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REPORT

TO

CRONULLA SUTHERLAND LEAGUES CLUB LIMITED

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED CRONULLA LEAGUES CLUB REZONING

AT

CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

27 September 2002

Ref: 17119SPrpt

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1 INTRODUCTION

This report presents the results of the review of previous geotechnical investigations at Shark Park, Woolooware, NSW. The investigation was commissioned by Mr Andrew Durbidge of BDO Property Pty Ltd on behalf of Cronulla Sutherland Leagues Club Ltd in a letter dated 4 September 2002.

We understand that it is proposed to rezone the property to the north, east and south of the existing Club. The rezoning is to allow the construction of:

- a double basement car park over the majority of the site area, requiring excavation to a level of about 0.3m AHD (a depth of about 3m to 3.5m);
- a two storey extension to the south of the existing club;
- a three storey hotel facility to the east of the proposed club extension;
- five buildings of three to five levels comprising residential units and aged care facilities to the north and north-east of the existing club;
- the placement of the existing high voltage power lines to the north of the site underground.

There could also be future extensions to the western grandstand of Shark Park, and a future vehicle drop-off zone at the southern side of Shark Park, however we understand that these are not part of the current rezoning application.

The purpose of the review was to compile the available geotechnical information on subsurface conditions, and to use this to provide comments and recommendations on earthworks, excavation, shoring, retaining wall design, construction techniques, footing design, and discussion of the effects of potential dewatering.

A review of the available environmental site screening information was completed in conjunction with this investigation by Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd. The results of the site screening are presented in the report E17119FK dated October 2002; the report should be reviewed in conjunction with this report.

2 EXISTING INFORMATION

Jeffery and Katauskas Pty Ltd have completed eight previous investigations within the proposed redevelopment area. A summary of these investigations is provided below.

- Reference 581 dated 27 July 1978 for a proposed grandstand - the investigation comprised 2 augered boreholes drilled into the underlying sandstone.
- Reference 7391S dated 6 April 1990 for an unspecified proposed development - the investigation comprised 2 boreholes cored into the sandstone bedrock, one borehole augered to 10 metres (m) depth, and 7 Electric Friction Cone Penetration (EFCP) Tests to 5m to 11m depth.
- Reference 8309K dated 25 July 1991 for a proposed amenities block - the investigation comprised drilling three augered boreholes to depths ranging from 3.8m to 4.8m below existing ground levels.
- Reference 11630SV dated 1 February 1996 for the proposed southern stand - the investigation comprised 7 augered boreholes to depths between 1.3m and 6.0m below existing ground levels.
- Reference 12308SV dated 24 January 1997 for proposed club extensions - the investigation comprised 2 boreholes augered into the underlying sandstone and three boreholes augered to between 4.8m and 6.0m below the existing ground levels.
- Reference 12765SV dated 2 September 1997 for proposed extensions to the club - the investigation comprised the coring of 2 boreholes into the sandstone bedrock, the augering of 2 boreholes into the bedrock and augering 2 boreholes to 6.7m and 7.0m depth.

- Reference 15009JTP dated 17 April 2000 for proposed redevelopment of the Shark Park area - the investigation comprised eight EFCP tests to refusal of the equipment (depths between 5.8m and 20.6m).

Several of the reports referred to obstructions and voids within the fill, and that metal, bricks and concrete were often encountered.

Copies of the borehole logs and EFCP test results are provided in Appendix A. The approximate locations of these tests are shown on the attached Figure 1; the locations have been scaled from the plans contained in the previous reports and so the plotted locations could be in error by about 10m or so. It should also be noted that these depths were from existing ground level at the time of the fieldwork for those investigations and depths may have subsequently changed following excavations or the placement of additional fill.

In addition to the above information, 12 boreholes have been auger drilled during the recent environmental investigation to obtain samples for acid sulphate soils assessment to depths of 6.0m below existing ground levels. The borehole logs from this recent investigation are also provided in Appendix A and the information has been used in compiling this report.

3 INVESTIGATION PROCEDURE

Generally the boreholes have been completed by auger drilling with a truck mounted drilling rig with the soil strength being assessed from the recorded Standard Penetration Tests. The sandstone bedrock, when encountered, was either augered with a tungsten carbide drilling bit (in which case the rock strength was assessed from observation of the auger drilling resistance and from examination of the rock cuttings recovered from the base of the augers) or diamond cored (where the strength was assessed from examination of the recovered core and from Point Load Strength Index tests completed on the core).

The EFCP tests were completed with a purpose built truck mounted friction cone rig. The inferred strata and soil strengths shown on the EFCP traces have been assessed from correlations of the data with published charts and so the interpreted data is approximate only. The refusal depths are often assumed to be the top of bedrock and there seems to be reasonable correlation between the rock depths encountered in the boreholes and the inferred depths from the EFCP tests.

4 RESULTS OF THE INVESTIGATIONS

4.1 Site Description

The site is located to the north of Captain Cook Drive, Woolooware. The site is generally flat with a slight slope (less than 1°) down to the north. The regional topography falls gently toward the bay to the north apart from the golf course to the south of Captain Cook Drive that is generally at a lower level than the site.

A large multistorey brick building used as the leagues club is located within the central section of the site; this appeared to be in good external condition from a brief inspection of the exterior.

The main football ground was to the west of the club and there was a large multistorey grandstand at the west side of the field. At the north and south ends of the field are landscaped mounds (approximately 4m and 2m respectively above the general site level) used as spectator viewing areas. To the west of the large stand are several single storey concrete and brick buildings used as a gymnasium, amenities block and media facilities.

A drainage channel crosses the site from south to north at the west of these buildings. Mangroves line this channel and the water level was approximately 1m to 1.5m below the general site level at the time of inspection.

Two football fields are located on the far side of the main football ground with asphaltic concrete car parking on the southern side of the fields.

To the east and north of the Leagues Club is a second asphaltic concrete paved car park used by the Leagues Club. This area slopes at approximately 1° to the north with the southernmost portion gently sloping at approximately 1° to the south (toward the Captain Cook Drive boundary).

There is vacant land and mangrove swamps to the east of the site. Captain Cook Drive and then Woolooware Golf Course were located to the south. Solander Playing Fields and then industrial land lies to the west. An easement for transmission lines and then Woolooware Bay lie to the north.

4.2 Subsurface Conditions

In general terms, the testing on the site has disclosed poorly compacted fill over soft and very soft bay deposits of organic silty clays over stiff to very stiff clayey soils and medium dense to very dense sandy soils. Sandstone or inferred sandstone bedrock was encountered at depths ranging from 7.7m to 13.3m below existing ground level in the proposed works area while the sandstone to the west of the existing clubhouse extends considerably deeper (as deep as 20.6m).

Within the proposed works area, the fill had a thickness between 2.2m and 4.5m. The fill was often logged as silty sand and sandy clay with varying proportions of metal, timber, sandstone and demolition rubble. The fill was assessed as being poorly compacted.

The organic clays with some areas of clayey silty sand were encountered from the base of the fill at depths between 2.2m and 4.5m. These were generally of very soft to soft strength and had thicknesses of about 2.0m to 3.0m, though the thickness was limited to about 1.0m at some of the test locations.

Silty clays of at least stiff strength (and usually of very stiff strength) and sands generally of medium dense relative density were encountered below depths of 5 to 6m.

The sandstone bedrock (or inferred bedrock) was encountered at depths ranging from 5.6m to 20.6m below existing ground level. In the vicinity of the existing club, a sandstone capping layer was often encountered, this sandstone was generally about 0.5m to 1.0m thick and was overlying further clay bands which had thicknesses of 0.9m to 4.2m. Shallow refusal (5.8m and 5.6m) was encountered at location 803, and at a retest (numbered 803a) which was completed within 1.0m of the original test; this refusal may have been on sandstone bedrock, though this cannot be confirmed. The bedrock depths and inferred bedrock depths at the test locations are shown on the attached Figure 1.

Groundwater was encountered at depths between 0.4m and 3.8m during previous investigations. No long term groundwater monitoring has been undertaken during any of the investigations.

4.3 Site Anomalies And Construction Difficulties

There are several difficulties associated with the development at this site. These include:

- The presence of the deep, poorly compacted fill providing potentially poor trafficability, poor foundation conditions and poor pavement subgrade.

- The presence of obstructions and voids in the fill resulting in difficult piling conditions and the use of excess grout in auger grout injected piles.
- Methane has been encountered during investigations by EIS. This will require the adoption of a methane drainage blanket and extraction system below proposed structures and pavements. Other gases often found with methane are corrosive and hence copper pipes would not be recommended for underground services.
- The very soft and soft organic clay layer which will undergo additional consolidation settlements if additional load is placed above this layer. This could also give rise to negative skin friction effects on piles if the organic clay consolidates.
- The organic clays were found during the recent investigation by EIS to have an acid sulphate generation potential. As a result, if these soils are disturbed by excavation or are removed during pile construction, treatment of the soil for potential acid generation will be required. Reference should be made to the EIS report for details on acid sulphate management.
- The relatively high groundwater which will make earthworks such as replacement of fill, proof rolling and additional fill compaction difficult. This may require dewatering or the adoption of bridging layers necessary.
- The generally deep sandstone bedrock which will require long piled footings to be adopted.
- The capping layer of sandstone on which many piling systems could refuse. Very limited bearing pressures would have to be adopted if the piling cannot penetrate to the more competent sandstone bedrock at depth.

Although the above are potential problems for the construction of the proposed development at the site, the construction nevertheless appears feasible. These difficulties on the site require that good planning, design and construction techniques are used.

5 COMMENTS AND RECOMMENDATIONS

The geotechnical information available for the site is from numerous previous investigations. Further investigation for the proposed development will be useful in some areas to confirm target founding depths and allowable bearing pressures.

5.1 General Earthworks Comments

Excavation

Excavation will be required for the basement construction and the installation of underground services, including placing the existing high voltage power lines to the north of the site underground. We expect that the excavation will be limited to about 3m to 3.5m below excavation level.

The excavated material will be a combination of existing fill and natural organic soils. Reference should be made to the EIS report for details of the waste classification for these materials, and for any necessary treatment prior to disposal.

Excavations through the soils above the water table should be temporarily battered at no steeper than 1 Vertical (V) in 1.5 Horizontal (H). Where these excavations will extend below the water table, it will be necessary to dewater so that the excavation will be in "dry" soil which will require shoring of the sides of the excavation. We understand that the acid-sulphate reactivity of the soil will necessitate quite stringent controls on dewatering and so the construction of a sheet pile wall around the excavation will probably be required. Sheet pile walls may be designed using active and passive earth pressure coefficients and unit weights as provided in the table below. Appropriate surcharge loads and hydrostatic pressures (taking into account the dewatered condition) would have to be included in the design of the shoring.

Soil Description	Total Unit Weight (kN/m³)	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)
Fill	19	0.35	3.0
Peat, Organic Clay, Organic Sand	10	0.50	2.0
Remaining Clayey and Sandy Soil	20	0.3	3.3

There would be two options with regard to the sheet pile walls. The first of these would be to cantilever the walls, though the lateral deflections may not be tolerable where near existing structures (such as the club building and the service station to the east). To limit the deflections, the second option would be to use embedment for toe restraint of the sheet piles in conjunction with an upper row of anchors or tie backs. The anchors could be soil anchors of either the grouted type (conventional anchors) or buried plate type (such as 'Platypus' anchors). Grouted anchors should be designed for a friction angle of 25° provided they are bonded into the fill and all anchors should be proof loaded to at least 1.3 times their working load.

Engineered Fill

A basement will extend over the majority of the site area, and so very little fill will be placed during the construction. The fill is likely to be below entry pavements (where suitable placement procedures are often detailed during the construction works as they have relatively little effect on the proposed construction) and in landscaping areas where only nominal compaction is required unless there will be additional pavements or structures in those areas.

Any new structural fill placed, such as below proposed pavements, should be placed as engineered fill. Such fill should preferably be a well graded, select granular fill containing no organics or other deleterious substances. The fill should be placed in layers not exceeding 200mm loose thickness and compacted to at least 98% of Standard Maximum Dry Density (SMDD). Clayey fill is not ideal for use, though it may be used following approval of the material by the geotechnical engineers, and it should be compacted strictly to between 98% and 102% of SMDD and within 2% of the Standard Optimum Moisture Content (SOMC).

Where fill is being placed in landscaped areas, or below areas which will be supported on piles, it should be compacted to at least 95% of SMDD.

5.2 Footing Design

The existing fill and organic clays on the site are not suitable for use as a bearing stratum for the proposed structures. We recommend that the proposed buildings be supported on piles founded on the sandstone bedrock. From the limited information available at present, we consider that piles founded within the bedrock of at least medium strength may be designed for an allowable end bearing pressure of 3500kPa. In many areas of the site, further investigations would be likely to prove bearing pressures to 6000kPa as being feasible. It should be noted however that in some areas, particularly around the existing club building, a capping layer of sandstone was found to overlie further clay bands; the piles would need to penetrate through these to the sandstone bedrock below to adopt the higher pressures. Allowable bearing pressures of about 600kPa appear to be feasible on the sandstone capping layer. Further specific investigation will be required at each of the building locations to provide further information on the variability so that the above allowable bearing pressures can be confirmed.

Provided the above pressures are adopted, we expect settlements would be less than 1% of the pile diameter (ie settlements probably less than 10mm).

Where piles would only need to support relatively light loads, it may be possible to support them within the stiff to very stiff clayey soils. Such piles may be designed for an allowable end bearing pressure of 300 kPa. Any socket into the stiff to very stiff clay greater than 0.5m in length may be designed for an allowable shaft adhesion of 17kPa.

There are several piling techniques that may be adopted at this site and these are discussed in more detail below.

It would be possible to use driven steel or concrete piles on the site. In this case, there would be no spoil which would require treatment for potential acid sulphate problems. Driven piles also have the benefit that their load capacity can be calculated using published pile driving formulae. We expect that vibrations from the pile driving would not be of concern in the majority of the proposed development area, however this should be confirmed by reputable pile driving companies prior to the adoption of this piling system. One potential drawback of this system is that the piles may refuse on the capping layer of sandstone and so the pile capacity may be relatively low. Pre-drilling could be considered to overcome this but would add substantially to the cost.

An alternative to the driven piles would be the 'G pile' system. This technique involves jacking the piles into the ground from a very large ballasted rig. The load capacity of these piles can also be calculated from the piling records. These piles have the advantage over driven piles that there is very little vibration from the pile installation and so can be used close to existing structures. These piles also have the potential problem that premature refusal may occur on a capping layer of sandstone resulting in limited pile capacity, again, pre-drilling is an option.

Auger grout injected piles would also be a possibility on this site. These would be particularly useful around the club where the depths to the rock are generally less than say 15m. More difficulty could be encountered however to the west of Shark Park where the rock was in excess of 20m. These piles have the benefit that they can be drilled to depth and therefore should have the capacity to drill through capping layers of sandstone, though drilling in sandstone is usually very slow and large volumes of excavated spoil are likely to be produced. We understand that this piling system has previously been used on the site and large volumes of grout were required, presumably to fill voids within the poorly compacted fill.

It may also be possible to drill piles using bentonite mud to support the hole during drilling and concreting. A variation to this would be to adopt barettes excavated through a bentonite slurry using a 'clamshell' mechanism (similar to that used for diaphragm wall construction). These drilling techniques are usually very expensive and are only likely to be economical if the column loads are very high.

Conventional bored piles are not considered suitable at this site due to the high groundwater level and the potential for collapse of the poor quality near surface soils.

Our recommended piling techniques would be to adopt either auger grout injected piles or piles drilled through bentonite slurry everywhere on the site, or a combination of driven piles when at a distance from existing structures (and where investigation shows there is no capping layer of sandstone) and auger grout injected piles elsewhere.

We note that obstructions within the fill have been previously noted and all of the above techniques could have difficulties with these. We therefore recommend that a low productivity and increased bit wear be allowed for in the tendering of piling.

Also, a provisional sum could be allowed for the possibility of having to excavate obstructions from the fill where premature refusal of the piling occurs.

5.3 Temporary And Permanent Groundwater Considerations

Some of the soils around the site have the potential to produce acidic leachate if they become unsaturated and oxygen is allowed to react with the soil. As a result, the level of groundwater will need to be carefully monitored and controlled during the construction period.

Dewatering of the basement excavation will be required with the currently proposed level of the basement. To reduce the effects of dewatering on the groundwater conditions outside the excavation, it will be necessary to have a 'cut-off' wall, such as a sheet pile wall, around the basement. This cut-off should be socketed below the base of the excavation such that the depth of embedment below the proposed excavation level is twice the distance between the basement level and the outside water level.

As the soils are generally likely to be of low permeability within the dewatering zone, conventional well or spearpoint dewatering systems are probably not generally suitable, though may be necessary in some areas. We suggest that the dewatering be trialed using a sump and pump technique. The sump could be formed by having large diameter drums or 'formatube' with many small holes in them installed into holes excavated below the base of the excavation. The void between the 'sump' and the excavated hole could then be filled with clean fine gravel and/or coarse sand as a filter. An automated pump system could then be installed in the sump. Reference should be made to the EIS report with regard to testing, treatment and disposal of the collected water.

It will then be necessary to have monitoring wells around the perimeter of the excavation to assess the effect of dewatering outside the cut-off wall; we would expect this effect to be very minor. If there is any drawdown of the groundwater outside the cut off, an injection system could be used to overcome the drawdown effect. The injected fluid could be:

- Water pumped from the sumps, treated as necessary;
- Water from the Bay;
- Water pumped from a deep well, at such depth that the water level near the surface will not be affected;
- Town water.

Appropriate injection of water would prevent drawdown of the water level in the short term. Any other environmental effects of using these waters, in relation to the injection of salt or chlorine is beyond our area of expertise but will need to be addressed by others.

Following the completion of the basement construction, the sheet piles should be removed to reduce their effect on the long-term groundwater flows. Following the sheet pile removal, the basement will extend only slightly below the water table. The majority of the soil between the water table and the bedrock will be left in place. There are also large areas along the foreshore where there will be no development intersecting the groundwater table. As a result, we would not expect there to be any significant effect on the long-term groundwater regime.

Further reduction of risk associated with changes to the groundwater regime could be achieved using a drainage and reinjection system. Such a system could comprise a subsoil drain directly above the existing groundwater level on the road side of the proposed basement, and by connecting this via a pipe and gravity drainage to a rubble soak away system above the current groundwater level on the Bay side of the proposed basement. We do not expect that such a system would be required.

5.4 Methane Drainage

We understand from EIS that there is a methane generation problem at the site and that a methane drainage system will be required. Such a system could comprise a drainage blanket of the entire development area, though we expect that this would be very expensive. Another alternative could be to complete the basement excavation and footing installation (piling), and excavate drainage slots, wrapped in filter geotextile and filled with clean, free draining, durable gravel and slotted PVC pipe. Following backfilling of these trench drains, a layer of 'bentofix' or 'claymax' should be placed over the entire site area and wrapped up the outside of retaining walls constructed inside the shored basement. This will provide a 'seal' to prevent the methane from entering the structures. For further details of the methane collection and disposal, reference should be made to the abovementioned EIS report.

5.5 Basement Design

The proposed two level car parking basement will extend slightly below the groundwater table. It will therefore be necessary to waterproof the basement to at least the highest foreseeable groundwater level. If more detailed information cannot be found, we recommend that allowance for hydrostatic pressures be made. A detailed study of local factors will be required to arrive at a realistic maximum level. The seal for the methane drainage will assist with the waterproofing of the basement, though we note that these products are of low permeability, not impermeable. We therefore recommend that the basement floor be designed to supply the waterproofing.

We note that the construction of the basement below the water table will either require dewatering, or hold down anchors, possibly of steel screw pile type, until there is sufficient load from the structures to withstand the potential uplift forces.

As the subgrade below the basement floor will be organic and wet, it will not be possible to prepare the subgrade to construct slab on grade. We therefore recommend that the basement floor be designed as suspended from the piles. This may not require any thicker floor as the basement floor will have to be designed for hydrostatic uplift pressures anyway.

6 FURTHER INVESTIGATIONS

As mentioned above, the current investigations have provided information on inferred rock depth or rock depth and quality at relatively large centres. Further investigation will therefore be required to provide specific comments and recommendations for developments of specific areas.

7 GENERAL COMMENTS

Occasionally, the subsurface soil conditions between the completed boreholes and EFCP test locations may be found to be different (or may be interpreted to be different) from those inferred/expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

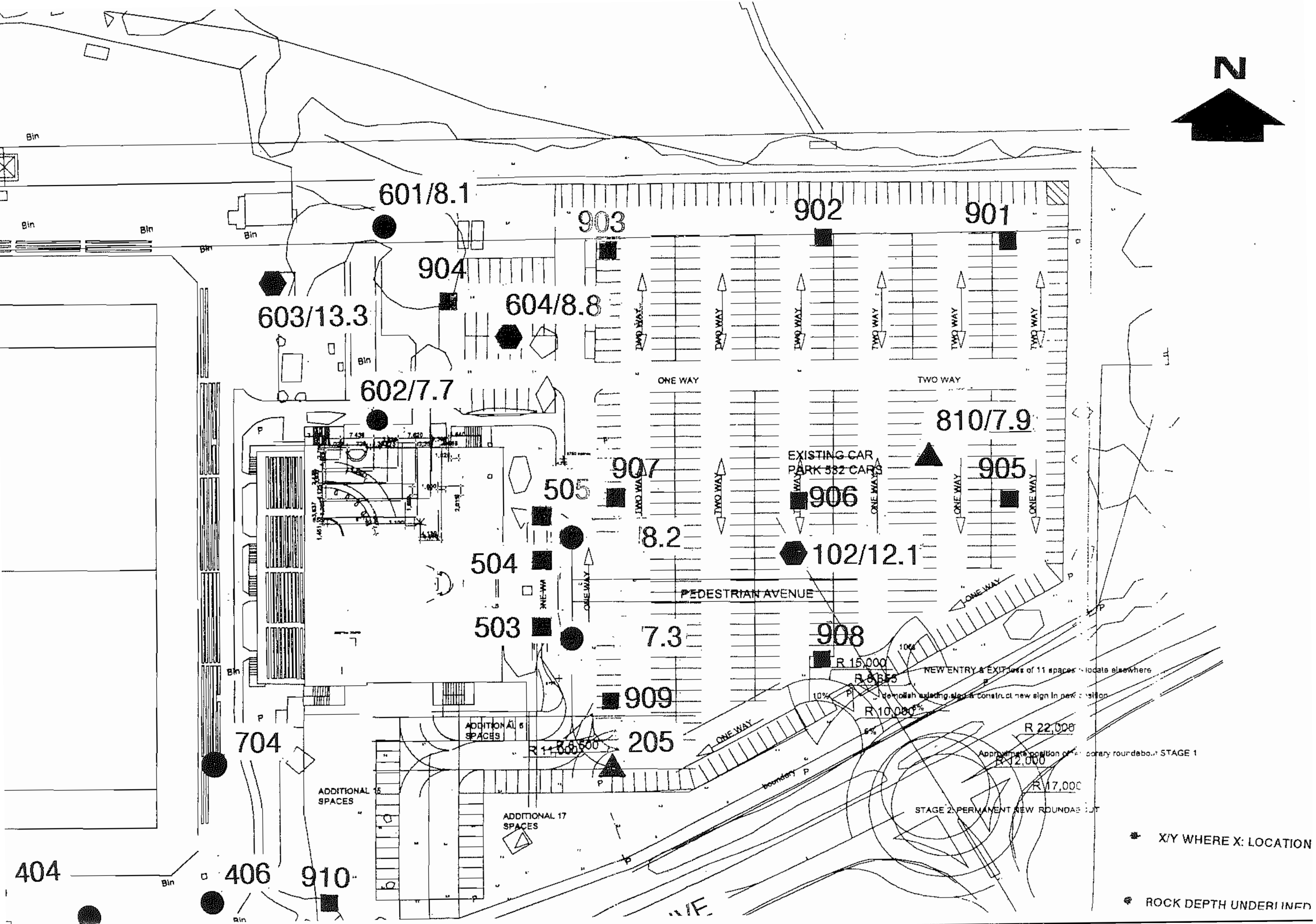
This report provides advice on geotechnical aspects of proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

The offsite disposal of soil may require classification in accordance with the EPA guidelines as inert, solid, industrial or hazardous waste. We can complete the necessary classification and testing if you wish to commission us. As testing requires about seven days to complete, allowance should be made for such testing in the construction program unless testing is completed prior to construction. If contamination is found to be present then substantial further testing and delays should be expected.

Should you have any queries regarding this report, please do not hesitate to contact the undersigned.

P Wright
Associate

P Stubbs
Director
For and on behalf of
JEFFERY AND KATAUSKAS PTY LTD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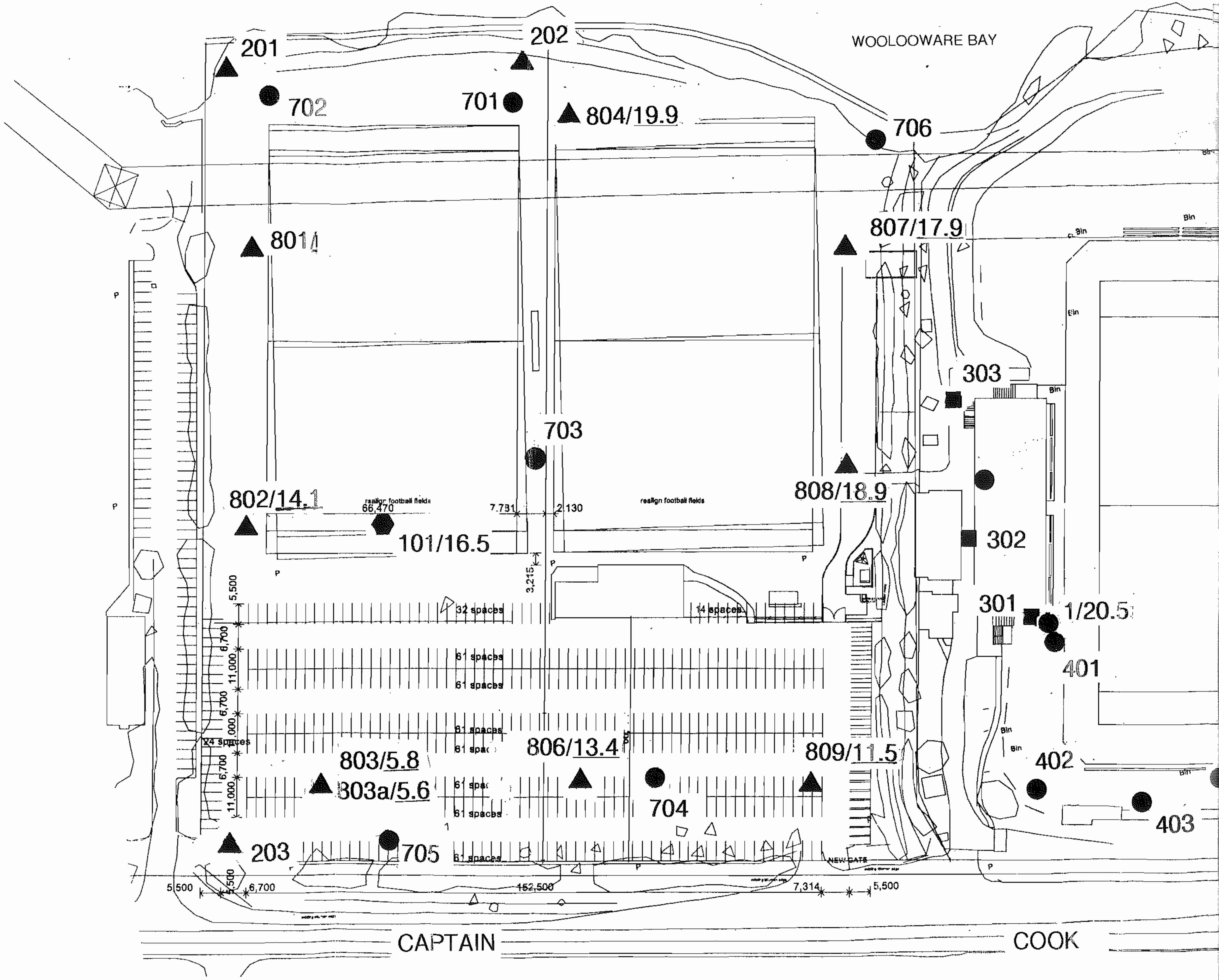

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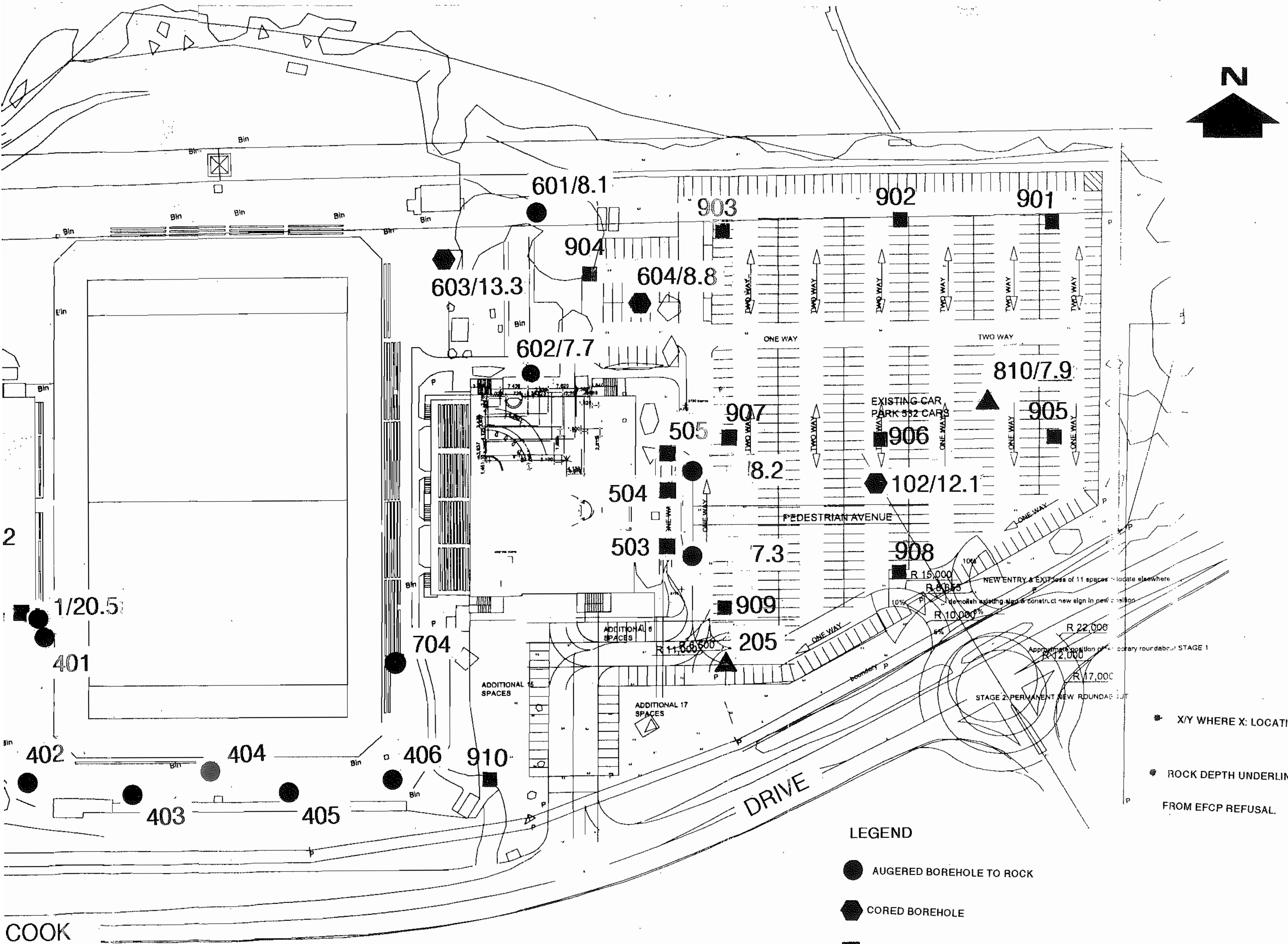


X/Y WHERE X: LOCATION NUMBER & Y: DEPTH TO ROCK IN m.

ROCK DEPTH UNDERLINED MEANS ROCK DEPTH INFERRED FROM EFCP REFUSAL.

LEGEND

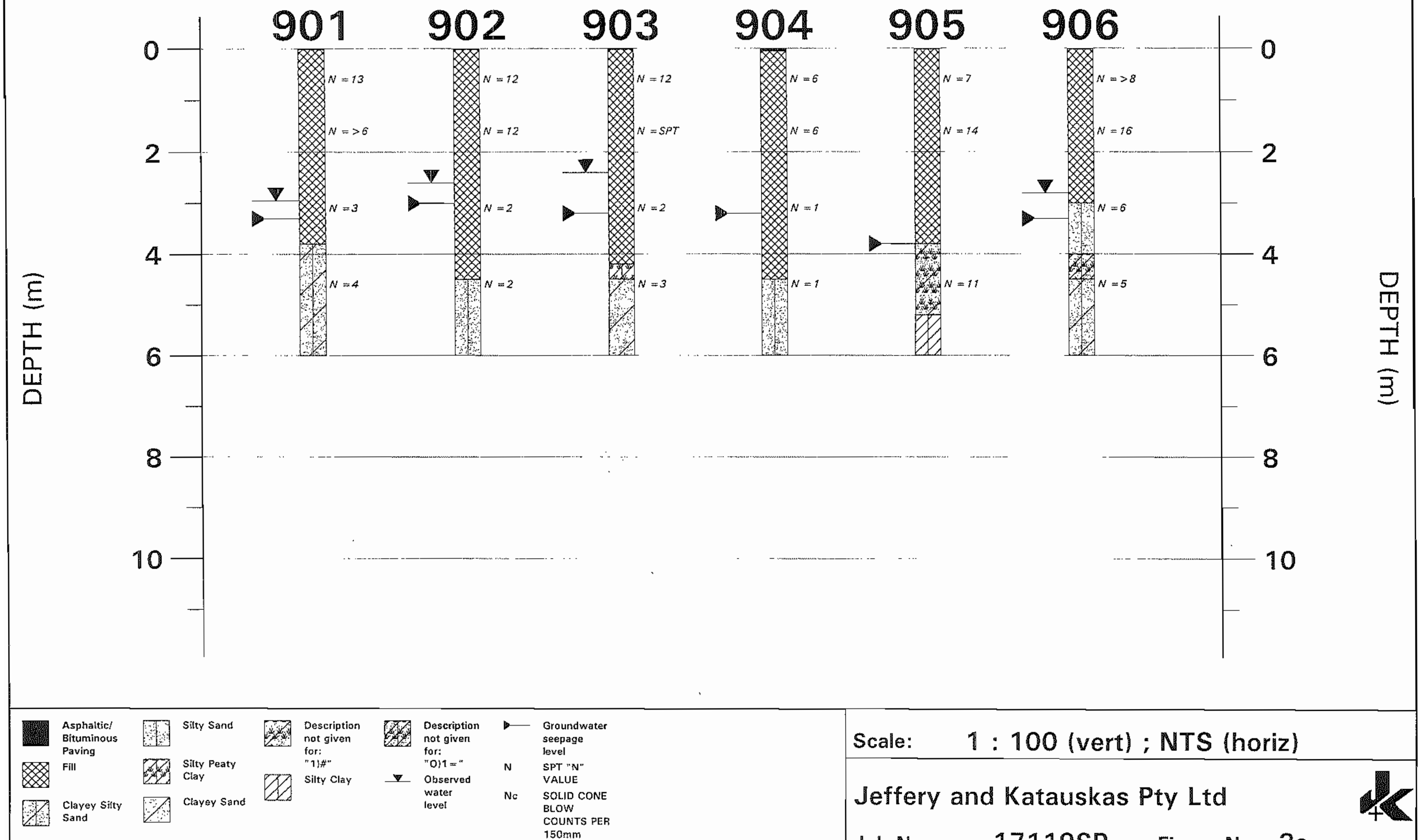
- AUGERED BOREHOLE TO ROCK
- CORED BOREHOLE
- SHOLLOW AUGERED BOREHOLE
- ELECTRICAL FRICTION CONE PENETRATION (EFCP) TEST

NVESTIGATION LOCATION PLAN

Jeffery and Katauskas Pty Ltd

Report No. 15009JTP Figure No. 1

GRAPHICAL BOREHOLE SUMMARY



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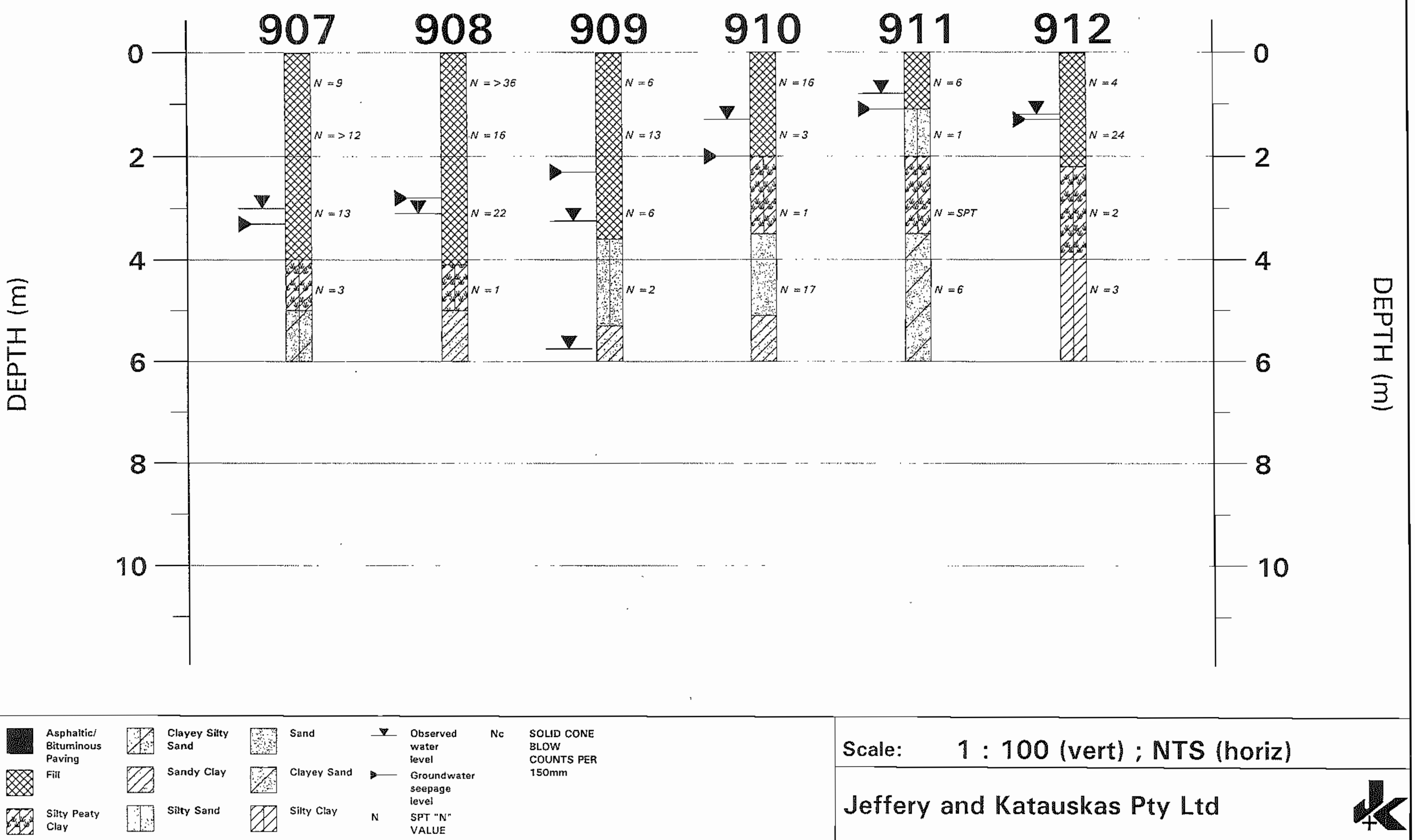
Jeffery and Katauskas Pty Ltd

Job No.: 17119SP Figure No.: 2a

GRAPHICAL BOREHOLE SUMMARY



Scale: 1 : 100 (vert) ; NTS (horiz)

Jeffery and Katauskas Pty Ltd

Job No.: 17119SP Figure No.: 2b

APPENDIX A

JEFFERY AND KATAUSKAS

FIELD LOG

Location No. BH1

1/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location. CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009-JTP
Date: 24 & 25 . 7 . 78

Method: AUGER & WASHBORE

R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer x100kPa 1 2 3 4	Structure & Geology
		0–2.6			FILL silt, sand with metal, construction rubble, wood, sandstone dark grey		loose		
▼ (approx. 1.4)	N=11 (3,9,7) (approx. 1.5–2.0)								
		2.6–5.8		OL	SILT AND CLAY, organic some shell pieces, pungent odour dark grey	MC>PL	V.Soft		
	N<1 (approx. 4.5–5.0)								
		5.8–6.1		CL	SANDY CLAY brown	MC>PL	V.Soft		
	NC=20 (approx. 6.0–6.5)	6.1–7.1		SM	SAND light grey fine to medium grained		M.Dense		
	NC=14 (approx. 7.8–8.2)	7.1–8.3		CL	SILTY CLAY, some sand layers grey.		Stiff		
	N=13 (10,9,4) (approx. 9.0–9.5)	8.3–9.8		SC	CLAYEY SAND some clay layers & shell pieces grey		loose		
NX CASING To 10.5m	N=8 (2,4,4) (approx. 10.5–11.0)	9.8–15		CH	CLAY high plasticity greenish grey then mottled grey and brown then mottled red and grey	MC>PL	Stiff	x (approx. 10.5)	
	N=25 (5,9,16) (approx. 13.5–14.0)							x x (approx. 13.5)	

JEFFERY AND KATAUSKAS

FIELD LOG

Location No. BH1

2/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009 JTP
Date: 24&25.7.78

Method: AUGER & WASHBORE

R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetro-meter 1 2 3 4	Structure & Geology
		15–17		CH	as above				
		18–20		CL	SANDY CLAY mottled brown and grey, some dark grey with depth				
		21			SANDSTONE				
					END BOREHOLE 21.0m.				

JEFFERY AND KATAUSKAS

FIELD LOG

Location No: BH2

1/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009-JTP
Date: 24 & 25.7.78
Method: AUGER & WASHBORE
R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer x100 KPa 1 2 3 4	Structure & Geology
		0–2			FILL silt, sand, bands of ripped sandstone, with metal, wood and rubble, dark grey		V.Loose		
▼ (approx. 1.7 m)	N<1; N<1								
	N=1	2–5		OL	SILT AND CLAY, organic, fibrous bands, pungent odour dark grey	MC>>PL	V.Soft		Natural Moisture Content 160%; 100%; 31%
	N<1; N<1	5–5.6		CL	SANDY CLAY, brown then bluish grey	MC>>PL	V.Soft		
	NC=20	5.6–7.6		SM	SAND, silty, some shell fragments grey		M.Dense		
	N=1	7.6–10		CL-CH	SILTY CLAY and CLAY medium to high plasticity some shell fragments slightly organic, dark grey	MC>PL	V.Soft		
	N>26 (4, 16, 10 for 0.07)	10–11.7		SC	CLAYEY SAND some clay bands, some shell pieces and charcoal fragments		M.Dense		
NX CASING TO 12m.	N=9 (2, 4, 5)	11.7–15		CH	CLAY high plasticity light grey then grey with red mottling.	MC>PL	Stiff		

JEFFERY AND KATAUSKAS

FIELD LOG

Location No
BH2

2/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009 JTP
Date: 24&25.7.78

Method: AUGER & WASHBORE

R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetro-meter 1 2 3 4	Structure & Geology
	N=16 (4,6,10)	15		CH	CLAY as above	M>PL	Stiff		
		16							
		17		CL	SANDY CLAY medium plasticity mottled grey and brown	M>PL	Stiff		
	N=7 (3,3,4)	18							
		19							
		20			SANDSTONE				
					END BOREHOLE 20.4m				

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 101

1/4

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP

Method: SPIRAL AUGER EDSON 3000

Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			0			FILL: Silty sand, fine gravel, dark brown.		VL		APPEARS POORLY COMPACTED
						FILL: Silt, sand, brick, concrete rubble, plastic & glass.				POOR SAMPLE RETURN ON AUGERS DUE TO VOIDS IN FILL
			1							
▷	DS									
	DS	N=5 1, 1, 4								
			2							
	DS				OL	ORGANIC SILTY CLAY: low plasticity, dark green brown with many shells & decayed roots.	MC>PL	VS		STRONG ORGANIC ODOUR
			3						30 45 50 50	
	DS	SUNK UNDER HAMMER WEIGHT N<1								
			4							
			5		CL	SANDY CLAY: low plasticity, mid brown, sand fine grained occasional gravelly bands.	MC>PL	S to F		
	DS									
		N=18 3, 8, 10	6		SP	SAND: fine grained grey & dark grey with occasional thin clayey bands.	W	MD		

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CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 101 2/4

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP.   Method: SPIRAL AUGER EDSON 3000

Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			7			SAND: as above grading to				1½ m. CAVE-IN CASED TO 7.5 m.
FULL RETURN					CH	SANDY CLAY: high plasticity, light grey, occasional orange brown veins, with occasional bands of clayey sand.	MC>PL	V. St.-H		
	DS	N=17 3, 7, 10							270 430 390	COMMENCED MUD DRILLING
			8							
			9							
			10		CL-CH	SANDY CLAY: medium to high plasticity, light grey, occasional pockets of red brown very sandy clay.				
	DS	N=12 3, 5, 7							250 200 350 410 280	
			11							
			12							
¼ RETURN						as above, but with occasional ironstone bands.	MC>PL	St. - V. St.		FLUSH LOSS IN IRONSTONE BANDS
			13							
FULL RETURN	DS	N=14 4, 6, 8							170 120 140 260 240	

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Borehole No.

101

3/4

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP

Method: SPIRAL AUGER EDSON 3000

Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			14			SANDY CLAY: as above	MC>PL	St.		
	DS	N=9 3, 5, 4	15						140 200 130 140	
			16							
						REFER TO CORED B.H. LOG				ATTEMPTED SPT 15 BLOWS/0mm.
			17							

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Borehole No. 101 4/4

CORED BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009JTP
Core Size: N.M.L.C.
Date Drilled: 26&27-2-90
Inclination: –
Drill Type: EDSON 3000
Bearing: –

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$	DEFECT SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		16		START CORING AT 16·49m.					
FULL RETURN		17		SANDSTONE: fine grained, light grey & red brown, occasional orange brown bands.	MW	W			BEDDING PARTING 0°, ORANGE BROWN STAINING
						W-MS			CLAY SEAM, 10mm.
TOTAL LOSS		18							JOINTS 30° PLANAR, SMOOTH
									CLAY SEAM 50mm.
					HW	EW			N.B. ALL DEFECTS NOT LABELLED ARE BEDDING PLANES, PLANAR, SMOOTH, & OCCASIONAL DRILLING BREAKS
		19		as above, but with occasional shale layers.	MW	MS			
				END OF BOREHOLE AT 19·58m.					
		20							

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CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 102 1/3

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP Method: SPIRAL AUGER EDSON 3000
Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
						BITUMINOUS PAVEMENT				
						FILL: Clayey sand, fine grained, orange & dark brown with some sandstone gravel.	D			APPEARS MODERATELY WELL COMPACTED
	DS		1			FILL: Silty clay, medium to high plasticity, dark brown, with some shale & brick gravel.				
	DS	N=10 6, 4, 6	2			FILL: Sand, fine to medium grained, orange brown with occasional sandstone gravel. Rubber fragments at 1.4m.				COMPACTION VARIES
	DS					FILL: Clayey sand, fine grained, dark grey with domestic refuse including rubber fragments, plastic, brick, cloth.				
▶			3			— — — becomes gravelly.				
	DS	N=12 2, 1, 11								
	DS		4		OL	ORGANIC SILTY CLAY: low plasticity, dark green grey, with many decayed roots & some shells.	MC>PL	VS		STRONG ORGANIC ODOUR
			5			— — — becoming sandy.				
	DS	N=3 1, 2, 1	6		SP	SAND: fine grained, dark brown, with shells.	W	VL		

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BOREHOLE LOG

Borehole No. 102 2/3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP   Method: SPIRAL AUGER
Date: 26-2-90   EDSON 3000

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			7		SP	SAND: as above				
					CH	SANDY CLAY: medium plasticity light grey & orange brown with ironstone bands.	MC>PL	V. St.		
	DS	N>10 14, 10/50mm.							410 500, 250	
			8			— — — becoming mid brown.				
	DS					— — — becoming light grey with some partially cemented sand layers.				COMMENCED WASH BORING
	DS	N>10 10/50mm.								
			9		CH	SILTY CLAY: medium to high plasticity, light grey with occasional orange brown mottling.				
							MC≑PL	H		
	DS	N>10 12, 10/50 mm.	10						450 450, 500	
			11							
			12			SANDSTONE: fine grained, light grey, moderately weathered, weak, occasionally medium strong with occasional clay bands.				
			13							
						— — — becomes fresh & medium strong.				ATTEMPTED SPT AT 14.0m. 5 BLOWS/0mm.

REFER TO CORED B.H. LOG

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CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 102 3/3

CORED BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009JTP.
Date Drilled: 26&27-2-90
Drill Type: EDSON 3000
Core Size: N. M. L. C.
Inclination: –
Bearing: –

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$ EW VW W MS S VS ES	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific	General
				START CORING AT 14.0m.						
TOTAL LOSS		14		SANDSTONE: fine grained, light grey, with some very thin dark grey laminae to 14.7m.	F	MS				
				as above, but light grey with dark grey bands.						
		15								
		16				S				
									— JOINT, 20° PLANAR, SMOOTH — CLAY SEAM, 5mm.	
		17		END OF BOREHOLE AT 16.95m.						
		18								
		19								

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Borehole No. 103

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP

Method: SPIRAL AUGER EDSON 3000

Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			0–2.3			FILL: Domestic refuse, including clothes, concrete & brick gravel, plastic. Some sandy clay & clayey sand.				POORLY COMPACTED, VOIDED
	DS	N=12 3, 7, 5	1.5–1.95							
			2.3			END OF BOREHOLE AT 2.3m.				OBSTRUCTION IN FILL CAUSED AUGER TO MOVE OUT OF LINE

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BOREHOLE LOG

Borehole No. 103A 1/2

1m. WEST OF B.H.3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP
Method: SPIRAL AUGER EDSON 3000
Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			0 – 1 – 2 – 3			FILL: silty clay, low plasticity, with some domestic refuse including bricks, cloth, plastic.	MC>PL	L		POORLY COMPACTED, VOIDED
	DS	N=4 1, 2, 2	3							
► (approx. 3.8 m)										
	DS		4		OL	ORGANIC SANDY SILTY CLAY: low plasticity, dark green grey with abundant decayed organic matter & some shells.	MC>PL	V.S.		STRONG ORGANIC ODOUR
	DS	SUNK UNDER HAMMER WEIGHT N<1	5							
	DS				CL	SANDY SILTY CLAY: medium plasticity, light grey.		VSt		
	DS	N=11 3, 4, 7	6						290 220 280 280	

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Borehole No. 103A 2/2

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP
Method: SPIRAL AUGER EDSON 3000
Date: 26-2-90

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			7			AS above — — becoming mid brown mottled, with sandstone layers.	MC>PL	V. St.		
	DS	N = 22 4, 8, 4							260 320 280 300	
			8							
			9							
	DS									
			10			END OF BOREHOLE AT 10.0m.				
			11							
			12							
			13							

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EFC PT No. 201
Sheet 1 of 2

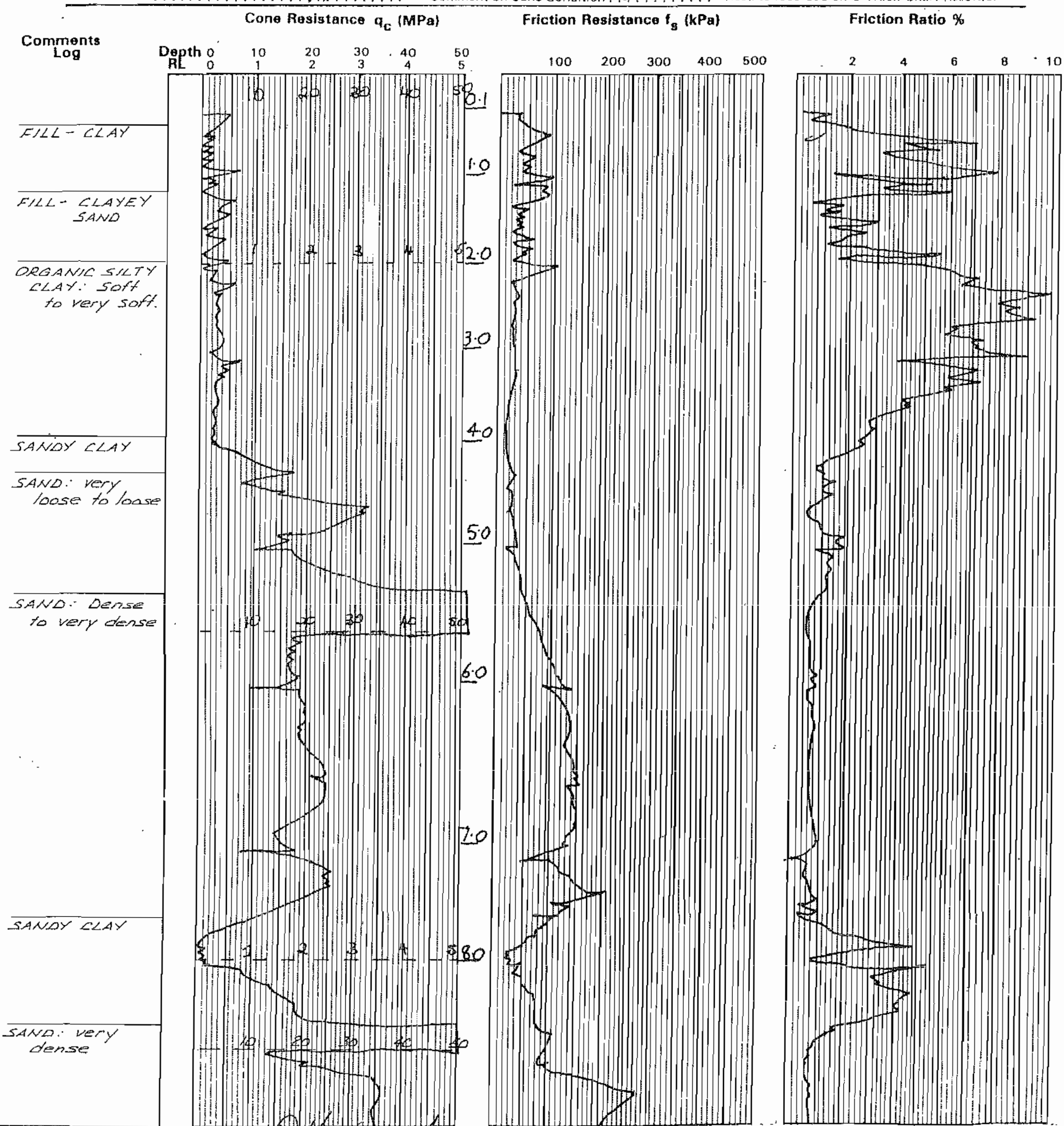
ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F5.1 - 1977)

Job No. 15009JTP
Client CRONULLA SHARKS
Project SHARK PARK REDEVELOPMENT
Location CAPTAIN COOK DRIVE, WOOLOOWARE

Operator BRYAN CLANCY
Time & Date 6-3-90
Last Calibration 9:30 a.m.
Comment on Cone Condition GOOD

Cone Type MACSIL
Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



Authorised Signatory ....

Date 8/3/90

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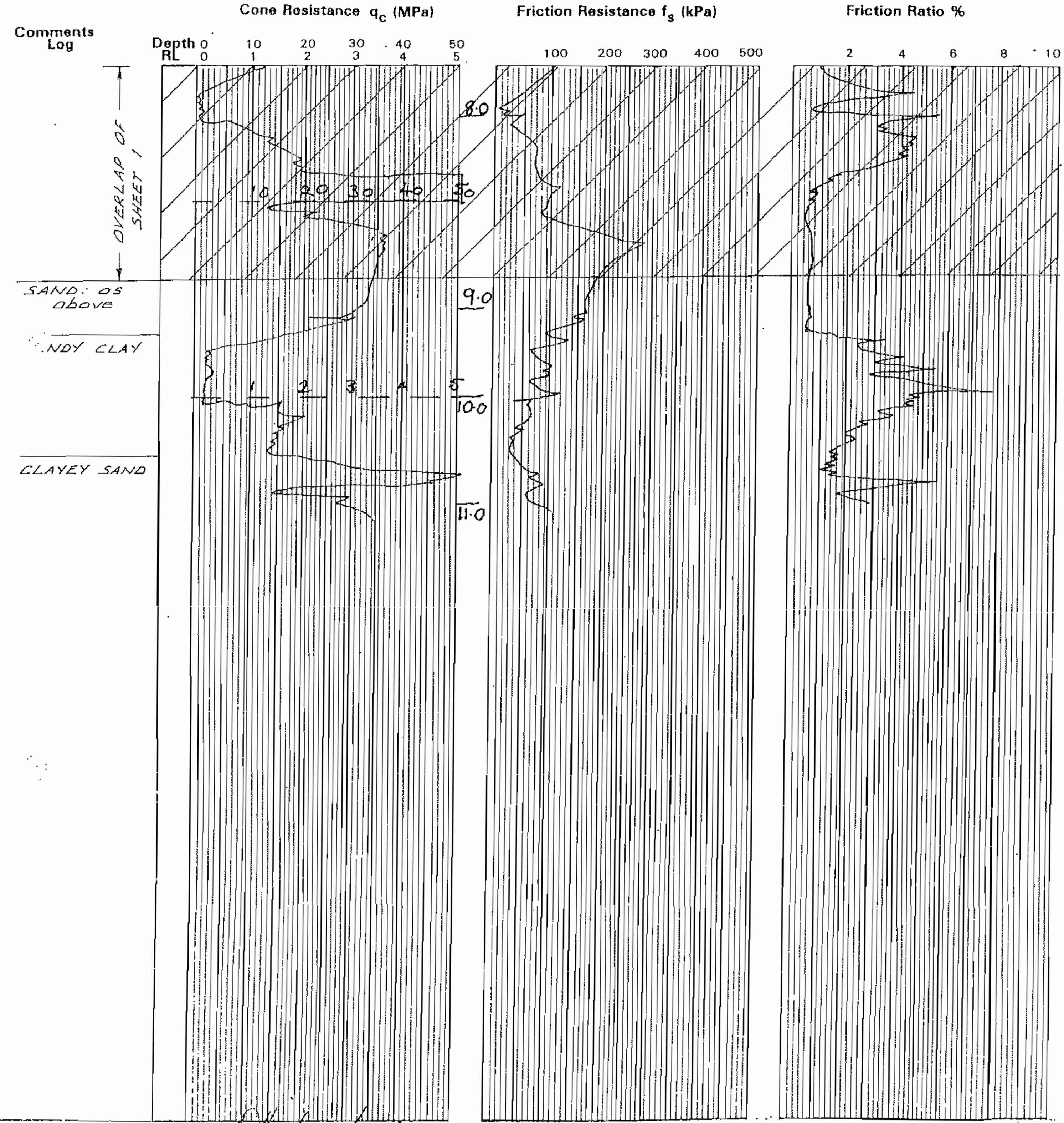
EFC PT No. 201
Sheet 2 of 2

ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F6.1 - 1977)

Job No. 15009JTP
Operator BRYAN CLANCY
Cone Type MACSIL
Client CRONULLA SHARKS
Time & Date 6-3-90
Project SHARK PARK REDEVELOPMENT
Last Calibration 9:30 a.m.
Location CAPTAIN COOK DRIVE WOOLOOWARE
Comment on Cone Condition GOOD

Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



Authorised Signatory ....

Date 8/3/90

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EFC PT No. 202
Sheet of

ELECTRONIC FRICTION CONE PENETROMETER TEST

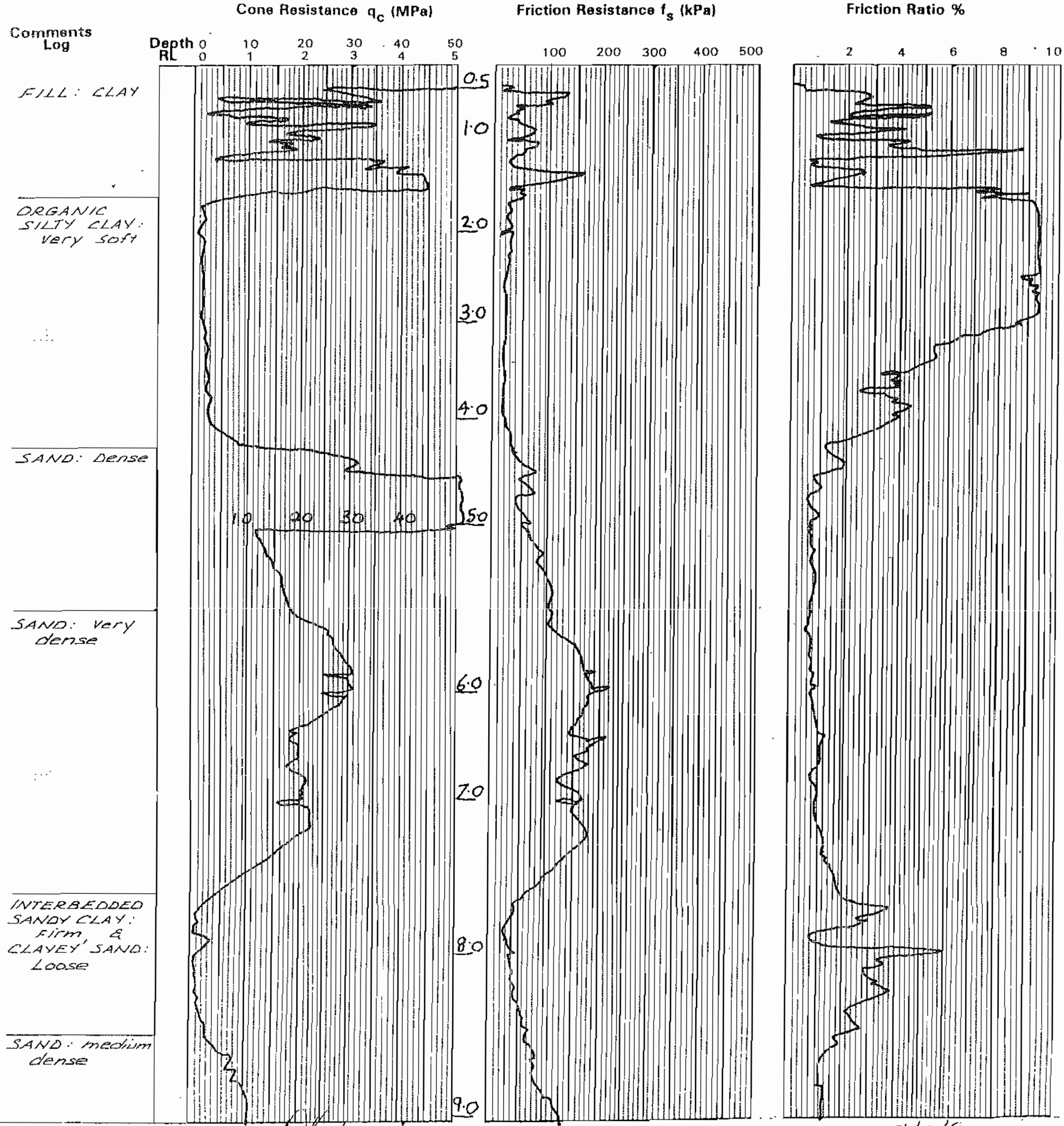
(TO AS. 1289 F6.1 - 1977)

Job No. 15009JTP
Client CRONULLA SHARKS
Project SHARK PARK REDEVELOPMENT
Location CAPTAIN COOK DRIVE, WOOLOOWARE

Operator BRYAN CLANCY
Time & Date 6-3-90
Last Calibration 9:30 a.m.
Comment on Cone Condition GOOD

Cone Type MACSIL

Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



Authorised Signatory ....

Date 8/3/90

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EFC PT No. 203
Sheet of

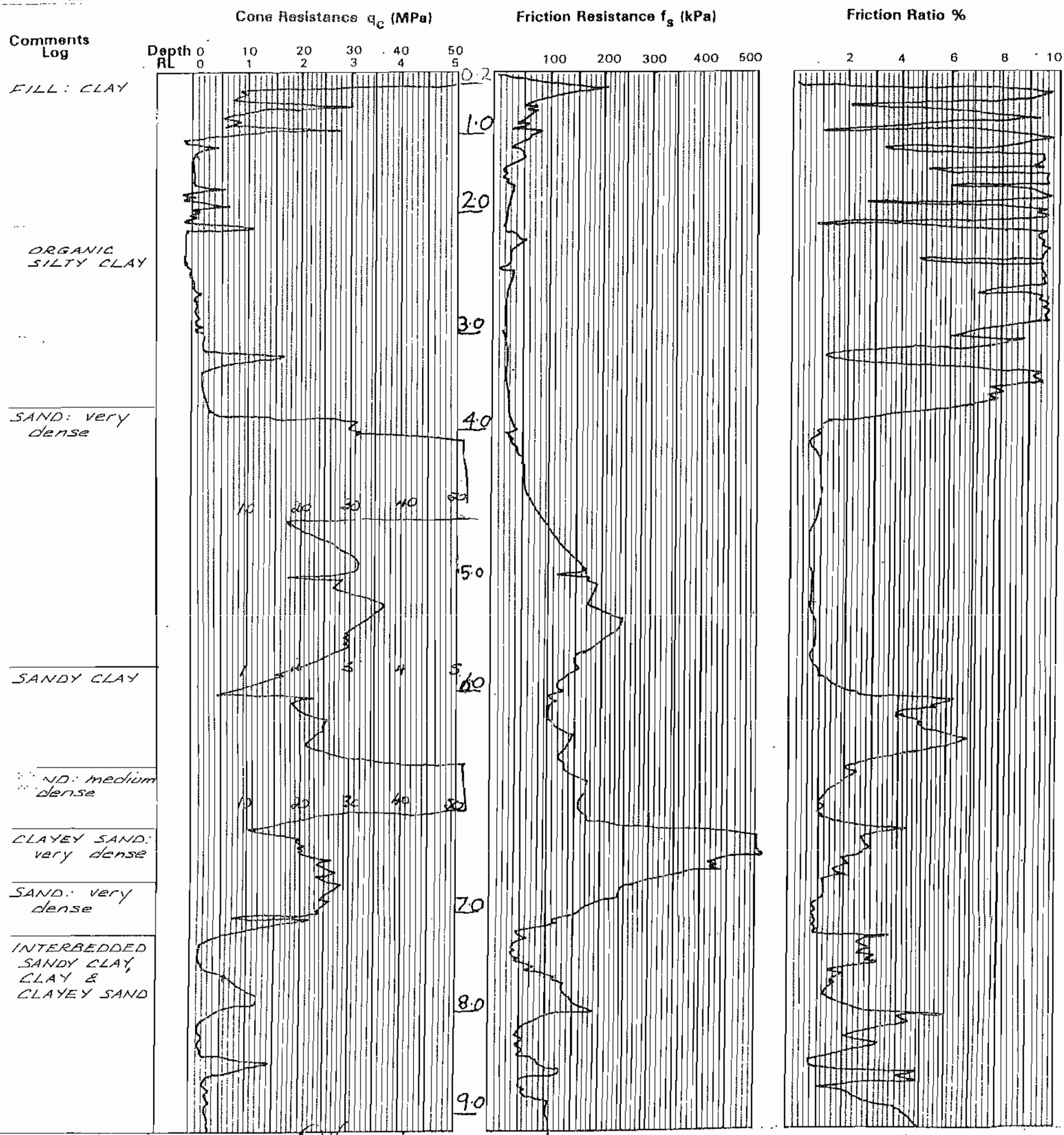
ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F6.1 - 1977)

Job No. 15009JTP
Client CRONULLA SHARKS
Project SHARK PARK REDEVELOPMENT
Location CAPTAIN COOK DRIVE, WOOLOOWARE

Operator BRYAN CLANCY
Time & Date 6-3-90
Last Calibration 9.30 a.m.
Comment on Cone Condition GOOD

Cone Type MAGSIL
Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



Authorised Signatory (signature)

Date 8/3/90

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EFC PT No. 204
Sheet of

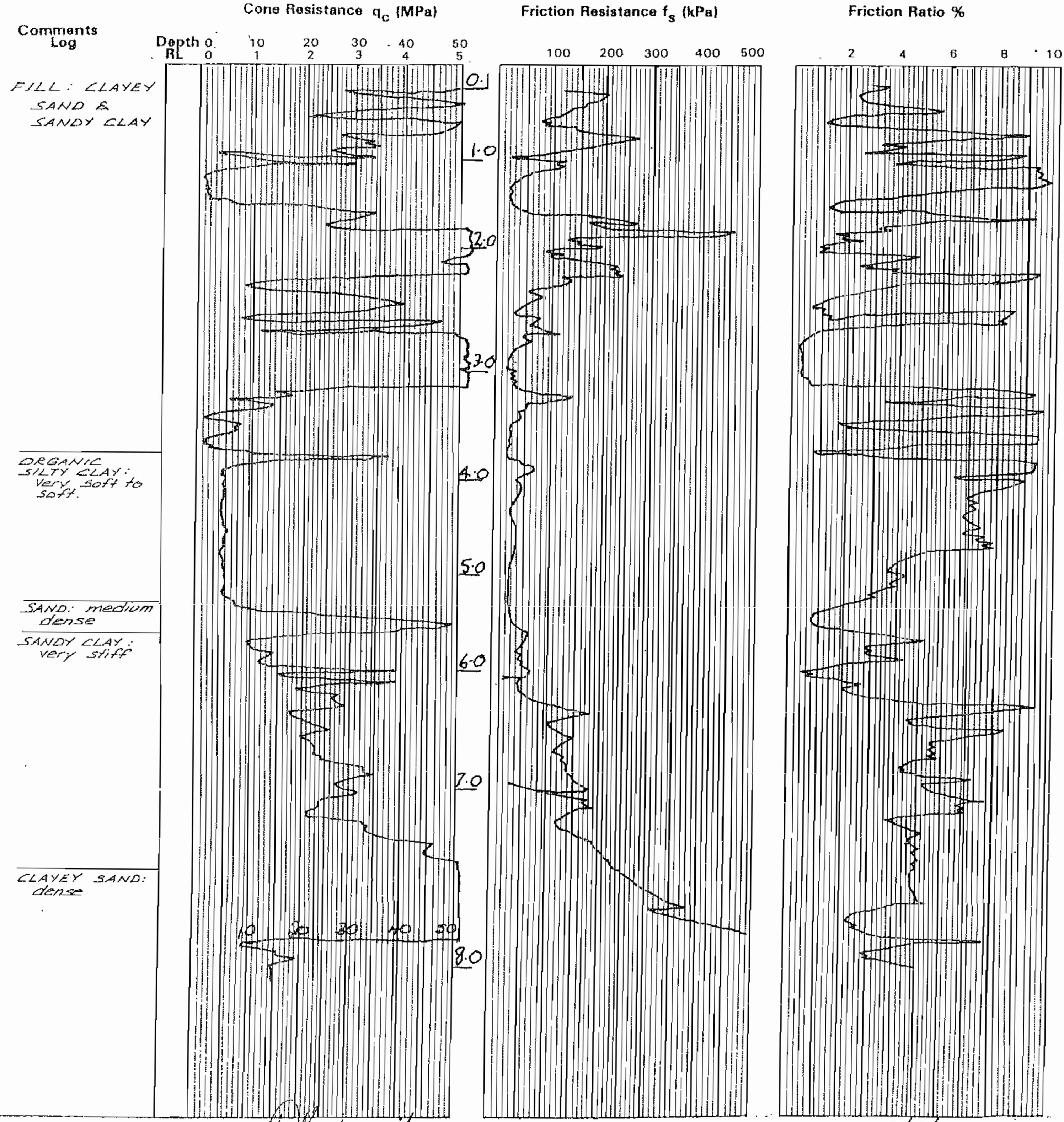
ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F5.1 - 1977)

Job No. 15009JTP
Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE

Operator: BRYAN CLANCY
Time & Date: 6-3-90
Last Calibration: 9:30 a.m.
Comment on Cone Condition: GOOD

Cone Type: MACSIL
Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



Authorised Signatory

Date 8/3/90

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EFC PT No. 205
Sheet 1 of 1

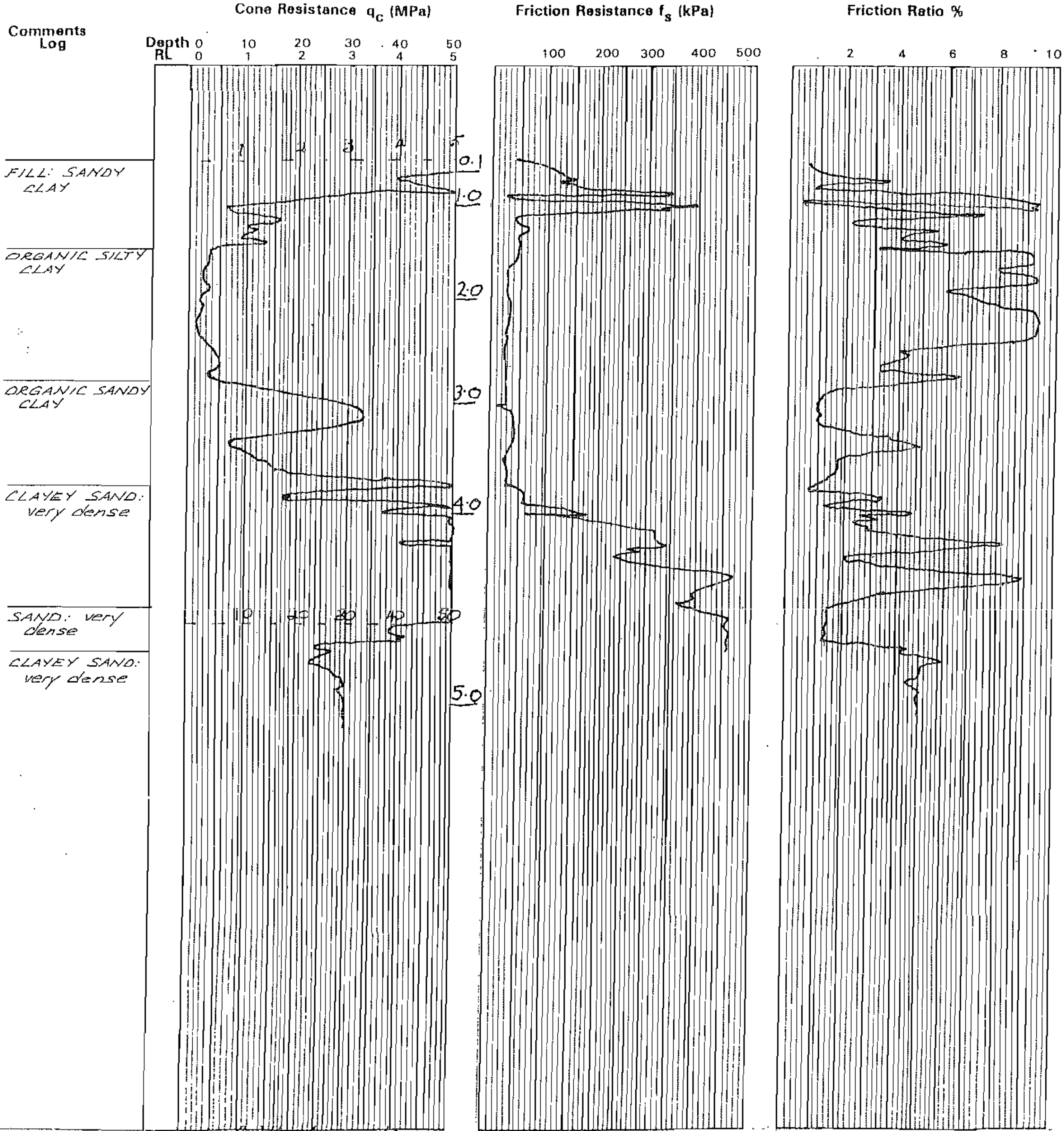
ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F6.1 - 1977)

Job No. 15009JTP
Client CRONULLA SHARKS
Project SHARK PARK REDEVELOPMENT
Location CAPTAIN COOK DRIVE, WOOLOOWARE

Operator BRYAN CLANCY
Time & Date 6-3-90
Last Calibration 9:30 a.m.
Comment on Cone Condition GOOD

Cone Type MACSIL
Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



Authorised Signatory

Date 8/3/90

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EFC PT No. 206
Sheet 1 of 1

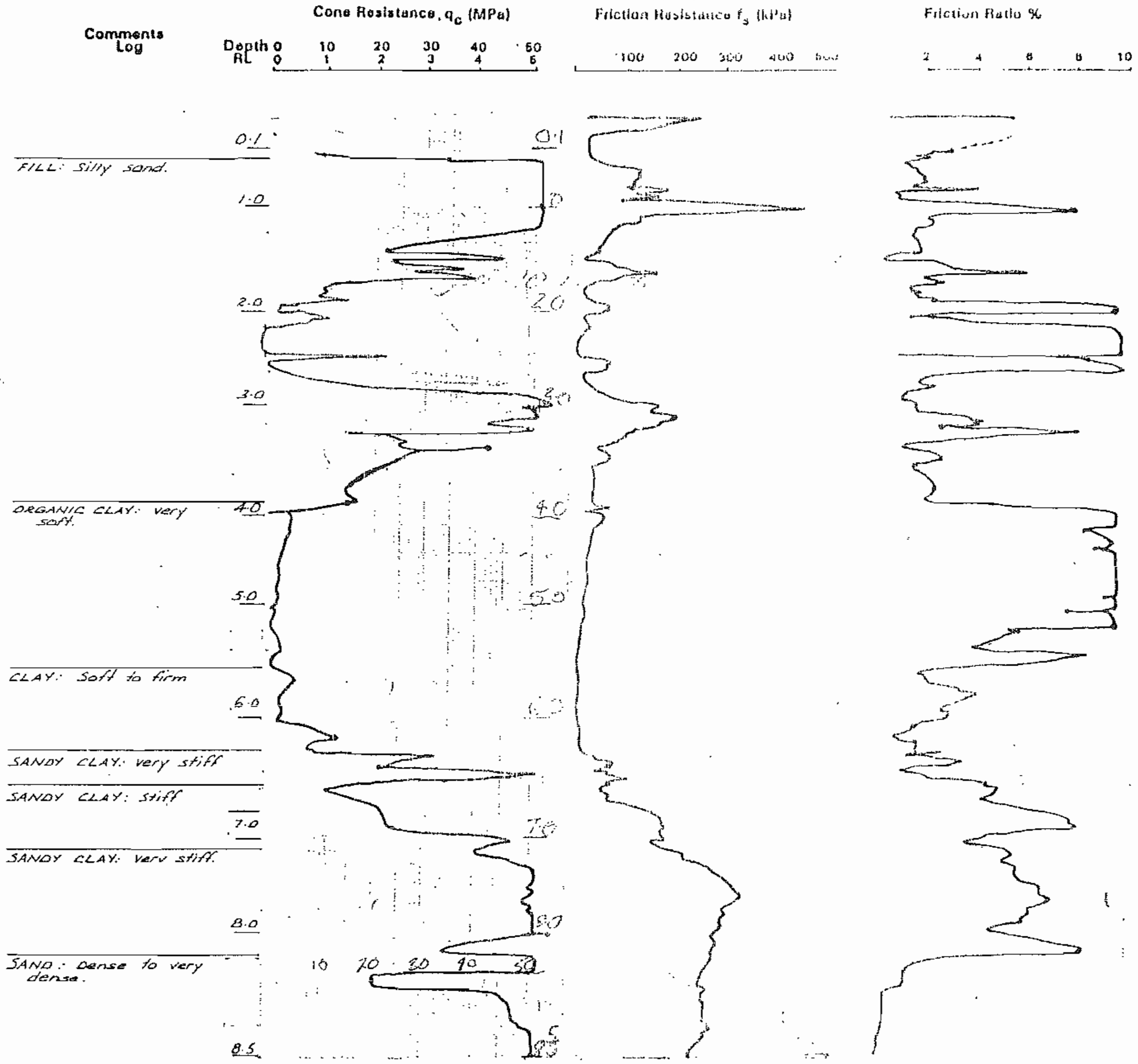
ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F6.1 - 1977)

Job No. 15009JTP
Client CRONULLA SHARKS
Project SHARK PARK REDEVELOPMENT
Location CAPTAIN COOK DRIVE, WOOLOOWARE

Operators BRYAN & STEVE
Time & Date 13-3-90
Last Calibration 9:30 a.m.
Comment on Cone Condition Good

Cone Type MACS4
Note: Test performed with 37mm dia. Rods. No Friction Reducer used. 15 tonne thrust Penetrometer used. Results recorded on 3 Track Chart Recorder



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EFC PT No
207
Sheet 1 of 1

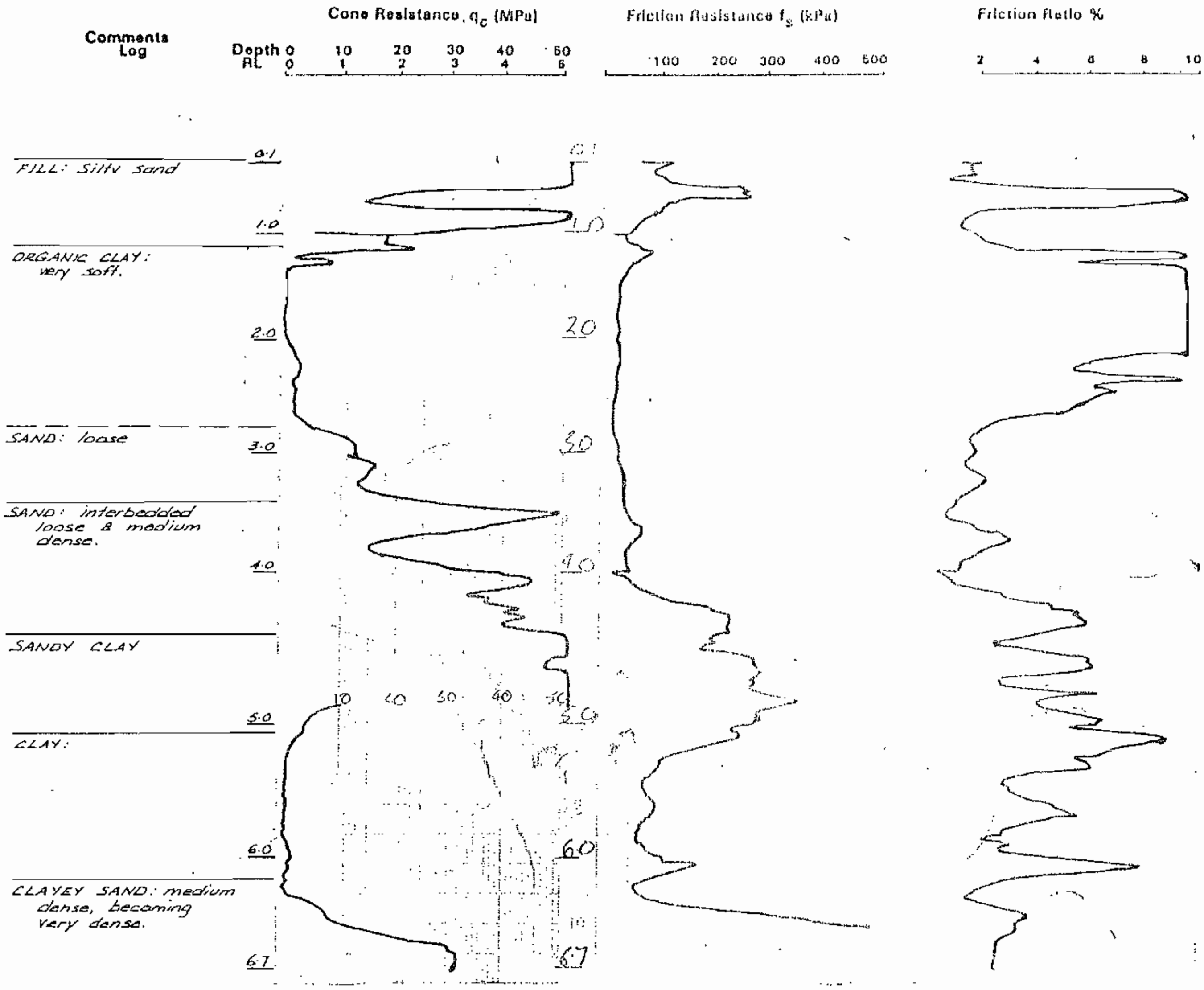
ELECTRONIC FRICTION CONE PENETROMETER TEST

(TO AS. 1289 F6.1 - 1977)

Job No. 15009JTP
Client CRONULLA SHARKS
Project SHARK PARK REDEVELOPMENT
Location CAPTAIN COOK DRIVE, WOOLOOWARE

Operators [illegible]
Time & Date [illegible]
Last Calibration [illegible]
Comment on Cone Condition [illegible]

Cone Type [illegible]
Note: Test performed with 37mm dia. Rods. No Friction Reducer used.
15 tonne thrust Penetrometer used.
Results recorded on 3 Track Chart Recorder



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CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 301 & 301A

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP
Date: 16 - 7 - 91
Method: SPIRAL AUGER G.C.H. RIG.
R.L. Surface: 2·4m.
Datum: A.H.D.

Groundwater record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			0–1			FILL: Clayey Sand with some gravel, glass, cobbles, broken tile, metal pieces, grey.				1A MEET REFUSAL AT 1M ON COBBLY FILL. POORLY COMPACTED.
	DS	N = 4 4, 2, 2	1							
▼ (≈2.0 m)		SUNK UNDER WEIGHT OF RODS	2							
	DS	N >12 1, 6, 11/50mm								
		BOUNCING	3							
					OH	ORGANIC CLAY: high plasticity, grey.	MC > PL	S		PUNGENT ODOUR.
		N < 1 2/700mm	4							
			5			END OF BOREHOLE AT 4·7m				
			6							
			7							

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Borehole No. 302

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP

Date: 16 - 7 - 91

Method: SPIRAL AUGER G.C.H. RIG.

R.L. Surface: 1·7m.

Datum: A.H.D.

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
						ASPHALTIC CONCRETE: over base.				PAVEMENT.
▼						FILL: Clayey Sand with gravel, rubble and abundant timber fragments, dark grey.				POORLY COMPACTED.
	DS	N = 6 2, 3, 3	1							
			2			becoming more silty sand.				
		N<1 1/700mm			OH.	ORGANIC CLAY: high plasticity, with shell fragments.	MC>PL	S		
			3							
		SUNK UNDER HAMMER WEIGHT.	4							
			5			END OF BOREHOLE AT 4·8m				
			6							
			7							

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Borehole No. 303

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP

Date: 16 - 7 - 91

Method: SPIRAL AUGER G.C.H. RIG.

R.L. Surface: 1·7m.

Datum: A.H.D.

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
			0 – 2.6			FILL: Sandy Clay / Clayey Sand medium plasticity, red brown and dark grey, some gravel and cobbles, trace of timber pieces.				POORLY COMPACTED.
		2, 9, 4, 2, 3, 1, 1	1							
▼ (approx. 1.5m)										
		2, 1, 1, 1	2							
		1, 0, 1, 1, 1, 1, 1	2.6 – 3.8		OL	ORGANIC SILTY CLAY: low to medium plasticity, dark grey, abundant reed inclusions.	MC >PL	S.		
			3							
			4			END OF BOREHOLE AT 3·8m.				
			5							
			6							
			7							

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Borehole No. 401 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** HAND AUGER **R.L. Surface:** N/A
Date: 25-1-96 **Datum:**
Logged/Checked by: D.J./

Groundwater Record	SAMPLES U50 DB DS ES	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		REFER TO SCALA SHEET	0		–	TOPSOIL: Silty sand, fine grained, brown, with some fine roots.	M			GRASS COVER
						FILL: Clayey silty sand, fine grained, grey, with some clay nodules and fine to medium gravel.				APPEARS POORLY TO MODERATELY COMPACTED
			1			FILL: Sand, fine to medium grained, yellow brown, with some clay bands.				
						END OF BOREHOLE AT 1.3m				HAND AUGER REFUSAL
			2							
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. 402 1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** HAND AUGER **R.L. Surface:** N/A
Date: 25-1-96 **Datum:** –
Logged/Checked by: D.J./

Groundwater Record	SAMPLES (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		REFER TO SCALA SHEET	0		–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
						FILL: Clayey silty sand, fine grained, grey, with some root bands and fine to medium gravel.				APPEARS MODERATELY COMPACTED
			1							
						as above, but with some coarse slag gravel.				
			2							
						FILL: Gravelly sandy clay, low to medium plasticity, brown, fine to coarse sandstone gravel.	MC>PL			
						END OF BOREHOLE AT 2.6m				HAND AUGER REFUSAL
			3							
			4							
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. 403

1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 25-1-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum: –
Logged/Checked by: D.J./

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
		N_c = 2, 3, 3, 3, 6, 3, 3, 4, 7, 12R	1			FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel.				APPEARS POORLY COMPACTED
AFTER 3.5 HRS.			2			FILL: Gravelly sandy clay, low to medium plasticity, brown, fine to coarse gravel, with some cobbles.	MC>PL			
		N_c = 1, 2, 3, 20, 6, 3, 3, 6, 4, 4, 4, 5	3							
			4		OL-OH	ORGANIC CLAY: medium to high plasticity, dark grey, with numerous fine roots.	MC>PL	St		–
			5			as above, but pale yellow brown, with some fine roots.				
			6			END OF BOREHOLE AT 6.0m				
			7							

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Borehole No. **404** 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 25-1-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum: –
Logged/Checked by: D.J./[signature]

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
	DS	N_c = 5, 8, 9, 14, 9, 5, 3, 2, 4, 9	0–2			FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel and cobbles.				APPEARS POORLY TO MODERATELY COMPACTED
AFTER 2.5 HRS	DS	N_c = 2, 1, 5, 5, 3, 2, 1, 1, 1	2–3.4				W			
	DS		3.4–4.5		OL–OH	ORGANIC CLAY: medium to high plasticity, dark grey, with some fine roots.	MC>PL	F	–	–
			4.5			END OF BOREHOLE AT 4.5m				

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Borehole No. 405 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 25-1-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum: –
Logged/Checked by: D.J./[signature]

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
	DS	N_c = 3, 6, 8, 9, 9, 11, 11, 9, 7, 6	1, 2			FILL: Clayey silty sand, fine grained, grey, fine to coarse gravel, with some cobbles.	W (from 1.9 m)			APPEARS MODERATELY COMPACTED
AFTER 1.75 HRS	DS	N_c = 2, 3, 1, ↓, 4, 5, 5, 6, 4, 6, 8	3							APPEARS POORLY COMPACTED
	DS		4		OL-OH	ORGANIC CLAY: medium to high plasticity, yellow brown with numerous fine to medium roots.	MC>PL	St	–	–
						END OF BOREHOLE AT 4.5m				
			5, 6, 7							

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Borehole No.
406
1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 25-1-96

Method: SPIRAL AUGER GCH RIG

R.L. Surface: N/A
Datum: –

Logged/Checked by: D.J./

Groundwater Record	SAMPLES (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		–	TOPSOIL: Silty san,d fine to medium grained, brown, with some fine roots.	M			GRASS COVER
	DS	N_c = 3, 3, 3, 5, 7, 5, 5, 4, 7, 7, 5	1			FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel.				APPEARS POORLY TO MODERATELY COMPACTED
AFTER 1 HOUR	DS	N_c = 1, 1, 1, 2, 1, 4, 6, 1, 2	2 3			FILL: Gravelly sandy clay, medium plasticity, brown, fine to coarse gravel.	MC>PL			APPEARS POORLY COMPACTED
	DS		4		OL–OH	ORGANIC CLAY: medium to high plasticity, grey brown, with some fine roots and a trace of shells.	MC>PL	(F)	–	–
			5 6 7			END OF BOREHOLE AT 4.5m				

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Borehole No. 407
1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** HAND AUGER **R.L. Surface:** N/A
Date: 4-4-97 **Datum:** –
Logged/Checked by: D.J./ [initials]

Groundwater Record	SAMPLES (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		REFER TO SCALA SHEET	0			FILL: Silty sand, fine to medium grained, brown, with some clayey sand bands and fine to medium gravel.	M			GRASS COVER APPEARS POORLY TO MODERATELY COMPACTED
						FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel.	MC>PL			
			1			FILL: Sandy clay, medium plasticity, various colours, with some fine to medium gravel.	M			
						FILL: Silty sand, fine to medium grained, brown, with some clay nodules and fine to coarse gravel.				
						END OF BOREHOLE AT 1.8m				HAND AUGER REFUSAL
			2							
			3							
			4							
			5							
			6							
			7							

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SCALA PENETRATION TEST RESULTS

Client:	CRONULLA SHARKS		
Project:	SHARK PARK REDEVELOPMENT		
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE		
Job No.	15009JTP	**Hammer Weight & Drop: 9kg/510mm**	
Date:	25-1-96	**Rod Diameter: 16mm**	
Tested By:	D.J.	**Point Diameter: 20mm**	

Number of Blows per 100mm Penetration

Test Location / Depth (mm)	401	402	407				
0 - 100	1	1	1				
100 - 200	2	3	2				
200 - 300	3	3	1				
300 - 400	3	14	4				
400 - 500	3	19	4				
500 - 600	5	18	6				
600 - 700	4	9	7				
700 - 800	3	6	7				
800 - 900	3	4	11				
900 - 1000	6	4	7				
1000 - 1100	6	4	6				
1100 - 1200	4	5	15				
1200 - 1300	3	7	19				
1300 - 1400	3	6	9				
1400 - 1500	8	25	11				
1500 - 1600	23	12	12				
1600 - 1700	13	9	9				
1700 - 1800	9	11	9				
1800 - 1900	14	10	9				
1900 - 2000	9	10	9				
2000 - 2100	8	11	10				
2100 - 2200	9	9	10				
2200 - 2300	8	7	10				
2300 - 2400	8	15	9				
2400 - 2500	8	12	10				
2500 - 2600	8	15	11				
2600 - 2700	8	21	10				
2700 - 2800	7	21	8				
2800 - 2900	8	20	9				
2900 - 3000	END	END	END				

Remarks:

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BOREHOLE LOG

Borehole No. 501
1/3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
Logged/Checked by: L.S./JP
R.L. Surface: N/A
Datum:

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE PAVEMENT: 20mm over 280mm of crushed igneous gravel.				PAVEMENT
	N_c = 4, 5, 6, 5, 6, 3, 3, 4, 6			FILL: Clayey sand, fine to medium grained, brown, red brown, yellow brown, grey, some grey clay nodules, some sandstone gravel, a trace of crushed igneous gravel and sandstone cobbles.	M	–	–	APPEARS MODERATELY COMPACTED
		1		FILL: Clay, high plasticity, grey and brown, some shale gravel, some sandy clay nodules (black) with organic fibres and fine roots, a trace of timber and wire.	MC>PL			APPEARS POORLY COMPACTED
AFTER 4 HRS	N_c = 2, 4, 5, 1, 2, 1, 2, 3, 5	2		FILL: Sandy clay, low plasticity, black, fine to medium sand, some brown nodules, some timber and organic fibres, a trace of wire, concrete, sandstone gravel and clay pipe and steel reinforcing.	MC>>PL			HARD BAND APPARENT CONCRETE 0.1m THICK
		3		FILL: Gravelly clayey sand, fine to coarse grained, black, fine to coarse ash gravel, some timber, a trace of wire and metal, slight organic odour.	W			
	N < 1 1,–,–	4 / 5	OL	ORGANIC CLAY: medium plasticity, dark brown to black, some shell fragments, a trace of fibrous material.	MC>PL	(S) / VS	– / 20, <20, 20	STRONG ORGANIC ODOUR TO 6.5m; ALLUVIAL
		6	SC	CLAYEY SAND: fine to medium grained, brown, some fine rootlets.	W	(VL)		
		7	CL	SANDY CLAY: medium plasticity, pale grey and orange brown mottled.	MC>PL	St		HP 150,120 IN SAMPLE FROM AUGER. RESIDUAL SOIL

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BOREHOLE LOG

Borehole No. 501 / 2/3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum:
Logged/Checked by: L.S./

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			7		CL	as above, but with some red brown mottling and fine grained sand, some silt.	MC>PL	(VSt)		25mm
		N = 30 R	8							
					–	SANDSTONE: fine to medium grained, pale grey, brown, dark brown and purple, some clay bands.	DW	M	–	MODERATE 'TC' BIT RESISTANCE
			9							
					CL	SANDY CLAY: medium plasticity, brown and pale grey.	–	–	–	–
			10							
			11		–	SANDSTONE: fine to medium grained, brown and grey.	DW	VL	–	VERY LOW RESISTANCE
			12							
						as above, but pale grey.		L		LOW RESISTANCE
			13					M		MODERATE RESISTANCE

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Borehole No. 501 3/3

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum:
Logged/Checked by: L.S./[signature]

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
				■		14			SANDSTONE: as above.		M		MODERATE RESISTANCE
											L		LOW RESISTANCE
						15			END OF BOREHOLE AT 15.0m				
						16							
						17							
						18							
						19							
						20							

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BOREHOLE LOG

Borehole No. 502
1/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
Logged/Checked by: L.S./[signature]
R.L. Surface: N/A
Datum:

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 40mm.t over crushed igneous gravel 340mm.t.				PAVEMENT
	N_c = 7, 7, 5, 7, 12, 10 R			FILL: Clayey sand, fine to medium grained, brown, orange brown, red brown and pale grey mottled, some sandstone gravel, and clay nodules.	M	–	–	APPEARS MODERATELY COMPACTED
		1		FILL: Sandy clay, medium plasticity, brown, with various coloured mottling, some timber, a trace of gravel.	MC>PL			← PIECE OF TIMBER
AFTER 1 HR		2		FILL: Sand, fine grained, dark brown to black, some clay, timber pieces (small) and fibrous material, slight organic odour, a trace of glass.				APPEARS POORLY COMPACTED
	N_c = 3, 1, 1, 1, 2, 1, 1, 1, 1, 1, 2, 3, 3, 4, 3, 4, 3, 3, 5	3						
		4	OL	ORGANIC CLAY: medium plasticity, brown to dark brown, some fibrous material.	MC>PL	(S)		STRONG ORGANIC ODOUR
				as above, but with some shell fragments.				ALLUVIAL
		5	SC	CLAYEY SAND: fine to medium grained, brown, some organic clay nodules and bands.	M	(L)		
		6	CL	SANDY CLAY: medium plasticity, pale grey, with orange brown and red brown bands, some thin very low strength sandstone bands.	MC>PL	(VSt-H)		RESIDUAL SOIL
		7						

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Borehole No.
502
2/2

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum:
Logged/Checked by: L.S./[signature]

Groundwater Record	ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						7		CL	SANDY CLAY: as above.	MC>PL	(H)		
								–	SANDSTONE: fine to medium grained, pale grey with brown to red brown bands.	SW	M		MODERATE 'TC' BIT RESISTANCE
						8		CL	SANDY CLAY: medium plasticity, brown.	–	(VSt)	–	–
								–	INTERBEDDED SANDSTONE AND SANDY CLAY: as above, but with thin low strength sandstone bands.	–	–	–	BANDED LOW RESISTANCE
						9, 10, 11		CL	SANDY CLAY: medium plasticity, brown, occasional very low strength sandstone bands.	–	(VSt)	–	–
						12, 13		–	SANDSTONE: fine to medium grained, pale grey.	SW	M	–	MODERATE RESISTANCE
									END OF BOREHOLE AT 13.5m				

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BOREHOLE LOG

Borehole No. 503
1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum:
Logged/Checked by: L.S./

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 40mm.t over crushed gravel in a silty sand matrix.	D			PAVEMENT
		N_c = 15, 21, 11	1			FILL: Clayey sand, fine to medium grained, brown with various coloured mottling, a trace of sandstone gravel and timber pieces, some clay nodules.	M	–	–	APPEARS WELL COMPACTED
		N_c = 5, 5, 4, 4, 8R	2			FILL: Interbedded clayey sand and sandy clay, low plasticity, fine to medium grained, dark brown with various gravel, timber and a large sandstone boulder.	M/ MC>PL			APPEARS MODERATELY COMPACTED NOTE: LOTS OF OBSTRUCTION WITHIN THE FILL MAKING DRILL PENETRATION DIFFICULT.
		N_c = 11, 11, 12, 17	3			FILL: Sandy clay, low to medium plasticity, dark brown fine grained sand, some wood pieces and gravel.	MC>PL			
AFTER 1/2 HR			4			FILL: Clayey sand, fine grained, low plasticity, dark brown, significant wood fibres and roots, strong organic odour, some metal, wire and steel pieces.				
			5		OL	ORGANIC CLAY: medium plasticity, dark brown to brown, strong organic odour, a trace of plant fibres.	MC>PL	VS–S		ALLUVIAL
						ORGANIC CLAY: as above, but with some shell fragments a trace of sand.				
			6			END OF BOREHOLE AT 6.0m				
			7							

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Borehole No. **504** 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum:
Logged/Checked by: L.S./[signature]

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		ASPHALTIC CONCRETE: over crushed igneous gravel in a silty sand matrix.				PAVEMENT
	DS (approx. 1.3–1.6m)	N = 9, 9, 6, 9, 10, 7, 8, 5, 12R	1–2		FILL: Clayey sand, fine to medium grained, brown with various coloured mottling, some sandstone gravel.	M	–	–	APPEARS MODERATELY TO WELL COMPACTED
	DS (approx. 2.8–3.0m)		2–3		FILL: Sandy clay, low plasticity, brown to dark brown with various coloured mottling, some roots and wood pieces, a trace of metal, wire and plastic.	MC>PL			APPEARS MODERATELY COMPACTED
▼ AFTER 1 HR		N = 9, 10, 16, 20	3–4		FILL: Clayey sand, fine to medium grained, dark brown, some root, wood pieces, metal, glass and wire.				
►			5	OL	ORGANIC CLAY: medium plasticity, brown, some organic fibres, strong organic odour.	MC>PL	(VS-S)	–	ALLUVIAL
					END OF BOREHOLE AT 5.2m				

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7

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Borehole No.
505
1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-12-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum:
Logged/Checked by: L.S./[signature]

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 40mm.t., over crushed igneous gravel in a silty sand matrix.				PAVEMENT
	DB	N_c = 11, 15, 9, 8, 12, 8	1			FILL: Clayey sand, fine to medium grained, orange brown, brown and dark brown with various coloured mottling, a trace of sandstone gravel with sandy clay bands up to 0.3m thick.	M	-	-	APPEARS WELL COMPACTED
	DS	7, 8, 5, 3, 5, 4, 4, 3, 2, 1, 16R	2, 3, 4			FILL: Sandy clay, low plasticity, dark brown with various coloured mottling, some wood pieces, plastic, gravel, glass, metal, wire and general rubbish.	MC>PL			APPEARS MODERATELY COMPACTED APPEARS POORLY COMPACTED
ON COMPLETION					OL	ORGANIC CLAY: medium plasticity, brown, some plant fibres, strong organic odour.	MC>PL	(VS-S)	-	ALLUVIAL
			5, 6, 7			END OF BOREHOLE AT 4.8m				

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Borehole No. 601 1/2

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-8-97
Method: SPIRAL AUGER BCD 350
R.L. Surface: N/A
Datum:
Logged/Checked by: S.E./[signature]

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Silty clay, low plasticity, brown, with fine to medium igneous gravel, ironstone gravel, sand and a trace of glass.	MC>PL			APPEARS POORLY TO MODERATELY COMPACTED
AFTER 4 HRS ▼ ▶		N = 7 2,3,4	1			FILL: Sand, fine to medium grained, grey brown, with ash, timber pieces, plastic and silt fines.	M			
		N < 1 2,2/ 300mm	2			FILL: Silty clay, low plasticity, dark grey, with roots, timber pieces and sand.	MC>PL			APPEARS POORLY COMPACTED
			3		OL	ORGANIC CLAY: medium plasticity, dark grey brown, with fine roots and shell fragments.	MC>>PL	S	–	ALLUVIAL SOIL
		N = 1 1,-,1	4						40 50 50	SLIGHT ORGANIC ODOUR BELOW 4.5m.
			5		CL	SILTY CLAY: medium plasticity, grey, with fine grained sand and a trace of shell fragments and fine roots.				
		N = 19 4,7,12	6		SM	SILTY SAND: fine to medium grained, grey.	W	MD		
					SP	SAND: fine to medium grained, pale orange brown.				
			7							

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BOREHOLE LOG

Borehole No. 601

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-8-97
Method: SPIRAL AUGER BCD 350
Logged/Checked by: S.E./[signature]
R.L. Surface: N/A
Datum:

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		N > 20 2,20/ 150mm BOUNCING	7		SC	CLAYEY SAND: fine to medium grained, pale brown and red brown, with bands of coffee rock.	M	MD-D		
			8		-	SANDSTONE: fine to medium grained, mottled pale grey and red brown, with a trace of sandy clay bands.	DW	L	-	LOW 'TC' BIT RESISTANCE
		N > 20 20/ 150mm BOUNCING	9		CH	SILTY CLAY: high plasticity, pale grey, with a trace of clayey sand bands.	MC<PL	H	-	-
			10		-	SANDSTONE: fine to medium grained, pale grey, with a trace of red brown mottling and clay bands	DW	L	-	LOW RESISTANCE
								L-M		LOW TO MODERATE RESISTANCE
			11							
			12							
						SANDSTONE: fine to medium grained, pale grey.	SW	M		MODERATE RESISTANCE
			13			END OF BOREHOLE AT 13.0m				

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Borehole No. 602 1/3

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-8-98
Method: SPIRAL AUGER BCD 350
R.L. Surface: N/A
Datum:
Logged/Checked by: S.E./

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			CONCRETE PAVEMENT: 130mm.t.				REINFORCEMENT 6mm.t., 100mm FROM SURFACE
						FILL: Sandy clay, low plasticity, grey, with fine to medium sandstone and ironstone gravel and a trace of timber and plastic pieces.	MC<PL			APPEARS MODERATELY COMPACTED
	DS		1							
	DS	N = 11 1,5,6								
			2			FILL: Gravelly clay, low plasticity, with fine to medium igneous, sandstone and ironstone gravel, sand and some pieces of plastic.				APPEARS POORLY COMPACTED
▶	DS	N = 4 2,2,2	3							
										COLLAPSED TO 3.7m AFTER 1/4 HOUR
			4		OL	ORGANIC CLAY: medium plasticity, dark grey, with fine rootlets.	MC>PL	F	–	–
										SPT SUNK 300mm UNDER OWN WEIGHT
	DS	N = 4 1,2,2	5						60 80 100	ALLUVIAL SOIL
					CL	SILTY CLAY: medium plasticity, dark grey, with a trace of fine grained sand.		S-F		
	DS	N = 2 1,1,1	6						60 30 60	SPT SUNK 200mm UNDER OWN WEIGHT
			7							

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Borehole No. 602 2/3

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** SPIRAL AUGER BCD 350 **R.L. Surface:** N/A
Date: 11-8-98 **Datum:**
Logged/Checked by: S.E./[signature]

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	DS	N = 2 1,1,1	7			SILTY CLAY: medium plasticity, grey, with a trace of fine sand and sandy bands.	MC>PL	St	100 110	HOLE COLLAPSING TO 7.0m. RESIDUAL SOIL
	DS		8		–	SANDSTONE: fine to medium grained, red brown mottled pale grey.	DW	M–H		MODERATE TO HIGH 'TC' BIT RESISTANCE
			9			as above, but with clay bands.				LOW TO MODERATE RESISTANCE
			10–11		CL	SANDY CLAY: low plasticity, pale brown and orange brown.	MC>PL	–	–	–
			12		–	SANDSTONE: fine to medium grained, pale grey.	DW	L	–	LOW RESISTANCE
	DS		13				SW	M–H		MODERATE TO HIGH RESISTANCE

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Borehole No. 602 3/3

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 11-8-98
Method: SPIRAL AUGER BCD 350
Logged/Checked by: S.E./[signature]
R.L. Surface: N/A
Datum:

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						14			SANDSTONE: fine to medium grained, pale grey.	SW	M-H		MODERATE TO HIGH RESISTANCE
									END OF BOREHOLE AT 14.75m				
						15							
						16							
						17							
						18							
						19							
						20							

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Borehole No. 603
1/3

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 12-8-97
Method: SPIRAL AUGER BCD 550
Logged/Checked by: S.E./[signature]
R.L. Surface: N/A
Datum:

Groundwater Record	Samples (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Silty sand, fine grained, grey, with a trace of fine ash, slag and fine roots.	M			GRASS COVER APPEARS POORLY COMPACTED
	DS	N = 7 3,2,5	1							
			2							SPT SUNK 200mm UNDER OWN WEIGHT
▶	DS	N < 1 1/450mm								
			3							
	DS	N < 1 6,1, 1/300mm								
			4		OL-OH	ORGANIC CLAY: medium to high plasticity, grey brown, with a trace of fine rootlets, fine grained sand and shell fragments.	MC>PL	S	–	ALLUVIAL SOIL
	DS	N = 2 1,1,1	5							
			6							
	DS	N = 15 3,5,10			SM	SILTY SAND: fine to medium grained, grey.	W	MD		
			7							

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BOREHOLE LOG

Borehole No. 603
2/3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 12-8-97
Method: SPIRAL AUGER BCD 550
Logged/Checked by: S.E./[signature]
R.L. Surface: N/A
Datum:

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			7		SM	SILTY SAND: fine to medium grained, grey.	W	MD		
	DS	N = 13 5,6,7	8			as above, but with sandy clay bands and a trace of extremely weathered shale bands.				RESIDUAL SOIL
	DS	N > 20 20/50mm	9							
			10							
			11							
			12							SANDSTONE BAND, 150mm.t.
			13							0mm
	DS				-	SANDSTONE: fine to medium grained, pale grey.	SW	M-H	-	MODERATE 'TC' BIT RESISTANCE
						REFER TO CORED BOREHOLE LOG				

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CORED BOREHOLE LOG

Borehole No. 603 3/3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Core Size:** NMLC **R.L. Surface:** N/A
Date: 12-8-97 **Inclination:** VERTICAL **Datum:**
Drill Type: BCD 550 **Bearing:** – **Logged/Checked by:** S.E./

Water Loss/Level	Barrel Lift	Depth (m)	Core Description (Rock Type, grain characteristics, colour, structure, minor components)	Weathering	Strength	Point Load Index Strength $I_s(50)$	Defect Details – Description (Type, inclination, thickness, planarity, roughness, coating)
		13					NOTE: DEFECTS NOT INDIVIDUALLY DESCRIBED ARE BEDDING PARTINGS 0-10°, PLANAR, ROUGH
		14	START CORING AT 14.06m				
FULL RETURN			SANDSTONE: fine to medium grained, pale grey and red brown banded, bedded at 5–10°.	DW	L	×	- XWS, 8mm.t.
		15	as above, but mottled pale grey and red brown.		L / M	× ×	- CS, 0°, 20mm.t. - XWS, 0°, 30mm.t. - J, 23°, P, R - Be, 17°, P, R - IRON INDURATED BAND WITH CLAY, 40mm.t. - CS, 0°, 30mm.t.
			SHALY CLAY: high plasticity, grey to dark grey, with thin sandstone bands, MC<PL, Hard.				
		16	INTERBEDDED SHALE AND SANDSTONE: dark grey shale and fine grained, pale grey sandstone.	XW	EL–VL		
			SANDSTONE: fine grained, grey.	DW	VL–L	×	- CS, 0°, 20mm.t.
		17	SANDSTONE: fine to medium grained, pale grey, bedded at 15°.	SW	H	×	
			END OF BOREHOLE AT 17.16m				
		18					
		19					
		20					

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BOREHOLE LOG

Borehole No. 604
1/3

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 14-8-97
Method: SPIRAL AUGER BCD 550
R.L. Surface: N/A
Datum:
Logged/Checked by: S.E./[signature]

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 35mm.t. over Roadbase, 250mm.t.				PAVEMENT
	DS	N = 3 3,2,1				FILL: Silty sand, fine to medium grained, brown, with timber pieces and a trace of glass, brick fragments, metal pieces, wire and general rubbish.	M			APPEARS POORLY COMPACTED FILL APPEARS TO CONTAIN VOIDS
	DS	N = 7 1,2,5	1							
▶ (approx. 2.4m)			2			as above, but grey and brown, with metal pieces and wire.	W			
			3							
			4							
	DS	N < 1 SUNK 1.0m UNDER OWN WEIGHT	5		OL	ORGANIC CLAY: medium plasticity, brown, with a trace of fine rootlets and shell fragments.	MC>PL	VS	–	ALLUVIAL SOIL
			6		CL	SILTY CLAY: medium plasticity, grey brown, with a trace of fine rootlets.		S	40 50 50	
			7							

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BOREHOLE LOG

Borehole No. 604

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** SPIRAL AUGER BCD 550 **R.L. Surface:** N/A
Date: 14-8-97 **Datum:**
Logged/Checked by: S.E./

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			7	CL	SILTY CLAY: medium plasticity, grey brown.	MC>PL	(F)		300mm
					SILTY CLAY: medium plsticity, pale grey, with a trace of fine sand.		(VSt)		75 RESIDUAL SOIL SANDSTONE BAND, 200mm.t.
			8						
			9	–	SANDSTONE: fine grained, pale grey, with red brown bands and clay bands.	XW	EL	–	EXTREMELY LOW 'TC' BIT RESISTANCE
			10						0mm
			11						
						DW	VL		VERY LOW RESISTANCE
			12		SANDSTONE: fine to medium grained, pale grey.	SW	M-H		MODERATE TO HIGH RESISTANCE
				CL	SHALY CLAY: medium plasticity, grey to dark grey.	(MC<PL)	(H)	–	–
			13	–	SANDSTONE: fine to medium grained, pale grey.	SW	H	–	HIGH RESISTANCE
					REFER TO CORED BOREHOLE LOG				

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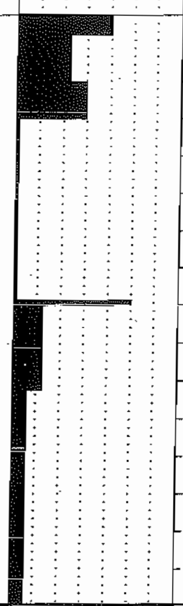
Borehole No. 604 3/3

CORED BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Core Size:** NMLC **R.L. Surface:** N/A
Date: 12-8-97 **Inclination:** VERTICAL **Datum:**
Drill Type: BCD 550 **Bearing:** – **Logged/Checked by:** S.E./

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_s(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific General
		13		START CORING AT 13.44m					
FULL RET-URN		14 15 16		SANDSTONE: pale grey with thin grey laminations.	SW	H	× × × × ×		- Be, 15°, P, R, CLAY COATED - Be, 15°, P, S - XWS, 45mm.t. - CS, 10mm.t. - XWS, 5mm.t. - Be, 10°, P, S - XWS, 10mm.t. - XWS, 10mm.t.
		17 18 19 20		END OF BOREHOLE AT 16.59m					



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BOREHOLE LOG

Borehole No. 605 1/1

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP

Date: 13-8-97

Method: SPIRAL AUGER BCD 350

R.L. Surface: N/A

Datum:

Logged/Checked by: W.T./

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		FILL: Sand, fine to medium grained, dark yellow brown, with sandstone gravel and concrete, a trace of glass and nails.	M			ROOT SYSTEM EXTENDS 0.2m BELOW GROUND SURFACE
	N > 14 14/ 100mm; N = 12 1,3,9	1		FILL: Sand, fine to medium grained, with organic material, sandstone and ironstone gravel and a trace of clay, ceramics and rubber.				APPEARS MODERATELY COMPACTED
AFTER 10 MINS	N = 15 4,10,5	2		FILL: Silty sand, fine to medium grained, brown and dark grey, with a trace of wood, clay and sandstone gravel.				
	N = 5 3,3,2; N = 2 1,1,1	3	OL	ORGANIC SILTY CLAY: medium plasticity, dark brown and black, with a trace of rootlets and fine to medium grained sand.	MC>PL	(F); VS-S	-; 20 40 30	NO RECOVERY OF SPT SAMPLE
	SANK UNDER OWN WEIGHT; N_c = 1, 1, 1, 2, 5, 7, 9, 12, 12, 17, 17	5	CL	SANDY CLAY: medium plasticity, grey.		(F); (VSt-H)		
		7		END OF BOREHOLE AT 7.05m				

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Borehole No. 606 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 13-8-97
Method: SPIRAL AUGER BCD 350
R.L. Surface: N/A
Datum:
Logged/Checked by: W.T./[signature]

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Sand, fine to medium grained, dark yellow and brown, with a trace of sandstone gravel.	M			ROOT SYSTEM EXTENDS APPROX. 200mm BELOW SURFACE
		N = 15 4,7,8				FILL: Gravelly sandy clay, medium plasticity, grey mottled red, with fine to coarse grained sand, sandstone gravel and glass.	MC>PL		320 280 170	APPEARS WELL COMPACTED
AFTER 5 MINS		N = 8 1,4,4	1 – 2			FILL: Silty sand, fine to coarse grained, light brown and black, with organic matter (wood) and clay fines.				APPEARS MODERATELY COMPACTED
		N = 1 1,0,1			OL	ORGANIC SILTY CLAY: medium plasticity, dark brown and black, with fine roots and a trace of rootlets and shell fragments.	MC>PL	VS-S		NO SAMPLE RECOVERED FROM SPT
		SOLID CONE SUNK 700mm UNDER OWN WEIGHT	3							
		N_c = 1, ↓, 1, 1, 1, 2, 1, 1, 2, 1, 2, 2, 2, 2, 3, 4, 8, 14, 17, 22	4					(S-F)		
					CL	SILTY CLAY: medium plasticity, light brown to dark grey, with fine grained sand.				
			5 – 6					(VSt-H)		
			7			END OF BOREHOLE AT 6.7m				

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BOREHOLE LOG

Borehole No. 701 1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 6-10-94
Method: SPIRAL AUGER BCD 450
R.L. Surface: –
Datum: –
Logged/Checked by: FK./JS

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	DS		0			FILL: Silty clayey sand, medium grained, brown to dark brown with bricks, glass and ripped sandstone fragments and some root fibres.	D			
	DS		1			as above, but with wood, plastic and igneous rock fragments.	M			
	DS, DS		2		–	CLAYEY SILT: low plasticity, dark brown with some fine roots.	MC>PL			ORGANIC ODOUR
▼			3							TEMPORAR Y PEIZOMETER INSTALLED TO 4.5m SLOTTED FOR 3m
	DS		4		–	SANDY SILT: low plasticity, dark brown with some orange brown ironstaining.	MC>PL			
			5			END OF BOREHOLE AT 4.5m				
			6							
			7							

PIGHT

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BOREHOLE LOG

Borehole No. 702 1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 6-10-94
Method: SPIRAL AUGER BCD 450
R.L. Surface: –
Datum: –
Logged/Checked by: FK./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	DS		0			FILL: Silty sandy clay, low to medium plasticity, brown with brick, timber, ripped sandstone, glass, steel and material fragments.	MC<PL			
▼ (approx. 1.2m)	DS		1			FILL: Silt, low plasticity, dark brown with some sand and some clay and wire, brick and ripped sandstone fragments.	MC>PL			
	DS		2		–	CLAYEY SILT: low plasticity, dark brown with some bands containing shell fragments, 100mm.t.	MC>PL			ORGANIC ODOUR TEMPORARY PIEZOMETER INSTALLED TO 4.5m. SLOTTED FOR 3m
	DS		4		SP	SAND: fine to medium grained, dark grey, with a trace of silt.	M			
			4.5			END OF BOREHOLE AT 4.5m				

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 703
1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 6-10-94
Method: SPIRAL AUGER BCD 450
R.L. Surface: –
Datum: –
Logged/Checked by: FK./RG

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Sandy clay, low to medium plasticity, dark brown with some igneous rock and ripped sandstone fragments.	D-M			
	ES		1			FILL: Silty sand, fine to medium grained, black with some igneous rock, glass and ripped sandstone fragments.	M			
			2							
	ES				–	CLAYEY SILT: low plasticity, dark brown.	MC>PL			MODERATE ORGANIC ODOUR TEMPORARY PIEZOMETER INSTALLED TO 4.5m. SLOTTED FOR 3m
			3							
▼	ES		4							
			5			END OF BOREHOLE AT 4.5m				
			6							
			7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 704 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 6-10-94
Method: SPIRAL AUGER GCH RIG
R.L. Surface: –
Datum: –
Logged/Checked by: FK./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Sand, fine to medium grained, brown with some silt and some igneous rock fragments.	D			
▶ (approx. 1.3 m)	ES		1			FILL: Silt, low plasticity, black, with some sand, and some wood, ceramic, igneous rock and ripped sandstone fragments.	MC>PL			
	ES		2							
	ES		3		–	CLAYEY SILT: low plasticity, dark brown.	MC>PL			
			4							
			4.5			END OF BOREHOLE AT 4.5m				
			5							
			6							
			7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL ENGINEERS

Borehole No. 705 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 6-10-94
Method: SPIRAL AUGER GCH RIG
R.L. Surface: –
Datum: –
Logged/Checked by: FK./[signature]

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Sand, medium grained, light brown with some silt and igneous rock fragments.	M			
▷	ES		1			FILL: Silty sandy clay, low to medium plasticity, brown with some glass, brick, ripped sandstone and timber fragments.	MC>PL			
	ES		2			as above, but with approximately 40% ripped sandstone and timber fragments.	MC>PL			
	ES		3		–	CLAYEY SILT: low plasticity, dark brown with some bands containing shell fragments.	MC>PL			TEMPORARY PIEZOMETER INSTALLED TO 4.5m SLOTTED TO 3m
	ES		4		SP	SAND: fine to medium grained, dark grey with a trace of silt.	M			
						END OF BOREHOLE AT 4.5m				
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. 706 1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 6-10-94
Method: SPIRAL AUGER GCH RIG
R.L. Surface: –
Datum: –
Logged/Checked by: FK./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES		0			FILL: Silty clay, medium to high plasticity, brown with some ironstone fragments.	MC<PL			
▶ (at 1m)	ES		1			FILL: Silt, low plasticity, dark brown with some sand, and some wood fragments.	MC>PL			
	ES		2.5		–	CLAYEY SILT: low plasticity, dark brown.	MC>PL			
	ES		3.5		CL	CLAY: low to medium plasticity, dark brown grey with some silt and some sand.	MC>PL			
			4.5			END OF BOREHOLE AT 4.5m				
			5							
			6							
			7							

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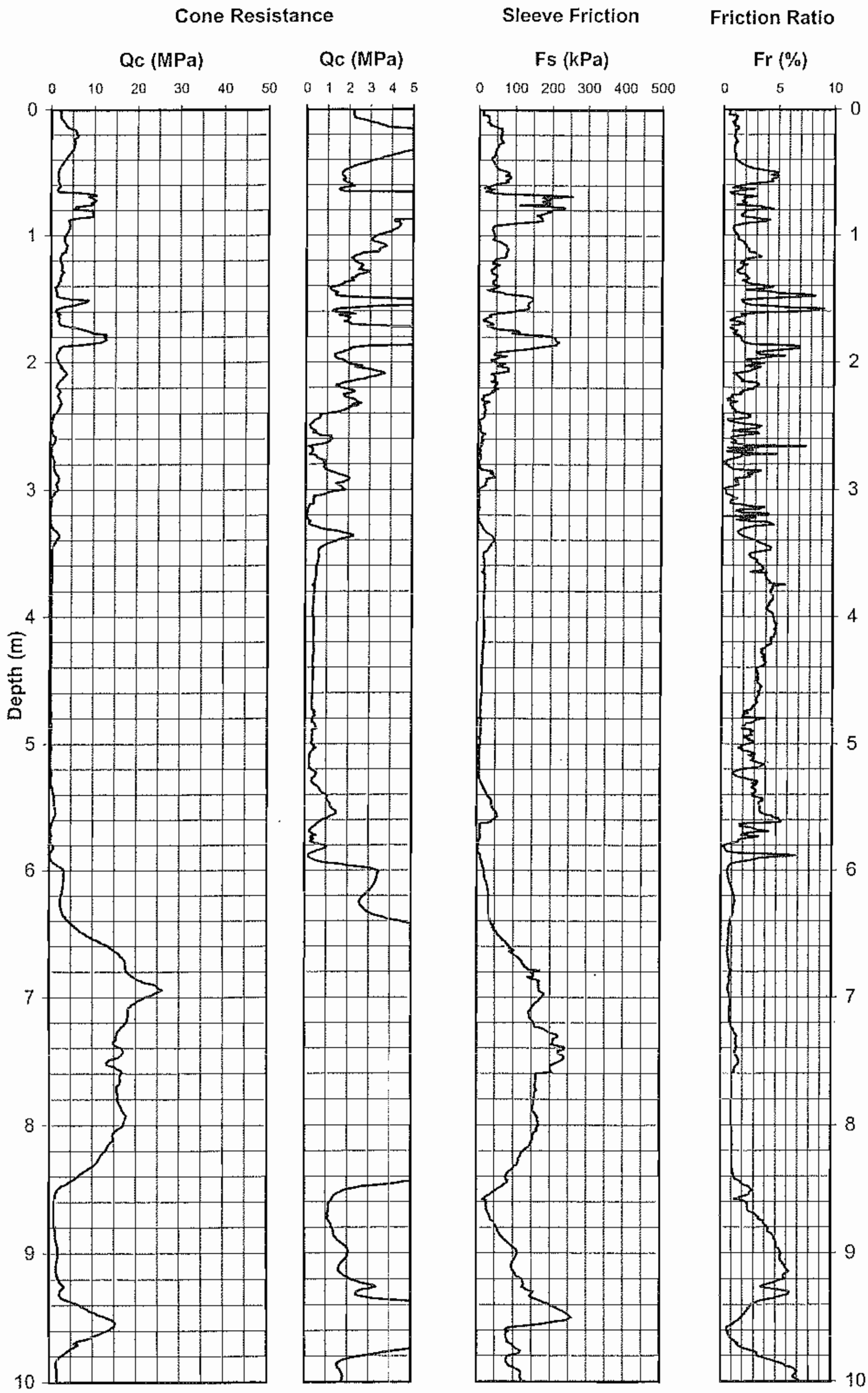
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **801**

1/3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt801	**RL Surface:** NA		**Data File:**	AP061129.H1
Test Date:	6/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted Profile

- FILL: Interbedded silty sand and silty clay, Appears poorly compacted.
- 1·5 (water level)
- SILTY CLAY: firm.
- ORGANIC SILTY CLAY: soft to firm.
- SILTY CLAY: soft.
- as above but firm to stiff.
- SILTY SAND: loose.
- SILTY SAND: medium dense to dense.
- SILTY CLAY: stiff.
- SILTY CLAY: stiff to very stiff.
- SILTY SAND: medium dense to dense.
- SILTY CLAY: very stiff.

Interpreted by: M.K.

Checked by: PW

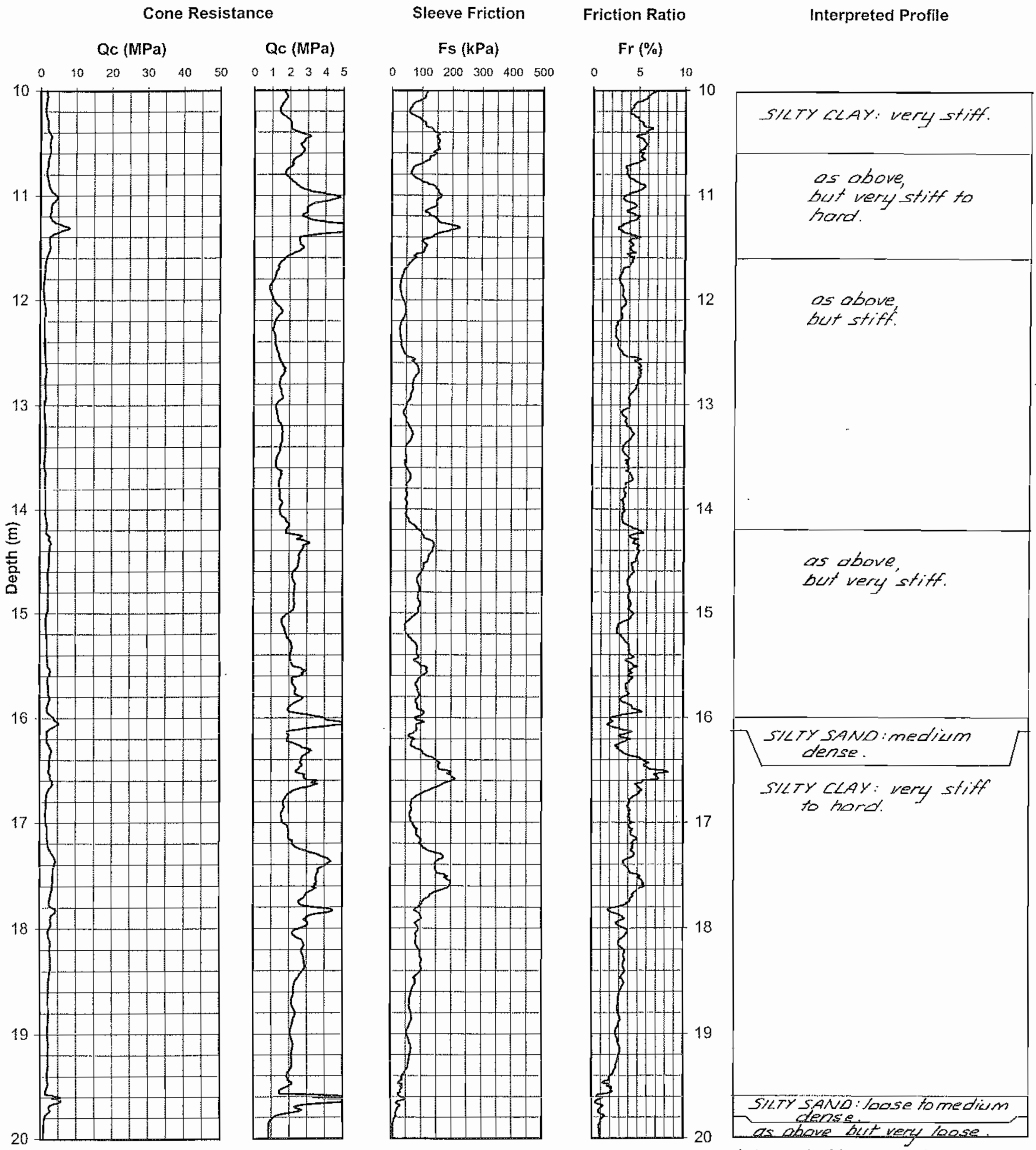
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
801
2/3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt801	**RL Surface:**	NA	**Data File:**	AP061129.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

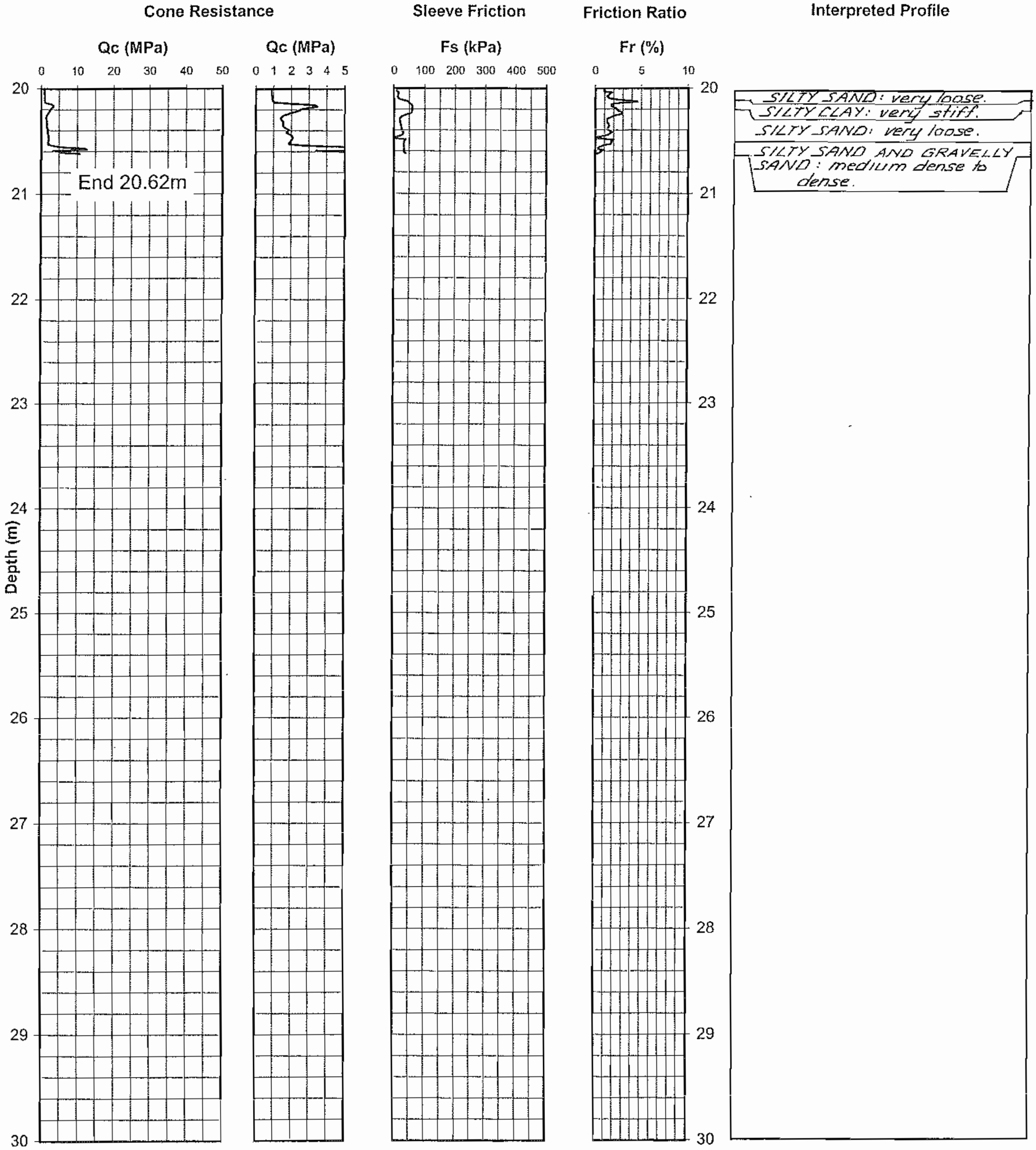
EFCP No. **801**

3/3

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt801	**RL Surface:**	NA	**Data File:**	AP061129.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.

Checked by: PW

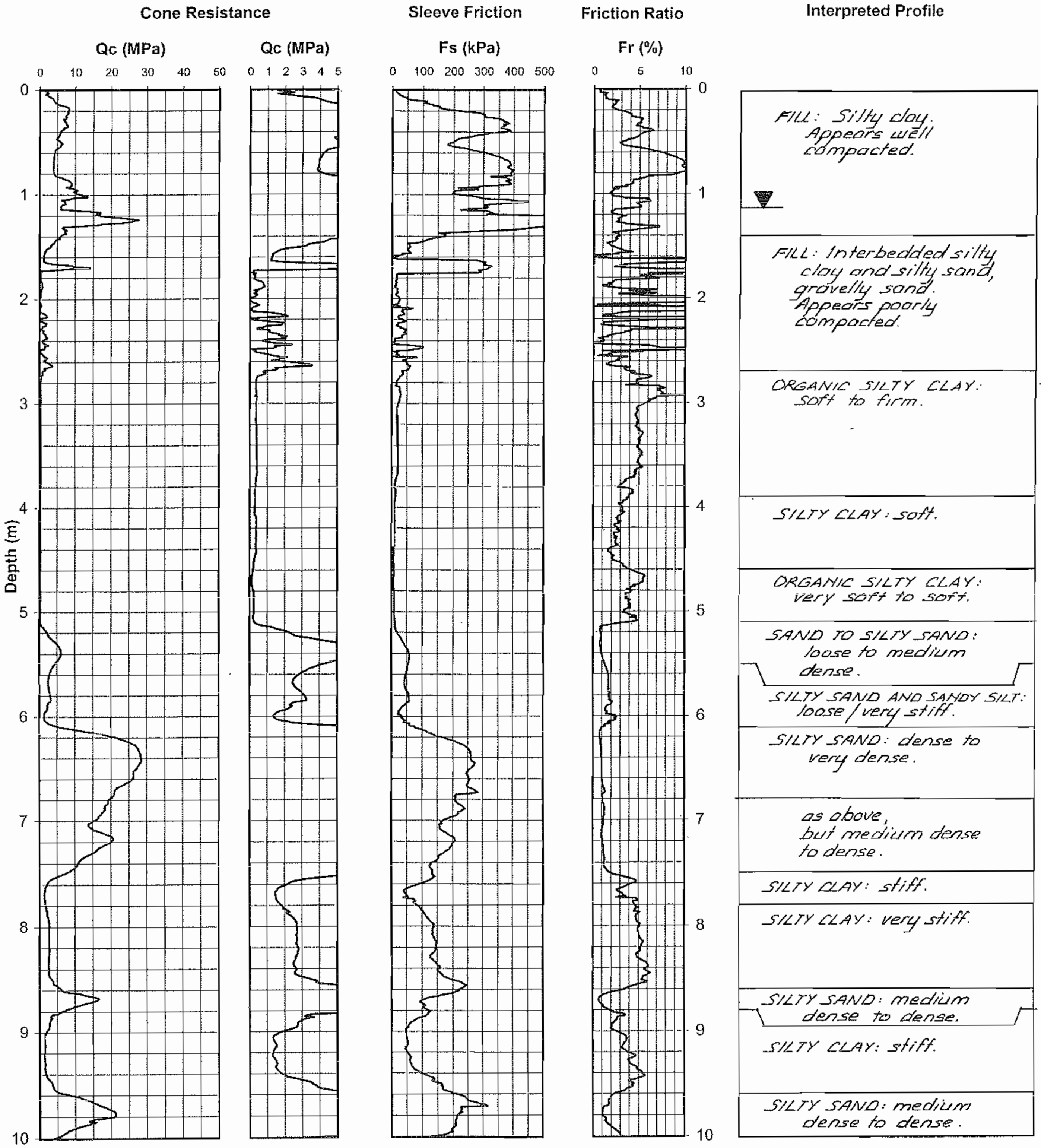
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
802
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt802	**RL Surface:**	NA	**Data File:**	AP061016.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd

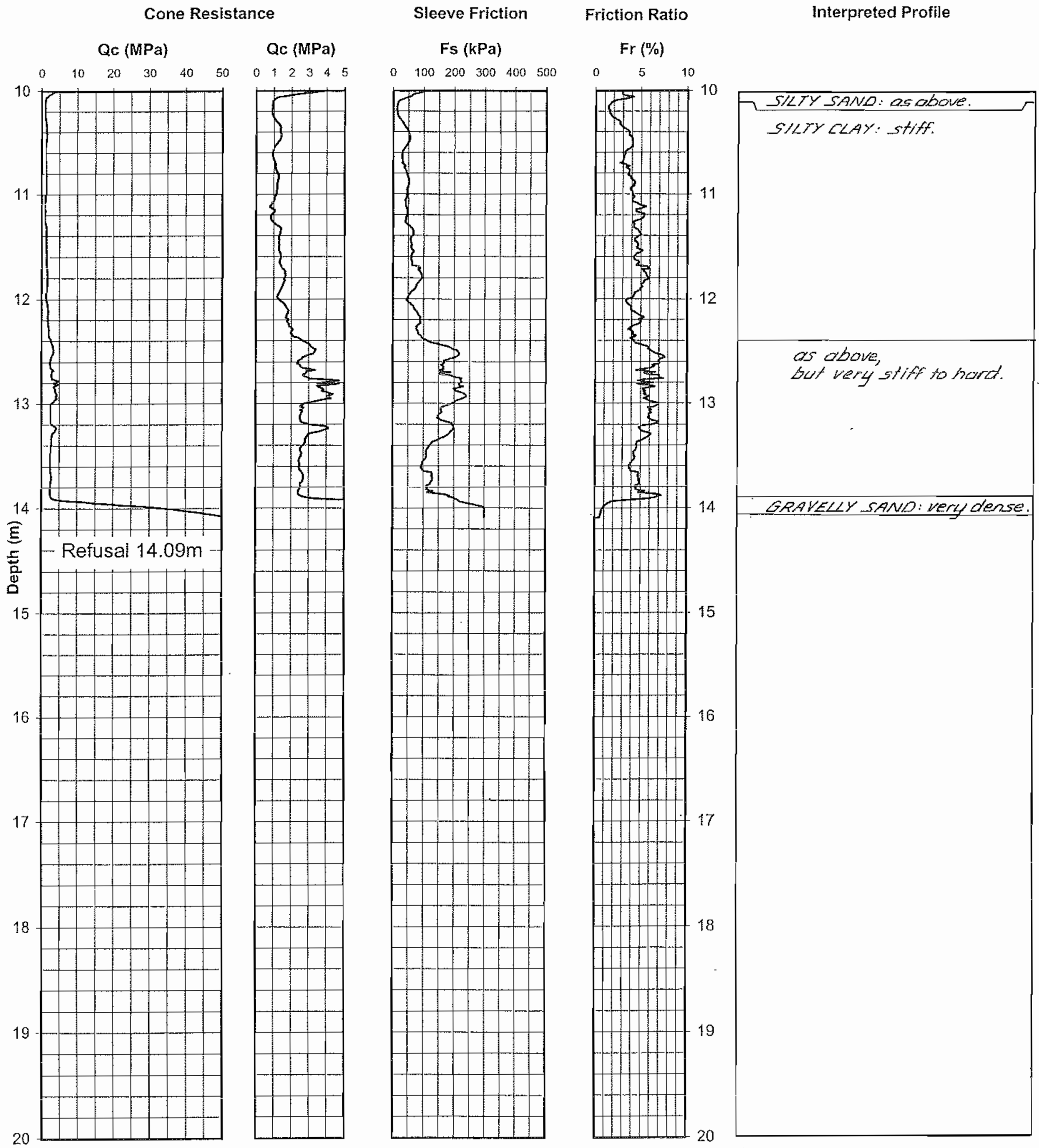
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
802
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt802	**RL Surface:**	NA	**Data File:**	AP061016.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

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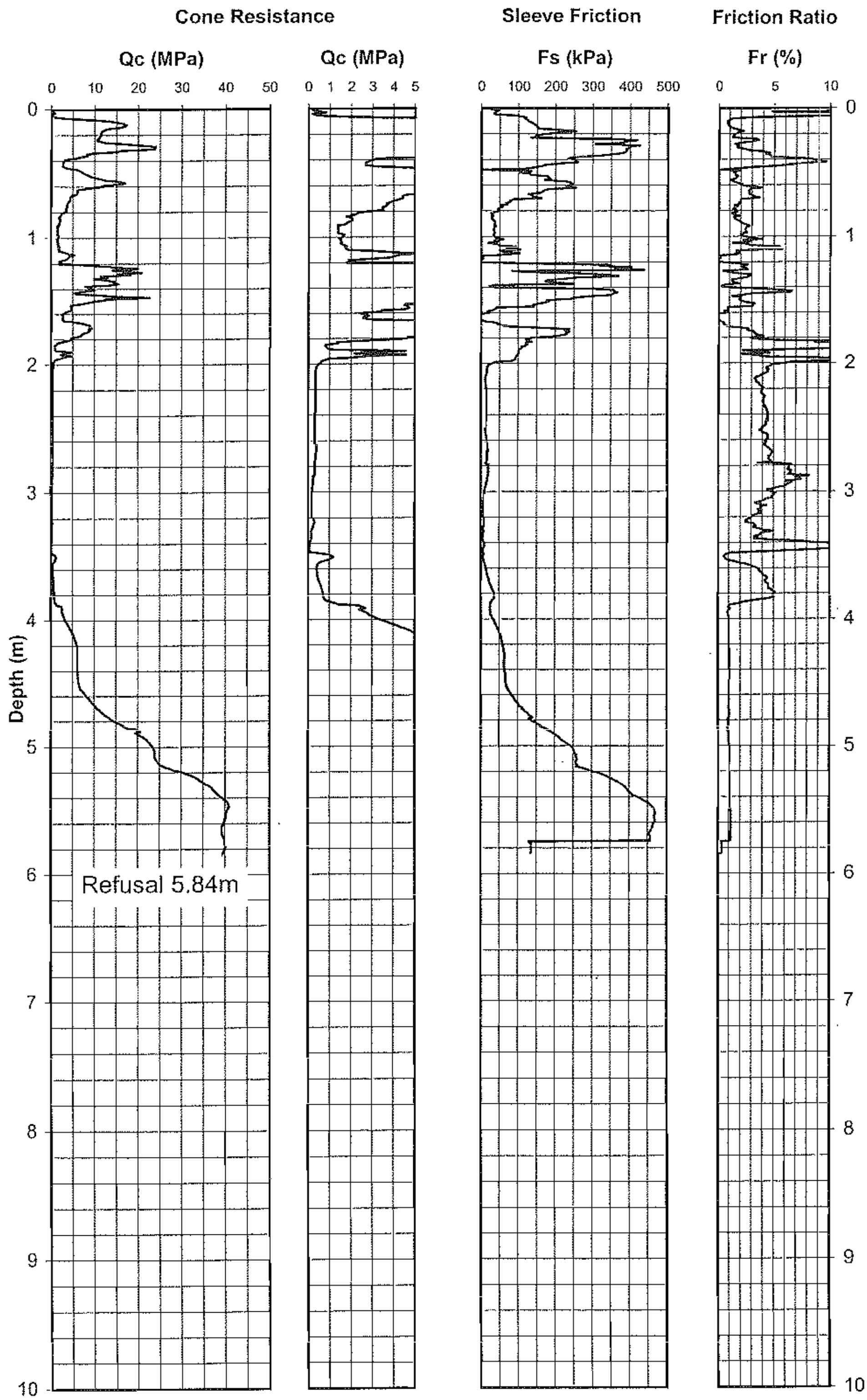
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
803
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt803	**RL Surface:**	NA	**Data File:**	AP051349.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted Profile

- FILL: Interbedded silty sand and silty clay. Appears well compacted.
- as above, but appears poorly to moderately compacted.
- as above, but appears moderately to well compacted.
- ORGANIC SILTY CLAY: soft to firm.
- SILTY SAND: loose to medium dense.
- as above, but dense to very dense.
- GRAVELLY SAND: very dense.

Interpreted by: M.K.

Checked by: PW

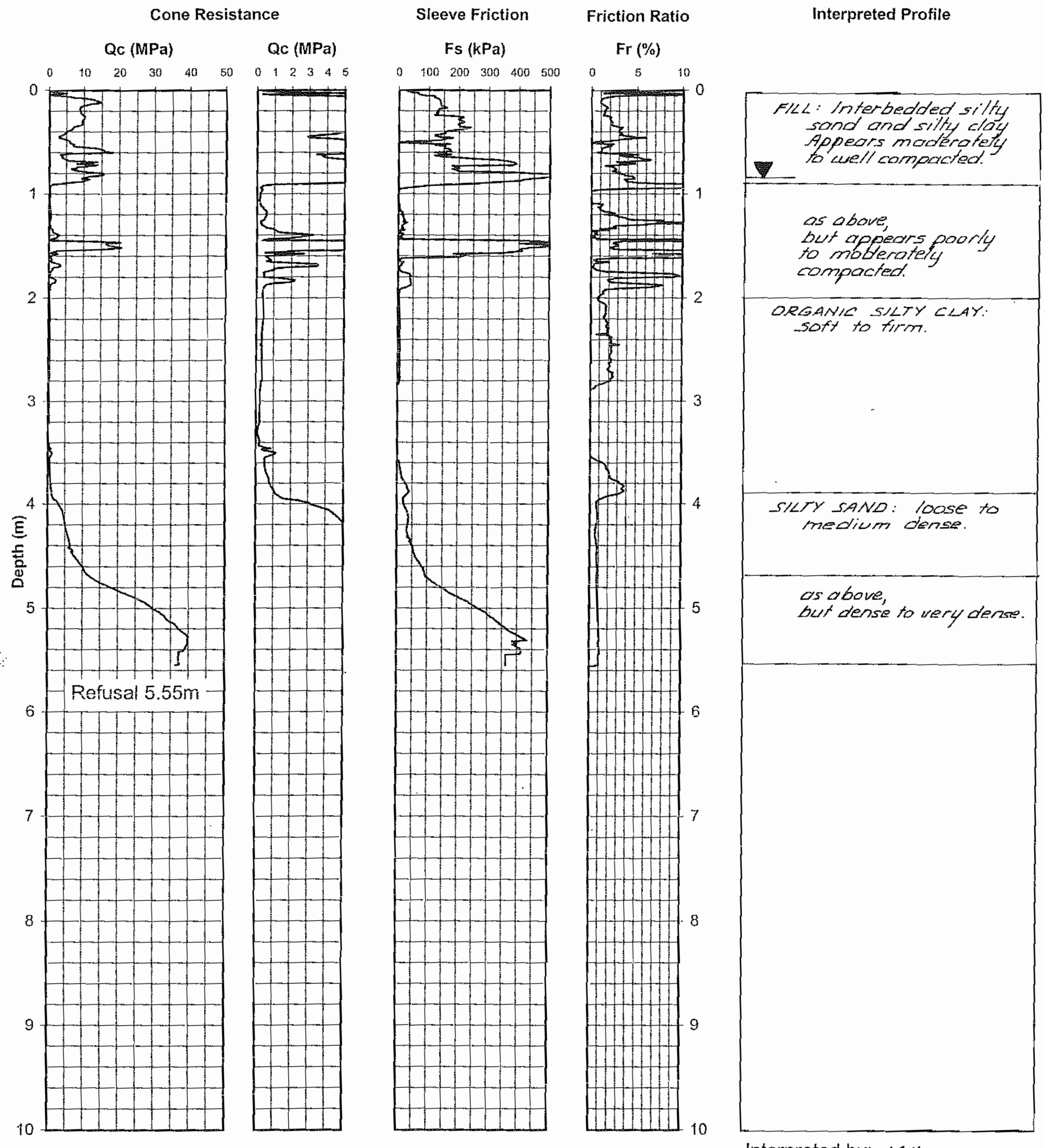
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
803a
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt803a	**RL Surface:**	NA	**Data File:**	AP051431.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted by: M.K.

Checked by: PW

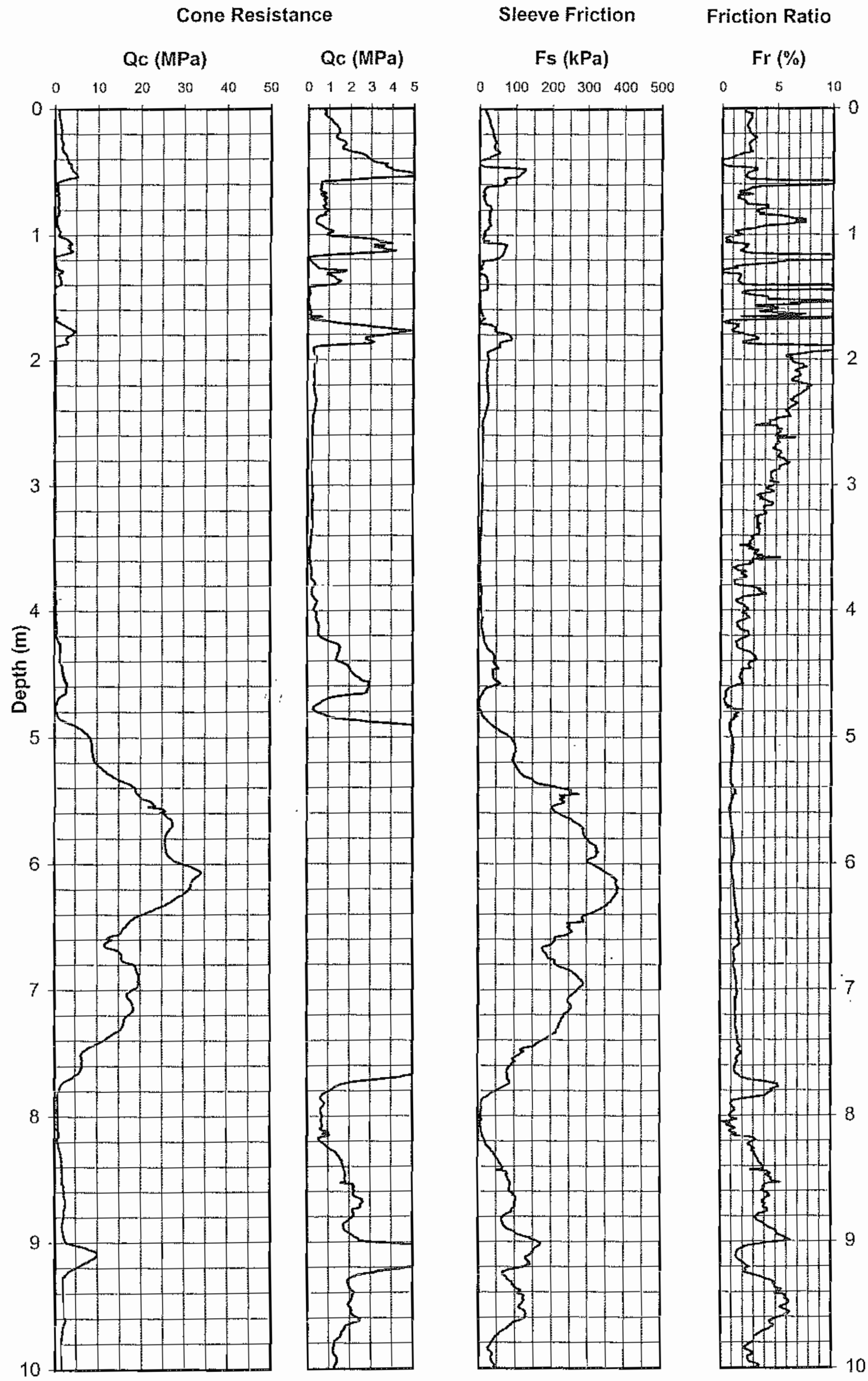
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
804
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW.				
Job Ref.:	15009JTPcpt804	**RL Surface:**	NA	**Data File:**	AP121115.H1
Test Date:	12/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted Profile

- FILL: Silty clay with silty sand. Appears poorly compacted.
- ORGANIC SILTY CLAY: very soft to soft.
- SILTY CLAY: very soft.
- as above, but very stiff to hard.
- SAND TO SILTY SAND loose to medium dense, with very loose bands.
- as above, but dense to very dense.
- as above but medium dense.
- SILTY CLAY: hard.
- SANDY SILT: firm to stiff.
- SILTY CLAY: very stiff.
- SILTY SAND: medium dense.
- SILTY CLAY: very stiff.
- as above, but stiff.

Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd

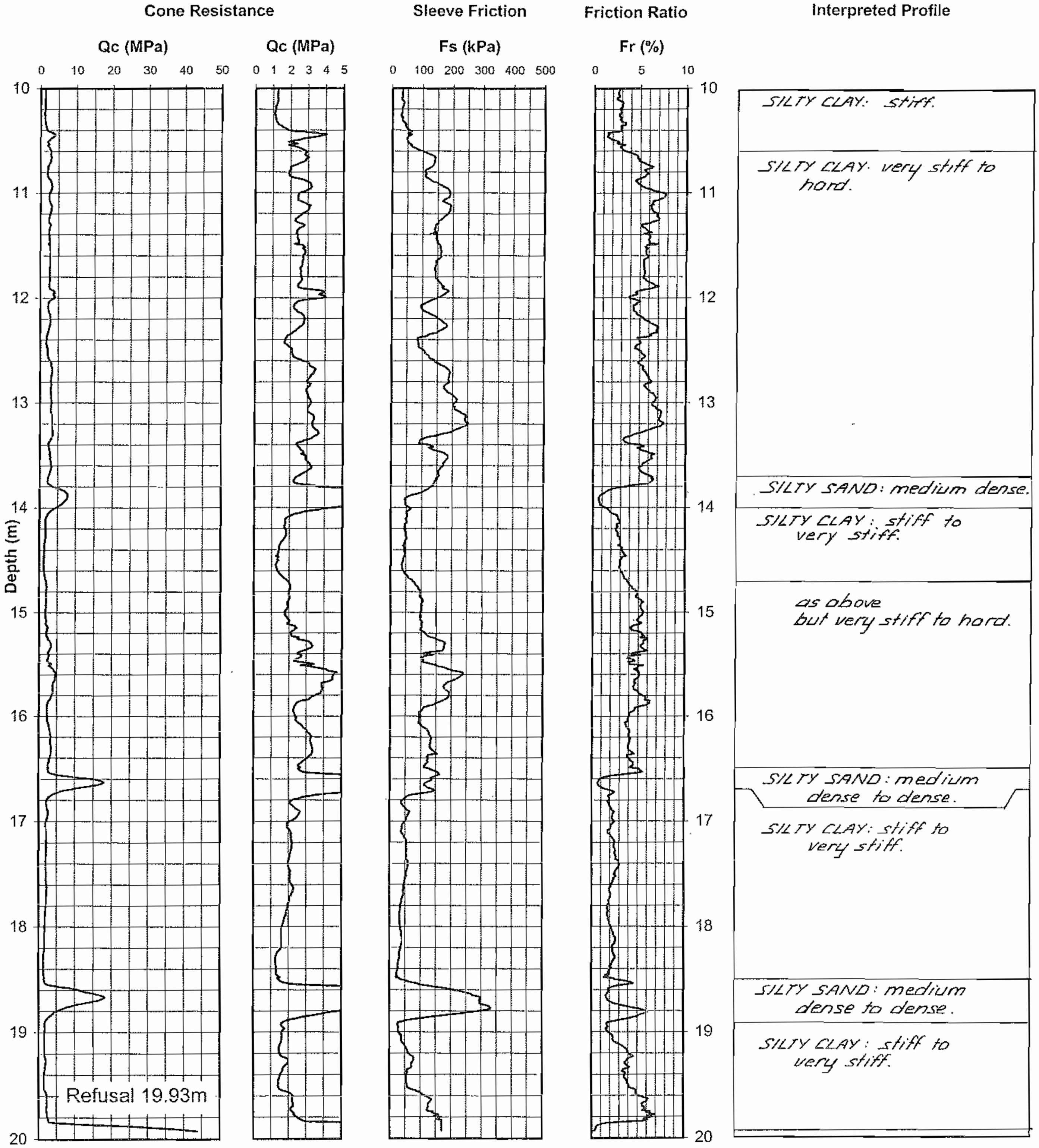
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
804
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW.

Job Ref.:	15009JTPcpt804	**RL Surface:**	NA	**Data File:**	AP121115.H1
Test Date:	12/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd

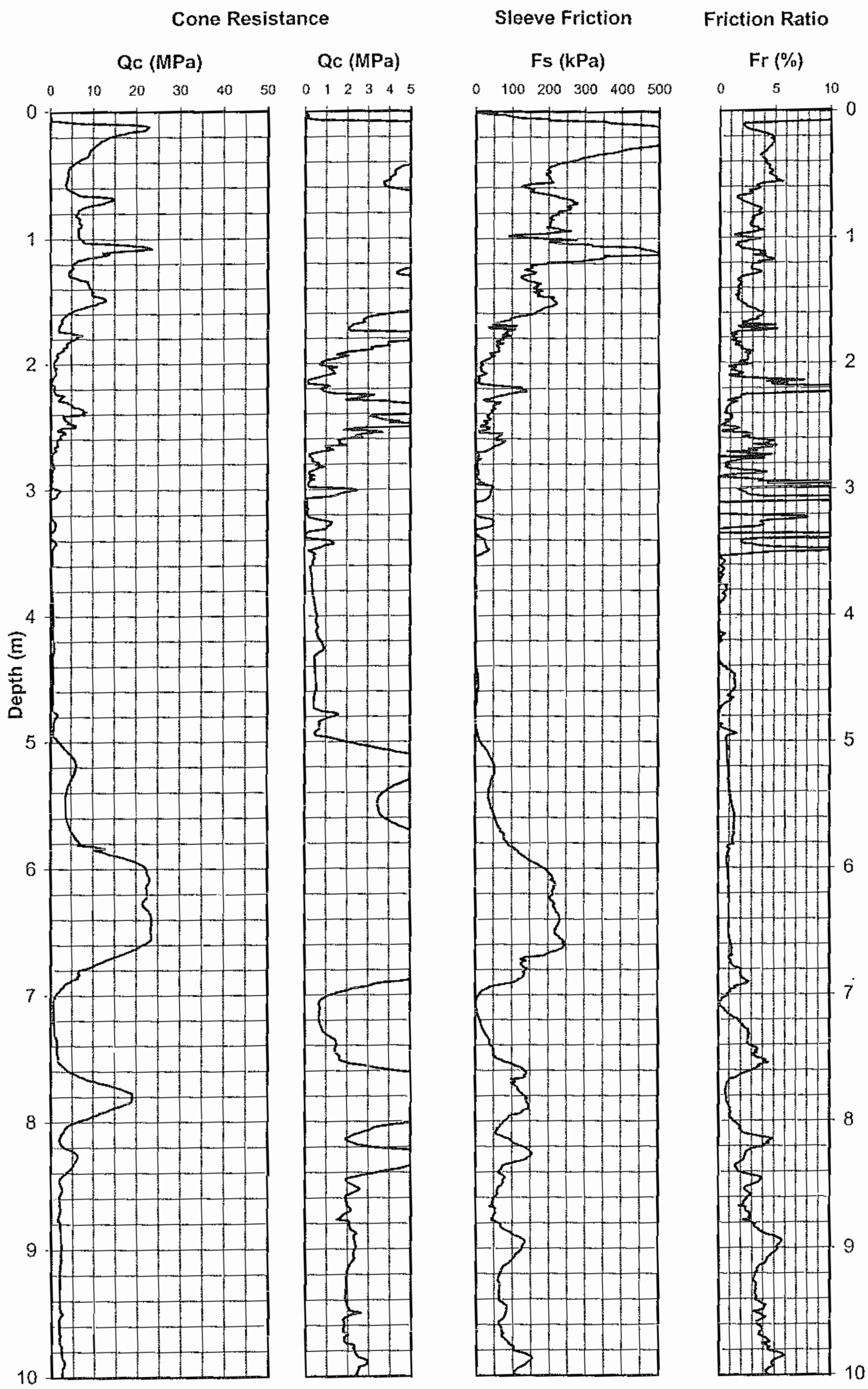
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
806
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt806	**RL Surface:**	NA	**Data File:**	AP051158.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted Profile

FILL: Silty clay. Appears moderately compacted.

FILL: Interbedded silty clay and silty sand. Appears poorly compacted.

ORGANIC SILTY CLAY: soft, with sand.

SAND TO SILTY SAND: loose to medium dense.

as above, but dense to very dense.

CLAY: firm to stiff.

SILTY SAND: medium dense to dense.

SILTY CLAY: very stiff

SILTY SAND TO SANDY SILT medium dense/hard.

SILTY CLAY: very stiff.

Interpreted by: M.K.

Checked by: PW

Jeffery and Katauskas Pty Ltd

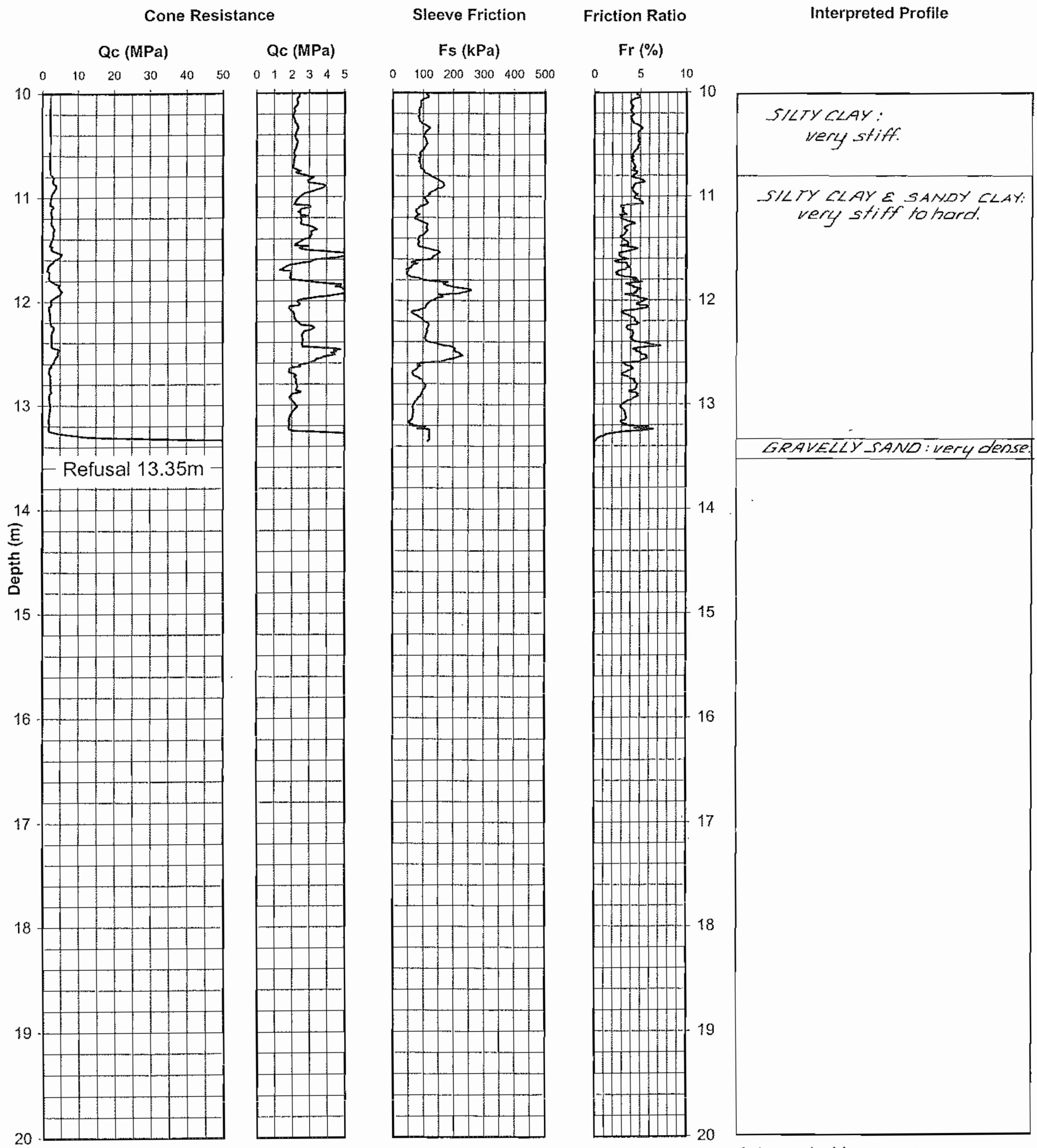
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
806
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt806	**RL Surface:**	NA	**Data File:**	AP051158.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd

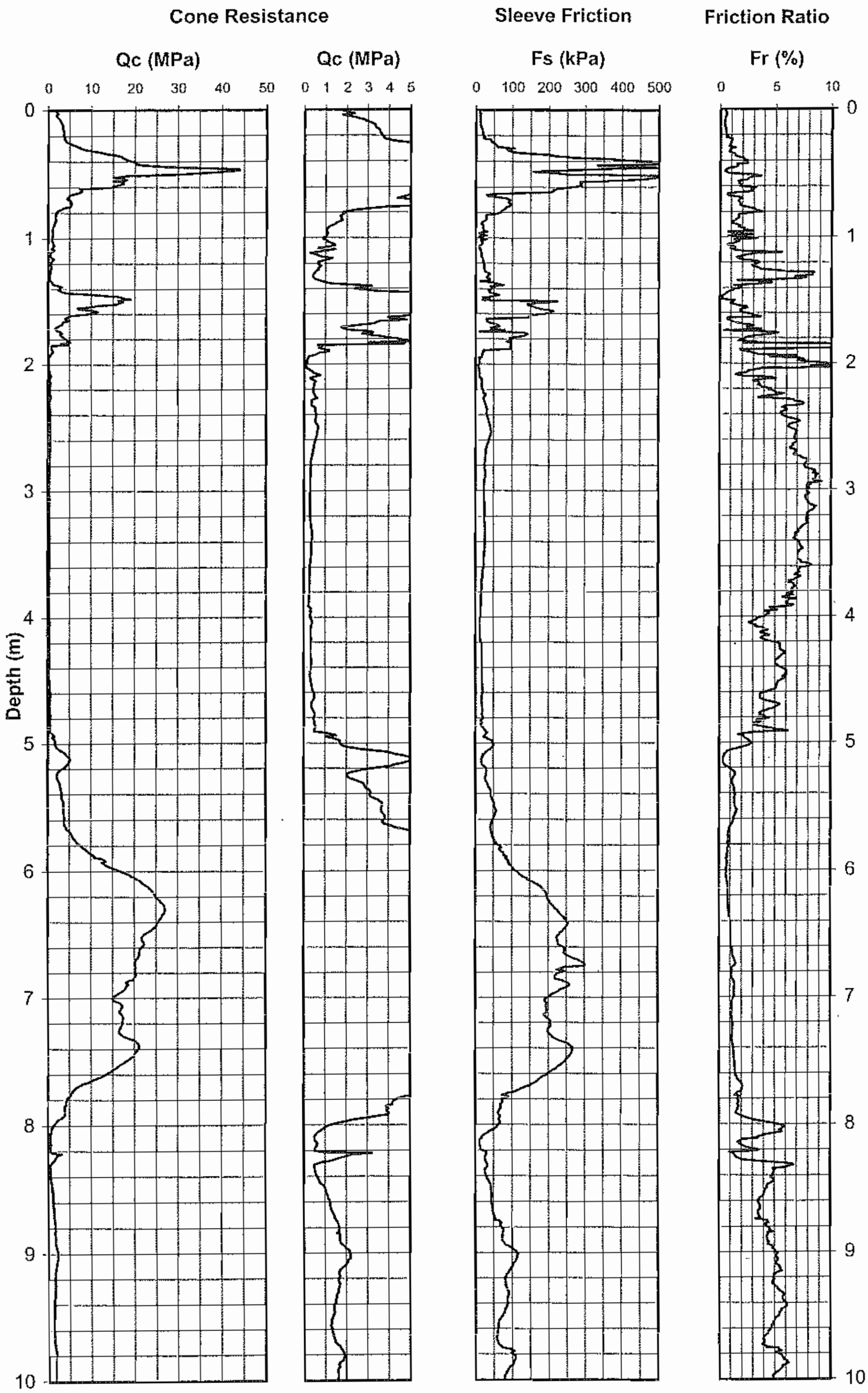
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **807**
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW.

Job Ref.:	15009JTPcpt807	**RL Surface:**	NA	**Data File:**	AP120934.H1
Test Date:	12/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted Profile

Interpreted Profile
FILL: Silty clay and silty sand. Appears poorly compacted.
ORGANIC SILTY CLAY: Soft to firm.
SAND TO SILTY SAND: loose.
as above, but loose to medium dense.
as above, but dense to very dense.
as above but dense.
ORGANIC SILTY CLAY: firm.
SILTY CLAY: stiff to very stiff.

Interpreted by: M.K.
Checked by: PW

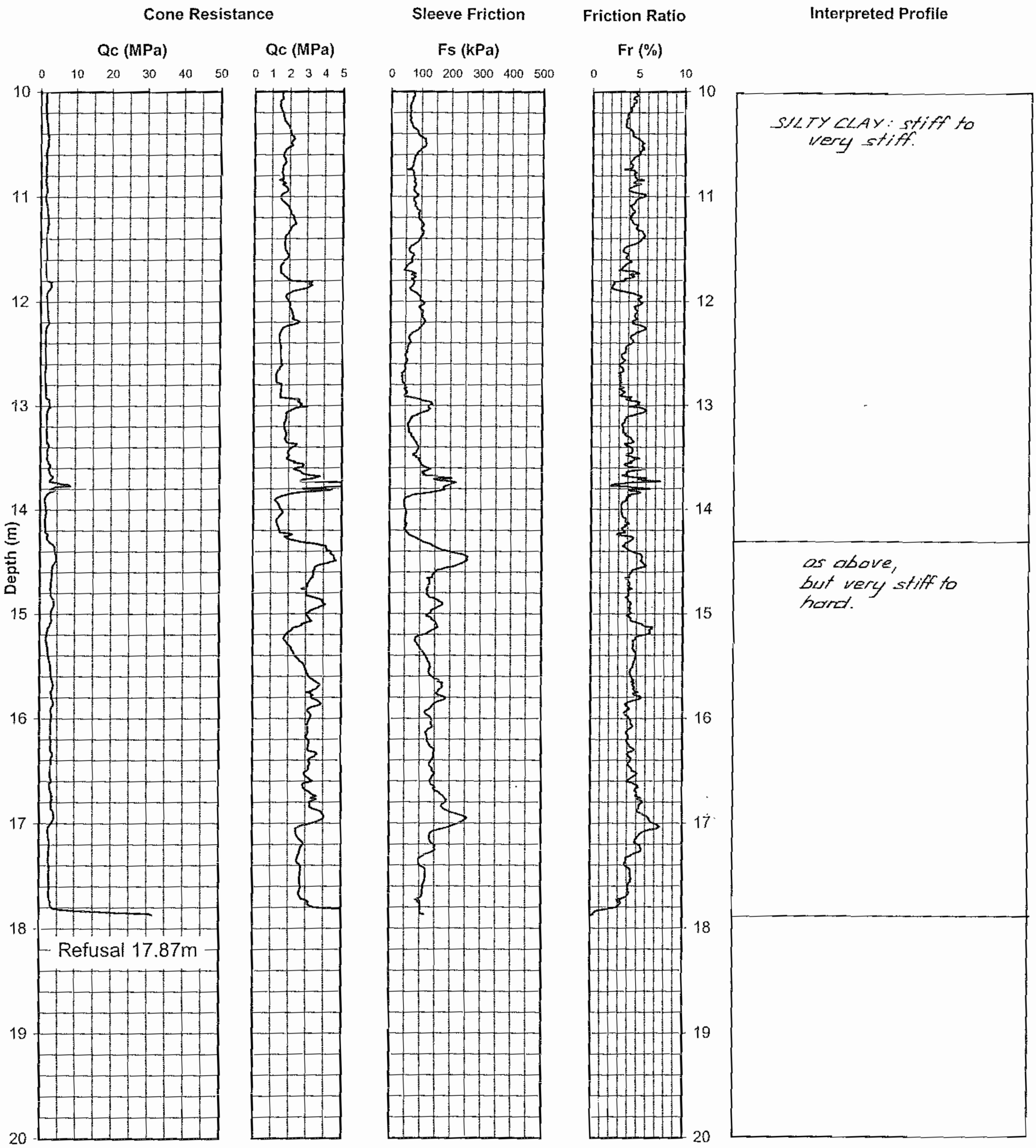
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **807** 2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW.				
Job Ref.:	15009JTPcpt807	**RL Surface:** NA		**Data File:**	AP120934.H1
Test Date:	12/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted by: M.K

Checked by: PW

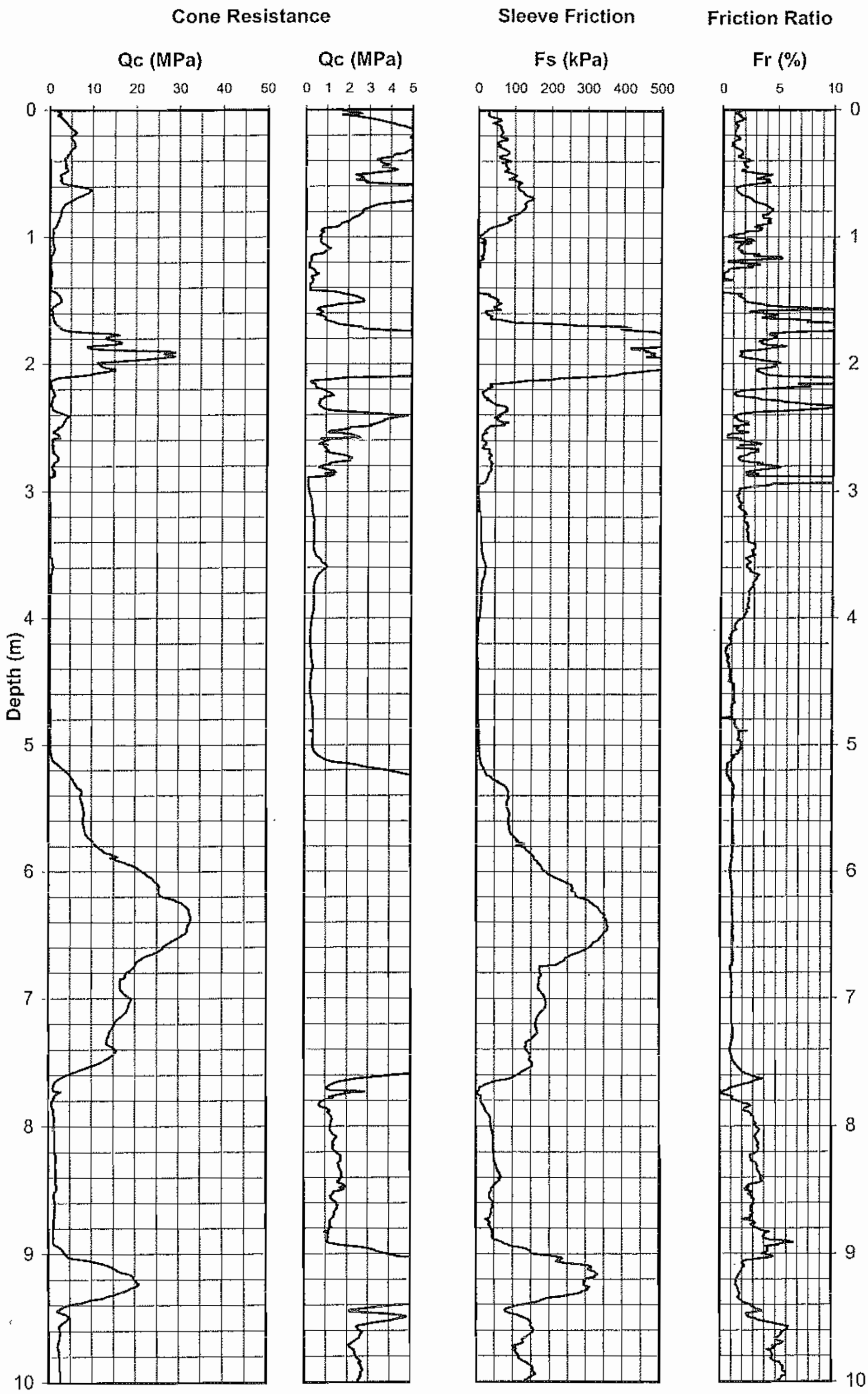
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
808
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:**	NA	**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted Profile

FILL: Silty sand. Appears poorly compacted.

FILL: Silty clay. Appears poorly compacted.

as above, but appears moderately compacted.

as above, but appears poorly compacted.

ORGANIC SILTY CLAY: very soft to soft.

SAND AND SILTY SAND: medium dense.

as above, but dense to very dense.

SILTY CLAY: stiff.

SAND TO SILTY SAND: medium dense to dense.

CLAY: very stiff.

Interpreted by: M.K.
Checked by: PW

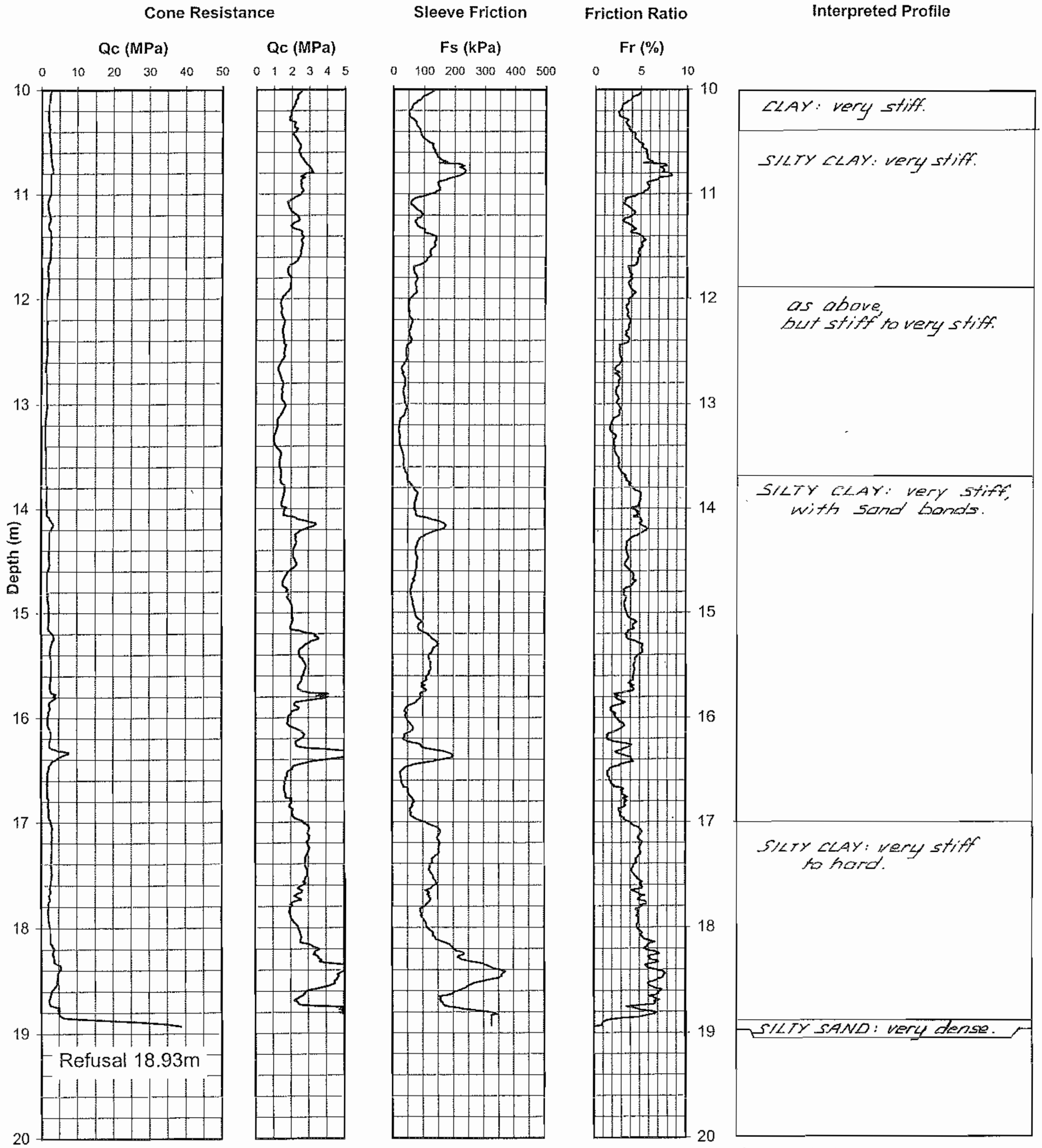
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **808** 2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:** NA		**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted by: M.K.

Checked by: PW

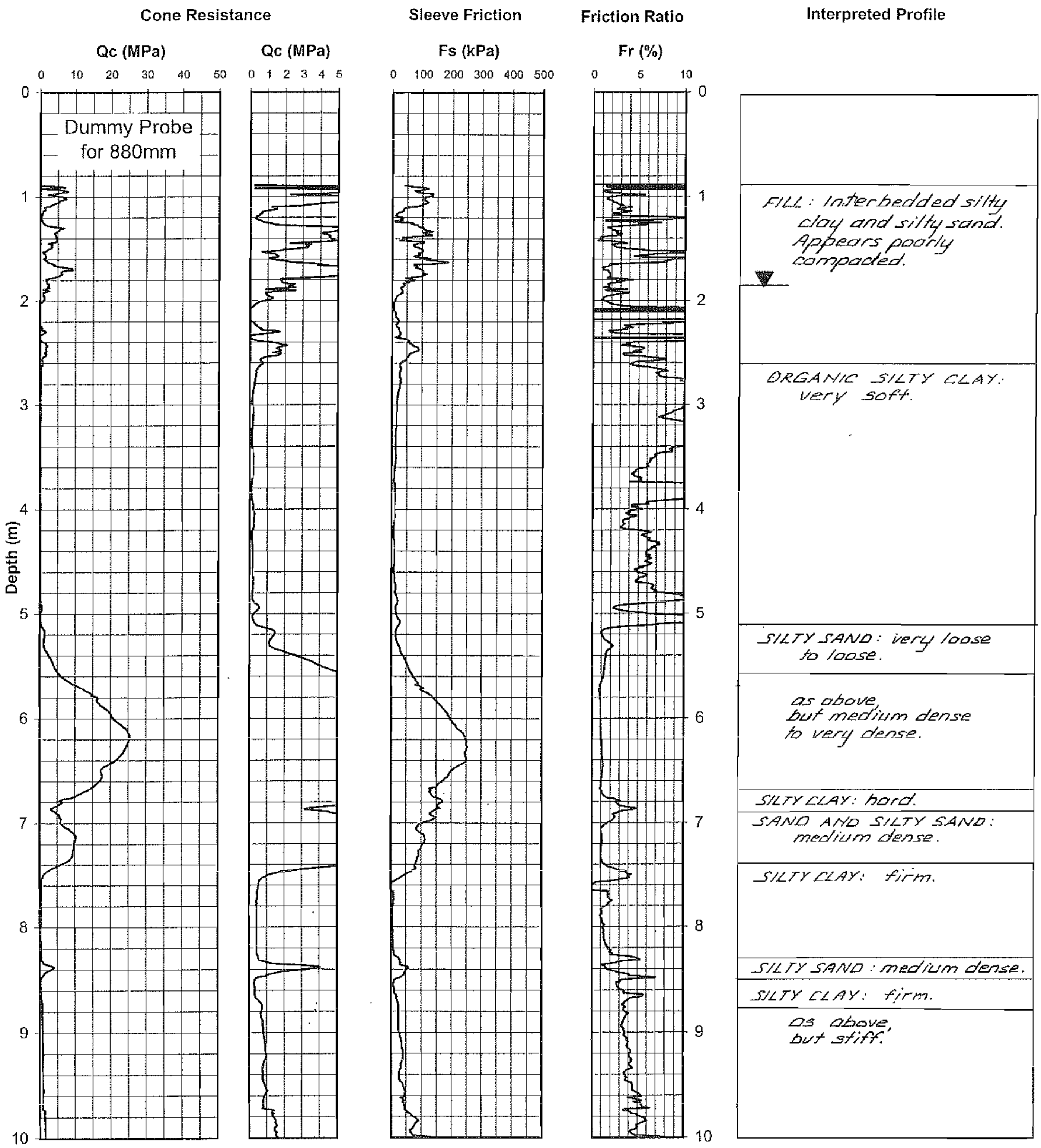
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
809
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt809	**RL Surface:**	NA	**Data File:**	AP051052.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW

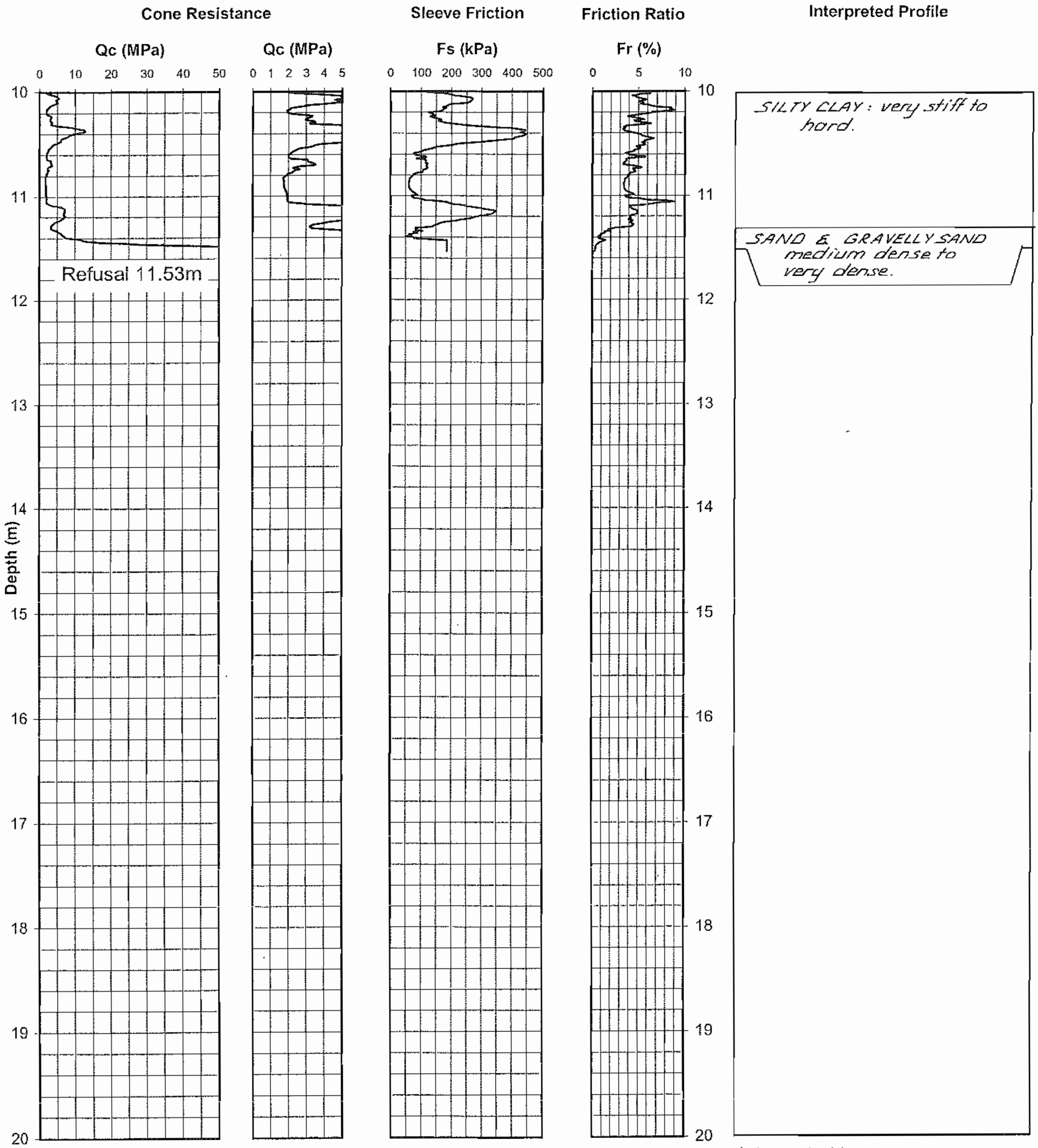
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
809
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt809	**RL Surface:**	NA	**Data File:**	AP051052.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



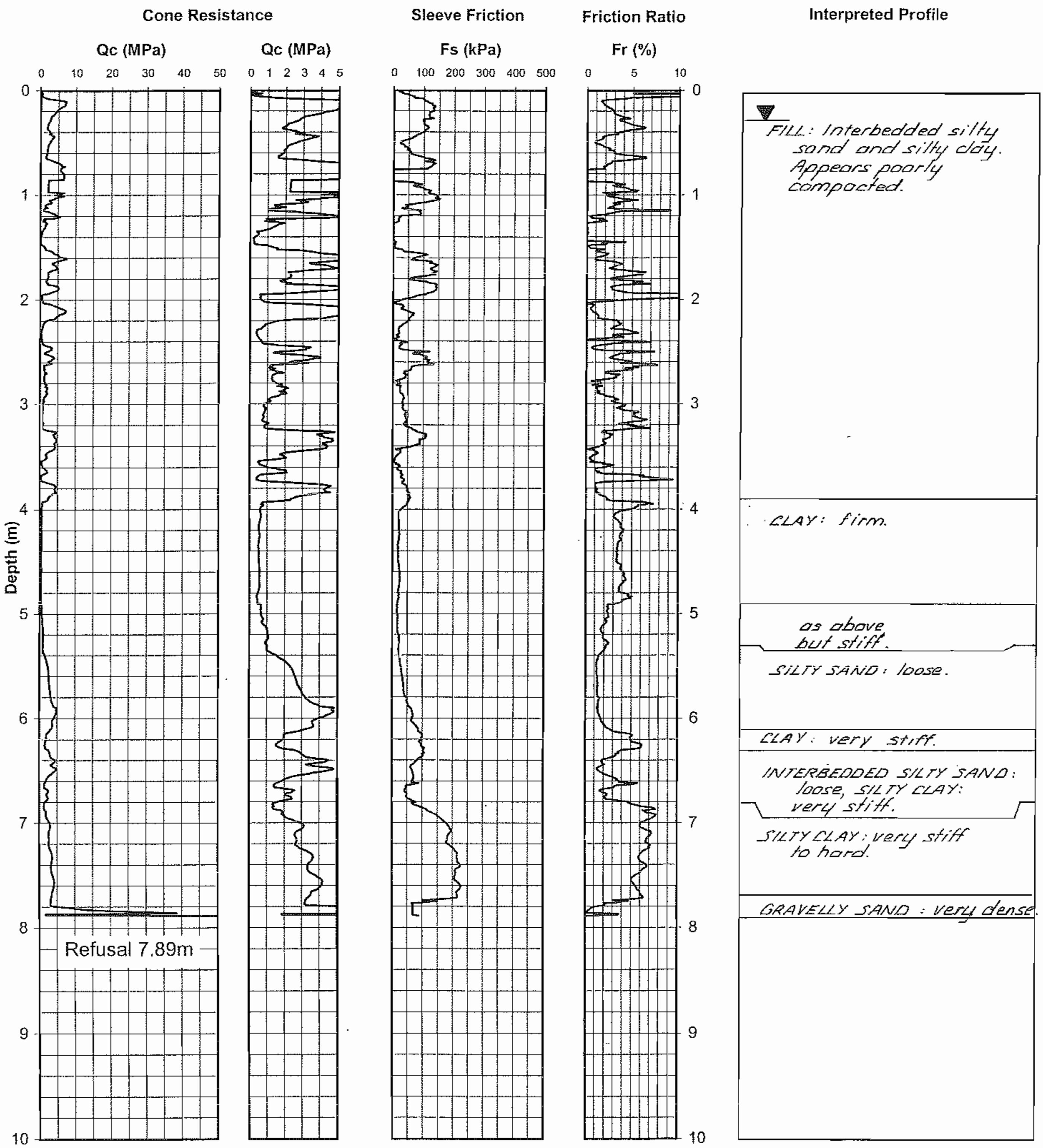
Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
810
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt810	**RL Surface:**	NA	**Data File:**	AP061409.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 901 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.4m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./ASH

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 8mm.t. over FILL: Sandy gravel, fine to coarse grained igneous gravel, fine to coarse grained sand.	MC≅PL			
		N = 13 5,5,8				FILL: Gravelly sandy clay, medium plasticity, orange brown, fine to medium grained sandstone and igneous gravel.				0.0%CH4 20.9%02 APPEARS MODERATELY COMPACTED
		N > 6 2,6/ 150mm REFUSAL	1			FILL: Clayey gravelly sand, fine to coarse grained, mottled orange brown, grey and brown, fine to coarse grained sandstone gravel, with a trace of timber, glass, wire and concrete fragments.				0.0%CH4 20.8%02
AFTER 26 HRS		N = 3 3,2,1	2 – 3			FILL: Silty sand, fine to coarse grained, dark grey, with a trace of fine to coarse grained sandstone gravel, timber, metal and brick fragments.	M			APPEARS POORLY COMPACTED NO RETURN IN SPT
		N = 4 3,2,2	4		SM/SC	CLAYEY SILTY SAND: fine to medium grained, dark grey brown, with a trace of rootlets.	W	VL-L	-	ORGANIC ODOUR 0.0%CH4 20.8%O2
			5			as above, but grey brown, with a trace of rootlets and shell material.				0.0%CH4 20.8%02
			6			END OF BOREHOLE AT 6.0m				STANDPIPE INSTALLED
			7							

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BOREHOLE LOG

Borehole No. **902** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.4m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./ ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Silty sandy gravel, fine to coarse grained, dark grey, igneous gravel.	D			0.0%CH4 20.9%O2
	N = 12 10,8,4	1		FILL: Silty sand, fine to medium grained, pale yellow brown.				APPEARS MODERATELY COMPACTED
	N = 12 2,9,3			as above, but with rootlets and a trace of timber.				0.0%CH4 20.9%O2
AFTER 4 HRS		2		FILL: Gravelly silty sand, fine to medium grained, brown.	M			
	N = 2 2,0,2	3		FILL: Silty sand, fine to medium grained, grey brown, with timber and a trace of sandstone gravel and clay nodules.	W			APPEARS POORLY COMPACTED 0.0%CH4 20.8%O2
	N = 2 1,1,1	4–5	SM	SILTY SAND: fine to medium grained, grey brown, with a trace of rootlets and shell material.	W	VL	-	AUGER REFUSAL AT 4.3m ON OBSTRUCTION IN FILL RE-DRILLED BOREHOLE 1m TO NORTH EAST (MARKED ON PLAN AS BH902A)
				as above, but yellow brown mottled grey with clay.				0.0%CH4 20.8%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

Samples columns: ES, U50, DB, DS

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BOREHOLE LOG

Borehole No. 903 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.3m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./ ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Sandy gravel, fine to coarse grained igneous gravel, fine to coarse grained sand.	D			
	N = 12 6,5,7	1		FILL: Silty gravelly clay, medium plasticity, red brown mottled grey, fine to medium grained ironstone and sandstone gravel.	MC>PL			0.0%CH4 20.9%O2 APPEARS MODERATELY COMPACTED
AFTER 3.5 HRS	SPT 7/150mm REFUSAL N = 2 2,1,1	2 3 4		FILL: Gravelly clayey sand, fine to medium grained, mottled grey and brown, fine to coarse grained ironstone, igneous and sandstone gravel, with a trace of wire, glass, plastic and timber fragments.				NO SAMPLE RECOVERY FROM SPT SAMPLER APPEARS POORLY COMPACTED
			OL	ORGANIC SILTY CLAY: low plasticity, grey brown, with rootlets.	MC>PL	(VS)	-	ORGANIC ODOUR
	N = 3 1,2,1	5	SC	CLAYEY SAND: fine to medium grained, grey brown, with a trace of rootlets and shell material.		VL		0.3%CH4 18.7%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

Samples columns: ES, U50, DB, DS. Graphic Log column present.

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BOREHOLE LOG

Borehole No. **904** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 9-9-02
Method: SPIRAL AUGER JK550
R.L. Surface: ≅ 3.0m
Datum: AHD
Logged/Checked by: J.R./ AJH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 6mm.t over FILL: Silty gravelly sand, fine to medium grained, grey brown, fine to medium grained igneous gravel.	D			
	N = 6 9,4,2							0.0%CH4 20.8%O2
		1		FILL: Silty sand, fine to medium grained, grey mottled brown, with a trace of fine to medium grained igneous gravel.				APPEARS POORLY COMPACTED
	N = 6 2,2,4			as above, but with timber, ash, fine to coarse grained sandstone and shale gravel.				0.0%CH4 20.9%O2
		2						
	N = 1 1,1,0	3						1.0%CH4 19.1%O2
▶				FILL: Organic matter, timber, roots and fabric.	W			APPEARS TO BE MANGROVE TREES
		4		FILL: Gravelly clayey sand, fine to medium grained, grey brown, fine to coarse grained sandstone gravel.				
	N = 1 1,0,1		SM	SILTY SAND: fine to medium grained, grey brown.	W	VL		0.2%CH4 18.9%O2
		5						ORGANIC ODOUR
				as above, but grey, with a trace of shell material.				0.2%CH4 19.4%O2
		6		END OF BOREHOLE AT 6.0m				STANDPIPE INSTALLED
		7						

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BOREHOLE LOG

Borehole No. **905** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.5m
Date: 10-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ ASH

Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Gravelly sand, fine to medium grained, brown, fine to coarse grained igneous gravel.	D			
N = 7 6,5,2			FILL: Sand, fine to medium grained, brown, with medium to coarse grained sandstone gravel and a trace of clay fines.				0.0%CH4 18.2%O2 APPEARS MODERATELY COMPACTED
N = 14 5,8,6	1		FILL: Sand, fine to medium grained, light brown with a trace of ash, fine to medium grained shale and sandstone gravel and timber.				0.0%CH4 17.4%O2
	2		FILL: Organic silty sand, fine to medium grained, dark brown, with fine to coarse grained sandstone and timber fragments.				APPEARS MODERATELY TO WELL COMPACTED
			FILL: Silty sand, fine to medium grained, brown, with a trace of ash, fine to medium grained sandstone gravel and steel wire.				
N > 8 2,3,5/ 10mm REFUSAL	3		FILL: Sandy organic matter, fine to medium grained sand, dark brown.	D-M			ORGANIC ODOUR 0.1%CH4 18.7%O2
			FILL: Organic matter, timber.				APPEARED TO BE MANGROVE TREES
	4	SC/OL	ORGANIC CLAYEY SAND: fine to medium grained, light grey.	W	MD	-	
N = 11 1,4,7	5						0.4%CH4 18.7%O2
		CL	SILTY CLAY: medium plasticity, light brown mottled light grey, with a trace of fine to coarse grained sandstone gravel and fine to medium grained sand.	MC>PL	(VSt)	-	0.7%CH4 17.1%O2
	6		END OF BOREHOLE AT 6.0m				
	7						

Groundwater Record: groundwater level marked at approx. 3.8m.

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Borehole No. **906** 1/1

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.9m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./AJH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Silty gravelly sand, fine to medium grained, pale brown and brown, fine to medium grained sandstone and igneous gravel.	D			
	N > 8 5,8/ 100mm REFUSAL			FILL: Silty sand, fine to medium grained, pale grey mottled pale brown, with a trace of fine grained sandstone gravel.				0.0%CH4 20.9%O2 APPEARS MODERATELY TO WELL COMPACTED
	N = 16 13,8,8	1		as above, but mottled grey brown, with a trace of timber, fabric, glass, metal and brick fragments.				0.0%CH4 20.8%O2
ON COMPLETION		2		FILL: Silty clayey sand, fine to medium grained, dark grey, with a trace of ash, fine to medium grained sandstone gravel, metal and timber.	M			
DURING SPT	N = 6 2,3,3	3	SM	SILTY SAND: fine to medium grained, dark grey brown, with organic matter.	W	L	-	0.0%CH4 20.93%O2
		4	OL	ORGANIC SILTY SANDY CLAY: low to medium plasticity, grey mottled dark brown.	MC>PL	(St)		ORGANIC ODOUR
	N = 5 2,3,2		SM/SC	SILTY CLAYEY SAND: fine to medium grained, grey brown, with organic matter and shell fragments.	W	L		0.0%CH4 20.8%O2
		5	CL/SC	SILTY SANDY CLAY/SILTY CLAYEY SAND: low to medium plasticity, fine to coarse grained, grey mottled, pale yellow brown and pale grey.	MC>PL			0.3%CH4 20.7%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

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BOREHOLE LOG

Borehole No. 907 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED

Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL

Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 4.0m

Date: 9-9-02 **Datum:** AHD

Logged/Checked by: J.R./ASH

Groundwater Record	Samples (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 8mm.t., over FILL: Sandy gravel, fine to coarse grained sub- angular igneous gravel, fine to medium grained sand.	D D-M			
		N = 9 3,4,5				FILL: Clayey gravelly sand, fine to coarse grained, pale brown, fine to medium grained igneous and sandstone gravel.	MC>PL			0.0%CH4 21.0%O2
			1			FILL: Silty clay, medium to high plasticity, grey mottled grey brown, with a trace of sand and rootlets, plastic, metal, timber and fine to coarse grained sandstone gravel.				APPEARS MODERATELY TO WELL COMPACTED
		N > 12 10,4,8/ 38mm REFUSAL	2							0.0%CH4 20.9%O2
AFTER 5 HRS						FILL: Clayey gravelly sand, fine to coarse grained, dark grey brown, fine to coarse grained sandstone gravel, with a trace of timber, metal brick fragments and concrete gravel.	M			
DURING SPT		N = 13 3,2,11	3							NO SAMPLE RECOVERED FROM SPT SAMPLER 0.0%CH4 20.8%O2
			4		OL	ORGANIC SILTY CLAY: low to medium plasticity, dark grey brown.	MC>PL	F-St		5.0%CH4 11.1%O2
		N = 3 2,1,2								NO RETURN ON SPT
			5		SM/SC	SILTY CLAYEY SAND: fine to medium grained, grey, with a trace of organic matter and shell material.	W	(L)		
			6			END OF BOREHOLE AT 6.0m				
			7							

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BOREHOLE LOG

Borehole No. **908** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.9m
Date: 10-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Gravelly sand, fine to medium grained, brown, fine to medium grained igneous gravel.	D			
	N > 24 7,14,10/ 60mm END			FILL: Gravelly sand, fine to medium grained, light brown, medium to coarse grained sandstone gravel.	MC≅PL			0.0%CH4 20.8%O2
		1		FILL: Silty sandy clay, low plasticity, brown, with fine to medium grained igneous and sandstone gravel.	D-M			APPEARS WELL COMPACTED
	N = 16 5,7,9			FILL: Gravelly sand, fine to medium grained, light brown, with igneous and sandstone gravel.				0.9%CH4 8.4%O2
		2		FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained concrete and sandstone gravel and a trace of rootlets.				
				FILL: Silty sand, fine to medium grained, dark brown.				
AFTER 25 hrs	N = 22 7,11,11	3		FILL: Sandy organic matter, brown, timber, fibre and roots, fine to medium grained sand and with a trace of sandstone gravel.	W			5.0%CH4 16.9%O2
				FILL: Organic matter, brown, root fibres, with silt.				APPEARS TO BE MANGROVE TREES
				FILL: Sand, fine to medium grained, light brown, with a trace of steel fragments.				ORGANIC ODOUR
	N = 1 1,0,1	4	OL	ORGANIC SILTY CLAY: low plasticity, brown.	MC>PL	VS	-	
		5	CL	SANDY CLAY: low plasticity, light grey and light brown, with a trace of fine to medium grained ironstone gravel.		(St)		
		6		END OF BOREHOLE AT 6.0m				
		7						

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BOREHOLE LOG

Borehole No. **909** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.5m
Date: 10-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ASH

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 8mm.t., over FILL: Silty gravelly sand, fine to medium grained, light brown, fine to medium grained sandstone and igneous gravel.	M			
		N = 6 1,1,5				FILL: Silty clay, high plasticity, brown mottled light brown, with a trace of organic matter.	MC>PL			0.0%CH4 20.8%O2
			1			FILL: Silty sand, fine to medium grained, brown, with a trace of rootlets, and fine to medium grained sandstone and igneous gravel.	M			APPEARS POORLY COMPACTED
		N = 13 4,6,7				FILL: Silty clay, medium plasticity, light brown, with sand and a trace of ash, rootlets, fine to medium grained sandstone gravel and organic material.	MC>PL			0.0%CH4 20.8%O2 APPEARS MODERATELY COMPACTED
			2			FILL: Organic matter, timber, roots, fibre and ash, dark brown.	MC>PL			APPEARS TO BE MANGROVE TREES
AFTER 26 HRS		N = 6 5,3,3	3			as above, but with fine to medium grained brown sand.				0.1%CH4 20.8%O2 APPEARS POORLY COMPACTED
					SM	SILTY SAND: fine to medium grained, dark brown, with a trace of organic fibres and rootlets.	W	VL	-	ORGANIC ODOUR
		N = 2 0,0,2	4			as above, but fine grained, brown, with a trace of organic matter.				1.1%CH4 20.3%O2 SPT SUNK 300mm UNDER SELF WEIGHT AT START OF TEST
AFTER 5 MINS			5		CL	SANDY CLAY: low plasticity, light grey, with a trace of fine to medium grained ironstone gravel.	MC>PL	(St)		1.3%CH4 19.8%O2
			6			END OF BOREHOLE AT 6.0m				
			7							

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BOREHOLE LOG

Borehole No. **910** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 11-9-02
Method: SPIRAL AUGER JK550
Logged/Checked by: S.O.C./ASH
R.L. Surface: ≅ 2.1m
Datum: AHD

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		FILL: Silty sand, fine to medium grained, brown, with fine to medium grained iron indurated sandstone gravel and a trace of timber fragments.	D			GRASS COVER
	N = 16 4,6,10							0.0%CH4 20.8%O2
ON COMPLETION		1		as above, but with occasional timber fragments.	M			APPEARS WELL COMPACTED
	N = 3 1,1,2			FILL: Silty clay, low plasticity, light grey mottled light brown.	MC>PL			0.2%CH4 20.4%O2
		2	OL	ORGANIC SILTY CLAY: low plasticity, grey with fibre, roots and occasional shell fragments.	MC>PL	(VS-S)	-	APPEARS POORLY COMPACTED; ORGANIC ODOUR
	N = 1 0,0,1	3						0.0%CH4 20.8%O2; SPT SUNK 300mm UNDER SELF WEIGHT AT START OF TEST
			SP	SAND: fine to medium grained, brown.	W	MD		
	N = 17 10,11,6	4						0.0%CH4 20.8%O2
		5	CL	SANDY CLAY: low plasticity, light brown mottled light grey.	MC>PL	(VSt-H)		0.0%CH4 20.5%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

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Borehole No. **911** 1/1

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** N/A
Date: 11-9-02 **Datum:**
Logged/Checked by: S.O.C./ [signature]

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
ON COMPLETION			0			FILL: Gravelly sand, fine to medium grained, light brown, fine to medium grained sandstone and igneous gravel.	D			
		N = 6 5,4,2				FILL: Sand, fine to medium grained, grey and brown, with a trace of clay fines.				0.0%CH4 20.8%O2 APPEARS POORLY COMPACTED
		N = 1 2,0,1	1		SM	SILTY SAND: fine to medium grained, brown, with roots and organic fibres	W	VL	-	POSSIBLY FILL TO 2.0m DEPTH 1.2%CH4 20.4%O2
		SPT SUNK UNDER SELF WEIGHT	2		OL	ORGANIC SILTY CLAY: low plasticity, dark grey, with fibre, roots and timber fragments.	MC>PL	(VS-S)		ORGANIC ODOUR 0.3%CH4 20.1%O2
		N = 6 1,2,4	3		SC	CLAYEY SAND: fine to medium grained, light brown and light grey, with fine to coarse grained iron indurated sand bands.	W	L		0.5%CH4 20.8%O2 0.7%CH4 20.4%O2
			6			END OF BOREHOLE AT 6.0m				
			7							

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BOREHOLE LOG

Borehole No. **912** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 11-9-02
Method: SPIRAL AUGER JK550
R.L. Surface: ≅ 1.9m
Datum: AHD
Logged/Checked by: S.O.C./ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 6mm.t., over FILL: Gravelly sand, fine to medium grained, brown.	D MC<PL			
ON COMPLETION	N = 4 3,2,2	1		FILL: Clayey silt, low plasticity, grey.				0.2%CH4 20.4% APPEARS POORLY COMPACTED
	N = 24 11,18,6	2		FILL: Silty sand, fine to medium grained, grey, with occasional steel wire, plastic and medium to coarse grained sandstone gravel.	W			1.6%CH4 18.86%O2 APPEARS WELL COMPACTED
	N = 2 0,0,2	3	OL	ORGANIC SILTY CLAY: low plasticity, grey, with shells, fibre.	MC>PL	(S)	-	SULPHUR ODOUR 19.0%CH4 18.8%O2 SPT SUNK 300mm UNDER SELF WEIGHT AT START OF TEST
	N = 3 0,1,2	4 5	CL	SILTY CLAY: low plasticity, light brown, with occasional shells.	MC>PL	VS	20 20 10	7.0%CH4 19.9%O2 SPT SUNK 150mm UNDER SELF WEIGHT AT START OF TEST
				SILTY CLAY: low plasticity, dark grey, with occasional timber fragments.		(S)		1.7%CH4 20.4%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the S.A.A. Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 - 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles.

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Tests (S.P.T.) as below:

Relative Density	S.P.T. "N" Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, "Shale" is used to describe thinly bedded to laminated siltstone.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits – These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the in situ soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling – A borehole of 50 to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers – The borehole is advanced using 75 to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and in situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by S.P.T.s or undisturbed samples) is of relatively lower reliability due to remoulding, contamination or softening of samples by groundwater, or uncertainties as to the orginal depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table. Use can be made of a Tugsten Carbide (T.C.) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments.

Wash Boring – The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling – Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (e.g. from S.P.T. and U50 samples) or from rock coring, etc.

Continuous Core Drilling – A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an N.M.L.C. triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests – Standard Penetration Tests (S.P.T.) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the S.P.T. test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the S.P.T. hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the S.P.T. The results of this Dynamic Cone Penetration Test are shown as "N_c" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation – Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (E.F.C.P.). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been copied from the original records.

The information provided on the charts comprises:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

There are two scales available for measurement of cone resistance. The lower (A) scale (0 to 5 MPa) is used in softer soils where increased sensitivity is required. The main (B) scale has a range of 0 to 50 MPa.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on friction ratios are only inferred and must not be considered as exact.

Correlations between E.F.C.P. and S.P.T. values can be developed for both sands and clays but may be site specific.

Interpretation of E.F.C.P. values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers – Portable Dynamic Cone Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (A.S. 1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (A.S. 1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or "reverted" chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determinted only by the inclusion of foreign objects (e.g. bricks, steel etc.) or by distinctly unusual colour, texture or fabric. Indentification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes." Details of the test procedure used are given on the individual report forms and the attached explanatory notes summarise important aspects of the Laboratory Test Procedures adopted.

ENGINEERING REPORTS

Engineering reports are prepared by qualifed personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (e.g. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (e.g. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- changes in policy or interpretation of policy by statutory authorities.
- the actions of persons or contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer. We would be happy to assist in this regard as an extension of our investigation commission.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to
ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
iii) full-time engineering presence on site.

SEPTEMBER, 1990

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CH)
- SILTY CLAY (CL, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML)
- PEAT AND ORGANIC SOILS

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE
- SILTSTONE, MUDSTONE, CLAYSTONE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

DEFECTS AND INCLUSIONS

- CLAY SEAM
- SHEARED OR CRUSHED SEAM
- BRECCIATED OR SHATTERED SEAM/ZONE
- IRONSTONE GRAVEL
- ORGANIC MATERIAL

OTHER MATERIALS

- CONCRETE
- BITUMINOUS CONCRETE, COAL
- COLLUVIUM

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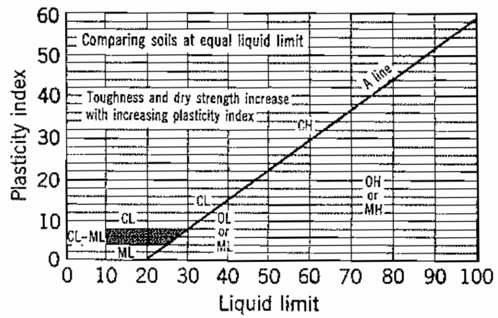
UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)				Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria	
Coarse-grained soils More than half of material is *larger* than 75 µm sieve size[b]	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 µm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures			Atterberg limits below "A" line, or *PI* less than 4 / Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics		Atterberg limits above "A" line, with *PI* greater than 7
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures			Atterberg limits below "A" line or *PI* less than 5 / Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures			Atterberg limits below "A" line with *PI* greater than 7

(The 75 µm sieve size is about the smallest particle visible to naked eye)

Use grain size curve in identifying the fractions as given under field identification

Fine-grained soils More than half of material is *smaller* than 75 µm sieve size	Identification Procedures on Fraction Smaller than 380 µm Sieve Size: Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
	Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	
Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
	Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils	Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart for laboratory classification of fine grained soils

NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

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LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.
		Extent of borehole collapse shortly after drilling.
		Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY - runs freely through fingers.
	M	MOIST - does not run freely but no free water visible on soil surface.
	W	WET - free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa
	S	SOFT - Unconfined compressive strength 25-50kPa
	F	FIRM - Unconfined compressive strength 50-100kPa
	St	STIFF - Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa
	H	HARD - Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 0-4
	L	Loose 15-35 4-10
	MD	Medium Dense 35-65 10-30
	D	Dense 65-85 30-50
	VD	Very Dense >85 >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

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LOG SYMBOLS

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
		0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
		0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
		1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
		3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
		10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	