

G.I.-30 SEPT. 1976

GEOCRES No. 40 I 14-102DIST. 2 REGION                     W.P. No. 40-66-10/11CONT. No. 80-77W. O. No.                     STR. SITE No. 19-529HWY. No. 402LOCATION C.P.R. Overhead  
(EBL & WBL)No of PAGES - 3.8 mi W of Hwy 2

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.REMARKS:

FILE!

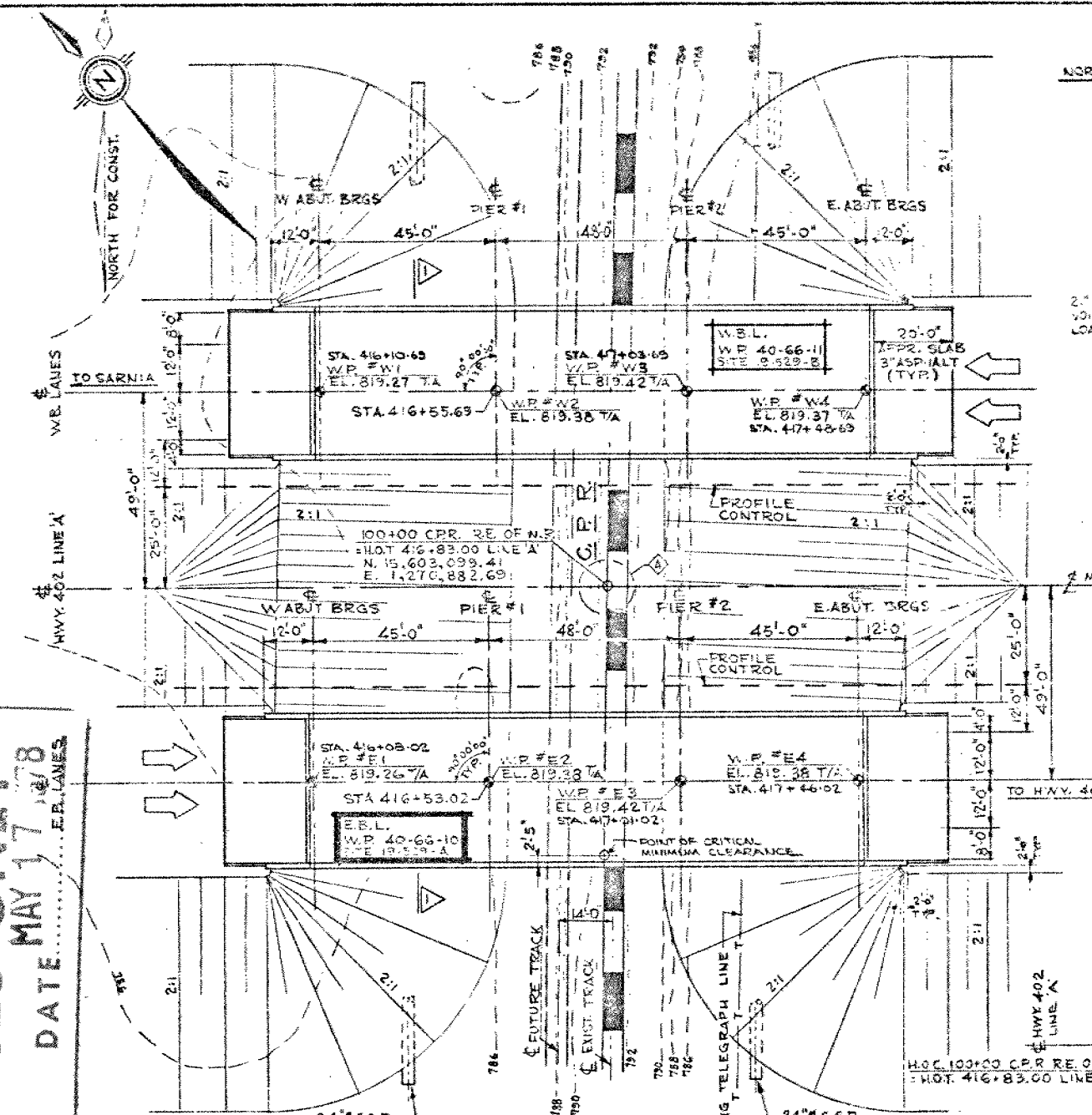
DIST. No 2  
CONT No  
WP No 40-66-10

SHEET

HWY 402, C.P.R. OVERHEAD  
3.5 MILES WEST OF HWY. 2  
E.B. LANE BRIDGE  
GENERAL LAYOUT

Morgan MacDonald  
Engineer & Architect  
Consulting Engineers

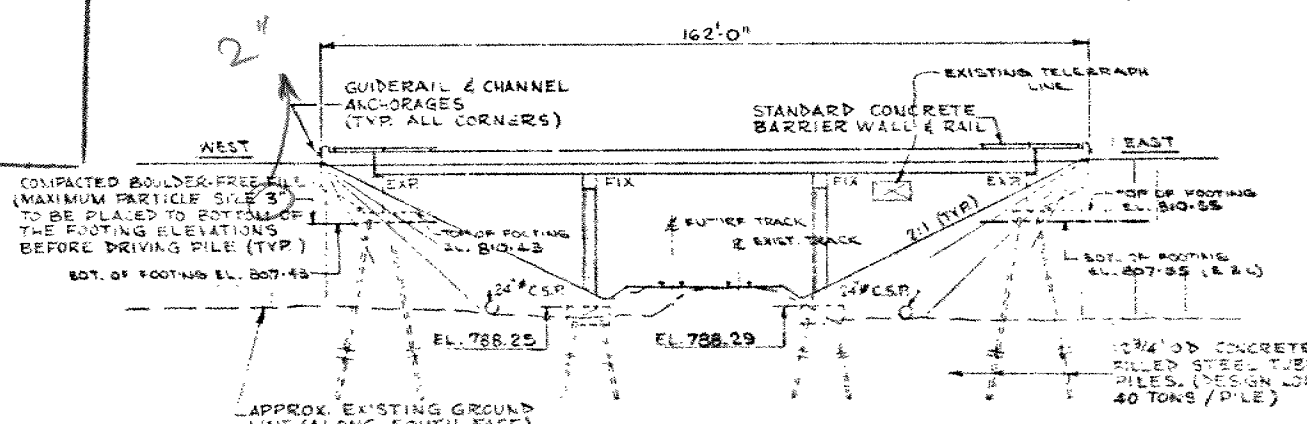
MMMB



PLAN

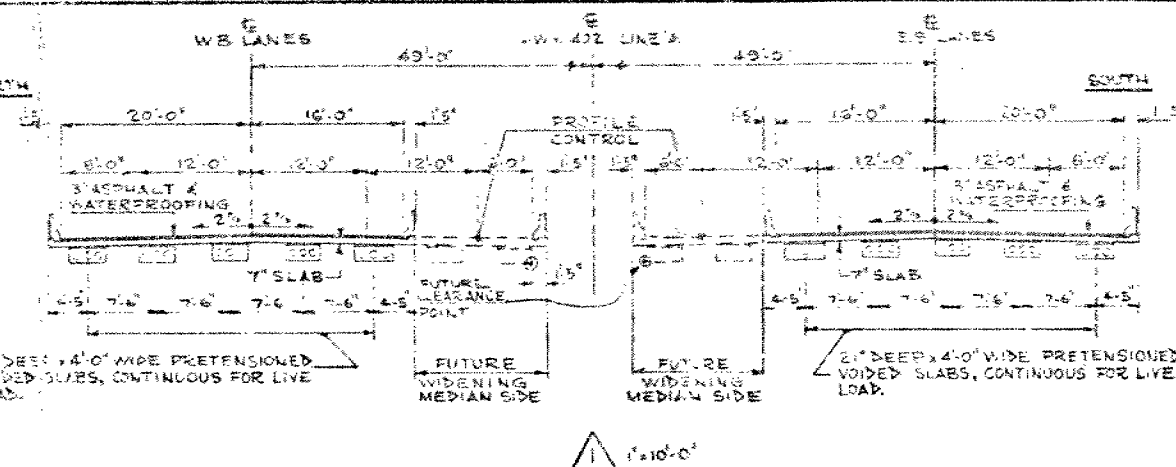
Scale: 1" = 20'-0"

• DENOTES WORKING POINT  
▲ DENOTES ELEVATION AT TOP OF FINISHED ASPHALT



ELEVATION (E.B.L. BRIDGE)

Scale: 1" = 20'-0"



PROFILE OF HWY. 402 ALONG PROFILE CONTROL (LINE A)

N.T.S.

V.C. = 1000'

L.V.C. = 1666'

TO SARNIA 13.00%

TO HWY. 401 3.00%

C.P.R. OVERHEAD

TOP OF PAVEMENT AT PROFILE CONTROL FOR REVISED GRADE

B.V.C. STA 408+07.00

B.V.C. STA 425+33.00

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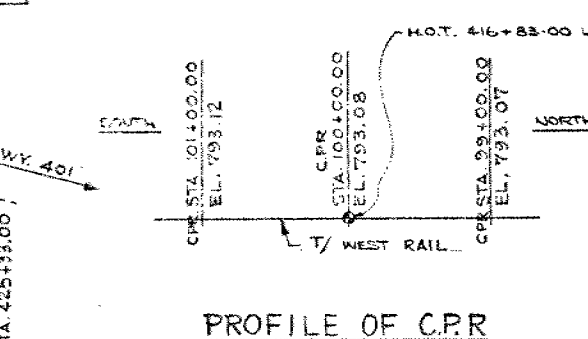
TO HWY. 401

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PROFILE OF C.P.R.

N.T.S.

CONCRETE QUANTITIES

CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROXIMATE LUMP SUM TENDER ITEMS:

a) CONCRETE IN PIERS	66 CU. YDS.
b) CONCRETE IN ABUTMENTS & WINGWALLS	53 CU. YDS.
c) CONCRETE IN DECK & DIAPHRAGMS	145 CU. YDS.
d) CONCRETE IN BARRIER WALLS	27 CU. YDS.
e) CONCRETE IN APPROACH SLABS	47 CU. YDS.

- LIST OF DRAWINGS:-
- 13-529-B - 1 GENERAL LAYOUT
  - 13-529-B - 2 BOREHOLE LOCATIONS & SOIL STRATA
  - 3 FOUNDATION LAYOUT & TRACK PROTECTION
  - 4 FOOTING REINFORCING & DETAILS
  - 5 WEST ABUTMENT & WINGWALLS
  - 6 EAST ABUTMENT & WINGWALLS
  - 7 PIER DETAILS
  - 8 SCREED ELEVATIONS & BEARING DETAILS
  - 9 BEAM LAYOUT & DETAILS
  - 10 DECK REINFORCEMENT DETAILS
  - 11 BARRIER WALL
  - 12 STEEL RAILING (SINGLE TUBE)
  - 13 20FT. APPROACH SLAB (BARRIER WALL)
  - 14 STANDARD DETAILS I
  - 15 STANDARD DETAILS II
  - 16 STANDARD DETAILS III
  - 17 AS CONSTRUCTED ELEVATIONS & DIMENSIONS

GENERAL NOTES

- CLASS OF CONCRETE:
- a) PRESTRESSED PRECAST BEAMS - 5000 PSI
  - b) DECK, BARRIER WALLS, ABUTMENTS, DIAPHRAGMS, PIERS & PIER CAPS - 4000 PSI
  - c) FOOTINGS & APPROACH SLABS - 3000 PSI

- CLEAR COVER TO REINF. STEEL UNLESS NOTED ON DRS:
- a) DECK - TOP 2", BOT. 1"
  - b) BARRIER WALLS & DIAPHRAGMS - 1 1/2"
  - c) PIERS, PIER CAPS, ABUTMENTS & APPROACH SLABS - 2"
  - d) FOOTINGS - 3"

REINFORCING STEEL TO BE GRADE 60; REINFORCING STEEL MARK IS GIVEN IN METRIC SIZES. #3, #4, #5, #6, #7, #8, #9, #10, #11, #12, #13, #14, #15, #16, #17, #18, #19, #20, #21, #22, #23, #24, #25, #26, #27, #28, #29, #30, #31, #32, #33, #34, #35, #36, #37, #38, #39, #40, #41, #42, #43, #44, #45, #46, #47, #48, #49, #50, #51, #52, #53, #54, #55, #56, #57, #58, #59, #60, #61, #62, #63, #64, #65, #66, #67, #68, #69, #70, #71, #72, #73, #74, #75, #76, #77, #78, #79, #80, #81, #82, #83, #84, #85, #86, #87, #88, #89, #90, #91, #92, #93, #94, #95, #96, #97, #98, #99, #100, #101, #102, #103, #104, #105, #106, #107, #108, #109, #110, #111, #112, #113, #114, #115, #116, #117, #118, #119, #120, #121, #122, #123, #124, #125, #126, #127, #128, #129, #130, #131, #132, #133, #134, #135, #136, #137, #138, #139, #140, #141, #142, #143, #144, #145, #146, #147, #148, #149, #150, #151, #152, #153, #154, #155, #156, #157, #158, #159, #160, #161, #162, #163, #164, #165, #166, #167, #168, #169, #170, #171, #172, 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DIST. No 2  
CONT No  
WP No 40-66-10

Hwy. 402, C.P.R. OVERHEAD  
3.8 MILES WEST OF HWY. 2.  
E.B. LANES BRIDGE  
FOUNDATION LAYOUT & TRACK PROTECTION.

Morrison, Hershfield,  
Burges & Huggins Limited  
Consulting Engineers

SHEET



# TRACK PROTECTION NOTES:-

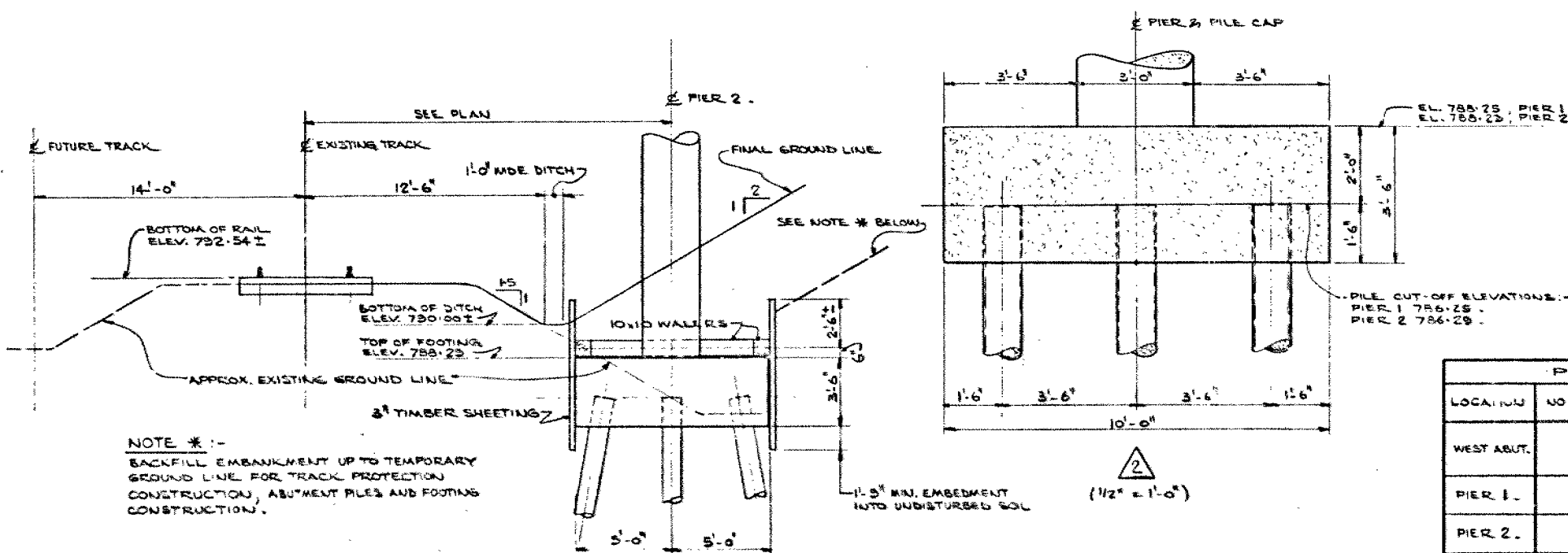
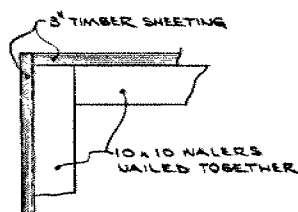
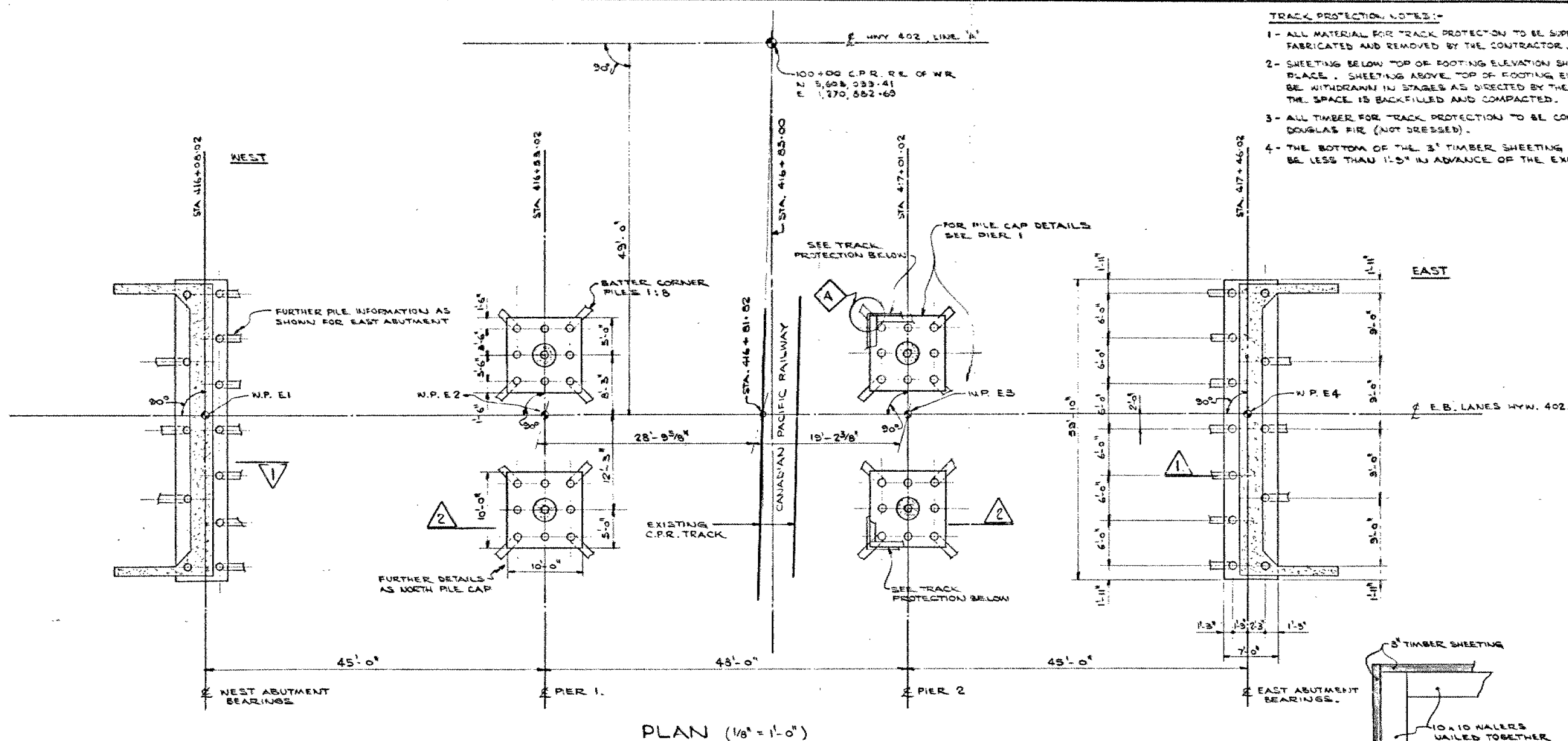
- 1- ALL MATERIAL FOR TRACK PROTECTION TO BE SUPPLIED, PLACED, FABRICATED AND REMOVED BY THE CONTRACTOR.
- 2- SHEETING BELOW TOP OF FOOTING ELEVATION SHALL BE LEFT IN PLACE. SHEETING ABOVE TOP OF FOOTING ELEVATION SHALL BE WITHDRAWN IN STAGES AS DIRECTED BY THE ENGINEER, WHILE THE SPACE IS BACKFILLED AND COMPACTED.
- 3- ALL TIMBER FOR TRACK PROTECTION TO BE CONSTRUCTION GRADE DOUGLAS FIR (NOT DRESSED).
- 4- THE BOTTOM OF THE 3" TIMBER SHEETING SHALL IN NO CASE BE LESS THAN 11.5" IN ADVANCE OF THE EXCAVATION.

## PILE NOTES:-

- 1- LAYOUT DIMENSIONS FOR PILES ARE GIVEN AT THE UNDERSIDE OF PIER AND ABUTMENT FOOTINGS.
- 2- PIER PILES AND ABUTMENT PILES SHALL BE 12 3/4" O.D. x 0.25" THICK WALL STEEL TUBE PILES AND SHALL BE DRIVEN IN ACCORDANCE WITH STD. 553-11 (DRG. 14) USING A SAFE DESIGN WORKING LOAD OF 40 TONS PER PILE, BUT MUST BE DRIVEN BELOW ELEVATION 750.00
- 3- FOR PILE SPlicing AND DRIVING SHOE DETAILS SEE DRG. 14
- 4- ALL PILES SHALL BE FILLED WITH 2000 PSI CONCRETE AFTER INSTALLATION AND INSPECTION OF PILES.
- 5- PILES SHALL BE DRIVEN SO THAT THEIR FINAL LOCATION, MEASURED AT THE UNDERSIDE OF THE FOOTINGS, DOES NOT VARY BY MORE THAN 3" FROM THEIR PROPER LOCATION.
- 6- ALL PILE STEEL SHALL BE TO CSA. G40-21 - GRADE 50W.
- 7- APPROX. CONCRETE IN TUBE PILES = 100 CYDS. CEMENT FOR CONCRETE IN TUBE PILES TO BE SUPPLIED BY THE CONTRACTOR.

## CO-ORDINATES OF WORKING POINTS:-

WORKING POINT	STATION	NORTH CO-ORDINATE	EAST CO-ORDINATE
E1	416+08.02	N 15,603,117.07	E 1,270,794.87
E2	416+53.02	N 15,603,085.51	E 1,270,826.35
E3	417+01.02	N 15,603,051.65	E 1,270,861.17
E4	417+46.02	N 15,603,020.29	E 1,270,893.76



PILE CUT-OFF ELEVATIONS:-  
WEST ABUTMENT 808.34  
EAST ABUTMENT 805.04

PILE CUT-OFF ELEVATIONS:-  
PIER 1 786.25  
PIER 2 786.29

LOCATION	NO. REQ'D	BATTER	LENGTH
WEST ABUT.	2	VERTICAL	66'-0"
	3	1:3	67'-0"
	7	1:3	70'-0"
PIER 1	10	VERTICAL	44'-0"
	8	1:3	45'-0"
PIER 2	10	VERTICAL	44'-0"
	8	1:3	45'-0"
EAST ABUT.	2	VERTICAL	66'-0"
	3	1:3	67'-0"
	7	1:3	70'-0"

FOR REDUCED PLAN  
USE SCALE BELOW

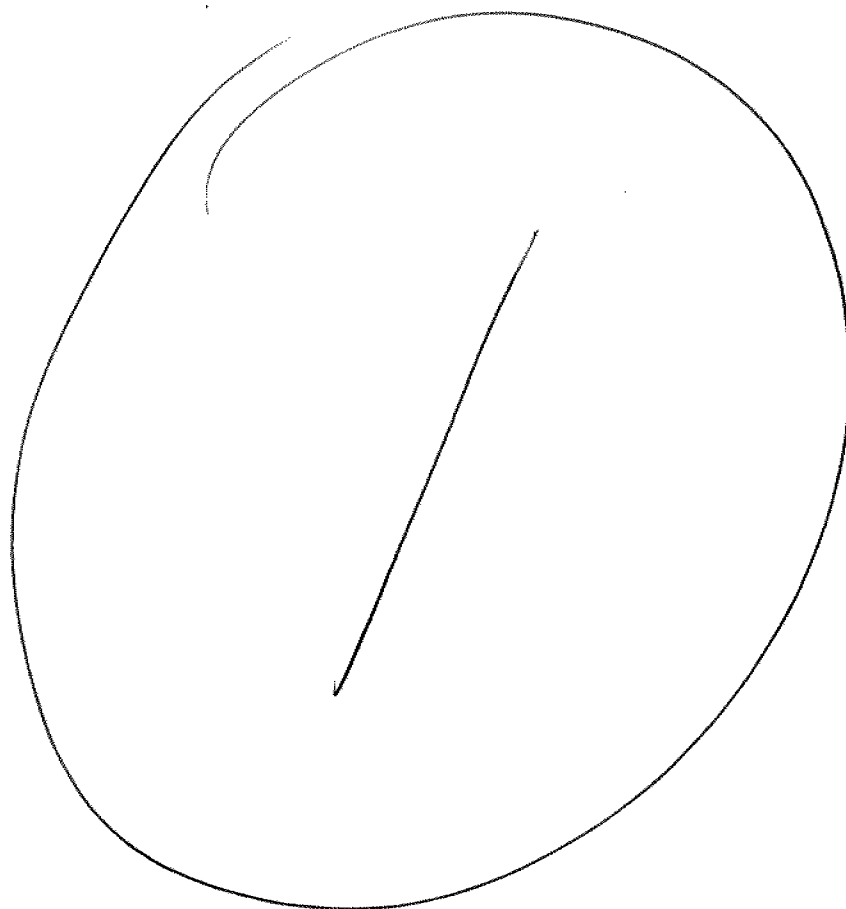


REVISIONS	DATE	BY	DESCRIPTION

DESIGN A.C. CHECK A.C. LOADING 11/2/73 DATE 11/2/73  
DRAWING A.C. CHECK A.C. SITE No. A 663-A DWG. 3

35MM

DRAWING



## MEMORANDUM

40I14-102

GEOCREG No.

TO: A.P. Watt (2)  
Regional Structural Planning Engineer  
Southwestern Region, London

FROM: Soil Mechanics Section  
Geotechnical Office  
West Bldg.

ATTENTION:

DATE: February 10, 1976

FEB 18 1976

OUR FILE REF.

IN REPLY TO

SUBJECT:

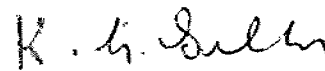
## FOUNDATION INVESTIGATION REPORT

For

W.P. 40-66-10/11  
Hwy. 402, District 2  
C.P.R. Overhead (EBL/WBL)  
3.8 Miles West of Hwy. 2

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your requirements. Should additional information be required, please do not hesitate to contact our Office.



K.G. Selby  
Supervising Engineer

KGS/bp

cc: R.S. Pillar  
C.S. Grebski  
B.J. Giroux  
G.A. Wrong  
A. Wittenberg  
J.R. Roy  
D.P. Collins  
  
R. Hore  
J. Anderson )  
A. Crowley ) Memo only  
G. Sloan )  
Files ✓  
Record Services

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4. GROUNDWATER CONDITIONS
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    - (5.3.3) Settlement
  - (5.4) Culvert Site

# FOUNDATION INVESTIGATION REPORT

for

W.P. 40-66-10/11  
Hwy. 402, District 2  
C.P.R. Overhead (EBL/WBL)  
3.8 Miles West of Hwy. 2

---

## 1. INTRODUCTION

A foundation investigation consisting of six boreholes was carried out at the above described location to determine the subsoil conditions. An additional borehole was put down adjacent to Vanheck Drain which is located approximately 200 ft. west of the railway track for similar purposes.

This report contains factual and interpreted soil data, together with recommendations for the design and construction of the proposed structures and approaches.

## 2. SITE DESCRIPTION

The proposed overhead structures will be located approximately 0.7 miles east of the intersection of C.P.R. tracks and Sideroad 20.

The surrounding terrain, with the exception of the 6 ft. high railway embankment, is flat. An approximate 20 ft. wide and 5-6 ft. deep ditch called Vanheck Drain, is situated about 200 ft. west of the tracks.

Physiographically the site is located in the region referred to as the Caradoc Sand Plains. Sands and other light textured waterlaid deposits are characteristics for this region.

## 3. SUBSURFACE CONDITIONS

### (3.1) General

Generally, uniform subsoil conditions were found to prevail over the area investigated.

The surficial deposit across the site is composed of loose to very dense silty sand to sandy silt, traces of clay, which varies from 59 to 63 ft. in thickness. This granular deposit is

underlain by a minimum 58 ft. thick very stiff to hard clayey silt stratum. The boundaries of the various deposits are shown on the accompanying Record of Borehole Sheets. The stratigraphical sections plotted on Drawing No. 406610 & 11-A have been inferred from this data. From ground level downward the various soil types encountered are described in some detail as follows:

### (3.2) Silty Sand to Sandy Silt, Traces of Clay

This deposit was intersected at every boring location immediately below ground surface but was not penetrated to its full extent in each borehole. The thickness was found to range from 59 to 63 ft. in Borehole #4 and #8 respectively.

The material in the stratum consists of sands and silts with varying proportions. The chief constituent is sand in the upper segment, while the lower part of the deposit contains a large percentage of silt. Traces of clay were also found within this zone. Grain size distribution testing was carried out on selected samples from the deposit. The results are plotted in envelope form on Figure 1.

Standard penetration testing was carried out within this granular deposit and the results are plotted on the Record of Borehole Sheets. The obtained 'N' values ranged from 4 blows/ft. to 92 blows per 6 inches. Based on these results, it is estimated that the relative density of this deposit varies from loose to very dense.

The natural moisture content ranges from 12% to 25%.

### (3.3) Clayey Silt

The granular deposit is underlain by a cohesive stratum of low plasticity in Borehole's #4 and #8, at elev. 726 and elev. 724 respectively. At the other borehole locations, the borings were terminated in the silty sand to sandy silt deposit. The stratum also contains occasional seams and layers of silt throughout.

A limited number of laboratory tests carried out on selected samples indicate the following physical properties:



---

	<u>Range</u>
Liquid Limit: (%)	20-32
Plastic Limit: (%)	13-16
Natural Moisture Content: (%)	20-25

The results of grain size distribution testing are plotted on Figure #2 of the Appendix.

The consistency of the stratum varies from very stiff to hard.

#### 4. GROUNDWATER CONDITIONS

The groundwater level was observed to be close to the existing ground surface (0.5'-2.5').

The following groundwater levels were observed during the field investigation:

Borehole #1	Elev. 785.5
#4	784.5
#5	785.0
#8	786.0
#9	784.5
#10	785.0
#11	783.5

#### 5. DISCUSSION AND RECOMMENDATIONS

##### (5.1) General

It is proposed to build three span (45'-45'-45') twin overhead structures at the crossing of C.P.R. and future Hwy. 402.

The proposed profile grade of Hwy. 402 will be approximately 29 ft. above the existing CP Railway embankment grade of elevation 792<sub>±</sub>. The existing ground level, in general, is at elevation 785<sub>±</sub>.

---

(5.2) Foundations

(5.2.1) Pile Support

All of the footings (Abutments and Piers) for both structures may be supported on one of the following pile types:

a) Franki Piles

Franki type displacement caissons may be used for footing support. The bulb of the pile can be formed at approx. elev. 770. For different sizes of piles the following safe design loads are recommended:

- 14 in. - 70 tons
- 18 in. - 125 tons
- 22 in. - 150 tons

b) Steel Tube Piles

The footings may be supported on piles driven to approx. elev. 745 ±. In the case of 12 3/4" O.D. and 1/4" thick wall steel tube piles, a safe design load of 40 tons per pile may be used. Pile driving should be controlled by employing the Hiley Dynamic Pile Driving Formula (MTC Standard SS3-10 & 11).

(5.2.2) Spread Footings on Compacted Fill

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 t.s.f. may be assumed.

The granular material should consist of granular 'A' and should be fully compacted according to the current MTC standards. A construction scheme is outlined on Figure 3 of the appendix.

(5.2.3) Frost Protection

The pile caps and the base of spread footings should be protected against frost action with a minimum of 4 ft. of earth cover.

#### (5.2.4) Dewatering

The footing excavations will be carried out below the observed groundwater level, therefore a dewatering scheme will be required.

#### (5.3) Approach Embankments

##### (5.3.1) Stability

The maximum height of the proposed approaches is in the order of 36 ft. Since the encountered subsoil is basically granular type material, no stability problems are expected. The slopes of the approaches should be constructed with 2 horizontal to 1 vertical.

##### (5.3.2) Embankment Material

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 grain sizes not larger than 3 inches.

##### (5.3.3) Settlement

Settlement of the subsoil due to the construction of the structure approaches should be immediate as loading is applied and should therefore not affect the structure.

#### (5.4) Culvert Site

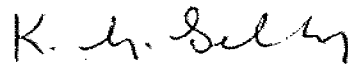
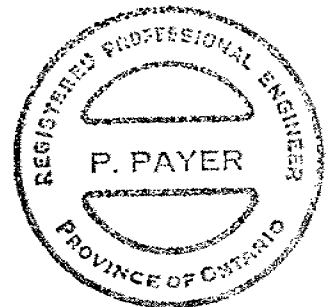
A culvert will be required for the Vanheck Drain, located some 200 ft. west of the proposed structure. no details (type and size) are available as yet.

Borehole #11 indicates similar subsurface conditions to those encountered at the structure site and described in paragraph 3.2 of this report.

In our opinion a circular C.S.P. pipe culvert can be employed at this location. The bedding and backfilling for the culvert should be carried out in accordance with current MTC practices. A minimum of 12 inches of granular 'A' should be placed below the invert. The bottom of the culvert excavation will be located below the encountered groundwater level, therefore a dewatering scheme will be necessary.



P. Payer, P. Eng.  
Senior Engineer



K.G. Selby, P. Eng.  
Supervising Engineer

## APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

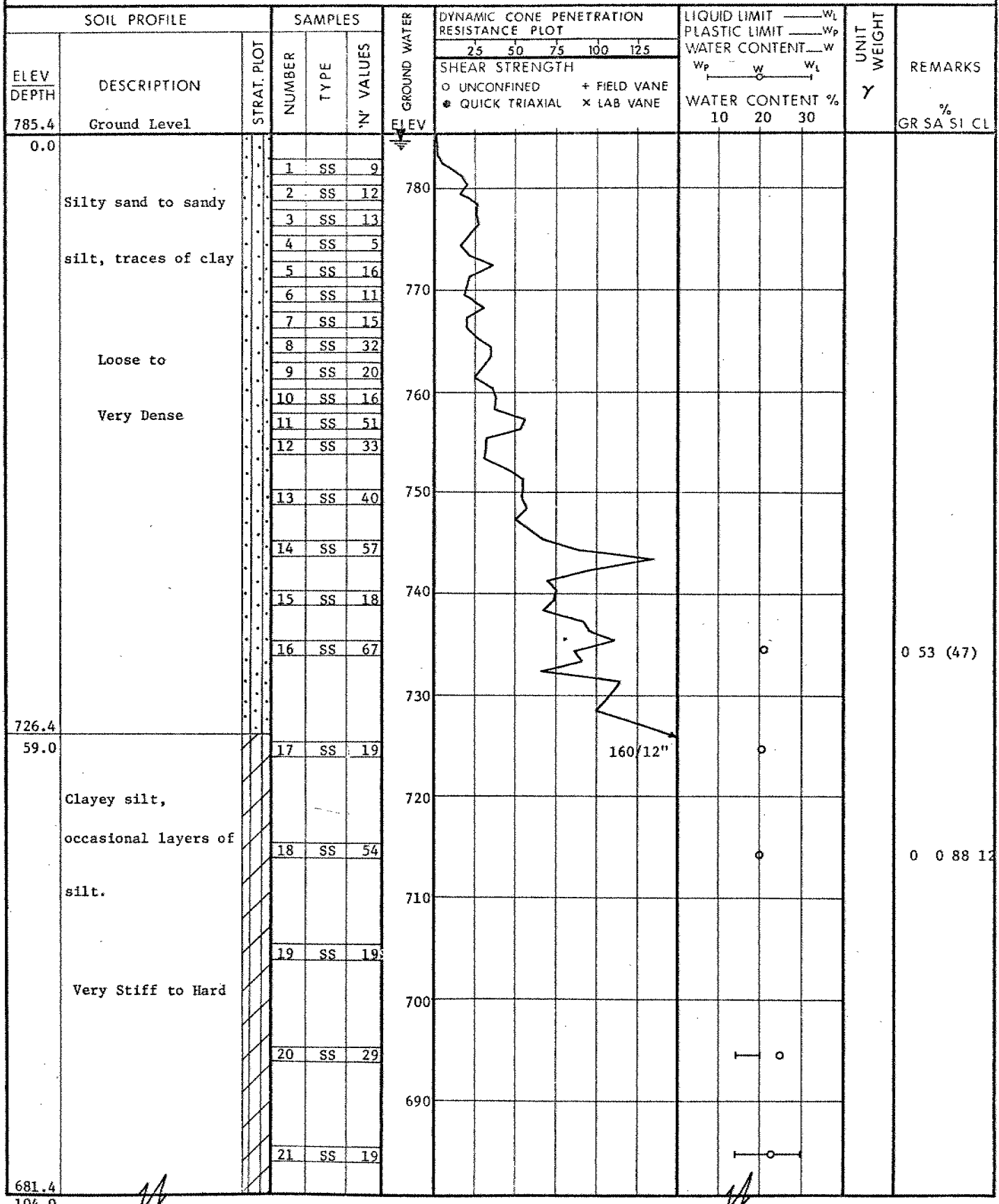
WP 40-66-10/11 LOCATION Co-ords. 15,603,114 N; 1,270,795 E. ORIGINATED BY MK  
DIST 2 HWY 402 BORING DATE December 12 - 15, 1975 COMPILED BY PP  
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS  % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
788.1	Ground Level															
0.0	Silty sand to sandy  silt, traces of clay  Compact to Very Dense.		1	SS	25											0 64 (36)
			2	SS	19											
			3	SS	32	780										
			4	SS	24											
			5	SS	15											
			6	SS	15											0 3 94 3
			7	SS	23	770										
			8	SS	48											
			9	SS	35											
			10	SS	61											0 93 ( 7 )
			11	SS	26	760										
			12	SS	27											
			13	SS	57	750										
			14	SS	66											
			15	SS	127	740										
			16	SS	163											0 57 (43)
731.6			17	SS	20											
56.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 40-66-10/11 LOCATION Co-ords. 15,603,015 N; 1,270,886 E. ORIGINATED BY MK  
DIST 2 HWY 402 BORING DATE December 2, 3, 1975 COMPILED BY BYV  
DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY



Continued

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4 Continued

WP 40-66-10/11 LOCATION Co-ords. 15,603,015 N; 1,270,886 E. ORIGINATED BY MK  
DIST 2 HWY 402 BORING DATE December 2, 3, 1975 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY *GP.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
681.4	continued															
104.0	clayey silt, occasional layers of silt.  Very Stiff to Hard		22	SS	104	680										
663.9			23	SS	29	670										
121.5	End of Borehole															



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 40-66-10/11 LOCATION Co-ords. 15,603,086 N; 1,270,964 E. ORIGINATED BY MK  
DIST 2 HWY 402 BORING DATE December 4, 5, 1975 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY *OP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
785.5	Ground Level															GR SA SI CL
0.0	Silty sand to sandy  silt, trace of clay   Loose to sand and gravel  Very Dense		1	SS	4											0 75 (25)
			2	SS	13											
			3	SS	16											
			4	SS	10											
			5	SS	34											
			6	SS	19											
			7	SS	6											
			8	SS	22											
			9	SS	20											
			10	SS	30											
			11	SS	60											
			12	SS	48											31 69 (0)
			13	SS	39											
			14	SS	45											
			15	SS	22											
734.0			16	SS	26											0 15 83 3
51.5 731.5	End of Borehole															
54.0	End of Cone										145/12"					

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 40-66-10/11 LOCATION Co-ords. 15,603,183 N; 1,270,866 E. ORIGINATED BY BVV  
DIST 2 HWY 402 BORING DATE December 12, 15, 16, 1975 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$ WATER CONTENT % 10 20 30	UNIT WEIGHT $\gamma$	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125			
787.4	Ground Level													
0.0	Silty sand to sandy  silt, traces of clay  Compact to  Very Dense		1	SS	11									
			2	SS	16									
			3	SS	20									
			4	SS	21									
			5	SS	23									
			6	SS	11									
			7	SS	21									
			8	SS	24									
			9	SS	57									
			10	SS	43									
			11	SS	56									
			12	SS	37									
			13	SS	57									
			14	SS	27									
			15	SS	39									
			16	SS	84									0 20 78 2
			17	SS	17									
724.4			18	SS	23									
63.0	Clayey silt, occasional seams and layers of silt  Very Stiff to Hard		19	SS	17									
			20	SS	28									0 0 89 11
			21	SS	68									
			22	SS	28									
			23	SS	26									0 0 46 54
683.4														
104.0														

20  
15 0-5 % STRAIN AT FAILURE  
10

Continued

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8 Continued

WP 40-66-10/11

LOCATION Co-ords. 15,603,183 N; 1,270,866 E.

ORIGINATED BY BVV

DIST 2 HWY 402

BORING DATE December 12, 15, 16, 1975

COMPILED BY BVV

DATUM Geodetic

BOREHOLE TYPE M.V. Hollow Stem Auger

CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_p$ WATER CONTENT $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
683.4	continued															
104.0			24	SS	26	680										
						670										
665.9			25	SS	30											
121.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 9

WP 40-66-10/11 LOCATION Co-ords. 15,603,087 N; 1,270 904 E. ORIGINATED BY MK  
DIST 2 HWY 402 BORING DATE December 8, 10, 1975 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY *etc.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		25	50	75	100	125	$w_p$	$w$	$w_L$		
785.5	Ground Level															
0.0	Silty sand to sandy  silt, traces of clay  Loose to Very Dense		1	SS	4											
			2	SS	12											
			3	SS	15											
			4	SS	12											
			5	SS	23											
			6	SS	37											
			7	SS	34											
			8	SS	40											
			9	SS	26											
			10	SS	58											
			11	SS	73											
			12	SS	58											
			13	SS	52											
			14	SS	98											
			17	SS	105											
			18	SS	20											
734.0			19	SS	30											
51.5	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE NO 10

WP 40-66-10/11 LOCATION Co-ords. 15,603,119 N; 1,270,863 E. ORIGINATED BY MK  
 DIST 2 HWY 402 BORING DATE December 11, 1975 COMPILED BY BVV  
 DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY BP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$W_P$	$W$	$W_L$		
786.8	Ground Level															
0.0			1	SS	12											
			2	SS	21											
			3	SS	35											
			4	SS	15											
			5	SS	18											
			6	SS	31											
			7	SS	42											
			8	SS	41											
			9	SS	22											
			10	SS	20											
			11	SS	57											
			12	SS	68											
			13	SS	92/6"											
			14	SS	65											
			15	SS	87											
			16	SS	33											
735.3			17	SS	30											
51.5	End of Borehole															

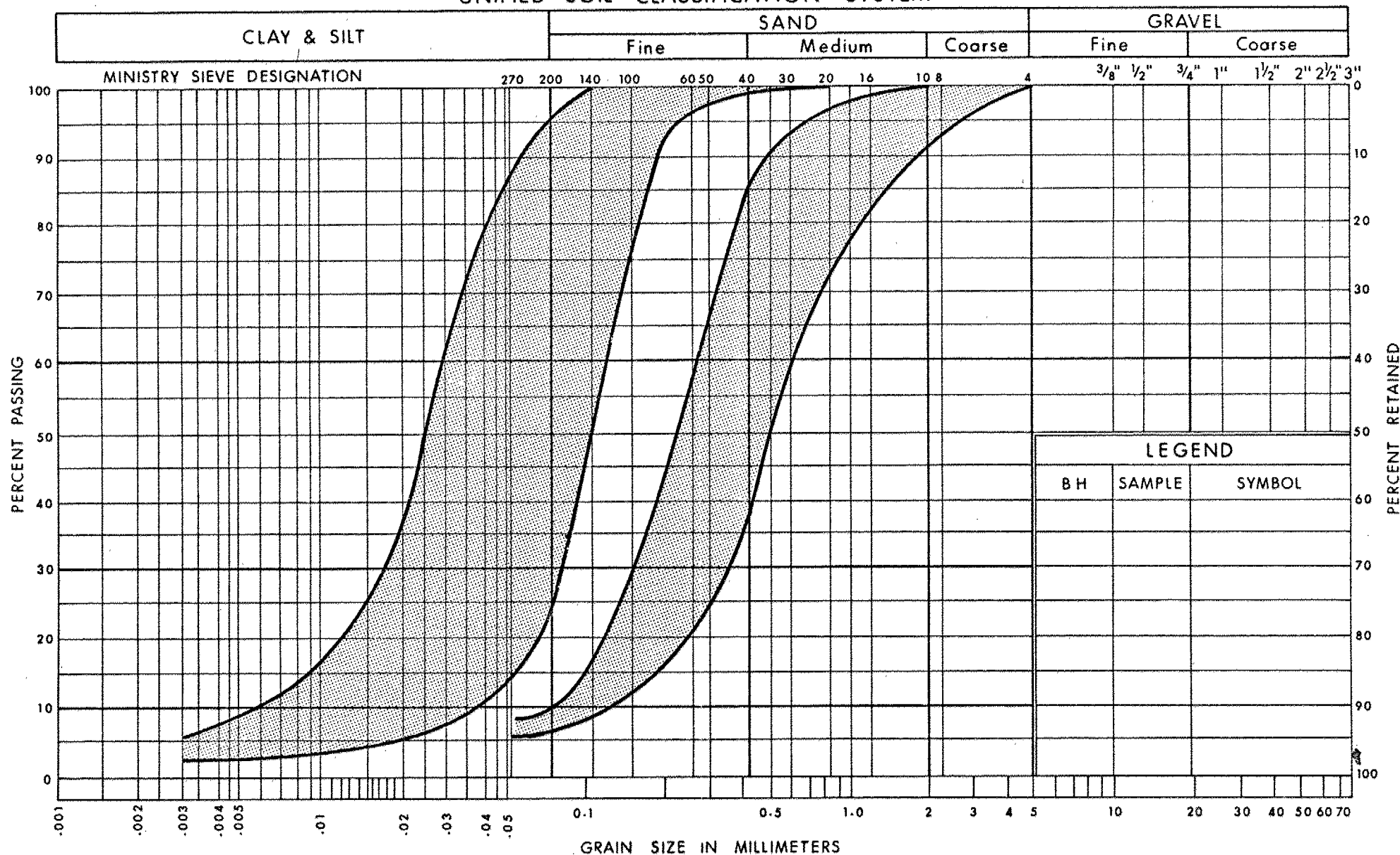
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO  
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION


RECORD OF BOREHOLE NO 11

WP 40-66-10/11 LOCATION Co-ords. 15,603,229 N; 1,270,751 E. ORIGINATED BY BVV  
DIST 2 HWY 402 BORING DATE December 17, 1975 COMPILED BY BVV  
DATUM Geodetic BOREHOLE TYPE M.V. Hollow Stem Auger CHECKED BY *ep.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		25	50	75	100	125	$w_p$ — $w$ — $w_L$				
							SHEAR STRENGTH					WATER CONTENT %				
786.5	Ground Level															
0.0	Silty sand to sandy  silt, traces of clay   <															

## UNIFIED SOIL CLASSIFICATION SYSTEM



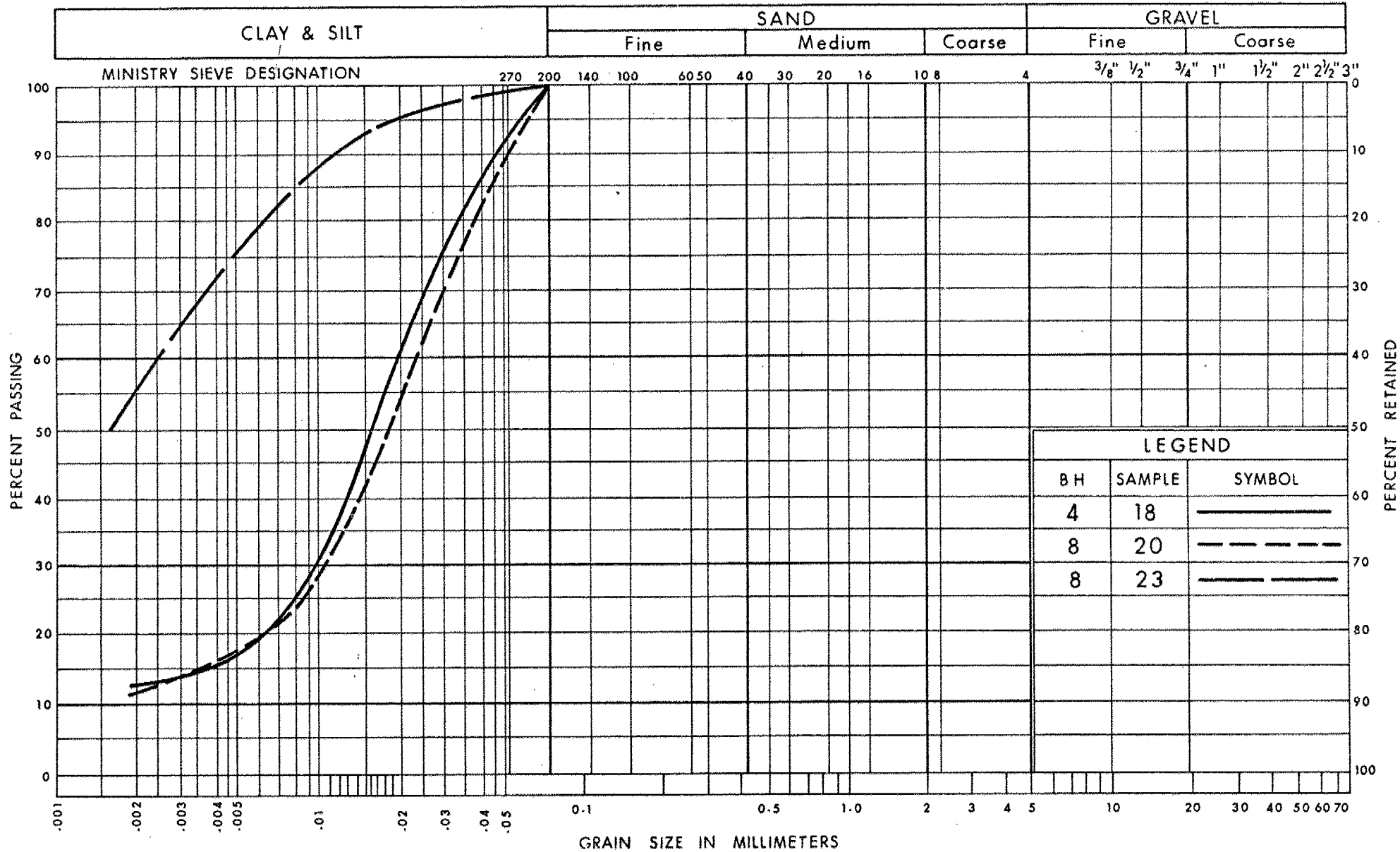
 Ministry of  
Transportation and  
Communications  
Ontario  
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION  
SILTY SAND TO SANDY SILT  
TRACES OF CLAY

FIG No 1

W P 40-66-10 & 11

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario  
ENGINEERING SERVICES BRANCH

Ministry of  
Transportation and  
Communications

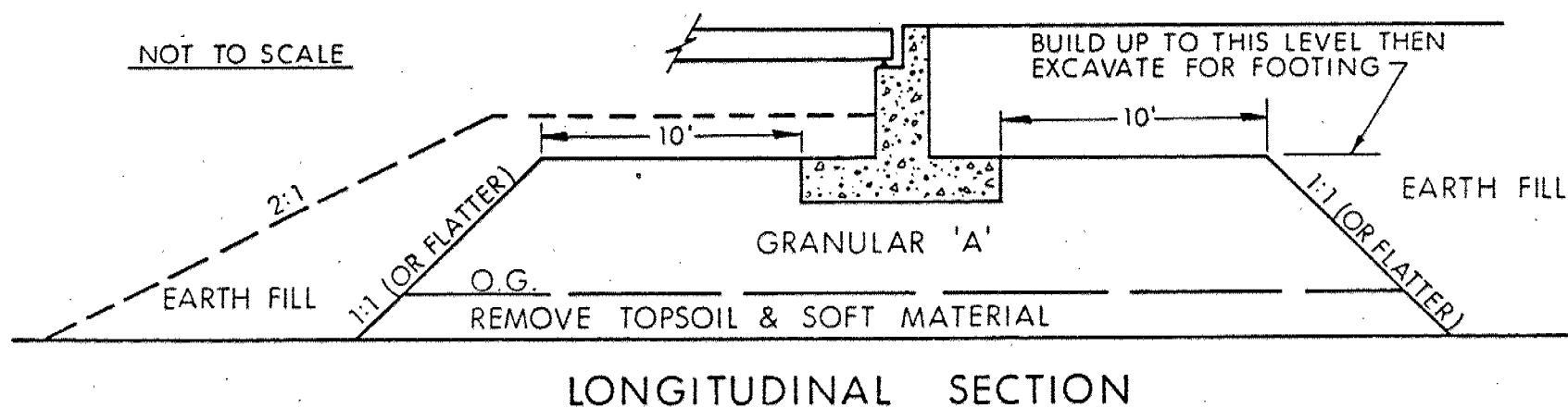
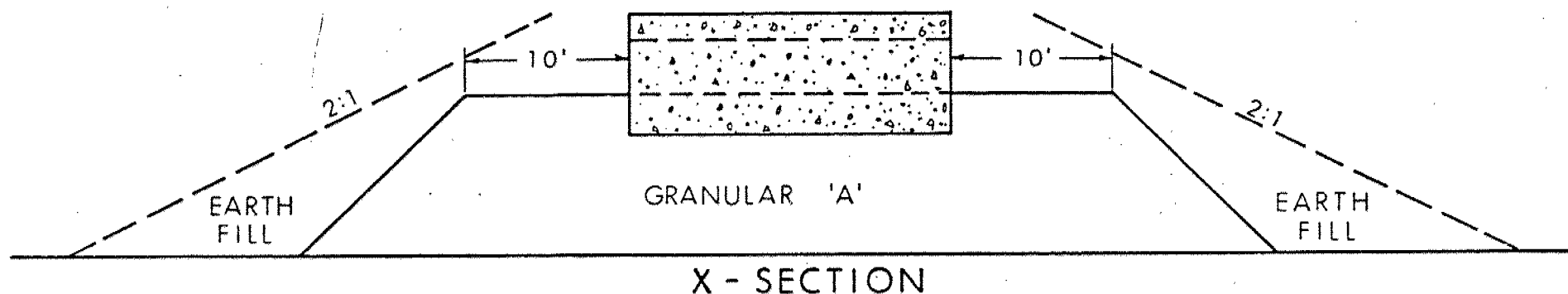
## GRAIN SIZE DISTRIBUTION CLAYEY SILT

FIG No 2

W P 40-66-10 &amp; 11



# 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 M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' MATERIAL FOR FOOTING.

## ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

### PENETRATION RESISTANCE

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

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

### SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

# ABBREVIATIONS & SYMBOLS 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
$w_g$	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
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	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

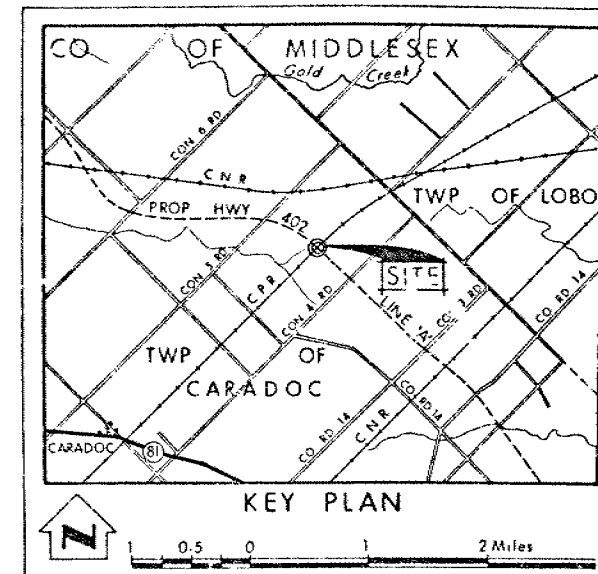
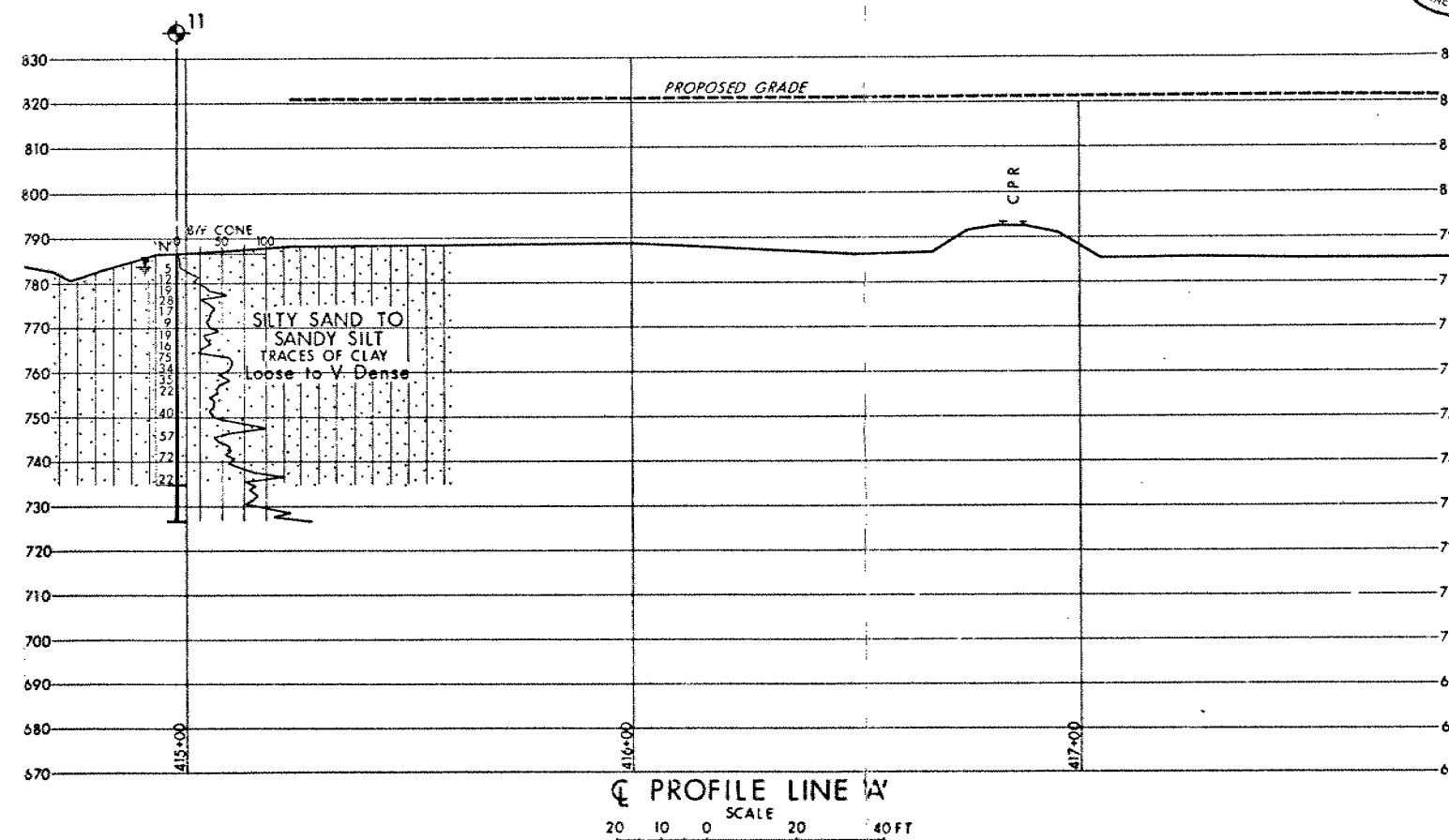
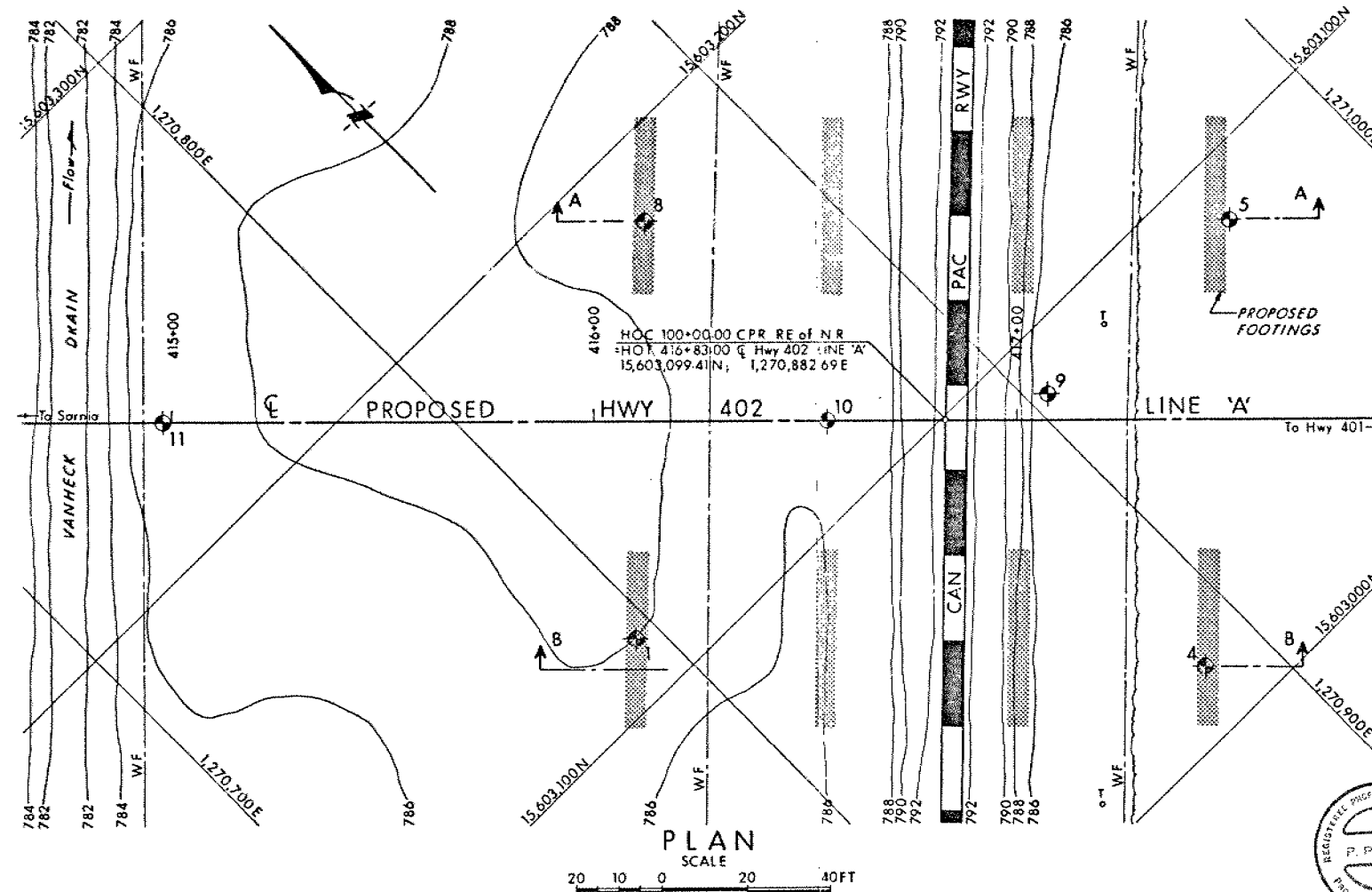
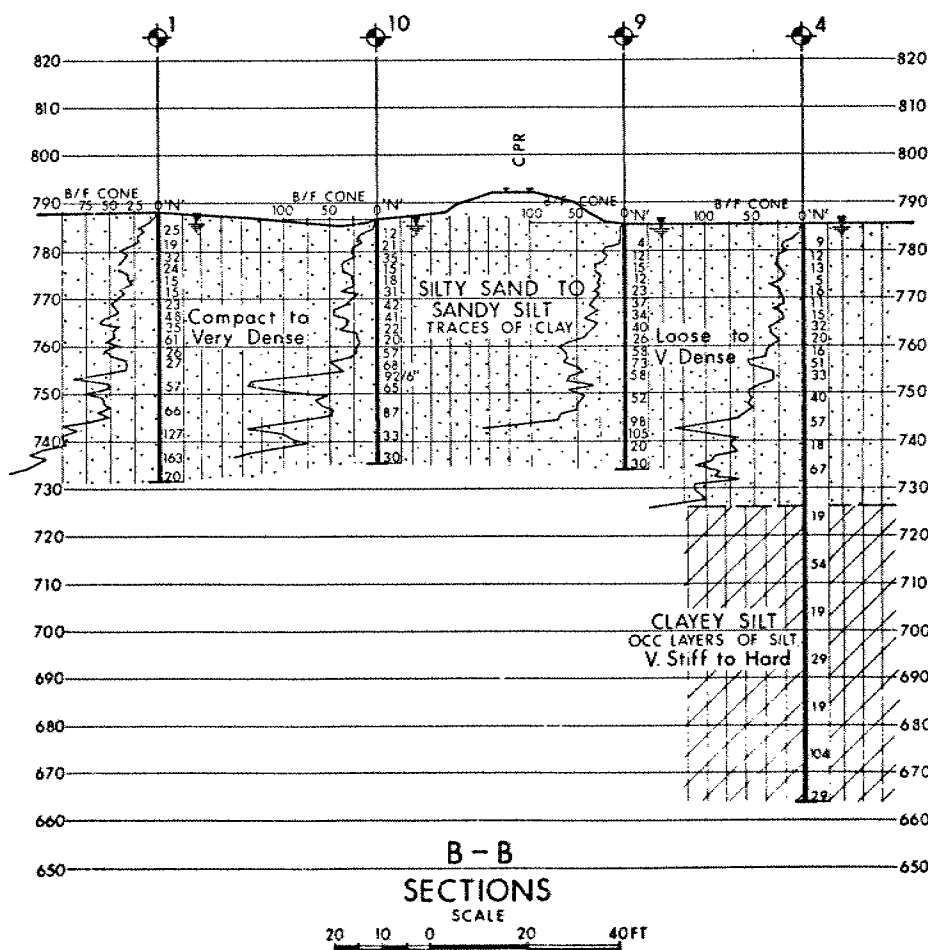
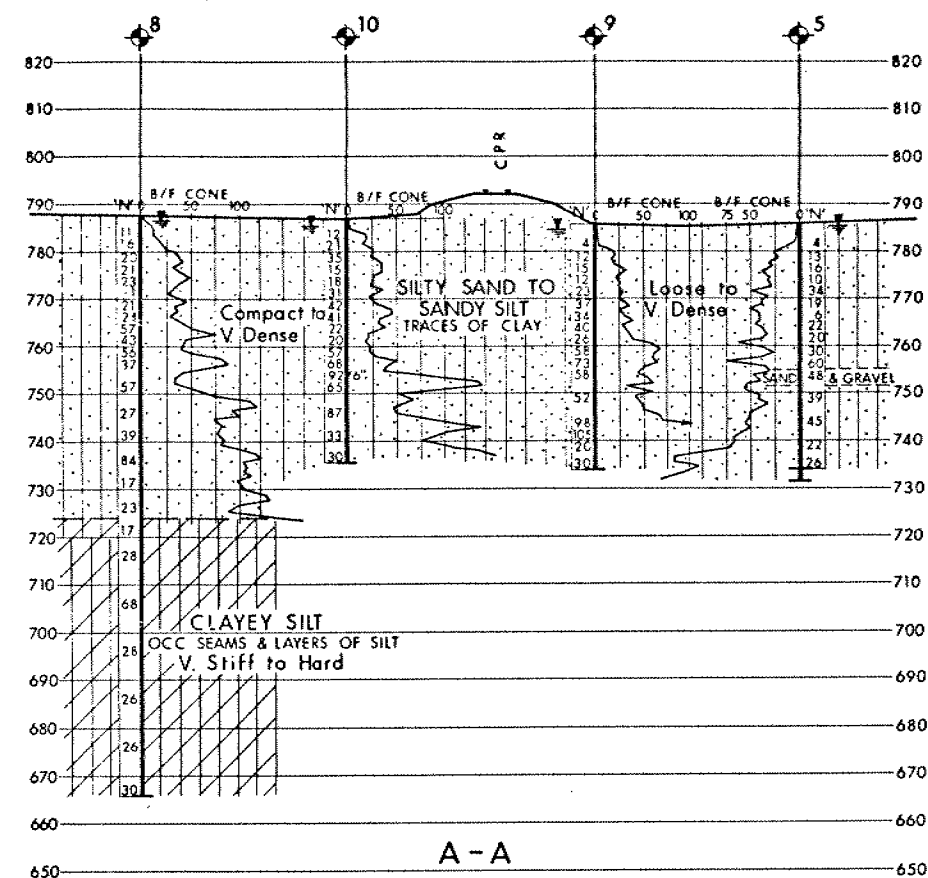
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## 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



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Resistance Test		
	B/F CONE - Blows/Ft. Cone Test (350 ft. lbs. energy/blow)		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Dec 1975		
NO.	ELEVATION	CO-ORDINATES NORTH	EAST
1	788.1	15,603,114	1,270,795
4	785.4	15,603,015	1,270,886
5	785.5	15,603,086	1,270,964
8	787.4	15,603,183	1,270,866
9	785.5	15,603,087	1,270,904
10	786.8	15,603,119	1,270,863
11	786.5	15,603,229	1,270,751

**NOTE**

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: FOR CONTRACT DOCUMENT

The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the LONDON District Office.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE—SOIL MECHANICS SECTION

**CANADIAN PACIFIC RAILWAY**  
(3.8 Miles West of Hwy 2)

HIGHWAY NO Proposed 402 LINE 'A' DIST NO 2  
CO MIDDLESEX  
TWP CARADOC LOT 22 CON IV

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBWDPP [ ] CHECKED [ ] WP NO 40-66-10 & 11 DRAWING NO 406610&11-A  
DRAWN [ ] CHECKED [ ] W NO  
DATE Feb 6, 1976 SITE NO 19-529 BRIDGE DRAWING NO  
APPROVED [ ] CONT NO