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GEOCRES No. 32D-5

DIST. 14 REGION Northern

W.P. No. 68-70-01


CONT. No. 76-102

W. O. No. \_\_\_\_\_

STR. SITE No. \_\_\_\_\_

HWY. No. 101

LOCATION Mattawasaga River  
Bridge

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 

REMARKS: documents to be unfolded  
before microfilming

# FOUNDATION INVESTIGATION REPORT

For

Mattawasaga River Bridge  
Hwy. 101, District 14, New Liskeard  
W.P. 68-70-2201

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## INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project. Fieldwork was done during the periods July 22nd and 23, 1969 and September 11th to 15, 1970, using a continuous flight auger machine equipped with solid augers and a conventional diamond drill adapted for soil sampling purposes.

## SITE DESCRIPTION

The site is located at the Mattawasaga River on Hwy. 101 some 41 miles east of Matheson. The surrounding area is bush covered and the topography is rolling.

The existing bridge consists of a 40 ft. steel beam main span with transverse laminated timber deck on timber pile bents. It is in very poor condition and in August, 1971 a 140 ft. span single standard wide Bailey Bridge was erected over the deck.

The river was only some 2 feet deep at the time of the investigation and the river bed lies 17 feet below the existing road grade. The approach fills to the existing structure are approximately 5 feet high at elev. 906.0. The fill was seen to consist of granular material with numerous boulders - no boreholes were undertaken through this fill.

## SUBSURFACE CONDITIONS

### General

The subsoil at the site consists of an initial layer of clayey silt with organics and sand overlying clay with some sand, organic clay with sand, silty clay to clay, clayey silt and, finally, sand, silt and gravel. One borehole only - i.e., B.H. #1, penetrated the silt, sand and gravel layer mentioned; once this point was reached, artesian water was released.

In Boreholes #5 and #7 the layer was reached as indicated by the emergence of artesian water.

A general plot of shear strength against depth for the subsoil is shown in Fig. #6.

The boundaries between the different deposits are shown on the Record of Borehole Sheets contained in the Appendix, together with descriptions of the soil types. The estimated stratigraphical profile shown on Dwg. 39E-155-2 of the Contract Drawings is based upon this information. From ground level downwards, the different deposits are described as follows:

Clayey Silt With Organic and Some Sand

This material was found in boreholes #1, #2 and #5 and varied in depth from 5.0 ft. to 11.0 ft. 'N' values as obtained from the Standard Penetration Test, varied from 6 to 13 blows/ft. indicating soft to stiff consistency. Field and laboratory tests gave the following results:

Moisture Content %	23 - 53
Liquid Limit %	29 - 34)
Plastic Limit %	15 - 21) (in non-organic zones)
Grain Size Analysis %	Gra. 0, Sa. 8-21, Si. 58-67 Cl. 21-25
Organic Content %	4.8 - 7.1
Bulk Density p.c.f.	104
Unconfined Shear Strength p.s.f.	280
Field Vane Tests p.s.f.	650
Sensitivity	4

Typical grain size distribution curves are shown in Fig. #1 in the Appendix.

Clay With Some Sand, Traces of Organics

This material was found in borehole #5 only, underlying the initial clayey silt deposit. The stratum was only 3 feet thick. The only 'N' value obtained had a value of 3 blows/ft., indicating a soft consistency. Field and laboratory tests gave the following results:

Moisture Content %	44
Liquid Limit %	55
Plastic Limit %	24
Field Vane Tests p.s.f.	920
Sensitivity	23

### Organic Clay With Sand

This material was found in borehole #5 only, underlying the clay deposit and had a thickness of 8 feet. The consistency of the material as indicated by the shear strength results, is estimated to be soft to firm. Field and laboratory tests gave the following results:

Moisture Content %	95 - 139	
	<u>Air-Dried</u>	<u>Oven-Dried</u>
Liquid Limit %	78 - 87	63 - 65
Plastic Limit %	56 - 61	48 - 55
Organic Content %	15.9 - 26	
Grain Size Analysis %	Gra. 0, Sa. 30 - 40, Si. 50 - 54 Cl. 10 - 16	
Bulk Density p.c.f.	80 - 85	
Unconfined Shear Strength p.s.f.	200 - 350	
Field Vane Test p.s.f.	800 - 900	
Sensitivity	11 - 21	

A plot of Plasticity Index against Liquid Limit and a typical grain size distribution curve are shown in the Appendix in Fig. #2 and #3, respectively.

### Silty Clay to Clay With Seams of Silt

This material was found as the surficial deposit in borehole #7 and to underlie the organic clay in borehole #5 and the clayey silt in boreholes #1 and #2. The thickness of the stratum varied from 6 feet to 24 feet. The consistency of the deposit as indicated by the shear strength obtained, is very soft to soft.

Field and laboratory tests gave the following results:

Moisture Content %	30 - 85	
Liquid Limit %	36 - 72	
Plastic Limit %	20 - 29	
Grain Size Analysis %	Gra. 0, Sa. 0 - 4, Si. 30 - 90 Cl. 10 - 66	
Bulk Density p.c.f.	96 - 116	
Unconfined Shear Strength p.s.f.	80 - 550	
Field Vane Tests p.s.f.	160 - 640	
Sensitivity	2.4 - 10.0	

Traces of organic material were found in the portion of the deposit lying in borehole #5; here the organic content varied from 1.2% to 3.8%. A plot of Plasticity against Liquid Limit is shown in Fig. #4 in the Appendix.

#### Clayey Silt With Seams of Sand, Silt and Silty Clay

This material was found in boreholes #1 and #7 only, below the silty clay to clay layer and varied in thickness from 12 to 15 feet. Its consistency as indicated from the shear strength results ranges from very soft to firm.

Field and laboratory tests gave the following results:

	<u>Clayey Silt</u>	<u>Silty Clay</u>
Moisture Content %	28 - 44	50 - 85
Liquid Limit %	23 - 30	38 - 47
Plastic Limit %	15 - 19	22 - 27
Grain Size Analysis %	Gra. 0, Sa. 0 - 25, Si. 42 - 90 Cl. 10 - 33	
Bulk Density p.c.f.	100 - 123	
Unconfined Shear Strength p.s.f.	200 - 1,000	
Field Vane Tests p.s.f.	300 - 880	
Sensitivity	1.8 - 4.3	

Plots of Plasticity Index against Liquid Limit are shown in Fig. #5 in the Appendix.

#### Silt, Sand and Gravel

As mentioned earlier in the report, only borehole #1 penetrated this layer.

The single Standard Penetration test performed on the material gave an 'N' value of 62 blows/3". This value plus the results of the cone tests indicate a compact to very dense material. Insufficient material was recovered to perform any laboratory tests.

The upper surface of the granular layer is estimated to vary from elev. 866.6 to 853.4 in boreholes #7 and #1, respectively, where it underlies the lower clayey silt layer and from elev. 879.8 to 864.6 in boreholes #5 and #2, respectively, where it underlies the silty clay to clay layer.

Groundwater

An artesian condition exists in the silt, sand and gravel deposit; where this layer was reached, the height above ground level which the water reached inside the casing was noted; the results are as recorded below:

Borehole #1	900.9 (4.3' above ground level)
Borehole #5	903.4 (1.8' above ground level)
Borehole #7	not taken

Existing groundwater elevations were noted as below:

Borehole #1	891.6
Borehole #2	891.0
Boreholes #5 & 7	unable to be taken - most probably lie around 6 ft. below ground level as in #1 & #2

*P. Payer*  
P. Payer, P. Eng.  
Senior Engineer



*K.G. Selby*  
K.G. Selby, P. Eng.  
Supervising Engineer

KGS/PP/gs  
October, 1976

## RECORD OF BOREHOLE NO 1

WP	68-70-02	LOCATION	Sta. 109 + 58 o/s 23' Rt. of Hwy. 101	ORIGINATED BY	PP
DIST	14 HWY 101	BORING DATE	July 22, 1969	COMPILED BY	PP
DATUM	Geodetic	BOREHOLE TYPE	Augering & Washboring and Cone Test	CHECKED BY	<i>[Signature]</i>

[illegible]

15  $\overset{20}{\underset{10}{\diamond}}$  5 % STRAIN AT FAILURE

## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE NO 2

WP 68-70-02

LOCATION Sta. 108 + 91 o/s 30' Lt. # Hwy. 101

ORIGINATED BY PP

DIST 14 HWY 101

BORING DATE July 22, 1969

COMPILED BY MV

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger and Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$ PCF	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$		
897.6	Ground Level															
0.0	Clayey silt with organics and some sand		1	SS	13	890										
	Soft to firm		2	TW	PM											
885.1																
12.5	Silty clay to clay with silt seams		3	TW	PM	880										
			4	TW	PM											
	Very soft to soft		5	TW	PM	870										
			6	TW	PM											
864.6																
33.0	End of Borehole					860										
	Probably sand, silt & gravel															
852.7	Very dense															
44.9	End of cone test					850										

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10



## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE No 3

WP 68-70-02 LOCATION Sta. 108 + 52 o/s 21' Rt. & Hwy 101 ORIGINATED BY PP  
 DIST 14 HWY 101 BORING DATE July 23, 1969 COMPILED BY PP  
 DATUM Geodetic BOREHOLE TYPE Cone Penetration Test Only CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ $w_p$ — $w$ — $w_L$ WATER CONTENT %	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
905.1 0.0	Ground Level									
853.7										
51.4	End of Cone Test									

## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE NO 4

WP 68-70-02 LOCATION Sta. 110 + 16 o/s 43' Lt. of Hwy. 101 ORIGINATED BY PP  
 DIST 14 HWY 101 BORING DATE July 23, 1969 COMPILED BY MV  
 DATUM Geodetic BOREHOLE TYPE Cone Penetration Test Only CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT <u>W<sub>L</sub></u> PLASTIC LIMIT <u>W<sub>P</sub></u> WATER CONTENT <u>W</u>			UNIT WEIGHT <u>Y</u>	REMARKS			
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH ○ UN. CONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					W <sub>P</sub>	W	W <sub>L</sub>
896.6	Ground Level																		
0.0																			
840.5																			
56.1	End of Cone Test																		

## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE NO 5

WP 68-70-02

LOCATION Sta. 107 + 67 o/s 41' Rt. &amp; Hwy 101

ORIGINATED BY JA

DIST 14 HWY 101

BORING DATE Sept. 11, 1970

COMPILED BY GA

DATUM Geodetic

BOREHOLE TYPE Washboring, NX Casing &amp; Cone test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$ PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$	
900.3	Ground Level					ELEV	400	800	1200	1600	2000	25	50	75	GR SA SI CL
0.0	Clayey silt with some sand & traces organics		1	SS	6	900									
895.8	Firm														
5.0	Clay with some sand & traces organics.		2	SS	3										
893.0	Soft														
7.8	Org.-ic clay with sand		3	TW	PM	890									15.9% org.
			4	TW	PM										2.6% org.
885.0	Soft to firm		5	TW	PM										0.30 54 16
15.8	Silty clay with traces of organics		6	TW	PM										16.8% org.
879.8	Soft					880									0.40 50 10
21.0	End of Borehole														
	Probably sand, silt & gravel														
870.3	Dense to very dense					870									Artesian Water Encountered
30.5	End of Cone Test														

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE NO 6

DATUM Geodetic BOREHOLE TYPE Cone Penetration Test only CHECKED BY [Signature]

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

## ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE NO 7

WP 68-70-02

LOCATION Sta. 112 + 56 o/s 39' Lt. of Hwy. 101

ORIGINATED BY GA

DIST 14 HWY 101

BORING DATE Sept. 14, 1970

COMPILED BY GA

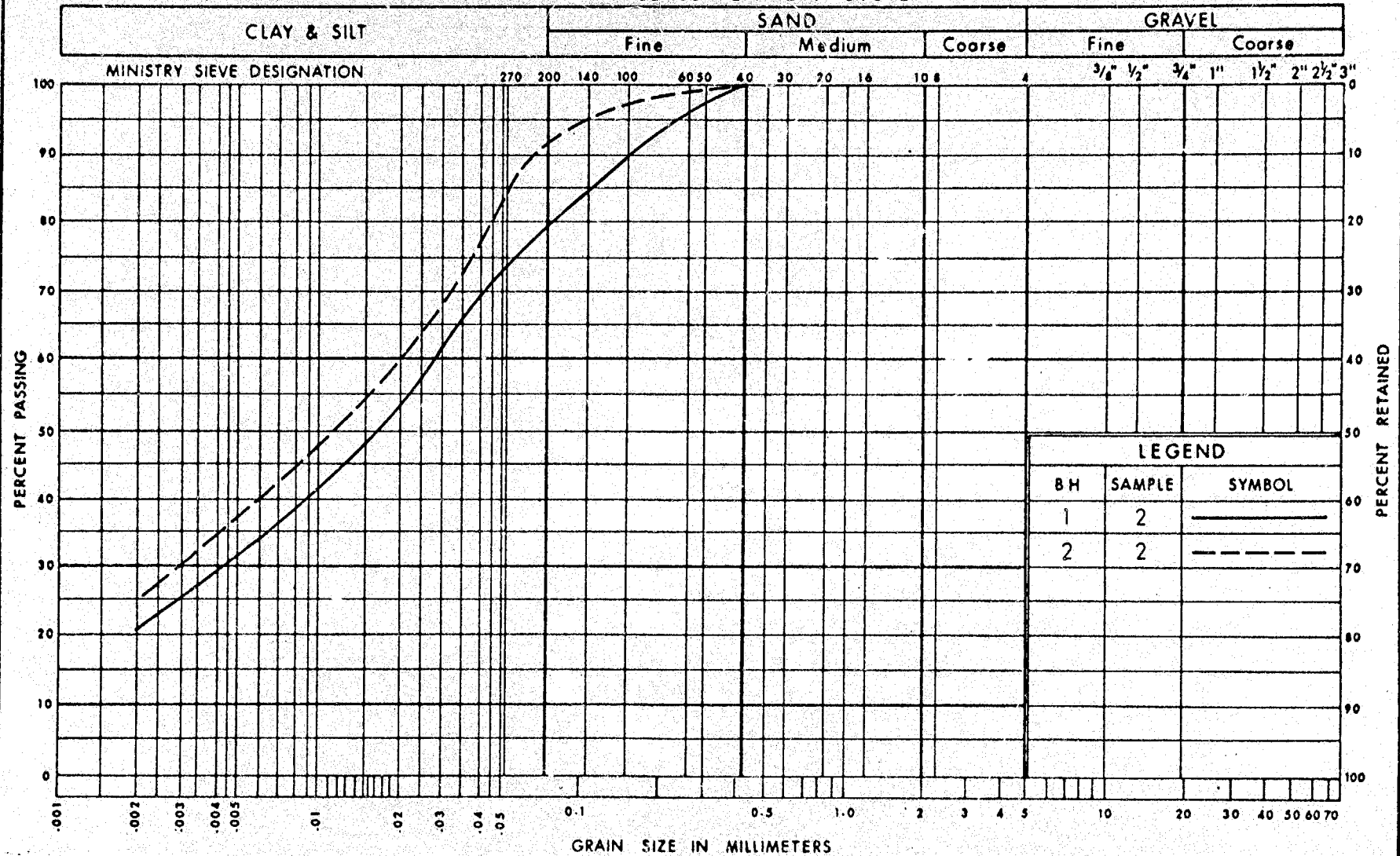
DATUM Geodetic

BOREHOLE TYPE Washboring, NX Casing &amp; Cone test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		20	40	60	80	0	$w_p$	$w$	$w_L$		
901.6	Ground Level					ELEV	400	800	1200	1600	2000	25	50	75	PCF	GR SA SI CL
0.0	Silty clay to clay with seams of silt		1	TW	PM	900									101.5	
			2	TW	PM										98.5	
			3	TW	PM										96	
	Very soft to soft		4	TW	PM	890									98	
			5	TW	PM										102	
880.															99	
21.6	Clayey silt with seams of sand, silt & silty clay.		6	TW	PM	880									100	
			7	TW	PM										105	0 25 42 33
	Soft		8	TW	PM	870									114	
866.6	End of Borehole														119	
35.0	Probably sand, silt & gravel					860										Artesian Water Encountered
	Compact to very dense					850										
843.6											150					
58.0	End of Cone Test					840										

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

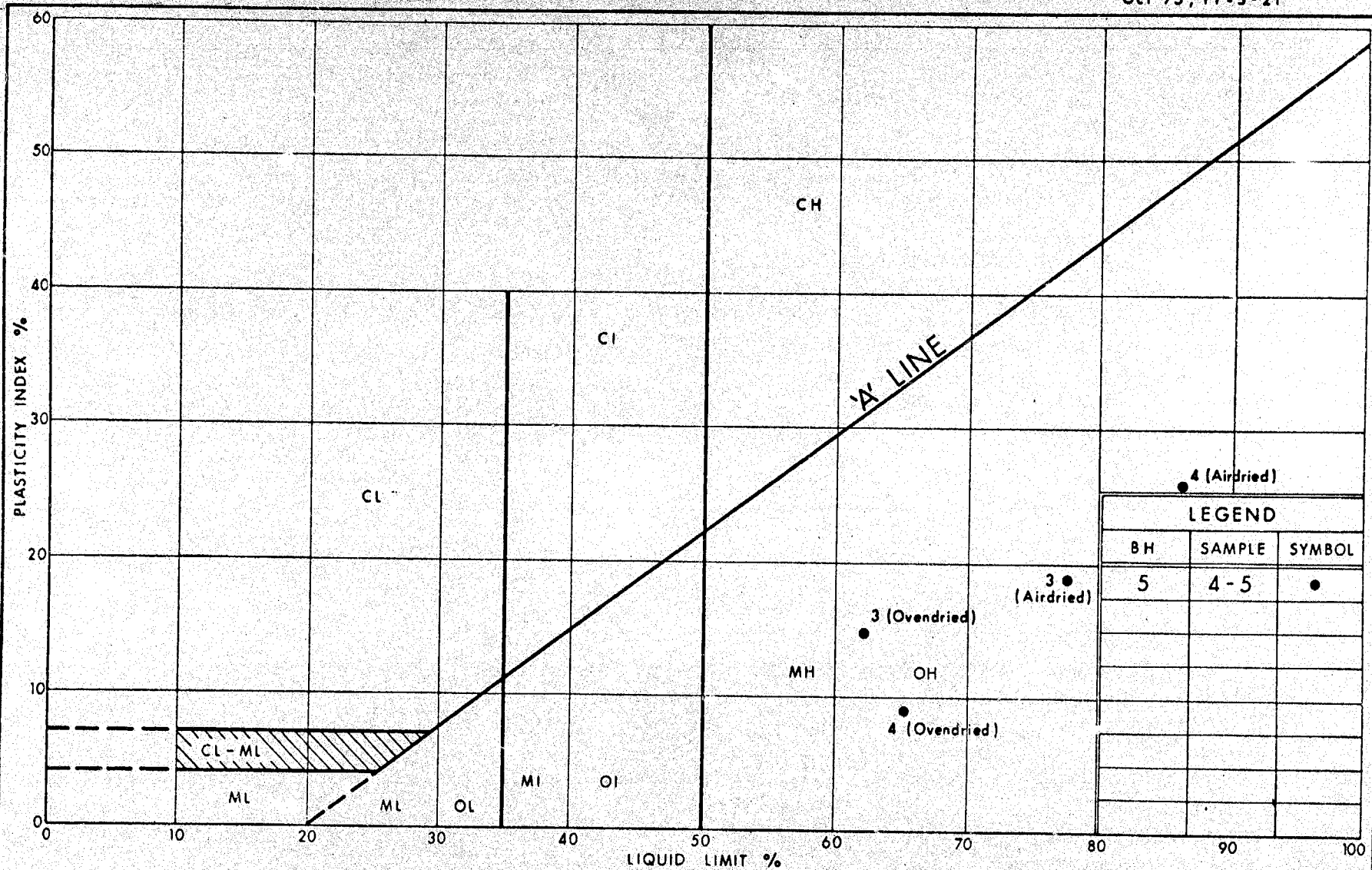
Ontario

ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT  
ORGANICS & SOME SAND

FIG No 1

W P 68-70-02

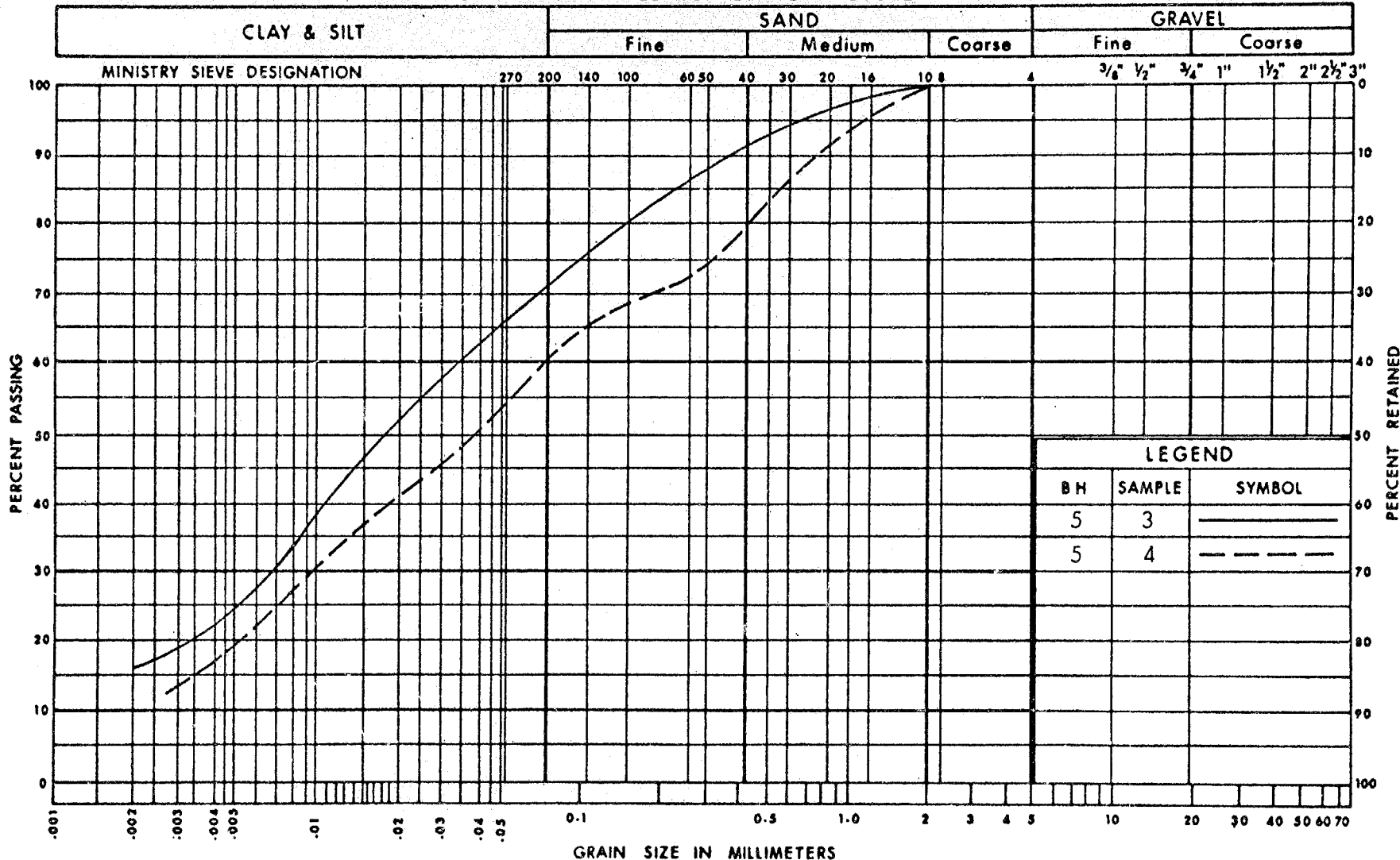


Ministry of  
Transportation and  
Communications  
Ontario  
ENGINEERING SERVICES BRANCH

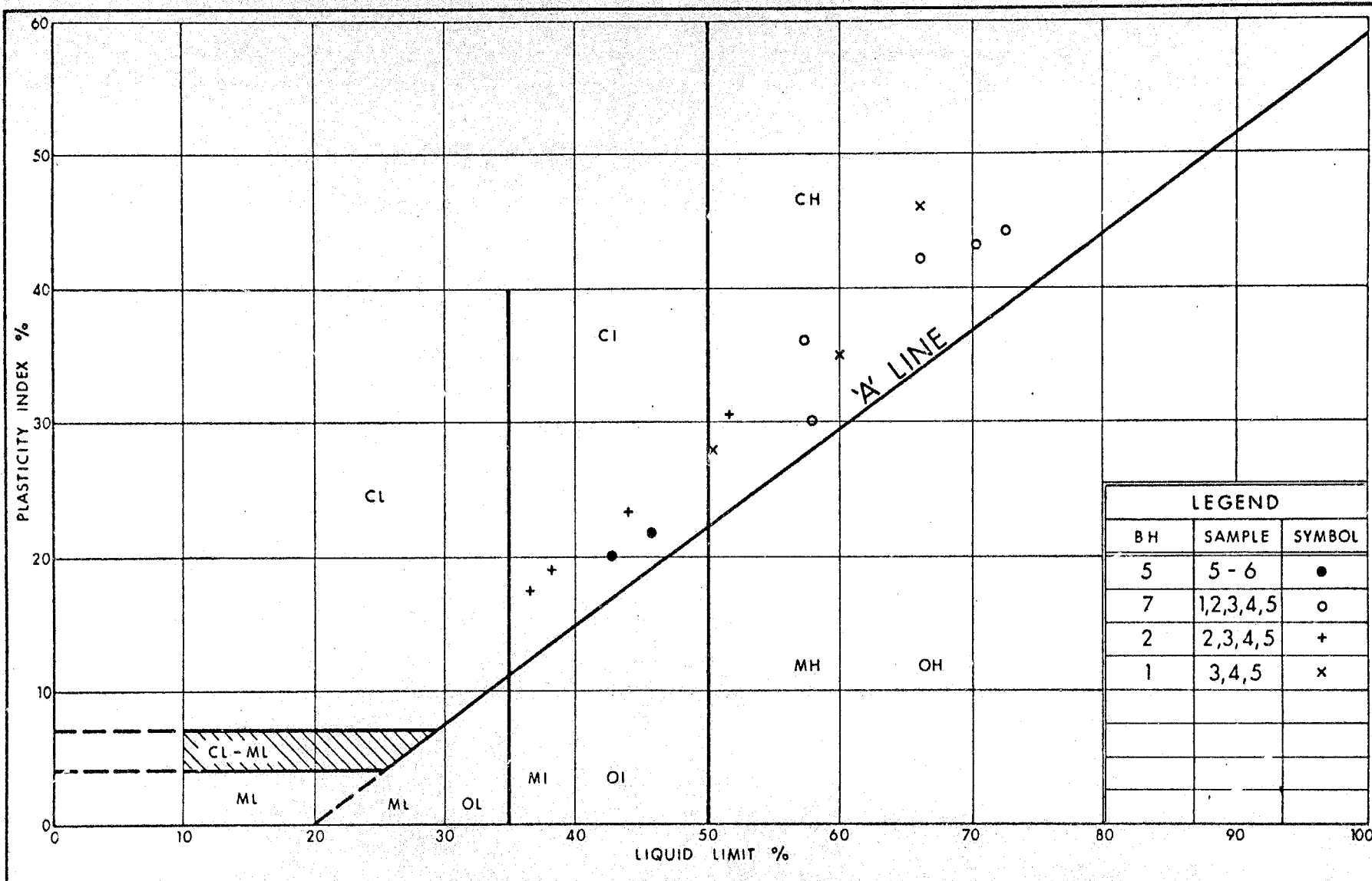
# PLASTICITY CHART ORGANIC CLAY WITH SAND

FIC No. 2  
W P 68-70-02

# UNIFIED SOIL CLASSIFICATION SYSTEM







Ontario

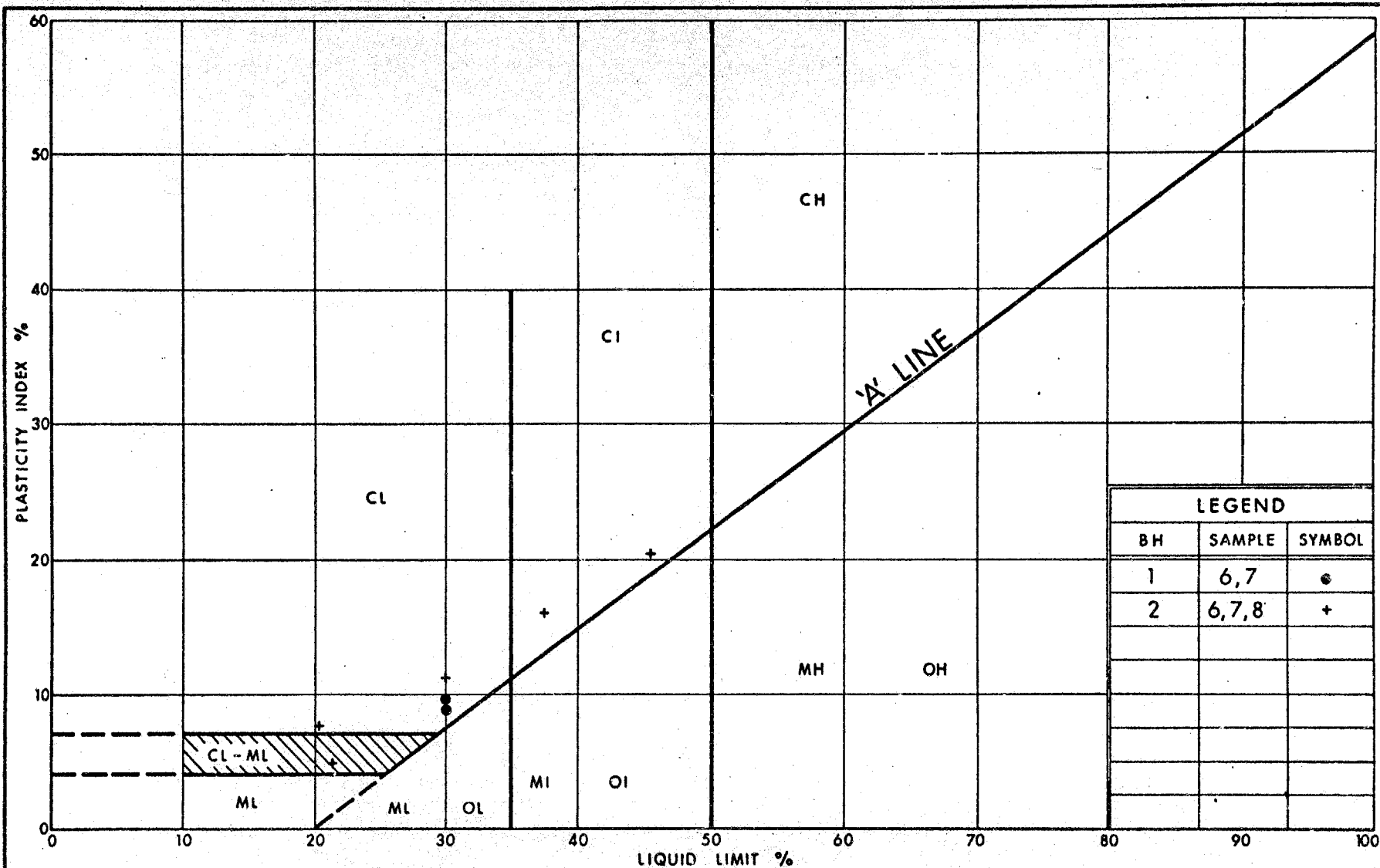
Ministry of  
Transportation and  
Communications

ENGINEERING SERVICES BRANCH

# PLASTICITY CHART SILTY CLAY TO CLAY

FIG No 4

W P 68-70-02



Ontario  
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Communications

PLASTICITY CHART  
CLAYEY SILT  
SEAMS OF SAND, SILT & SILTY CLAY

FIG No 5  
W P 68-70-02

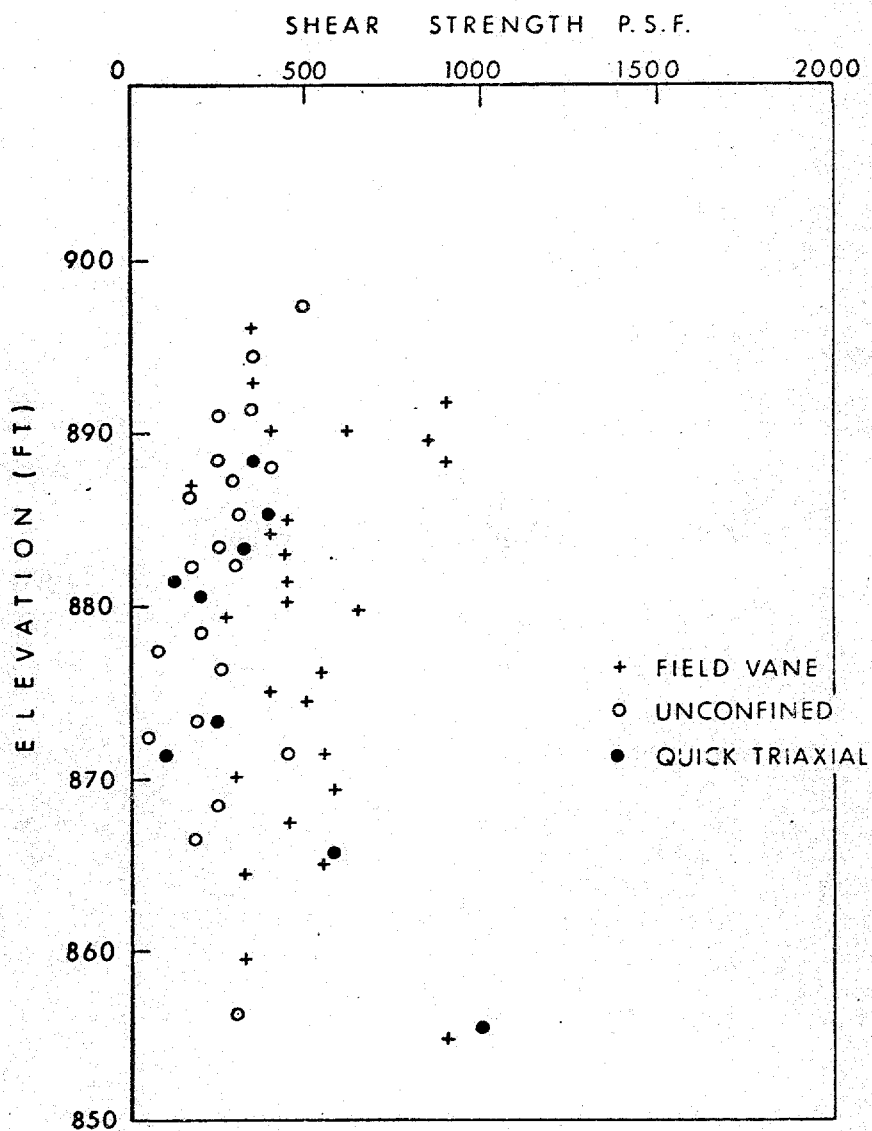


FIG. 6

W.P. 68-70-02

FOUNDATION INVESTIGATION REPORT  
For  
Mattawasaga River Structure  
Highway #101  
District No. 14 (New Liskeard)  
W.O. 70-11072 -- W.P. 68-70-01

1. INTRODUCTION:

A foundation investigation was previously undertaken at the above mentioned site in July, 1969, at which time it was anticipated that the new structure would be in the same location as the existing bridge; the results of this investigation, however, indicated that a new alignment may be more feasible. This report investigates an area covering both sides of the existing bridge and incorporates the results obtained in the initial investigation (#69-F-58).

2. DESCRIPTION OF THE SITE:

The site is located in the Mattawasaga River on Hwy. #101 some 41 miles east of Matheson. The surrounding area is bush-covered and the topography is rolling.

The existing bridge consists of a 40-ft. steel beam main span with transverse laminated timber deck on timber pile bents. It is in very poor condition and the Foundation Section have already recommended a new bridge at an early date. (Presently the existing bridge is being kept under surveillance and any repair work required being done by District personnel.)

The river was only some 2 feet deep at the time of the investigation and the river bed lies 17 feet below the existing road grade. The approach fills to the existing structure are approx. 5 feet high at elev. 906.0. The fill was seen to consist of granular material with numerous boulders - no boreholes were undertaken through this fill.

### 3. FIELD AND LABORATORY WORK:

A total of 2 boreholes (No. 5 and 7) and 3 cones - (5, 6 and 7), was carried out during the course of the field work. Two boreholes (Nos. 1 and 2) and 4 cones (Nos. 1, 2, 3 and 4) done under W.J. 69-F-58, are also included in this report.

Boring was achieved by means of a Diamond Drill adapted for soil sampling purposes. Undisturbed samples were recovered using a 2" I.D. Shelby tube pushed manually into the soil, while disturbed samples were recovered using a split-spoon sampler which was driven into the soil according to the requirements of the Standard Penetration Test.

The locations and elevations of the boreholes were surveyed in the field by the author, and are shown in Dwg. 70-11072A which accompanies this report.

All samples were visually identified in the field and then returned to the laboratory where further tests were carried out to determine Atterberg limits, moisture contents, particle size distribution, unconfined compressive strength, organic content, and consolidation characteristics.

### 4. SUBSOIL CONDITIONS:

#### 4.1) General:

The subsoil at the site consists of an initial layer of clayey silt with organics and sand overlying clay with some sand, organic clay with sand, silty clay to clay, clayey silt and, finally, sand, silt and gravel. One borehole only - i.e., B.H. No. 1, penetrated the silt, sand and gravel layer mentioned; once this point was reached, artesian water was released. In Boreholes #5 and #7 the layer was reached as indicated by the emergence of artesian water, and in B.H. #2 the upper level of the layer was estimated from the results of the cone penetration test.

A general plot of Shear Strength against Depth for the subsoil is shown in Fig. #6.

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

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

The boundaries between the different deposits are shown on the Record of Borehole sheets, together with descriptions of the soil types. The estimated stratigraphical profile shown in Dwg. 70-11072A is based upon this information. From ground level downwards, the different deposits are described as follows:

4.2) Clayey Silt with Organic and some Sand:

This material was found in boreholes 1, 2, and 5 and varied in depth from 5.0' to 11.0'. 'N' values as obtained from the Standard Penetration Test, varied from 6 to 13 blows/ft. indicating a consistency of soft to stiff. Field and laboratory tests gave the following results:

Moisture Content %	23 - 53	
Liquid Limit %	29 - 34	}-(In non-organic zones)
Plastic Limit %	15 - 21	
Grain-Size Analysis %	Gra. 0, Sa. 8-21, Si. 58-67, Cl. 21-25	
Organic Content %	4.8 - 7.1	
Bulk Density p.c.f.	104	
Unconfined Shear Strength p.s.f.	280	
Field Vane tests p.s.f.	650	
Sensitivity	4	

Typical grain-size distribution curves are shown in Fig. #1 in the Appendix.

4.3) Clay with some Sand, traces of Organics:

This material was found in borehole #5 only, underlying the initial clayey silt deposit. The stratum was only 3 feet thick. The only 'N' value obtained had a value of 3 blows/ft.,

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

4.3) Clay with some Sand, traces of Organics: (cont'd.) ...

indicating a consistency of soft. Field and laboratory tests gave the following results:

Moisture Content %	44
Liquid Limit %	55
Plastic Limit %	24
Field Vane tests p.s.f.	920
Sensitivity	23

4.4) Organic Clay with Sand:

This material was found in borehole #5 only, underlying the clay deposit and had a thickness of 8 feet. The consistency of the material as indicated by the shear strength results, is estimated to be soft to firm. Field and laboratory tests gave the following results:

Moisture Content %	95 - 139	-
	<u>Air-dried:</u>	<u>Oven-dried:</u>
Liquid Limit %	78 - 87	63 - 65
Plastic Limit %	56 - 61	48 - 55
Organic Content %	15.9 - 26	
Grain-size Analysis %	Gra. 0, Sa. 30 - 40, Si. 50 - 54, Cl. 10 - 16	
Bulk Density p.c.f.	80 - 85	
Unconfined Shear Strength p.s.f.	200 - 350	
Field Vane tests p.s.f.	800 - 900	
Sensitivity	11 - 21	

A plot of Plasticity Index against Liquid Limit and a typical grain-size distribution curve are shown in the Appendix in Fig. #2 and #3, respectively.

4.5) Silty Clay to Clay with Seams of Silt:

This material was found as the surficial deposit in borehole #7 and to underlie the organic clay in borehole #5

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

4.5) Silty Clay to Clay with Seams of Silt: (cont'd.) ...

and the clayey silt in boreholes #1 and #2. The thickness of the stratum varied from 6 feet to 24 feet. The consistency of the deposit as indicated by the shear strength obtained, is very soft to soft.

Field and laboratory tests gave the following results:

Moisture Content %	30 - 85
Liquid Limit %	36 - 72
Plastic Limit %	20 - 29
Grain-size Analysis %	Gra. 0, Sa. 0 - 4, Si. 30 - 90, Cl. 10 - 66
Bulk Density p.c.f.	96 - 116
Unconfined Shear Strength p.s.f.	80 - 550
Field Vane tests p.s.f.	160 - 640
Sensitivity	2.4 - 10.0

Traces of organic material were found in the portion of the deposit lying in borehole #5; here the organic content varied from 1.2% to 3.8%. A plot of Plasticity against Liquid Limit is shown in Fig. #4 in the Appendix.

4.6) Clayey Silt with Seams of Sand, Silt and Silty Clay:

This material was found in boreholes #1 and #7 only, below the silty clay to clay layer and varied in thickness from 12 to 15 feet. Its consistency as indicated from the shear strength results, is soft.

Field and laboratory tests gave the following results:

	<u>Clayey Silt:</u>	<u>Silty Clay:</u>
Moisture Content %	28 - 44	50 - 85
Liquid Limit %	23 - 30	38 - 47
Plastic Limit %	15 - 19	22 - 27
Grain-size Analysis %	Gra. 0, Sa. 0 - 25, Si. 42 - 90, Cl. 10 - 33	
Bulk Density p.c.f.	100 - 123	
Unconfined Shear Strength p.s.f.	200 - 1,000	
Field Vane tests p.s.f.	300 - 880	
Sensitivity	1.8 - 4.3	



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

4.6) Clayey Silt with Seams of Sand, Silt and Silty Clay:  
(cont'd.) ...

Plots of Plasticity Index against Liquid Limit are shown in Fig. #5 in the Appendix.

4.7) Silt, Sand and Gravel:

As mentioned earlier in the report, only borehole #1 penetrated this layer.

The single Standard Penetration test performed on the material gave an 'N' value of 62 blows/3". This value plus the results of the cone tests indicate a compact to very dense material. Insufficient material was recovered to perform any lab. tests.

The upper surface of the granular layer is estimated to vary from elev. 866.6 to 853.4 in boreholes #7 and #1, respectively, where it underlies the lower clayey silt layer and from elev. 879.8 to 864.6 in boreholes #5 and #2, respectively, where it underlies the silty clay to clay layer.

5. GROUNDWATER CONDITIONS:

An artesian condition exists in the silt, sand and gravel deposit; where this layer was reached, the height above ground level which the water reached inside the casing was noted; the results are as noted below:

Borehole #1	:	900.9 (4.3' above ground level)
Borehole #5	:	903.4 (1.8' above ground level)
Borehole #7	:	not taken

Existing groundwater elevations were noted as below:

Borehole #1	:	891.6
Borehole #2	:	891.0
Boreholes #5 & 7	:	unable to be taken - most probably lie around 6 ft. below ground level as in #1 & #2.

## 6. DISCUSSION AND RECOMMENDATIONS:

### 6.1) General:

The existing bridge carrying Hwy. #101 over the Mattawasaga River is in very poor condition, and it is proposed to replace it with either a new bridge or a multi-plate pipe arch culvert.

Mr. J. C. McAllister, Regional Bridge Supervisor, indicated that the new culvert could be located either side of the existing bridge within limits ranging from approximately 150 ft. west to 300 ft. east of the centre-line of the existing bridge. On the other hand, a new structure could only be located on the east side of the existing bridge due to the proximity of a logging road running north from the highway. Should a culvert be adopted, it would be a 24 feet by 16 feet S.P.A. with an invert at elev. 866.6. There will be no raise in grade of the road.

Several boreholes were undertaken in the immediate vicinity of the existing structure last year by this Section; these have been included in the report.

The subsoil conditions varied from the west to the east limits of the investigation, as noted below:

In the immediate vicinity of the bridge, an initial layer of 11 - 13 feet of clayey silt with organics and sand overlies 20 feet of silty clay to clay. This latter layer overlies the silt, sand and gravel deposit in borehole #2 on the west bank at elev. 869.6 approx., while in borehole #1 on the east bank, some 12 feet of clayey silt underlies the silty clay to clay layer before the granular deposit is reached at approx. elev. 853.4.

In the most westerly borehole - i.e., No. 5, an initial layer of 5 ft. clayey silt with sand and traces of organics overlies 3 ft. of clay with some sand and traces of organics, and 8 feet of organic clay with sand before the silty clay to clay layer is reached at approximately the same elevation as boreholes #1 and #2 - i.e., 835.0; here the silty clay to clay has a thickness of only some 5 feet before reaching the silt, sand and gravel layer.

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

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

At the eastern end of the investigation in borehole #7 the silty clay to clay layer existed from ground surface down some 22 feet overlying 13 ft. of clayey silt with seams of sand, silt and silty clay before the granular deposit was reached at elev. 866.6.

An artesian condition exists within the granular deposit which was found to rise within the casing to a maximum elevation in borehole #5 - i.e., 902.6.

Due to the proximity of the granular layer to the ground surface in borehole #5 - i.e., only 20 feet below ground level lying at elev. 879.8, it is recommended that the west side of the existing bridge be disregarded with respect to location of the new culvert; hence, this leaves a choice of a culvert or structure located to the east of the existing bridge; both alternatives are considered below. (The site of the existing bridge is not recommended due to the artesian water flow around the present timber piles.)

6.2) Structure:

Stability analyses in terms of total stresses, were carried out for the forward slopes. A design strength of 300 p.s.f. and a density of 105 p.c.f. were assumed for the subsoil. It was found that mid-height benches of length 100 feet would be required to give the necessary minimum factor of safety; this arrangement is shown in Fig. #7A.

The structure can safely be supported on timber piles. It is estimated that #14 Class 'A' treated timber piles will have a safe load of 15 tons/pile with 40 ft. penetration into original ground.

A minimum of 6 feet of cover will be required to the pile caps to provide the necessary frost protection.

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

6.3) Culvert:

The alternative proposal of a 24' x 16' S.P.P.A. culvert is the more feasible proposition.

To ensure stability of the side slopes during excavation, it is recommended that 50 ft. mid-height benches be adopted; this will involve removal of existing fill and subsoil, as shown in Fig. #7B. A lower safety factor is required in this case, than that required for the bridge forward slope.

With regard to bedding requirements, the excavation for the pipe should be taken down to 1 ft. below the invert level and should have a minimum width at this depth extending 5 ft. either side of the pipe. Bedding should consist of G.B.C. Class 'A' material, and should be placed as follows:

- 1) For the width of area under the bottom radius of the pipe arch the bed should be levelled and left uncompacted.
- 2) The area adjacent to the haunches of the pipe and under the portion of sloping invert should be compacted by means of hand tamping.
- 3) Apart from the areas mentioned above, the bedding material should be machine-compacted on both sides of the pipe simultaneously in equal lifts.

The above bedding recommendations should be read in conjunction with the relevant D.H.O. standards.

Slope protection should be provided; this will depend on the recommendations of the Hydrology Section.

7. MISCELLANEOUS:

The field work for this report was carried out during the period September 11 to 15, 1970, under the supervision of Mr. G. Allen, Project Foundation Engineer, who also prepared this report.

Equipment used was owned and operated by Dominion Soil Investigation, Ltd.

Mr. K. G. Selby, Supervising Foundation Engineer, reviewed the report.

January, 1971

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 1 (69-F-58)

FOUNDATION SECTION

JOB	70-11072	LOCATION	Sta. 109 + 58 o/s 23' Rt.	ORIGINATED BY	PP
W.P.	68-70-01	BORING DATE	July 22, 1969	COMPILED BY	PP
DATUM	Geodetic	BOREHOLE TYPE	Augering & Washboring and Cone	CHECKED BY	<i>[Signature]</i>

SOIL PROFILE			SAMPLES	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	Liquid Limit ——— w <sub>L</sub> Plastic Limit ——— w <sub>P</sub> Water Content ——— w	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER TYPE	BLOWS / FOOT				
896.6	Ground Level							
0.0	Clayey silt with organics & sand		1 SS L					▽ 891.6
885.6	Soft		2 TW PM					0 3 37 60 0 21 58 21 7.1% Orgs.
11.0	Silty clay to clay with silt seams		3 TW PM					107.5
			4 TW PM					102 103
	Very Soft to Soft		5 TW F..					108.5 0 2 59 35
865.6			6 TW PM					116
31.0	Clayey silt with seams sand, silt and silty clay.		7 TW PM					118.5 0 0 90 10
	Soft to Firm		8 TW PM					122 0 1 83 16
853.4	End of Borehole		9 SS 62/3"					▽ 853.4
43.2	Sand, Silt & gravel Very Dense							Artesian water encountered
846.7								
49.9	End of Cone Test							

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 2 (69-F-58)

FOUNDATION SECTION

JOB 70-11072 LOCATION Sta. 108 + 91 o/s 30' Lt. ORIGINATED BY PP  
 W.P. 68-70-01 BORING DATE July 22, 1969 COMPILED BY MY  
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger and Cone CHECKED BY JK

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS/FOOT	25	50	75	100	125	SHEAR STRENGTH P.S.F.		
897.6	Ground Level														
0.0	Clayey silt with organics and some sand.		1	SS	13	890									
	Soft to Firm		2	TW	PM										
885.1															
12.5	Silty clay to clay with silt seams		3	TW	PM	880									
			4	TW	PM										
	Very soft to soft		5	TW	PM	870									
864.6			6	TW	PM										
33.0	End of Borehole					860									
	Probably sand, silt & gravel.														
852.7	Very Dense														
44.9	End of Cone Test					850									







DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 70-11072 LOCATION Sta. 107 + 67 o/s 41' Rt. ORIGINATED BY GA  
 W.P. 68-70-01 BORING DATE Sept. 11, 1970 COMPILED BY CA  
 DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY AK

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — $w_L$		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE		BLOWS/FOOT	RESISTANCE	PLASTIC LIMIT — $w_p$	WATER CONTENT — $w$		
900.8	Ground Level						25 50 75 100 125				
							SHEAR STRENGTH P.S.F.				
							○ UNCONFINED + FIELD VANE				
							● QUICK TRIAXIAL x LAB. VANE				
							1000 2000				
0.0	Clayey silt with some sand & traces organics		1	SS	6						
895.8	Firm										
5.0	Clay with some sand & traces organics. Soft		2	SS	3						
893.0											
7.8	Organic clay with sand.		3	TW	FM						
885.0	Soft to Firm		4	TW	FM						
15.8	Silty clay with traces of organics		5	TW	FM						
879.8	Soft		6	TW	FM						
21.0	End of Borehole										
	Probably sand, silt & gravel.										
870.3	Dense to Very Dense										
30.5	End of Cone Test										

JOB 70-11072 LOCATION St. 111 + 38 O/S 40' Rt. ORIGINATED BY CA  
W.P. 68-70-01 BORING DATE Sept. 15, 1971 COMPILED BY CA  
DATUM Geodetic BOREHOLE TYPE Cone Penetration Test Only 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 $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	25	50	75	100	125	WATER CONTENT % $w_p$ — $w$ — $w_L$		
901.8	Ground Level													
0.0						900								
						890								
						880								
						870								
						860								
850.1						850								
51.7	End of Cone Test													

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 70-11072

LOCATION Sta. 112 + 56 o/s 39' Lt.

ORIGINATED BY GA

W.P. 68-70-01

BORING DATE Sept. 14, 1970

COMPILED BY GA

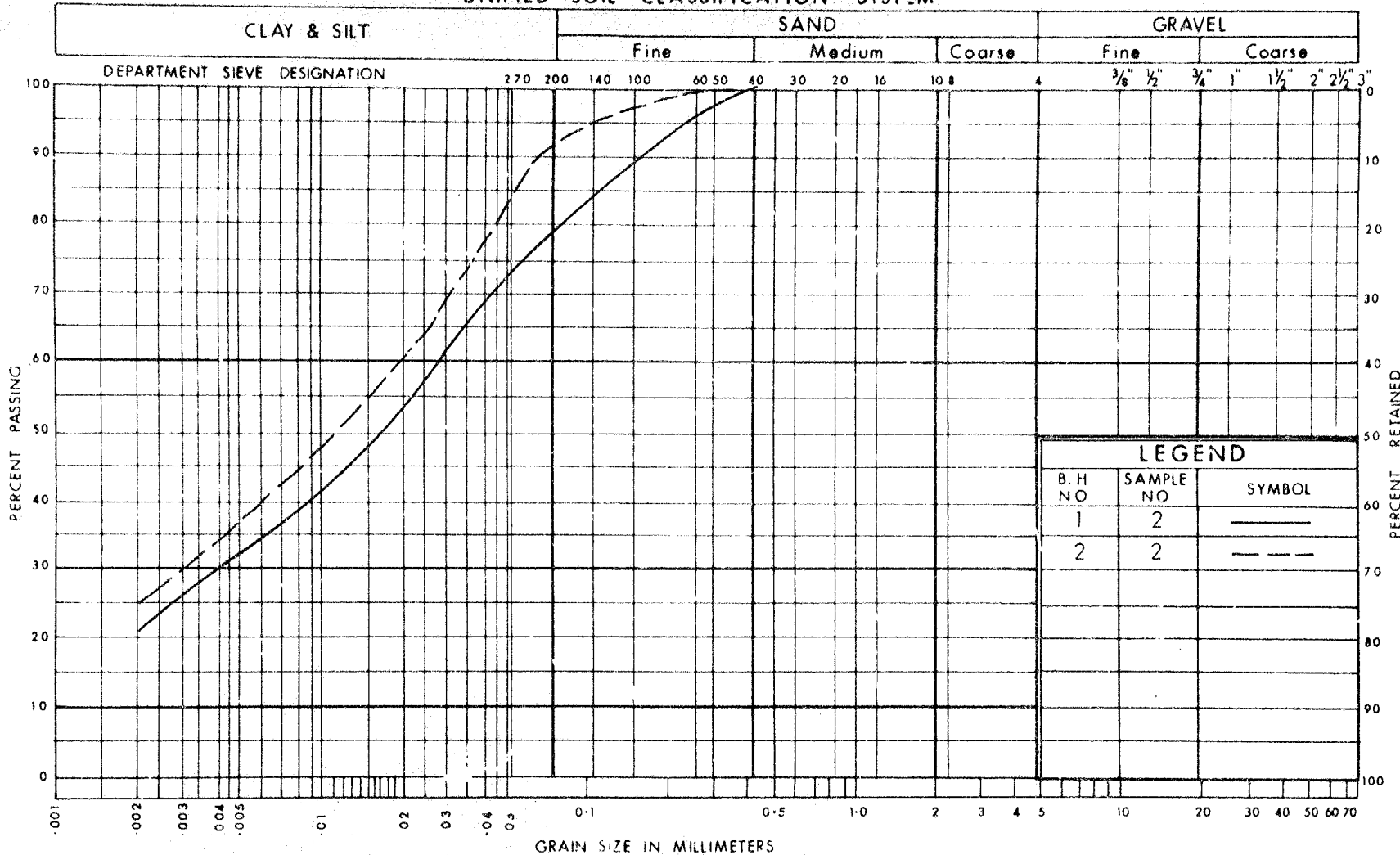
DATUM Geodetic

BOREHOLE TYPE Washboring, NX Casing

CHECKED BY *JK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY Y	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %		
901.6	Ground Level						25	50	75	100	125	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE			25 50 75			P.C.F.	GR. SA. SI. CL.
0.0	Silty clay to clay with seams of silt		1	TW	PM	900												101.5	
			2	TW	PM													98.5	
			3	TW	PM													96	
	Very Soft to Soft		4	TW	PM	890												98	
			5	TW	PM													102	
880.0						880											99		
21.6	Clayey silt with seams of sand, silt & silty clay.		6	TW	PM													100	
			7	TW	PM													105	
	Soft		8	TW	PM	870												114	
866.6	End of Borehole																	119	
35.0	Probably sand, silt & gravel.					860													
	Compact to Very Dense					850													
843.6	End of Cone Test										150								
58.0						840													
						830													

# UNIFIED SOIL CLASSIFICATION SYSTEM



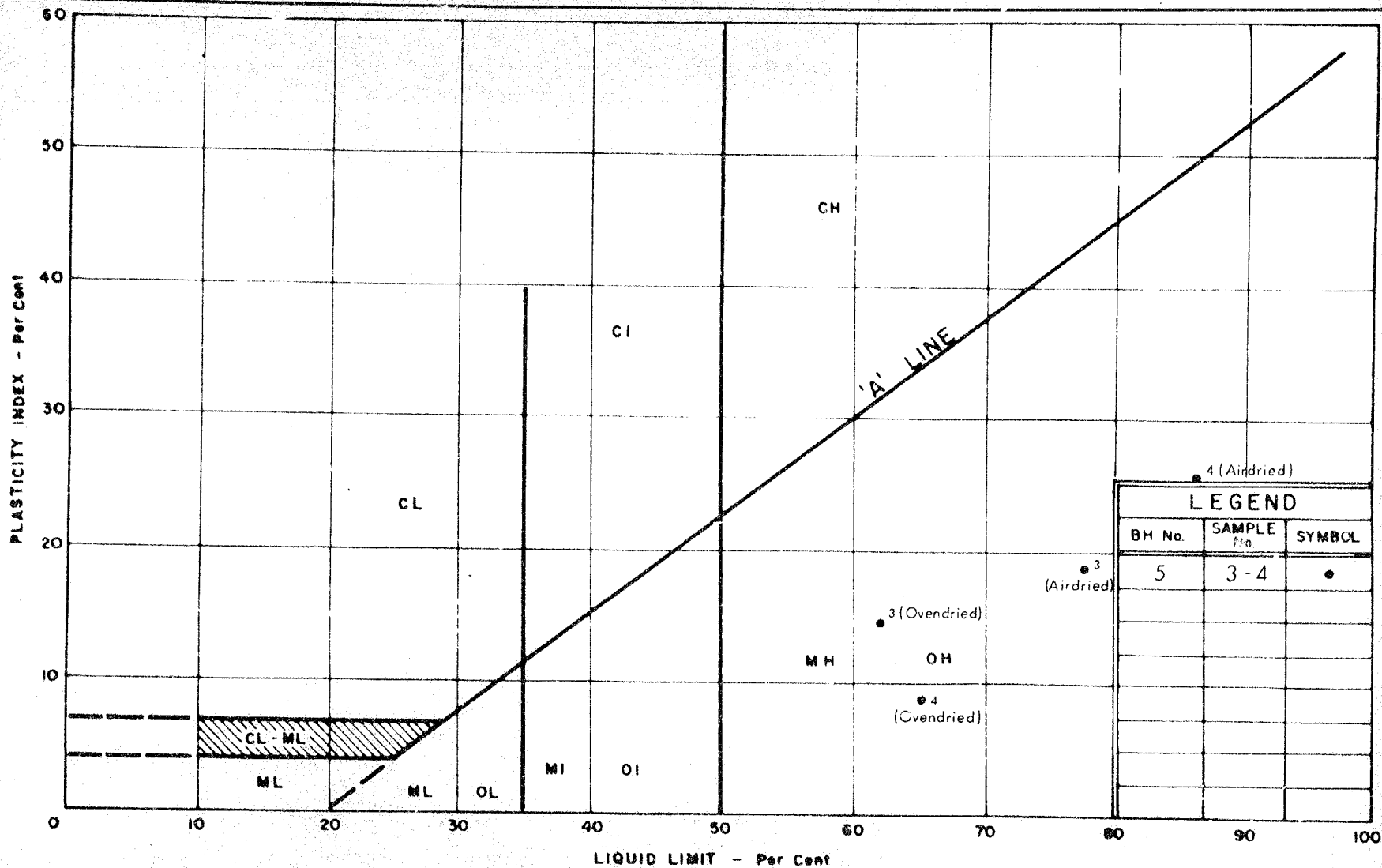
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT  
ORGANICS & SOME SAND

W.P. No. 68-70-01

JOB No. 70-11072

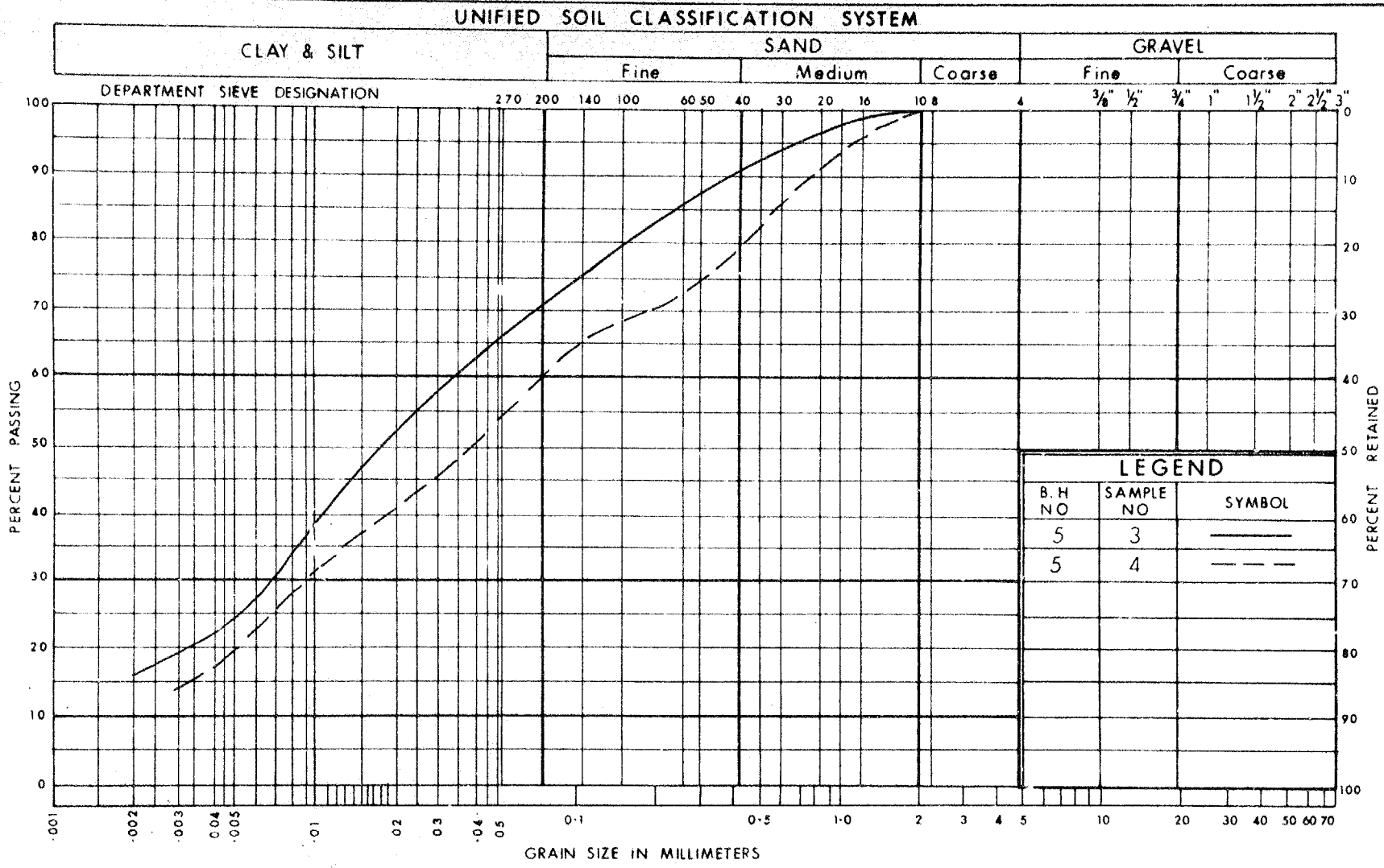
FIG. 1



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART ORGANIC CLAY WITH SAND

WP. No. 68-70-01  
JOB No. 70-11072  
FIG. 2



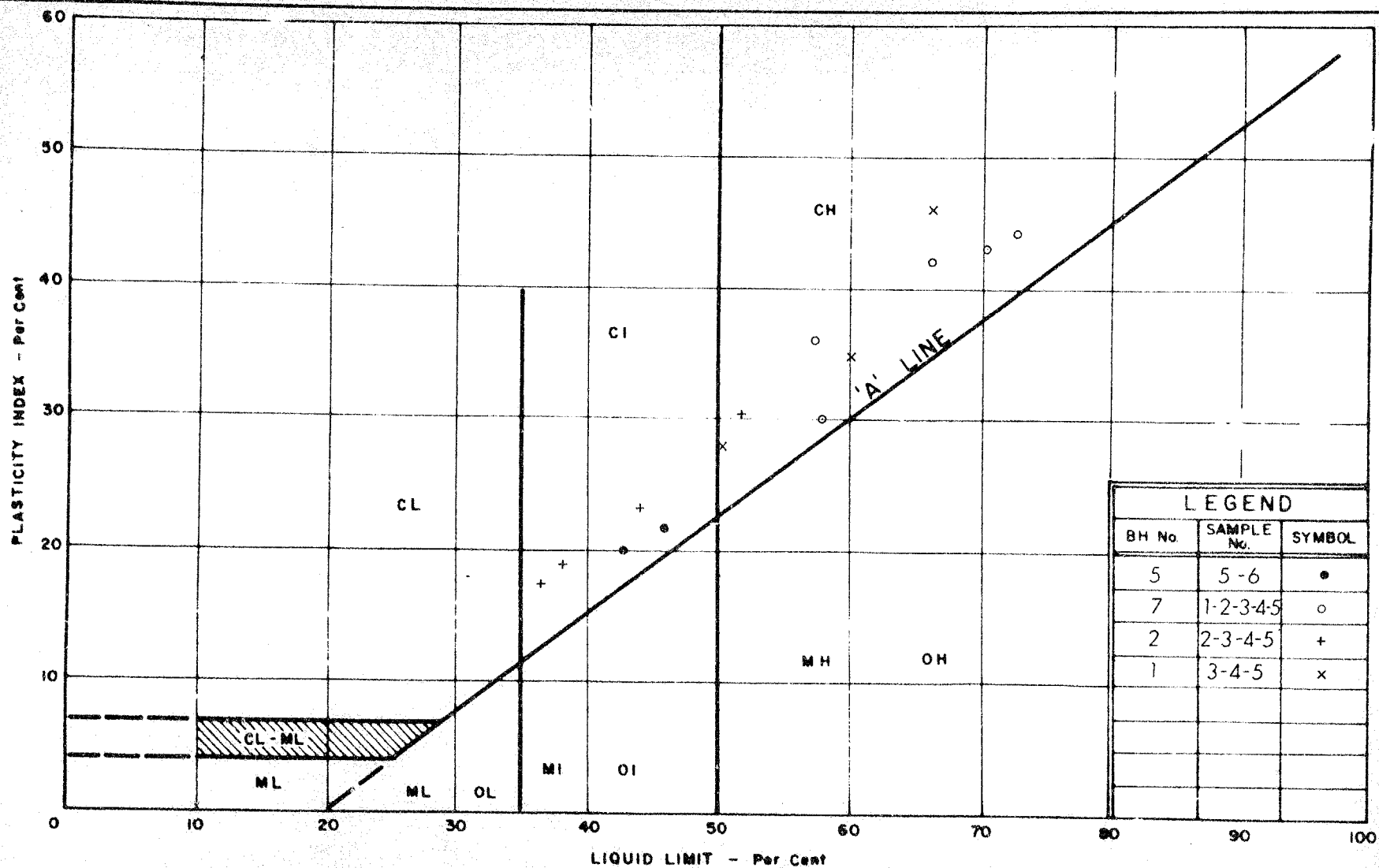
DEPARTMENT OF HIGHWAYS  
**MATERIALS and  
TESTING  
DIVISION**

**GRAIN SIZE DISTRIBUTION  
ORGANIC CLAY  
WITH SAND**

W.P. No. 68 - 70 - 01  
JOB No: 70 - 11072

FIG. 3





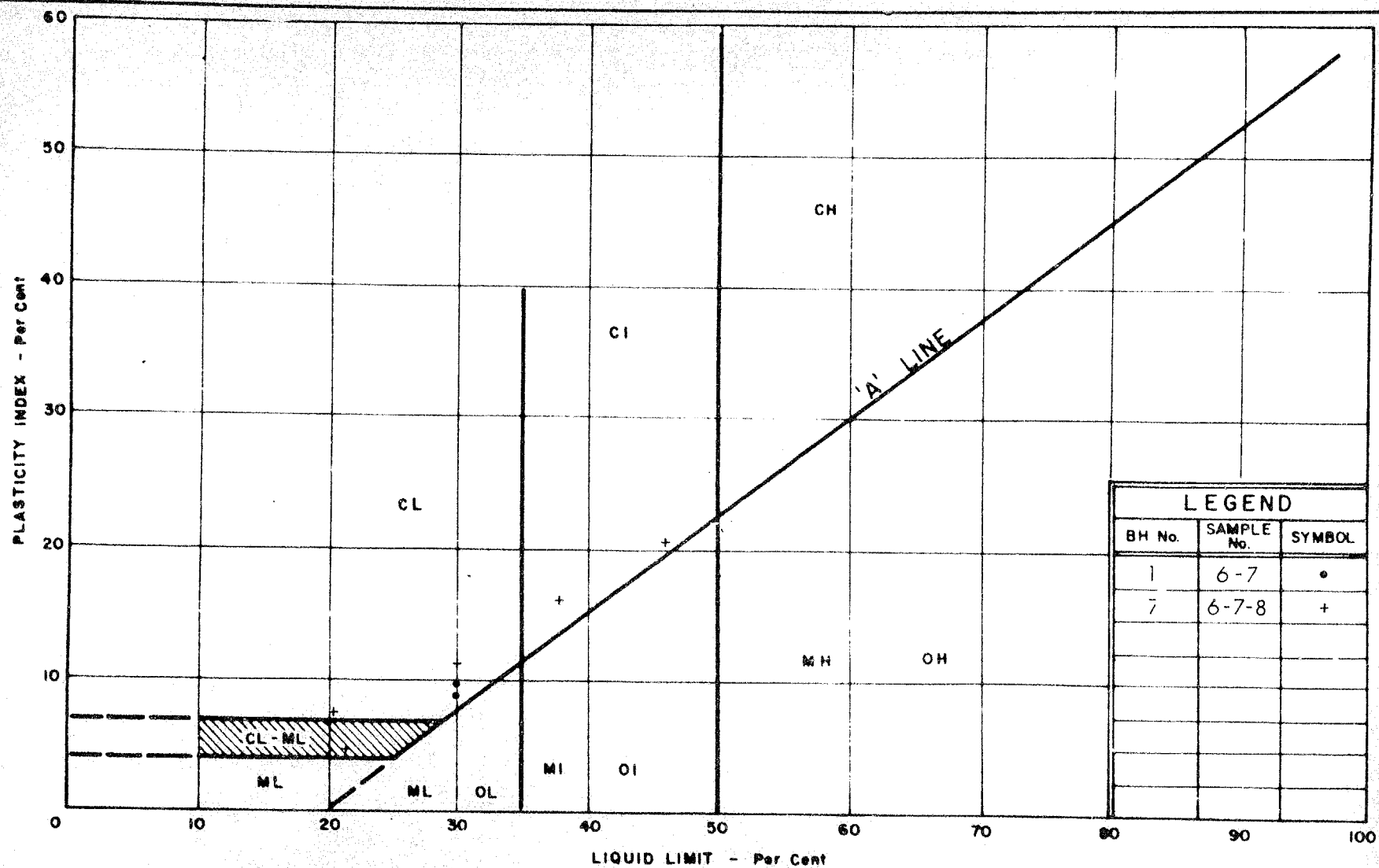
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART SILTY CLAY TO CLAY

W.P. No. 68-70-01

JOB No. 70-11072

FIG. 4



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1	6-7	•
7	6-7-8	+



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT SEAMS OF SAND, SILT & SILTY CLAY

WP. No. 68-70-01  
JOB No. 70-11072  
FIG. 5

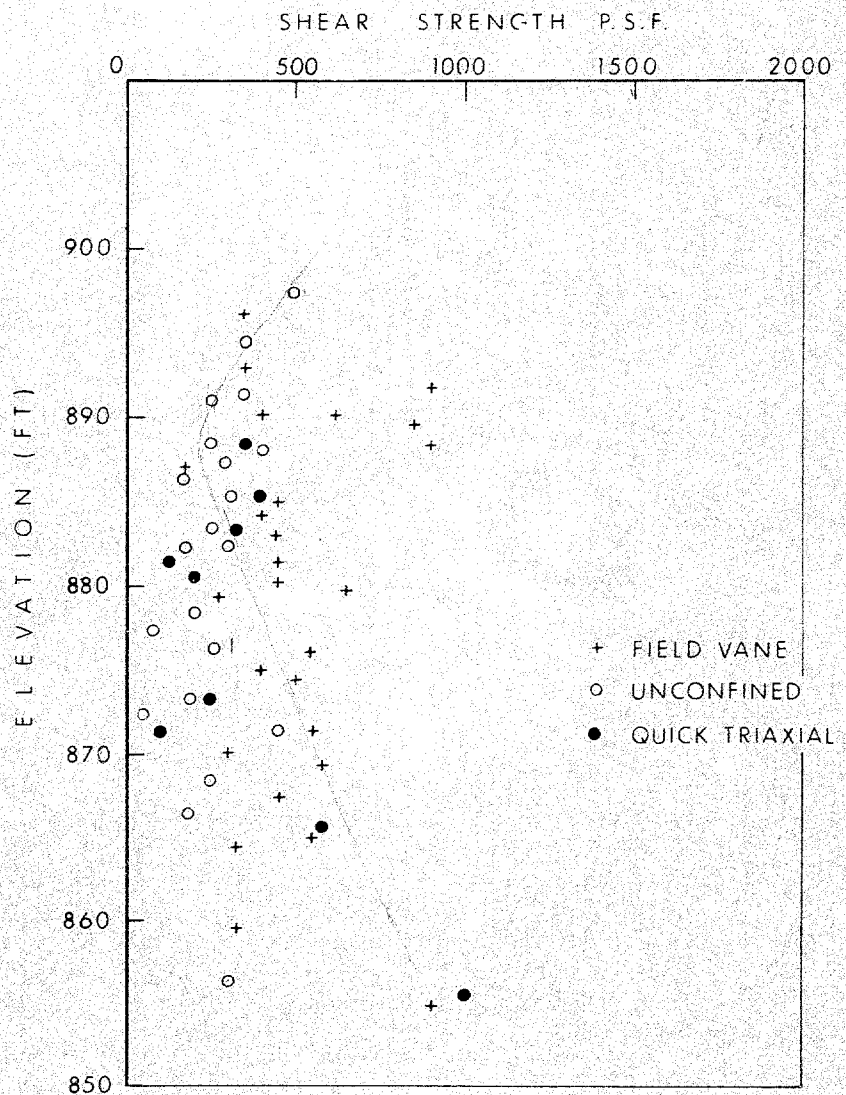


FIG. 6

70-11072

FIG. 7A - PERMANENT BENCHING REQUIRED FOR STRUCTURE

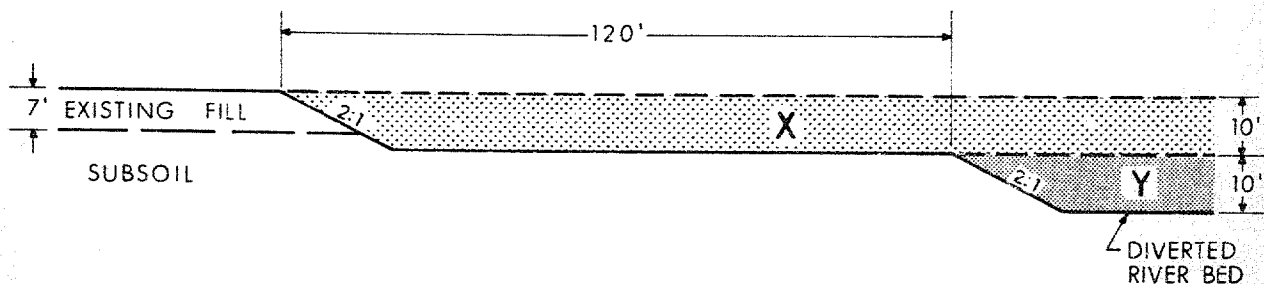
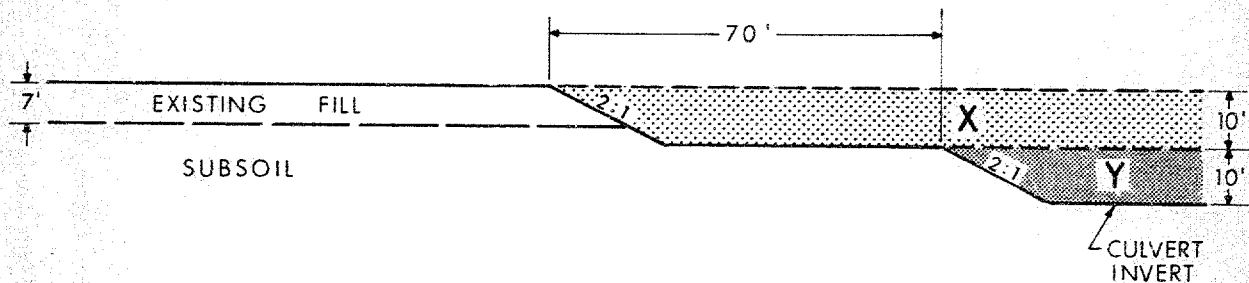


FIG. 7B - TEMPORARY BENCHING REQUIRED IN EXCAVATING FOR CULVERT



NOTE

AREA 'X' TO BE REMOVED BEFORE COMMENCING  
EXCAVATION OF AREA 'Y' IN BOTH CASES.

## 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

$\gamma$	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 = $\frac{c_v i}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	SHEAR STRENGTH
c'	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

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

## STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	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

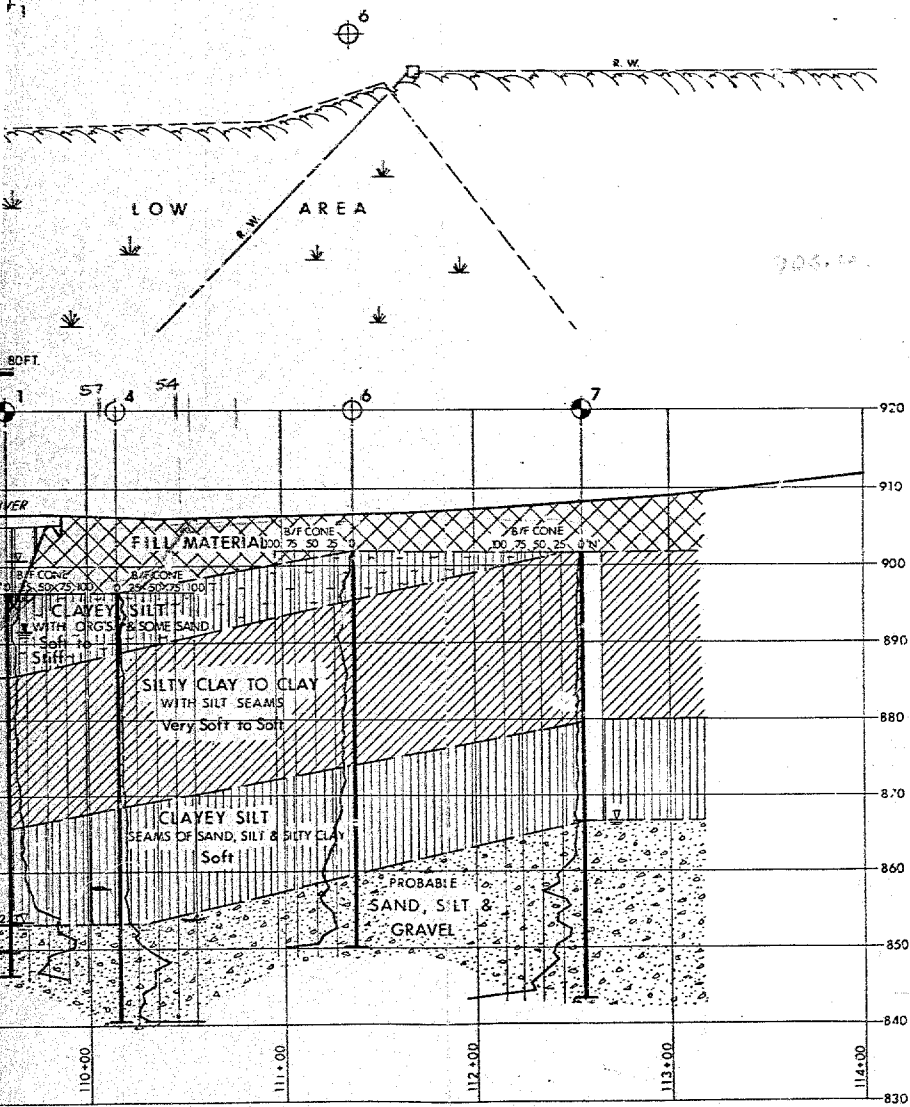
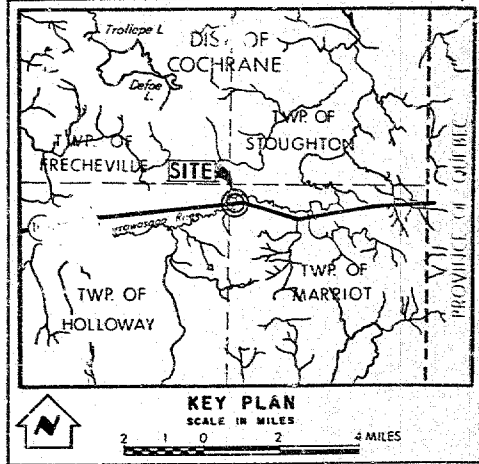
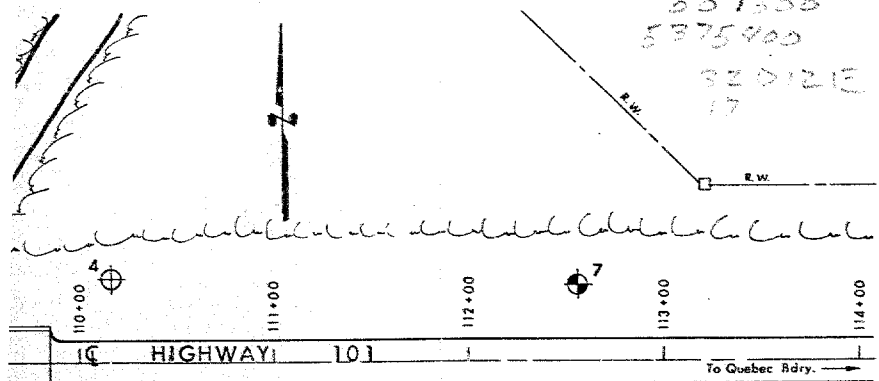
## FOUNDATIONS

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 & Core Penetration Hole		
	Water Levels established at time of field investigation, SEPT., 1970.		
	Head Artesian Water		
	Encountered		
NO.	ELEVATION	STATION	OFFSET
1	896.6	109+58	23' RT.
2	897.6	108+91	30' LT.
3	905.1	108+52	21' RT.
4	896.6	110+16	43' LT.
5	900.8	107+67	41' RT.
6	901.8	111+38	40' RT.
7	901.6	112+56	39' LT.

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

REVISIONS	DATE	BY	DESCRIPTION

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

**MATTAWASAGA RIVER**

KING'S HIGHWAY NO. 101 DIST. NO. 14  
DIST. COCHRANE  
TWP. MARRIOT LOT COM.

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D G.A. CHECKED	W.P. NO. 68-70-01	M&T DRAWING NO.
DRAWN E.D. CHECKED	JOB NO. 70-11072	70-11072-A
DATE NOV. 10, 1970	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT. NO.	



~~DISSEMINATION/REPRODUCTION~~

MEMORANDUM

TO: Mr. J. C. McAllister,  
Regional Bridge Planning Engineer,  
NORTH BAY.

FROM: Foundation Section,  
Design Services Branch,  
Room 107, Lab. Bldg.

DATE: August 16, 1971

IN REPLY TO

SUBJECT:

Mattawasaga River Bridge  
Hwy. #101 W.P. 68-70-02  
Site 39-155 W.J. 70-11072  
Dist. #14 (New Liskeard)

Following your memo of June 10, 1971, we have reviewed the foundation report for the abovementioned project with regard to the possibility of constructing a new 24 x 16 S.P.P.A., located at Station 110 + 80 on a 22° right skew. Our comments are as follows:

(1) Due to the fact that the original ground is some 3 to 5 feet higher than the level at the edge of the existing river bank a cut some 13 to 14 feet deep would be required for the proposed diversion channel. Assuming soil conditions along the diversion to be similar to those at the culvert site (B.H. #7), the new channel would require extensive benching to ensure stability. The exact dimensions of these benches can not be determined until a contoured plan of the proposed diversion is available, but it is obvious that they would add considerably to the cost of the job.

(2) Fig. #7 of our report shows the safe section required for both bridge and culvert and the safe height (i.e. 10 ft.) for 2:1 slopes. From this, it can be deduced that the culvert must be of sufficient length to extend some 90 feet beyond the outside edge of the shoulder to ensure stability in the lateral direction. It would also be necessary to place about 4 ft. of fill on that portion of the culvert which projects above the original ground level.

(3) In view of the foregoing, it appears to us that the cost of constructing a diversion and culvert at this site might outweigh any advantages gained by selecting a new site. Whilst it is usually undesirable to carry out new construction over an area where failures have occurred in the past, it is still technically feasible, in this case to construct a new trestle bridge at the site of the existing one, although the presence of artesian springs would preclude the possibility of installing a culvert. We recommend, therefore, that you give further

Re: Mattawasaga River Bridge - New Liskeard (cont'd) ...

consideration to constructing a bridge with forward slopes as shown on Fig. #7A of the foundation report. The sequence of construction should be as follows:

(a) Remove material from behind existing abutments to conform with sketch on Page 3.

(b) Demolish existing bridge - do not extract piles; they should be cut off at ground level.

(c) Excavate for river channel and allow for placing a 2 ft. thick blanket of Granular 'A' on the 2:1 lower forward slopes to act as a filter and drain for the artesian springs, and for the placing of rip rap.

(d) Place filter blanket on slopes and rip rap. Sufficient rip rap must be placed at this time in the river bed to prevent scour, or the stability of the slopes, and hence also of the structure will be endangered. This latter point should be referred to the Bridge Hydrology Engineer.

(e) Drive piles and construct new bridge.

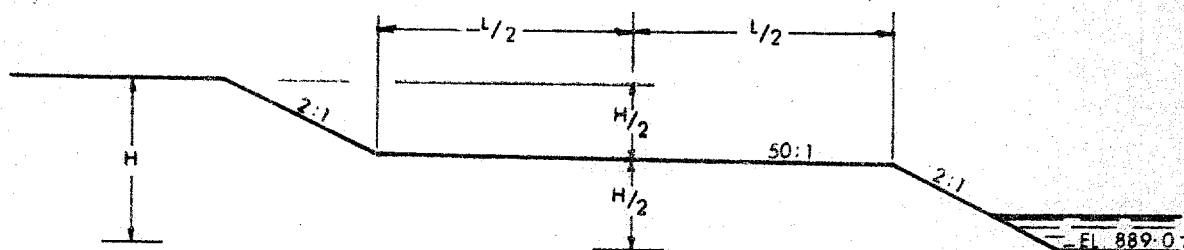
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Since a temporary detour will be required during construction of the new bridge we suggest that consideration be given to re-aligning the highway so that the new structure may be built alongside the existing one in two stages. We believe that a line shift of about 25 ft. would achieve the required result in this case. If it is decided to construct a separate detour with a Bailey bridge, it will be necessary to comply with recommendations given above for the stability of the approaches to the temporary crossing. The Bailey bridge may be supported on rock-filled cribs placed on the original ground (after removal of organic soil) assuming a safe bearing capacity of 600 p.s.f. It will be necessary to carry out further stability analyses, however, and this will be done as soon as we are supplied with specific proposals, including a profile along the  $\phi$  of the proposed detour.

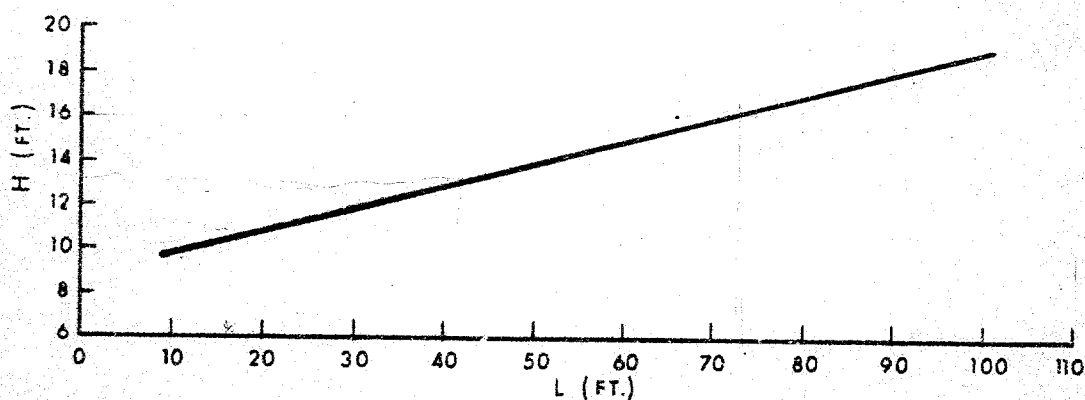
The foregoing has been discussed with A. Radkowski, Regional Bridge Design Engineer, who is in general agreement with the feasibility of our proposals.

August 16, 1971

Re: Mattawasaga River Bridge - New Liskeard (cont'd)....



LONGITUDINAL SECTION



HEIGHT OF EMBANKMENT  $H$  versus BERM LENGTH  $L$

It should be noted that recommendations given in this memorandum supercede those given in our original report #70-11072.

If further information is required concerning this project, please contact this Office.  
KS/ht

c.c. Messrs. B.R. Davis  
A. Radkowski  
D.W. Farren  
H. McArthur  
T.A. Sharpe  
J. Gruspier  
B.J. Giroux

*K.G. Selby*  
K.G. Selby,  
Supervising Foundation Engineer  
Per:  
A.G. Stermac,  
Principal Foundation Engineer.

Foundation Files  
General Files

A-68

## MEMORANDUM

TO: Mr. A. Stermac,  
Principal Foundation Engineer,  
Downsview.

FROM: Bridge Planning,  
North Bay.

ATTENTION: Mr. K. Selby

DATE: June 10, 1971.

OUR FILE REF.

IN REPLY TO

## SUBJECT:

Re: W. P. 68-70-02      Site 39-155  
Mattawasaga River Bridge  
Hwy. # 101      District # 14

I am now in the process of issuing the above structure for design. It is my intention to recommend the use of a 24' X 16' S. P. P. A. located at sta. 110 + 80 on a 22° right skew.

The following questions occur to me after closely reading your report, W. O. 70-11072.

- a) Will normal 2:1 lateral slopes be adequate for stability with the proposed design.
- b) Will any special precautions be necessary when filling in the existing crossing after construction of the new culvert.

An early reply would be greatly appreciated.

JCMcA/bn

c. c. - Mr. R. Murphy



J. C. McAllister,  
Regional Bridge  
Planning Supervisor.

Copy for the information of

Mr. A. Stermac

Mr. D. A. Osborne-White  
District Engineer  
New Liskeard

J. C. McAllister  
Bridge Planning, North Bay

February 12, 1970

B. S. 39-155; Hwy. #101; District #14;  
Mattawasaga River Bridge  
40.4 miles east of Matheson

On January 21, 1970, the above site and structure were inspected by Mr. S. McCombie and myself.

The structure consists of a 40' steel beam main span with transverse laminated timber deck on timber pile bents and three spans (12', 16', 12') of longitudinally laminated timber on pile bents at each end. The bridge, though only built in 1957, is in poor condition with many of the timber piles spliced at ground level; others badly sheared. Many piles are badly out of plumb and are split over the exposed length, with the drift pins useless and only partial bearing for the capsills. There is considerable transverse movement of the structure (about 12") over the three west approach spans.

Severe settlement of the piles has allowed the deck to undulate; noticeable at the second bent from the west on the north side.

I understand that trouble with artesian water and movement of the approaches caused piles to shift during construction. The piles were pulled back into place at that time and have since tended to return. This lateral movement, if it continues, will cause collapse of the structure.

A foundation investigation, carried out by the Foundation Section, confirmed the presence of 30' to 35' of very soft to soft varved clay below river bed level, overlying very dense sandy silt. Artesian water flowing out of the approach fills and adjacent to the piles will cause progressive deterioration of the overall stability. The Foundation Section is of the opinion that, although the structure may last a few more years, the progressive deterioration demands that the structure be replaced rather than carry out extensive repair work.

Cont'd...

Mr. McCombie and I agree with this opinion. We feel, however, that a minimum effort should be made to obtain a few more years of life out of the structure which is only thirteen years old. We are of the opinion that the engineering should be completed and available for a new structure and that a very close watch by the District should be maintained on the existing, such that if the movement of the piles and structure accelerate a contract can be called very quickly.

The Foundation Section have requested that when studying the location of the new structure consideration be given to diverting the river to cross the highway at a different location than at present because of the disturbed condition of site material. Air photos of the area are of 1959 vintage and do not show the intersection of a lumber road near the north west end of the structure. The best location for a diversion would seem to be at this west side where a zero skew crossing can be obtained with little difficulty. A diversion to the east would be slightly longer and have a curved approach on the upstream side of the bridge. During pre-engineering surveys will be requested to plot the lumber road intersection and also the river for 500' upstream and downstream in order to determine the best revision possible.

A preliminary hydrology study was carried out by Mr. K. E. Jorns mainly to determine the feasibility of using pipe or pipes at this location. Multiple pipes were not recommended but a C. M. P. A., size 24' x 16', was considered theoretically adequate but was open to blocking by debris. A bridge type structure will be governed in size by foundation stability conditions rather than hydrology. Both types of structures will be costed before a design is undertaken.

Therefore, based on the available information and site inspection, the following is recommended:

1. Carry out minimum repairs to existing structure, i. e. as recommended by Mr. W. Birch in his memo of April 17, 1969.
  - a) Level out bridge deck to eliminate impact from traffic;
  - b) Wedge loose pipe tops;
  - c) Keep under constant surveillance, maintaining minimum repairs.

Cont'd...

2. Program pre-engineering immediately and have completed design available for use should deterioration accelerate.

The design alternatives are as follows:

- a) Stream diversion on west side of existing structure, using either a pipe or bridge;
- b) Stream diversion on east side of existing structure, using either pipe or bridge;
- c) Pipe or bridge at existing site.

Of the three possible locations the west side seems to be the most advantageous. The proximity of the intersection of the highway and the lumber road may, however, force the use of a pipe only at that location.

J. C. McAllister  
Regional Bridge  
Planning Supervisor

cc: Mr. D. Barr  
Mr. S. McCombie  
Mr. A. Stermac

AKJ

Mr. C. McCombie,  
Bridge Planning Engineer,  
Bridge Office,  
Admin. Bldg.

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

October 15, 1969

Mr. J. McAllister,  
Regional Bridge Location  
Supervisor - North Bay

Mattawasaga River Bridge (Site 39-155)  
40.4 Miles East of Matheson,  
Hwy. #101 - District No. 14 (New Liskeard)  
M.J. 69-P-58 --

---

We have recently carried out a foundation investigation at the above mentioned site as requested by you in your memo dated June 12, 1969. During the investigation the site was visited by the writer, at which time certain observations with regard to the condition of the existing bridge, were made. Since that time, discussions have been carried out with Mr. C. Rahn of the Bridge Maintenance Section. Our complete foundation report will be forwarded to you in the near future; however, for your information at the present time, we have summarized the main points of our investigation as follows:

- (1) Structurally the bridge is in poor condition.
- (2) Evidence is present that lateral earth movements have taken place, or are taking place, resulting in lateral movement of piles.
- (3) Artesian water is flowing out of the ground adjacent to some piles, and possibly undetected, also through the approach slopes. This causes progressive deterioration of the overall stability.
- (4) Subsoil consists of 30 to 35 ft. (measured from river bed level) of very soft to soft varved clay overlying very dense sandy silt.
- (5) Artesian water was encountered in the sandy silt stratum, with a head to 10 ft. above river water level.



Mr. S. McCombie,  
Bridge Planning Engineer,  
Bridge Office,  
Admin. Bldg.

Attn: Mr. J. McAllister,  
Regional Bridge Location Engr. - N. Bay

Oct. 15, 1969

Ottawasaga River Bridge (Site 39-155) - W.J. 69-8-58

In view of the foregoing, our opinion is that a new bridge should be constructed at this site. It is not possible to say with certainty, at this time, that the present bridge will not hang on for a few more years, but the fact is that we have evidence of a deteriorating situation. In any event, we would recommend strongly in favour of a new bridge rather than extensive repair work, and this at the earliest time possible.

KCS/KSeP

K. G. Selby,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. C. Stermac,  
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. D. A. O. White  
W. D. Birch  
B. R. Davis  
A. Crowley  
E. R. Saint

Foundations Files ✓  
Gen. Files

Mr. D.M. Hopper,  
Manager,  
Contract Control Office.

Construction Office,  
3rd Floor, Central Building,  
Downsview.


November 16th, 1976.

Contract 76-102, Mattawasaga River Bridge  
Site 39E-155, Highway 101, District #14

---

Confirming my telephone call to Mr. J. Davidson, the  
addendum requested in my memorandum of November 12th, 1976,  
should not be sent out.

If problems arise during the driving these will be  
handled by the field staff in consultation with our office  
and the Soil Mechanics Section.

  
A.E. McKim,  
Asst. Construction Engineer,  
Structures.

AEM:jg

cc: C. Mirza ✓  
R. Dorton  
M. Bernhardt



1265  
↓  
file 76-102

*Mr. M. Devata*  
October 14, 1976.

Meeting of  
Structural Review Committee

Time: October 13, 1976, 9:30 a.m.

Place: West Tower, Boardroom, 4th Floor

Attending: Messrs. W. Hashizume - Construction Branch  
M. Stoyanoff - Structural Office  
A. Radkowski - Structural Office  
R. Haynes - Structural Office  
P. Roy - Structural Maintenance  
K. Selby - Soils Mechanics Section  
M. Devata - Soils Mechanics Section  
K. Jorns - Hydrology Section

Projects Reviewed: (a) Mattawasaga River Bridge,  
Site 39E-1tt, W.P. 68-70-02.  
(b) Union Creek Culvert,  
Site 32-22, W.P. 40-68-04.

The first project to be reviewed was Mattawasaga River Bridge. A summary presentation of the design and other pertinent features was made by Mr. Radkowski. The following items were brought up and discussed.

Foundatio.s

The location and design of the detour was reviewed to ensure there would be no infringement on the stability of the approaches and berm for the proposed structure.

Construction staging was reviewed and meets the requirements of the Soils Mechanics Section, particularly for the removal of existing piling.

Structure

- (a) The deck is to be machine finished.
- (b) In the event that construction joints are required in the deck this will be taken care of by the Construction Branch at the time of construction.



The second project, Union Creek Culvert, was presented by Mr. R. Haynes with the following comments by the meeting.

Detour

The staging of construction was questioned and it was ascertained that the staging is detailed on the grading drawings.

A note is to be added on drwg. -1 of the structure drawings referring to the grading drawings for construction staging.

Foundations

Unwatering was questioned and it was pointed out that a tender item has been provided and that the culvert, and granular backfill must be placed in the dry.

Hydrology

The design meets all the requirements of the Hydrology Section.

No other matters were brought up and the meeting adjourned at 12:00 noon.

MS/im



M. Stoyanoff,  
Structural Contract Engineer.

c.c. J. B. Wilkes

W. G. Wigle

E. Orr

R. Dorton

C. Grebski

G. Burkhardt

W. Lin

J. Keen

K. Bassi

B. McKenna

All attending meeting.



Memorandum

To: Mr. S. McCombie,  
Regional Manager,  
Reg. Planning & Design Office,  
Northern Region, North Bay.

From: Structural Office,  
West Building, Downsview.

Attention:

Date: June 16, 1976.

Our File Ref.

In Reply to

Subject: W. P. 68-70-02, Site 39E-155,  
Mattawasaga River Bridge,  
Highway 101, District 14.

Kindly change the list of drawings on the first page of the D4  
Form to read: "39E-155-1 to 12 inclusive, Reinforcing Steel  
Schedule and D-3821-1 and 2.

AR/cf

A. Radkowski,  
Regional Structural Design Engineer.

c.c. J. Wear  
J. J. McNamee  
K. C. Howe  
B. Giroux  
A. E. McKim  
J. McAllister  
E. Van Beilen  
C. Mirza  
J. Harris  
N. Zoltay



Mr. W. D. Birch,  
Structural Maintenance Eng.,  
Maintenance Branch,  
Central Bldg., Downsview.

Mr. F. Gormek.

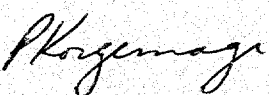
Geotechnical Office,  
Engineering Services Branch,  
West Bldg., Downsview.

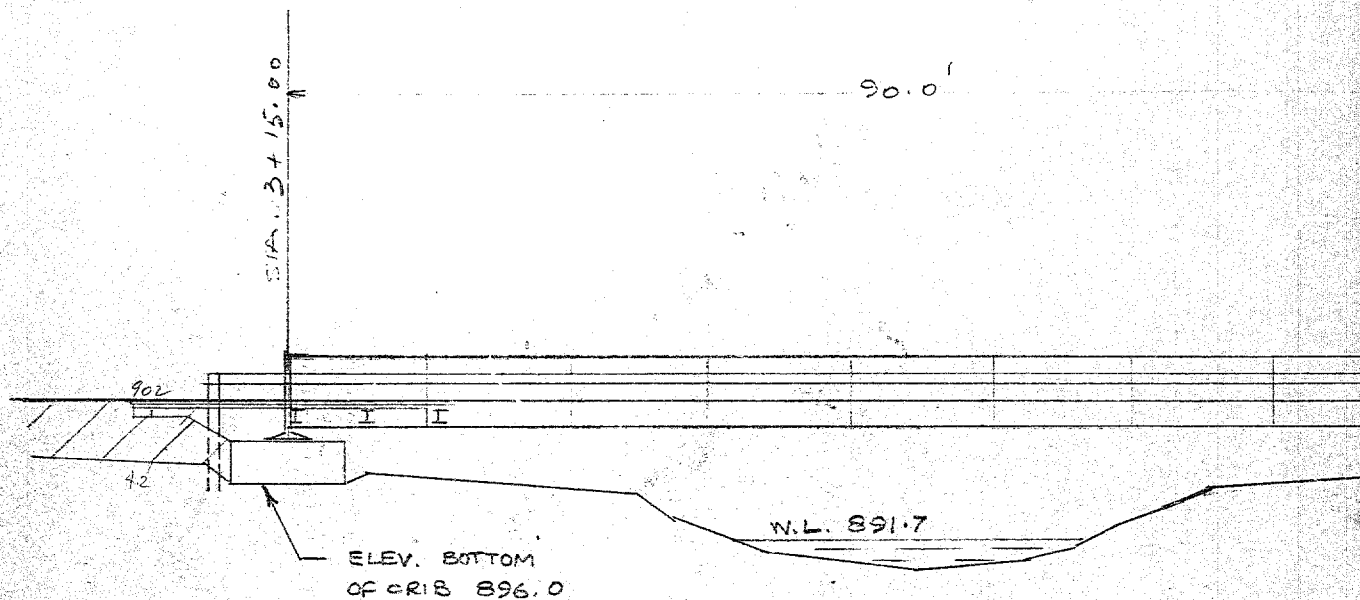
January 4, 1974.

Mattawasaga River Bailey Bridge (110' Span)  
Highway #101, Twp. of Marriott, County of Cochrane  
W.O. 70-11072      W.P. 68-70-02

We have reviewed your Drawing 39-155-1 for the above-mentioned project. The Bailey Bridge appears to have been designed in accordance with our memorandum of June 25, 1973, and there should be no problems.

PK/ao

  
P. Korgemagi,  
Project Foundations Engineer,  
For: K. G. Selby,  
Supervising Foundations Eng.



SCALE  $\frac{3}{32}$ " = 1'-0"

W. O. 70-11072  
W. P. 68-70-02

90.0'

STA. 4+05.00

W.L. 891.7

ELEV. BOTTOM  
OF CRIB 896.0

SCALE  $\frac{3}{32}$ " = 1'-0"

MATTAWASAGA RIVER  
BAILEY BRIDGE



MEMORANDUM

TO: J. McAllister,  
Reg. Structural Planning Supervisor,  
NORTHERN REGION, North Bay.

FROM: Structural Office,  
West Building,  
Downsview.

ATTENTION:

DATE: April 13th, 1973.

OUR FILE REF.

IN REPLY TO:

SUBJECT: Mattawasaga River Bridge,  
W.P.#68-70-02, Site #39E-155,  
Hwy. #101, District #14.

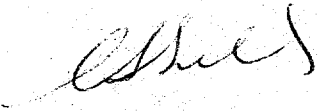
70-11-072

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-39E-155-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$200,000 which includes tender, materials, engineering, and sundry construction.

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

CSG:dp  
Attach.

  
C. S. Grebski,  
Structural Design Engineer.

cc. B. R. Davis,  
W. D. Birch,  
A. E. McKim,  
A. G. Stermac (2), ✓  
J. Anderson,  
R. Murphy,  
J. Harris,  
W. McFarlane,  
M. Stoyanoff.

No comments

AR

10/5/73

Ontario  
Department of Transportation and Communications  
~~XXXXXXXXXXXXXXXXXXXX~~

MEMORANDUM

TO: Mr. J. C. McAllister,  
Regional Bridge Planning Engineer,  
NORTH BAY.

FROM: Foundation Section,  
Design Services Branch,  
Room 107, Lab. Bldg.

ATTENTION:

DATE: August 16, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT:

Mattawasaga River Bridge  
Hwy. #101 W.P. 68-70-02  
Site 39-155 W.J. 70-11072  
Dist. #14 (New Liskeard)

Following your memo of June 10, 1971, we have reviewed the foundation report for the abovementioned project with regard to the possibility of constructing a new 24 x 16 S.P.P.A., located at Station 110 + 80 on a 22° right skew. Our comments are as follows:

(1) Due to the fact that the original ground is some 3 to 5 feet higher than the level at the edge of the existing river bank a cut some 13 to 14 feet deep would be required for the proposed diversion channel. Assuming soil conditions along the diversion to be similar to those at the culvert site (B.H. #7), the new channel would require extensive benching to ensure stability. The exact dimensions of these benches can not be determined until a contoured plan of the proposed diversion is available, but it is obvious that they would add considerably to the cost of the job.

(2) Fig. #7 of our report shows the safe section required for both bridge and culvert and the safe height (i.e. 10 ft.) for 2:1 slopes. From this, it can be deduced that the culvert must be of sufficient length to extend some 90 feet beyond the outside edge of the shoulder to ensure stability in the lateral direction. It would also be necessary to place about 4 ft. of fill on that portion of the culvert which projects above the original ground level.

(3) In view of the foregoing, it appears to us that the cost of constructing a diversion and culvert at this site might outweigh any advantages gained by selecting a new site. Whilst it is usually undesirable to carry out new construction over an area where failures have occurred in the past, it is still technically feasible, in this case to construct a new trestle bridge at the site of the existing one, although the presence of artesian springs would preclude the possibility of installing a culvert. We recommend, therefore, that you give further

Re: Mattawasaga River Bridge - New Liskeard (cont'd) ...

consideration to constructing a bridge with forward slopes as shown on Fig. #7A of the foundation report. The sequence of construction should be as follows:

(a) Remove material from behind existing abutments to conform with sketch on Page 3.

(b) Demolish existing bridge - do not extract piles; they should be cut off at ground level.

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(d) Place filter blanket on slopes and rip rap. Sufficient rip rap must be placed at this time in the river bed to prevent scour, or the stability of the slopes, and hence also of the structure will be endangered. This latter point should be referred to the Bridge Hydrology Engineer.

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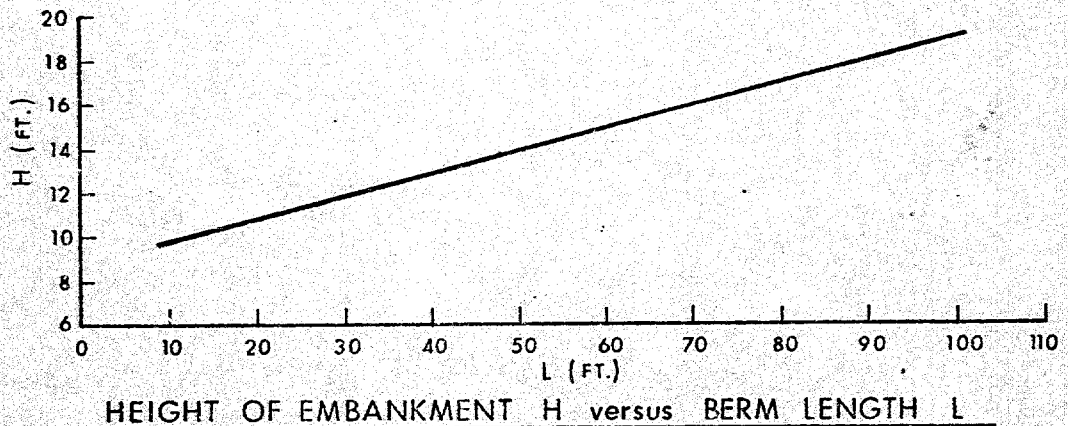
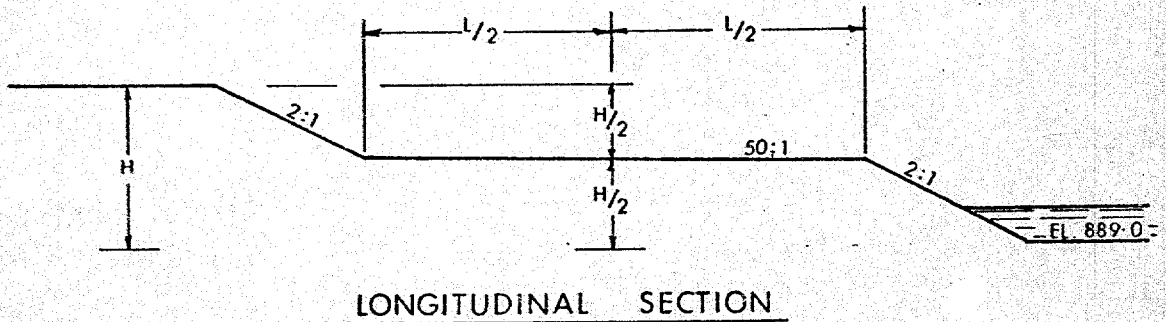
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The foregoing has been discussed with A. Radkowski, Regional Bridge Design Engineer, who is in general agreement with the feasibility of our proposals.

August 16, 1971

Re: Mattawasaga River Bridge - New Liskeard (cont'd)....



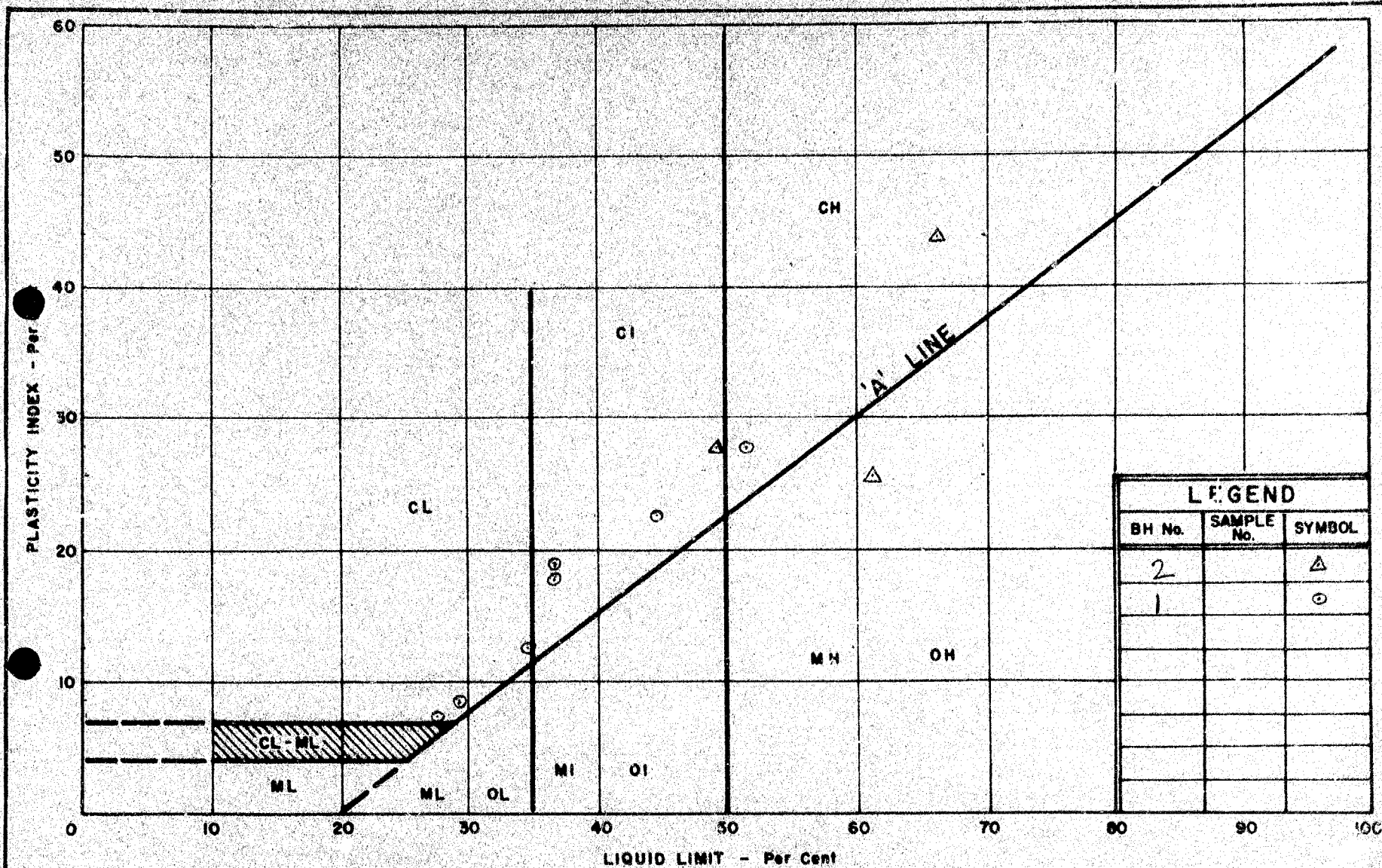
It should be noted that recommendations given in this memorandum supercede those given in our original report #70-11072.

If further information is required concerning this project, please contact this Office.  
KS/ht

c.c. Messrs. B.R. Davis  
A. Radkowski  
D.W. Farren  
H. McArthur  
T.A. Sharpe  
J. Gruspier  
B.J. Giroux

*K.G. Selby*  
K.G. Selby,  
Supervising Foundation Engineer  
Per:  
A.G. Stermac,  
Principal Foundation Engineer.

Foundation Files  
General Files



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART

FIGURE 1.

W.P. No.

NIL

JOB No.

69-F-58