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Ministry of  
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# foundation investigation and design report

ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

WP 7420-83-01

DIST 9

HWY 16

STR SITE

Culvert Failure South of McFarlane Drive

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FOUNDATION INVESTIGATION REPORT  
FOR  
Culvert Failure South of McFarlane Dr.  
W.P. 7420-83-01  
Hwy. 16, District #9, Ottawa

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INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out on 84 01 05 and 84 01 06 at the structure site mentioned above. The field work consisted of one sampled borehole advanced by means of wash boring techniques utilizing a diamond drill and two shallow test pits. The borehole was advanced to a depth of 9.8 m with a dynamic cone driven from the bottom of the hole to a depth of 14.3 m.

SITE DESCRIPTION

The site is located just south of the intersection of Highway 16 and McFarlane Road in the City of Nepean, Regional Municipality of Carlton.

Land use in the area is primarily rural residential.

The topography in the vicinity of the site is gently rolling terrain sloping slightly to the east towards the Rideau River. The investigated area is located at the bottom of a deep stream valley cut into the gently rolling ground. The valley is approximately 9 m deep with treed 1.5:1 to 2:1 side slopes. Erosion of the north roadway ditch has taken place and embankments are very steep in this area. See Fig. A for pictures of the valley and north ditch.

The stream flows in an easterly direction and drains into the Rideau River 500 m east of the site. The creek at the time of the investigation was 150 mm deep by 1 m wide.

The site is located in the physiographic region known as the Russell and Prescott Sand Plains. This area is characterized by sand plains generally bounded by the Ottawa Valley Clay Plains.

## SUBSURFACE CONDITIONS

### General

The investigation was confined to a borehole on the floor of the stream valley and 2 test pits on the embankment slope. The surficial deposit at the borehole location was found to be a stiff silty clay with a trace of sand 2.7 m thick. Underlying the silty clay is a 4.0 m thick deposit of compact silt traces of sand and clay. A stratum of compact to dense sand lies below the silt and was sampled to a depth of 9.8 m. This sand probably extends to at least elevation 64.5, this being inferred from a dynamic cone driven from 9.8 to 14.3 m.

Test pits on the roadway embankment were advanced to depths of 0.9 and 1.8 m. The fill was found to vary from a granular material to a cohesive material.

The boundaries between the various soil types in-situ and laboratory test results are shown on the attached Record of Borehole Sheets. The location of the boreholes and test pits are shown on Drawing No. 74208301.

The various soil types encountered are described in the following paragraphs.

### Silty Clay trace of Sand

The surficial deposit on the valley floor was found to be a silty clay trace of sand and is 2.7 m thick at the borehole location.

Atterberg limit testing conducted on samples from this stratum indicate the material to vary from a silty clay of low to intermediate plasticity (CL and CI zones). The results of this test are plotted on Figure 1.

Some organic matter in the form of leaves and root structure was found in the upper 0.5 m of the silty clay. A test completed on a sample from this stratum indicate the organic content to be 2.9 percent by weight.

In-situ field vane tests yielded undrained shear strengths ranging from 75 to 80 kPa and a laboratory unconfined compression test yielding an undrained shear strength of 97 kPa indicate the deposit to be of a stiff consistency.

#### Silt trace to some Sand and trace of Clay

This 4.0 m thick deposit of silt was found between the surficial silty clay and the underlying sand.

Grain size distribution tests completed on samples from this layer generally indicate the silt portion to be predominant with varying amounts of sand and traces of clay. Results of the tests are plotted on Figure 2.

The stratum is predominantly a non-plastic silt with denseness assessed as compact based on Standard Penetration Test "N" values ranging from 12 to 23.

#### Sand trace of Silt

This deposit was encountered at elevation 72.1 and sampled to elevation 69.0. Drilling was terminated at an elevation of 69.0 and a dynamic cone was driven to an elevation of 64.5 where refusal was encountered. The cone test indicates that the sand deposit probably extends to at least the elevation of refusal.

One grain size distribution test carried out on a sample from this deposit indicates the sand is predominant with traces of silt. The results of this test are plotted on Figure 2.

The denseness of this stratum is assessed as compact to dense based on Standard Penetration Test "N" values of 25 to 43.

#### Embankment Fill Material

The roadway embankment fill was investigated in 2 shallow hand dug test pits. The fill was found to be very variable ranging from a cohesive silty clay material to a granular sand some silt material.

A grain size distribution test was conducted on a sample taken from the granular fill, indicates the material to be sand some silt traces of gravel and clay. The results of this test are plotted on Figure 2.

A field vane test carried out on the cohesive portion of the fill material yielded an undrained shear strength of 13 kPa which indicates a soft consistency.

#### Groundwater Conditions

The groundwater was measured at an elevation of 75.2 in the open borehole. This is approximately 3 m below the ground surface, and approximately 2.5 m below the creek water level adjacent to the borehole.

## DISCUSSION AND RECOMMENDATIONS

### General

The existing 1525 x 1219 mm concrete box culvert under Highway 16 just south of McFarlane Drive has failed. The Regional Structural Section was informed of the failure on June 20, 1983. The culvert was inspected by the Structural Section on June 21, 1983 and found that 7 m of the culvert had broken off and settled to an approximate 10° angle. Fill had also entered the culvert through the break.

The failure appears to be a result of erosion of the bedding material and the supporting subsoils. This loss of underlying material is probably a result of a combination of seepage through an old construction joint and erosion of the stream channel downstream of the culvert. Loss of material from the stream channel is partly a result of erosion caused by the roadway ditch north of the culvert and the stream itself.

Remedial measures are required to repair the 7 m section of culvert which has broken off. The Regional Structural Section has proposed a number of alternatives, with a C.S.P.A. being the least expensive. In our opinion a concrete extension would be preferable as this would eliminate many of the problems associated with connection of a C.S.P.A. to a concrete box culvert.

### Culvert Extension

The culvert should be placed on a minimum of 300 mm of Granular "A" bedding. All soft or loose material underlying the culvert should be sub-excavated and backfilled with granular "C". A class II non-woven geotextile with an E.O.S. < 150 m should be placed directly underneath the culvert over the granular "A".

This geotextile should extend from the existing concrete culvert east-erly to the outlet of the new extension. The outfall area of the culvert should be protected rip rap or rock gabion baskets underlain by geotextile. The geotextile will prevent the loss of fines from the underlying granular materials and original ground.

See Figure B below for a sketch of a typical profile of the above recommendations.

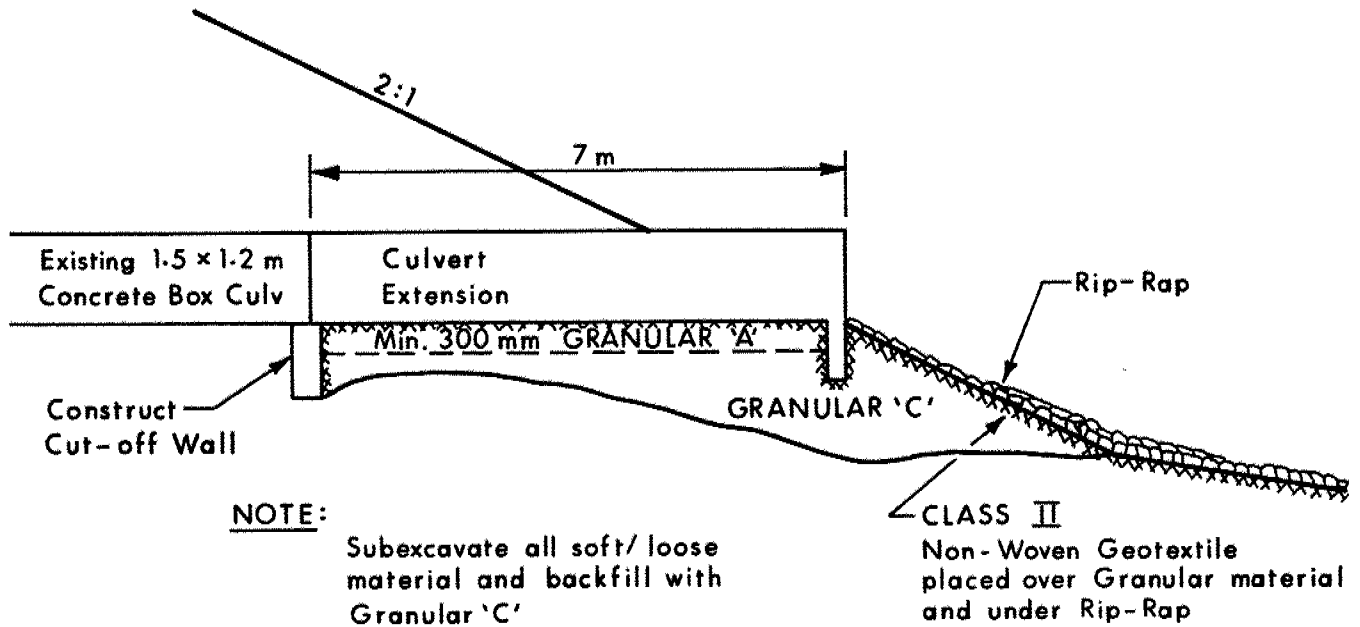


Figure B: Typical profile of the proposed culvert bedding

The north ditch draining into the creek valley should be protected from further erosion by rip rap underlain by geotextile.

Prior to placement of the new culvert extension, an inspection of the existing culvert should be made to check for voids. If voids are evident they should be grouted, and a clay blanket should be placed on the face of the west embankment around the culvert up to the high water level. The clay blanket will prevent movement of water through the fill which would be indicated by voids around the existing culvert.

#### Roadway Protection

For design of the roadway protection scheme, active earth pressures should be calculated assuming a cohesive material with an undrained design strength ( $C_u$ ) of 15 kPa and a bulk weight of  $19 \text{ kN/m}^3$ . For lateral resistance the piles should be driven into the compact silt and sand deposits. The fill material should not be relied upon to provide any significant lateral resistance.



Miscellaneous

The fieldwork for this investigation was carried out under the supervision of Mr. H.J. Sturm, Project Foundations Engineer utilizing equipment owned and operated by Marathon Soil Investigation, Ottawa. This report was written by Mr. H.J. Sturm and reviewed by Mr. M. Devata, Senior Foundations Engineer.



A handwritten signature of H.J. Sturm in black ink.

H. J. Sturm, P. Eng.,  
Project Foundations Engineer.



A handwritten signature of M. Devata in black ink.

M. Devata, P. Eng.,  
Senior Foundations Engineer

## APPENDIX

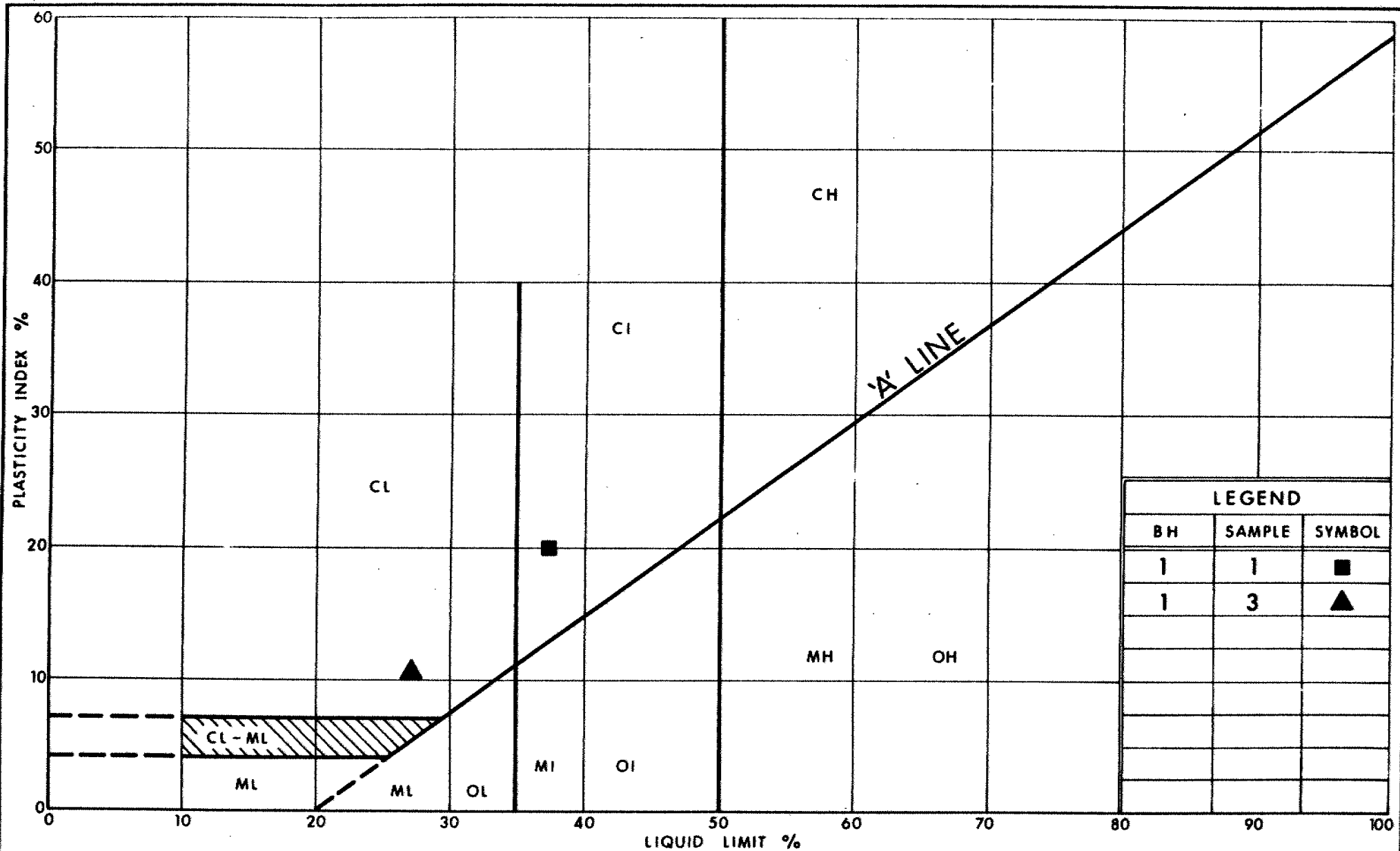


View of failed  
culvert section  
and stream valley.



Erosion  
of  
North  
Ditch

Figure A: Site Pictures



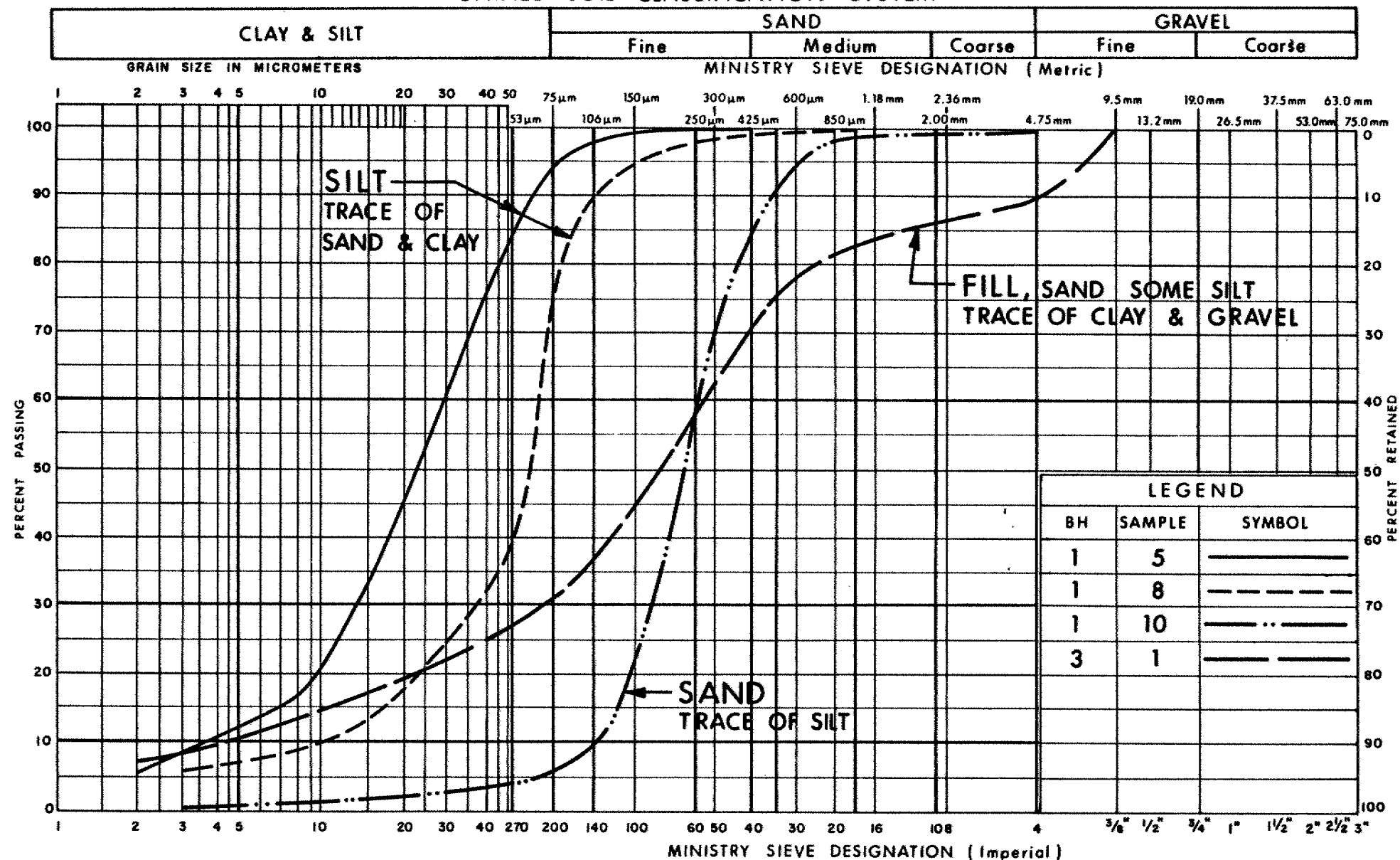
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# PLASTICITY CHART SILTY CLAY TRACE OF SAND

FIG No 1

W P 7420-83-01

## UNIFIED SOIL CLASSIFICATION SYSTEM



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## GRAIN SIZE DISTRIBUTION

FIG No 2

W P 7420-83-01

## 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:

R Q D (%)	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

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	m <sup>2</sup> /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
$S_f$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

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

# RECORD OF BOREHOLE No 1

METRIC

W P 7420-83-01

LOCATION

Sta. 10 + 026.2 o/s 4.0 m Rt & Culvert

ORIGINATED BY HS

DIST 9

HWY 16

BOREHOLE TYPE

Wash Boring, NX Casing & Cone Test

COMPILED BY HS

DATUM

Geodetic

DATE

84 01 04/05

CHECKED BY CP

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	VALUES		20	40	60	80	100					
78.8	Ground Surface															
0.0	Silty Clay trace sand Stiff		1	SS	3										*O.M. =2.9%	
76.1			2	TW	PM										16.7	
2.7			3	SS	9											
	Silt trace to some sand trace clay Compact		4	TW	PM										20.0	0 4 91 5
			5	SS	23											
			6	SS	15											
			7	SS	22											
72.1	Sand trace silt Compact to Dense		8	SS	12											1 26 68 5
6.7			9	SS	43											
69.0			10	SS	25											1 94 5 0
9.8	End of Borehole															
	Probable Sand															
64.5																
14.3	End of Cone Test															
	* O.M. = percentage of organic matter by weight															

\*<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

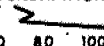


20  
15 → 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF TEST PIT No 2

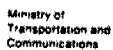
METRIC

W P 7420-83-01 LOCATION Sta. 10 + 014.6; o/a 0.5 m Lt & Culvert ORIGINATED BY HS  
 DIST 9 HWY 16 BOREHOLE TYPE Test Pit Hand Dug COMPILED BY HS  
 DATUM Geodetic DATE 84 01 05 CHECKED BY GP

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					
84.0	Ground Surface															
0.0	Silty Clay (Fill) some sand		1	CS												
82.2	Bottom of Test Pit															
1.8																

OFFICE REPORT ON SOIL EXPLORATION





## METRIC

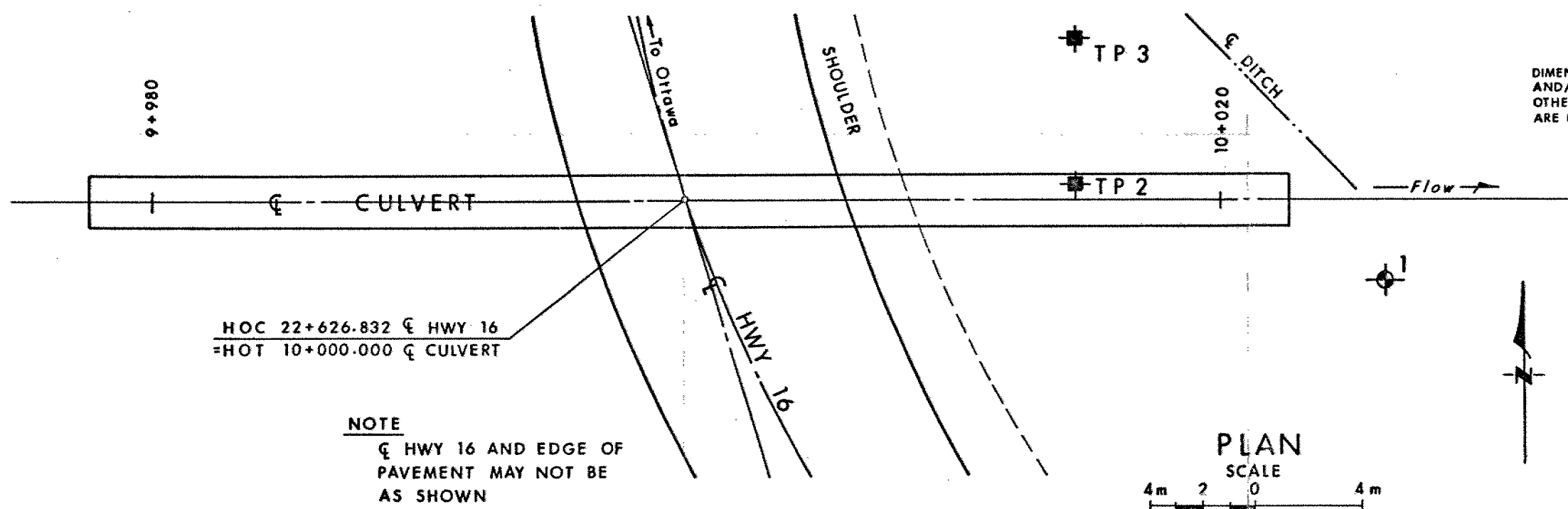
W P 7420-83-01 LOCATION Sta. 10 + 014.6; o/s 6.0 m Lt 4 Culvert ORIGINATED BY HS  
DIST 9 HWY 16 BOREHOLE TYPE Test Pit Hand Dug COMPILED BY HS  
DATUM Geodetic DATE 84-01-05 CHECKED BY SK

[illegible]

**+3, x5 : Numbers refer to Sensitivity**

15  $\phi$  5 (%) STRAIN AT FAILURE

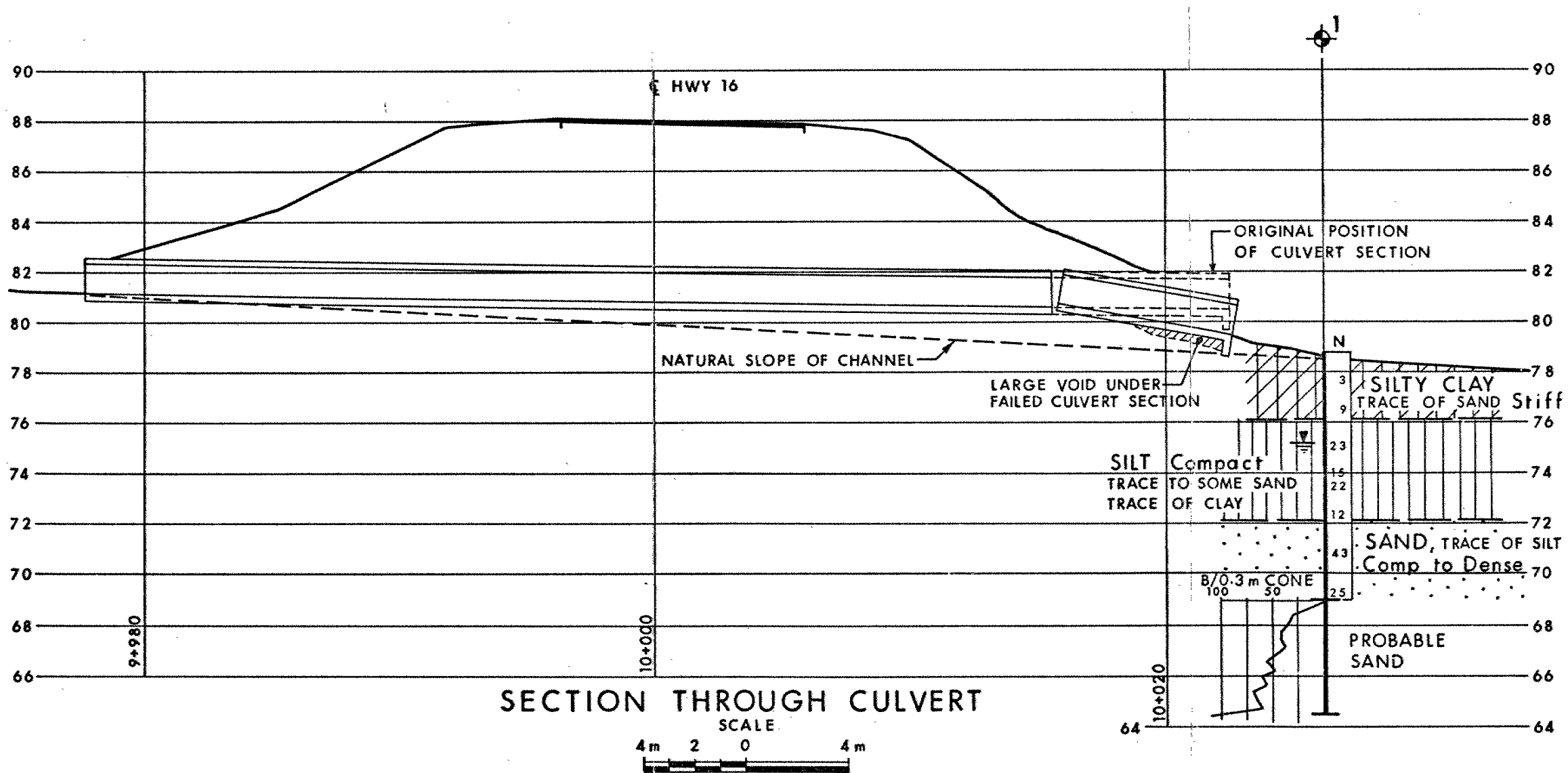
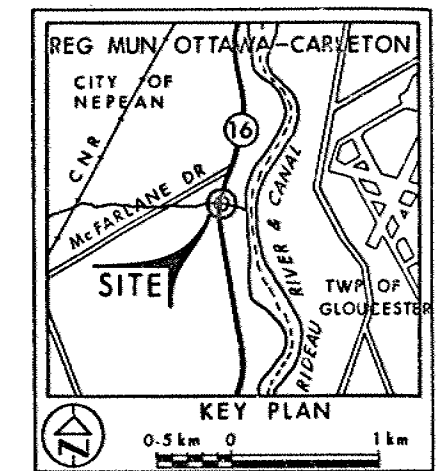
OFFICE REPORT ON SOIL EXPLORATION






CONT No  
WP No 7420-83-01

CULVERT FAILURE HWY 16  
SOUTH OF McFARLANE DR  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND			
	Bore Hole & Cone		
	Test Pit		
CONE    Blows/0.3m (60° Cone, 475 J/blow)			
	W L at time of investigation 1984 01 05		
No.	ELEV	STA	OFFSET
1	78.8	10+026.2	4.0m Rt
2	84.0	10+014.6	0.5m Lt
3	84.0	10+014.6	6.0m 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.

Geocres No 31G5-136

HWY No 16	DIST 9
SUB'D HS CH'D	DATE 84 02 13 SITE
DRAWN CH'D	DWG 74208301-A

# METRIC

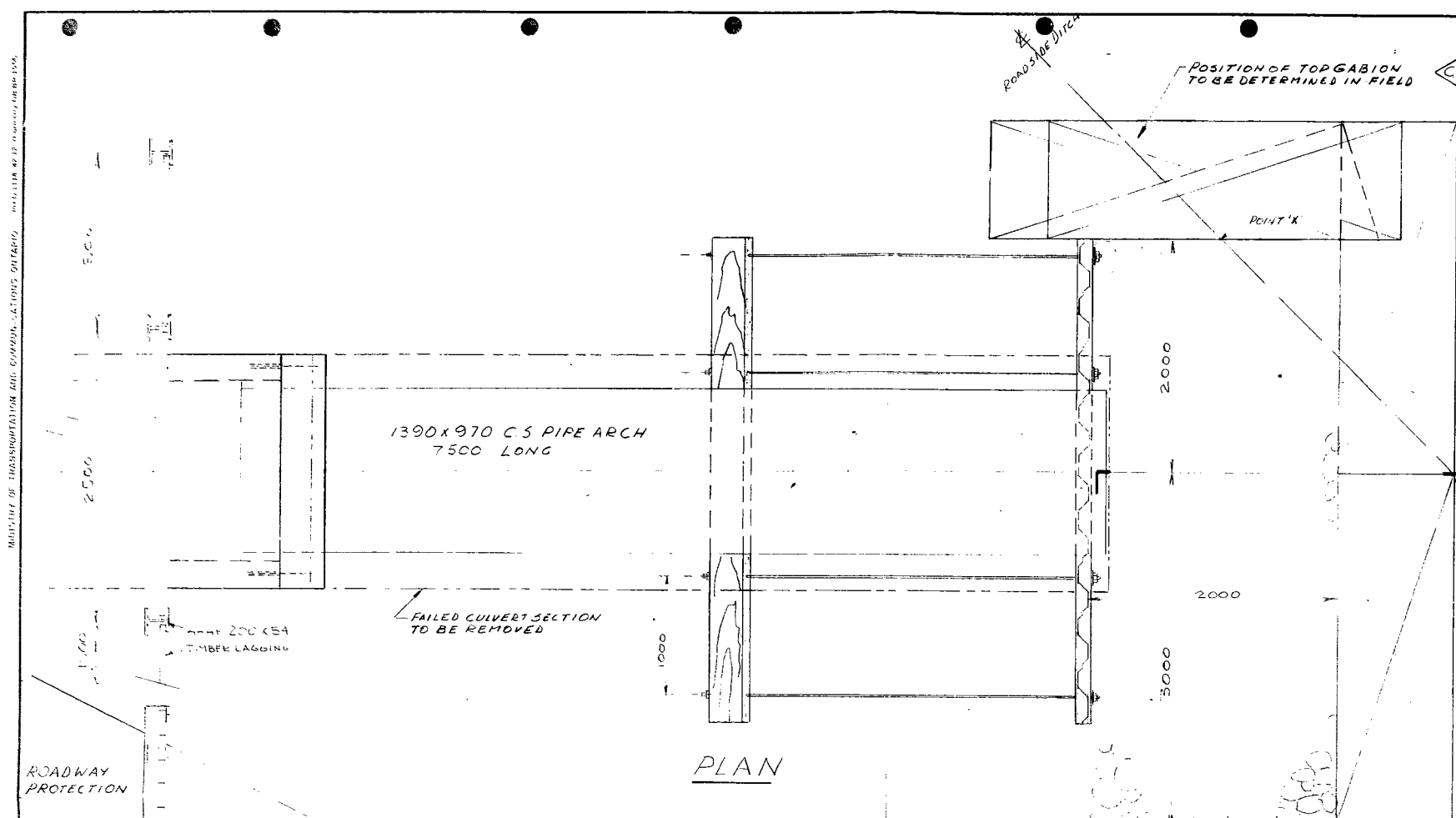
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

Dist. No 9  
CONT No  
WP No 7420-83-01

## CULVERT REPAIRS

SHEET

HIGHWAY 16 AT McFARLANE DR.



PLAN

### MATERIAL SPECIFICATIONS

- CLASS OF CONCRETE 20 MPa
- REINFORCING STEEL GRADE 400
- STEEL SHEETING SHALL BE ARMCO TYPE M581, GAUGE 10, OR EQUAL
- STEEL SHEETING SHALL BE HOT-DIP GALVANIZED TO THE REQUIREMENTS OF A.S.T.M. SPEC. A526 OR EQUAL
- TIE RODS AND ASSOCIATED HARDWARE SHALL BE HOT-DIP GALVANIZED TO THE REQUIREMENTS OF CSA STANDARD G164 M, OR EQUAL.
- TIMBER SHALL BE 5 PF #2 AND PRESSURE TREATED TO THE REQUIREMENTS OF CSA STANDARD O80.14 AND AWPA STANDARD M1, M2 AND M3.
- ROCKFILL SIZE SHALL BE 0.01m<sup>3</sup> MIN.

### REINFORCING STEEL

BARMARK	NO	LENGTH	DETAIL
H15001	1	700	H=200
H15002	2	750	H=250
H15003	2	950	H=450
H15004	7	1050	H=550
H15005	10	755	H=255
H15006	4	1350	
H15007	2	2100	
H15008	4	1850	

TOTAL MASS 0.05TONNES

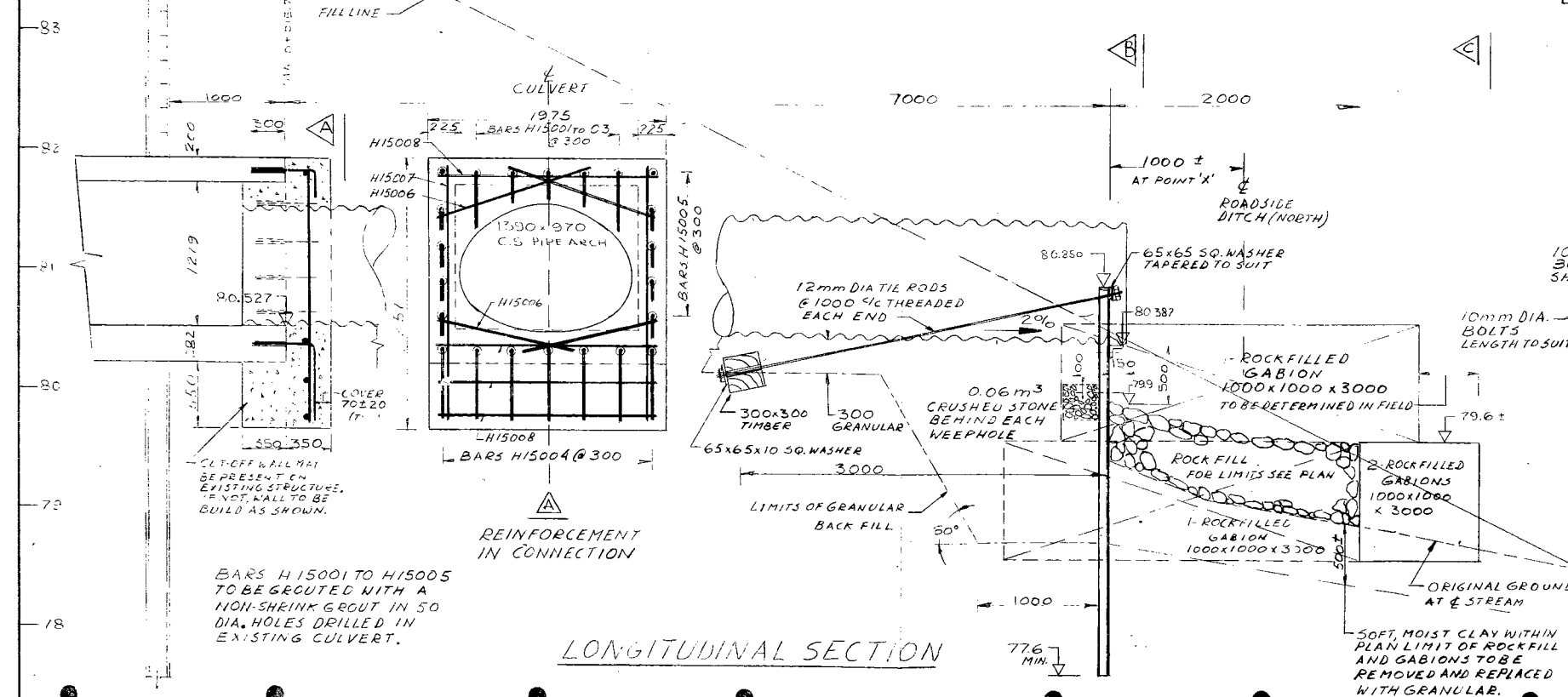
### CONSTRUCTION NOTES

**ROADWAY PROTECTION:** AN ALTERNATIVE METHOD MAY BE PROPOSED BY THE CONTRACTOR. DRAWINGS SHOWING HIS PROPOSED SCHEME SHALL BE SUBMITTED FOR APPROVAL THREE WEEKS PRIOR TO STARTING WORK.  
**PILING IN THE ROADWAY PROTECTION IS TO BE REMOVED OR CUT-OFF A MINIMUM OF 1.0 METRES BELOW FILL GRADE UPON COMPLETION OF THE WORK.**

**GABIONS AND ROCKFILL:** ROCKFILL IN GABIONS AND/OR IN FRONT OF THE STEEL SHEETING ENDWALL MAY BE SUBSTITUTED WITH BROKEN CONCRETE FROM CULVERT SECTION TO BE REMOVED. INDIVIDUAL PIECES SHALL BE NOT LARGER THAN 200 X 300 X 300mm AND SHALL NOT BE CONNECTED WITH REINFORCING STEEL.

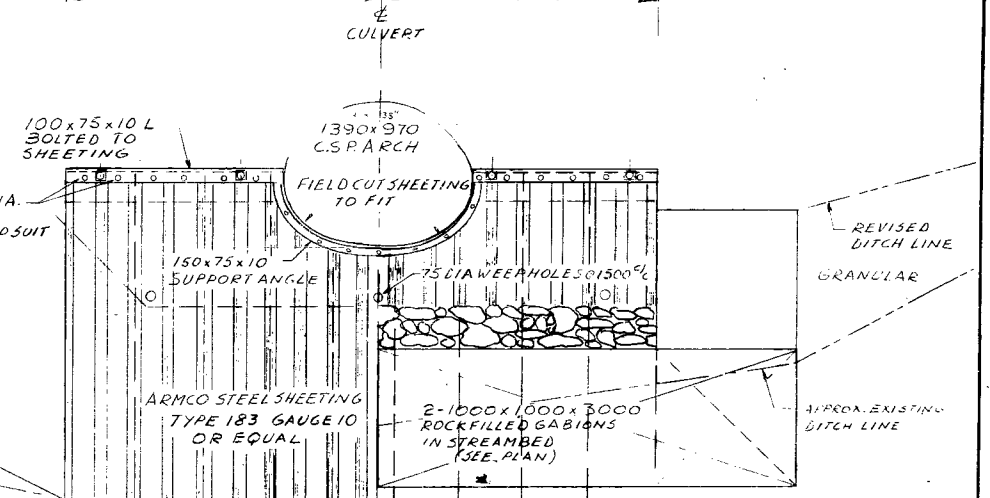
**STEEL SHEETING ENDWALL:** THE IN-PLACE STEEL SHEETING SHALL BE FIELD CUT TO FIT THE C.S. PIPE ARCH. THE ARCH SHALL BE CONNECTED TO THE STEEL SHEETING WITH A 150X75X10 ROLLED ANGLE. THE 75mm DIA. WEEPHOLES SHALL BE FIELD CUT AS SHOWN.

ALL AREAS OF THE STEEL SHEETING DAMAGED BY FIELD CUTTING SHALL BE CLEANED AND PAINTED WITH A ZINC-RICH PAINT.



LONGITUDINAL SECTION

9 SECTIONS ARMCO SHEETING TYPE M581 OR EQUAL  
2500 2000



SCALE 1:25

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWINGS

REVISIONS	DATE	BY	DESCRIPTION
DESIGN E.C.I.			LOADING O.H.B.C.
DRAWING A.V.			CHE E.C.I. SITE No 3-CULVERT
			DATE NOV 83
			DWG P 1

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

# METRIC

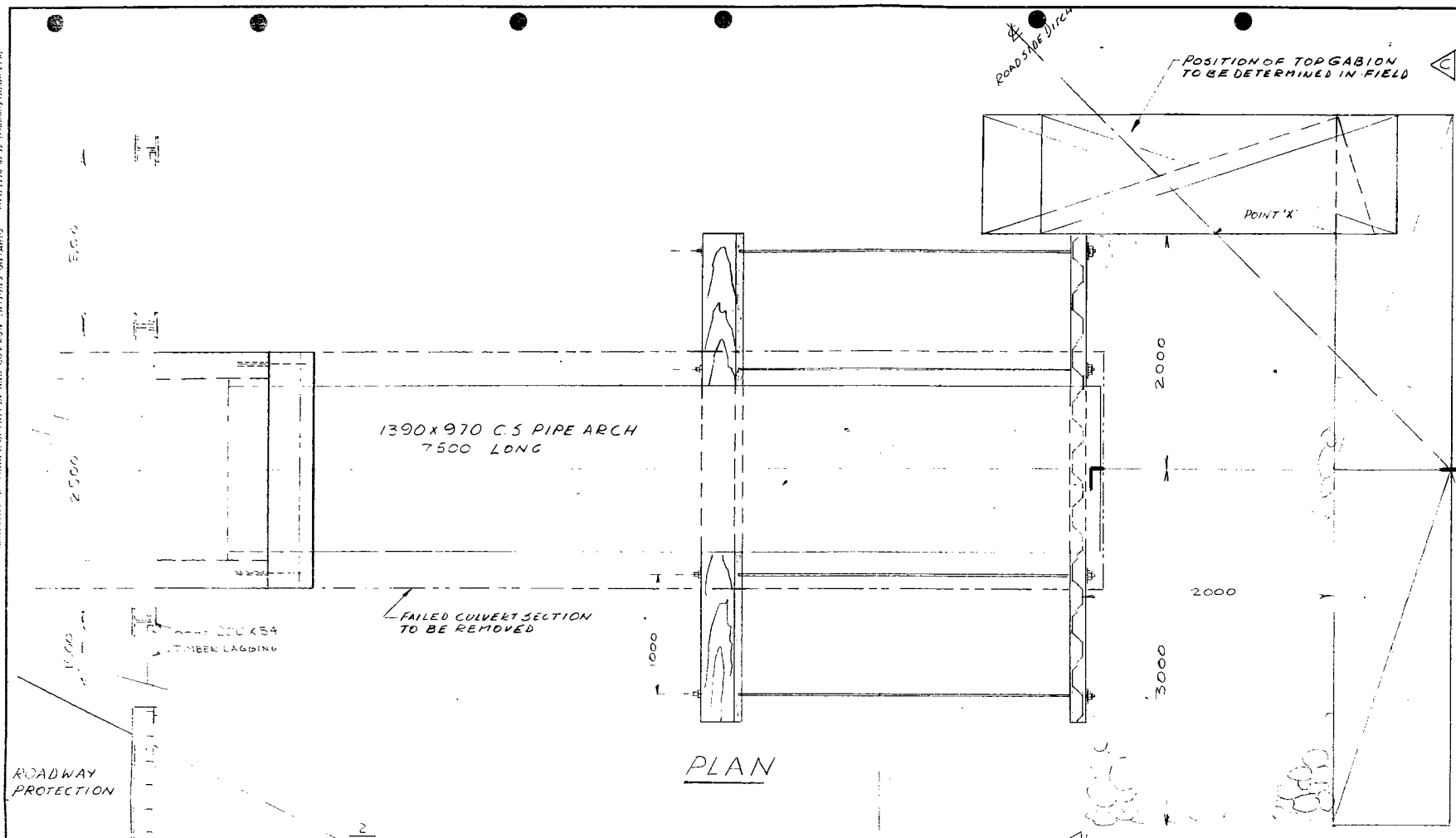
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

Dist. No 9  
CONT No  
WP No 7420-83-01

## CULVERT REPAIRS

SHEET

HIGHWAY 16 at McFARLANE DR.



### MATERIAL SPECIFICATIONS

- CLASS OF CONCRETE 20 MPa
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- STEEL SHEETING SHALL BE HOT-DIP GALVANIZED TO THE REQUIREMENTS OF A.S.T.M. SPEC. A526 OR EQUAL
- TIE RODS AND ASSOCIATED HARDWARE SHALL BE HOT-DIP GALVANIZED TO THE REQUIREMENTS OF C.S.A. STANDARD G164 M, OR EQUAL
- TIMBER SHALL BE 5 PF\*2 AND PRESSURE TREATED TO THE REQUIREMENTS OF C.S.A. STANDARD O80.14 AND A.W.P.A. STANDARD M1, M2 AND M3
- ROCKFILL SIZE SHALL BE 0.01 m<sup>3</sup> MIN.

### REINFORCING STEEL

BAR MARK	NO	LENGTH	DETAIL
H15001	1	700	H=200
H15002	2	750	H=250
H15003	2	950	H=450
H15004	7	1050	H=550
H15005	10	755	H=255
H15006	4	1350	
H15007	2	2100	
H15008	4	1850	

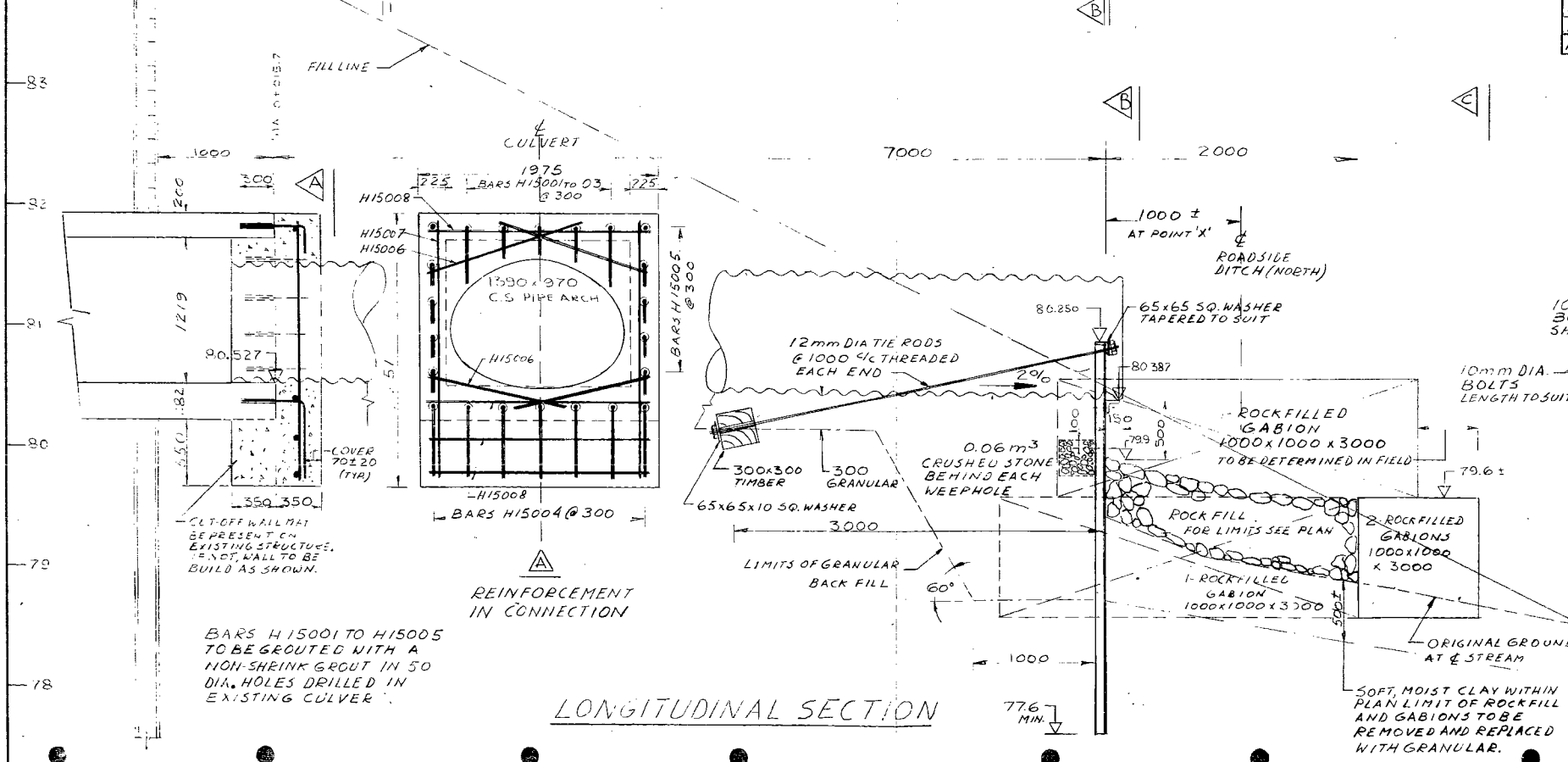
TOTAL MASS 0.05 TONNES

### CONSTRUCTION NOTES

**ROADWAY PROTECTION:** AN ALTERNATIVE METHOD MAY BE PROPOSED BY THE CONTRACTOR. DRAWINGS SHOWING HIS PROPOSED SCHEME SHALL BE SUBMITTED FOR APPROVAL THREE WEEKS PRIOR TO STARTING WORK.  
**PILING IN THE ROADWAY PROTECTION IS TO BE REMOVED OR CUT OFF A MINIMUM OF 1.0 METRES BELOW FILL GRADE UPON COMPLETION OF THE WORK.**

**GABIONS AND ROCKFILL:** ROCKFILL IN GABIONS AND/OR IN FRONT OF THE STEEL SHEETING ENDWALL MAY BE SUBSTITUTED WITH BROKEN CONCRETE FROM CULVERT SECTION TO BE REMOVED. INDIVIDUAL PIECES SHALL BE NOT LARGER THAN 200 X 300 X 300mm AND SHALL NOT BE CONNECTED WITH REINFORCING STEEL.

**STEEL SHEETING ENDWALL:** THE IN-PLACE STEEL SHEETING SHALL BE FIELD CUT TO FIT THE C.S.P. ARCH. THE ARCH SHALL BE CONNECTED TO THE STEEL SHEETING WITH A 150X75X10 ROLLED ANGLE. THE 75mm DIA. WEEPHOLES SHALL BE FIELD CUT AS SHOWN. ALL AREAS OF THE STEEL SHEETING DAMAGED BY FIELD CUTTING SHALL BE CLEANED AND PAINTED WITH A ZINC-RICH PAINT.



### 9 SECTIONS ARMCOSHEETING TYPE M581 OR EQUAL

2500 2000

CULVERT

100x75x10 L BOLTED TO SHEETING

1390x970 C.S.P. ARCH

FIELD CUT SHEETING TO FIT

150x75x10 SUPPORT ANGLE

75 DIA WEEPHOLES @ 1500c/c

ARMCO STEEL SHEETING TYPE 183 GAUGE 10 OR EQUAL

2-1000x1000x3000 ROCKFILLED GABIONS IN STREAMBED (SEE PLAN)

APPROX. EXISTING DITCH LINE

REVISED DITCH LINE

SCALE 1:25

DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGNED BY			CHECK E.C.L. LOADING C.H.B.D.C.
DRAWING A.V.			CHECK E.C.L. SITE NO 3-CULVERT DWG P1