CROZIER GEOTECHNICAL CONSULTANTS

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REPORT ON GEOTECHNICAL SITE INVESTIGATION

into

EXISTING SITE CONDITIONS

at

98 OLD PITTWATER ROAD, BROOKVALE, NSW

Prepared For

SP19670

Project No.: 2019-228

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0	27th February 2020	Original issue
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GEOTECHNICAL REPORT INTO EXISTING SITE CONDITIONS
98 OLD PITTWATER ROAD, BROOKVALE, NSW

1. INTRODUCTION:

This report details the results of two phases of geotechnical investigation carried out to assess foundation conditions due to apparent cracking in an existing industrial building at 98 Old Pittwater Road, Brookvale, NSW. The investigation was undertaken by Crozier Geotechnical Consultants (CGC) at the request of the client SP19670.

The site contains a two storey brick industrial building block. It appears that the internal and external walls of the building had developed significant cracking and the slab had settled up to 300mm in depth in part. It is further understood that previous attempts to lift slabs and footings have been only partly successful.

Geotechnical investigations and reporting were requested to assess the foundation conditions to assist with identification of the causes and design of remedial measures as required.

The initial investigation was undertaken as per the Tender P19-478, Dated: 3rd December 2019, except the attempts to excavate two test pits along the northern wall were unsuccessful due to very dense fill and service lines. Instead, following discussion with the engineer and the client, two extra boreholes were drilled to identify the ground profile more accurately.

The investigation comprised:

a) A detailed geotechnical inspection and mapping of the site and adjacent properties by a geotechnical engineer including a photographic record of site conditions.
b) Drilling of seven boreholes using a restricted access drill rig, along with Dynamic Cone Penetrometer (DCP) testing to investigate the subsurface geology and identification of ground water conditions.

An additional investigation was undertaken as per the Tender: P19-478.1, Dated: 10th February 2020. The investigation comprised:

a) Onsite clearance of test locations by an accredited service location contractor.

b) Drilling of seven boreholes using a restricted access drill rig, along with Dynamic Cone Penetrometer (DCP) testing within Unit 2 and Unit 3 to investigate the subsurface geology and identification of ground water conditions.

2. SITE FEATURES:

2.1. Description:

The property is located at the corner of Old Pittwater Road and Clearview Place within gently south dipping topography. The proposed boreholes for the initial investigation are located between road reserve of Clearview Place and the northern wall of the existing industrial building. This area is grassed, near level and approximately 1.30m above the floor level of the site building.

The site building comprises a two storey commercial building along the northern bounding with carpark to the south. The building is formed with concrete floor slab with concrete block side walls and high span steel frame roof.

2.2. Geology:

Reference to the Sydney 1: 100,000 Geological Series sheet (9130) indicates that the site is close to a boundary between Quaternary Sediments (Qha) and Hawkesbury Sandstone (Rh).

The Quaternary sediments consist of silty to peaty quartz sand, silt and clay that are ferruginous with humic cementation in places, and shell layers are common.

The Hawkesbury Sandstone is of Triassic Age and typically comprises medium to coarse grained quartz sandstone with minor lenses of shale and laminite.

An extract for the site location is provided below.

3. FIELD WORK:

3.1. Methods:

The initial investigation comprised an inspection of the site by a Geotechnical Engineer along with a photographic record of site conditions on the 13th January 2020.

It also included the drilling of five boreholes (BH1 to BH5) on 13th January 2020 and two extra boreholes (BH6 and BH7) on 13th February 2020 along the northern side of the site using a restricted access drill rig employing solid stem spiral flight augers and a tungsten carbide bit to determine sub-surface geology.

The additional investigation comprised concrete coring at seven test locations within Unit 2 and Unit 3. It also included drilling of one auger borehole at each location (BH101 to BH107) on 17th and 22nd June 2020 using a restricted access drill rig employing solid stem spiral flight augers and a tungsten carbide bit to determine sub-surface geology.

DCP testing was carried out from ground surface adjacent to and within the boreholes in accordance with AS1289.6.3.2 ï 1997, ñDetermination of the penetration resistance of a soil ï 9kg dynamic cone penetrometerò to estimate near surface soil conditions.

Strata identification was undertaken on material recovered from the boreholes with samples collected as per ñAS1726: 2017 Geotechnical Site Investigationò for logging purposes.

Explanatory notes are included in Appendix: 1. Test locations are shown on Figure: 1 along with detailed borehole log and DCP sheets in Appendix: 2. A geological model/section is provided as Figure: 2 and Figure 3, Appendix: 2.

3.2. Field Observations:

Clearview Place contains a bitumen pavement. It is near level where it passes the site. A grass reserve lies between the road and the site boundary. It is understood that the grass reserve has settled during the past decade.

Based on the communication with the client and ground surface observation, stormwater pipes are approximately 0.50m off the external wall of the building in the road reserve and below the building.

The existing brick building has developed significant cracking in the internal and external walls and settlement up to 300mm in the concrete slab that appears centred around the central dividing wall of Unit 2 and Unit 3 and the northern external wall.

3.3. Field Testing:

BH1 to BH7 were discontinued at varying depths between 4.00m and 5.50m. DCP tests extended to 4.20m depth.

BH101, BH104, BH105 and BH107 were discontinued at 5.50m depth with DCP tests extended to 4.20m depth in these borehole locations. BH102 encountered auger refusal at 0.85m depth on possible secondary concrete slab. BH103 and BH106 encountered auger refusal at 5.00m and 3.53m depth, respectively, on interpreted sandstone bedrock of at least low strength.

It should be noted that the ground level within the existing building (BH101 to BH107) is approximately 1.30m lower than that of the road reserve.

Based on the investigation results the subsurface conditions at the project site can be classified as follows:

- **CONCRETE –** this layer was encountered in BH101 to BH107 to 0.15m depth. A secondary concrete slab may exist at BH102 from 0.85m depth.
- **FILL –** this layer was encountered in BH1 to BH7 from ground surface to varying depth between 1.50m and 2.30m, whilst it was encountered in BH101, BH103 to BH107 below the concrete slab to varying depths between 1.30m and 1.80m. It was encountered in BH102 below the concrete to auger refusal at 0.85m depth. It is classified as medium dense to very dense, brown, dry silty sand with gravel, tile, root, steel, etc.
- **SAND/Silty SAND/Clayey SAND –** this layer was encountered below the fill to varying depths between 2.50m to 5.00m in BH1, BH4, BH5, BH7, BH101 and BH103 to BH107. It is classified as orange and grey, fine to medium grained, moist clayey sand and sand that is loose to medium dense in BH1 and BH7 and medium dense to very dense in BH4 and BH5. It is classified as medium dense to very dense, grey to dark grey, fine grained, moist to saturated sand/silty sand with minor bands of organic rich clay in BH101 and BH103 to BH107.
- **Silty/Sandy CLAY –** this layer was encountered below the sand/clayey sand layer in BH1 and BH7 at the west end of the site to the end of boreholes at 4.00m depth. It is classified as firm to stiff, grey, medium plasticity, moist silty/sandy clay.

- **Silty SAND –** this layer was encountered below the fill in the centre of the site to the end of BH2 and BH6 at 4.00m depth and to 4.20m in BH3. It is classified as very loose to loose, dark grey, fine to medium grained wet silty sand.
- **PEAT/ORGANIC CLAY –** this layer was encountered below the sand/silty sand layer in BH3, BH101, BH104, BH105 and BH107 to the end of the boreholes at 5.50m depth. It is classified as brown/black, fibrous, organic.
- **SANDSTONE BEDROCK –** based on the borehole log and DCP results, sandstone bedrock of at least low strength is interpreted at 5.00m and 3.53m depth at the locations of BH103 and BH106, respectively.

A groundwater table was encountered between 4.00m and 5.50m depth during drilling and situated at varying depths between 1.30m and 2.10m below the floor level of the existing warehouse after drilling.

3.4. Adjacent Site Conditions:

The near surface ground condition within the site appears similar to that identified in the property on the other side of the road, No. 22 Clearview Place. According to previous investigation and reporting by CGC (Job No. 2011-028, Dated: 30th November 2011), an organic rich soft clay horizon was encountered at relatively shallow depth (4.0m depth) for up to 4.50m thickness within the south-east corner of the property. A thick sequence of very low density sand and soft clay was also identified between 3.50m and 12.00m depth at the east centre of the property. The sandstone bedrock within the eastern side of the property was encountered up to 27.60m depth, whilst the bedrock is at 8.40m depth in the west. Groundwater related to the water table or seepage was identified at between 2.70m and 5.00m depth across the property.

4. COMMENTS:

4.1. Geotechnical Assessment:

The site investigation identified a layer of fill up to 2.30m depth, overlying superficial soils to varying depths between 2.50m (BH107) and the maximum investigation depth at 5.50m.

In the western portion of the site, the superficial soils below the fill are generally loose to medium dense sand and firm to stiff clay, in the eastern portion, they are medium dense to very dense sand with hard clay bands.

However, in the centre portion of the site (Unit 2, Unit 3 and part of Unit 4), the superficial soils comprise very loose to loose wet silty sand to the north of the northern external wall of the site building to at least

4.20m depth. A layer of highly compressible organic clay/peat was encountered below the superficial soils to the south of the wall, from varying depths between 2.50m (BH107) and 3.70m (BH101) to maximum investigation depth at 5.50m, and also below the very loose silty sand in BH3.

In the southern end of the area of investigations, BH103 and BH106, interpreted sandstone bedrock was encountered at 5.00m and 3.53m depth, respectively.

Wet soils were encountered at approximately 2.50m depth within the centre portion of the site. Slightly pressured groundwater was encountered between 4.00m and 5.50m during borehole drilling and the water levels stabilised at varying depths between 1.30m and 2.10m after drilling.

Generally, the medium dense to very dense soil would be a suitable foundation for bearing pressure of 150kPa to 300kPa. However, the very loose to loose soil and its underlying organic clay/peat are always considered unsuitable for foundation and would generally be expected to result in excess settlement under footing loads. The peaty soils are particularly problematic even under negligible loading due to organic decomposition.

The existing ground surface to the north of the building external wall is approximately 1.30m higher than the building ground floor slab level. The fill depth outside the building varies from 1.50m to 2.30m with the fill generally deeper in the centre portion of the site, whilst the fill depth varies from 1.30m to 1.80m inside the centre of the building. This is probably due to previous backfill and compaction over very loose material. It is considered that the existing building is founded on a shallow footing/slab at near the base of the fill or in the fill within shallow depth of the internal floor level. This is reinforced by the apparent floor raising achieved by under floor injection at the front of the site.

Considering that the settlement and cracking is occurring mostly in the centre north of the building and that relatively shallow bedrock was interpreted underlying the south of the building, it is expected that differential settlement between the very loose wet silty sand and organic clay/peat and shallow soil above bedrock is the primary cause of the excess cracking. This could also explain why the previous attempts to lift slabs and footings by injection system at the north end of the site have been unsuccessful.

Remediation is likely to be achieved through extending footings to below the very loose to loose sand and organic clay/peat, however, any footing in soil will still be subject to settlement under loading. Therefore, it is recommended to extend/construct footings to found off bedrock.

Based on the site conditions, it is expected that pile footings are required. Due to the saturated, very loose silty sand and organic clay/peat as well as the water level at 1.30m depth, the most suitable method for concrete pile footings will be CFA piles. However, significant cost should be allowed for, and existing building walls are expected to require some demolition to accommodate this style of rig. Alternatively, screw piles could be utilised. However, the success of these pile systems depends on defining bedrock surface levels.

Pending the final stabilising/remedial works requirements, further investigation may be required to define bedrock depths.

The recommendations and conclusions in this report are based on investigations utilising only surface observations and a restricted access drill rig. This test equipment provides limited data from small isolated test points across the entire site, therefore some minor variation to the interpreted sub-surface conditions is possible, especially between test locations. However the results of the investigation provide a reasonable basis for identification of the causes and design of remedial measures.

4.2. Design & Construction Recommendations:

Design and the construction recommendations are tabulated below:

4.2.1. Footings:	
Site Classification as per AS2870 ï 2011 for new footing design	Class óPôsite due to site soils
Type of Footing	Piles
Sub-grade material and Maximum Allowable Bearing Capacity	- Medium dense silty sand: 150kPa - Dense silty sand: 250kPa - Very dense silty sand: 350kPa - Very low strength bedrock: 700kPa - Low to medium strength bedrock: 1000kPa*
Site sub-soil classification as per *Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia*	C_e ï shallow soil site Hazard factor (z) = 0.08
Remarks: *Higher bearing pressures maybe available through core drilling of bedrock New footing/underpinning excavations must be maintained in a moist condition (not dry or saturated) until placement of concrete All new footings must be inspected and tested by an experienced geotechnical professional before concrete or steel are placed to verify the density of the founding strata. This is mandatory to allow them to be ócertifiedôat the end of the project.	

5. CONCLUSION:

The investigation identified that a significant layer of soft and highly compressible material underlies the centre northern part of the site and is considered to be the most likely cause to the depression and settlement identified in the existing building.

Pending the final stabilising /remedial works requirements, deeper investigation to define bedrock depths may be required.

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Appendix 1

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NOTES RELATING TO THIS REPORT

Introduction

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

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very soft	Less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300mm)	CPT Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

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

Disturbed samples taken during drilling to allow information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing a sample of the soil 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.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is 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.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. 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.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube 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 as 4, 6, 7 then N = 13
- In the 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 then as 15, 30/40mm.

The results of the test can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually 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 friction resistance on a separte 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected buy electrical 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) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results 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 in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

Qc (MPa) = (0.4 to 0.6) N blows (blows per 300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

Qc = (12 to 18) Cu

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Dynamic Penetrometers

Dynamic penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.3). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is generally 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.

Borehole Logs

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

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Details of the type and method of sampling are given in the report and the following sample codes are on the borehole logs where applicable:

D	Disturbed Sample	E	Environmental sample	DT	Diatube
B	Bulk Sample	PP	Pocket Penetrometer Test		
U50	50mm Undisturbed Tube Sample	SPT	Standard Penetration Test		
U63	63mm " " " " "	C	Core		

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, 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. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made. More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified 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 (eg. A three-storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. 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 condition, 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 depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

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

Site Anomalies

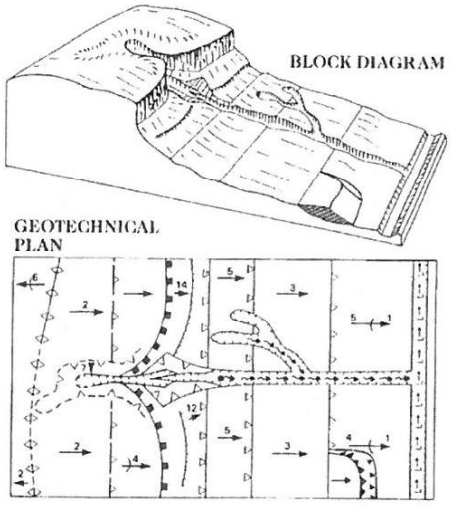
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some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

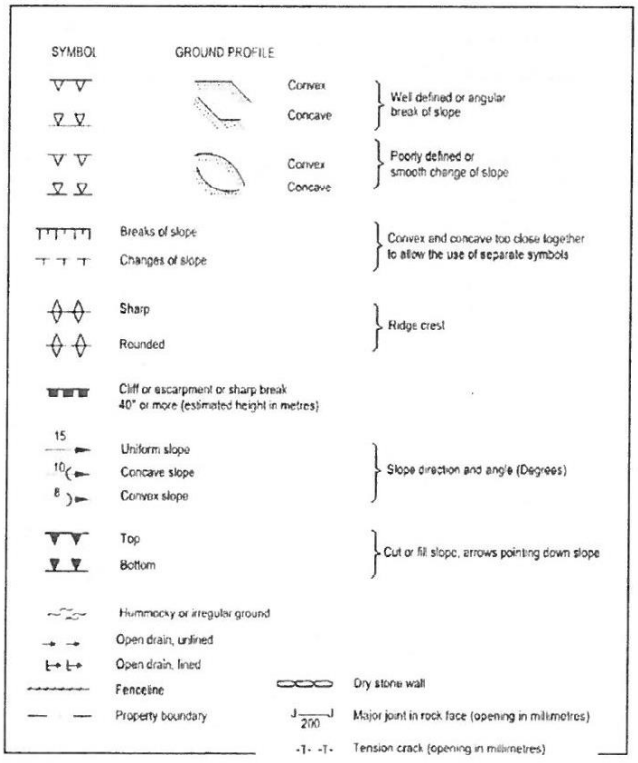
Reproduction of Information for Contractual Purposes

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 special ally 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.

Site Inspection

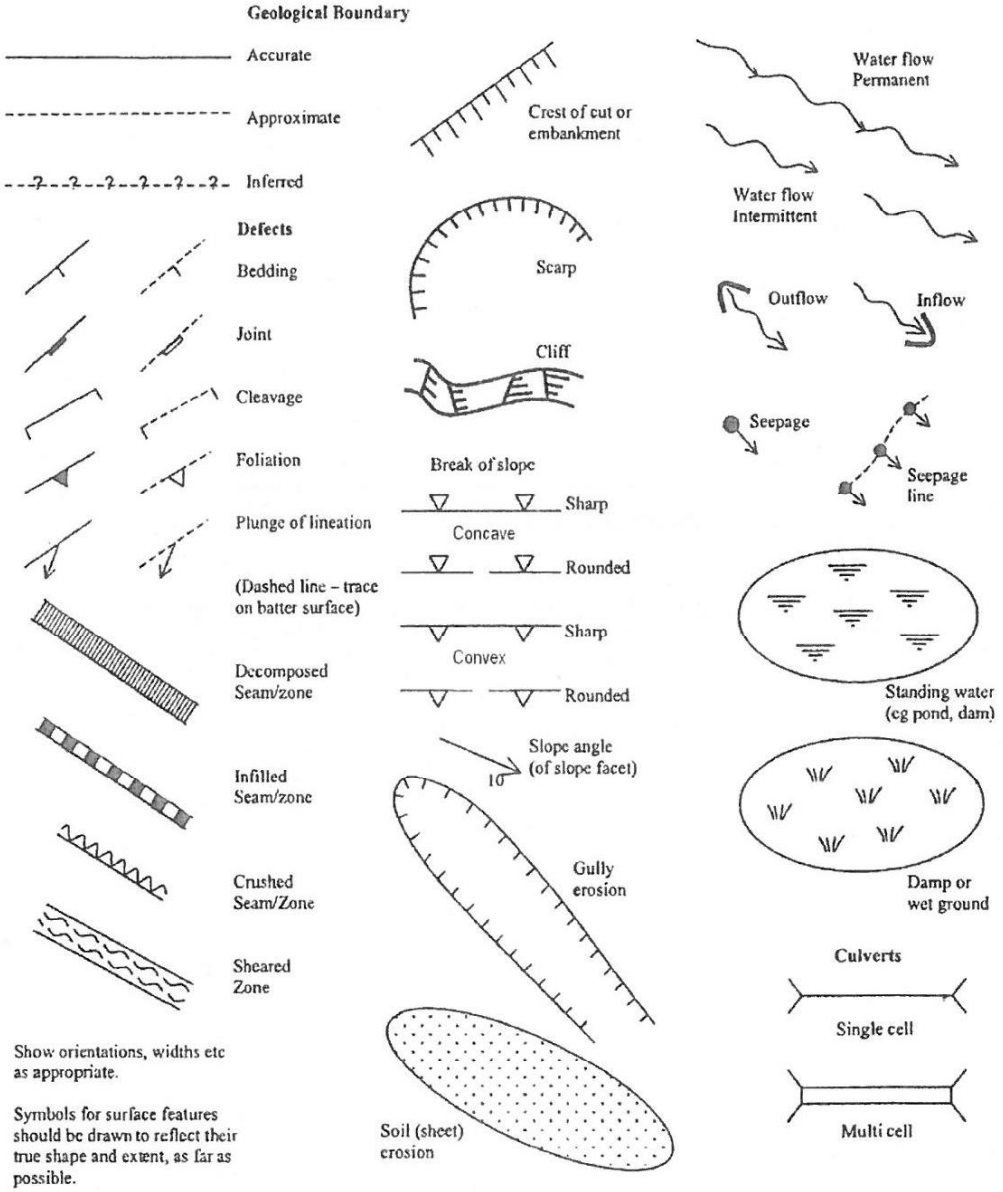
The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.





Example of Mapping Symbols
(after V Gardiner & R V Dackombe (1983).Geomorphological Field Manual. George Allen & Unwin).

APPENDIX E - GEOLOGICAL AND GEOMORPHOLOGICAL MAPPING SYMBOLS AND TERMINOLOGY



Examples of Mapping Symbols (after Guide to Slope Risk Analysis Version 3.1 November 2001, Roads and Traffic Authority of New South Wales).

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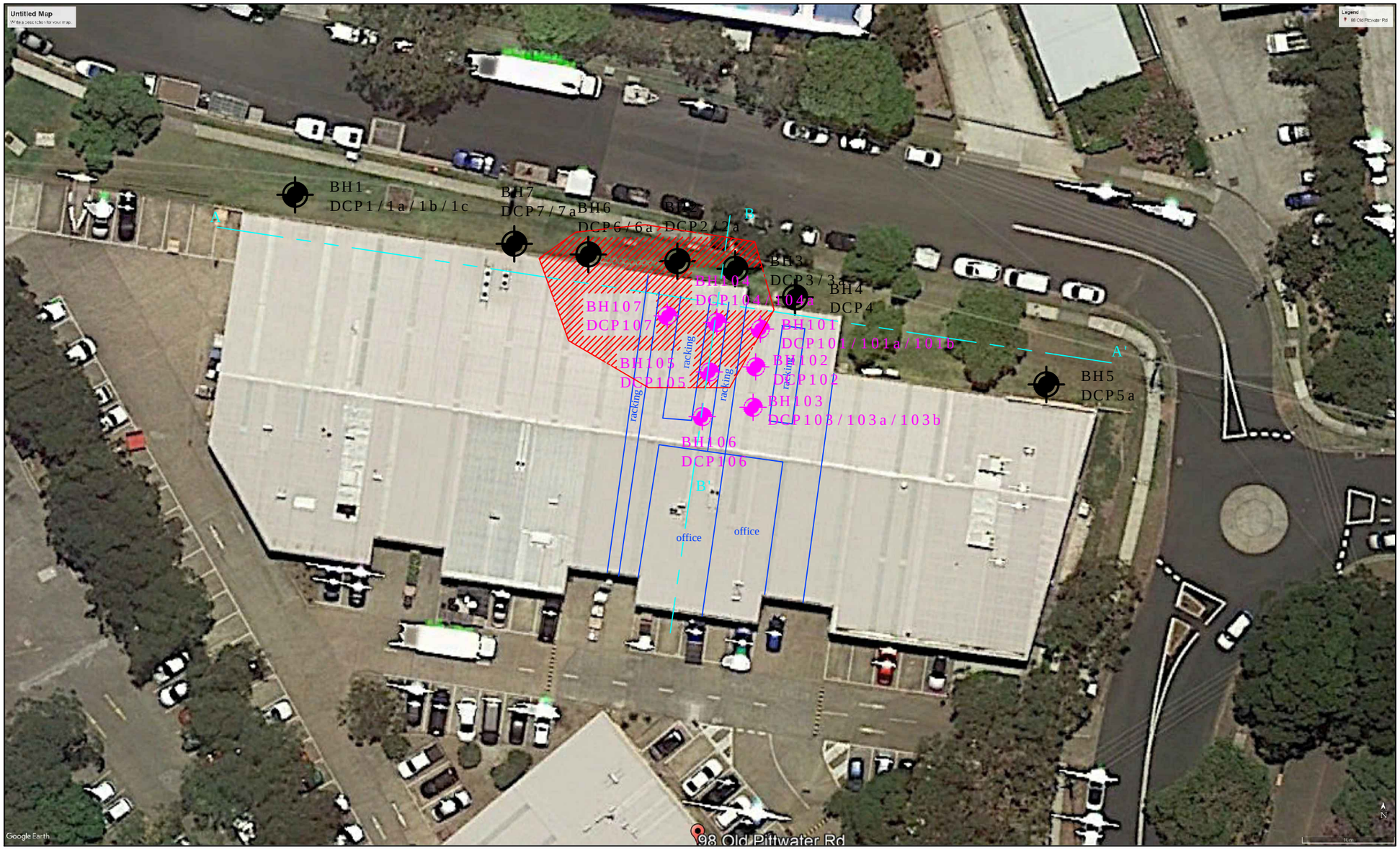
Appendix 2



VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

SITE PLAN & TEST LOCATIONS FIGURE 1.

CROZIER GEOTECHNICAL CONSULTANTS

Crozier Geotechnical ABN: 96 113 453 624
Unit 12, 42-46 Wattle Road Phone: (02) 9939 1882
Brookvale NSW 2100 Fax: (02) 9939 1883
Crozier Geotechnical is a division of PJC Geo-Engineering Pty Ltd

LEGEND

A — A' CROSS-SECTION REFERENCE LINE

AREA WITH WEAK MATERIAL UNDERGROUND

BH / DCP AUGER / DYNAMIC CONE PENETROMETER LOCATION OF SECOND INVESTIGATION

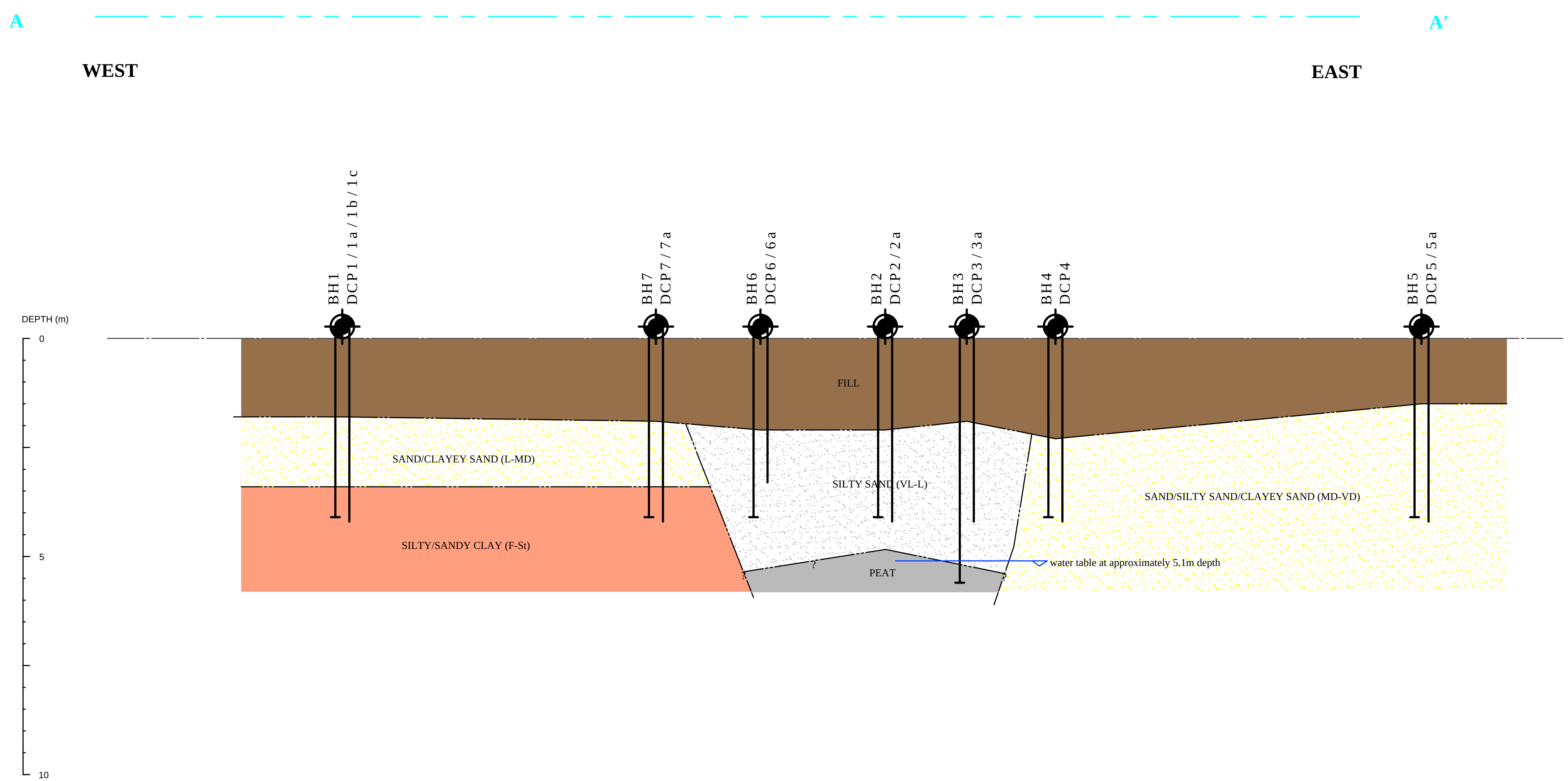
BH / DCP AUGER / DYNAMIC CONE PENETROMETER LOCATION

SCALE: NOT TO SCALE
DRAWING: FIGURE 1
DATE: 01/07/2020

APPROVED BY: TMC
DRAWN BY: JY
PROJECT: 2019-228

PREPARED FOR:
SP19670

ADDRESS:
98 Old Pittwater Road, Brookvale



VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

NB. FOR LOCATION OF SECTION A-A', PLEASE REFER TO FIGURE 1. SITE PLAN AND TEST LOCATIONS

GEOLOGICAL MODEL FIGURE 2.

CROZIER GEOTECHNICAL CONSULTANTS

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Crozier Geotechnical is a division of PJC Geo-Engineering Pty Ltd

LEGEND

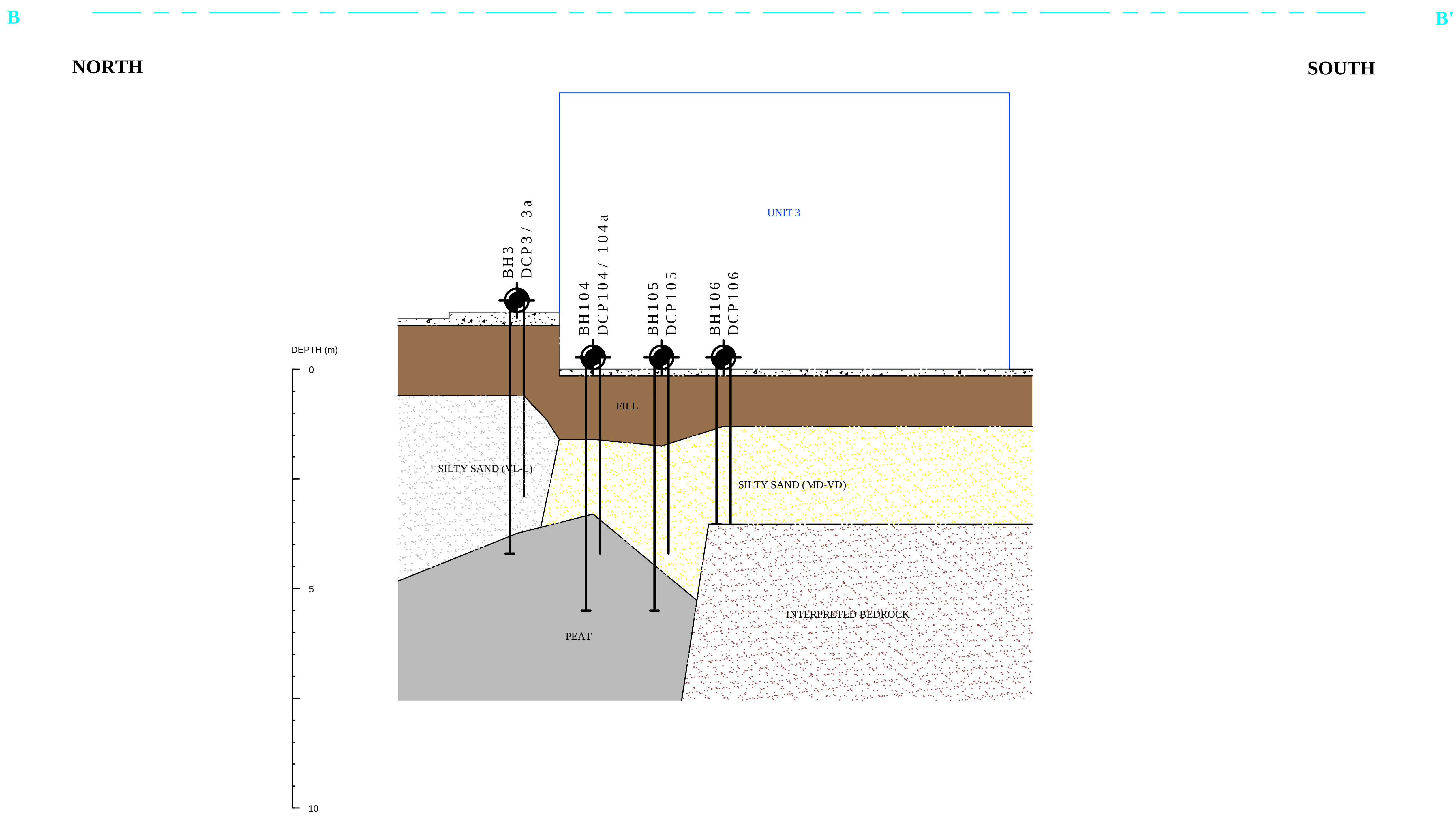
- A — A' CROSS-SECTION REFERENCE LINE
- BH / DCP AUGER / DYNAMIC CONE PENETROMETER LOCATION
- SAND
- PEAT
- FILL

SCALE: NOT TO SCALE
DRAWING: FIGURE 2
DATE: 02/07/2020

APPROVED BY: TMC
DRAWN BY: JY
PROJECT: 2019-228

PREPARED FOR: SP19670

ADDRESS: 98 Old Pittwater Road, Brookvale



VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

CROZIER GEOTECHNICAL CONSULTANTS

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LEGEND

A — A' CROSS-SECTION REFERENCE LINE

BH / DCP AUGER / DYNAMIC CONE PENETROMETER LOCATION

SAND

PEAT

FILL

SANDSTONE BEDROCK

SCALE: NOT TO SCALE
DRAWING: FIGURE 3
DATE: 02/07/2020

APPROVED BY: TMC
DRAWN BY: JY
PROJECT: 2019-228

PREPARED FOR:
SP19670

ADDRESS:
98 Old Pittwater Road, Brookvale

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/01/2020 **BORE No.:** 1

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
1.90						
2.00	SP	SAND: medium dense, orange, medium grained, moist				
3.40						
	CI	Silty/Sandy CLAY: firm to stiff, grey, medium plasticity, moist				
4.00						
		End of borehole at 4.00m depth				

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/01/2020 **BORE No.:** 2

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
			1.8			
1.90		band of orange sandy clay at 1.90m depth	1.9	D		
2.00						
2.10	SM	Silty SAND: Loose to medium dense, grey, fine to medium grained, moist				
			2.4			
			2.5	D		
3.00		became wet (saturated) below 3.00m depth				
3.45		became loose below 3.45m depth				
4.00			4.0			
		End of borehole at 4.00m depth	4.1	D		

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/01/2020 **BORE No.:** 3

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
1.90						
2.00	SM	Silty SAND: Loose to medium dense, grey, fine to medium grained, moist				
3.90		became very loose to loose below 3.90m depth				
4.00						
4.20	OL	Peaty SAND: Black, fine to medium grained, moist				
5.10		band of brown clayey sand at 5.10m depth				
5.50		End of borehole at 5.50m depth				

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: Groundwater table between 4.10m and 5.60m depth

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/01/2020 **BORE No.:** 4

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
1.00						
2.00						
2.30	SM	Silty SAND: dense to very dense, grey, fine to medium grained, moist				
3.00						
3.70	SP	SAND: medium dense, pale brown, medium grained, wet				
4.00		End of borehole at 4.00m depth				

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/01/2020 **BORE No.:** 5

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
1.00						
1.50	SC	Clayey SAND: medium dense to dense, orange, fine to medium grained, moist				
2.00						
2.70	CI/CH	CLAY: hard, brown, medium to high plasticity, moist				
3.00						
3.20	SM	Silty SAND: medium dense to very dense, grey, fine to medium grained, moist				
4.00		End of borehole at 4.00m depth				

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/02/2020 **BORE No.:** 6

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
2.00		é band of sandy clay between 2.10m and 2.30m depth				
2.50	SM	Silty SAND: Loose to medium dense, grey, fine to medium grained, moist				
4.00		End of borehole at 4.00m depth				

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 13/02/2020 **BORE No.:** 7

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00		FILL: medium dense to very dense, brown, silty sand with gravel, tile, root, steel, etc.				
1.00						
1.90						
2.00	SC	Clayey SAND: loose to medium dense, orange, fine to medium grained, moist to wet				
3.00						
3.40						
	Cl	Silty/Sandy CLAY: firm to stiff, grey, medium plasticity, moist				
4.00						
		End of borehole at 4.00m depth				

RIG: Dingo restricted access rig DRILLER: AC LOGGED: JY

METHOD: Solid stem spiral flight auger, tungsten carbide bit

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

DYNAMIC PENETROMETER TEST SHEET

CLIENT: SP19670 **DATE:** 13/01/2020

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SHEET:** 1 of 2

	Test Location							
Depth (m)	DCP1	DCP1a	DCP1b	DCP1c	DCP2	DCP2a	DCP3	DCP3a
0.00 - 0.15	14	16	--	--	--	--	--	--
0.15 - 0.30	ref at 0.15m depth	ref at 0.15m depth	--	--	--	--	--	--
0.30 - 0.45			--	--	--	--	--	--
0.45 - 0.60			--	--	--	--	--	--
0.60 - 0.75			--	--	--	--	--	--
0.75 - 0.90			--	--	--	--	--	--
0.90 - 1.05			--	--	--	--	--	--
1.05 - 1.20			7	--	11	--	8	--
1.20 - 1.35			6	--	9	--	15	--
1.35 - 1.50			0	--	6	--	8	--
1.50 - 1.65			6	--	20	--	7	--
1.65 - 1.80			10	--	18	--	4	--
1.80 - 1.95			6	--	11	--	6	--
1.95 - 2.10			5	--	8	--	3	--
2.10 - 2.25			9	--	7	4	3	--
2.25 - 2.40			8	--	8	3	3	--
2.40 - 2.55			discontinued	--	discontinued	4	discontinued	--
2.55 - 2.70				6		7		4
2.70 - 2.85				6		6		4
2.85 - 3.00				5		3		3
3.00 - 3.15				6		3		5
3.15 - 3.30				8		3		5
3.30 - 3.45				12		4		4
3.45 - 3.60				14		2		3
3.60 - 3.75				12		2		3
3.75 - 3.90				5		2		2
3.90 - 4.05				7		2		1
4.05 - 4.20				8		2		2

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:

(B) Test hammer bouncing upon refusal on solid object

-- No test undertaken at this level due to prior excavation of soils

DYNAMIC PENETROMETER TEST SHEET

CLIENT: SP19670 **DATE:** 13/01/2020

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SHEET:** 2 of 2

	Test Location							
Depth (m)	DCP4	DCP5	DCP5a	DCP6	DCP6a	DCP7	DCP7a	
0.00 - 0.15	--	--	--	--	--	--	--	
0.15 - 0.30	--	--	--	--	--	--	--	
0.30 - 0.45	--	--	--	--	--	--	--	
0.45 - 0.60	--	--	--	--	--	--	--	
0.60 - 0.75	--	--	--	--	--	--	--	
0.75 - 0.90	--	--	--	--	--	--	--	
0.90 - 1.05	--	--	--	--	--	--	--	
1.05 - 1.20	--	1	--	--	--	--	--	
1.20 - 1.35	--	12	--	--	--	--	--	
1.35 - 1.50	--	25	--	5	--	2	--	
1.50 - 1.65	--	10	--	7	--	5	--	
1.65 - 1.80	21	9	--	8	--	7	--	
1.80 - 1.95	7	10	--	4	--	4	--	
1.95 - 2.10	9	11	--	3	--	4	--	
2.10 - 2.25	26	12	--	3	--	7	--	
2.25 - 2.40	36	11	--	4	--	3	--	
2.40 - 2.55	11	discontinued	--	1	--	4	--	
2.55 - 2.70	16		--	7	--	6	--	
2.70 - 2.85	23		--	2	2	6	3	
2.85 - 3.00	28		9	2	3	5	1	
3.00 - 3.15	20		22	3	20	6	3	
3.15 - 3.30	14		22	3	10 (B) ref at 3.30m	6	1	
3.30 - 3.45	12		23	discontinued		discontinued	4	
3.45 - 3.60	8		10				6	
3.60 - 3.75	5		9				6	
3.75 - 3.90	5		11				3	
3.90 - 4.05	6		15				4	
4.05 - 4.20	10		34				5	

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:

(B) Test hammer bouncing upon refusal on solid object

-- No test undertaken at this level due to prior excavation of soils

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 22/06/2020 **BORE No.:** 107

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
1.30						
		SILTY SAND: medium dense to dense, dark grey/black, fine grained, moist silty sand trace gravel				
1.60		é becoming pale brown, fine to medium grained sand				
2.00						
2.50		PEAT: brown, fibrous, organic				
4.00						
4.90						
5.00		SILTY SAND: dark grey/black, fine grained, moist silty sand				
5.50		End of borehole at 5.50m depth				

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: water table at 1.50m depth after drilling

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 22/06/2020 **BORE No.:** 106

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
1.00		é geofab at 1.00m depth				
1.30		SILTY SAND: medium dense, dark grey/black, fine grained, moist silty sand trace gravel				
2.00						
3.53		Auger refusal at 3.53m depth on interpreted sandstone bedrock				
4.00						

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: water table at 2.10m depth after drilling

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 17/06/2020 **BORE No.:** 105

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
1.75		é geofab at 1.75m depth				
		SILTY SAND: medium dense, dark grey/black, organic riched, moist silty sand trace root				
2.00						
2.40		é becoming brown/grey, fine to medium grained, moist sand below 2.40m depth				
3.00		é becoming organic rich silty clay trace charcoal below 3.00m depth		3.10		
			D	3.20		
3.90		é becoming fine to medium grained sand below 3.90m depth				
4.00						
4.60		PEAT: brown, fibrous, organic				
5.00						
5.50		End of borehole at 5.50m depth				

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: water table at 1.50m depth after drilling

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 17/06/2020 **BORE No.:** 104

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
1.00		é gravel band between 1.00m and 1.20m depth				
1.60	SP	SAND: dense to very dense, dark grey, fine to medium grained, moist sand trace gravel and organic				
2.00		é becoming black organic rich clayey sand below 2.00m depth				
2.25		é becoming medium dense below 2.25m depth				
2.50		é becoming saturated below 2.50m depth				
3.30				3.30		
		PEAT: brown, fibrous, organic	D			
3.90		é band of silty sand between 3.90m and 4.00m depth		3.90		
4.00						
5.00				5.30		
			D			
5.50				5.50		
		End of borehole at 5.50m depth				

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: water table at 1.50m depth after drilling

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 17/06/2020 **BORE No.:** 103

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
1.00						
1.80				1.80		
2.00	SM	SILTY SAND: dense to very dense, pale brown to grey, fine grained, moist silty sand trace gravel and charcoal	D	2.00		
2.30		é dark grey/black below 2.30m depth		2.30		
			D	2.50		
2.70		é becoming loose to medium dense below 2.70m depth				
3.00		...becoming saturated, with minor bands of organic rich clay, below 3.10m depth		3.00		
			D	3.20		
4.00						
4.80		é trace sandstone gravel		4.80		
5.00			D	4.00		
		Auger refusal at 5.00m depth on interpreted sandstone bedrock				

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: water table at 1.30m depth after drilling

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 17/06/2020 **BORE No.:** 102

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
0.85		Auger refusal at 0.85m depth on possible secondary concrete slab				
2.00						
4.00						
5.00						

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: No freestanding groundwater found

REMARKS: CHECKED:

BOREHOLE LOG

CLIENT: SP19670 **DATE:** 17/06/2020 **BORE No.:** 101

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228 **SHEET:** 1 of 1

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SURFACE LEVEL:** NA (1.30m lower than outside)

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Tests	Type	Results
0.00						
0.15		CONCRETE				
		FILL: grey to brown, fine to medium grained, moist clayey sand trace gravel				
1.00		é gravel band between 1.00m and 1.20m depth				
1.55	SP	SAND: dense to very dense, pale brown to grey, fine grained, moist sand trace clay				
2.00						
				2.40		
2.55		é becoming medium dense below 2.55m depth	D	2.50		
3.10		...becoming saturated and clayey sand below 3.10m depth				
3.40		é minor bands of organic rich clay in sand to clayey sand				
3.70				3.70		
	OH	Organic CLAY: very stiff, black to dark grey/brown, wet organic rich silty clay and trace sand/gravel	D	3.80		
4.00						
5.00				5.00		
			D	5.20		
5.50						
		End of borehole at 5.50m depth				

RIG: Dingo restricted access rig DRILLER: AC

METHOD: Solid stem spiral flight auger, tungsten carbide bit LOGGED: JY

GROUND WATER OBSERVATIONS: water table at 1.30m depth after drilling

REMARKS: CHECKED:

DYNAMIC PENETROMETER TEST SHEET

CLIENT: SP19670 **DATE:** 17/06/2020

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SHEET:** 1 of 2

	Test Location							
Depth (m)	101	101a	101b	102	103	103a	103b	104
0.00 - 0.15	--	--	--	--	--	--	--	--
0.15 - 0.30	--	--	--	10	16	--	--	--
0.30 - 0.45	16	--	--	9	24	--	--	--
0.45 - 0.60	9	--	--	8	24	--	--	--
0.60 - 0.75	12	--	--	7	24	--	--	--
0.75 - 0.90	12	--	--	6 (B) ref at 0.85m	26	--	--	--
0.90 - 1.05	15	--	--		25	--	--	--
1.05 - 1.20	20	17	--		22	20	--	--
1.20 - 1.35		23	--			20	--	13
1.35 - 1.50		8	--			19	--	17
1.50 - 1.65		10	--			17	--	23
1.65 - 1.80		10	--			15	--	20
1.80 - 1.95		11	--			13	--	14
1.95 - 2.10		22	--			19	--	19
2.10 - 2.25		21	--			10	--	12
2.25 - 2.40		18	--			12	--	7
2.40 - 2.55			--				--	
2.55 - 2.70			7				--	
2.70 - 2.85			10				1	
2.85 - 3.00			5				1	
3.00 - 3.15			8				1	
3.15 - 3.30			9				2	
3.30 - 3.45			7				4	
3.45 - 3.60			4				3	
3.60 - 3.75			5				3	
3.75 - 3.90			8				2	
3.90 - 4.05			6				4	
4.05 - 4.20			9				1	

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:

(B) Test hammer bouncing upon refusal on solid object

-- No test undertaken at this level due to prior excavation of soils

DYNAMIC PENETROMETER TEST SHEET

CLIENT: SP19670 **DATE:** 17/06/2020

PROJECT: Existing structure stability issues **PROJECT No.:** 2019-228

LOCATION: 98 Old Pittwater Road, Brookvale, NSW **SHEET:** 2 of 2

	Test Location							
Depth (m)	104a	105	106	107				
0.00 - 0.15	--	--	--	--				
0.15 - 0.30	--	--	--	--				
0.30 - 0.45	--	--	--	--				
0.45 - 0.60	--	--	--	--				
0.60 - 0.75	--	--	--	--				
0.75 - 0.90	--	--	--	--				
0.90 - 1.05	--	--	--	--				
1.05 - 1.20	--	--	--	--				
1.20 - 1.35	--	--	--	--				
1.35 - 1.50	--	--	--	--				
1.50 - 1.65	--	--	--	--				
1.65 - 1.80	--	--	--	--				
1.80 - 1.95	--	5	--	6				
1.95 - 2.10	--	9	--	8				
2.10 - 2.25	--	6	--	9				
2.25 - 2.40	--	4	3	13				
2.40 - 2.55	--	7	7	16				
2.55 - 2.70	10	7	4	10				
2.70 - 2.85	12	3	3	6				
2.85 - 3.00	9	6	3	6				
3.00 - 3.15	10	7	21	10				
3.15 - 3.30	11	7	2	8				
3.30 - 3.45	8	6	4	7				
3.45 - 3.60	8	7	10 (B) ref at 3.48m	7				
3.60 - 3.75	9	7		8				
3.75 - 3.90	10	7		7				
3.90 - 4.05	8	7		17				
4.05 - 4.20	7	7		18				

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:

(B) Test hammer bouncing upon refusal on solid object

-- No test undertaken at this level due to prior excavation of soils