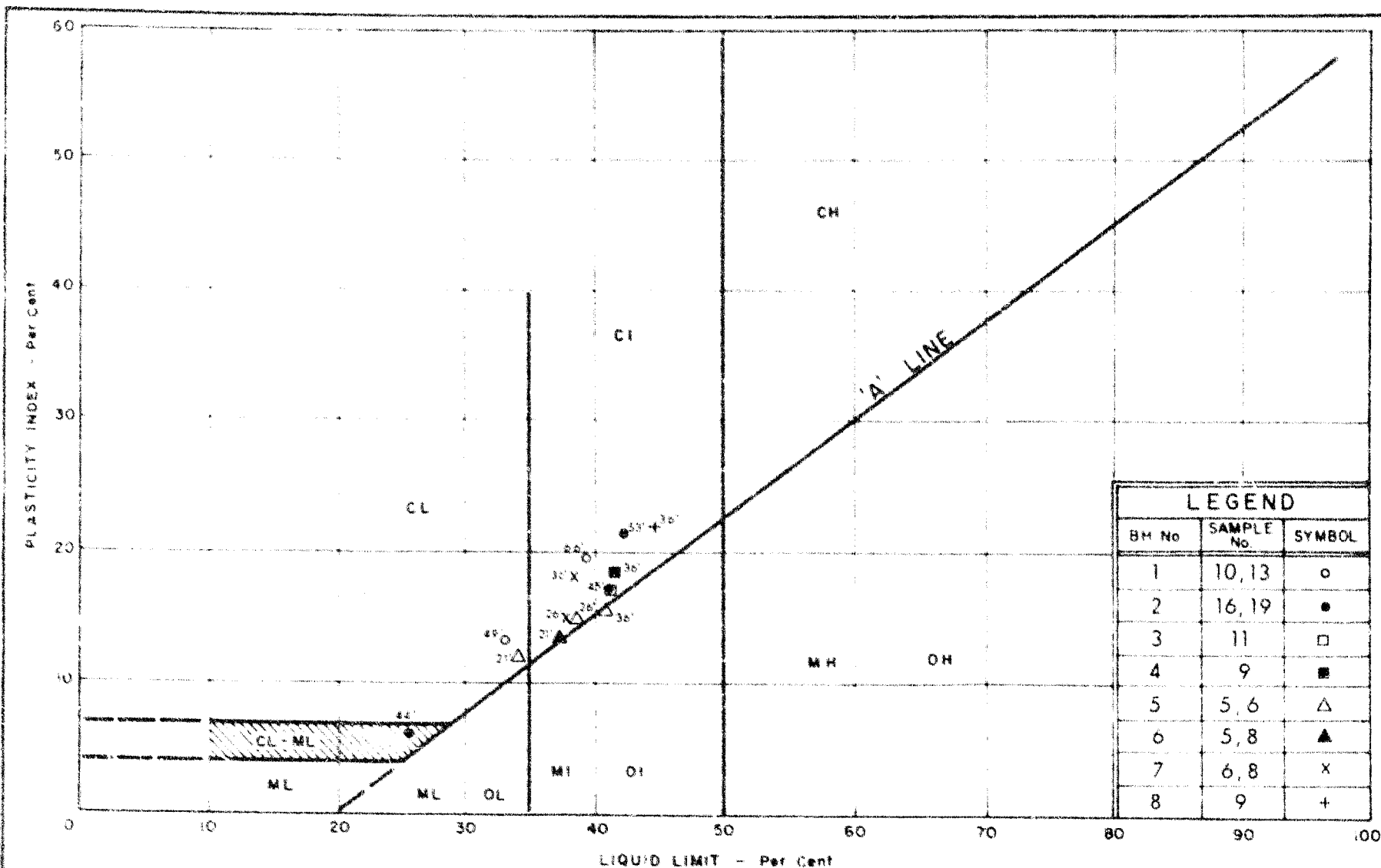
COMPILED BY C.M.

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		BLOWS/FOOT	BLANK	PLASTIC LIMIT	WATER CONTENT		
135.2	Ground Level										
0.0	Organic - Soil	1	SS	1							W.L. elev. 157.2
	Peat with decayed wood	2	SS	1	130						25.3% orgs.
	V. Soft	3	SS	1							W.L. elev. 130.2
	Brown - Black	4	SS	1							Tip Elev. 120.2
124.2	Sand	5	SS	30	120						100-0
11.0	(uniformly graded)	6	SS	34							
118.2	Compact - Dense	7	SS	52							
17.0	Grey	8	SS	52	110						
	Silty Clay	9	SS	71							tip elev. 105.2
	Hard	10	SS	79/10"	100						Piezometers read June 26
99.4	Grey										
35.8	End of Borehole										
					90						



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

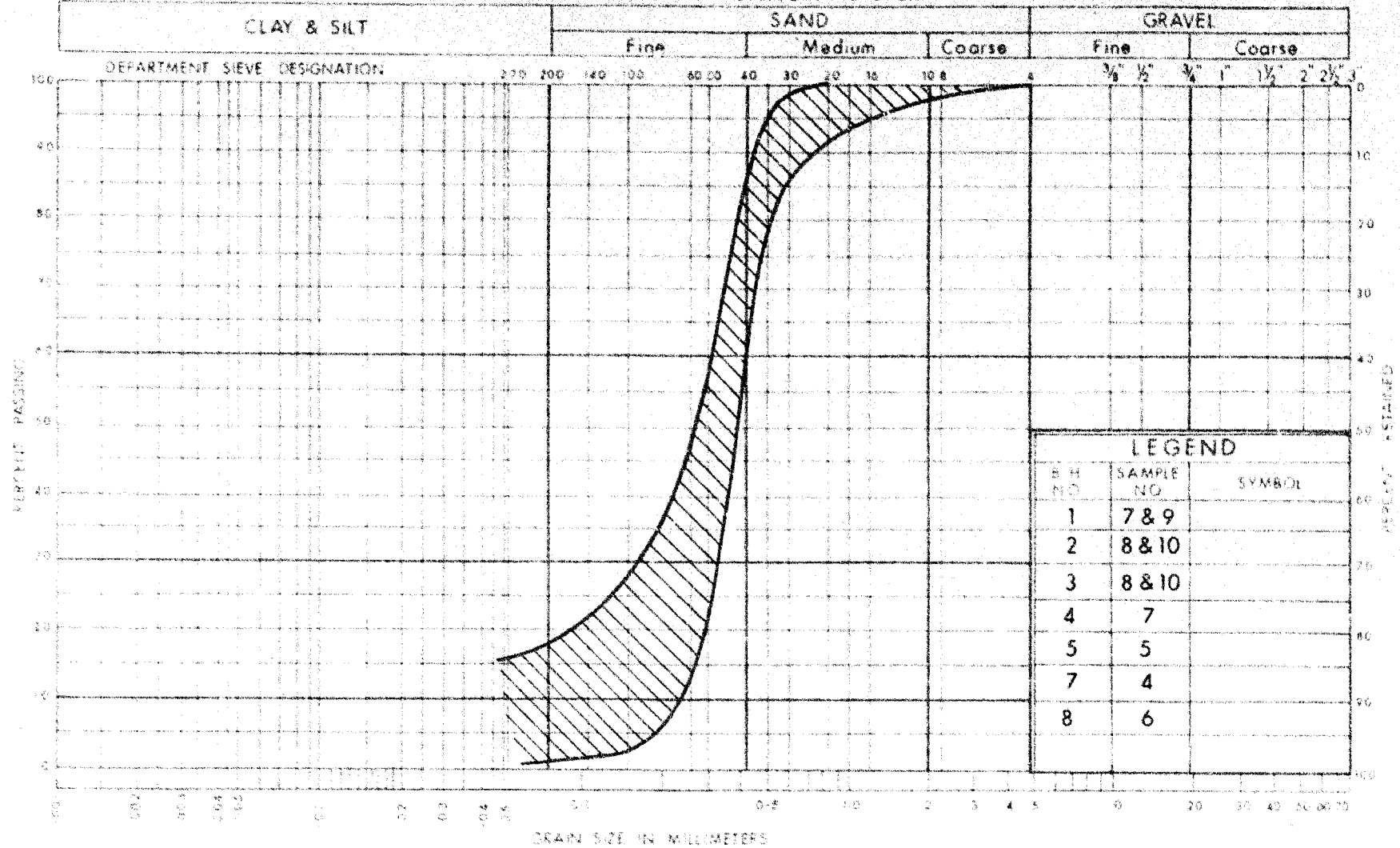
# PLASTICITY CHART CLAYEY SILT TO SILTY CLAY

WP No. 37-66-05

JOB No. 69-F-31

FIG. NO. 3

# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION

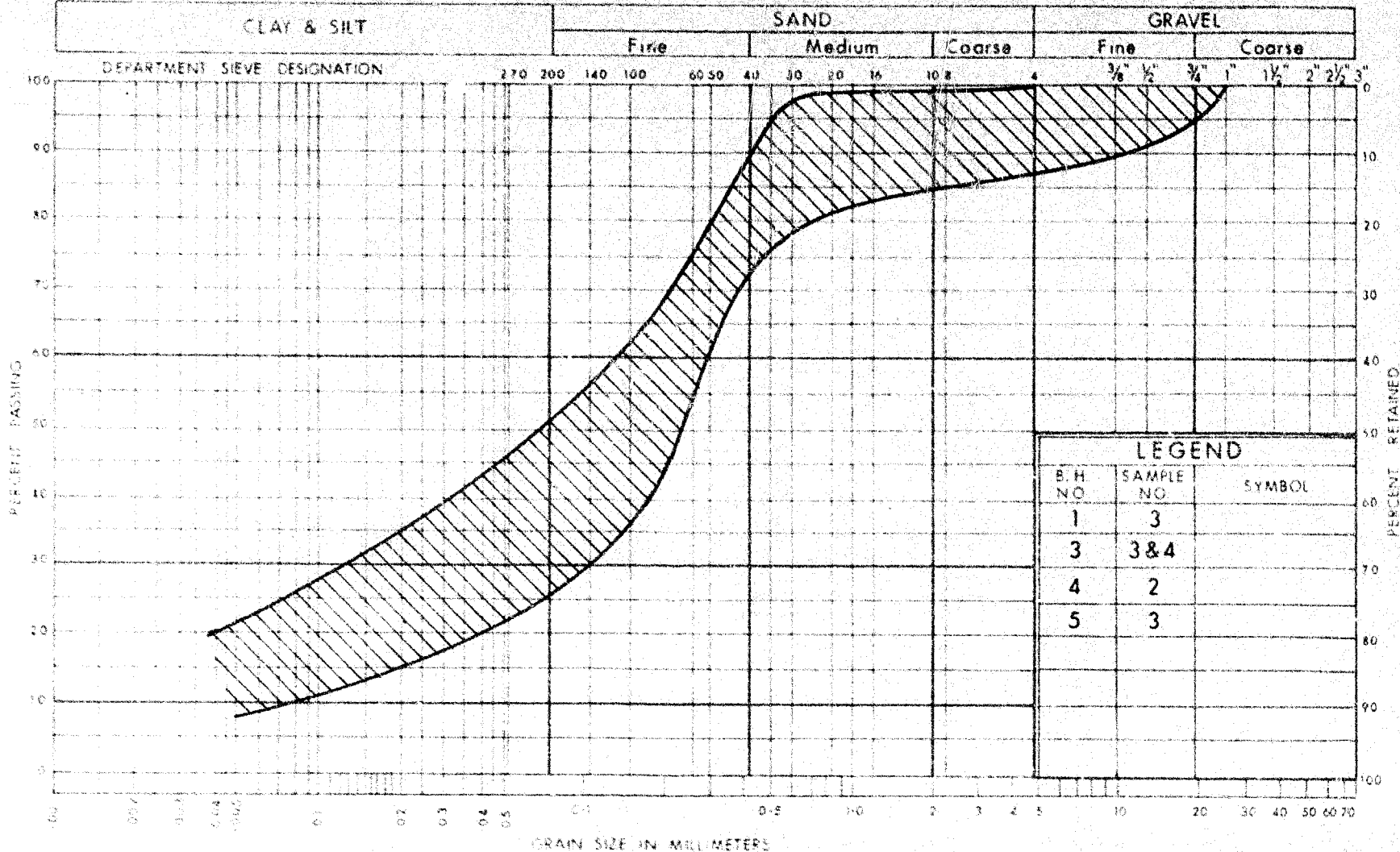
WP No 37-66-05

JOB No. 69-F-31

FIG. NO. 2



# UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
B.H. NO.	SAMPLE NO.	SYMBOL
1	3	
3	3&4	
4	2	
5	3	



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION

W.P. No. 37-66-05

JOB No. 69-F-31

FIG. NO. 1

## 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, FIYED 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

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau$	SHEAR STRENGTH
c	EFFECTIVE COHESION INTERCEPT
$\phi$	EFFECTIVE ANGLE OF SHEARING RESISTANCE OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
S	SENSITIVITY

### GENERAL

$\pi$	$\approx 3.1416$
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ 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
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
e	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

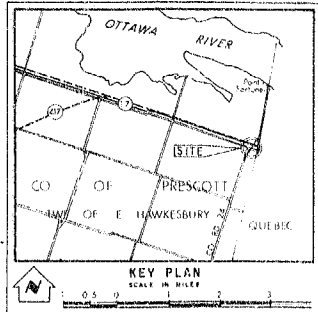
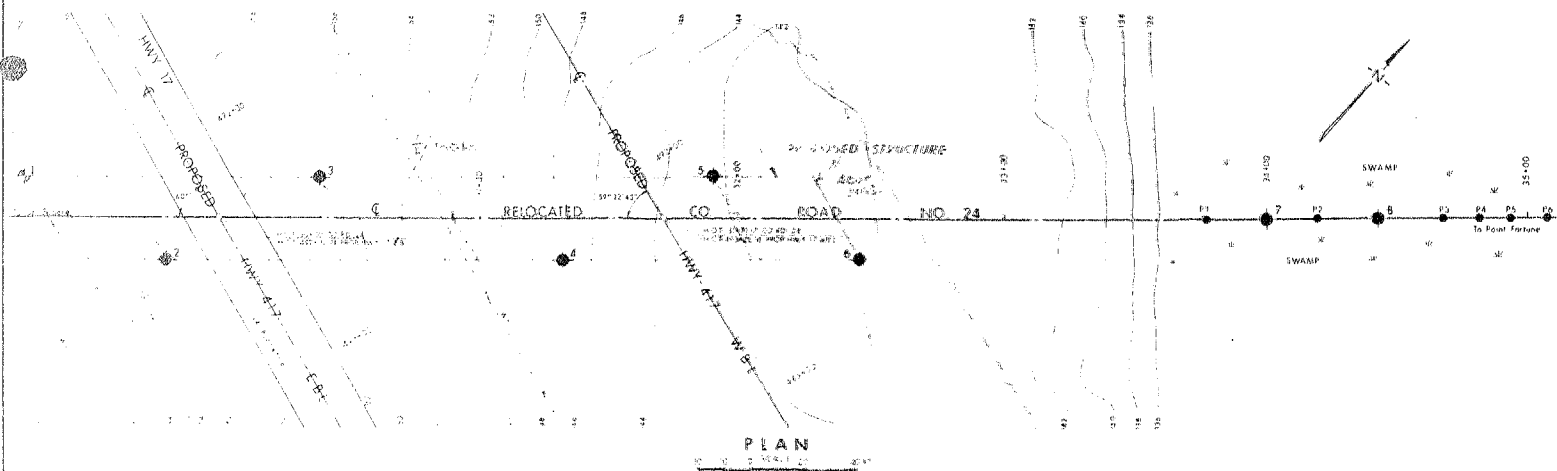
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

### 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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



**LEGEND**

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation: June 1972
- Probe Hole
- Atterberg Shrinkage
- Pyrometer
- Countersink

NO.	ELEVATION	STATION	OFFSET
1	140.7	20+72	10' 1"
2	151.4	20+80	16' 8"
3	154.4	30+19	16' 7"
4	146.6	31+11	16' 8"
5	142.7	31+19	16' 1"
6	140.9	32+47	15' 0"
7	135.2	34+00	5'
8	135.2	34+61	5'
P1	135.2	33+72	5'
P2	135.2	34+18	5'
P3	135.2	34+66	5'
P4	135.2	34+80	5'
P5	135.2	34+83	5'
P6	135.2	35+08	5'

**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.

NO.	STATION	DEPTH	SOIL STRATA
1	20+72	10' 1"	2' TOPSOIL
2	20+80	16' 8"	SAND
3	30+19	16' 7"	Compact to Very Dense
4	31+11	16' 8"	CLAYEY SILT TO SILTY CLAY
5	31+19	16' 1"	W. Silt to Hard
6	32+47	15' 0"	PEAT
7	34+00	5'	Very Soft

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING OFFICE - FOUNDATION SECTION

**RELOCATED COUNTY RD. NO. 24**

KING'S HIGHWAY NO. 417 (L.B.L. & W.B.L.) DIST. NO. 7

CO. PRESQUITT

TWP. E. HAWKESBURY ST. 1 COR. 1 GORE

**BORE HOLE LOCATIONS & SOIL STRATA**

DRAWN BY: [Signature] CHECKED BY: [Signature] DATE: 30 JULY 1972

BORE HOLE NO. 69-F-31A

DATE: 30 JULY 1972

APPROVED BY: [Signature]

PROFILE

Department of Highways Ontario

Copy for the information of  
Foundation Office

Mr. A. Starnac,  
Principal Foundation Engineer,  
Room 107, Lab. Bldg.

C.S. Grebski,  
Bridge Office

June 1, 1970

County Rd. #24 Underpass  
0.1 Mile West of Quebec Border  
W.P. 37-66-15, Site 27-199  
Highway 417, District No. 9

69-F-31

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.

CSG:rd

C.S. Grebski,  
Bridge Design Engineer

Attach.

c.c. Foundation Office

J. L. Lavoie

June 12, 1970

On the map 37-66-15-1743  
there are 14 bridges. The  
one on the 12th bridge is the

## MEMORANDUM

To: Mr. A. G. Stermac,  
Principal Foundation Engineer,  
Laboratory Building,  
Downsview, Ontario.

FROM: Bridge Section,  
Kingston, Ontario.

ATTENTION:

DATE: May 7, 1969.

OUR FILE REF.

IN REPLY TO

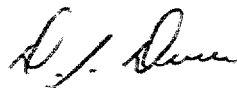
SUBJECT:

W.P. 37-66-15, Site 27-199,  
County Road 24 Underpass,  
(0.1 Miles West of Quebec Border),  
Highway 417, District 9

67-F-31

We are sending to you herewith Preliminary Structure Site Report together with two prints of Bridge Site Plan E-4672-1 on which we have marked in red the proposed location of the subject structure.

Please make the necessary arrangements for foundation soils investigation and we will be pleased to have your report which is scheduled to be completed on or before September 17, 1969.



D. J. Druce  
For: Gavin Scott, P. Eng.  
Regional Bridge Location Engineer

DJD/GS/hl

Encls.

c.c. (with print of Plan)

Bridge Office Files Section

Completion date July 8th 1969

PRELIMINARY STRUCTURE SITE REPORT

69-5-31

HWY. 417 W.P. 37-6615 STATION 492+32.91 DISTRICT 9  
(E.B.L.)  
PLAN NO. 9-F.P.-1 PROFILE NO. 9-F.P.-2 SITE PLAN NO. E-4672-1

Purpose of Structure: River Crossing R.R.X  
Grade Separation X Other \_\_\_\_\_

Is Structure located on D.H.O. right-of-way? Yes. If not, who owns property and was permission obtained to carry out necessary exploration work? \_\_\_\_\_

Describe Soil Conditions at Site. This is to be determined chiefly from a visual observation and possibly a limited amount of hand exploration and should include the general geological formation, anticipated soil conditions, bedrock if visible, etc.

Sandy

Is Structure Site readily accessible with Core Drill or Power Auger?

Yes

Would preliminary borings by Power Auger be advantageous?

Preliminary borings have already been made.

Is water available at the site? No If not, where is closest source?

In creeks within 3 miles of site.

Should Approach Fills be investigated for stability?

Yes

REMARKS: -

DATE May 6, 1969

ENGINEER [Signature]  
Regional Bridge Location Engr.

#69-F-31

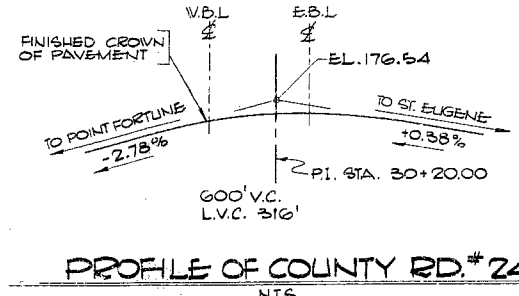
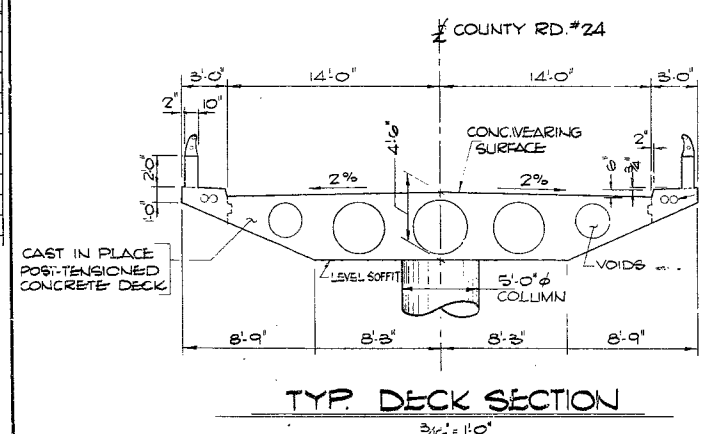
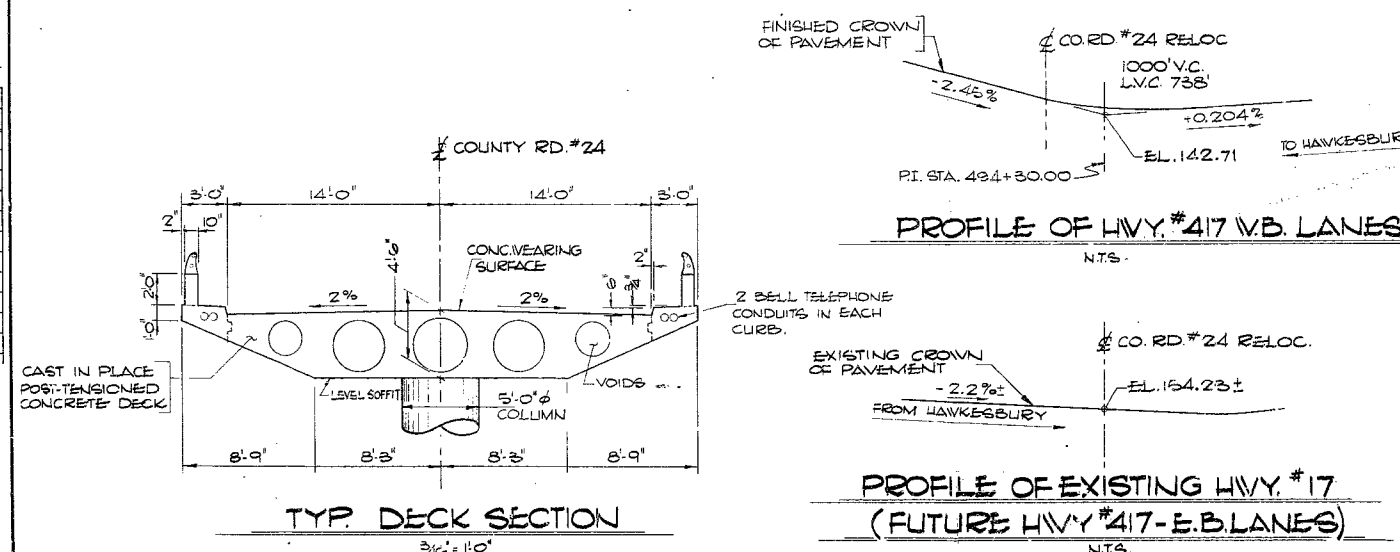
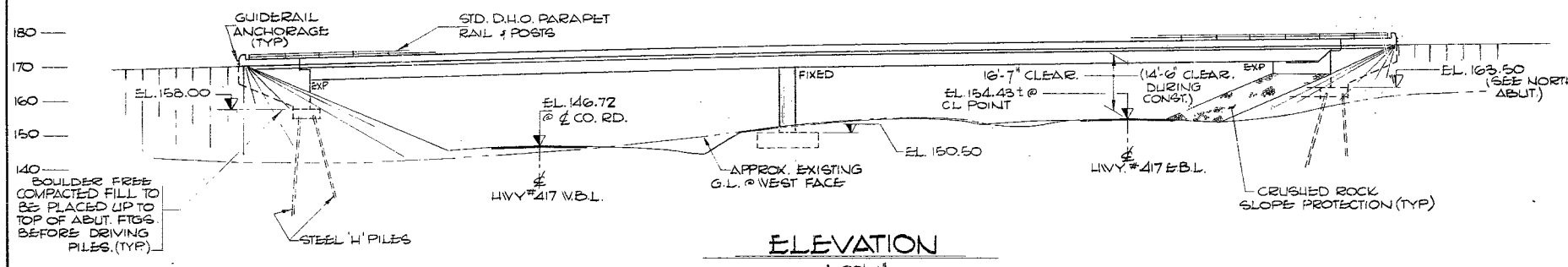
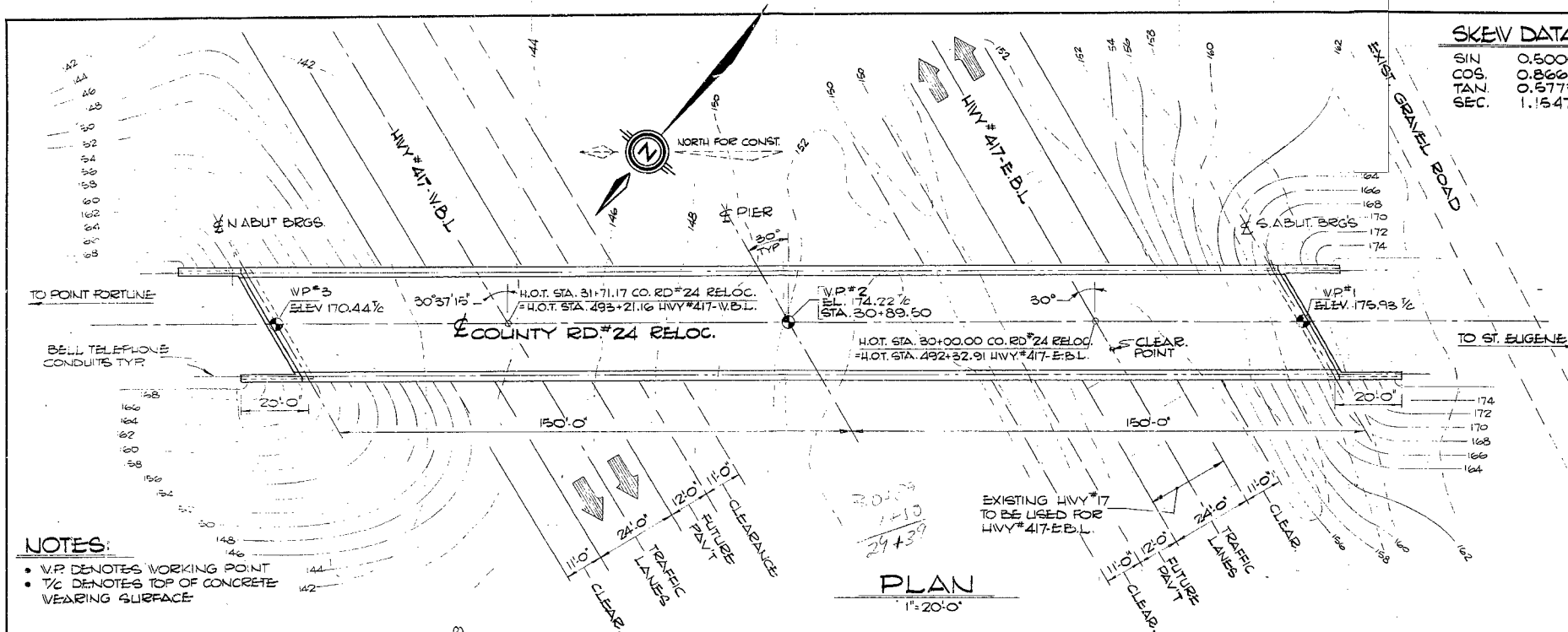
W.B. 37-66-15 (S.T.R.)

HWY #417 (E.B.L. AND W.B.L.)

COUNTY RD. #24

UNDERPASS





REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO  
 BRIDGE DIVISION  
 69-F-31

**COUNTY RD. #24 UNDERPASS**  
 0.1 MILE WEST OF QUEBEC BORDER

KING'S HIGHWAY No. 417 DIST. No. 9  
 CO. PRESCOTT  
 TWP. E. HAWKESBURY LOT BROKEN LOT CON. I GORE

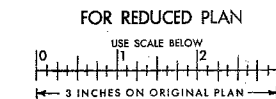
**GENERAL LAYOUT**

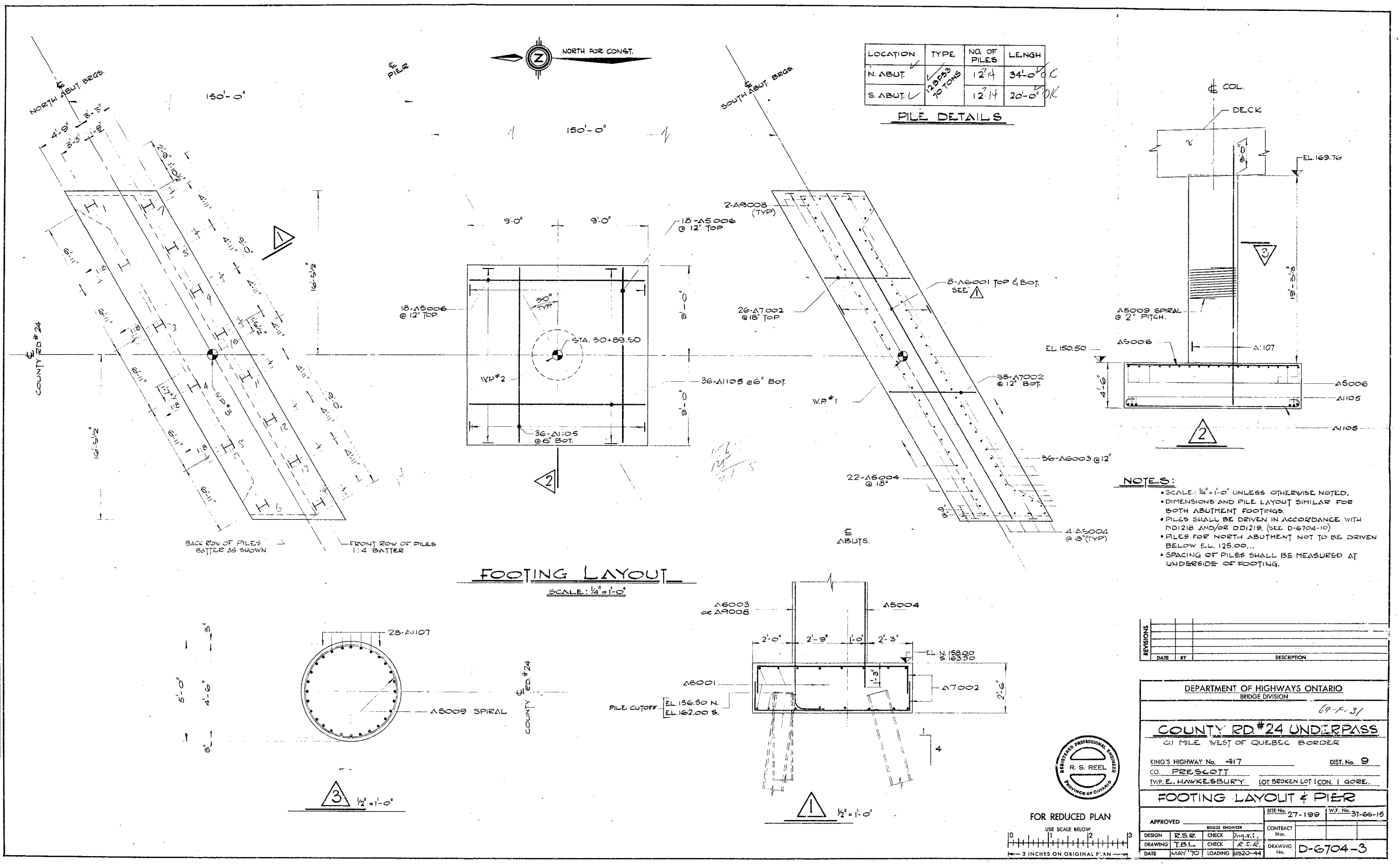
APPROVED \_\_\_\_\_  
 BRIDGE ENGINEER

DESIGN R.S.R. CHECK J.P.S.  
 DRAWING G.D.T. CHECK R.S.R.  
 DATE MAY '70 LOADING 15-20-44

CONTRACT No. \_\_\_\_\_  
 DRAWING No. D-6704-1

SITE No. 27-199 W.P. No. 37-66-15





PRINT RECORD		
No.	FOR	DATE