

25-67-01

SOIL INVESTIGATION  
UNDERPASS BRIDGE - HIGHWAY NO. 401  
TOWNSHIP OF SANDWICH SOUTH  
COUNTY OF ESSEX  
(SITE NO. 6-231 - PROJECT W.P. 132-64)

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May 12, 1965.

OUR REF: 5-3-8

Ontario Department of Highways,  
Materials & Testing Division,  
Hwy. #401 & Keele St.,  
DOWNSVIEW, Ontario.

Attention: Mr. A. Rutka, P.Eng.,  
Materials & Testing Engineer.

Re: Your W.P. 132-64 - Soil Investigation  
for Proposed Intersection Highway #401  
Site #6-231, Township of Sandwich South,  
County of Essex.

Dear Sirs:

This letter accompanies our detailed report  
on the investigation carried out at the above site.

From the point of view of foundation design,  
the significant soil strata underlying the site consists  
of hard to stiff clayey tills. Thus it is considered that  
the site is suitable for the use of normal shallow spread  
and strip footing foundations for which an allowable bearing  
value of 9000 pounds per square foot has been given.  
Computed values of settlement under the foundations and  
the approach embankments are given in the report. Because  
these settlements are relatively high, it is suggested  
that the spans of the bridge be simply supported.

We thank you for this opportunity to be of  
service to you and trust that our report contains all the  
information that you require. However, if you should have  
any questions or wish to discuss the report in any way,  
please do not hesitate to call on us.

Yours very truly,

DOMINION SOIL INVESTIGATION LTD.

  
K. H. King, P.Eng.,  
Chief Engineer.

KHK/is



ONTARIO DEPARTMENT OF HIGHWAYS  
MATERIALS AND TESTING DIVISION  
DOWNSVIEW - ONTARIO

REPORT ON  
SOIL INVESTIGATION  
FOR  
UNDERPASS BRIDGE - HIGHWAY NO. 401  
TOWNSHIP OF SANDWICH SOUTH  
COUNTY OF ESSEX  
(SITE NO. 6-231 - PROJECT NO. W.P. 132-64)

SUBMITTED BY  
DOMINION SOIL INVESTIGATION LIMITED  
77 CROCKFORD BOULEVARD  
SCARBOROUGH ONTARIO

REFERENCE 5-3-8  
MAY - 1965

## CONTENTS

	<u>PAGE NO.</u>
SUMMARY .....	1
INTRODUCTION .....	2
SUBSURFACE CONDITIONS .....	2,3,4,5
WATER CONDITIONS .....	6
DISCUSSION .....	6,7,8,9,10,11
CONSTRUCTION .....	11 & 12
REFERENCES .....	13
APPENDIX I - Procedures .....	14 & 15
APPENDIX II - Table II Laboratory Test Results .....	16

## ENCLOSURES

LIST OF SYMBOLS, ABBREVIATIONS, ETC.....	#1
GEOTECHNICAL DATA SHEETS .....	#2,3,4,5,6
CONSOLIDATION TEST RESULTS .....	#7
SITE PLAN, PROFILES, SECTIONS .....	Dwg. No. 5-3-8/1

SUMMARY

The soil investigation at Bridge Site No. 6-231 on Highway No. 401 has been completed. A hard to stiff clay till forms the main soil type at the site of the proposed underpass. At depth of approximately 10 feet below ground level, normal spread footings can be used for the foundations and an allowable bearing pressure of 9000 pounds per square foot is suggested.

The settlements which will occur under the foundations will be caused mainly by the loading of the approach embankments. The structure should be designed as simply supported. If the embankments are constructed in advance of the structure, the settlement due to consolidation will be of the order of 2.0 inches at the centre pier and 3.6 inches at the intermediate piers.

No unusual construction problems are envisaged.

## INTRODUCTION

The Department of Highways, Ontario, propose to erect a 4-span bridge with approach embankments to provide an underpass at the intersection of Highway No. 401 with road which runs between Concessions VIII and IX in the Township of Sandwich South, Essex.

An exploration of the site was carried out by Dominion Soil Investigation Limited to determine the subsurface condition in order to provide information for the design of the foundations for the proposed works and to assess any problems which are likely to be of importance during construction. This report describes the findings of the investigation with relevant recommendations.

## SUBSURFACE CONDITIONS

On Drawing No. 5-3-8/1 two sections of the generalized soil profile are shown. These profiles have been inferred from the soils encountered in the boreholes which were advanced in accordance with the procedures outlined in Appendix I.

The details of the borehole logs are shown on Enclosures No. 2 to No. 6 and the results of Laboratory Tests on representative samples of the soils are tabulated in Appendix II, Table II.

The soil conditions are fairly uniform over the site and the soil profile may be divided into 2 main groups.

- I           The superficial deposits of silt and clay mixed with organic matter; sand and gravel fill and topsoil.
- II          An underlying clayey till, the upper zone of which has been weathered and heavily preconsolidated.

In more detail, the properties of the soils may be considered as follows:

I           The surface deposits consist of thin layers of topsoil or fill material covering a dark brown silty clay in which there are traces of gravel and, in the region covered by Boreholes No. 4 and No. 5, a high organic matter content. These deposits range in thickness between 4 and 8.5 feet and are of firm to stiff consistency. "N" values within the deposits range between 4 and 12 blows per foot, and the undrained shear strength determined in situ by the vane method falls between 2540 pounds per square foot and 4130 pounds per square foot. The sensitivity of the soil as determined by the vane test, ranges between 2 and 3.5. One unconfined compression test was carried out on a sample of the soil recovered in the split-spoon sampler. The shear strength determined from this test gives a value of 2200 pounds per square foot.

Tests on one sample of this material gave a Liquid Limit of 39.0 percent, a Plastic Limit of 16.8 percent and a Dry Density of 102 pounds per cubic foot at a natural moisture content of 17.1 percent. The relatively low dry density and high Liquid Limit suggest a fairly high organic content in this soil and distinguish it from the underlying material.

II            The glacial till is encountered as a distinct change in soil type. The uppermost 5 feet consist of a hard brown silty clay containing traces of sand and gravel. "N" values in this region range between 20 and 51 blows per foot with an average value of 36 blows per foot.

The natural moisture content falls between 12% and 16% and is close to the Plastic Limit of 14.5%. With a Liquid Limit of 25%, the Liquidity Index of this stratum is very small suggesting a heavily overconsolidated material with high shear strength. Unconfined compression tests on specimens obtained in the split-spoon sampler indicate shear strength values of 5000 to 7000 pounds per square foot. The bulk density was determined at values between 128 and 134 pounds per cubic foot.

Below a depth of 12 feet, the soil colour changes to grey and the consistency changes from hard to the range of stiff to very stiff. The "N" values tend to decrease with depth and range between 36 and 15 blows per foot.



At a depth of approximately 18 feet, the soil decreases in silt content and can be described as a stiff grey clay with some silt and traces of gravel. The "N" values in this zone range between 10 and 15 blows per foot. The natural moisture content in this layer shows a tendency to increase with depth and ranges between 16% and 20%. The Plastic Limit remains almost constant at about 15% but the Liquid Limit increases slightly to 27%. The Liquidity Index increases to between 0.25 and 0.6 and indicates that the soil has not been preconsolidated to the same extent as the upper crust.

The undrained shear strength measured in situ by the vane ranges between 2060 pounds per square foot and 3740 pounds per square foot with a sensitivity range of 1.4 to 2.0. The unconfined compression tests in the laboratory gave shear strength values between 1000 and 2200 pounds per square foot. The bulk density of this soil was estimated to be between 123 and 127 pounds per cubic foot.

Consolidation tests were carried out on the stiff grey clay sample recovered at a depth of 26 feet, in a thin-walled sample tube in Borehole No. 1. The relationship between pressure and void ratio is shown on Enclosure No. 7. Also presented on Enclosure No. 7 is the curve showing the variation of the coefficient of consolidation with the consolidating pressure.

The compression index of the clay measured on the normal consolidation part of the curve is 0.140 and compares favourably with the value of 0.15 obtained from the empirical relationship between the Liquid Limit and compression index of clays of medium sensitivity.

From the shape of the consolidation curve, it is estimated that at this site the clay has been precompressed by consolidation pressures of about 3 tons per square foot in excess of the existing overburden pressures.

#### WATER CONDITIONS

During the period covered by the exploration there was appreciable surface water runoff and infiltration. The depths to water in the boreholes were determined at various times and the observations are recorded on the Geo-technical Data Sheets.

The most reliable observation was taken in Borehole No. 5 in which the elevation of the water table was at 607.20 at the time of the exploration.

#### DISCUSSION

A bridge approximately 194 feet long and 34 feet wide together with approach embankments will provide the underpass for the main highway. The bridge will consist of two approach spans each 35 feet long and two intermediate spans each 62 feet long. To provide adequate headroom, approach fills will be approximately 20 feet high with side

slopes assumed at 1 (Vertically) on 2 (Horizontally) from a top width of 40 feet.

The loading on the centre pier is estimated at 18 tons per lineal foot, on the intermediate bents at 15 tons per lineal foot and on the abutments at 6 tons per lineal foot.

The surface deposit of silty clay varies considerably in organic matter content and consistency. It is advisable therefore that the foundations for the bridge be taken down to the next layer consisting of the hard brown silty clay till.

At and below Elevation 609, normal spread footings can be used. Between Elevations 609 and 606, the safe bearing pressure is estimated at 9000 pounds per square foot. This value allows for a Factor of Safety of 3 against shear failure and takes into consideration the decrease in soil strength below Elevation 600. It is desirable that the foundations be kept as close as possible to the top of the hard brown layer (El. 609) in order to take advantage of its higher load bearing capacity and the load distributing effect.

The stability of the approach embankments has been examined by the slip circle method and the Factor of Safety against sliding found to be greater than 2.5. In the exploration of Borehole No. 1 a thin layer of loose saturated sandy silt was described but similar layers were not encountered

in the other boreholes. It is concluded that the saturated sandy silt occurs in an isolated pocket; as such it is enclosed by the stronger clay layers and its presence is not therefore considered as significant.

The bearing capacity of the subsoil is therefore considered very suitable for the construction of normal spread footings to support the structure and the settlement characteristics will be examined next.

It was not practicable to obtain undisturbed samples of the hard crust forming the uppermost 5 feet of the glacial till for laboratory tests. It is, however, inferred from the consistency of this layer that the soil has been heavily preconsolidated and for practical purposes this layer may be considered as incompressible within the range of loading which will be induced by the structure.

The thickness of the underlying grey clayey till was not measured, but it is known from published information that the stratum extends down to Elevation 460 approximately (Ref.1).

It is considered that the results of tests carried out on the sample of the stiff grey clayey till recovered from depth 26 feet in Borehole No. 1 are representative of this layer in which the settlement which will be caused by consolidation will be significant. These results which are illustrated on Enclosure No. 7 have been used in the calculation of the settlements.

In the computation of the settlements, the width of footings was assumed to be 5 feet and the trapezoidal embankment section was considered as an equivalent rectangular load. The loading of the approach embankments has a considerable influence on the settlement of the abutments and the intermediate piers but has no significant effect on the centre pier.

In Table I below are presented the estimated settlements under the foundations:-

TABLE I  
Settlement of the Bridge Foundations

<u>Location</u>	<u>Load</u>	<u>Estimated Settlement in Inches</u>	
Abutment	Embankment "	Elastic	2.7
		Consolidation	2.6
	Structure		<u>0.6</u>
		Total	<u>5.9</u>
Intermediate Pier	Embankment "	Elastic	1.6
		Consolidation	1.7
	Structure		<u>1.9</u>
		Total	<u>5.2</u>
Centre Pier	Structure	Total	<u>2.0</u>

If the embankments are constructed in advance of the footings, the total settlements will be reduced to:

Abutments	3.2 inches
Intermediate Piers	3.6 inches
Centre Piers	2.0 inches.

The settlements given above have been corrected for lateral deformation as proposed by Skempton and Bjerrum (Ref. 2). The Modulus of Elasticity of the soil was assumed to be 200 tons per square foot for the purpose of estimating the elastic settlement.

Due to the fact that the upper desiccated crust of the till layer has been neglected in the settlement calculation, it can be safely predicted that the given settlement values represent a conservative estimate. However, it is believed that, irrespective of the amount of settlement, the difference in settlements between the various bridge supports will remain and could possibly be even slightly larger. Because of this possibility, it is recommended that:

1. The bridge superstructure be designed with simply supported spans, and
2. The approach embankments be built in advance of the structure. This does not mean that stage construction is suggested but rather the proper construction sequence is outlined. This sequence will take care of the elastic settlements and thus reduce the total settlements to be expected after the superstructure is built.

An examination of the coefficient of consolidation and the range of applied pressures has indicated that no significant benefit would be derived from the application of

some surchar. It is also estimated that it will take at least about 30 years for the greatest part of the aforementioned settlements to take place.

For the foundation of the abutments one of the following alternatives is recommended.

(a) Spread footings using 2.0 tons per square foot placed on compacted fill. The use of granular material for the portion of the compacted fill under the abutment footings is suggested because good compaction is easier achieved.

(b) Footings on piles driven through the embankment and the surface deposit 2 feet into the hard till crust. Steel tube, timber or concrete piles with an allowable load of 30 tons/pile are recommended. It should be emphasized that no benefit would be derived by driving the piles any deeper.

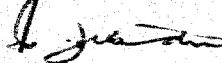
### CONSTRUCTION

There are no construction problems which are considered to be worthy of note. The excavation for the proposed foundations will be carried out within the surface deposit of firm to stiff silty clay which may be braced or sloped.

In view of the low permeability of the soil, the quantity of water seeping into the excavation will be relatively small and together with any surface runoff can be readily removed by pumping from sumps.

The field work was carried out under the supervision of Mr. V. Chan, B.Sc., and the report which was reviewed by Mr. A. G. Stermac, P.Eng., M.Sc., was prepared by Mr. F. Debidin, Soils Engineer.

DOMINION SOIL INVESTIGATION LIMITED,



F. Debidin,  
Soils Engineer.

FD/1s



REFERENCES

1. L. G. Soderman, T. C. Kenney and A. K. Loh,  
Geotechnical Properties of Glacial Clays in Lake  
St. Clair Region of Ontario, Proceedings of the  
Fourteenth Canadian Soil Mechanics Conference,  
Technical Memorandum No. 69, page 55.
2. G. A. Leonards, Foundation Engineers,  
McGraw-Hill Book Company, Inc., page 573.

## APPENDIX I

### PROCEDURE

#### Field Work

The field work was carried out by drilling 5 boreholes during the period 2nd - 7th April, 1965. The location of the boreholes is shown on the plan of Drawing No. 5-3-8/1.

Drilling was carried out by the washboring method. Bx size casing was driven to depths of 10 feet beyond which the hole was advanced without casing. Samples were recovered in a 2" O.D. split-spoon sampler used in the Standard Penetration Resistance Test. Where the consistency of the soil permitted, shear vane tests were carried out with a 4-blade 2" diameter vane, 4 inches long. Both the undisturbed and remolded shear strengths were determined.

Cone penetration tests were carried out adjacent to each borehole by driving a 2" diameter 60 degree apex cone into the soils. Samples of soil were also recovered in thin walled sample tubes, sealed and shipped to the laboratory for further testing.

The water levels in the boreholes were observed at convenient intervals and the elevation of the ground surface at each borehole determined using as a reference the bench mark on the concrete culvert for which a value of El. 613.97 was given.

The maximum depth explored was approximately 40 feet.

Laboratory Tests

On selected representative samples, tests were carried out in the laboratory to determine the unconfined compressive strength, natural moisture contents, Liquid and Plastic Limits and bulk density of the soils. Consolidation tests were carried out on one sample to obtain the relevant factors for determining the settlement characteristics of the soil strata.

# APPENDIX II - TABLE II

## LABORATORY TEST RESULTS

Borehole No.	Sample No.	Depth Ft.	Shear Strength p.s.f.	L.L. %	P.L. %	Natural Moisture Content %	Liquidity Index	Density Bulk	p.c.f. Dry
1	2	6	2220	39.0	16.8	17.1	0.01	119	102
	3	8	3600	25.3	15.4	14.6	-	128	112
	4	11	5530	-	-	12.4	-	131	117
	5	13	6105	-	-	13.3	-	128	114
	6	15	-	24.9	14.7	14.7	-	-	-
	9	26	2380	26.6	14.8	15.8	0.09	123	107
	12	36	-	25.0	13.8	20.3	0.58	-	-
2	3	7.5	3520	-	-	18.7	-	134	113
3	1	3	-	-	-	21.5	-	-	-
	2	6	-	-	-	22.3	-	-	-
	3	9	4820	-	-	16.8	-	128	110
4	2	6	2530	-	-	20.3	-	132	110
	3	9	7280	-	-	15.6	-	125	-
5	2	6	7070	-	-	17.7	-	123	-
	5	16	3730	28.4	14.7	13.4	-	-	-
	7	22	2195	-	-	15.7	0.07	127	111
	8	26	-	28.9	15.4	16.5	-	127	-
	9	31	-	25.9	13.8	18.0	0.25	-	-
	11	36	1085	-	-	19.7	0.49	-	-
	12	39	-	27.5	14.1	17.3	-	123	-
						18.1	0.30	-	-

Enclosures

# LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

## SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
Ø > 8"	3"	¾"	4.75mm	2.0	0.42	0.074	0.002	>	NO SIZE LIMIT			
U.S. Standard Sieve Size:		No.4	No.10	No.40	No.200							

## SAMPLE TYPES.

AS Auger sample  
CS Sample from casing  
CHS Chunk sample

RC Rock core  
% Recovery  
SS Split spoon sample

TP Piston, thin walled tube sample  
TW Open, thin walled tube sample  
WS Wash sample

SAMPLER ADVANCED BY static weight : w  
" pressure : p  
" tapping : t

OBSERVATIONS MADE WHILE CORING  
Steady pressure  
No pressure  
Intermittent pressure

Washwater returns  
Washwater lost

## PENETRATION RESISTANCES.

**DYNAMIC PENETRATION RESISTANCE** : to drive a 2" Ø, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

**STANDARD PENETRATION RESISTANCE, -N-** : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

### EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SYMBOL :



322

## SOIL PROPERTIES.

W % Water content  
LL % Liquid limit  
PL % Plastic limit  
PI % Plasticity index  
LI Liquidity index

γ Natural bulk density (unit weight)  
e Void ratio  
RD Relative density  
C<sub>v</sub> Coeff. of consolidation  
m<sub>v</sub> Coeff. of volume compressibility

k Coeff. of permeability  
c Shear strength — in terms of total stress  
φ Angle of int. friction — in terms of total stress  
c' Cohesion — in terms of effective stress  
φ' Angle of int. friction — in terms of effective stress

## UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST  
UNCONFINED TEST

LABORATORY VANE TEST  
FIELD

POCKET PENETROMETER TEST

Strain at failure is represented by direction of stem

20%  
15% + 5%  
10%

St : sensitivity =  $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

## SOIL DESCRIPTION.

COHESIONLESS SOILS :

RD :

Very loose 0 - 15 %  
Loose 15 - 35 %  
Compact 35 - 65 %  
Dense 65 - 85 %  
Very dense 85 - 100 %

COHESIVE SOILS :

c lbs/sq.ft.

Very soft less than 250  
Soft 250 - 500  
Firm 500 - 1000  
Stiff 1000 - 2000  
Very stiff 2000 - 4000  
Hard over 4000

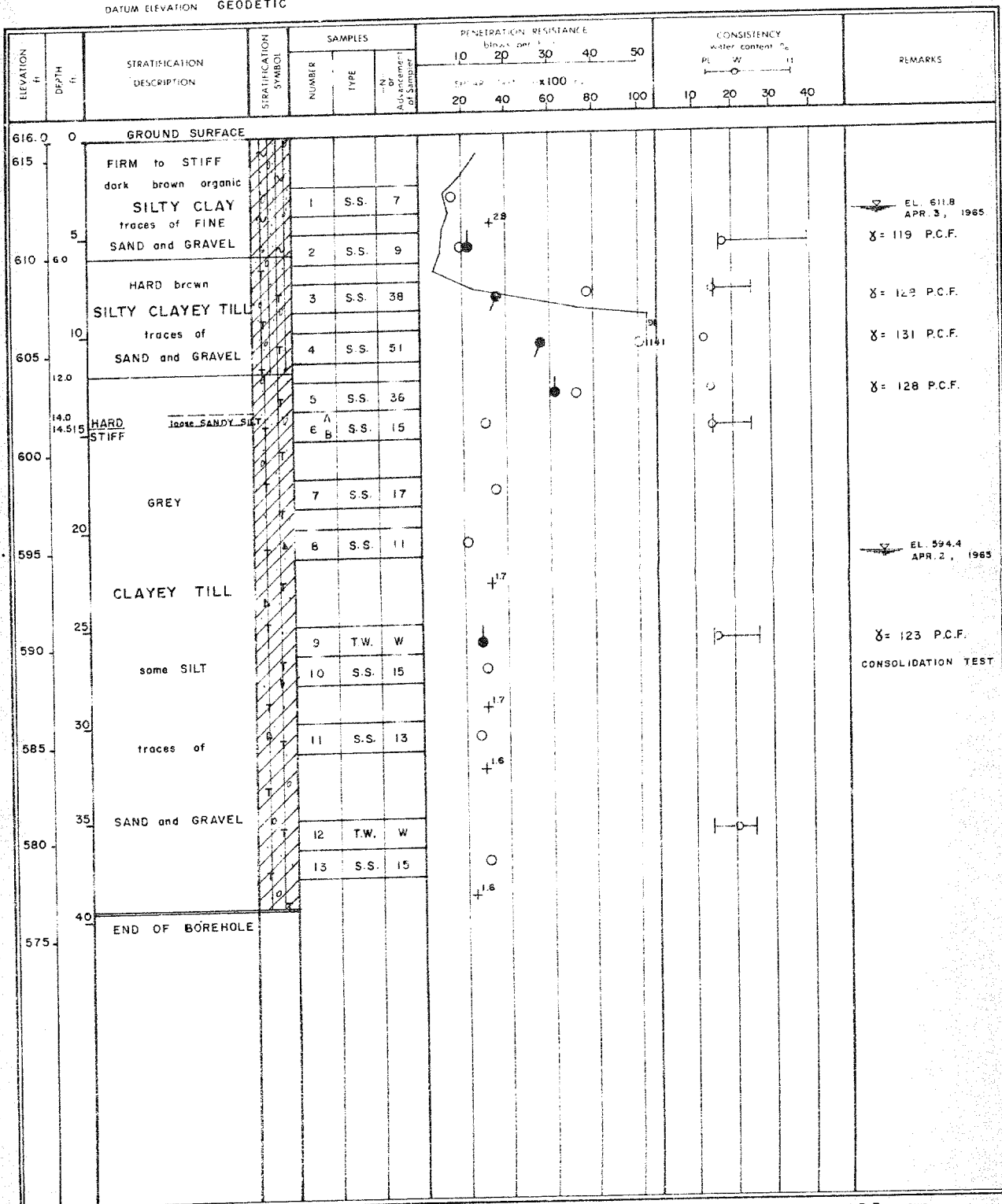
# GEOTECHNICAL DATA SHEET FOR BOREHOLE . . I . . .

OUR REFERENCE NO. 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
 PROJECT: PROPOSED UNDERPASS  
 LOCATION: BRIDGE SITE NO. 6-231 HWY. NO. 401  
 DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASH-BORING  
 DIAMETER OF BOREHOLE: 2 3/8"  
 DATE: APRIL 2, 1965.

ENCLOSURE NO. 2



VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J.B.E. CHD

# GEOTECHNICAL DATA SHEET FOR BOREHOLE . 2 . .

OUR REFERENCE NO. 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
 PROJECT: PROPOSED UNDERPASS  
 LOCATION: BRIDGE SITE N<sup>o</sup> 6-231  
 DATUM ELEVATION: GEODETIC

METHOD OF BORING WASH BORING  
 DIAMETER OF BOREHOLE 2 3/8"  
 DATE: APRIL 2, 1965

ENCLOSURE NO 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	N - Advance of Sample	10	20	30	40	50	PL	W	LI		
617.0	0	GROUND SURFACE														
615	2	GRANULAR FILL		1	S.S.	11										
610	5	STIFF brown SILTY CLAY		2	A S.S.	9										
610	7.5	HARD brown SILTY CLAYEY TILL traces of SAND and GRAVEL		3	T.W.	W										
605	10			4	S.S.	50										
605	12.5	GREY HARD STIFF CLAYEY TILL some SILT traces of SAND and GRAVEL		5	S.S.	33										
600	15			6	S.S.	24										
595	20	END OF BOREHOLE														

EL. 616.4  
APR. 6, 1965.

EL. 612.6  
APR. 5, 1965.

X = 134 P.C.F.

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J.B.E. CHD.



# GEOTECHNICAL DATA SHEET FOR BOREHOLE . 3 . . .

OUR REFERENCE NO 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
 PROJECT: PROPOSED UNDERPASS  
 LOCATION: BRIDGE SITE N° 6-231 HWY. N° 401  
 DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASH BORING  
 DIAMETER OF BOREHOLE: 2 3/8"  
 DATE: APRIL 5, 1965.

ENCLOSURE NO 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	N° of Advancement of Sampler	10	20	30	40	50	PL	W	LI		
616.7	0	GROUND SURFACE														
	0.8	TOPSOIL	~ ~													
615	2.1	GRANULAR FILL														
	5	FIRM brown organic		1	S.S.	4										
		SILTY CLAY														
		traces of														
610		SAND and GRAVEL		2	T.W.	W										
	8.5															
	10	HARD brown		3	S.S.	34										
		SILTY CLAYEY TILL														
		traces of														
605		SAND and GRAVEL														
	13.0															
	15	VERY STIFF grey		4	S.S.	26										
		CLAYEY TILL														
		some SILT														
		traces of														
600		SAND and GRAVEL		5	S.S.	17										
	20															
		END OF BOREHOLE														
595																

EL. 616.7  
 APR. 6, 1965

δ = 128 P.C.F.

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J.B.E. CH'D.

# GEOTECHNICAL DATA SHEET FOR BOREHOLE . 4 . . .

OUR REFERENCE NO. 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
PROJECT: PROPOSED UNDERPASS

METHOD OF BORING WASH-BORING  
DIAMETER OF BOREHOLE 2 3/8"

ENCLOSURE NO 5

LOCATION: BRIDGE SITE N° 6-231 HWY. N° 401  
DATUM ELEVATION: GEODETIC

DATE: APRIL 5, 1965.

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE Blows per foot					CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	N <sub>c</sub> or Advancement of Sampler	10	20	30	40	50	PL	W	LI		
617.3	0	GROUND SURFACE														
	1.0	GRANULAR FILL														EL. 617.1 APR. 6, 1965.
615		COMPACT grey organic CLAYEY SILT		1	S.S.	12										$\bar{X} = 132$ P.C.F. EL. 610.3 APR. 5, 1965. $\bar{X} = 125$ P.C.F.
	5	some SAND and GRAVEL		2	T.W.	W										
610	7.5	HARD brown														
	10	SILTY CLAYEY TILL traces of SAND and GRAVEL		3	S.S.	35										
605	12.5	VERY STIFF grey CLAYEY TILL		4	S.S.	29										
600	15	some SILT traces of SAND and GRAVEL		5	S.S.	18										
	20	END OF POREHOLE														
595																

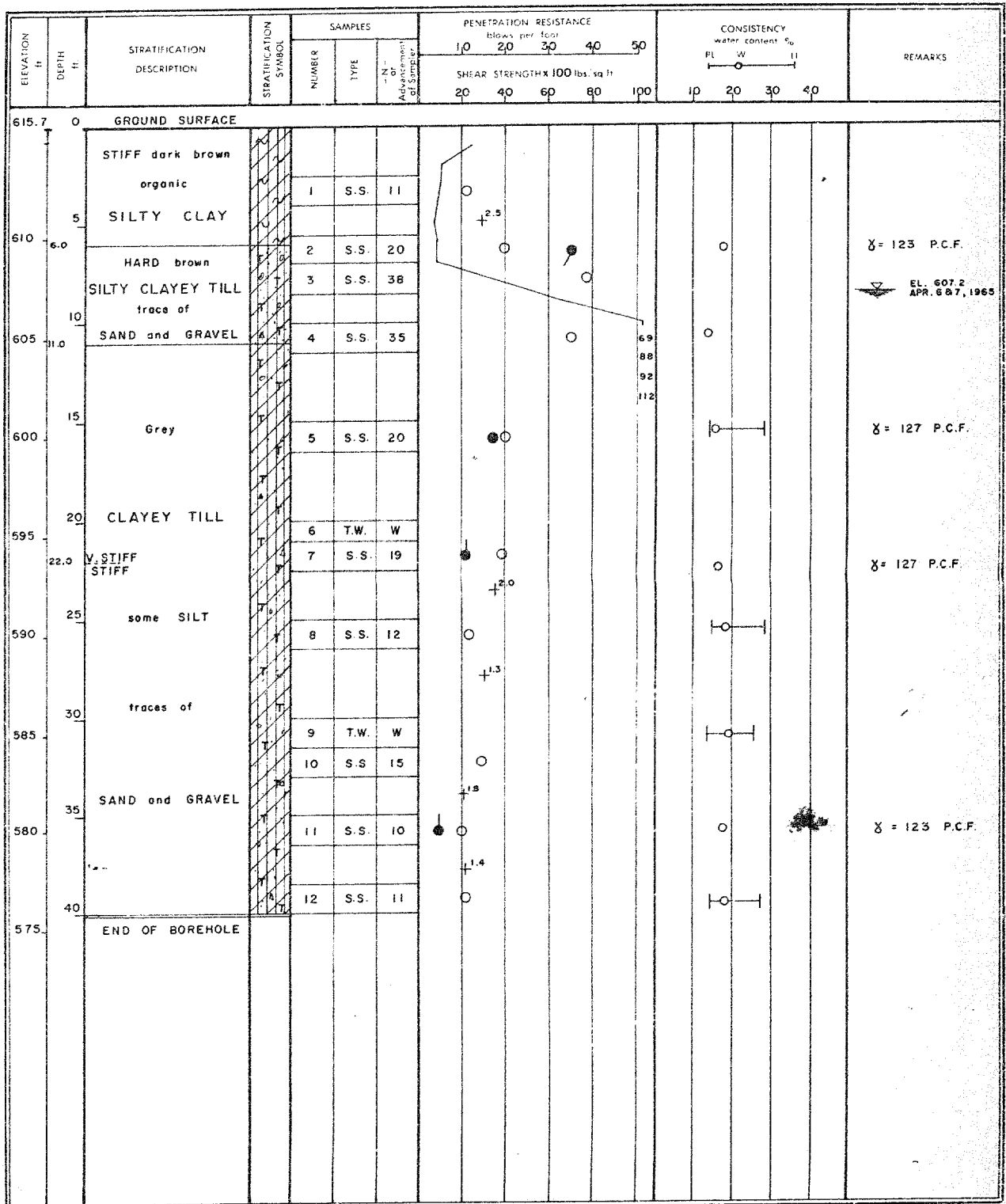
# GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 5 . . .

OUR REFERENCE NO 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS  
PROJECT: PROPOSED UNDERPASS  
LOCATION: BRIDGE SITE N° 6-231 HWY. N° 401  
DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASH-BORING  
DIAMETER OF BOREHOLE: 2 3/8"  
DATE: APRIL 6, 1965

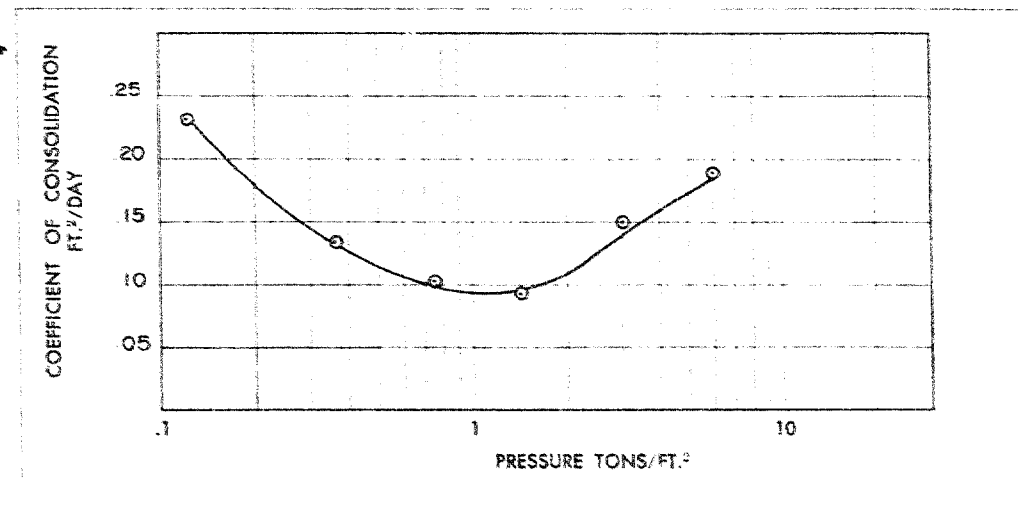
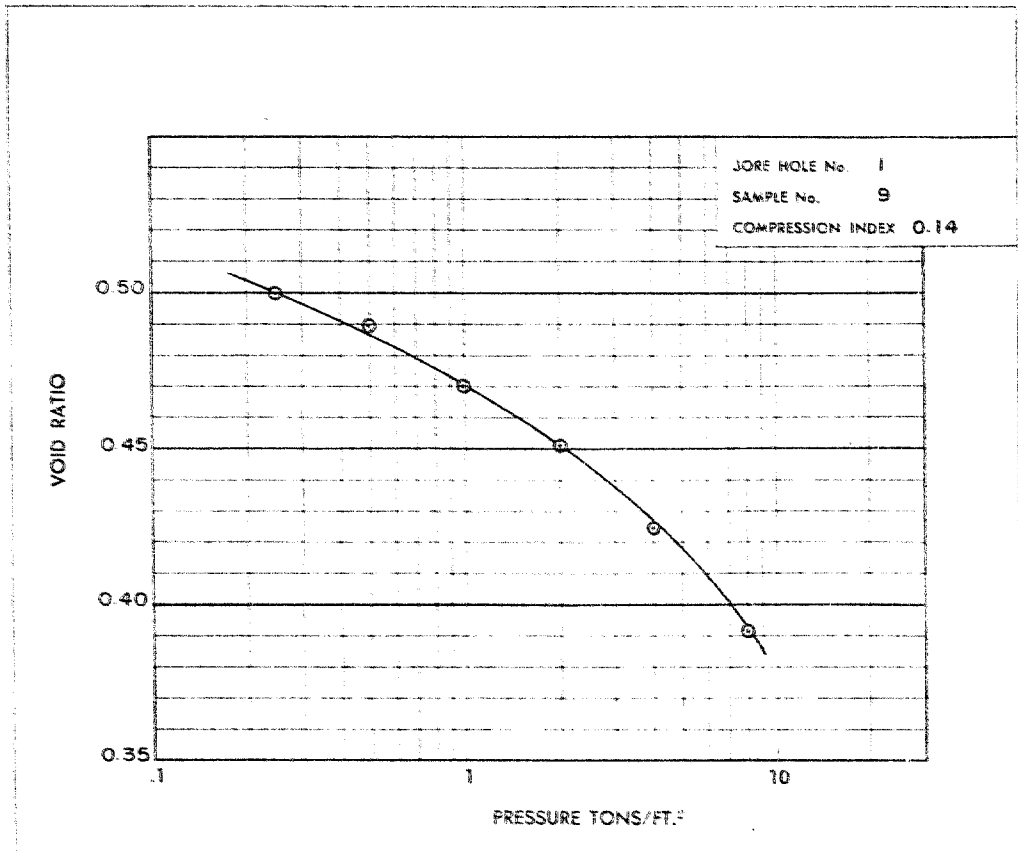
ENCLOSURE NO 6



VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J.B.E. CHD.

**Dominion Soil Investigation Ltd.****CONSOLIDATION TEST**

Mr. A. M. Toye,  
Bridge Engineer,  
Bridge Division.

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

Attention: Mr. S. MacGhie

May 17, 1965

FOUNDATION INVESTIGATION REPORT BY:  
Dominion Soil Investigation, Limited.  
Underpass Bridge - Highway No. 401,  
Township of Sandwich South, County of  
Essex, District #1 (Chatham, Ontario)  
Site No. 6-231 -- W.P. 132-64

Attached, please find the above-mentioned report submitted by the Consultant, Dominion Soil Investigation, Ltd. We have reviewed the report and found the factual information both adequate and well presented. We are in agreement with the recommendations contained therein, and since we find these self-explanatory, no comment is needed.

Should there be any queries in connection with this project, please do not hesitate to contact our office.

KYL/McF  
attach.

cc: Messrs. A. M. Toye (2)  
H. A. Tregaskes  
H. D. McMillan  
A. Cater  
F. C. Brown  
J. Roy  
A. Watt

Foundations Office  
Gen. Files

*KYL*  
K. Y. Lo,  
SUPERVISING FOUNDATION ENGINEER

#65-F-205

W.P. #132-64

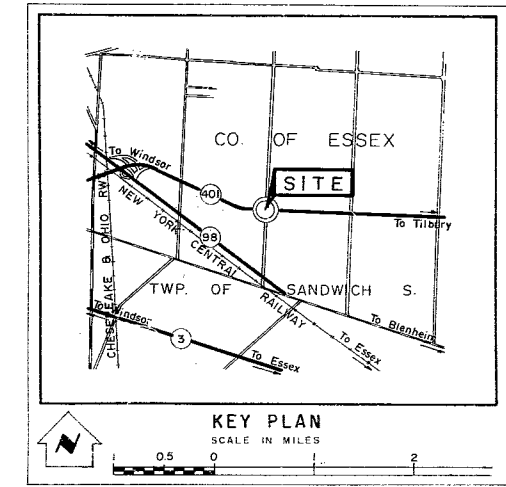
Hwy. #401

UNDERPASS

BRIDGE SITE

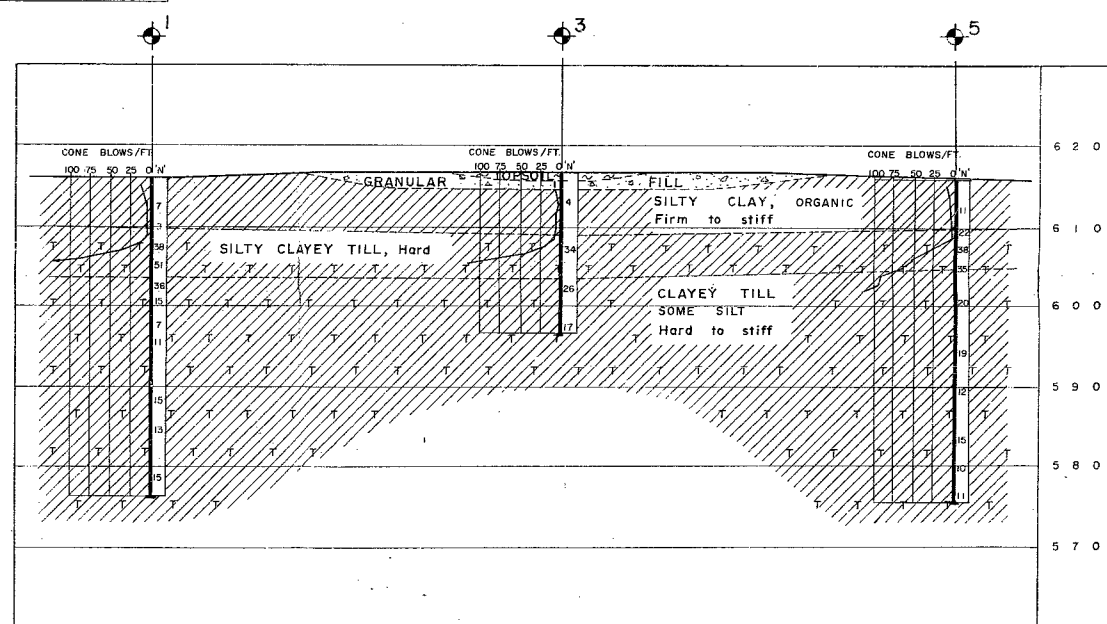
#6-231

SANDWICH S. TWP.



SCALE

20 10 0 20 40 FT.



SECTION B—B

A horizontal scale bar with markings at 20, 10, 0, 20, and 40 FT. The segment from 0 to 20 is shaded with a cross-hatch pattern.

- 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.

<b>REVISIONS</b>			
	<b>DATE</b>	<b>BY</b>	<b>DESCRIPTION</b>

DOMINION SOIL INVESTIGATION LTD.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

PROPOSED UNDERPASS  
BRIDGE NO. 6-231

KING'S HIGHWAY NO. 401 DIST. NO. I  
CO. ESSEX  
TWP. SANDWICH SOUTH LOT 12 CON. VIII & IX

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D D.S.I.	CHECKED F.D.	W.P. NO. 132-64	DRAWING NO.
DRAWN J.B.E.	CHECKED	JOB NO.	5-3-8 / 1

DATE	APRIL 27, 1965	SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

[illegible]