

#59-F-72

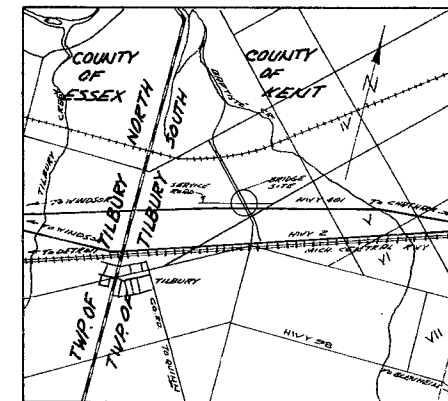
W.P. 295-59

HWY #401

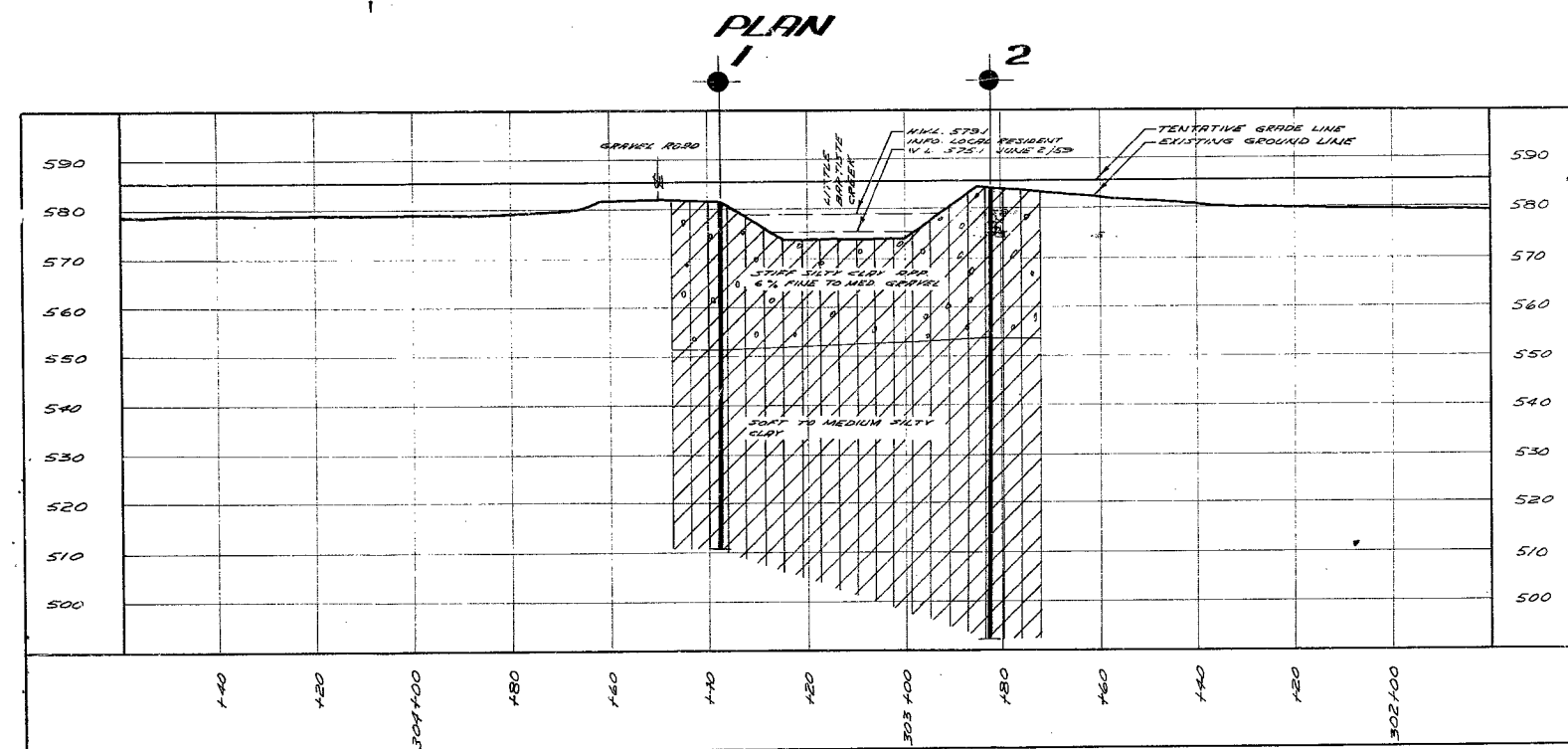
SERVICE RD. :

LITTLE BAPTISTE

CR. DIV.



KEY PLAN
SCALE 1 IN. = 8 MI.



PROFILE

LEGEND

BORE HOLE

PENETRATION HOLE

BORE & PENETRATION HOLE

WALL NO.	ELEVATION	STATION	DISTANCE FROM "Z"
1	582.0'	303+38	1/2
2	584.0'	302+82	1/4

- 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.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

**LITTLE BAPTISTE CREEK
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. ⁴⁰¹ SERVICE ROAD DISTRICT 1 COUNTY KENT
TOWNSHIP TILBURY EAST LOT 14 & 15 CON. IV
LOCATION APP 1 1/2 MI. N.E. OF TILBURY

DRAWN BY: T. MELLOWS		CHECKED BY: <i>[Signature]</i>	W.P. 295-59
DATE 31 JULY 59		APPROVED BY:	DRAWING NO.
SCALE 1 IN. = 20 FT.			F59-7



ONTARIO

DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, **Date** August 19, 1959.
Bridge Engineer. **Subject** FOUNDATION REPORT -
From Materials & Research Section. W.P. 295-59 - W.J. F-59-72.

Attention: Mr. S. McCombie.

Re: Hwy. 401 Service Road & Little Baptiste Creek Crossing,
Approximately 1 1/2 Miles N.E. of Tilbury,
Lots 14 & 15, Con. IV, Township of Tilbury East.

Enclosed herewith is our detailed report on the foundation investigation recently completed at the above noted structure site. Reference to the contents of the report shows that subsoil conditions at this site are similar to the crossing site of Hwy. 401 & Little Baptiste Creek (W.P. 162-58), previously investigated by E.M. Peto & Associates, approximately 180 ft. South of this structure location.

For your convenience, principal comments contained in the report are summarized as follows:-

1. Subsoil at this site consists of a deep deposit of lacustrine clay, the upper zone of which has been desiccated and exists in a stiff condition for a depth of approximately 30 ft. Underneath this upper stiff clay crust, the thick stratum of soft to medium silty clay is encountered.
2. Strength and compressibility characteristics are such that spread footing support can be obtained in the upper stiff crust. A safe allowable footing pressure of 2 t.s.f. is recommended for footings founded at Elev. 568' or below, and not below Elev. 558'. Footings founded at Elev. 568' or below, are believed to provide adequate protection from stream erosion and scour. At this elevation or below, it is also believed that allowance for future deepening of the creek channel should be sufficient.
3. To eliminate swelling or shrinking, it is recommended that a lean mix of concrete be placed upon the clay immediately upon excavations.

cont'd. /2 ...

Principal Comments: (cont'd.) ...

4. Long-term settlements resulting from the application of 2.t.s.f. footing pressure, have been estimated to be of the order of 3 inches. For a single-span structure, total and differential settlements are considered tolerable.
5. No excessive seepage problems with respect to footing excavations are anticipated.
6. No approach fill stability problems are anticipated. Bank slopes on the upstream face of the structure, should be protected by rip-rap.

If there are any queries regarding the contents of this report, please contact our office.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.
per:

AKGh

(A. K. Loh,
Project Foundation Engr.)

AKL/MdeF
Encl.

cc: Messrs. A. M. Toye
H. A. Tregaskes
D. G. Ramsay
A. Gater
G. U. Howell
J. Roy
A. Watt
Foundation Section
Gen. Files.

FOUNDATION REPORT

on

Hwy. 401 Service Road & Little Baptiste Creek Crossing,
Approximately 1 1/2 Miles N.E. of Tilbury,
Lots 14 & 15, Con. IV, Township of Tilbury East.

Plan No: F-3534-7.

Profile No: F-3534-8.

Distribution:

Mr. A. M. Toye, Bridge Engineer.	(2)
Mr. H. A. Tregaskes, Construction Engineer.	(1)
Mr. D. G. Ramsay, Rd. Design Engineer.	(1)
Mr. A. Gater, Sr. Project Design Engr.	(1)
Mr. G. U. Howell, District Engr., Chatham.	(1)
Mr. J. Roy, Regional Soils Engr.	(1)
Mr. A. Watt, Ont. Water Resources Commission.	(1)
Foundation Section.	(1)
Gen. Files.	(1)

W.J. F-59-72.

W.P. 295-59.

INTRODUCTION

Presented in this report are the results of a subsoil investigation carried out at a structure location approximately $1\frac{1}{2}$ miles northeast of Tilbury where proposed Highway 401 Service Road crosses the Little Baptiste Creek in Lots 14 & 15, Con. IV, township of Tilbury East. This report contains the field and laboratory findings and recommendations for the foundation of the structure.

The field work commenced on July 9, 1959 and was completed on July 13, 1959.

DESCRIPTION OF THE SITE AND GEOLOGY

The site and its surrounding areas are generally flat farmland; the areas on both sides of the creek are presently under cultivation. The creek has been dredged and widened into the present drainage channel. At the time of the investigation, the water level of the creek was approximately 2 ft. above its stream-bed. It has been reported, however, that during Spring run-off the high water level of the creek reached a height of approximately 2 ft. below the top of the banks (approximately 7 to 8 ft. above the stream-bed elevation). The banks were heavily treed and bushed. Erosion due to scour are evidenced along the banks of the creek.

Physiographically, the site under consideration is located in the St. Clair Clay Plains, which were inundated by glacial lakes Whittlesey and Warren. According to available geological information, these extensive plains, covering a large part of

South-western Ontario are covered by deep deposits of lacustrine clay overlying bedrock of limestone or shale. At this site, the upper zone of the clay deposit was found to be desiccated and exists in a stiff condition for a depth of approximately 30 feet.

DESCRIPTION OF FIELD AND LABORATORY WORK

Field work consisted of 2 sampled boreholes, carried out by a continuous flight auger adapted for soil sampling. Conventional auger boring procedures were followed and samples were recovered at depths required. Two inch I.D. thin-walled Shelby tube samplers were used in the cohesive subsoil. Upon recovery, samples were visually examined and identified and wax-sealed for transport to our laboratory. In addition, a dynamic cone penetration profile was obtained adjacent to Boring 1. In-situ vane shear tests were also carried out in this boring.

Upon receipt in the laboratory, samples were visually examined and identified. Triaxial shear and consolidation tests as well as routine index tests were performed on selected representative samples. Laboratory test results have been presented in the borehole logs and detailed in Table No. 1 under Appendix I.

The location plan and subsoil profile are presented in Drawing No. F-59-72A.

SUBSOIL CONDITIONS

Subsoil conditions at this site are similar to the Crossing site of Highway 401 and Little Baptiste Creek (WP162-58), previously investigated by the consultants approximately 180' south of this proposed structure location. The site is

underlain by a deep deposit of lacustrine clay, the upper zone of which has been desiccated and exists in a stiff condition for a depth of approximately 30 feet. Underneath this upper stiff clay crust is the thick stratum of soft to medium silty clay.

In each of the sampled boreholes, the topsoil or road bed gravel was found to be underlain by a 30 ft. stiff silty clay crust extending from Elevs. 584 - 582 to 554 - 552. Underneath this stiff crust the thick stratum of soft to medium silty clay was encountered. This stratum was explored to a depth of 92 feet (i.e. at approximately Elev. 492'). In general, the soil types encountered are as follows:-

1. Stiff Silty Clay

This stiff condition of the upper zone of lacustrine clay is believed to be the result of desiccation and has been subjected to oxidation resulting in its present brownish colour. Below the oxidized zone the colour is predominately grey. The material contains approximately 25% silt, 15% sand and 6% fine to medium gravel. The average unit weight and moisture content were found to be 130 p.c.f. and 21% respectively. Liquid and plastic limits averaged 28% and 17%. Laboratory shear strength test results show an average of 2500 p.s.f. to be representative for this upper stiff clay crust. A plot of shear strength versus depth has been presented and is included in this report under Appendix I. Judging from its moisture content and Atterberg limits, the stiff silty clay appears to be fully saturated and preconsolidated.

This is borne out by the consolidation test.

2. Soft To Medium Silty Clay

Underneath the stiff clay crust the thick stratum of soft to medium silty clay was encountered. The colour is predominantly grey. It contains approximately 25% silt, 15% sand and 4% fine to medium gravel. The average unit weight was found to be 124 p.c.f. Its consistency is defined by moisture content of 24%, liquid and plastic limits of 30% and 17% respectively. Laboratory tests show that the shear strength of the silty clay decreases with depth and reaches a constant value of 750 p.s.f. below approximately Elev. 544'. A plot of shear strength versus depth has been presented and is included under Appendix I. The soft to medium clay is fully saturated and consolidation results show that it is normally consolidated.

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

WATER CONDITIONS

Due to the impermeable nature of the clayey subsoil it was not possible to accurately establish the water table at the site during the boring programme. All the samples obtained below the creek water level are saturated and the water table at the site has been assumed at approximately Elev. 575', the normal creek water level. In view of the fact that no artesian water conditions or water-bearing sand seams of any significance were encountered during the investigation, no serious ground water problems during footing excavations are anticipated. The impermeable nature of the clay will allow excavations below the creek water level to be carried out in the dry.

FOUNDATION CONSIDERATIONS

The upper stiff silty clay crust is competent to provide adequate foundation support for the proposed structure. Strength and compressibility characteristics are such that spread footing support can be obtained in the upper stiff clay crust at Elev. 574' or below. At this elevation or below for footings of 7 to 10' in width, a bearing pressure of 2 T.s.f., which incorporates a safety factor of 3, can be used for spread footing design. In order to avoid undermining of the footings due to streamerosion and scour and to allow for future deepening of the creek channel, it is recommended that footings be founded at Elev. 568' or below. To avoid overstressing of the underlying soft to medium clay and hence excessive settlements, footings should not be founded below Elev. 558'. The stiff clay swells considerably upon removal of pressure and/or access of water and shrinks upon drying. It is, therefore recommended that a lean mix of concrete be placed on the underlying clay immediately upon excavations.

Long term settlements resulting from the application of 2 t.s.f. bearing pressure have been estimated to be of the order of 3 inches. This magnitude of settlements is due to the fact that stresses caused by the applied load will influence the underlying soft clay deposit for a considerable depth. In view of the relatively uniform subsoil conditions at the site, little differential settlements of any significance need be anticipated of a single span structure since each abutment will virtually settle the same amount.

No excessive seepage problems during footing excavations are anticipated. Due to the impermeable nature of the clay, excavations below the creek water level can be carried out in the dry.

Under the proposed grade line of the service road the maximum height of fill is only 5 ft. The subsoil can safely support this embankment loading.

CONCLUSIONS & RECOMMENDATIONS

1. the site is underlain by a deep deposit of lacustrine clay, the upper zone of which has been desiccated and exists in a stiff condition for a depth of approximately 30 ft. Underneath this upper stiff clay crust is the thick stratum of soft to medium silty clay.
2. Subsoil conditions are such that spread footing support can be obtained in the upper stiff clay crust. At Elev. 574 or below, for footings of 7 to 10' in width a bearing pressure of 2 t.s.f. can be used for spread footing design. To avoid undermining of the footings due to stream erosion and scour and to allow for future deepening of the creek channel, it is recommended that footings should be founded at Elev. 568' or below. In order to avoid overstressing of the underlying soft clay and hence excessive settlements, footings should not be founded below Elev. 558'.

To eliminate swelling or shrinkage of the clay, it is recommended that a lean mix of concrete be placed upon the underlying clay immediately upon excavation.

3. Long term settlements as a result of the application of 2 t.s.f. bearing pressure have been estimated to be of the order of 3 inches. In view of the relatively uniform subsoil conditions at the site, little differential settlements of any consequence need be anticipated of a single-span structure.
4. No excessive seepage problems during footing excavations are anticipated.
5. No approach fill stability problems are anticipated. Bank slopes on the upstream face of the structure should be protected by rip-rap.

AKL:am

AKL
A. K. Loh
Project Foundation Engineer

APPENDIX I.

TABLE NO. 1

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-72
W.P. 295-59

SOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETN RESIST. BLOWS FT	MOIST. CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH P.S.F.	UNIT WEIGHT P.C.F.	REMARKS
1	T1	3' - 4.5'	Stiff grey-brown fissured silty clay	P	31.4	-	-	2220	117.6	Approx. 6% fine to medium gravel throughout.
	T2	6' - 7.5'	" " " "	P	23.7	23.9	49.8	2180	122.2	
	T3	10'-11.5'	Stiff grey fissured silty clay	P	17.0	18.8	33.1	4120	132.3	
	vane	11.5'	" " " "	-	-	-	-	>2000	-	
	T4	13'-14.5'	" " " "	P	22.6	17.2	29.2	2350	131.8	
	vane	14.5'	" " " "	-	-	-	-	>2000	-	
	T5	18'-19.5'	Stiff grey silty clay	P	20.9	20.9	28.0	1660	128.8	
	vane	19.5'	" " " "	-	-	-	-	>2000	-	
	T6	25'-26.5'	" " " "	P	20.7	17.1	28.0	896	125.7	
	vane	28'	" " " "	-	-	-	-	2000	-	
	T7	33'-34.5'	Soft to medium grey silty clay	P	21.1	-	-	979	127.9	Approximately 4% fine to medium gravel throughout Sens: 1.9
	T8	40'-41.5'	" " " "	P	24.2	16.4	30.3	653	124.9	
	vane	43'	" " " "	-	-	-	-	1040	-	
	T9	53.5'-55'	" " " "	P	-	18.7	28.5	569	122.8	Sens: 1.1
	vane	57'	" " " "	-	-	-	-	720	-	
	T10	70'-71.5'	" " " "	P	23.7	17.0	28.4	778	125.1	
2	T1	5' - 6.5'	Stiff grey-brown fissured silty clay	P	28.7	-	-	-	-	Approx. 6% fine to medium gravel throughout.
	T2	11' - 12.5'	" " " "	P	19.1	-	-	5250	129.0	
	T3	15'-16.5'	Stiff grey fissured silty clay	P	20.3	-	-	1620	128.8	
	T4	20'-21.5'	" " " "	P	22.4	17.4	30.7	1140	126.9	
	T5	25'-26.5'	Stiff grey silty clay	P	-	-	-	-	-	
	T6	30'-31.5'	Soft to med. grey silty clay	P	-	-	-	-	-	Approx. 4% fine to med. gravel throughout
	T7	35'-36.5'	" " " "	P	21.3	17.5	31.0	1430	129.0	
	T8	45'-46.5'	" " " "	P	25.0	17.4	31.0	656	121.1	
	T9	55'-56.5'	" " " "	P	23.8	16.9	26.6	616	125.2	
	T10	65'-66.5'	" " " "	P	24.8	18.3	30.9	525	121.4	
	T11	90'-91.5'	" " " "	P	28.0	22.0	35.5	828	122.4	

TABLE NO. 1

SUMMARY OF FIELD & LABORATORY TESTS

JOB F 59-72

W.P. 29 5-59

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	PENETN RESIST BLOWS FT	MOIST CONT. %	PLASTIC LIMIT %	LIQUID LIMIT %	SHEAR STRENGTH PSI	UNIT WEIGHT PCF	REMARKS
			<p>T denotes thin walled Shelby Sample</p> <p>Consolidation characteristics:-</p> <p>Depth 0 - 30' - Coefft of volume compressibility 0.007 ft 2/day</p> <p>Coefft. of consolidation 0.14 sq.ft./day</p> <p>Preconsolidation pressure 1 t.s.f.</p> <p>Depth 30' & below - Compression Index 0.18</p> <p>Coefft. of consolidation 0.0875 sq. ft./day</p> <p>Normally consolidated.</p>							

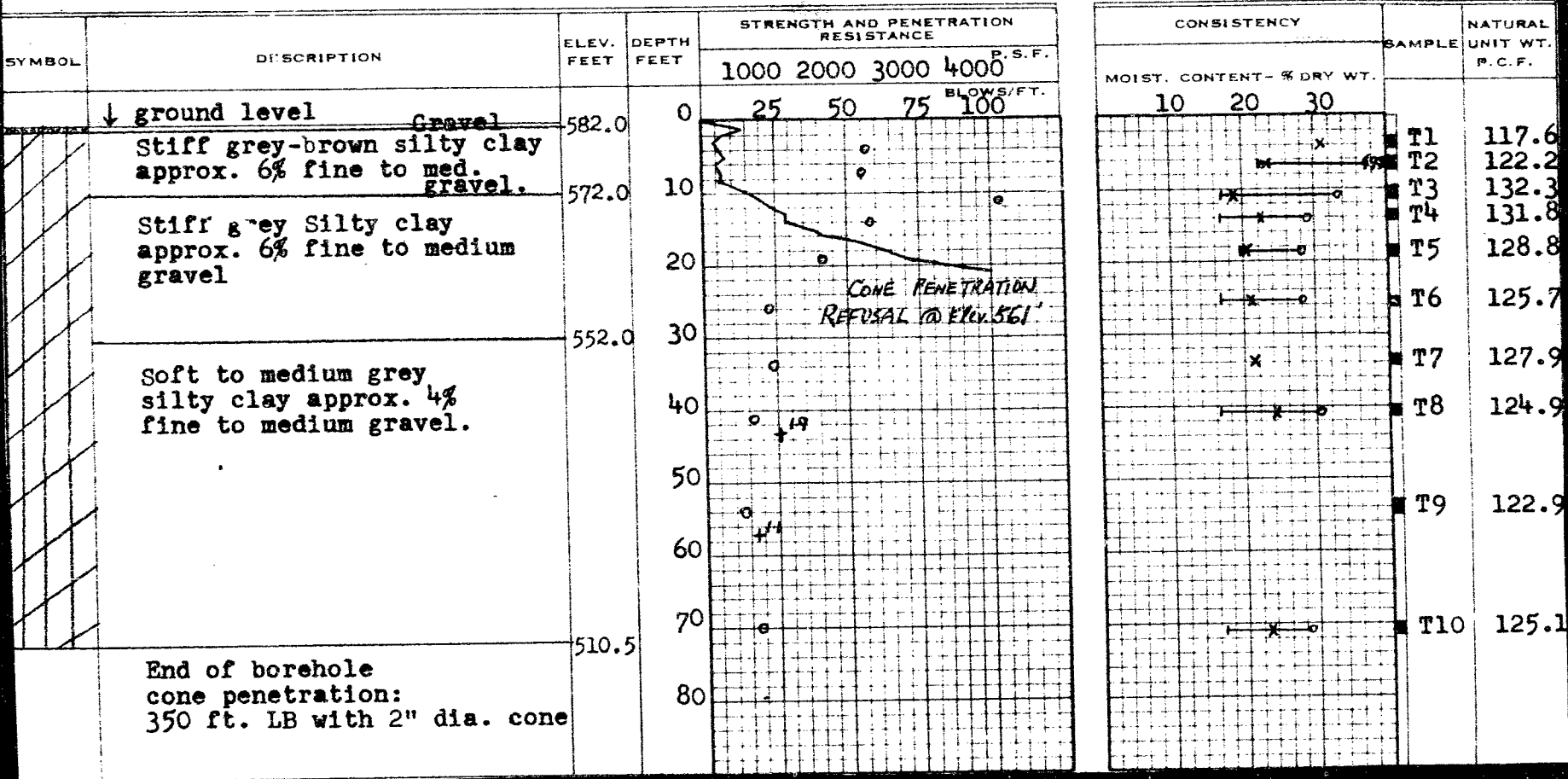
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

W.P. 295-59 BORE HOLE NO. 1
JOB F-59-72 STATION 302+82 (E)
DATUM 582.0' COMPILED BY BK
BORING DATE July 9/59 CHECKED BY AL

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) +S
NATURAL MOISTURE AND LIQUIDITY INDEX LI
LIQUID LIMIT X
PLASTIC LIMIT



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND RESEARCH SECTION

P. 295-59 BORE HOLE NO. 2

OB F 59-72 STATION 303+38 (E)

ATUM 584.0' COMPILED BY BK

AGING DATE July 13/59 CHECKED BY AL

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) -----	+S
NATURAL MOISTURE AND	
LIQUIDITY INDEX -----	X
LIQUID LIMIT -----	
PLASTIC LIMIT -----	

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE				
				1000	2000	3000	4000	P.S.F. BLOWS/FT.
	↓ ground level Topsoil	584.0	0	25	50	75	100	
	Stiff grey-brown silty clay approx. 6% fine to med. gravel.	571.0	10					
	Stiff grey silty clay approx. 6% fine to medium gravel.	554.0	20					
	Soft to medium grey silty clay. Approx. 4% fine to medium gravel.		30					
			40					
			50					
			60					
			70					
			74					
			86					
		492.5	90					
	End of borehole							

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.				
10	20	30		
			T1	-
			T2	129.0
			T3	128.8
			T4	126.9
			T5	
			T6	
			T7	129.0
			T8	121.1
			T9	125.2
			T10	121.4
			T11	122.4

SHEAR STRENGTH IN P.S.F.

