

61-20 SEP 1976

GEOCRES No. 40J14-33  
DIST. 2 REGION Southwestern  
W.P. No. 89-69-01

CONT. No. 78-96

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

STR. SITE No. \_\_\_\_\_

HWY. No. \_\_\_\_\_

LOCATION Proposed St. Thomas  
Expressway

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 2

REMARKS: documents to be unfolded  
before microfilming

FOUNDATION INVESTIGATION REPORT  
For  
Proposed St. Thomas Expressway  
Culverts No. 1, 4, 5, 6 and 7  
Twp. of Southwold and Yarmouth  
County of Elgin  
District No. 2 (London)  
W.O. 73-11019 - W.P. 89-69-01

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1. INTRODUCTION:

A request for a foundation investigation for five culverts in conjunction with the proposed St. Thomas Expressway was received from Mr. A.P. Watt, Regional Structural Location Engineer, Southwestern Region, in a memo dated March 29, 1973.

Subsequently, the Foundations Office carried out a field investigation to determine the subsoil and groundwater conditions existing at the location of each culvert.

This report contains all the factual data from this investigation, together with recommendations pertaining to the excavation for and installation of these culverts.

2. DESCRIPTION OF SITE AND GEOLOGY:

Culverts # 1 (Sta. 328 + 75), # 4 (Sta. 378 + 60), # 5 (Sta. 429 + 78) and # 6 (Sta. 114 + 20) are all located in an area of flat to very gently rolling land. The land is generally cultivated for agricultural use. Culvert # 7 (Sta. 140 + 31) is located in a small brush and tree covered valley of some 20 - 30 ft. depth and 250 to 300 ft. width. The valley walls seem to be in good condition with natural 3:1 slopes.

Physiographically, the region in which the culvert locations lie is referred to as the Mount Elgin Ridges.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of fourteen sampled boreholes and ten dynamic cone penetration tests were carried out during the course of the field work. Three boreholes were put down at each culvert location, except culvert # 1, where only two boreholes were put down. Boring was achieved by means of two CME hollow stem auger machines; each of which was adapted for soil sampling purposes. During the field work, disturbed samples were obtained by means of a standard 2 inch O.D. split spoon sampler; the driving energy conformed to the requirements of the Standard Penetration Test.

Dynamic cone penetration tests were carried out adjacent to ten boreholes. Driving energy to advance the cone was 350 ft.-lb. per blow.

All boreholes were surveyed in the field by personnel from Southwestern Region Engineering Surveys Section. The locations and elevations of the boreholes and cone tests are marked on Drawings No. 73-11019A&B which accompany this report.

All borehole samples were subjected to a careful visual examination and classification in the field and subsequently 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

The results of the field and laboratory tests are summarized on the Record of Borehole sheets and Figures 1 to 5 which are contained in the Appendix of this report.

4. CULVERT # 1:

4.1 Subsoil Conditions:

The boreholes (C1-1,2) at this location were placed to a depth of 31.5 feet (about elevation 745) into a clayey silt stratum. A layer of sand was encountered in one borehole.

The clayey silt stratum consists of very stiff to hard clayey silt, some sand, and a trace of gravel. A 7-foot thick layer of dense to very dense sand, some clayey silt, and a trace of gravel occurs in this stratum at a depth of from 14 to 21 feet (between elevations 762.2 and 755.2) in borehole C1-1. This sand layer is immediately underlain by a one foot thick layer of silt.

Standard Penetration 'N' values for this stratum vary from 18 to 103 blows per foot with an average value of 37 blows per foot.

The physical properties of the clayey silt are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	11 - 15	13
Liquid Limit	27 - 30	29
Plasticity Index	11 - 13	12

These values are indicative of a material of low plasticity and are illustrated on Figure 1 in the Appendix of this report.

#### 4.2 Groundwater Conditions:

The groundwater level was not established at this location.

#### 4.3 Discussion & Recommendations:

##### 4.3.1 General:

It is proposed to construct an 18' by 7' rigid frame concrete culvert. The bottom of the culvert is proposed to be between elevations 769 and 770. The existing stream bed is at elevation 770.6. The maximum elevation of the top of the embankment is about 783. The subsoil is very stiff to hard clayey silt.

##### 4.3.2 Foundations:

The subsoil is very stiff at shallow depths. For this reason the culvert may be supported on spread footings. In order to attain a minimum cover of 4 feet below the stream bed for frost

protection, the footings should be placed at or below elevation 766.5. The maximum allowable bearing pressure for design purposes is 3.0 t.s.f. The culvert should be designed to the appropriate Ministry standard. Because of the relatively impermeable nature of the subsoil, no major dewatering problems are anticipated.

4.3.3. Embankment Stability and Settlement:

The maximum height of the embankment is about 13 feet. Because of the very stiff to hard nature of the subsoil, no stability problems are anticipated. There should be little or no settlement of the culvert foundations.

5. CULVERT # 4:

5.1 Subsoil Conditions:

The boreholes at this location were placed to a depth of 31.5 feet (about elevation 747) into a clayey silt stratum. This stratum consists of stiff to hard clayey silt, some sand, a trace of gravel, and occasional silt seams or pockets.

Standard Penetration 'N' values for this stratum vary from 13 to 38 blows per foot with an average value of 30 blows per foot.

The physical properties are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	12 - 20	15
Liquid Limit	25 - 37	31
Plasticity Index	10 - 18	14

These values are indicative of a material of low plasticity and are illustrated on Figure 2 in the Appendix of this report.

5.2 Groundwater Conditions:

The groundwater level was not established at this location.

### 5.3 Discussion & Recommendations:

#### 5.3.1 General:

It is proposed to construct a 14' by 6' concrete box culvert. The bottom of the culvert is proposed to be between elevations 772.5 and 773.5. The existing stream bed is at elevation 775.1. The maximum elevation of the top of the embankment is about 785.5. The subsoil is stiff to hard clayey silt.

#### 5.3.2 Foundations:

The subsoil is very stiff at shallow depths. For this reason the culvert may be supported on spread footings. In order to attain a minimum cover of 4 feet below the stream bed for frost protection, the footings should be placed at or below elevation 771. The maximum allowable bearing pressure for design purposes is 3.0 t.s.f. The culvert should be designed to the appropriate Ministry standard. No major dewatering problems are anticipated at this location.

#### 5.3.3. Embankment Stability & Settlement:

The maximum height of the embankment is about 10 feet. Because of the stiff to hard nature of the subsoil no stability or settlement problems are anticipated.

### 6. CULVERT # 5:

#### 6.1 Subsoil Conditions:

##### 6.1.1 General:

The subsoil at this location consists of hard clayey silt underlain by compact to very dense silt. The subsoil strata described from ground level downwards are as follows:

##### 6.1.2 Clayey Silt:

This 7 to 13 foot thick stratum consists of hard clayey silt, a trace to some sand, and a trace of gravel. The Standard Penetration 'N' values for this stratum vary from 32 to 52 blows per foot with an average value of 38 blows per foot. The natural moisture content is about 16%. This stratum is of low plasticity with a liquid limit of about 34 and a plasticity index of about 16.

### 6.1.3 Silt:

This stratum is a minimum of 23.5 feet thick and has a maximum thickness of more than 33.5 feet. All three boreholes were terminated in this deposit. It consists of compact to very dense silt, a trace to some sand and clay, a trace of gravel, and occasional layers of clayey silt. Standard Penetration 'N' values for this stratum vary from 24 to 105 blows per foot with an average value of 50 blows per foot.

The physical properties of this stratum are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	13 - 21	17
Liquid Limit	18 - 21	19
Plasticity Index	2 - 7	4

These values are indicative of a material of slight plasticity and are illustrated on Figure 3 in the Appendix of this report.

### 6.2 Groundwater Conditions:

The groundwater level was not established at this location.

### 6.3 Discussion & Recommendations:

#### 6.3.1 General:

It is proposed to place a 7' by 5'-1" corrugated steel pipe arch culvert at this location. The proposed invert elevation varies from 763.5 to 765. The existing stream bed is at elevation 764.9. The maximum elevation of the top of the embankment is 773. The subsoil is hard clayey silt underlain by compact to very dense silt.

#### 6.3.2 Culvert Placement:

The culvert should be designed and placed according to the appropriate Ministry standards. A minimum 1 foot thick granular 'B' bedding should be adequate beneath the culvert. A filter blanket should be placed at the downstream end of the culvert. An impervious clay blanket should be placed at the

upstream end. It is recommended that the creek bed at both the upstream and downstream ends be protected by rip-rap. The size of the area to be covered by rip-rap should be determined by the Hydrology Office. The lack of the above protective measures might cause serious washouts of the granular bedding, which in turn would endanger the stability of the embankment.

No major dewatering problems are anticipated, if the culvert is placed at the proposed invert elevation.

#### 6.3.3 Embankment Stability and Settlement:

The maximum height of the proposed embankment is 10 feet. Because of the hard nature of the subsoil, no embankment stability or settlement problems are anticipated.

### 7. CULVERT # 6:

#### 7.1 Subsoil Conditions:

##### 7.1.1 General:

The subsoil at this location consists of stiff to very stiff clayey silt underlain by compact to dense silt to clayey silt. The subsoil strata described from ground level downwards are as follows:

##### 7.1.2 Clayey Silt:

This 8 foot thick stratum consists of stiff to very stiff clayey silt, traces of sand and gravel, and occasional silt seams. The Standard Penetration 'N' values for this stratum vary from 12 to 23 blows per foot with an average value of 16 blows per foot. The natural moisture content is about 20%. This stratum is of low plasticity with a liquid limit of about 34 and a plasticity index of about 16.

##### 7.1.3 Silt to Clayey Silt:

This stratum was penetrated 23.5 feet in every borehole. It consists of compact to dense silt to clayey silt and a trace of sand. Standard Penetration 'N' values for this stratum vary from 21 to 50 blows per foot with an average value of 35 blows per foot.



The physical properties of this stratum are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	12 - 27	17
Liquid Limit	19 - 25	22
Plasticity Index	5 - 10	7

These values are indicative of a material of slight to low plasticity and are illustrated on Figure 4 in the Appendix to this report.

## 7.2 Groundwater Conditions:

The groundwater level was not established at this location.

## 7.3 Discussion & Recommendations:

### 7.3.1 General:

It is proposed to construct a 10' by 6' concrete box culvert at this location. The bottom of the culvert is proposed to be between elevations 754 and 754.5. The existing streambed is at elevation 756.3. The maximum elevation of the top of the embankment is 767. The subsoil is stiff to very stiff clayey silt underlain by compact to very dense silt to clayey silt.

### 7.3.2 Foundations:

The culvert will be founded in the silt to clayey silt stratum which is compact at shallow depths. For this reason the culvert may be supported by spread footings. In order to attain a minimum cover of 4 feet below the stream bed for frost protection, the footings should be placed at or below elevation 752. The maximum allowable bearing pressure for design purposes is 3.0 t.s.f.

### 7.3.3 Culvert Placement:

The culvert should be designed and placed according to the appropriate Ministry standard. Because the subsoil has slight to low plasticity, a major dewatering scheme should not be required. However there may be some water-bearing silt seams which will allow water to flow into the excavation. For this

reason pumping of water from the excavation may be required in order to place the concrete in the dry.

#### 7.5.4 Embankment Stability and Settlement:

The maximum height of the proposed embankment is 11 feet. Because of the stiff to very stiff nature of the subsoil immediately below the proposed embankment, no stability or settlement problems are anticipated.

### 8. CULVERT # 7:

#### 8.1 Subsoil Conditions:

##### 8.1.1 General:

The subsoil at this location consists of firm to hard clayey silt to silty clay underlain by a very dense glacial till. The subsoil strata described from ground level downwards are as follows:

##### 8.1.2 Clayey Silt to Silty Clay:

This 37 to 40 foot thick stratum consists of firm to hard clayey silt to silty clay, a trace to some sand, and a trace of gravel. The Standard Penetration 'N' values range from 7 to 65 blows per foot with an average value of 25 blows per foot.

The physical properties as determined from laboratory tests are as follows:

	<u>Range of Values</u>	<u>Average Value</u>
Natural Moisture Content (%)	10 - 25	18
Liquid Limit	21 - 42	30
Plasticity Index	8 - 20	13

These values are indicative of a material of low to medium plasticity and are illustrated on Figure 5 in the Appendix of this report.

##### 8.1.3 Glacial Till:

This stratum was penetrated to a maximum of 3 feet. It consists of a very dense, heterogeneous mixture of sand, silt, clay and gravel. Standard Penetration 'N' values are greater

than 100 blows per foot. The natural moisture content is about 6%. The fine-grained material in this stratum is of low plasticity with a liquid limit of about 21 and a plasticity index of about 9.

### 8.2 Groundwater Conditions:

The groundwater level was not established at this location.

### 8.5 Discussion & Recommendations:

#### 8.5.1 General:

It is proposed to construct a 10' by 7' concrete box culvert at this location. The bottom of the culvert is proposed to be between elevations 716.5 and 717. The existing stream bed is at elevation 719. The maximum elevation of the top of the embankment is 761.5. The subsoil is firm to hard clayey silt to silty clay underlain by a very dense glacial till.

#### 8.5.2 Foundations:

The culvert will be founded in the clayey silt to silty clay stratum which is very stiff at shallow depths. For this reason the culvert may be supported on spread footings. In order to attain a minimum cover of 4 feet below the stream bed for frost protection, the footings should be placed at or below elevation 715. The maximum allowable bearing pressure for design purposes is 2.0 t.s.f. The culvert should be designed and placed according to the appropriate Ministry standard. No major dewatering problems are anticipated at this location.

#### 8.5.3 Embankment Stability and Settlement:

The maximum height of the proposed embankment is 42.5 above the stream bed. The subsoil is firm to hard. The embankment should be stable with 2 horizontal to 1 vertical side slopes. It is expected that the embankment will settle about 3 inches at its maximum height.

9. MISCELLANEOUS:

The field work was carried out during the period of May 18 to June 4, 1973, under the supervision of Mr. L.J. Hodge, Project Foundations Engineer and Mr. P. Korgemagi, Project Foundations Engineer. The equipment was owned and operated by P.V.E. & Sons and Dominion Soil Investigations Ltd.

This report was written by Mr. E.A. Wood, Project Foundations Engineer with the assistance of Mr. L.J. Hodge. The entire project was under the supervision of Mr. A. Prakash, Senior Foundations Engineer. This report was reviewed by Mr. K.G. Selby, Supervising Foundations Engineer.

*E.A. Wood*  
E.A. Wood, P. Eng.

*K.G. Selby*  
K.G. Selby, P. Eng.

RAW/zh  
September 12, 1973.

FOUNDATIONS OFFICE

JOB 73-11019

LOCATION Co-ords. 15,558,786 N; 1,536,588 E.

ORIGINAL ED BY LJH

WP 89-69-01

BORING DATE June 4, 1973

COMPILED BY L JH

DATUM Geodetic

BOREHOLE TYPE Auger & Cone Test

CHECKED BY CE

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100	LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$ $w_p$ — $w$ — $w_L$	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT % 10 20 30	BULK DENSITY $\gamma$ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	SIR. PLOT	NUMBER	TYPE	BLOWS/FOOT							
776.2	Ground Level											
0.0	Clayey silt, some sand, trace of gravel. Brown Grey		1	SS	18	770						
	Very Stiff		2	SS	28							
762.2	Sand, some clayey silt, trace of gravel, Dense to Very Dense. Brown		3	SS	32	760						
14.0	Silt Grey		4	SS	10							
755.2	Clayey silt, some sand, trace of gravel. Hard, Grey		5	SS	53	750						
21.0			6	SS	49							
744.7	End of Borehole					740						
21.5												
NOTE: Groundwater level not established.												

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C1-2

JOB 73-11019

LOCATION Co-ord's N. 15,558,532; E. 1,336,884

ORIGINATED BY L.J.E.

W.P. 89-69-01

BORING DATE June 4, 1973

COMPILED BY L.J.E.

DATUM Geodetic

BOREHOLE TYPE Auger &amp; Core Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>p</sub> WATER CONTENT — W W <sub>p</sub> — W — W <sub>L</sub> WATER CONTENT % 10 20 30	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
777.0	Ground Level									
0.0			1	SS	21	770				1 15 58 2
	Brown Grey		2	SS	26					
	Clayey silt, some sand, trace of gravel. Very stiff		3	SS	26	760				
			4	SS	26					
			5	SS	29	750				4 11 49 36
745.5			6	SS	26					
31.5	End of Borehole					740				
	NOTE: Groundwater level not established									

FOUNDATIONS OFFICE

ORIGINATED BY L. J. H.

COMPILED BY L.J.H.

CHECKED BY                     

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C4-2

JOB 73-11019

LOCATION Co-ord's N. 15,556,592; E. 1,341,088

ORIGINATED BY L.J.H.

W.P. 89-69-01

BORING DATE May 22, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— $w_L$			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			PLASTIC LIMIT ——— $w_p$			
778.3	Ground Level													
0.0														
	Very stiff Brown Hard, Grey		1	SS	29	770								
	Clayey silt, some sand. Trace of gravel. Occasional silt seams or pockets.		2	SS	30									
			3	SS	30	760								
			4	SS	31									
			5	SS	38	750								
746.8			6	SS	33									
31.5	End of Borehole													
						740								
	NOTE: Groundwater level not established.													



DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C4-3

JOB 73-11019

LOCATION Co-ord's N. 15,556,482; E. 1,341,048

ORIGINATED BY L.J.H.

W.P. 89-69-01

BORING DATE May 18, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$			BULK DENSITY $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			$W_p$ $W$ $W_L$ WATER CONTENT % 10 20 30				
778.6	Ground Level												P.C.F.	GR. SA. SI. CL.
0.0	Brown Grey  Clayey silt, some sand, traces of gravel. Very stiff to hard.		1	SS	25	770								
			2	SS	34									
			3	SS	32	760								
			4	SS	21									
			5	SS	26	750								
			6	SS	29									
747.1	End of Borehole.					740								
31.5	NOTE: Groundwater level not established.													

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C5-1

JOB 73-11019

LOCATION Co-ord's. N. 15,554,553; E. 1,345,627

ORIGINATED BY L.J.H.

W.P. 89-69-01

BORING DATE June 4, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Auger &amp; Cone Test

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	$w_p$	$w$	$w_L$	
766.7	Ground Level														
0.0	Clayey silt, trace of sand and gravel. Hard.														
	Brown		1	SS	52	760									
	Grey		2	SS	32										
753.7															
13.0	Silt, trace to some sand and clay, trace of gravel, dense to very dense, Grey.		3	SS	39	750									3 1 85 14
			4	SS	105										
			5	SS	87	740									0 23 72 5
			6	SS	56										
730.2			7	SS	30	730									0 0 84 16
36.5	End of Borehole.														
	NOTE: Groundwater level not established					720									

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

# RECORD OF BOREHOLE NO C5-2

JOB 77-11019 LOCATION Co-ord's N. 15,554,438; E. 1,345,678 ORIGINATED BY L.J.H.  
 W.P. 89-69-01 BORING DATE June 1, 1973 COMPILED BY L.J.H.  
 DATUM Geodetic BOREHOLE TYPE Auger & Con<sup>c</sup> Test CHECKED BY G.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	Wp	W		
765.2	Ground Level														
0.0	Clayey silt, some sand, trace of gravel. Hard Brown		1	SS	35	760									
758.2			2	SS	27										
7.0	Silt, some clay, trace of sand and gravel. Occ. layers of clayey silt. Dense to very dense. Grey		3	SS	54	750									
			4	SS	49										
			5	SS	50	740									
733.7			6	SS	26										
31.5	End of Borehole.					730									
	NOTE: Groundwater level not established														

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C5-3

JOB 73-11019

LOCATION Co-ord's. N. 15,554,334; E. 1, 345,743

ORIGINATED BY L.J.H.

W.P. 89-69-01

BORING DATE June 1, 1973

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Auger &amp; Cone Test

CHECKED BY

SOIL PROFILE.			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					$w_p$ — $w$ — $w_L$ 10 20 30				
764.9	Ground Level															
0.0	Clayey silt, some sand, traces of gravel. Hard Brown		1	SS	34	760										
756.9			2	SS	81											
8.0	Silt, some clay, trace of sand and gravel, very dense to compact, Grey.		3	SS	45	750										
			4	SS	52											
			5	SS	54	740										
			6	SS	33											
			7	SS	24	730										
723.4			8	SS	29											
41.5	End of Borehole.					720										
NOTE: Groundwater level not established.																

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

# RECORD OF BOREHOLE NO C6-1

JOB 73-11019

LOCATION Co-ord's. 15,553,795 N; 1,347,576 E.

ORIGINATED BY L.J.H.

W.P. 89-69-01

BORING DATE June 1, 1975

COMPILED BY L.J.H.

DATUM Geodetic

BOREHOLE TYPE Auger & Cone Test

CHECKED BY SP

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT $W_L$		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE		BLOWS/FOOT	BLOWS / FOOT	PLASTIC LIMIT $W_P$	WATER CONTENT $W$		
61.7	Ground Level						20 40 60 80 100				
							SHEAR STRENGTH P.S.F.		$W_P$ $W$ $W_L$		
							○ UNCONFINED + FIELD VANE		WATER CONTENT %		
							● QUICK TRIAXIAL x LAB VANE		10 20 30		
0.0	Clayey silt, trace of sand, occasional silt seams, stiff brown		1	SS	12	760					0 8 56 30
753.7			2	SS	26	750					0 2 70 20
8.0	Silt to clayey silt, trace of sand, compact to dense, grey		3	SS	50						0 13 68 19
			4	SS	43	740					
			5	SS	39						
730.2			6	SS	22	730					0 0 71 19
31.5	End of Borehole.										
NOTE: Groundwater level not established.											

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C 6-2

JOB 75-11019

LOCATION Co-ord's. 15,553,749 N; 1,247,469 E.

ORIGINATED BY I.J.E.

W.P. 89-69-01

BORING DATE June 1, 1973

COMPILED BY I.J.E.

DATUM Geodetic

BOREHOLE TYPE Auger &amp; Cone Test

CHECKED BY S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W <sub>L</sub> PLASTIC LIMIT — W <sub>P</sub> WATER CONTENT — W			BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
761.8	Ground Level															
0.0	Clayey silt, trace of sand, stiff, brown.		1	SS	72	760										
753.8			2	SS	25	750										0 5 72
8.0	Silt to clayey silt, trace of sand, compact to dense, grey		3	SS	21											
			4	SS	29	740										0 1 70
			5	SS	25											
730.3			6	SS	44	730										0 0 81
31.5	End of Borehole.															
	NOTE: Groundwater level not established.															

ORIGINATED BY L. J. E.

COMPILED BY L. J. M.

CHECKED BY                     

20  
15  $\phi$  5 % STRAIN AT FAILURE  
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

# RECORD OF BOREHOLE NO C7-1

JOB 75-11019

LOCATION Co-ordin. 15,551,005 N; 1,729,203 E.

ORIGINATED BY J.E.E.

W.P. 89-09-01

BORING DATE May 31, 1972

COMPILED BY J.E.E.

DATUM Canadian

BOREHOLE TYPE Auger & Core Test

CHECKED BY

SOIL PROFILE			SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 0 20 40 60 80 100	LIQUID LIMIT $W_L$ PLASTIC LIMIT $W_P$ WATER CONTENT $W$ $W_p \rightarrow W \rightarrow W_L$	WATER CONTENT % 10 20 30	BULK DENSITY $\gamma$ P.C.F. OR SA S.C.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. NO.	NUMBER	TYPE						
724.7 0.0	Ground Level									
	Brown Grey Clayey silt, some sand, trace of gravel, firm to hard.		1	SS	7					4.28 47
			2	SS	11					
			3	SS	11					
			4	SS	14					4.10 44
			5	SS	14					
	(glacial till) Heterogeneous mixture of sand, silt, gravel and clay, very dense		6	SS	15					
			7	SS	27					
			8	SS	15					
686.3										
685.8	End of Borehole.									
38.4										
	Groundwater level not established.									

OFFICE REPORT SOIL EXPLORATION



DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C7-2

JOB 77-11019

LOCATION Co-ord's. 15,551,795 N; 1,349,180 E.

ORIGINATED BY L.J.E.

W.P. 89-69-01

BORING DATE May 31, 1975

COMPILED BY L.J.E.

DATUM Gneissic

BOREHOLE TYPE Auger &amp; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		20	40	60	80	100	$w_p$	$w$	$w_L$	
726.1	Ground Level													
0.0	Silty clay to clayey silt, some sand, trace of gravel, stiff to hard. Brown Grey		1	SS	15									
			2	SS	27									
			3	SS	27									1 15 48
			4	SS	25									
			5	SS	24									1 18 46
	(glacial till) heterogeneous mix. of sand, silt, gr. and clay, very dense. Grey		6	SS	24									
689.7			7	SS	65									
685.4			8	SS	100									8 55 34
59.9	End of Borehole.													
	NOTE: Water not established													

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO C7-3

JOB 77-11019

LOCATION Co-ord's. 15,551,712 N: 1,549,099 E.

ORIGINATED BY T.J.E.

W.P. 89-69-01

BORING DATE May 31, 1975

COMPILED BY T.J.E.

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT $W_L$		BULK DENSITY $\gamma$	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE		BLOWS/FOOT	BLOWS / FOOT		PLASTIC LIMIT $W_P$			
									WATER CONTENT $W$			
						SHEAR STRENGTH P.S.F.		$W_P$ $W$ $W_L$		WATER CONTENT %		
						○ UNCONFINED + FIELD VANE				10 20 30		
						● QUICK TRIAXIAL x LAB VANE						
721.7	Ground Level									P.C.F.	GR SA SI CL	
0.0	Clayey silt, trace to some sand, trace of gravel, stiff to hard. <u>Brown</u> <u>Grey</u>		1	SS	12	720					1 1. 51	
			2	SS	12				10			
			3	SS	20	710						
			4	SS	20				10		2 12 46	
			5	SS	20	700						
			6	SS	22				10		0 2 48	
687.2			7	SS	17	690						
34.5	End of Borehole											
	Note: Groundwater level not established					680						

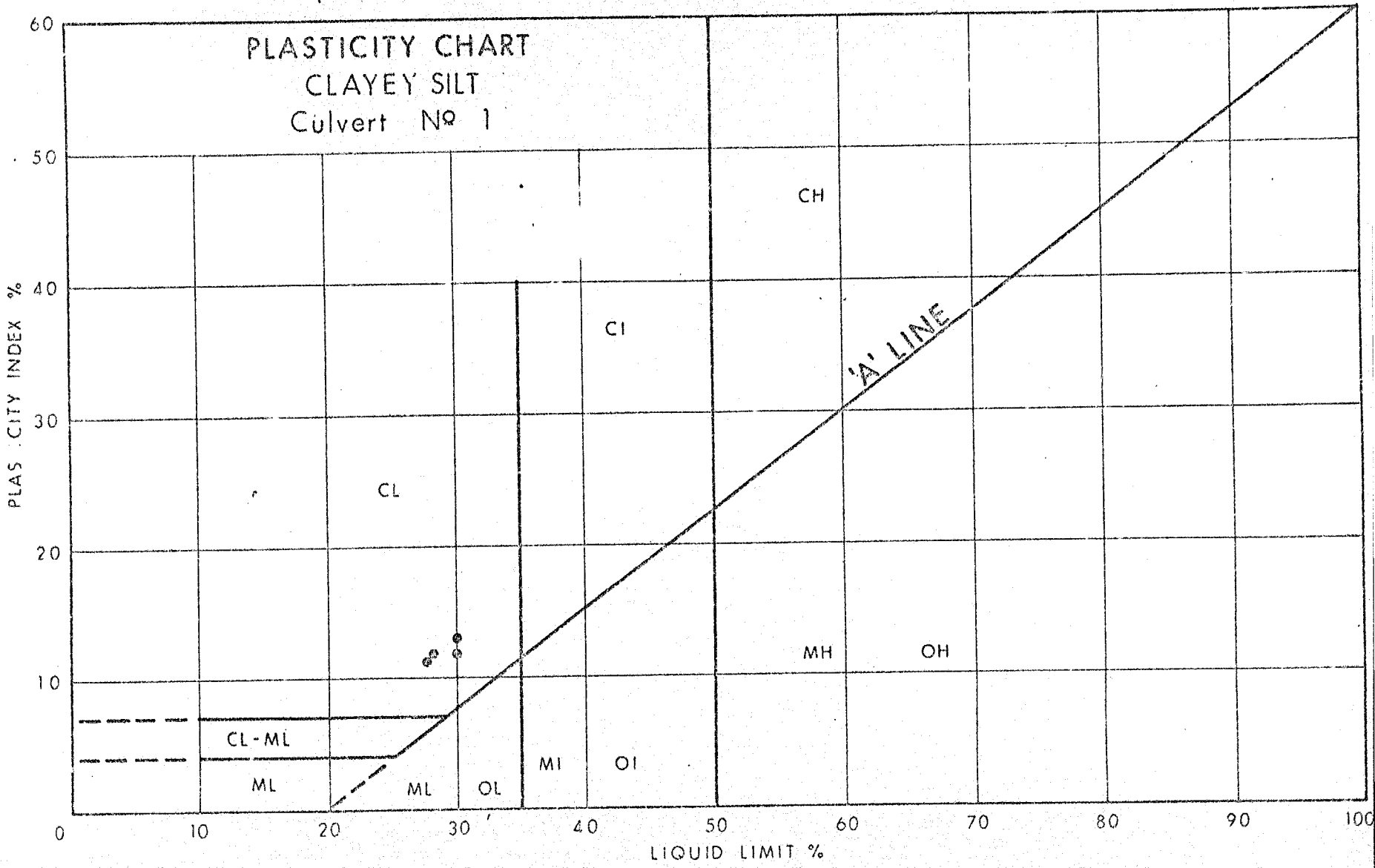


FIG. 1

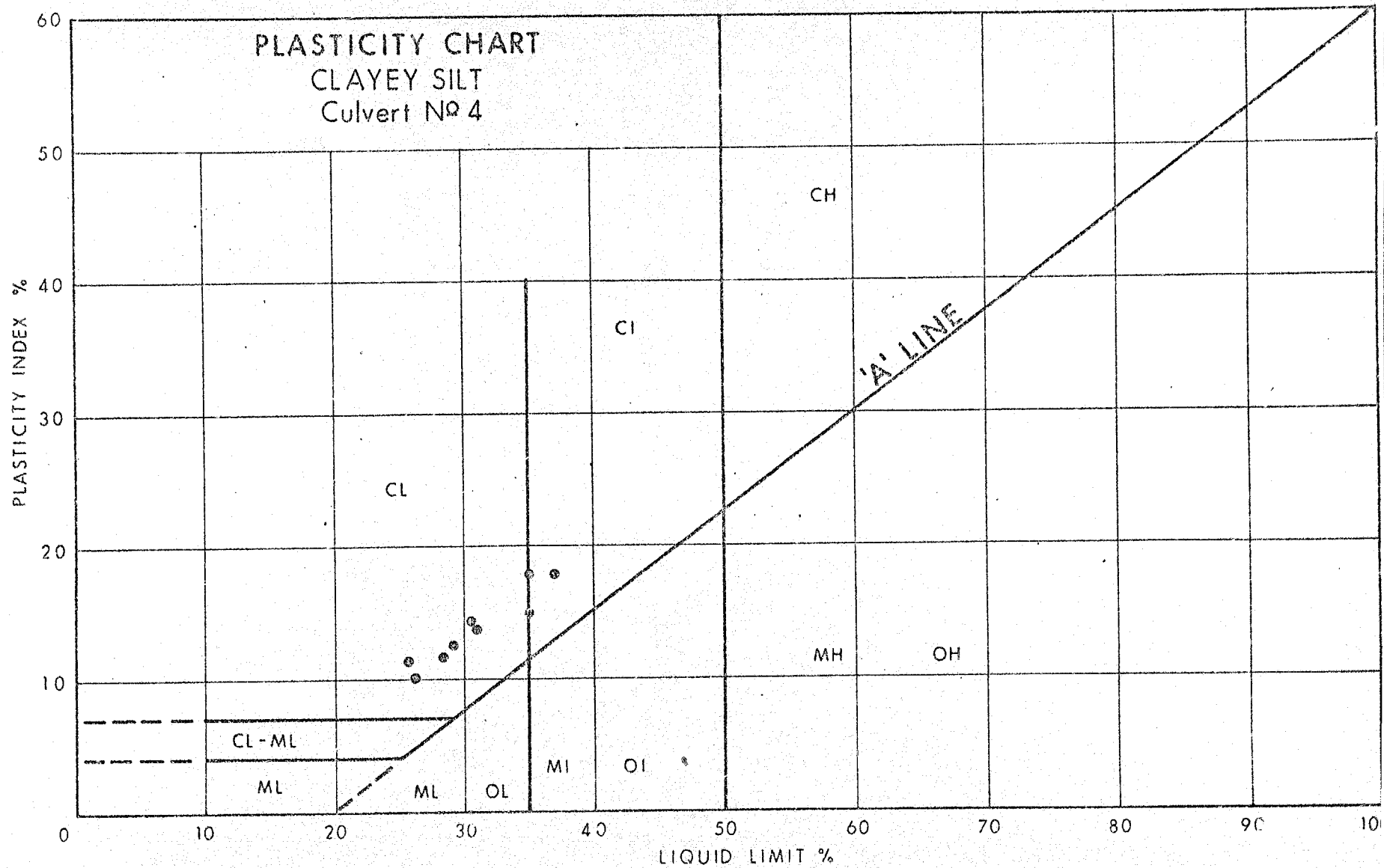


FIG. 2

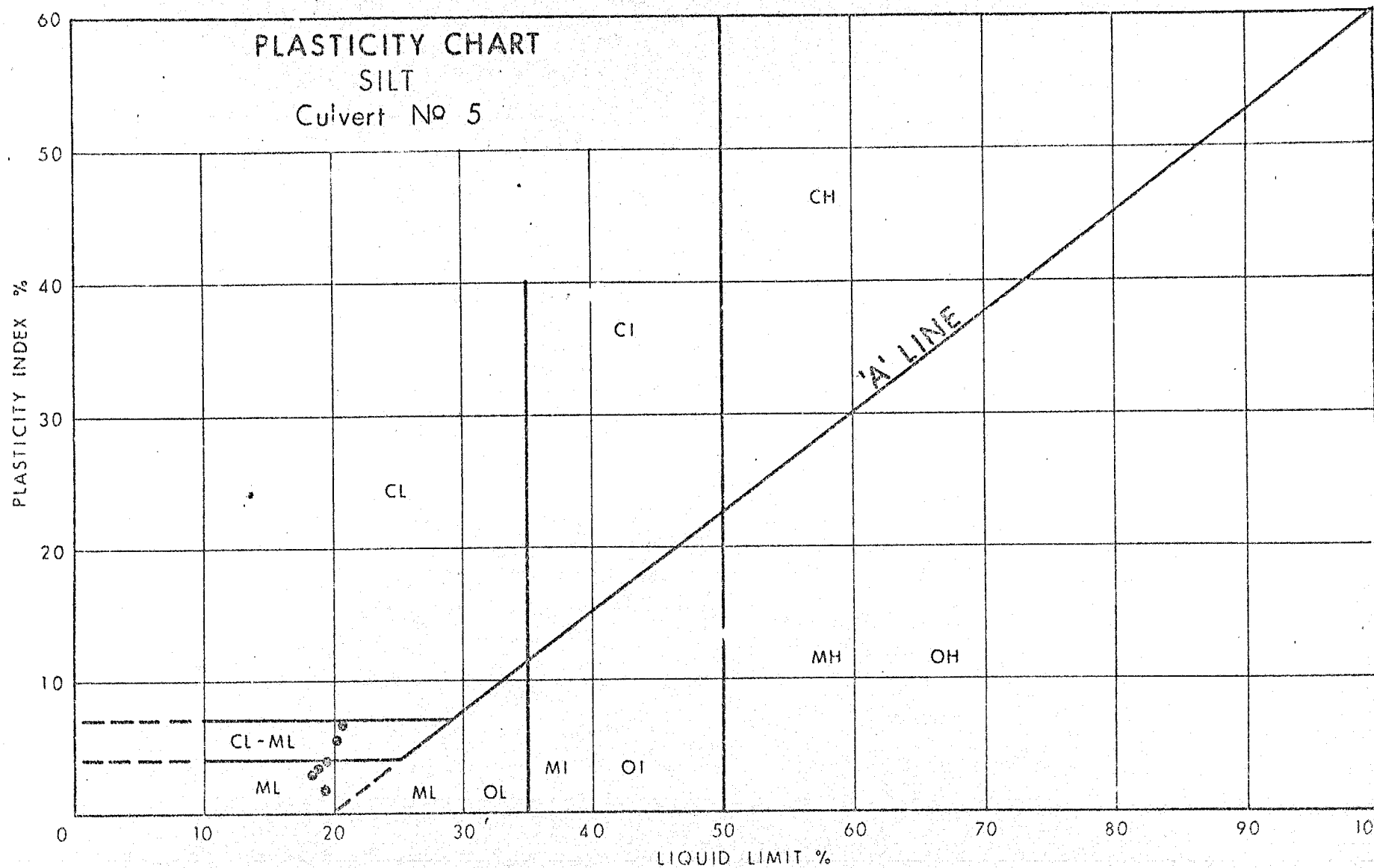


FIG. 3

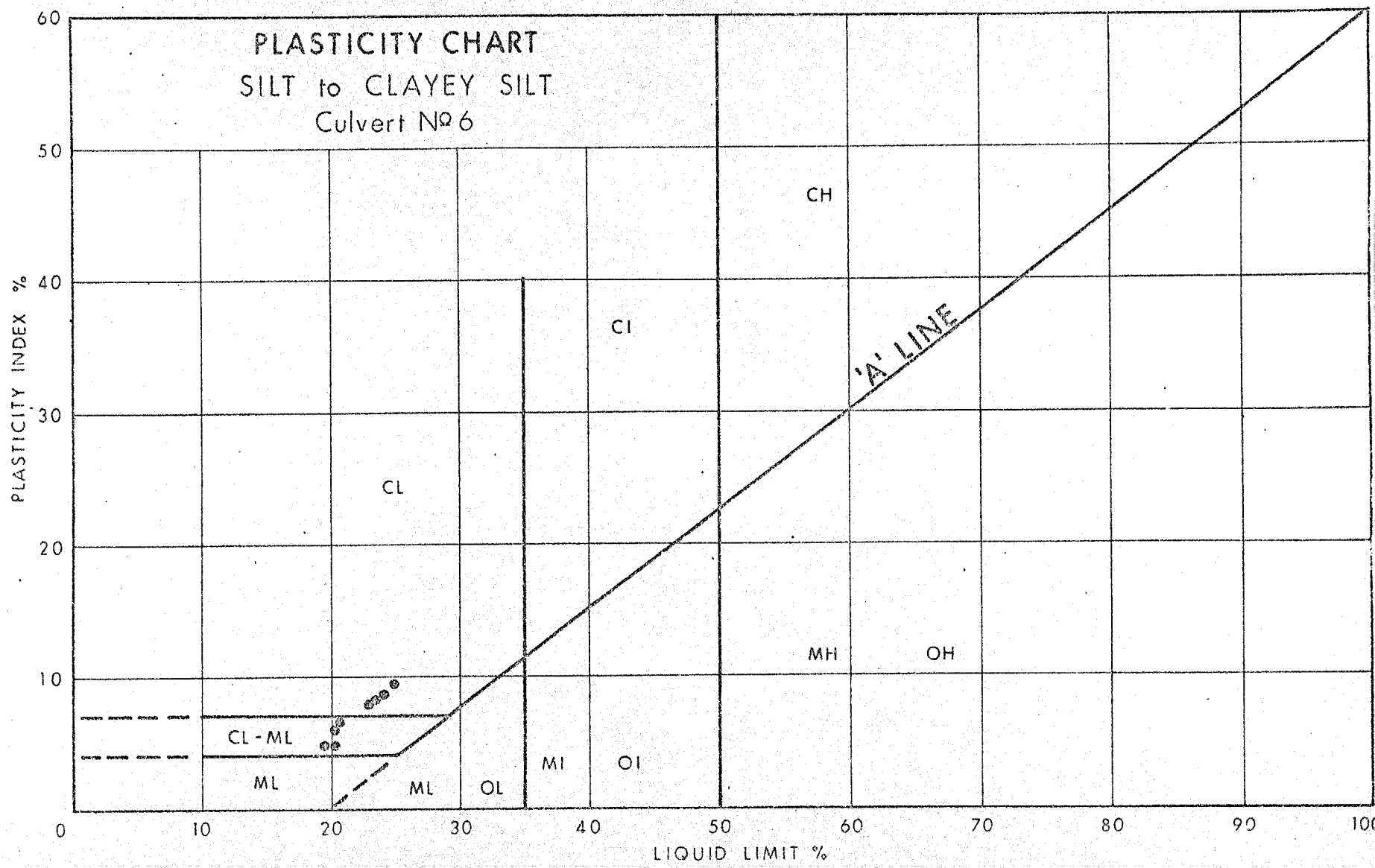


FIG. 4

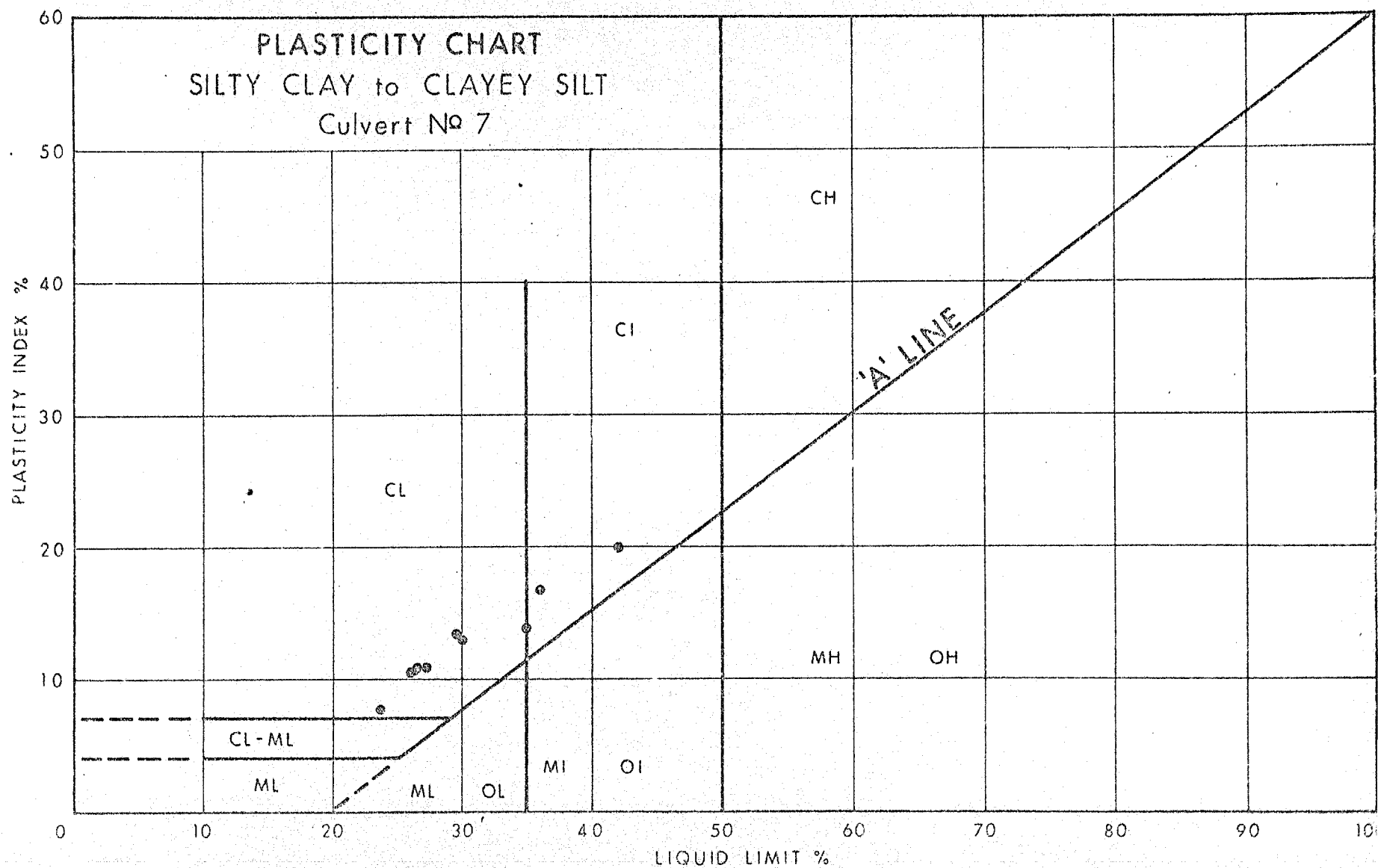
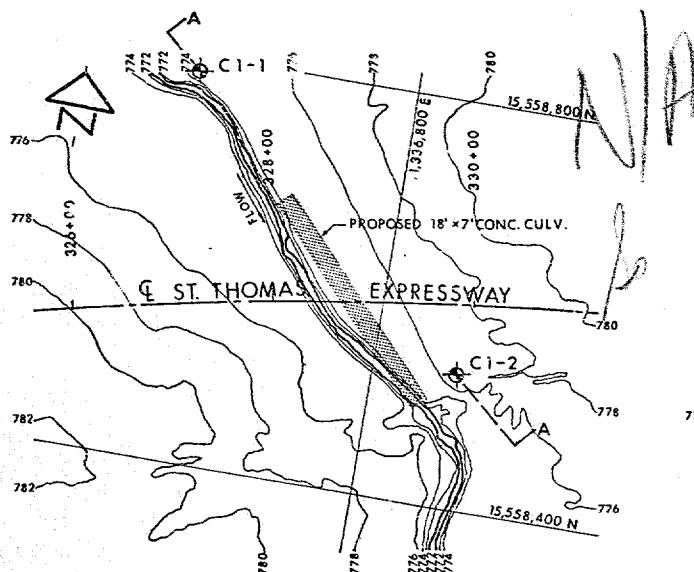
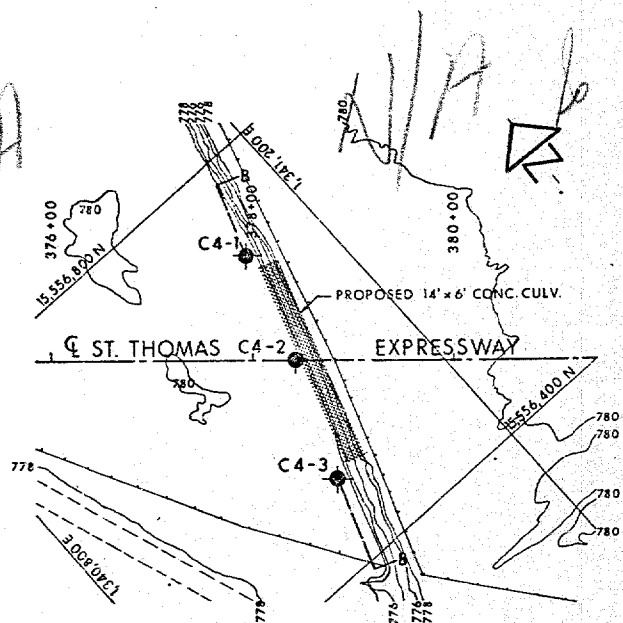


FIG. 5

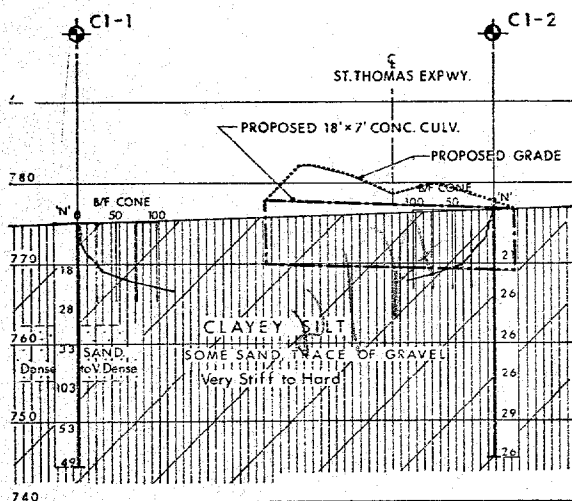


CULVERT NO.1

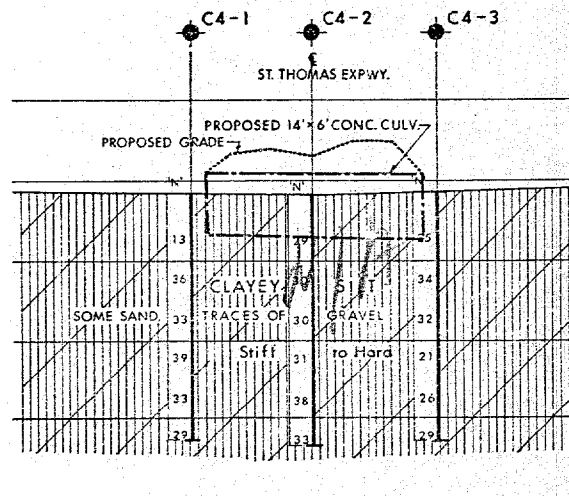


CULVERT NO.4

PLANS

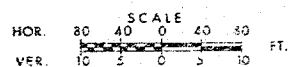


CULVERT NO.1  
A-A

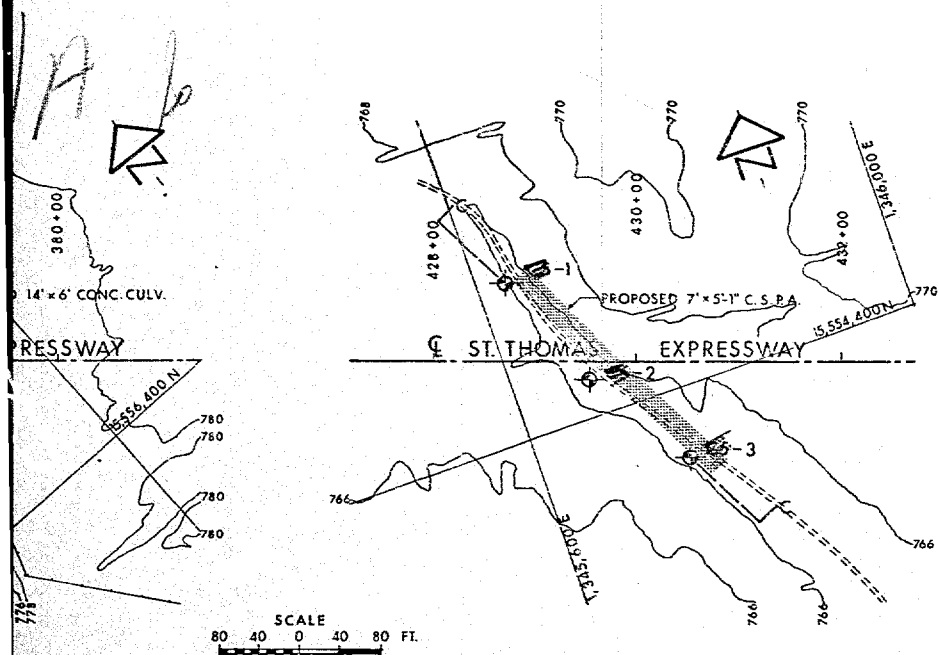


CULVERT NO.4  
B-B

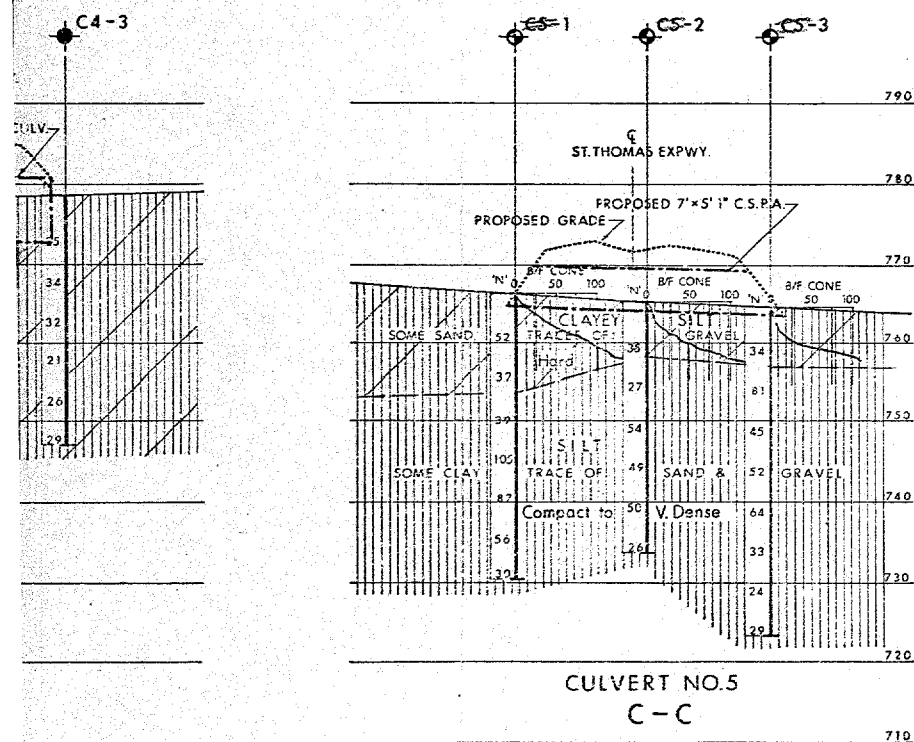
SECTIONS







CULVERT NO.5

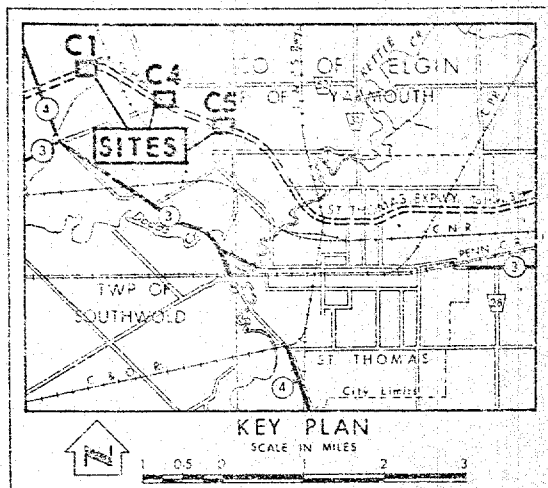


CULVERT NO.5  
C-C

CONTRACT DOCUMENT NOTE

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

REF. NO. 8-95-23  
8-95-24  
8-95-25



LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- NOT  
Water Levels established at time of field investigation, May & June 73

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
Gl-1	776.2	15,558,786	1,336,588
C1-2	777.0	15,558,532	1,336,884
C4-1	778.8	15,556,704	1,341,125
C4-2	778.3	15,556,592	1,341,088
C4-3	778.6	15,556,480	1,341,048
CS-1	766.7	15,554,553	1,345,627
CS-2	765.2	15,554,438	1,345,678
CS-3	764.9	15,554,334	1,345,743

— NOTE —

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

REVISIONS	DATE	BY	DESCRIPTION

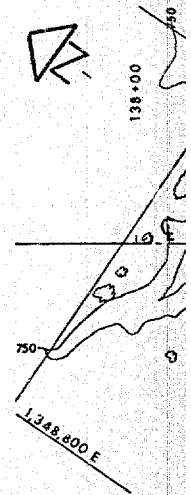
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

CULVERTS NO. 1, 4 & 5.

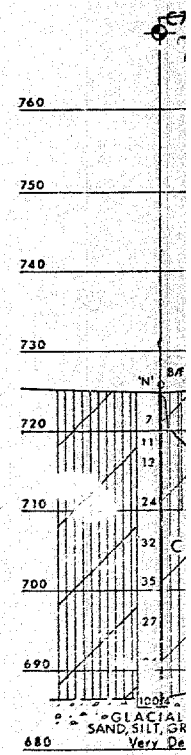
HIGHWAY NO. ST. THOMAS EXPWY. DIST. NO. 2  
CO. ELGIN  
TWP. SOUTHWOLD LOT.   CON.  

BORE HOLE LOCATIONS & SOIL STRATA

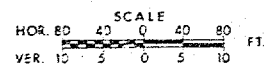
SUBMD A & B	CHECKED	W.P. NO. 29-69-01	DRAWING NO.
DRAWN O.L.	CHECKED	W.O. NO. 73-11019	<b>73-11019A</b>
DATE SEPT. 10 1973	SITE NO.		BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT. NO.		
PRINCIPAL FOUNDATION ENGINEER			

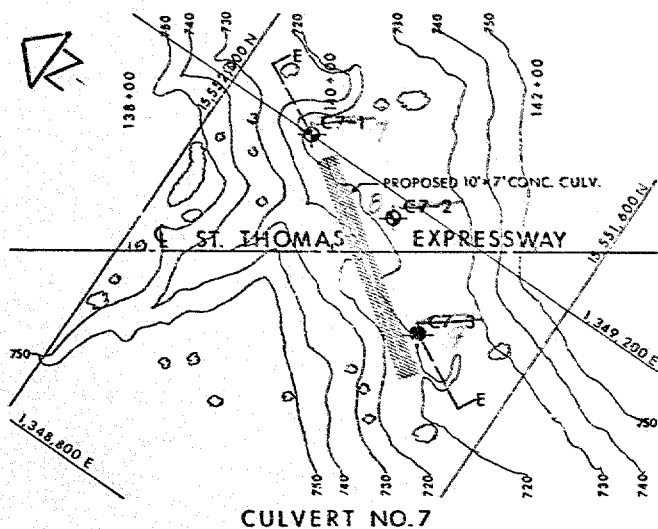


## PLANS

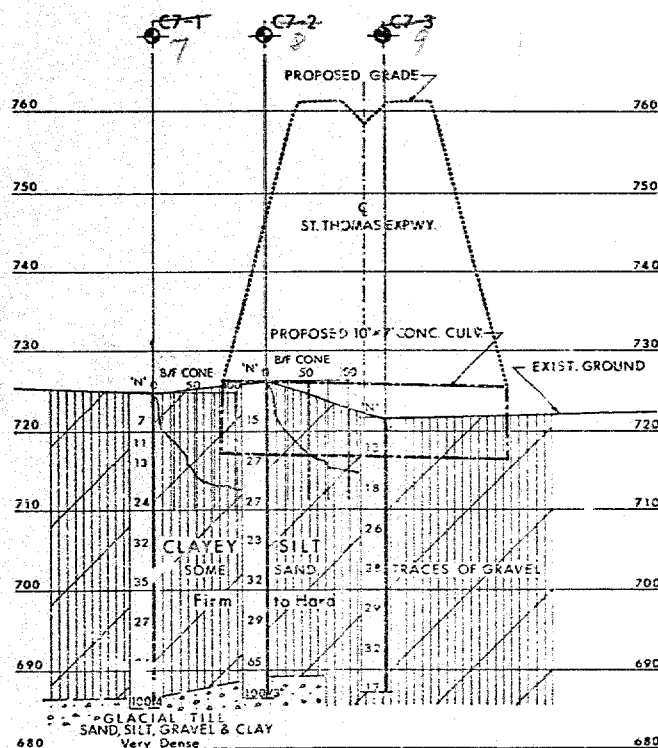


## SECTIONS

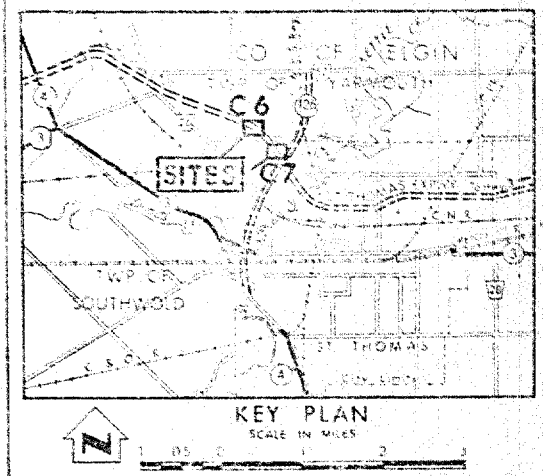




CULVERT NO. 7



CULVERT NO. 7  
E - E



### LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- NOT  
Water Level, established at time of field investigation, May & June 73

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
C6-1	761.7	15,553,795	1,347,576
C6-2	761.8	15,553,749	1,347,469
C6-3	761.8	15,553,706	1,347,356
C7-1	724.7	15,551,906	1,349,200
C7-2	726.3	15,551,793	1,349,180
C7-3	721.7	15,551,712	1,349,099

### CONTRACT DOCUMENT NOTE

The complete soil investigation report for this structure may be examined at the Structural and Foundations Office Downsview and at the London District Office.

### NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

### CULVERTS NO. 6, & 7.

HIGHWAY NO. ST. THOMAS EXPWY. DIST. NO. 2  
CO. ELGIN  
TWP. YARMOUTH LOT CON.

### BORE HOLE LOCATIONS & SOIL STRATA

SUBMIT A.P.	CHECKED BY	WP NO. 80-60-01	DRAWING NO.
DRAWN BY J.	CHECKED BY	WP NO. 79-11019	73-11019B
DATE SEP 14 1973	SITE NO.		BRIDGE DRAWING NO.
APPROVED	CONT. NO.		

REF. NO. E-120-21

POST REVIEW MEETING (CONTRACT DOCUMENTS)

BOARDROOMS E-1 and E-2  
DOWNSVIEW, Ont.

November 7, 1975

WP.89-69-01

CONTRACT: 76-

HIGHWAY: 3N (St. Thomas Expwy)

TYPE OF WORK: Grading, Drainage, Granular Base, Hot Mix Paving & Structure

LOCATION: From Hwy. 4 Easterly to Centennial Rd. (8.8 miles)

DISTRICT: 2

ADVERTISING DATE: 1976

ATTENDANCE

J.R. Wear  
E.J. Willis  
D. Miehms  
Fenco

S. Cant  
G. Metcalfe  
R. Northwood  
A. McKim

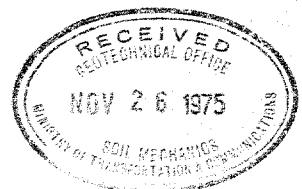
J. Cramie  
K. Selby  
J. Keen  
B. Giroux

W. Sawyer  
M. Duckett  
W. O'Dell  
J. Jenkins

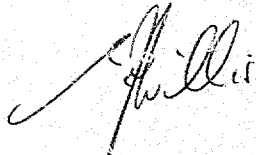
POINTS OF DISCUSSION

1. Mr. Adachi said that there was a definite problem in disposing of waste wet material, approximately 20,000 cu yds from sewer excavation in 'Wet' area, M&T did not wish to have any wet material at all placed on R.O.W. In all there is a quantity of 50,000 cu yds of waste and it was thought to be unjust to have Contractor dispose outside R.O.W. knowing full well no one would accept it. One thought was that maybe we could treat (lime) it to make it acceptable, it was resolved to have Region investigate further for a disposal site. Maybe site of Hwy 126 in N.W area would suit?  
  
Mr. Adachi went on to explain staging of cut/fill and lime treatment, bearing in mind that all is involved with relocation of the creek. R.O.W to be prepared, early in project, so that a paved haul route can be provided to bring fill from east of St. Thomas to two structure sites west of that city (a distance of approx. 4 miles +)
2. Quantity of lime, for treatment, to be 1% which may be increased at the discretion of the Engineer. M&T felt that lime as a ton item best method as, if more lime required, we can increase tonnage with little fuss.
3. Mr. Keen said scraper size would be in excess of our standard (75 tons). Estimating said weight would likely be 78 & 90 tons and present design is for a 83 ton load. Structure Office are to check for maximum load present design could support (it is estimated that earth moving will require 25,000 trips). If economically feasible then we should 'Beef up' structure.
4. Lime treatment - 12" depth to be treated and 9" taken. Should specify what should be left, depthwise, should we treat greater depth. Special Provision will be revised to so state. Measuring of moisture content will be controlled by District. Special Provisions on lime treatment will be revised by Contract Review and distributed to interested parties for comment.
5. Granular vs. Native backfill - Mr. Selby felt that if excavation carried out in summer then no problem as material in situ is of good quality, but in view of previous experience, where extensive area involved, the design should be for granular material in case work done in winter. Then falsework could be erected on a good base and not on frozen unusable material. Mr. Adachi opined that staging would obviate the need for backfill and Mr. Metcalfe said remove interim gradeline so that backfill not required. It was stated that backfill to footings must be considered and how to accommodate falsework - falsework not to be placed on native material. It was decided that problem was one of control by District.

cont....



- \*6. Seeding - feeling was that Contractor is to seed permanent slopes (contract item) which are to be 'accepted'. Any repair work which might be required later payment to be by contingencies. Special to state when seeding to take place as this has an environmental impact.
- \*7. Working day/liquidated damages provisions - Contract Control, District and Operations are to be asked to resolve this whole question.
- 8. A Special Provision may be required to explain on site conditions to our Contractor, in view of changes occasioned by the CNR contractor's work which should be well under way before this contract is let.



E.J. Willis  
Supervisor, Contract Documentation  
for  
J.R. Wear  
Head, Contract Review Section

EJW:kc

c.c.

J.R. Wear

E.J. Willis

D. Mieha

Fenco

S. Cant

\* D. Thrasher

R. Northwood

A. McKim

\* J. Crannie

K. Selby

J. Keen

B. Giroux

W. Sawyer

M. Duckett

W. O'Dell

J. Jenkins

\* D. Hopper

J. MacDougall

DOCUMENT NO. \_\_\_\_\_ DATE \_\_\_\_\_

GEOCRES No. 40114-33

DIST 2 REGION Southwestern

W.P. No. 89-69-01

CONT. No. 78-96

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

STR. SITE No. \_\_\_\_\_

HWY. No. \_\_\_\_\_

LOCATION Opposed St. Thomas

Expressway

\_\_\_\_\_

\_\_\_\_\_

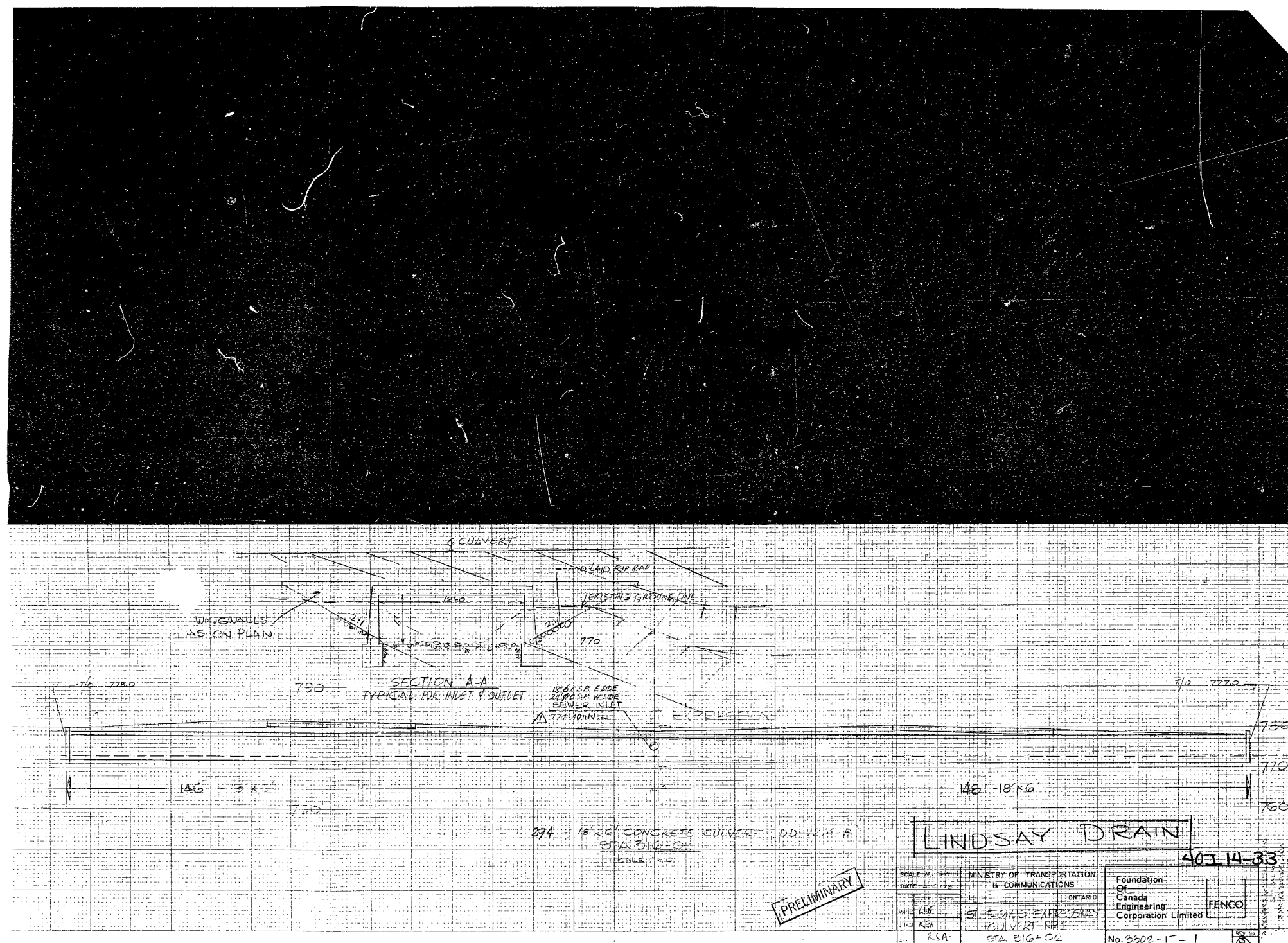
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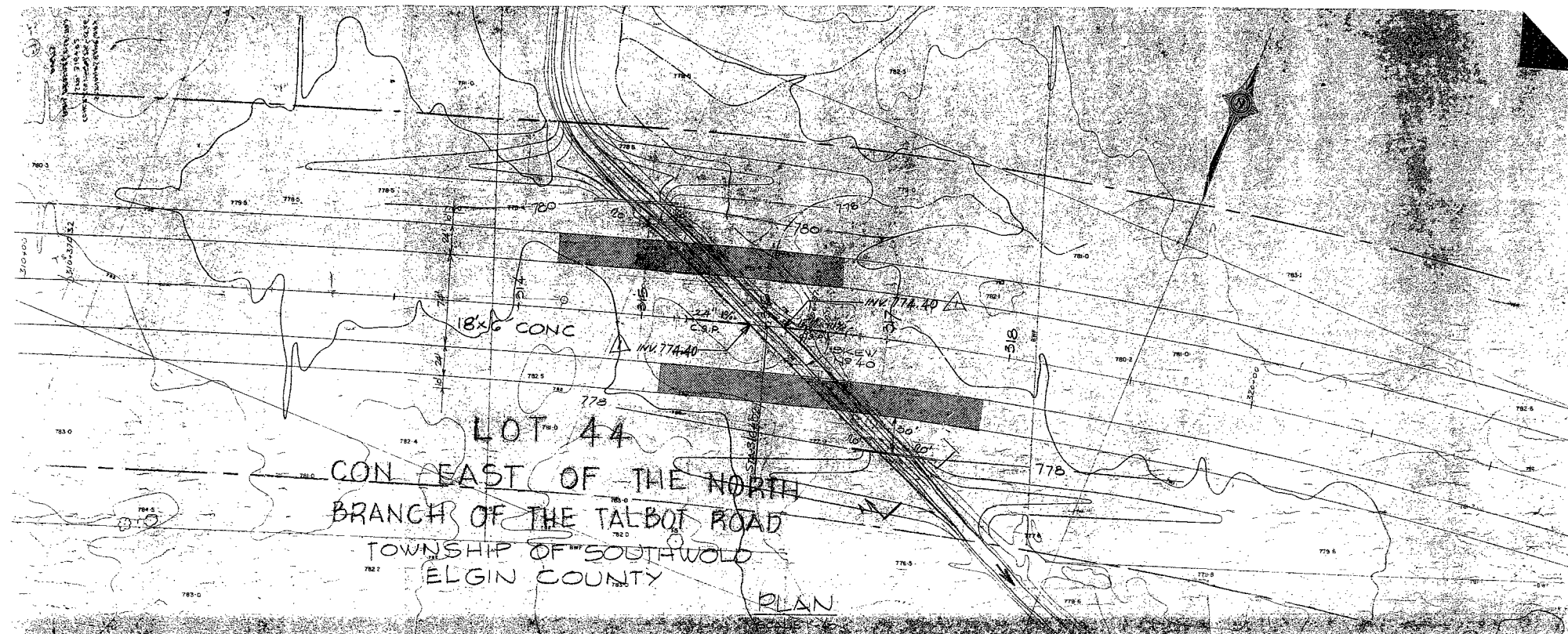
REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_





1/11/73

4/11/73

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