

G.I.-30 SEPT. 1976

GEOCRES No. 40I14-66DIST. 2 REGION W.P. No. 88-69-04CONT. No. 73-138W. O. No. STR. SITE No. 5-220HWY. No. LOCATION St. Thomas ExpresswayNo. of PAGES -=====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

XXXXXXXXXXXXXXXXXXXX

MEMORANDUM

401-66

TO: Mr. A. P. Watt,
Regional Bridge Planning Engineer,
LONDON, Ont.

FROM: Foundation Section,
Design Services Branch,
Room 107, Lab. Bldg.

ATTENTION:

DATE: August 26, 1971

OUR FILE REF.

IN REPLY TO

AUG 30 1971

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed Crossing At
Burwell Rd. & St. Thomas Expressway
City of St. Thomas Co. of Elgin
District No. 2 (London)
W.O. 71-11064 -- W.F. 88-69-04

CONT. 73-138

401A-66

GEOCRES No.

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design purposes. Should additional information be required, please feel free to contact our Office.

AGS/ht
Attach

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

c.c. Messrs. A.P. Watt (2)
B.R. Davis
F.G. Allen
D.W. Farren
W. Zonnenborg
L.E. Walker
J. Roy
B.J. Giroux
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Foundation Files
Documents

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF SITE.
 3. FIELD AND LABORATORY INVESTIGATION PROCEDURES.
 4. SUBSOIL CONDITIONS.
 - 4.1) General.
 - 4.2) Fill, Sand and Gravel.
 - 4.3) Clayey Silt to Silty Clay, Traces of Sand & Gravel.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS.
 - 6.1) General.
 - 6.2) Foundations.
 - a) Spread Footings in Original Ground.
 - b) Spread Footings on Compacted Fill.
 - c) Perched Abutments on Short Piles.
 - 6.3) Approach Embankments.
 7. MISCELLANEOUS.
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FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing At
Burwell Rd. & St. Thomas Expressway
City of St. Thomas Co. of Elgin
District No. 2 (London).
W.O. 71-11064 -- W.P. 88-69-04

1. INTRODUCTION:

A request for a foundation investigation at the crossing of Burwell Road and St. Thomas Expressway, was received from Mr. T. P. Hodgson, Bridge Location Engineer, in a memo, dated June 23, 1971.

A field investigation was subsequently carried out by the Foundation Section to determine the subsoil conditions existing at the site. This report contains the results of this investigation and our recommendations pertaining to the design of the proposed structure foundations and approach embankments.

2. DESCRIPTION OF SITE:

The site of the proposed crossing is located in the eastern part of the city of St. Thomas.

The surrounding area is flat with barren land on the west side and cultivated farm land on the east side of Burwell Rd.

Physiographically, the site is located in the region referred to as the Mount Elgin Moraines.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of five sampled boreholes and five dynamic cone penetration tests was carried out during the course of the field work. Boring was achieved by means of a continuous flight auger

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES: (cont'd) ... machine (Penn Drill), and a C.M.E. hollow stem auger machine, adapted for soil sampling and diamond drilling purposes. During the field work, disturbed samples were obtained by means of a standard split-spoon sampler; the energy used in driving it, conformed to the requirements of the Standard Penetration Test. Undisturbed samples were recovered using 2-inch I.D. Shelby tubes which were pushed into the soil hydraulically. Where possible, field vane tests were carried out at elevations 12 inches below sample depths.

Dynamic cone penetration tests were carried out adjacent to each borehole. Driving energy used to advance the cone was 350 ft.-lbs. per blow.

All boreholes were surveyed in the field by personnel from London Region Engineering Survey Section. The locations and elevations of the borings are shown on Drawing No. 71-11064A, which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection, laboratory tests were carried out on selected samples to determine the following physical properties:

Atterberg Limits

Moisture Content

Grain-Size Distribution

Undrained Shear Strength

Bulk Density

Consolidation Characteristics

The results of the field and laboratory tests are summarized on the Record of Borehole sheets contained in the

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES: (cont'd) ...

Appendix to the report.

4. SURSOIL CONDITIONS:

4.1) General:

Generally, uniform subsoil conditions were found to prevail over the area investigated. The subsoil consists of a deep deposit of stiff to hard clayey silt to silty clay with traces of sand and gravel, overlain by 3.0 - 4.5 ft. of compact sand and gravel fill.

The boundaries between various soil types are shown on the Record of Borehole sheets. The estimated stratigraphical profile shown on Drawing No. 71-11064A is based upon this information.

A detailed description of soil types and soil properties is given, as follows:

4.2) Fill, Sand and Gravel:

This material was found in all boreholes, from ground surface downward to depths of 3.0 to 4.5 ft. The material consists of sand and gravel. The single grain-size analysis carried out shows the following distribution:

Gravel.	11%
Sand.	77%
Silt and Clay	12%

Standard Penetration test gave 'N' value of 25 blows/ft., indicating compact relative density.

4. SUBSOIL CONDITIONS: (cont'd) ...

4.3) Clayey Silt to Silty Clay, Traces of Sand & Gravel:

This was the predominant soil deposit, and was encountered in all boreholes. All boreholes were terminated in this stratum. The deepest borehole was 81.5 ft.

The material, in general, consists of clayey silt to silty clay with traces of sand and gravel. There were occasional seams of silt and/or fine sand up to 4 inches in thickness. These seams were apparently randomly distributed and could possibly act as water bearing seams. In Borehole 3, a 1-2 ft. thick layer of sand with some gravel was intersected between elevations 736 and 740.

The consistency of the material varies from stiff to hard. A number of field vane tests were attempted, but it was not possible to turn the vane, - except once, where a shear strength of 1760 p.s.f. was recorded - indicating that the undrained shear strength, in general, was in excess of 2,000 p.s.f. . Only four undisturbed samples were obtained, at places where the material appeared to be softer. Only two laboratory tests were carried out to determine the undrained shear strength, and the results were 1600 and 2060 p.s.f. .

Physical properties of the cohesive portion of the deposit, as determined from laboratory tests are as follows:
(See Figure 1).

		<u>Min.</u>	<u>Max.</u>	<u>Average</u>
Liquid Limit	(%)	26	42	32
Plastic Limit	(%)	15	23	18
Natural Moisture Content	(%)	14	24	21

4. SUBSOIL CONDITIONS: (cont'd) ...

4.3) Clayey Silt to Silty Clay, Traces of Sand & Gravel:
(cont'd) ...

Grain-size analyses on the same samples indicate the following distributions, and are plotted on Figure 2.

		<u>Min.</u>	<u>Max.</u>	<u>Average</u>
Gravel	(%)	0	5	1
Sand	(%)	1	24	7
Silt	(%)	37	84	48
Clay	(%)	15	57	44

5. GROUNDWATER CONDITIONS:

The following water levels were observed in the boreholes at the time of investigation.

Borehole	1	Elevation	714.7 ft.
Borehole	3	Elevation	754.6 ft.

No water levels were established in Boreholes 2, 4 and 5.

The water in Borehole 3 came from the sand and gravel layer, which was intersected at a depth of about 30 ft. It is believed to be perched water.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a four-span (35'-61'-61'-35') underpass structure at the crossing of St. Thomas Expressway and Burwell Road. The proposed grade of the St. Thomas Expressway will be at approximate elevation 766, i.e., about 4 ft. below the present

6. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

6.1) General: (cont'd)

grade of Burwell Road. The future grade of Burwell Road will be at approximate elevation 787.0, resulting in a maximum approach height of about 21 ft.

In general, the subsoil at the site consists of a deep deposit of stiff to hard clayey silt to silty clay with traces of sand and gravel, underlying 3.0 - 4.5 ft. of compact sand and gravel fill.

6.2) Foundations:

a) Spread Footings in Original Ground:

As described earlier, the shear strength of the subsoil is in general greater than 2,000 p.s.f. . Therefore, it is recommended that the entire structure be supported on spread footings. A safe net pressure of 2.0 tons/sq. ft. may be assumed for design purposes.

b) Spread Footings on Compacted Fill:

As an alternative, the abutments may be supported on spread footings placed on well compacted, suitable granular material within the approach fills. A safe design load of 2.0 TSF may be assumed. The granular material should consist of G.B.C. Class 'A' and should be fully compacted according to the current Standards. A detailed construction scheme is outlined on Figure 3 of the Appendix.

c) Perched Abutments on Short Piles:

As a second alternative, the abutments may be constructed within the approach fills and supported on short piles driven through the fill to approx. elevation 762.0. In the case of

6. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

6.2) Foundations: (cont'd) ...

c) Perched Abutments on Short Piles: (cont'd) ...

12 - 3/4" O.D. and 1/4" thick wall steel tube piles, a safe design load of 25 tons per pile may be used.

It is estimated that the following maximum settlements will occur in the subsoil at various locations over a long period of time following the end of construction.

Pier	- Spread footings in original ground	1.0 - 1.5 inches
Abutment	- Spread footings in original ground	} 3.0 - 4.0 inches 1.5 - 2.0
	Spread footings on compacted fill	
	Perched abutments on short piles	

Regardless of which of the above methods is adopted, the structure should be built to accomodate the possible 3.0 inches differential settlements between the abutments and the piers.

All foundations and pile caps should be protected against frost action by at least 4 ft. of earth cover.

6.3) Approach Embankments:

The shear strength of the subsoil is such that it will be able to safely support the 21-ft. high approach embankments constructed with 2:1 side slopes. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 3 inches.

Based on the performance of structures and embankments built in the same general area and with somewhat similar subsoil conditions, it is estimated that maximum settlements of 3 to 4

6. DISCUSSION AND RECOMMENDATIONS: (cont'd) ...

6.3) Approach Embankments: (cont'd) ...

inches will occur beneath the abutment locations. To minimize the effect of differential settlements between the abutments and pier footings, it is recommended that the approach embankments be built in advance of the structure for as long a period as possible. The topsoil and the soft organic material should be removed in accordance with the pertinent Standards within the construction area.

7. MISCELLANEOUS:

The field investigation was carried out during the period of July 13 - 15, 1971, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

Equipment was owned and operated by P.V.K. and Sons Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

August, 1971

APPENDIX

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11064 LOCATION 549,570 N. 358,120 E. ORIGINATED BY A.P.
W.P. 88-69-04 BORING DATE July 13 - 14, 1971 COMPILED BY A.P.
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger, & Cone. CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					WATER CONTENT % 10 20 30
769.7	Ground level.															GR. SA. SI. CL.	
0.0	Fill																
766.7	Sand & gravel.																
3.0	Clayey silt to silty clay, Traces of sand & gravel. Occasional sand/silt seams. Stiff to hard.		1	SS	11											M 0 2 48 50	
			2	SS	19												L 1 21 43 35
			3	SS	32	760											M 0 5 50 45
			4	SS	21												
			5	SS	14												
			6	SS	20	750											L 1 7 52 40
			7	SS	15												
			8	SS	19												
			9	SS	18	740											M 1 3 46 50
			10	SS	15												
			11	SS	23	730											
			12	SS	30	720											2 24 42 32
																	▼ 714.7
			13	SS	29	710											
		14	SS	31	700											5 4 54 37	
688.2			15	SS	48	690										0 1 75 24	
81.5	End of borehole.																
						680											

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-11064

LOCATION 549,537N. 358,144 E.

ORIGINATED BY A.P.

W.P. 88-69-04

BORING DATE July 15, 1971

COMPILED BY A.P.

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	w_p	w	w_L		
769.9	Ground level.															
0.0	Fill															
766.9	Sand & gravel.															
3.0	Clayey silt to silty clay, Traces of sand & gravel. Occasional sand/silt seams. Stiff to hard.		1	SS	18											
			2	SS	20											
			3	SS	34	760										
			4	SS	29											
			5	SS	26											
			6	SS	24	750										
			7	SS	10											
			8	TW	PH											
			9	SS	24	740										
733.4			10	SS	36											
36.5	End of borehole.					730										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11064

LOCATION 549,472N. 358,119E.

ORIGINATED BY A.P.

W.P. 88-69-04

BORING DATE July 13, 1971

COMPILED BY A.P.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger, and Cone

CHECKED BY *AK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					PLASTIC LIMIT ——— w_p					
							20	40	60	80	100	WATER CONTENT ——— w					
							SHEAR STRENGTH P.S.F.					w_p ——— w ——— w_L					
							○ UNCONFINED + FIELD VANE					WATER CONTENT %					
							● QUICK TRIAXIAL x LAB. VANE					10 20 30					
769.7	Ground level.																
0.0	Fill																
765.2	Sand & gravel.		1	SS	25											11 77 (12)	
4.5	Compact.		2	SS	40											5 7 50 38	
	Clayey silt to silty clay, Traces of sand & gravel. Occasional sand/silt seams. Stiff to hard. Sand & Gravel.		3	SS	31	760										LTCL	
			4	SS	17												0 6 43 51
			5	SS	13	750											MCL
			6	SS	24												755.7
			7	SS	73	740											0 3 37 60
			8	SS	20												M.C.I.
			9	SS	45	730											13 79 (8)
																	LTCL
728.2	Sand															3 18 43 36	
41.5	End of borehole.					720											

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 71-11064

LOCATION 549,411 N. 358,147 E.

ORIGINATED BY A.P.

W.P. 88-69-04

BORING DATE July 15, 1971

COMPILED BY A.P.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger, & Cone.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS/FOOT	20	40	60	80	100	10	20		
768.7	Ground level															
0.0	Fill															
765.7	Sand and gravel.															
3.0	Clayey silt to silty clay, traces of sand and gravel Occasional sand/silt seams Stiff to hard.		1	SS	21											
			2	SS	24											
			3	SS	21											
			4	SS	16											
			5	TW	PH											
			6	SS	19											
			7	SS	17											
			8	SS	17											
			9	SS	16											
			10	SS	19											
729.7	Silt		11	SS	25											
39.0	End of Borehole															

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 71-11064 LOCATION 549,376 N. 358,119 E.

ORIGINATED BY A.P.

W.P. 89-66-04 BORING DATE July 14, 1971

COMPILED BY A.P.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger, & Cone.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _P	W	W _L		
769.8	Ground level.															
0.0	Fill															
766.8	Sand & Gravel.															
3.0	Clayey silt to silty clay, Traces of sand & gravel. Occasional sand/silt seams. Stiff to hard.		1	SS	17											
			2	SS	37											
			3	SS	41											
			4	SS	27	760										
			5	SS	27											
			6	SS	22											
			7	SS	17	750										
			8	SS	17											
			9	SS	22	740										
			10	SS	18											
			11	SS	21	730										
			12	SS	31											
			13	SS	58	720										
			14	SS	46	710										
			15	SS	42	700										
688.3			16	SS	42	690										
81.5	End of borehole.															
						680										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 5A

JOB 71-11064

LOCATION STA 101+00 Burwell Rd

CO-ORDS: 549373N 358131.9E

ORIGINATED BY L.J.H.

W.P. 88-69-04

BORING DATE JAN 30, 1974

COMPILED BY L.J.H.

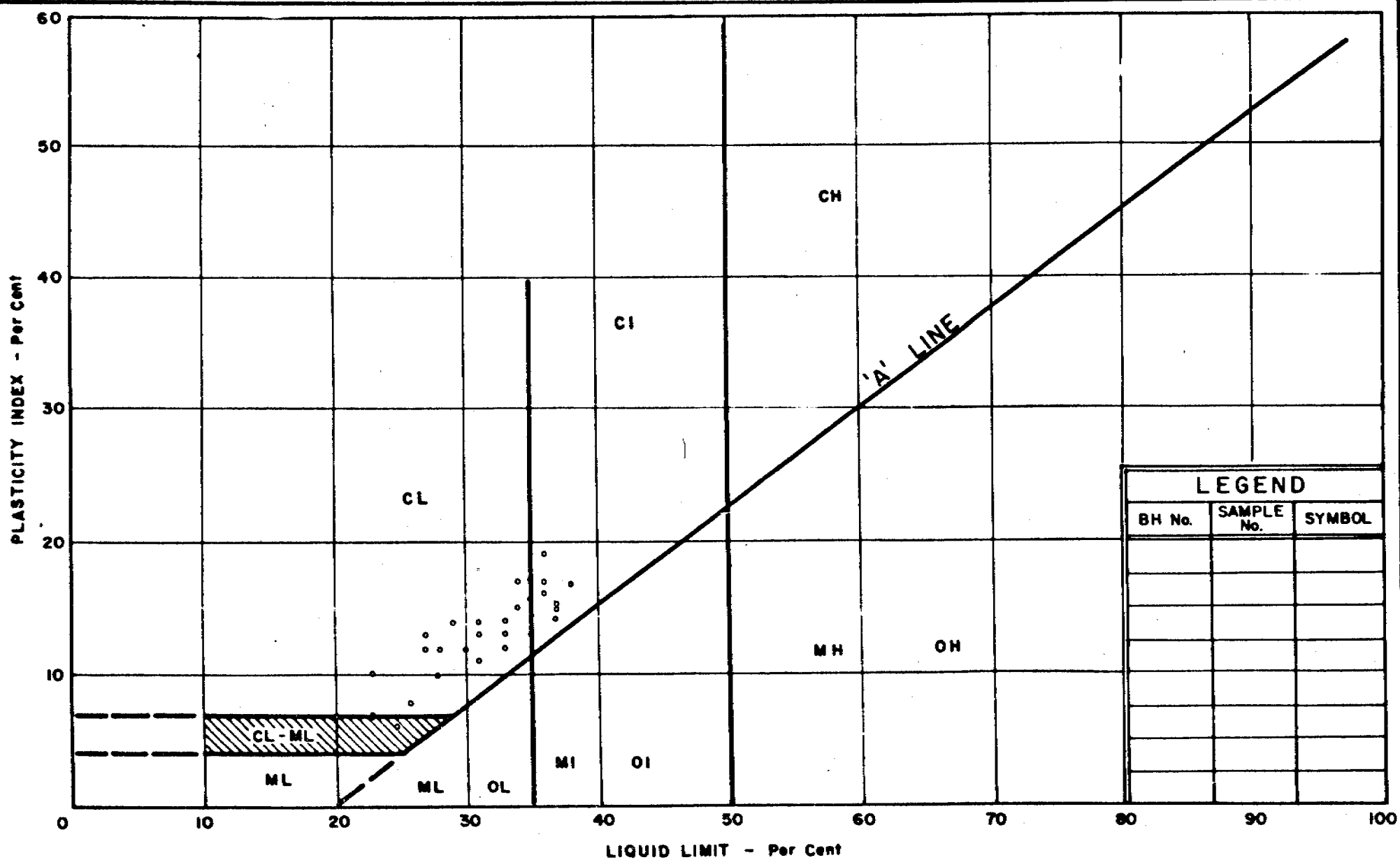
DATUM GEODETIC

BOREHOLE TYPE CONTINUOUS FLIGHT AUGER

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT		PLASTIC LIMIT — W_P	WATER CONTENT — W		
766.5 0.0	GROUND LEVEL						SHEAR STRENGTH P.S.F.		WATER CONTENT %			
							O UNCONFINED + FIELD VANE		W_P — W — W_L			
							● QUICK TRIAXIAL X LAB VANE					
						760						
						750						
						740						
						730						
						720						
						710						
						700						
						690						
684.0												
82.3	Glacial Till, Clayey silt, some sand and gravel grey Hard.		1	SS	215	680						
670.5												
96.0	END of Borehole		2	SS	180/10	670						

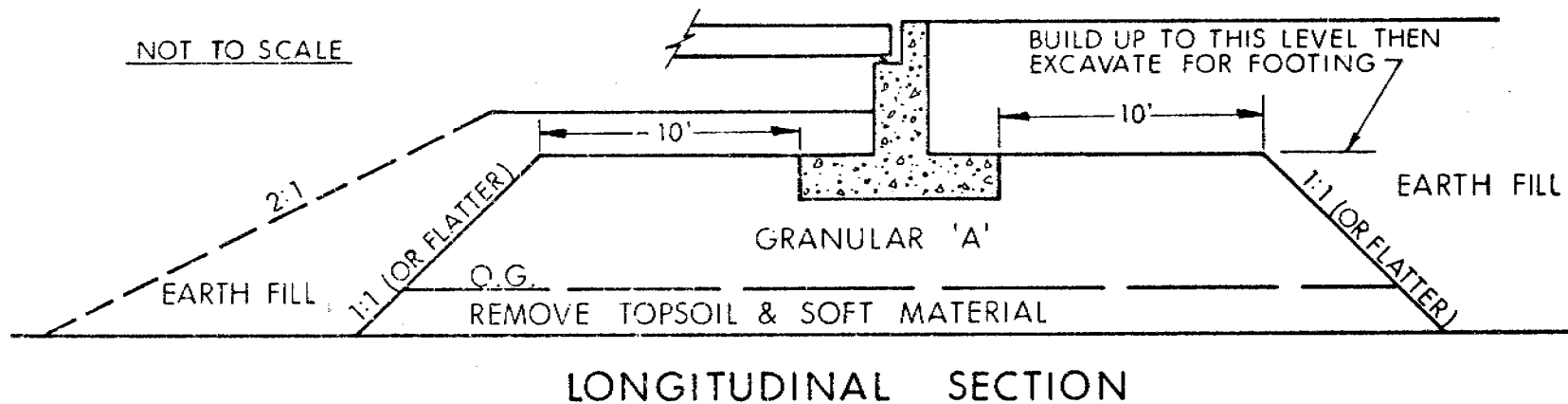
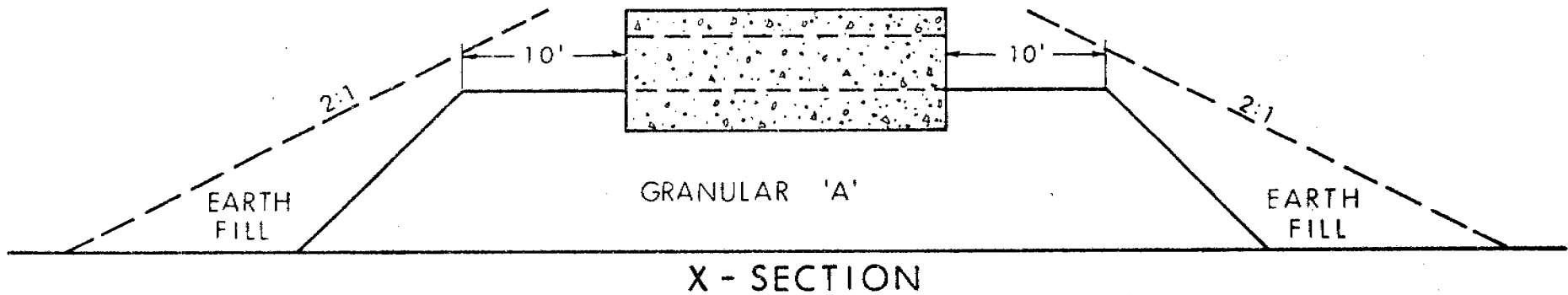
OFFICE REPORT ON SOIL EXPLORATION



PLASTICITY CHART
CLAYEY SILT TO SILTY CLAY
TRACES OF SAND & GRAVEL

FIG. 1

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



NOTES

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A'.
- 2 - PLACE GRANULAR 'A' TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT D.H.O. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

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 INTERCEPT
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_0	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

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 :-

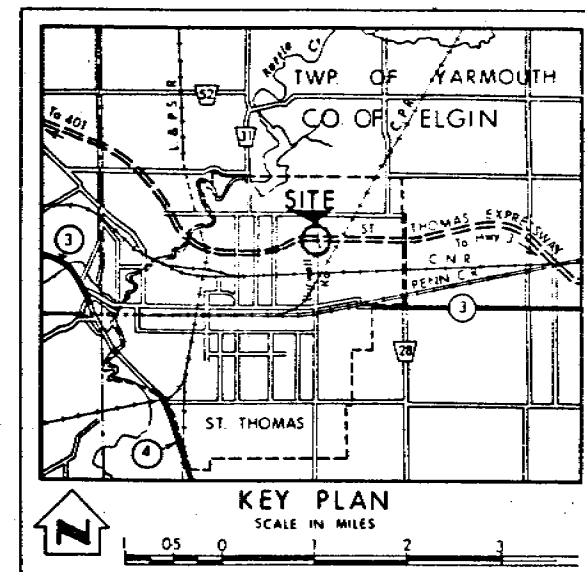
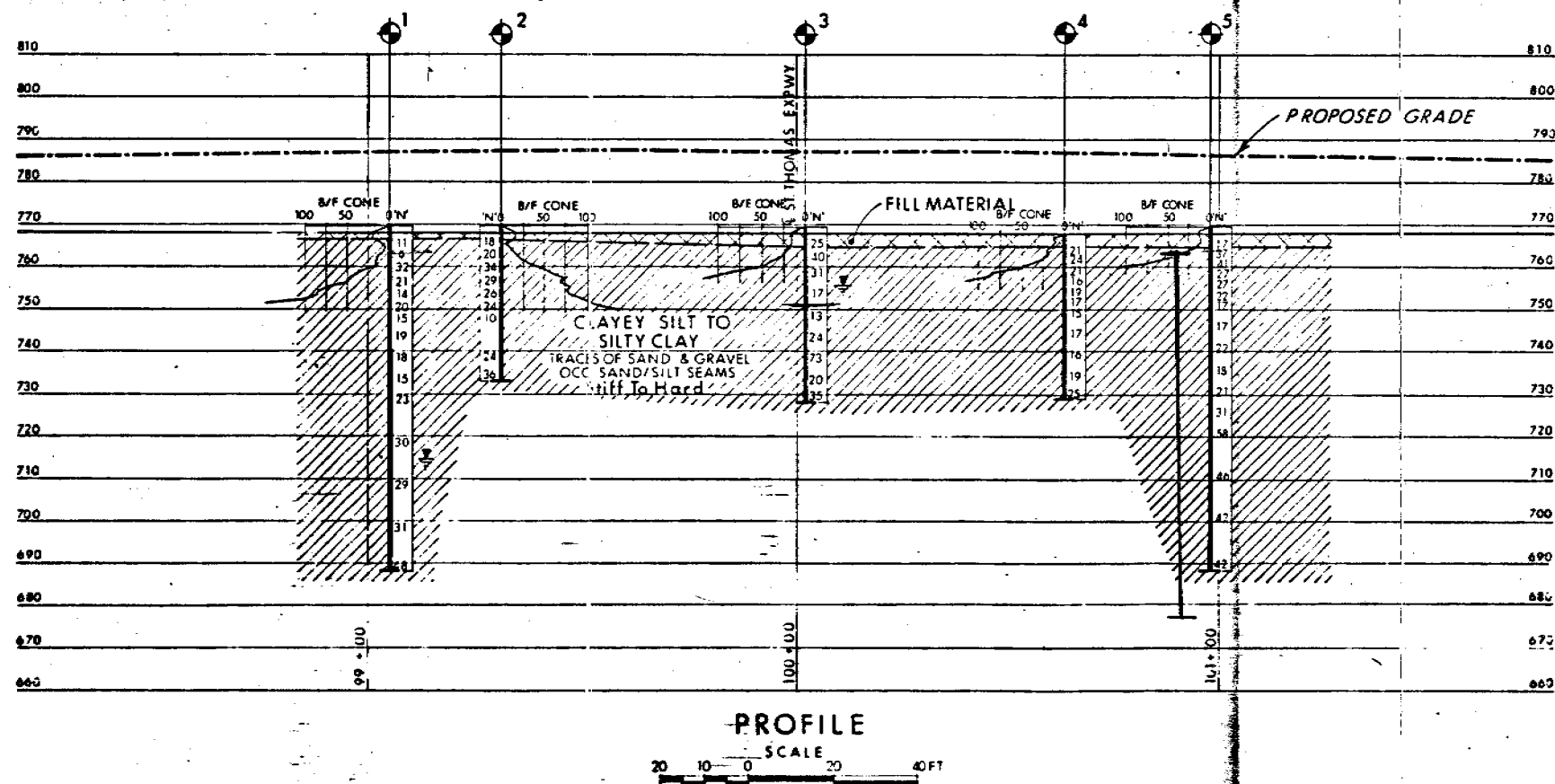
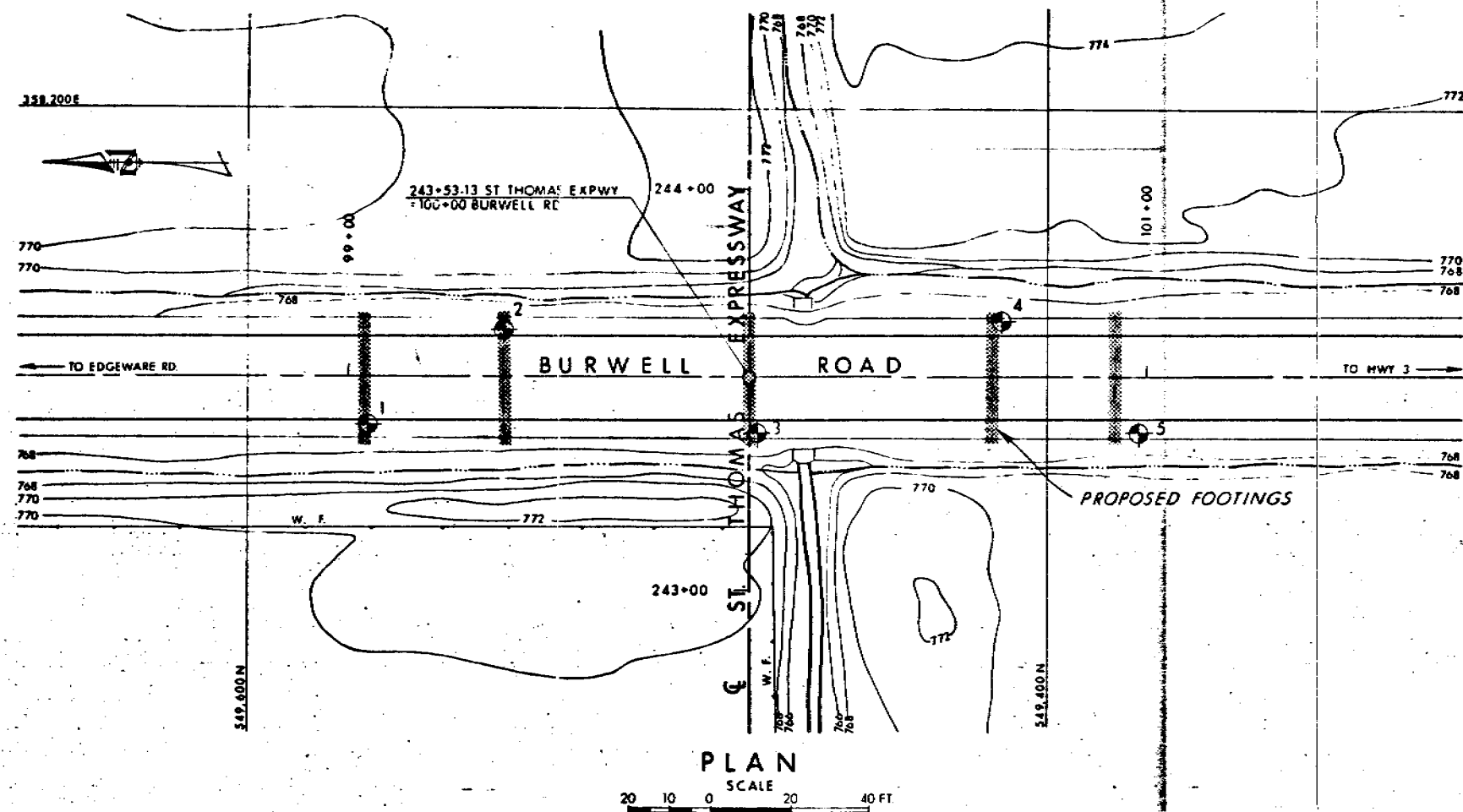
<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	>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



LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊗ Bore Hole & Cone Test
- ≡ Water Levels established at time of field investigation JULY 1971
- Water Levels not established in Boreholes 2, 4 & 5.

NO	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	769.7	549,570	358,120
2	769.9	549,537	358,144
3	769.6	549,472	358,119
4	768.7	549,411	358,147
5	769.8	549,376	358,119

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.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH—FOUNDATION OFFICE

BURWELL ROAD

HIGHWAY NO. ST. THOMAS EXPRESSWAY DIST. NO. 2
CO. ELGIN CITY OF ST. THOMAS
TWP. YARMOUTH LOT. CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMIT A.P. CHECKED	WP NO. 88-69-04	DRAWING NO.
DRAWN BY CHECKED	JOB NO. 71-11064	71-11064 A
DATE AUGUST 23 1971	SITE NO.	BRIDGE DRAWING NO.
APPROVED	CONT. NO.	