

OVER

MEMORANDUM

To: Mr. A. Stermac,  
Principal Foundation Eng.,  
Materials & Research Section,  
Downsview.

FROM: G. C. E. Burkhardt

DATE: June 18, 1963.

OUR FILE REF.

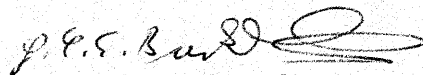
IN REPLY TO

SUBJECT: Township of Caradoc,  
Bridge over the Gold Creek,  
Lot 23, Con. VIII/IX,  
County of Middlesex,  
Structure Site No. 20-203,  
Our File No. BA 1653

Attached please find one copy of the Foundation Report, by Dominion Soil Investigation Limited, and one copy of the Final Plans for your comments.

We would like to approve the plans as soon as possible. Therefore, we would appreciate it very much, if we could have your comments at your earliest convenience.

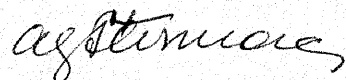
GCER/ah



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

NOTE:  
ON BRIDGE DRAWING NO 2. EITHER WELLPPOINTS OR  
TIMBER SHEETING IS RECOMMENDED FOR DEWATERING.  
IF SHEETING IS USED IT SHOULD BE DRIVEN FOR  
A DISTANCE BELOW FOOTING EQUAL TO <sup>at 75% OF</sup> DISTANCE OF  
WATER ABOVE FOOTING (THIS NOTE IS ESSENTIAL)

TO G.C.E. BURKHARDT  
BY PHONE JUNE 24. 1963



NOTE 2: FACTOR OF SAFETY CAN BE LOW BECAUSE OF END BEARING  
PILES.

OVER

$$\begin{array}{r}
 W.L. \quad 92.0 \\
 F.L. \quad 84.0 \\
 \hline
 8.0 \\
 \hline
 76.0
 \end{array}$$

$$B = 6.0 \text{ FT}$$

$$H_w = 8.0 \text{ FT}$$

$$B/H_w = \frac{6.0}{8.0} = 0.75$$

0.6

BA 1653

MESSRS. A.M. SPRIET AND ASSOCIATES  
CONSULTING ENGINEERS  
234 Queens Avenue  
LONDON ONTARIO

Report on  
SOIL INVESTIGATION  
for  
ROAD BRIDGE  
CARADOC TOWNSHIP  
COUNTY OF MIDDLESEX

by  
DOMINION SOIL INVESTIGATION LIMITED  
363 Queens Avenue  
LONDON ONTARIO

Reference No. S-3-17  
March 1963

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## ENCLOSURES

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SUMMARY

The strata consist mainly of fine sand to a depth of almost 40 feet, where a deposit of grey silt and clay was encountered. The condition of the sand stratum is loose for an appreciable depth and does not become truly dense until a depth of 30 to 35 feet is reached.

In the prevailing conditions it would be impossible to make an excavation for footings below the water table without recourse to expensive dewatering procedures. The use of timber piles is recommended as probably the least expensive and the simplest solution.

## I INTRODUCTION

Verbal authorization was received from Mr. A.M. Spriet to carry out a soil investigation at the site of a proposed new bridge in Caradoc Township. An existing 25-foot span bridge carries a gravel road over a tributary of the Sydenham River. The proposed new bridge will have a span of 40 feet with its centre-line probably 10 feet to the west of that of the existing bridge.

The purpose of this investigation was to reveal the subsurface conditions and to determine the necessary soil properties for the design and construction of foundations.

## II PHYSIOGRAPHY

The site is located approximately 5 miles east of the town of Strathroy in the physiographic area known as the Caradoc Sand Plains. This sand deposit is a delta of the early Thames River, formed at the time of the glacial lake Whittlesey which occupied the Erie Basin and that part of Southern Ontario to the west of London. The sand layer covers most of the township, thinning out towards the west until the underlying clay appears on the surface. The area is generally flat except where it has been eroded by the tributary streams of the Sydenham and the present Thames Rivers.

## III FIELD WORK

Field work was carried out on the 25th, 27th and 28th of March 1963, and consisted of 2 boreholes with adjacent dynamic cone penetration tests at the locations shown on enclosure 2. The holes were advanced by washboring and lined with Bx (3-inch) casing. Standard Penetration tests were made at frequent intervals of depth to determine the relative density of the soil and to obtain disturbed samples.

The results of the field tests are recorded on geotechnical data sheets comprising enclosures 3 and 4. Elevations have been referred to the level of the deck of the existing bridge which is taken to be 100.0 feet.

#### IV SUBSURFACE CONDITIONS

Details of the stratification at each borehole are shown on the data sheets, and a general picture of the subsurface conditions is given by the profile on enclosure 2.

The strata consist almost entirely of sand and sandy silt. Depths of 8 and 5 feet of fill are shown at boreholes 1 and 2 respectively, although any of the loose material below this level which contains organic matter, wood fragments, etc. to a depth of about 15 feet could also be fill or recent sediments of the stream. Below 15 feet, the density of the sand increases irregularly to a depth of 32 feet, where there is an abrupt increase in density and a colour change from brown to grey.

Near El. 61, at a depth of approximately 39 feet, the bottom of the sand stratum was encountered. Below this level there is a dense stratified deposit of silt and hard silty clay.

The prevailing water level at the time of the investigation was near El. 97 feet. This was generally above the surrounding ground surface because of seasonal flooding. The bed of the creek was located by sounding with a drilling rod, and found to lie between Els. 89 and 90 feet.

#### V FOUNDATIONS

The following is an analysis of different types of construction which have been considered for the prevailing conditions.

##### (a) Spread Footings

The highest elevation at which the sand is sufficiently dense to give a practical bearing value is at El. 75 feet where the allowable net soil pressure is about 3000 p.s.f. To brace the sides of the excavation and to prevent the bottom from heaving or "boiling" when water is pumped out, it will be necessary to drive sheet piles into the clay stratum at El. 60. The sheet piles would thus be approximately 40 feet long and, together with very deep footings, would lead to a costly foundation.

(b) Spread footings in permanent sheet pile enclosure

The lateral restraining effect of permanent steel sheet piling can be used to allow footings to be placed at a higher elevation in the looser sand. The highest recommended elevation for the bottom of footings in such a case would be El. 82 feet. Provided that the sheet piling is permanent (a necessary condition to prevent excessive settlement) a net soil pressure of 3000 p.s.f. may be used at this level. Again, however, there is the problem of preserving hydraulic stability when the water is pumped from the excavation. Assuming the water table is at El. 95 feet, the sheet piles should be driven at least to El. 69 and preferably several feet further, to prevent "boiling". This is the level at which timber piles, as discussed below, are expected to set, so that the foregoing arrangement would clearly be more expensive.

(c) Timber Piles

Timber piles are ideally suited to the circumstances in that they will penetrate easily through the loose and compact upper strata, and should quickly reach a satisfactory set in the very dense sand layer below El. 70 feet. A working load of 20 tons per pile is proposed for piles driven in accordance with the Hiley formula. Because the piles will be permanently below water, untreated timber will be suitable.

In making the excavation for the pile cap which will be located at or near El. 85 feet, precautions should be taken to prevent the excavation from "boiling" with possible adverse effects on the pile groups. This can be done by forming a sheet pile enclosure, with the piles driven to El. 75 feet.\* In the loose to compact soil conditions it may be possible to use timber sheeting.

Alternatively, dewatering can be effected with well-points which could be jetted easily into the fine sand deposit. In

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\* As a general rule, the depth of piles below the excavation level should be equal to or greater than the unbalanced head of water when the excavation is pumped out, e.g. if the prevailing water level is El. 95 and the excavation is taken to El. 85, a difference of 10 feet, the pile tips should reach at least 10 feet below the excavation, i.e., to El. 75.



this case it would be necessary to divert surface water using some form of temporary cofferdam.

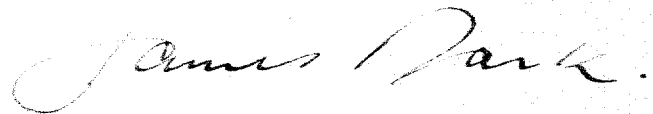
The foregoing solution will probably be the least expensive, and the simplest one to carry out in the field.

VI

REFERENCES

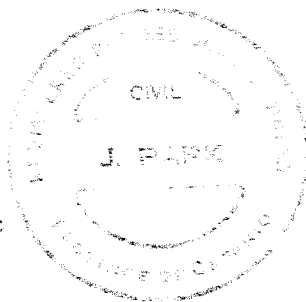
1. The Physiography of Southern Ontario by L.J. Chapman and D.F. Putman of the Ontario Research Foundation, University of Toronto Press 1951.
2. Procedures for Testing Soils, ASTM, April 1958, pp. 186 to 198 (Unified Soil Classification System, by A.A. Wagner).
3. Proceedings of the 4th International Conference on Soil Mechanics and Foundation Engineering (Research on Determining the Density of Sands by Spoon Penetration Testing, by H.J. Gibbs and W.G. Holtz of the United States Bureau of Reclamation.), London, 1957.
4. Terzaghi and Peck: Soil Mechanics in Engineering Practice, John Wiley and Sons, New York, 1948.
5. Standard Penetration Tests and Bearing Capacity of Cohesionless Soils, by G.G. Meyerhof, ASCE Paper 866, January 1956.

DOMINION SOIL INVESTIGATION LIMITED



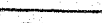

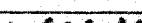


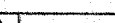



James Park, M.Sc., P.Eng.

Encl.  
JP/mc



# LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

## SOIL COMPONENTS AND GROUND WATER CONDITIONS.

												
BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
Ø > 8"	3"	¾"	4.76mm	2.0	0.42	0.074	0.002	>	NO SIZE LIMIT			
U.S. Standard Sieve Size:		No. 4	No. 10	No. 40	No. 200							

## SAMPLE TYPES.

AS Auger sample	RC Rock core	TP Piston, thin walled tube sample
CS Sample from casing	% Recovery	TW Open, thin walled tube sample
ChS Chunk sample	SS Split spoon sample	WS Wash sample

SAMPLER ADVANCED BY	static weight - w	OBSERVATIONS MADE WHILE CORING	Steady pressure
"	pressure - p		No pressure
"	tapping - t		Intermittent pressure

Washwater returns  
Washwater lost

## PENETRATION RESISTANCES.

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

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

### EXTRAPOLATED -N- VALUE

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

SYMBOL :

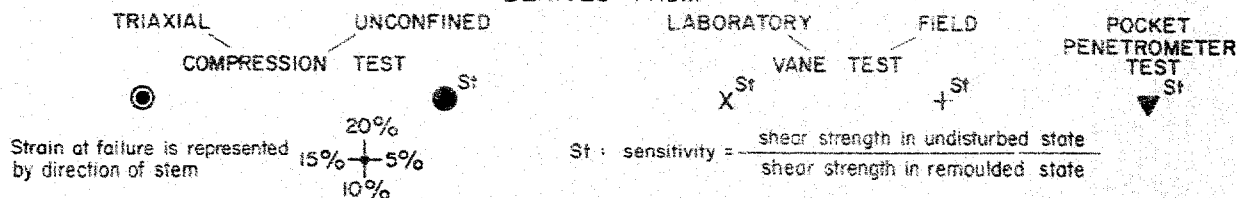
322

## SOIL PROPERTIES.

W % Water content	$\delta^+$ Natural bulk density (unit weight)	k Coeff. of permeability
LL % Liquid limit	e Void ratio	C Shear strength in terms of total stress
PL % Plastic limit	RD Relative density	$\phi$ Angle of int. friction in terms of effective stress
PI % Plasticity index	Cv Coeff. of consolidation	C' Cohesion
LI Liquidity index	$m_v$ Coeff. of volume compressibility	$\phi'$ Angle of int. friction

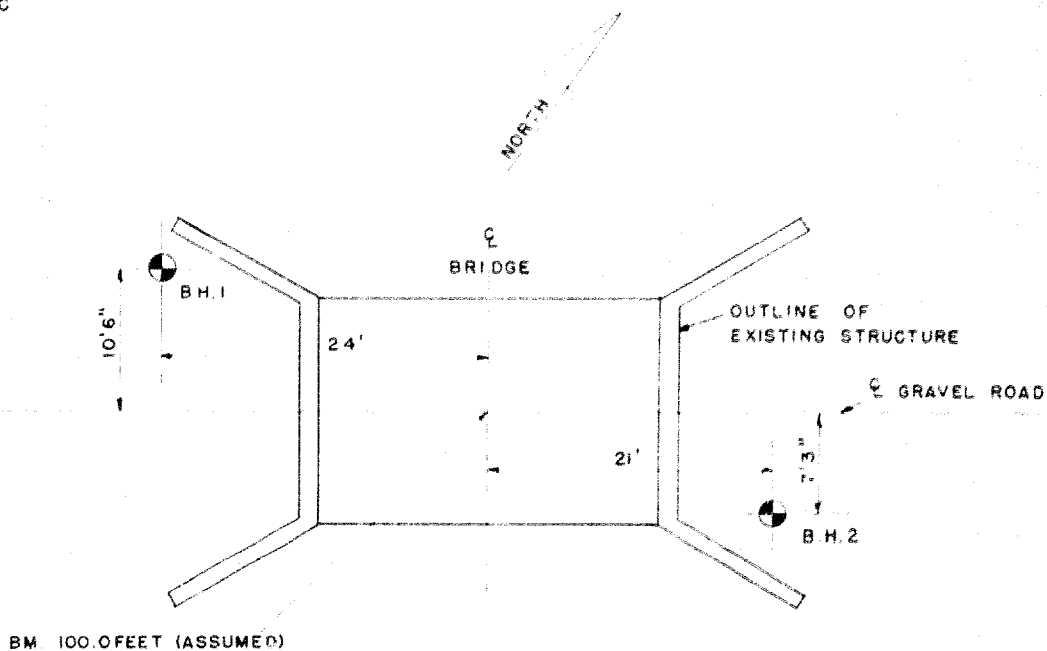
## UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

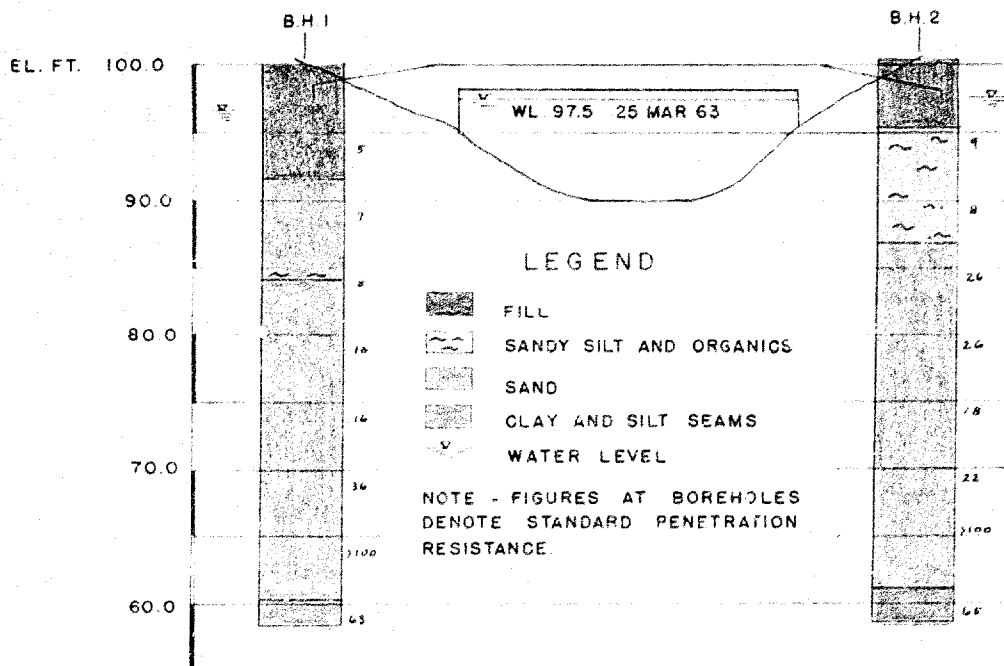


## SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq.ft
Very loose	0 - 15 %	Very soft	less than 250
Loose	15 - 35 %	Soft	250 - 500
Compact	35 - 65 %	Firm	500 - 1000
Dense	65 - 85 %	Stiff	1000 - 2000
Very dense	85 - 100 %	Very stiff	2000 - 4000
		Hard	over 4000



LOCATION OF BOREHOLES  
SCALE - 1 INCH TO 10 FEET



SUBSURFACE PROFILE  
SCALE - 1 INCH TO 10 FEET

# GEOTECHNICAL DATA SHEET FOR BOREHOLE

OUR REFERENCE NO. 3-5-17

CLIENT Mr. A.M. Spriet

PROJECT Road Bridge

LOCATION Caradoc Township, Lot 23, Conc. 8 and 9

DATUM ELEVATION Centre of existing bridge deck 100.0 feet

TESTED BY

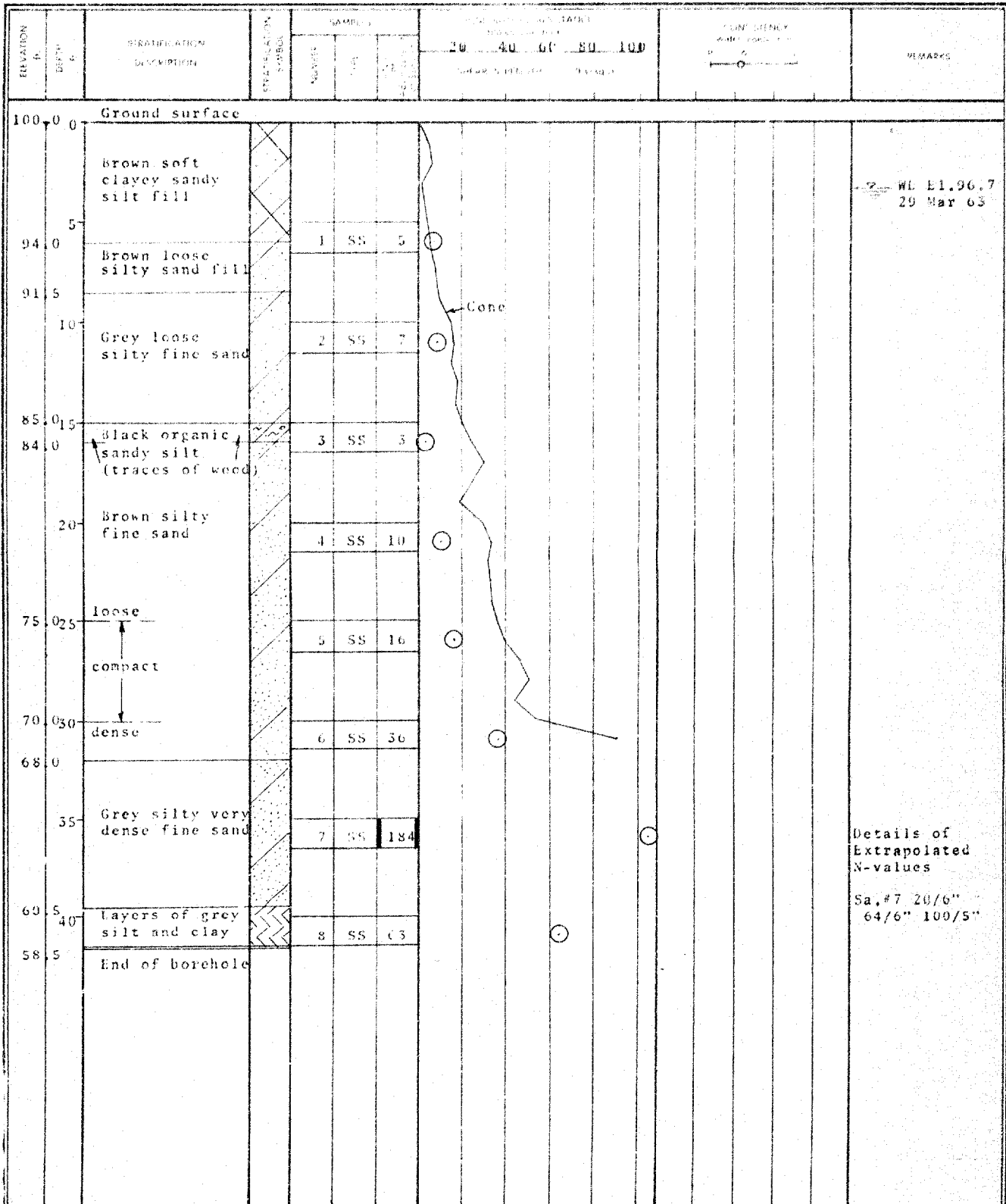
Washburn

DIAMETER OF BOREHOLE

8x (3-inch)

ENCLOSURE NO. 3

DATE 25/27 Mar 63



# GEOTECHNICAL DATA SHEET FOR BOREHOLE

OUR REFERENCE NO. 3-3-17

CLIENT Mr. A.M. Sriet

PROJECT Road Bridge

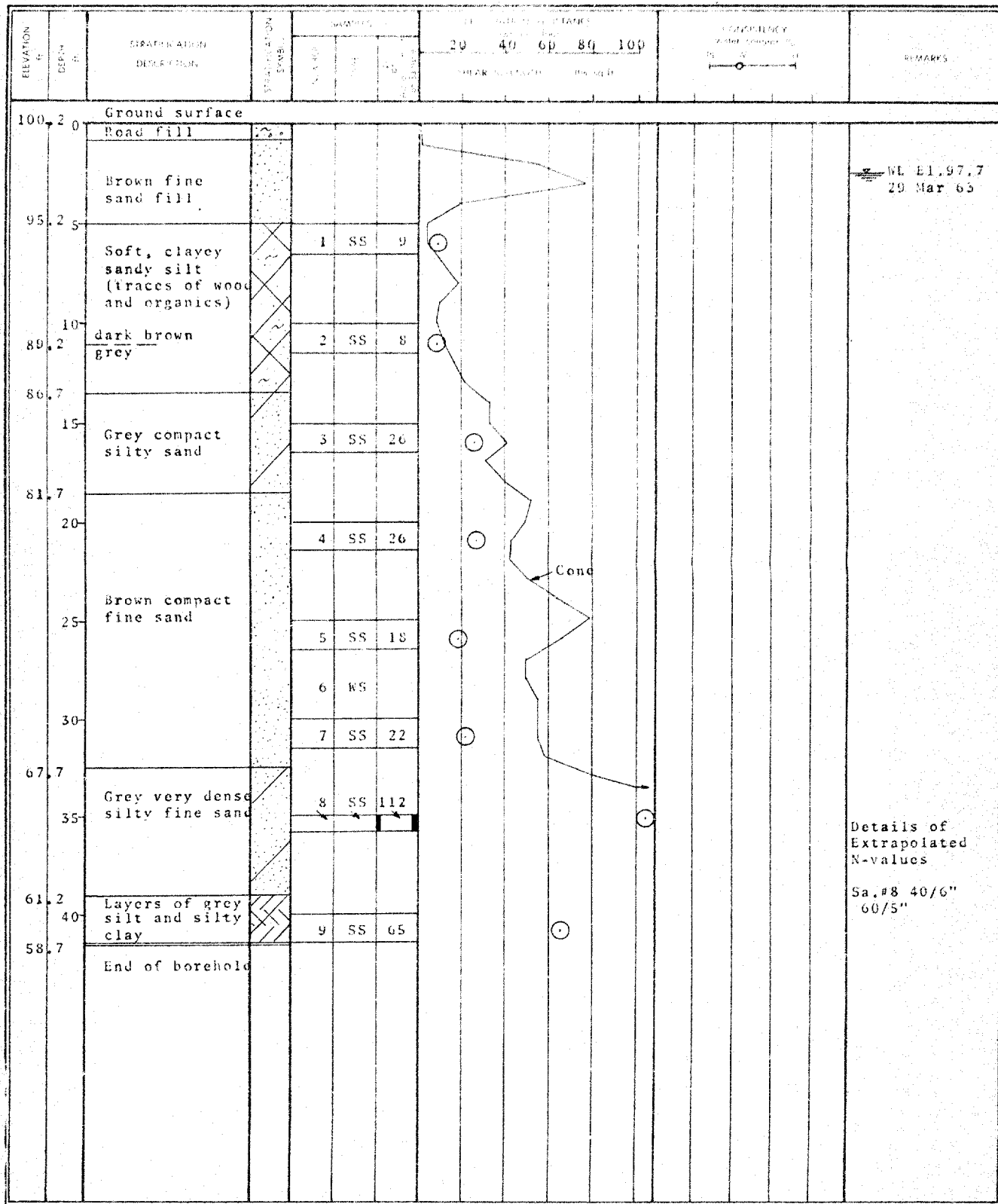
LOCATION Caradoc Township, Lot 23, Conc. 8 and 9

DATE 28 March 65

TESTED BY Washboring

TESTED BY 6x (3-inch)

EXAMINER NO. 4



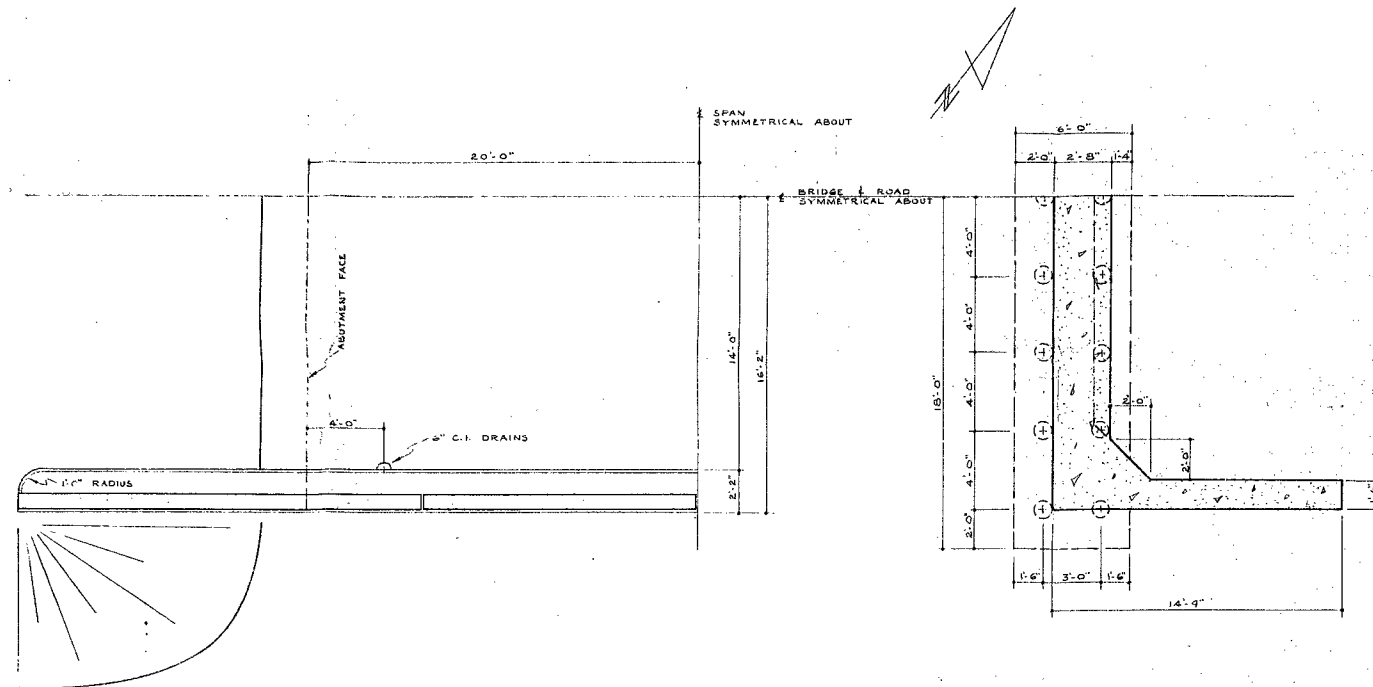
#63 - F - 249 M

RD. BRIDGE

GOLD CREEK

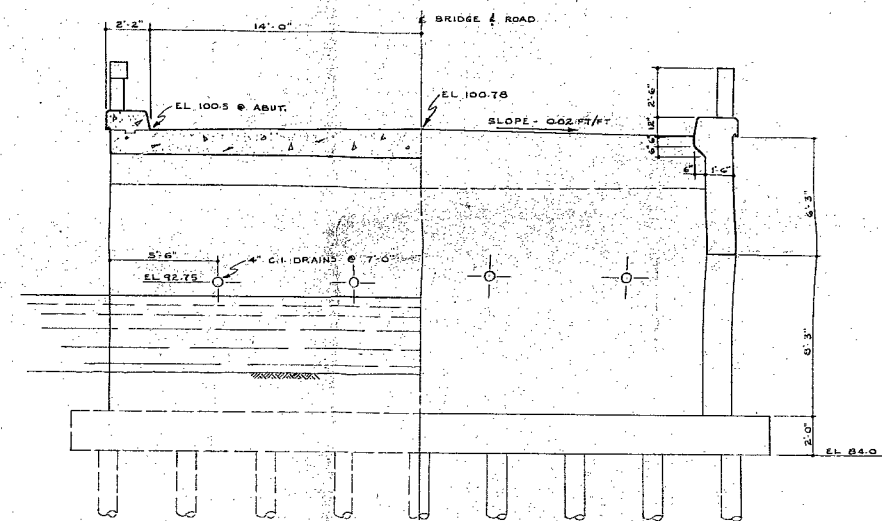
LOT 23, CON. VIII/IX

CARADOC TWP.



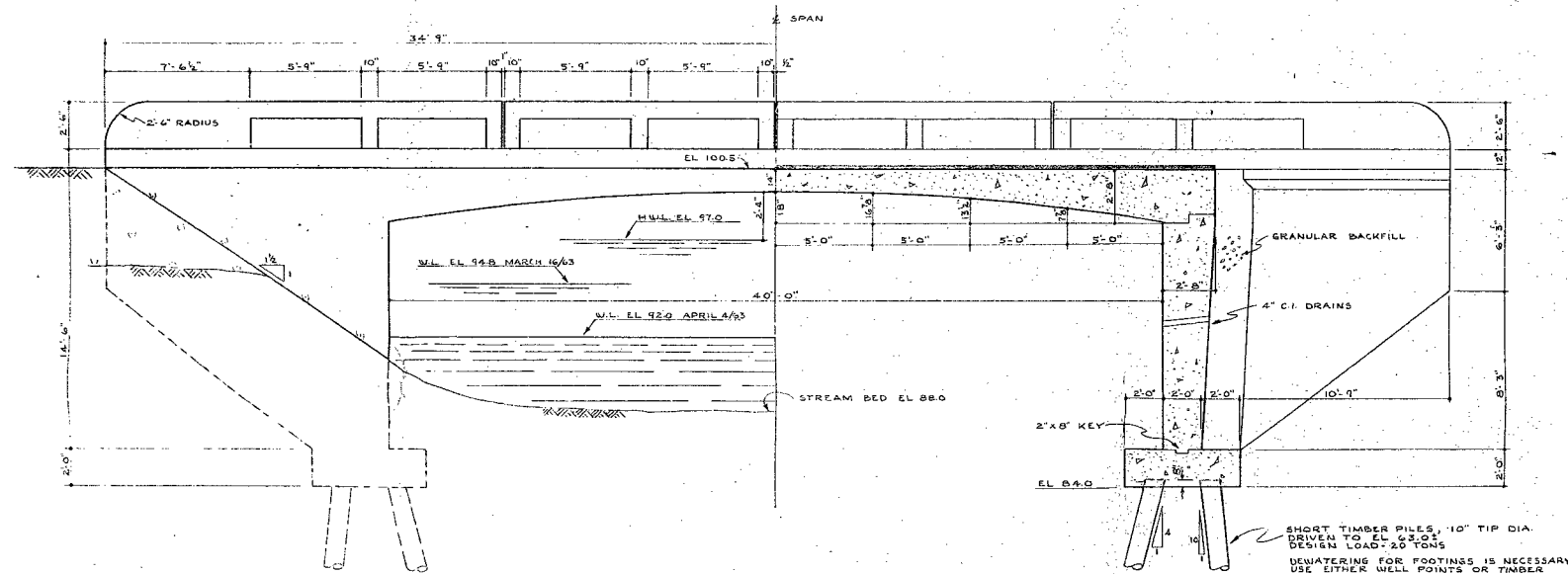
**HALF PLAN HALF SECTION**

SCALE  $\frac{1}{4}" = 1'-0"$



**HALF CROSS SECTION HALF END VIEW**

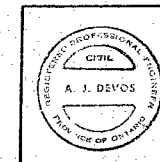
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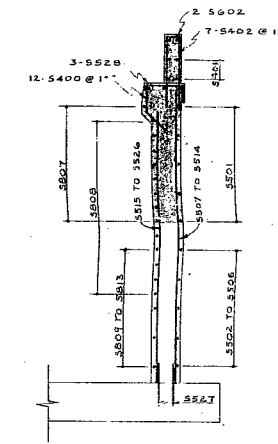
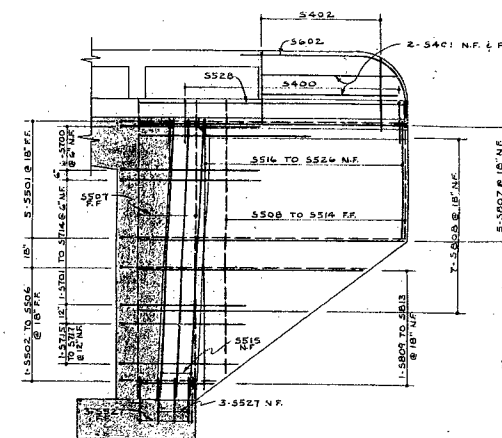
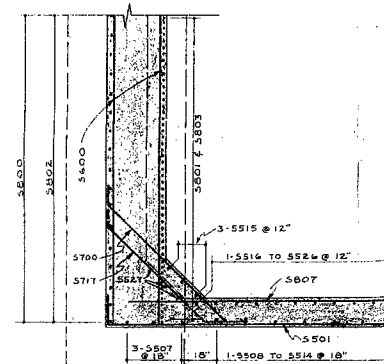
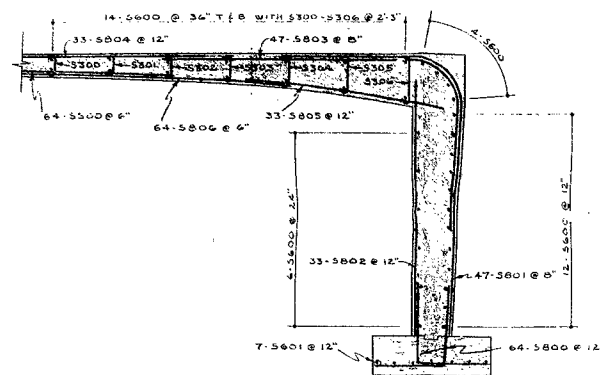
**HALF ELEVATION HALF SECTION**

SCALE  $\frac{1}{4}" = 1'-0"$

- GENERAL NOTES**
- Structure designed for H20 S16 loading.
  - Work on the structure must not be commenced until monuments to fix control points have been erected and checked by the Engineer.
  - Structure to be built in accordance with D.H.O. Form 9 Revised and the Engineer's specifications.
  - The complete soil investigation report by Dominion Soil Investigation Limited may be examined at the Consulting Engineer's office. The Consulting Engineer does not guarantee the accuracy of this report.
  - Pile Foundation  
Type - 10" tip diameter timber piles Design Load - 20 tons per pile
  - Footings excavations to be finished to the neat dimensions and the concrete shall be poured against undisturbed material. (Where applicable)
  - Excavations for footings in rock or granular material, shall be made as neat as possible. But in any case they shall be filled completely with footing concrete. (Where applicable)
  - No concrete shall be placed in the footings before the character of the soil and excavation for footings has been approved by the Engineer. (Where applicable.)
  - Concrete Mix  
(a) Minimum strength at 28 days, 3000 p.s.i.  
(b) All concrete except in footing shall include an approved air entraining agent.  
(c) Maximum size of aggregate shall be 3/4" in deck slab, curb and guardrail; 1 1/2" in footings and 1" elsewhere or as specified.  
(d) Concrete Mix 1 - 2 1/2 - 3 1/2
  - All exposed edges to be chamfered 1" unless otherwise noted. All acute angles shall be filleted as indicated.
  - No concrete to be poured before materials, mix, formwork, falsework and reinforcing have been checked by the Engineer.
  - Deck falsework shall not be struck until all backfill has been placed and compacted behind the abutments, to the satisfaction of the Engineer. In the case of girders and beams, no backfill to be placed before girders are erected and secured.
  - Backfill behind abutments to be brought up simultaneously at both ends.
  - Construction joints not shown on plans must be approved by the Engineer.
  - Reinforcing Steel - to be Hi-Bond  
"Clear" cover unless otherwise noted: 3" in footings and all surfaces in contact with earth or water; 1 1/2" in bottom of decks; 2" elsewhere.
  - Estimated Quantities  
Concrete 242.2 cu. yds.  
Reinforcing Steel - 17.85 tons.



<b>BRIDGE - CONC. VIII &amp; IX</b>			
<b>TOWNSHIP OF CARADOC</b>			
SCALE: AS SHOWN	APPROVED BY:	JOB NO. 6308	DRAWN BY: A.J.D.
DATE: 10-4-45			REVISED
<b>PLAN, SECT. &amp; ELEV.</b>			
MCM. SPIRIT & ASSOCIATES CONSULTING ENGINEERS LONDON & S.W.			

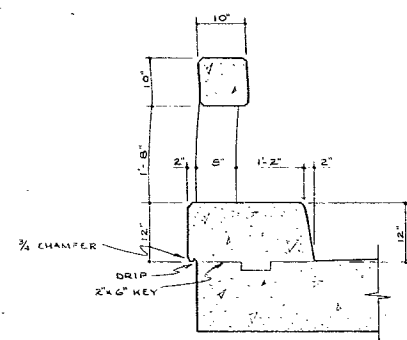


### HALF FRAME SECTION

HALF ABUT. SECTION

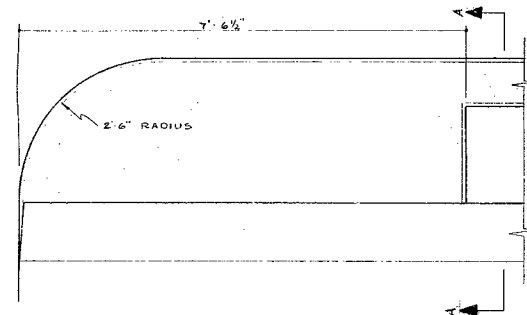
### WINGWALL ELEVATION

WINGWALL SECTION



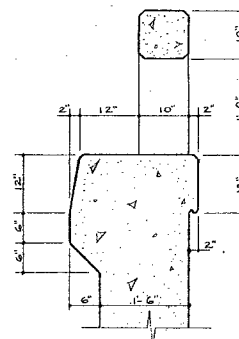
CURB & RAIL DETAIL

**SCALE**  $\frac{3}{4}" = 1' - 0"$



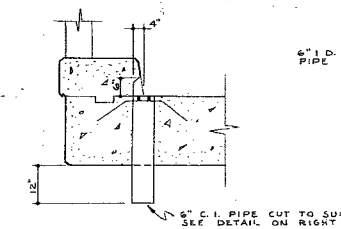
END POST DETAIL

SCALE  $3_4^R = 1' - 0''$



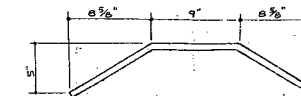
SECTION A-A

SCALE  $\frac{3}{4}" = 1' - 0"$



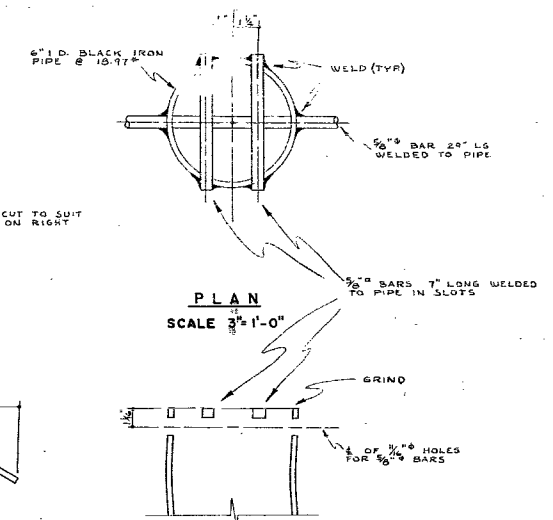
DRAIN DETAIL

SCALE  $\frac{1}{2}'' = 1' - 0''$



DETAIL OF 5" BAR.

SCALE .3" = 1'-0"



PLAN

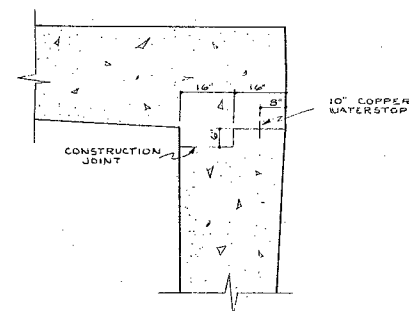
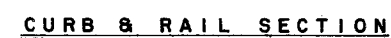
SCALE 3" = 1'-0"



SECTION

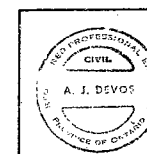
SCALE 3" = 1'-0"

DECK DRAIN DETAIL



KNEE DETAIL

SCALE  $\frac{1}{2}" = 1' - 0"$



BRIDGE - CONC. VIII & IX  
TOWNSHIP OF CARADOC

SCALE: AS SHOWN	APPROVED BY:	JOB NO. 6308	DRAWN BY A.J.D.
DATE: 18-4-63			REVISED

MISC. DETAILS &amp; REINFORCING

A. M. SPIRET & ASSOCIATES CONSULTING ENGINEERS LONDON & SIMCOE	DRAWING NUMBER 3
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