BR769-F

Mr. H. D. McMillan,
Asst. Road Design Engineer.
K. Peaker.

9th June, 1959.

Re: Catfish Creek - Bank Stability, Hwy. #3, Station 116+00 to 123+00, near New Sarum Twp., Yarmouth.

The stability analysis presented in Geocon's report has been reviewed by the Foundation Section. We are in agreement with the solution for bank stabilization as presented in this report. If the highway is to continue without realignment the suggested method of stabilization should be carried out. In addition to the recommendations made by Geocon, it is the opinion of this section that tile drains should be placed near the bottom of the counterfort and header trenches. These drains will permit better drainage should the granular material not meet the gradation suggested by Geocon. As the report indicates the present inclination of the slope is generally about 26° (or 2:1), little or no additional property will be required.

Alternative methods of partial stabilization and re-alignment may prove more economical. One such method entails trimming the banks to the required slopes and then sodding. Wire mesh would be required to hold the sod in place until the grass roots were sufficiently developed. Tile drains should be installed to intercept and drain off water seeping through the sand seam indicated by Geocon's drawing No. S6913-1, Section B-B. A second method consisting of blanketing the area with

cont'd /2

gravel to the approximate slope of 2:1 is also feasible. However, with the second alternate method large quantities of gravel may make the method too costly.

With the partial stabilization, a realignment of the highway to the south of stations 116+00 to 123+00 would be required. This will guard against possible further surface slides which might occur.

After this report has been reviewed by your department, we would appreciate discussing the facts presented and any conclusion you may have reached.

A. Rutka
A/Materials & Research Engineer

K. Peaker

Per: K. Peaker
Field Supervising Engineer.

KP:LG
c.c. Messrs. H.A. Tregaskes
W.C. Fraser
A. Mantle
H. Orlando
A. Grey
W. Bidell
S. McCombie ✓
I. Weinberg
F. Gill
J. Roy
D. Suzuki
Files - L.G.S.

GEOCON LTD

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180 VALLÉE ST., MONTREAL 18, QUEBEC
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REXDALE, TORONTO, ONT.
TEL. CH. 4-8641

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VANCOUVER 5, B.C.
TEL. MU. 1-8926

Rexdale, Ontario,
May 29th, 1959.

Department of Highways, Ontario,
Parliament Buildings,
Toronto 5, Ontario.

59-F-230

Attention: Mr. L.G. Soderman, P. Eng.,
Principal Soils and Foundation Engineer.

Re: Soil Investigation and Stability Analysis,
Highway 3,
New Sarum, Ontario.

Dear Sirs:

This letter accompanies our detailed report covering the soil investigation and stability analysis of the existing river slope of Catfish Creek near Highway 3, New Sarum, Ontario.

The site was found to be covered by up to 44 feet of stiff clay underlain by dense glacial till.

It is considered that the observed instability in the slope is due to shallow surface slides occurring annually following spring thaw conditions. It is computed that the slides are caused by a progressive deterioration in cohesion within the upper clay. This deterioration, due to increase in water content, is accelerated by frost action.

Remedial measures to stabilize the slope are given in detail in the report.

We feel that this report presents the most practical method of stabilizing the slope at this present time. It is recommended that periodic measurements be taken in order to determine the degree of instability of the slopes adjacent to the area investigated. If we can be of any further service, we would be pleased if you would call us.

Yours very truly,

GEOCON LTD

V. Milligan, P. Eng.,
District Engineer.

VM/dw
S6913

S6913

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SOIL CONDITIONS AND STABILITY ANALYSIS

HIGHWAY 3

NEW SARUM ONTARIO

Distribution:

10 Copies - Department of Highways, Ontario,
Toronto, Ontario.

2 Copies - Geocon Ltd,
Toronto, Ontario.

GEOCON

INDEX

INTRODUCTION

Geocon Ltd has been retained by the Department of Highways, Ontario under the terms of our proposal dated April 14th, 1959 and accepted April 30th, 1959 to determine the soil conditions in the immediate vicinity of Stations 116+00 to 123+00 on Highway 3 just east of New Sarum, Ontario and to conduct an engineering study of the slope in this area. The purpose of the study has been to investigate evidence of instability in the natural slope extending from the side of the highway down to Catfish Creek, to evaluate the overall stability of the slope as it affects the safety of the highway, and to recommend remedial measures.

The results of the study are discussed below, together with recommended remedial measures. The procedures followed in the field investigation, a description of the site and its geology, a detailed description of the soil conditions, and logs of the boreholes are presented in Appendix I. Supporting figures and drawings will be found in Appendix II and in the pocket at the rear of this report.

SUMMARIZED SOIL CONDITIONS

The site is generally covered with a thin veneer of clayey topsoil, followed by up to 42 feet of stiff brown to grey silty clay with traces of sand and gravel. The clay is apparently heavily overconsolidated throughout its depth. In the eastern section of the site, a layer of sand up to 9 feet thick was encountered in the upper portion of the clay stratum, but the layer was found to be thinner towards the west and disappeared in the vicinity of Station 121+00. The clay is underlain by a stratum of very dense sandy glacial till.

DISCUSSION

General

The slope under consideration extends generally northward from Highway 3 to Catfish Creek, which is 60 to 70 feet below the level of the road. It forms part of one wall of the valley which has been produced as a result of down cutting and lateral erosion by the creek. The inclination of the slope is generally about 26 degrees, except at the western end of the site where it is of the order of 23 degrees.

The surface of most sections of the slope is clearly unstable as indicated by the tilting of trees and telephone poles, river erosion at the toe of the slope, and the scars of surface sloughing. According to local information, the time of instability in the slope is always confined to the period immediately following the spring thaw. During this period each year sheets of clay approximately 2 to 3 feet thick apparently slide off the surface of some parts of the slope; this type of movement was observed at the time of the field investigation. According to one long time resident of the area, the slope in the vicinity of Station 119+00 has thus progressively moved back towards the highway for about 20 feet in the past 10 years.

Causes of Instability

The causes of the observed instability are indicated by the results of an analysis of the stability of the slope against shallow surface slides. The analysis was carried out for three representative slope angles, and was based on the effective stress shear strength parameters measured for the clay. The latter were determined by means of consolidated undrained triaxial tests with pore pressure measurements; the angle of shearing resistance, ϕ', was found to be 26 degrees with

Causes of Instability (continued)

a cohesion, C', of 200 pounds per square foot. The Mohr circle diagram from which these values were deduced is shown as Figure 3 of Appendix II.

The results of the stability analysis, which are summarized graphically on Drawing S6913-2 in the pocket at the rear of this report, show that the most unstable condition for any slope is when the free water surface is coincident with the surface of the slope. This corresponds to conditions at the time of spring thaw when the combination of snow melt, low permeability, and high precipitation saturates the upper portion of the slope, forming what is in effect a perched water table.

However, even for slope angles of 30 degrees, the cohesion required to maintain stability in the upper 3 to 5 feet of the slope is considerably less than the 200 pounds per square foot measured in the laboratory. Therefore, in view of the observed instability of the slope, it is considered that a loss of shear strength is occurring in the unstable zone. Such a loss of strength is indicated by the results of the vane shear tests in borehole 3 which are plotted on the Office Report in Appendix I. These show the average undrained shear strength in the upper 5 feet to be about one third of the average from 5 to 10 feet.

The reduction in shear strength of the clay is probably a direct result of the gradual dissipation of the cohesion due to fissuring and an increase in water content. This process is undoubtedly accelerated in the upper 3 feet of the clay by the foramtion of ice lenses as a result of frost action in the winter. Examination of the sliding surfaces of several small slips which occurred during the course of the field investigation revealed thin ice lenses in the

Causes of Instability (continued)

bedding planes of the clay and extensive fissuring. Thus, on the basis of the analysis, it would appear that the cohesion, C', is being decreased to a value of about 50 pounds per square foot or less.

Although the major causes of instability in the slope are considered to be as outlined above, observations at the site indicate that a significant contributing factor to instability is the erosion of its banks by Catfish Creek. During the field investigation, it was observed that one fairly extensive slip was preceeded by minor slumps of the bank at the toe of the slope due to undercutting by the stream. It is also significant to note that the portion of the slope at the west end of the area under consideration, where bank erosion has been controlled by a revetment, is relatively stable.

Due to the steepness and height of the slope an analysis of its stability against a deep-seated failure along a circular arc was also carried out, although no evidence of this type of failure was observed in the area. It was computed that the factor of safety against such a failure under conditions of complete saturation of the slope is greater than 1.3, which is satisfactory.

Remedial Measures

The general measures recommended for stabilizing the slope are to prevent further erosion by the creek and to maintain the shear strength of the clay by controlling seepage of water in the slope and by providing frost protection.

The slope from about station 116 to station 121 should be stripped of topsoil, graded, and trimmed to a maximum inclination of 2 horizontal to 1 vertical. Counterfort trenches should then be

Remedial Measures (continued)

excavated at 50 feet intervals along the entire slope to a depth of about 6 feet. Near the head of the slope, at about elevation 740, a 6 feet deep header trench should be excavated paralleling the highway from station 116 to station 124. This trench should intercept the counterfort trenches and should be graded in order to promote drainage to them. The interceptor trench and counterforts should be of a practical working width of about 3 feet and should be backfilled with coarse sand and gravel. It is recommended that sand and gravel be well graded, and such that at least 15 percent sizes are greater than 3 inches in diameter and not more than 10 percent sizes pass a No. 40 sieve.

The portions of the slope which have been stripped, trimmed, and graded should be provided with a 3 feet thick protective blanket of coarse gravel for frost protection and to facilitate surface drainage. It is also suggested that gutters be constructed along the north side of the highway in order to prevent excess runoff water from entering the slope above the interceptor trench.

In order to prevent further erosion of the creek bank in the unstable area, it will be necessary to construct a revetment from the end of the existing one to a point approximately opposite station 115. It is suggested that the revetment should be composed of rock fill not less than 1 foot in least diameter and should be placed on a slope of $1\frac{1}{2}$ to 1. It should be about 4 feet in thickness and extend at least 10 feet above the creek bed. Before placing the rock fill the slope bank should be trimmed and a 2 foot thick coarse sand and gravel filter placed to prevent migration of the bank material through the rock fill. The grading of the filter material should be similar to that recommended above for the trench backfills.

Remedial Measures (continued)

As noted above, stripping and grading of the slope west of station 121 has not been recommended, although recommendations have been made for establishing interceptor drain and counterforts as in the remainder of the slope. Due to the milder slopes and relative stability of this area, it is considered that the latter measures will be sufficient to correct the minor degree of instability observed. However, it is recommended that periodic checks be made of the performance of this area, and if warranted, that additional remedial measures along the lines discussed above be taken.

CONCLUSIONS AND RECOMMENDATIONS

1. The site was found to be underlain by up to 44 feet of stiff brown to grey silty clay with traces of sand and gravel, followed by very dense glacial till.

2. The observed instability in the slope was concluded to be due to shallow surface slides in the clay which occur annually following the spring thaw.

3. Analysis indicated that the slides are caused by a progressive deterioration of the shear strength of the clay due to increasing water content and fissuring accelerated by frost action.

4. It was observed that the instability of the slope is aggravated by the erosive action of Catfish Creek at the toe of the slope.

5. Remedial measures to stabilize the slope are discussed in the report. These involve the control of erosion by the creek, control of groundwater, and frost protection for the slope.

PERSONNEL

The field work for this investigation was carried out under the supervision of Mr. R. Sorokoski. The report was written by Messrs. A. Gass and V. Milligan, and reviewed by Mr. M.A.J. Matich.

REGISTERED PROFESSIONAL ENGINEER
V. MILLIGAN
PROVINCE OF ONTARIO

V. Milligan, P.Eng.

VM/dw
S6913

APPENDIX I

Procedure

Site and Geology

Soil Conditions

Water Conditions

Office Reports on Soil Exploration

GEOCON

PROCEDURE

The field work was carried out between March 25th, 1959 and April 8th, 1959 inclusive. Three boreholes, with adjacent dynamic penetration tests were put down in BX size using a standard skid-mounted machine drillrig. Three hand auger holes were also put down and vane shear testing was carried out in one of the boreholes.

Drawings S6913-1 and S6913-2 located in the pocket at the rear of this report show the location of the boreholes and auger holes together with the inferred soil stratigraphy and results of stability analyses carried out on the slope. A detailed log of each boring is given on the Office Reports on Soil Exploration in this Appendix.

The laboratory testing was carried out in the Soil Mechanics Laboratory of Geocon Ltd in Toronto. The results are plotted on the Office Reports on Soil Exploration in this Appendix and on Figure 1 in Appendix II. The samples remaining after testing will be stored until November 1st, 1959 and will then be discarded unless instructions to the contrary are received.

Elevations are referred to Geodetic Datum and were obtained from bench mark No. 11 with elevation 756.32 located 30.46 feet north of Station 136+41.59 of existing Highway 3, as shown on Department of Highways, Ontario, Profile No. C-820.

SITE AND GEOLOGY

The site is located along existing Highway 3 just east of New Sarum on Lot 21, Concession 9, in the Township of Yarmouth, County of Elgin. The investigated area includes the north bank of Catfish Creek and existing Highway 3 between approximate chainages 115+00 and 122+00. Ground elevations at the site vary from about 687 at creek level to 760 at road surface.

From available geological information, it is known that the site is overlain by sands, silts, and clays deposited as a major delta in glacial lakes Whittlesly and Warren. These deposits are underlain by glacial drift and in recent years have been incised 75 to 100 feet by rivers forming deep meandering river valleys. The glacial drift is reported to be underlain by Devonian bedrock of the Norfolk formation.

SOIL CONDITIONS

The principal soil strata encountered by the borings are as follows:

Topsoil

Dark grey clayey topsoil was encountered in all borings to a maximum depth of one foot. The topsoil contains roots, silt, sand and some gravel sizes up to 2 inches in diameter. Brick fragments were encountered within the topsoil at auger holes 4 and 5.

Brown to Grey Silty Clay

Underlying the topsoil is a stratum of brown to grey silty clay with traces of sand and gravel. The top of the stratum is at about elevation 760 and its bottom is at about elevation 718. Thus, its maximum thickness is about 42 feet, making it the major component of the slope. The colour of the clay grades from brown in the upper weathered portion to grey with depth. It has a horizontally bedded structure, and is generally fissured in the upper 5 feet. The fissuring is most pronounced in the upper 3 feet.

Brown to Grey Silty Clay (continued)

The liquid limit of the material ranges from a high of 48 in the weathered zone to a low of 31 with depth, with an average of 36. Plastic limits range from 23 to 15 with an average of 19, and the average plasticity index is 17. The water content ranges from 22 percent to 39 percent in the upper 5 feet with an average of 28 percent. Below this depth, throughout the remainder of the stratum, the average water content is 16 percent within the very narrow range of plus or minus 1 percent. On the basis of these index properties it can be concluded that the silty clay has been heavily overconsolidated.

The undrained compressive strengths of the clay range from a low of 1.4 tons per square foot in the upper 5 feet of the stratum to a high of 6.4 tons per square foot with depth. It is significant to note that in situ vane shear tests carried out in borehole 3 indicated an average shear strength of less than 0.5 tons per square foot in the upper 5 feet of the stratum, with a marked change to an average of about 1.4 tons per square foot between the depths of 5 and 10 feet. On the basis of the undrained strength, the consistency of the silty clay ranges from firm to hard, and is generally stiff. The results of the triaxial testing and vane testing are plotted on the Office Reports in this Appendix.

A series of consolidated undrained triaxial tests were carried out with measurement of pore pressures. The results are plotted on a Mohr circle diagram given as Figure 1 in Appendix II, and show that, in terms of effective stress, the clay has an angle of shearing resistance, ϕ', equal to 26 degrees, and a cohesion of 0.1 tons per square foot.

Brown to Grey Silty Clay (continued)

The wet unit weights measured for the clay ranged from 114 to 142 pounds per cubic foot with an average of 130 pounds per cubic foot.

Brown Stratified Sand

In borehole 1 and auger holes 4 and 5 a layer of brown stratified sand was encountered 6 to 9 feet below ground level. It was not encountered in auger hole 6. The thickness of the layer varied from a maximum of 9 feet in borehole 1 to a minimum of 4 feet in auger hole 4. From the results of the boreholes and observations along the crest of the slope, it is considered that the sand layer disappears in the vicinity of station 121+00.

The layer is generally stratified with the stratifications ranging from a 2 inch sandy silt layer at the top to a 6 inch thick coarse sand layer at the bottom. Two "N" values of 8 and 46 were obtained in the layer indicating that its relative density is loose to dense.

It is signficant to note that no groundwater or indications of seepage within this layer were observed during the course of the investigation.

Grey Sandy Till

Underlying the silty clay is a stratum of grey sandy till. The till stratum encountered at about elevation 718 by all borings was penetrated for 16 feet by borehole 1. Difficulty in sampling was experienced in this stratum because of the very dense relative density. However, samples obtained at the top

Grey Sandy Till (continued)

of the stratum show the till to be generally comprised of silty sand and gravel with some clay. A boulder about 10 inches in diameter was encountered at the surface of the stratum at borehole 1 and a subangular fragment of limestone about 2 inches in size was sampled at a lower depth.

Standard penetration resistance or "N" values of over 100 blows for 6 inches obtained in the stratum indicate that the relative density of the sandy till is very dense.

WATER CONDITIONS

During the course of the investigation, observation pipes were installed in the boreholes and groundwater level readings were taken. In boreholes 2 and 3 located along the creek bank, groundwater level was at about 9.5 and 4.5 feet below ground level respectively. Borehole 1 and auger holes 4 and 5 were dry, while in auger hole 6 the groundwater level was encountered 10 inches below ground level, probably due to surface water seepage. Water level in Catfish Creek during the investigation was at about elevation 687.

EXPLANATION OF THE FORM
"OFFICE REPORT ON SOIL EXPLORATION"

The object of this form is to enable a comprehensive study of the soil to be made by combining on one sheet all of the information obtained from the boring. An explanation of the various columns of the report follows.

ELEVATION AND DEPTH

This column gives the elevation and depth of boundaries between the various soil strata. The elevation is referred to the datum shown in the general heading.

WATER CONDITIONS

In this column the water level in the casing at the time of boring or the water table in the ground, determined by a series of observations in a piezometer or standpipe, is indicated to scale by a horizontal line with the symbol W.L. or W.T. above the line. A notation of any complicated groundwater conditions will be made in this column.

DESCRIPTION

A description of the soil, using standard terminology, is contained in this column. The consistency of cohesive soils and the relative density of non-cohesive soils are described by the following terms:

Consistency	U-Strength Tons/sq. ft.
Very soft	0.03 to 0.25
Soft	0.25 to 0.5
Firm	0.5 to 1.0
Stiff	1.0 to 2.0
Very stiff	2.0 to 4.0
Hard	over 4.0

Relative Density	Standard Penetration Resistance. Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

STRATIGRAPHIC PLOT

The stratigraphic plot follows the standard symbols of the National Research Council, Canada.

ELEVATION SCALE

The information in all columns is plotted to a true elevation scale which is shown in this column.

GRAPHS

The main body of the report forms a graph which is used to plot to correct elevation the important soil properties which are obtained through field and laboratory tests. The scales and symbols for the plotting are shown at the head of the column.

OTHER TESTS

In this column are shown, by symbol, the other field or laboratory tests which have been performed on the soil and for which the results have not been plotted on the above graph.

SAMPLES

The first three columns describe the condition, type and number of each sample obtained from the boring. The location and extent of each sample is plotted to scale.

In the last column is shown the penetration resistance in blows of 4200 inch-pounds required to drive one foot of the sampler into the ground. When a 2 inch Drive Sampler is used the result obtained is termed the "Standard Penetration Resistance".

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OFFICE REPORT ON SOIL EXPLORATION

CONTRACT S6918 BORING # 1 DATUM GEODETIC CASING BX
BORING DATE MARCH 30, 1959 REPORT DATE APRIL 13, 1959 COMPILED BY J.A. CHECKED BY
SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION
- DISTURBED
- FAIR
- GOOD
- LOST

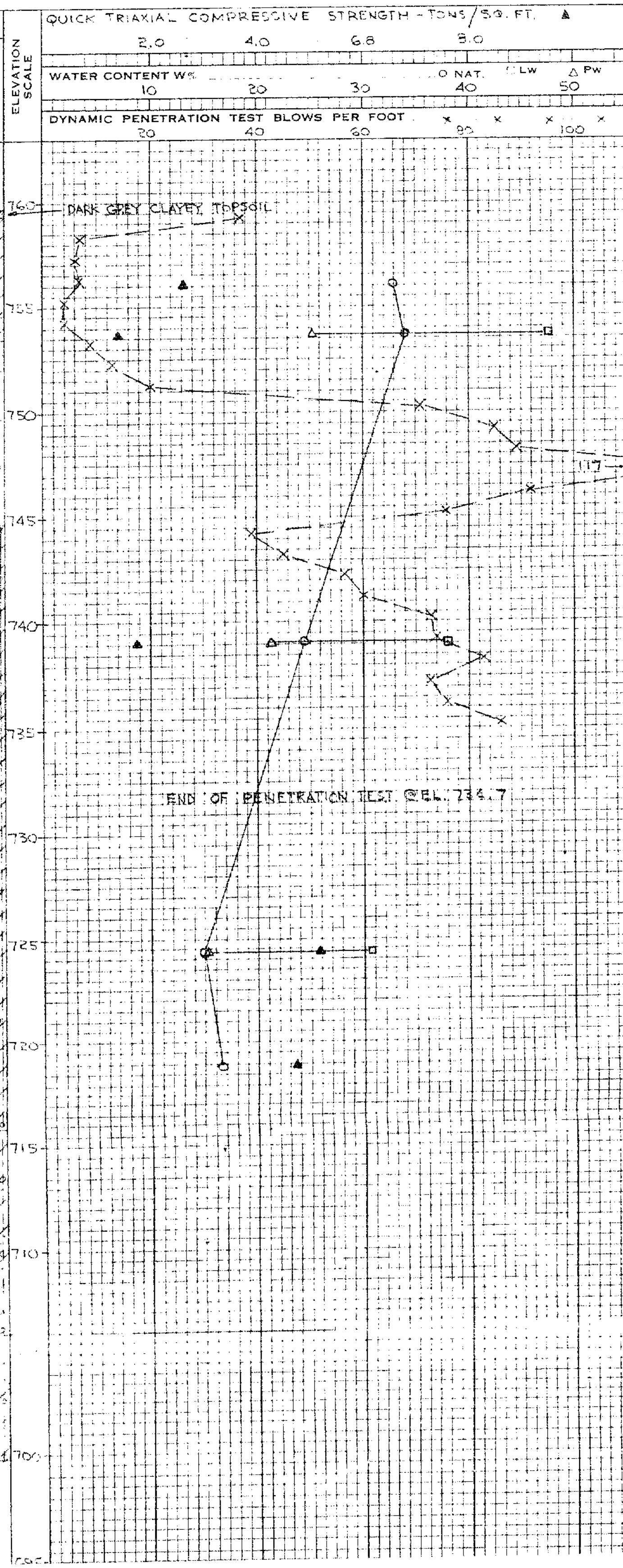
SAMPLE TYPES
- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F.S. - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS
- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- Qc - TRIAXIAL CONSOLIDATED QUICK
- Q - TRIAXIAL QUICK
- S - TRIAXIAL SLOW
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEVN. / DEPTH	DESCRIPTION
759.7	GROUND LEVEL
0.3	STIFF BROWN TO GREY SILTY CLAY TRACE OF SAND
753.5 / 6.2	LOOSE TO DENSE STRATIFIED BROWN SAND
744.7 / 15.0	STIFF BROWN TO GREY SILTY CLAY TRACE OF SAND AND GRAVEL
715.9 / 43.8	VERY DENSE GREY SANDY FILL
699.7 / 60.0	END OF HOLE

WATER CONDITIONS: HOLE DRY TO EL. 715.7 MAY 9, 1959



OTHER TESTS / SAMPLES

OTHER TESTS	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
γ = 115	2"SO	1	11
γ = 125	SO	2	9
	SO	3	8
	2"DO	4	46
	DO	5	20
γ = 128	2"SO	6	11
	SO	7	20
	SO	8	25
γ = 139	SO	9	36
γ = 139	SO	10	32
	R.C. AXT	11	—
	2"DO	12	>100
	W.S	13	—

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56913 BORING # 2 DATUM GEODETIC CASING BX
BORING DATE APRIL 2, 1959 REPORT DATE APRIL 13, 1959 COMPILED BY J.A. CHECKED BY VM
SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SAMPLE TYPES

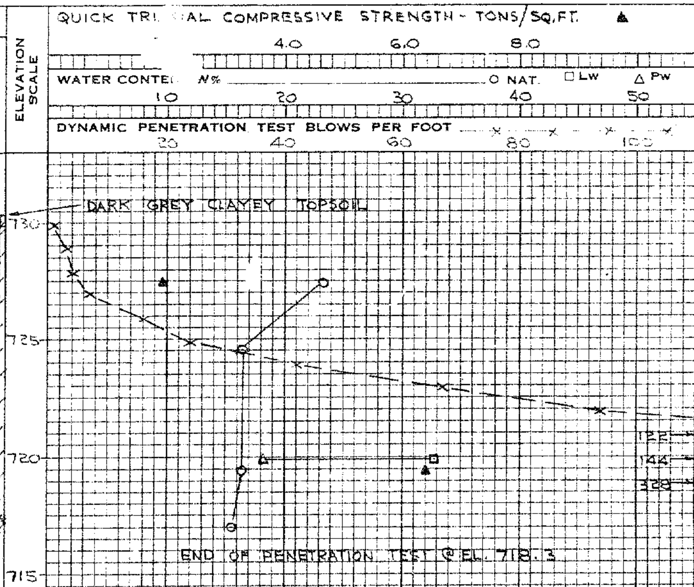
- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F.S. - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS

- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- Qc - TRIAXIAL CONSOLIDATED QUICK
- Q - TRIAXIAL QUICK
- S - TRIAXIAL SLOW
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEVN. / DEPTH	WATER CONDITIONS	DESCRIPTION
730.3		GROUND LEVEL
0.5	W.L. @ EL. 720.8 MAY 9, 1959	STIFF BROWN TO GREY SILTY CLAY TRACES OF SAND AND GRAVEL
717.3 / 13.5		END OF HOLE
		VERY DENSE GREY SANDY TILL



OTHER TESTS	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
γ = 128		2" SO	1	6
		SO	2	22
γ = 142		SO	3	27
		SO	4	>100

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 56913 BORING # 3 DATUM GEODETIC CASING BX

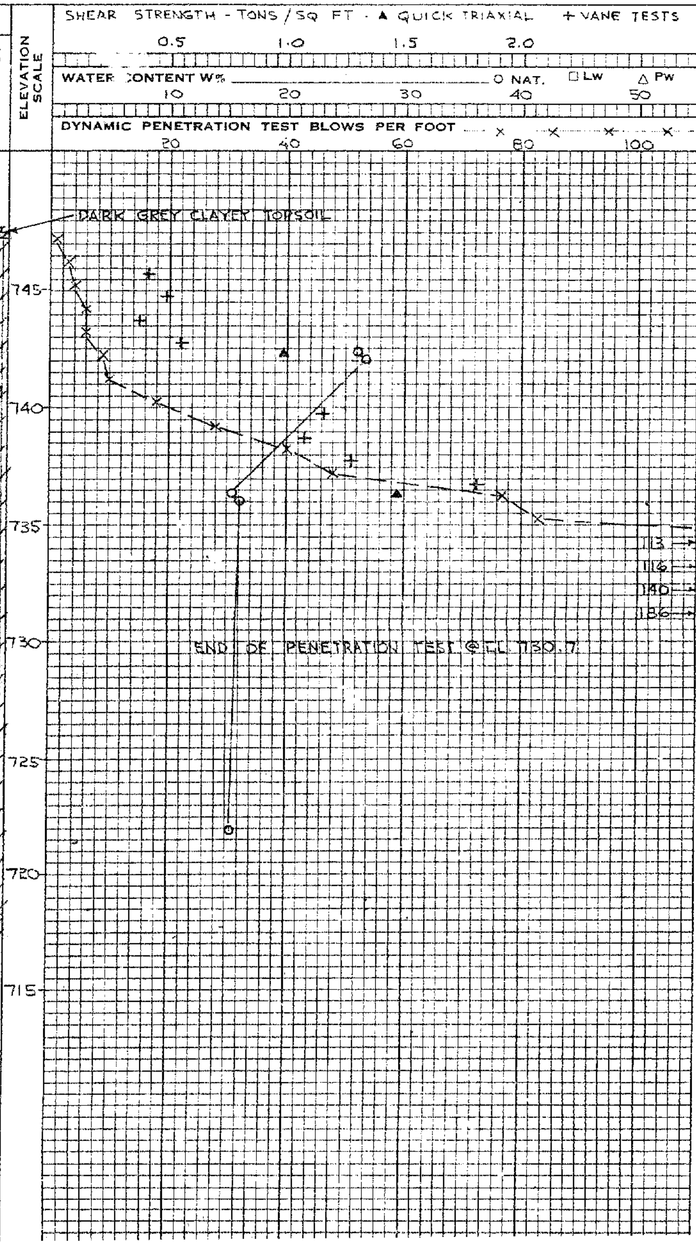
BORING DATE APRIL 4, 1959 REPORT DATE APRIL 13, 1959 COMPILED BY J.A. CHECKED BY [illegible]

SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION	SAMPLE TYPES		ABBREVIATIONS	
DISTURBED	A.S. - AUGER SAMPLE	F.S. - FOIL SAMPLE	V - IN-SITU VANE TEST	γ - WET UNIT WEIGHT
FAIR	S.T. - SLOTTED TUBE	S.O. - SLEEVE-OPEN	M - MECHANICAL ANALYSIS	K - PERMEABILITY
GOOD	W.S. - WASHED SAMPLE	S.F. - SLEEVE-FOOT VALVE	U - UNCONFINED COMPRESSION	C - CONSOLIDATION
LOST	D.O. - DRIVE-OPEN	T.O. - THIN WALLED OPEN	QC - TRIAXIAL CONSOLIDATED QUICK	
	D.F. - DRIVE-FOOT VALVE	R.C. - ROCK CORE	Q - TRIAXIAL QUICK	WL - WATER LEVEL IN CASIN
	C.S. - CHUNK SAMPLE		S - TRIAXIAL SLOW	WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEVN. / DEPTH	WATER CONDITIONS	DESCRIPTION
747.7	W.L. @ EL. 742.5 MAY 9, 1959	GROUND LEVEL
0.5		DARK GREY CLAYEY TOPSOIL
		STIFF BROWN TO GREY-BROWN SILTY CLAY TRACES OF SAND AND GRAVEL
718.2		
717.4 / 30.3		VERY DENSE GREY SANDY TILL
		END OF HOLE



SAMPLES

OTHER TESTS	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
γ = 128		2" SO	1	5
γ = 137		SO	2	24
		SO	3	26
		SO	4	30
		SO	5	43
		SO	6	>100

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT S6913 AUGERHOLES ~~BORING~~ # 4, 5 AND 6 DATUM GEODETIC CASING —
BORING DATE APRIL 7, 1959 REPORT DATE APRIL 13, 1959 COMPILED BY J.A. CHECKED BY V.A.
SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOW OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION
- DISTURBED
- FAIR
- GOOD
- LOST

SAMPLE TYPES
- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F.S. - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS
- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- QC - TRIAXIAL CONSOLIDATED QUICK
- Q - TRIAXIAL QUICK
- S - TRIAXIAL SLOW
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

SOIL PROFILE | ELEVATION SCALE | WATER CONTENT W% — O NAT. □ Lw △ Pw | DYNAMIC PENETRATION TEST BLOWS PER FOOT | OTHER TESTS | SAMPLES

4

ELEVN. DEPTH	WATER CONDITIONS	DESCRIPTION	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
762.1 / 0.0	HOLE DRY - MAY 9, 1959	GROUND LEVEL; DARK GREY CLAYEY TOPSOIL				
1.0		STIFF BROWN TO GREY SILTY CLAY TRACES OF SAND AND GRAVEL	Disturbed	A.S.	1	—
			Disturbed	A.S.	2	—
753.1 / 9.0		LOOSE TO DENSE STRATIFIED BROWN SAND	Disturbed	A.S.	3	—
749.1 / 13.5		END OF HOLE STIFF BROWN TO GREY SILTY CLAY				

5

ELEVN. DEPTH	WATER CONDITIONS	DESCRIPTION	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
762.0 / 0.0	HOLE DRY - MAY 9, 1959	GROUND LEVEL; DARK GREY CLAYEY TOPSOIL				
1.0		STIFF BROWN TO GREY SILTY CLAY TRACES OF SAND AND GRAVEL	Disturbed	A.S.	1	—
755.9 / 6.1		LOOSE TO DENSE STRATIFIED BROWN SAND	Disturbed	A.S.	2	—
749.3 / 13.0		END OF HOLE STIFF BROWN TO GREY SILTY CLAY				

6

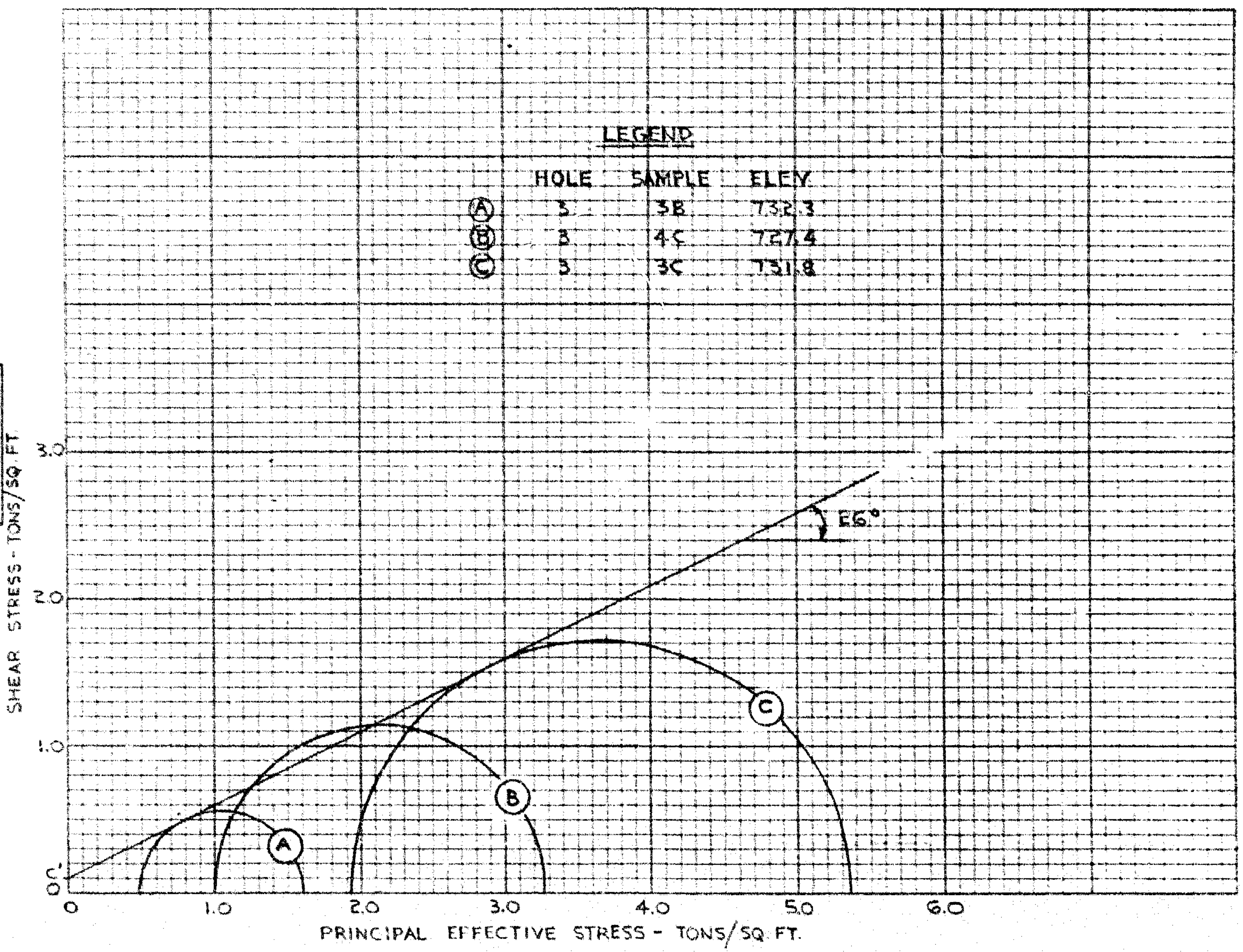
ELEVN. DEPTH	WATER CONDITIONS	DESCRIPTION	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
759.1		GROUND LEVEL; DARK GREY CLAYEY TOPSOIL				
0.5		STIFF BROWN TO GREY SILTY CLAY TRACES OF SAND AND GRAVEL	Disturbed	A.S.	1	—
			Disturbed	A.S.	2	—
752.1 / 7.0		END OF HOLE				

Elevation scale: 760, 755, 750, 745

APPENDIX II

FIGURES

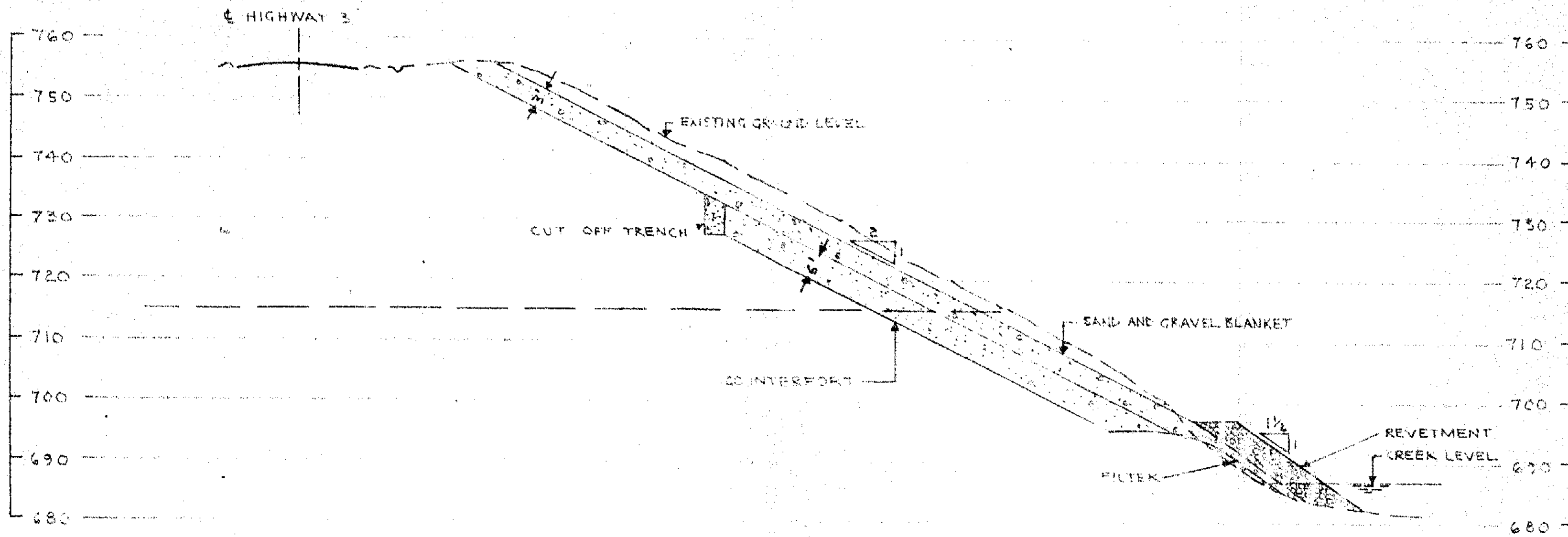
GEOCON



CONSOLIDATED UNDRAINED TRIAXIAL TESTS

GREY - BROWN SILTY CLAY

APPENDIX II
FIGURE 1
PROJECT S 6913



TYPICAL SECTION THROUGH COUNTERFORT TRENCHES

IN VICINITY OF STAT. 118+00

REFERENCE	
DWG. NO.	DESCRIPTION

GEOCON LTD

DEPARTMENT OF HIGHWAYS, ONTARIO

TORONTO ONTARIO

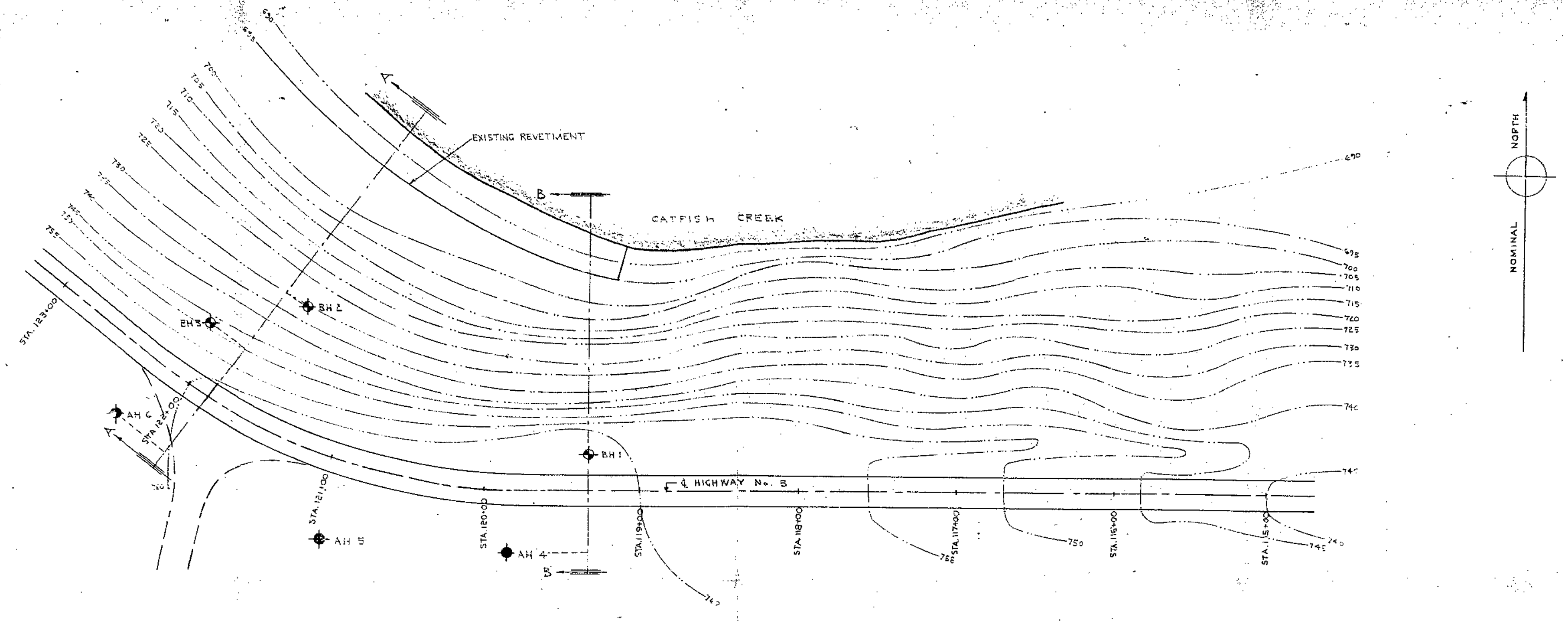
HIGHWAY 3 - NEW SARUM

RECOMMENDED REMEDIAL MEASURES

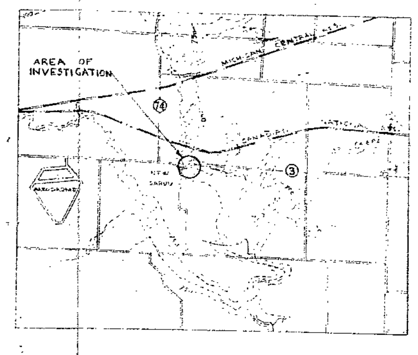
DATE MAY 21, [illegible] SCALE [illegible]

MADE	CHKD.	APPD.	
M.V.	[illegible]	[illegible]	No. [illegible] - 3

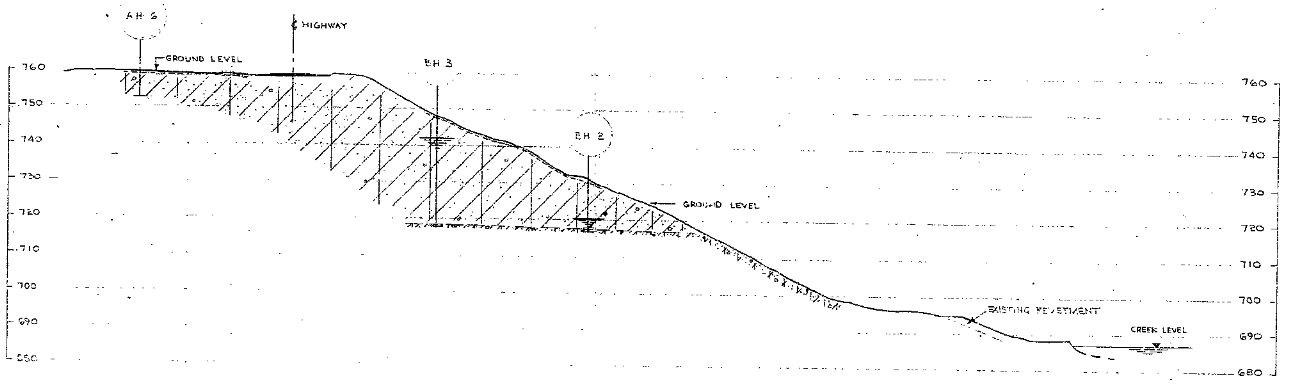
#59-F-230C
Hwy #3
NEAR NEW SARUM
CATFISH CREEK
BANK STABILITY



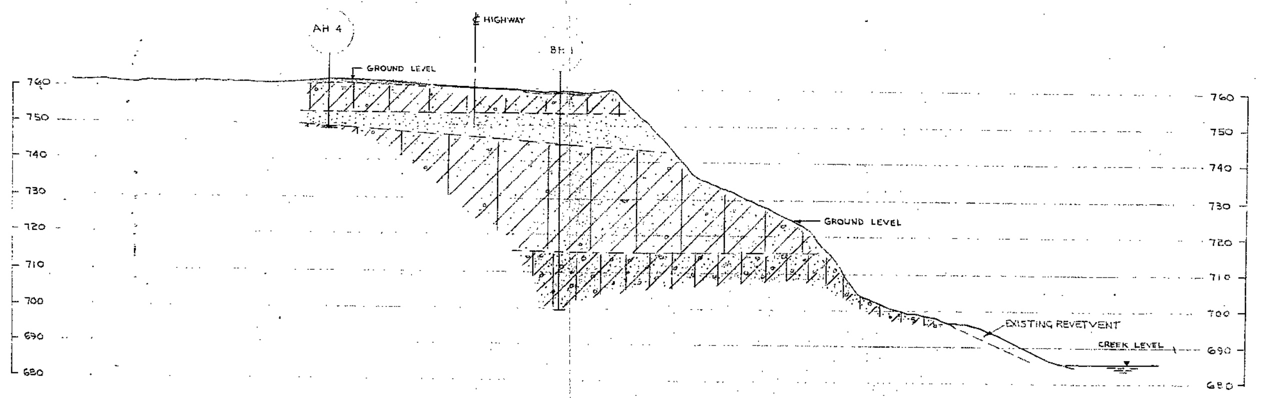
PLAN
SCALE 1" = 40'-0"



KEY PLAN



SECTION A-A
SCALE 1" = 20'-0"



SECTION B-B
SCALE 1" = 20'-0"

LEGEND

- BOREHOLE WITH PENETRATION TEST IN PLAN
- BOREHOLE WITH PENETRATION TEST IN ELEVATION
- AUGERHOLE IN PLAN
- AUGERHOLE IN ELEVATION
- WATER LEVEL IN HOLE - MAY 9, 1959

STRATIGRAPHY

- DARK GREY CLAYEY TOPSOIL
- STIFF BROWN TO GREY SILTY CLAY, TRACE OF SAND AND GRAVEL
- LOOSE TO DENSE STRATIFIED BROWN SAND
- VERY DENSE GREY SANDY TILL

SPECIAL NOTE. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

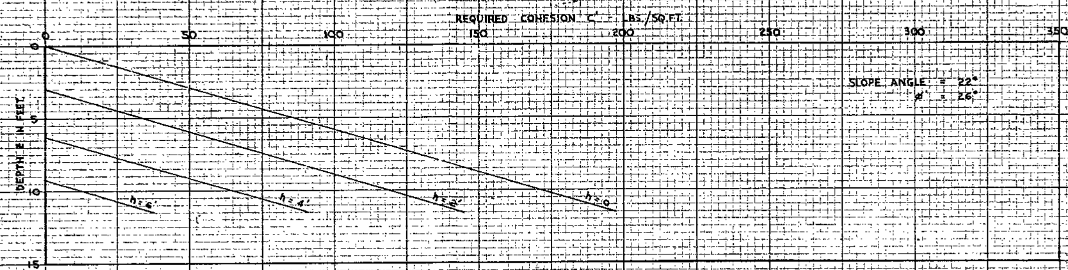
BA 769-A

REVISIONS			REVISIONS			REFERENCE		REFERENCE	
MARK	DATE	DESCRIPTION	MARK	DATE	DESCRIPTION	DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION
								5-B-120	PLAN OF HIGHWAY 3 - SUPPLIED BY D.H.O. PROFILE OF HIGHWAY 3 - SUPPLIED BY D.H.O.

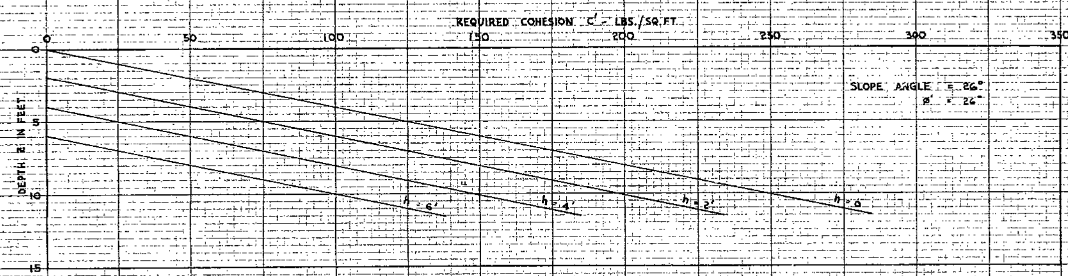
DEPARTMENT OF HIGHWAYS, ONTARIO
TORONTO ONTARIO
HIGHWAY 3 - NEW SARUM
TOWNSHIP OF YARMOUTH - COUNTY OF ELGIN - ONTARIO
BORING PLAN AND SOIL STRATIGRAPHY

GEOCON LTD

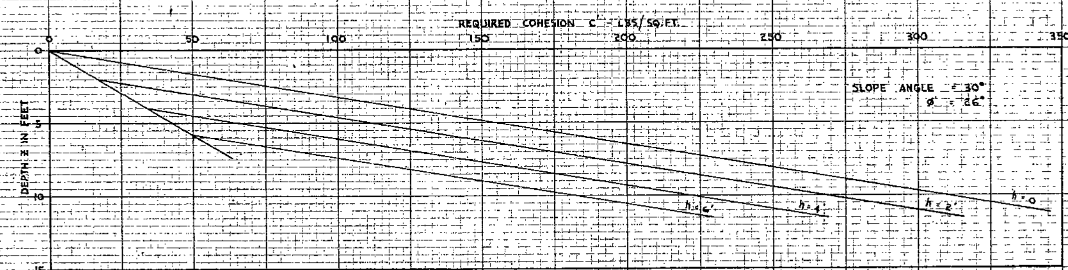
DATE MAY [illegible] SCALE AS SHOWN
MADE MW CHKD. [illegible] APPD. [illegible] No. S 6313-1



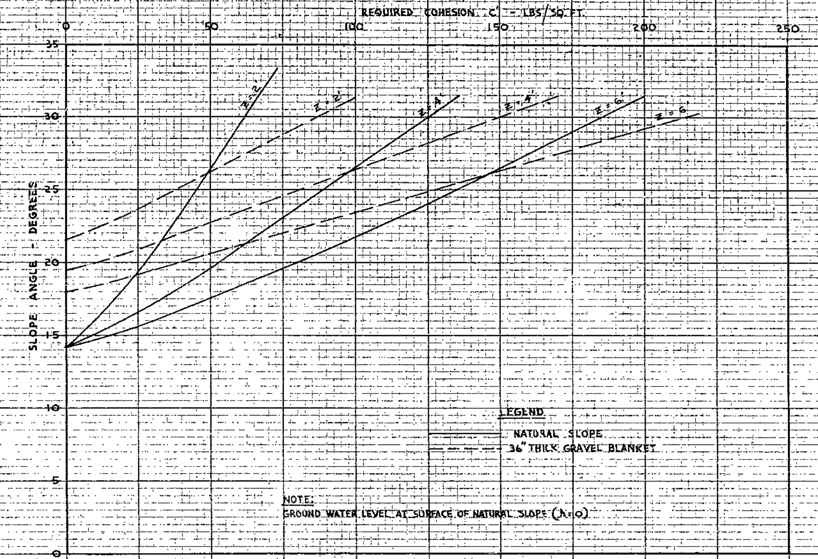
COHESION REQUIREMENTS FOR STABILITY FOR VARYING GROUND WATER CONDITIONS ON A 22° SLOPE, Ø' = 26°



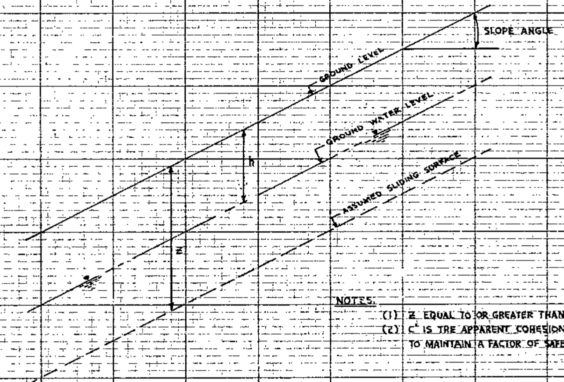
COHESION REQUIREMENTS FOR STABILITY FOR VARYING GROUND WATER CONDITIONS ON A 26° SLOPE, Ø' = 26°



COHESION REQUIREMENTS FOR STABILITY FOR VARYING GROUND WATER CONDITIONS ON A 30° SLOPE, Ø' = 26°



EFFECT OF 36" GRAVEL BLANKET ON STABILITY REQUIREMENTS



NOTES:

(1) Z EQUAL TO OR GREATER THAN h

(2) C' IS THE APPARENT COHESION REQUIRED TO MAINTAIN A FACTOR OF SAFETY = 1.0

REFERENCE	
DWG. NO.	DESCRIPTION

DEPARTMENT OF HIGHWAYS, ONTARIO
TORONTO ONTARIO

HIGHWAY 3 - NEW SARUM

TOWNSHIP OF YARMOUTH - COUNTY OF ELGIN - ONTARIO

SUMMARISED REQUIREMENTS FOR STABILITY AGAINST SURFACE SLIDING

GEOCON LTD

DATE MAY 14, 1959 SCALE AS SHOWN

MADE J.A. CHKD. APPD. No. S6913 - 2