



SOIL PROBE LTD.

Consulting Geotechnical, Inspection & Testing Engineers

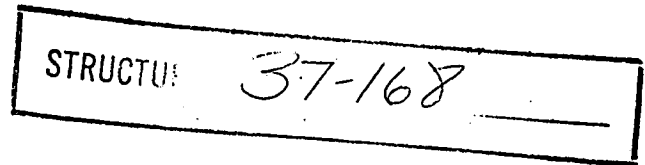
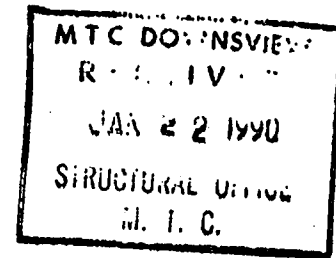
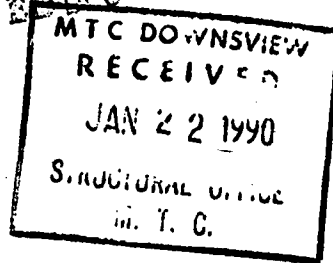
120 Amber Street, Suite 3, Markham, Ontario L3R 3A3
Telephone: (416) 479-7030 Fax: 479-9915

GEOCRES No
30M14-334

December 15, 1989

Mr. Kasey Bartusevicius
2553 Merrington Crescent
Mississauga, Ontario
M5K 2B8

RECEIVED DEC 20 1989



Dear Sir:

RE : PROPOSED BRIDGE OVER ROUGH RIVER AT 14th
AVENUE, TOWN OF MARKHAM

1.0 Pile Design

Our boreholes indicate that competent load bearing strata are found at depth between 10 and 16m below the existing grade. The axial load capacity of 0.3m diameter steel tube piles filled with concrete strata at Ultimate Limit State is found to be 1080kN (122 tons).

2.0 Lateral Earth Pressure

Since, at this point, we do not know the properties of the backfill soil we recommend that the following equivalent fluid pressures be used for preliminary design at Ultimate limit States.

i) Active state	8.0 KPa/m
ii) At-rest state	12.0 KPa/m
iii) Passive state	45.0 KPa/m

We hope the above information satisfy your present needs. Please do not hesitate to contact the undersigned if you have any questions.

Yours very truly,

SOIL PROBE LTD.

John Dogbey, P.Eng.
JD/mlh

c.c. Blossoming Rose Management Inc.

Blossoming Rose Management Inc. &
Laburnham Investments Inc.
c/o East Woodbridge Developments Ltd.
100 Strada Drive
Unit #1
Woodbridge, Ontario
L4L 5V7



RE: SITE INVESTIGATION FOR THE
PROPOSED TRUNK SEWER LINE
ALONG 14th AVE TO 9th LINE CONNECTION
TOWN OF MARKHAM, ONTARIO

RECEIVED JUL 31 1989

REPORT NO. 88-1708

DISTRIBUTION:

- 6) Blossoming Rose Management Inc. &
Laburnham Investments Inc.
- 1) Dipen Mukherjee & Associates Ltd.
- 1) File

SOIL PROBE LTD.

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SOIL PROBE LTD.

CONSULTING GEOTECHNICAL, INSPECTION & TESTING ENGINEERS

101 Amber Street, Suite 2, Markham, Ontario L3R 3B2
Telephone: (416) 479-7030

DATE: July 5, 1988

Our Report No.: 88-1708

Our File No.: SP-1190

1.0 INTRODUCTION

Soil Probe Ltd. was authorized by Mr. Ivano Manias, MCIP of East Woodbridge Developments to carry out a site investigation for the Proposed Trunk Sewer Line along 14th Avenue to 9th Line connection, Town of Markham, Ontario.

This study which involved field and laboratory tests was carried out for the purpose of evaluating the subsoil and ground water conditions and to determine their relevant properties for the construction of the Proposed Trunk Sewer Line and Bridge over the Rouge River.



2.0 FIELD WORK AND TESTING

The field work was carried out between April 8 to April 25, 1988 and consisted of nineteen (19) boreholes. These boreholes were sunk to depths between 8.08m (26.51ft) and 26.21m (85.99ft). The locations of the probe holes are shown on the Plot Plan of Enclosure Nos. 31 and 32. The boreholes were advanced to the sampling depths by means of a 114.3mm diameter, power-driven flight auger machine. Standard Penetration tests were carried out at frequent intervals of depth and representative samples were recovered. The results of Standard Penetration tests in terms of 'N' values are referred to in this study as consistency for the cohesive soils and relative density for the granular materials.

Standpipes were installed in Boreholes #'s 2 and 5 for the purpose of measuring the ground water level. Measurements of the ground water level in the standpipes are shown in Enclosure Nos. 39 and 40. These standpipes were left in place as they will be useful in monitoring any subsequent dewatering operation during construction later on.

The field work was supervised by a Soils Engineer. The borehole locations and elevation of the existing grade at these points were established by us in accordance with the profile drawing submitted by Dipen Mukherjee & Associates Ltd.

Please note that the Boreholes 12,13,14 & 15 were included in our previous report #88-1617 dated May 19, 1988 submitted to you earlier.



3.0 LABORATORY TESTS

Soil samples recovered from the split-spoon sampler were brought back to our laboratory for routine testing which included moisture contents and unconfined compressive strength of the cohesive strata. Grain Size Distribution and Moisture-Density relationship of bulk samples obtained from Borehole Nos. 1, 8 & 13 were also determined. The field and laboratory tests' results are illustrated on the Enclosures 33 through 38 appended to this report.

4.0 SUBSOIL CONDITIONS

Details of the subsoil conditions encountered in the boreholes are shown on the logs, Enclosures 1 through 30 inclusive and the strata are briefly described as follows.

4.1 Fill

At the immediate surface of all the boreholes except No. 10, layers of fill were found. The near-surface fill consisted of brown sand and gravel. This deposit was followed by brown to dark brown sandy silt with trace of organics. The fill extended to the depths of 1.37m (Nos. 1, 6 & 9), 1.14m (Nos. 2 & 5), 0.46m (Nos. 3 & 8), 0.76m (No. 4), 0.61m (No. 7), 1.52m (No. 16) and 1.68m (No. 17).

4.2 Topsoil

In Borehole 10, a 0.91m thick layer of topsoil was found at the existing grade.



4.3 Natural Ground

It has been revealed that the sandy silt till with some gravel and occasional boulders was the predominant deposit underlying the site. The colour of the glacial till was generally brown and changed to grey with depth. Based on the results of Standard Penetration tests, the relative density of the sandy till was compact to dense to very dense.

Within the till mantle, intermittent layers of brown to grey, fine to medium to coarse sand and occasionally, silt were discovered. The relative density of these deposits varied between compact to dense to very dense. A soil profile along 14th Avenue is illustrated on Enclosure#43.

A total of six (6) boreholes were sunk at the four corners of the proposed bridge crossing. The soil profile from these holes are shown on Enclosures 20 through 30 inclusive. It is evident that somewhat unusual ground conditions prevailed at this location, perhaps, due to the presence of the creek bed. That is, the fill was underlain by intermittent layers of compact to loose sand and gravel, followed by sandy till and then again sand. Within these strata, grey clayey silt was also penetrated. The clayey silt layers were encountered between depths of 6.68m and 8.53m (No.9), 4.27m and 8.08m (No.10), 9.14m and 11.58m (No.10A), 5.33m and 8.08m (No. 16), 2.90m and 11.58m (No.11). Based on the 'N' values, the consistency of the clayey silt ranged between soft to firm to stiff. Eventually Holes 9,9A,10A,



16 and 17 were terminated in a very dense layer of wet grey medium to coarse sand.

5.0 GROUND WATER TABLE

The boreholes were sunk by dry augering and ground seepage water was found at the depths of 4.06m (No.1), 5.20m (No.2), 2.82m (No.3), 1.30m (No.4), 1.09m (No.5), 2.01m (No.6), 3.10m (No.7), 4.47m (No.8), 1.52m (Nos 9&9A), 1.42m (Nos.10&10A), 1.27m (No.16) and 2.50m (No.17) below the existing grade. Based on the above information and visual examination of the samples obtained, the seepage water represents large bodies of sand and/or silt trapped between the impervious glacial till. The water level in most of the holes rose above the till/sand contact, indicating artesian conditions. Stabilized head of water was observed from the piezometer installed in Boreholes 2 and 5 only.

Based on previous experience in the area, significant seasonal variations in the ground water table may be anticipated at the site.



6.0 DISCUSSION & RECOMMENDATIONS

It is understood that a trunk sewer line will be installed along 14th Avenue and that a bridge will be built over the Rouge River. Based on the above field and laboratory information collected by us, our comments and recommendations are as follows.

6.1 Trench Excavation

Subject to ground water control measures discussed in the following section, it is considered that excavation may be carried out in open cut using conventional equipment. All the excavations deeper than 1.2m should be sloped to conform with the Ontario Safety Regulations "The Ontario Occupational Health and Safety Act, 1981".

Locally shallow trenches within the sandy till may have steeper slopes, subject to actual site conditions at the time of construction and the approval of Soil Probe personnel. In areas of persistent seepage, it may become necessary to flatten the side slopes.

In areas of deep sewer installations or in any such areas where persistent seepage at depth necessitates flatter side slopes which may lead to excessive trench width, sheeting may be used to support the trench side walls. The sheeting should be designed to resist the lateral earth pressure of 'P' which may be calculated in accordance with the following expression:



$$P = K_o (\gamma h + q)$$

where K_a = Active Earth Pressure Coefficient (0.3)
 γ = The Bulk Unit Weight (19KN/m³)
 q = The Surcharge Load at Ground Surface(kPa)
 h = Height (m)

It is recommended that the construction slopes should be regularly inspected by geotechnical personnel throughout the construction period, particularly following the periods of heavy rainfall, spring thaw or if the trenches are left opened for longer periods. It is advisable to co-ordinate trenching and backfilling operations in such a manner that the slopes are not left opened for periods that are more than absolutely necessary.

6.2 Ground water Control

It seems obvious that ground water occurs within the sand and silt deposits at the site. Immediately after augering, the water level in the open boreholes ranged between 1.27m and 5.2m below the existing grade. This is significantly higher than the invert level of the proposed trunk sewer. Therefore, it may be necessary to introduce ground water control measures to prevent loss of subgrade support and running/instability of trench side walls. To dewater large bodies of water-bearing sands and sandy silts, installation of either vacuum well point system or deep wells may be required prior to excavation. In some areas where wet soil tends not to be thick, conventional method of dewatering from the sump holes in the glacial till may be tried.



It is pointed out that the ground water table at the site is subjected to seasonal fluctuations. Further, the rate of infiltration into an opened trench is highly dependent on the permeability of the soil which varies from location to location. As such, it is recommended that the contractors tendering the job should dig some test pits and make their own assessment as well.

In addition, random water-bearing sand lenses will be encountered within the sandy silt till unit throughout the site. The quantity of water from these lenses will depend upon the seasonal fluctuations together with the lateral extent and thickness of the layer. Most of the seams will be likely to produce only nuisance seepage, however, local persistently wet zones should be expected. Within these zones, it may be necessary to drive close-spaced sheeting to below the invert level in order to control the seepage.

Local minor seepage or surface water which inadvertently enters the trench should be removed by conventional sump pumping methods.

6.3 Bedding

Based on the boring results, the sewer pipe will sit on the dense to very sandy silt till deposit. In an undisturbed state it can support the service pipes and other related structures.



In our opinion, HL-6 stone bedding will perform satisfactorily for the pipes founded on the stable and firm sandy glacial till. Any localized soft and unstable areas within the till deposit that were not detected during this investigation should however be stabilized with 50mm Crusher Run limestone prior to placing stone bedding.

For the trunk sewer sitting on the wet sand/silt under artesian pressure should however, be founded on concrete Class 'A' bedding and/or crushed stone wrapped around with a filter cloth. Further, the pipe joints should be adequately sealed in these instances to prevent any fines migrating into the system, which could result in loss of ground and subsequent failure of the pipe.

6.4 Reuse of On-site Excavated Soil as a Compacted Backfill

It is understood that the trunk sewer alignment follows along the route of 14th Avenue. Therefore, it is imperative that the sewer trench is backfilled in such a manner that a firm and stable subgrade is achieved for supporting a pavement.

Borings have indicated that the on-site excavated inorganic existing fill, sandy glacial till, sand and silty sand soils are generally suitable materials for reuse as compacted backfill.



It is evident that the insitu moisture contents of the predominant soil (glacial till) are close to Optimum Moisture Contents of between 9.8% to 17.3% (Enclosures 33, 34 and 35). Based on the previous experience and these test results, a high degree of compaction of backfill earth will not be too difficult to achieve. The compaction should be carried out in thin uniform layers (not exceeding 200mm per lift) and compacted with heavy sheepsfoot rollers. The granular soils, e.g. sand and gravel portions of the on-site excavated soils should however be compacted with smooth surface vibratory rollers.

A minimum of 95% Standard Proctor Maximum Dry Density is recommended for all the backfill earth placed in the proposed trunk sewer trench.

Any wetter silty materials may be used for backfill in the lower trench area subject to inspection during construction. Topsoil or excessively wet materials should be discarded.

To minimize potential sloughing problems, backfilling operations should follow closely after excavation so that only a minimal length of trench slope is exposed. Should construction extend to the winter season, particular attention should be given to ensure that frozen material is not dumped in the trench.

Around close quarters, e.g. manholes, catchbasins, etc., imported Granular 'B' material should be utilized and compacted with light equipment.



6.5 Pavement Design

Evidently, the final subgrade is anticipated to consist of sandy silt till and perhaps, in places medium to coarse sand.

The pavement design has been determined based upon the frost susceptibility and strength characteristic of these materials.

It is understood that 14th Avenue will function as a residential collector roadway. The following pavements are recommended and are considered satisfactory for the conditions at the site.

Asphaltic Concrete	HL-3	40mm
	HL-8	75mm
20mm Crusher Run Limestone Base		150mm
50mm Crusher Run Limestone Subbase		350mm

The above materials should meet the M.T.C. specification requirements. The granular bases should be compacted to at least 100% of their Standard Proctor Maximum Dry Densities. Asphaltic concrete should be compacted to minimum of their 96% Marshall Density.

The pavement design considers that construction will be carried out during the drier months of the year and that the subgrade will remain stable, not heaving under construction traffic. If the subgrade is wet or unstable,



additional granular subbase may become necessary.

Prior to placing stone bases, the final subgrade should be proof-rolled and inspected. Any soft spots detected should then be rectified as deemed necessary. The final subgrade should be compacted and prepared in accordance with the standards of the Town of Markham.

The ability of the native till soils to provide adequate subgrade support is reduced if allowed to become wet. In addition, the material is moderately frost susceptible. Consequently, it is essential to provide good and efficient subgrade and granular base drainage. In this regard, sub-drains should be installed on both sides of the road and connected to nearby catchbasins. Further, the manholes and catchbasins should be backfilled with imported Granular 'B' to facilitate the drainage and alleviate potential differential settlement problems.

6.6 Bridge Foundation Design

The boreholes sunk in the vicinity of the proposed bridge abutments indicate that the superficial alluvial deposits to the approximate depths of 11m (B.H.#'s 9 & 9A), 15m (B.H.#'s 10 & 10A), 8.5m (B.H.#16) and 12m (B.H.#17) do not possess the required strength characteristics to support the proposed structure.

In light of this, as well as the high ground water level, we recommend that the bridge abutments should be supported on piles. The pile foundations will also eliminate the



possibility of loss of bearing capacity that a shallow foundation may suffer due to the scouring action of the river and/or other erosion problems.

A 300mm (12") diameter steel tube pile filled with concrete, driven into the very dense strata below the fluvial deposits may be designed to carry a load of 598KN (60 tons) per pile.

The installation of the piles should be supervised by an experienced geotechnical engineer to ensure that the piles are driven to suitable bearing stratum.

SOIL PROBE LTD.

Anwar Memon, P.Eng.

AM/za

Enclosures





SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 1

ENCLOSURE No. 1
DATE April 8/88

Page 1 of 3

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 178.91m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

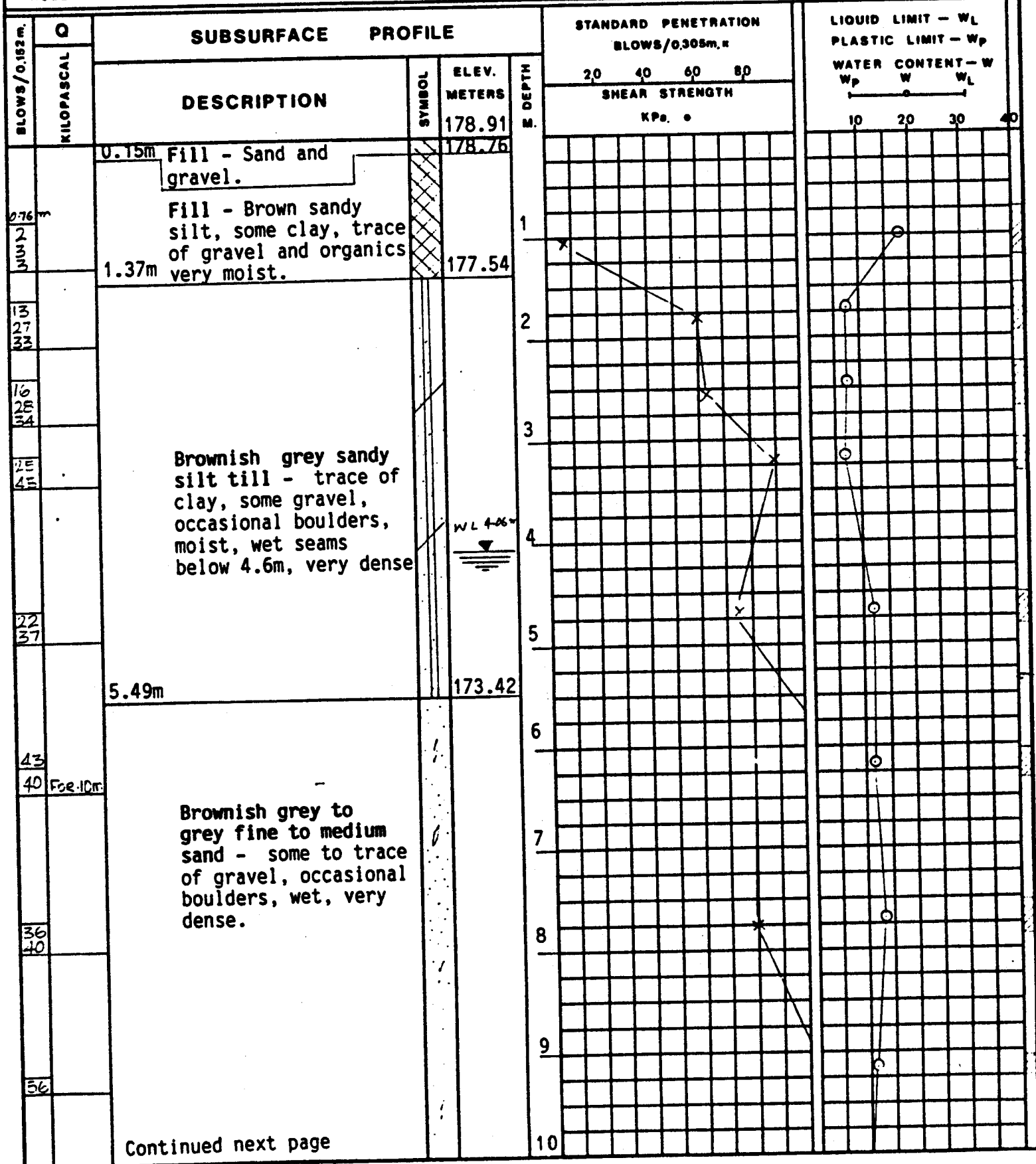
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +⁰

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☐





SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 1

ENCLOSURE No. 2
DATE April 8/88

Page 2 of 3

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 178.91m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

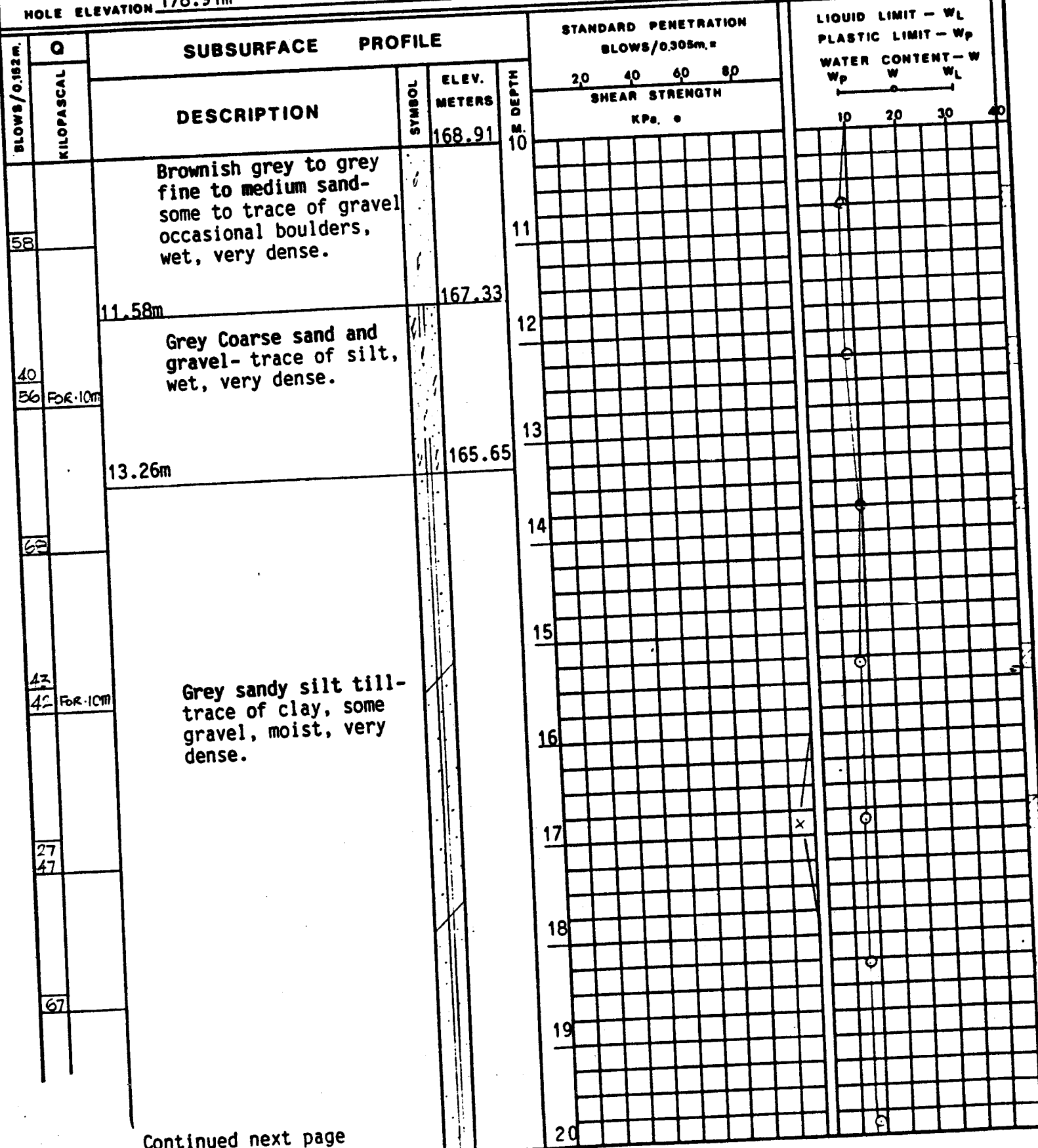
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) \pm

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☐



Continued next page



SOIL PROBE LIMITED

ENCLOSURE No. 3
DATE April 8/88

RECORD OF BOREHOLE No. 1

Page 3 of 3

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 178.91m

W.L.-WATER LEVEL
O-PENETROMETER TEST RESULT
0.05m. O.D. SPLIT TUBE ☒
0.05m. I.D. SHELBY TUBE ☐
VANE TEST &
SENSITIVITY (S) +
UNDRAIN TRIAXIAL AT
OVERBURDEN PRESSURE ☒

BLOWS/0.152m.	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m. =		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W	
		DESCRIPTION	SYMBOL	ELEV. METERS	DEPTH M	20 40 60 80 SHEAR STRENGTH KPa. •	W _p W W _L	
				158.91	20			
					21			
31 50 For. C.M.					22			
32 53		Grey sandy silt till- trace of clay, some gravel, moist, very dense.			23			
					24			
					25			
41 80		26.21m		152.70	26			
		B.H. caved to 4.06m			27			



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 2

ENCLOSURE No. _____

DATE April 12/88

Page 1 of 3

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 177.55m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

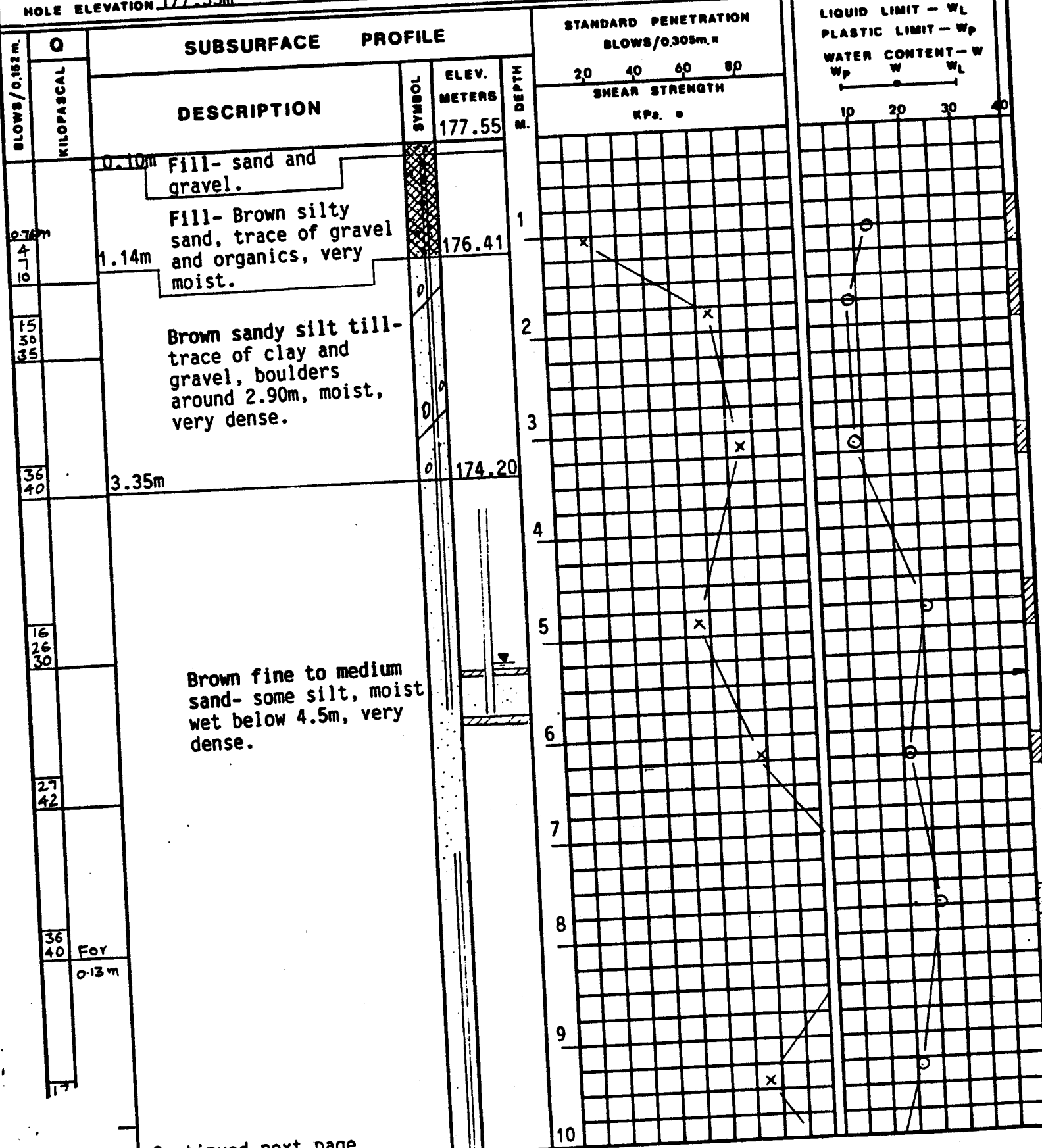
0.05m. O.D. SPLIT TUBE ☒0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +°

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE



Continued next page



SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 2

ENCLOSURE No. 5
DATE April 12/88

Page 2 of 3

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 177.55m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m, O.D. SPLIT TUBE ☒

0.05m, I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +⁸

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE 0

BLOWS/0.13m	Q KILOPASCAL	SUBSURFACE PROFILE		STANDARD PENETRATION BLOWS/0.305m, x		LIQUID LIMIT - WL PLASTIC LIMIT - WP WATER CONTENT - W	
		DESCRIPTION	ELEV. METERS	20 40 60 80 SHEAR STRENGTH KPa, o	10 20 30 40		
			167.55				
		Brown fine to medium sand- some silt, moist wet below 4.5m, very dense.	166.58				
75 For 0.13 m							
		Grey sandy silt till- trace of clay and gravel, moist, very dense.					
31 For 0.13 m							
40 For 0.10 m							

Continued next page



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 2

ENCLOSURE No. 6
DATE April 12/88

Page 3 of 3

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 177.55m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +³

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☒

BLOWS/0.305m	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m		LIQUID LIMIT - WL PLASTIC LIMIT - WP WATER CONTENT - W WP W WL	
		DESCRIPTION	SYMBOL	ELEV. METERS	20 40 60 80 SHEAR STRENGTH KPa. °	10 20 30 40		
				157.55	20			
					21			
50 For 0.19 m		Grey sandy silt till- trace of clay and gravel, moist, very dense.			22			
					23			
					24			
40 69		24.69m			25			
				152.86	26			
		B.H. caved to 5.36m						
		<u>PIEZOMETER SUMMARY</u>						
			Depth (m)	Elev. (m)				
		Tip of piezometer	5.72	171.83				
		Water level-Apr. 13	5.20	172.23				
		Water level Apr. 19	5.20	172.23				

SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 3

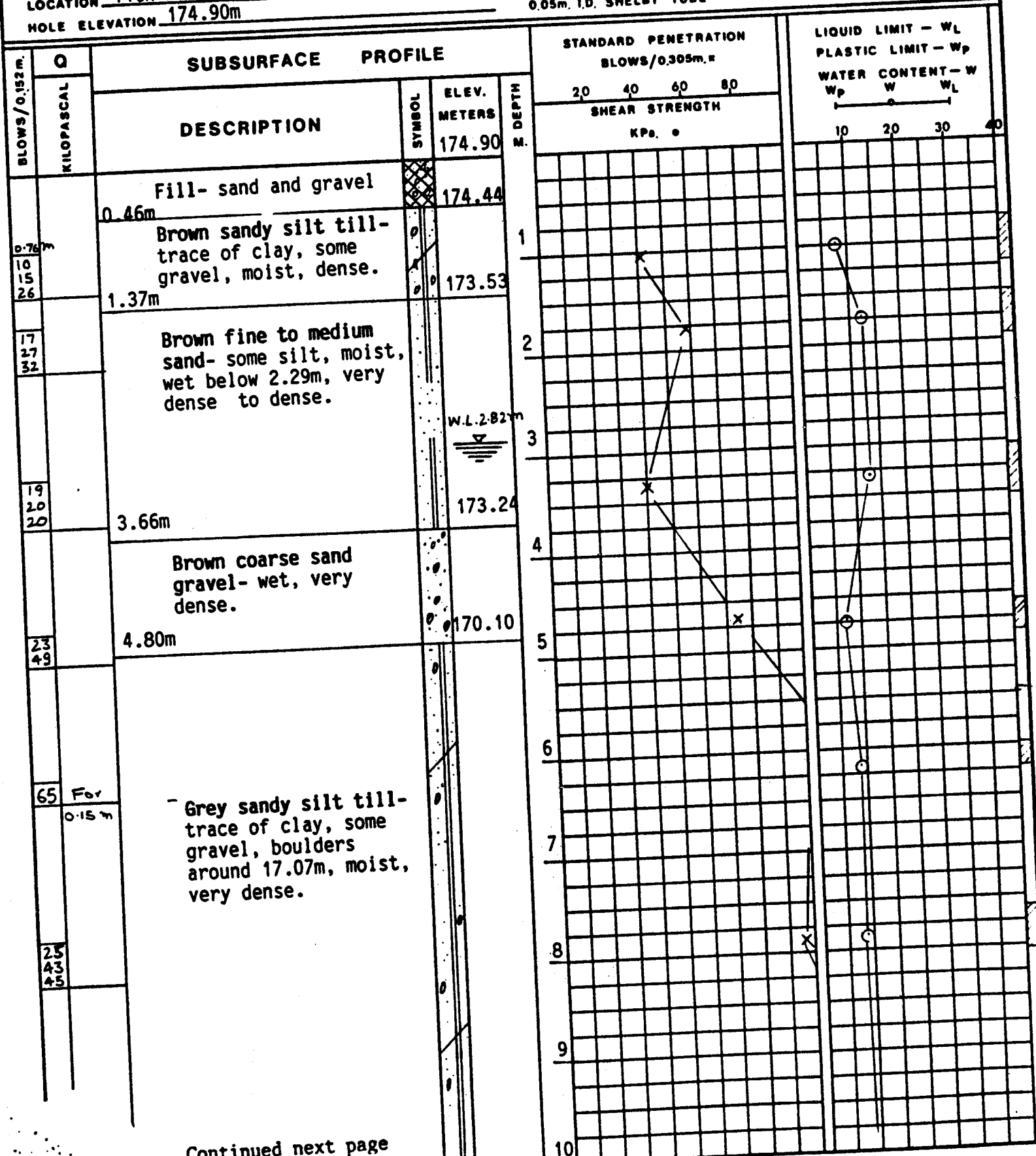
ENCLOSURE No. 1
DATE April 13/88

Page 1 of 3

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 174.90m

W.L.-WATER LEVEL
O-PENETROMETER TEST RESULT
0.05m. O.D. SPLIT TUBE ☒
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &
SENSITIVITY (S) +
UNDRAIN TRIAXIAL AT
OVERBURDEN PRESSURE



Continued next page

SOIL PROBE LIMITED

ENCLOSURE No. 8
DATE April 13/88

Page 2 of 3

RECORD OF BOREHOLE No. 3

OUR ORDER No. SP-1190

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 174.90m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.09m. O.D. SPLIT TUBE

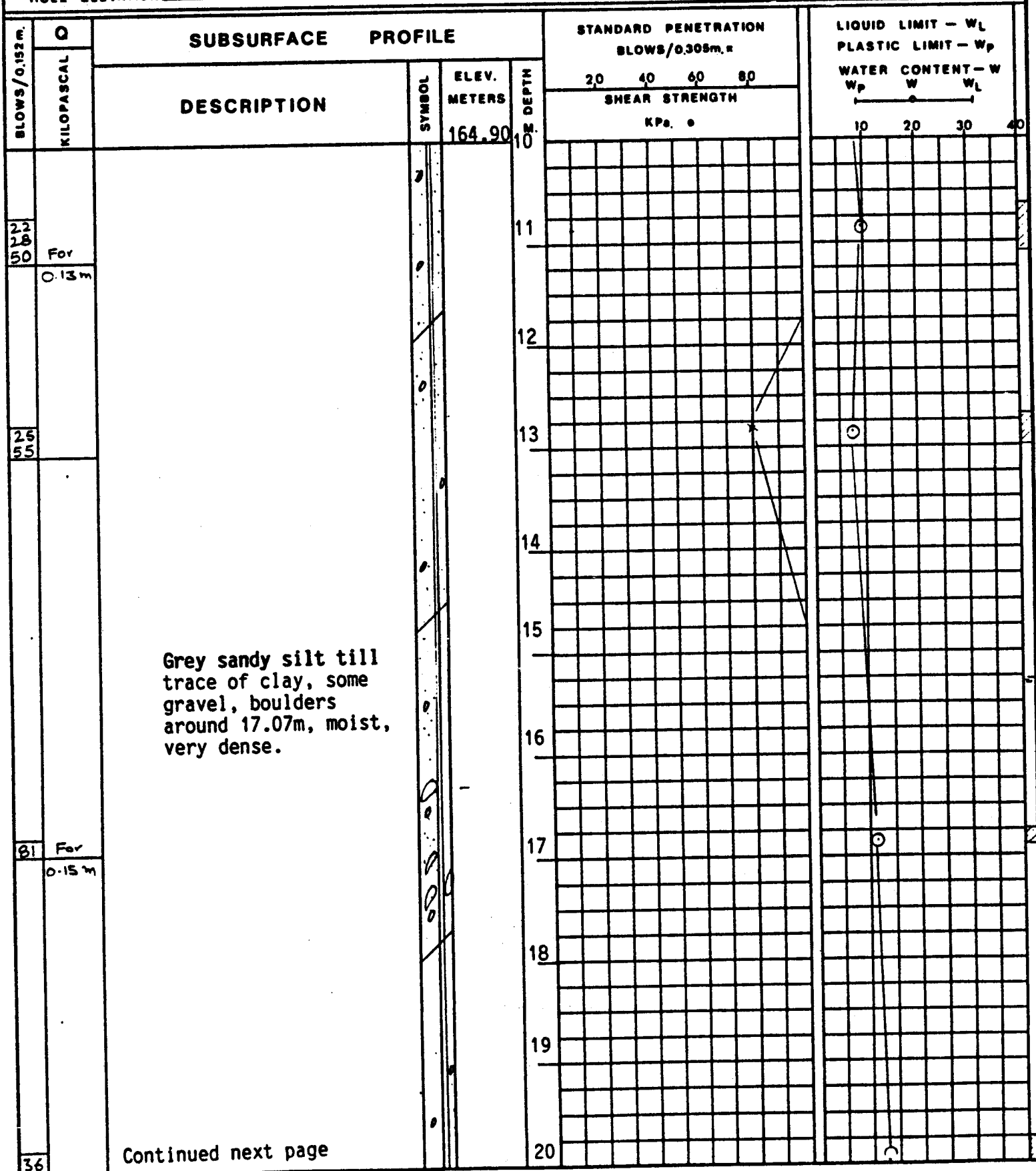
0.03m. I.D. SHELBY TUBE

VANE TEST &

SENSITIVITY (S) +⁸

UNDRAIN TRIAXIAL AT

OVERBUNDEN PRESSURE ●





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 3

ENCLOSURE No. 9

DATE April 13/88

Page 3 of 3

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 174.90m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +⁵

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE

SUBSURFACE PROFILE

DESCRIPTION

SYMBOL

ELEV.
METERSDEPTH
M.

STANDARD PENETRATION BLOWS/0.305m. x

20 40 60 80

SHEAR STRENGTH

KPa. e

LIQUID LIMIT - W_LPLASTIC LIMIT - W_p

WATER CONTENT - W

W_p W W_L

10 20 30 40

Grey sandy silt till-
trace of clay, some
gravel, boulders
around 17.07m, moist,
very dense.

B.H. caved to 3.66m



SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 4

ENCLOSURE No. 10
DATE April 18/88

Page 1 of 2

OUR ORDER No. SP-1120

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

MOLE ELEVATION 171.52m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

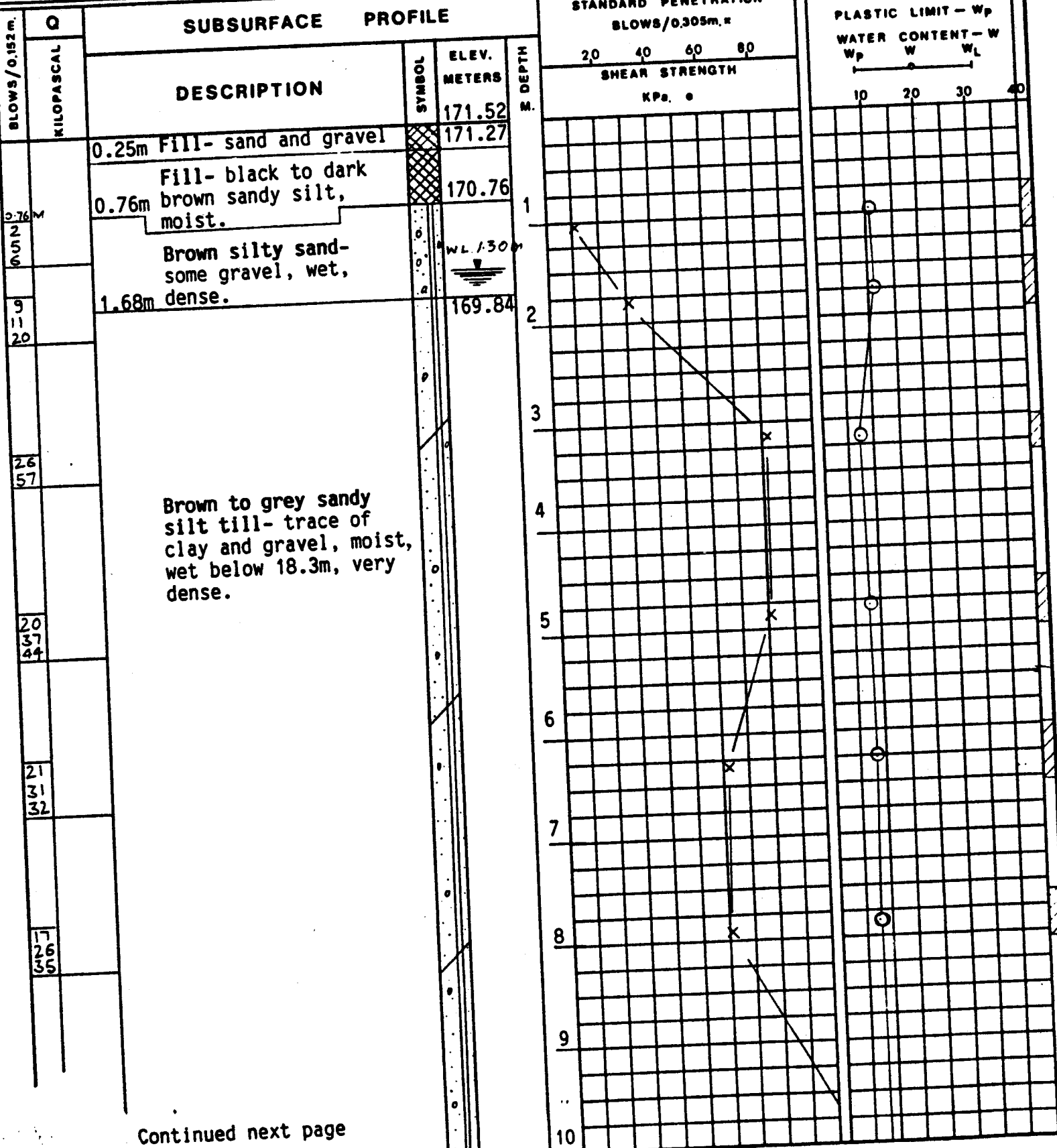
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) \pm

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE \odot



Continued next page



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 4

ENCLOSURE No. 11
DATE April 18/88
Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 171.52m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +°

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE

BLOWS/0.152m.	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m. =		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W	
		DESCRIPTION	SYMBOL	ELEV. METERS	DEPTH M.	20 40 60 80 SHEAR STRENGTH KPa. @	10 20 30 40	
				161.52	10			
31 60					11			
					12			
					13			
38 55					14			
					15			
					16			
55	For 0.15m				17			
					18			
					19			
84	For 0.15m			151.59	20			
				19.93m				

Brown to grey sandy silt till- trace of clay and gravel, moist, wet below 18.3m, very dense.



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 5

ENCLOSURE No 12
DATE April 15/88

Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 169.23m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m, O.D. SPLIT TUBE ☒

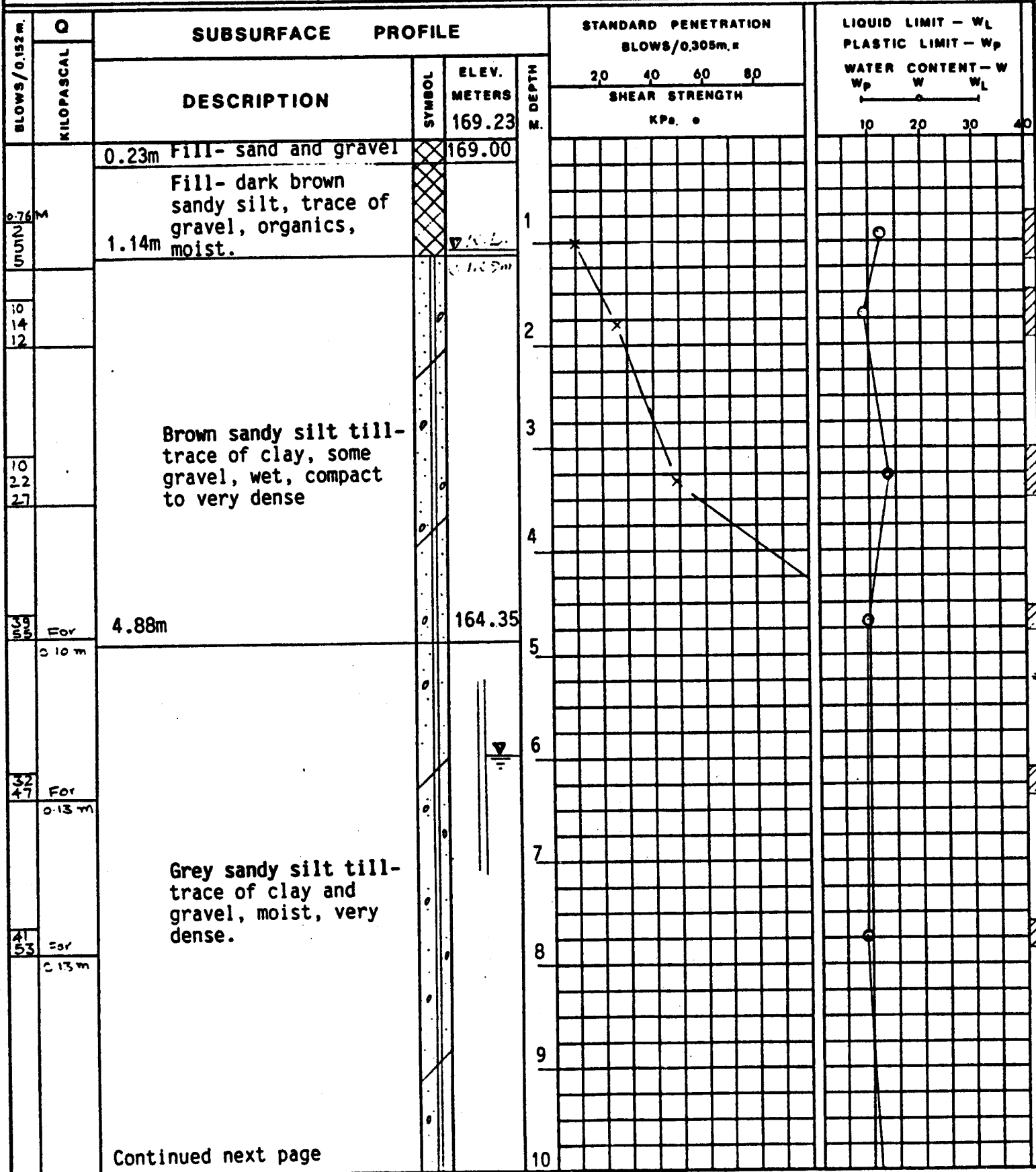
0.05m, I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 5

ENCLOSURE No. 13
DATE April 11/88

Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 169.23m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

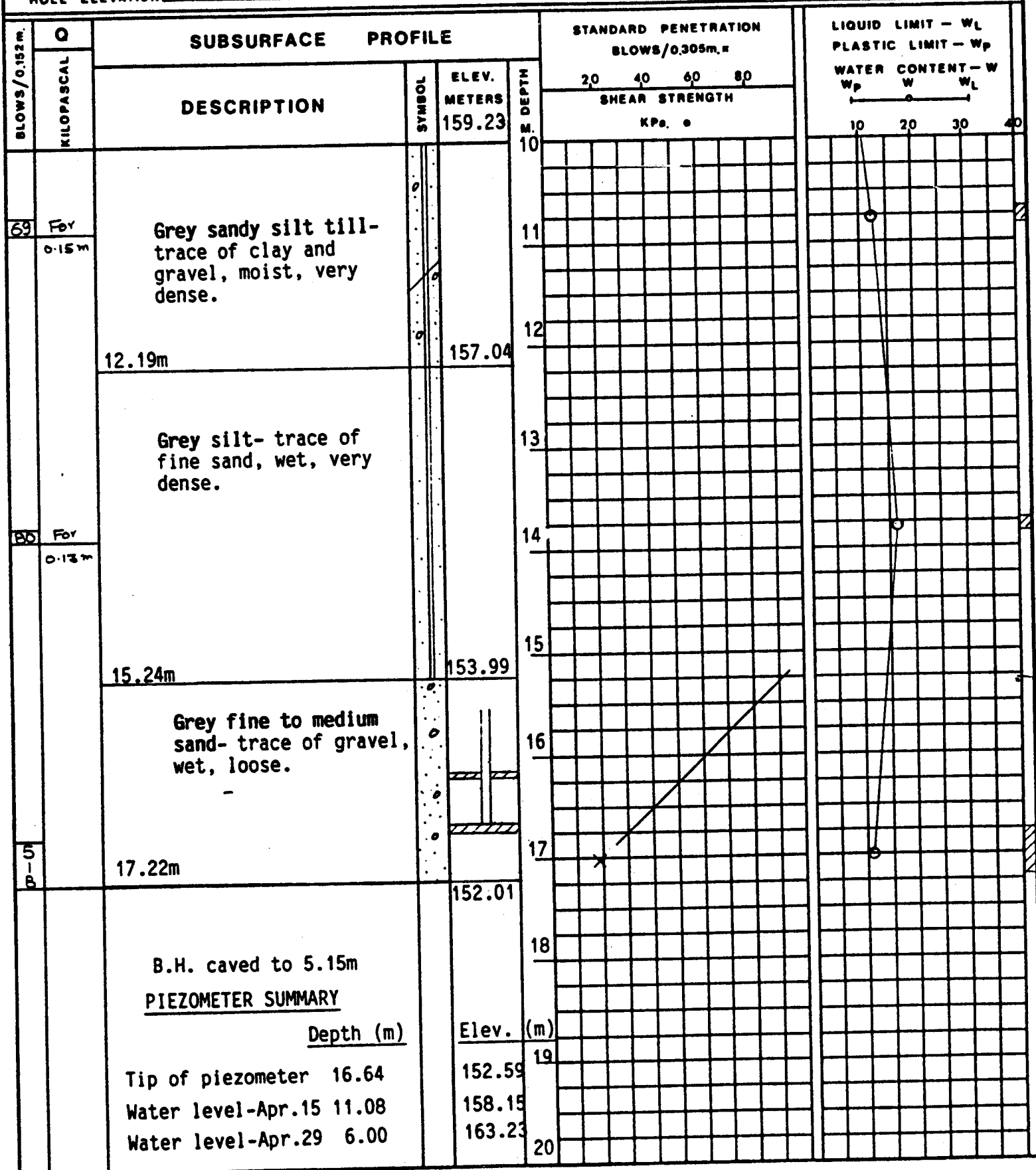
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +⁸

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 6

ENCLOSURE No. 14
DATE April 11/88
Page 1 of 2

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 167.80m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

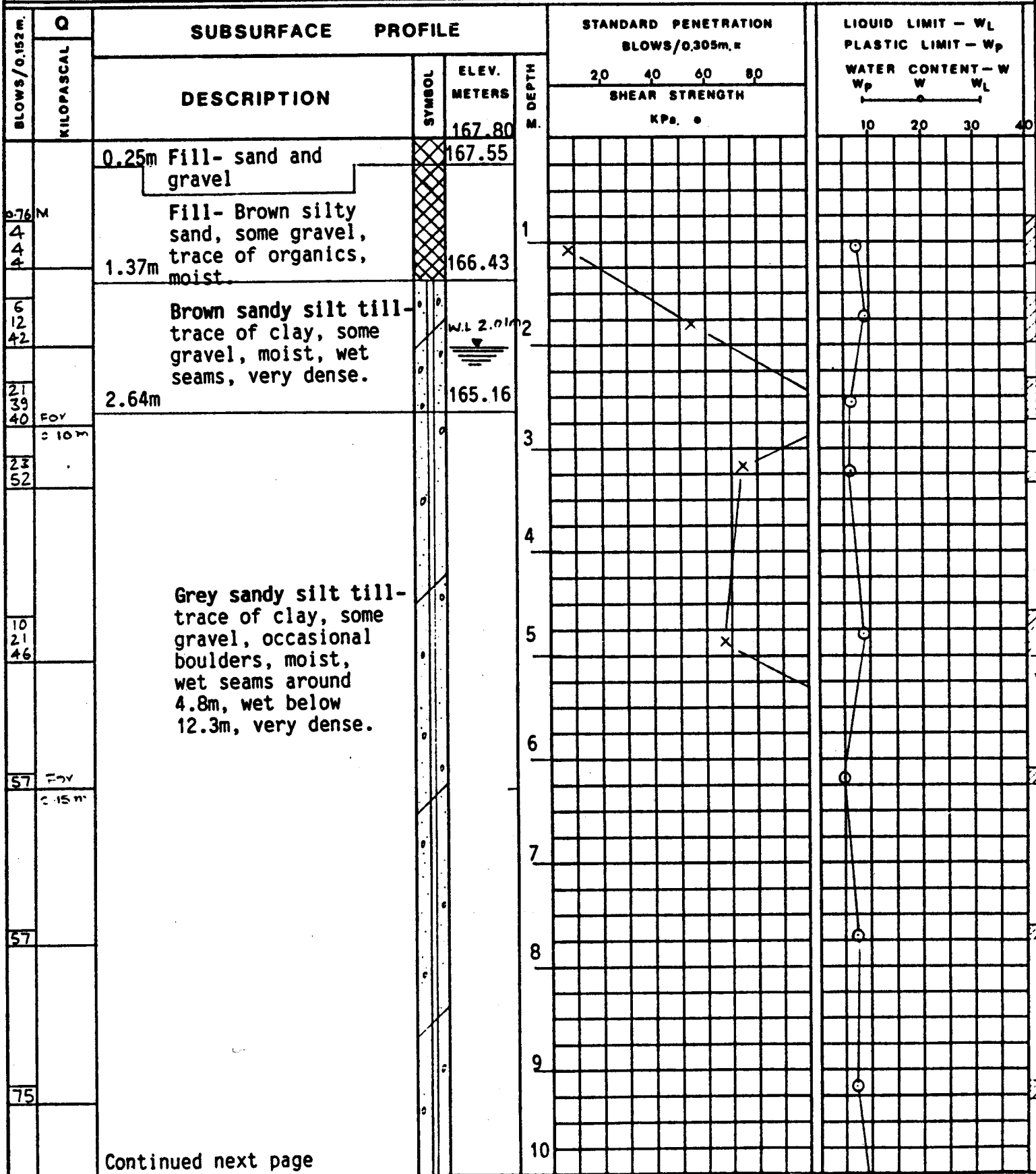
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE



Continued next page



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 6

ENCLOSURE No. 15

DATE April 11/88

Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 167.80m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

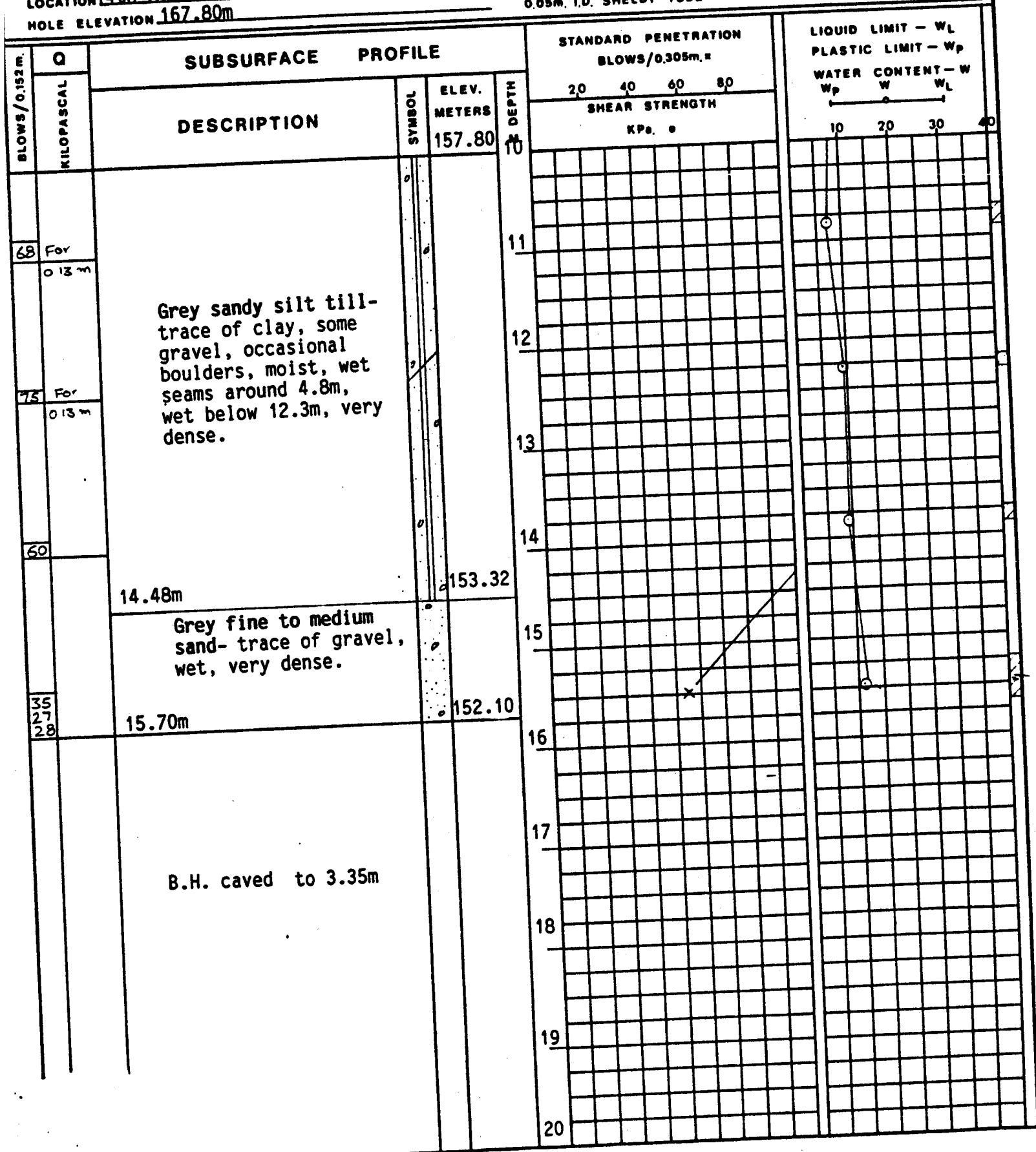
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 7

ENCLOSURE No. 16
DATE April 15/88

Page 1 of 2

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdivision
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 165.81m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m, O.D. SPLIT TUBE ☒

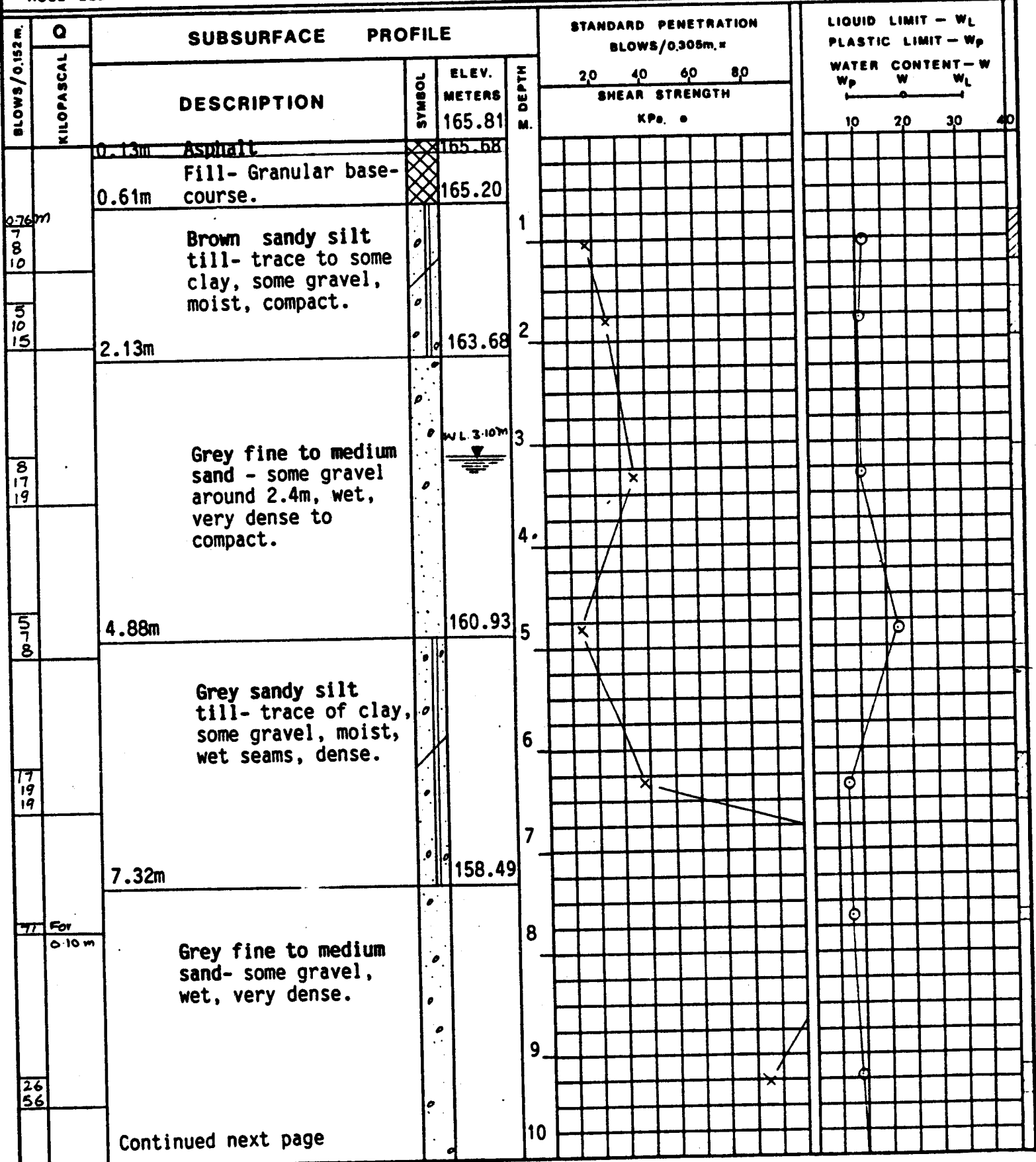
0.05m, I.D. SHELBY TUBE ☐

VANE TEST ☐

SENSITIVITY (S) \pm

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☐





SOIL PROBE LIMITED

ENCLOSURE No. 17
DATE April 15/88

RECORD OF BOREHOLE No 7

Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 165.81m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +°

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE

BLOWS/0.152m.	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m. x		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W	
		DESCRIPTION	SYMBOL	ELEV. METERS	20 40 60 80 SHEAR STRENGTH KPa. °	W _p W W _L		
				155.81				
69	Fov 0.13m	Grey fine to medium sand- some gravel, wet, dense.						
72	Fov 0.13m	12.32m		153.49				
		B.H. caved to 6.25m						

SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 8

ENCLOSURE No. 18
DATE April 18/88
Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdivision

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 163.30m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE

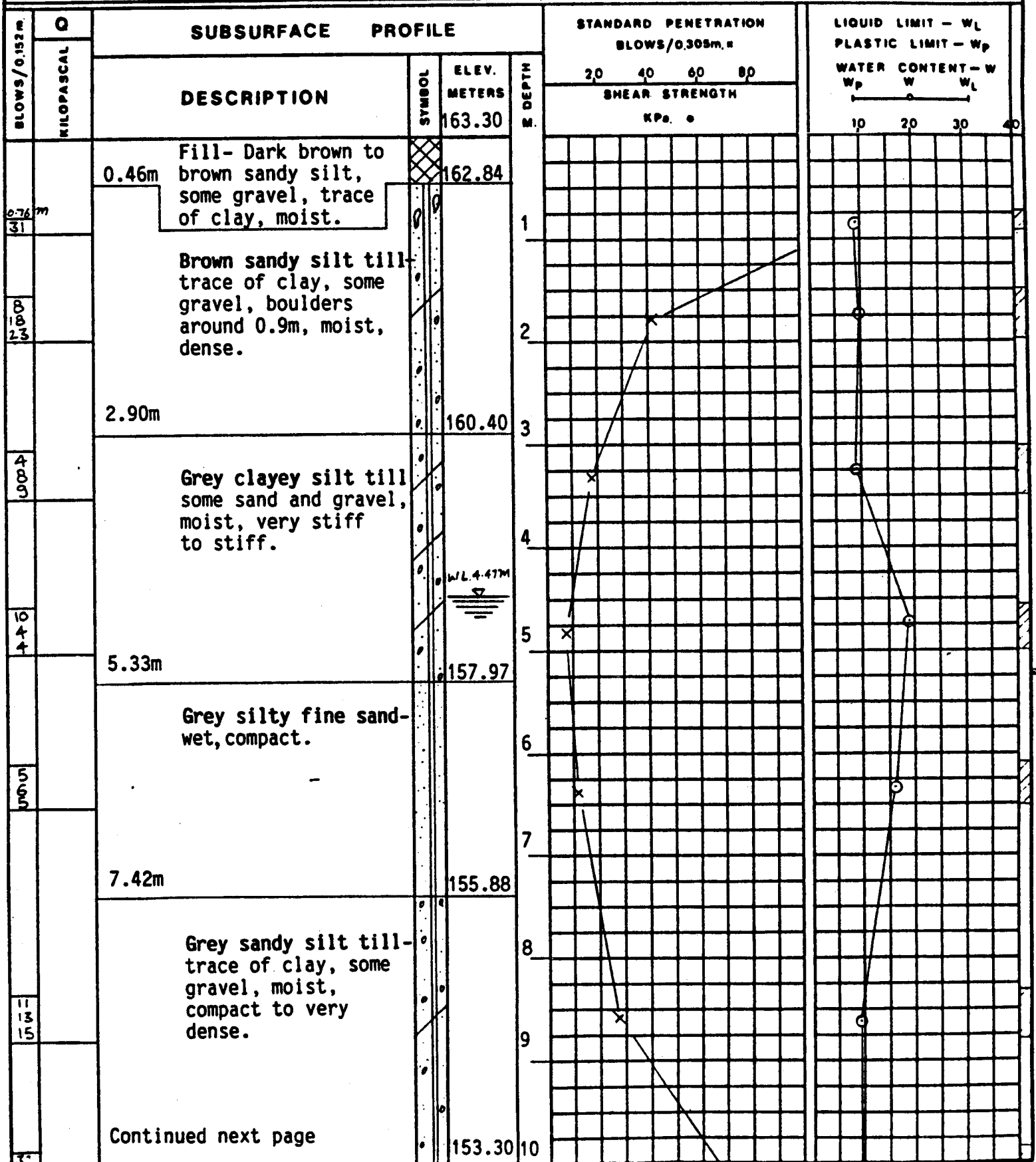
0.05m. I.D. SHELBY TUBE

VANE TEST &

SENSITIVITY (S) +⁰

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ●



SOIL PROBE LIMITED

RECORD OF BOREHOLE No⁹

ENCLOSURE No. 20
DATE April 19/88

Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave, Markham, Ont

MOLE ELEVATION 153.95m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

0.05m I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) \pm

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☒

SUBSURFACE PROFILE

DESCRIPTION

SYMBOL

ELEV. METERS

DEPTH M.

STANDARD PENETRATION BLOWS/0.305m.

20 40 60 80
SHEAR STRENGTH
KPa. ϕ

LIQUID LIMIT - W_L PLASTIC LIMIT - W_p WATER CONTENT - W

10 20 30 40

Fill - Dark brown sandy silt, some clay, trace of organics, wet

1.37m

W.L. 152M

Brown sandy gravel - pockets of clayey silt wet, dense to loose

2.90m

151.05

Grey sandy silt till - some clay and gravel, moist, compact

5.18m

148.77

Grey sandy gravel - some silt, wet, loose

6.68m

147.27

Grey clayey silt - trace of sand, wet stiff

8.53m

145.42

Grey fine to medium sand- trace of silt, wet, loose to dense.

Continued next page

SOIL PROBE LIMITED

ENCLOSURE No. 21

DATE April 22/88

Page 2 of 2

RECORD OF BOREHOLE No 9

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

NOLE ELEVATION 153.95m

WL-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE 0.05m. I.D. SHELBY TUBE —

VANE TEST 8

SENSITIVITY (S) +⁸

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ●

BLOWS/0.305m	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m =		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W		
		DESCRIPTION	SYMBOL	ELEV. METERS	DEPTH M.	SHEAR STRENGTH		W _p W W _L	
						20	40	60	80
				143.95	10				
7 17 23		Grey fine to medium sand - trace of silt, wet, loose to dense		142.63	11				
		B.H. caved to 3.89m			12				
					13				
					14				
					15				
					16				
					17				
					18				
					19				
					20				

SOIL PROBE LIMITED

ENCLOSURE No 22

DATE April 19/88

Page 1 of 2

RECORD OF BOREHOLE No 9A

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 153.95m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.03m. O.D. SPLIT TUBE


0.05m. I.D. SHELBY TUBE —

VANE TEST &

SENSITIVITY (S) +⁰

UNDRAIN TRIAXIAL AT

OVERBUNDEN PRESSURE ●

BLOWS / 0.305 m	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS / 0.305 m		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W		
		DESCRIPTION	SYMBOL	ELEV. METERS	DEPTH M.	SHEAR STRENGTH		W _p W W _L	
						KPa c		10 20 30 40	
				153.95					
				W.L. @ 1.52 m 	1				
					2				
					3				
					4				
					5				
					6				
					7				
					8				
					9				
					10				

Augered to 12.19m

Continued next page

Continued next page

SOIL PROBE LIMITED

ENCLOSURE No. 23
DATE June 6/88
Page 2 of 2

RECORD OF BOREHOLE No 9A

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

LOCATION _____
HOLE ELEVATION 153.95m

WL-WATER LEVEL

O-PENETROMETER TEST RESULT

0.08m. O.D. SPLIT TUBE

0.03m I.D. SHELBY TUBE —

VANE TEST 8

SENSITIVITY (S) +⁹

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE

BLOWS/0.305m	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W							
		DESCRIPTION	SYMBOL	ELEV. METERS	SHEAR STRENGTH		W _p — W — W _L							
					20	40	60	80	10	20	30	40		
				143.95	10									
		Augered to 12.19m			11									
12.19m		12.19m		141.76	12									
14 78		Grey sandy silt fill - trace of clay and gravel, boulder around 13.72m wet, very dense.			13									
75 For 0.3m		13.72m		140.23	14									
		Grey coarse sand and gravel - wet, very dense			15									
135 For 0.15m		15.39m		138.56	16									
					17									
					18									
					19									
					20									



SOIL PROBE LIMITED

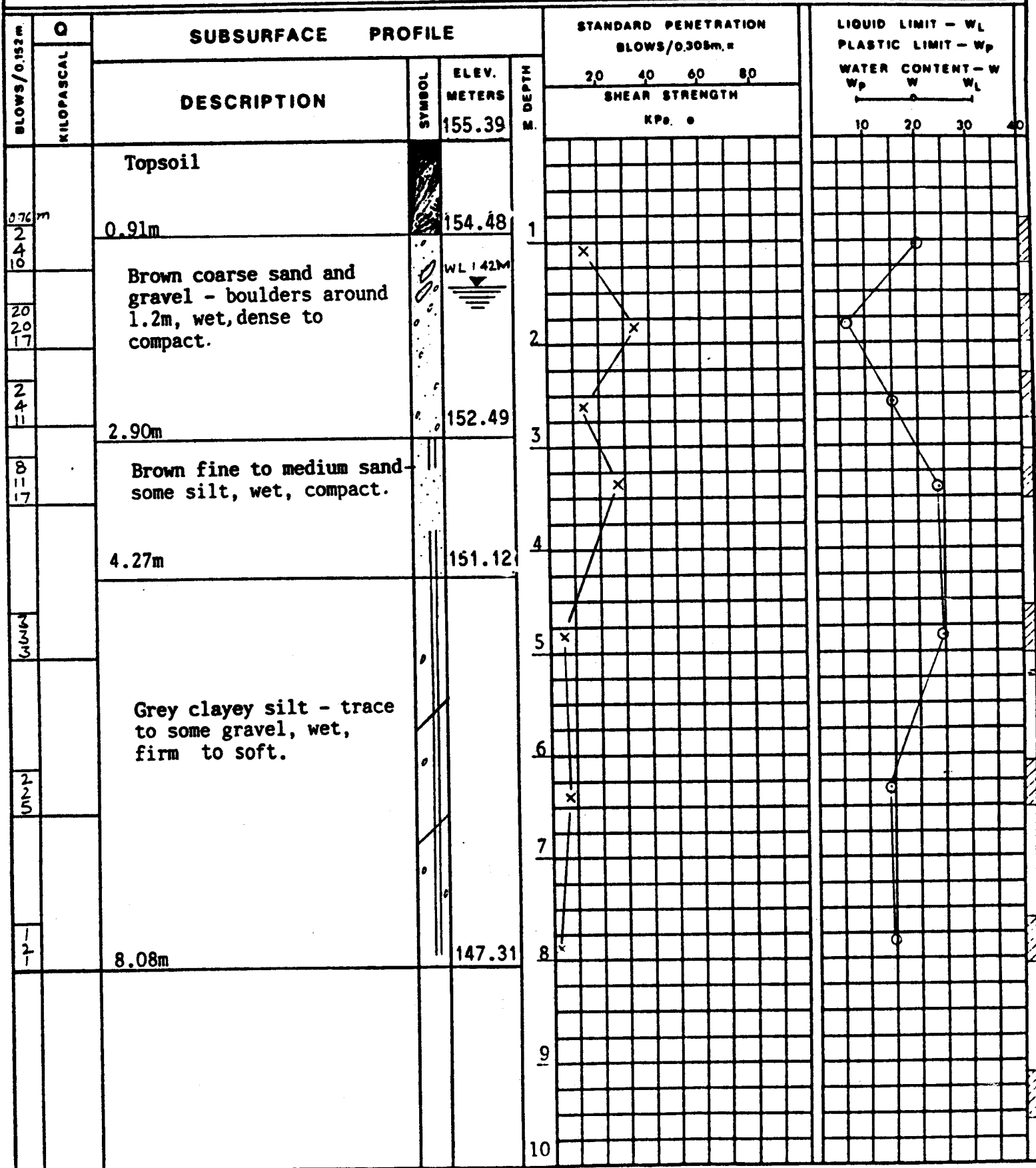
RECORD OF BOREHOLE No 10

ENCLOSURE No. 24
DATE April 19/88
Page 1 of 2

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdiv.
LOCATION 14th Avenue, Markham, Ont.
HOLE ELEVATION 155.39m

W.L.-WATER LEVEL
O-PENETROMETER TEST RESULT
0.05m. O.D. SPLIT TUBE ☒
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &
SENSITIVITY (S) +
UNDRAIN TRIAXIAL AT
OVERBURDEN PRESSURE 0



SOIL PROBE LIMITED

ENCLOSURE No. 25
DATE April 22/88

Page 1 of 2

RECORD OF BOREHOLE No 10A

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 155.39m

W.L.-WATER LEVEL

VANE TEST A

Q-PENETROMETER TEST RESULT

SENSITIVITY (S) +⁹

0.05m. O.D. SPLIT TUBE  

UNDRAIN TRIAXIAL AT

0.05m I.D. SHELBY TUBE

OVERBURDEN PRESSURE ●

[illegible]

SOIL PROBE LIMITED

RECORD OF BOREHOLE No 10A

ENCLOSURE No 26
DATE April 1978

Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave. Markham, Ont.

HOLE ELEVATION 155.39m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m O.D. SPLIT TUBE ☒

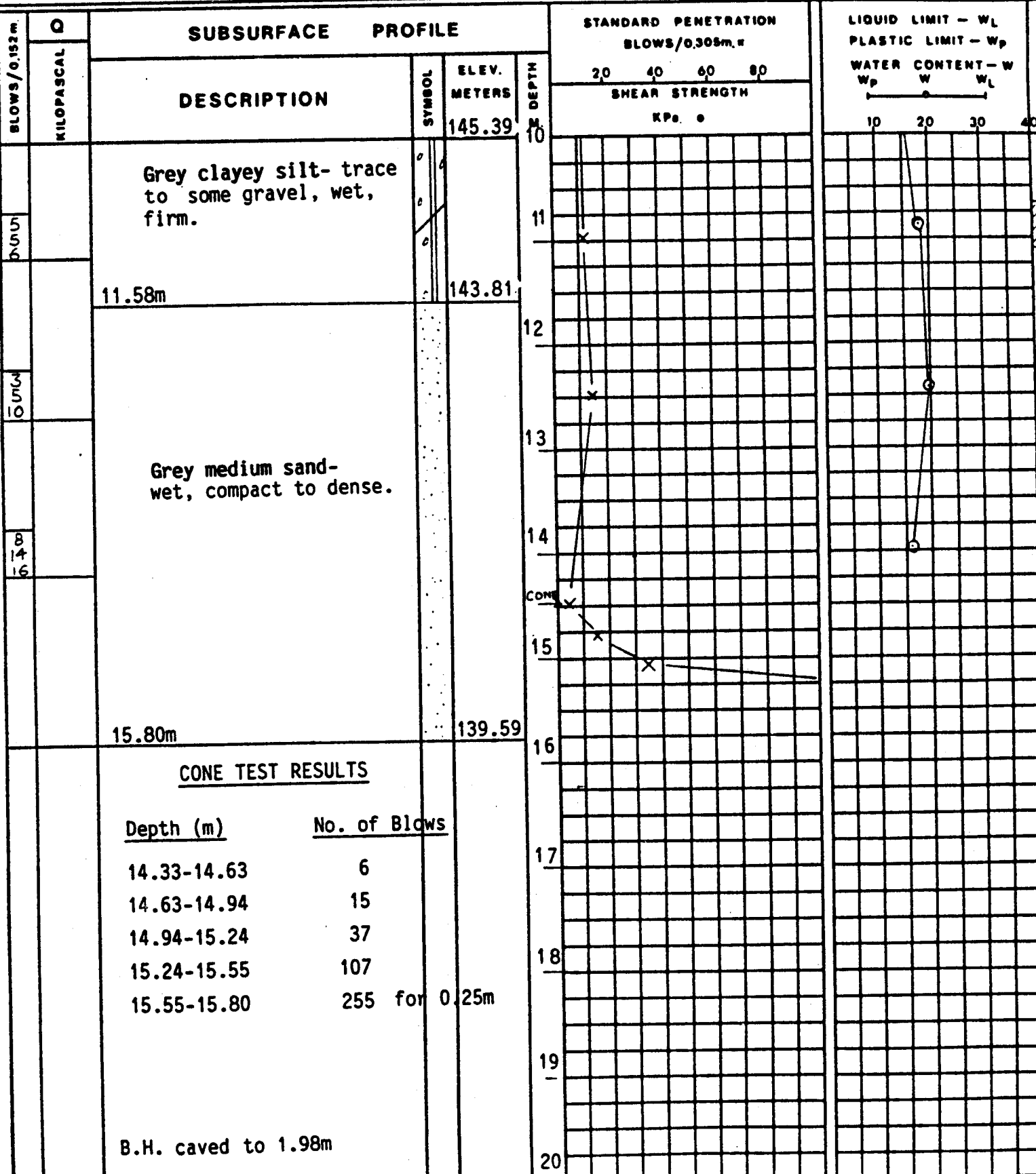
0.05m I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) 4°

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☐





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 16

ENCLOSURE No. 27

DATE April 25/88

Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave. Markham, Ont.

HOLE ELEVATION 153.41m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

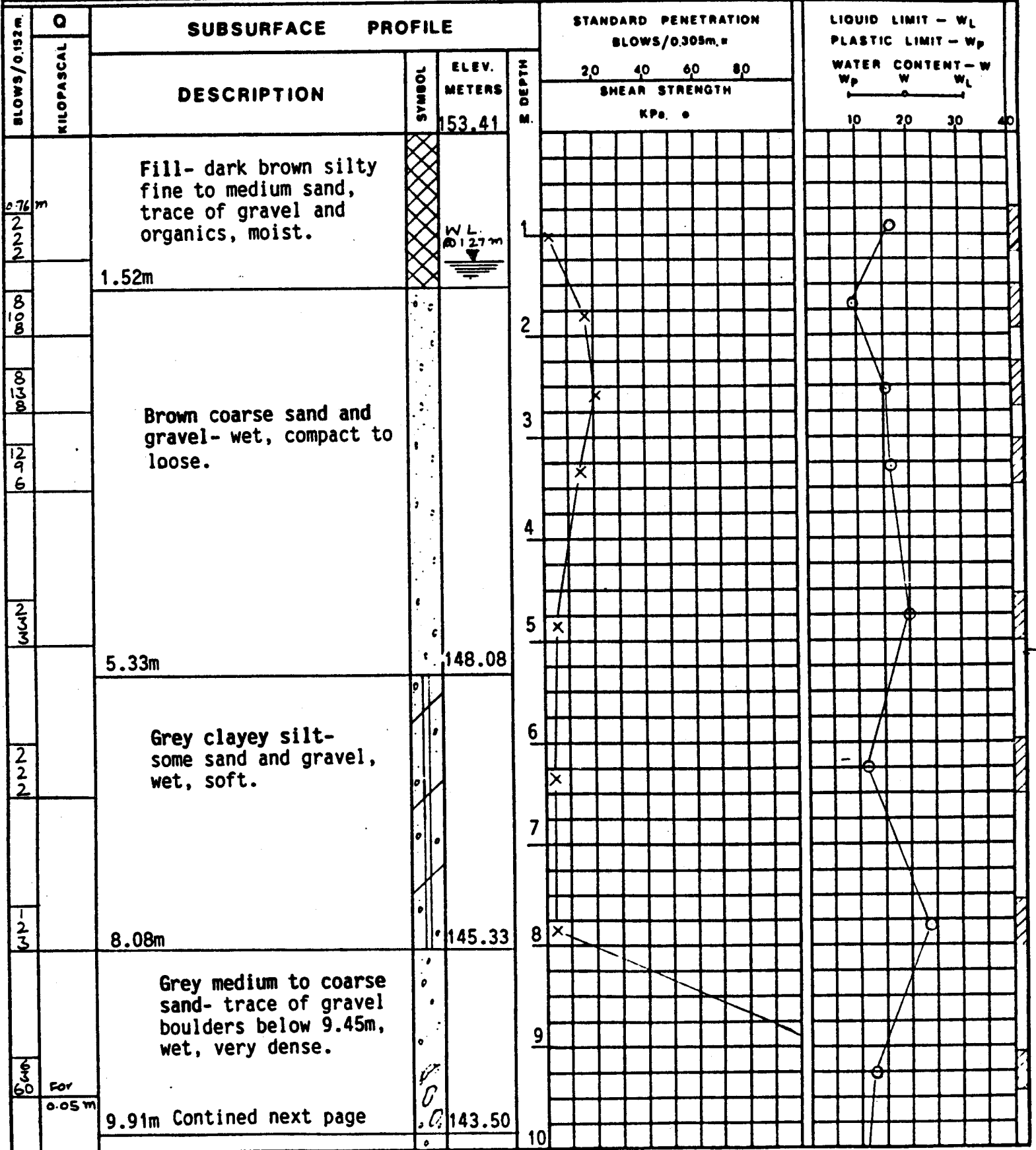
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +°

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE @





SOIL PROBE LIMITED

RECORD OF BOREHOLE No. 16

ENCLOSURE No. 28

DATE April 25/88

Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave. Markham, Ont.

HOLE ELEVATION 153.41m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

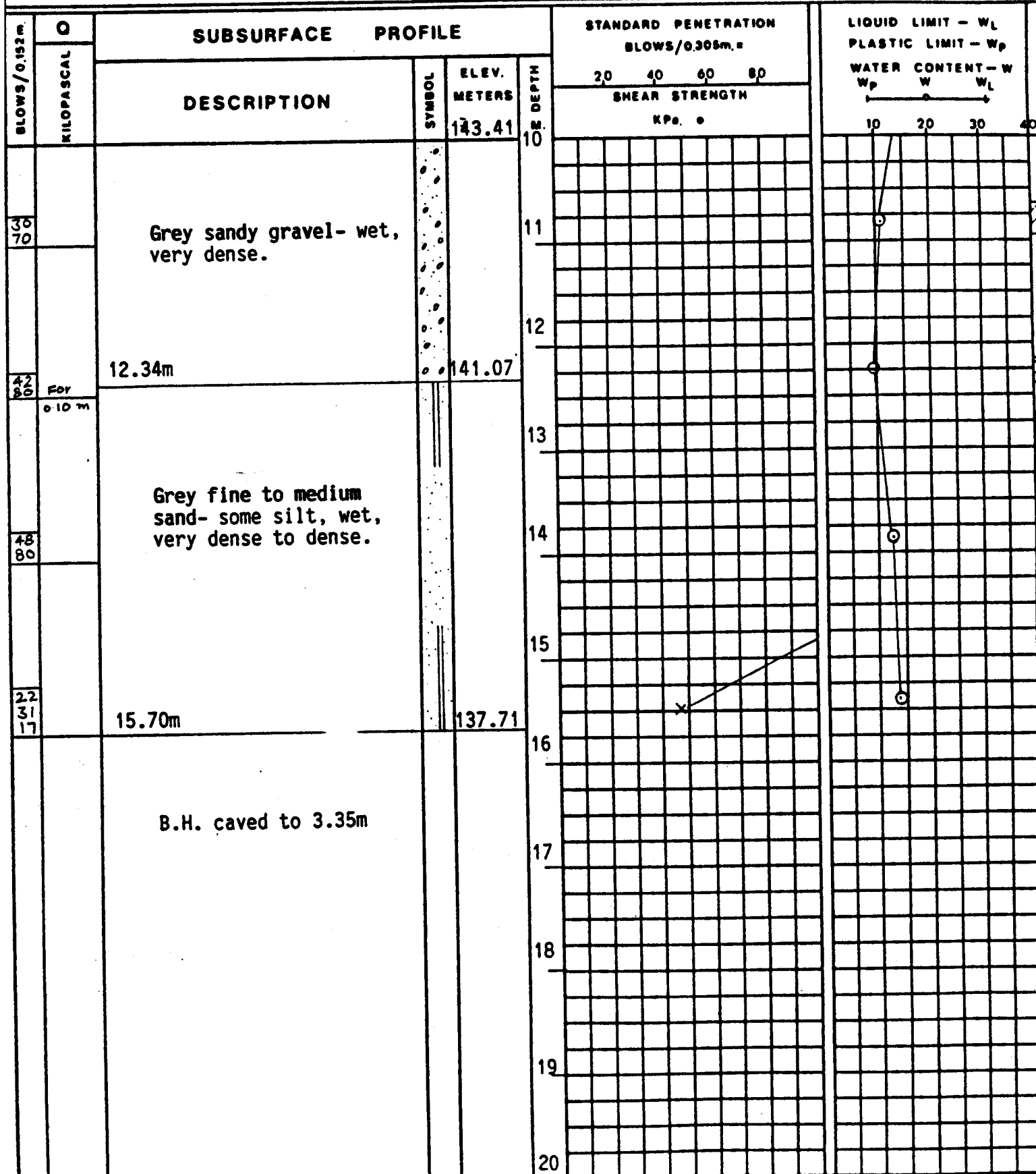
0.05m. O.D. SPLIT TUBE ☒0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +³

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 17

ENCLOSURE No. 29DATE April 22/88

Page 1 of 2

OUR ORDER No. SP-1190PROJECT Proposed North Rouge Res. Subdiv.LOCATION 14th Ave. Markham, Ont.HOLE ELEVATION 155.21m

W.L.-WATER LEVEL

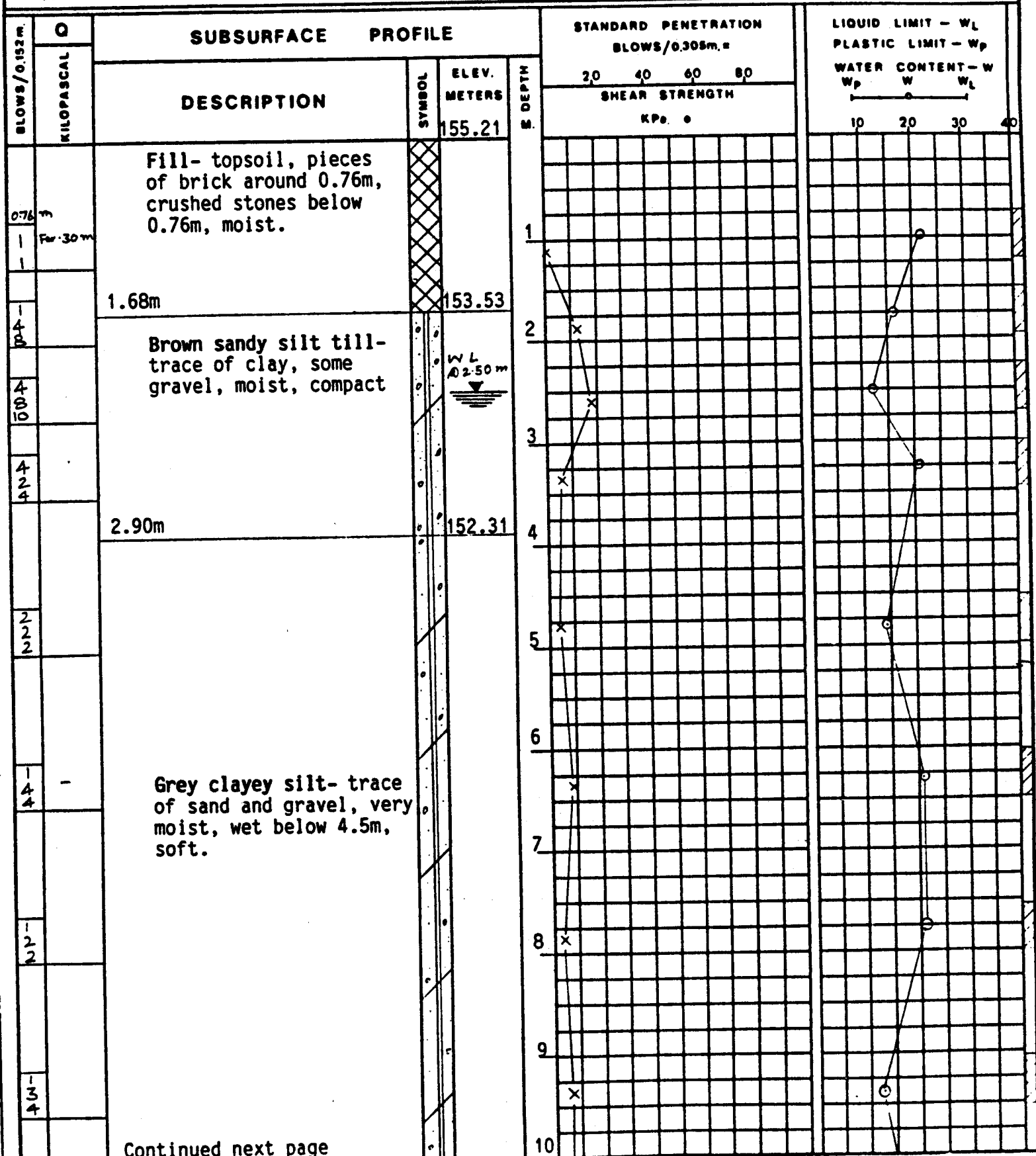
O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒0.05m I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) 4°

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ϕ 



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 17

ENCLOSURE No. 30
DATE April 22, 1989

Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 155.21m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

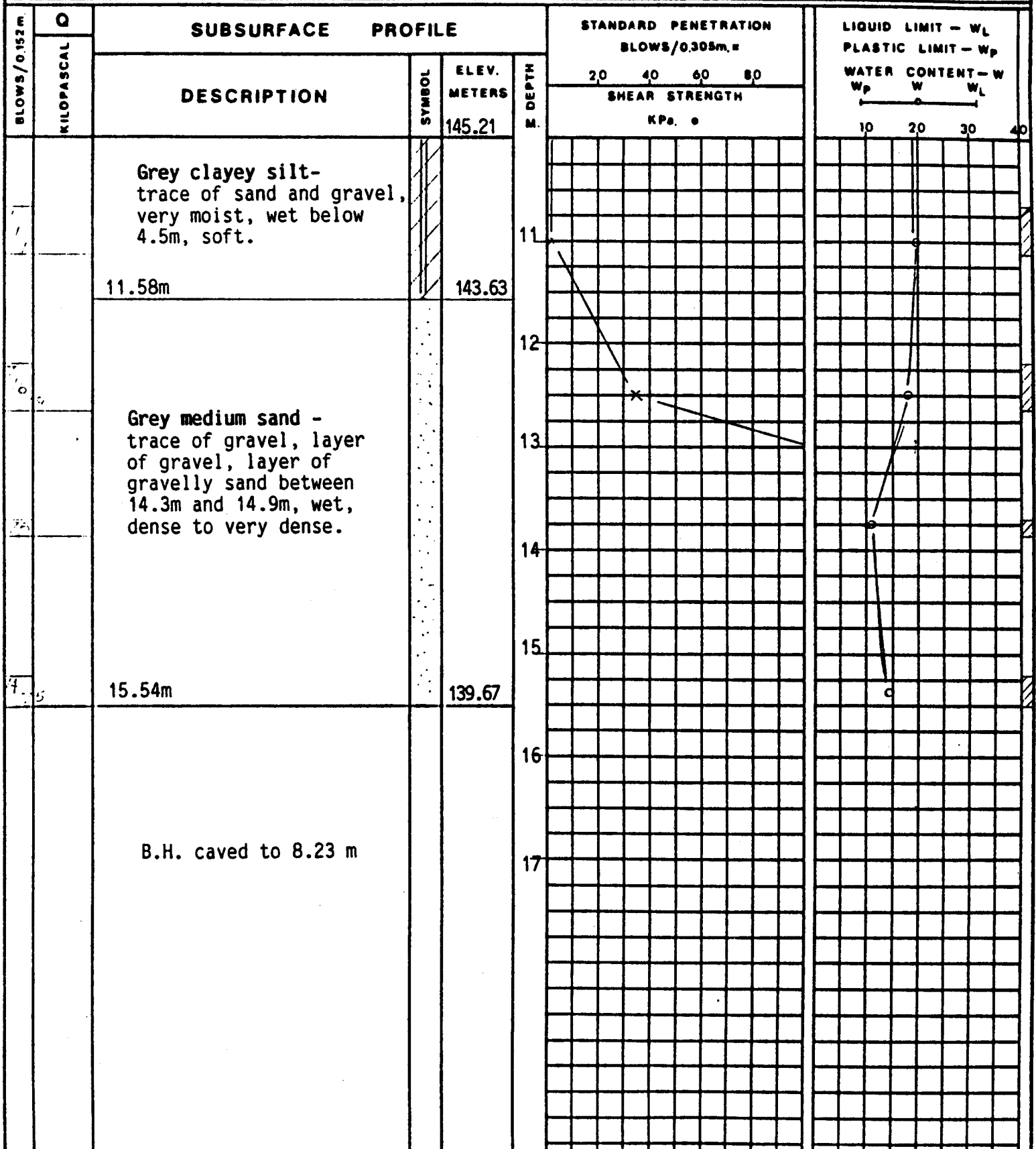
0.05m. I.D. SHELBY TUBE ☐

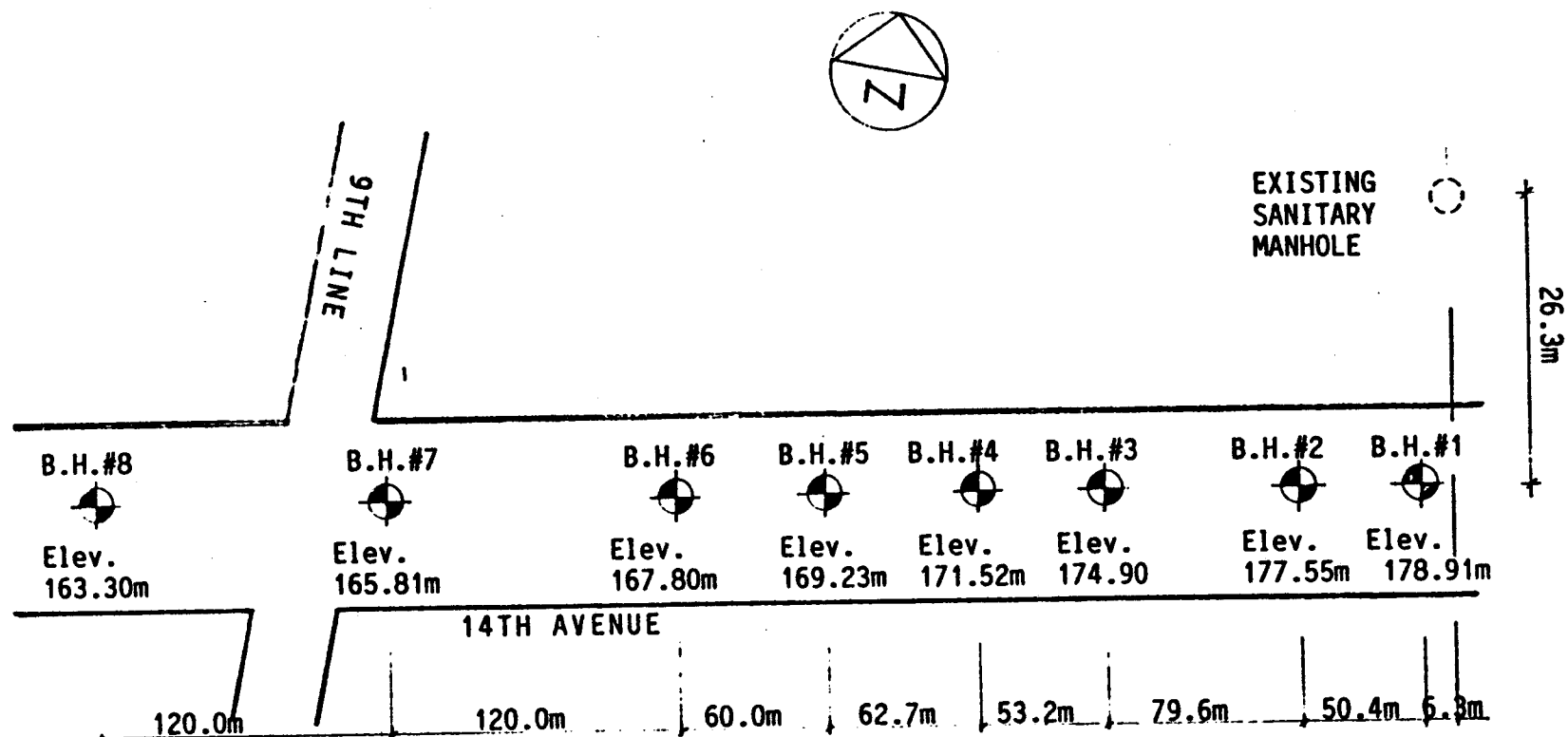
VANE TEST &

SENSITIVITY (S) +°

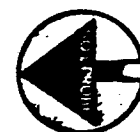
UNDRAIN TRIAXIAL AT

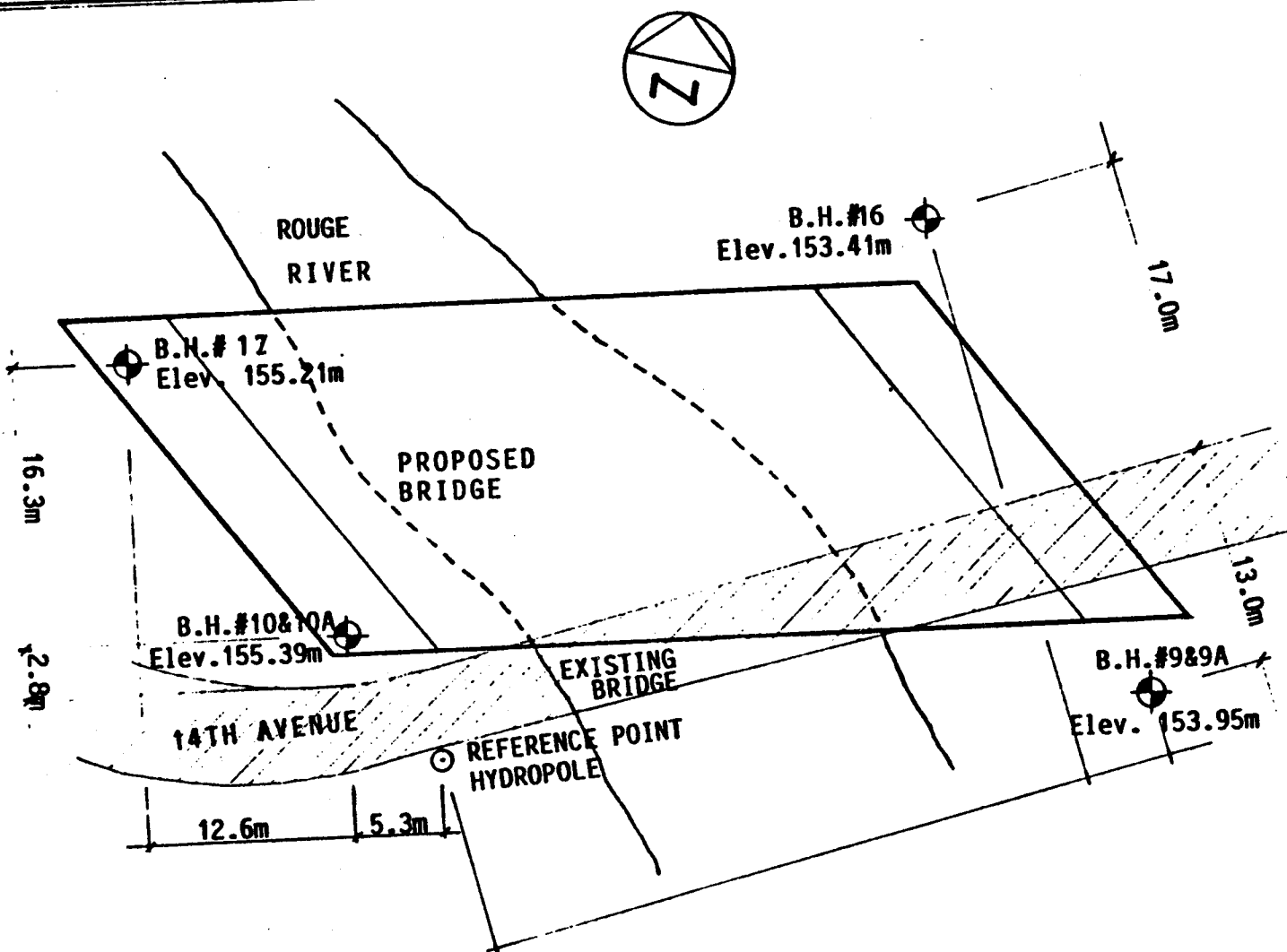
OVERBURDEN PRESSURE 0



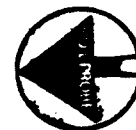


SKETCH SHOWING BOREHOLE LOCATIONS FOR PROPOSED TRUNK SANITARY SEWER, NORTH ROUGE RESIDENTIAL SUBDIVISION, 14TH AVENUE, MARKHAM, ONTARIO.

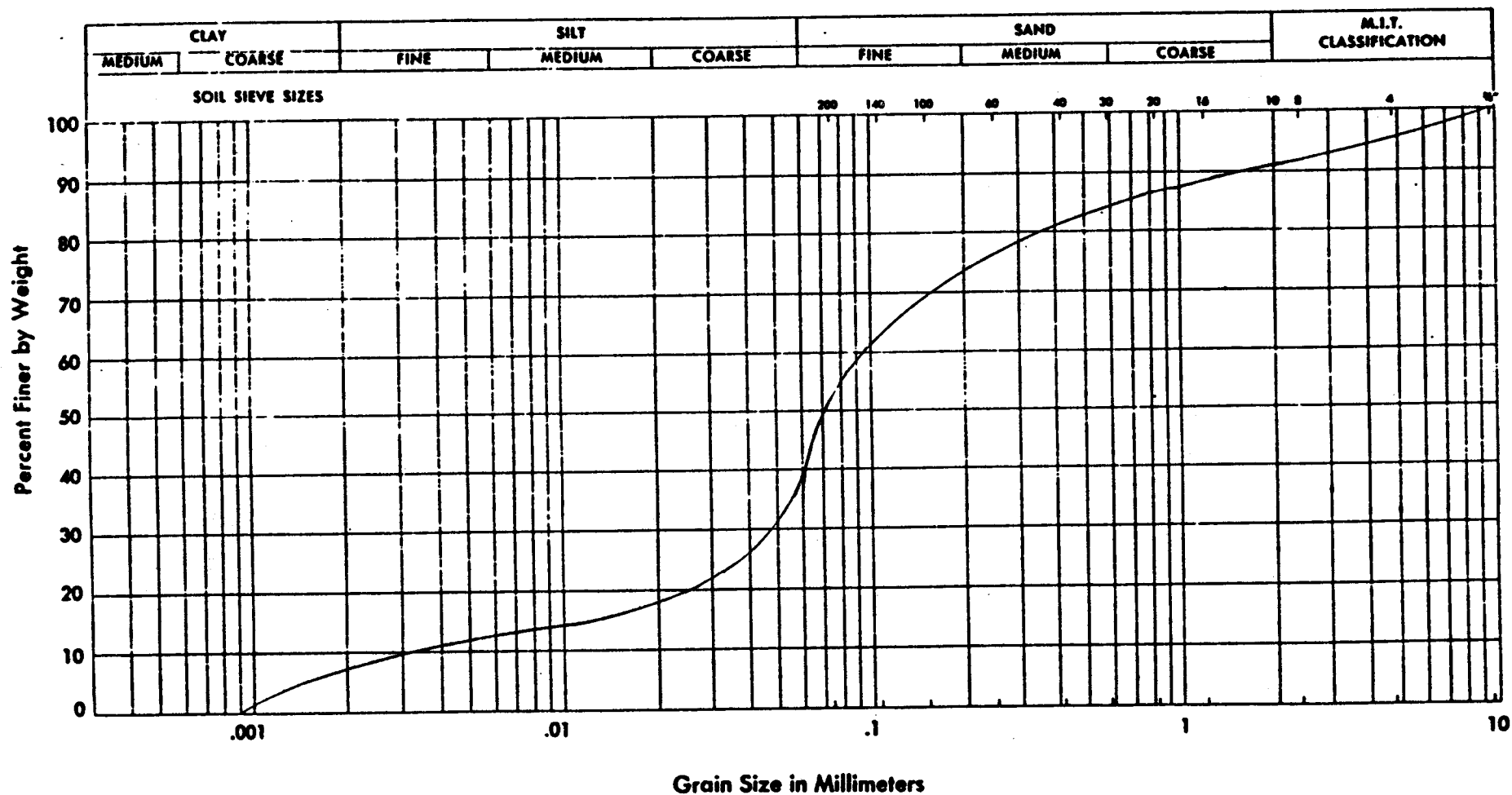




SKETCH SHOWING BOREHOLE LOCATIONS FOR THE PROPOSED BRIDGE OVER
ROUGE RIVER AT 14TH AVENUE, MARKHAM, ONTARIO



GRAIN SIZE DISTRIBUTION



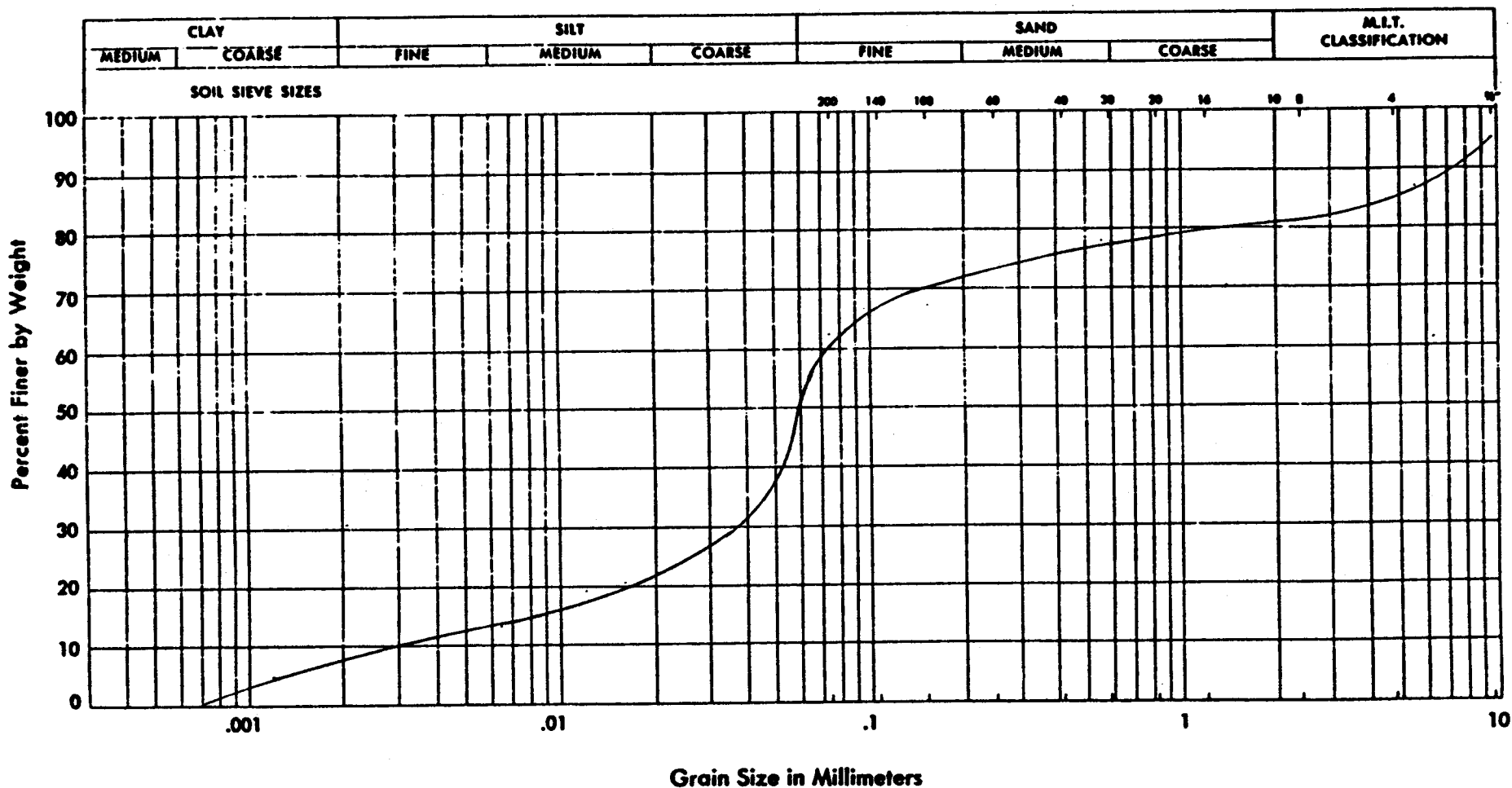
Project: Proposed Trunk Sewer Line
Along 14th Ave to 9th Line
Connection, Town of Markham,
Ontario

Order No. SP-1190

B.H. 1
Depth: 1.52m to 3.10m



GRAIN SIZE DISTRIBUTION

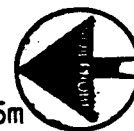


Project : Proposed Trunk Sewer Line Along
14th Ave to 9th Line Connection
Town of Markham, Ontario

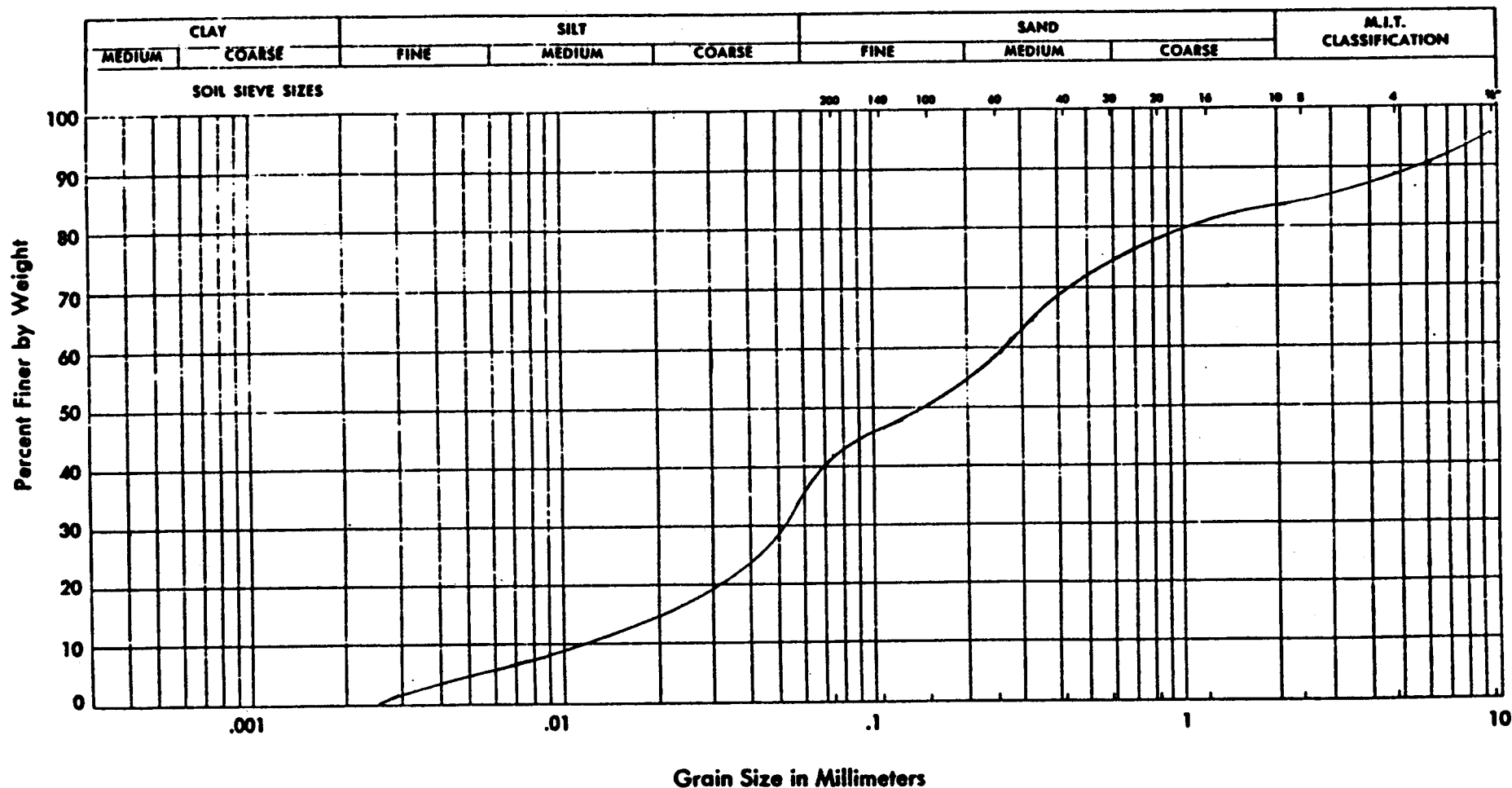
Order No. SP-1190

B.H. #8

Depth: 1.52m to 3.05m



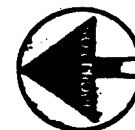
GRAIN SIZE DISTRIBUTION



Project: Proposed Trunk Sewer Line Along
14th Avenue to 9th Line Connection
Town of Markham, Ontario

Order No. SP-1190

B.H.13
Depth 1.52m to 3.05m



Report No. 88-1708
Order No. SP-1190

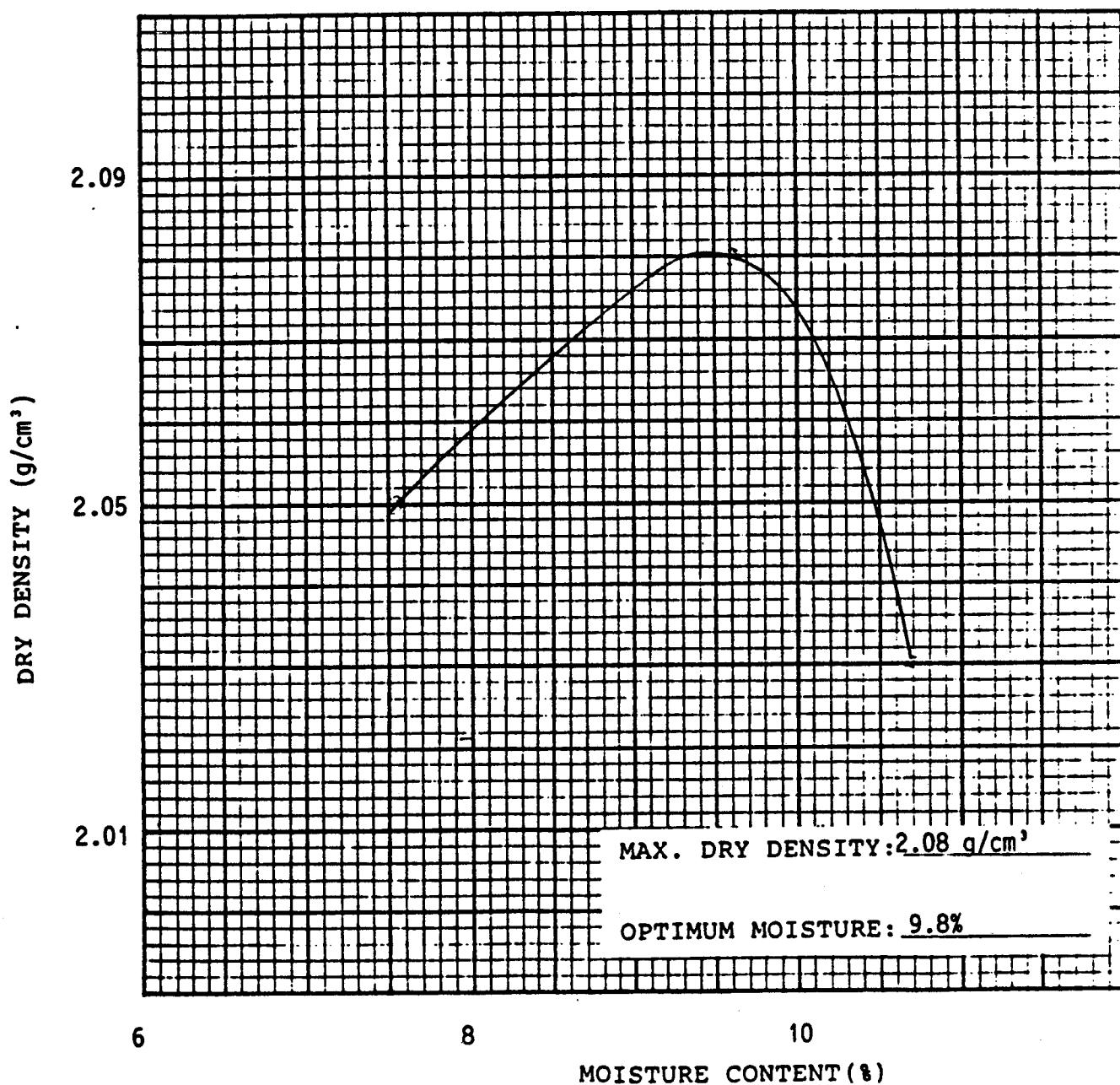
Enclosure No. 36
Date: July 6/88



Client: Blossoming Rose Management & Laburnham Investments Inc.
Project: Proposed Trunk Sewer Line Along 14th Ave & 9th Line Connection
Sample: On-site Location: B.H. 1; Depth 1.52m to 3.05m

MOISTURE - DENSITY RELATIONSHIPS

Mode of Proctor: Standard



Report No. 88-1708
Order No. SP-1190

Enclosure No. 37
Date: July 6/88



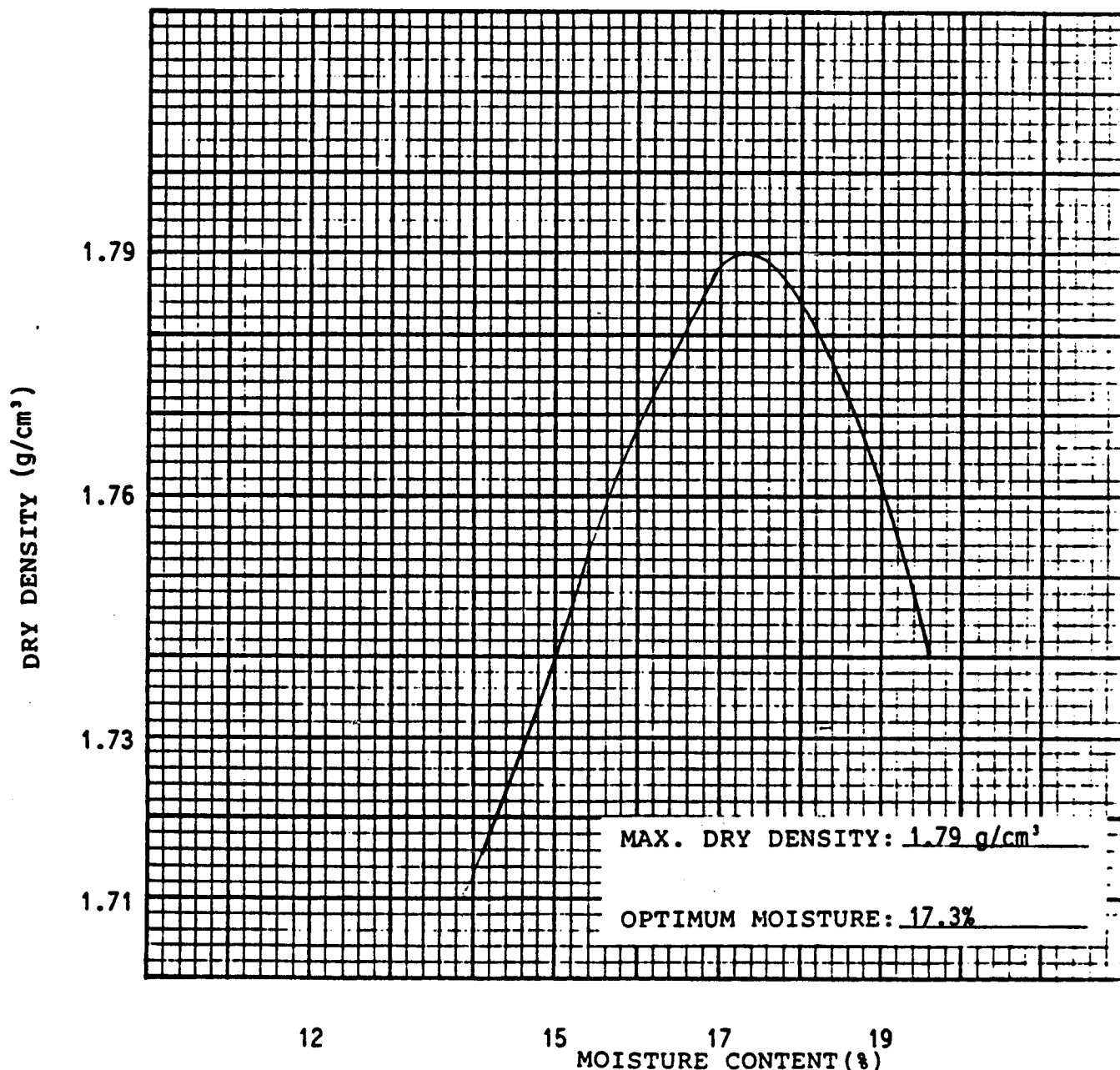
Client: Blossoming Rose Management & Laburnham Investments Inc.

Project: Proposed Trunk Sewer Line Along 14th Ave & 9th Line Connection

Sample: On-site Location : B.H. 8; Depth 1.52m to 3.05m

MOISTURE - DENSITY RELATIONSHIPS

Mode of Proctor: Standard



Report No. 88-1708
Order No. SP-1190

Enclosure No. 38
Date: July 6/88



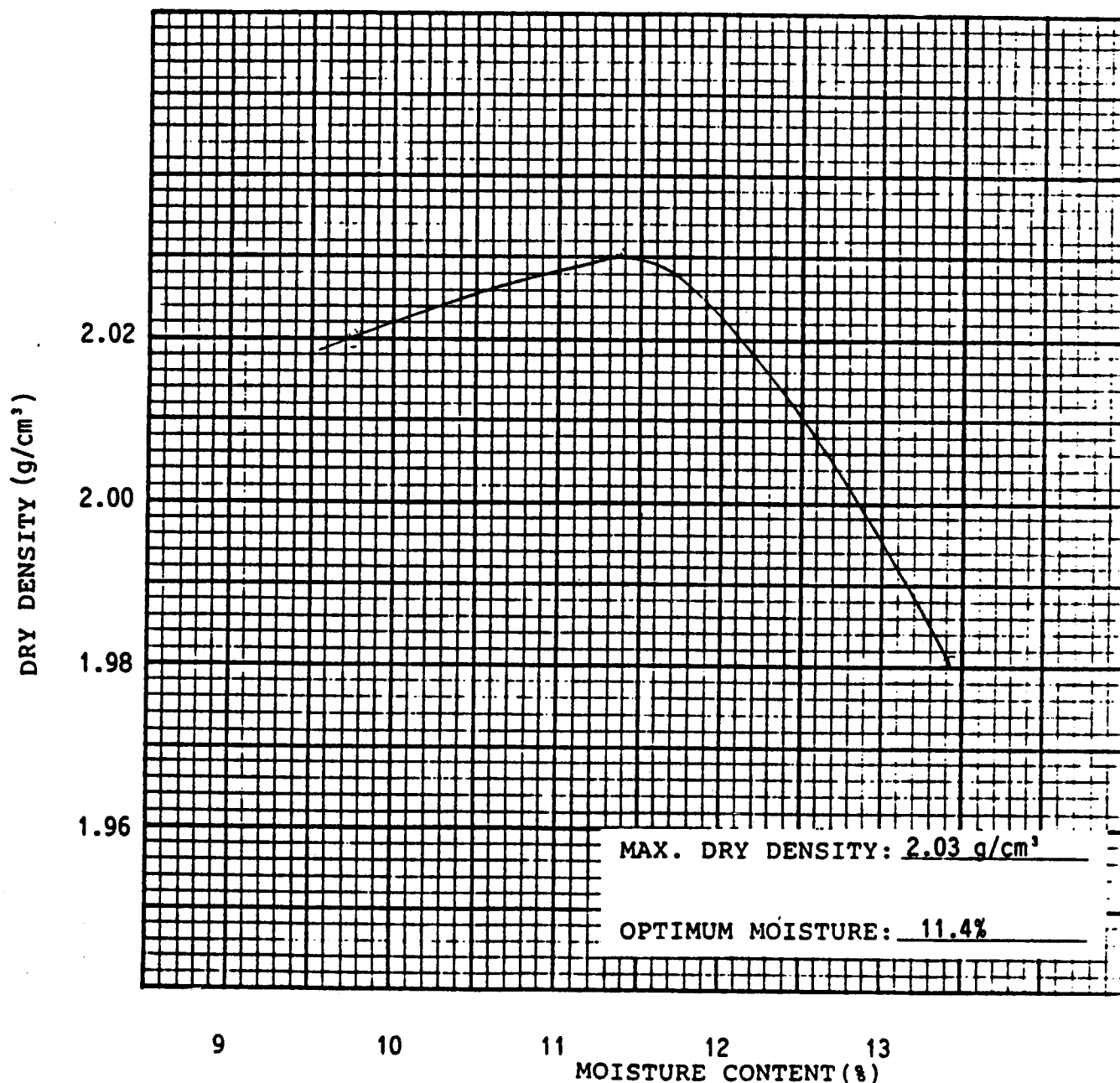
Client: Blossoming Rose Mgt. & Laburnham Inv. Inc.

Project: Proposed Trunk Sewer Line Along 14th Ave & 9th Line Connection

Sample: On-site Location: B.H. 13; Depth 1.52m to 3.05m

MOISTURE - DENSITY RELATIONSHIPS

Mode of Proctor: Standard





SOIL PROBE LIMITED

PIEZOMETER/STAND PIPE RECORD

JOB NO. SP-1190 BOREHOLE NO. 5
 DATE INSTALLED April 15/88 TIME 12:30 p.m.
 DEPTH OF TIP OF PIEZOMETER/STAND PIPE BELOW GRADE 16.64m
 ELEVATION: GRADE 169.23m
 TIP OF PIEZOMETER/STAND PIPE 152.59m
 TOP OF PIEZOMETER/STAND PIPE 169.23m

READINGS

Date	Time	Water Level		Remarks
		Depth(m)	Elevation(m)	
April 15/88	1:15 p.m.	12.35	156.88	
April 15/88	4:50 p.m.	11.08	158.15	
April 16/88	10:30 a.m.	7.75	161.48	
April 18/88	8:00 a.m.	6.05	163.18	
April 18/88	11:30 a.m.	6.05	163.18	
April 18/88	5:15 p.m.	6.05	163.18	
April 19/88	7:45 a.m.	6.00	163.23	
"	5:45 p.m.	6.00	163.23	
April 25/88	3:55 p.m.	6.00	163.23	
April 29/88	4:30 p.m.	6.00	163.23	
May 4/88	3:30 p.m.	6.03	163.20	

GENERAL OBSERVATIONS:



SOIL PROBE LIMITED

Enclosure No. 40

PIEZOMETER/STAND PIPE RECORD

JOB NO. SP-1190 BOREHOLE NO. 2

DATE INSTALLED April 12/88 TIME 5:15 p.m.

DEPTH OF TIP OF PIEZOMETER/STAND PIPE BELOW GRADE 5.72m

ELEVATION: GRADE 177.55m

TIP OF PIEZOMETER/STAND PIPE 171.83m

TOP OF PIEZOMETER/STAND PIPE 177.47m

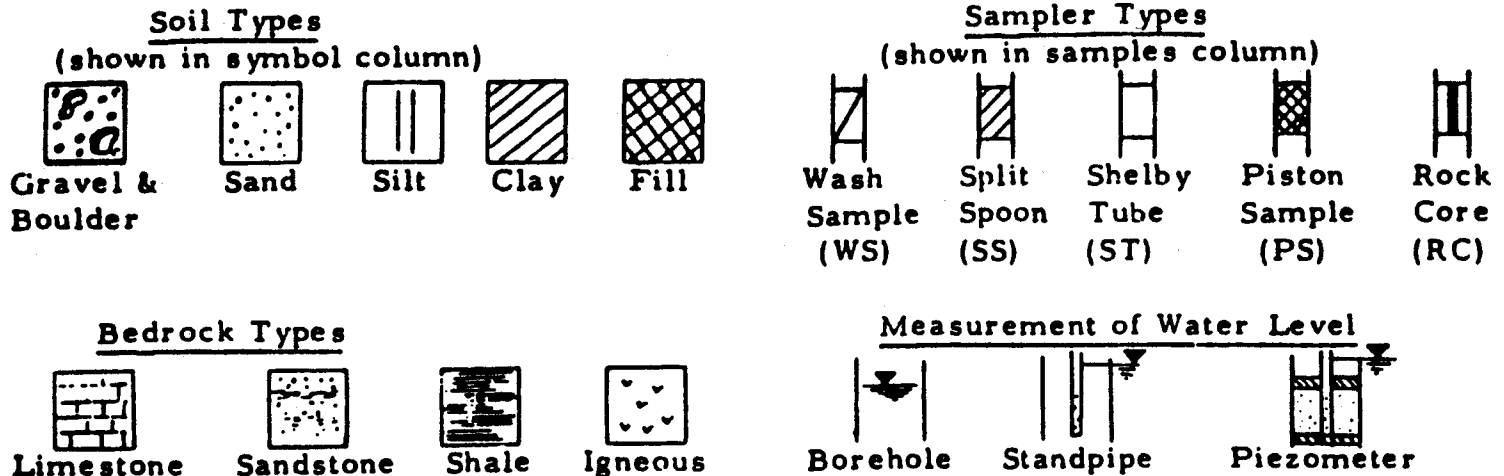
READINGS

Date	Time	Water Level		Remarks
		Depth(m)	Elevation(m)	
April 13/88	7.45 a.m.	5.20	172.23	
"	12:24 p.m.	5.20	172.23	
"	4:30 p.m.	5.20	172.23	
April 14/88	7:24 a.m.	5.20	172.23	
April 15/88	10:30 a.m.	5.20	172.23	
"	5:15 p.m.	5.20	172.23	
April 16/88	10:45 a.m.	5.20	172.23	
April 18/88	11:15 a.m.	5.20	172.23	
April 18/88	5.00 p.m.	5.20	172.23	
April 19/88	7:50 a.m.	5.20	172.23	
"	5:49 p.m.	5.20	172.23	

GENERAL OBSERVATIONS:



SYMBOLS AND TERMS USED ON THE OFFICE BOREHOLE RECORD



TERMS DESCRIBING RELATIVE DENSITY & SOIL CONSISTENCY

- A. COARSE GRAINED SOILS** (major portion retained on No. 200 sieve): includes (1) clean gravels, sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests or by the Standard Penetration Test Resistance "N" -value (the number of blows of a 140-pound hammer falling 30 inches, required to drive a 2-inch o.d. split spoon sampler one foot into the soil).

<u>DESCRIPTIVE TERM</u>	<u>"N"-VALUE</u> (blows/foot)	<u>RELATIVE DENSITY</u> (%)	<u>FRICTION ANGLE</u> (degrees)
Very loose	< 4	< 15	< 28
Loose	4 to 10	15 - 35	28 - 32
Compact or medium	10 to 30	35 - 65	32 - 36
Dense	30 to 50	65 - 85	36 - 40
Very dense	> 50	> 85	> 40

Note: Occasionally correlation is attempted from the Dynamic Cone Penetration Test results, which involves recording the number of blows of a 140-pound hammer falling 30 inches, required to drive a 2-inch diameter 60-degree cone one foot into the soil where the cone is attached to an "A" size drill rod and casing is not used.

- B. FINE GRAINED SOILS** (major portion passing No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, silty clays, and (3) clayey silts. Consistency is rated according to undrained shear strength as indicated by in-situ field or Laboratory Vane tests, unconfined compression tests, or occasionally by standard penetration tests.

DESCRIPTIVE TERM**UNDRAINED SHEAR STRENGTH**
(Pounds per sq. ft.)**"N"-VALUE**
(blows per ft.)

Very soft	< 250	< 2
Soft	250 to 500	2 - 4
Firm	500 to 1000	4 - 8
Stiff	1000 to 2000	8 - 15
Very stiff	2000 to 4000	15 - 30
Hard	> 4000	> 30

Note: Slickensided and fissured clays may have lower shear strengths than shown above, because of planes of weakness or cracks in the soil.

Terminology used for describing various soil strata encountered in a borehole is based upon the proportion of individual particle sizes present in the deposit as follows:-

DESCRIPTIVE TERM**PROPORTION**
(%)

Trace	< 10
Some	10 - 20
Adj (eg. Silty or Sandy)	20 - 35
and (eg. Silt and Sand)	35 - 50

SOIL TESTS PERFORMED
(Shown on Borehole Record)

H - Hydrometer Analysis	V - In-situ Field Vane
S - Sieve Analysis	v - Laboratory Vane in Tube Sample
A - Atterberg Limits	U - Unconfined Compression Test
W - Water Content	UU - Unconsolidated Undrained Triaxial
γ_u - Unit Weight	CU - Consolidated Undrained Triaxial with pore water pressure measurements
G _s - Specific Gravity	CD - Consolidated Drained Triaxial
C - Consolidation	

TERMS CHARACTERIZING SOIL STRUCTURE

<u>Desiccated</u>	- having visible signs of weathering by oxidation of clay minerals, etc. and a conspicuous cubic structure.
<u>Fissured</u>	- containing shrinkage cracks, usually more or less vertical
<u>Varved</u>	- composed of thin layers of varying color and texture.
<u>Stratified</u>	- composed of thin alternate layers of different soil types, e.g. silt & sand or silt & clay.
<u>Well graded</u>	- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
<u>Uniformly graded</u>	- predominantly of one grain size.

Balke Engineering Inc.
Structural Engineers
2553 Merrington Crescent
Mississauga, Ontario
L5K 2B8



Attn : Mr. K. Bartusevicius, P.Eng.

**RE: PILE FOUNDATION DESIGN
FOR BRIDGE ACROSS THE
ROUGE RIVER AT 14TH. AVENUE
TOWN OF MARKHAM, ONTARIO**

REPORT NO. 90-3160
September 14, 1990

RECEIVED SEP 21 1990

SITE NO. 37-168

DISTRIBUTION

- 2) Balke Engineering Inc.
- 1) East Woodbridge Development Ltd.
- 1) Dipen Mukherjee & Associates Ltd.
- 1) File (SP-1190)

SOIL PROBE LTD.



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SOIL PROBE LTD.

CONSULTING GEOTECHNICAL, INSPECTION & TESTING ENGINEERS

110 Ironside Crescent, Unit 20, Scarborough, Ontario M1X 1M2

Tel: (416) 754-7055

Fax: (416) 754-1259

DATE September 14, 1990

Our Report No.: 90-3160

Our File No.: SP-1190

1.0 INTRODUCTION

Mr. K. Bartusevicius, P. Eng. of Balke Engineering Inc. requested Soil Probe Ltd. to use field and laboratory data collected during earlier soil investigation for the design of the pile foundation of the proposed bridge across the Rouge River on 14th. Avenue, Town of Markham, according to the Ontario Highway Bridge Design Code (OHBD) . In addition the stability of the slopes at the site, both before and after the construction, should be determined.

The Ministry of Transportation was contacted for clarification of certain points, especially concerning the slope stability analysis.

Permission was sought from Dipen Mukherjee and Associates Inc. and East Woodbridge Development Limited who gave us the authority to proceed.

An earlier report has been submitted. This report is a revision of the earlier report after further consultations with the Ministry of Transportation.



2.0 PILE FOUNDING LEVELS

After reviewing the field data obtained from Boreholes 9, 9A, 10, 10A, 16 and 17 as shown in Enclosure Nos. 1 through 12, we recommend the use of 0.30m diameter steel pipe end-bearing piles. In our estimation the piles will develop end-bearing at the following depths of 12.5m (B.H.# 9A), 15m (B.H.# 10A), 9.5m (B.H.# 16) and 12.5m (B.H. # 17). This corresponds to the elevations of 141.45m (B.H.# 9A), 140.39 (B.H.#10A), 143.91m (B.H.# 16) and 142.71m (B.H.# 17).

Based on the results of the standard penetration and dynamic cone driving tests, we estimate the values for the following parameters for the soil at the load bearing level.

Angle of internal friction (ϕ') = 45°
Wet unit weight of soil (γ) = 22 kN/m³



For soils above this depth, the following values are assumed:

Angle of internal friction (ϕ) = 32°
Wet unit weight of soil (γ) = 22kN/m^3

The soil at the bearing stratum is non-cohesive.

3.0 AXIAL LOAD BEARING CAPACITIES OF THE PILES

The following load capacities have been determined for HP 310 x 79 and HP 310 x 110 piles as well as for 300mm outside diameter steel pipe piles (with 5.56mm thick walls):

- a) Ultimate Capacity
- b) Factored Axial Capacity at Ultimate Limit State (ULS)
- c) Factored Axial Capacity at Serviceability Limit State (SLS) Type II

3.1 Ultimate Capacity

The ultimate capacity was determined using the dynamic Hiley Formula and the following results were obtained.



Report No. 90-3160

- 4 -

PILE	ULTIMATE CAPACITY
	(kN)
HP 310 x 79	2500
HP 310 x 110	3500
300mm Diameter steel pipe	2100

3.2 Factored Axial Capacity at Ultimate Limit State (ULS)

The factored axial capacity at ULS is obtained by multiplying the ultimate capacity as obtained by dynamic analysis i.e Hiley formula, as presented in Section 3.1 with a strength factor (F_b). The appropriate F_b in this case is 0.4.

Therefore the axial capacity at ULS are as follow:

<u>PILE</u>	AXIAL CAPACITY AT ULS
	(kN)
HP 310 x 79	1000
HP 310 x 110	1400
300mm Diameter Steel pipe	840

.../5



3.3 Axial Capacity at Serviceability Limit State (SLS) Type II

The axial capacity of the piles at SLS Type II have been determined to be as follow:

<u>PILE</u>	<u>AXIAL CAPACITY AT SLS</u> <u>(TYPE II) kN</u>	
HP 310 x 79		830
HP 310 x 110		1160
300mm diameter steel pipe		700

4.0 LATERAL CAPACITY OF PILES

The lateral capacities of the vertical piles at Ultimate Limit State (ULS) and serviceability Limit States (SLS) Type II are :

<u>PILE</u>	<u>CAPACITY (kN)</u>	
	<u>ULS</u>	<u>SLS</u>
HP 310 x 79	60	40
HP 310 x 110	80	60
300mm diameter steel pipes	80	60



5.0 EARTH PRESSURE

We assume the backfill material will be granular 'B'. It is recommended that the backfill material should be compacted to a minimum of 95% standard Proctor maximum dry density. The compacted granular 'B' will have unit weight (γ) and angle of internal friction of 20 kN/m³ and 30°, respectively.

5.1 Ultimate Limit State

Factored angle of internal friction (ϕ_f) can be obtained from the same relationship given in Section 1.0.

$$\begin{aligned}\text{Therefore } \tan \phi_f &= F_\phi \tan \phi \\ F_\phi &= 0.8 \\ \phi_f &= 25^\circ\end{aligned}$$

The coefficients of earth pressure are as follows:

a) Active state	0.41
b) Passive state	2.46
c) At-rest state	0.58

Load factors must be applied to the earth pressures obtained. The load factors for active, passive and at-rest conditions are, respectively, 1.25, 0.6 and 1.40.



5.2 Serviceability Limit States

The coefficients of earth pressure to be used are as follows.

a) Active state	0.33
b) Passive state	3.00
c) At-rest state	0.50

6.0 SLOPE STABILITY ANALYSIS

As mentioned earlier, we have been requested to analyse the slopes in the vicinity of the proposed bridge. Further clarification was sought from the Ministry of Transportation regarding this item. The ministry indicated that they want the slopes analysed for conditions before and after the construction.

The steepest slope, according to the drawing provided by Balke Engineering Inc. was the west bank of the Rouge River at the south side of the proposed bridge.

This slope was analysed as it is. The minimum factor of safety obtained was 1.89. The computer print-out for this analysis showing the minimum failure circle is shown in Enclosure No. 13.



The final slope after the completion of the bridge was analysed both for normal water level and for 100 year flood water level. The live loading applied to the slope was the OHBD Lane Load for Class B highway. The result of the analysis for the normal water level shows the minimum factor of safety of 1.85 (see Enclosure No. 14) while that for the 100 - year flood level is 1.58 as illustrated in Enclosure No.14. These analyses show that the slopes before and after construction are stable.

7.0 CLOSURE

We hope the above information satisfy your present needs. If you have any questions please do not hesitate to contact the undersigned.

Respectfully Submitted,
SOIL PROBE LTD.

A handwritten signature in black ink, appearing to read "John Dogbey".

John Dogbey, P.Eng.

JD/as

Encls.





SOIL PROBE LIMITED

RECORD OF BOREHOLE No⁹

ENCLOSURE No. 1

DATE April 19/88

Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave, Markham, Ont

HOLE ELEVATION 153.95m

WL-WATER LEVEL

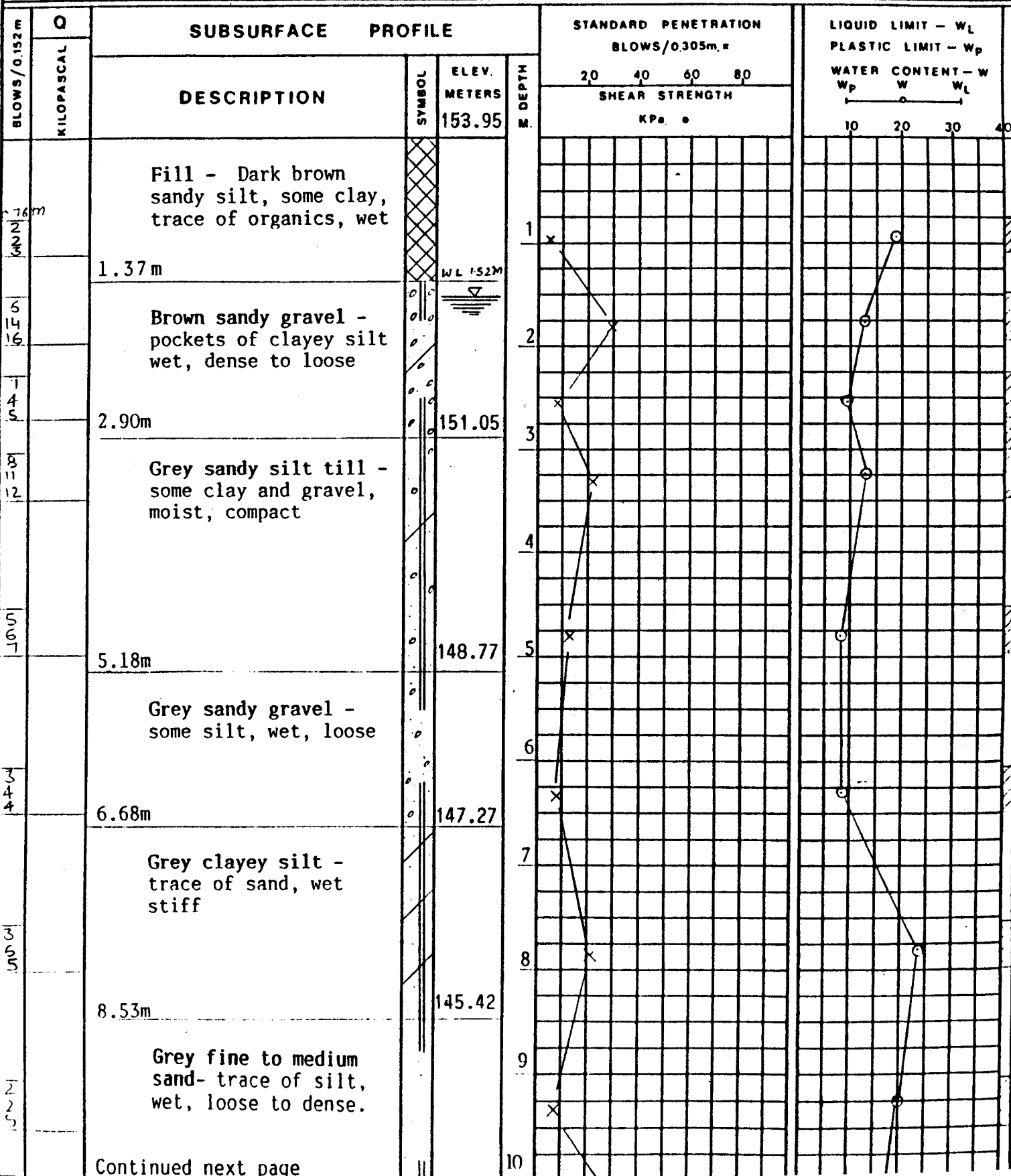
O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +⁸

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ☒

SOIL PROBE LIMITED

ENCLOSURE No. 2
DATE April 22/88

Page 2 of 2

RECORD OF BOREHOLE No 9

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdiv.
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 153.95m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE 

0.05m. I.D. SHELBY TUBE — 

VANE TEST 8

SENSITIVITY (S) +⁹

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ●

BLOWS/0.152 m	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m. =		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W		
		DESCRIPTION	SYMBOL	ELEV. METERS	DEPTH M.	SHEAR STRENGTH		W _p W W _L	
						KPa. •		10 20 30 40	
				143.95	10				
7 17 29		Grey fine to medium sand - trace of silt, wet, loose to dense		142.63	11	X			
		11.32m			12				
		B.H. caved to 3.89m			13				
					14				
					15				
					16				
					17				
					18				
					19				
					20				

SOIL PROBE LIMITED

ENCLOSURE No. 3

DATE April 19/88

Page 1 of 2

RECORD OF BOREHOLE No 9A

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 153.95m

WL-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE

0.05m. I.D. SHELBY TUBE

VANE TEST 8

SENSITIVITY (S) +⁰

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ●

BLOWS / 0.152 m	Q KILOPASCAL	SUBSURFACE PROFILE	ELEV. METERS	DEPTH M.	STANDARD PENETRATION BLOWS / 0.305m = SHEAR STRENGTH KPa •	LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W W _p W W _L
		DESCRIPTION			20 40 60 80	10 20 30 40
			153.95	0		
				1		
				2		
				3		
				4		
				5		
				6		
				7		
				8		
				9		
				10		

Augered to 12.19m

W.L.
@ 1.52m
▼
≡≡≡

Continued next page



SOIL PROBE LIMITED

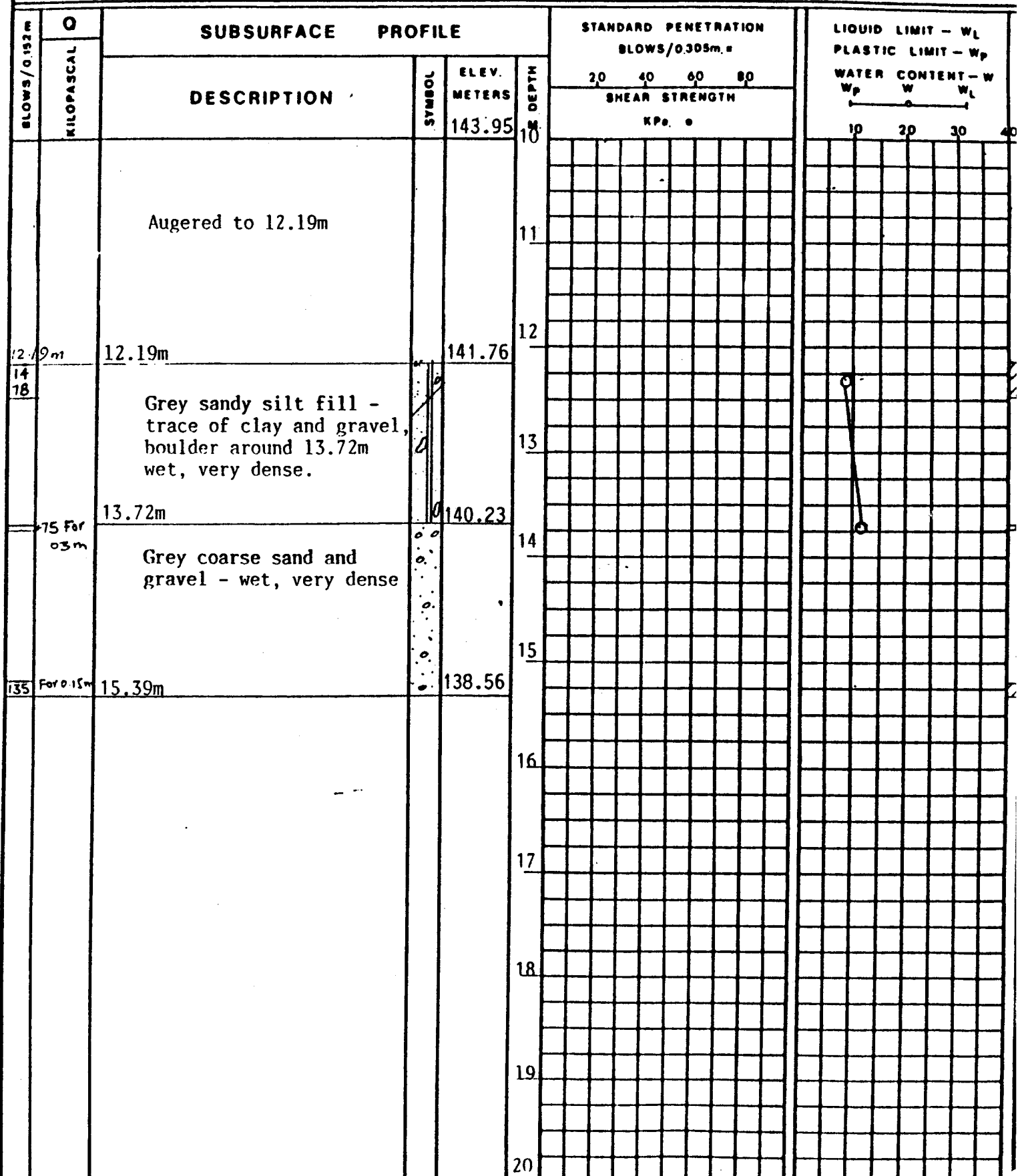
RECORD OF BOREHOLE No 9A

ENCLOSURE No. 4
DATE June 6/88
Page 2 of 2

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdiv.
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 153.95m

W.L.-WATER LEVEL
Q-PENETROMETER TEST RESULT
0.05m O.D. SPLIT TUBE ☒
0.05m I.D. SHELBY TUBE ☐

VANE TEST &
SENSITIVITY (S) +
UNDRAIN TRIAXIAL AT
OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 10

ENCLOSURE No. 5DATE April 19/88

Page 1 of 2

OUR ORDER No. SP-1190PROJECT Proposed North Rouge Res. Subdiv.LOCATION 14th Avenue, Markham, Ont.HOLE ELEVATION 155.39m

WL-WATER LEVEL

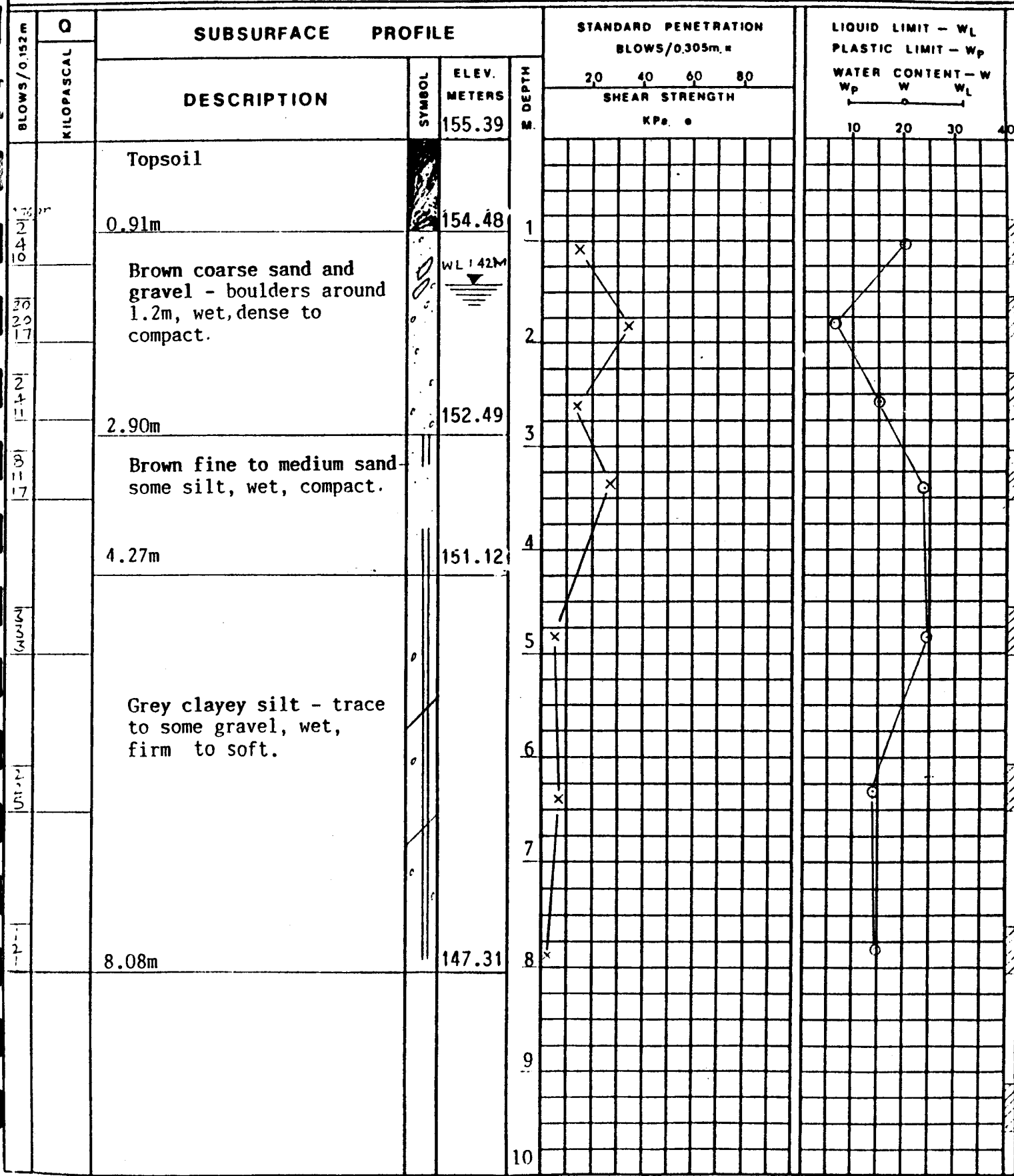
O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) \pm

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ϕ 



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 10A

ENCLOSURE No. 6
DATE April 22/88

Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Avenue, Markham, Ontario

HOLE ELEVATION 155.39m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

0.05m I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +³

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE 0

BLOWS/0.152m	Q KILOPASCAL	SUBSURFACE PROFILE			STANDARD PENETRATION BLOWS/0.305m. x		LIQUID LIMIT - W _L PLASTIC LIMIT - W _p WATER CONTENT - W	
		DESCRIPTION	SYMBOL	ELEV. METERS	DEPTH M.	20 40 60 80 SHEAR STRENGTH KPa. 0	10 20 30 40	
				155.39				
					1			
					2			
					3			
					4			
					5			
					6			
					7			
					8			
					9			
					10			

Augered to 9.14m

Grey clayey silt

9.14m 146.25

Continued next page



SOIL PROBE LIMITED

RECORD OF BOREHOLE No 10A

ENCLOSURE No 7
DATE April 19/88

Page 2 of 2

OUR ORDER No SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave, Markham, Ont.

HOLE ELEVATION 155.39m

W.L.-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m O.D. SPLIT TUBE ☒

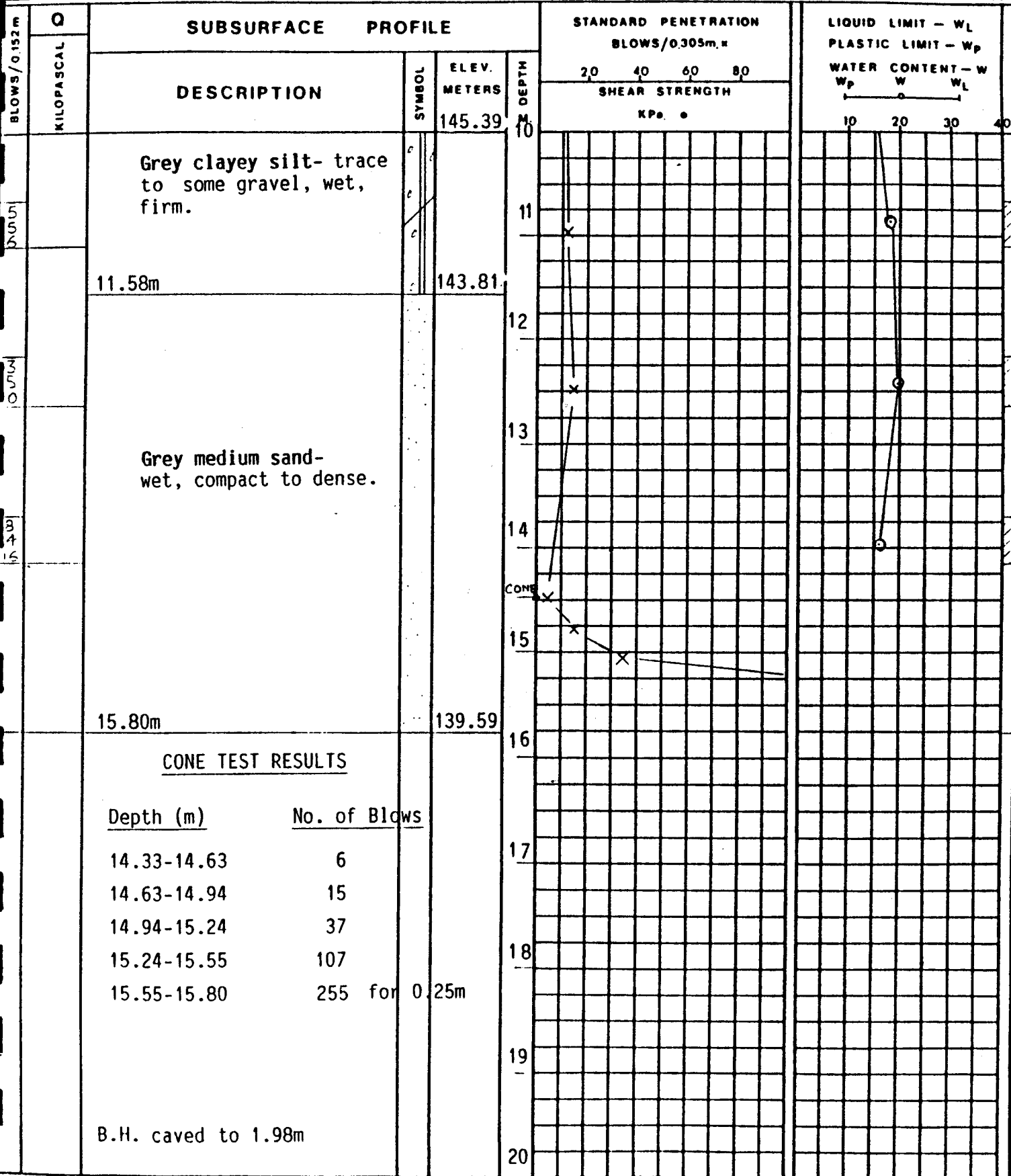
0.05m I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +³

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE



SOIL PROBE LIMITED

ENCLOSURE No. 8
DATE April 25/88

Page 1 of 2

RECORD OF BOREHOLE No. 16

OUR ORDER No. SP-1190

OUR ORDER No. SI-1150
PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave, Markham, Ont.

HOLE ELEVATION 153.41m

WL-WATER LEVEL

Q-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE

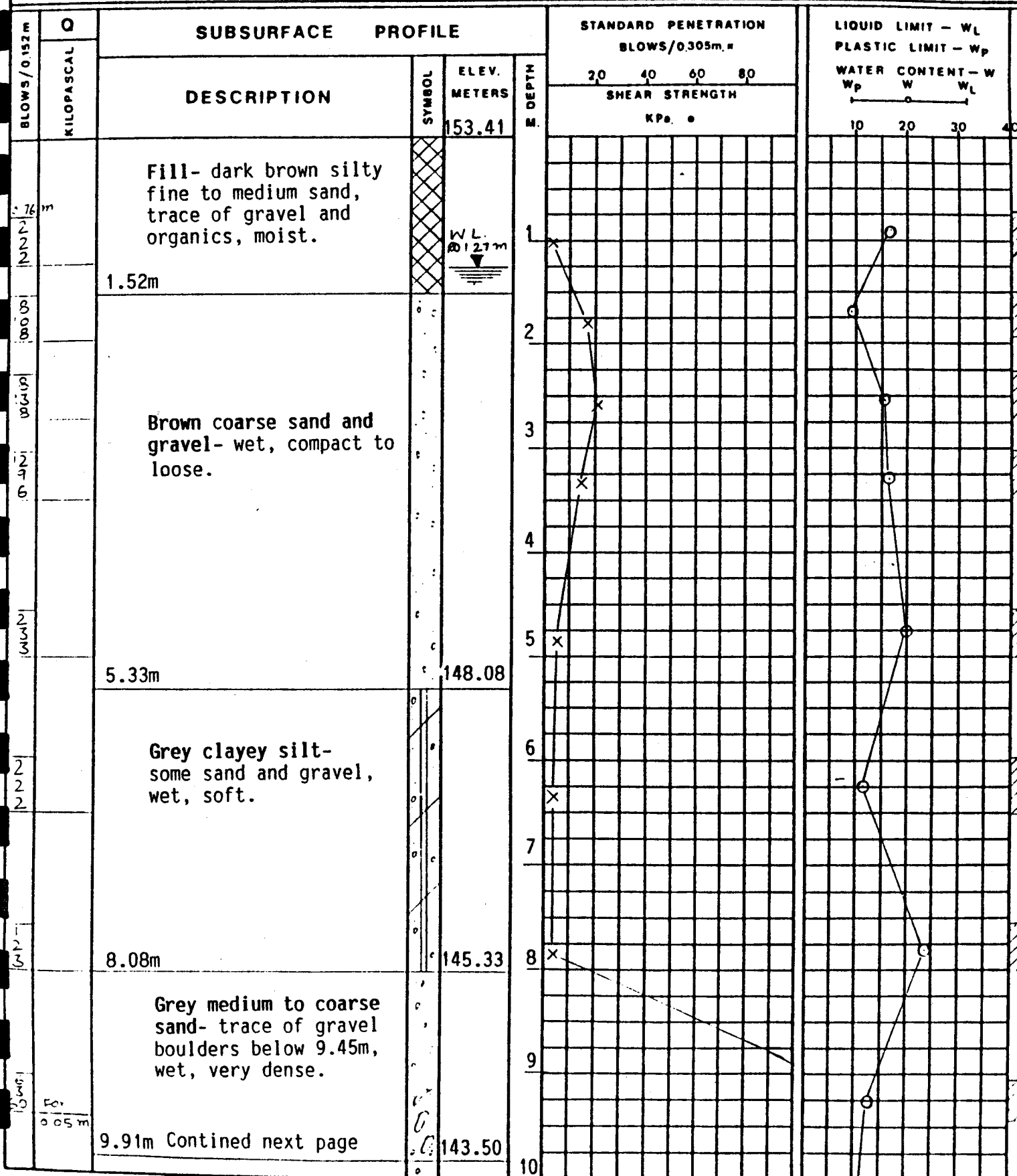
0.05m. I.D. SHELBY TUBE

VANE TEST 1

SENSITIVITY (S) +⁰

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE ●





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 16

ENCLOSURE No. 9
DATE April 25/88
Page 2 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave, Markham, Ont.

HOLE ELEVATION 153.41m

WL-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

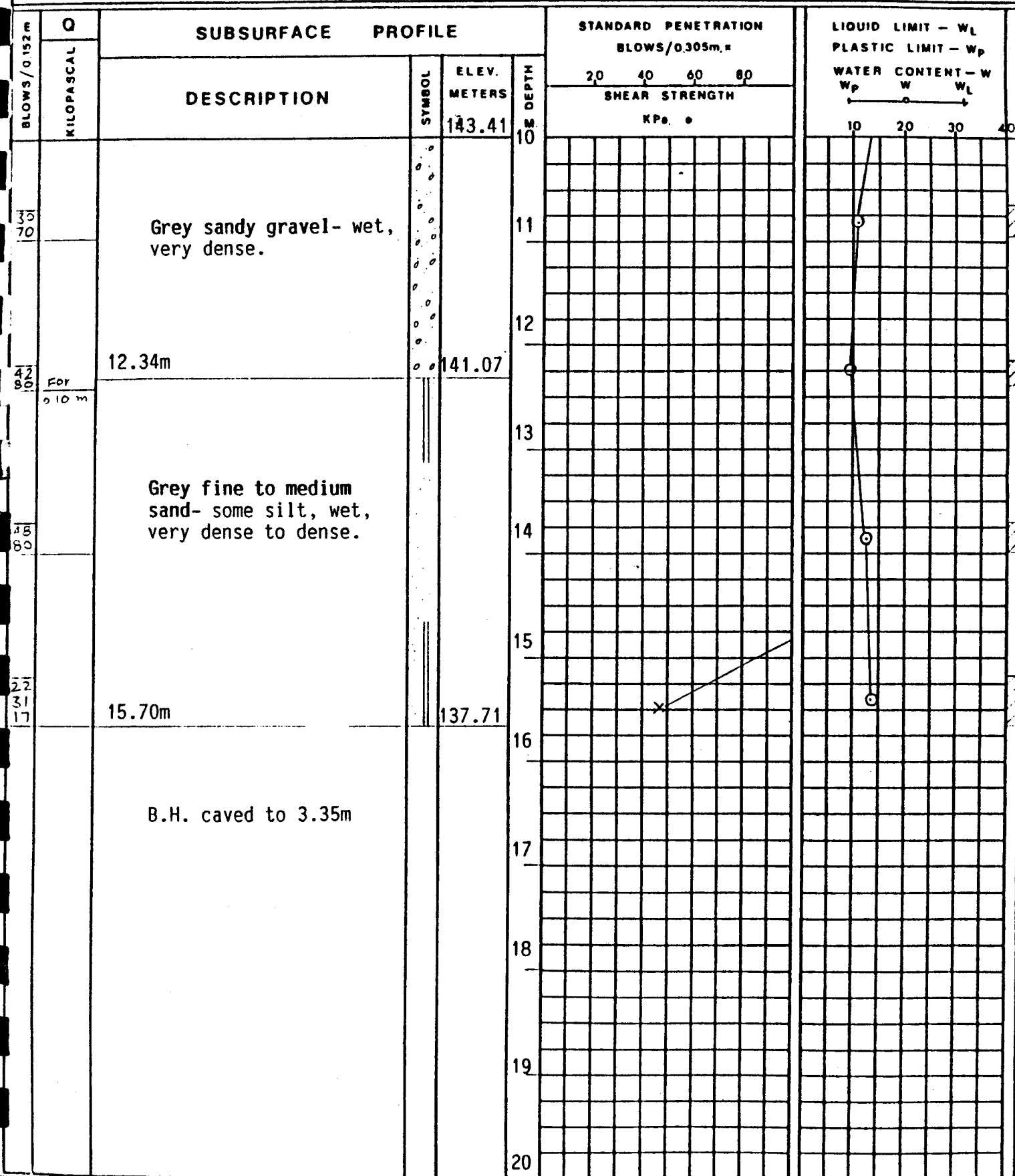
0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +³

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 17

ENCLOSURE No 10

DATE April 22/88

Page 1 of 2

OUR ORDER No. SP-1190

PROJECT Proposed North Rouge Res. Subdiv.

LOCATION 14th Ave. Markham, Ont.

HOLE ELEVATION 155.21m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

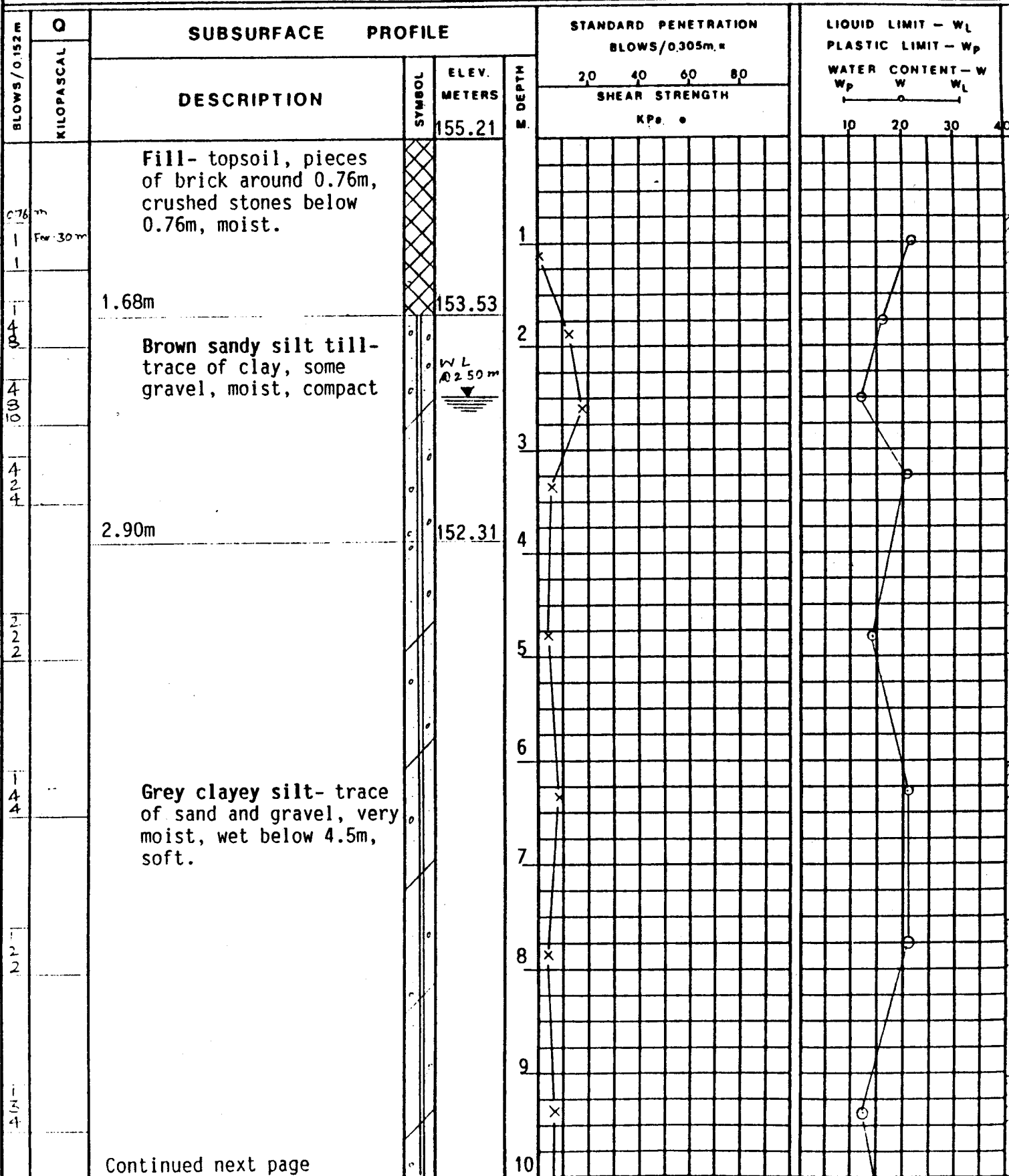
0.05m. O.D. SPLIT TUBE ☒0.05m. I.D. SHELBY TUBE ☐

VANE TEST &

SENSITIVITY (S) +

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SOIL PROBE LIMITED

RECORD OF BOREHOLE No 17

ENCLOSURE No 11
DATE April 22, 1989

Page 2 of 2

OUR ORDER No. SP-1190
PROJECT Proposed North Rouge Res. Subdiv.
LOCATION 14th Avenue, Markham, Ontario
HOLE ELEVATION 155.21m

W.L.-WATER LEVEL

O-PENETROMETER TEST RESULT

0.05m. O.D. SPLIT TUBE ☒

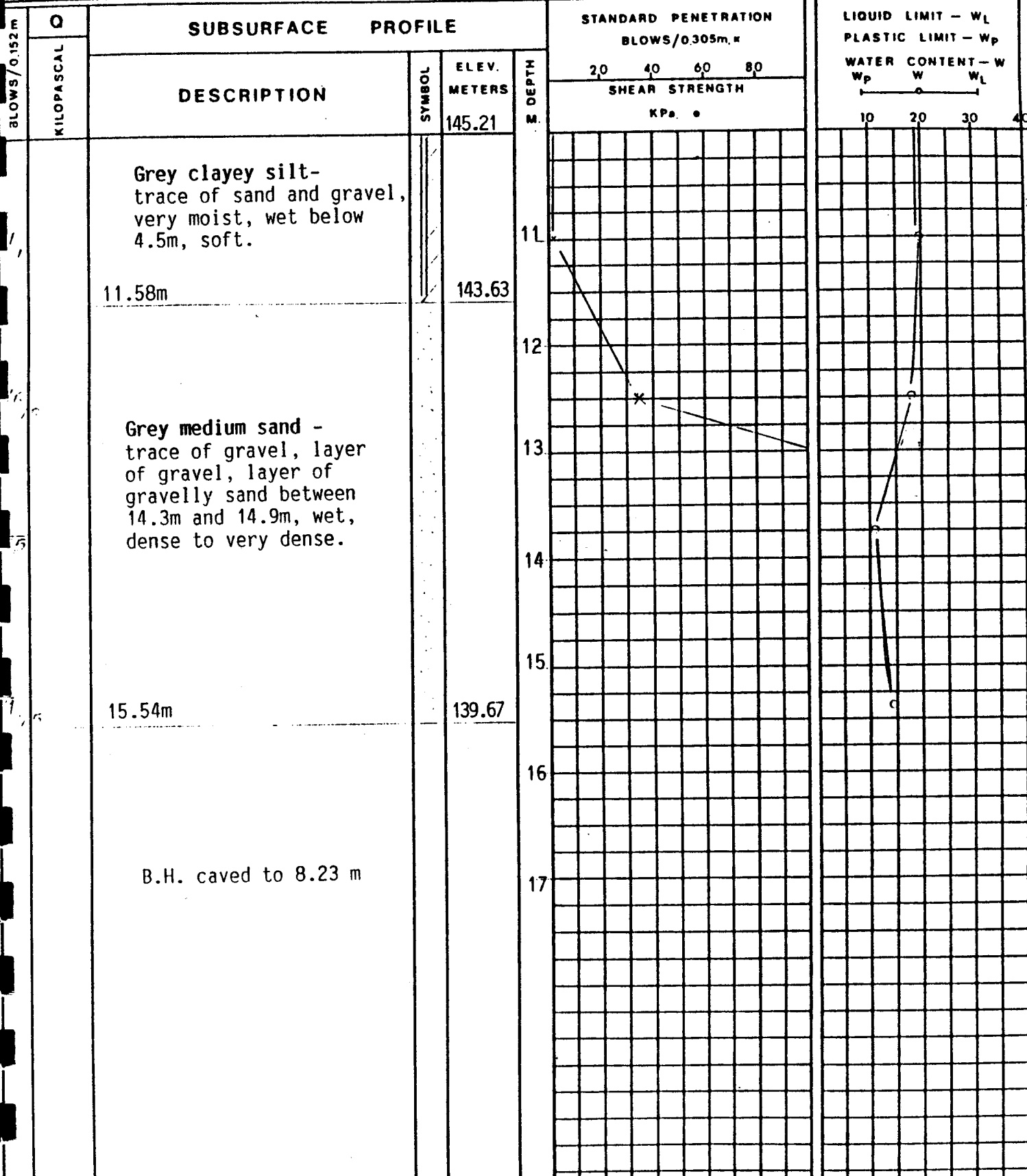
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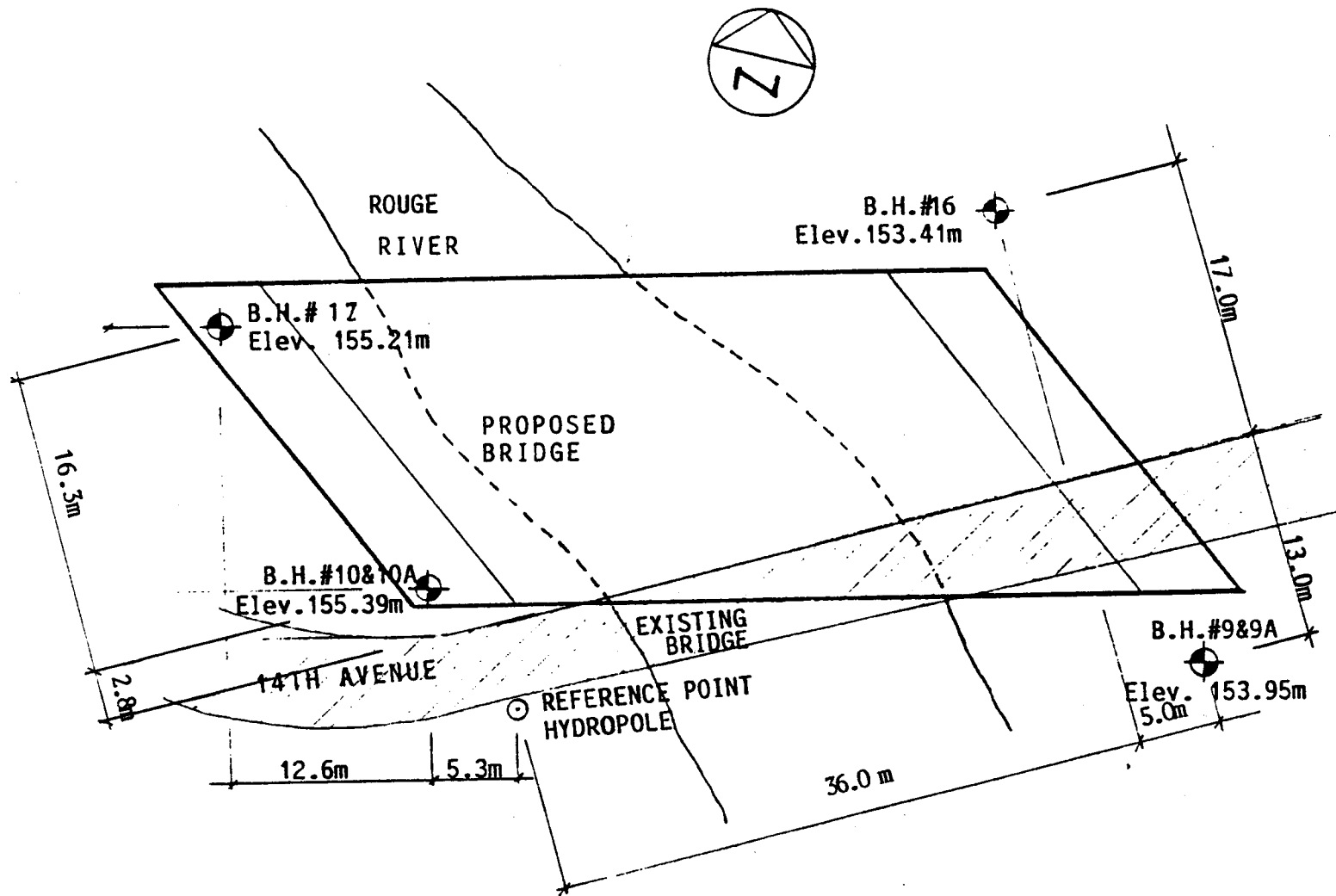
VANE TEST &

SENSITIVITY (S) +

UNDRAIN TRIAXIAL AT

OVERBURDEN PRESSURE





SKETCH SHOWING BOREHOLE LOCATIONS FOR THE PROPOSED BRIDGE OVER
ROUGE RIVER AT 14TH AVENUE, MARKHAM, ONTARIO

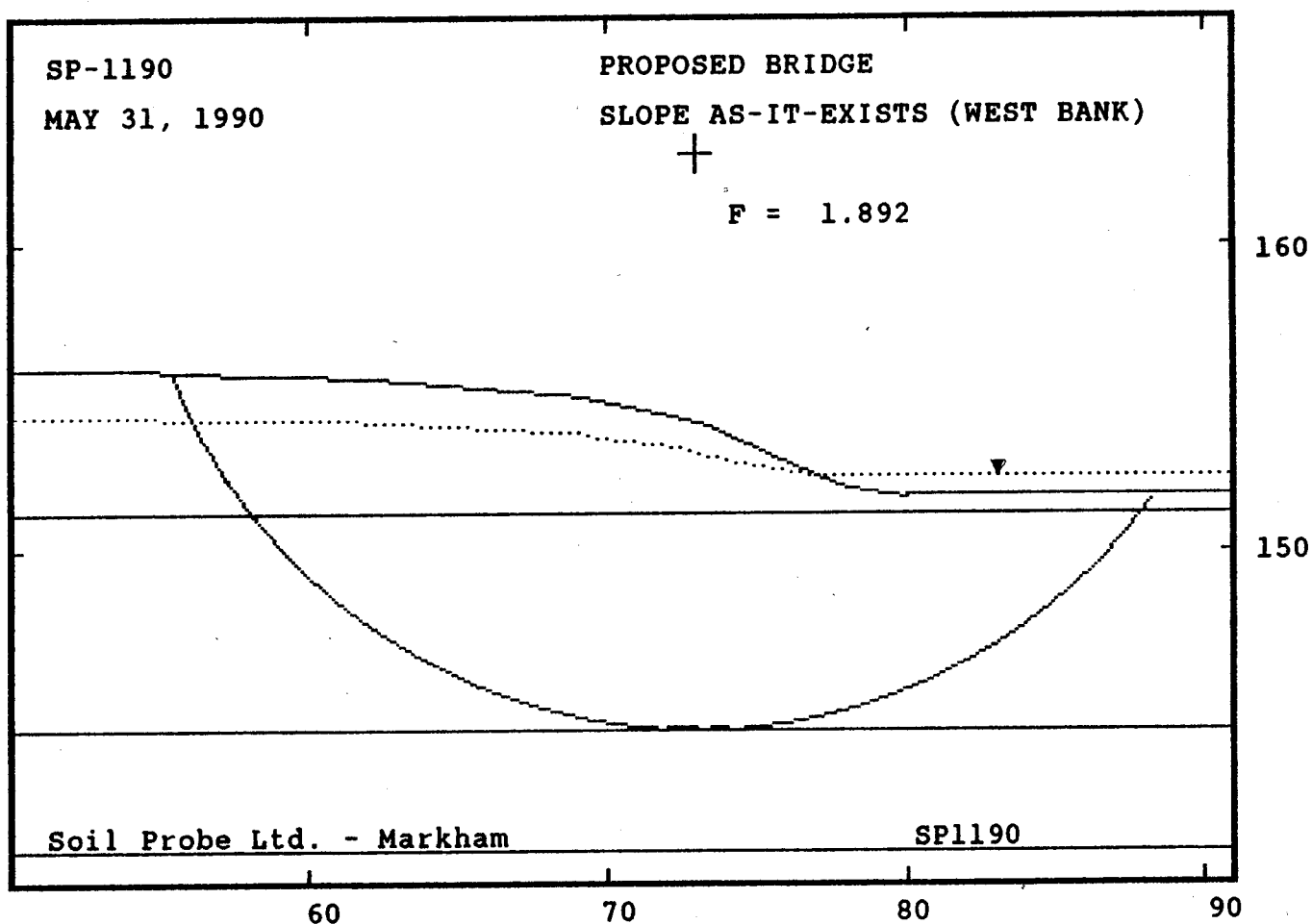


Enclosure No 13

Report No.

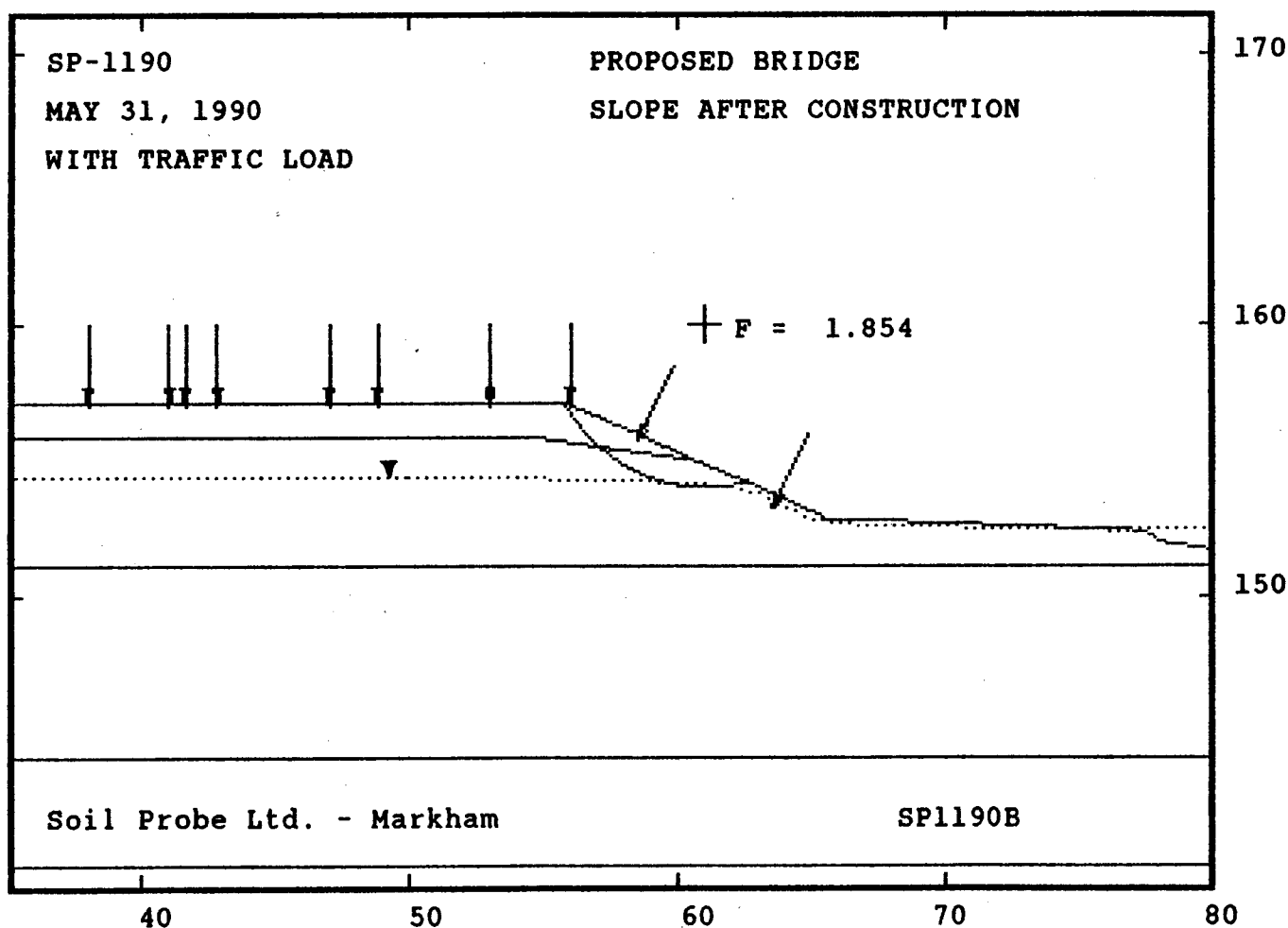


Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Sand	22	0	32	1	0
# 2 -Clayey silt	22	30	0	1	0
# 3 -Compact Sand	22	0	35	1	0
# 4 -Dense Sand	25	0	45	1	0



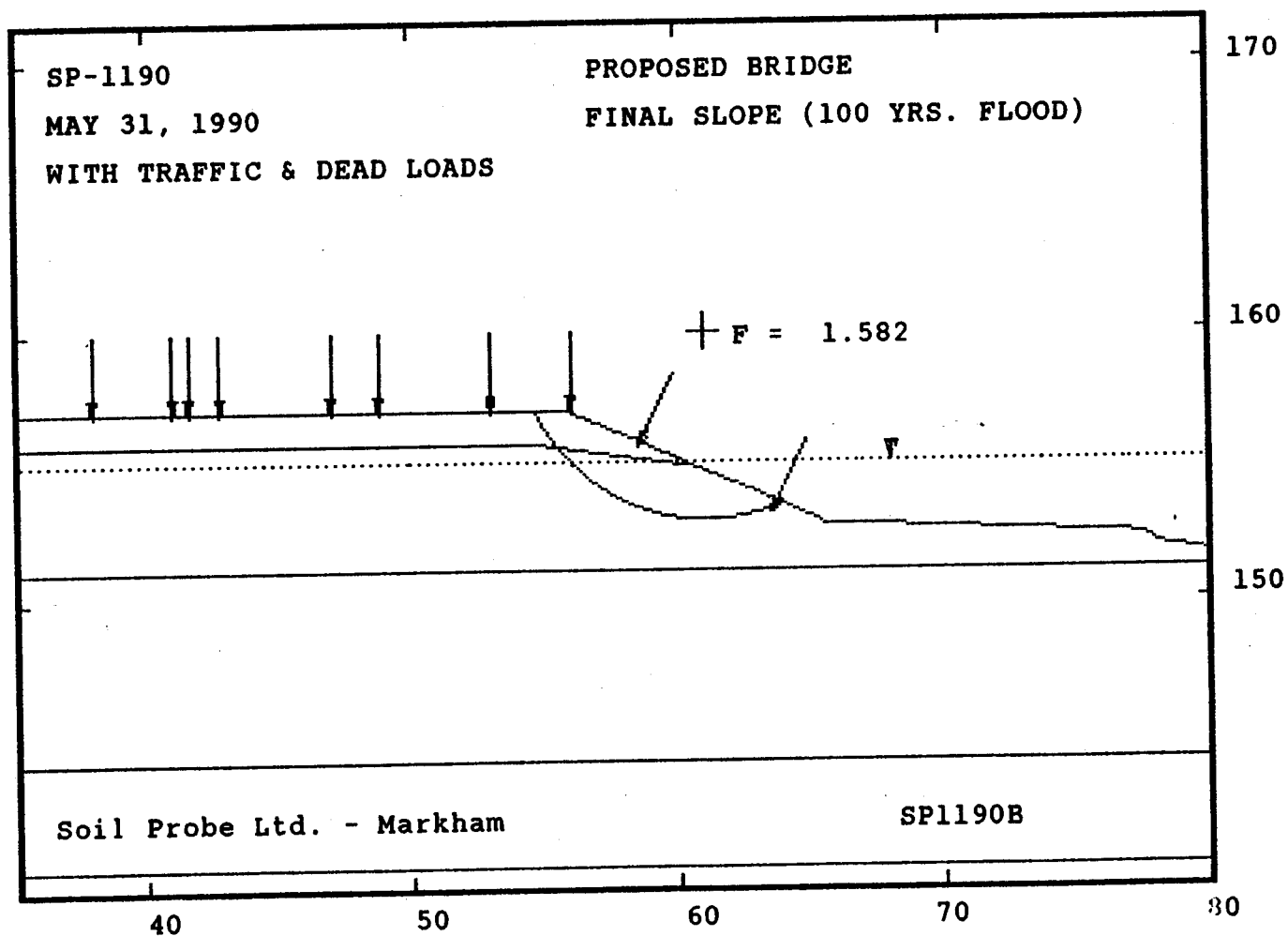


Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Fill	20	0	30	0	0
# 2 -Sand	22	0	32	1	0
# 3 -Clayey silt	22	30	0	1	0
# 4 -Compact Sand	22	0	35	1	0
# 5 -Dense Sand	25	0	45	1	0





Material	Unit Wt	Cohesion	Friction Angle	Piezo Surface	Ru Value
# 1 -Fill	20	0	30	0	0
# 2 -Sand	22	0	32	1	0
# 3 -Clayey silt	22	30	0	1	0
# 4 -Compact Sand	22	0	35	1	0
# 5 -Dense Sand	25	0	45	1	0



MEMORANDUM

To: M. Holowka 90 07 06
Head, Approvals Section
Structural Office

Attn: R. Mihaljevic

From: Foundation Design Section
Room 315, Central Building

Re: Town of Markham
Rouge River Bridge at 14th Avenue
FDS WO # 90-11007, MTO Site 37-168

Further to your memo of June 25/90, we have reviewed

- the bridge foundation portion of the Soil Probe report for this project dated July 5/88
- the Soil Probe letter to Mr. Kasey Bartusevicius of Balke Eng. dated Dec.15/89
- Drawings # S1 and S2 of the Balke Eng Inc, structural drawings dated Mar. 22/90

The structural drawings have been returned to you under cover of this memo.

Our comments follow:

Soil Probe Report

In our opinion, this report provided insufficient recommendations for design of the proposed structure as it only addressed structure foundations. Recommendations are also required for dewatering, frost protection, temporary and permanent slope stability, erosion protection, earth pressure design and any other issues needed for design and construction of the foundations.

Regarding the recommendations for structure foundations, based on our experience, 300 mm diameter concrete-filled steel tube piles will provide neither the most efficient nor the most economical solution. Give these conditions if this were an MTO project, the bridge would be founded on steel H piles driven below elevation 142 m, then in accordance with MTO SS 103-10 or SS 103-11 (Hiley Formula) assuming the following ultimate pile capacities:

PILE TYPE	ULTIMATE CAPACITY
310 HP 79	2475 kN
310 HP 110	3450 kN

For design purposes, the pile tip elevations would be assumed to be elevation 140 m.

For piles driven to these specifications the following OHBDC capacities would be recommended:

	310 HP 79	110 HP 110
Factored Axial Capacity at ULS	1150 kN	1600 kN
Axial Capacity at SLS Type II	825 kN	1150 kN
Factored Lateral Capacity at ULS	60 kN	80 kN
Lateral Capacity at SLS Type II	40 kN	60 kN

Additional lateral capacity, if required, would be obtained by utilizing the lateral component of battered piles.

However, we were not involved with this project and the consultant should be responsible for design of the foundations and should be required to submit appropriate recommendations for structure foundations and the other issues that have been noted.

Soil Probe Letter

Our comments regarding pile capacity have been provided above. Regarding lateral earth pressures, the consultant does in fact know what type of material will be backfill to the abutments since this will be an engineered fill. For an MTO project, backfill to structures would consist of granular material in accordance with MTO Standard Special Provision #121 (83 10). Computation of earth pressures would be in accordance with Section 6.6 1.2 of the OHBDC. For design purposes, the physical properties of the backfill would be as follows:

Material	ϕ	γ
Granular A	35°	22.8 kN/m ³
Granular B	30°	21.2 kN/m ³

Structural Drawings

- S1 - it would be prudent to provide erosion protection for the future widening portion of the abutments
- S2 - since the underside of pile caps is elevation 151.3 m and the groundwater level has been reported as 152± m, dewatering provisions are required
 - the number of piles appears excessive for a bridge of this size and we recommend that this aspect should be reviewed by a structural designer
 - there is confusion over the ultimate pile capacity in the NOTES

If there are any questions, please advise.



D. Dundas, P. Eng.
Sr. Foundation Engineer

for

M. Devata, P. Eng.
Chief Foundation Engineer

DD/1h