

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40I/3-30

DIST. 1 REGION Southwestern

W.P. No. 42-66-10

CONT. No. 76-47

W. O. No. \_\_\_\_\_

STR. SITE No. 14-354

HWY. No. 402

LOCATION Township Rd. Underpass  
1.8 miles E. of Hwy. 7, Hwy. 402

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 3

REMARKS: \_\_\_\_\_

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Crossing at  
Twp. Road and C.A.H. #402, Line 'C'  
Lots 12 & 13; Concessions 1 & 2  
Twp. of Warwick -- County of Lambton  
District No. 1 (Chatham, Ont.)  
W.O. 71-11033      --      W.P. 42-66-10

1. INTRODUCTION:

A request for a foundation investigation at the crossing of the proposed C.A.H. #402, Line 'C' and Twp. Road, was received from Mr. A. P. Watt, Regional Bridge Planning Engineer, in a memorandum dated April 5, 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 THE SITE:

The site of the proposed underpass structure is situated S.E. of the Town of Warwick, approx. 0.9 mi. south of Hwy. #7 on Twp. Road.

The surrounding area on the west side of the Twp. Rd. is wood-covered, and flat, cultivated farmland on the east side.

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 three sampled boreholes and six 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 mounted on a Bombardier. 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 performed at elevations 12 inches below sample depths.

Dynamic cone penetration tests were carried out adjacent to each borehole and also at three other locations. Driving energy to advance the cone was 350 ft.-lbs. per blow.

The locations and elevations of the borings are shown on Drawing No. 71-11033A, 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:

Subsoil at the site consists of about three different deposits. In general, the conditions are fairly uniform over the area investigated. The boundaries of the different deposits, as determined in the boreholes, are shown on the Record of Borehole

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

4.1) General: (cont'd.) ...

sheets attached to the Appendix. The estimated stratigraphical profile of Drawing No. 71-11033A is based upon this information.

From ground level downward, the various soil types are as follows:

4.2) Topsoil:

This material was encountered in all boreholes from the existing ground level to an approx. depth of 1 to 2 ft. The material in the deposit consists of sand, silt and clay with decayed and undecayed organic substances.

4.3) Sand:

This deposit was intersected in all borings and extends from immediately below the topsoil, down to approx. El. 711. The material is basically sand. The relative density ranges from loose to compact.

4.4) Clayey Silt with Sand and Traces of Gravel:

This stratum was found to underlie the sand zone and extends to the depth of exploration. The material in the deposit consists of clayey silt with sand and traces of gravel. A plot of Plasticity Index versus Liquid Limit (Fig. 1) shows the points to fall within the CL zone. With random variation, occasional seams of silt and layers of silty clay, sand and gravel were also observed. At or around El. 685 shale fragments were discovered within the deposit.

The shear strength of the deposit increases with depth, being 1,000 PSF at El. 707. From this level on, it increases very rapidly to over 4,000 PSF at El. 695.

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

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

4.4) Clayey Silt with Sand and Traces of Gravel: (cont'd.) ...

Natural Moisture Content (%)	:	10	-	20
Liquid Limit (%)	:	20	-	32
Plastic Limit (%)	:	12	-	18
Bulk Density (PCF)	:	124	-	133
Unconfined Shear Strength (PSF)	:	1,000	-	3,070
'N' Value (Blows/ft.)	:	10	-	100 <

Typical grain-size distribution curves are included in the Appendix of this report (Fig. 2).

The consistency of the overall deposit may be described as stiff to hard.

5. GROUNDWATER CONDITIONS:

The following groundwater levels were observed during the field investigation:

B.H. #1	:	El. 714.8
#2	:	El. 715.0
#3	:	El. 714.8

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to build a two-span ( 126' - 126' ) underpass structure at the crossing of Hwy. #402, Line 'C' and Twp. Road. The proposed profile grade of Twp. Road will be approximately 20 ft. above the proposed Hwy. #402 grade of elevation 717.

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

6.1) General: (cont'd.) ...

As described in the previous paragraphs of this report, the subsoil consists of a shallow, surficial deposit of loose sand, followed by an approx. 25-ft. thick layer of clayey silt, with sand and traces of gravel. The shear strength of this zone increases with depth. Due to the compressible nature of the clayey silt deposit, it is inevitable that consolidation settlements will occur over a long-term period due to the imposed loads of structure and embankment. Past experience, however, indicates that these settlements will be of a minor nature.

6.2) Foundations:

a) Spread Footings in Original Ground:

The entire structure may be supported on spread footings within the subsoil at or below El. 710. A safe net pressure of 2.0 TSF may be assumed for design purposes. The clayey silt material is susceptible to softening on contact with water, therefore, it is recommended that the base of the footing excavations be protected by a concrete working slab, immediately on exposure.

All foundations should be protected against frost action by at least 4 feet of earth cover in this area.

Due to the observed high groundwater level, some dewatering scheme may be required.

The estimated maximum settlement will be in the order of 1.0 to 1.5 inches under the pier footing.

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

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

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 Fig. 3 of the Appendix.

c) End-Bearing Piles:

As a second alternative, the abutments and pier may be supported on 12 BP 53 steel 'H' or 12 $\frac{3}{4}$ " O.D. steel tube piles. A safe design load of 50 tons per pile may be assumed for both types of piles. The piles should be driven to approx. El. 680.

6.3) Approach Embankments:

The shear strength of the subsoil is such that it will be able to safely support the 20-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 under somewhat similar subsoil conditions, it is estimated that the maximum settlement caused by embankment loading will be in the order of 3 to 4 inches. 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 April 15 - 20, 1971, under the supervision of Mr. P. Payer, Project Foundation Engineer, who also prepared this report.

Equipment was owned and operated by Master Scil Investigation Ltd.

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

June, 1971



1072 Nov 22

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11033

LOCATION Sta. <sup>3</sup>212 + 51 126' Lt. E Hwy. 402

ORIGINATED BY PP

W.P. 42-66-10

BORING DATE April 15, 1971

COMPILED BY PF

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY 

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT — W <sub>L</sub>	PLASTIC LIMIT — W <sub>P</sub>	WATER CONTENT — W	BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.						
716.0	Ground Level						25 50 75 100 125						
0.0	Topsoil - organics	[Pattern]											GR. SA. SI. CL.
1.5	Sand - Loose	[Pattern]	1	SS	8								714.8
711.0													
5.0	Clayey silt with some sand, occ. seams of silt,	[Pattern]	2	SS	18	710							0 1 58 41
	Layers of sand and gravel	[Pattern]	3	SS	10								
			4	SS	17								
			5	SS	14	700							
			6	SS	62								
	Stiff to hard	[Pattern]	7	SS	66/6"								0 4 77 19
689.5			8	SS	55	690							
26.5	End of Borehole												
						680							

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-11033

LOCATION Sta. 212 + 49 0

ORIGINATED BY PP

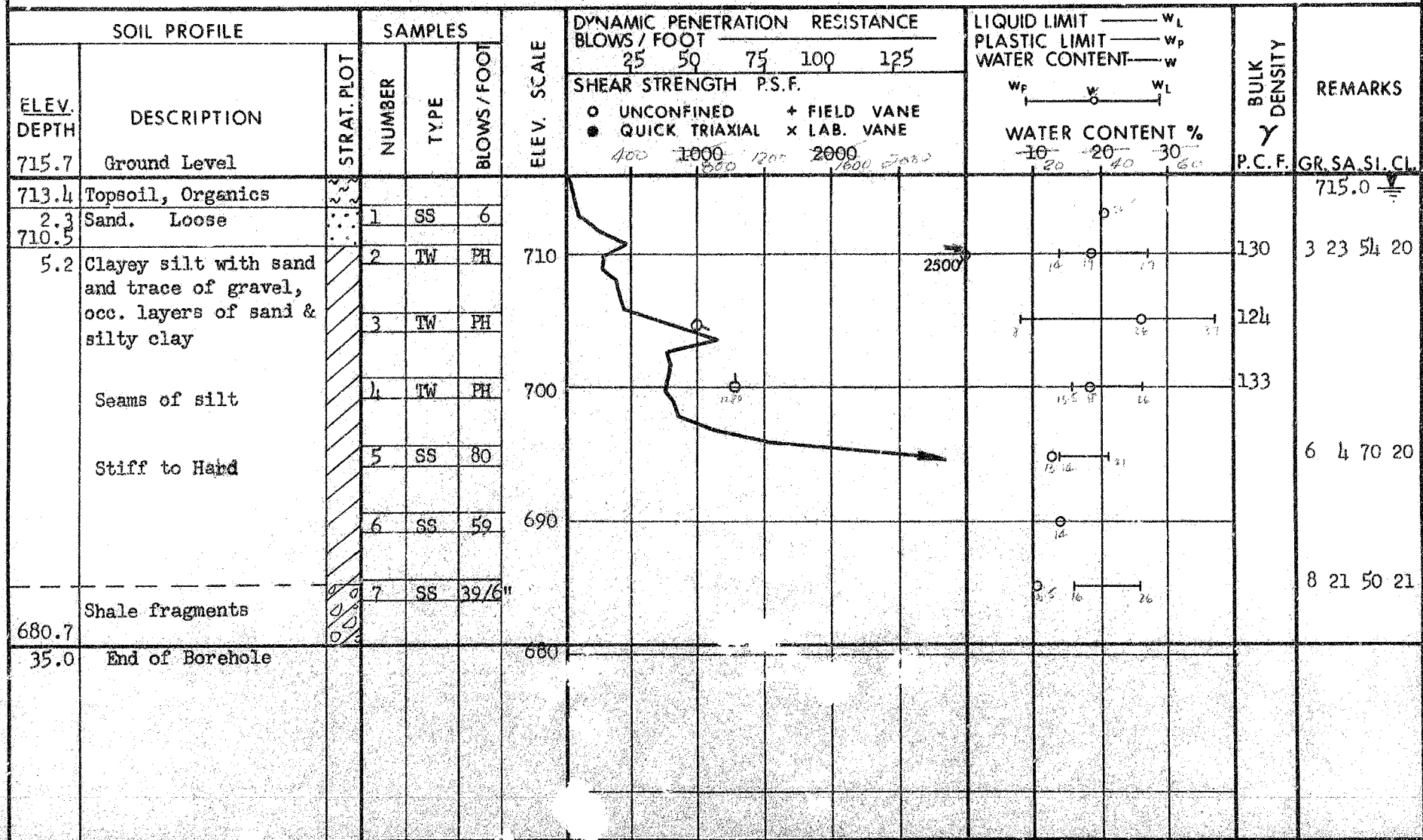
W.P. 42-66-10

BORING DATE April 16, 1971

COMPILED BY PP

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY *SK*

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11033 LOCATION Sta. 213 + 01 130' Rt. ORIGINATED BY PP  
W.P. 42-66-10 BORING DATE 28 April 19, 1971 COMPILED BY PP  
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [Signature]

[illegible]

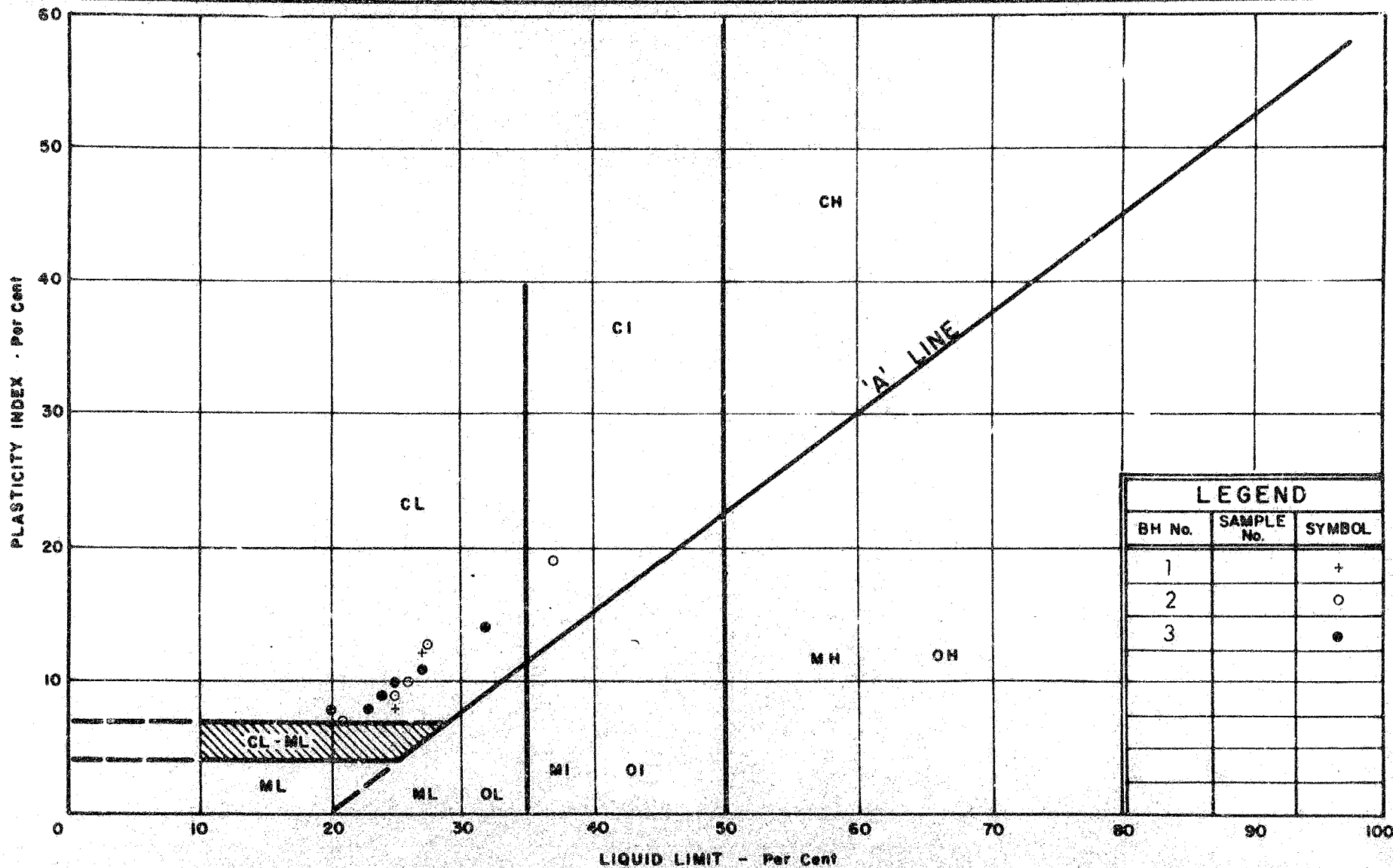




FOUNDATION SECTION

CHECKED BY 

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT ———— W <sub>L</sub> PLASTIC LIMIT ———— W <sub>P</sub> WATER CONTENT ———— W	BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.	W <sub>p</sub> W      W <sub>L</sub> WATER CONTENT %	P.C.F.	GR. SA. SI. CL.
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE			
716.2	Ground Level									
0.0	Probably Topsoil Sand Clayey silt					710				
						700				
695.3										
20.9	End of Test Cone					690				



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT SOME SAND & TRACE OF GRAVEL

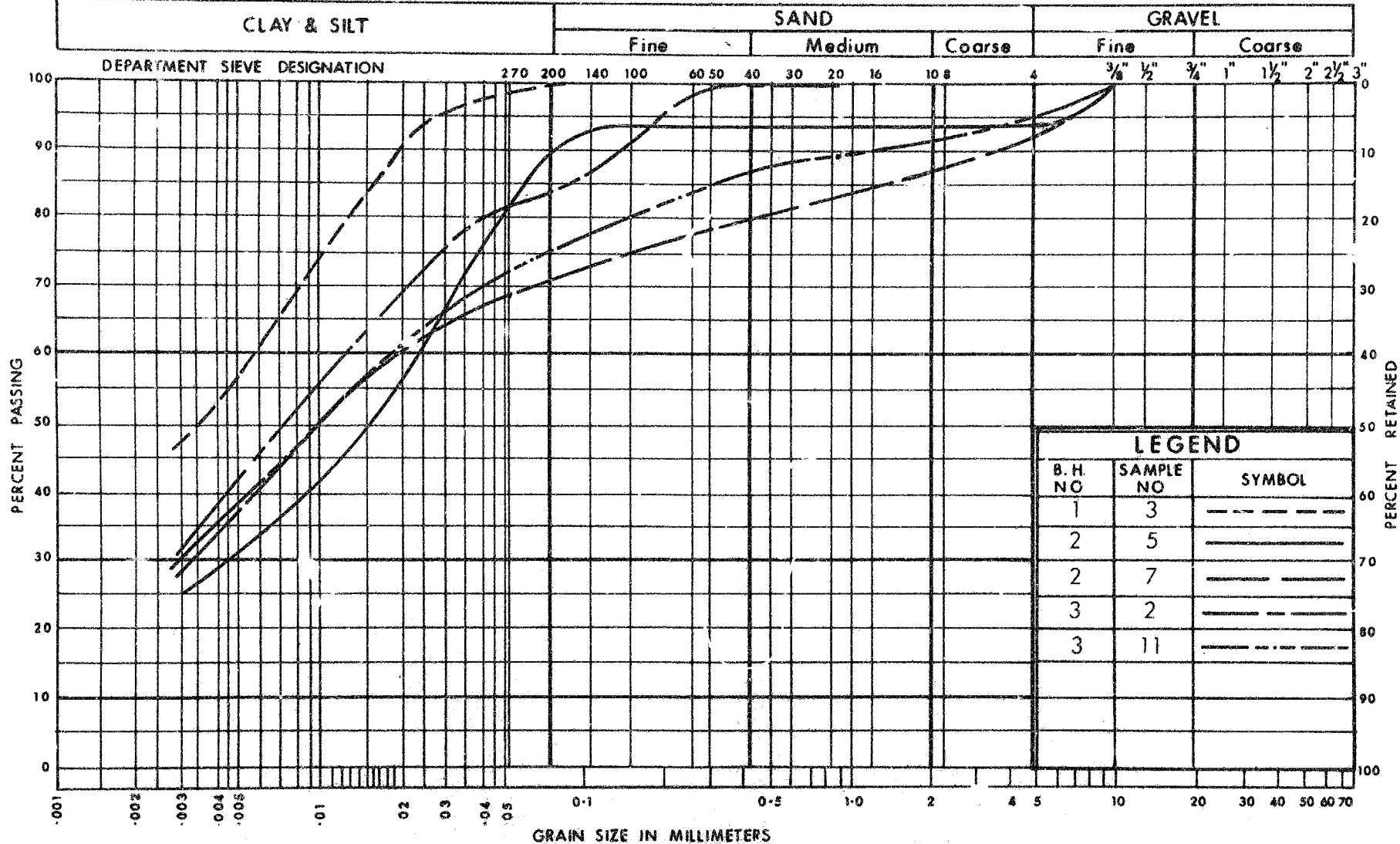
WP No. 42-66-10

JOB No. 71-11033

FIG. 1



# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
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TESTING  
DIVISION

**GRAIN SIZE DISTRIBUTION**  
**CLAYEY SILT**  
SOME SAND & TRACE OF GRAVEL

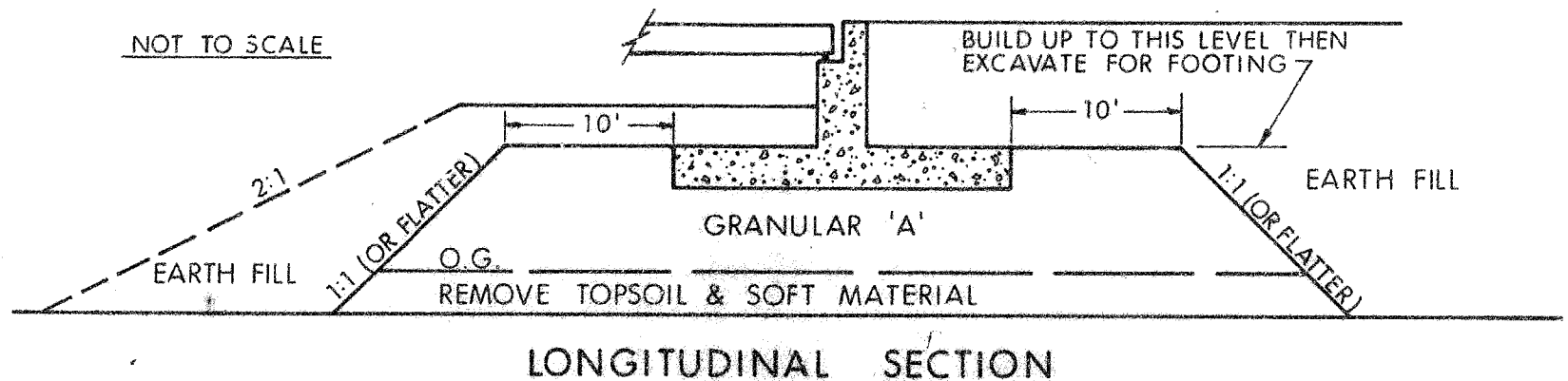
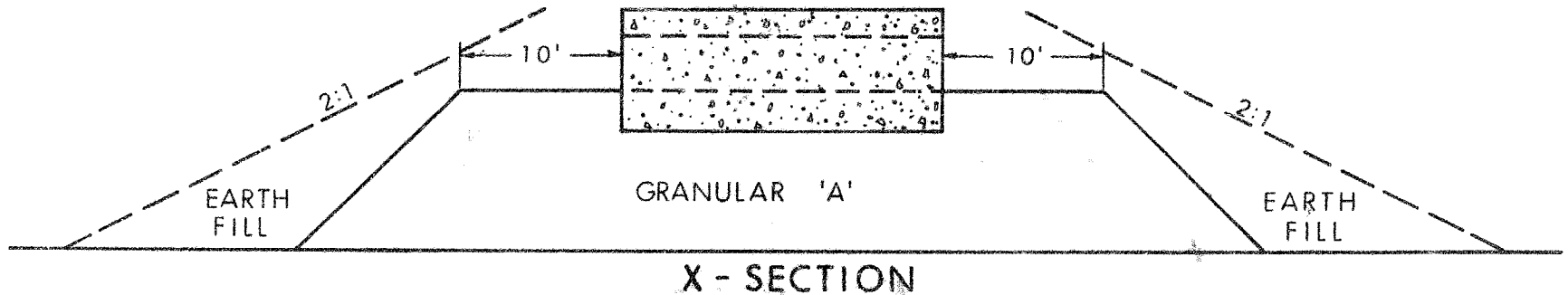
W.P. No. 42-66-10

JOB No: 71-11033

FIG. 2



# ABIUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE

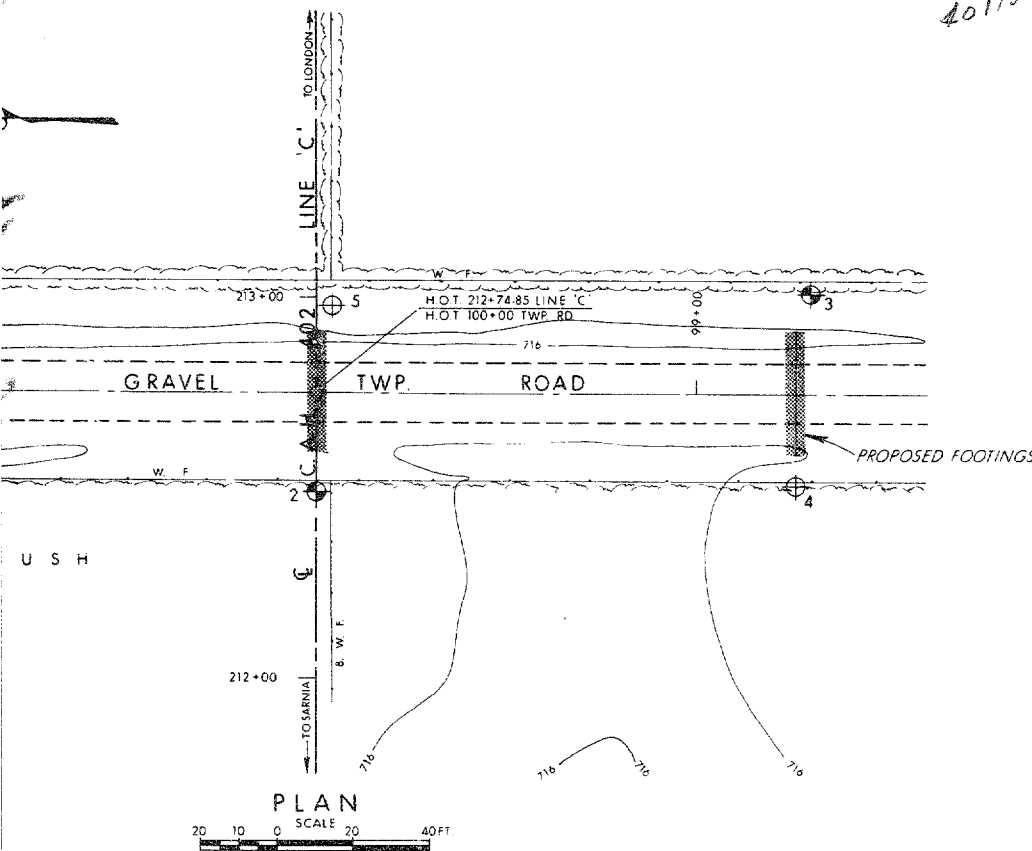
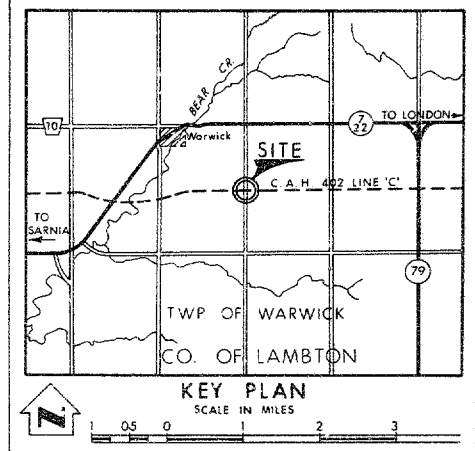


## NOTES

- 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

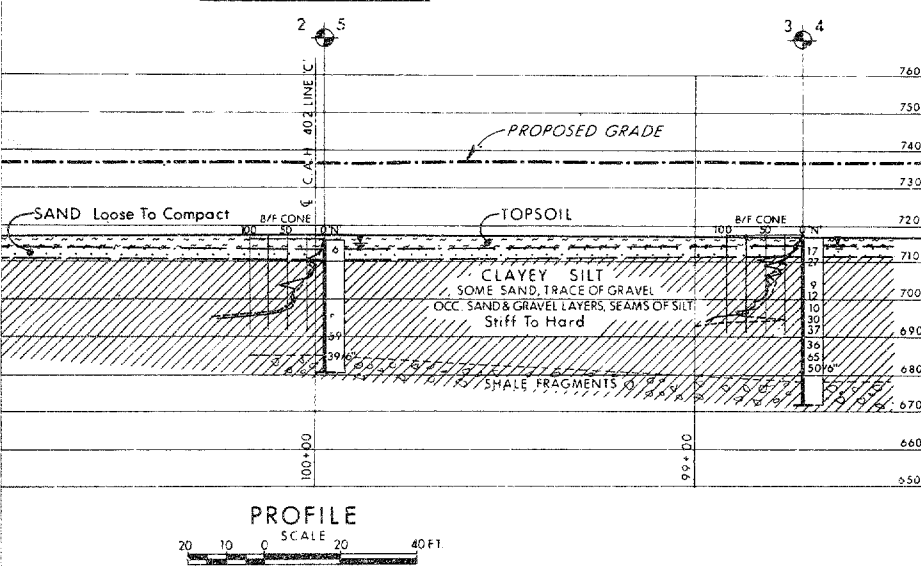


40113-31



LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, APRIL 1971.		
NO.	ELEVATION	STATION	OFFSET
1	716.0	212+51	126' LT.
2	715.7	212+49	6'
3	716.3	213+01	130' RT.
4	717.3	212+51	126' RT.
5	716.0	212+98	4' RT.
6	716.2	213+00	126' LT.

**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.



DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS  
DESIGN SERVICES BRANCH — FOUNDATION SECTION

**TOWNSHIP ROAD**

HIGHWAY NO. 402 (LINE 'C') DIST. NO. 1  
CO. LAMBTON  
TWP. WARWICK LOT 12 & 13 CON. 1 & 2

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBMD. P.P. CHECKED	W.P. NO. 42-66-10	M.T. DRAWING NO.
DRAWN BY CHECKED	JOB NO. 71-11033	71-11033A
DATE JUNE 25, 1971	SITE NO.	BRIDGE DRAWING NO.
APPROVED	CONT. NO.	

PRINCIPAL FOUNDATION ENGINEER

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO:

Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Central Bldg.

FROM:

Structural Office,  
West Bldg., Downsview.

ATTENTION:

DATE:

January 19, 1972.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: Township Road Underpass,  
1.8 Mi. East of Hwy. #7,  
W.P. #42-66-10, Site 14-354,  
Hwy. No. 402, District #1.

71-11-033

Attached herewith we are submitting the final  
bridge drawings which show the foundation design for  
this structure.

Kindly give us your comments at your earliest  
convenience.

  
C.S. Grebski,  
Structural Design Engineer.

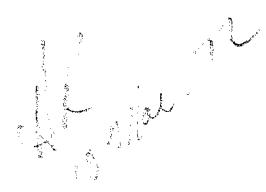
CSG:sr  
Attach.

c.c. Foundation Office

No comments

K.L. Sullivan

Feb 10<sup>th</sup> 1972



Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

~~Mr. L. P. Watt,~~  
Regional Bridge Planning  
Engineer,  
Southwestern Regional Office,  
London.

Structural Office,  
West Building,  
Downsview.

October 7, 1971.

Township Road Underpass,  
1.3 Miles East of Highway #7,  
W.P. #42-66-10, Site #14-354,  
Highway #402, District #1.

71-11-033

Attached herewith are prints of the Preliminary Bridge  
Plan Drawing D-7062-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is  
\$192,000 which includes tender, materials, engineering and  
sundry construction.

Any comments or revisions you may have should be  
submitted within three weeks.

C. S. Grebski,  
Structural Design Engineer.

CSG/mh

ENCL\*

cc: A. McKim,  
B.R. Davis,  
A. Stermac (2),  
J. Anderson,  
A. Crowley.

COMMENTS:

- 1) THE COMPACTED FILL AT THE ABUTMENT LOCATIONS SHOULD CONSIST OF ROLLER  
FILL (LESS THAN 3 INCHES) MATERIAL
- 2) FILL FOUNDATION: STEEL FOOTING, 2.0 TSP SAFE DESIGN LOAD AT 02  
PERIOD B L 710.

PP  
OCT. 19/71

W. E. Egan

DOCUMENT NO. \_\_\_\_\_ REVISION \_\_\_\_\_

GEOCREs No. 40 I B - 30

DIST. 1 REGION SOUTHWESTERN

W.P. No. 42-66-10

CONT. No. 76-47

W. O. No. \_\_\_\_\_

STR. SITE No. 14-354

HWY No. 402

LOCATION TOWNSHIP RD. UNDERPASS

1.8 MILES E. OF HWY. 7, HWY 402

\_\_\_\_\_

\_\_\_\_\_

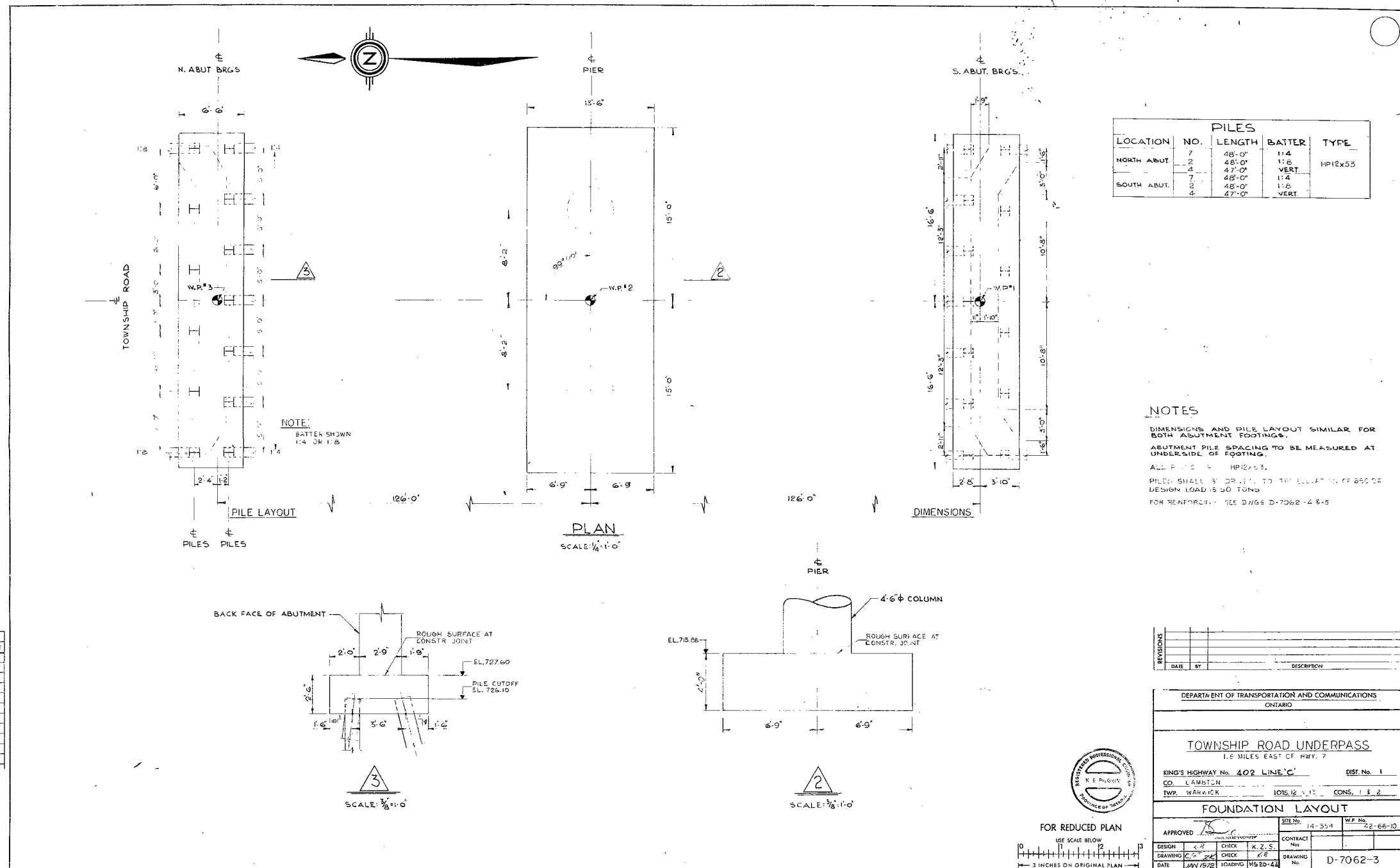
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REMARKS: 3

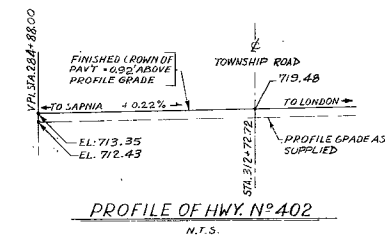
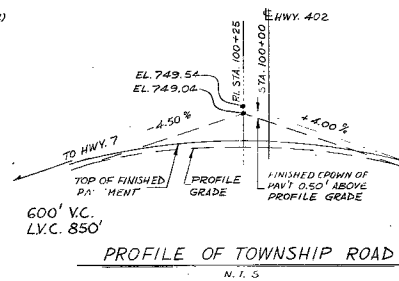
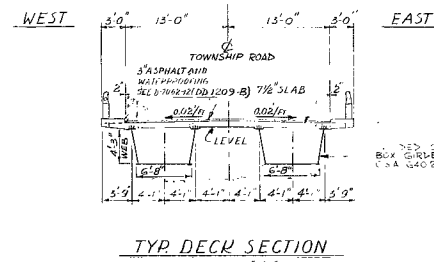
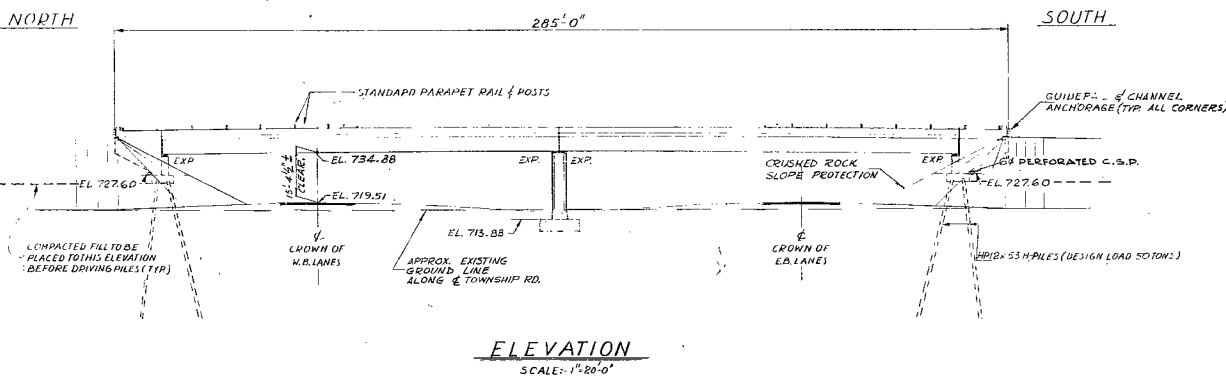
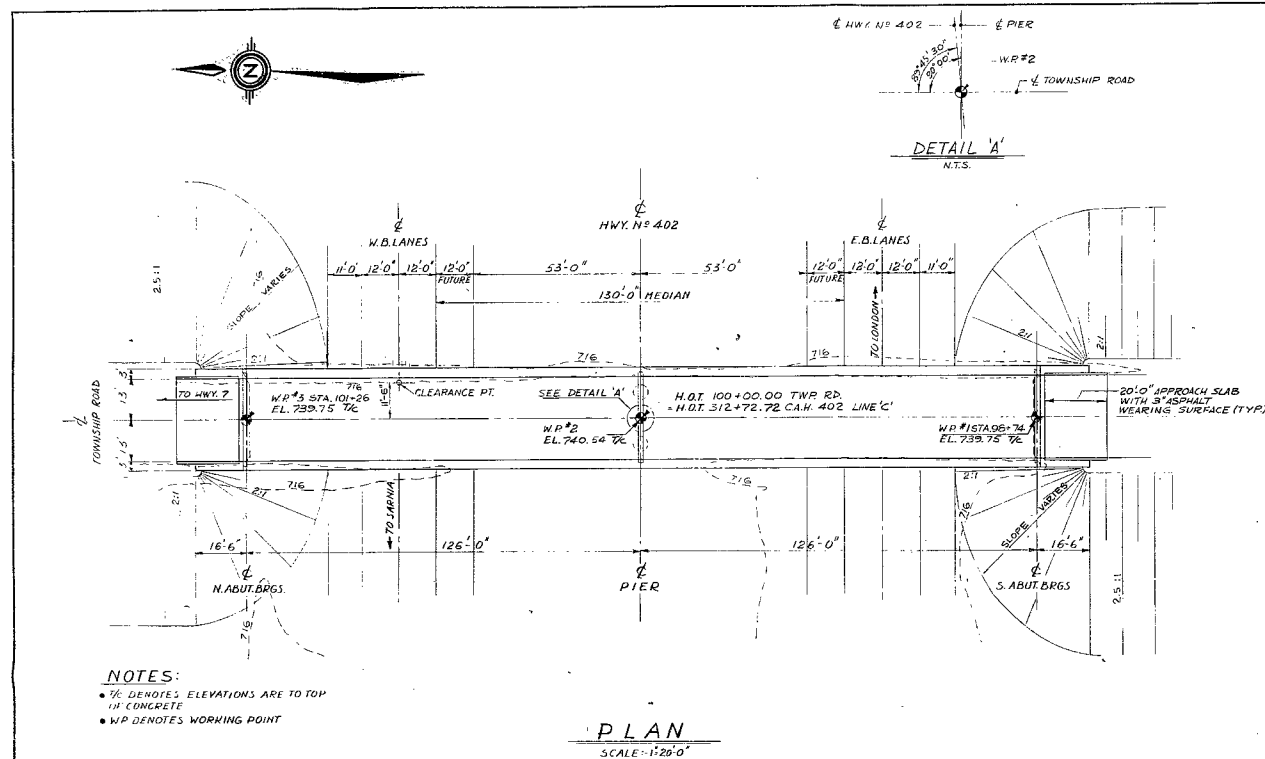
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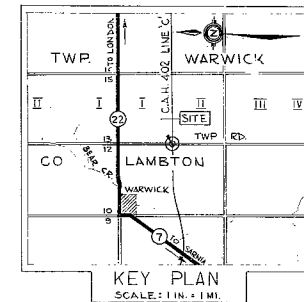
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90113-30



- LIST OF DRAWINGS.**
- D-7062 - 1 GENERAL LAYOUT
  - 2 BOREHOLE LOCATIONS AND SOIL STRATA
  - 3 FOUNDATION LAYOUT
  - 4 ABUTMENTS
  - 5 PIER
  - 6 STRUCTURAL STEEL I
  - 7 STRUCTURAL STEEL II & BEARING DETAILS
  - 8 DECK
  - 9 PARAPET WALL DETAILS
  - 10 STANDARD STEEL PARAPET RAIL
  - 11 APPROACH SLABS
  - 12 STANDARD DETAILS I
  - 13 STANDARD DETAILS II
  - D-7062 - 14 AS CONSTRUCTED ELEV. & DIM.



# NOTES:

- CLASS OF CONCRETE**
- DECK, CURBS AND PARAPET WALLS - 4000 P.S.I.
  - PIER COLUMNS - 4000 P.S.I.
  - REMAINING - 5000 P.S.I.
  - AND/OR AS NOTED ON DRAWINGS.
- CONCRETE COVER ON REIN. STEEL**
- FOOTINGS, ABUTMENTS, PIER COLUMNS, DECK: TOP, BOT. - 3"
  - CURBS, PARAPET WALLS, APPROACH SLABS - 2"
  - AND/OR AS NOTED ON DRAWINGS.
- CONSTRUCTION NOTES**
- THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF  $\pm 1/8$  INCH.
  - NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.
- CONCRETE QUANTITIES**
- CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:
- 1. CONCRETE IN PIER, ABUTMENTS AND VINGWALLS - 31 cu yd 4000 P.S.I.
  - 2. CONCRETE IN DECK - 226 cu yd
  - 3. CONCRETE IN PARAPET WALLS - 36 cu yd
  - 4. CONCRETE IN APPROACH SLABS - 35 cu yd
- STRUCTURAL STEEL QUANTITIES**
- TOTAL - 159 TONS

# B.M. 717.62 GEODETIC DATUM

N. 4 W. 1/4 NW. 20.0' ASH  
394.0' LT. 313+0.3 LINE 'C'

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS  
ONTARIO

# TOWNSHIP ROAD UNDERPASS

1.8 MILES EAST OF HWY. 7

KING'S HIGHWAY No. 402 LINE 'C' DIST. No. 1

CO. LAMBTON TWP. WARWICK LOTS 12 & 13 CONS. 1 & 2 SOUTH OF FOREMAN RD.

GENERAL LAYOUT.

APPROVED: [Signature] SHEET: 14-354 CONTRACT: 42-66-10

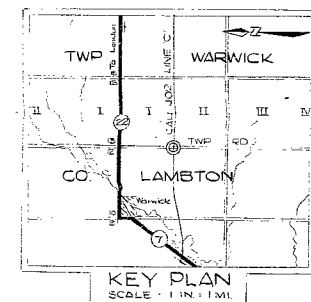
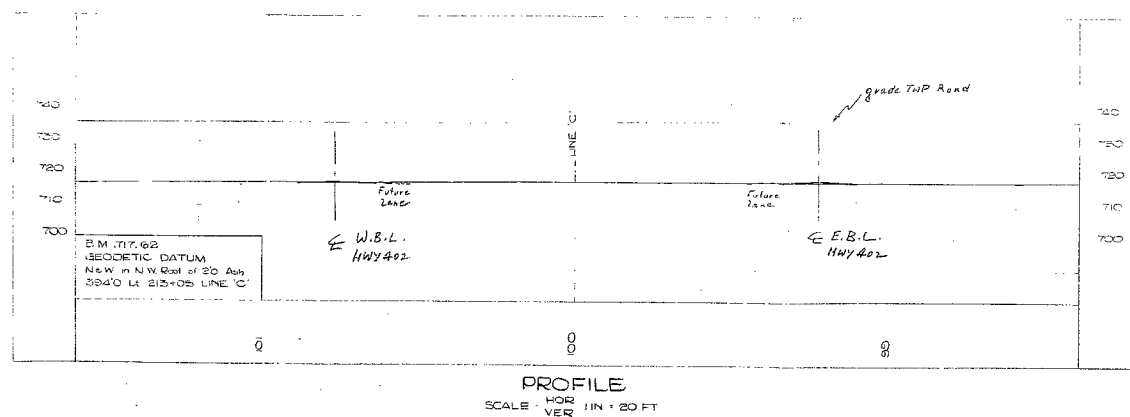
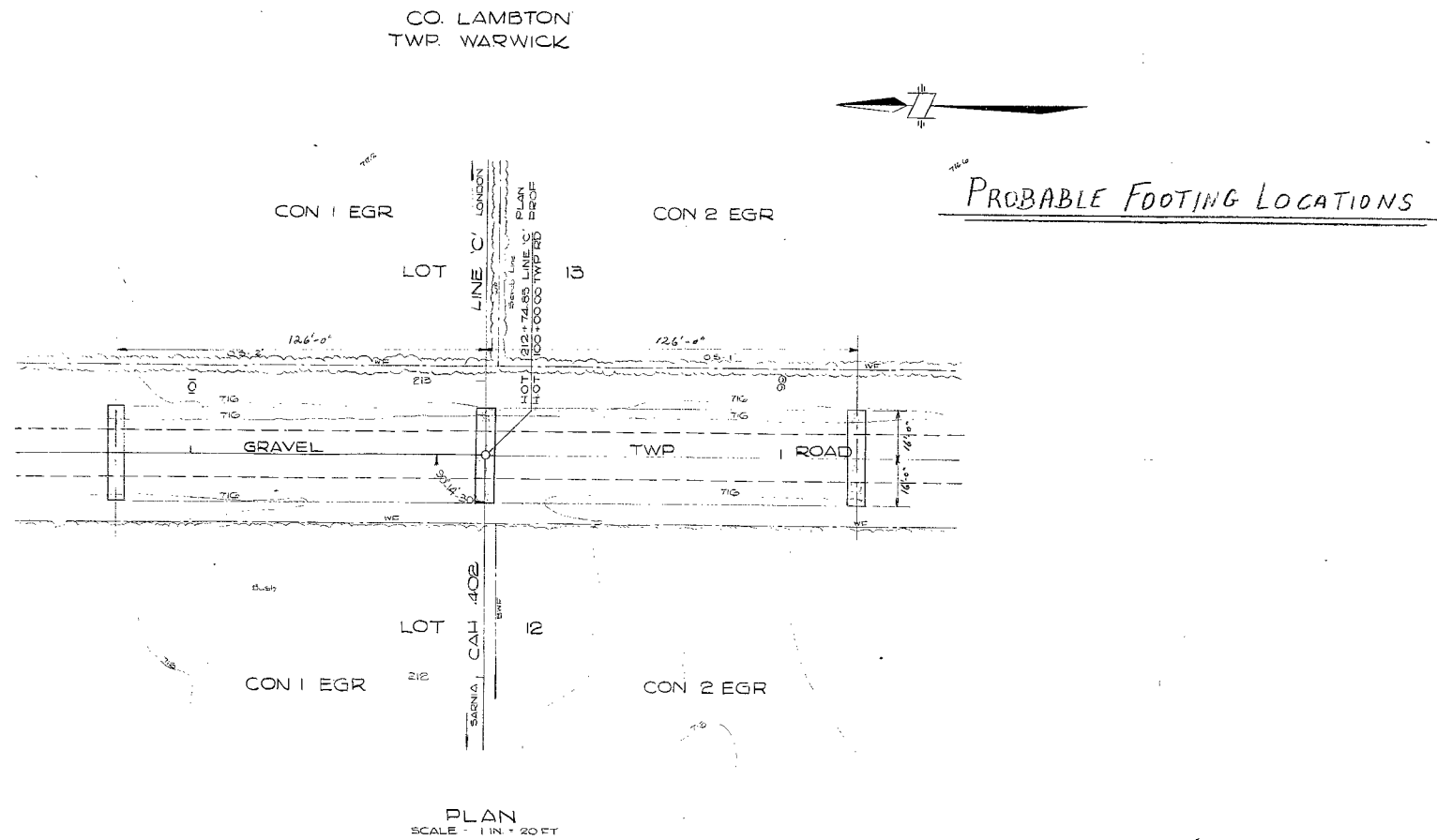
DESIGN: K.Z.S. CHECK: K.Z.S. DRAWING: [Signature] DATE: JAN. 1972

FOR REDUCED PLAN USE SCALE BELOW



40113-30





STR WP 42-66-10

DATE REVISIONS & ADDITIONS BY CHKD

71-11033

DEPARTMENT OF HIGHWAYS ONTARIO  
DESIGN BRANCH  
ENGINEERING SURVEYS OFFICE

BRIDGE SITE

PROPOSED CROSSING  
AT  
TWP. RD  
AND  
C.A.H. 402 LINE 'C'

LOTS 22 & 23 CON 1 & 2  
(SOUTH OF EGRESSMENT RD.)  
TOWNSHIP OF WARWICK COUNTY OF LAMBTON

SCALE AS SHOWN	DISTRICT CHATHAM	REGION SOUTH WESTERN
W.O. 222-42-66-10 Date of Survey NOV. 69	Site 14-354	
SURVEY BY Chief of Party - G. TELFORD Supervisor - W. SMYTH	DRAWN BY Draftsman - J. COOKEY & S. BOY Supervisor - P.J. BULE	
CHECKED BY Draftsman - G. COOKEY Supervisor - P.J. BULE	PLAN E-4872-1	

40113-30