

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P2-39

DIST. 4 REGION                     

W.P. No. 72-62-01

CONT. No. 85-24

W. O. No.                     

STR. SITE No. 23-89-298

HWY. No. 403

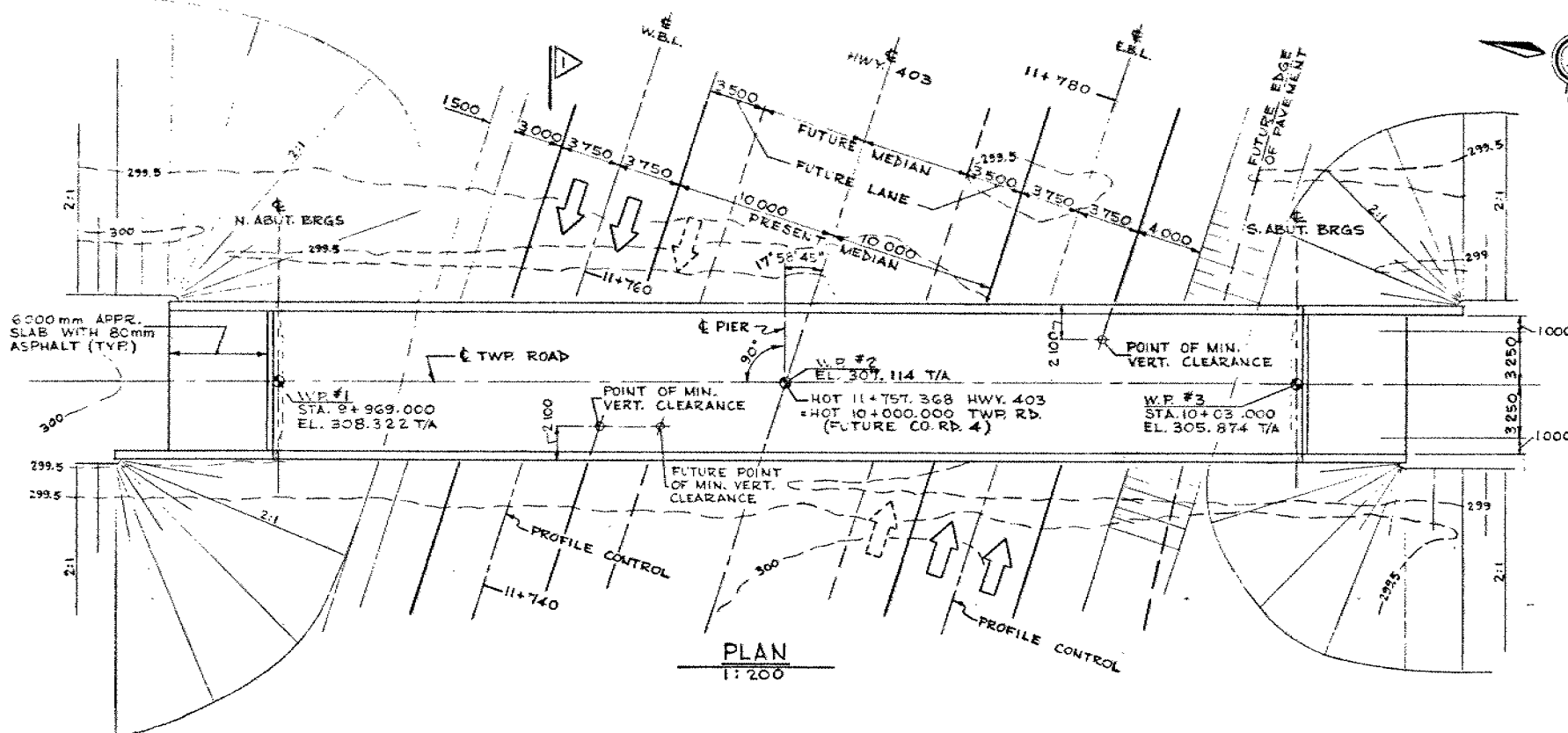
LOCATION Future Co. Rd. #4 underpass  
5 km W of Hwy 53

No of PAGES -                     

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     

REMARKS:



**METRIC**

DIMENSIONS ARE IN MILLIMETRES  
UNLESS OTHERWISE SHOWN.  
ELEVATIONS, COORDINATES, CURVE  
AND ALIGNMENT DATA ARE IN METRES.  
STATIONS ARE IN KILOMETRES + METRES.

DIST. No. 2	CONT No	SHEET
WP No 72-62-01		
TOWNSHIP ROAD UNDERPASS (FUTURE COUNTY RD. 4) 5 Km WEST OF HWY. 53 GENERAL ARRANGEMENT		

**LIST OF ABBREVIATIONS**

- W.P. = WORKING POINT
- T/A = TOP OF ASPHALT
- T/F = TOP OF FOOTING
- F.F. = FRONT FACE
- B.F. = BACK FACE
- E.F. = EACH FACE

**NOTES:**

- CLASS OF CONCRETE**
- DECK & PIER COLUMN — 35 MPa
  - ABUTMENTS, WINGWALLS, BARRIER WALLS & FOOTINGS — 30 MPa
  - REMAINDER — 20 MPa

**REINFORCING STEEL**

GRADE 400.  
BAR MARK WITH SUFFIX 'C' DENOTES COATED BAR.

NOMINAL CLEAR COVER AND TOLERANCE TO REINF. STEEL	mm
FOOTINGS	100 ± 25
ABUTMENTS & WINGWALLS	
FRONT FACE	80 ± 20
BACK FACE	70 ± 20
PIER COLUMN	80 ± 20
DECK TOP	70 ± 20
DECK BOTTOM & SIDES	50 ± 10
REMAINDER UNLESS OTHERWISE NOTED	70 ± 20

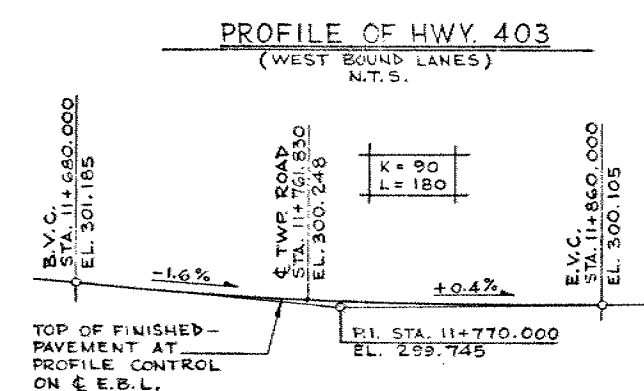
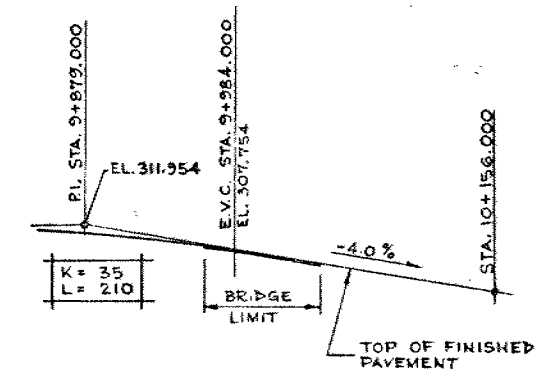
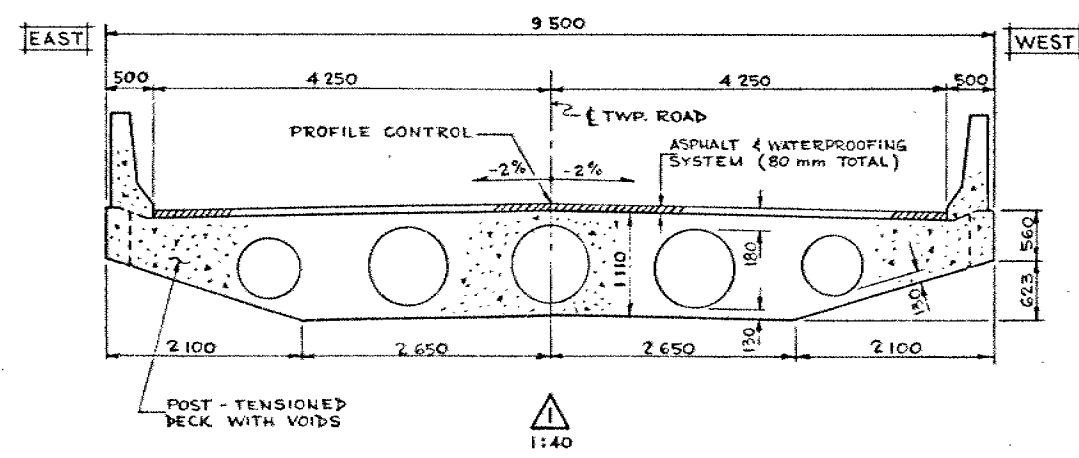
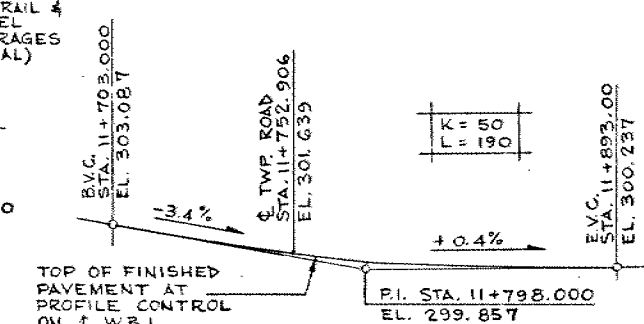
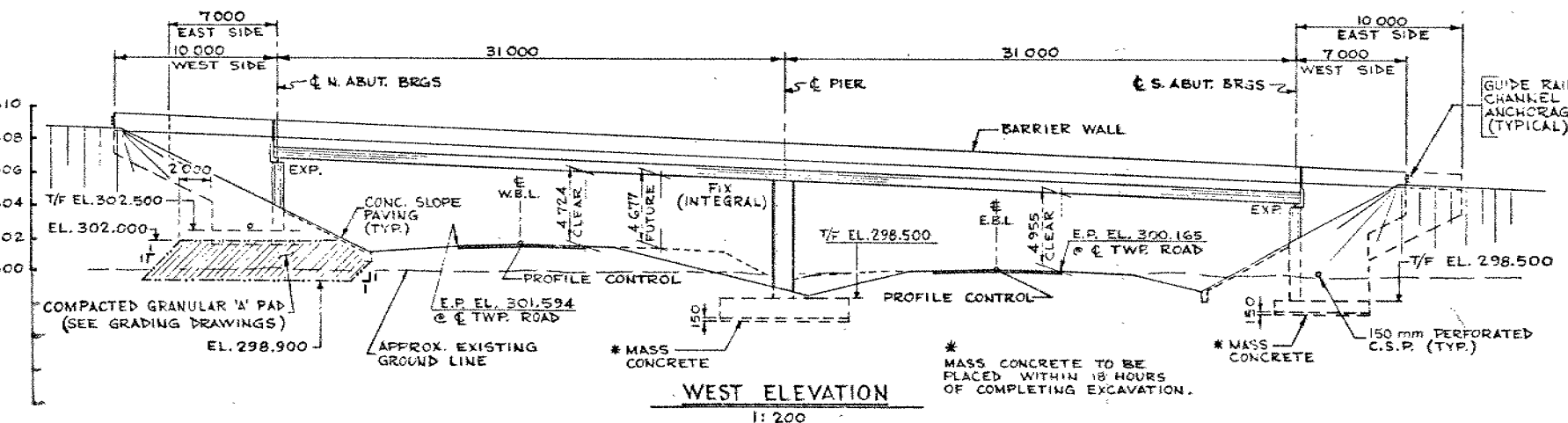
**CONSTRUCTION NOTES**

THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 3 mm.

NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED, STRESSED & GROUTED.

**LIST OF DRAWINGS**

- 23-89-298-1 GENERAL ARRANGEMENT
- 2 BORE HOLE LOCATIONS & SOIL STRATA
  - 3 FOOTING LAYOUT
  - 4 FOOTING REINFORCING & PIER
  - 5 NORTH ABUTMENT
  - 6 SOUTH ABUTMENT
  - 7 N.E. & S.W. WINGWALLS
  - 8 DECK DETAILS & ABUT. BRGS.
  - 9 LONGITUDINAL CABLE DETAILS
  - 10 TRANSVERSE CABLE DETAILS I
  - 11 TRANSVERSE CABLE DETAILS II
  - 12 DECK REINFORCEMENT I
  - 13 DECK REINFORCEMENT II
  - 14 BARRIER WALL
  - 15 6000 APPROACH SLAB
  - 16 DETAILS OF CONC. SLOPE PAVING
  - 17 AS CONSTRUCTED ELEV. & DIM.
  - 18 BRIDGE DATA & SITE NUMBER DATA
  - 19 STANDARD DETAILS
  - 20 QUANTITIES
  - 21 QUANTITIES



BM 307.789  
CUT CROSS ON CONC. CULVERT  
22.2 m LT. OF & CO. RD. 4  
STA. 9+673.4

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING



REVISIONS	DATE	BY	DESCRIPTION
DESIGN			
CHECK			
DRAWING			

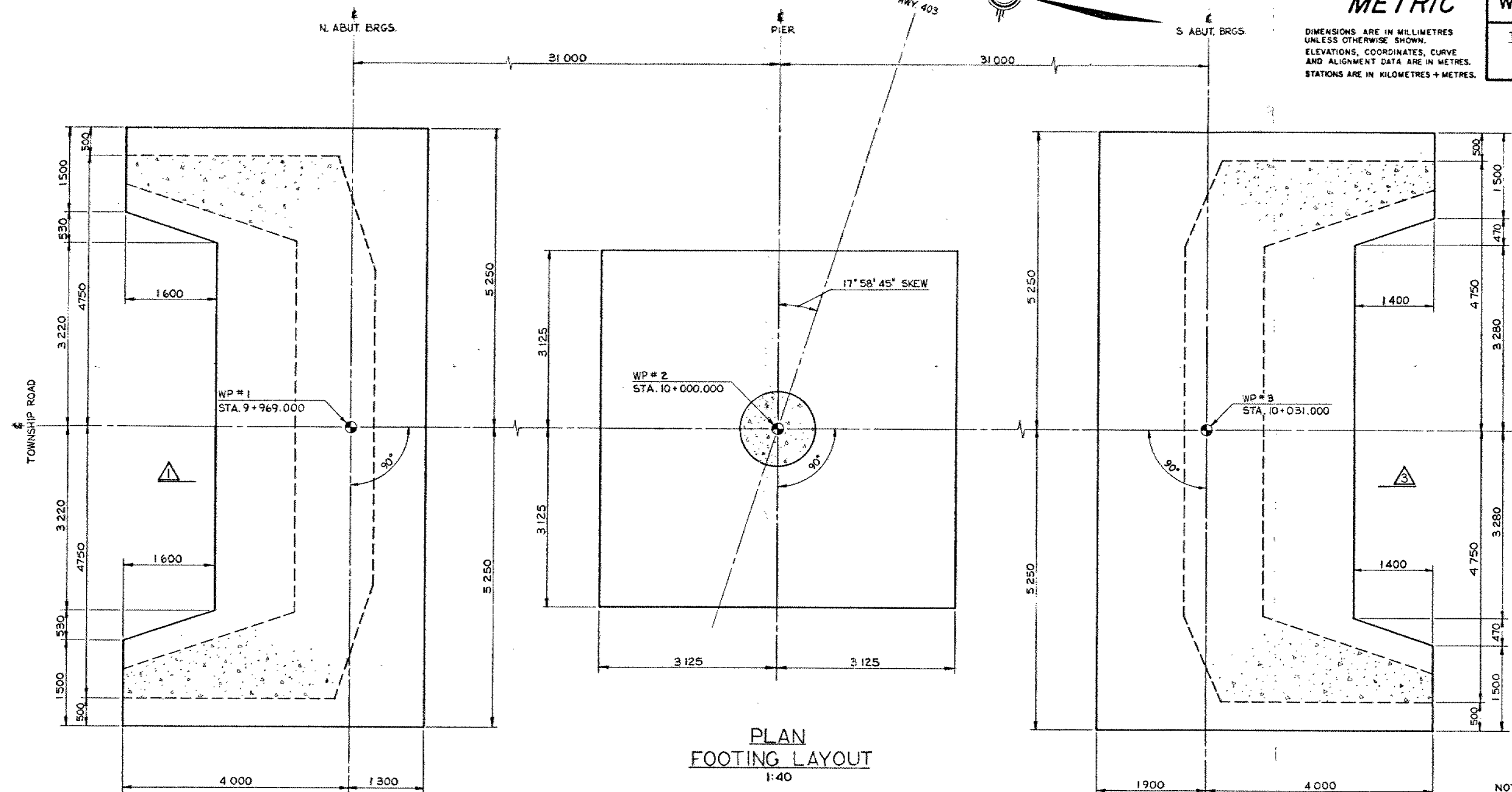
DIST. No. 2  
**CONT No**  
**WP No** 72-62-01

TOWNSHIP ROAD UNDERPASS  
(FUTURE COUNTY RD. 4)  
**FOOTING LAYOUT**

**SHEET**

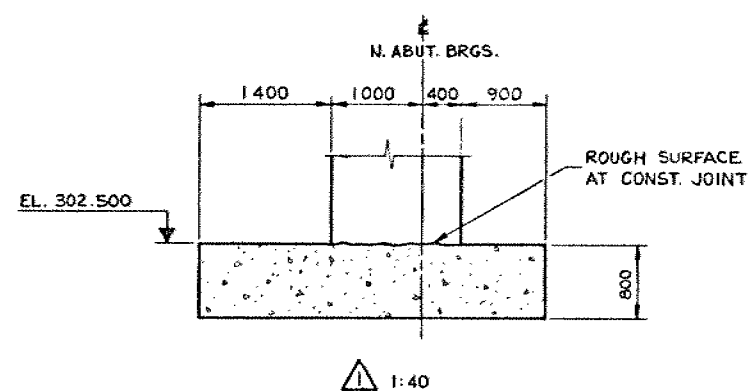
**METRIC**

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STATIONS ARE IN KILOMETRES + METRES.

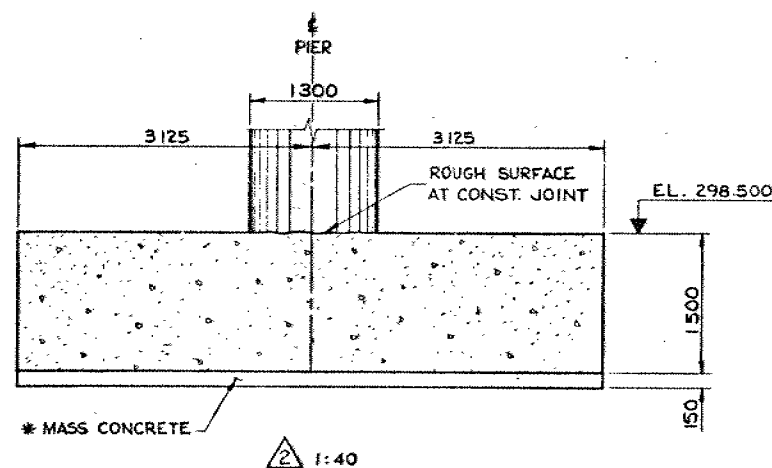


**PLAN  
FOOTING LAYOUT**  
1:40

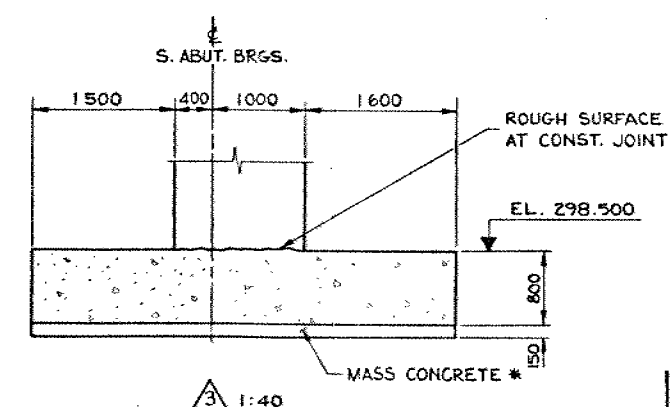
NOTE:  
FOR FOOTING REINFORCING  
SEE DWG. 4.



1:40



2:40



3:40

\* MASS CONCRETE TO BE  
PLACED WITHIN 18 HOURS  
OF FOOTING EXCAVATION.



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	83.01	83.01	83.01
CHECK	83.01	83.01	83.01
DRAWING	83.01	83.01	83.01

CONT  
85-24



Ministry of  
Transportation and  
Communications

# foundation investigation and design report

ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

WP 72-62-01

DIST 2

HWY 403

STR SITE 23-89-298

Future Co. Rd. 4 Underpass

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# FOUNDATION INVESTIGATION REPORT

For

W.P. 72-62-01, Site 23-89-298

Future Co. Rd. 4 Underpass

Hwy. 403, District 2, London

## INTRODUCTION:

This report summarizes the results of the foundation investigation required for the proposed structure and approach embankments at this site.

The fieldwork was conducted during the period from 82 07 15 - 20 utilizing a continuous-flight auger machine equipped with 82 mm I.D. hollow-stem augers.

This work consisted of 3 sampled boreholes/dynamic cone penetration tests.

## SITE DESCRIPTION

The site is located east of Co. Rd. 15 and south of Hwy. 401 at Woodstock (Lots 12 & 13, Con. II, Twp. Norwich, Geog. Twp. (East) Oxford, County of Oxford).

Physiographically, the site is located in the Oxford Till Plain.

## SUBSURFACE CONDITIONS

### General

The Record of Borehole Sheets (Appendix) illustrate the conditions at the borehole locations. The location and elevations of the boreholes, and a stratigraphical profile based on the borehole data are shown on Drawing No. 726201-A.

At the site, approximately 23 m (thickness) of firm to hard silty clay till overlies a very dense deposit of silty sand. None of the boreholes penetrated farther than this silty sand layer. A deposit (thickness estimated at 5±m), containing occasional layers of silty sand, was encountered at a depth of approximately 14 m below the surface at all borehole locations. In addition, at BH #3, occasional layers of silty sand were encountered at elevation 297.1 m.

Silty Clay (CL), Some Sand, Trace/Some Gravel

This firm to hard till material is the main deposit at the site, extending from the surface (approx. elev. 299 m) to a depth of approximately 22.9 m. The deposit is generally silty clay of low plasticity containing some sand and traces to some gravel. The upper 1.8 to 2.7 m of the deposit contains traces of organics. Occasional layers of silty sand were encountered at all boreholes at elev. 285 m and extending for an estimated thickness of 5 m. In addition, at BH #3 occasional layers of silty sand were encountered at elev. 294.9, extending for a thickness of 2.1 m. The denseness of the silty sand layers ranged from loose to very dense. However, a denseness range from compact to very dense is considered to be more representative of the silty sand layers.

Physical properties of the cohesive portion of the material as determined from field and laboratory tests, are summarized below:

	<u>Range</u>	<u>Average</u>	<u>Median</u>
Natural Moisture Content (w) %	10.5-13.5%	11.9%	11.8%
Liquid Limit (W <sub>L</sub> ) %	14.5-28.5%	21.9%	26.0%
Plastic Limit (W <sub>p</sub> ) %	11.0-14.5%	12.8%	13.0%

The material did not fail during field vane shear testing, indicating undisturbed shear strengths in excess of 107 kPa. Shear strength values from unconfined compression tests of similar material in the immediate vicinity of this site led to the selection of 150 kPa as the average shear strength for the silty clay till deposit.

Figure 1 illustrates a typical grain size distribution for the cohesive portion of this deposit.

Silty Sand, with Gravel, trace Clay

This very dense till deposit was encountered below the silty clay layer at elev. 276.7 m at BH #1. It is anticipated that this material underlies the silty clay deposit across the entire site.

Groundwater

The groundwater elevation was estimated at 296 m. This estimate was based on field observations, data from previous foundation investigations in the immediate vicinity, and well records.



## DISCUSSION AND RECOMMENDATIONS

A grade separation is proposed so that Co. Rd. 4 will overpass Hwy. 403. In order to establish the proposed profile grade of Co. Rd. 4, approach fills up to 9± m high will be required. A two-span structure is proposed.

### General Recommendations (Applicable To All Alternatives)

- No stability problems are anticipated for the proposed embankment heights with slopes of 2:1 or flatter.
- Total settlements under the embankments will be less than 75 mm, 50% of which should occur during construction. Total settlement for the recommended footing foundation alternatives will be less than 25 mm. The resulting differential settlements will be less than 25 mm. The structure should be designed to accommodate the anticipated settlements.
- Earth pressure acting on abutments and retaining walls should be computed as per Subsection 6.6.1.2.2 of the O.H.B.D.C. assuming a yielding foundation with  $k_a = 0.33$  for granular backfill
- For frost protection, cover should be greater than 1.2 m
- Dewatering is not anticipated to be a major problem because of the impermeable nature of the foundation soil

### Foundation Alternatives

The foundation alternative which leads to the least expensive design should be adopted.

#### Alternative 1 - Spread Footings on Silty Clay

The entire structure may be supported on spread footings founded at or below elev. 297.5.

For resistance to lateral forces, the adhesion between the base of the footings and the foundation soil = 60 kPa.

Cover the foundation soil with a 15 cm pad of mass concrete within 18 hours of exposure.

The following design values are recommended:

- net safe bearing pressure = 300 kPa  
and for purposes of the O.H.B.D.C.:
- Factored Bearing Capacity at U.L.S. = 450 kPa
- Bearing Capacity at S.L.S. Type II = 300 kPa

#### Alternative 2 - Perched Footings on Compacted Fill

The abutments may be supported on perched abutments on compacted granular fill. Refer to the enclosed Figure 2 for design details.

All loose or soft material beneath the approach embankment in the vicinity of the abutment locations should be removed.

For computing sliding resistance between the base of the concrete footing and the compacted fill, the friction coefficient = 0.6.

The following design values are recommended:

- net safe bearing capacity = 340 kPa  
and for purposes of the O.H.B.D.C.:
- Factored Bearing Capacity at U.L.S. = 600 kPa
- Bearing Capacity at S.L.S. Type II = 340 kPa

#### Alternative 3 - Steel H-Piles in Overburden

The entire structure may be supported on steel H-piles equipped with reinforced tips and driven in accordance with M.T.C. Standards SS 103-10 or SS 103-11. For calculation purposes the following values are recommended:

<u>Pile Type</u>	<u>Ultimate Capacity</u>
310 HP 110	3000 kN
310 HP 79	2150 kN

For estimation purposes it may be assumed that the recommended pile capacities will be achieved at the following elevations:

<u>Station (Co. Rd. 4 Chainage)</u>	<u>Elevation</u>
Sta. 9+965	273
Sta. 10+000	275
Sta. 10+035	278

If desired, the abutment footings (supported on steel H-Piles) may be perched within the embankment fill. In this case, to facilitate pile driving, particle sizes in the fill immediately beneath the pile locations should not exceed 75 mm.

<u>Pile Type</u>	<u>Safe Capacity</u>
310 HP 110	1000 kN
310 HP 79	720 kN

and for the purposes of the O.H.B.D.C.:

<u>Pile Type</u>	<u>Factored Capacity at U.L.S.</u>	<u>Capacity at S.L.S. Type</u>
310 HP 110	1350 kN	1000 kN
310 HP 79	970 kN	720 kN

#### Alternative 4 - Combination of Previous Alternatives

If desired, the previous alternatives may be combined so that different alternatives are employed at different footing locations.

For example, the centre pier footing may be supported on steel H-piles while the abutment footings are perched on compacted granular fill.

#### MISCELLANEOUS

The fieldwork for this project was carried out under the supervision of Mr. B. Yiu (student field technician). The report was written by Mr. D. H. Dundas, Project Foundations Engineer, and reviewed by Mr. K. G. Selby, Senior Foundations Engineer. The equipment used was owned and operated by Atcost Soil Drilling Inc.



*D. H. Dundas*

D. H. Dundas, P. Eng.  
Project Foundations Engineer

*K. G. Selby*

K. G. Selby, P. Eng.  
Senior Foundations Engineer

## APPENDIX



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# RECORD OF BOREHOLE No 1

METRIC

W P 72-62-01 LOCATION Sta. 9 + 965, 5.0 m Rt. of Twp. Rd. ORIGINATED BY BY  
DIST 2 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DD  
DATUM Geodetic DATE 82 07 15, 19 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
299.6	Ground Surface													
0.0														
	trace organics		1	SS	20									2 15 58 25
			2	SS	24									
			3	SS	25									
			4	SS	18									
			5	SS	12									
	Silty Clay (Cl)		6	SS	13									
	Some Sand													
	Trace/some Gravel		7	SS	12									
	Stiff to Hard (Till)		8	SS	14									
			9	SS	21									
			10	SS	21									
			11	SS	18									
	occ. layers of Silty Sand		12	SS	13									
	Compact to Dense													
			13	SS	36									
			14	SS	54									
276.7														
22.9	Silty Sand with Gravel, Trace Clay													
274.9	Very Dense		15	SS	120/ 30 cm									
24.7	End of Borehole													
	** Stabilised ground water level estimated from well records													*Cu > 107 kPa

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

METRIC

W P 72-62-01 LOCATION Sta. 9 + 999, 5.0 m Rt. of Twp. Rd. ORIGINATED BY BY  
DIST 2 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DD  
DATUM Geodetic DATE 82 07 16 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
299.3	Ground Surface													
0.0			1	SS	6									
	trace organics		2	SS	10									
			3	SS	23									
			4	SS	13									
			5	SS	19									
	Silty Clay (Cl)		6	SS	21									
	Some Sand		7	SS	20									
	Trace/some Gravel		8	SS	22									
	Firm to Hard (Till)		9	SS	33									
			10	SS	25									
			11	SS	22									
	occ. layers of Silty Sand, compact		12	SS	20									
283.6														
15.7	End of Borehole													
	** Stabilized ground water level estimated from well records													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 3

METRIC

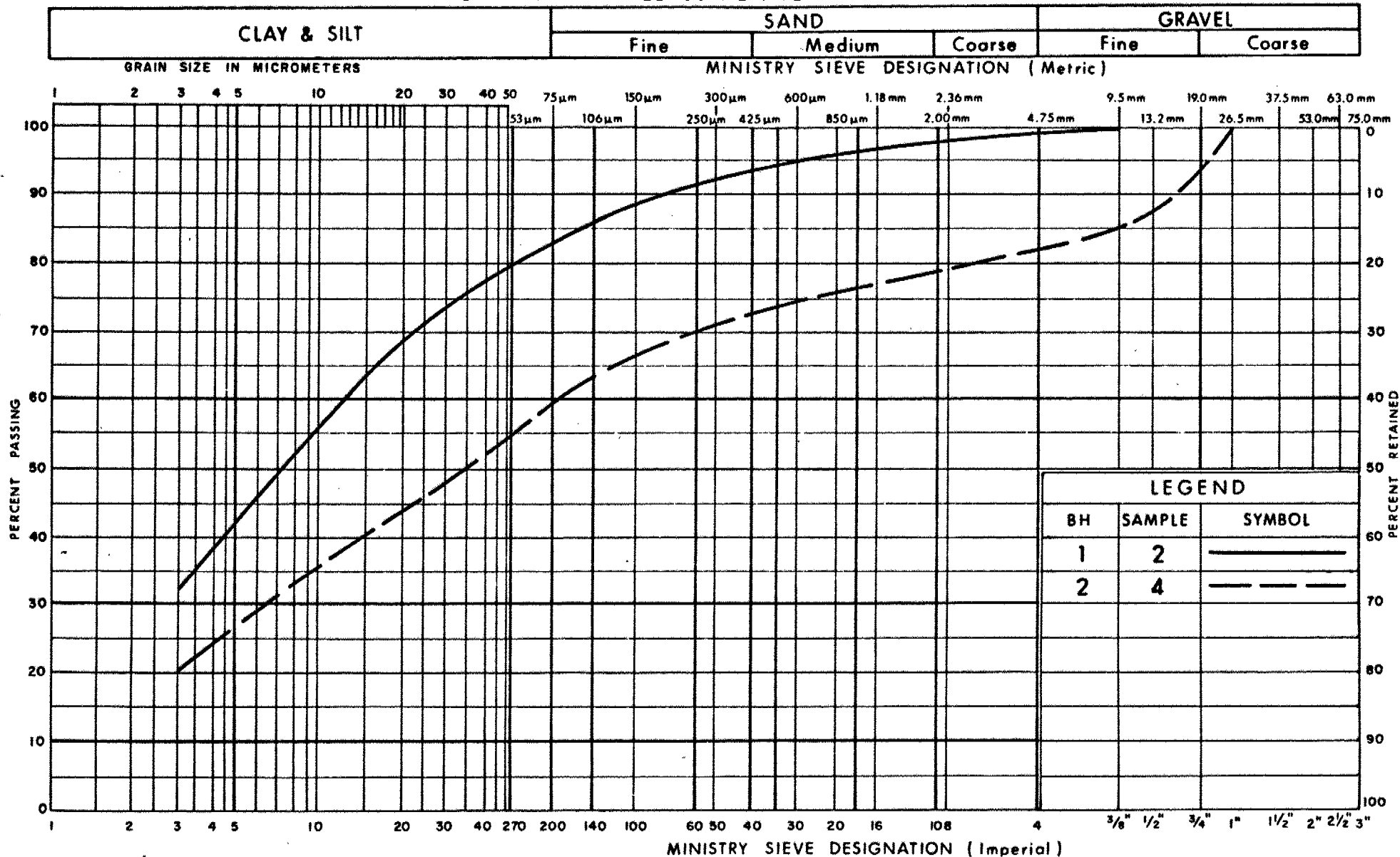
W P 72-62-01 LOCATION Sta. 10 + 034, 5.0 m Rt. of Twp. Rd. ORIGINATED BY BY  
DIST 2 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DD  
DATUM Geodetic DATE 82 07 20 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	20 40 60 80 100					
298.9	Ground Surface												
0.0													
	trace organics		1	SS	19								
			2	SS	25								
			3	SS	29								
			4	SS	18								
	occ. layers of Silty Sand Some Gravel Trace Clay Compact		5	SS	21								20 43 32 5
			6	SS	15								5 36 47 12
			7	SS	24								
	Silty Clay (Cl)		8	SS	28								
	Some Sand												
	Trace/some Gravel		9	SS	27								
	Very Stiff to Hard (Till)		10	SS	26								
			11	SS	24								
	occ. layers of Silty Sand Some/with Gravel Trace Clay Loose to Very Dense		12	SS	7								10 33 47 10
			13	SS	200/	30 cm							30 61 ( 9 )
278.3			14	SS	100/	14 cm							22 42 28 8
20.6	End of Borehole												
	** Stabilized ground water level estimated from well records												*C <sub>u</sub> > 107 kPa

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5  
0  
5  
10  
15  
20  
(%) STRAIN AT FAILURE

## UNIFIED SOIL CLASSIFICATION SYSTEM



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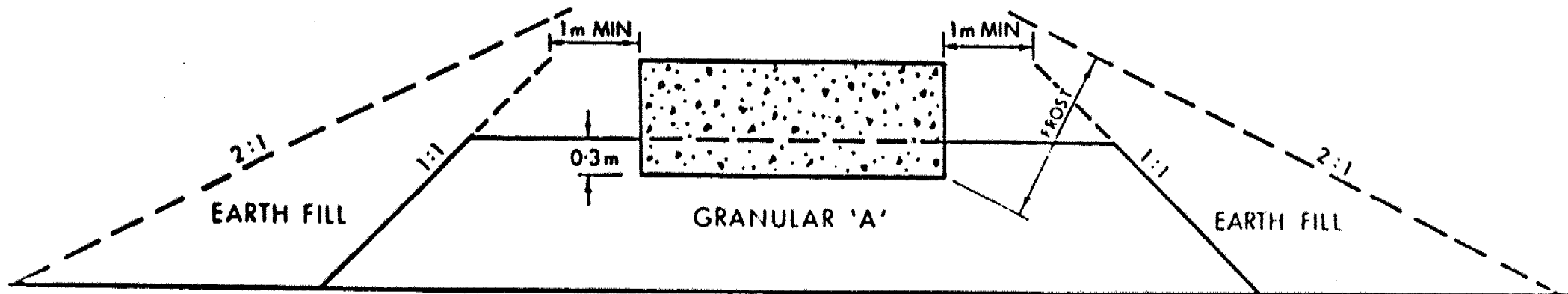
**GRAIN SIZE DISTRIBUTION**  
**SILTY CLAY (Till)**  
**SOME SAND TRACE / SOME GRAVEL**

FIG No 1

W P 72-62-01

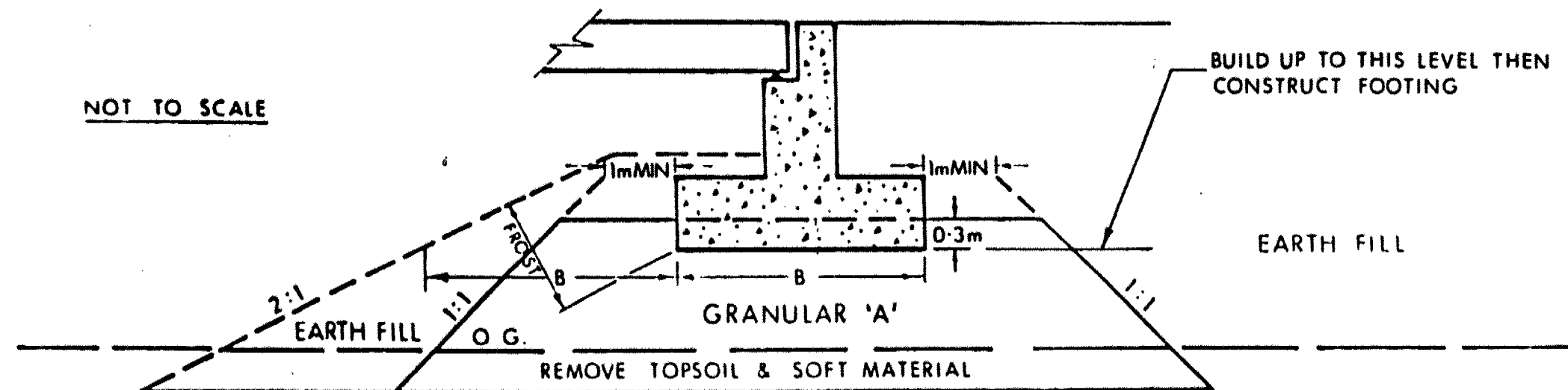


# ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

## NOTES:

- 1 - REMOVE TOPSOIL & /OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED

FIG. 2

## EXPLANATION OF TERMS USED IN REPORT

**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS  $\bar{N}$ .

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH ( $c_u$ ) AS FOLLOWS:

$c_u$ (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

**DENSENESS:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

**RECOVERY:** SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

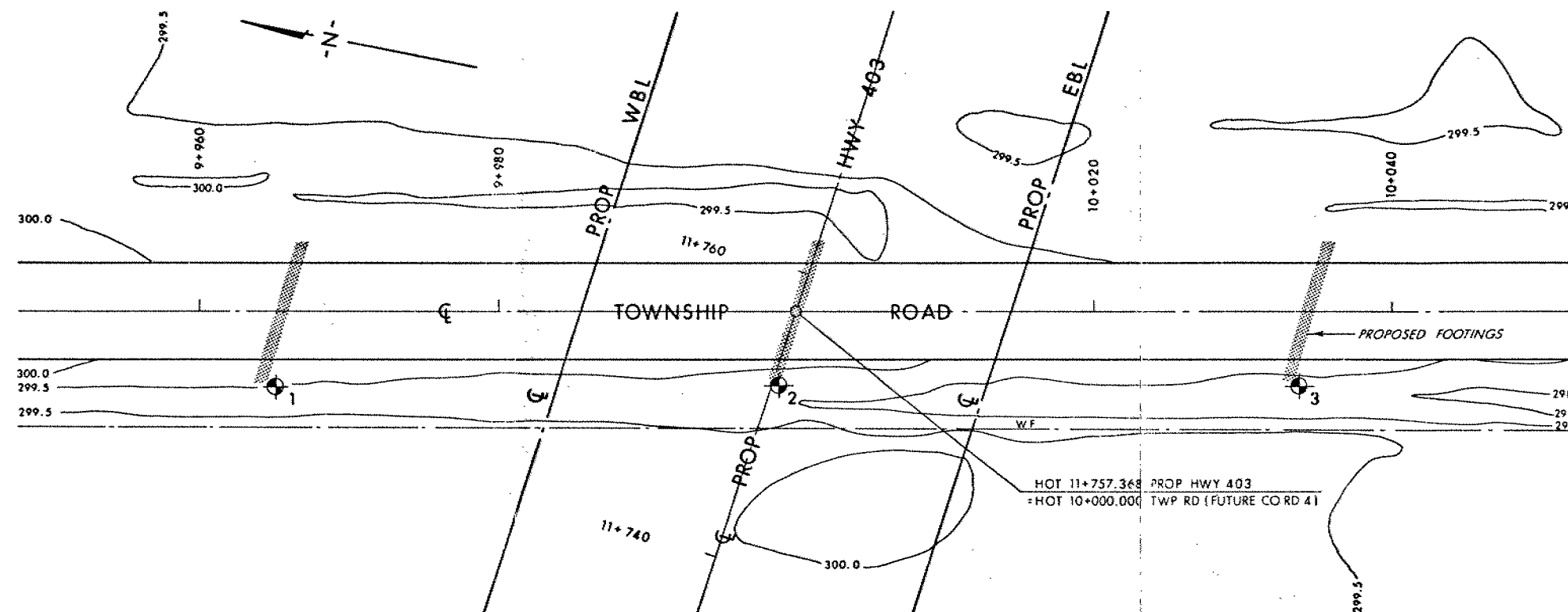
$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
P	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES

CONT No  
WP No 72-62-01  
TOWNSHIP ROAD U'PASS  
(5.0 km W of Hwy 53)  
BORE HOLE LOCATIONS & SOIL STRATA

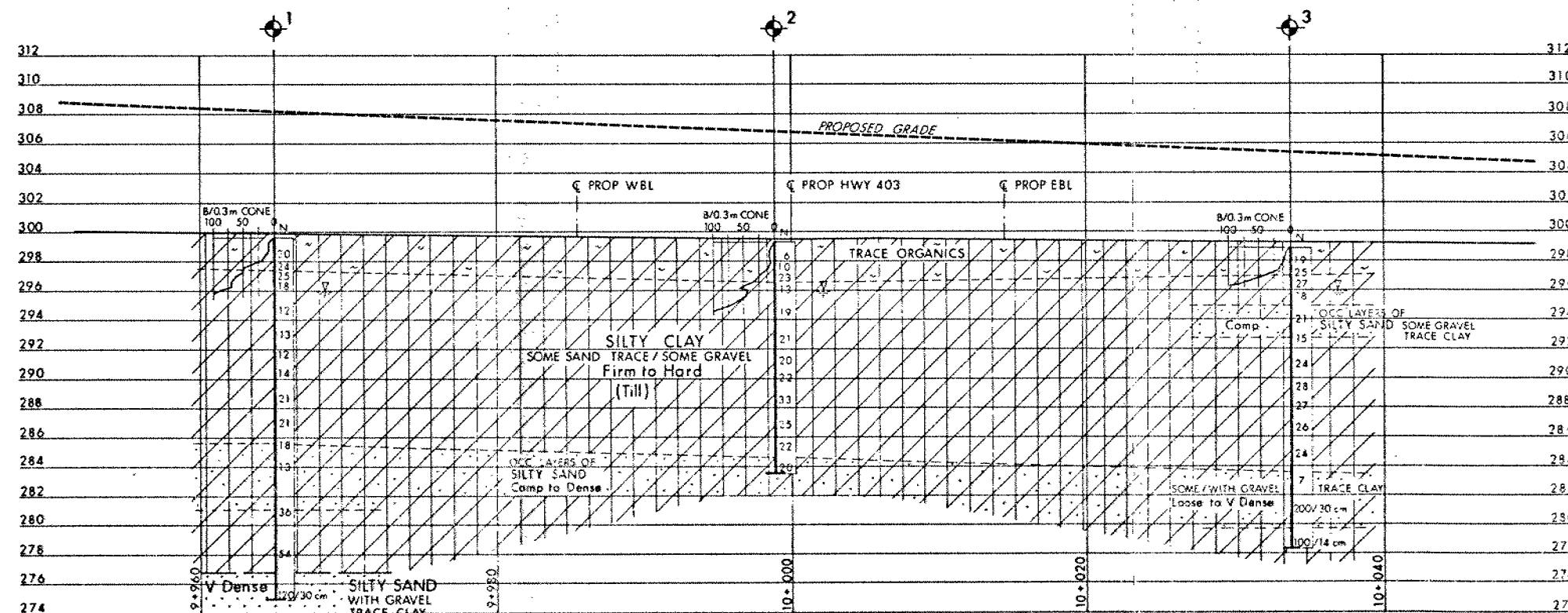


SHEET



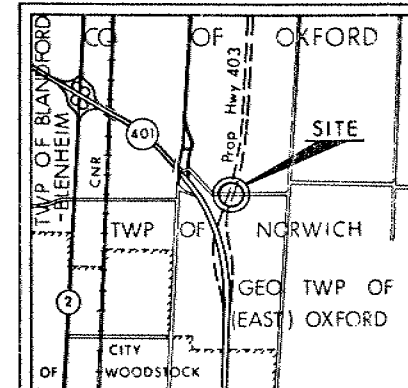
PLAN

SCALE  
4 2 0 4 m



PROFILE - TWP RD

SCALE  
4 2 0 4 m



KEY PLAN

SCALE  
1 0.5 0 1 km

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 1/blow)
- CONE Blows/0.3m (60° Cone, 475 1/blow)
- W.L. at time of investigation
- Stabilized Ground Water Level  
Estimated from Well Records 82 07

No	ELEVATION	STATION	OFFSET
1	299.6	9+965	5.0 m RT
2	299.3	9+999	5.0 m RT
3	298.9	10+034	5.0 m 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.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office. Downstream, information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

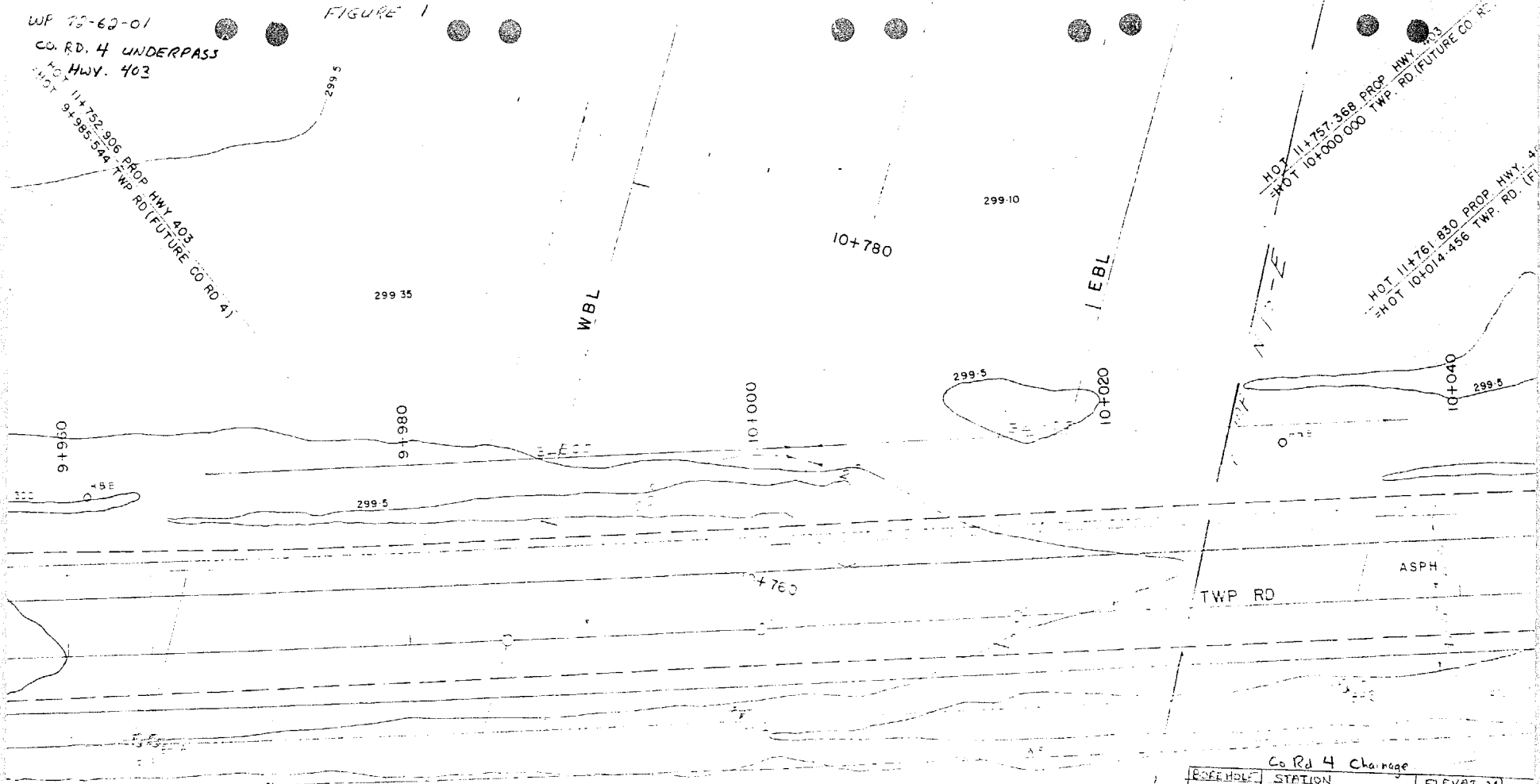
REV	DATE	BY	DESCRIPTION
1			
Geocres No 40P2-39			
HWY No PROP 403			
SUBMD DD CHECKED DATE 82 10 26 SITE 23-RD-298			
DRAWN SO CHECKED DATE 82 10 26 DWG 726201-A			

WP 75-62-01

FIGURE 1

CO. RD. 4 UNDERPASS  
HWY. 403

HOT 11+752.806 PROP. HWY. 403  
HOT 9+985.544 TWP. RD. (FUTURE CO. RD. 4)



HOT 11+757.368 PROP. HWY. 403  
HOT 10+000.000 TWP. RD. (FUTURE CO. RD. 4)

HOT 11+761.830 PROP. HWY. 403  
HOT 10+014.456 TWP. RD. (FUTURE CO. RD. 4)

Co Rd 4 Chaining		
ROSEHOLE	STATION	ELEVATION
1	Sta. 9+964, 5.0 RT.	299.6
1A	Sta. 9+965, 5.0 RT.	299.6
2	Sta. 9+999, 5.0 RT.	299.3
3	Sta. 10+034, 5.0 RT.	298.9