DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M13-47

DIST. 6 REGION

W.P. No.

CONT. No.

W. O. No. 2000 - 11009

STR. SITE No. 37-1034

HWY. No.

LOCATION WILLIS RD BRIDGE & APPROACHES

No. OF PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

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SOIL INVESTIGATION

PROPOSED WILLIS ROAD BRIDGE

AND

APPROACHES

TOWN OF VAUGHAN, ONTARIO

DIST. 6

Ref. No. 76-7-5
September 1976

Prepared For:

Town of Vaughan
c/o Marshall Macklin Monaghan Limited
Toronto, Ontario

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C O N T E N T S

E N C L O S U R E S

1.0 INTRODUCTION

In accordance with written instructions dated July 16, 1976 from Marshall Macklin Monaghan Limited, we have completed our soil investigation for the proposed Willis Road Bridge and Approaches in the Town of Vaughan, Ontario. The proposed bridge will be a three-span structure over the Humber River with a total length of 360± feet. The western approach to the bridge will be approximately 300 feet long and will be on an embankment generally less than 10 feet high. The eastern approach will have a total length of approximately 1000 feet of which approximately 350 feet is on an embankment between 15 and 25 feet high.

Between Chainage 19 + 00 and 21 + 00 the proposed road will run along the top of an existing slope approximately 25 feet high.

The purpose of the investigation was to reveal the subsurface conditions and to determine the relevant soil properties for the design and construction of the bridge foundations and the approach roads. In addition, the stability of the natural side-slope between Chainage 19 + 00 and 21 + 00 is to be studied.

2.0 FIELD WORK

The field work was carried out between July 22 and 30, 1976 and consisted of eight (8) boreholes at the locations shown on the Borehole Location Plans, Enclosures 1, 2, and 3. The boreholes were advanced to the sampling depths by means of a power auger machine equipped with hollow-stem augers for soil sampling. Standard Penetration tests were carried out at frequent intervals of depth and the results are shown on the Borehole Logs as 'N'-values. At one borehole bedrock was proved by obtaining a 6.8 foot length of BX core.

The field work was supervised by a soils technician who also determined the ground elevation at each borehole location. These elevations were referred to two temporary benchmarks established by Marshall Macklin Monaghan Limited near Chainages 12 + 00 and 20 + 00. The elevations of these benchmarks are 476.83 feet and 516.06 feet respectively above the geodetic datum.

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3.0 SUBSURFACE CONDITIONS

Full details of the soils encountered in each borehole are shown on the Borehole Logs comprising Enclosures 5 to 12 inclusive and the inferred subsurface profile is shown on Enclosure 4. The following notes are therefore intended only to amplify this data.

Fill and Alluvial Deposits

A surface deposit of fill and/or alluvium was encountered in all boreholes and extends to depths of between 12-inches and 21 feet below the ground surface. The base of the fill or alluvium is at Elevation 468.4 to 473.4 in the Humber valley and Elevations 509 to 510 on the higher ground to the east.

The fill and alluvium generally consist of sandy silt or silty sand with occasional gravel and traces of organic material. Typical grain size distribution curves for the fill and alluvium are shown on Enclosures 13 and 14 respectively. Standard Penetration tests carried out in the fill gave 'N'-values ranging from 3 to 35 blows per foot. The higher values were generally due to the presence of the gravel or wood fragments.

At Borehole 5 there is 12 feet of mixed loose fill which, we understand, was dumped recently on top of 9 feet of fairly clean alluvial deposits. We also understand that no vegetation or topsoil was removed in this area prior to dumping.

Sand

Below the fill and/or alluvium in Boreholes 1, 2, 3, 4, 5, and 8, there is a deposit of silty sand which extends to depths of between 12 feet and more than 27 feet below the ground surface. This sand is fine to coarse grained with occasional to frequent cobbles and boulders. Standard Penetration tests carried out in the sand gave 'N'-values ranging from 13 blows per foot to more than 65 blows for 6-inches. From these values, the relative density of sand is considered to range from compact to very dense. Typical grain size distribution curves for the sand are shown on Enclosure 15.

Sandy Silt

Below the fill at Borehole 7 and the silty sand at Borehole 8 there is a deposit of sandy silt which extends to depths of between 10.5 and more than 45.5 feet below the ground surface. This sandy silt is well graded and contains occasional to frequent seams of silty fine sand and clayey silt and also occasional fine gravel. The general texture of the silt is similar to non-cohesive silt till. Typical grain size distribution curves for the silt are shown on Enclosure 16. Standard Penetration tests carried out in the deposit gave 'N'-values ranging from 17 to 77 blows per foot and, from these, its relative density is considered to range from compact to very dense.

Silt Till

In Boreholes 6 and 7 there are deposits of silty sand till or silt till present below the fill and these deposits extend to depths of at least 13.5 feet below the ground surface. Standard Penetration tests carried out within the tills gave 'N'-values ranging from 23 to 70 blows per foot and from these, the relative density is considered to range from compact to very dense.

Bedrock

Refusal to further augering was encountered in Boreholes 2, 3, 4, 5 and 6 at depths of between 13.5 and 27 feet (Elevation 445.3 to 463.4 feet). In Borehole 4, the obstruction was cored to a depth of 6.8 feet and the examination of the core indicated grey shale bedrock which is weathered to a depth of about 3 feet and then is reasonably sound.

.../...

4.0 GROUNDWATER CONDITIONS

A free water surface was observed in Boreholes 1, 2, 3, 4, 5 and 8 at depths ranging from 0 to 26 feet (Elevation 468.1 to Elevation 490 feet). In Boreholes 1 to 5, which were located within the river valley, the groundwater elevation was observed to be between 468.1 and 473.3 feet.

At the time of the investigation the water level in the Humber River was at Elevation 473.3 feet. From these observations, together with the pervious nature of the subsoil, we consider that the groundwater table in the valley will be directly controlled by fluctuations in the river level.

5.0 DISCUSSION & RECOMMENDATIONS

The boreholes show that the river valley is generally underlain by variable deposit of fill or alluvium followed by compact to very dense silty sand. The higher ground to the east is covered by minor deposits of fill with the principal soil types being very dense sandy silt or silty sand.

5.1 Bridge Foundations

Boreholes 2, 3, and 4 were drilled at the proposed locations of the east abutment, west abutment and the east pier, respectively. These showed alluvial deposits to a depth of 7 feet underlain by compact to dense silty sand or sandy silt with auger refusal on presumed bedrock being encountered in Boreholes 2 and 3 at Elevations 449 and 445.3 feet respectively. At Borehole 4, the shale bedrock was proved by coring from 455.4± feet.

5.1.1 Spread Footings

All loads from the bridge should be carried through the alluvium to either the silty sand or to the underlying bedrock. Normal spread footings should be located below the anticipated maximum depth of scour at or below the surface of the undisturbed silty sand which is located at depths of between 4 feet and 7 feet below the existing grade (between Elevations 473 and 465 feet).

At Boreholes 2 and 3 normal spread footing foundations can be designed using a maximum allowable bearing pressure of 8 k.s.f..

At Borehole 4, however, (the east abutment), the presence of a layer of less competent clayey sand results in a reduction of the allowable bearing pressure to 3 k.s.f. for foundations located less than 12 feet below the existing ground surface. A higher bearing pressure of 6 k.s.f. could be obtained by locating the footings for this abutment at a depth of at least 14 feet below the ground surface (Elevation 466 feet). Total and differential settlements for foundations loaded to the above bearing pressures will be less than 1-inch and 3/4-inches respectively and likely to be acceptable for this type of structure.

5.1.2 Pile Foundations

Since the surface of the bedrock is located at depths of between 25 and 27 feet below the existing ground surface, driven piles could be considered as an economical alternative foundation type. Since occasional to frequent cobbles or boulders were encountered in the boreholes, we would recommend the use of steel 'H' piles rather than steel tube piles since they are likely to encounter less difficulties in driving. If steel 'H' piles are used, these could be designed using an allowable stress of 10,000 p.s.i. over the steel cross-section. The piles will be driven to virtual refusal and their load carrying

capacity should be checked in the field using the Hiley or any other approved dynamic pile driving formula. All lateral loads in a piled foundation should be carried by inclined piles. The tip of the piles should be reinforced with a steel driving shoe.

5.1.3 Excavation & Dewatering

As previously indicated, the groundwater table in the valley is directly controlled by the river level and at the time of the investigation the groundwater table at the bridge site was located between Elevation 471.7 and 473.3 feet. Reference to the Borehole Logs and the subsurface profile indicates that some excavation will be necessary below the water table and that dewatering will be required.

The most convenient method of dewatering the excavations is likely to be by pumping from within closed interlocking sheet piling. The sheeting should be driven to a depth below the proposed foundation grade at least equal to the height of the water level above the grade.

The use of well points is likely to be less successful in view of the close proximity of the river and the relatively high permeability of the subsoil.

.../...

5.2 Retaining Walls

We understand that a low retaining wall approximately 4 feet high will be required between Station 17 + 80 and 18 + 65 on Willis Road and also between Chainage 2 + 00 and 3 + 00 on the River Side Drive Connection. Boreholes 7 and 6 are located at these sites respectively. The retaining wall foundations should be located below any existing fill and should bear on undisturbed soil (probably dense sand). In Borehole 6 the recommended foundation level is 480 feet and in Borehole 7 Elevation 509 feet. At these levels the footings can be designed for a maximum allowable bearing pressure of 6 k.s.f.

They should also be designed to resist a lateral earth pressure whose magnitude at depth D is given by:

$$p = K.\gamma.D$$

where K = 0.3 (for horizontal surface behind the wall)
or = 0.70 (for a slope of less than 35 degrees to the horizontal)

γ = 125 p.c.f.

D = depth in feet below top of wall

The walls should be designed to resist sliding and a coefficient of friction = 0.45 can be taken between the wall base and the sand subgrade. A factor of safety of at least 1.5 against sliding should be achieved in the stability calculations.

.../...

5.3 SLOPE STABILITY

5.3.1 Existing Slopes

Between Chainage 19 + 00 and 21 + 00 the road is to be located at the top of the existing slope which is approximately 25 feet high. A cross-section of this slope by Marshall Macklin Monaghan Limited indicates that the slope angle is 34 degrees to the horizontal.

Reference to Borehole 8 (located at the top of the slope) shows that the subsoil consists of dense or very dense silty sand and sandy silt which have 'N'-values ranging between 40 and 64 blows per foot. From these 'N'-values, the angle of internal friction is estimated to be in excess of 40 degrees.

Based on this data, we estimate that the factor of safety of the slope against general shear failure under fully drained conditions is approximately 1.24. This factor of safety is generally acceptable. We would, however, recommend that the edge of the road (curb line) be located at least 5 feet from the top of the slope.

The main problem with steep slopes is generally a result of surface or toe erosion. An examination of the face of the slope indicates that some surface erosion has occurred and several trees appear to have moved from the vertical. In order to control erosion caused by run-off, we would recommend that adequate drainage be provided at the top of the slope by means of road

drains which should be located at a depth of at least 6 feet below the finished grade. In addition, the existing vegetation on the slope should be left undisturbed.

5.3.2 New Slopes

We understand that the proposed side slopes for the approach embankments (up to 20 feet high) will be at least 2 horizontal to 1 vertical. This side slope should be adequate provided that the embankment fill is placed in layers 6-inches to 8-inches thick and compacted to at least 98% of the Standard Proctor maximum dry density.

We understand that the end slopes at the abutments will be 1.5 to 1 and 2 to 1. As previously indicated, the 2 to 1 slope should be adequate if well compacted fill is used. The 1.5 to 1 slope, however, will result in a factor of safety of only about 1.15 if granular fill is used. We would, therefore, recommend that where granular fill is used, the end slopes should be not steeper than 1.75 to 1, which would give a factor of safety of about 1.35.

too small use 2:1

On completion of the embankments, the side slopes should be protected by sodding as soon as possible if surface erosion is to be avoided. The end slopes of the embankments at the abutments should be protected below the high water level by means of rip-rap and should be sodded above the high water level.

5.3.3 Embankment Construction

All topsoil and organic materials should be removed and the subgrade properly inspected by a representative from this company before any fill is placed. In general, the clean alluvial and fill deposits can be left in place provided that they are recompacted from the surface.

The loose fill which has been dumped in the vicinity of Borehole 5 should be completely removed, together with any topsoil or organic material.

The samples of this fill which we obtained from the borehole appeared to be resonably clean. If this is generally the case, it may be possible to re-use this fill for embankment construction provided that it is not allowed to become wet and that it is replaced in 6 to 8-inch layers, compacted to at least 98% of its Standard Proctor maximum dry density. This is particularly important in this area, since the final embankment height is to be at least 20 feet and could be subject to excessive differential settlement if it is not founded on natural ground or clean acceptable alluvial deposits.

DOMINION SOIL INVESTIGATION LIMITED

V. Wood

V. Wood, M. Eng., P. Eng.

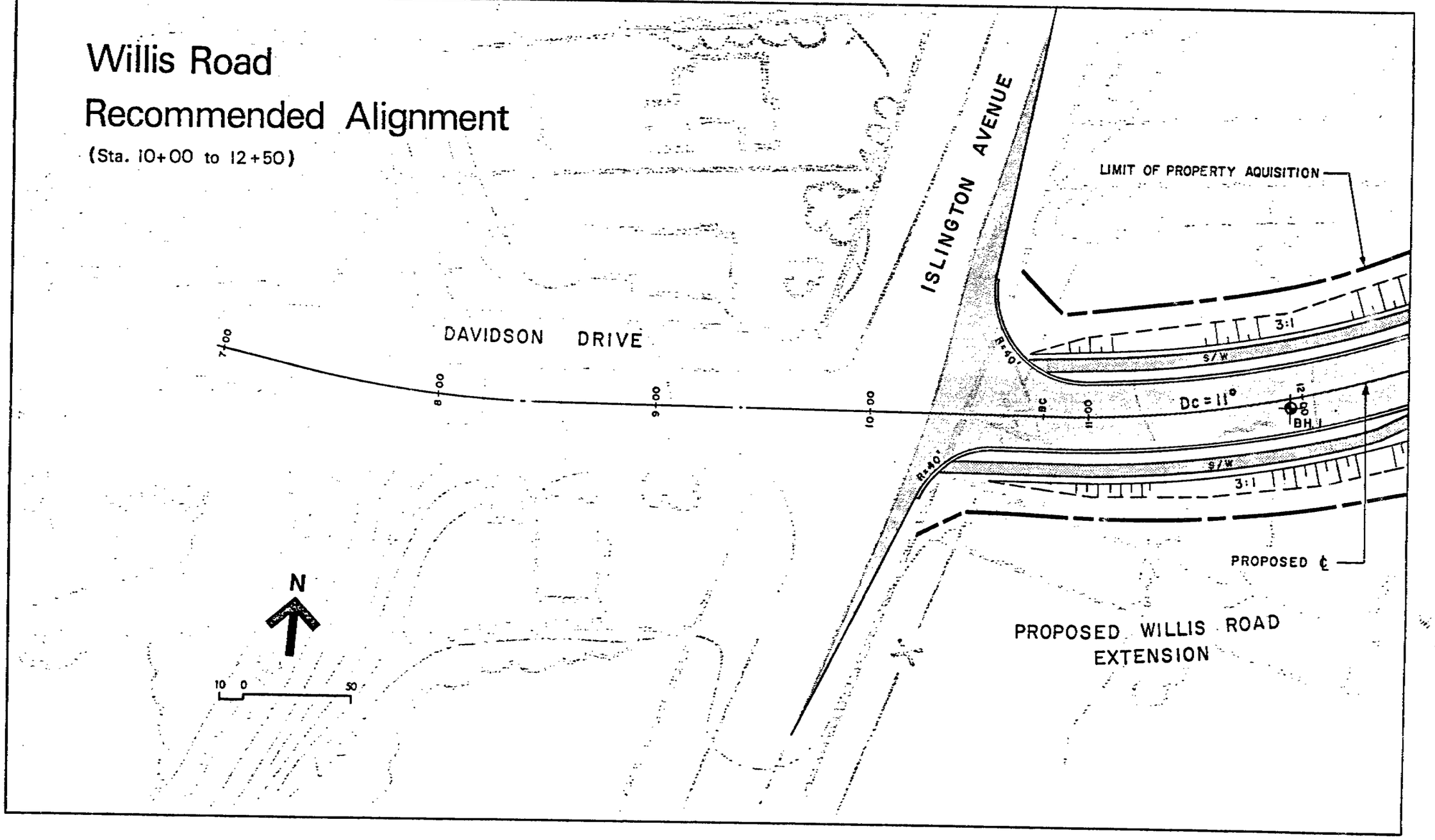
/js

REGISTERED PROFESSIONAL ENGINEER
V. WOOD
PROVINCE OF ONTARIO

DOMINION SOIL INVESTIGATION LIMITED

E N C L O S U R E S

Willis Road
Recommended Alignment
(Sta. 10+00 to 12+50)



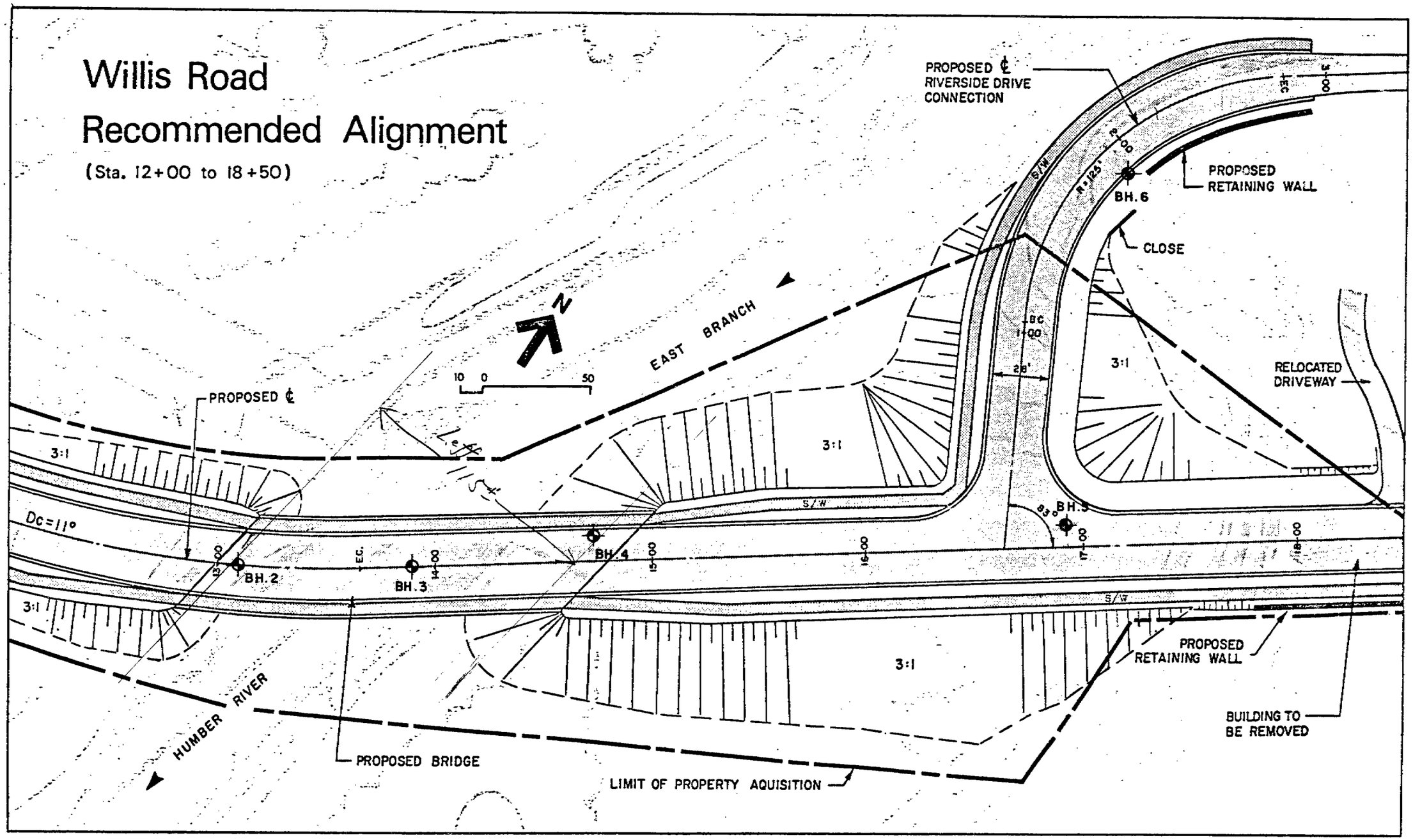
BOREHOLE LOCATION PLAN

OUR REF. No. 76 - 7 - 5

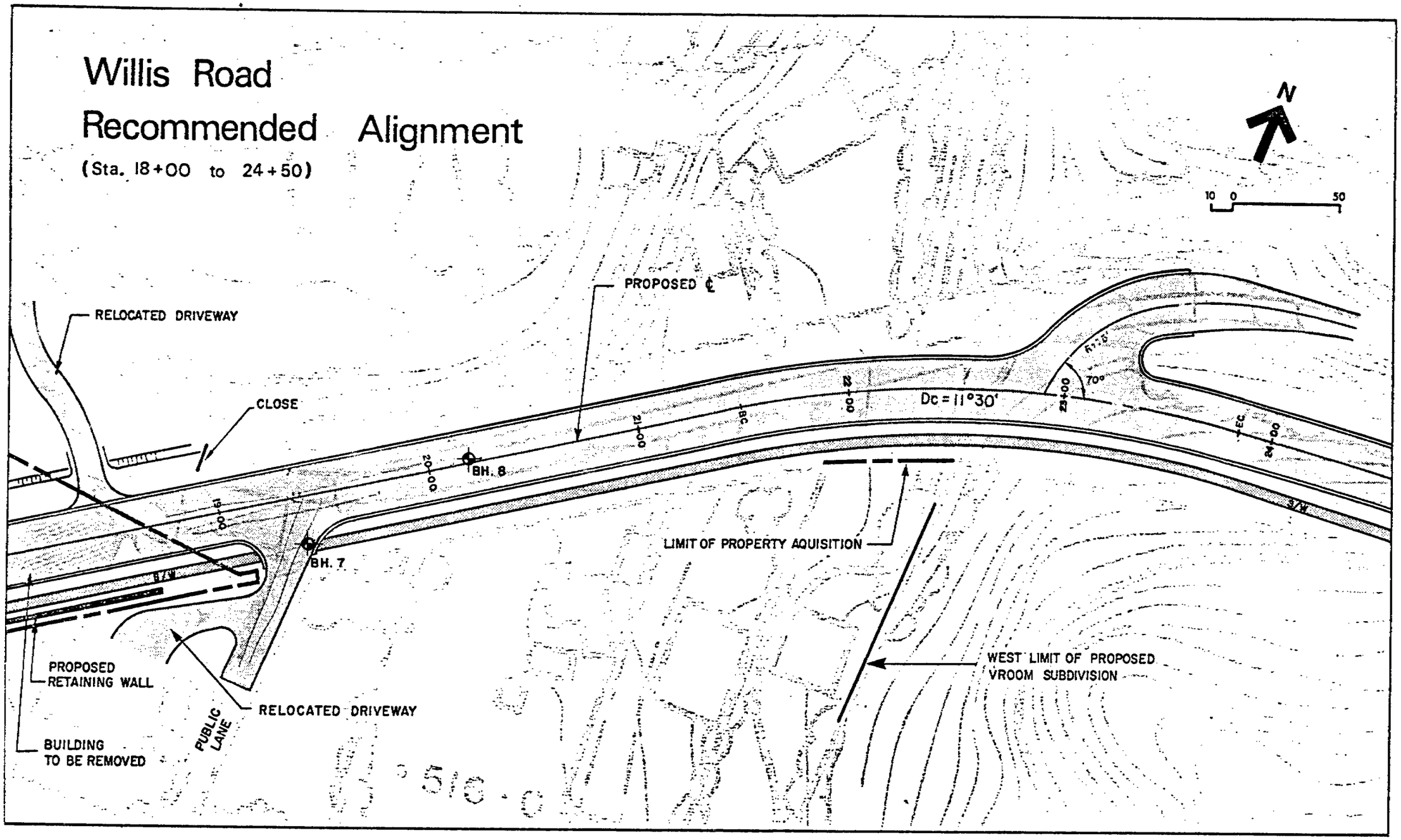
DOMINION SOIL INVESTIGATION LIMITED

ENCLOSURE No. 1

Willis Road
Recommended Alignment
(Sta. 12+00 to 18+50)



BOREHOLE LOCATION PLAN



BOREHOLE LOCATION PLAN

OUR REF. No. 76 - 7 - 5

DOMINION SOIL INVESTIGATION LIMITED

ENCLOSURE No. 3

OVERSIZE DRAWING(S)

LOG OF BOREHOLE 1

Enclosure No. 5

Our Reference No. 76-7-5

CLIENT: MARSHALL MACKLIN AND MONAGHAN
PROJECT: WILLIS ROAD BRIDGE.
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC.

DRILLING DATA
Method: AUGERING(H/S)
Diameter: 6 1/2"
Date: JULY 22, 1976

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	PENETRATION RESISTANCE Blows/Foot (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH p.s.f. (+ FIELD VANE TEST, ● COMPRESSION TEST)	WATER CONTENT % (PLASTIC LIMIT W_P, NATURAL W, LIQUID LIMIT W_L; 5 10 15 20 25)	REMARKS
476.6	0	GROUND SURFACE								
		Sandy Silt FILL Occasional gravel with traces of topsoil & wood fragments			1	SS	35	○	○	
	5				2	SS	35/3"	→		
470.6	6.0	Compact to dense SILTY SAND fine to medium grained Occasional gravel wet below 8 ft.		▼ W.L. El.468.1' Jly.22	3	SS	33	○		
	10				4	SS	21	○		
465.1	11.5	END OF BOREHOLE								

VERTICAL SCALE: 1 inch to 5 feet

DRAWN: F.L. CHECKED:

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE 2

Our Reference No. 76-7-5

Enclosure No. 6

CLIENT: MARSHALL MACKLIN AND MONAGHAN.
PROJECT: WILLIS ROAD BRIDGE.
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC

DRILLING DATA
Method: AUGERING (H/S)
Diameter: 6 1/2"
Date: JULY 23, 1976

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	PENETRATION RESISTANCE Blows/Ft. (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH p.s.f. (+ FIELD VANE TEST, ● COMPRESSION TEST)	WATER CONTENT % (PLASTIC LIMIT W_P — NATURAL W — LIQUID LIMIT W_L)	REMARKS
474·0	0	GROUND SURFACE								
		ALLUVIUM Silty sand with some gravel		W.L. El. 471.7' Jly.23/76	1	SS	11	o		
470·0	4·0	Compact to dense SILTY SAND fine to coarse grained frequent cobbles & boulders from 7 ft. to 18 ft.			2	SS	43	o		
	10				3	SS	50/4"	→		
		wet			4	SS	50/5"	→		
	15									
	20				5	SS	48	o		
449·0	25	END OF BOREHOLE			6	SS	65/6"	→		Refusal to further augering @ 25 ft.
	30									
	35									
	40									
	45									

VERTICAL SCALE: 1 inch to 5 ft.

DOMINION SOIL INVESTIGATION LIMITED

DRAWN: F. L. CHECKED:

LOG OF BOREHOLE 3

Our Reference No. 76-7-5

Enclosure No. 7

CLIENT: MARSHALL MACKLIN AND MONAGHAN.
PROJECT: WILLIS ROAD BRIDGE.
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC

DRILLING DATA
Method: AUGERING (H/S)
Diameter: 6 1/2"
Date: JULY 30, 1976.

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	REMARKS
472.3	0	GROUND SURFACE						
		12" Muck Very dense, grey SAND TILL			1	SS	50	
467.8	4.5	Very dense grey SILT, occas. gravel			2	SS	46	
465.3	7.0	Very dense SILTY SAND fine to medium grained occasional gravel & seams of sandy silt		W.L. Elev. 472.3 ft. July 30/76	3 4 5	SS SS SS	43 42 48	
		wet			6	SS	68	
					7	SS	30/1"	
					8	SS	30/2"	
445.3	27.0	END OF BOREHOLE						Refusal to further augering @ 27 ft.

PENETRATION RESISTANCE Blows/Ft. 20 40 60 80 100
UNDRAINED SHEAR STRENGTH p.s.f. + FIELD VANE TEST ● COMPRESSION TEST

WATER CONTENT %
PLASTIC LIMIT W_p — NATURAL W — LIQUID LIMIT W_L

VERTICAL SCALE: 1 inch to 5 ft.

DOMINION SOIL INVESTIGATION LIMITED

DRAWN: F. L. CHECKED:

LOG OF BOREHOLE 4

Our Reference No. 76-7-5

Enclosure No. 8

CLIENT: MARSHALL MACKLIN AND MONAGHAN.
PROJECT: WILLIS ROAD BRIDGE.
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC

DRILLING DATA
Method: AUGERING (H/S)
Diameter: 6 1/2"
Date: JULY 29, 1976.

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	PENETRATION RESISTANCE Blows/Ft. (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH p.s.f. (+ FIELD VANE TEST, ● COMPRESSION TEST)	WATER CONTENT % (PLASTIC LIMIT W_p — NATURAL W — LIQUID LIMIT W_L)	REMARKS
480·4	0	GROUND SURFACE								
		Silt, sand & gravel FILL or ALLUVIUM trace of organics & wood fragments			1	SS	18	o		
	5				2	SS	32	o		
473·4	7·0	Compact SILTY SAND		W.L. El. 472.9' Jly.30/76	3	SS	27	o		
471·4	9·0	Stiff CLAYEY SAND occasional gravel wet			4	SS	13	o		
	10				5	SS	26	o		
466·4	14·0	Compact SILTY SAND fine to coarse grained Occasional gravel wet			6	SS	28	o		
	15									
	20				7	SS	42	o		
455·4	25	Grey SHALE Reasonably sound below 28 ft.			8	SS	50/3"			
	30				9	RC	74%			
448·6	31·8	END OF BOREHOLE								
	35									
	40									
	45									

VERTICAL SCALE: 1 inch to 5 ft.

DOMINION SOIL INVESTIGATION LIMITED

DRAWN: F. L. CHECKED:

LOG OF BOREHOLE 5

Our Reference No. 76-7-5

Enclosure No. 9

CLIENT: MARSHALL MACKLIN AND MONAGHAN.
PROJECT: WILLIS ROAD BRIDGE.
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC

DRILLING DATA
Method: AUGERING (H/S)
Diameter: 6 1/2"
Date: JULY 30, 1976

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	PENETRATION RESISTANCE Blows/Ft. 20 40 60 80 100 / UNDRAINED SHEAR STRENGTH p.s.f. + FIELD VANE TEST ● COMPRESSION TEST	WATER CONTENT % PLASTIC LIMIT W_P NATURAL W LIQUID LIMIT W_L 5 10 15 20 25	REMARKS
489.4	0	GROUND SURFACE								
		Loose clay, silt sand & gravel FILL			1	SS	12	o	o	
	5	Traces of topsoil and organics			2	SS	6	o		
		damp to moist			3	SS	5	o	o	
	10				4	SS	32	o		
477.4	12.0	loose organic stained SILT with some sand and gravel		W.L. El. 473.4' Jly. 30/76	5	SS	3	o		
	15			▼	6	SS	6	o	o	
		wet below 15 ft.								
	20									
468.4	21.0	Dense SILTY SAND occasional gravel and clayey seams			7	SS	20	o		
	25				8	SS	33/6"			Refusal to further augering @ 26 ft.
463.4	26.0	END OF BOREHOLE								
	30									
	35									
	40									
	45									

VERTICAL SCALE: 1 inch to 5 ft.

DOMINION SOIL INVESTIGATION LIMITED

DRAWN: F. L. CHECKED:

LOG OF BOREHOLE 6

Enclosure No. 10

Our Reference No. 76-7-5

CLIENT: MARSHALL MACKLIN AND MONAGHAN
PROJECT: WILLIS ROAD BRIDGE
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC.

DRILLING DATA
Method: AUGERING(H/S)
Diameter: 6 1/2"
Date:

SUBSURFACE PROFILE					SAMPLES			PENETRATION RESISTANCE Blows/Foot (20 40 60 80 100) UNDRAINED SHEAR STRENGTH p.s.f. (+ FIELD VANE TEST, ● COMPRESSION TEST)	WATER CONTENT % (PLASTIC LIMIT W_P, NATURAL W, LIQUID LIMIT W_L; 5 10 15 20 25)	REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows/Ft.			
488.7	0	GROUND SURFACE								
		Compact sandy silt FILL occasional gravel & wood fragments		HOLE DRY	1	SS	47/6"			
	5	frequent boulders			2	SS	28			
481.7	7.0	Compact grey SILTY SAND TILL			3	SS	23			
	10									
477.7	11.0	Very dense grey SILT TILL			4	SS	70			
					5	SS	30/2"			
475.2	13.5	END OF BOREHOLE								Refusal to further augering @ 13.5 ft.

VERTICAL SCALE: 1 inch to 5 feet

DRAWN: F. L. CHECKED:

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE 7

Our Reference No. 76-7-5

Enclosure No. 11

CLIENT: MARSHALL MACKLIN AND MONAGHAN
PROJECT: WILLIS ROAD BRIDGE.
LOCATION: TOWN OF VAUGHAN, ONT.
DATUM ELEVATION: GEODETIC.

DRILLING DATA
Method: AUGERING(H/S)
Diameter: 6 1/2"
Date:

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	PENETRATION RESISTANCE Blows/Foot (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH p.s.f. (+ FIELD VANE TEST, ● COMPRESSION TEST)	WATER CONTENT % (PLASTIC LIMIT W_P, NATURAL W, LIQUID LIMIT W_L)	REMARKS
		GROUND SURFACE								
514.5	0	12" Granular FILL Loose to Compact brown & grey sandy SILT FILL			1	SS	8	o		
510.0	4.5	Dense to very dense brown SANDY SILT Occasional gravel		HOLE DRY	2	SS	32	o		
	5				3	SS	46	o		
504.0	10									
	10.5	Very dense SILT TILL			4	SS	70	o		
503.0	11.5	END OF BOREHOLE								

VERTICAL SCALE: 1 inch to 5 feet

DRAWN: F. L.

CHECKED:

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE 8

Our Reference No. 76-7-5

Enclosure No. 12

CLIENT: MARSHALL MACKLIN AND MONAGHAN
PROJECT: WILLIS ROAD BRIDGE
LOCATION: TOWN OF VAUGHAN, ONT
DATUM ELEVATION: GEODETIC

DRILLING DATA
Method: AUGERING (H/S)
Diameter: 6 1/2"
Date: JULY 30, 1976

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Ft.	PENETRATION RESISTANCE Blows/Ft. 20 40 60 80 100 / UNDRAINED SHEAR STRENGTH p.s.f. + FIELD VANE TEST ● COMPRESSION TEST	WATER CONTENT % PLASTIC LIMIT W_p NATURAL W LIQUID LIMIT W_L	REMARKS
514.9	0	GROUND SURFACE								
		Compact SILTY SAND (probably FILL) damp			1	SS	38			
509.4	5.5	Very dense brown SILTY SAND fine to coarse grained occasional fine gravel damp			2	SS	39			
					3	SS	34/6"			
	10				4	SS	53/6"			
502.9	12.0	Compact to dense brown or grey SANDY SILT with occasional to frequent seams of silt fine sand & clayey silt occasional fine gravel			5	SS	64			
	15				6	SS	58			
	20				7	SS	77			
	25	brown grey			8	SS	40			
	30	moist or wet below 25 ft.			9	SS	17			
	35				10	SS	44			
	40				11	SS	49			
	45				12	SS	60/6"			Piezometer installed @ El. 469.4 ft.
469.4	45.5	END OF BOREHOLE								

VERTICAL SCALE: 1 inch to 5 ft.

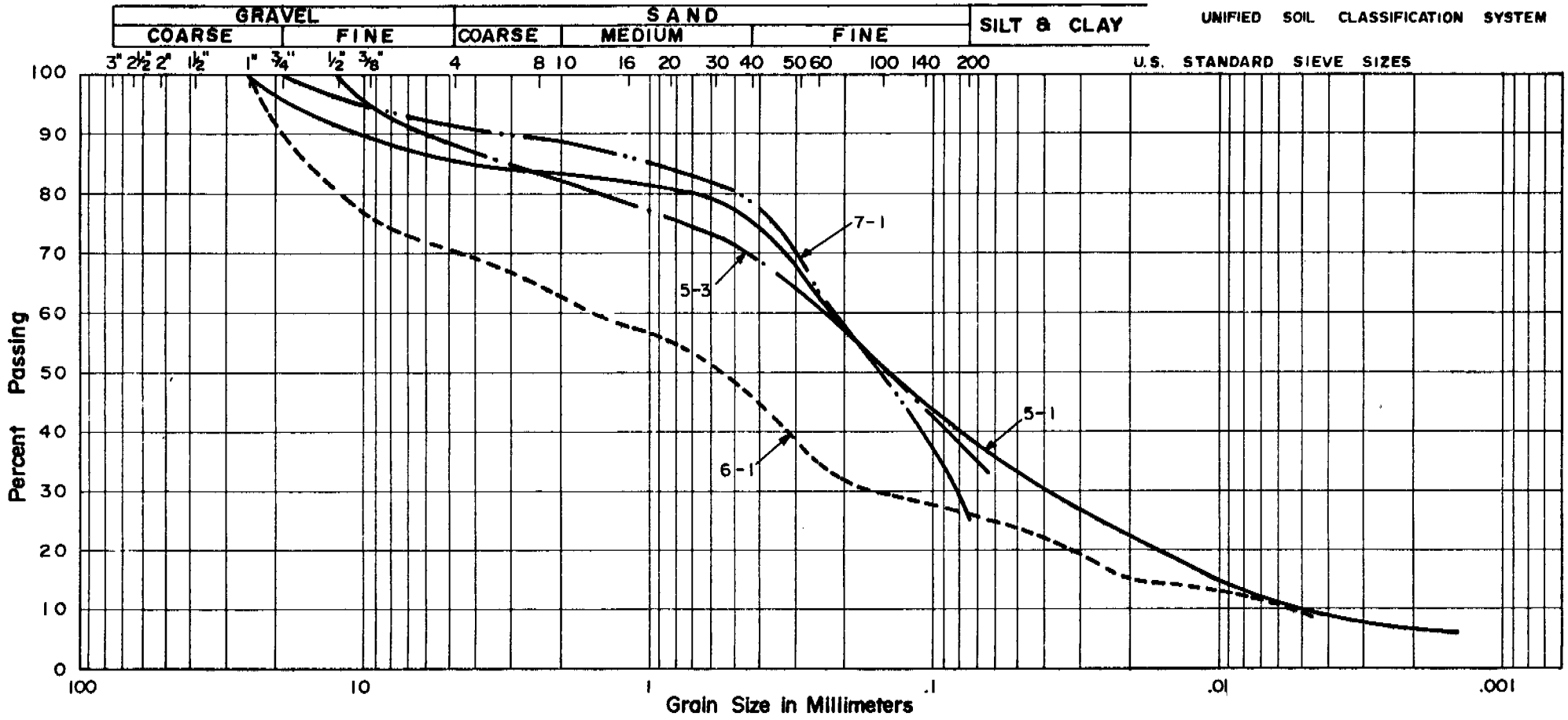
DOMINION SOIL INVESTIGATION LIMITED

DRAWN: F. L. CHECKED:

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-7-5



PROJECT: WILLIS ROAD BRIDGE

LOCATION: TOWN OF VAUGHAN, ONT.

BOREHOLE Nº:	5	5	6	7
SAMPLE Nº:	1	3	1	1
DEPTH:				
ELEVATION:				

COEFFICIENT OF UNIFORMITY :

COEFFICIENT OF CURVATURE :

Classification of Sample and Group Symbol:

F I L L

PLASTIC PROPERTIES

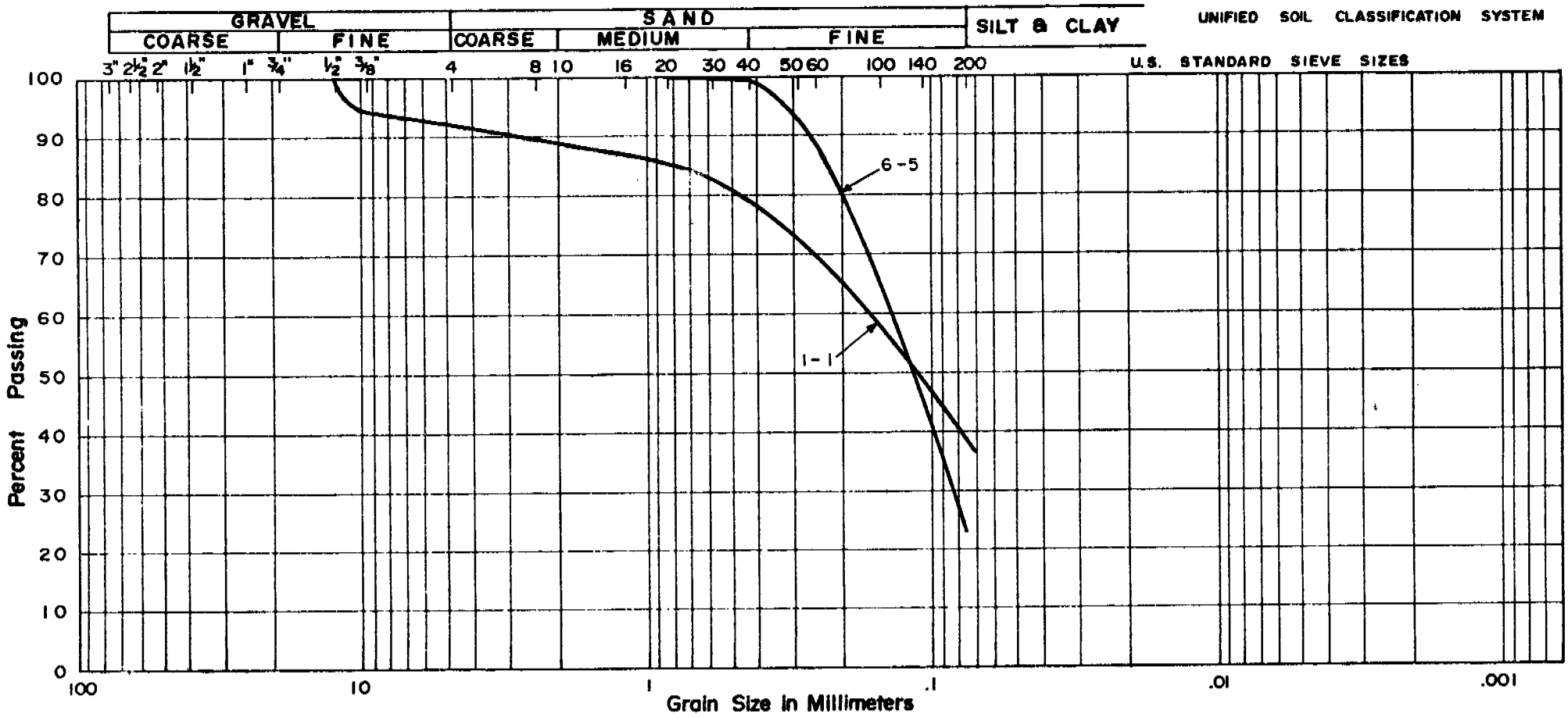
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =

ENCLOSURE Nº 13

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-7-5



PROJECT: WILLIS ROAD BRIDGE

LOCATION: TOWN OF VAUGHAN, ONT.

BOREHOLE Nº: 1 5

SAMPLE Nº: 1 6

DEPTH:

ELEVATION:

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SILTY FINE SAND

(Alluvium)

PLASTIC PROPERTIES

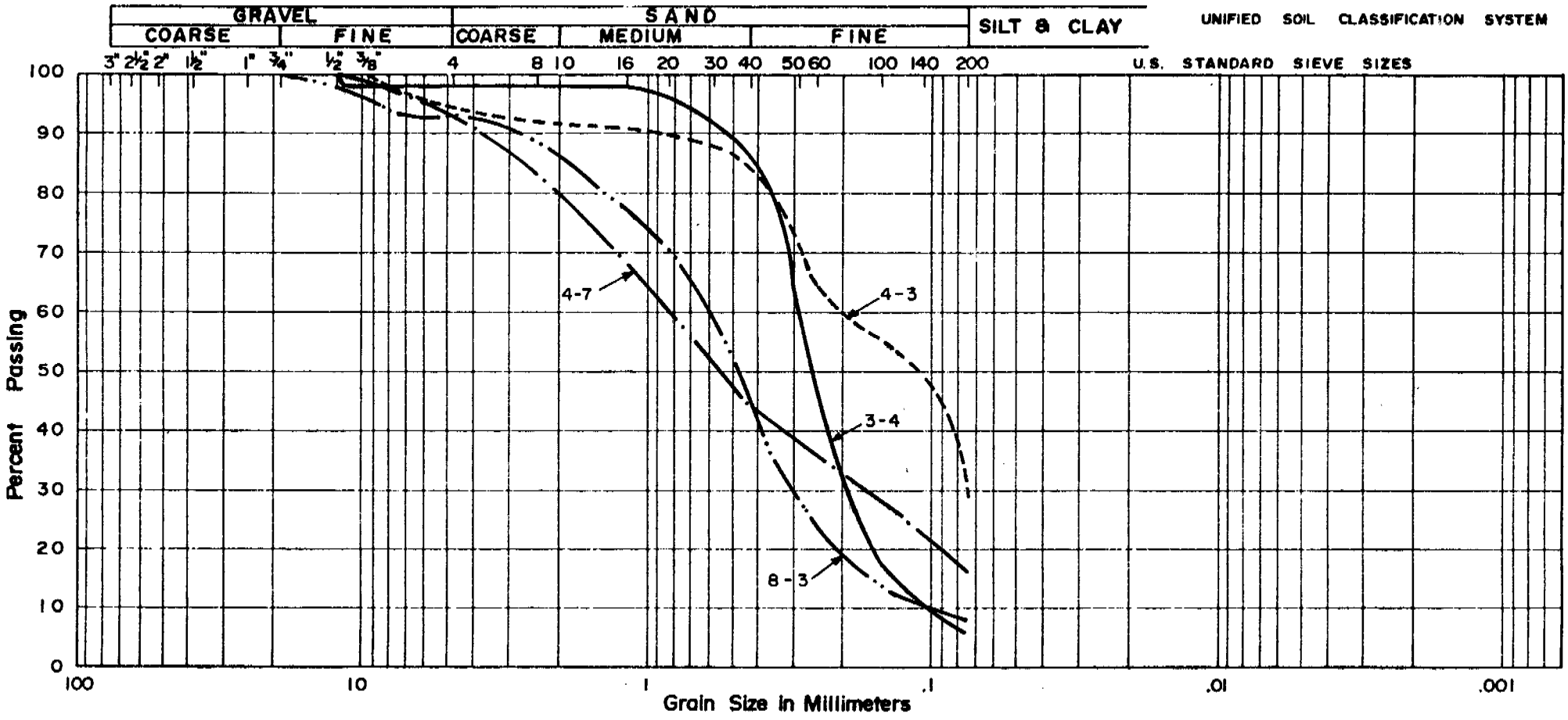
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =

ENCLOSURE Nº 14

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-7-5



PROJECT: WILLIS ROAD BRIDGE

LOCATION: TOWN OF VAUGHAN, ONT.

BOREHOLE Nº:	3	4	4	8
SAMPLE Nº:	4	3	7	3
DEPTH:				
ELEVATION:				

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SAND

Silty Fine to well graded

PLASTIC PROPERTIES

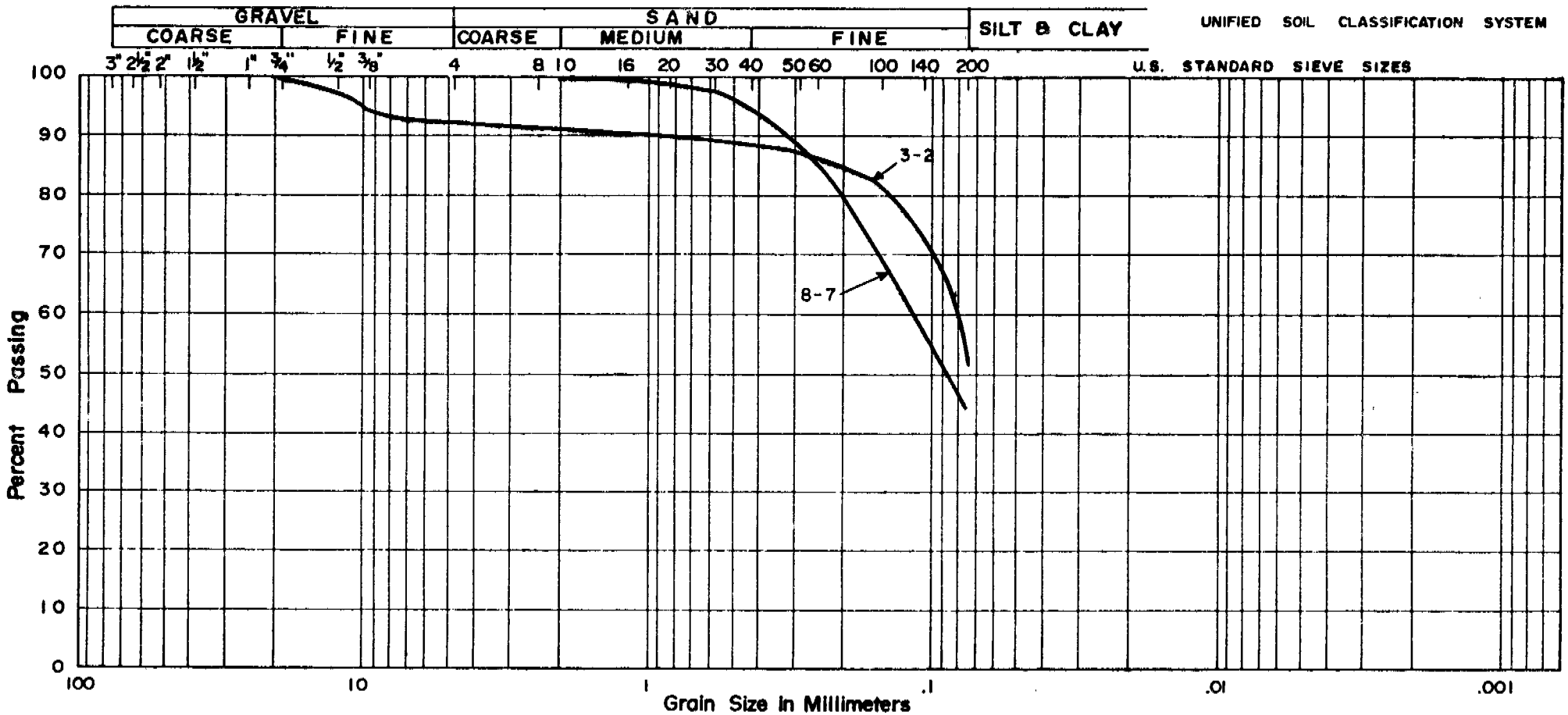
LIQUID LIMIT	%	=
PLASTIC LIMIT	%	=
PLASTICITY INDEX	%	=
MOISTURE CONTENT	%	=

ENCLOSURE Nº 15

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-7-5



PROJECT: WILLIS ROAD BRIDGE

LOCATION: TOWN OF VAUGHAN, ONT.

BOREHOLE Nº:	3	8
SAMPLE Nº:	2	7
DEPTH:		
ELEVATION:		

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

SANDY SILT TO
SILTY FINE SAND

PLASTIC PROPERTIES

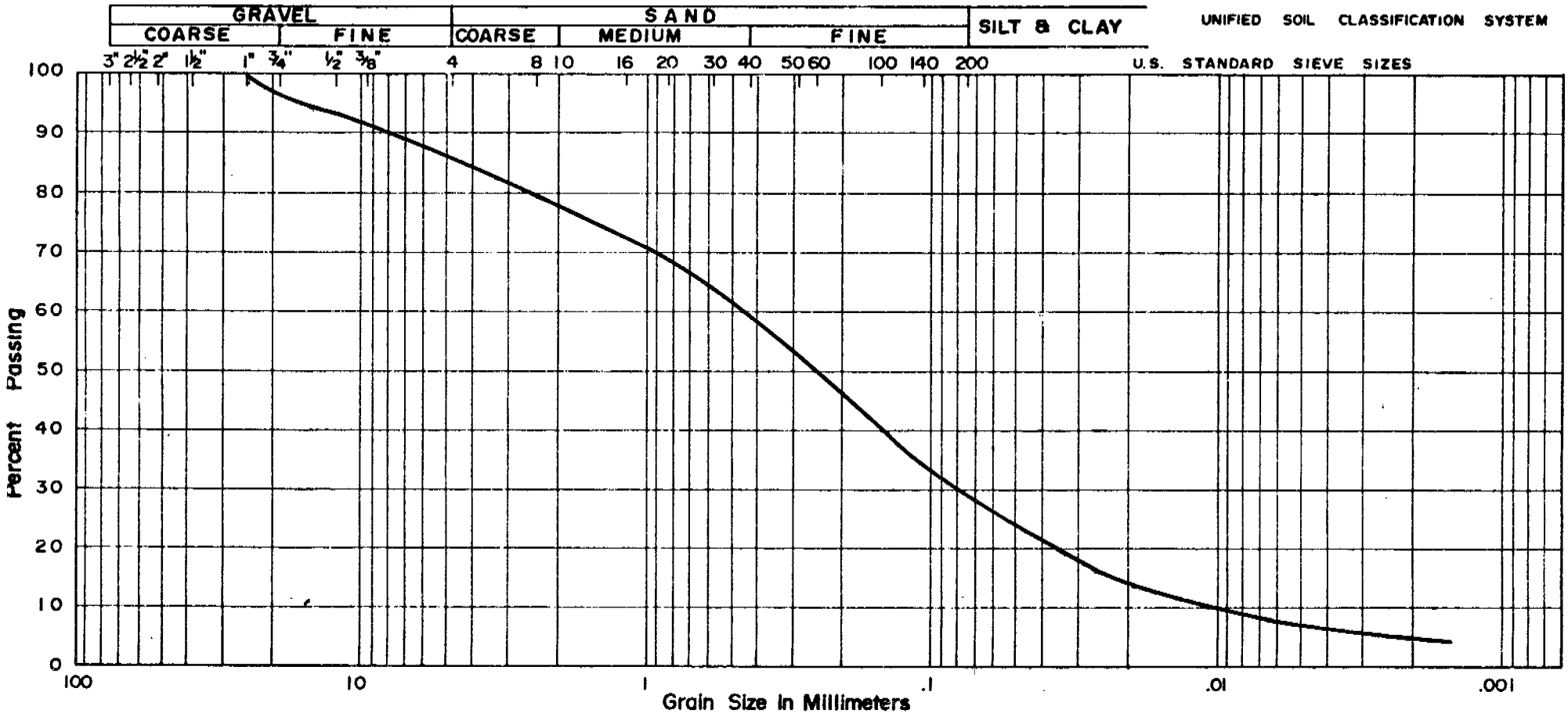
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =

ENCLOSURE Nº 16

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-7-5



PROJECT: WILLIS ROAD BRIDGE

LOCATION: TOWN OF VAUGHAN, ONT.

BOREHOLE Nº: 4

SAMPLE Nº: 4

DEPTH:

ELEVATION:

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

CLAYEY SAND TILL

PLASTIC PROPERTIES

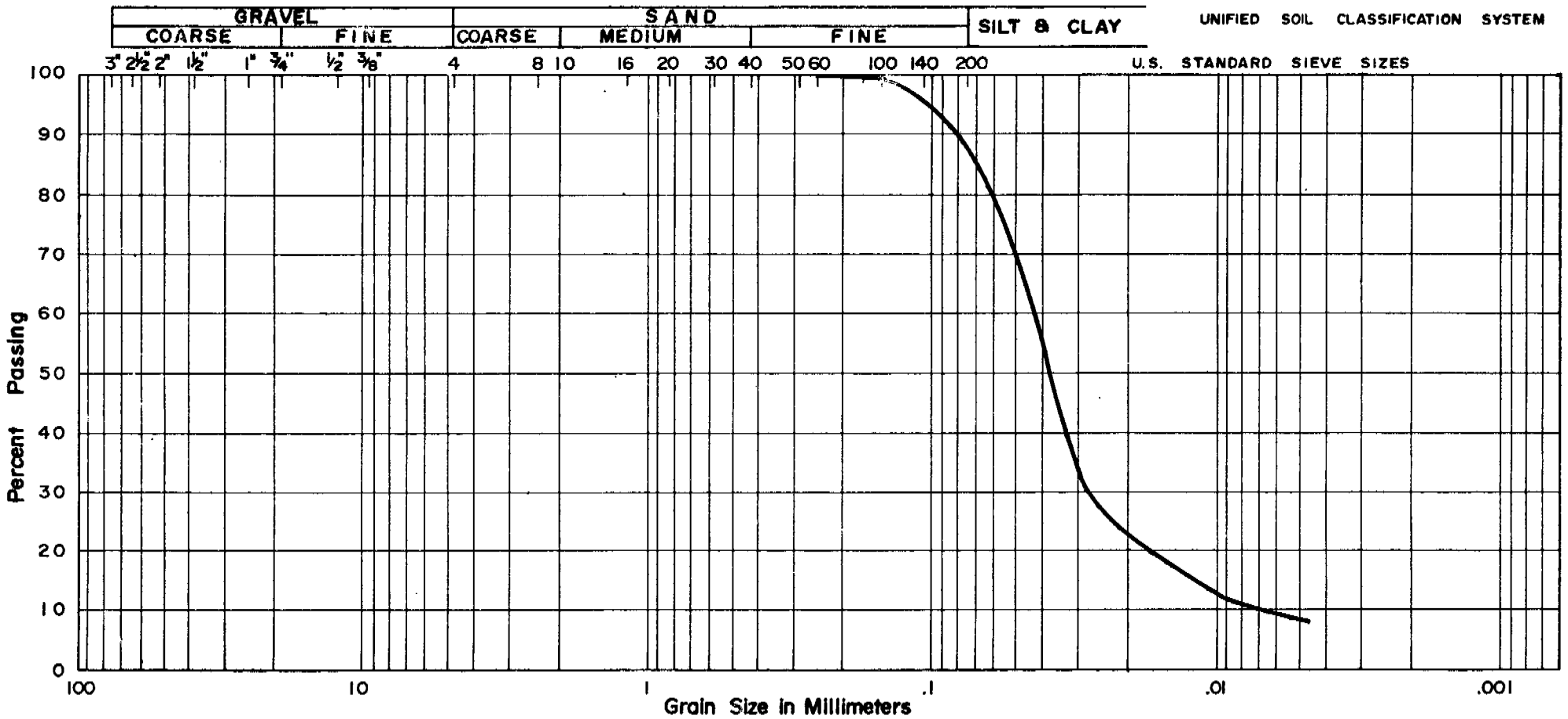
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% =

ENCLOSURE Nº 17

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-7-5



PROJECT: WILLIS ROAD BRIDGE

LOCATION: TOWN OF VAUGHAN, ONT.

BOREHOLE Nº: 8

SAMPLE Nº: 10

DEPTH:

ELEVATION:

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

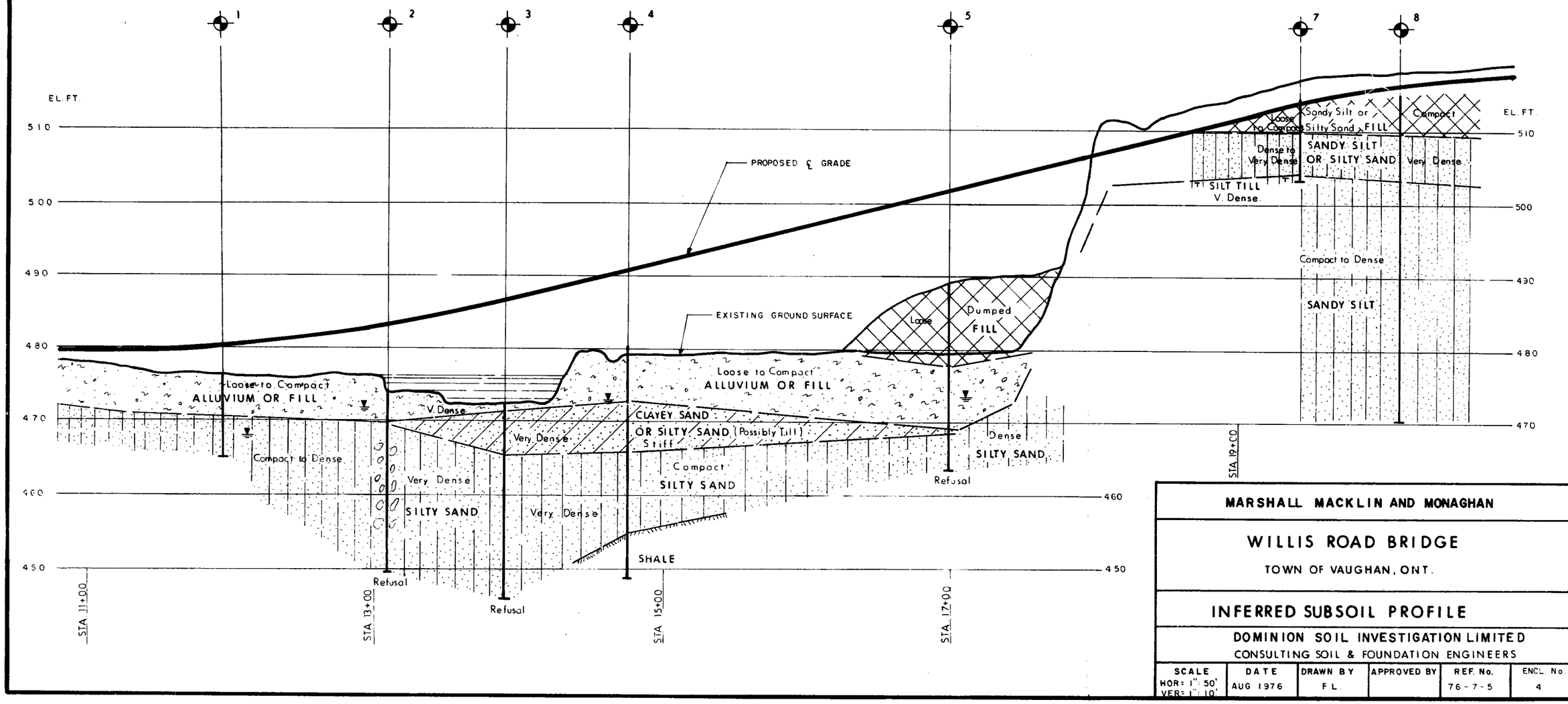
Classification of Sample and Group Symbol:

CLAYEY SILT

PLASTIC PROPERTIES

LIQUID LIMIT	%	=
PLASTIC LIMIT	%	=
PLASTICITY INDEX	%	=
MOISTURE CONTENT	%	=

ENCLOSURE Nº 18



MARSHALL MACKLIN AND MONAGHAN

WILLIS ROAD BRIDGE

TOWN OF VAUGHAN, ONT.

INFERRED SUBSOIL PROFILE

DOMINION SOIL INVESTIGATION LIMITED
CONSULTING SOIL & FOUNDATION ENGINEERS

SCALE	DATE	DRAWN BY	APPROVED BY	REF. No.	ENCL. No.
HOR: 1": 50' VER: 1": 10'	AUG 1976	F.L.		76-7-5	4