

60-F-326M

BANNOCK BURN BRIDGE

NEAR VARNA



ONTARIO

DEPARTMENT OF HIGHWAYS

Bridge Division.

Memo to Mr. A. Stermac Date March 9, 1962.
Principal Foundation Engineer,
Materials & Research Section, Subject County of Huron, Lot 24
Room 107, Lab. Building Bannockburn Bridge
From G. C. E. Burkhardt Twp. of Stanley, Con. BRN-BRS
our file #BA1369

We are enclosing, herewith, a copy of the Foundation Report, by Universal Geotechnique Limited, for your information.

The new bridge is a three span continuous steel beam structure. The piers have been founded 5 feet below river bed.

We have approved the preliminary design, by S. M. Ross, P. Eng., October 5, 1961 and intend to approve the final plans, March 12, 1962.

GCSB/ea

G. C. E. Burkhardt
G. C. E. Burkhardt
for K. L. Kleinsteinber,
Municipal Bridge Liaison Engineer.

*G. C. E. Burkhardt informed by phone
March 13, 1962 - No comments.*

*The Bridge Office has checked on the Bridge
drawing that footings are within the till
stratum*

AGS

March 13, 1962.

UNIVERSAL
GEOTECHNIQUE

LIMITED



REPORT

on

FOUNDATION INVESTIGATION

at

BRIDGE B-53

(BANNOCKBURN BRIDGE)

near VARNA

COUNTY OF HURON

ONTARIO

6-7-52611

Report N° T.458/60

100 University Avenue,
Toronto 1, Ontario.

REPORT

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COUNTY OF HURON

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INTRODUCTION

The County Engineer of Huron, Mr. J. W. Britnell, is proposing the replacement of the existing concrete bridge that at present carries the County Road from Brucefield to Varna over the Bannockburn River approximately 2 miles west of Brucefield, and Universal GEOTECHNIQUE Limited were requested to carry out subsurface exploration to ascertain the soil conditions in relation to foundation design and this Report contains the pertinent data and recommendations.

AVAILABLE INFORMATION

The existing bridge is a 2-span concrete structure that shows signs of deterioration and is of narrow width. It is understood that tentative designs for the new bridge envisage a wider structure of possibly 3 spans and that due to the relatively high level of the road above the river consideration will be given to stub abutments on piles and pile bents for the piers.

THE SITE

The new bridge will be located on the same site as the existing structure which carries the County Road across the Bannockburn River which is at a depth of over 20 feet beneath the road at this point. The position of the bridge site relative to Brucefield is shown on Key Plan, Drawing N° 1.

SUBSURFACE EXPLORATION

Subsurface exploration was carried out during the period 1st to the 6th of October, 1960 and originally comprised 4 exploratory boreholes in locations as shown on Drawing N° 2 accompanying this Report. Due to borehole BH.2 meeting refusal conditions at a shallow depth an additional borehole BH.2A was located within 3 feet of BH.2

The positions of the boreholes were staked and the ground surface elevations obtained by the Staff of GEOTECHNIQUE, the elevations being relative to the centre of the deck of the existing bridge at mid-span with an assumed elevation of 100.0.

Boreholes BH.2, 2A and 4 were located immediately adjacent to the river banks whilst BH.1 and BH.3 were at higher elevations in locations which were approximately on the line of the proposed abutments to the new bridge.

During the operation of soil boring, soil samples were obtained generally at intervals of 2-1/2 feet down to a depth of 15 feet and thereafter at intervals of about 5 feet, and where noticeable changes of strata occurred the depths of such changes were recorded.

The state of compaction of the essentially cohesionless strata and the general consistency of cohesive strata was determined by means of standard penetration tests taken during the operation of soil sampling. (The standard penetration test, as referred to in this Report, involves the recording of the number of blows (N) of a 140 lb. hammer falling 30 inches that are required to drive a 2 inch diameter split barrel sampler 1 foot into the soil at the bottom of the borehole).

Visual examination and classification of all soil samples was carried out in the laboratory and the results of such examination together with the values of the standard penetration tests are given on the borehole logs which form part of this Report. Also included are geological sections, a key plan, and a borehole location plan.

Subsurface conditions given in this Report are those indicated by material encountered in the boreholes. The accuracy of extrapolation to obtain the soil profile should be associated directly with the geological conditions and inversely with the spacing of the boreholes.

GEOLOGICAL FEATURES

The site is situated in an extensive glacial spillway system which is bordered by the Wyoming moraine in the west and a comparatively flat till plain in the east.

From the information obtained from the exploratory boreholes it may be concluded that the strata down to the explored depths can be classified as follows:

FILL

Fill extending to a depth of about 3 feet and consisting of loam and sandy silt containing organic matter was found in boreholes BH.1 & 3.

TOP SOIL

Dark brown loam containing organic matter was encountered beneath the fill in borehole BH.1 and at the ground surface in BH.4.

FLUVIAL DEPOSITS

Under the description of fluvial deposits have been included the sands, silts and clays which were encountered as a thin stratum in all the boreholes. These deposits are in part alluvial and in part glaciofluvial and range from loose to dense.

BROWN TILL

Very stiff to hard sandy silty clay containing subangular gravel underlies the fluvial deposits to the full depth of exploration.

GROUND WATER

A limited amount of free water was recorded in the fluvial deposits. This water was obviously flowing over the surface of the brown till towards the river and is really surface run-off.

LABORATORY TESTS

In addition to visual examination of all soil samples in the laboratory certain of the samples were tested for index properties and the results are given in the appendix in Table N° 1. Furthermore, a few representative samples of the brown till were subjected to compression testing and the results are given as follows:

BOREHOLE N°	SAMPLE N°	DEPTH BELOW GROUND SURFACE	UNCONFINED COMPRESSION STRENGTH lbs./sq. ft.	REMARKS
BH.2A	2	6'-6" to 7'-6"	5200	at 17% strain
BH.4	3	7'-3" to 8'-3"	7800	at 20% strain
	5	13'-0" to 13'-6"	9600	at 10% strain

NOTE: ALL SAMPLES FROM 2" DIAMETER SPLIT BARREL SAMPLER

DISCUSSION

The results of the subsurface exploration have revealed that the site of the bridge is situated within an eroded channel in the underlying glacial till which at this site is a heavily overconsolidated material that can be classified as hard.

No problem with regard to foundations need be anticipated at this site as the hard glacial till will provide excellent support to whatever type of foundation is adopted. If consideration was to be given to the use of spread footings then an allowable bearing capacity of 4.0 tons/sq.ft. could be used in design where the underside of such footings were located at a minimum depth of 4 feet below the upper surface of the till.

It is understood that due to the height at which the road crosses the valley in which the Bannockburn River flows, consideration will be given to a bridge design incorporating stub abutments on piles and pile bents for the river piers. Under such conditions either steel pipe piles or steel H section piles could be used as both these types of piles could be driven to obtain a high resistance in the glacial till.

Assuming the use of steel piles driven to a resistance of at least 120 tons as calculated by the Hiley formula and designed to carry a 60 ton working load as a short column, the following particulars could be used in developing suitable designs.

PILE SECTION	DRIVING RESISTANCE Tons	SAFE LOAD Tons (as short column)	PROBABLE PENETRATION INTO GLACIAL TILL
12" diameter pipe by 5/16" wall thickness (concrete filled)	120	60	plus/minus 15 feet
14" diameter pipe by 5/16" wall thickness (concrete filled)	150	75	plus/minus 15 feet
Note: Pipe piles driven closed-ended and subsequently filled with concrete.			
12" H section at 53 lbs.	120	60	plus/minus 20 feet
14" H section at 73 lbs.	180	90	plus/minus 20 feet

It is difficult to forecast with any precision the exact depth to which piles will penetrate into hard glacial till because variations in the percentage of clay has a marked effect especially on the proportion of the resistance developed in end bearing.

A steel H section pile as compared with a closed-ended pipe pile will drive easier in the initial stages and will also penetrate small boulders with much greater ease. Where the strata is likely to contain a considerable number of large boulders, both the foregoing types of pile are not particularly suitable. However, whereas the possibility of large boulders occurring within the depths to which piles would penetrate at this site cannot be dismissed, it would be reasonable to believe that they may not be prevalent.

It perhaps is worth mentioning that where there is a probability of encountering large boulders above the elevation to which it is considered necessary to drive piles, a more satisfactory choice is a pipe pile driven open-ended and with a reinforced cutting shoe, the soil being excavated from within the pipe and where boulders are encountered which cannot be displaced or broken by heavy driving they can be penetrated after breaking them either by drilling and blasting or by the continued impact of a heavy drill bit such as used in rock drilling with a cable-tool rig. Both the foregoing methods of penetrating boulders are obviously expensive due to the necessity for halting the pile driving to carry out other operations with additional equipment.

Whatever type of pile is used it should be driven by a hammer giving a suitable relationship of hammer weight to pile weight and the driving resistance should be calculated by means of the Hiley formula, and a satisfactory penetration obtained in the hard underlying glacial till.

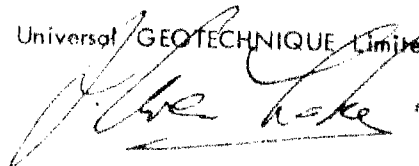
CONCLUSIONS

From the results of the subsurface exploration and subsequent study the following conclusions may be stated.

1. The site of the proposed bridge is underlain by a very limited thickness of fluvial deposits which rest upon hard glacial till.
2. The glacial till would give excellent support to normal spread footings founded at a minimum depth of 4 feet below the upper surface of the till and an allowable bearing capacity of 4.0 tons/sq.ft. could be used for design purposes.

3. If consideration is given to designs incorporating stub abutments on piles and pile bents in lieu of river piers, steel pipe piles or H section steel piles would obtain satisfactory support when driving to a suitable penetration and resistance in the glacial till. Typical allowable loads on certain steel sections have been given in this Report together with the probable depths to which such piles would have to be driven.

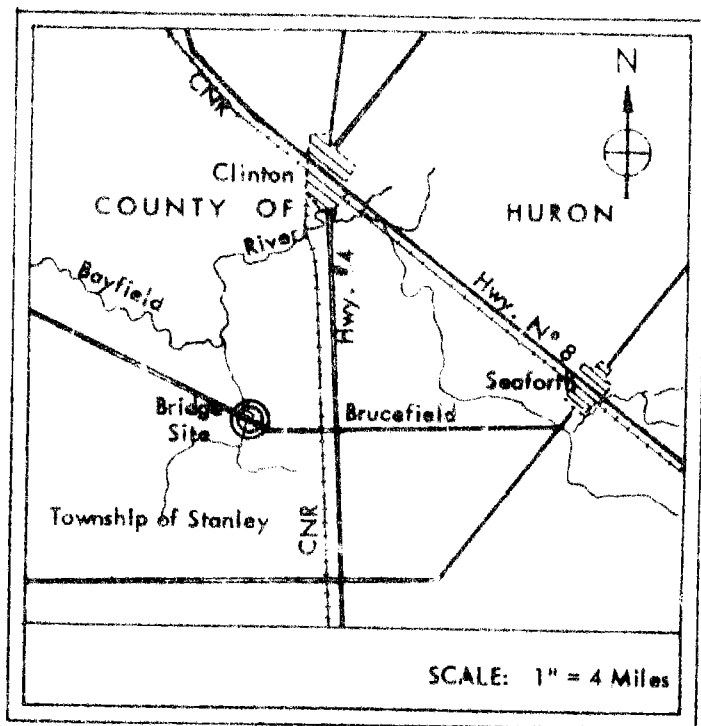
Universal GEOTECHNIQUE Limited,



L. Baskin, P. Eng.

Report N° T.458/60

November, 1960.



PROJECT Huron County Bridge N° B-53, Ontario.

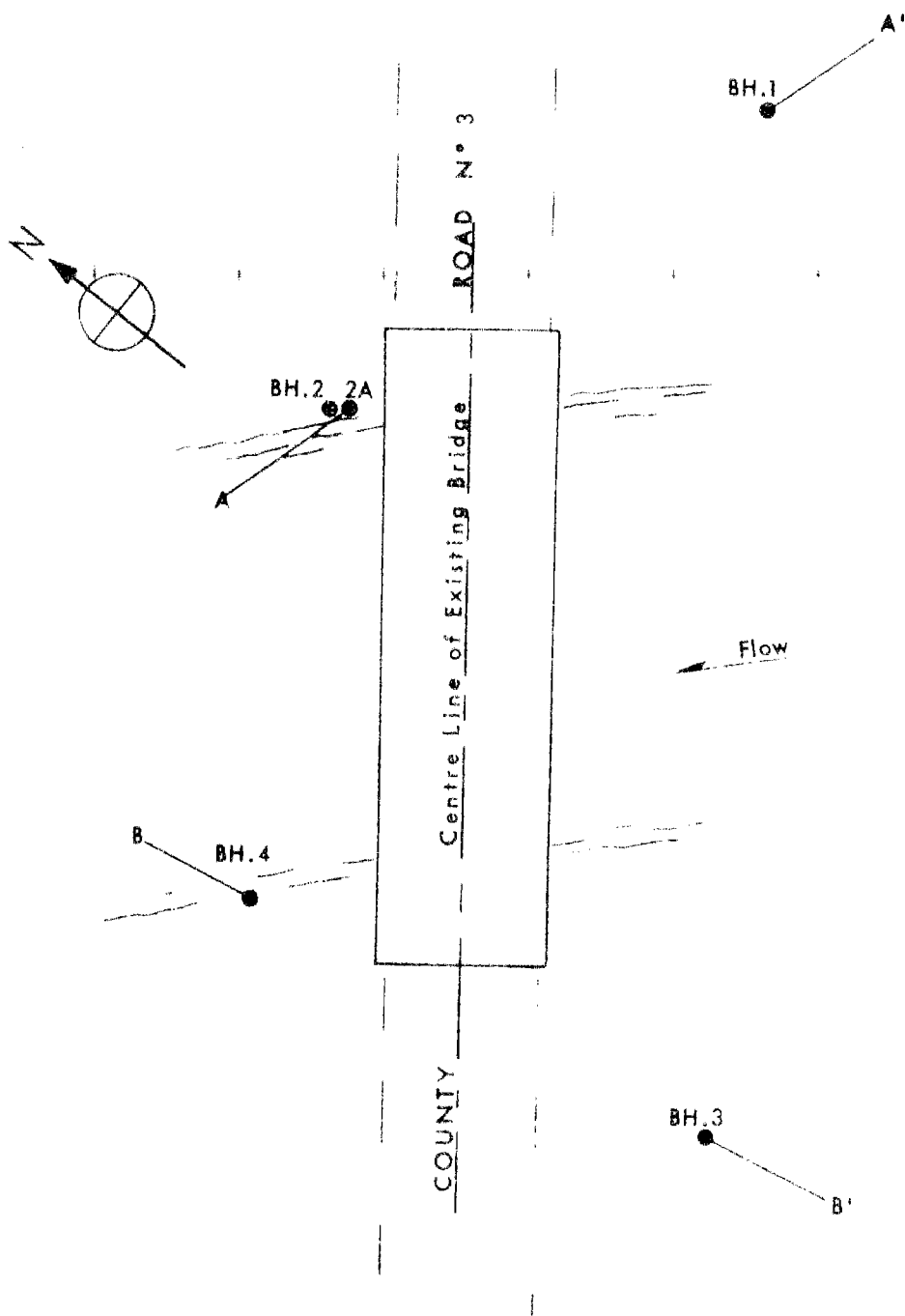
TITLE Key Plan

DRG. NO. 1

ORDER NO. T.458/60



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SCALE: 1" = 20'-0"

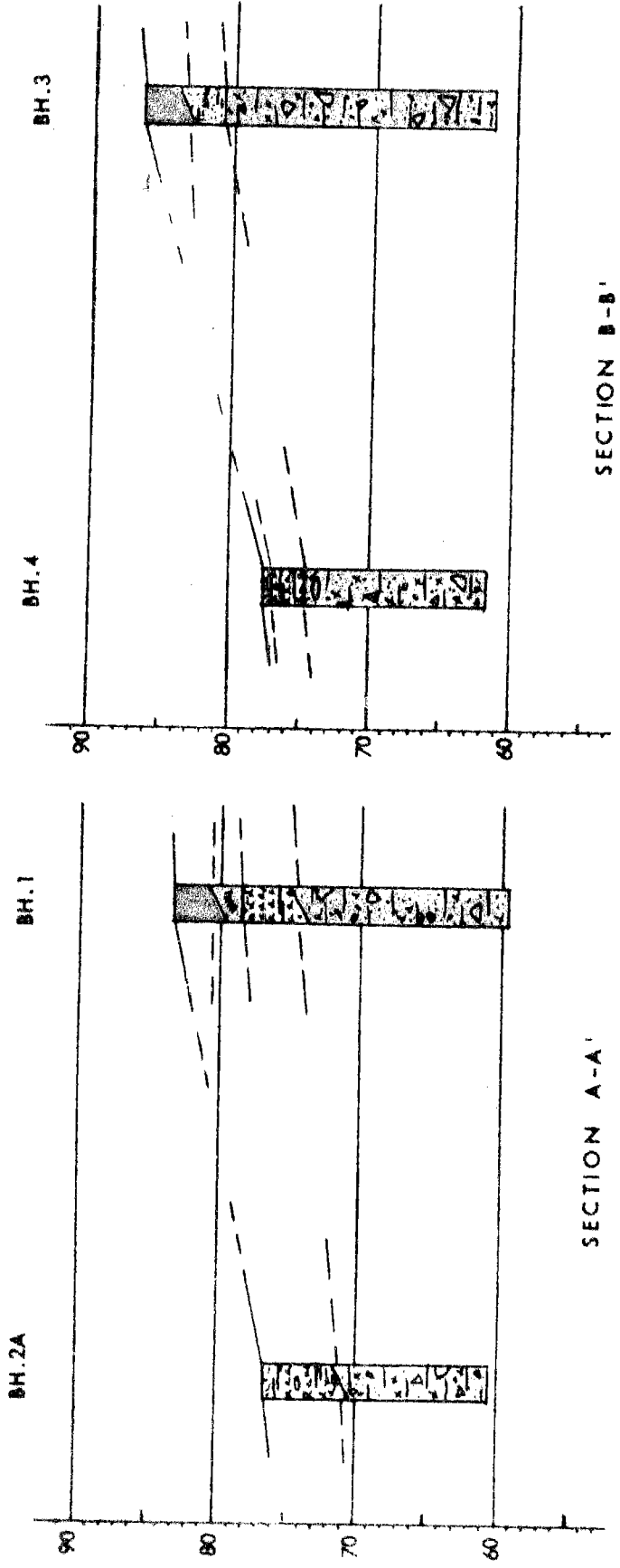
PROJECT Huron County Bridge N° B-53, Ontario.

TITLE Borehole Location Plan

DRG. NO. 2 ORDER NO. T. 458/60




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SECTION B-B'

SECTION A-A'

LEGEND

- | | | | |
|---|----------|--|------------------|
|  | FILL |  | FLUVIAL DEPOSITS |
|  | TOP SOIL |  | BROWN TILL |

SCALE

Horizontal = 1" = 20'-0"
Vertical = 1" = 10'-0"

PROJECT Muron County Bridge N° B-53, Ontario.
TITLE Geological Section
DRG. NO. 3 ORDER NO. T.458/60



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SOIL MECHANICS LABORATORY

BOREHOLE LOGPROJECT Huron County Bridge N° B-53, Ontario.ORDER No. T. 458/60CLIENT County of Huron (Mr. J. W. Britnell, County Engineer)BOREHOLE NO. BH. 1DIAMETER 2-1/2"CASING 2-1/2"BOREHOLE LOCATION See PlanINCLINATION VerticalBEARING FORM G-1-A 800
UNIVERSAL TESTING EQUIPMENT CO.











DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
Light brown loam with some organic matter. FILL.	83.2			Zero			
Loose dark brown loam with organic matter.	80		• 1			7	Damp. Medium dry strength.
Loose light brown sandy SILT, some iron staining.			• 2	4'-9"		9	Wet. Low to medium dry strength.
Dense light brown sandy SILT with occasional thin layer of clay.			• 3			40	do
Hard brown somewhat dessicated sandy silty CLAY with fine to medium subangular gravel.			• 4			30	Damp. High dry strength.
Hard brown sandy silty CLAY with fine to coarse subangular gravel.	70		• 5			45	do
do			• 6			53	do
do			• 7			73(9')	do
do	60		• 8	23'-9"		37(3')	do
				End of Borehole			

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOGPROJECT Huron County Bridge N° B-53, Ontario.ORDER NO. T. 458/60CLIENT County of Huron (Mr. J. W. Britnell, County Engineer)BOREHOLE NO. BH.2 & BH.2ADIAMETER 2-1/2"CASING 2-1/2"BOREHOLE LOCATION See PlanINCLINATION VerticalBEARING

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
BH.2							
Lenses of clay, silt and sand with gravel and black organic concentrations.	76.6			Zero			Sands & Silts: Wet Clay: Moist.
Very stiff brown sandy silty CLAY with fine to medium subangular gravel.			• 1	3'-0"		21	Damp. High dry strength
Hard do	70		• 2			33	do
do			• 3			40	do
			• 4	10'-6"		60(Zero)	Refusal Conditions. Presumed Boulder.
				End of Borehole			
BH.2A							
Same as BH.2	76.6			Zero			
Dense light brown SILT with clayey and dark organic concentrations.			• 1	3'-0"		33	Damp. Medium dry strength.
Hard brown sandy silty CLAY with fine to medium subangular gravel.	70		• 2			26	Damp. High dry strength.
do			• 3			66(6")	do
do			• 4			38(3")	do
do	60		• 5	16'-0"		60(3")	do
				End of Borehole			

SCALE: 1" = 5'-0" • DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

SOIL MECHANICS LABORATORY

BOREHOLE LOGPROJECT Huron County Bridge No B-53, OntarioORDER NO. I.458/60CLIENT County of Huron (Mr. J. W. Britnell, County Engineer)BOREHOLE NO. BH.3 & BH.4DIAMETER 2-1/2"CASING 2-1/2"BOREHOLE LOCATION See PlanINCLINATION VerticalBEARING ---

DESCRIPTION OF STRATA	ELEVATION	LEGEND	SAMPLE	DEPTH	THICKNESS	N	REMARKS
BH.3							
Clayey sandy silt, some gravel and organic matter. FILL.	86.7			Zero			
Very loose brown silty clayey SAND with dark organic lenses, iron stained.			• 1			1	Wet.
do							Medium dry strength.
Without organic lenses			• 2	5'-9"		5	do
Brown sandy CLAY with gravel.	80		• 3			32	Damp
Hard brown somewhat dessicated sandy silty CLAY with fine to coarse subangular gravel.			• 4			56	High dry strength.
			• 5			50	No recovery.
Hard brown sandy CLAY with fine to coarse subangular gravel, pockets of dense silt.			• 6			22	Damp. Clay: High dry strength.
Very stiff to hard brown sandy CLAY with fine to coarse subangular gravel.	70		• 7			41	Silt: Medium dry strength.
			• 8	25'-0"		45	Damp. High dry strength.
do				End of Borehole			do
With pockets of sand and fine gravel.							
do							
BH.4							
Brown loam with organic matter.	77.5			Zero			
Light brown SILT with layers of clay, iron stained, traces of organic matter.			• 1	0'-9"		30	Damp.
Hard brown sandy silty CLAY with fine to medium subangular gravel, somewhat dessicated.			• 2	3'-0"		28	High dry strength.
Very stiff brown sandy silty CLAY with fine to medium subangular gravel.	70		• 3			30	do
do			• 4			63	do
Hard do			• 5			52	do
do			• 6	16'-0"		84	do
do				End of Borehole			

SCALE: 1" = 5'-0"

• DISTURBED SAMPLE

■ UNDISTURBED SAMPLE

FOOTED 2-6 000-3-24
JULIEN STAMMEYER CO.

TABLE NO. _____

SHEET NO. 1

PROJECT Huron County Bridge N° 8-53, Ontario
TITLE Laboratory Tests
ORDER NO. 7.458/60



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