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GEOCRES No. 30L14-33

DIST. 4 REGION

W.P. No. 446-65-02

CONT. No. 77-42

W. O. No.

STR. SITE No. 34-220

HWY. No. Q.E.W.

LOCATION Townline Rd. Extension
Underpass

No. OF PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Mr. W. McFarlane
Regional Structural Design Engineer
Structural Office
West Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 05 27

Re: Townline Road Extension Underpass
W.P. 446-65-02, Site 34-220
QEW, District 4, Hamilton

A review of the final bridge drawings submitted shows the design to be adequate from a soil mechanics viewpoint.

P. Stuart
Project Engineer

For: K.G. Selby
Supervising Engineer

PS/gs

cc: Files
Record Services

Mr. C.S. Grebski
Structural Planning Engineer
Structural Office
West Bldg.

Soil Mechanics Section
Geotechnical Office
West Building, Downsview

June 9, 1975

TOWNLINE ROAD EXTENSION U'PASS
Hwy. #: Q.E.W., District #4 (Hamilton)
WP: 446-65-02, Site #34-220

We have reviewed the final bridge drawings (Sheet 1 and 3) for the above structure. The designer appears to have followed the recommendations contained in Foundation Report #68-F-30 issued on June 20, 1968.

P. Payer
Senior Engineer

for

K.G. Selby
Supervising Engineer

c.c. Files
Record Services

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. S. McCombie

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

Date: June 14, 1968

Our File Ref.

In reply to JUN 20 1968

Subject:

FOUNDATION INVESTIGATION REPORT
For Crossing at Proposed
Townline Road Extension and the
Queen Elizabeth Way
Lots 19 and 20, 1st Cross Con.
Twp. of Willoughby, Cty. of Welland
District No. 4 (Hamilton)
W.J. 68-F-30 -- W.P. 446-65

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.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
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Townline Road Extension and the
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Lots 19 and 20, 1st Cross Con.
Twp. of Willoughby, Cty. of Welland
District No. 4 (Hamilton)
W.J. 68-F-30 -- W.P. 446-65

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation for a proposed underpass structure at the crossing of the proposed Townline Road Extension and the Q.E.W. in Willoughby Twp., Welland Cty, some 12 miles south of Fort Erie. The request was contained in a memo from the Bridge Division (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer) dated March 25, 1968, which also contained a request for foundation investigations at two other sites in the vicinity.

Subsequently an investigation was carried out by this Section to determine the subsoil conditions at the above site. This report contains the results of the investigation, together with recommendations for the foundations of the proposed structure and the stability of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located some 12 miles south of Fort Erie on the Q.E.W. in the vicinity of the Black Creek and Q.E.W. crossing. At this location, the Q.E.W. is a 4-lane paved highway with associated median and gravel shoulders. The Q.E.W. grade is about 4 to 5 ft. above the surrounding ground level. The inverts of the ditches located along the shoulders of the highway are 1 to 2 ft. below adjacent ground level. On either side of the highway, the ground is generally flat and covered with light to dense bush growth.

cont'd. /2 ...

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

Physiographically, the area is situated in the "Haldimand Clay Plain" region which is known for its lacustrine clay deposits. These deposits overlie a glacial till resting on interbedded shales and dolomites of the Salina formation.

3. FIELD AND LABORATORY WORK:

A total of 5 boreholes, each accompanied by a dynamic cone penetration test, was carried out during the course of the field investigation. Four additional dynamic cone penetration tests were driven to practical refusal in order to substantiate estimates of the subsoil stratigraphy. The boreholes and cone tests were carried out by a conventional diamond drill rig adapted for soil sampling purposes.

Samples were recovered at required depths by means of a 2" O.D. split-spoon sampler which was hammered into the soil, or by manually pushing 2" I.D. Shelby tubes in the cohesive strata. The method of driving the split-spoon sampler conformed to the specifications for the Standard Penetration Test. The same procedure was used to advance the dynamic cone penetration tests. Field vane tests were carried out, where possible, in the cohesive portions of the overburden in order to determine the undrained shear strength. Bedrock was core-drilled in all the washborings in AXT size.

The locations and elevations of the borings and dynamic cone penetration tests are shown on Drawing 68-F-30A, together with the estimated stratigraphical profile across the site. Surveying was undertaken by personnel from the Central Region Engineering Surveys Section. The elevations are referred to a geodetic bench mark.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Representative samples were then selected in order to determine the following physical properties:

cont'd. /3 ...

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

Natural Moisture Contents
Atterberg Limits
Bulk Densities
Undrained Shear Strengths
Grain-Size Distributions

The results of these tests are plotted on the individual Borelog sheets as well as on the Figures in the Appendix to this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The predominant stratum across the site is a stiff to hard deposit of silty clay to clay of 13 to 16 ft. thickness. This deposit overlies a stratum of hard clayey silt with sand and gravel (glacial till) which varies in thickness between 3 and 6 ft. and is underlain by interbedded shale and dolomite bedrock.

From ground surface downwards, the following soil strata were encountered in all the boreholes, and are inferred to have been encountered at the locations of the dynamic cone penetration tests:

4.2) Silty Clay to Clay:

A deposit of silty clay to clay was encountered beneath a surficial cover of topsoil some 6 to 12 inches thick. The thickness of the deposit ranged between 13 ft. at B.H.'s #2 and #3, and 16.5 ft. at B.H.'s #1 and #5. Visual examination of samples from this deposit revealed the presence of numerous silt seams up to 1/8 inch in thickness as well as occasional sand pockets and a trace of gravel. The samples also exhibited fissuring both in the horizontal and vertical directions. These fissures contained carbonaceous deposits and also remnants of old root systems.

cont'd. /4 ...

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

4.2) Silty Clay to Clay: (cont'd.) ...

A summary of the physical properties of the deposit, as determined in the field and laboratory, follows:

		Range	Average
Natural Moisture Contents	(W) - %	20 - 30	26
Liquid Limit	(W_L) - %	45 - 57	50
Plastic Limit	(W_P) - %	22 - 26	24
Bulk Density	(δ) - p.c.f.	119 - 129	124
Undrained Shear Strength	(C_u) - p.s.f.		
- Field Vane		> 2000	
- Unconfined Compression		1970 - 4885	3100
- Laboratory Vane		2630 - 3530	2500
Standard Penetration Resistance (N) - blows/ft.		18 - 46	30

The Atterberg limits shown on the Plasticity Chart (Figure 1, Appendix I), indicate that the deposit is an inorganic clay of medium to high plasticity (CI - CH). The natural moisture content of the deposit is approximately equal to the plastic limit. It is therefore inferred that the soil is highly preconsolidated as a result of past geological events or desiccation.

The 'N' values and undrained shear strengths indicate that the consistency of the deposit varies at random from stiff to hard, being generally very stiff.

4.3) Clayey Silt with Sand and Gravel (Glacial Till):

Underlying the silty clay to clay deposit is a stratum of reddish-brown clayey silt with sand and gravel (glacial till), encountered between elevations 562 and 564. The thickness of the glacial till stratum varied from 3.3 ft. at B.H. #4 to 5.5 ft. at B.H. #5.

cont'd. /5 ...

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

4.3) Clayey Silt with Sand and Gravel (Glacial Till): (cont'd.) ...

The natural moisture content of the stratum averaged about 7%. The liquid and plastic limits averaged respectively 21% and 12%, and are shown on the Plasticity Chart in Figure 2, Appendix I, which indicates the matrix of the glacial till to be an inorganic clayey silt of low plasticity (CL). Typical grain-size distribution curves for samples from this deposit are shown on Figure 3 in the Appendix.

The 'N' values ranged between 26 and in excess of 100 blows/ft. generally increasing with depth. The consistency of the deposit is therefore considered to be hard, based on the Standard Penetration Test.

4.4) Bedrock:

Bedrock was proven in all the washborings by obtaining 2.4 ft. to 5.5 ft. of rock core in AXT size. At the locations of the dynamic cone penetration tests, it is assumed that the cone met practical refusal either at or slightly above the bedrock surface. The bedrock was encountered between elevations 558.0 and 560.1 - i.e., at depths of 20 to 22 ft. below existing ground surface.

Examination of the recovered core samples indicates the bedrock to be a siliceous dolomite interbedded with shale. Gypsum inclusions were observed in the rock cores obtained from B.H.'s #3 and #4. The surface of the rock cores was generally "pitted" indicating solutioning. The upper 2 to 3 ft. of the rock yielded cores generally of 1/2 inch length, indicating close jointing down to about elevation 557. Core recoveries ranged between 80% and 100%, indicating the bedrock to be generally sound.

5. GROUNDWATER CONDITIONS:

Observations in the open boreholes immediately upon completion of the field work indicated a water level at about elevation 557 - i.e., some 2 to 3 ft. below existing ground surface.

cont'd. /6 ...

5. GROUNDWATER CONDITIONS: (cont'd.) ...

During the drilling operations, a loss of wash water was observed once the boreholes penetrated into the glacial till stratum. Upon coring bedrock, however, no further loss was observed and the water level rose up in the casing indicating the closely jointed bedrock to be a source of water.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an interchange at the crossing of the Q.E.W. and the revised Townline Road Extension. At present, a 4-span structure (40'-92'-92'-40') is contemplated at this crossing, having maximum approach fill heights in the order of 30 ft. above the existing ground surface.

The investigation reveals that the predominant stratum across the site is a 13 to 16 ft. thick deposit of stiff to hard silty clay to clay. This deposit is underlain by a 3 to 6 ft. thick glacial till stratum of hard consistency overlying sound bedrock some 20 to 22 ft. below the existing ground surface.

6.2) Structure Foundations:

In view of the competent subsoil conditions, the structure foundations may be supported on spread footings at or below elevation 575 with a safe bearing pressure of 2.5 t.s.f.

The abutments may be supported on spread footings placed within the approach fills. The fill material below the footings should consist of well compacted G.B.C. Class 'A' material and should extend to a horizontal distance of at least 10 ft. 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 at least a distance of 50 feet behind the abutments before re-excavating for the footings. A design load of 2.0 t.s.f. may be used for the abutment footing foundations.

cont'd. /7 ...

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

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

All organic topsoil should be subexcavated from within the plan limits of the granular fill prior to construction of the embankment in this area. Differential settlements should be within tolerable limits.

As an alternative, the abutments may be supported on end-bearing piles driven to bedrock. The load carrying capacity of such piles will depend on the section chosen. For example, 14 BP 73 steel H-pile sections could be designed to carry 90 tons/pile. Care should be taken that no bouldery fill is placed in the areas where piles have to be driven.

Footings and pile caps should be provided with a minimum soil cover of 4 ft. to satisfy the frost protection requirements in the area.

No major dewatering problems are anticipated for the construction of the footings in view of the relatively impermeable nature of the subsoil. Any seepage could be handled by ordinary pumping methods. In order to prevent softening of the subsoil at footing level as a result of seepage or surface runoff into the excavations, it is recommended that the base of the excavations be provided with a 12-inch granular pad or a thin mat of lean concrete.

6.3) Approach Embankments:

No major stability problems are anticipated for approach fills constructed with standard 2:1 slopes.

7. SUMMARY:

A foundation investigation for the proposed crossing of the Q.E.W. by the revised Townline Road Extension, some 12 miles south of Fort Erie, is reported.

cont'd. /8 ...

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

Subsoil at the site consists of a stiff to hard deposit of silty clay to clay some 13 to 16 ft. in thickness overlying a relatively thin, hard, glacial till deposit. Bedrock is encountered at depths of 20 to 22 ft. below existing ground surface.

The structure foundations may be supported on spread footings designed for a safe bearing pressure of 2.5 t.s.f. The abutments may be supported on spread footings located within the approach fill on compacted granular material (G.B.C. Class 'A'), or on end-bearing piles driven to bedrock.

No major dewatering problems are anticipated.

No major stability problems are anticipated for the approach fills with standard 2:1 slopes.

8. MISCELLANEOUS:

The field work, performed during the period April 23 - 30, 1968, was carried out by Mr. V. Korlu, Project Foundation Engineer.

The preparation of this report was undertaken by Mr. C. Mirza, Project Foundation Engineer, under the general supervision of Mr. M. Devata, Supervising Foundation Engineer.

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

June, 1968.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 1

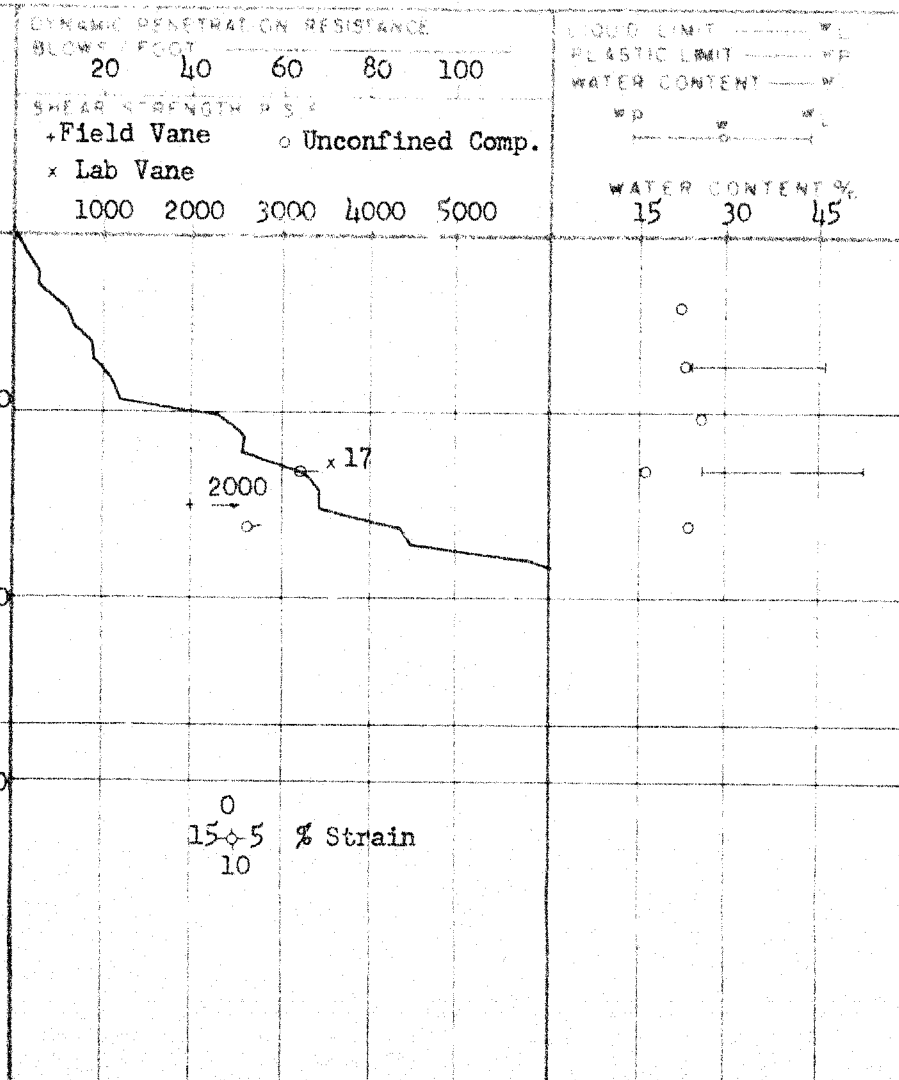
FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 29+25 ℄ Townline Rd. Ext. o/s 35' Lt. ORIGINATED BY WH

W P 446-65 BORING DATE April 23, 1968 COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX, BX Casing CHECKED BY

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE	BULK DENSITY P.C.F.	REMARKS Gr.Sa.Si.Cl
579.6	Ground Level						
0.0	Silty clay to clay with occ. sand and gravel. Fissured with silt seams. Very stiff. Reddish Brown	1	SS	26			▼576.6
		2	SS	46			
		3	SS	20	570		
		4	TW	PM		129	
562.1 / 17.5		5	TW	PM		127	
	Clayey silt with sand & gravel. Hard. (glacial till)	6	SS	173/10"	560		25 27 34 14
558.6 / 21.0	Interbedded siliceous dolomite and shale Bedrock	7	AXT RC	80% Rec			
553.1 / 26.5	End of Borehole				550		



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66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 1A

FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 28+96 ℄ Townline Rd.Ext. o/s 32' Rt. ORIGINATED BY VK

W P 446-65 BORING DATE April 30, 1968 COMPILED BY VK

DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P S F	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / WATER CONTENT %	UNIT WEIGHT PCF	REMARKS
579.5	Ground Level									
0.0	Probably silty clay.					570				
562.5										
560.5	Probably glacial till.					560				
19.0	Practical Refusal Probably Bedrock									

FORM CR MT 1
66 4744

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 2

FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 28+34 ℄ Townline Rd. Ext. o/s 30' Rt. ORIGINATED BY VK
W P 446-65 BORING DATE April 24, 1968 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX Casing CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P S F + Field Vane ○ Unconfined 1000 2000 3000 4000 5000	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % 15 30 45	UNIT DRY WEIGHT P C F	REMARKS
579.4	Ground Level									Gr.Sa.Si.Cl
0.0	Silty clay with occ. sand and grave. Fissured with silt to clayey silt seams. Stiff to hard. Reddish Brown.		1	TW	PM				128	▼ 577.1
565.4			2	SS	44					
			3	SS	18	570				
			4	TW	PM					
14.0	Clayey silt with sand & gravel. Occ.boulders Very stiff to hard. Glacial Till		5	SS	26					17 26 42 15
560.1			6	AXT		560				
19.3	Interbedded silicous dolomite & shale Bedrock			RC						
557.7										
21.7	End of Borehole						0 15 5 10 % Strain			

FORM 108 MT 12
66 4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 2A

FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 28+82 ℄ Townline Rd. Ext. o/s 35' Lt. ORIGINATED BY VK
W P 446-65 BORING DATE April 30, 1968 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	UNIT WEIGHT P C F	REMARKS
572.1	Ground Level									
0.0	Probably silty clay					570				
563.1 9.0										
560.1	Probably glacial till									
19.0	Practical Refusal Probably Bedrock					560				

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 3

FOUNDATION SECTION

JOB 68-F-32 LOCATION Sta. 30+74 ℄ Townline Rd. Ext. o/s 31' Rt. ORIGINATED BY VK

W P 446-65 BORING DATE April 25, 1968 COMPILED BY GK

DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
577.0	Ground Level					
0.0	Silty clay with occ. sand & gravel. Fissured with silt seams. Very stiff to hard. Reddish Brown		1	SS	30	
			2	TW	PM	570
			3	TW	PM	
564.0						
13.0	Clayey silt with sand & gravel. Hard. (glacial till)		4	SS	35	
			5	SS	167	
558.0			6	SS	150	560
19.0	Interbedded siliceous	75%	7	AXT	100%	
554.0	dolomite & shale bedrock			RC	Rec	
23.0	End of Borehole					550

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH PSF
x Lab Vane o Unconfined
1000 2000 3000 4000 5000

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %
15 30 45

UNIT WEIGHT
γ
PCF

REMARKS

6.5

125
120

Gr.Sa.Si.Cl
12 27 45 16

22 26 37 15

0
15 ✧ 5 % Strain
10

FORM CR MT S
66 4343

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 3A

FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 31+02 ℄ Townline Rd.Ext. o/s 36' Lt. ORIGINATED BY VK

W P 446-65 BORING DATE April 30, 1968 COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY A.C.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	BLOWS / FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P S F	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	UNIT WEIGHT P C F	REMARKS
577.0	Ground Level									
0.0	Probably silty clay					570				
564.0										
13.0	Probably glacial till									
561.5						560				
25.5	Practical Refusal									

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 31+49 ℄ Townline Rd.Ext. o/s 36' Lt. ORIGINATED BY VK

W. P. 446-65 BORING DATE April 26, 1968 COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH PSF × Lab Vane ○ Unconfined 1000 2000 3000 4000 5000	LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w WATER CONTENT % 15 30 45	UNIT WEIGHT γ PCF	REMARKS
579.4	Ground Level									
0.0	Silty clay to clay with occ. sand & gravel		1	SS	25					▼ 577.4
	Fissured with silt seams		2	SS	36					
	Very stiff to hard.		3	TW	PM	570			128	
	Reddish Brown		4	TW	PM				123	
562.4			5	TW	PM				120	
17.0	Clayey silt with sand & gravel Hard. (glacial till)		6	SS	190/10"	560				
559.1										
20.3	Interbedded siliceous dolomite & shale Bedrock		7	AXT RC	100% Rec.					
554.1										
25.3	End of Borehole					550				

15 10 0 5 % Strain

FORM DB MT-
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 4A

FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 31+23 ℄ Townline Rd.Ext. o/s 32' Rt. ORIGINATED BY VK

W P 446-65 BORING DATE April 30, 1968 COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F	LIQUID LIMIT — PLASTIC LIMIT — WATER CONTENT — WP W WL WATER CONTENT %	UNIT DENSITY P.C.F	REMARKS
579.8	Ground Level									
0.0	Probably Silty Clay					570				
563.8										
561.8	Probably glacial till									
18.0	Practical Refusal					560				

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS ONTARIO

RECORD OF BOREHOLE NO 5

MATERIALS & TESTING DIVISION — FOUNDATION SECTION

JOB 68-F-30 LOCATION Sta. 30+00 ℄ Townline Rd.Ext. o/s 2' Rt. ORIGINATED BY VK

W P 446-65 BORING DATE April 29, 1968 COMPILED BY CM

DATUM Geodetic BOREHOLE TYPE Diamond Drill - NX Casing CHECKED BY

SOIL PROFILE: ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE
581.8	Ground Level					
0.0	Silty clay with occ. sand & gravel. Fissured with silt seams.		1	SS	17	580
			2	SS	26	
			3	SS	30	
	Stiff to Hard.		4	TW	PM	570
564.3	Reddish Brown		5	TW	PM	
17.5	Clayey silt with sand & gravel. Hard.		6	SS	31	
558.8	(glacial till)		7	SS	240	560
23.0	Interbedded siliceous dolomite and shale		8	AXT RC	100% Rec	
553.8	Bedrock					
28.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

SHEAR STRENGTH P S F: ○ Unconfined — 1000 2000 3000 4000 5000

LIQUID LIMIT —— %, PLASTIC LIMIT —— %, WATER CONTENT —— %: WP ○ WL — WATER CONTENT % 15 30 45

P C F: 119

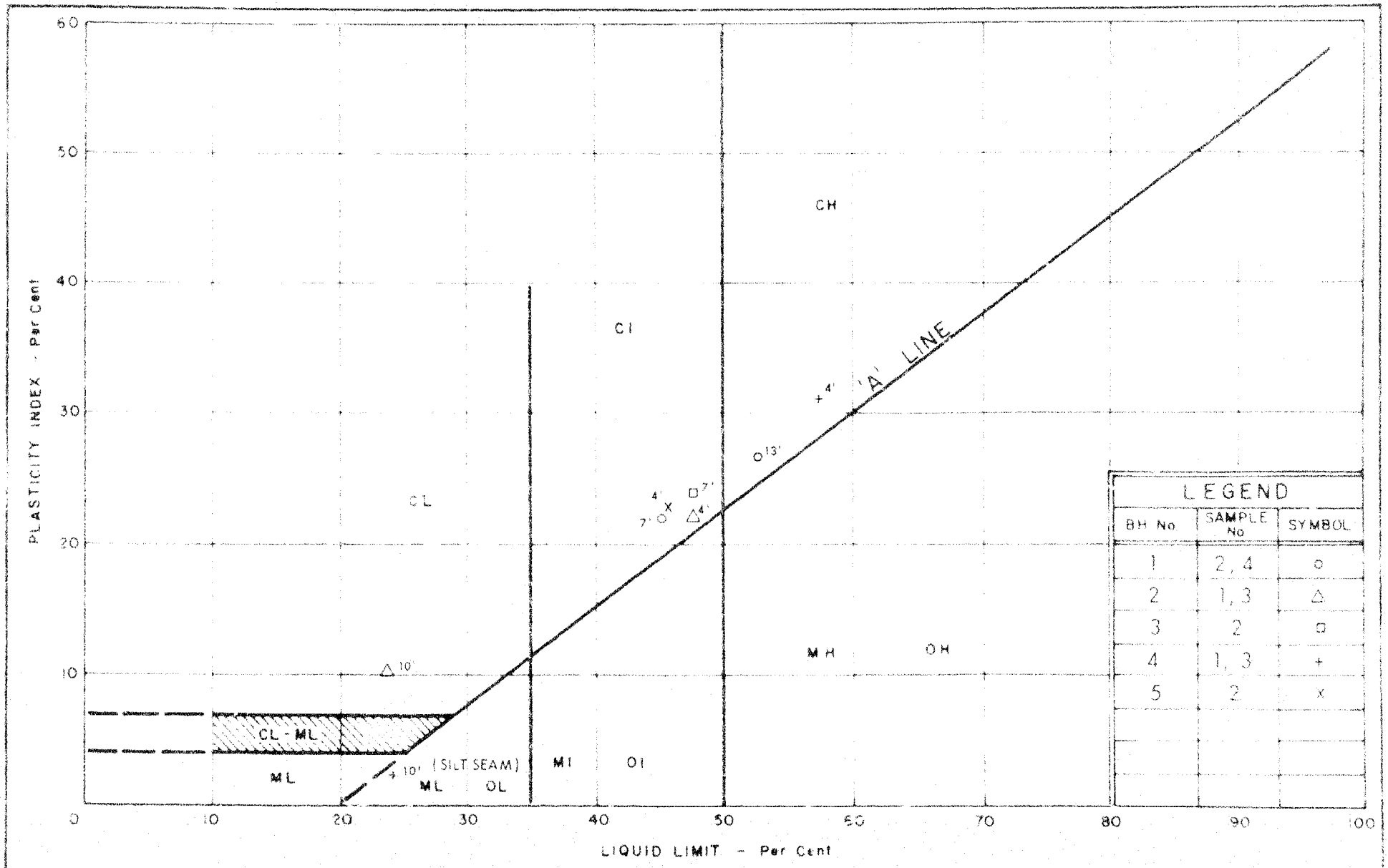
REMARKS: Gr.Sa.Si.Cl.

▼ 577 0

25 34 40 11

0
15 ± 5 % Strain
10

FORM 08-MT-252
REVISED JUL 1966

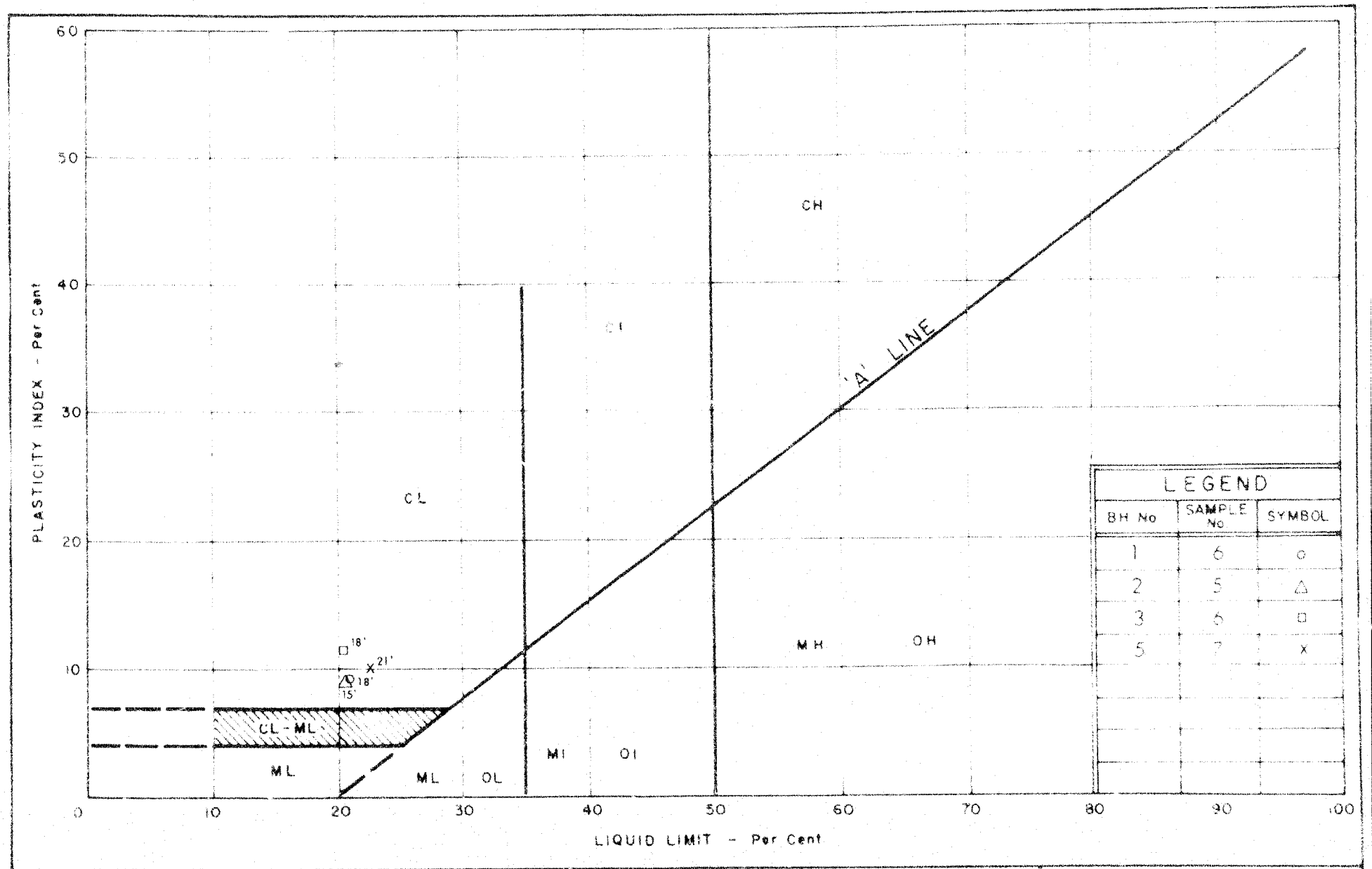


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART
SILTY CLAY TO CLAY

W.P. No. 446-65
JOB No. 68-F-30
FIG. 1

FORM OB-MT-252
REVISED JUL[illegible] 966



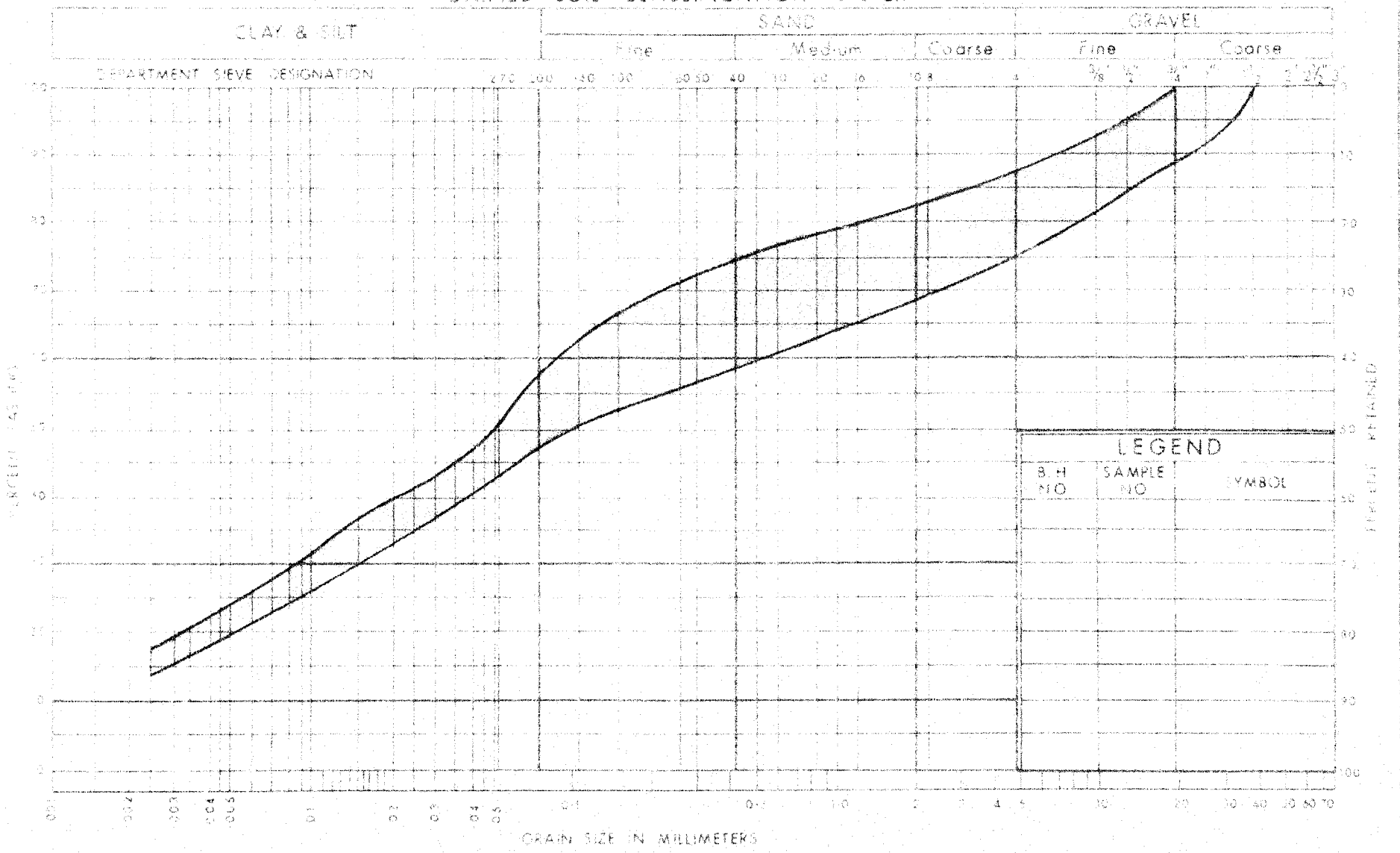
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART
GLACIAL TILL

W.P. No.	446-65
JOB No.	68-F-30
	FIG. 2

FORM DB MT - 17
REV. APR 1965

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

GLACIAL TILL

W.P. No.	446-65
JOB No.	68-F-30
	FIG. 3

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

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 :-

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

TYPE OF SAMPLE

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

SOIL TESTS

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

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

Department of Highways Ontario
Copy for the information of

FOUNDATION OFFICE

Mr. T. Stermac
Principal, Foundation Engineer
West Building

C.S. Grebski
Structural Office - West Bldg.

July 28, 1972

Townline Rd. Extension Underpass
W.P. 446-68-02 Site 34-22A
District 4

68-F-30

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/kvc
Encls.

C.S. Grebski
Structural Design Engineer

cc Foundation Office

RECEIVED
FOUNDATIONS OFFICE
JUL 31 1972
Ministry of Transportation & Communications

No comments
M. Devata
Aug 3/72

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

PROGRESS MEETING NO. 18

MINUTES OF MEETING

68-F-30

Subject: Queen Elizabeth Way - Fort Erie
W.P. No. 446-65

Time and Place: M.T.C. Central Region, Tuesday, June 19, 1973 at 9:30 a.m.

Present:		
	W. Roters	Regional Systems Design
	N. Sen	Regional Systems Design
	D. Hogg	Materials and Testing
	R. Lewis	C. C. Parker and Associates
	E. Wilson	C. C. Parker and Associates

1. O.M.B. Hearing — Action By:

The hearing is to be held on June 28, 1973. — N. Sen

Two objectors have been heard from:

a) Motel - objects mainly to interchange location - motel is hidden by bush;

b) Property Owner in Douglastown - appears to be confused as to his access to Q.E.W.

Both objectors will be contacted by M.T.C.

2. Completion Date

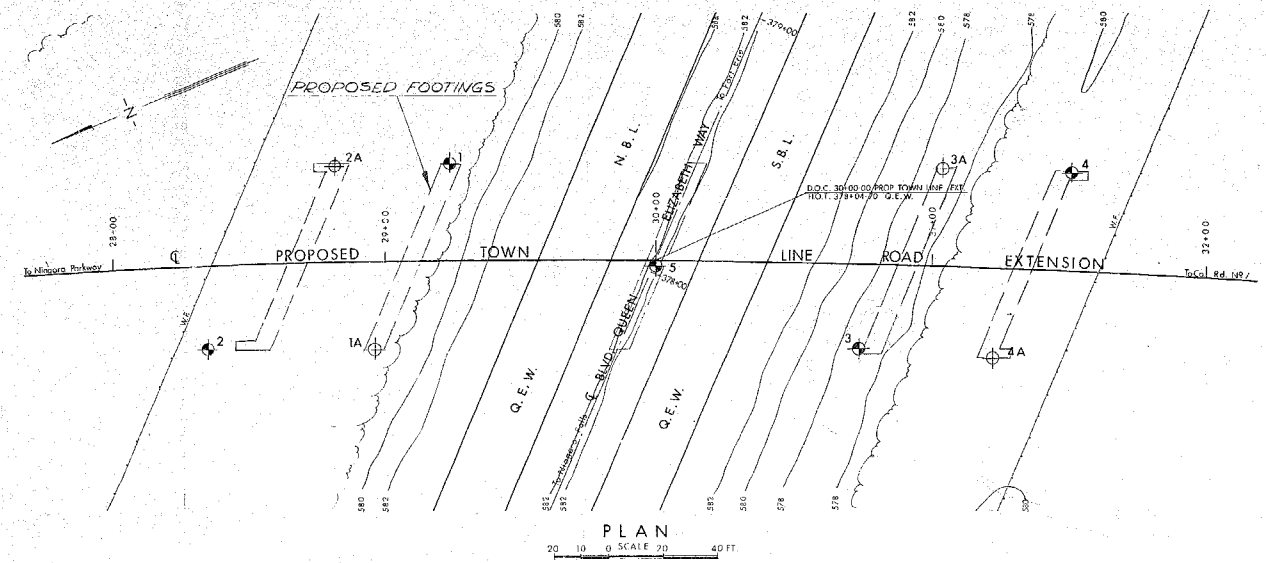
A revised completion date will be established upon receipt of the O.M.B. order. — W. Roters

3. Next Meeting

The next progress meeting will be held on Tuesday, July 17, 1973 at 9:30 a.m.

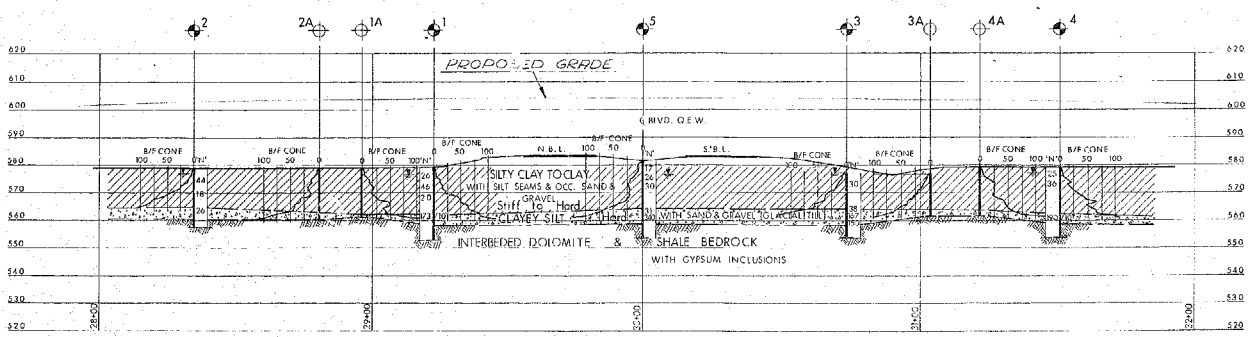
F. E. Wilson

F. E. Wilson, P. Eng.,
C. C. Parker and Associates Limited.



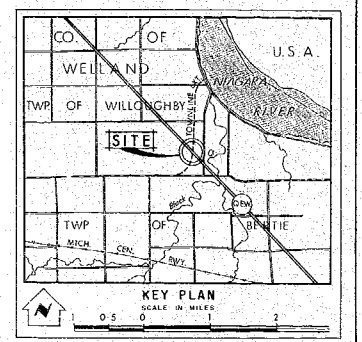
PLAN

SCALE 20 10 0 20 40 FT.



℄ PROFILE

SCALE 20 10 0 20 40 FT.



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, APRIL 1968.

NO.	ELEVATION	STATION	OFFSET
1	579·6	29+25	35' LT.
1A	579·5	28+96	32' RT.
2	579·4	28+34	30' RT.
2A	579·1	28+82	35' LT.
3	577·0	30+24	31' RT.
3A	577·0	31+02	36' LT.
4	579·4	31+49	36' LT.
4A	579·8	31+23	32' RT.
5	581·0	30+00	2' RT.

– NOTE –

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

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS – ONTARIO

MATERIALS & TESTING DIVISION – FOUNDATION SECTION

TOWNLINE ROAD EXTENSION

KING'S HIGHWAY NO. Q.E.W. DIST. NO. 4

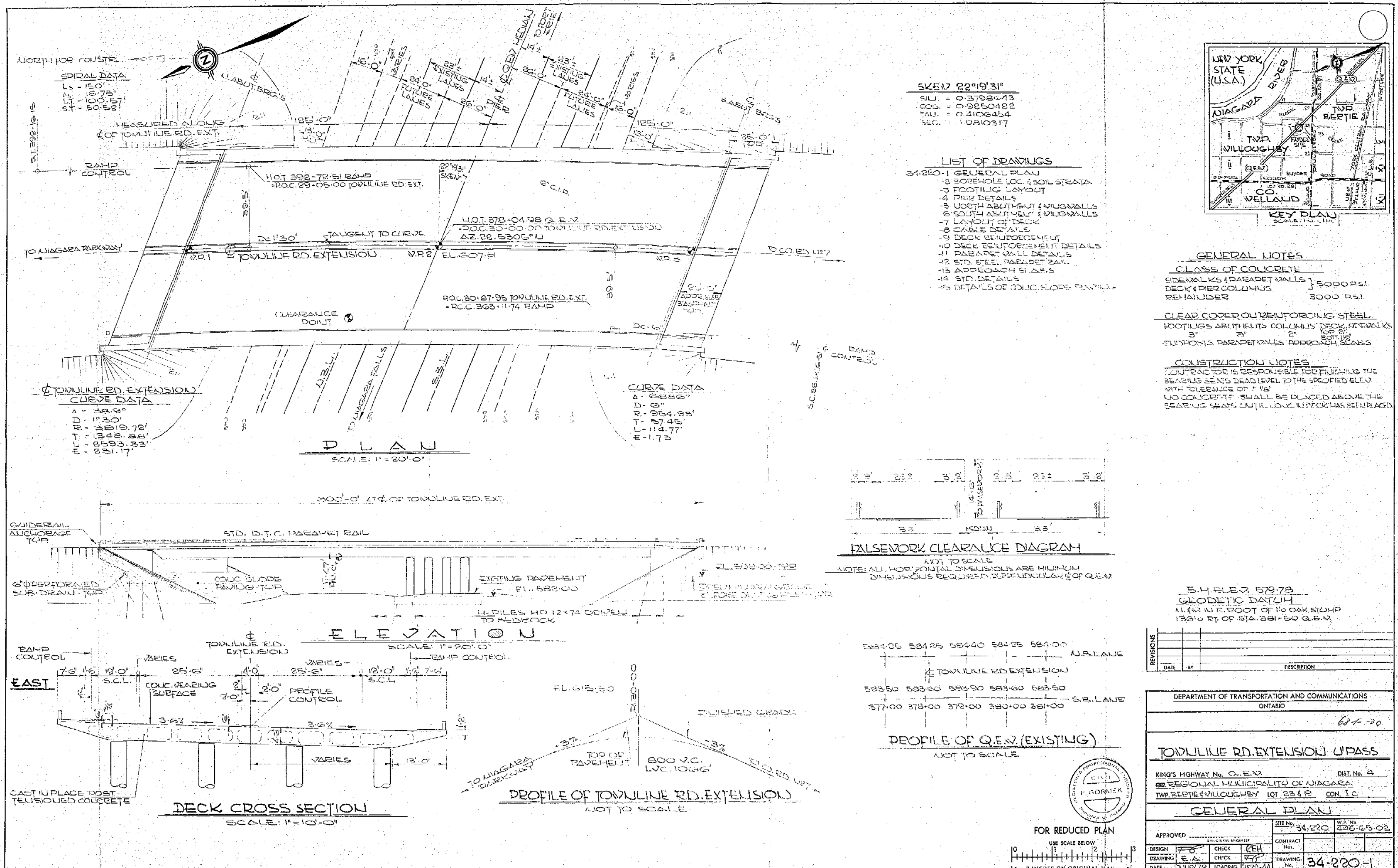
CO. WELLAND

TWP. WILLOUGHBY LOT 19&20 CON. 1st. C.C.

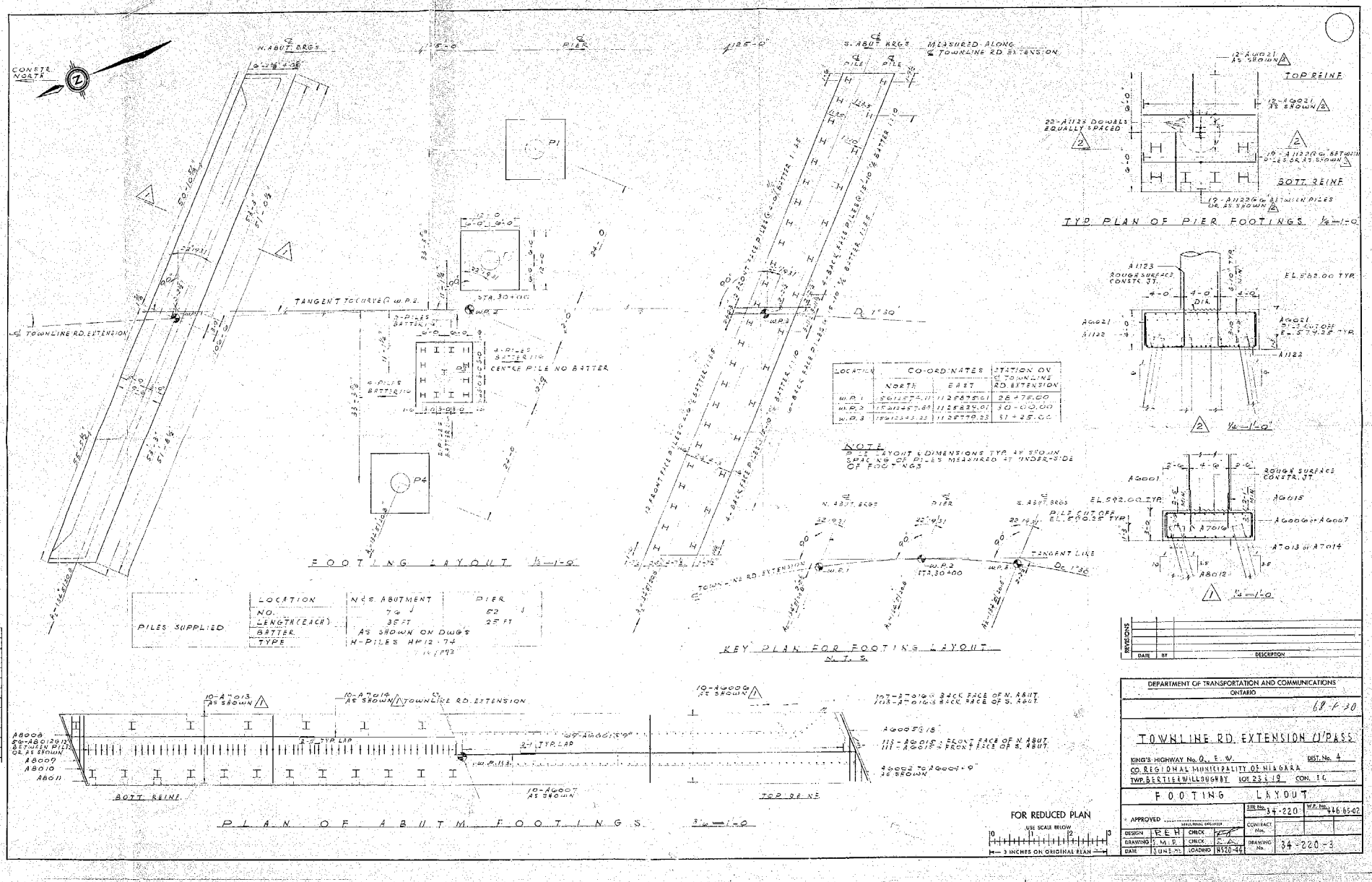
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. V.K.	CHECKED	W.P. NO. 446-65	P.&T. DRAWING NO. 68-F-30A
DRAWN S.O.	CHECKED	JOB NO. 68-F-30	
DATE 12 JUNE 1968		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

REF. NO. E 4903-1



PLAN
SCALE: 1" = 20'-0"
SPIRAL DATA
Ls - 150'
Δs - 16.75°
LT - 100.57'
ST - 50.52'
℄ TOWNLINE RD. EXTENSION
CURVE DATA
Δ - 38.9°
D - 1°30'
R - 3819.72'
T - 1348.88'
L - 2593.33'
E - 231.17'
CURVE DATA
Δ - 6.886°
D - 6°
R - 954.93'
T - 57.45'
L - 114.77'
E - 1.73
TO NIAGARA PARKWAY
TOWNLINE RD. EXTENSION
TO CO. RD. 127
CLEARANCE POINT
RAMP CONTROL
N. ABUT. BRGS.
S. ABUT. BRGS.
EXISTING LANES
FUTURE LANES
N.B.L.
S.B.L.
TO NIAGARA FALLS
SKEW 22°19'31"
SIN. = 0.3798643
COS. = 0.9250482
TAN. = 0.4106454
SEC. = 1.0810317
LIST OF DRAWINGS
34-220-1 GENERAL PLAN
-2 BOREHOLE LOC. & SOIL STRATA
-3 FOOTING LAYOUT
-4 PIER DETAILS
-5 NORTH ABUTMENT & WINGWALLS
-6 SOUTH ABUTMENT & WINGWALLS
-7 LAYOUT OF DECK
-8 CABLE DETAILS
-9 DECK REINFORCEMENT
-10 DECK REINFORCEMENT DETAILS
-11 PARAPET WALL DETAILS
-12 STD. STEEL PARAPET RAIL
-13 APPROACH SLABS
-14 STD. DETAILS
-15 DETAILS OF CONC. SLOPE PAVING
NEW YORK STATE (U.S.A.)
NIAGARA RIVER
TWP. BERTIE
TWP. WILLOUGHBY
CO. WELLAND
KEY PLAN
GENERAL NOTES
CLASS OF CONCRETE
SIDEWALKS & PARAPET WALLS, DECK & PIER COLUMNS – 5000 P.S.I.
REMAINDER – 3000 P.S.I.
CLEAR COVER ON REINFORCING STEEL
FOOTINGS ABUTMENTS COLUMNS DECK SIDEWALKS
CONSTRUCTION NOTES
CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEV. WITH TOLERANCE OF ± 1/8"
NO CONCRETE SHALL BE PLACED ABOVE THE BEARING SEATS UNTIL CONC. IN DECK HAS BEEN PLACED
ELEVATION
SCALE: 1" = 20'-0"
300'-0" ℄ OF TOWNLINE RD. EXT.
GUIDERAIL ANCHORAGE TYP.
STD. D.T.C. PARAPET RAIL
6" Ø PERFORATED SUB-DRAIN TYP.
CONC. SLOPE PAVING TYP.
EXISTING PAVEMENT EL. 582.00
H. PILES HP 12×74 DRIVEN TO BEDROCK
FALSEWORK CLEARANCE DIAGRAM
NOT TO SCALE
NOTE: ALL HORIZONTAL DIMENSIONS ARE MINIMUM DIMENSIONS REQUIRED PERPENDICULAR TO ℄ OF Q.E.W.
B.M. ELEV. 579.78
GEODETIC DATUM
DECK CROSS SECTION
SCALE: 1" = 10'-0"
EAST
RAMP CONTROL
TOWNLINE RD. EXTENSION
CONC. WEARING SURFACE
PROFILE CONTROL
CAST IN PLACE POST-TENSIONED CONCRETE
PROFILE OF TOWNLINE RD. EXTENSION
NOT TO SCALE
EL. 615.50
TOP OF PAVEMENT
800 V.C.
LVC. 1066'
FINISHED GRADE
TO NIAGARA PARKWAY
TO CO. RD. 127
PROFILE OF Q.E.W. (EXISTING)
NOT TO SCALE
N.B. LANE
S.B. LANE
℄ TOWNLINE RD. EXTENSION
PRINT RECORD
No. FOR DATE
REVISIONS
DATE BY DESCRIPTION
DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
TOWNLINE RD. EXTENSION U'PASS
KING'S HIGHWAY No. Q.E.W.
DIST. No. 4
REGIONAL MUNICIPALITY OF NIAGARA
TWP. BERTIE & WILLOUGHBY LOT 23 & 19 CON. 1 C
GENERAL PLAN
APPROVED
SITE No. 34-220
W.P. No. 4216-65-02
DRAWING No. 34-220-1
DATE JUNE/72
LOADING HS20-44
FOR REDUCED PLAN
USE SCALE BELOW
3 INCHES ON ORIGINAL PLAN



LOCATION	CO-ORDINATES NORTH	CO-ORDINATES EAST	STATION ON ℄ TOWNLINE RD EXTENSION
W.P.1	5011557.11	1125875.01	28+78.00
W.P.2	5011345.89	1125825.01	30-00.00
W.P.3	5011233.33	1125770.23	31+25.00

NOTE
PILE LAYOUT DIMENSIONS TYP. AS SHOWN
SPACING OF PILES MEASURED AT UNDER-SIDE OF FOOTINGS

	LOCATION	N & S. ABUTMENT	PIER
PILES SUPPLIED	NO.	7 @	5 @
	LENGTH (EACH)	35 FT	25 FT
	BATTER	AS SHOWN ON DWG'S	
	TYPE	H-PILES HP12:74	

PRINT RECORD No.	FOR	DATE

REVISIONS DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS ONTARIO

68-F-30

TOWNLINE RD. EXTENSION U/PASS

KING'S HIGHWAY No. 0. E. W. DIST. No. 4
CO. REGIONAL MUNICIPALITY OF NIAGARA
TWP. BERTIE & WILLOUGHBY LOT 23 & 19 CON. IC

FOOTING LAYOUT

APPROVED ..... STRUCTURAL ENGINEER		SITE No. 34-220	W.P. No. 446 85-02
		CONTRACT No.	
DESIGN R.E.H.	CHECK		
DRAWING S. M. D.	CHECK	DRAWING No.	34-220-3
DATE JUNE 71	LOADING HS20-44		