B.A. 1734

MESSRS. A. M. SPRIET & ASSOCIATES
CONSULTING ENGINEERS
264 WELLINGTON ROAD
LONDON ONTARIO

64-F-252M

Report on

SOIL INVESTICATION

for

PROPOSED BRIDGE
ELM STREET
TOWN OF AYLMER
COUNTY OF ELGIN

Malahide

by

DOMINION SOIL INVESTIGATION LIMITED
363 Queens Avenue
LONDON ONTARIO

Reference No. 4-1-L1
January 1964

CONTENTS

ENCLOSURES

SUMMARY

Two boreholes were put down in the area of the proposed bridge, indicating the following stratification:

(i) From the ground surface to El.74 (±) a dark brown fill consisting of mixed material.

(ii) Below El.74 (±) to an undetermined depth but at least to El.50.0 a hard silty-clayey glacial till with excellent foundation characteristics.

The ground water table was encountered at El.72.0 (±).

It is recommended that the footings be taken down to El.67.0 and designed for a bearing value of 8000 pounds per square foot with a maximum allowable edge pressure of 10,000 pounds per square foot.

Design values for the evaluation of the horizontal sliding resistance under the footings are given in the text.

No unusual construction problems are anticipated.

I INTRODUCTION

Subsequent to verbal authorization from Mr. A. M. Spriet, a subsurface investigation was carried out within the Town of Aylmer, in the area where the construction of a new bridge across the Catfish Creek is proposed.

The new bridge will join the so far separated sections of Elm Street between Creek and Spruce Streets. The project will also include the diversion and regulation of the presently meandering creek. The proposed sixty or seventy-foot span bridge will span across the newly constructed channel.

To determine the subsurface conditions two boreholes were put down, one at the location of each abutment.

The following report gives a full account of the subsurface conditions encountered, together with recommendations for the design of the foundations.

II FIELD WORK

The location of the boreholes in the field is shown on the enclosed site plan.

Each borehole was accompanied by a dynamic cone penetration test, in which a 2-inch diameter 60° point cone was driven into the ground, using a standard energy of 350 foot-pounds per blow. The number of blows for each foot of penetration was recorded and is indicated on the attached geotechnical data sheets.

The boreholes were advanced by standard wash-boring methods, i.e. by driving 3-inch outside diameter casings to the depth from where samples are required and by removing the soil by washing. Disturbed samples were recovered at 5-foot intervals of depth by driving a 2-inch outside diameter split-spoon sampler 18 inches into the ground. The driving energy was delivered by a 140-pound hammer, falling freely 30 inches. The number of blows required for the last 12 inches of penetration was recorded as the standard penetration resistance or 'N' value in blows per foot.

All elevations given in this report are referred to a temporary bench mark located at Sta. 7 + 40. The bench mark was described as the top of the north-west corner of the concrete porch of the existing brick building on the east side of Elm Street. The same bench mark was used by the Elgin County Engineers who made a survey of the site. The elevation of the bench mark was given as 100.49 feet.

III SOIL CONDITIONS

Detailed results of the encountered subsurface conditions are shown on the geotechnical data sheets and on the inferred soil profile shown on enclosure 2.

In the following, only a brief description will be given of the main soil types as referred to on the borehole logs.

1. Fill

The natural ground in the area is overlain by about 10 to 12 feet of fill consisting mostly of sand and silt with some clay, gravel and considerable organic content.

It is believed that the fill was obtained from local excavations, as its composition resembles the composition of the natural till deposit in the area. However as some "foreign" material (chips of concrete, brick and glass) was also detected there is little doubt about its man-made origin.

The standard and, in particular, the cone penetration tests indicated that the relative density of the fill material is only *loose* to *compact*.

2. Glacial Till

In both boreholes the natural soil was encountered at El.74 (±) and is a hard silty-clayey till with some small pebbles embedded in a fine textured matrix. The till has generally a grey colour, except in borehole 1 where above the water table it is brown.

The till, which can be regarded as a cohesive material, is believed to be of low to medium plasticity with the natural moisture contents at or slightly above the plastic limit. The undrained shear strength of the till is estimated to be over 4000 pounds per square foot.

As both boreholes were terminated at El.50.0 (±) the total depth of the stratum is undetermined.

IV WATER CONDITIONS

The ground water levels in the boreholes were observed shortly after the field work was completed but in borehole 1 it was possible to observe the water level for a longer period. In borehole 1 the ground water appeared to reach a static level at El.71.9. In borehole 2 the last measurement indicated the water table at El.73.9. However it is believed that this higher ground water level reading is

due to the low permeability of the till and the short time available for the observation.

At the time of the survey the water level in the nearby creek was at El.72.0 (±). Based on the above observations it is believed that the ground water level at the site would also be at El.72.0 (±) and would probably fluctuate as the water level does in the creek.

V DISCUSSION

It is understood that the proposed bridge will have a single span of approximately 60 feet, and will carry normal urban street traffic on two lanes. Most likely it will be constructed of reinforced concrete and designed as a rigid frame.

Under these circumstances the maximum total reaction at the base of the abutments is estimated to be about 140 tons.

The proposed invert level of the future channel at the location of the new bridge will be at El.72 (±). To leave sufficient earth cover over the footings, to protect them against frost action and/or scour, it is recommended that the footings be carried 5 feet below the invert level of the creek i.e. to El.67.0 (±).

The investigation indicated that the site is underlain by about 10 to 12 feet of fill extending to approximately El.74.0 under which the natural soil is a hard silty-clayey glacial deposit.

The geotechnical properties of the till, in particular its high undrained shear strength and its low plasticity, make this stratum an excellent foundation material.

Based on the estimated shear strength of the stratum it is recommended that the footings of the abutments be designed for a maximum uniform soil pressure of 8000 pounds per square foot. In case of a non-uniform pressure distribution, as may arise from the eccentricity of the loads, a peak pressure of 10,000 pounds per square foot may be allowed at the edge of the footings.

The long-term settlement under the footings, due to the consolidation of the till, is estimated not to exceed one inch. Differential settlement is unlikely to exceed 0.5 inch.

The stability of the footings against horizontal sliding should be checked both for the short (immediately after construction) and the long-term cases.

In the *short-term* case the adhesion between the poured concrete footings and the till should be taken as 3000 pounds per square foot. Furthermore it is recommended that the surface of the till be roughedned prior to the pouring of the concrete.

When considering the *long-term* case the design should be based on the assumption that the coefficient of friction is equal to 0.35. If this does not provide sufficient resistance against sliding, the footings could be lowered and the passive earth resistance of the till below the level of maximum scour could also be considered. The following design values are recommended for this case:

Unit weight of the undisturbed till γ = 140 P.C.F.

Coefficient of passive earth pressure $K_p = 3.0$

For both cases (i.e. the *short* and the *long*-term cases) a safety factor of 1.75 is suggested.

No undue construction problems are expected. While excavating through the fill it will be necessary to slope the sides of the excavation at 1 to 1 or alternatively shoring and bracing may be required. However the sides of the excavation in the till will need no support as they will stand up temporarily with nearly vertical faces.

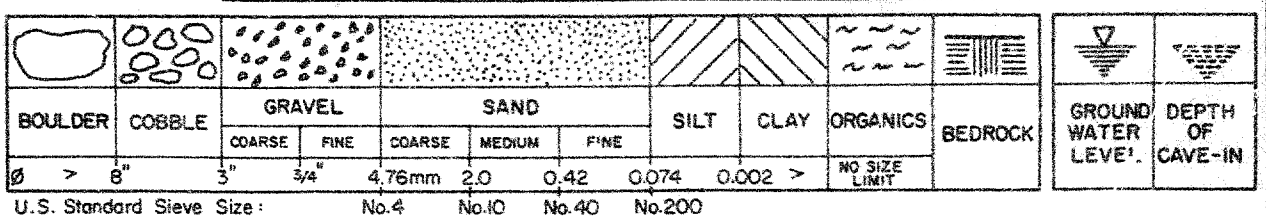
Owing to the low permeability of the till it will be possible to keep the excavations dewatered by usual dewatering methods.

DOMINION SOIL INVESTIGATION LIMITED

I. P. Lieszkowszky, P.Eng.

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



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
" pressure : p
" tapping : t

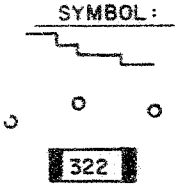
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"Ø, 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.

SYMBOL :



EXTRAPOLATED -N- VALUE

The ene[illegible] for the penetration resistances is supplied by a [illegible] lb. hammer falling 30 inches

SOIL PROPERTIES.

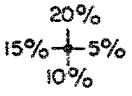
W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion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

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST — UNCONFINED TEST — LABORATORY VANE TEST — FIELD VANE TEST — POCKET PENETROMETER TEST

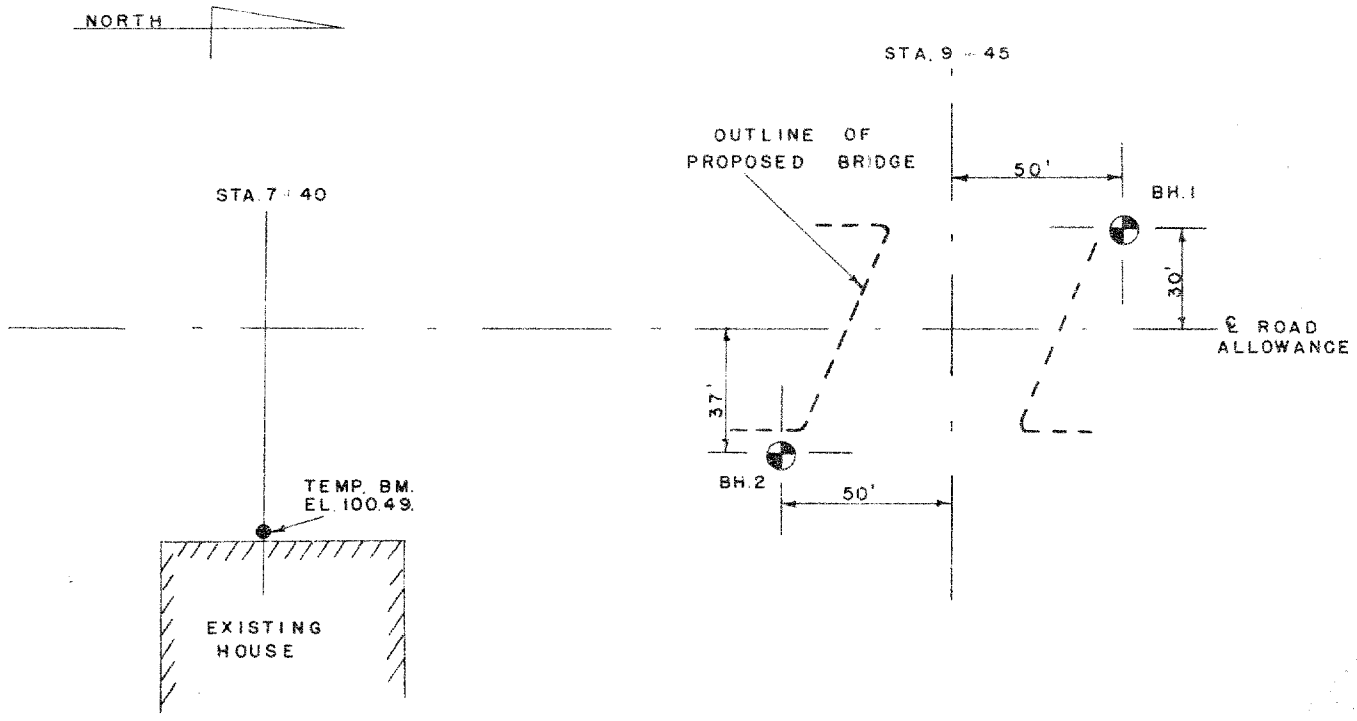
Strain at failure is represented by direction of stem



St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

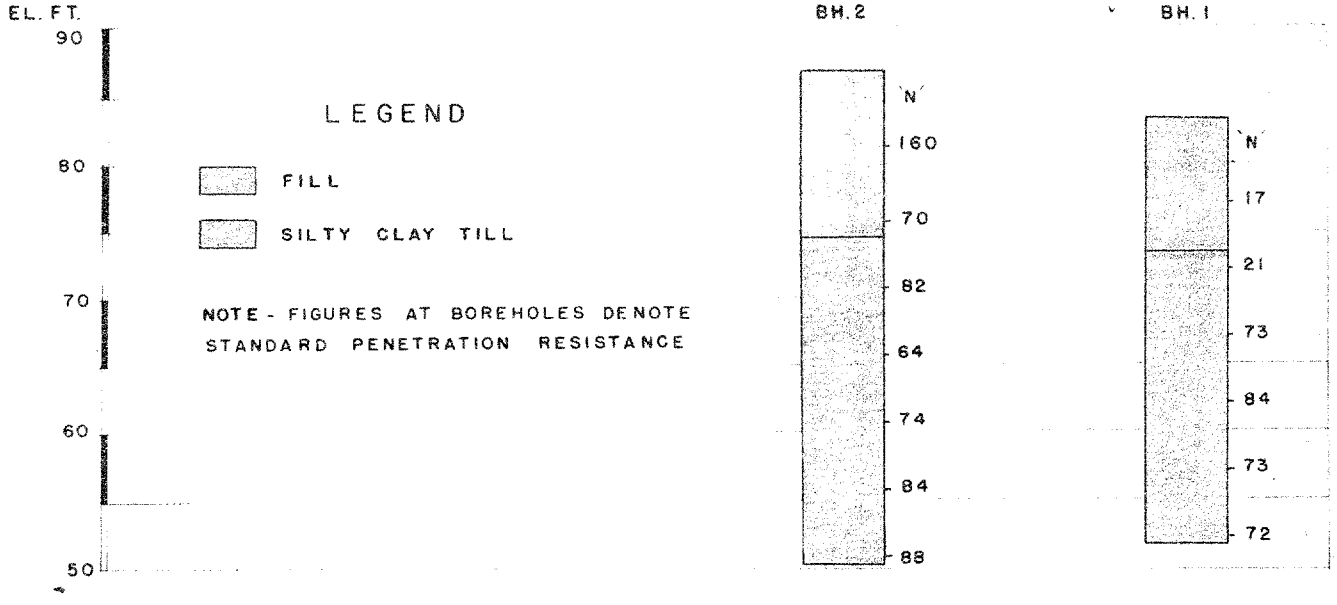
SOIL DESCRIPTION.

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 40 FEET



SUBSURFACE PROFILE

SCALE: HORIZONTAL - 1 INCH TO 40 FEET
VERTICAL - 1 INCH TO 10 FEET

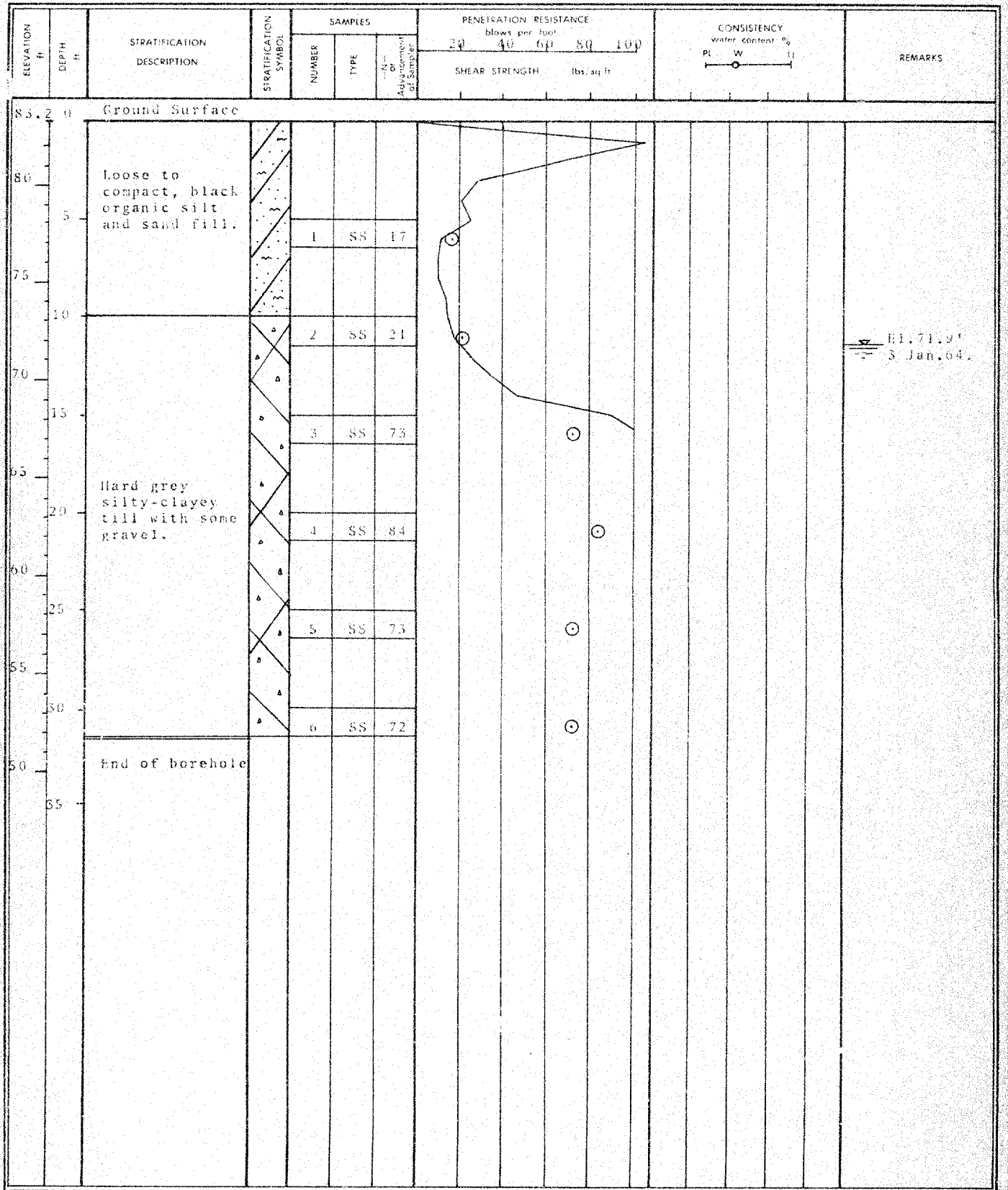
GEOTECHNICAL DATA SHEET FOR BOREHOLE 1

OUR REFERENCE NO. 4-1-11

CLIENT: A. N. Spriet and Associates
PROJECT: Proposed Elm Street Bridge
LOCATION: Aylmer, Ontario.
DATUM ELEVATION: Temporary BM.

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: 8x (3-inch)
DATE: January, 1964.

ENCLOSURE NO. 3



VERTICAL SCALE: 1 IN. TO 5 FT.

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MADE: SB CH'D: IL

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 7 . . .

OUR REFERENCE NO. 4-1-L1

CLIENT: A. M. Spriet and Associates
PROJECT: Proposed Elm Street Bridge
LOCATION: Aylmer, Ontario.
DATUM ELEVATION: Temporary BM.

METHOD OF BORING: washboring
DIAMETER OF BOREHOLE: BX (3-inch)
DATE: January, 1964.

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N — or Advancement of Sampler	PENETRATION RESISTANCE blows per foot 20 40 60 80 100 / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % PL W LL	REMARKS
86.9	0	Ground Surface							
85		Loose to compact brown sandy, clayey, gravelly fill, some organic content.		1	SS	160			Refusal on concrete or boulder.
80	5								
	10			2	SS	70			El. 73.9' 3 Jan. 64.
75									
70	15			3	SS	82			
	20			4	SS	64			
65		Hard grey silty-clayey till, with some gravel.							
60	25			5	SS	74			
55	30			6	SS	84			
	35			7	SS	88			
50		End of borehole							
40									

VERTICAL SCALE: 1 IN. TO 5 FT.

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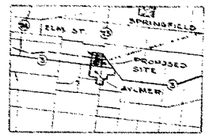
MADE: SB CH'D: IL

64-F-252M

ELM ST. + SPRUCE ST.

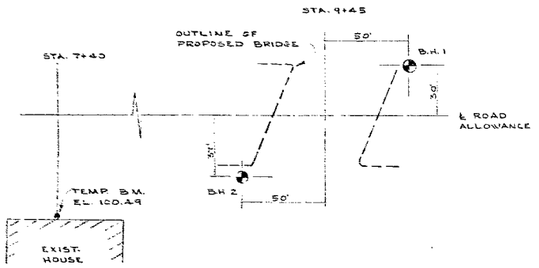
CATFISH CREEK

AYLMER

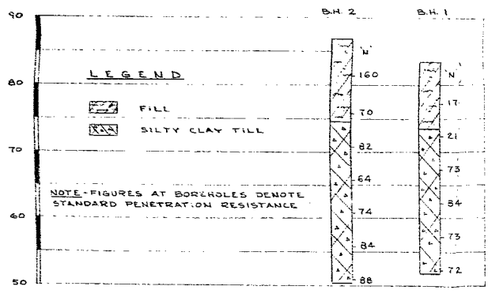


KEY MAP
SCALE 1" = 4MI.

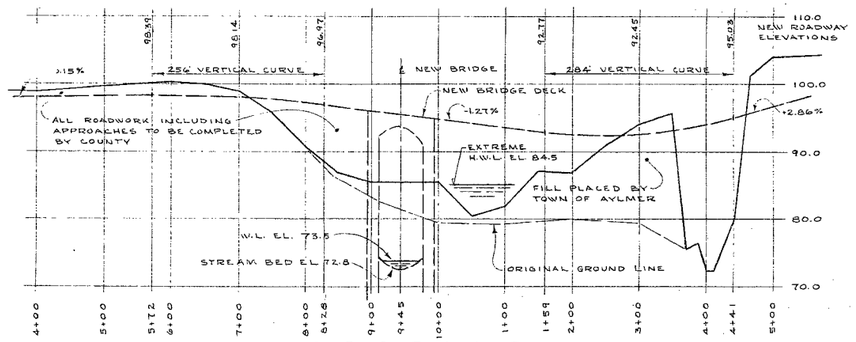
SITE PLAN SCALE 1"=100'



BOREHOLE LOCATION PLAN
SCALE 1"=40'



SUBSURFACE PROFILE
SCALE 1"=10'



PROFILE
SCALES HOR. 1"=100' VERT. 1"=10'

DATA

1. Special Features: Waterfalls, Exceptional Floods, Ice, Driftwood, Sliding Banks, etc.

   Occasionnl ice jamming, approx. flood rise of 12', fairly flat watershed, approx. 6' to 8' high banks, reasonably good fall, creek meanders considerably.

2. (A) Upstream and Downstream Bridges (Give location, length, height, above M.H.W.L., net cross-sectional area at H.W.L., estimated age

   (1) 1/5 mi. upstream, 82' clear span steel truss, 14'± vertical clearance, 16' roadway width curb to curb, 16.6' u/s bottom chord to W.L., 1.5' W.L. to stream bed, approx. 50 yrs. old.

   (2) 1/3 mi. upstream, 60' clear span concrete arch rigid frame, 40' roadway width curb to curb, 20.5' u/s deck to W.L., 1.5' W.L. to stream bed, approx. 40 years old.

   (3) 1 mi. upstream, 65' clear span prestressed conc. beams on 15° to 20° skew, 30' roadway width curb to curb, 9.0' u/s to ice, 3' to 4' ice to stream bed, built in 1962.

   (4) 1½ mi. downstream, 85' clear span truss type on steel tube piles filled with concrete with approach spans of 13' and 17' respectively, wooden deck, stringers, 5 tons load limit, 13.5' roadway width, 14.0' u/s bottom chord to W.L., 9'± W.L. to stream bed, approx. 50 yrs. old.

   (B) Reasons why these bridges are, or are not, fair indications of size of proposed bridge.

   The above bridges are a good indication of the size required. Some are slightly oversized for the watershed area.

3. Reasons for changes in height or length from that of old bridge:

   There was no bridge here originally. A new bridge is required because Elm Street is being extended across Catfish Creek. The new deck elevations conform with the proposed road grade as shown on the profile.

4. Is ditch, stream, or river gradient liable to be lowered? NO

5. Is a temporary detour required? NO

   Who will build it? —

   Who will maintain it? —

6. Information and evidence of extreme flooding was obtained from local residents, and reflects Highest Water Elevation in the area of this construction to be 84.5 and the Lowest Water Elevation to be 73.2.

7. Has approval been obtained under Navigable Waters Protection Act? NO

8. Road Design Information: Estimated A.D.T. NEW ROAD vehicles
   Design Speed 60 m.p.h.
   Stopping Sight Distance 600 feet

STRUCTURE DATA

1. Net Span Length and Type of Bridge: 65' SPAN RIGID FRAME
2. Roadway Width on Bridge: 32'
3. Number and Width of Sidewalks: TWO AT 3'-0"
4. Skew Angle: 12° RIGHT SIDED
5. Total Length and Type of Piling: —
6. Approx. Volume of Concrete: 368.0 cu. yds.
7. Approx. Weight of Str. Steel — Tons
8. Approx. Weight of Reinforcement 35 Tons
9. Approx. Volume of Approach Fill 100' Each Side of Structure 4000 Cu. yds.
10. Drainage Area 43.0 Sq. mi.

Field Investigation Made JAN. 18, 1964 By A. M. SPRIET, SURVEY ENGINEER

ELM STREET BRIDGE

AYLMER ONTARIO

OWNER
COUNTY
TOWN

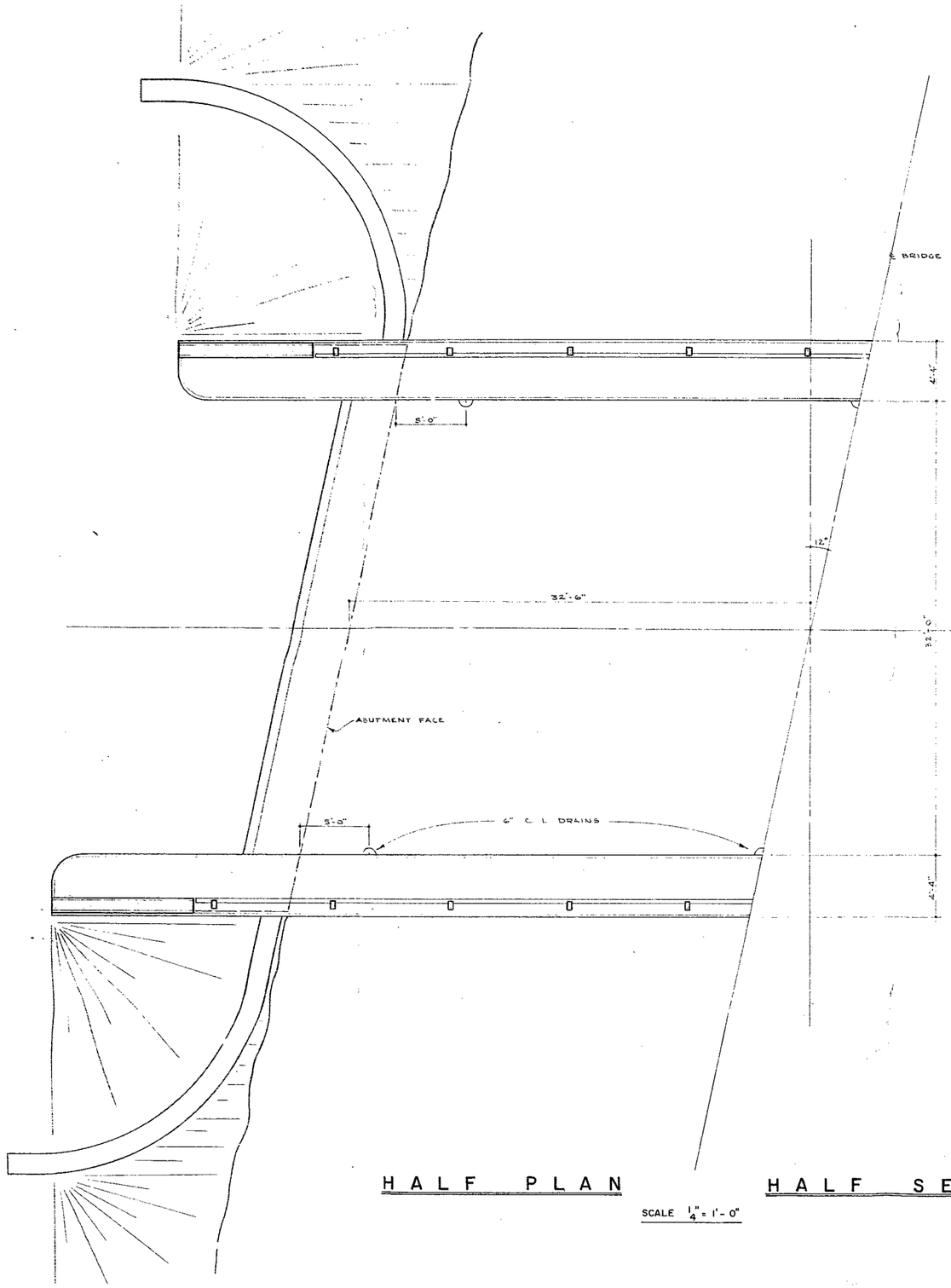
MUNICIPAL DISTRICT NO.
STREET

SITE PLAN

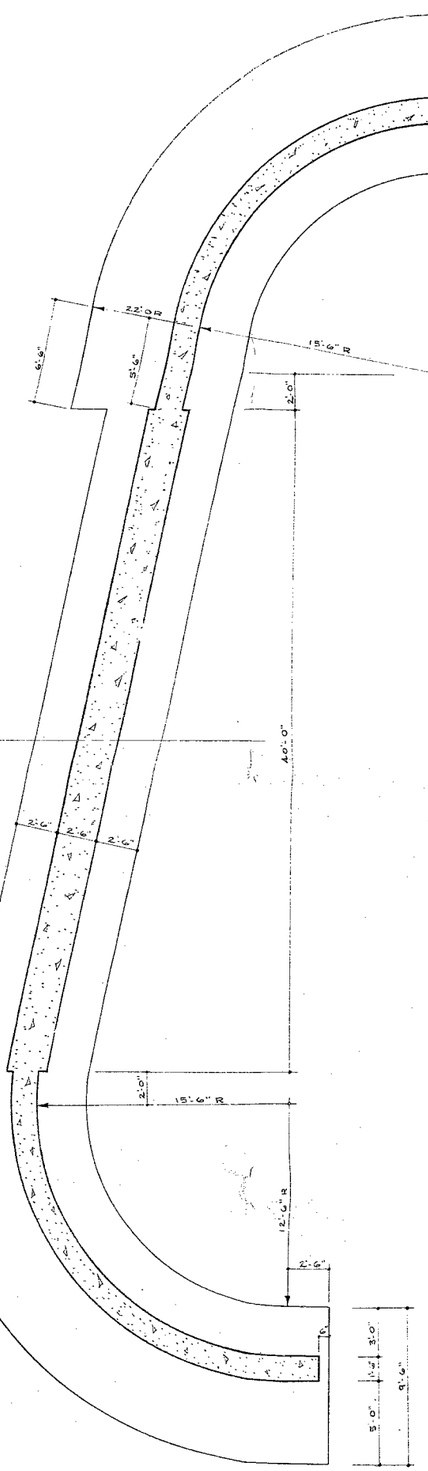
SCALE: AS NOTED | APPROVED BY: | JOB NO. 6354 | DRAWN BY A.J.D.
DATE: 31-1-64 | REVISED

R. G. MOORE P. ENG.
COUNTY ENGINEER COUNTY OF ELGIN

DRAWING NUMBER 1



HALF PLAN



HALF SECTION

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

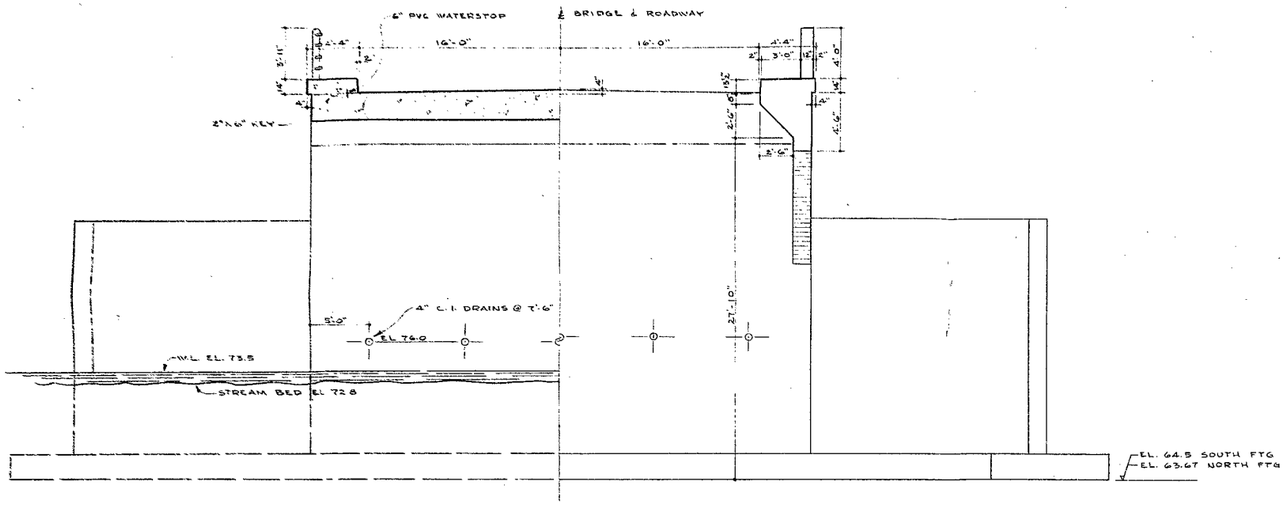
ELM STREET BRIDGE

COUNTY OF ELGIN

SCALE: AS NOTED	APPROVED BY:	JOB NO. 6354	DRAWN BY A.J.D.
DATE: 31-1-64			REVISED

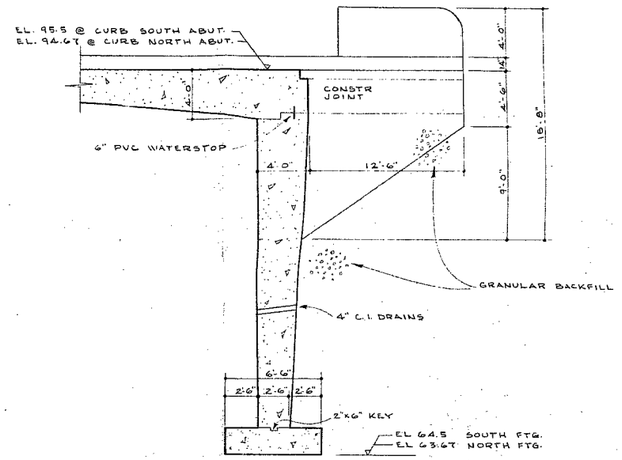
PLAN & SECT

DRAWING NUMBER 2



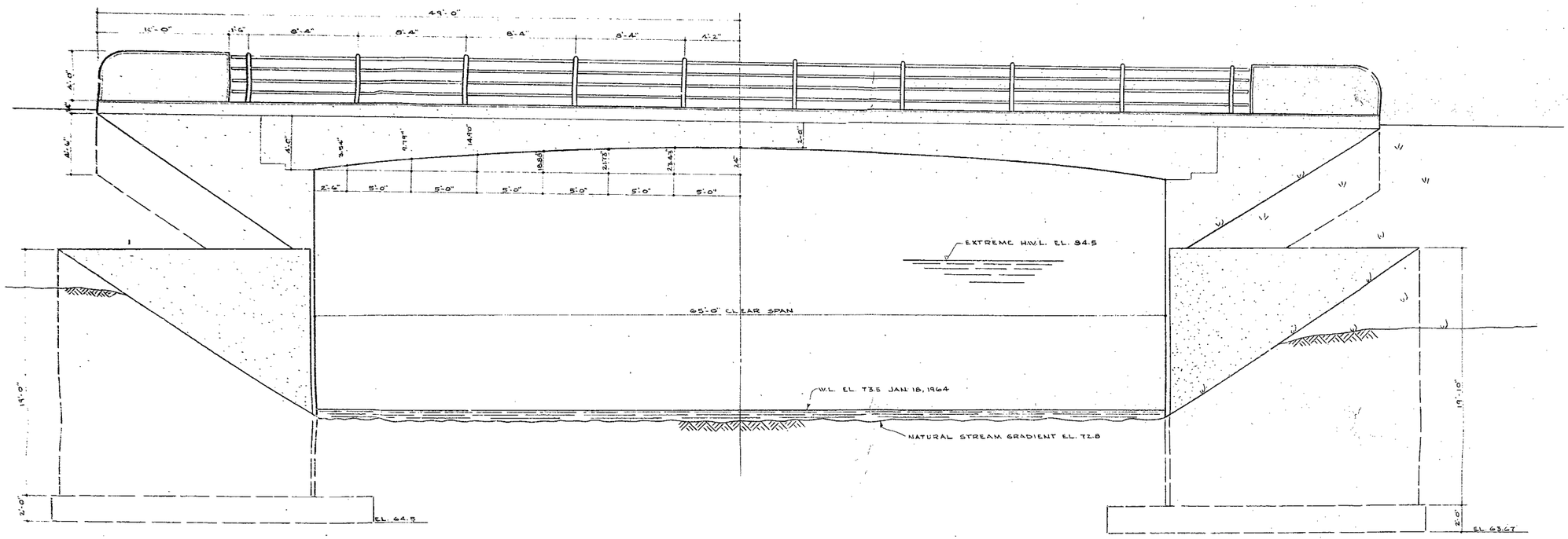
HALF CROSS SECTION HALF END VIEW

SCALE $\frac{3}{16}$" = 1'-0"



SECTION

SCALE $\frac{3}{16}$" = 1'-0"



ELEVATION

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

ELM STREET BRIDGE

COUNTY OF ELGIN

SCALE: AS NOTED | APPROVED BY: | JOB NO. 6354 | DRAWN BY A.J.D.

DATE: 31-1-64 | REVISED

ELEV. & SECT.

DRAWING NUMBER 3