



# LARKIN BROS LTD

06500/728-00  
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DEVELOPERS AND BUILDING CONTRACTORS  
INDUSTRIAL, COMMERCIAL, SHOPFITTING SPECIALISTS

P00857  
P00858  
P00884

24 January 1996

Rotorua District Council  
Private Bag RO 3029  
ROTORUA

Attn: Property Records Office

Dear Sir/Madam,

RE: SECTIONS 16. 34. 25 (BLOCK LXIII) AND LOT 1 D.P.S. 19165,  
PUKUATUA STREET, ROTORUA.

Please find enclosed a copy of a Geotechnical Investigation Report covering the above site, together with a covering letter from Browne Spurr and Kronast.

This Geotechnical Report, prepared by Tonkin and Taylor Limited, Consulting Geotechnical Engineers, describes ground conditions on the site and contains test data, interpretation and recommendations.

Please attach this report to the Property File as future engineering design will likely refer to information contained therein.

Yours faithfully,

Eugene Larkin  
for Messrs Kingston, Larkin, Rykers



251 1 012	252 2124 1416	253 4120 954	254 2115 954	255 5110 1012	256 2 506	257 117 506	258 1107 1012	259 736
742	741	740	739	738	737	736		
LXIX								
105/3 012 28 251 171	765/1 1416 18 322	765 1012 19 251 107	764 809 5 201 105	763 4 103	762 809 5 201 101	747 789 157 340	789	789
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783/1 3 1011 783 1	251 6-170 809	7105 783	8100 782	1049 781	251 10162 809	55-02 1155 1406	251 1154 1012	777
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795								

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ST.

251 9 1012	10100	11104	251 12102 1012	1.111 3035	96	251 1694 1012	253 35 1012	748
735	734	733	732	D.P.S. 19165	729	728	748	
LXIII 731								
2 4	D.P.	349	85	757	756	755	754	753
761	760	759	758	757	756	755	754	753
1012	135	135A	862	1012	29	30	31	32
251 137	1	2	3135	28	131	129	127	125
761	152	135	214	251 131	129	127	125	123
753								

ST.

776 251 13 1012	775 148 1164	774 144 1309	773 140 1306	772 150 1274	767 13019 1012	766 20 1012	750 2548
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8		D. P. S.	28899	LXIV	787	786	D.P.S.
794	793	792	791	790	789	788	28464
1012	31	1014	506	506	653	675	1012
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251 105	251	251	125	162	167	173	251 95
794	792	792	792	792	792	792	792

ST.

COPY


**BROWNE SPURR & KRONAST**  
**CONSULTING CIVIL & STRUCTURAL ENGINEERS**


144 Hinemou Street, P.O. Box 23, Rotorua. Telephone (07) 348-5394. Facsimile (07) 348-2311

Larkin Brothers Ltd.  
 P O Box 696  
 ROTORUA

15 November 1995

Attention: Mr. J. Larkin

Dear Sir,

**Re: SECTIONS 16. 34. 35 (BLOCK LXIII) AND LOT 1 D.P.S. 19165**  
**PUKUATUA STREET, ROTORUA**

As requested, we have perused the site investigation report prepared by Tonkin and Taylor Limited for this property which consists of five lots adjacent to the Ranolf Street corner. The report, which was completed in December 1992, has been based on information gained from boreholes and extensive cone penetrometer testing carried out over the site.

The report confirms the presence of soft surface silts over the site/ varying in depth from 4.0m to 12.0m. These silts are very compressible, and make the site unsuitable for surface founding. However, dense sand and gravel layers are located immediately under the soft silts, uniformly throughout the site. This means that a driven pile foundation would prove to be a most satisfactory alternative to surface foundations for buildings up to three stories high, which is the maximum height permitted on site/

We have used short driven piles of this nature on several buildings in Rotorua over the years, and confidently recommend this alternative as being not only very economical, but also very positive in terms of eliminating the risk of differential settlement which can occur when surface founded buildings are constructed on soft or suspect silt layers.

We trust that this provides the assurance you require at this time, and would be pleased to follow this up with more detailed information should the preliminary design and layout of any proposed development for the site become established.

Yours faithfully,

**A.M. BROWNE**  
**BROWNE SPURR & KRONAST**

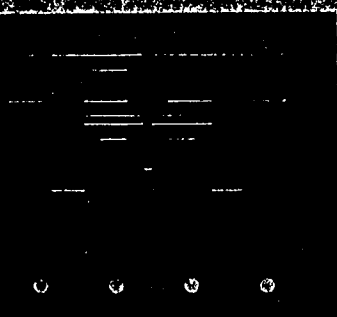
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T O N K I N & T A Y L O R R E P O R T

SITE INVESTIGATION

PUKUATUA ST DEVELOPMENT

ROTORUA





**TONKIN & TAYLOR LTD.** CONSULTING ENGINEERS

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P.O. BOX 5271 AUCKLAND 1 NEW ZEALAND

PH: 64-9-377 1865 FAX 64-9-307 0265

**COPY**

**SITE INVESTIGATION**

**PUKUATUA ST DEVELOPMENT**

**ROTORUA**

Ref: 11722  
December 1992

**PREPARED FOR:**

Pukuatua Street Partnership  
C/- Neville Rykers  
127 Mountain Road  
EPSOM

**DISTRIBUTION:**

Pukuatua Street Partnership  
Tonkin & Taylor Ltd (File)

- 2 copies
- 2 copies



**SITE INVESTIGATION**  
**PUKUATUA STREET DEVELOPMENT**  
**ROTORUA**  
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## 1.0 INTRODUCTION

### 1.1 General

This report presents the results of a site investigation carried out for potential development at the corner of Pukuatua Street and Ranolf Street, Rotorua site. The work was carried out for the Pukuatua Street Partnership at the direction of Mr Neville Rykers. The work is in general accordance with our proposal of 18 November 1992.

The results of the investigation show that the near-surface soils present at the site are generally poor and it is recommended that the proposed development be supported on driven piles.

### 1.2 Scope of Work

The work comprised the following:

- Two machine augered boreholes with in situ testing to a depth of approximately 10 m.
- Nine cone penetrometer tests (CPT) to a depth of approximately 10 m.
- Laboratory testing of undisturbed soil samples to characterise the nature and performance of the materials.
- Investigation of available subsurface information from published geological data and previous Tonkin & Taylor investigations in the vicinity of the proposed site.
- Office evaluation of the investigation and subsequent compilation of a report.

### **1.3 Fieldwork**

The fieldwork was carried out on 27 November 1992 by Geotech Drilling of Wairakei. The work was supervised by a senior technician from Tonkin & Taylor who also logged the boreholes. Disturbed samples of the materials obtained from the augered boreholes were retained and inspected by a geotechnical engineer to confirm the nature of the soils encountered.

Nine cone penetrometer tests (CPT) were carried out over the site. Also, standard penetration tests (SPT) were carried out in both boreholes at regular intervals of depth. The augered boreholes allow the CPT results to be rationalised against the SPT results and the disturbed samples recovered from the site. The locations of the augered boreholes and cone penetration tests are shown on the site plan, see Drawing No. 11722-1. Detailed geological logs of the augered boreholes are presented in Appendix A with core penetration test results in Appendix B.

### **1.4 Laboratory Testing**

Laboratory testing has been undertaken to characterise the recovered soil samples and to investigate their physical response to applied loads. To achieve this, the cohesive soil specimens have been subjected to shear vane tests and one dimensional consolidation tests. Results from these tests have been used in the analysis of the expected bearing capacity and settlement for the various materials. The non-cohesive specimens have been subjected to a particle size analysis to assess the potential for liquefaction under earthquake induced ground motions.

Results of all laboratory tests are presented in Appendix C. The undrained shear strengths obtained for the undisturbed silt samples are summarised in Table 1.



**Table 1**  
**Undrained Shear Strengths From Laboratory Tests**

Borehole	Depth (m)	Cu (kPa)
1	1.3	67
2	2.3	3
2	5.2	0

The silt samples recovered from borehole 2 show exceptionally low strength. Consolidation tests on the material from borehole 2 also confirm high compressibility with a coefficient of volume compressibility ( $M_v$ ) of  $0.87 \text{ m}^2/\text{MN}$  for the loading range of 26.8 kPa to 53.6 kPa. The specimen from borehole 1 displayed a lower coefficient of compressibility of  $0.25 \text{ m}^2/\text{MN}$  for the same loading range.

Particle size analyses have been carried out using sample of non-cohesive soil from boreholes 1 and 2. Both samples contain grain sizes ranging from fine sand to fine gravel which when deposited in a saturated, loose state has the potential to liquefy during earthquake induced ground shaking.

## 2.0 SITE CONDITIONS

### 2.1 Surface Conditions

The proposed site comprises five existing sections situated at the corner of Pukuatua Street and Ranolf Street, Rotorua. The length of the Pukuatua Street boundary is approximately 125 m while the length of the Ranolf Street boundary is approximately 40 m. Numbering the sections one to five from west to east, sections Three and Four include old weatherboard houses with section Three also containing a garage. A hot water bore is located on the north side of section Three and the lawns are described as "soft". Section Five contains single level flats with block end walls and timber frames and cladding. Section Two contains a preload of relatively low density fill with depths ranging from 1.0 m to 1.8 m at the south-east corner. The fill has been in place for a period of approximately 5 years. Section One is clear of any structures or features.

### 2.2 Subsurface Conditions

The New Zealand Geological Survey Map 1:250,000 Rotorua, Sheet 5, 1st Edition describes the geological conditions in the region of the site as being sedimentary alluvium and terrace and fan deposits. These materials are part of the Hawera Series and are of Pleistocene to Holocene age.

Our experience with soils in the Rotorua area reveals that in several locations there are deposits of silt with low shear strength and high sensitivity. This material is difficult to work with since its low shear strength is further reduced when disturbed.

The geological logs of the boreholes undertaken in this study are presented in Appendix A. They indicate that there is a significant variation of subsurface conditions across the site in an east-west direction. Borehole 2, to the east identifies alternating silt and sand layers to approximately 3.2 m depth where medium dense to dense gravels are located. The gravels are underlain by alternating layers of sand and silt to the end of the borehole at a depth of 10.55 m. Other features to note on the log of borehole 1 are the presence of organic silts at depths of 0.1 m and 2.6 m, both with a

thickness of 0.2 m. The latter is logged as "soft" and hence is expected to be highly compressible. There are loose sand deposits identified at depths of 2.8 m and 7.9 m which may have the potential to liquefy during earthquake events. Groundwater has been identified at a depth of 1.3 m below the ground surface. Liquefaction potential will be addressed in a later section of this report.

The geological log for borehole 2 identifies the presence of a significant deposit of sensitive silt which is interrupted by a 0.7 m thick layer of loose sand at 6.4 m depth. There are also relatively thin alternating layers of sand and silt from 9.9 m depth. The majority of the silt is described as "soft" with traces of peat at approximately 0.4 m depth and 9.2 m depth. Tubular roots are also found in the silt over most of the borehole depth. Elevated soil temperatures were detected from approximately 6 m on. This raises the possibility of hydrothermal alteration which further complicates the properties of the soil. The groundwater level in borehole 2 has been identified at a depth of 1.0 m below the ground surface.

The cone penetrometer test (CPT) results are shown plotted against depth in Appendix B. Tests 1 and 2 correspond with the location of boreholes 1 and 2 respectively and the various material layers discussed above are clearly identifiable. In the plot of CPT 1 the gravels at 3.2 m depth show significant cone resistance while the sand layers show moderate cone resistance. The plot for CPT 2 indicates the presence of very low penetration resistance silts apart from thin sand layers at approximately 6.5 m. The materials below the maximum borehole depth (10.70 m) show somewhat greater penetration resistance with friction ratios suggesting the presence of loose to medium dense sands and gravels.

Analysis of the CPT data indicates that the apparent competency of the soils deteriorates from east to west across the site. The variation of soil type across each section in the north-south direction is, however, relatively small. The gravels at the 3 m depth are evident over the two eastern sections but not over the remainder of the site. The remaining CPT plots are dominated by the presence of low penetration resistance silts and occasional sand layers. Signs of increased material competence are apparent at greater depth, i.e. 7 m to 12 m with friction ratios suggesting the presence of sands and gravels.

### 3.0 GEOTECHNICAL ENGINEERING

#### 3.1 Introduction

Recommendations and opinions in this report are based on data from the two boreholes and nine cone penetration tests. The nature and continuity of the soils away from the test locations is inferred but it must be appreciated that the actual conditions could vary from the assumed model.

#### 3.2 Foundations

The borehole and CPT results obtained for the western side of the site are dominated by low strength, compressible silts. These observations are confirmed by shear vane and consolidation tests obtained from the laboratory investigation.

For a period of approximately 5 years, section number 2 has been subjected to a fill preload of 1.0 to 1.8 m depth. The preload has had the effect of improving the soil conditions, however, the effective improvement has been restricted to the upper 2 m. Considering the time scale and the limited success of the preload, further use of preloading is not recommended, and isolated shallow foundations are not expected to be suitable for the site.

We recommend the use of driven timber or similar piles for founding the proposed structure(s). The use of piles minimises the effect of the variable soil conditions and reduces the probability of differential settlements. The piles would develop the majority of their capacity from end bearing in the gravels found at depths varying from approximately 4 m on the eastern side to approximately 12 m on the western side. The ultimate bearing capacity of such piles should be taken as 5 MPa. Applying a factor of safety of 3.0 results in an allowable bearing capacity of 1.7 MPa. Note that side friction has not been considered due to the low shear strength and high sensitivity of the silts. Piled foundations carrying the allowable stress specified above are expected to experience very small settlements (less than 5 mm under the working stress loads).

The piles should be driven with careful control on both set and depth. Special care should be taken to drive the piles to the appropriate depth and not to over-drive them. A suitable pile driving formula should be used (e.g. Hiley) to confirm the pile capacity at the time of installation. Table 2 identifies the expected pile lengths for each of the CPT locations.

**Table 2**  
**Approximate Pile Founding Depths**

<b>CPT Location</b>	<b>Pile Founding Depth (m)</b>
1	3.5
2	10.5
3	11.0
4	11.0
5	12.5
6	8.0
7	3.5
8	4.0
9	4.0

An alternative foundation option is to use a concrete raft foundation. This would reduce the applied pressures to a low level, but the structure would be subject to considerable total and differential settlements. The raft foundation would also be susceptible to further settlements caused by seismic events.

### **3.3 Liquefaction Potential**

The borehole logs presented in Appendix A indicate the presence of various layers of loose, saturated sands beneath the site. In addition, the laboratory analysis has shown that these materials are contained within a grading envelope which is susceptible to liquefaction.

The consequence of liquefaction at the site is dependant on the type of foundation employed. It is considered that driven pile foundations would not be significantly affected by earthquake ground motions; as the area is relatively flat, but a raft foundation would be likely to experience increased total and differential settlements. Note that the pile driving operation has the effect of compacting the loose sand deposits, hence reducing the potential for liquefaction and providing increased side frictional stresses during seismically induced settlements.

The lateral load capacity of the pile foundations should be considered carefully at the time of detailed design.

## 4.0

## SUMMARY

The following factors have emerged from the site investigation and Pukuatua St, Rotorua.

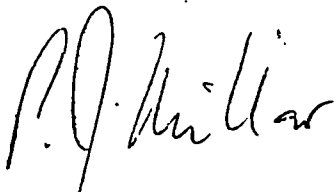
- The subsurface soil conditions are dominated by the presence of soft silts. Their low shear strength and high compressibility have been confirmed by laboratory testing.
- Medium dense to dense sands and gravels have been identified at depths ranging from approximately 4 m in the east to 12 m in the west.
- It is recommended that driven pile foundations are adopted for the proposed structure. The piles should extend to the depth of the gravel layers.
- The use of driven piles to the recommended depths would provide an allowable bearing capacity of 1.7 MPa. It also limits total and differential settlements to a negligible level and reduces the susceptibility of the proposed structure to further settlements caused by liquefaction during seismic events.
- If possible, the proposed structure should be positioned towards the eastern side of the site. The soils in this area are of relatively higher competence and the required pile lengths are shorter.
- A concrete raft foundation is an alternative option, however, it would be susceptible to relatively large total and differential settlements. It would also have inferior performance when subjected to earthquake induced ground motions.

## 5.0 APPLICABILITY

This report has been prepared for the particular brief given to us and data or opinions contained in it may not be used in other contexts or for any other purpose without our prior review and agreement.

During excavation and construction, the site should be examined by an engineer competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based. We would be pleased to provide this service to you and believe your project would benefit from the continuity. However, it is important that we be contacted if there is any variation in subsoil conditions from those described in the report.

TONKIN & TAYLOR LTD  
Consulting Engineers

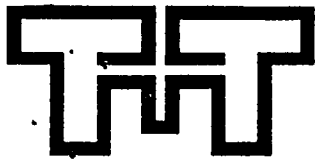


P.J. Millar  
GEOTECHNICAL GROUP MANAGER

Report prepared by: R.J. Peploe



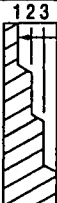
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













## ENGINEERING LOG TERMINOLOGY

## DRILLING OR EXCAVATION

FLUID LOSS	WATER	CORE RECOVERY	METHOD/CASING	PENETRATION
		Core recovered expressed as percentage of the length of the core run.	Shows drilling method and depth of casing.	


## SAMPLES AND TESTS

SAMPLE TYPE	TESTS	GRAPHIC LOG	TYPICAL SYMBOLS
<input type="checkbox"/> OPEN BARREL	N = 22 SPT. UNCORRECTED BLOW COUNT FOR 300MM	The Graphic Log shows soil and rock substances, significant defects, and core loss. Soil and rock substances represented by clear contrasting symbols consistent for each project.	 CLAY
 DOUBLE OR TRIPLE TUBE	● 75kPa UNDRAINED SHEAR STRENGTH AS MEASURED BY FIELD VANE		 SILT
 STANDARD PENETRATION TEST	<input checked="" type="checkbox"/> PRESSUREMETER TEST		 SAND
 LARGE DIAMETER THIN WALLED TUBE	* LABORATORY TEST(S) CARRIED OUT — UNSPECIFIED OR SPECIFIED AS BELOW		 GRAVEL
 SMALL DIAMETER THIN WALLED TUBE	LV - LABORATORY VANE AL - ATTERBERG LIMITS		 ORGANIC MATERIAL
 BULK SAMPLE	UU - UNDRAINED TRIAXIAL PSD - PARTICLE SIZE		 MUDSTONE
Length of sample indicated by length of symbol.	C' - EFFECTIVE STRESS		 SANDSTONE
	DS - DIRECT SHEAR	CONS - CONSOLIDATION	 BASALT
	UC - UNCONFINED COMPRESSION	IS - POINT LOAD	 NO CORE

## SOIL DESCRIPTION

CLASSIFICATION SYMBOL	MOISTURE CONTENT	UNDRAINED SHEAR STRENGTH	RELATIVE DENSITY
Based on USBR Unified Soil Classification System Visual Method for field identification. Classification symbols based on laboratory Method may differ.	D - DRY, LOOKS AND FEEL DRY	Cu (kPa)	SPT-UNCORRECTED
	M - MOIST, NO FREE WATER ON HAND WHEN REMOULDING	VS - VERY SOFT < 10	N VALUE
	W - WET, FREE WATER ON HAND WHEN REMOULDING	S - SOFT 10 to 25	VL - VERY LOOSE 0 to 4
		F - FIRM 25 to 50	L - LOOSE 4 to 10
		St - STIFF 50 to 100	MD - MEDIUM DENSE 10 to 30
	Moisture content may be compared to the plastic limit (PL) eg M > PL = moist, moisture content greater than the plastic limit	VSt - VERY STIFF 100 to 200	D - DENSE 30 to 50
		H - HARD > 200	VD - VERY DENSE > 50
		Fb - FRIABLE	

## ROCK DESCRIPTION

WEATHERING	ROCK STRENGTH	SIGNIFICANT DEFECTS
Fr - FRESH	UCS (MPa)	
SW - SLIGHTLY WEATHERED	EXTREMELY LOW < 2	
HW - HIGHLY WEATHERED	VERY LOW 2 to 6	
EW - EXTREMELY WEATHERED	LOW 6 to 20	
	MODERATE 20 to 60	
	HIGH 60 to 200	
	VERY HIGH > 200	



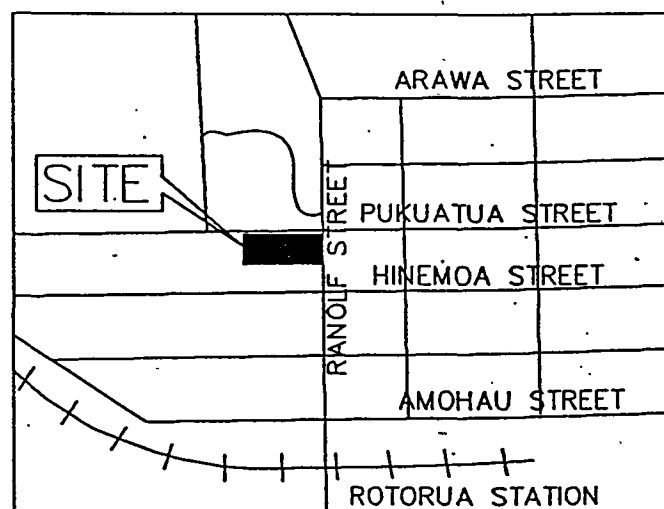
TONKIN &amp; TAYLOR LTD.

## BOREHOLE LOG

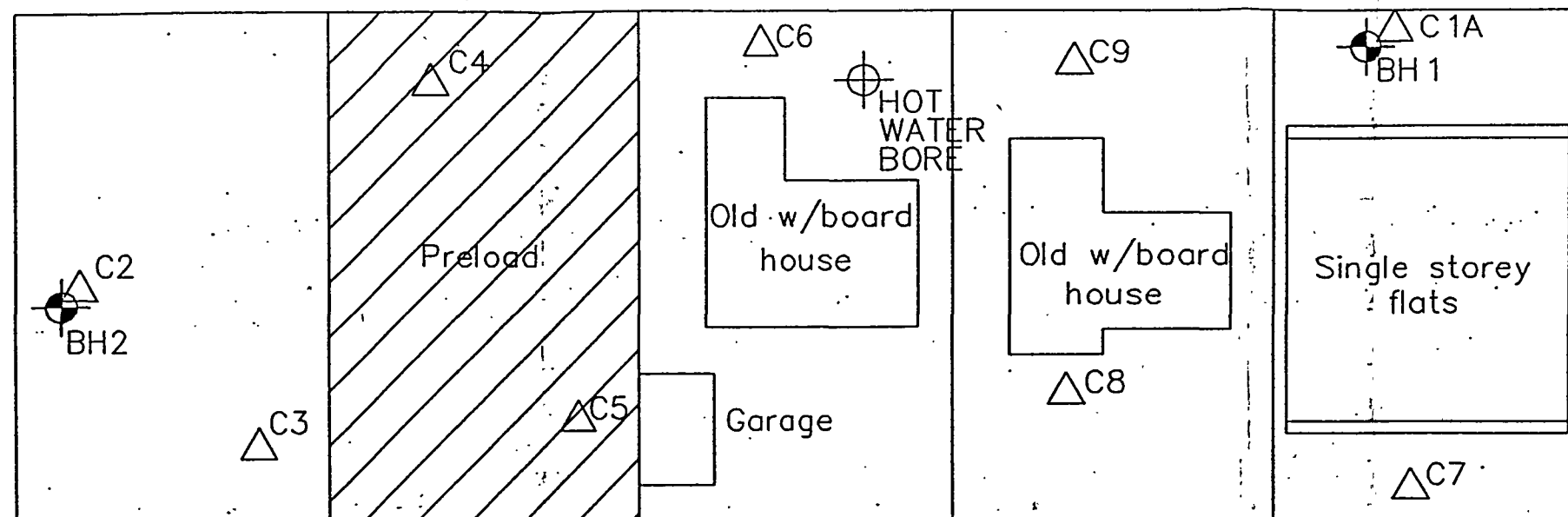
BOREHOLE No: 1

SHEET 1 OF 1

PROJECT: SITE INVESTIGATION		LOCATION: PUKUATUA ST ROTORUA		JOB No: 11722													
CO-ORDINATES N/A		DRILL TYPE: MOBILE		HOLE STARTED: 27.11.92													
R.L.		DRILL METHOD: 180mm HOLLOW AUGER		HOLE FINISHED: 27.11.92													
DATUM N/A		DRILL FLUID: N/A		DRILLED BY: GEOTECH DRILLING													
				LOGGED BY: LPA CHECKED: RJP													
GEOLOGICAL		ENGINEERING DESCRIPTION															
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (kPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.  ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
			500	SPT	N/A	N = 2	1		1.0	X	GW	M	MD				GRAVEL: Seal sand, coarse, grey
			450	SPT			2			X	OL		F				SILT: organic, dark brown
			750	TUBE			3			X	ML						- light grey & brown, thin organic layers, becomes dark yellow
			450	SPT		N = 6	4		2.0	X	MH		Vst				- white, pumiceous
			450	SPT			5			X	SW		F				- brown, slightly organic
			450	SPT			6			X	SP		MD				SAND: medium, lt grey
			600	SPT		N = 0	7		3.0	X	OH	W	S				- fine, silty, brown, slightly organic
			500	TUBE			8			X	SW	M	L				SILT: organic, dark brown
			400	AUGER			9			X	GW		D				SAND: medium, grey
			450	SPT		N = 31	10		4.0	X							GRAVELS: pumiceous, white, up to 6mmφ, sand matrix, grey
			1050	AUGER			11		5.0	X			MD				
			450	SPT		N = 17	12		6.0	X	SW						- grades to sand
			1050	AUGER			13		7.0	X	ML		Vst				SAND: medium to coarse, grey
			450	SPT		N = 2	14			X							SILT: pumiceous, grey, warm
			550	AUGER			15			X							- grades to sand
			400	TUBE			16		8.0	X	SW		L				SAND: medium, grey, some fine pumiceous gravels
			450	SPT		N = 4	17			X	ML						
			1250	AUGER			18		9.0	X			MD				SILT: sandy, green, some rounded gravels up to 5mmφ
			450	SPT		N = 15	19		10.0	X							
			550	AUGER			20			X							END OF BORE AT 10.55m



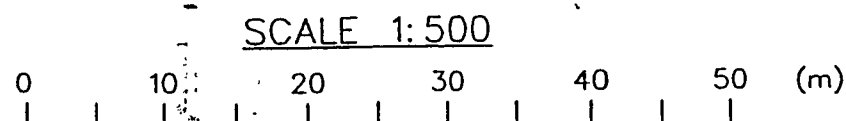
LOCALITY PLAN  
(NOT TO SCALE)



SITE PLAN

LEGEND

- Tonkin & Taylor borehole 1992
- Tonkin & Taylor cone penetrometer test 1992



PUKUATUA STREET PARTNERSHIP  
PUKUATUA STREET DEVELOPMENT  
Field Test Location Plan



Drawing No.	Rev.
11722-1	
Date	
DECEMBER 1992	
Drawn	Checked
RAF	RJP

# BOREHOLE LOG

BOREHOLE No: 2

SHEET 1 OF 1

[illegible]

# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: CPT1A  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

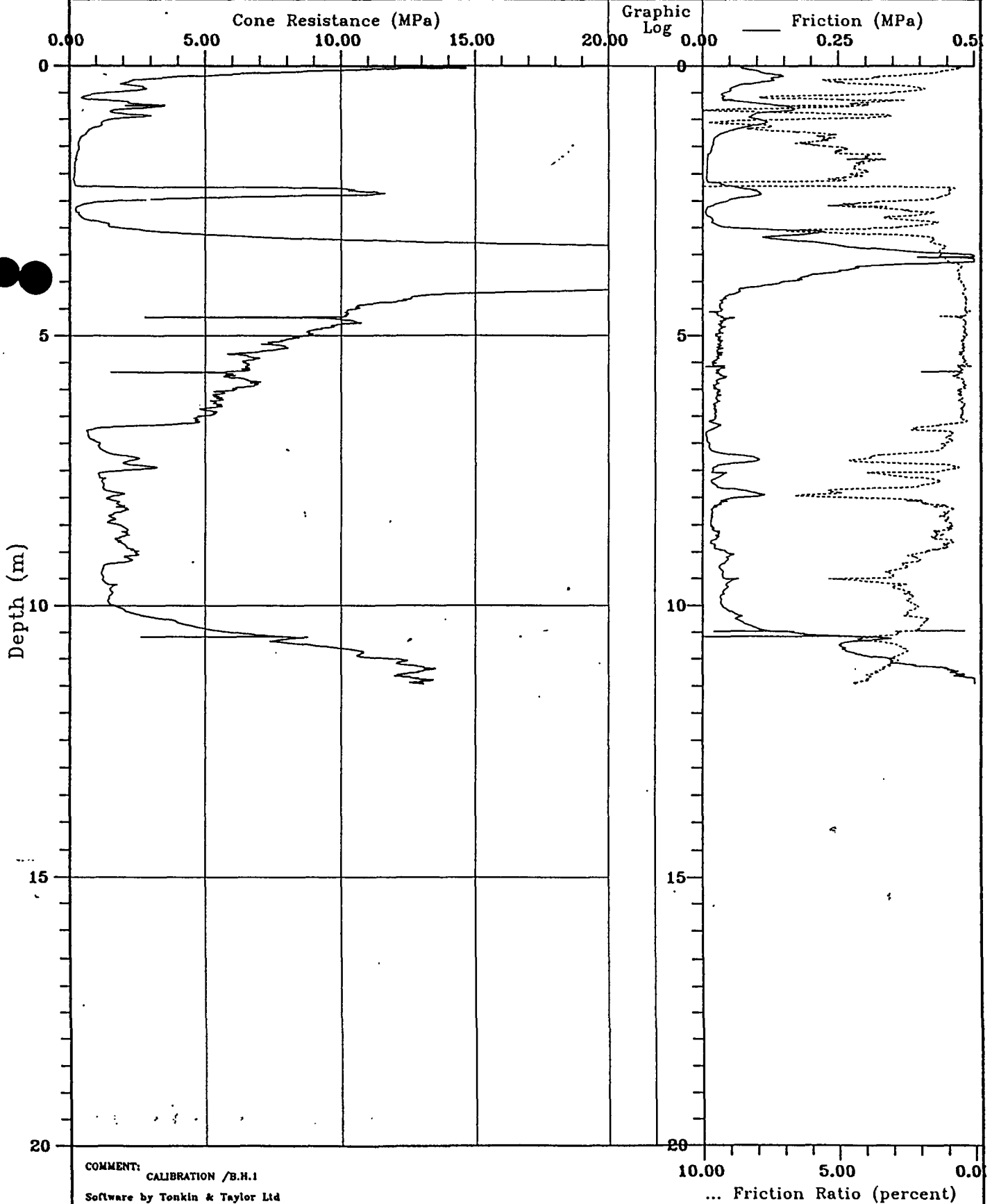
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt2  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

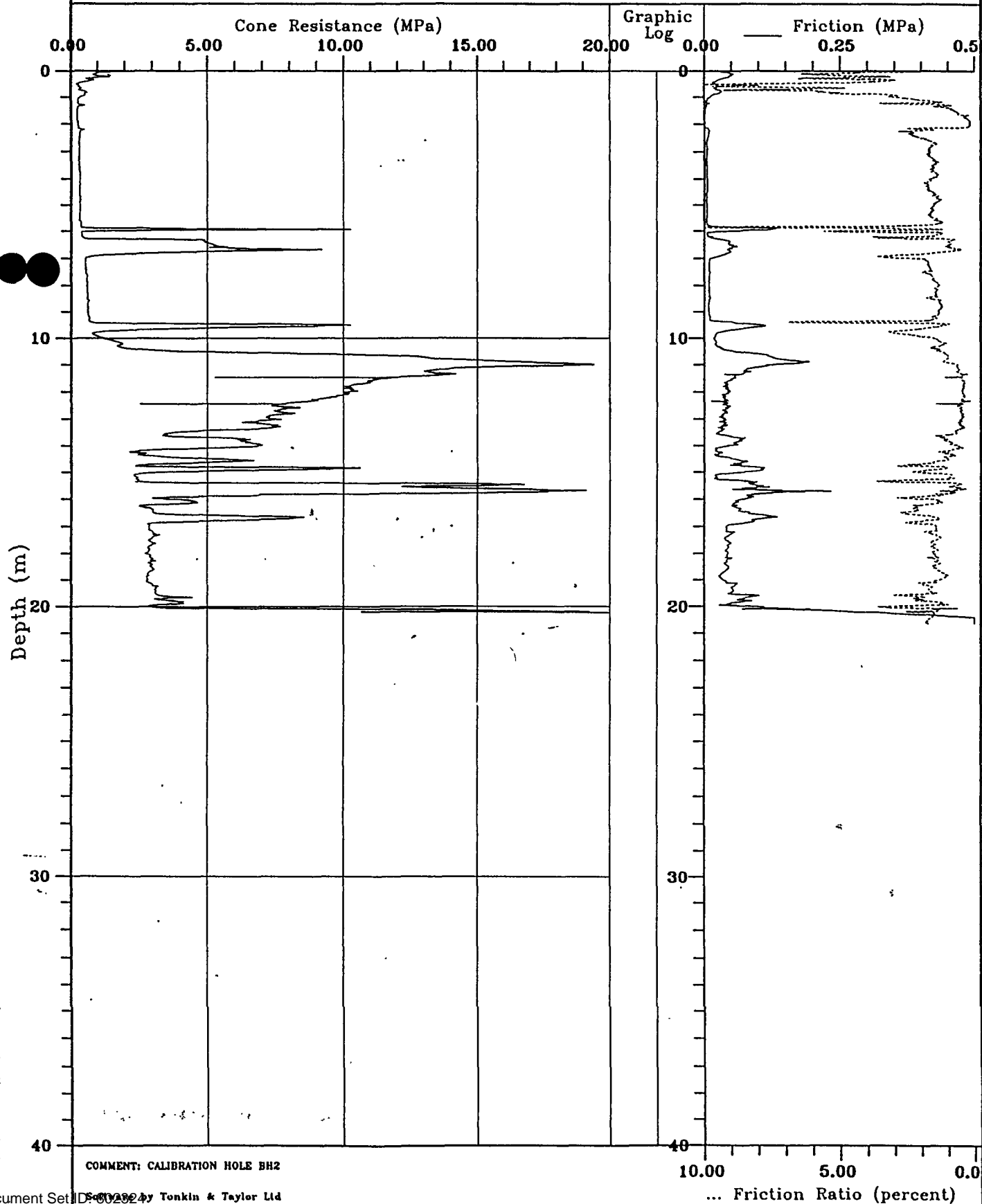
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt3  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

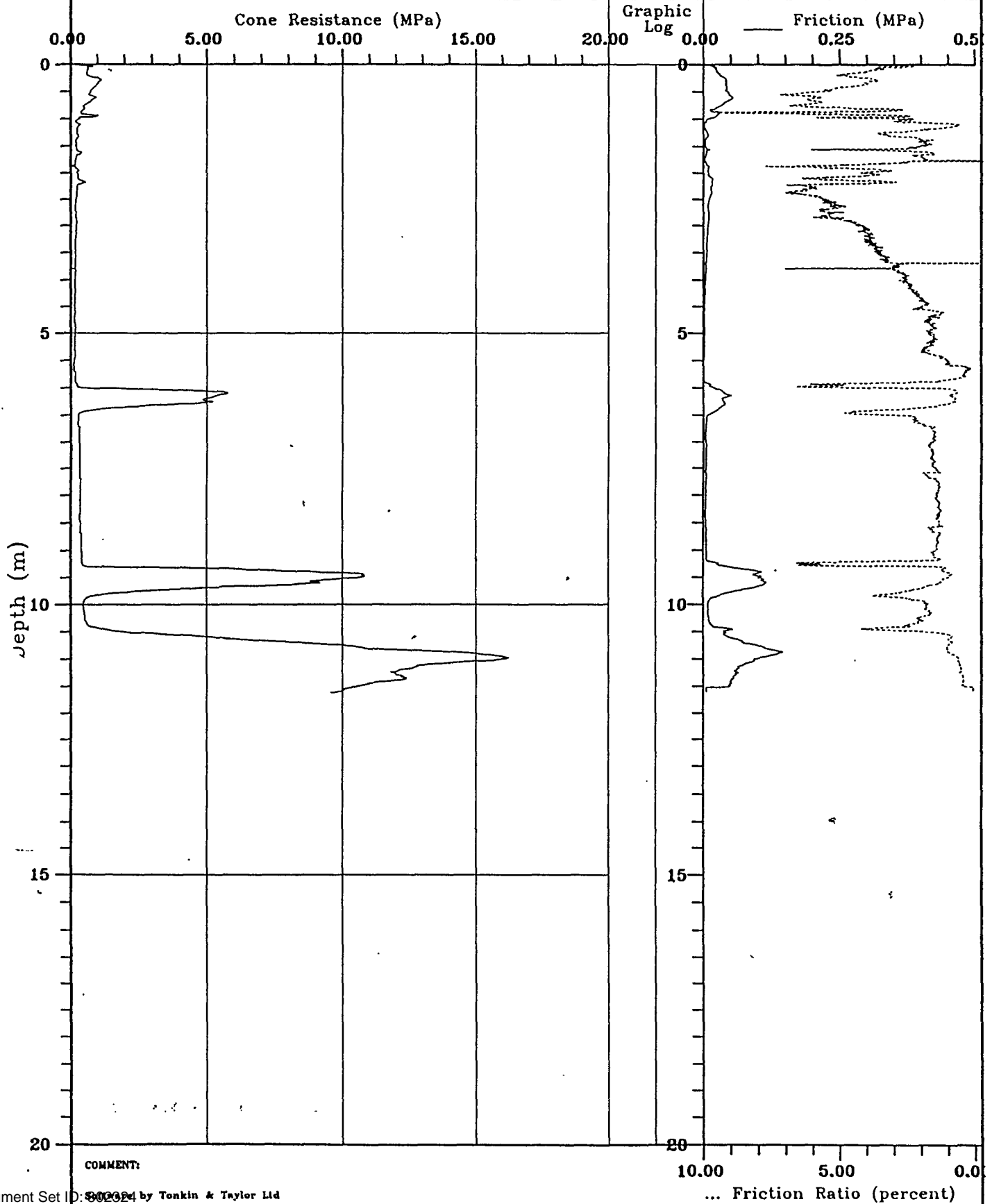
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt4  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

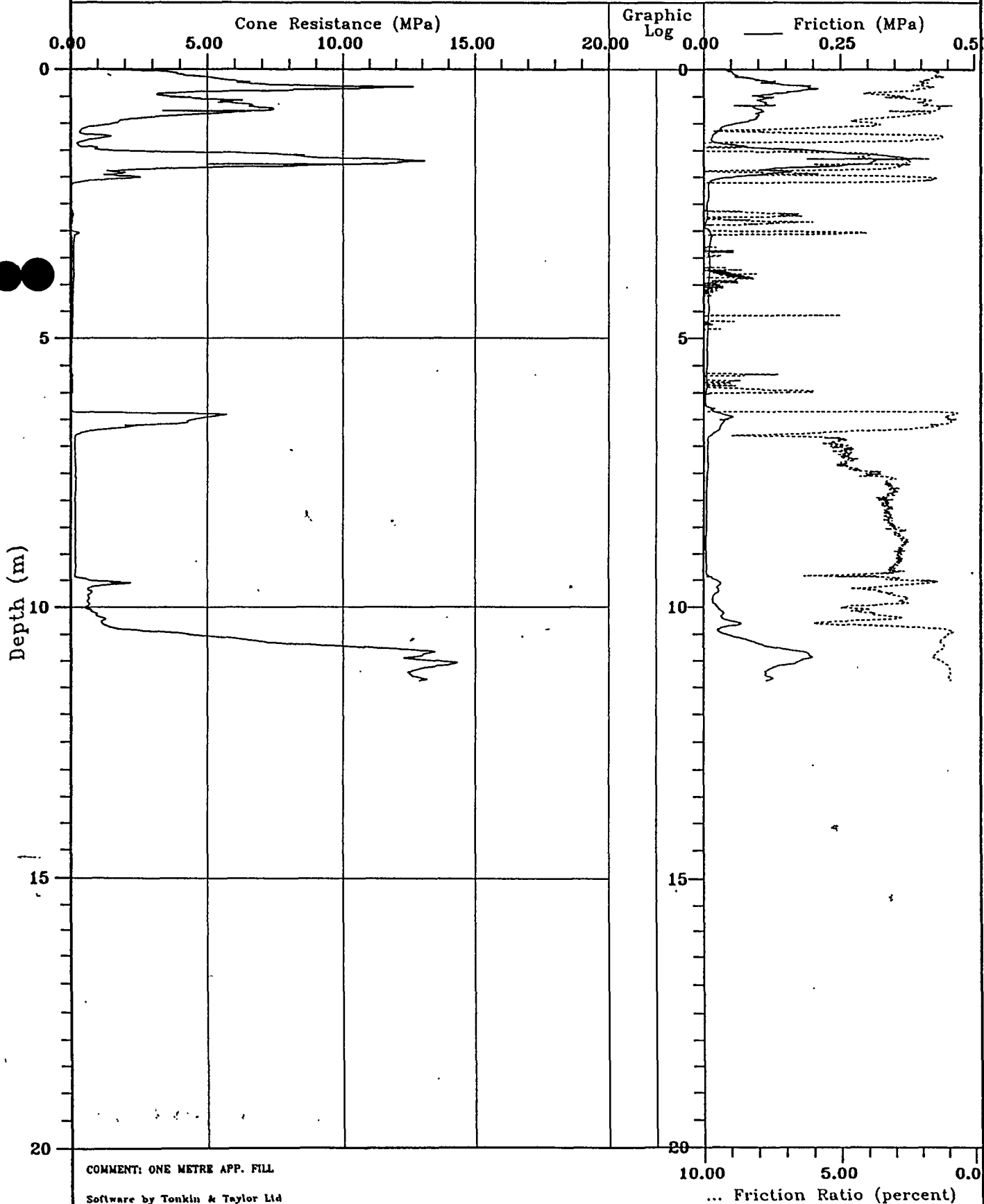
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -





# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt5  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

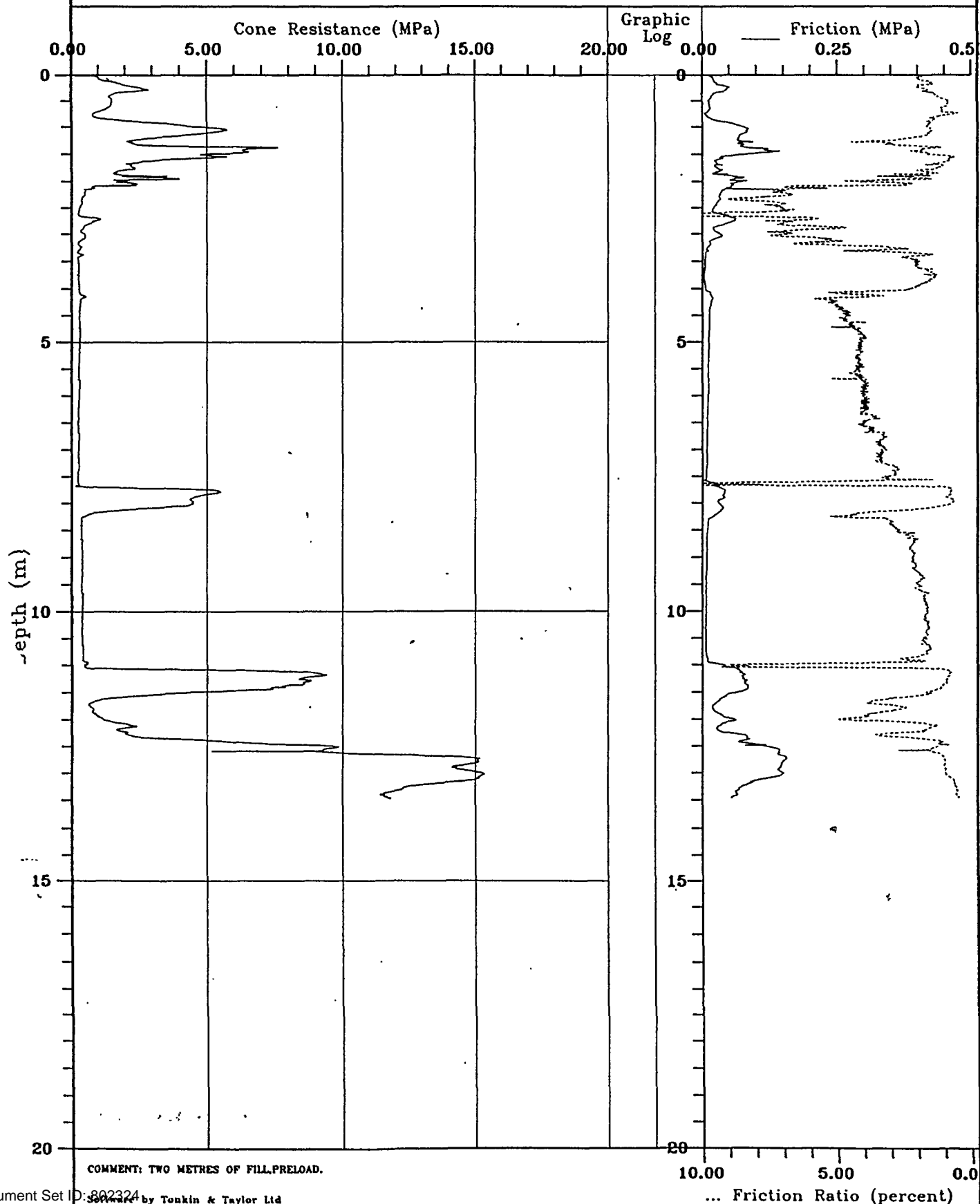
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



COMMENT: TWO METRES OF FILL, PRELOAD.

# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt6  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

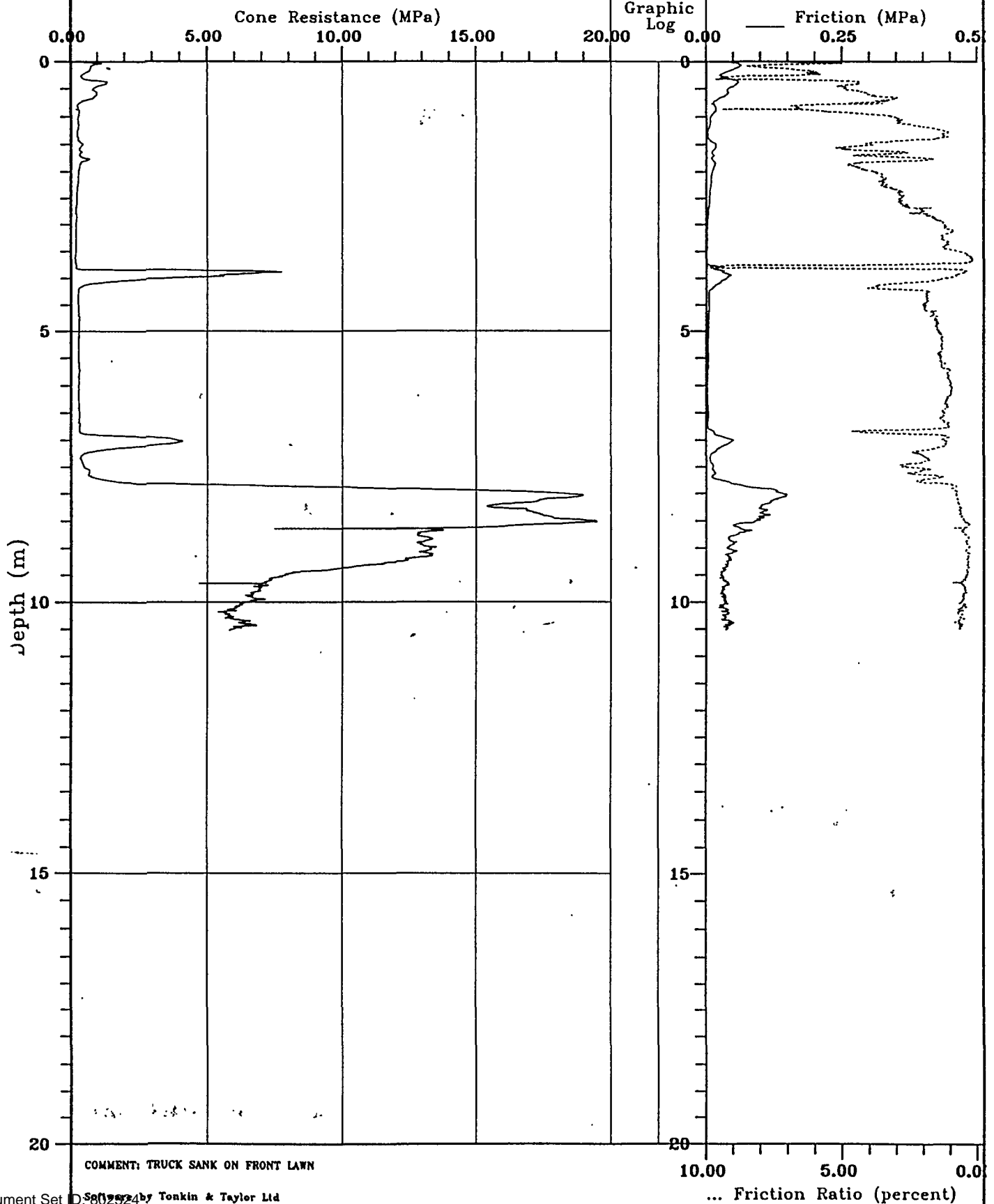
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



COMMENT: TRUCK SANK ON FRONT LAWN

Software by Tonkin &amp; Taylor Ltd

# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt7  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

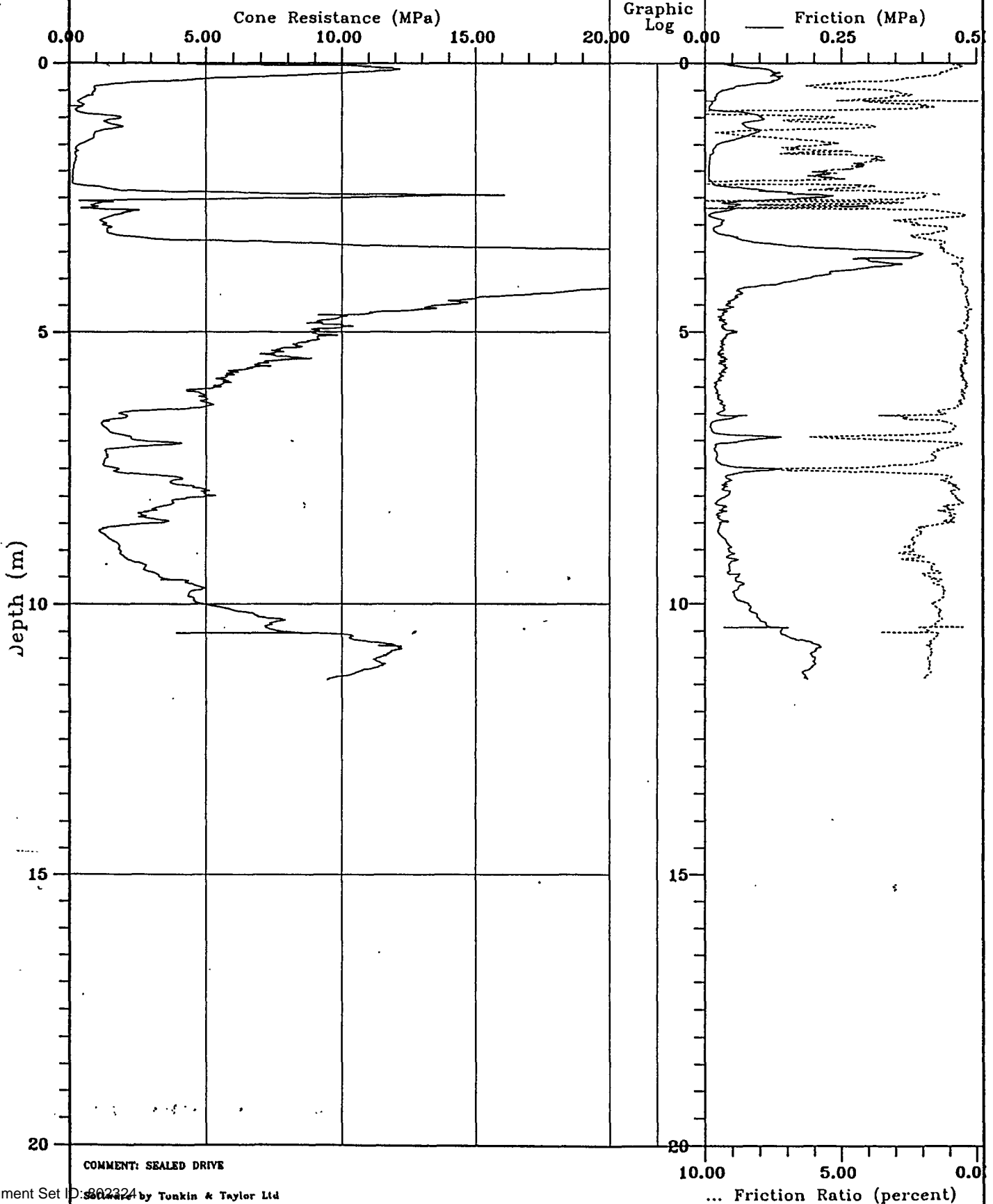
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt8  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

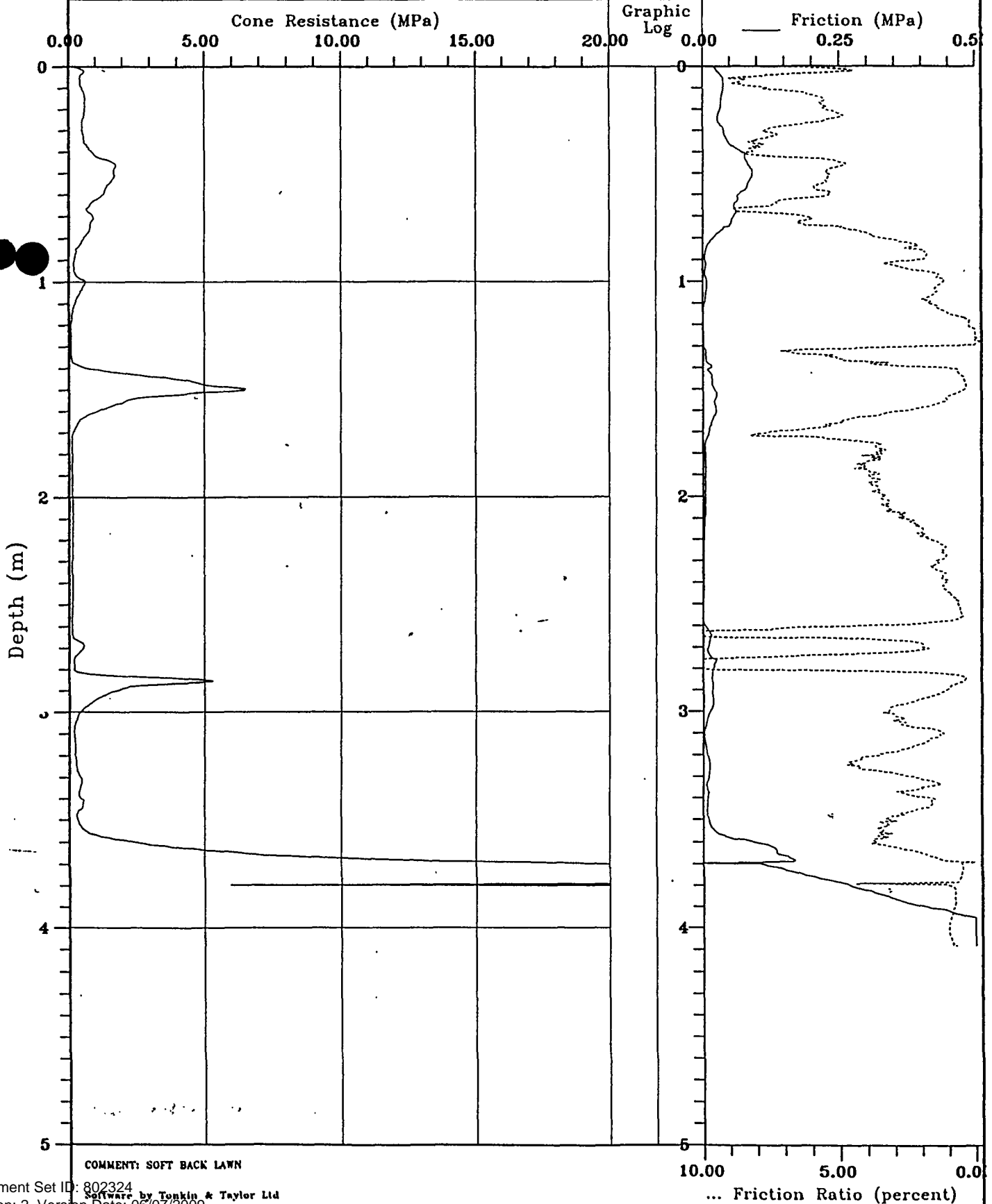
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



COMMENT: SOFT BACK LAWN

# GEOTECH DRILLING CONE PENETROMETER

CLIENT: PUKUATUA ST PARTNERS

CPT No: cpt9  
1 of 1

PROJECT: CPT SURVEY

LOCATION: PUKUATUA ST

JOBNO: 11722

Date: 11-27-1992

Cone Range: 100kN

Client Ref: -

R.L.: -

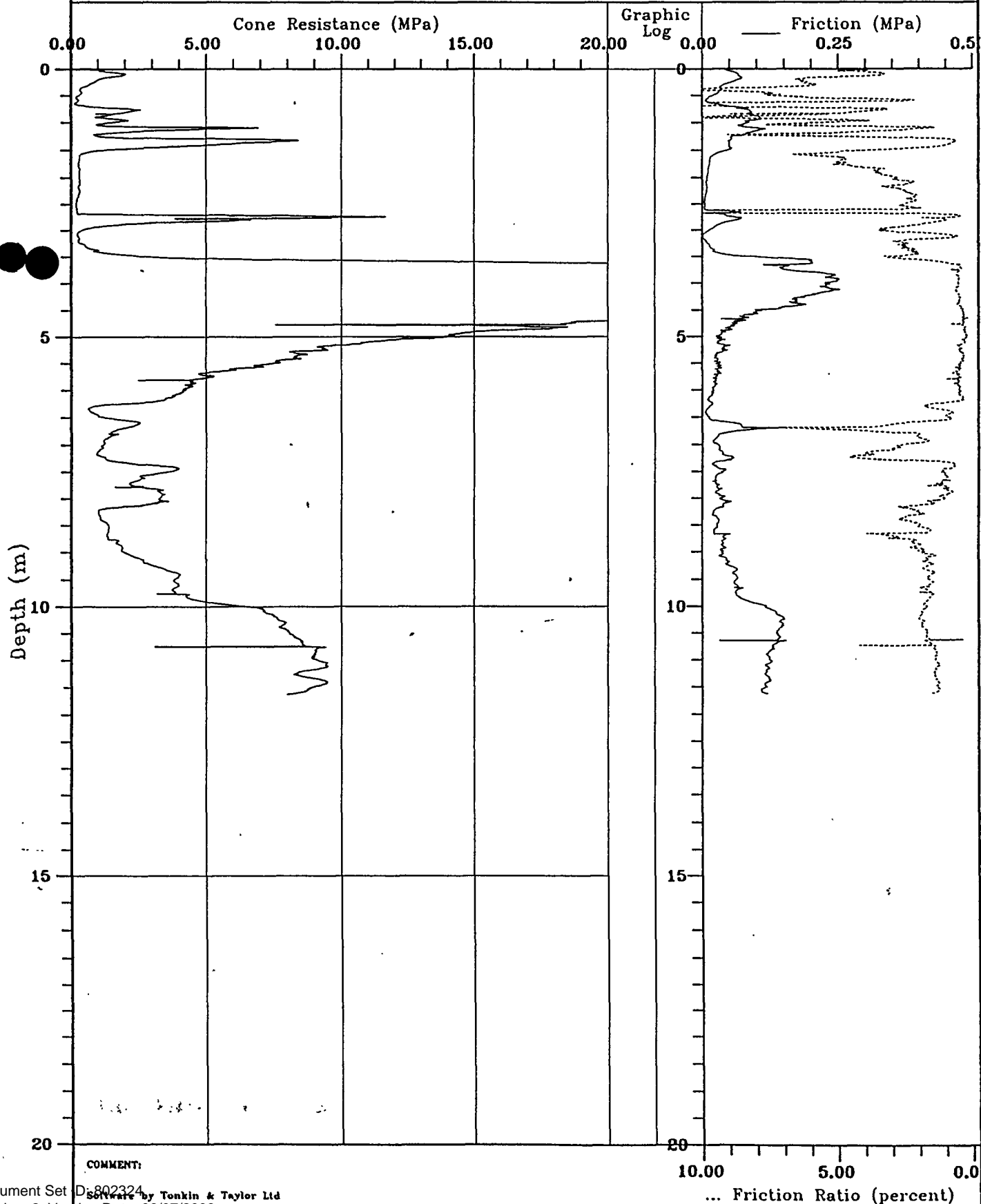
Operator: G.L.BARNETT

East: -

Datum: -

Grid Ref: -

North: -



COMMENT:

Plate No. 1

Page 2 of 6

Site : Pukuatua Road

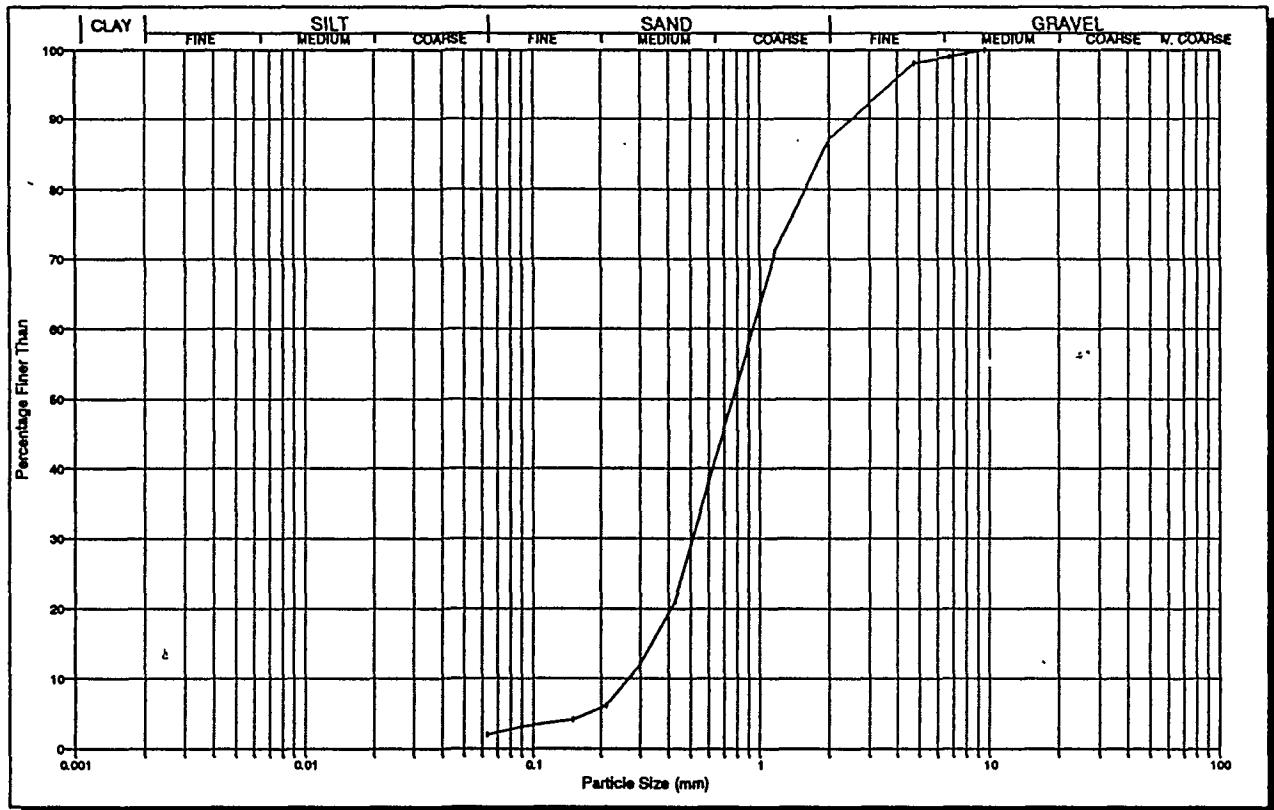
Job No. : 11722

Borehole No. : 1

Sample No. : 6

Depth : --- (m)

Test Method Used : NZS 4402:1986 Test 2.8.2 Dry Sieve



Sieve (mm)	Total % Passing
75.0	---
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
16.0	---
13.2	---
9.5	100
6.7	99
4.75	98

Sieve (mm)	Total % Passing
2.00	87
1.18	71
0.600	38
0.425	21
0.300	12
0.212	6
0.150	4
0.090	3
0.063	2

Sample history: As received natural.

Soil description: SAND, (fine - coarse), loose, grey, some fine gravels.

Remarks : Percentage gain = 0.3 %

Entered by: MRS

Date: 20-12-92

Checked by: RAF

Date: 21-12-92

Plate No. 2

Page 3 of 6

Site : Pukuatua Road

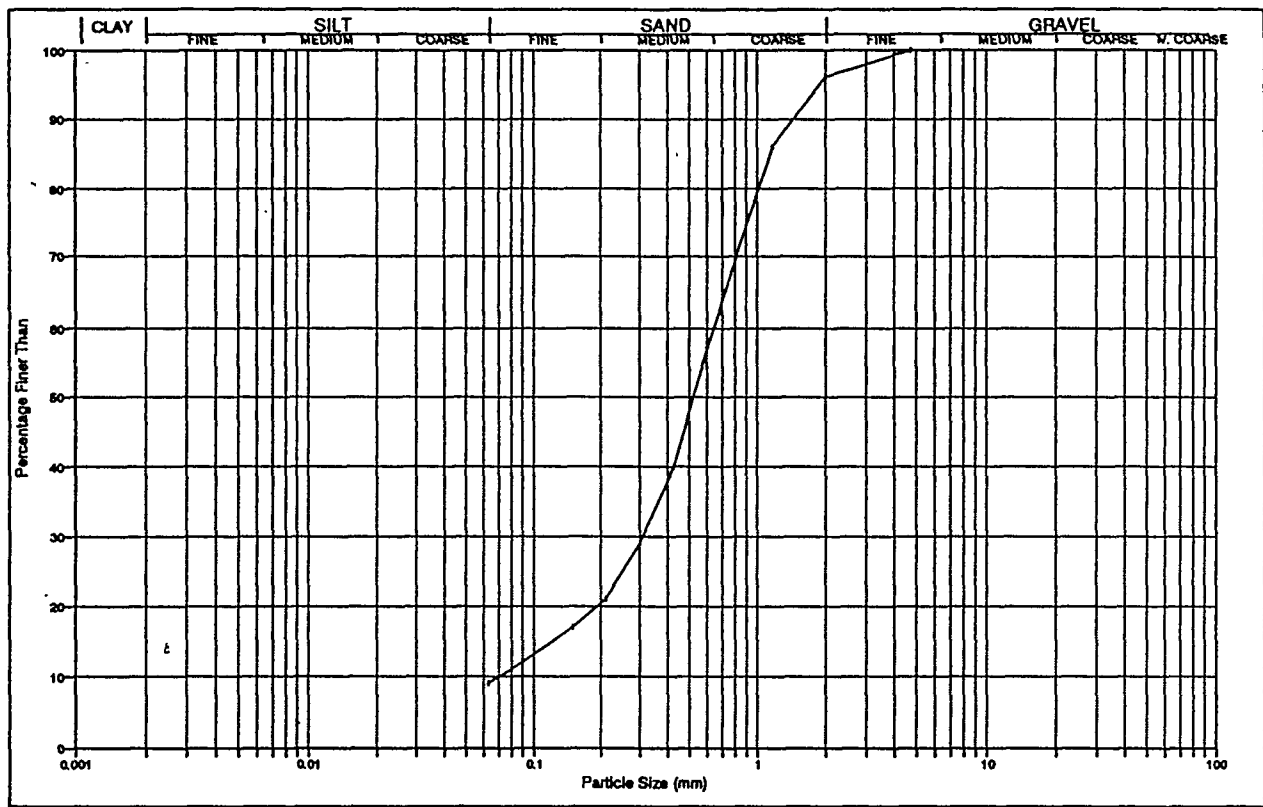
Job No. : 11722

Borehole No. : 2

Sample No. : 9

Depth : 6.8 - 7.25 (m)

Test Method Used : NZS 4402:1986 Test 2.8.2 Dry Sieve



Sieve (mm)	Total % Passing
75.0	---
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
16.0	---
13.2	---
9.5	---
6.7	---
4.75	100

Sieve (mm)	Total % Passing
2.00	96
1.18	86
0.600	57
0.425	40
0.300	29
0.212	21
0.150	17
0.090	12
0.063	9

Sample history: As received natural.

Soil description: SAND, (fine - coarse), loose, grey, some silt.

Remarks : Percentage loss = 0.2 %

Entered by : MRS

Date : 20-12-92 Checked by : RAF

Date : 21-12-92

Site : Pukuatua Rd.

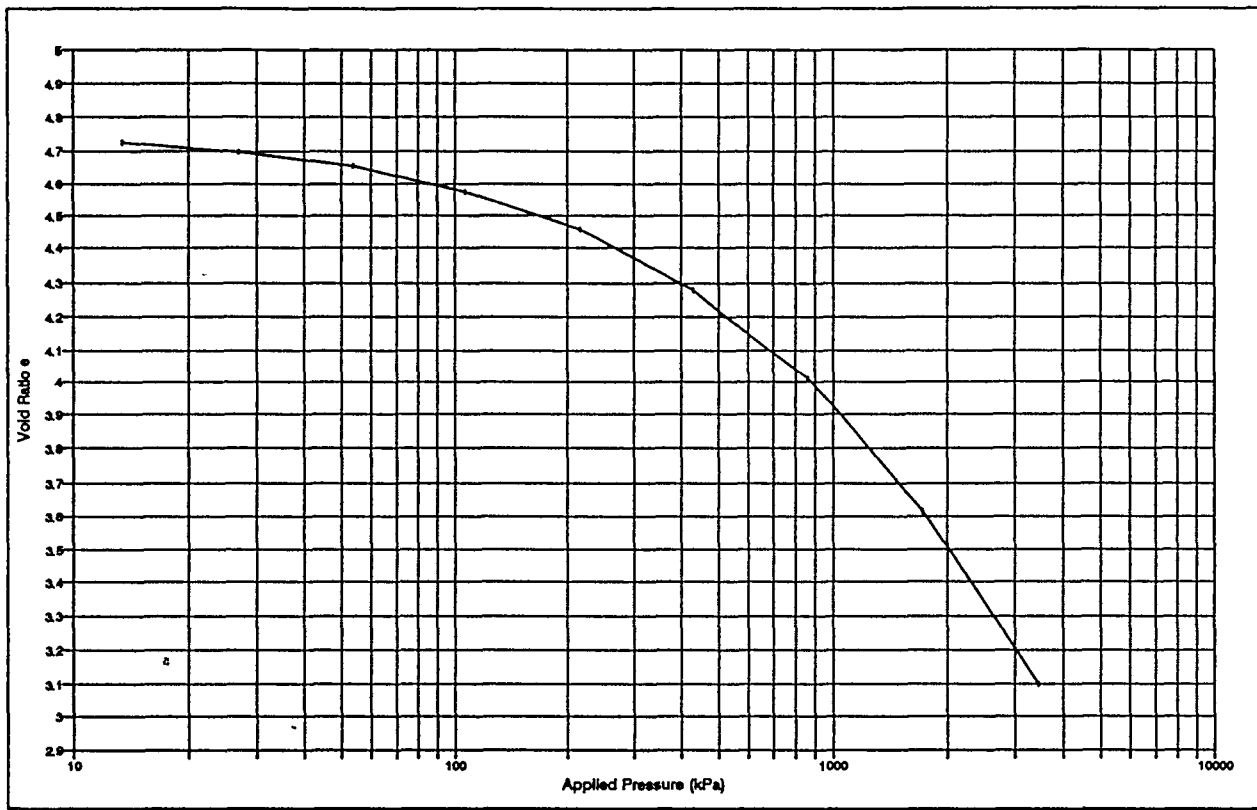
Job No. : 11722

Borehole No. : 1

Sample No. : 3

Depth : 1.3 (m)

Test Method Used : NZS 4402:1986 Test 7.1 One-Dimensional Consolidation



Pressure (kPa)	Void Ratio e	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m <sup>2</sup> /yr)	Coefficient of Compressibility Mv (m <sup>2</sup> /MN)
As recieved	0			
13.4	4.727	0 to 13.4	NA	NA
26.8	4.698	13.4 to 26.8	240	0.38
53.6	4.658	26.8 to 53.6	68	0.25
107	4.575	53.6 to 107	59	0.27
215	4.457	107 to 215	300	0.19
429	4.279	215 to 429	120	0.14
858	4.015	429 to 858	270	0.11
1716	3.617	858 to 1716	240	0.08
3433	3.097	1716 to 3433	84	0.05
6867	---	3433 to 6867	---	---
Rebound	13.4	NA		

Sample History : Undisturbed core trimmed at NWC. SQR of time fitting method used.

Soil description : SILT, soft - firm, lt. grey - white.

Initial Dry Density : 0.46 (t/m<sup>3</sup>)

Initial Water Content : 170 (%)

Solid Density : 2.65 (t/m<sup>3</sup>) assumed

Initial Saturation : 93 (%)

Temperature During Testing : max = 22°C min = 15°C

Entered by: *MRS*Date: *20-12-92* Checked by: *RAF*Date: *21-12-92*



Site : Pukuatua Rd.

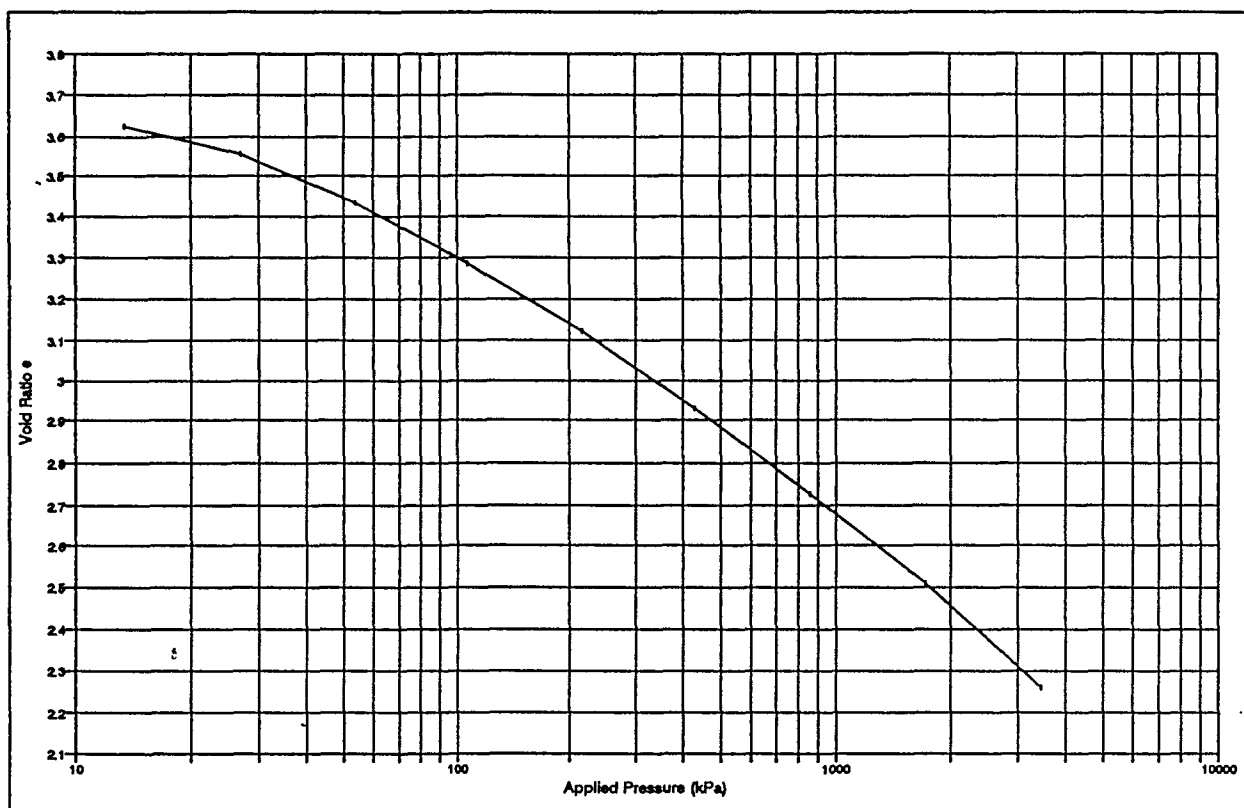
Job No. : 11722

Borehole No. : 2

Sample No. : 3

Depth : 2.3 (m)

Test Method Used : NZS 4402:1986 Test 7.1 One-Dimensional Consolidation



Pressure (kPa)	Void Ratio e	Pressure Increment (kPa)	Coefficient of Consolidation Cv (m <sup>2</sup> /yr)	Coefficient of Compressibility Mv (m <sup>2</sup> /MN)
As recieved	0	4.204		
13.4	3.625	0 to 13.4	NA	NA
26.8	3.556	13.4 to 26.8	4.5	0.99
53.6	3.434	26.8 to 53.6	6.6	0.87
107	3.286	53.6 to 107	20	0.53
215	3.125	107 to 215	21	0.29
429	2.930	215 to 429	25	0.17
858	2.729	429 to 858	54	0.09
1716	2.507	858 to 1716	49	0.05
3433	2.262	1716 to 3433	90	0.03
6867	---	3433 to 6867	---	---
Rebound	13.4	NA		

Sample History : Undisturbed core trimmed at NWC. SQR of time fitting method used.

Soil description : SILT, v. soft, lt. brown.

Initial Dry Density : 0.51 (t/m<sup>3</sup>)

Initial Water Content : 154 (%)

Solid Density : 2.65 (t/m<sup>3</sup>) assumed

Initial Saturation : 97 (%)

Temperature During Testing : max = 22°C min = 15°C

Entered by : MRS

Date : 20-12-92

Checked by : RAF

Date : 21-12-92



GEOTECHNICS LTD. MATERIALS TESTING &amp; INSTRUMENTATION SPECIALISTS

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19 MORGAN STREET NEWMARKET AKL 1

TELEPHONE (09) 793 067 TELEX NZ 21594 FAX (09) 370 265

Form No. M 2.

Sht. 1. of 6.

Engineer RJP Date 21-12-92 Site PUKUAHUA Rd Job No. 11722

BOREHOLE NO		1	1	2	2	2	2	2	2										
SAMPLE NO		3	6	3	19	2	4	6	9										
DEPTH (m)		1.3		2.3				5.2	6.8										
WATER CONTENT (%)						90.2	84.9	132											
BULK DENSITY (t/m <sup>3</sup> )																			
DRY DENSITY (t/m <sup>3</sup> )																			
LIMITS	LL																		
For sample history and fraction tested, refer to test sheets	PL																		
	PI																		
SOLID DENSITY (t/m <sup>3</sup> )																			
SIEVE			✓					✓											
SEDIMENTATION																			
ORGANIC CONTENT (%)																			
pH DETERMINATION																			
ALLOPHANE CONTENT (%)																			
COMPACTION																			
LABORATORY VANE (kPa)																			
For vane details ref. test shts		67		3				0											
TRIAXIAL (UU)																			
TRIAXIAL (drained)																			
TRIAXIAL (CUP)																			
UNCONFINED COMPRESSION (kPa)																			
PERMEABILITY (f/head) (cm/sec)																			
PERMEABILITY (c/head Press.k) (cm/sec)																			
PINHOLE DISPERSION																			
CONSOLIDATION		✓		✓															
SUSPENDED SOLIDS (mgm/l)																			
RELATIVE DENSITY (kg/m <sup>3</sup> )	MAX																		
	MIN																		
SHEAR BOX																			
Other:																			

CHECKED

INITIALS: mps

☒ - Test performed - see separate result sheet

TEST RESULT SUMMARY