

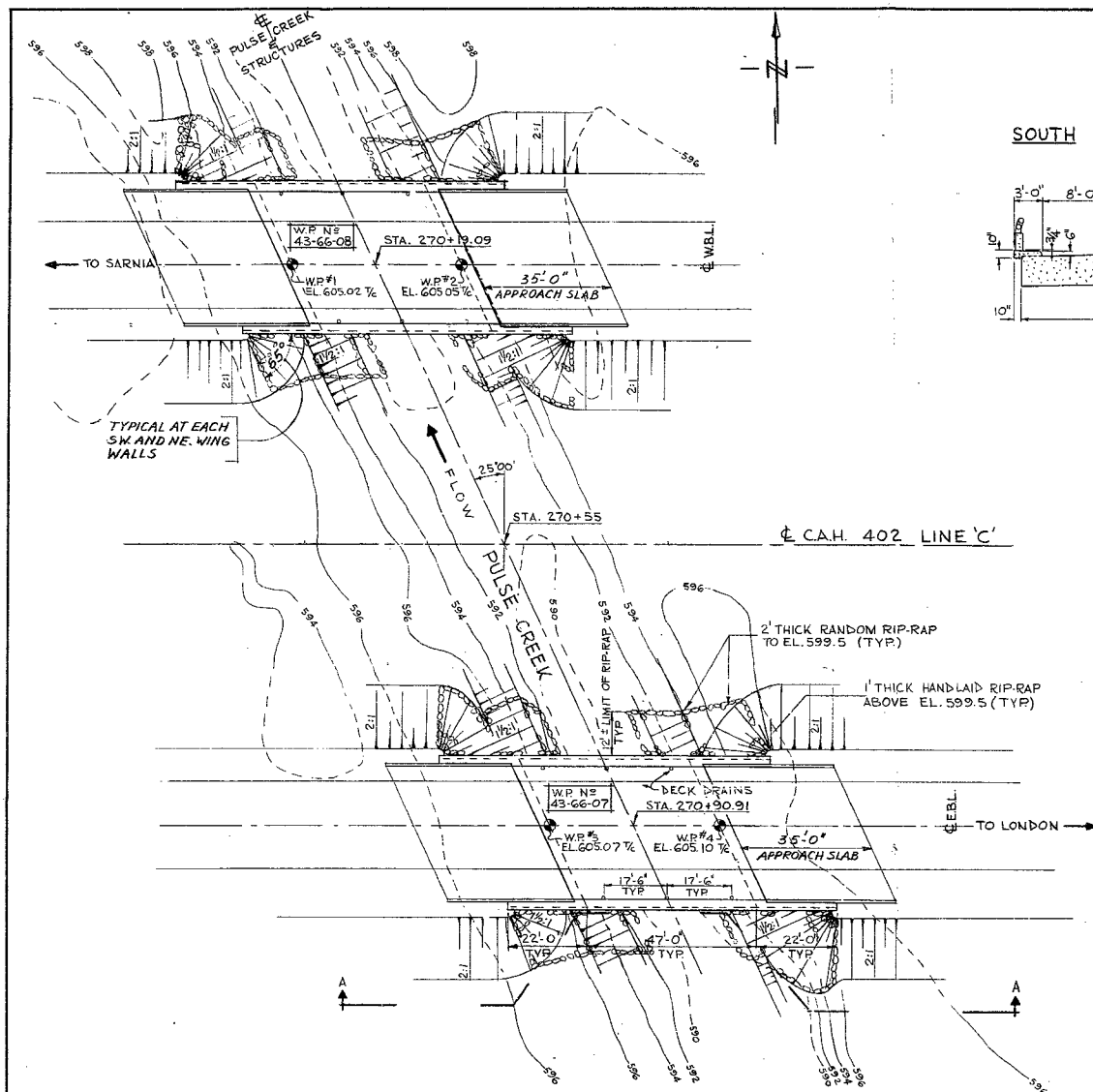
#69-F-94

W.P. 43-66-07 AND 08

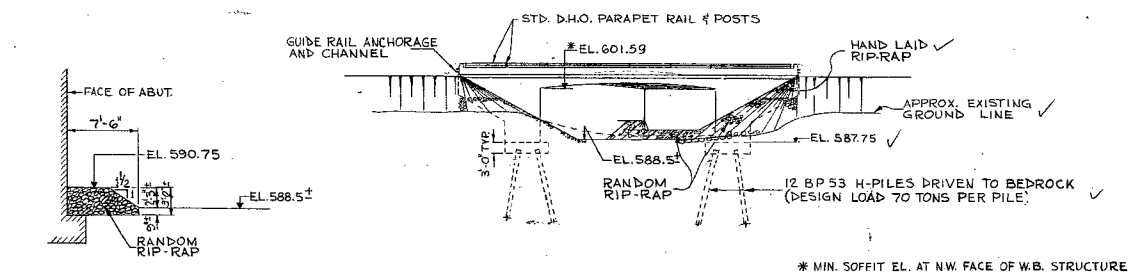
H.W.Y. #402, LINE 'C,'

AND CAH.

PULSE CREEK

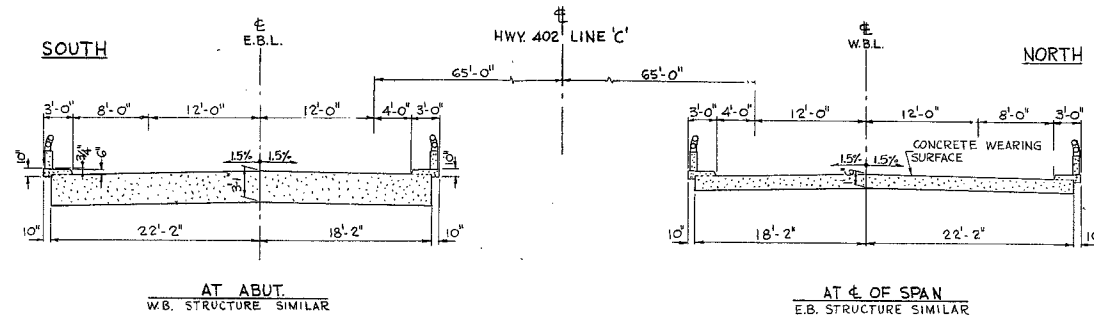


PLAN  
SCALE: 1"=20'-0"



RIP-RAP UNDER STRUCTURE  
SECTION A TO ABUTMENT  
N.T.S.

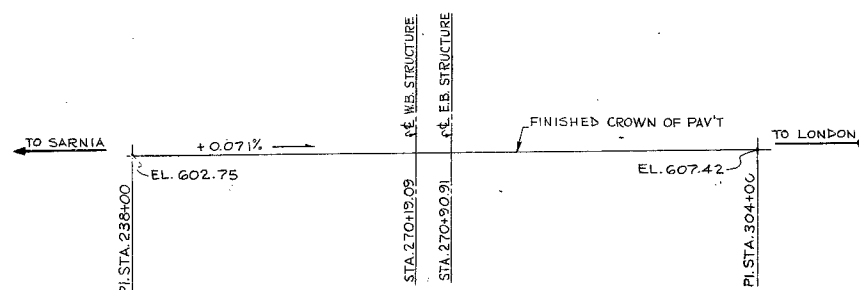
ELEVATION A-A  
SCALE: 1"=20'-0"



TYPICAL DECK SECTION  
SCALE: 1/8"=1'-0"

NOTE:  
T/C DENOTES ELEVATIONS ARE SHOWN TO  
TOP OF CONCRETE WEARING SURFACE.  
W.P. DENOTES WORKING POINT.

25°00' SKEW  
SIN. 0.4226183  
COS. 0.9063078  
TAN. 0.4663077  
SEC. 1.1033779

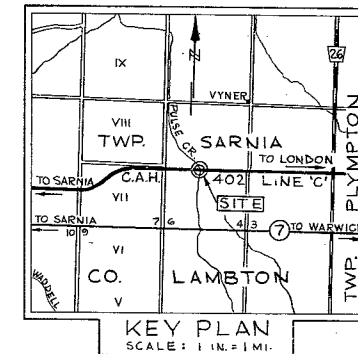
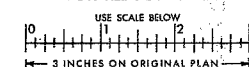


PROFILE OF HWY. 402 LINE 'C'  
N.T.S.

#### LIST OF DRAWINGS

- D-6780-1 GENERAL LAYOUT
- D-6780-2 BOREHOLE LOCATIONS & SOILS STRATA
- D-6780-3 FOOTINGS & PILE LAYOUT
- D-6780-4 FRAME & CURBS
- D-6780-5 WINGWALLS
- D-6780-6 PARAPET WALL DETAILS
- D-6780-7 APPROACH SLABS
- D-6780-8 STANDARD STEEL PARAPET RAIL
- D-6780-9 STANDARD DETAILS

FOR REDUCED PLAN



KEY PLAN  
SCALE: 1 IN. = 1 MI.

#### NOTE

**CLASS OF CONCRETE**  
DECK, CURBS AND PARAPET WALLS 4000 psi  
REMAINDER 3000 psi OR AS NOTED ON DRAWINGS

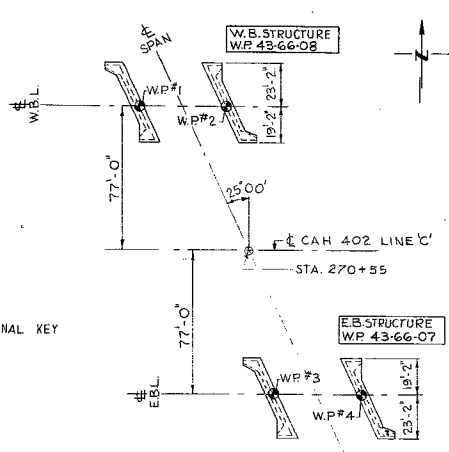
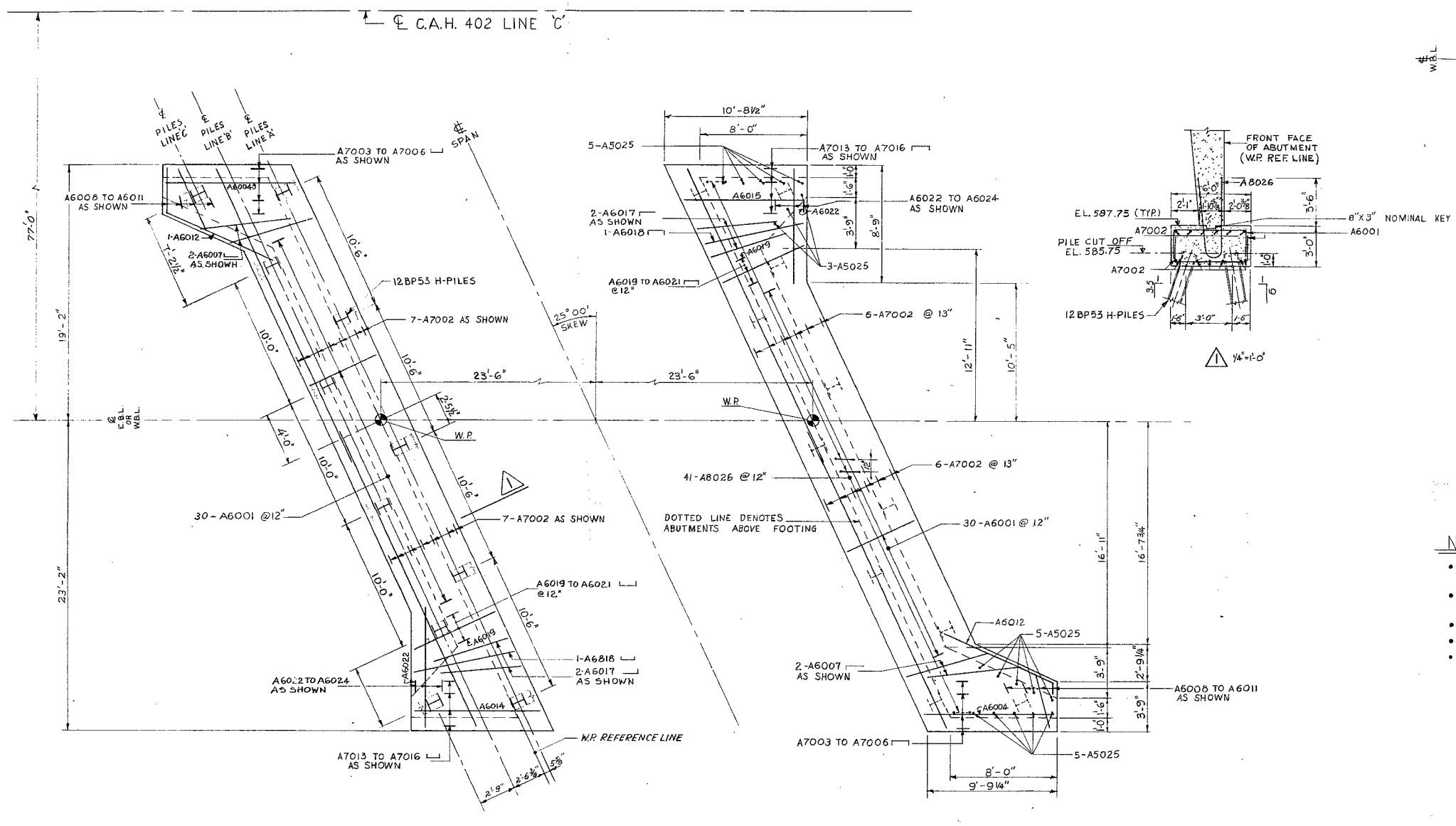
**CLEAR COVER ON REIN STEEL**  
FOOTINGS, WING WALLS, ABUTMENTS, DECK: TOP, BOTT.  
3' 3' 3' 2 1/2' 2'  
CURBS, PARAPET WALLS, APPROACH SLABS.  
2' 1 1/2' 2'

**CONSTRUCTION NOTES**  
FALSEWORK SUPPORTING WING WALLS SHALL NOT BE  
REMOVED UNTIL CONCRETE IN THE DECK SLAB HAS  
BEEN POURED AND ATTAINED THE MIN. STRENGTH OF 3000 p.s.i.  
BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND  
BOTH ABUTMENTS FOR EACH STRUCTURE KEEPING THE  
HEIGHTS OF THE BACKFILL APPROXIMATELY THE SAME.  
AT NO TIME SHALL THE DIFFERENCE IN ELEVATIONS  
BE GREATER THAN 2 FEET.

B.M. 597.89  
GEODETIC DATUM  
N. & W. IN W. ROOT OF 1' MAP.  
163' RT. 269+78 LINE 'C'

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
69-F-94			
PULSE CREEK BRIDGES E. & W.B. STRUCTURES 1.8 MILES WEST OF COUNTY ROAD NO. 26			
KING'S HIGHWAY No. 402		DIST. No. 1	
CO. LAMBTON		CON. 7	
TWP. SARNIA		LOT 5	
GENERAL LAYOUT			
APPROVED		SITE No. 14-345 W.P. No. 43-66-07608	
DESIGN	S.V.V.	CHECK	J. Bz.
DRAWING	G.F.M.S.	CHECK	J. Bz.
DATE	AUG 1970	LOADING	HS20-44
DRAWING No.		D-6780-1	



LOCATION PLAN OF FOOTINGS  
SCALE: 1" = 40'-0"

- NOTES**
- DIMENSIONS & PILE LAYOUT SIMILAR FOR ALL ABUTMENTS
  - ABUTMENT PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTINGS.
  - ALL PILES ARE 12 BP53 H-PILES
  - PILES TO BE DRIVEN TO BEDROCK
  - DESIGN LOAD = 70 TONS/PILE

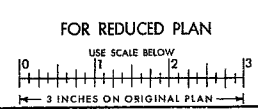
PRINT RECORD		
No.	FOR	DATE

BOTTOM REINFORCEMENT  
AND PILE LAYOUT

PLAN OF SOUTH STRUCTURE  
SCALE: 1/4" = 1'-0"

TOP REINFORCEMENT

PILES SUPPLIED				
LOCATION	NºS	LENGTH	TYPE	
NORTH STRUCTURE WEST ABUT.	11	106'	SEE NOTES	
EAST ABUT.	11	106'		
SOUTH STRUCTURE WEST ABUT.	11	106'		
EAST ABUT.	11	106'		



REVISIONS	
DATE	DESCRIPTION
DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION	
69-F-94	
PULSE CREEK BRIDGES E & W.B. STRUCTURES	
1.8 MILES WEST OF COUNTY ROAD Nº 26	
KING'S HIGHWAY Nº. 402	DIST. Nº. 1
CO. LAMBTON	
TWP. SARNIA	LOT 5 CON. 7
FOOTINGS & PILE LAYOUT	
APPROVED	SITE Nº. 14-345 W.P. Nº. 43-66-07408
DESIGN S.W. CHECK J.S.	CONTRACT
DRAWING G.F.M./B.R. CHECK J.S.	DRAWING Nº. D-6780-3
DATE AUG. 1970	LOADING 4520-44

MEMORANDUM

To: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Office,  
Admin. Bldg.

FROM: Foundation Section,  
Materials & Testing Office,  
Room 107, Lab. Bldg.

ATTENTION: Mr. S. McCombie

DATE: December 10, 1969

OUR FILE REF.

IN REPLY TO

DEC 12 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Crossing at Pulse Creek  
And C.A.H. #402, Line 'C'

Lot 5, Concession VII

Twp. of Sarnia -- Co. of Lambton

District #1 (Chatham, Ont.)

W.J. 69-F-94 -- W.P. 43-66-07 & 08

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 requirements. Should additional information be required, please feel free to contact our Office.

ACS/MEF

Attach.

cc: Messrs. B. R. Davis (2)

H. A. Tregaskes

D. W. Farren

W. Zonnenberg

F. C. Brown

A. P. Watt

J. Roy

B. A. Singh

Foundations Files

Gen. Files

*A. S. Sternac*

A. S. Sternac

PRINCIPAL FOUNDATION ENGINEER

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  3. FIELD AND LABORATORY INVESTIGATION PROCEDURES.
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    - 4.2) Sandy Silt with some Clay and Traces of Organics.
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    - 4.5) Bedrock.
  5. GROUNDWATER CONDITIONS.
  6. DISCUSSION AND RECOMMENDATIONS:
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    - 6.2) Foundations.
    - 6.3) Approach Embankments.
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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Crossing at Pulse Creek  
And C.A.H. #402, Line 'C'  
Lot 5, Concession VII  
Twp. of Sarnia -- Co. of Lambton  
District #1 (Chatham, Ont.)  
W.J. 69-F-94 -- W.P. 43-66-07 & 08

1. INTRODUCTION:

A request for a foundation investigation at the crossing of the proposed C.A.H. #402, Line 'C' and Pulse Creek, was received from Mr. A. P. Watt, Regional Bridge Planning Engineer, in a memorandum dated October 6, 1969.

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 THE SITE:

The site of the proposed structure is situated about 8 miles east of Sarnia, approx. 3/4 mile north of Hwy. #7.

The surrounding area is flat with cultivated farm land on the east side and scattered scrub on the west side. The banks of the creek are about 6 ft. high.

Physiographically, the site is located in the region referred to as the St. Clair Clay Plain.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of four sampled borsholes and two dynamic cone penetration tests was carried out during the course of the field work. Two boreholes (#2 and 4) were put down on the top of the bank, and two (#1 and 3) close to the bottom of the creek. Boring

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

was achieved by means of a continuous flight auger machine, 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, or by hand. 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 and also at five other locations. Driving energy used to advance the cone was 350 ft.-lbs. per blow.

The bedrock was proved at one borehole location using BXL rock coring equipment.

All boreholes were surveyed in the field by personnel from London Region Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 69-F-94A, 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

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

#### 4. SOIL TYPES AND SOIL CONDITIONS:

##### 4.1) General:

Generally uniform subsoil conditions were found to prevail over the site investigated. The subsoil consists of organic sandy silt followed by a deep deposit of clayey silt and silty clay with some sand and traces of gravel. The combined thickness of these deposits is approximately 110 ft.

The boundaries between different deposits are shown on the Record of Borehole sheets attached to the Appendix. The estimated stratigraphical profile of Dwg. No. 69-F-94A is based upon this information.

From ground level downward, the following soil types were encountered:

##### 4.2) Sandy Silt with some Clay and Traces of Organics:

This surficial material was found in all boreholes from the ground surface to a depth of about 5 ft. The material is sandy silt with some clay and traces of organics, which results in a higher plasticity than would otherwise be the case. Tests on two samples gave the following values of Atterberg Limits:

Liquid Limit	:	37 - 51%
Plastic Limit	:	24 - 35%
Water Content	:	30 - 35%

Grain-size analyses carried out on one sample gave the following distribution: (See Fig. 2)

Gravel	:	1%
Sand	:	41%
Silt	:	43%
Clay	:	15%

The 'N' values ranged between 12 and 18, indicating a compact denseness.



4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

4.3) Clayey Silt with some Sand and Traces of Gravel:

This deposit was intersected in all borings below the sandy silt layer and extends down to approx. El. 557.0. The material in the deposit consists of clayey silt with some sand and traces of gravel. A plot of Plasticity Index versus Liquid Limit of the material is shown on Figure 1 of the Appendix.

Only B.H. 4 shows the presence of a desiccated crust, presumably because of higher ground and proximity of trees. Other boreholes do not indicate the crust of any appreciably high shear strength.

The consistency of the undesiccated deposit was found to range from firm to stiff. It is generally firm in boreholes 1 and 3 which are near the bottom of the creek, and generally stiff in boreholes 2 and 4 which are on top of the bank. Field and laboratory shear strength measurements indicate values ranging between 550 and 1350 p.s.f. The average in boreholes 1 and 3 is about 800 p.s.f., and that in boreholes 2 and 4, about 1050 p.s.f.

These results are plotted on Figure 4 of the Appendix.

Physical properties of the overall stratum, as determined from field and laboratory tests, are as follows:

Natural Moisture Content (%)	:	16 to 24
Liquid Limit (%)	:	26 to 35
Plastic Limit (%)	:	14 to 17
Bulk Density (PCF)	:	127 to 129
Field Vane Test (PSF)	:	550 to >2000
Unconfined Shear (PSF)	:	770 to 1340
Sensitivity:	:	1.3 to 4.0

Typical grain-size distribution curves are included in the Appendix (Figure 2).

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

4.4) Silty Clay with some Sand and Traces of Gravel:

Beneath the clayey silt zone a deep deposit of silty clay with some sand and traces of gravel was encountered. The lower boundary of the deposit was found to be at approximate El. 485 which is also the assumed elevation of the bedrock.

The following physical properties were obtained from field and laboratory tests:

Natural Moisture Content (%)	:	19 to 32
Liquid Limit (%)	:	35 to 46
Plastic Limit (%)	:	18 to 23
Unconfined Shear (PSF)	:	720 to 1300
Field Vane Test (PSF)	:	640 to 2000 +
Sensitivity:	:	1.7 to 2.7
'N' Values (Blows/ft.)	:	2 to 100
Bulk Density (PCF)	:	116 to 126

Some of the test results are also plotted on Figures #1 and #4.

Typical grain-size distribution curves are shown on Figure #3 of the Appendix.

4.5) Bedrock:

The bedrock was proven in B.H. 2. In other boreholes the bedrock surface was assumed to be the level at which practical refusal to augering was reached. The rock core obtained shows the bedrock to be shaley limestone in sound condition as indicated by almost 100% recovery. The bedrock surface varies from El. 483.3 to 486.3.

5. GROUNDWATER CONDITIONS:

The following water levels were observed during the field work:

B.H. #1	:	El. 589.5
2	:	588.0
3	:	588.4
4	:	Dry

It is pointed out, that the foregoing quoted figures may not represent the true groundwater levels, due to the relatively impermeable nature of the subsoil and the short duration of the field work.

Natural gas was observed in B.H.'s #1, 2 and 3 near the bedrock.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to build a twin, single-span structure at the crossing of new Hwy. #402, Line 'C' and Pulse Creek. The span of each bridge will be 50 ft. and each will be at a skew to the centre line. The proposed profile grade (El. 606) will be approximately 18 ft. above the bottom of the creek. The surrounding ground level on either side of the creek is about El. 594. Therefore, 12-ft. high embankments will be constructed for approaches.

As described earlier, the subsoil consists of a thin layer of organic sandy silt followed by a deep deposit of clayey silt and silty clay with some sand and traces of gravel.

6.2) Foundations:

Because of relatively low shear strength of the soil and absence of a suitable hard desiccated crust, spread footing type foundations are not considered suitable. Therefore, it is recommended that the proposed bridge be supported on No. 14 'treated' timber piles. For 45 ft. of embedment of friction timber piles, a safe load of 20 tons per pile may be assumed for design purposes.

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

6.2) Foundations:

It has been decided to carry out a number of pile load tests in this area in the near future. The foregoing recommendation relating to pile capacity, is therefore subject to change if the results of loading test warrant it.

As an alternative, the structure may be supported on steel H-piles driven to bedrock. For design purposes the maximum allowable design load may be used for the particular steel section used. This proposal will require about 100-ft. long piles. In our opinion, this may not be the most economical solution.

The foregoing recommendations must be reviewed in the light of hydrological requirements to ensure that special needs may be fulfilled.

6.3) Approach Embankments:

The proposed 12-ft. raise in grade will result in a maximum height of embankment of 18 ft. above the bottom of the creek. The shear strength of the subsoil is such that it will be able to support the approach embankments constructed with 2:1 forward and side slopes. The fill should consist of well compacted acceptable material.

Scour protection should be provided according to hydrological requirements.

Based on past experience with the structures with somewhat similar subsoil conditions, it is anticipated that maximum settlement of 2 - 3 inches will occur under the approaches.

Consolidation settlements are anticipated to be in the order of 2 - 3 inches.

The topsoil and any organic material should be removed in accordance with the pertinent D.H.O. Standards within the construction area.

7. MISCELLANEOUS:

The field investigation was carried out during the period October 31 - November 6, 1969, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

Equipment was owned and operated by Dominion Soil Investigation Ltd., and George Wimpey Co. Ltd.

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

December 1969

APPENDIX I

---

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-P-94  
W.P. 43-66-08  
DATUM Geodetic

LOCATION Hwy. 402 Line 'C', Sta 270+40, 95 59' Lt.  
BORING DATE Oct. 31-Nov. 3, 1969  
BOREHOLE TYPE Continuous Flight Auger

ORIGINATED BY AP  
COMPILED BY AP  
CHECKED BY *AL*

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P S F					WATER CONTENT %				
591.3	Ground Level						400	800	1200	1600	2000	10	20	30		
0.0	Sandy silt, some clay traces of organics compact Black					590										589.5
586.3			1	SS	13											
5.0			2	SS	10											
	Clayey silt some sand, traces of gravel Brown & Grey	Stiff	3	TW	PH											
			4	SS	7	580										10-17-47-26
		Firm	5	TW	PH											
			6	SS	7	570										
			7	TW	PH											
			8	SS	2	560										
557.0		Stiff														
34.3			9	TW	PH											
			10	SS	7	550										
		Firm														
	Silty Clay, some sand traces of gravel	Stiff	11	TW	PH	540										
			12	SS	47	530										
	Grey	Very stiff to Hard														
			13	TW	PH	520										
			14	SS	70	510										
						500										
			15	SS	75	490										
483.3																
108.0	Probable Bedrock End of Borehole					480										

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-94  
W.P. 43-66-08  
DATUM Geodetic

LOCATION Hwy. 402 Line 10', Sta. 269+80, O/S 86' Lt.  
BORING DATE November 3-4, 1969  
BOREHOLE TYPE Continuous Flight Auger, BX Casing & Core

ORIGINATED BY AP  
COMPILED BY AP  
CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w <sub>L</sub> PLASTIC LIMIT — w <sub>p</sub> WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.					WATER CONTENT %				
								400	800	1200	1600	2000	10	20	30	
596.1	Ground Level															
0.0	Sandy Silt, some clay traces of organics compact Black		1	SS	12											
591.1			2	SS	7	590										
5.0			3	SS	14											
			4	SS	8											
	Clayey silt some sand, traces of gravel		5	TW	PH	580										
			6	SS	11											
	Brown & Grey		7	TW	PH	570										
	Stiff		8	SS	8											
	Firm		9	TW	PH	560										
556.1			10	SS	8											
40.0																
			11	TW	PH	550										
	Silty clay, some sand, traces of gravel		12	SS	8	540										
			13	TW	PH	530										
	Firm Stiff to Very Stiff		14	SS	22	520										
	Grey		15	SS	22	510										
						500										
						490										
485.1																
111.0	Bedrock		BXL	100%												
480.1	Shaley Limestone		16 RC	REC		480										
116.0	End of Borehole															



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

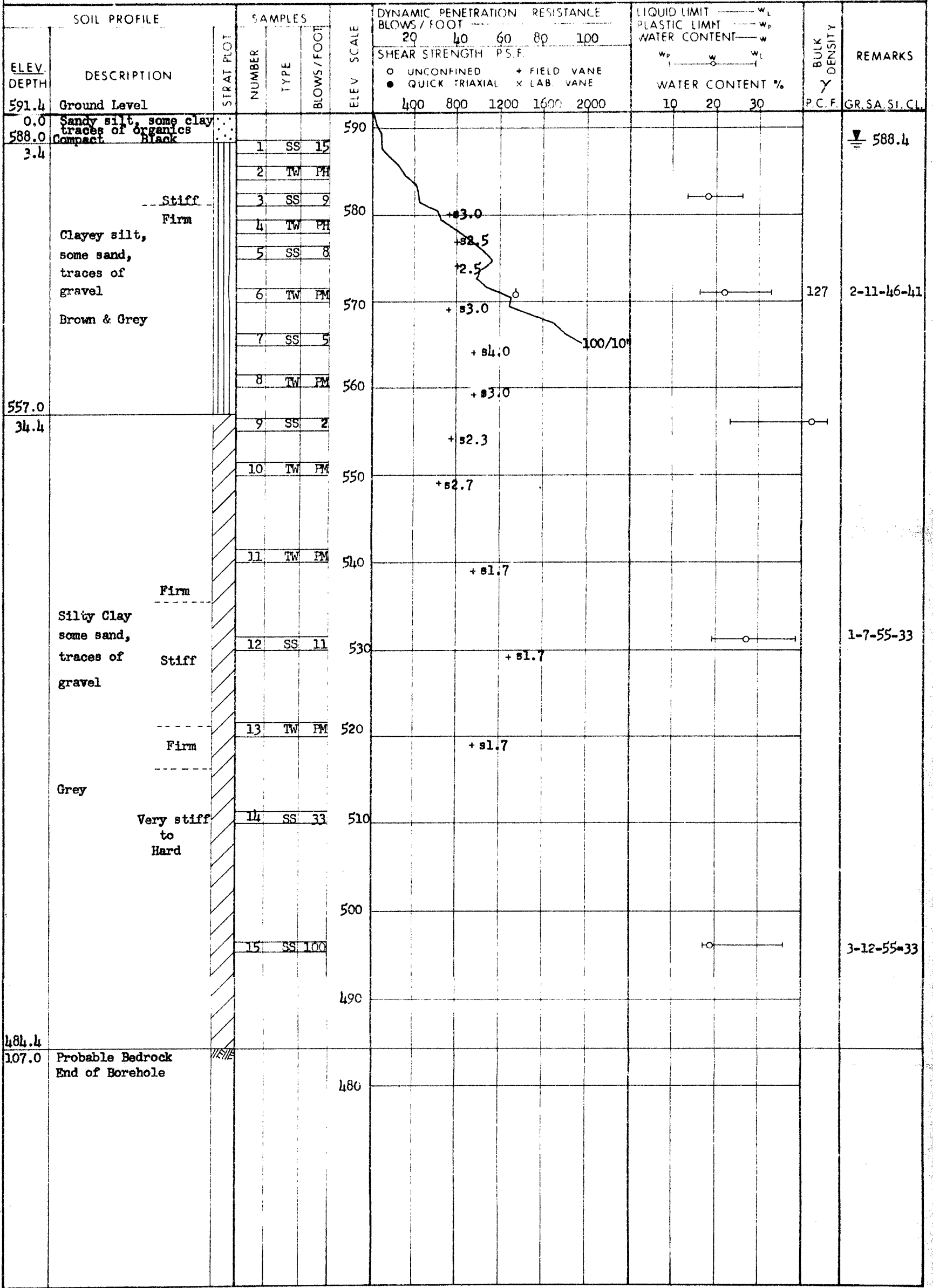
RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

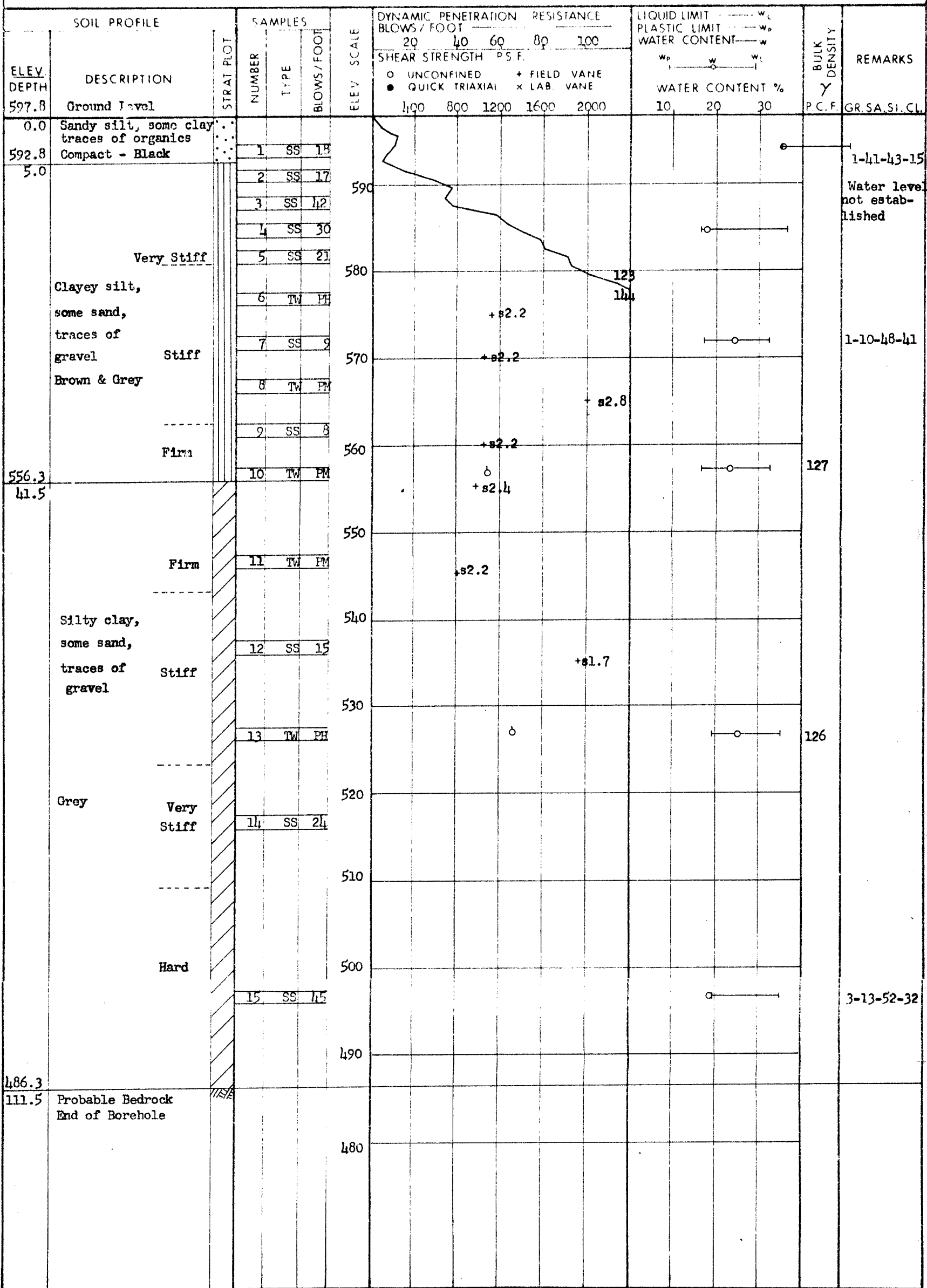
JOB 69-F-94  
W.P. 43-66-07  
DATUM Geodetic

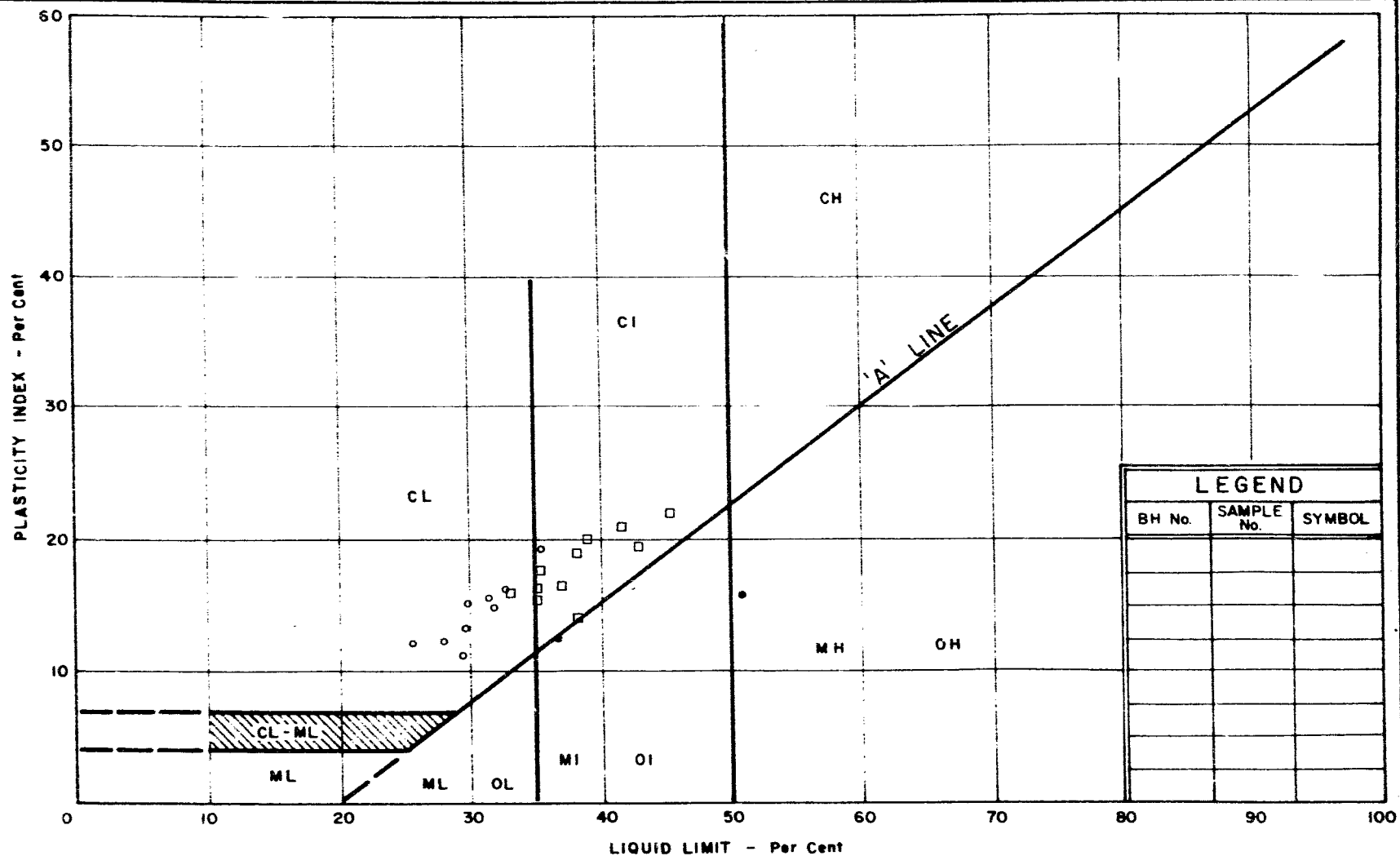
LOCATION Hwy. 402 Line 'C', Sta. 271+05, O/S 82' Rt.  
BORING DATE Nov. 4-5, 1969  
BOREHOLE TYPE Bombardier Flight Auger & Cone

ORIGINATED BY AP  
COMPILED BY AP  
CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO		<b>RECORD OF BOREHOLE No. 4</b>		FOUNDATION SECTION	
MATERIALS & TESTING OFFICE					
JOB 69-E-04	LOCATION Hwy. 402 Line 'C', Sta. 270+57, O/S 93' Rt.	ORIGINATED BY AP			
W.P. 43-66-07	BORING DATE Nov. 5-6, 1969	COMPILED BY AP			
DATUM Geodetic	BOREHOLE TYPE Continuous Flight Auger & Conn	CHECKED BY			





## PLASTICITY CHART

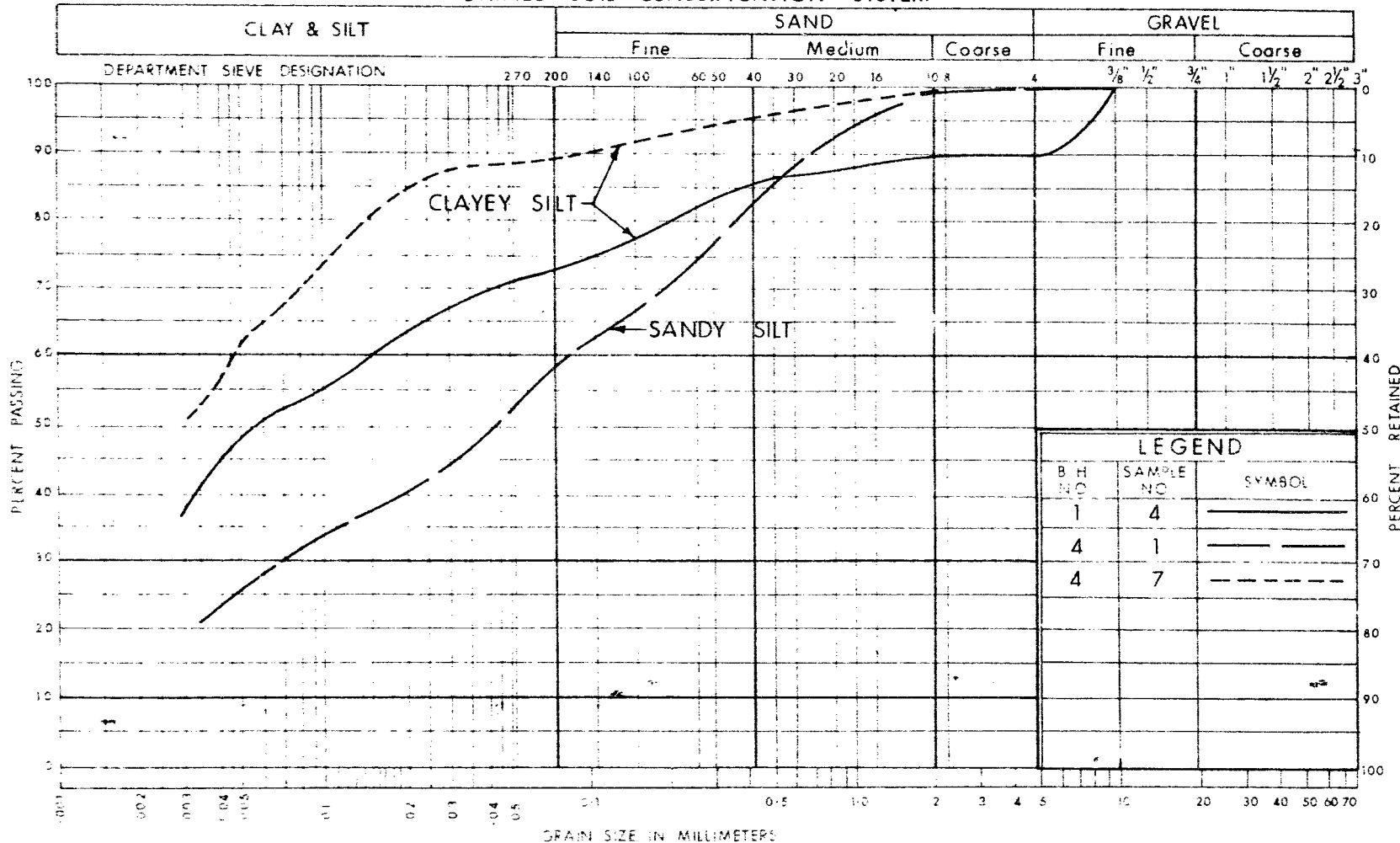
● ORGANIC SANDY SILT    ○ CLAYEY SILT    □ SILTY CLAY

W.P. No. 43-66-07 & 08

JOB No. 69 - F - 94

FIG. 1

# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

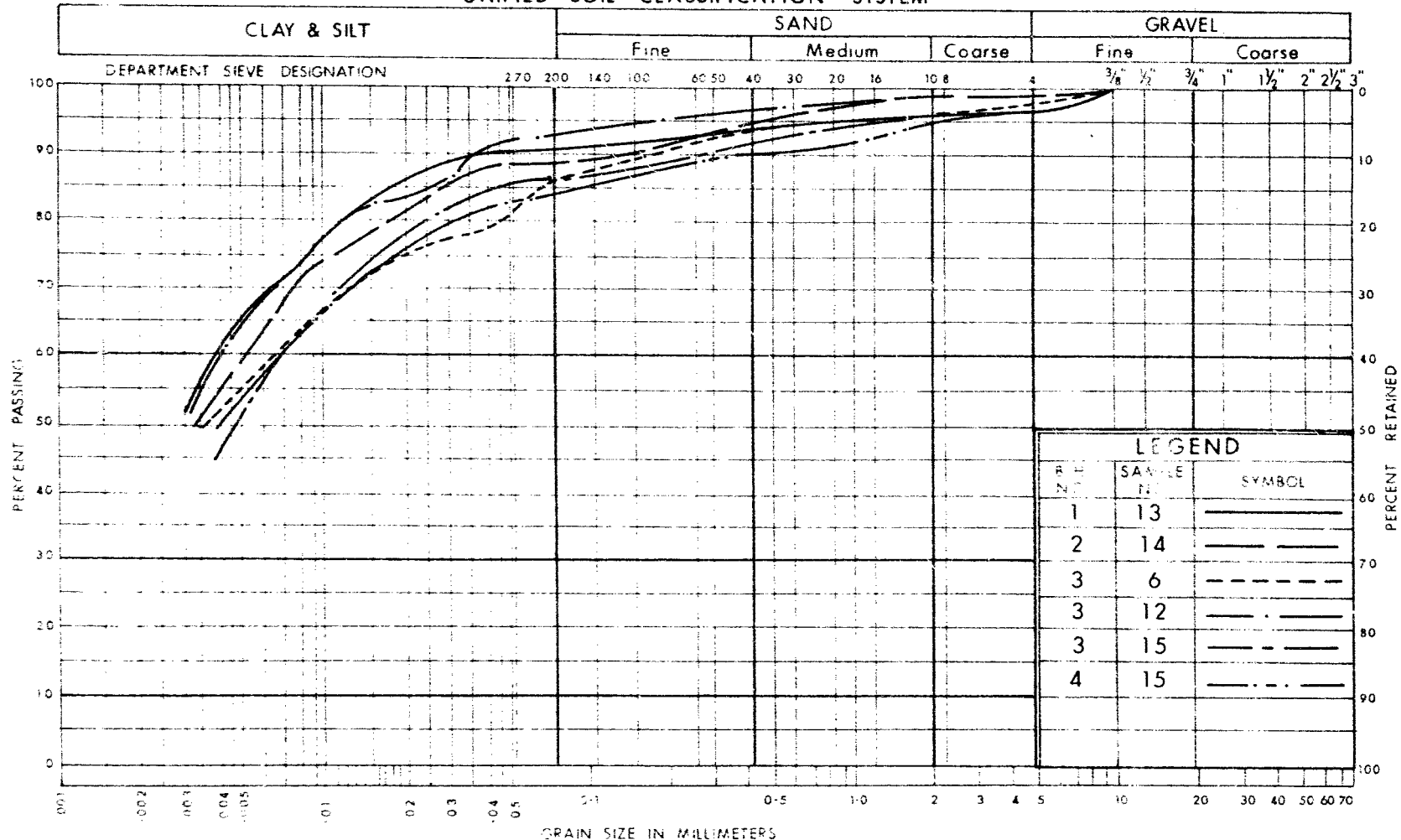
## GRAIN SIZE DISTRIBUTION

WP No. 43-66-07 & 08

JOB No. 69-F-94

FIG. 2

# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
SILTY CLAY

W.P. No. 43-66-07 & 08

JOB No. 69-F-94

FIG. 3

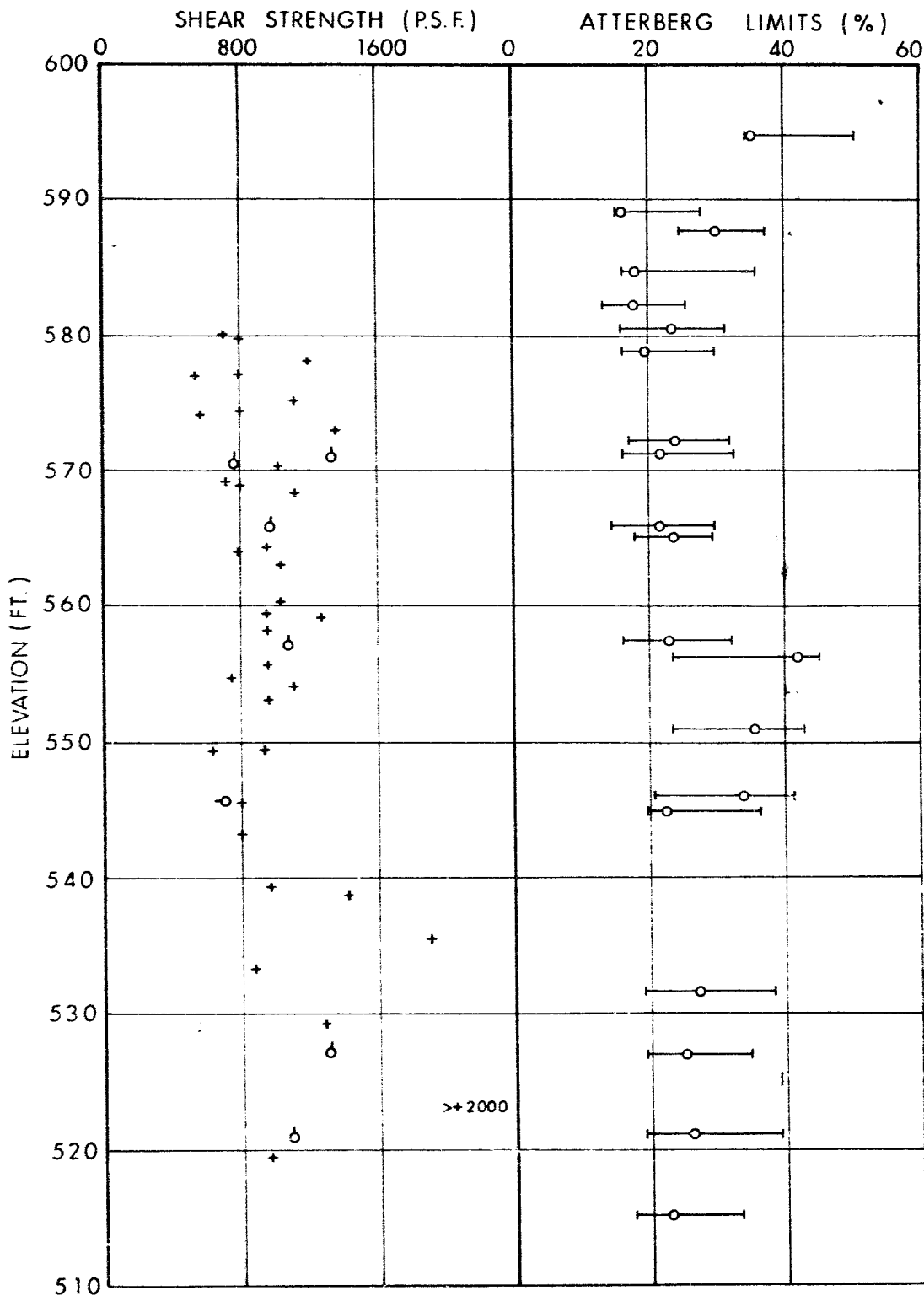


FIG. 4

## 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

Q <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cu</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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

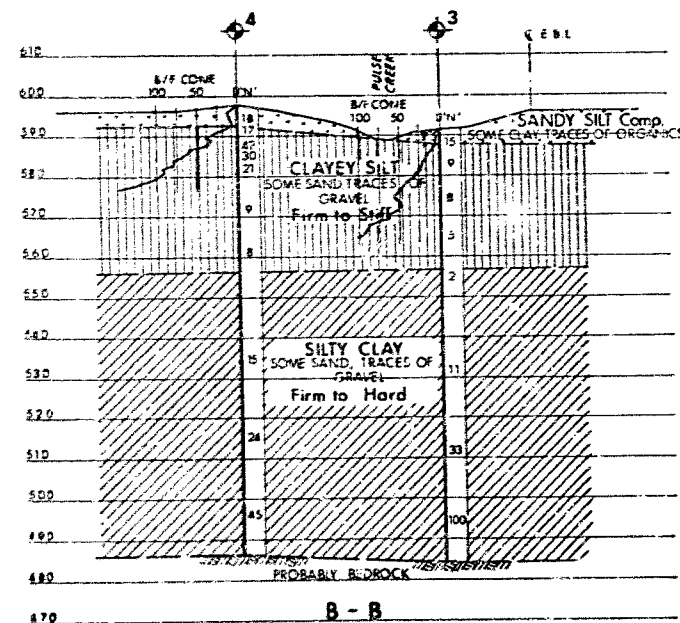
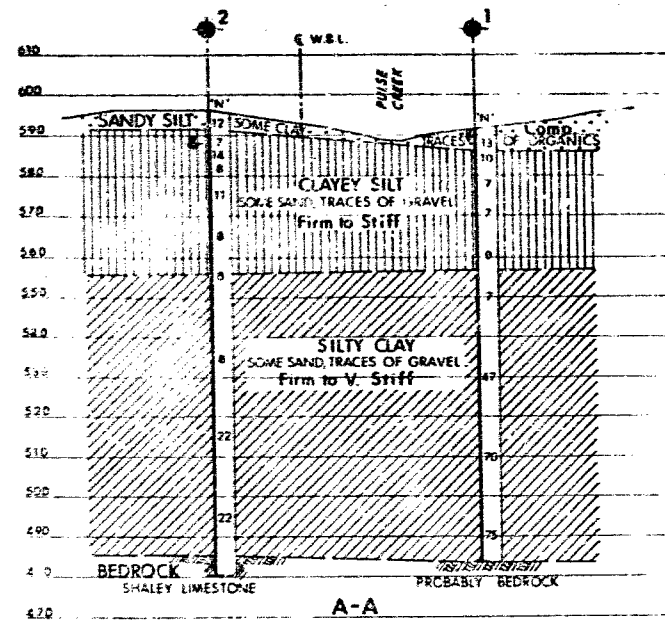
## FOUNDATIONS

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

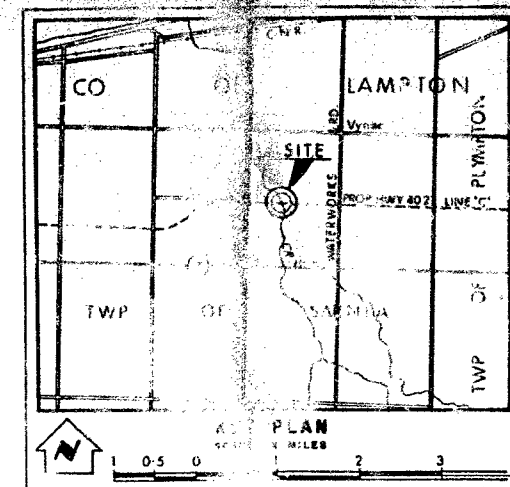
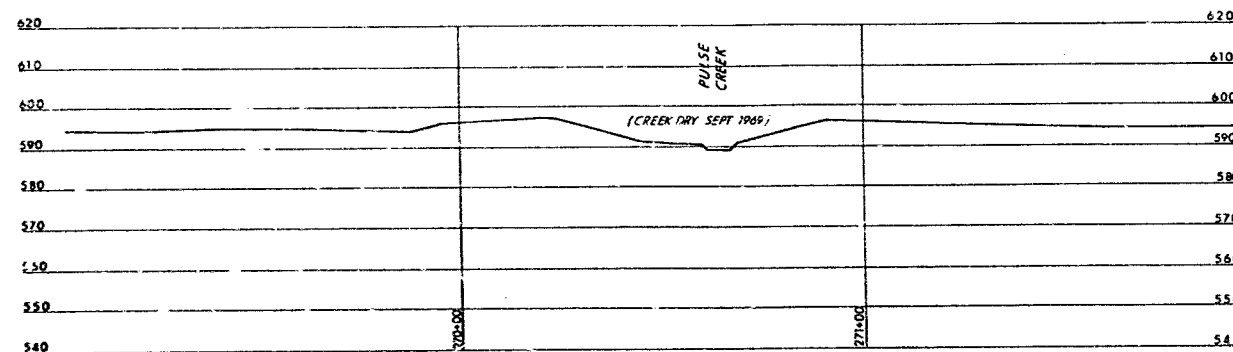
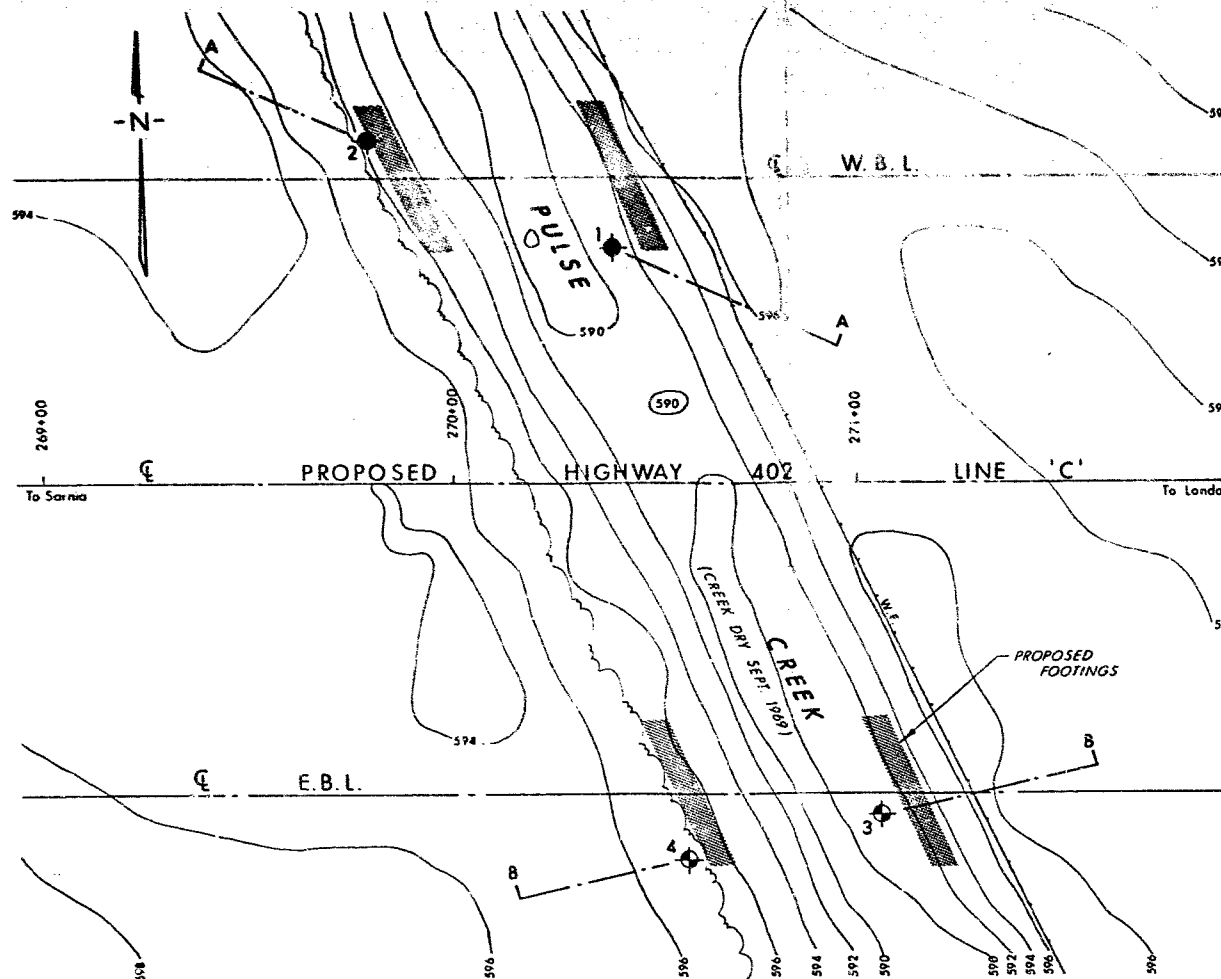
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL





**SECTIONS**

20 10 0 SCALE 20 40 FT.



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, OCT. & NOV. 69		
	Water Level not established in Bore Hole 4 at time of field investigation.		
NO.	ELEVATION	STATION	OFFSET
1	591.3	270+40	59' LT.
2	596.1	269+80	86' LT.
3	591.4	271+05	82' RT.
4	597.8	270+57	93' 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.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

**PULSE CREEK**

KING'S HIGHWAY NO. 402 LINE 'C' DIST. NO. 1  
CO. LAMBTON  
TWP. SARNIA LOT 5 CON. VII

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D. A.P.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 43-66-07&08	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED <input checked="" type="checkbox"/>	JOB NO. 69-F-94	<b>69-F-94A</b>
DATE 6 DEC. 1969	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		

## MEMORANDUM

TO: Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Building

FROM: C.S. Grebski,  
Bridge Office

ATTENTION:

DATE: August 25, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 43-66-07 & 08, Site No. 14-345  
Pulse Creek Bridges  
E. and W.B. Structures  
1.8 Mi. W. of County Road No. 26  
Highway 402, District No. 1

69-F-94

Attached herewith we are submitting the final  
bridge drawings which show the foundation design for  
the above-mentioned structures.

Kindly give us your comments at your earliest  
convenience.

CSG:rd



C.S. Grebski,  
Bridge Design Engineer

Attach.

c.c. Foundation Office

Forwarded Notes are 1 1/2 : 1  
and 2 : 1 as approved and  
the Notes will be 1 1/2 : 1 Notes



1/9/70  
K. L. S. S.