



ONTARIO

DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, **Date** July 24, 1959.
Bridge Engineer. **Subject** Re: FOUNDATION REPORT -
From Materials & Research Section. W.P. 195-58 - W.J. F-59-68.
Attention: Mr. S. McCombie.

This memo accompanies our detailed report covering the investigation for the above structure site. Reference to the contents of this report shows that a shallow layer of hard, silty clay overlies shale bedrock. The strength and compressibility characteristics of the subsoil are such that the structure can be supported on spread footings founded at shallow depth.

If footings are founded within the cohesive stratum, an allowable bearing capacity of 5 tons/sq. ft. can be used; and if footings are founded directly on the shale bedrock, a minimum bearing pressure of at least 10 tons/sq. ft. is permissible.

The strength and compressibility characteristics of the clay layer are such that the approach embankments can be designed using a standard 2:1 slope.

If you have any queries concerning the contents of this report, please contact our office.

LGS/MdeF
Encl.

cc: Messrs.

A. M. Toye
H. A. Tregaskes
D. G. Ramsay
J. Ford
R. E. Richardson
P. F. Weber
A. Watt
Foundation Section
Gen. Files.

for L. G. Soderman
L. G. Soderman,
PRINCIPAL SOILS AND FOUNDATIONS ENGINEER.

FOUNDATION REPORT

ON

Hwy. No. 403, Line 'B' Rd. All'ce. between
Lots 6 & 7, Con. I, Twp. of Flanborough East.

Site Plan No: 59-68A.

Plan No: F 2407-26.

Profile No: F 2407-27.

Chainage: Sta. 208/14.

Distribution:

Mr. A. M. Toye, Bridge Engineer.	(2)
Mr. H. A. Tregaskes, Construction Engineer.	(1)
Mr. D. G. Ramsay, Road Design Engineer.	(1)
Mr. J. Ford, Project Design Engineer.	(1)
Mr. R. E. Richardson, District Engineer, Hamilton.	(1)
Mr. P. F. Weber, Regional Soils Engineer.	(1)
Mr. A. Watt, Ont. Water Resources Commission.	(1)
Foundation Section.	(1)
General Files.	(1)

W.P. 195-58.

W.J. F-59-68.

INTRODUCTION:

Presented in this report are the results of a subsoil investigation carried out at a structure location approximately 1/2 mile north of Aldershot. At this location proposed Hwy. #403 Line 'B' crosses the existing paved road between Lots 6 & 7, Con. I, Twp. of Flanborough East (Sta. 202/14, Profile No. F 2407-27). This report contains the field and laboratory findings and recommendations for the foundation of the structure.

The field work commenced on June 25th, 1959 and was completed on July 1st, 1959.

DESCRIPTION OF THE SITE & GEOLOGY:

The topography of the site is generally level to undulating. The areas on both sides of the gravel road are presently uncultivated, and in pasture. The surrounding region consists of several fairly large valleys. A broad belt of red shale is exposed and the long lower slopes on the north-east side of the site are highly eroded.

The site is located on the Niagara Escarpment which extends from Niagara River to Bruce Peninsula. According to available geological information, this region is the valley of a pre-glacial river which joined the basins of Lake Ontario and Lake Erie. This site is generally covered by shallow deposits of clay, underlain by shale bedrock.

DESCRIPTION OF FIELD & LABORATORY WORK:

Field work consisted of 4 sampled boreholes with dynamic cone penetration tests adjacent to each borehole. The exploration programme was carried out by a standard core-drill machine adapted for soil sampling. Conventional wash boring procedures were followed.

DESCRIPTION OF FIELD & LABORATORY WORK: (cont'd.) ...

Samples were recovered at depths required by means of a 2" O.D. split spoon sampler. The dimensions of this spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration test. Rock samples were obtained by rotary drilling using an AXT corebit and retained in a 5-ft. double tube core-barrel.

Upon receipt in the laboratory, samples were visually examined and identified. Routine index tests were performed on selected representative samples.

Laboratory and field test results have been summarized in Table No. 1 and are included in this report under Appendix I.

Drawing No. F 59-68A shows the borehole locations and the estimated subsoil stratigraphy.

SUBSOIL CONDITIONS:

The site is underlain by shale bedrock covered by a shallow overburden of very hard clay.

In each of the sampled boreholes, the topsoil was found to be underlain by clay silt, silty clay and clay. This stratum extends approximately 10 to 16 ft. below the existing ground surface. Underlying this stratum and immediately overlying the shale bedrock, a thin layer of red clay with gravel and fragments of shale was encountered.

Bedrock was drilled and cored in order to determine its quality and soundness.

cont'd. /3 ...

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

In the order of stratigraphic succession, the following soil types are defined:-

1. Hard, Clayey Silt to Silty Clay:

The layer of clayey silt to silty clay was found to be continuous over the site. The upper zone has been subjected to oxidation resulting in its present brown colour. Below the oxidized zone the colour is predominantly grey. The very hard dense clay silt contains 60% of silt and 10% sand. The average unit weight and moisture content were found to be 135 p.c.f. and 12%, respectively. Standard penetration tests carried out during sampling, gave 'N' values varying from 50 to 60.

Underneath the hard clayey silt crust the thin stratum of very hard silty clay was encountered. The colour is also red and contains approximately 45% of silt, 12% of sand and 12% fine to medium gravel. Its consistency is defined by moisture content of 12%, liquid and plastic limits of 28% and 17%, respectively. The average 'N' value was found to be 90 blows.

The hard silty clay layer is followed by a thin layer of very hard red clay. The moisture content is 14% and has a plastic limit of 14%. The bedrock was encountered immediately below the hard red clay.

2. Bedrock:

The bedrock formation consists of interbedded red and grey shale. The top layer of 6" of the bedrock is medium soft. The shale is in a sound condition with no signs of weathering or

cont'd. /4 ...

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

2. Bedrock: (cont'd.) ...

fracture. Bedrock is at Elev. 356.7' in Boring 1; Elev. 359.1' in Boring 2; Elev. 350.0' in Boring 3, and at Elev. 349.3' in Boring 4. From the elevations of bedrock surface encountered in the four borings, it appears that the rock surface is sloping in a South-Westerly direction.

WATER CONDITIONS:

Observations and measurements carried out during boring and sampling operations indicate that a water table is at approximately Elev. 362' in Borings 1 & 2, and Elev. 357' in Borings 3 & 4. In view of the fact that no water-bearing sand seams of any significance, or artesian water conditions were encountered during the exploration programme, seepage into footing excavations will be local and of minor quantities.

FOUNDATION CONSIDERATIONS:

Reference to the borehole logs appended to the report, shows that the subsoil conditions at the site consist of shale bedrock overlain by a very hard silty clay layer varying from 12 to 18 feet in thickness. Reference to the profile of Hwy. 403 at this site, shows that the proposed grade line elevation is 359.0'.

At the location of Borings 1 & 2 (approximate north abutment location) shale bedrock was encountered at elevations 359.1' to 356.7'. Because of the proximity of the underlying bedrock to the proposed grade line, footings for this abutment can be founded directly within the bedrock formation. An allowable

FOUNDATION CONSIDERATIONS: (cont'd.) ...

bearing capacity of at least 10 tons/sq. ft. can be used. A nominal amount of scaling of the upper fragmented and weathered layer of the bedrock surface can be anticipated.

At the south abutment location (i.e., Boreholes 3 & 4) the bedrock was encountered at Elevations 349.3' and 350.1'. The hard silty clay overlying the bedrock, has sufficient strength to safely support a footing pressure of 5 tons/sq. ft.

At this abutment location, footings can either be founded on the bedrock using a design pressure of 10 tons/sq. ft., or founded in the hard cohesive material overlying the bedrock, using a bearing pressure of 5 tons/sq. ft.

Strength and compressibility characteristics of the subsoil at this site are such that the approach embankments can be designed using a standard 2:1 slope.

CONCLUSIONS & RECOMMENDATIONS:

- (1) The site is underlain by red shale bedrock covered by a shallow layer of very hard stiff clayey glacial till.
- (2) At the location of the north abutment, it is recommended that footings be founded directly on the underlying shale bedrock formation, and that a bearing pressure of 10 tons/sq.ft. be used. A nominal amount of scaling of the surface of the bedrock formation can be expected. At the south abutment location, the thickness of the overburden is such that footings can either be founded in the hard clay stratum, or carried down to the bedrock formation. If spread footings are founded within the hard cohesive layer overlying the

CONCLUSIONS & RECOMMENDATIONS: (cont'd.) ...

(2) (cont'd.) ...

bedrock, an allowable bearing pressure of 5 tons/sq. ft. is recommended. If footings are founded directly upon the bedrock formation, an allowable bearing pressure of 10 tons/sq.ft. can be used.

(3) No ground water problems with respect to footing excavation, are anticipated. Total and differential settlements should be negligible.

(4) The proposed grade line does not present any approach fill stability problems.

M. Devata,
Foundation Engineer.

APPENDIX I.

SUMMARY OF FIELD & LABORATORY TESTS

JOB F59-68

W.P. 195-58

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENET'N RESIST. BLOWS/FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH p.s.f.	UNIT WEIGHT p.c.f.	REMARKS
1	S1	3'-4.5'	Very hard dark brown clay silt with sand and gravel	63	15.9			---	133.7	
	S2	6'-6.5'	Very hard red silty clay with gravel and sand	4"-64	9.2	18.4	32.5	---	-----	
	S3	10'-10.5'	Very hard red clay with fine to medium gravel	5"-64	16.0	13.9	----	---	-----	
	S4	15'-15.5'	Very hard red clay with fine to medium gravel	5"-100	17.6	----	----	---	-----	
2	S1A	3'-4.5'	Very hard red silty clay with sand and gravel	88	9.6	----	----	---	-----	
	B S2	6'-7.5'	Very hard red silty clay with sand and gravel	>180	9.9 11.0	17.7 ----	25.8 ----	---	-----	
	S3	10'-10.5'	Very hard red clay with gravel	7.5"110	18.3	----	----	---	-----	
3										
4	S1	3'-4.5'	Dry hard red clay with fine gravel	53	8.2	----	----	-----	-----	
			S Denotes split spoon sample							

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 195-58 BORE HOLE NO. 1
JOB F59-68 STATION 202+40.59 (PT)
DATUM 372.7' COMPILED BY B.K.
BORING DATE June 25/59 CHECKED BY M.D.

2" DIA. SPLIT TUBE _____
2" SHELBY TUBE _____
2" SPLIT TUBE _____
2" DIA. CONE _____
2" SHELBY _____
CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) -----	0
VANE TEST (C) AND SENSITIVITY (S) -----	+ S
NATURAL MOISTURE AND	
LIQUIDITY INDEX -----	X
LIQUID LIMIT -----	0
PLASTIC LIMIT -----	1

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION	
				RESISTANCE	P. S. F.
	↓ Ground level				
	Top soil	372.7	0		
		371.7			
	Very hard dark brown clay silt with sand and gravel	366.7			
	Very hard red silty clay with gravel and sand	362.7			
	Very hard red clay with fine to medium gravel	356.7			
	Shale bed rock				
	Ax core 16.0-20.0 100% recovery				
	" " 20.0-25.0 Medium hard				
	shale no sign of weathering				
	End of borehole	347.7			
	Cone penetration:				
	350 ft./lb. with 2" Dia. cone				

Graph showing blow count (blows/ft.) versus depth (feet) for a borehole. The graph shows a sharp increase in blow count starting around 10 feet depth, indicating a transition to a harder material (shale bed rock). A note on the graph reads "REPAIRED AT 865.81".

CONSISTENCY		SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT-- % DRY WT.			
10	20	30	
		S1	133.7
		S2	---
		S3	---
		S4	---

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 195-58 BORE HOLE NO. 2
JOB P59-68 STATION 201+65 (53' RT)
DATUM 371.1 COMPILED BY B.K.
BORING DATE June 30/59 CHECKED BY M.D.

2" DIA. SPLIT TUBE _____
2" SHELBY TUBE _____
2" SPLIT TUBE _____
2" DIA. CONE _____
2" SHELBY _____
CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) _____	0
VANE TEST (C) AND SENSITIVITY (S) _____	+ %
NATURAL MOISTURE AND LIQUIDITY INDEX _____	LI
LIQUID LIMIT _____	X
PLASTIC LIMIT _____	0

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P. S. F.	
	↓ Ground level	371.1	0		
	Top soil	370.1			
	Dry hard brown silty clay	368.1			
	Very hard red silty clay with sand and gravel				
	Very hard red clay with gravel	361.1	10		
	Ax Core 12-13.5 red shale	359.1			
	" " 13.5-18.5 red shale interbedded with gray, no weathering or fracture				
	End of borshole	352.6	20		
	Cone penetration: 350 ft/lb with 2" Dia. cone		30		

Graph showing Strength and Penetration Resistance (P.S.F.) vs. Depth (Feet). The graph includes a curve for penetration resistance and a line for strength resistance. A label 'REFUSAL AT 24.5' is present on the strength resistance line.

CONSISTENCY		SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.			
10	20	30	
X	X		S1
X			S2
	X		S3

B. H. 2

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 195-58 BORE HOLE NO. 3
JOB F59-68 STATION 201+80 (S9' LT)
DATUM 367.1 COMPILED BY B.K.
BORING DATE July 1/59 CHECKED BY M.D.

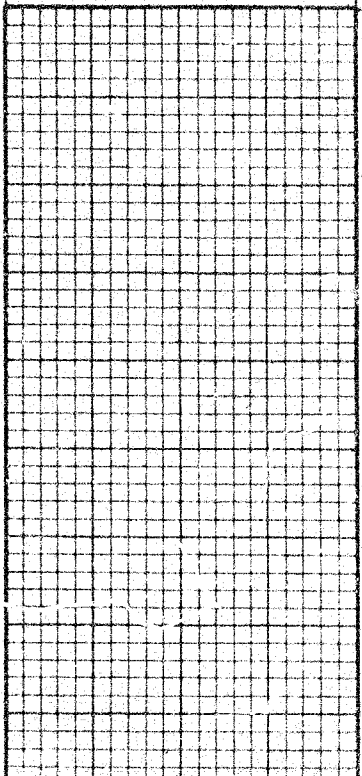
2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
2" SHELBY
CASING

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) _____ O
VANE TEST (C) AND SENSITIVITY (S) _____ +
NATURAL MOISTURE AND LIQUIDITY INDEX _____ LI
LIQUID LIMIT _____ X
PLASTIC LIMIT _____

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	
	↓ Ground level				
	Top soil	367.1	0		
	Very hard dry brown clay	366.1			
	Very hard light grey clay and gravel	362.1			
	Light brown clay with gravel dry and hard	358.1			
	Ax Core 17-21.5' red and gray shale 90% recovery	350.1			
	End of borehole	345.6			
	Cone penetration: 350 ft/lb with 2" cone				

Graph showing Strength and Penetration Resistance (P.S.F.) vs. Depth (Feet). The curve starts at 0 P.S.F. at 0 feet, rises to about 100 P.S.F. at 2 feet, then drops sharply to about 20 P.S.F. at 4 feet, and remains relatively constant at that level down to 10 feet. A label 'SPECIAL AT 8600'' is present near the 10-foot mark.

CONSISTENCY		NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.	SAMPLE	
		

B.H.

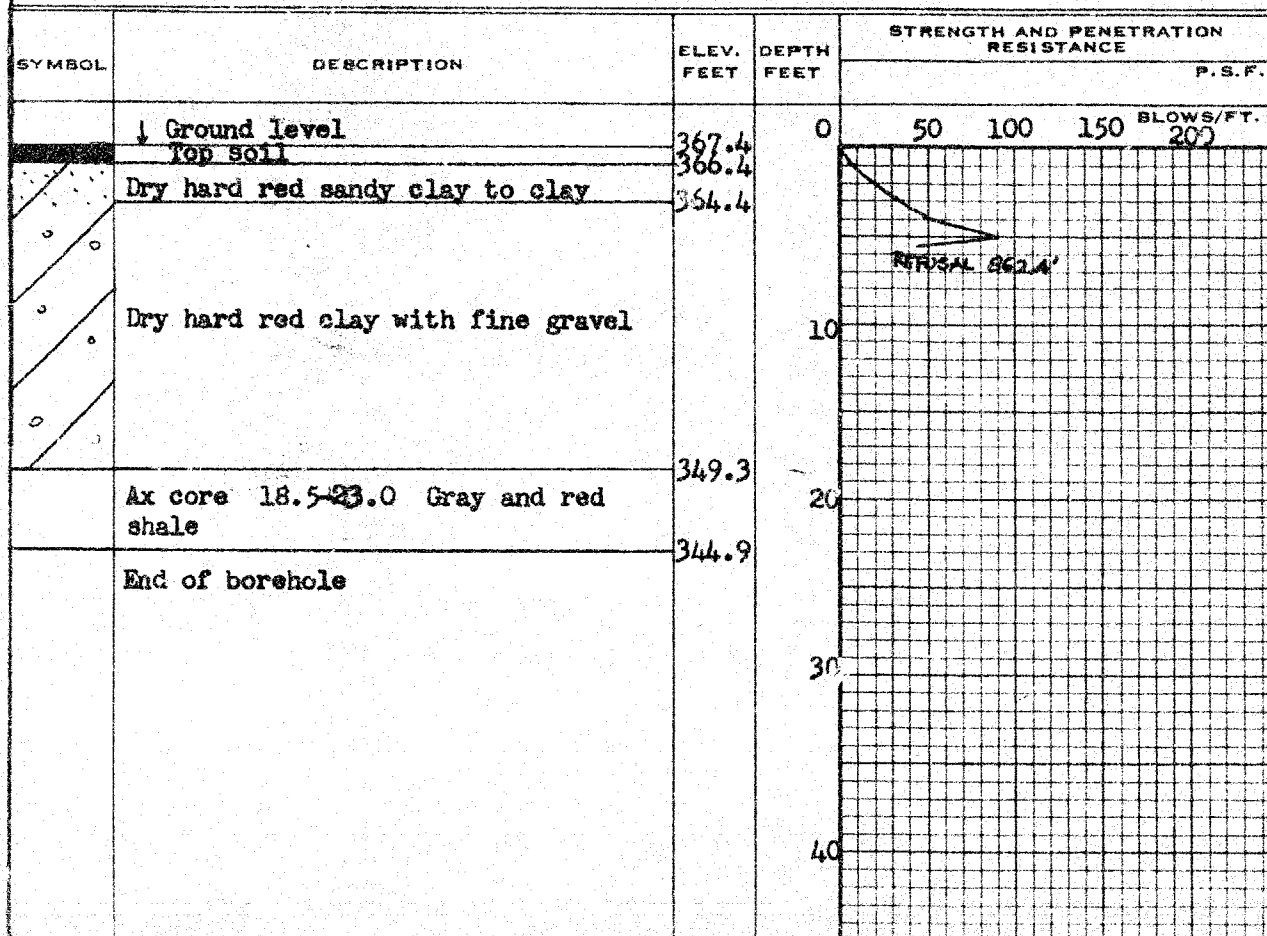
DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

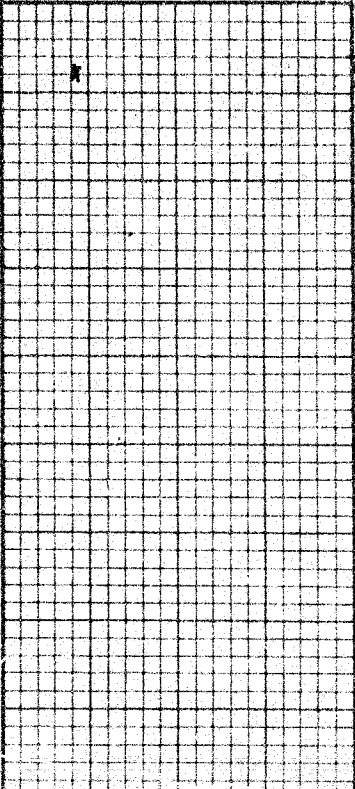
W.P. 195-58 BORE HOLE NO. 4
 JOB F59-68 STATION 202+56 (59 27)
 DATUM 367.9' COMPILED BY B.K.
 BORING DATE July 1/59 CHECKED BY M.D.

2" DIA. SPLIT TUBE _____
 2" SHELBY TUBE _____
 2" SPLIT TUBE _____
 2" DIA. CONE _____
 2" SHELBY _____
 CASING _____

LEGEND

1/2 UNCONFINED COMPRESSION (Qu) _____
 VANE TEST (C) AND SENSITIVITY (S) _____
 NATURAL MOISTURE AND LIQUIDITY INDEX _____
 LIQUID LIMIT _____
 PLASTIC LIMIT _____

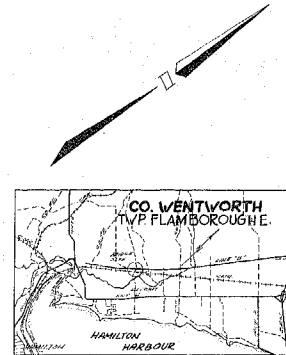
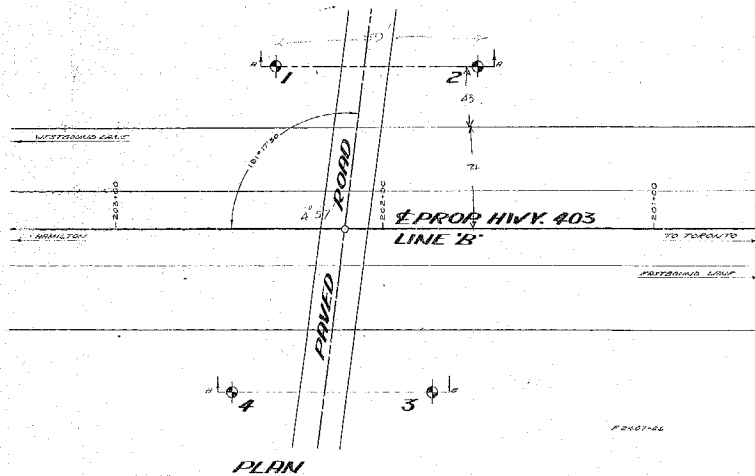


CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
10	20	30	S1	
				

B.H. 4

B.H. 4

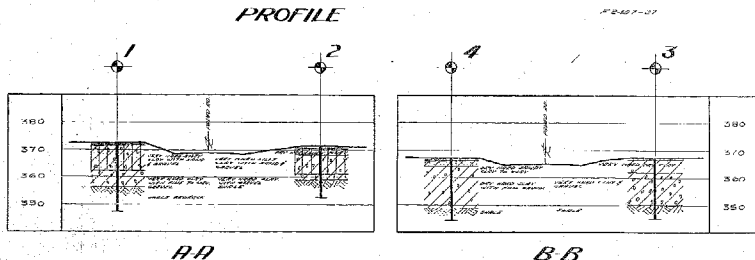
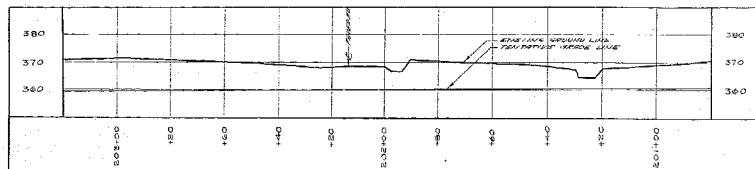
201+25.82
161 01-19



LEGEND

ROAD MARK
UNIMPROVED ROAD
ROAD WITH UNIMPROVED ROAD

HOLE NO.	ELEVATION	STATION	OUTSIDE OF
1	372.8	200+40	5.0' RT
2	371.1	201+65	5.0' RT
3	367.1	201+80	5.0' RT
4	367.6	201+125	5.0' RT



NOTE

THE BOUNDARIES BETWEEN THE TOWNSHIP AND THE COUNTY HAVE BEEN ESTABLISHED ONLY AT THE POINTS SHOWN. THE BOUNDARIES ARE ASSUMED TO BE THE SAME AS SHOWN ON THE MAP OF THE TOWNSHIP AND THE COUNTY.

DEPARTMENT OF HIGHWAYS - ONTARIO
NATIONAL & RESEARCH SECTION

**PAVED ROAD
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF HOLE

HWY. 403	DISTRICT	COUNTY	WENTWORTH
TOWNSHIP	FLAMBOROUGH	WENTWORTH	FLAMBOROUGH
LOCATION	201+25.82	201+25.82	201+25.82
DRAWN BY	STANLEY J. J.	CHECKED BY	W. J. J.
DATE	2/20/77	APPROVED BY	W. J. J.
SCALE	1" = 20' H	1" = 20' V	1" = 20' H

REVISION NO. **F53-68N**