

MEMORANDUM

cc: GEN. FILES
Dist. 28-2

To: Mr. R. G. Gascoyne,
Functional Planning Engr.,
South-Western Region (London).

FROM: Foundation Section,
Materials and Testing Div.,
Room 107, Lab. Bldg.

DATE: December 20, 1965

JAN 17 1966

OUR FILE REF.

IN REPLY TO

SUBJECT:

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
Functional Study of Proposed Hwy. 126
Extension Crossing of Kettle Creek in
St. Thomas, District 2 (London)
W.J. 65-F-123 -- W.P. (Nil)

In order to provide the necessary information for the functional study, we are forwarding to you, four (4) copies of our Preliminary Foundation Investigation Report on subsoil conditions existing at the above site.

We believe that the factual data and recommendations contained therein, although preliminary in nature only, will prove adequate for your present requirements.

Should there be any queries regarding this report, please do not hesitate to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. R. G. Gascoyne (4)
B. R. Davis
A. Gater
H. C. Dernier
J. Roy

Foundations Office (2)
Gen. Files

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

PRELIMINARY
FOUNDATION INVESTIGATION REPORT

For
Functional Study of Proposed Hwy. 126
Extension Crossing of Kettle Creek in
St. Thomas, District 2 (London)
W.J. 65-F-123 -- W.P. (111)

A request was received in November, from Mr. A. McConnell, Regional Project Planning Engineer, London, to carry out a preliminary foundation investigation at the crossing of the proposed Highway 126 extension and Kettle Creek.

Subsequently, an investigation was carried out by this Section, in order to determine the subsoil conditions existing at the site. Field data and laboratory test results are presented in this report, together with our recommendations pertaining to future structure foundations and embankments.

At the proposed site, Kettle Creek has cut into Pleistocene glacial deposits to create a wide plain flanked on the north and south by steep banks of approximately 70 feet and 60 feet, respectively. The present creek flows in a channel approximately 12 feet deep at the toe of the north bank.

Three sampled boreholes and five cone penetration tests were conducted along the proposed centre line. The location of these holes and the soil stratigraphy encountered, are given in the Appendix of this report.

In general, the north bank is composed of a very stiff to hard clayey silt with some sand and gravel (glacial till). 'N' values varied from 18 to 57 blows per foot, except at the end of the borehole which was terminated in the material with an 'N' value in excess of 100 blows per foot.

The plain area is covered by a relatively recent fluvial deposit of loose silty sand or firm clayey silt and sand, approximately 6 feet thick,

which is underlain by very hard clayey silt (glacial till). 'N' values varied from 55 to much in excess of 100 blows per foot. This deposit extends to a considerable depth and was proven to 51.5 feet on the north side and to 39.5 feet on the south side of the plain area. The deposit is broken at a depth of 16 feet by a 7-foot thick layer or pocket of very dense sand with some silt on the south side of the plain area.

The proposed highway grade would require a bridge structure and a high embankment. Precise details of the structure and embankment were not determined when this report was prepared; however, no foundation problems are anticipated for the bridge structure. The material in the north bank is suitable for the use of a spread footing type of foundation. A pile foundation could also be used, if desired, for hydrological reasons. Although the material in the plain area is excellent for the use of a spread footing type of foundation, the height of the embankment might necessitate the use of piles driven through the fill and into the natural ground a relatively short distance.

No foundation problem is anticipated for the embankment, and no stability problems are anticipated for any cut required through the north bank.

The field investigation was carried out in November 1965, using equipment owned and operated by F. E. Johnston Co., under the supervision of Mr. L. Palmer, Project Foundation Engineer, who subsequently prepared this report.

The entire project was under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

December 1965.

APPENDIX I

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma'}$
C_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
K_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

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DOWN LONR 1 NOV 9/65 11.10A

A STERMAC FOUNDATION ENGR

RE HWY 126 EXTENSION, LONDON TO ST. THOMAS

KETTLE CREEK CROSSING IN CITY OF ST. THOMAS.

THE PUBLIC UTILITIES COMMISSION OWN ALL THE LAND ON EACH SIDE OF
THIS RIVER AND HAVE NO OBJECTIONS TO YOU PUTTING IN A DRILL RIG.

THEY WOULD LIKE A COPY OF THE RESULTS FOR THEIR CONSULTING ENGINEER
BUT WILL NOT BE ON THE SITE DURING YOUR WORK.

A MCCONNEL REG PROJ PLAN ENGR

1965 NOV 26 PM 4:20

DOWN LONR ⁶ NOV 26/65 3.49P

M DEVTA FOUNDATION SECTION

RE PROPOSED HWY 126 EXTENSION AND KETTLE CREEK CROSSING IN
ST. THOMAS, DIST 2, LONDON.

FURTHER TO YOUR PHONE CALL OF NOV. 26/65, AND UPON CHECKING OUR FILE,
I FIND THAT NO LETTER OF REQUEST FOR THIS FOUNDATION INVESTIGATION
WAS EVER WRITTEN. IT WAS BROUGHT ABOUT AS A RESULT OF A PHONE
CONVERSATION BETWEEN MR. STERMAC AND MYSELF. ONE T. T. OF NOV. 9/65
TO MR. STERMAC INDICATES THE OWNERSHIP OF LAND INVOLVED AND THAT
THE OWNER HAS NO OBJECTIONS TO US DRILLING ON THISLAND. TO PROVIDE
YOU WITH THIS REQUEST, I STATE THE FOLLOWING:-

WOULD THE FOUNDATION SECTION CARRY OUT A PRELIMINARY FOUNDATION
INVESTIGATION AT THE PROPOSED CROSSING OF KETTLE CREEK AND HWY 126
EXTENSION AS SHOWN ON PLANS PROVIDED TO MR. L. PALMER IN OUR OFFICE.
{ THE INVESTIGATION SHOULD INDICATE THE FEASIBILITY OF LOCATING A
STRUCTURE AT THIS LOCATION. KINDLY PROVIDE US WITH A REPORT ON
THIS MATTER AS SOON AS POSSIBLE.

I TRUST THIS WILL ADEQUATELY COVER YOUR WORK IN THIS MATTER.

NO BETTER PLANS THAN THOSE ALREADY PROVIDED TO YOU ARE YET AVAILABLE.

A MCDONNELL REG PROJ PLAN ENGR

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MATERIALS & TESTING DIVISION

JOA 65-F-123

LOCATION Hwy 126 Extension, 81475 on E

ORIGINATED BY L.P.

W. P.

BORING DATE Nov. 16, 1965.

COMPILED BY L.P.

DATUM Contours.

BOREHOLE TYPE Washboring.

CHECKED BY M.D. *AK*

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W	BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	SHEAR STRENGTH P.S.F.	WATER CONTENT % WP — W — WL	P.C.F.		
761.5	Groundlevel								
0.0	Silty clay to clayey silt. Very stiff to hard, some sand, occasional gravel. Brown.								
			1	SS	27				
			2	SS	62				
			3	SS	44				
			4	SS	49				
747.5			5	SS	37				
14.0	Clayey silt - very stiff to hard. Some sand and gravel. (Till).		6	SS	43				
			7	SS	57				
			8	SS	18				
			9	SS	39				
			10	SS	39				
			11	SS	31				
			12	SS	49				
			13	SS	51				
702.0		14	SS	63 2/3"					
59.5	Borehole Terminated.								

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— wp	WATER CONTENT ——— w		
695.0	Groundlevel											
0.0	Silty sand - Loose, brown, trace of organics.		1	SS	8	690						
689.0			2	SS	55							
6.0	Clayey silt - Hard, some sand and gravel. (Till), grey.		3	SS	127							
			4	SS	104							
			5	SS	70/6"	680						
			6	SS	60/6"							
			7	SS	65/6"	670						
			8	SS	59/6"							
			9	SS	70/6"	660						
			10	SS	73							
			11	SS	103	650						
			12	SS	71							
643.5	Porehole Terminated.					640						

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-123

LOCATION Hwy 126 Extension, 68+00 on E

ORIGINATED BY L.P.

W. P.

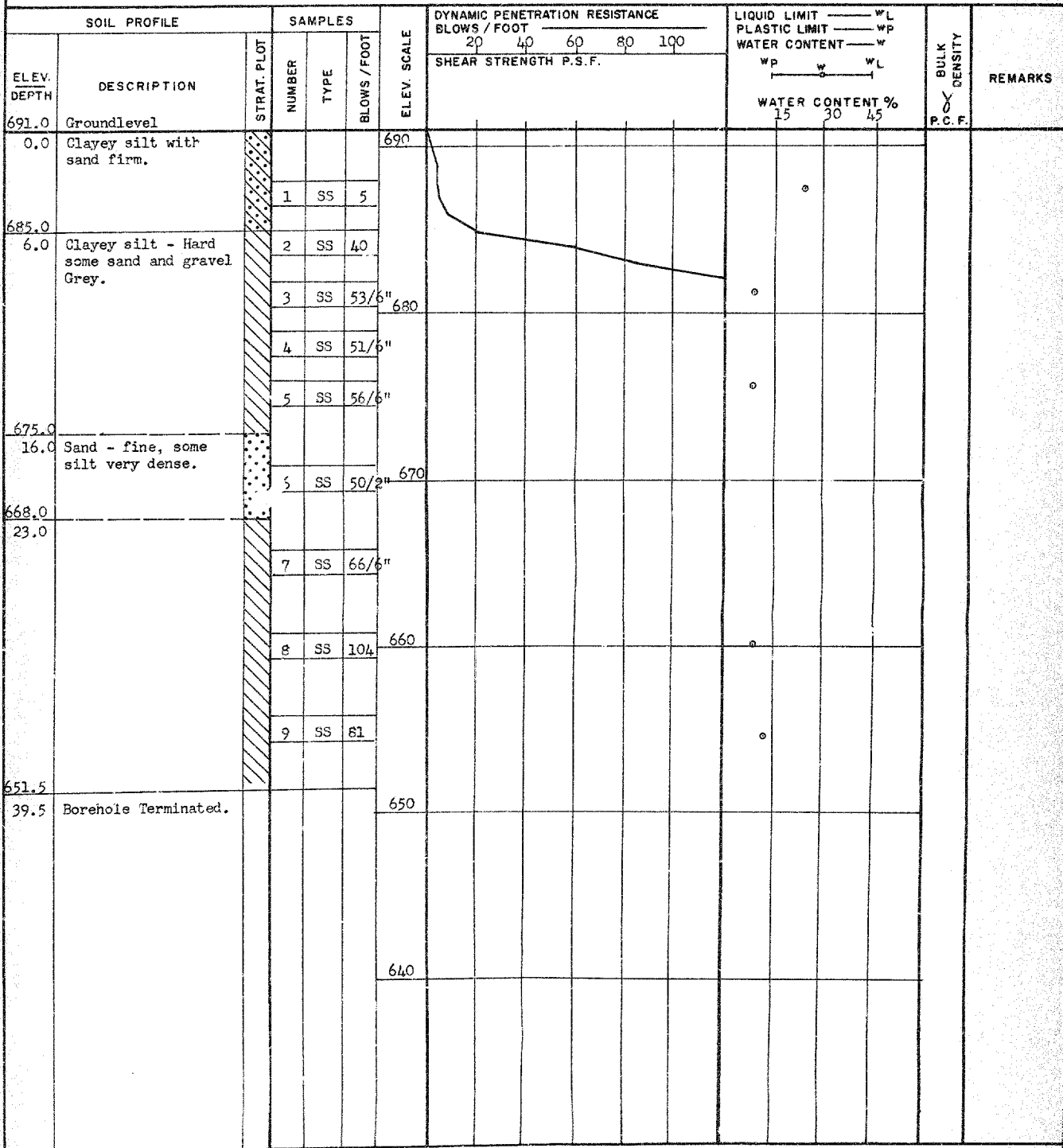
BORING DATE Nov. 23, 1965.

COMPILED BY L.P.

DATUM Contours

BOREHOLE TYPE Washboring.

CHECKED BY M.D.



[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
RECORD OF BOREHOLE NO. 5
FOUNDATION SECTION

MATERIALS & TESTING DIVISION

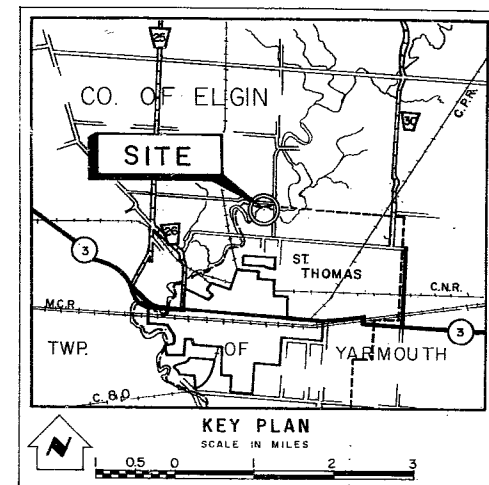
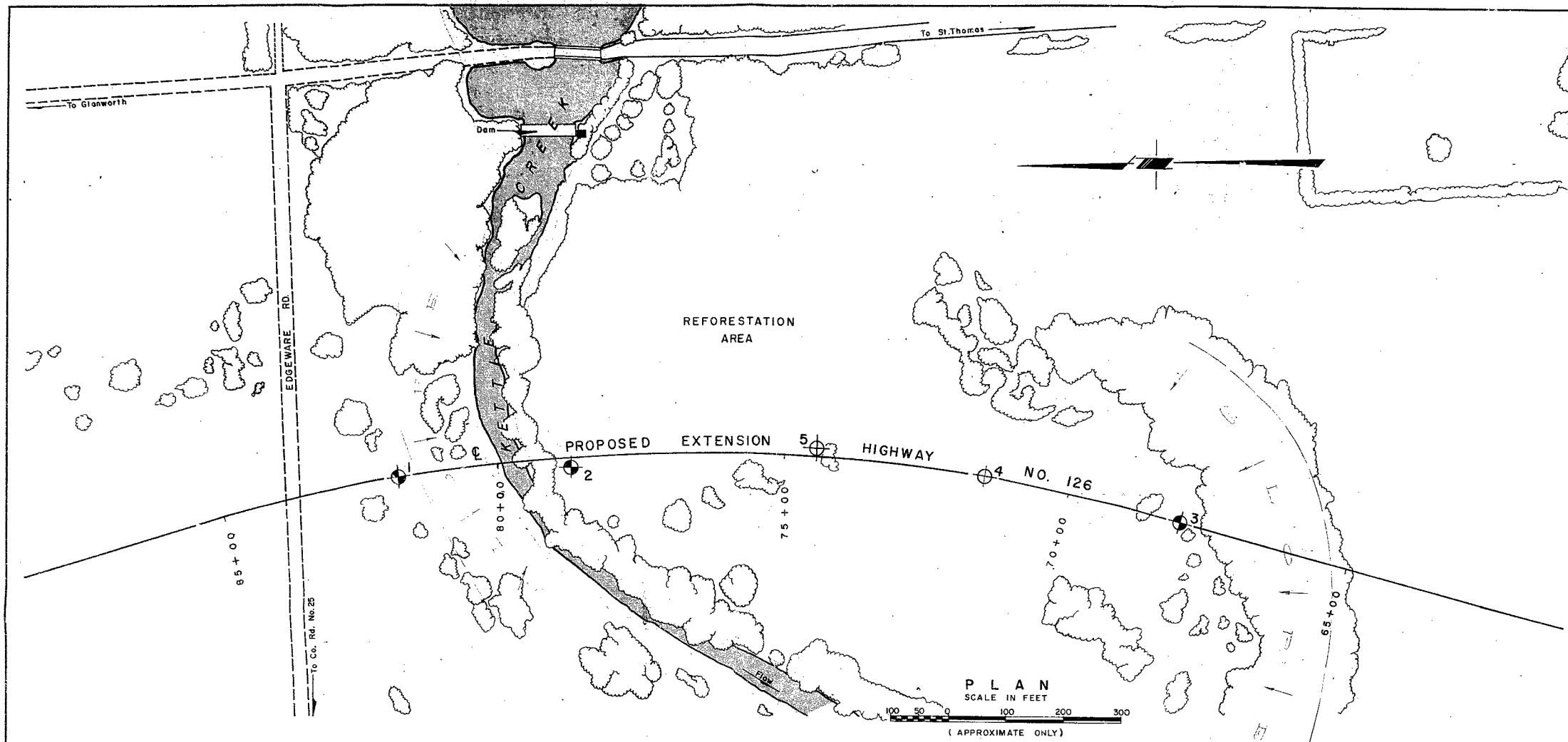
JOB 65-F-123
LOCATION Hwy 126 Extension, 7 1/2' 12' Rt.
ORIGINATED BY L.P.

W.P.
BORING DATE Nov. 24, 1965.
COMPILED BY L.P.

DATUM Contours
BOREHOLE TYPE Dynamic Cone Penetration.
CHECKED BY M.D.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W Wp — W — WL WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT					
692.5 0.0	Groundlevel					690				
680.5 12.0	End of Cone Test.					680				
						670				

#65-F-123
Hwy #126
EXTENSION
CROSSING
KETTLE CREEK

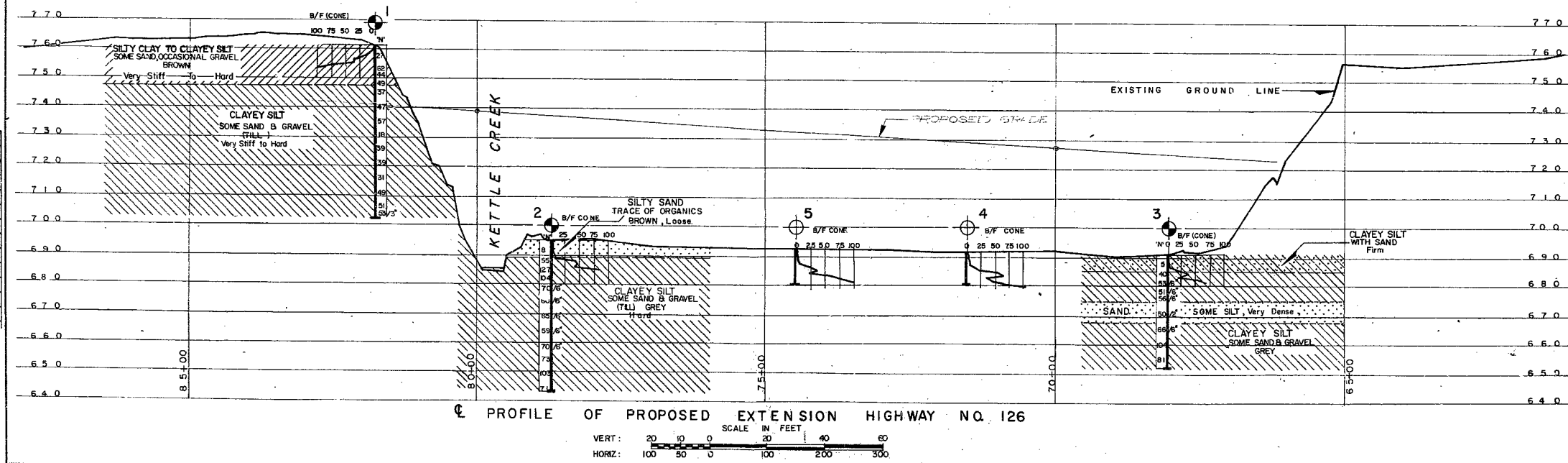


LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation.		

NO.	ELEVATION	STATION	OFFSET
1	761.5	81+75	CENTERLINE
2	695.0	78+72	13' LT
3	691.0	68+00	CENTERLINE
4	691.5	71+56	CENTERLINE
5	692.5	74+47	12' RT

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PRINT RECORD		
NO.	FOR	DATE



DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & TESTING DIVISION - FOUNDATION SECTION			
KETTLE CREEK			
KING'S HIGHWAY NO. 126 PROPOSED EXTENSION DIST. NO. 2			
CO. OF ELGIN		CITY OF ST. THOMAS	
TWP. OF YARMOUTH		LOT CON.	
BORE HOLE LOCATIONS & SOIL STRATA			
SUBM'D. L.P.	CHECKED	W.P. NO.	M.B.T. DRAWING NO.
DRAWN J.N.	CHECKED	JOB NO. 65-F-123	65-F-123 A
DATE 30 DEC. 1965.	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>A. J. Thomas</i>	PRINCIPAL FOUNDATION ENGINEER	CONT. NO.	