1962 NOV 29 AM 11:26

DOWN KINR 12 NOV 29/62 11:15A

A STERMAC MATERIALS AND RESEARCH

RE HWY 401 WOOD CREEK CONT 62-82

FOR YOUR INFORMATION THE CONTRACTOR MAY START DRIVING PILES AT THIS LOCATION IN ABOUT 2 WEEKS

J E GRUSPIER M & R

CAM

TELETYPE

R 1170

W.P. 117-59
LANCASTER TWP
BR. # 13
Hwy. # 401 & Wood Cr
Sept. 24th 196

Phoned J. Metcalf
to-day and asked him
to inform us a few
days in advance of the
pile driving operations at
the above structure.

K. L. Smith

23-62-82

Mr. A. M. Toye,

Bridge Engineer.

Materials & Research Section.

December 22, 1960

Attention: Mr. J. B. Curtis

Re: W.P. 188-60
Hwy. 401, Service Road
at Wood Creek

W.P. 117-59
Lancaster Twp. Br. #13
Hwy. 401 at Wood Creek

We have received and reviewed the preliminary plans for the above mentioned structures. The rising of the embankment fill from 5 - 7 or 8 feet in height will have some influence on the amount of settlement, but we think that this increase of settlement should not be a cause for any change in the design. A certain maintenance of the approach embankment pavement will be required.

As to the question of changing the slopes from 2:1 to 1½:1, we have no objection. The overall stability of the approach fill is adequate and the stability of the slope itself depends on the compaction of the material. Therefore, supervision of the compaction of this portion of the fill should be kept very close to see that the compaction specifications are met.

AS:am

c.c. to Foundations (2)
General File

L. G. Soderman
Principal Foundations Engineer

Per: A. Stermac

A. Stermac
Foundations Office Engineer

OFFICE LOCATION
DOWNSVIEW AVE.,
KEELE ST. - HIGHWAY 401
TORONTO, ONTARIO.

ONTARIO
DEPARTMENT OF HIGHWAYS

POSTAL ADDRESS
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS,
TORONTO 2, ONTARIO

Bridge Division,
December 9th, 1960.

W.

MEMORANDUM TO:

Mr. L.G. Soderman,
Principal Soils & Foundations Engineer,
Room 107,
Downsview, Ontario.

H.G. ACRES JUL 60

Re: W.P. 188-60 — Hwy. 401, Service Road at Wood Creek
W.P. 117-59 Lancaster Twp. Br. #13 Hwy. 401 at Wood Creek

Preliminary Plan
Approval, Dist. 9

Enclosed find one preliminary plan for each of the above structures.

The designer appears to have followed all the recommendations of the foundation reports except that the approach fills appear to be seven or eight feet high. The reports state that five foot approach fills will have negligible settlement but make no statement on seven or eight foot fills.

Would you also consider putting 1½:1 slopes at these structures if the slopes are rip-rapped with pre-cast concrete slabs?

J.B. Curtis,
Bridge Location Engineer.

JBC/ek

Mr. A. M. Toye,

Bridge Engineer,

Materials & Research Section.

September 30, 1960.

FOUNDATION INVESTIGATION REPOR

by: H. G. Acres & Company, Limited

Attention: Mr. S. McCombie.

Re: Proposed Crossing Hwy. 401 and Wood Creek,
Twp. of Lancaster, District 9, W.P. 117-59.

Attached we are forwarding to you the report for the above mentioned foundation investigation submitted by H. G. Acres & Co., Ltd.

We have reviewed the report, and on the basis of the presented factual data and information, we agree with the conclusions and recommendations contained therein.

We believe that the given recommendations will prove to be adequate for your future design work. However, should there be any other questions in connection with the above project that you would like to discuss, please feel free to call on our Office.

L. G. Sederman,
PRINCIPAL FOUNDATIONS ENGR.
Per:

(A. Stermac,
FOUNDATIONS OFFICE ENGR.)

A. /NdeP
Attach.
Cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. C. Ramsay
J. Ford
L. E. Wallace
J. M. Gruspier
A. Watt
Foundations Office
Gen. Files.

ONTARIO DEPARTMENT OF HIGHWAYS
Toronto, Ontario

REPORT

on

FOUNDATION CONDITIONS

PROPOSED CROSSING
HIGHWAY 401 AND WOOD CREEK
TOWNSHIP OF LANCASTER, DISTRICT NO. 9
WP 117-59

H.G. ACRES & COMPANY LIMITED
Consulting Engineers
Niagara Falls, Canada

July, 1960

ONTARIO DEPARTMENT OF HIGHWAYS
Toronto, Ontario

REPORT

on

FOUNDATION CONDITIONS

PROPOSED CROSSING
HIGHWAY 401 AND WOOD CREEK
TOWNSHIP OF LANCASTER, DISTRICT NO. 9
WP 117-59

Table of Contents

ONTARIO DEPARTMENT OF HIGHWAYS
Toronto, Ontario

REPORT

on

FOUNDATION CONDITIONS

PROPOSED CROSSING
HIGHWAY 401 AND WOOD CREEK
TOWNSHIP OF LANCASTER, DISTRICT NO. 9
WP 117-59

Introduction

This is a report on the foundation conditions at the proposed Highway 401 bridge crossing of Wood Creek in Lancaster Township.

Soil explorations were carried out by H.G. Acres & Company Limited to determine the foundation conditions for the bridge and its approach embankment. A plan of the site is shown on Plate I.

The F.E. Johnston Drilling Company Limited performed the drilling and soil sampling operations, and Mr. R.J. Conlon of H.G. Acres & Company Limited supervised the work. The field work commenced on July 6, 1960, and was completed on July 19, 1960. Laboratory testing of the soil samples was completed in August 1960.

The results of the field and laboratory work are presented in this report, together with our interpretations and recommendations.

Geology of the Site

The site of the proposed crossing is in a very flat lowland plain which extends about eight miles back from the St. Lawrence River. The area is underlain by limestone bedrock at an undetermined depth. During glacial times the bedrock surface was covered with a variable thickness of till. This till is composed mainly of sand and gravel with many large boulders. After the glaciers retreated, the area was inundated by the Champlain Sea and, in this marine environment, the till was buried beneath deposits of fine sand, silt and clay. Subsequent uplift has resulted in the present non-marine environment. Weathering and desiccation have developed a stiff crust about ten feet thick on the marine deposit.

Wood Creek, a meandering stream only about four feet deep, has cut its channel in the crust of the marine deposit. The stream is bounded by intermittent marshy areas. It is doubtful if the stream ever was much larger because there are no indications that any characteristic stream deposits exist.

Exploratory Work

Two diamond drills were used in the exploration work. Borings were made on both sides of Wood Creek and in the stream bed. For the borings in the stream bed, one of the drills was mounted on a raft.

In the marine deposit, the wash boring method was employed and BX casing was used to advance the hole. Two-inch diameter Shelby tube samples were taken at 6-foot intervals after the general soil profile had been established by sampling at 4-foot intervals in the initial hole (No. 393-1). Where possible, in situ vane tests were performed 18 inches below the lower elevations of the Shelby tube samples, immediately after the samples were removed.

When the till was encountered, standard penetration tests were performed and the split-spoon samples were retained. When boulders were encountered, the BX casing could not be advanced; under these circumstances, hole (No. 893-1) was advanced by diamond drilling with AX casing nine feet through a succession of boulders but bedrock was not encountered. All other holes were stopped when they reached boulders or when the casing could not be advanced in the dense till without causing damage to it.

A total of eight holes were drilled and sampled, and in each of these, vane tests and ground water observations were made.

The program of work is given in Appendix A.

Site Conditions and Soil Properties

The site investigated is in a very flat lowland plain. The general ground surface elevation is approximately 156 feet. The land is used mostly for pasture or is brush covered. It is poorly drained with only a few open ditches to carry surface water to Wood Creek. The creek surface elevation is approximately 152.2 feet.

The materials which were encountered in the exploratory holes are described in the attached drilling reports, Plates II to IX, inclusive. The soil conditions are quite uniform in horizontal extent except for the variable elevation of the surface of the till.

(a) - Clay Crust - This is the stiff, weathered and desiccated layer of the marine clay deposit. The crust has a variable thickness as shown on Plate I. However, the transition to the underlying deposit is at a uniform elevation of approximately 147 feet. Therefore, the crust does not exist in the stream bed.

Within this layer, the soil has the following average properties:

Liquid limit	=	69 per cent
Plastic limit	=	32 per cent
Water content	=	42 per cent

Vane tests were not performed because this soil was too stiff to fail by this means. The natural undrained shear strength, determined from laboratory compression tests, decreases from 2,000 psf at an elevation of 150 feet to 1,200 psf at an elevation of 146 feet. The sensitivities at these two elevations are 2.2 and 3.0, respectively.

(b) - Clay - This deposit is known as the Leda Clay, and generally appears to be homogeneous, although some samples do show stratification when dried. The depth of this deposit varies because of the irregular surface of the underlying glacial till shown on Plate 1.

From the samples obtained, this clay was found to have the following average properties:

Liquid limit	=	75 per cent
Plastic limit	=	31 per cent
Water content	=	80 per cent

The natural undrained shear strength was measured by means of field vane tests and laboratory compression tests.

It was found that the compression test results generally combined low strengths and high values of failure strain as shown on Plate XII, whereas, it is known that this type of clay, if undisturbed, should fail at very low values of strain. Therefore, it is considered that results which display high failure strains are indicative of sample disturbance. The tests in which failure occurred at strains of 2 to 3 per cent indicate relatively undisturbed samples, and in these cases the shear strengths obtained agree closely with the vane test results. The average natural undrained shear strength obtained from the vane tests is approximately 350 psf.

The results of the laboratory tests are summarized in Appendix B and shown graphically on Plates XII and XIII. The results of the field vane tests are summarized in Appendix C and shown graphically on Plate XIII.

The maximum sensitivity of this clay indicated by the field vane tests is 5.8, but experience has shown that sensitivities measured by this method are generally lower than those measured in the laboratory. Unfortunately, when remoulded in the laboratory, the soil was too soft to test with the conventional equipment available and,

for this reason, the sensitivity could not be determined. It has been suggested, however, that the sensitivity of this material exceeds 100(1).

Consolidation tests were run on this clay, and the "p-e" curves are presented on Plates X and XI. From these data, it may be deducted that the clay has experienced overconsolidation even below the crust. The curves for the clay have the shape characteristic of sensitive soil and once the preconsolidation pressure is exceeded, this clay is very compressible. The apparent preconsolidation pressures have been estimated and the results are summarized on Plate XIII. Sample disturbance reduces the apparent preconsolidation pressure, and because the laboratory compression tests have indicated that many of the samples were disturbed, the estimates of preconsolidation pressure are probably low.

(c) - Silt - A layer of silt from 2.5 to 3.5 feet thick was encountered beneath the clay in holes Nos.

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(1) Eden, W.J. and Crawford, C.B. 1957. "Geotechnical Properties of Leda Clay in the Ottawa [illegible]a" Proc. 4th International Conference on Soil Mechanics, Vol. 1. p.p. 22-27.

893-1, 893-3, 893-5, and 893-6. Since it was not observed in the other borings, it probably is not continuous. Vane tests in this material indicate a lower value of natural undrained shear strength than in the clay. It is believed, however, that these low strength values are a result of high water pressures transmitted from the underlying till rather than the natural consistency of the silt layer. This hydrostatic pressure condition is more fully discussed in a subsequent section dealing with ground water conditions.

(d) - Sand and Gravel Till - This till is a heterogeneous deposit of sand and gravel with some silt and clay. In general, it is of medium density as indicated by the N-values obtained from the standard penetration tests. It contains many large boulders. An outcrop of the till about one mile from the site was examined; here the boulders were as much as 6 feet in diameter. Hole No. 893-1 was advanced through the sand and gravel till 5 feet until a boulder was encountered; the hole was then continued 9 feet by drilling through a succession of boulders, but bedrock was not encountered. Since the drilling proved the existence of large boulders, it was considered impractical to support the foundation of the proposed structure on bedrock; and all other

exploratory holes were, therefore, discontinued when boulders were encountered. The cores from the drilling of the boulders in hole No. 893-1 indicated the boulders to be limestone.

(e) - Ground Water Conditions - The elevation of the free ground water surface in the clay and clay crust is probably about the elevation of the surface of Wood Creek. There are indications, however, of an excess hydrostatic pressure in the underlying sand and gravel till, and the observations supporting this conclusion are presented on the boring reports. The most significant evidence was obtained from hole No. 893-1. After this hole was completed and before the casing was removed, the water level rose to an elevation of 155.6 feet, which is 3.4 feet above the surface of Wood Creek. After water had been pumped from this hole continuously for one-half hour, the level returned immediately to an elevation of 155.6 feet. This indicates a permeable aquifer as well as the excess hydrostatic pressure.

Design Considerations

(a) - Bearing Capacity

Road Embankment - The maximum height of the road embankment is approximately 5 feet, and the load due to

this embankment is 650 psf. If the shear strength of the subsoil is taken as 850 psf, the bearing capacity beneath the embankment would be at least 4,400 psf without considering an increase due to the surface crust. Therefore, the factor of safety against a bearing capacity failure beneath the embankment is greater than 6.5.

Bridge Piers - One method of supporting the bridge would be with spread footings. The net bearing pressure for a shallow footing on clay is given by the following expression:

$$q_{net} = 5(1 + 0.2 \frac{D}{B}) \quad (1 + 0.2 \frac{B}{L}) \quad Su$$

where: q_{net} denotes the net bearing capacity of the foundation soil.

D denotes the depth of the base of the footing below the surface of the overburden.

B denotes the footing width.

L denotes the footing length.

Su denotes the natural undrained shear strength of the foundation soil.

The base of the footings would be located where the crust is thin or non-existent and, therefore, an average value of shear strength of 850 psf would be applicable. In addition, to make allowance for the

possibility of scour by the stream, the value of D has been assumed to be zero. Applying a factor of safety of 3 and a one-third reduction for eccentric loading, the allowable uniformly distributed bearing pressure can be calculated. A chart giving the allowable bearing pressures for all shapes of footings is presented on Plate XIV.

The bridge will be approximately 120 feet long and 60 feet wide. Even if a centre pier were used, the total load on it would be approximately 1,500 kips, and would require a footing having the impractical dimensions of 60 feet by 24.5 feet. The allowable bearing pressure would be 1,020 psf as shown on Plate XIV.

The alternative to spread footings for the support of the bridge piers is bearing piles driven to refusal in the course till underlying the marine clay. However, due to the high sensitivity of the clay, a non-displacement type pile such as cast-in-place concrete piles, steel pipe piles, or steel H-piles, should be used.

The cast-in-place concrete piles and the steel pipe piles, would require the use of a steel casing. In one type, a casing is advanced and the soil cleaned out of the casing simultaneously. In the other type, the casing

is driven open ended and cleaned out subsequent to completion of driving. If the latter type were used at this site, it would be necessary to clean out the casing when it had been advanced through the crust in order to prevent the crust from plugging the casing, thereby converting it into a full displacement type of pile. Such a pile might best be placed by drilling an uncased hole through the crust prior to driving the casing. The existence of hydrostatic pressure in the continuous aquifer of sand and gravel till might result in a blowout in the bottom of the hole if either of these preceding types were used. In order to prevent such a blowout, the holes would have to be kept full of water and the concrete placed by displacement of the water. Such a method always leaves some doubt concerning the condition of the bottom of the pile.

Steel H-piles have very low displacements, and their installation and performance would not be affected adversely by the existing ground water conditions. It might be difficult, however, to develop the full capacity of such a pile in the sand and gravel till. Some piles might come to rest on large boulders, whereas others would be driven to refusal in the sand and gravel till. Therefore, the capacities of adjacent piles might

vary markedly. It is impossible to predict accurately the capacities of these piles and it would be uneconomical to load test each of them. However, H-piles driven to a refusal of one-quarter inch per blow with a 15,000-foot pound hammer could develop a working capacity of approximately 50 tons.

(b) - Settlement

Road Embankment - The maximum height of the road embankment is approximately 5 feet. On the basis of the laboratory consolidation tests, the apparent pre-consolidation pressure of the marine clay has been estimated. Due to sample disturbance, these estimated values are probably low. However, the total applied pressure at any depth including the embankment and the existing overburden will not exceed these estimated values of preconsolidation. Therefore, only small elastic and consolidation settlements will occur, and these will take place primarily during placement of the embankment.

Bridge Footings - Throughout the depth of the clay layer, the overburden pressure plus the pressure due to the 60-foot by 24.5-foot spread footing does not exceed the apparent preconsolidation pressure of the marine clay. This would suggest that spread footings, if constructed, would be subject only to small elastic and consolidation

settlements of the soil. However, this conclusion is dependent on the soil being undistrubed. The disturbance to the soil directly beneath the footing by construction operations might cause significant but incalculable settlements.

Conclusions

(a) - From the drilling work done at the site, the general soil profile consists of a surface deposit of marine clay varying in depth from 31 to 50 feet. The clay has a horizontal surface crust approximately 10 feet thick. Wood Creek has cut its channel through the surface crust. Beneath the marine clay is a coarse, granular till containing many large boulders. It is the irregular surface of this deposit that causes the variation in the thickness of the clay layer.

(b) - The properties of the foundation soils are summarized on Plates XII and XIII.

(c) - The 5-foot high embankment approaching the bridge can be supported safely by the foundation soils. The settlement of the embankment foundation will be negligible.

(d) - Calculations using the undisturbed properties of the sensitive clay indicate that spread footings 60

feet by 24.5 feet could support the bridge structure. However, the size of these footings and the uncertainties about their performance on the sensitive clay make the use of spread footings inadvisable.

(e) - The bridge can best be supported by bearing piles of a non-displacement type. The use of H-piles would eliminate any ground water problems that might be encountered with open-ended piles and would produce virtually no displacement of the sensitive marine clay.

Recommendations

It is recommended that the bridge be supported on H-piles and that these be driven into the till to develop a capacity of approximately 50 tons per pile.

APPENDIX A

Program of Work

July 6, 1960 - Diamond Drills No. 1 and No. 2 arrived at the site. Holes Nos. 893-1 and 893-2 were commenced.

July 7, 1960 - Holes Nos. 893-1 and 893-2 were continued.

July 8, 1960 - Holes Nos. 893-1 and 893-2 were completed. Hole No. 893-3 was commenced.

July 12, 1960 - Hole No. 893-3 was completed.

July 13, 1960 - Hole No. 893-5 was commenced.

July 14, 1960 - Holes Nos. 893-4, 893-6 and 893-7 were commenced. Holes Nos. 893-4 and 893-5 were completed.

July 15, 1960 - Holes Nos. 893-6 and 893-7 were completed.

July 18, 1960 - Hole No. 893-8 was commenced.

July 19, 1960 - Hole No. 893-8 was completed.

Summary of Time

Work Type	No. of Holes	Total Length (Feet)	Total Time Hours
Modified wash boring	8	338	76
Diamond drilling	1	9	6

Note: The drilling and sampling operations were performed on an integrated exploration program which included the adjacent service road (WP 188-60).

APPENDIX B

Summary of Laboratory Test Results

Hole No.	Sample No.	Elevation (Feet)	Water Content %	Liquid Limit %	Plastic Limit %	S_{u_n} psf	e_f %	S_{u_r} Ksf	St
893-1	1	150	41.7	68.1	34.6	1990	6.0	916	2.2
	2	146	54.3	71.0	29.9	1219	10.0	402	3.0
	3	142	82.8	77.1	30.9	1117	2.0	B30*	-
	6	130	76.2	62.5	36.2	886	2.5	B16	-
	8	122	71.8	76.4	32.0	-	-	B56	-
893-4	1	143	94.0	76.9	36.1	618	3.5	B11	-
	2	137	55.9	51.6	24.3	456	17.5	B21	-
893-5	1	149	55.3	-	-	1603	4.5	-	-
	2	145	78.8	-	-	609	6.0	B21	-
	3	139	75.7	-	-	619	5.0	B19	-
	4	133	77.7	-	-	861	3.0	-	-
	5	127	42.7	-	-	519	20.0	-	-
893-8	1	147	60.3	79.8	29.6	753	10.0	253	3.0
	3	135	80.0	-	-	628	5.0	B42	-

e_f - Failure strain.
S_{u_n} - Natural undrained shear strength.
S_{u_r} - Remoulded undrained shear strength.
St - Sensitivity.
B30 - Number of shocks in liquid limit device.
* When a remoulded sample was too soft for a compression test, the number of shocks in the liquid limit device at natural water content is given.

APPENDIX C

Summary of Field Vane Test Results

Hole No.	Elevation Feet	Undrained Shear Strength Psf		
		Natural	Remoulded	Sensitivity
893-1	143.7	651	222	3.8
	138.9	1,056	259	4.1
	135.2	1,090	222	4.9
	130.9	1,148	250	4.6
	127.4	943	250	3.8
	123.4	1,055	195	5.4
	117.4	1,055	185	[illegible]
	110.9	630	314	2.0
893-2	143.0	814	222	3.7
	137.0	907	185	4.9
	131.0	852	250	3.4
	125.0	907	203	4.5
	119.0	667	222	3.0
893-3	140.8	796	157	5.1
	134.8	852	296	2.9
	128.8	925	277	3.3
893-4	137.7	888	268	3.3
	132.2	777	204	3.8
	125.2	944	185	5.1
	119.5	694	166	4.2
893-5	142.2	1,082	268	4.0
	136.2	741	138	5.4
	130.2	1,138	333	3.4
893-6	126.2	593	120	4.9
	120.7	758	250	3.0

Hole No.	Elevation Feet	Undrained Shear Strength Psf		Sensitivity
		Natural	Remoulded	
893-7	143.8	759	157	4.8
	137.8	934	240	3.9
	131.3	916	157	5.8
	123.8	749	213	3.5
893-8	143.2	778	203	3.8
	137.7	89[illegible]	222	4.0
	131.7	87[illegible]	[illegible]33	1.8
	125.7	70[illegible]	277	2.5

APPENDIX D

List of Plates

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT HP 117-59 — HOLE No. 893-1

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited — STARTED 8.00 A.M. July 6, 19 60 — FINISHED 4.00 P.M. July 7, 19 60

METHOD OF DRILLING: SOIL Modified Wash Boring — CASING DIAM. BX and AX

ROCK Diamond Drill — CORE DIAM. AXT

LOCATION: ~~EASTERLY~~ Chainage 405+76 — ELEVATIONS: DATUM GSC

DEPARTURE 50 Feet Right — DRILL PLATFORM

BEARING — GROUND SURFACE 155.9

INITIAL DIP 90 Degrees — ROCK SURFACE

OTHER DIPS — BOTTOM OF HOLE 95.9

WATER TABLE 153.4**

DEPTH	SOIL TYPE	DESCRIPTION, COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC	SAMPLE NO	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RETD	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0	Silty Clay	Mottled, grey brown, very stiff	1	SS	2	5.5		
						7.0	18	Driven
9.0	Clay	Blue-grey, homogeneous, medium to soft	2	BO	2	9.5		Bar
						10.7	15	Pushed
				Vane	Test	12.2		
			3	BO	2	13.5		
						15.5	18	Pushed
				Vane	Test	17.0		
			4	BO	2	17.5		
						19.0	18	Pushed
				Vane	Test	20.7		
			5	BO	2	21.5		
						23.0	18	Pushed
				Vane	Test	25.0		
			6	BO	2	25.5		
						27.0	18	Pushed

SAMPLING METHOD
* A — SPLIT TUBE
B — THIN WALL TUBE
C — PISTON SAMPLER
D — CORE BARREL
E — AUGER
F — WASH

SHIPPING CONTAINER
N — INSERT
O — TUBE
P — WATER CONTENT TIN
Q — GLASS JAR
R — CLOTH BAG
S — PLIOFILM BAG
Z — DISCARDED

INSPECTOR J. Bateson

LOGGED BY J. MacLeod

APPROVED D. H. MacDonald.

DATE July, 1960

Plate TTL

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT: Ontario Department of Highways — JOB No. 893

PROJECT: WP 117-59 — HOLE No. 893-1

SITE: Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION, COLOUR, CONSISTENCY, STRUCTURE, PARTICLE SIZE, WATER CONTENT, PLASTICITY, FLOW PACKING, WATER LOSS OR GAIN, ETC.	SAMPLE NO.	SAMPLE TYPE	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RUN	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
				Vane	Test	28.5		
			7	BQ	2	29.5		
						31.0	18	Pushed
				Vane	Test	32.5		
			8	BQ	2	35.5		
						37.0	18	Pushed
				Vane	Test	38.5		
			9	BQ	2	42.0		Bar
						43.6	9	Pushed
42.5	Clayey Silt	Grey homogeneous soft		Vane	Test	45.0		
46.0	Sand and Gravel	Grey, heterogeneous, dense with some silt and clay	10	AQ	2	48.0		
						48.5		26
						49.0		29
						49.5	6	24
51.0	Limestone Boulders	Succession up to at least 18 inches						
60.0		End of hole						

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

** Water Table
The elevation given was the equilibrium elevation of the ground water in the test hole after the casing had been removed. While the casing was in the ground the ground water elevation was 155.6 and returned to this level even after prolonged pumping.

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-2

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited — STARTED 2.00 P.M. July 6, 1960 — FINISHED 9.00 P.M. July 7, 1960

METHOD OF DRILLING: SOIL Modified Wash Boring — CASING DIAM. BX

ROCK Diamond Drill — CORE DIAM.

LOCATION: ~~LATITUDE~~ Chainage 405+76 — DEPARTURE 50 Feet Left — BEARING — INITIAL DIP 90 Degrees — OTHER DIPS

ELEVATIONS: DATUM GSC — DRILL PLATFORM — GROUND SURFACE 156.0 — ROCK SURFACE — BOTTOM OF HOLE 100.0 — WATER TABLE 153.5**

DEPTH	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RET'D	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0	Silty Clay	Mottled grey brown, stiff						
			1	BO	2	5.0		
						5.5		Pushed
						6.0		Driven
						6.5	18	Driven
			2	BO	2	10.0		Machine
11.5	Clay	Blue grey, homogeneous, medium to soft				11.5	18	Pushed
				Vane	Test	13.0		
			3	BO	2	16.0		
						17.5	18	Pushed
				Vane	Test	19.0		
			4	BO	2	22.0		
						23.5	18	Pushed
				Vane	Test	25.0		
			5	BO	2	28.0		
						29.5	18	Pushed
				Vane	Test	31.0		

SAMPLING METHOD
* A — SPLIT TUBE
B — THIN WALL TUBE
C — PISTON SAMPLER
D — CORE BARREL
E — AUGER
F — WASH

SHIPPING CONTAINER
N — INSERY
O — TUBE
P — WATER CONTENT TIN
Q — GLASS JAR
R — CLOTH BAG
S — PLIOFILM BAG
Z — DISCARDED

INSPECTOR J. MacLeod

LOGGED BY J. MacLeod

APPROVED D. H. MacDonald

DATE July, 1960

Plate IIIA

FORM NO. 91-A

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No 893

PROJECT WP 117-59 — HOLE No 893-2

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION COLOUR CONSISTENCY STRUCTURE WATER CONTENT MAXIMUM SIZE FACTORS WATER LOSS OR ARTESIAN FLOW	SAMPLE NO	SAMPLE TYPE	SAMPLE SIZE In.	CORE Ft	WATER In.	PENETRATION TEST Blows *
Feet								
			6	AQ	2	34.0		
						35.5	18	Flushed
				Vane Test		37.0		
43.0	Sand and Gravel	Grey, medium density, some silt and clay, the gravel consists of dark angular limestone	7	AQ	2	44.0		
						44.5		7
						45.0		8
						45.5	7	7
			8	AQ	2	48.0		
						48.5		18
						49.0		29
						49.5	8	20
			9	AQ	2	54.0		
						54.5		71
						55.0		100
						55.5	12	40
56.0	Boulders	End of hole						

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

** Water Table
The elevation given was the equilibrium elevation of the ground water in the test hole after the casing had been removed.

Plate IIIB

FORM NO. 91-B

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT: Ontario Department of Highways — JOB No.: 893

PROJECT: WP 117-59 — HOLE No.: 893-3

SITE: Highway 401 and Wood Creek, Lancaster Twp. — SHEET No.: 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited — STARTED: 1.00 P.M. July 8, 1960 — FINISHED: 11.00 A.M. July 12, 1960

METHOD OF DRILLING: SOIL: Modified Wash Boring — CASING DIAM.: BX

ROCK: Diamond Drill — CORE DIAM.:

LOCATION: [redacted] Chainage 407+56 — DEPARTURE: Centreline — BEARING: — INITIAL DIP: 90 Degrees — OTHER DIPS:

ELEVATIONS: DATUM: GSC — DRILL PLATFORM: — GROUND SURFACE: 155.8 — ROCK SURFACE: — BOTTOM OF HOLE: 100.0 — WATER TABLE:

DEPTH	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO.	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RET'D	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0	Silty Clay	Mottled, grey brown, medium to stiff	1	SO	2	6.0		Bar
						7.5	18	Pushed
10	Clay	Blue grey, homogeneous, medium to soft	2	SO	2	12.0		
						13.5	18	Pushed
				Vane	Test	15.0		
		Blending into pinkish grey and then blue grey again from 18 to 19 feet	3	SO	2	18.0		
						19.5	18	Pushed
				Vane	Test	21.0		
			4	SO	2	24.0		
						26.0	24	Pushed
				Vane	Test	27.0		
			5	SO	2	30.0		
						31.5	18	Pushed
				Vane	Test	33.0		
			6	SO	2	36.0		
						37.5	18	Pushed

SAMPLING METHOD
* A – SPLIT TUBE
B – THIN WALL TUBE
C – PISTON SAMPLER
D – CORE BARREL
E – AUGER
F – WASH

SHIPPING CONTAINER
N – INSERT
O – TUBE
P – WATER CONTENT TIN
Q – GLASS JAR
R – CLOTH BAG
S – PLIOFILM BAG
Z – DISCARDED

INSPECTOR: R.J. Conlon

LOGGED BY: R.J. Conlon

APPROVED: D. H. MacDonald.

DATE: July, 1960

Plate IVA

FORM NO. 91-A

H. G. ACRES & COMPANY LIMITED – CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No 893

PROJECT WP 117-59 — HOLE No 893-3

SITE Highway 401 and Wood Creek - Lancaster Twp. — SHEET No 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION COLOUR CONSISTENCY STATE TURE WATER CONTENT PLASTICITY ORIGIN PACTNESS WATER LOSS OR GAIN ETC	SAMPLE					PENETRATION TEST
			NO	TYPE	SIZE	DEPTH	RUN	Blows *
Feet					In.	Ft	In.	
			1	Vane	Test	39.0		
			7	BC	2	42.0		
						43.5	18	Pushed
				Vane	Test	45.0		
			8	BC	2	48.0		
						49.5	0	Pushed
51.0	Silty Clayey Sand	Grey, loose, with some dark angular limestone gravel	9	AQ	2	51.0		
						51.5		11
						52.0		3
						52.5	6	4
55.0	Sand	Uniform, fine, of medium density with little gravel	10	AQ	2	55.0		
						55.5		8
						55.8	3	50 plus
55.8	Boulders	End of hole						

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

Plate IV8

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-4

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited
STARTED 9.30 A.M. July 14, 1960
FINISHED 3.45 P.M. July 14, 1960

METHOD OF DRILLING: SOIL Modified Wash Boring — CASING DIAM. BX
ROCK Diamond Drill — CORE DIAM

LOCATION: Chainage 405+00
DEPARTURE 50 Feet Left
BEARING
INITIAL DIP 90 Degrees
OTHER DIPS

ELEVATIONS: DATUM GSC
DRILL PLATFORM
GROUND SURFACE 149.2
ROCK SURFACE
BOTTOM OF HOLE 116.2
WATER TABLE 152.2**

DEPTH	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RET'D	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0		Water						
3	Clay	Creek bed, blue grey, homogeneous, soft to medium	1	BO	2	8.0		
						9.5	18	Pushed
				Vane Test		11.5		
			2	BO	2	14.5		
						16.0	18	Pushed
				Vane Test		18.0		
			3	BO	2	20.5		
						22.0	18	Pushed
				Vane Test		24.0		
			4	BO	2	26.2		
						27.7	18	Pushed
				Vane Test		29.7		
30.0	Sand and Gravel	Grey, medium density, with some silt and clay						

SAMPLING METHOD
* A — SPLIT TUBE
B — THIN WALL TUBE
C — PISTON SAMPLER
D — CORE BARREL
E — AUGER
F — WASH

SHIPPING CONTAINER
N — INSERT
O — TUBE
P — WATER CONTENT TIN
Q — GLASS JAR
R — CLOTH BAG
S — PLIOFILM BAG
Z — DISCARDED

INSPECTOR J. Bateson
LOGGED BY R.J. Conlon
APPROVED D. H. MacDonald.
DATE July, 1960

Plate VA

FORM NO. 91-A

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-4

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION, COLOUR, CONSISTENCY, STRUCTURE, PURE WATER CONTENT, PLASTICITY, CUTTINGS, PACKINGS, WATER LOSS, ETC.	SAMPLE					PENETRATION TEST
			NO.	TYPE	SIZE	DEPTH	RECD.	
Feet					In.	Ft	In.	Blows *
31.0	Boulders		5	AQ	2	30		80
						31.5		19
32.0		End of hole				32.0	Nil	10

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

** Water Table
The elevation given is the surface of Wood Creek.

FORM NO. 21-B

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-5

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited — STARTED 2.45 P.M. July 13, 1960 — FINISHED 4.30 P.M. July 14, 1960

METHOD OF DRILLING: SOIL Modified Wash Boring — CASING DIAM. BX

ROCK Diamond Drill — CORE DIAM.

LOCATION: Chainage 404+30
DEPARTURE 50 Feet Left
BEARING
INITIAL DIP 90 Degrees
OTHER DIPS

ELEVATIONS: DATUM GSC
DRILL PLATFORM
GROUND SURFACE 152.7
ROCK SURFACE
BOTTOM OF HOLE 120.7
WATER TABLE 152.2**

DEPTH	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RET'D	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0	Silty Clay	Mottled, grey brown, stiff with small fine sand inclusions	1	BO	2	5.0		Bar
						7.0	24	Pushed
6	Clay	Blue grey, homogeneous, medium to soft	2	BO	2	7.5		
						9.0	18	Pushed
				Vane Test		10.5		
		Blending into pinkish grey and then blue grey from 10 to 11 feet	3	BO	2	13.5		
						15.0	16	Pushed
				Vane Test		16.5		
			4	BO	2	19.5		
						21.0	18	Pushed
				Vane Test		22.5		
			5	BO	2	25.5		
						27.0	17	Pushed
27.0	Silt	Grey, soft	6	AQ	2	27.3		
						27.8		
						28.3		
						28.8	8	Pushed

SAMPLING METHOD
* A — SPLIT TUBE
B — THIN WALL TUBE
C — PISTON SAMPLER
D — CORE BARREL
E — AUGER
F — WASH

SHIPPING CONTAINER
N — INSERT
O — TUBE
P — WATER CONTENT TIN
Q — GLASS JAR
R — CLOTH BAG
S — PLIOFILM BAG
Z — DISCARDED

INSPECTOR R.J. Conlon
LOGGED BY R.J. Conlon

APPROVED D. H. MacDonald.
DATE July, 1960

Plate VIA

FORM NO. D1-A

H. G. ACRES & COMPANY LIMITED CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No 893

PROJECT WF 117-59 — HOLE No 893-5

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION (COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, ETC.) OR (ROCK TYPE, WEATHERING, FRACTURES, WATER LOSS, ETC.)	SAMPLE NO.	TYPE	SIZE	DEPTH	RUN	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
29.5	Sand and Gravel	Grey heterogeneous of medium density with some silt and clay	7	AQ	2	29.5		
						30.0		3
						30.5		6
						31.0	12	8
32.0	Boulders	End of hole						

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

** Water Table
The elevation given is the surface of Wood Creek. However, when the hole was completed the ground water seeped out on the ground surface.

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-6

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR F.E. Johnston Drilling Company Limited — STARTED 4.15 A.M. July 14, 19 60 — FINISHED 1.30 P.M. July 15, 19 60

METHOD OF DRILLING: SOIL Modified Wash Boring — CASING DIAM. BX

ROCK Diamond Drill — CORE DIAM.

LOCATION: ~~Altitude~~ Chainage 405+00
DEPARTURE 50 Feet Right
BEARING
INITIAL DIP 90 Degrees
OTHER DIPS

ELEVATIONS: DATUM GSC
DRILL PLATFORM
GROUND SURFACE 148.2
ROCK SURFACE
BOTTOM OF HOLE 118.2
WATER TABLE 152.2**

DEPTH	SOIL TYPE	DESCRIPTION, COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO.	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RET'D	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0		Water						
4	Clay	Creek bed, blue grey, homogeneous, soft to medium	1	B	2	8.5		
						10.0	Nil	Pushed
		The first two attempts to obtain samples with the thin walled tube failed due to a stone or other object being pushed ahead of the tube.	2	B	2	12.5		
						14.0	Nil	Pushed
			3	BO	2	17.5		
						19.0	18	Pushed
				Vane	Test	22.0		
			4	BO	2	24.5		
						26.5	18	Pushed
				Vane	Test	27.5		
28.0	Sand	White with some small angular pebbles, medium density						

SAMPLING METHOD
* A — SPLIT TUBE
B — THIN WALL TUBE
C — PISTON SAMPLER
D — CORE BARREL
E — AUGER
F — WASH

SHIPPING CONTAINER
N — INSERT
O — TUBE
P — WATER CONTENT TIN
Q — GLASS JAR
R — CLOTH BAG
S — POLYTHENE BAG
Z — DISCARDED

INSPECTOR J. Bateson

LOGGED BY R.J. Conlon

APPROVED D. H. MacDonald

DATE July, 1960

Plate VIIA

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-6

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION COLOUR CONSISTENCY STRUCTURE MOISTURE WATER CONTENT PLASTICITY ETC PACKER WATER LOSS ETC	SAMPLE NO	SAMPLE TYPE	SAMPLE SIZE In.	SAMPLE DEPTH Ft	SAMPLE DEPTH In.	PENETRATION TEST Blows *
Feet								
29.3	Silt	Grey homogeneous soft containing some clay	5	AQ		29.0		
						29.5		2
						30.0		1
						30.5		4
31.0	Sand and Gravel	Grey heterogeneous of medium density with some silt and clay	6	AQ		32.5		
						33.0		9
						33.5		5
34.0	Boulders	End of hole				34.0		40

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

** Water Table
The elevation given is the surface of Wood Creek. However, the water level rose to an elevation of 155.2 in the casing after completion of the hole.

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-7

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited — STARTED 4.30 P.M. July 14, 1960 — FINISHED 4.00 P.M. July 15, 1960

METHOD OF DRILLING: SOIL Modified Wash Boring — CASING DIAM. BX

ROCK Diamond Drill — CORE DIAM.

LOCATION: [redacted] Chainage 402+50 — DEPARTURE On Centreline — BEARING — INITIAL DIP 90 Degrees — OTHER DIPS

ELEVATIONS: DATUM GSC — DRILL PLATFORM — GROUND SURFACE 156.8 — ROCK SURFACE — BOTTOM OF HOLE 115.8 — WATER TABLE

DEPTH	SOIL TYPE	DESCRIPTION, COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO.	SAMPLE TYPE *	SAMPLE SIZE	SAMPLE DEPTH	SAMPLE RET'D	PENETRATION TEST Blows *
Feet					In.	Ft	In.	
0	Silty Clay	Mottled, grey brown, stiff to very stiff with some small sand inclusions	1	BO	2	6.0		Bar
						7.5	18	Pushed
9.0	Clay	Blue grey, homogeneous, medium to soft	2	BO	2	10.0		
						11.5	14	Pushed
				Vane Test		13.0		
		Blending to pinkish grey and then blue grey again from 14 to 15 feet						
			3	BO	2	16.0		
						17.5	18	Pushed
				Vane Test		19.0		
			4	BO	2	22.0		
						24.0	0	Pushed
				Vane Test		25.5		
			5	BO	2	30.0		
						31.5	18	Pushed
				Vane Test		33.0		

SAMPLING METHOD
* A — SPLIT TUBE
B — THIN WALL TUBE
C — PISTON SAMPLER
D — CORE BARREL
E — AUGER
F — WASH

SHIPPING CONTAINER
N — INSERT
O — TUBE
P — WATER CONTENT TIN
Q — GLASS JAR
R — CLOTH BAG
S — PLIOFILM BAG
Z — DISCARDED

INSPECTOR R.J. Conlon

LOGGED BY R.J. Conlon

APPROVED D. H. MacDonald

DATE July, 1960

Plate VIIIA

FORM NO. 91-A

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT WP 117-59 — HOLE No. 893-7

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 2 OF 2

DEPTH	SOIL TYPE	DESCRIPTION COLOUR CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE					PENETRATION TEST
			NO.	TYPE	SIZE	DEPTH	RECD	Blows *
Feet					In.	Ft	In.	
			6	BO	2	36.0		
						37.5	18	Pushed
37.5	Sand and Gravel	Grey, heterogeneous of medium density with some silt and clay	7	AQ		37.5		
						38.0		4
						38.5		6
						39.0	8	8
			8	AQ		40.0		
						40.5	2	4
41.0	Boulder	End of hole				41.0		20 Plus
						41.5		

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT: Ontario Department of Highways — JOB No. 893

PROJECT: WP 117-59 — HOLE No. 893-8

SITE: Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 1 OF 2

CONTRACTOR: F.E. Johnston Drilling Company Limited

STARTED 1.45 P.M. July 18, 19 60

FINISHED 12.00 A.M. July 19, 19 60

METHOD OF DRILLING: SOIL Modified Wash Boring; ROCK Diamond Drill

CASING DIAM. BX

CORE DIAM.

LOCATION: [redacted] Chainage 404+30; DEPARTURE 50 Feet Right; BEARING; INITIAL DIP 90 Degrees; OTHER DIPS

ELEVATIONS: DATUM GSC; DRILL PLATFORM; GROUND SURFACE 152.2; ROCK SURFACE; BOTTOM OF HOLE 116.2; WATER TABLE 152.2**

DEPTH	SOIL TYPE	DESCRIPTION: COLOUR, CONSISTENCY, STRUCTURE, WATER CONTENT, PLASTICITY, COMPACTNESS, WATER LOSS OR GAIN, ETC.	SAMPLE NO.	SAMPLE TYPE *	SAMPLE SIZE In.	SAMPLE DEPTH Ft	SAMPLE RET'D In.	PENETRATION TEST Blows *
Feet								
0	Organic	Decaying plant remains						
1.5	Clay	Blue grey, homogeneous, medium to stiff	1	BO	2	5.0		Bar
						6.5	18	Pushed
7.5	Clay	Blue grey, homogeneous, soft to medium		Vane Test		9.0		
			2	BO	2	11.0		
						12.5	18	Pushed
				Vane Test		14.5		
			3	BO	2	17.0		
						18.5	18	Pushed
				Vane Test		20.5		
			4	BO		23.0		
						24.5	18	Pushed
				Vane Test		26.5		
			5	B		29.8		
30.2	Sand and Gravel	Grey, heterogeneous of medium density with some silt and clay				30.2	Nil	Pushed

SAMPLING METHOD
* A — SPLIT TUBE; B — THIN WALL TUBE; C — PISTON SAMPLER; D — CORE BARREL; E — AUGER; F — WASH

SHIPPING CONTAINER
N — INSERT; O — TUBE; P — WATER CONTENT TIN; Q — GLASS JAR; R — CLOTH BAG; S — PLIOFILM BAG; Z — DISCARDED

INSPECTOR J. Bateson

LOGGED BY R.J. Conlon

APPROVED D. H. MacDonald

DATE July, 1960

Plate IXA

FORM NO. 91-A

H. G. ACRES & COMPANY LIMITED — CONSULTING ENGINEERS
NIAGARA FALLS, CANADA

DRILLING REPORT

CLIENT Ontario Department of Highways — JOB No. 893

PROJECT HP 117-59 — HOLE No. 893-8

SITE Highway 401 and Wood Creek, Lancaster Twp. — SHEET No. 2 OF 2

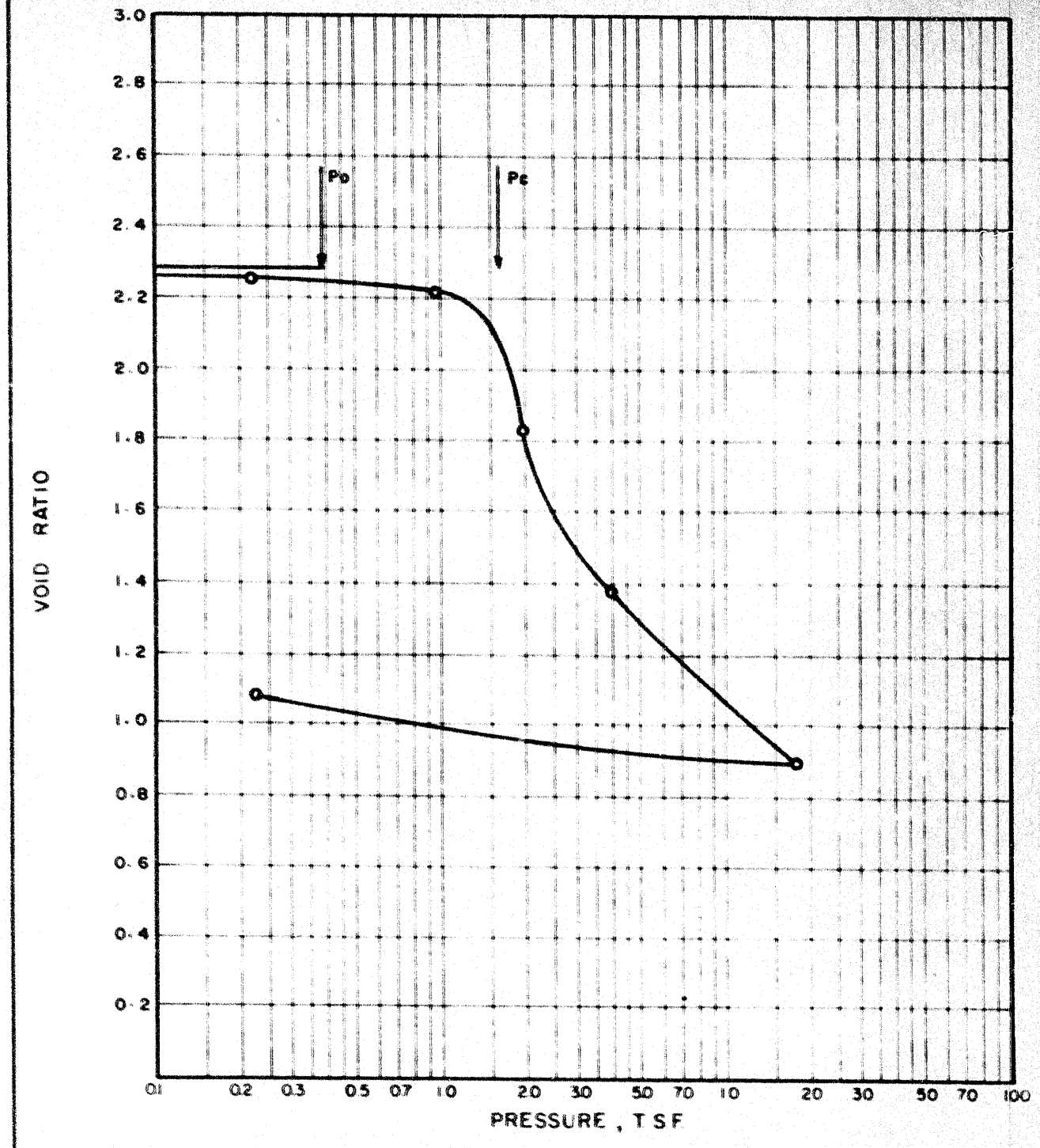
DEPTH	SOIL TYPE	DESCRIPTION COLOUR CONSISTENCY STRUCTURE WATER CONTENT PLASTICITY FROM RACINES WATER LOSS OR GAIN ETC	SAMPLE					PENETRATION TEST
			NO.	TYPE	SIZE	DEPTH	RECD	Blows *
Feet					In.	Ft	In.	
			6	AQ		29.7		
						30.2		24
						30.7		8
						31.2	12	9
			7	A		34.2		
						34.3	Nil	40 Plus
35.7	Boulder	End of hole						

* Penetration Test
The value given to the number of blows of a 140-lb weight falling freely 30 inches required to advance the standard split-spoon sampler 6 inches to the depth indicated.

** Water Table
The elevation given is the level of the surface of Wood Creek. However, the water rose in the casing to elevation 152.7 one-half hour after completion of the hole.

Plate TAB

FORM NO. 3-B



OVERBURDEN PRESSURE — P_o = 0.39 TSF

CONSOLIDATION PRESSURE — P_c = 1.62 TSF

NATURAL WATER CONTENT 82.2%

LOADING INTERVAL 100% PRIMARY CONSOLIDATION

SAMPLE No. 893-80-3

TEST No 893-9-1

TEST DATE AUGUST 17, 1960

TESTED BY R.L.

H. G. ACRES & COMPANY LIMITED
CONSULTING ENGINEERS
NIAGARA FALLS CANADA

ONTARIO DEPARTMENT OF HIGHWAYS

WP-117-59

CONSOLIDATION TEST

HOLE No. 893-1 SAMPLE ELEV 142.0'

APPROVED

D. H. MacDonald.

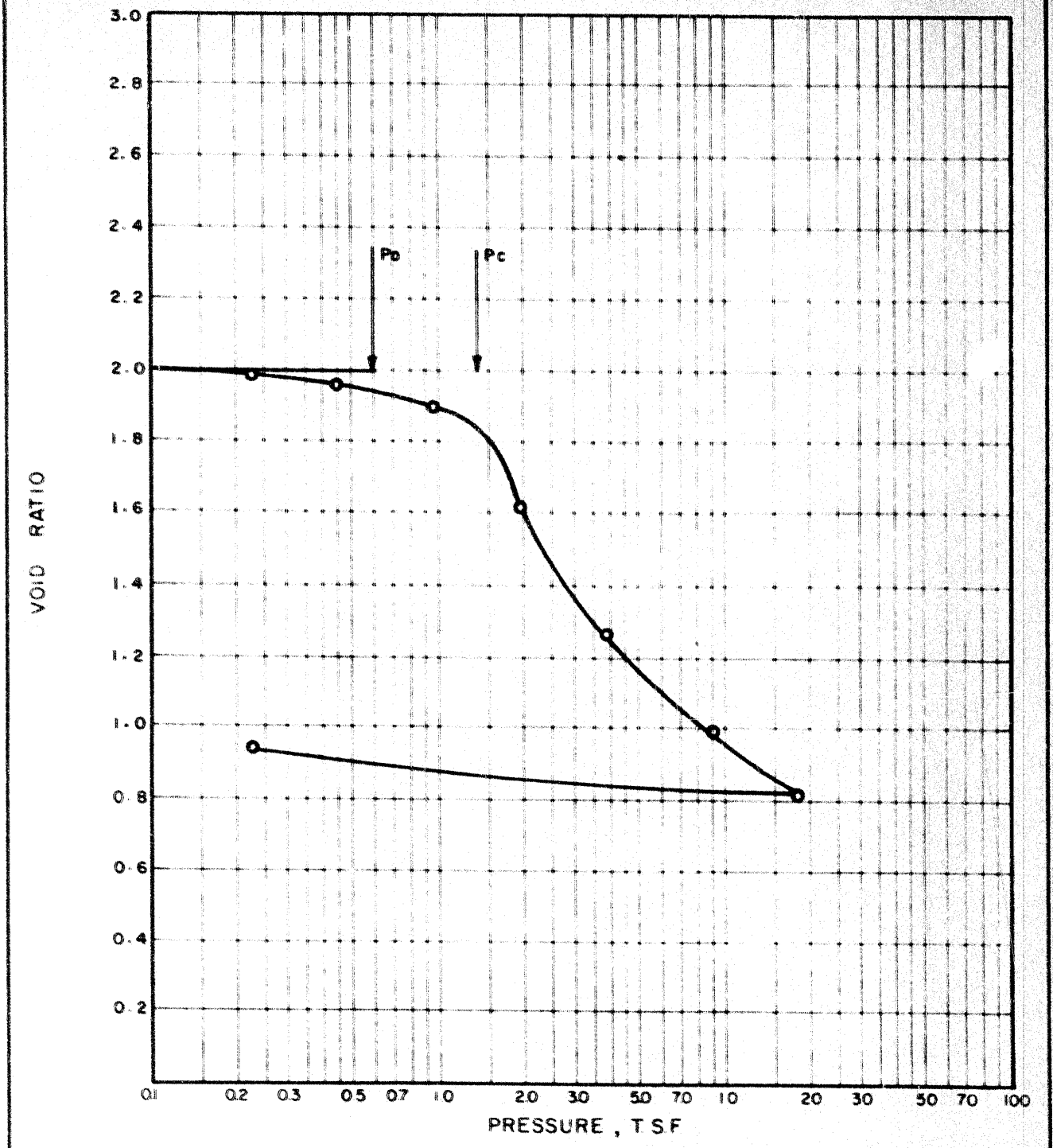
H G ACRES & COMPANY LTD

DATE AUGUST, 1960

JOB No. 893

PLATE - X

SK-893-LS-10



OVERBURDEN PRESSURE — P_0 = 0.60 TSF

CONSOLIDATION PRESSURE — P_c = 1.39 TSF

NATURAL WATER CONTENT 72.6 %

LOADING INTERVAL 100% PRIMARY CONSOLIDATION

SAMPLE No. 893-80-6

TEST No 893-9-2

TEST DATE AUGUST 18, 1960

TESTED BY R.L.

H. G. ACRES & COMPANY LIMITED
CONSULTING ENGINEERS
NIAGARA FALLS CANADA

ONTARIO DEPARTMENT OF HIGHWAYS

WP - 117 - 59

CONSOLIDATION TEST

HOLE No 893 - 1 SAMPLE ELEV 130.0'

APPROVED

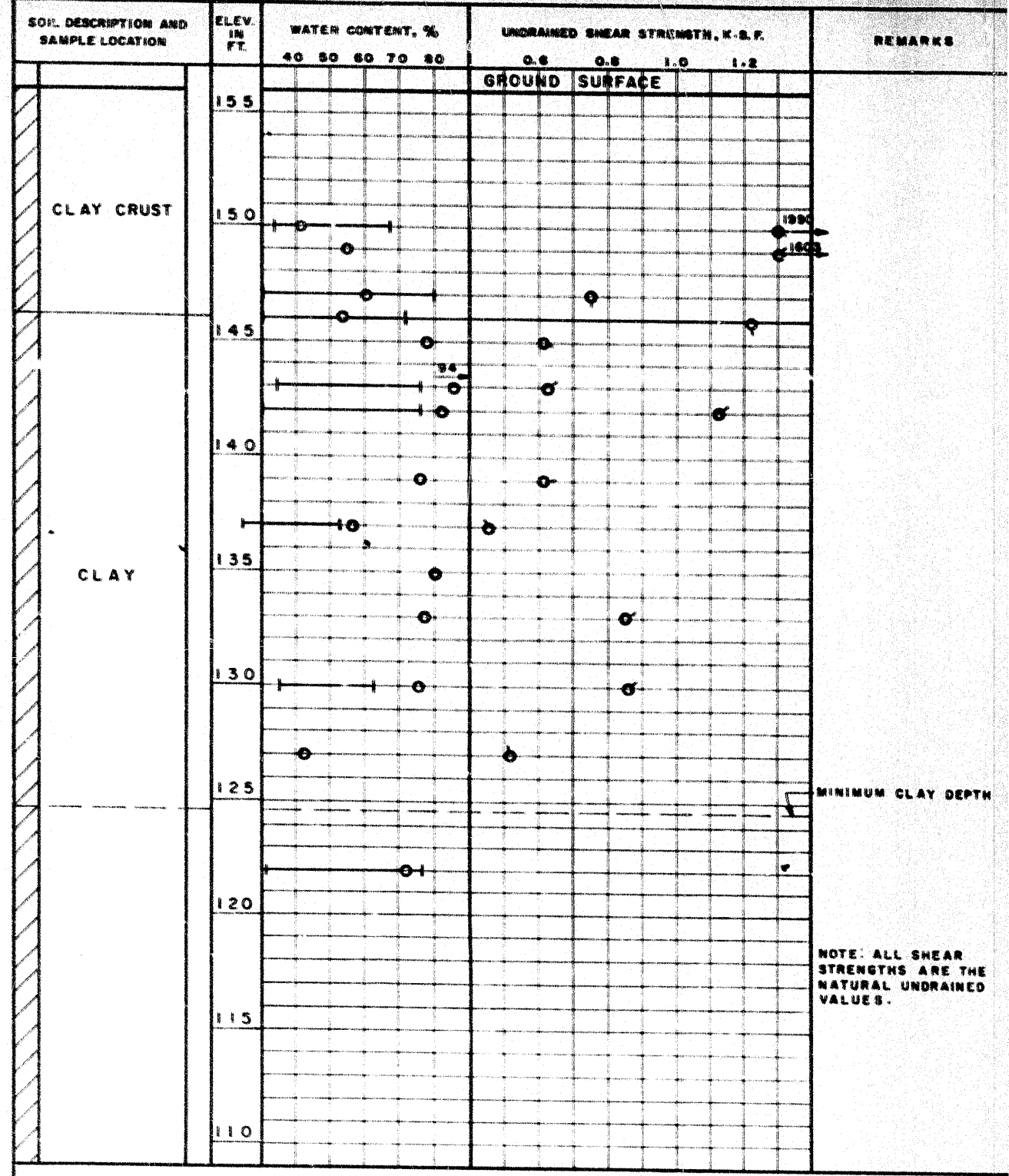
D. H. MacDonald

H G ACRES & COMPANY LTD

DATE AUGUST, 1960

JOB No. 893

PLATE - XI



3 SOIL SAMPLE
NATURAL WATER CONTENT
LIQUID LIMIT
PLASTIC LIMIT

UNDRAINED COMPRESSION TEST
FIELD VANE TEST
NATURAL STRENGTH
REMOULDED STRENGTH

0
15 5
10
FAILURE STRAIN

H. G. ACRES & COMPANY LIMITED
CONSULTING ENGINEERS
NIAGARA FALLS CANADA

ONTARIO DEPARTMENT OF HIGHWAYS

W.P. 117-59

SUMMARY OF DRILLING AND TEST RESULTS

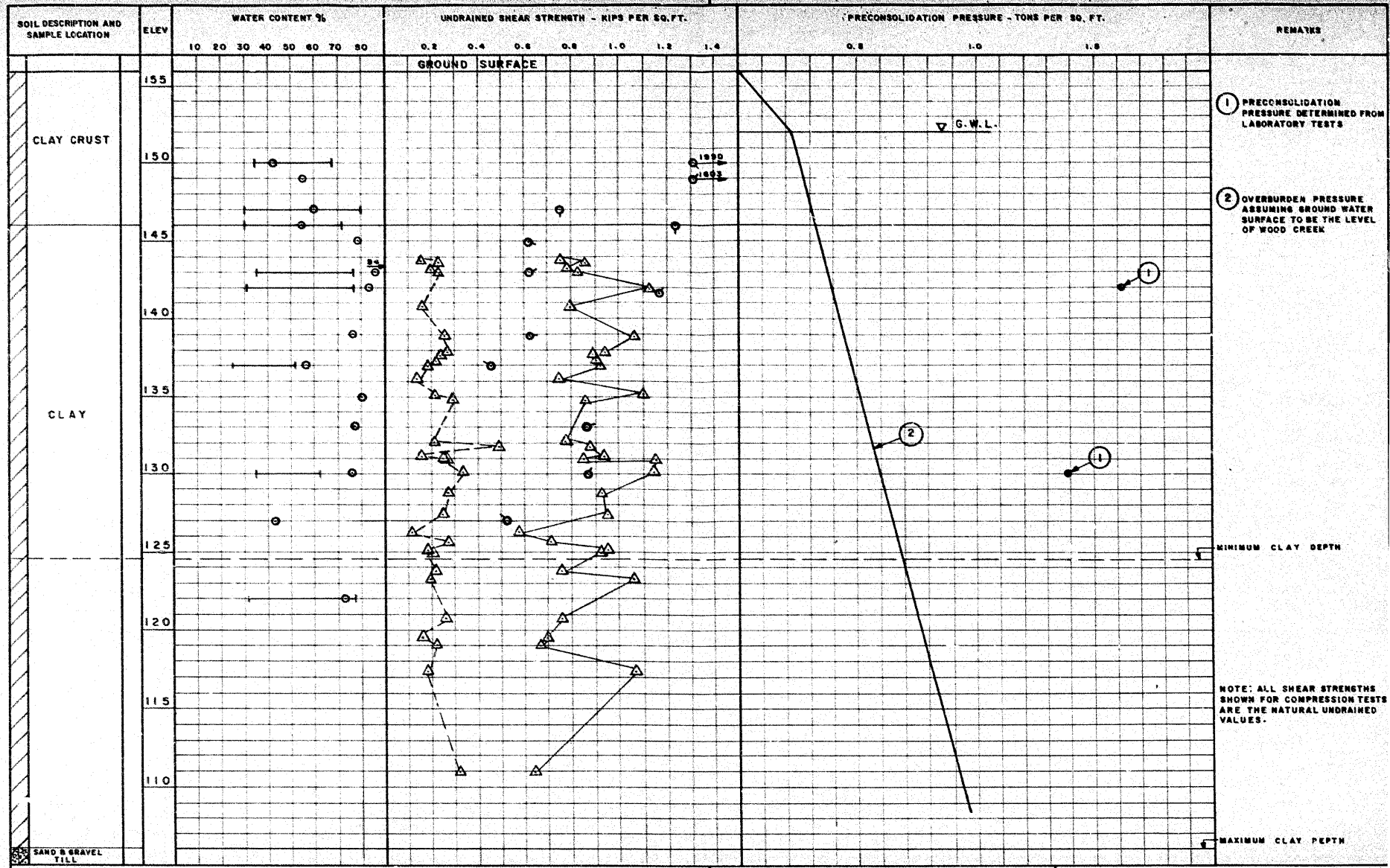
LABORATORY TESTS

APPROVED
D. H. Macdonald
H.G ACRES & COMPANY LTD.

DATE: AUGUST, 1960

JOB No. 893

PLATE - XII



H. G. ACRES & COMPANY LIMITED
CONSULTING ENGINEERS
NIAGARA FALLS CANADA

ONTARIO DEPARTMENT OF HIGHWAYS

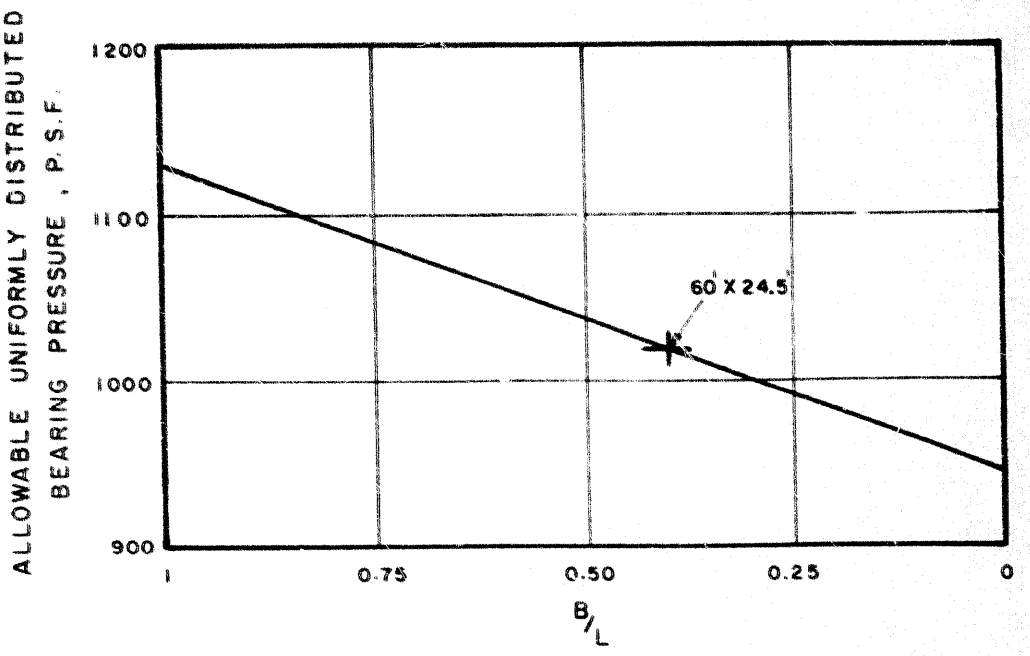
WP 117 - 59

SUMMARY OF DRILLING AND TEST RESULTS

COMPARISON OF ALL TESTS

APPROVED
D. H. MacDonald
H. G. ACRES & COMPANY LIMITED

DATE: AUGUST, 1960
JOB No. 893
PLATE - XIII



NOTE:

B DENOTES FOOTING WIDTH

L DENOTES FOOTING LENGTH

H. G ACRES & COMPANY LIMITED
CONSULTING ENGINEERS
NIAGARA FALLS CANADA

ONTARIO DEPARTMENT OF HIGHWAYS

WP 117 - 59

FOOTING DESIGN CHART

APPROVED	DATE: AUGUST, 1960
	SCALE / JOB No. 893
H.G. ACRES & COMPANY LIMITED	PLATE - XIV

SK - 893 - LS - 14

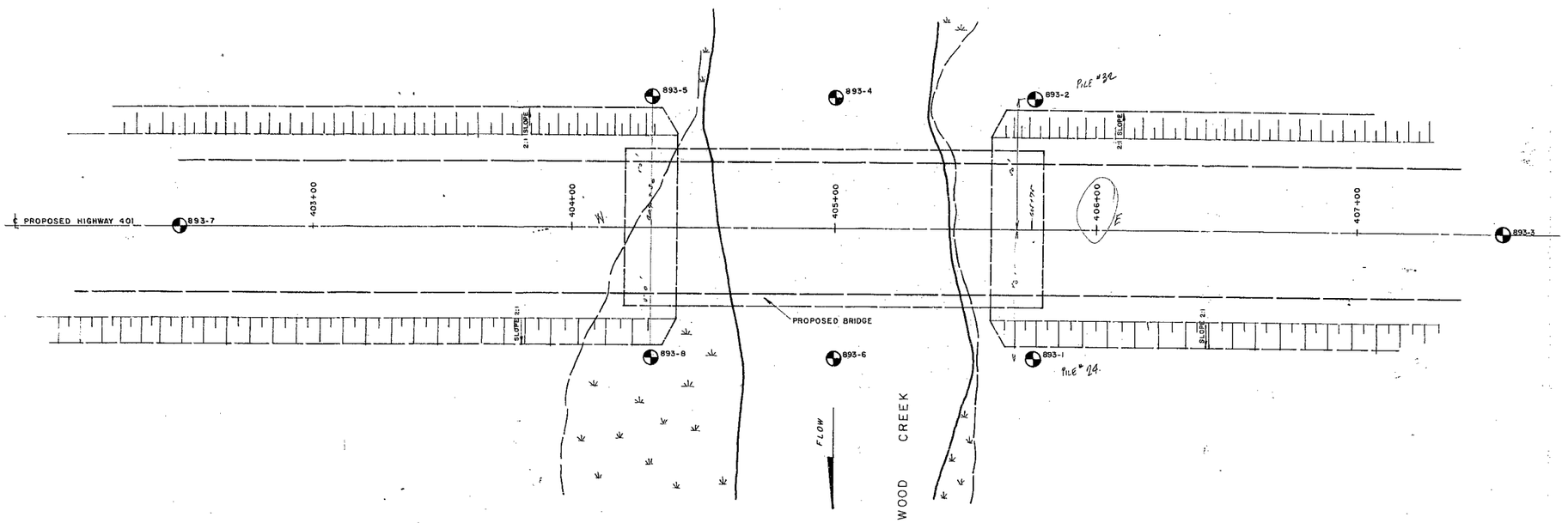
#60-F-209

W.P. # 117-59

Hwy. # 401

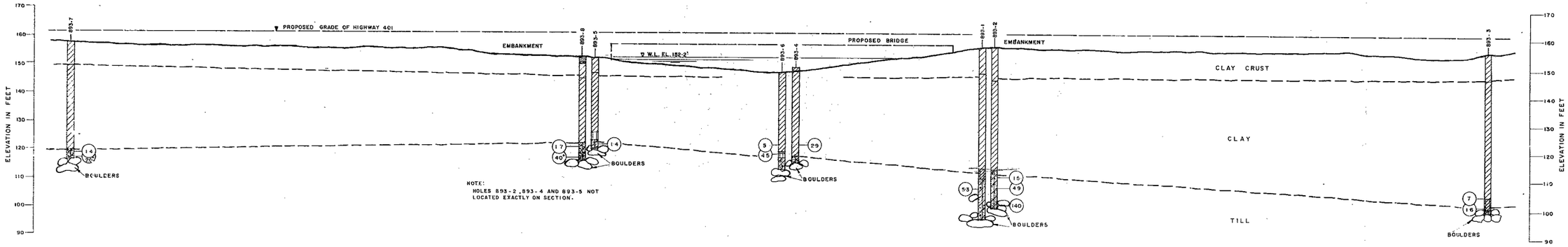
CROSSING

WOOD CREEK



PLAN

SCALE : 1 IN. = 20'-0"



SECTION ALONG ℄ OF PROPOSED HIGHWAY 401

SCALE : 1 IN. = 15'-0"

LEGEND

- ORGANIC SOIL
- CLAY
- SILT
- SAND
- GRAVEL
- BEDROCK
- ▽ WATER TABLE
- EXPLORATORY DRILL HOLE
- SWAMP
- (52) BLOWS PER FOOT FOR STANDARD PENETRATION TEST

KEY PLAN
SCALE: 1 IN. = 4 MI.

H. G. ACRES & COMPANY LIMITED
CONSULTING ENGINEERS
NIAGARA FALLS CANADA

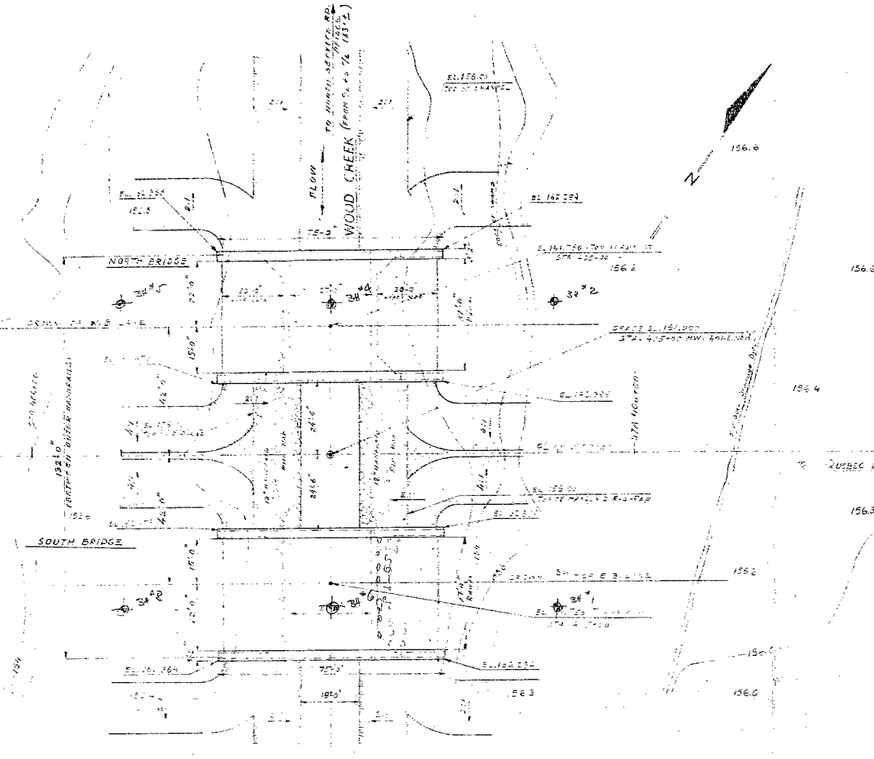
ONTARIO DEPARTMENT OF HIGHWAYS

W.P. 117-59

EXPLORATORY HOLES PLAN AND SECTION

APPROVED	DATE: AUGUST, 1960
D. H. MacDonald	SCALE AS NOTED / JOB No. 893
H.G. ACRES & COMPANY LIMITED	PLATE I

SK-893-C-1



PLAN

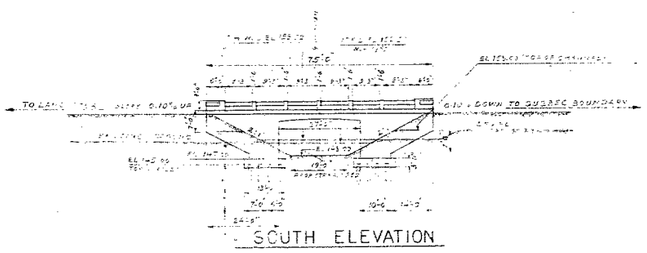
SCALE: 1 IN.=20 FT.

CROSS SECTION ON ℄ OF BRIDGES

SCALE: ⅛ IN.=1'-0"

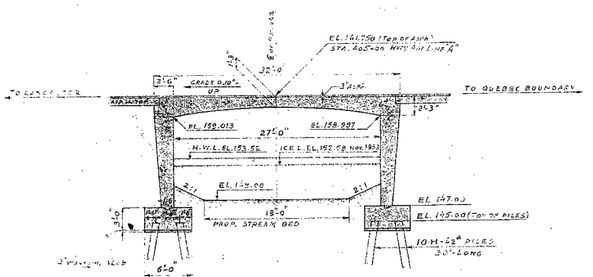
KEY PLAN

SCALE - 1 IN. = 0.8 Mi.



SOUTH ELEVATION

SCALE: 1 IN.=20 FT.



LONGITUDINAL SECTION ON CROWN

SCALE: ⅛ IN.=1'-0"

WP 117-59

DEPARTMENT OF HIGHWAYS:-ONTARIO-

BRIDGE OFFICE:-TORONTO

LANCASTER TWP. BRIDGE N° 13

(OVER WOOD CREEK)

THE KING'S HIGHWAY No. 401-LINE 'A' DIST. No. 9

CO. GLENGARRY

TWP. LANCASTER LOT 6 CON. I

PRELIMINARY PLAN

APPROVED

BRIDGE ENGINEER DESIGN ENGINEER

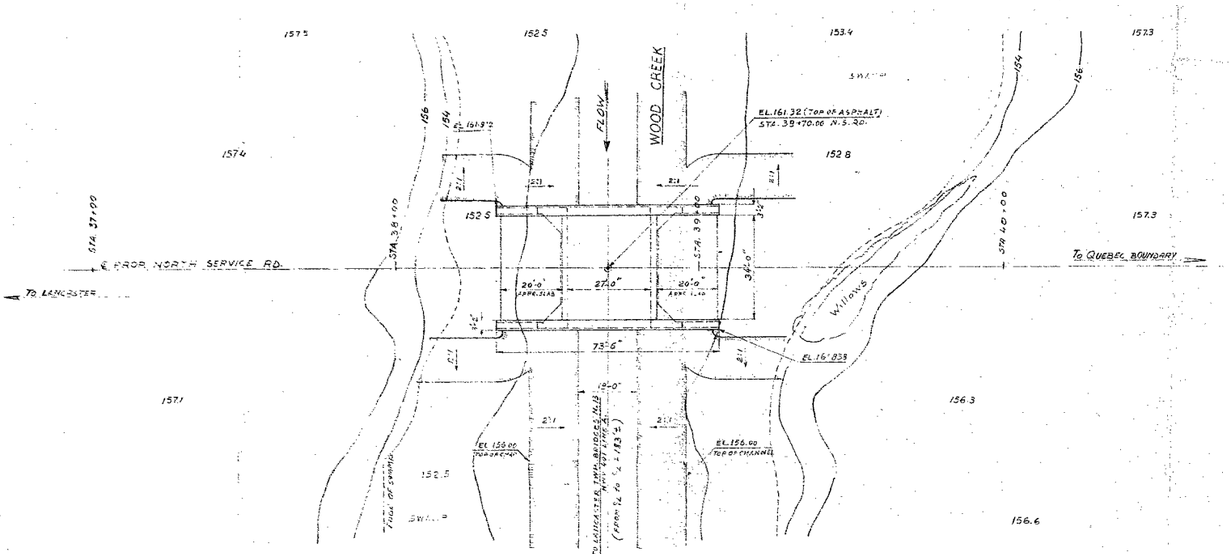
DESIGN	A.R.B.	CHECK	H.H.	CONTRACT NUMBER	
DRAWING	A.R.B.	CHECK	H.H.		
TRACING		CHECK		LOADING	M 20 S 16
DATE	DEC. 1960			DRAWING NUMBER	D-4776-P

REVISIONS:

DATE	BY	DESCRIPTION

REFERENCE PLANS

7-B-23
P-4067-2
E-3791-1
BA-1123
SW-373

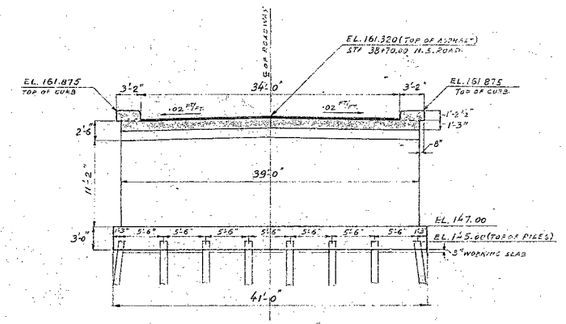


PLAN

SCALE: 1 IN. = 20 FT.

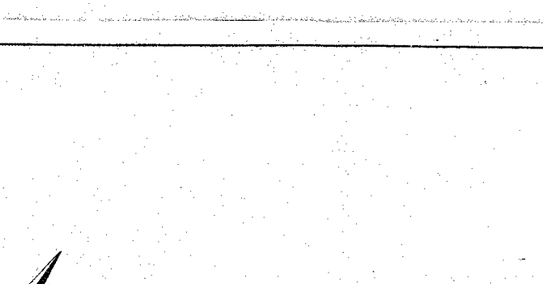
SOUTH ELEVATION

SCALE: 1 IN. = 20 FT.



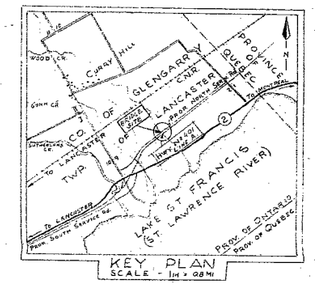
CROSS SECTION ON ℄ OF BRIDGE

SCALE: 1/8 IN. = 1'-0"



LONGITUDINAL SECTION ON CROWN

SCALE: 1/8 IN. = 1'-0"



WP-188-60

DEPARTMENT OF HIGHWAYS:-ONTARIO-

BRIDGE OFFICE:-TORONTO

WOOD CREEK BRIDGE

(NORTH SERVICE RD.)

THE KING'S HIGHWAY No. 401 DIST. No. 9

CO. GLENGARRY

TWP. LANCASTER LOT 5 CON. I

PRELIMINARY PLAN

APPROVED

BRIDGE ENGINEER DESIGN ENGINEER

DESIGN	A.R.B.	CHECK	G.D.C.	CONTRACT NUMBERS	
DRAWING	A.R.B.	CHECK	G.D.C.		
TRACING		CHECK		LOADING	4-20 S-16
DATE	DEC. 1960			DRAWING NUMBER	D-4777-P

REVISIONS

DATE	BY	DESCRIPTION

REFERENCE PLANS

7-B-83
E-4067-4
E-3751-1
BA-1125
BW-373