62-F-214-C

BRIDGE OVER SPITLER CREEK AT BOUNDARY OF DEREHAM & NORWICH TWPS.

Mr. A. M. Toye,

Bridge Engineer.

Materials & Research Division,

(Foundation Section)

April 6, 1962.

FOUNDATION INVESTIGATION REPORT
By: Dominion Soil Investigation Limited.

(Municipal Job)

Attention: Mr. K. L. Kleinsteiber.

Re: Subsoil Investigation for Hayes Bridge over the Spitler Creek -- District #2.

Attached, we are forwarding to you, the report on the subsoil investigation for the above-mentioned structure submitted by the Consultant, Dominion Soil Investigation, Ltd.

We have reviewed the report and found the factual information well presented and the recommendations correct. It is also believed that the information contained in the report will be sufficient for your future design work. However, should there be any other questions that you would like to discuss, please feel free to call on our office.

A. G. Sterne,
PRINCIPAL FOUNDATION ENGINEER

AGS/MDeF
Attach.

cc: Messrs. A. M. Toye (3)
F. P. Howard
T. S. Caldwell
J. Loy
Z. Petit

Foundations Office
Gen. Files

ONTARIO
DEPARTMENT OF HIGHWAYS
MATERIALS AND RESEARCH DIVISION
TORONTO - ONTARIO

REPORT ON
SUBSOIL INVESTIGATION
FOR
HAYES BRIDGE OVER THE SPITLER CREEK
OXFORD COUNTY - BOUNDARY S. NORWICH & DEREHAM TWP.
OPPOSITE CONCESSION VIII, DISTRICT #2, LONDON

Submitted by

DOMINION SOIL INVESTIGATION LIMITED
77 Crockford Boulevard
SCARBOROUGH - ONTARIO

OUR REFERENCE: 2-3-29

April 1962.

CONTENTS

ENCLOSURES

INTRODUCTION

A letter of authorization dated March 22nd, 1962 was received from the Ontario Department of Highways, Materials and Research Division, to conduct a subsoil investigation at the site of a proposed bridge over the Spitler Creek.

The proposed project will replace the existing narrow bridge which does not meet the requirements of modern traffic.

The site was located with the aid of a drawing supplied to us (prepared by Mr. V.R.Astrop, Consulting Engineer).

The purpose of the investigation was to reveal the subsoil conditions and advise on the design and construction of foundations.

.... 2

SUMMARY

(1) HARD OR VERY DENSE SOILS OF GLACIAL ORIGIN WERE ENCOUNTERED AT THE SITE BELOW A LOOSE AND SOFT TOPSOIL AND SILT WITH SAND LAYER.

(2) THE WATER LEVEL IS SLIGHTLY ABOVE THAT IN THE CREEK.

(3) ELEVATION 90 FT. OR LOWER IS SUGGESTED AS BASE LEVEL AND AN ALLOWABLE GROSS BEARING PRESSURE OF 6000 PSF IS RECOMMENDED.

(4) NO CONSTRUCTION PROBLEMS ARE ANTICIPATED. THE ENCLOSING OF THE EXCAVATION BY SHEET PILES MAY BE REQUIRED, DEPENDING ON THE PROPOSED FOOTING GRADE.

..... 3

I. DESCRIPTION OF SITE AND GEOLOGY

The proposed bridge will replace the existing one about four miles north of Tillsonburg, in Oxford County. It will carry a gravel road (comprising the eastern boundary of Dereham Township) over the Spitler Creek. The surrounding area is a gently rolling farmland with no outstanding topographic features.

The region was glaciated several times during the Ice Ages and this, of course, had a very important mechanical effect on the substrata - i.e. the subsoil was greatly preconsolidated by the enormous weight of the ice shield having lain above them.

II. FIELD AND LABORATORY WORK

Field work was carried out on the 26th and 27th March, 1962 and comprised two boreholes and two dynamic cone penetration tests at the locations shown on Enclosure #1. The positions of the test holes were set out on the site with the assistance of a drawing (as referred to in the Introduction) provided to us. Elevations were measured relative to a spike in a 4 ft. diameter willow located on the southern shore of the creek, east of the bridge (= el. 100.0 ft.) also indicated on the above drawing.

The boreholes were of varying diameter. Nx casing (3½" dia.) was driven to 5 ft. depth and this prevented the inflow of water through the upper strata. Bx casing (2 7/8" dia.) was advanced telescopically to the required sampling depths by alternating driving and cleaning procedures. Cleaning was done by a short auger or by washing - depending on practicability.

..... 4

Standard penetration tests were made at frequent intervals using a 2 in. outside diameter split spoon driven into the bottom of the clean borehole by a constant driving energy (140 pound hammer dropping 30 ins.). The dynamic cone penetration test is one type of deep sounding in which the Bx rods with a 2 in. diameter 60 degree apex cone driving point are driven into the subsoil without casing and applying the same driving energy as above. The former test provided disturbed samples of the substrata indicating their relative density and consistency and the latter a continuous record of soil density.

An approximate value of the unconfined compressive strength was obtained in the field using a pocket penetrometer.

The samples were shipped to our laboratory where they were thoroughly examined and classified. The results of this analysis, together with the field penetration test data comprise the basis on which the geotechnical properties of the substrata are being evaluated.

The stratification of the subsoil, sampling depths and the results of the penetration and pocket penetrometer tests are recorded on geotechnical data sheets comprising Enclosures #2 and #3.

..... 5

III. SUBSURFACE CONDITIONS

The subsurface stratigraphy can be best visualized with the aid of a profile presented on Enclosure #1. In the following, an attempt is made to describe the properties of the various strata:

(a) Organic topsoil-(color on the profile: brown). Both boreholes were located in the drainage ditch running alongside the road. The soft highly permeable silty-clayey humus probably originates from elsewhere and was deposited here as a driftof drainage waters.

(b) Soft silt and loose sand -(color on the profile: yellow). This can be partly flood sediment, partly road fill which fell aside. It is highly permeable to water.

Below these two layers, glacial tillswere found. Till is a common term denoting soils deposited by the ice. They are generally nonsorted. They may consist entirely or clay or of boulders. Innumerable combinations of these or intermediate sizes are possible. Four different types of tills were encountered in the present borings:

(c) Clayey, sandy silt - (color on the profile: violet). The stratum is hard, has a moisture content of about 10% and its grain-size distribution is similar to that of concrete aggregates: elongated lying S shaped curve; ascertaining a low void ratio, hence a high density. The material is brown in the upper half, grey below the zone of weathering.

Angular grains of coarse sand, gravel are embedded in the main material. These types of soils have favourable engineering properties: low permeability and high shear strength.

(d) Very dense silt - (color on the profile: green). This till consists of cohesionless particles passing the #200 sieve mesh. It exposes no plasticity at all, free water is observable on the surface and water is expelled upon shaking (dilatancy). The shear strength is derived by friction only. The stratum is permeable. It has an unstable structure and it is subject to piping.

..... 6

(e) Layers of hard clay and silt - (color on profile: light blue). This till has a definite layered structure; it is varved. The shearing properties depend on which layer is investigated: the clay or the silt. It has a high bearing capacity and the permeability in a vertical direction is practically zero - that in the horizontal one is higher owing to the pervious silt beds.

(f) Hardy silty clay - (color on the profile: indigo blue). The stratum has significant cohesion and it is "stone-hard". In fact, "soft shale" would be just as good a term to describe this soil.

The groundwater table is somewhat higher than in the creek, which is quite natural in the time of spring thaw. The supply of water comes from the more permeable strata: topsoil and silt with sand, and the silt between the impervious, clay or clayey layers.

IV. DISCUSSION AND RECOMMENDATIONS

(a) Design

The subsoil is capable of supporting the proposed bridge on spread footings. Elevation 90 ft. is suggested as the highest base level. The layers above this level either do not have sufficient bearing capacity or are subject to the danger of erosion.

The gross allowable bearing pressure at elevation 90 ft. or lower is 6000 psf. The bearing capacity of the subsoil increases with depth; however, it is believed that the value suggested above is sufficient for the present structure.

Settlements will be negligibly small and no differential settlements are anticipated.

..... 7

(b) Construction

Only the dewatering of the excavation may present some difficulties. The pit, however, can be kept reasonably dry if the following recommendations are adhered to:

Water can flow into the pit from above (surface water) or seep through the walls and bottom of the excavation if the soil is permeable. Surface waters can be diverted through a culvert and can be held away from the excavation by means of small dikes, etc. The flow of water through the uppermost layers (see (a) and (b) in the previous paragraph) can be stopped by temporary ditches established around the perimeter of the excavation.

The hard clayey silt is practically impermeable. No appreciable quantity of water can seep through this material. However, the subgrade and probably the lower portion of the walls of the excavation will consist of the cohesionless silt. Water may enter the pit from this material. The best and safest method of dewatering would be by enclosing this lower portion of the excavation with sheet piles driven into the impervious hard clay and silt stratum. Thereafter, the water can be pumped out and the construction of the footings can be done in the dry excavation.

The possibility exists that if the base level is only slightly below the top of the silt stratum, no precautions such as above will be required. In this case, a lean concrete "blanket" should be provided on the footing grade as soon as possible, and this would ascertain watertightness of the bottom of the excavation. Seepage from the sides can be collected in a sump and removed by pumping.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

L. R. Szalatkay

LRS/oed

L. R. Szalatkay, P.Eng.
Senior Soils Engineer.

Encls.

..... 9

V. REFERENCES

(1) Procedures for Testing Soils, ASTM April 1958, pp 186 to 198. (Unified Soil Classification System - by A. A. Wagner).

(2) 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).

(3) Terzaghi and Peck: Soil Mechanics in Engineering Practice. John Wiley and Sons, New York - 1948.

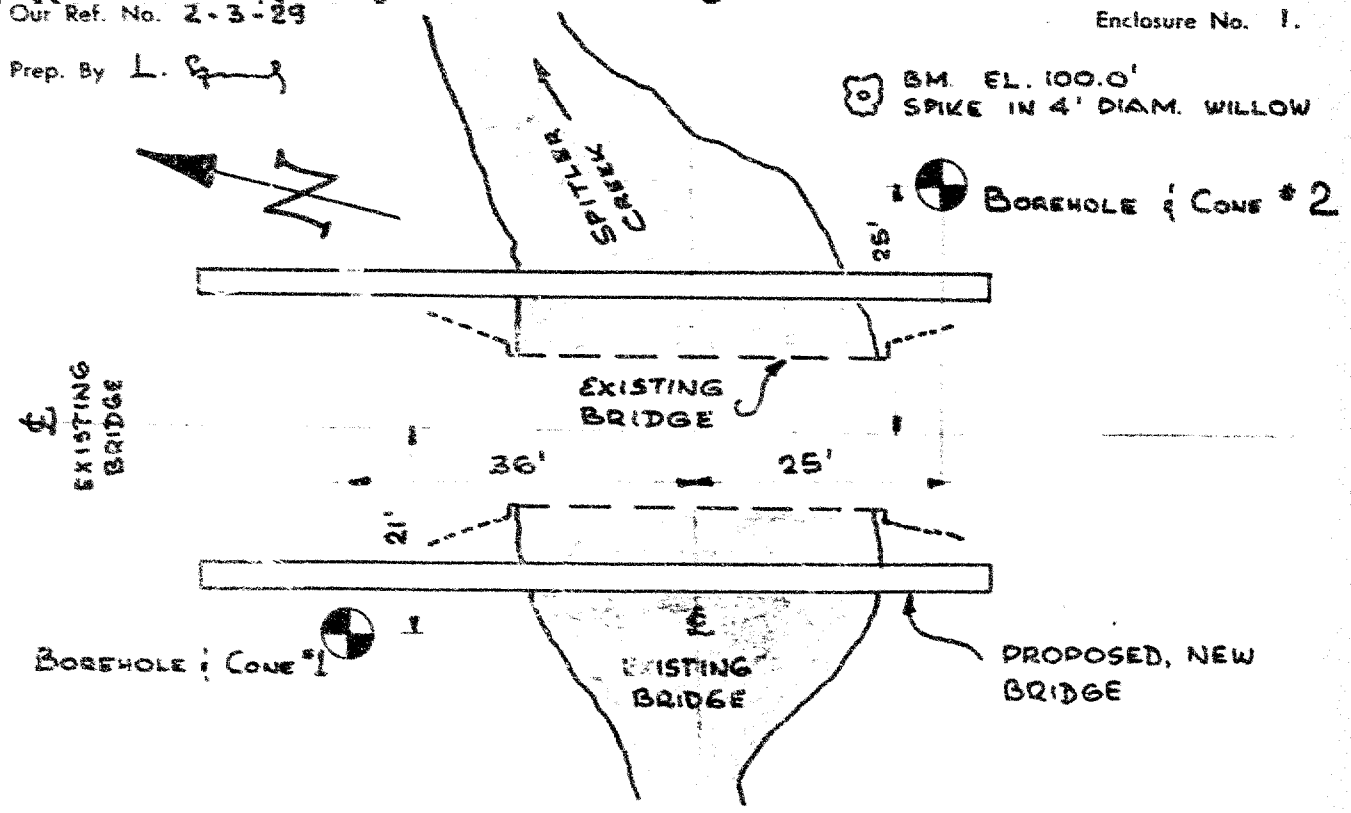
(4) The Physiography of Southern Ontario by L.J. Chapman and D.F.Putnam of the Ontario Research Foundation - University of Toronto Press 1951.

Enclosures

Our Ref. No. 2-3-29

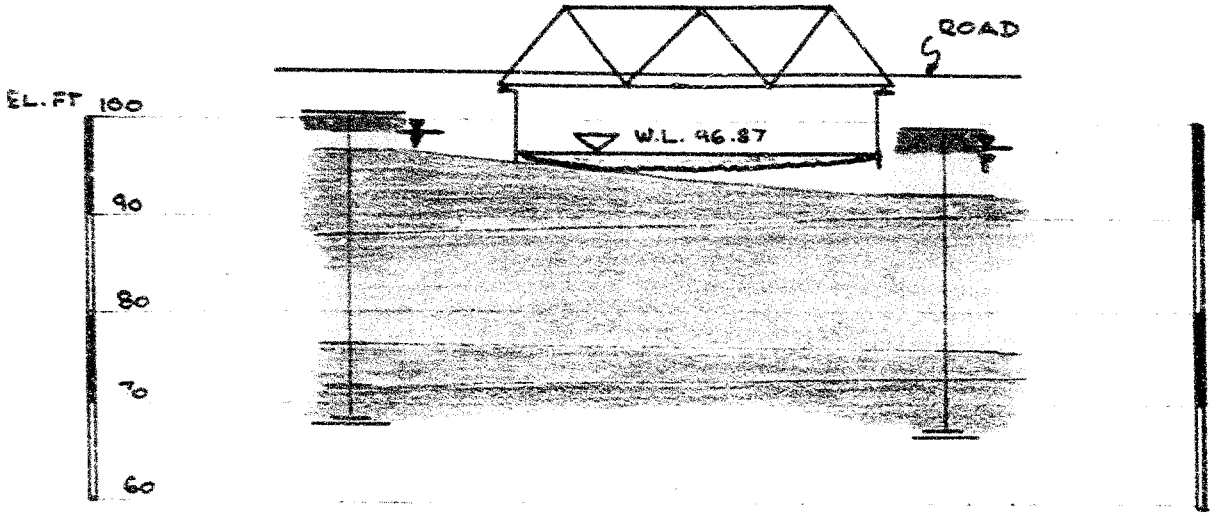
Enclosure No. 1.

Prep. By L. [illegible]



LOCATION OF BOREHOLES

SCALE : 1" TO 20'



SUBSURFACE PROFILE

SCALE : 1" TO 20'

LEGEND:

MORE PERMEABLE SOILS

- ORGANIC TOPSOIL
- SOFT OR LOOSE SAND & SILT
- VERY DENSE SILT

PRACTICALLY IMPERMEABLE SOILS

- HARD CLAYEY SANDY SILT
- LAYERS OF HARD CLAY & SILT
- HARD SILTY CLAY

DOMINION SOIL INVESTIGATION LIMITED

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1

CIVIL REFERENCE NO. 2-3-29

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO METHOD OF BORING: WASHBORING ENCLOSURE NO. 2.

PROJECT: HAYES BRIDGE DIAMETER OF BOREHOLE: 3½" TO 5 ft - 2⅞" 5 TO 30 ft

LOCATION: OVER SPITLER CREEK, OXFORD COUNTY DATE: MAR. 26. 1962.

DATUM ELEVATION: 100.5

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	GRAPHIC LOG SYMBOL	SAMPLES No.	TYPE	BLOWS PER FOOT	DYNAMIC CONE PENETRATION RESISTANCE (BLOWS PER FOOT) 20 40 60 80 100	SHEAR STRENGTH (LBS. PER SQ. FT.) 2000 4000 6000 8000 10000	CONSISTENCY (water content %) W P L	REMARKS
100.5	0	ORGANIC TOPSOIL								Nx CASING WAS USED TO 5 FT DEPTH
		BROWN WET SOFT SILT		MAR. 27. 1	SS	5	o			Bx CASING, TELESCOPICALLY WAS USED TO 15 FT DEPTH
95	5	DAMP, HARD brown CLAYEY grey SANDY SILT with angular coarse sand and gravel embedded in it		2	SS	28	o +			NO CASING WAS USED BELOW 15 FT
90	10			3	SS	44	+o			GROUND WATER CONDITIONS: THE LAYERS TO 4 FT ARE AQUIFER ONES
85	15	GREY, SATURATED VERY DENSE SILT		MAR. 27. 4	SS	98	o			THE SILT BETWEEN 12½' AND 24' IS ALSO AQUIFER.
80	20			5	SS	61	o			ALL OTHER STRATA ARE PRACTICALLY IMPERMEABLE
75	25	alternating layers of HARD, DAMP, GREY CLAY AND GREY, VERY DENSE, DAMP SILT		6	SS	53	o			
70	30	GREY, DAMP HARD SILTY CLAY		7	SS	51	+ o			

DYNAMIC CONE PENETRATION RESISTANCE

STANDARD CO' PENETRATION RES.

▽ DENOTES WATER LEVEL

DEPTH WHERE THE HOLE CAVED IN

THE DATES INDICATE THE MEASURING DAYS

\+ DENOTES UNDRAINED SHEAR STRENGTH AS MEASURED BY A POCKET PENETROMETER

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: CH'D:

OUR REFERENCE NO 2-3-29

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 4 . .

CLIENT DEPARTMENT OF HIGHWAYS, ONTARIO
PROJECT HAVES BRIDGE
LOCATION OVER SPITLER CREEK, OXFORD COUNTY
DATUM ELEVATION 99.7

METHOD OF BORING AUGERING AND WASHBORING
DIAMETER OF BOREHOLE 3½" TO 5 ft - 2⅞" 5 TO 30 FT
DATE MAR. 27. 1962.

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIGRAPHIC SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS PER FOOT	PENETRATION RESISTANCE Blows per foot 20 40 60 80 100	SHEAR STRENGTH lbs. per sq. ft. 2000 4000 6000 8000 10000	CONSISTENCY Water content % P W L	REMARKS
99.7	0	ORGANIC TOPSOIL		MAR. 27						
		LOOSE SAND WITH SOFT SILT TRACES OF GRAVEL		1	SS	10				
95	5			2	SS	4				
		HARD CLAYEY SILT								
90	10			3	SS	35				
		GREY, SATURATED VERY DENSE SILT		MAR. 27.						
85	15			4	SS	43				
80	20			5	SS	66				
		alternating layers of HARD CLAY AND VERY DENSE SILT								
75	25			6	SS	29				
		GREY, DAMP, HARD SILTY CLAY								
70	30			7	SS	39				

Nx CASING WAS USED TO 5 FT DEPTH

Bx CASING TELESCOPICALLY WAS USED TO 30 FT DEPTH

GROUND WATER CONDITIONS:

THE LAYERS TO 23 FT DEPTH ARE AQUIFER ONES

BELOW THIS DEPTH THE STRATA ARE PRACTICALLY IMPERMEABLE

FOR NOTATIONS SEE ENC. 2.

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: CH'D: