



**REPORT TO
FDC CONSTRUCTION (NSW) PTY LTD
ON BEHALF OF CHARTER HALL HOLDINGS PTY LTD**

**ON
GEOTECHNICAL INVESTIGATION**

**FOR
PROPOSED HUNTINGWOOD PROCESSING
EXPANSION**

**AT
65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW**

Date: 5 August 2021
Ref: 34067BCrptRev2

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DOCUMENT REVISION RECORD

| Report Reference | Report Status | Report Date |
|------------------|--|---------------|
| 34067BCrptDRAFT | Draft Report | 18 June 2021 |
| 34067BCrpt | Final Report | 1 July 2021 |
| 34067BCrptRev1 | Revised report to Adjust Development Description | 20 July 2021 |
| 34067BCrptRev2 | Revised report to Adjust Development Description | 5 August 2021 |

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ATTACHMENTS

STS Table A: Moisture Content, Atterberg Limits & Linear Shrinkage Test Report

STS Table B: Four Day Soaked California Bearing Ratio Test Report

Envirolab Services Certificate of Analysis No. 269508

Borehole Logs 101 to 106 Inclusive

Figure 1: Site Location Plan

Figure 2: Borehole Location Plan

Report Explanation Notes

Appendix A- Previous Borehole Logs

1 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed development at 65 Huntingwood Drive, Huntingwood, NSW. The location of the site is shown in Figure 1. The investigation was commissioned by FDC Construction (NSW) Pty Ltd on behalf of Charter Hall Holdings Pty Ltd (the client). The commission was on the basis of our fee proposal (Ref. P54095BC) dated 6 May 2021.

We have been advised by the client that the proposed development will be as detailed in the following table:

| Element | Proposed |
|---------------------|--|
| Site Preparation | <ul style="list-style-type: none"> ▪ Removal of existing car parking, driveway and ancillary structures. ▪ Vegetation clearing. ▪ Excavation for car park and bulk earthworks and supporting structures. ▪ Drainage connections. ▪ Land stabilisation. |
| Development summary | <ul style="list-style-type: none"> ▪ Construction of a new processing facility (24,775sqm) with first-floor amenities in the north-western corner of the site. ▪ Construction of a new ingredient silo building (1,000sqm) along the Huntingwood Drive frontage. ▪ Construction of a storage building (270sqm) to the east of the existing building. ▪ Construction of a new processing building (1,200sqm) and ingredient silo building (120sqm) to the south of the main facility. ▪ Replacement of the existing on-site detention (OSD) basin with an OSD tank below the basement car park. ▪ Landscaped setbacks along both street frontages to screen the new processing facility and loading area. |
| Access and Parking | <ul style="list-style-type: none"> ▪ New loading area above two levels of car parking (468 spaces) at the north-west corner of Huntingwood Drive and Brabham Drive. ▪ Trucks will utilise the existing access point adjacent to the eastern boundary of the site. ▪ The existing (westernmost) vehicle access to Huntingwood Drive will be retained and upgraded to provide access to the new basement car park. |

Further to the above, from review of the supplied architectural drawings by HL Architects Pty Ltd (Project No. 200810, Drawing No.(-Rev) DA-002-A, 003-Q, 004-D, 005-J, 100-B, 101-D, 120-B, 121-C, 200-E, 210-F and 211-G, dated 24 March 2021) the main level of the facility will be at RL65.4m, with the lowest level of the car park in the north-western portion of the site at RL59m. This will require excavation to a maximum depth of about 4m within the north-western part of the site to achieve the Basement 2 (B2) floor level. In the south-western, central and north-eastern portions of the site the proposed building is above the existing ground surface levels and will require fill to a maximum depth/height of about 4.5m if the slab is to be supported on fill. We understand from email correspondence with Chris Webb of Triaxial Consulting that the preliminary footing design consists of pad footings founded within material suitable for an allowable bearing pressure (ABP) of 150kPa.

We previously completed geotechnical investigations (trading as Jeffery and Katauskas Pty Ltd) in 1988 (Ref. 6236W), 1989 (Ref. 6236XW) and 1993 (Ref. 9292WH/vm) for the original Arnott's Biscuits development on the site. The relevant information contained within these reports (including borehole logs) have been used in preparing this report and are included in Appendix A.

The purpose of the investigation was to review the previously obtained geotechnical information and obtain further subsurface information as a basis for providing comments and recommendations on subgrade preparation, engineered fill, excavation conditions, batters, retaining walls, footings, groundwater considerations, pavements and slabs on ground.

2 INVESTIGATION PROCEDURE

2.1 Previous Investigations

JK Geotechnics have previously carried out geotechnical investigations between 1988 and 1993 within the Arnott's site, which comprised the drilling of a total of 52 boreholes using both auger and rock coring techniques. Twenty-two boreholes were drilled within or immediately adjacent to the current development area and comprised the following:

- The spiral auger drilling of 22 boreholes (BH1 to BH6, BH10 to BH13, BH17 to BH20, BH24 to BH27 and BH31 to BH34) to depths ranging from 1.8m (BH34) to 6.56m (BH26) using a truck-mounted drilling rig.
- Subsequent extension of BH3, BH5, BH12, BH17, BH26 and BH31 to final depths ranging from 6.56m (BH26) to 9.5m (BH5) by diamond coring techniques using an NMLC core barrel with water flush.

The apparent compaction of fill and strength of natural soils were assessed by the Standard Penetration Test (SPT) 'N' value and augmented by hand penetrometer readings on cohesive samples recovered in the SPT split tube sampler. Within the augered portions of the boreholes, the strength of the bedrock was assessed by observation of auger penetration resistance when using a Tungsten Carbide (TC) bit, tactile assessment of the recovered rock chips and correlation with subsequent laboratory moisture content testing. The strength of the cored siltstone (Shale) was assessed from inspection of the recovered core and subsequent laboratory Point Load Strength Index ($I_{S(50)}$) test results. The point load strength index test results are summarised on the cored borehole logs.

Groundwater observations were made during and on completion of drilling of the individual boreholes. Groundwater monitoring wells were installed in some boreholes and groundwater measures made as shown on the logs.

2.2 Current Investigation

The fieldwork for the current investigation comprised the spiral auger drilling of six boreholes (BH101 to BH106) to depths ranging from 6.0m (BH101, BH102, BH103) to 9.0m, (BH106) using our track-mounted JK305 drill rig.

The borehole locations, as shown on the attached Figure 2, were set out by trundle wheel measurements from existing surface features. The ground surface reduced levels (RLs) at the borehole locations were estimated by interpolation between spot heights and ground contours shown on the provided survey plan by ICD Asia Pacific Pty Ltd (Ref. 10848, dated 8 October 2020). The survey datum is the Australian Height Datum (AHD). Figure 2 also shows the locations of the previous boreholes and the surface levels determined at that time are shown on the borehole logs.

The apparent compaction of fill and strength of natural soils were assessed by the Standard Penetration Test (SPT) 'N' value and augmented by hand penetrometer readings on cohesive samples recovered in the SPT split tube sampler. The strength of the bedrock was assessed by observation of auger penetration resistance when using a Tungsten Carbide (TC) bit, tactile assessment of the recovered rock chips and correlation with subsequent laboratory moisture content testing.

Groundwater observations were made during and on completion of drilling of the individual boreholes. A groundwater monitoring well was installed on completion of BH103 and a return visit made 6 days after drilling to measure the groundwater level. No longer-term groundwater monitoring has been carried out.

Our geotechnical engineer, Arthur Kourtesis, was present on-site on a full-time basis and set out the borehole locations, directed in-situ testing and sampling, directed groundwater monitoring well installation and prepared the attached borehole logs. For details of the investigation procedures adopted and a glossary of logging terms and symbols used, reference should be made to the attached Report Explanation Notes.

Selected soil and rock chip samples were submitted to NATA accredited laboratories Soil Test Services Pty Ltd (STS) and Envirolab Services Pty Ltd for laboratory moisture content, Atterberg limits, linear shrinkage, standard compaction, soaked CBR I, I pH, chloride content, sulphate content and resistivity testing. The results of testing are provided in the attached STS Tables A and B and Envirolab Certificate of Analysis (No. 269508). We note that due to an error in the laboratory request to Envirolab the borehole numbers on the Certificate of Analysis start with a "2" rather than a "1", i.e. BH201 is BH101. Unfortunately, Envirolab are unable to correct these numbers on the Certificate of Analysis.

3 RESULTS OF INVESTIGATION

3.3 Site Description

The proposed development site is located within the north-western portion of the existing Arnott's factory site. The Arnott's site is located within the Huntingwood Industrial Estate, 32km west of the Sydney Central Business District and 4km south of Blacktown Town Centre. The site is located on a north-western facing hillslope which grades gently at about 3° to 4°.

The Arnott's site is occupied by a large 'L' shaped multi-storey building located across the eastern and southern areas, with other similar buildings associated with the main building. This building was used as the processing/packaging facility of Arnott's Biscuits. The building is serviced by asphaltic concrete roadways and pavements, with landscaped areas in between. The main Arnott's site is bound to the south by the M4 Motorway, to the west by Brabham Drive, to the north by Huntingwood Drive and to the east by Endeavour Energy containing commercial offices and associated roadways and parking areas. A detailed description of the areas within and immediately surrounding the proposed development site is given below.

At the time of the fieldwork, the proposed development site featured a grass playing field and concrete surfaced courts within its northern portion, an asphaltic concrete (AC) car park within its southern portion and an AC, tree-lined driveway towards its eastern edge. An additional AC car park was present to the east of the driveway and several gardens with small to large trees were scattered about the site. A single-level brick amenities block and timber shelter were located centrally within the site. Site levels stepped down towards the north-west through a series of batters formed to accommodate the existing development. We understand that the playing field acts as an on-site detention basin. All structures within and nearby to the site appeared to be in good condition based on a cursory external inspection.

The proposed development site is bound to the north and west by Huntingwood Drive and Brabham Drive, respectively. Grassed batters were present along the full length of both the northern and western site boundaries, ranging in height from 1m to 3.5m with gradients ranging from about 10° to 20° down to the adjacent roadways. The crest of these batters was about 1m higher than the level of the playing field.

To the east and south of the proposed development site were the Arnott's facility, containing three large free standing industrial buildings. The building to the south and east of the site is 'L' shaped and the ground surface sloped up to this building from the existing car park and roadway at about 10° to 20° for height of about 3m to 4m.

3.4 Subsurface Conditions

The 1:100,000 geological map of Penrith indicates that the site is underlain by Bringelly Shale of the Wianamatta Group.

We note that the previous boreholes referenced below refer to shale being encountered, whereas our current boreholes refer to the rock being siltstone. This change in rock descriptions is due to changes to

AS1726:2017 where the descriptors for bedrock of this nature has changed. However, the rock encountered is still part of the Bringelly Shale bedrock unit and the terms “shale” and “siltstone” may be interchangeable. For simplicity, within this report the term siltstone has mostly been used.

From comparison between the surface levels given in our 1990s boreholes and the current survey plan it is apparent that since the drilling of the previous boreholes, cut and/or fill earthworks have been carried out, such that the previous boreholes may have been drilled from above or below current site levels. The table below provides an estimate of the fill heights and some cut at the previous borehole locations.

| Borehole | Surface Level (AHD) | Estimated Current Surface Level (AHD) | Estimated Fill(+)/Cut(-) |
|----------|---------------------|---------------------------------------|--------------------------|
| 1 | 58.88m | 60.5m | 1.6m |
| 2 | 59.92m | 61.4m | 1.5m |
| 3 | 58.7m | 59.7m | 1.0m |
| 4 | 60.12m | 60.2m | 0.1m |
| 5 | 61.62m | 61.4m | -0.2m |
| 6 | 63.93m | 66.2m | 2.3m |
| 10 | 59.04m | 61.5m | 2.5m |
| 11 | 60.68m | 60.5m | -0.2m |
| 12 | 62.76m | 62.8m | 0.0m |
| 13 | 64.88m | 66.2m | 1.3m |
| 17 | 58.66m | 61.7m | 3.0m |
| 18 | 60.4m | 63.7m | 3.3m |
| 19 | 63.21m | 64.2m | 1.0m |
| 20 | 65.72m | 66.5m | 0.8m |
| 24 | 59.98m | 62.3m | 2.3m |
| 25 | 60.86m | 64.3m | 3.4m |
| 26 | 62.14m | 65.4m | 3.3m |
| 27 | 64.91m | 66.5m | 1.6m |
| 31 | 60.48m | 66.2m | 5.7m |
| 32 | 61.96m | 66.2m | 4.2m |
| 33 | 63.81m | 66.2m | 2.4m |
| 34 | 65.58m | 66.5m | 0.9m |

In summary, the subsurface profile comprises fill covering residual silty clay that grades into weathered siltstone bedrock. For details of subsurface conditions at specific locations, reference should be made to the attached borehole logs. A summary of the pertinent subsurface conditions is provided below

Pavement

Asphaltic concrete, of 30mm thick, was encountered at the surface of BH106.

Fill

Fill was encountered in BH101 to BH106 to depths ranging from 0.8m to 4m. The fill generally comprised silty clay, but locally silty sand and gravel was encountered. The fill included ironstone, sandstone and igneous

gravels and was assessed to be generally moderately to well compacted. However, in BH104 poorly compacted fill was encountered below a depth of 3m.

As discussed above, the depth of fill encountered within the previous 1990s boreholes is unreliable due to the earthworks that appears to have been completed and so have not been reported here.

Residual Soil

Within the current investigation boreholes residual silty clays were encountered below the fill to depths ranging from 0.8m (BH101) to 4m (BH104 and BH106). The residual silty clay from the previous investigations was assessed to be initially of stiff to very stiff strength improving to very stiff to hard strength with depth. However, the current investigation boreholes encountered residual silty clays only of very stiff to hard strength. The residual silty clays from previous and current investigations were assessed to be medium to high plasticity.

Weathered Bedrock

Weathered siltstone (or shale) bedrock interbedded or interlaminated with sandstone bedrock, initially of extremely weak strength (hard soil strength) to low (or weak) strength was encountered at reduced levels ranging from RL62.52m (BH20) to RL55.30m (BH102), stepping down to the north-west. The depth and reduced level to the surface of the bedrock is summarised in the table below.

| Borehole | Surface Level (AHD) | Depth and Approximate Level to the Top of Bedrock | |
|----------|---------------------|---|---------------------|
| | | Depth | Approx. Level (AHD) |
| 1 | 58.88 | 2.6m | 56.28m |
| 2 | 59.92 | 1.8m | 58.12m |
| 3 | 58.71 | 1.9m | 56.81m |
| 4 | 60.12 | 2.3m | 57.82m |
| 5 | 61.62 | 4.1m | 57.52m |
| 6 | 63.93 | Not Encountered | |
| 10 | 59.04 | 3.3m | 55.74m |
| 11 | 60.68 | 2.8m | 57.88m |
| 12 | 62.76 | 3.2m | 59.56m |
| 13 | 64.88 | 3.6m | 61.28m |
| 17 | 58.66 | 3.1m | 55.56m |
| 18 | 60.40 | 2.7m | 57.70m |
| 19 | 63.21 | 3.8m | 59.41m |
| 20 | 65.72 | 3.2m | 62.52m |
| 24 | 59.98 | 3.9m | 56.08m |
| 25 | 60.86 | 3.3m | 57.56m |
| 26 | 62.14 | 2.65m | 59.49m |
| 27 | 64.91 | 3.6m | 61.31m |
| 31 | 60.48 | 1.8m | 58.68m |
| 32 | 61.96 | 3.2m | 58.76m |
| 33 | 63.81 | 3.3m | 60.51m |
| 34 | 65.58 | Not Encountered | |
| 101 | 62.3* | 2.7m | 59.6m |
| 102 | 59.3* | 4m | 55.3m |
| 103 | 62.4* | 2.7m | 59.7m |
| 104 | 62.5* | 5.3m | 57.2m |

| | | | |
|-----|-------|------|-------|
| 105 | 65.6* | 5.2m | 60.4m |
| 106 | 62.4* | 6.7m | 55.7m |

Notes: * Based on approximate Reduced Level interpolated from supplied survey plan.

Where the rock was cored in BH3, BH5, BH12, BH17 and BH26, the upper cored rock was assessed to be generally highly weathered to distinctly weathered and of low to medium strength, improving to medium strength below depths ranging from 4.5m to 5.8m. However, bands of extremely weathered rock were encountered in some of the cored rock.

Defects within the cored bedrock comprised core loss zones, clay bands, fragmented zones, sub-horizontal bedding partings and joints inclined at up to 80°.

Groundwater

No groundwater seepage was encountered during or on completion of drilling the boreholes drilled in the 1990s and the current boreholes. The following table provides a summary of groundwater levels measured in the wells installed within the previous geotechnical investigations, including the time after completion of the groundwater measurements.

| Borehole | Surface Level (AHD) | Measured Groundwater Depth and Level | | Time Elapsed Since Completion of Drilling |
|----------|------------------------|--------------------------------------|---------------------|--|
| | | Depth | Approx. Level (AHD) | |
| 1 | 58.88m | 2.6m | 56.3m | 144 hours (6 days) |
| 13 | 64.88m | 4.6m | 60.3m | 144 hours (6 days) |
| 18 | 60.40m | 2.4m | 58.0m | 140 hours (5.8 days) |
| 24 | 59.98m | 2.4m | 57.6m | 140 hours (5.8 days) |

Within the groundwater monitoring well installed in BH103, no groundwater was present within the well to a depth of 6m (RL56.4m) during our visit to site 6 days after installation.

3.5 Laboratory Test Results

Based on the Atterberg limits and linear shrinkage test results, the silty clay tested is of high plasticity and is assessed to have a high potential for shrink/swell movements with changes in moisture contents. The samples of the clay fill tested are of medium or high plasticity and are assessed to have a moderate to high potential for shrink/swell movements with changes in moisture contents.

The moisture content test results showed reasonably good correlation with our field assessment of rock strength. The previous Point Load Strength Index testing carried out on the returned rock core returned estimated Unconfined Compressive Strength (UCS) values generally ranging from 2MPa to 8MPa, with some higher results of up to 20MPa.

The four day soaked CBR tests on a samples of the silty clay fill from BH101, BH104 and BH105 compacted to 98% of their Standard Maximum Dry Density (SMDD) measured CBR values of 1.5%. The swell measured during soaking ranged from 2% to 3% confirming the plasticity of the clays.

The pH values on samples of the fill ranged from 6.6 to 8.2 indicating slightly acidic to alkaline conditions, and the pH of the residual silty clay ranged from 5.5 to 5.9, indicating slightly acidic soil conditions. The sulphate contents for all samples ranged from 21mg/kg to 360mg/kg, the chloride contents ranging from 24mg/kg to 930mg/kg, and the resistivity ranged from 1,200ohm.cm to 5,800ohm.cm. Based on these results, the fill and residual silty clay would be classified as 'non-aggressive' exposure classification for concrete piles in accordance with Table 6.4.2(C) of AS2159-2009 'Piling – Design and Installation' and 'mild' exposure classification for steel piles in accordance with Table 6.5.2(C) of AS2159-2009.

4 COMMENTS AND RECOMMENDATIONS

4.1 Geotechnical Issues

The main geotechnical issue for this site is the presence of fill, encountered within the current boreholes to a maximum depth of 4m. We are unaware of any records of placement or compaction control of the fill and as such it must be considered 'uncontrolled'. Such uncontrolled fill is not suitable to support footings or floor slabs. If records of fill placement and compaction control can be found, including a report from the Geotechnical Inspection and Testing Authority (GITA), then we may be able to reassess the nature of the fill and its suitability to support floor slabs.

Excavations will be required for the proposed basement car park, but the main building will mostly be above the existing surface levels. If the slab is to be supported by the fill then all existing uncontrolled fill would need to be removed and replaced within controlled engineered fill, which would add substantially to the earthworks. In addition, such excavations would extend close to the existing building and would likely then require retention systems to be constructed to support the excavations during excavation and this would increase the complexity and cost of the work.

At least part of the floor slab of the main building will need to be designed as a suspended slab where it is over the basement car park. Therefore, we consider that the most practical option would be to design the entire floor slab as a fully suspended slab so that excavation and replacement of the existing fill is not required. If the material excavated from the basement excavation is to be left on site it could be placed below the main building as 'form fill' and formed at suitable permanent batters where only nominal compaction would be required. This may also potentially simplify the design of the basement walls as they may not need to be designed as retaining walls or may retain a lower height of soil.

For the proposed basement slab, excavation and replacement of the fill may be practical, although this would still involve excavation and replacement of 2m of fill in the area of BH102.

The other issue is the low CBR values measured and some form of subgrade improvement is recommended within external pavement areas to reduce the thickness of the pavement layers.

Further comments on these issues and other geotechnical matters are provided within the following sections of this report.

4.2 Excavation and Groundwater

Excavation will be required to maximum depths of about 4m along the southern side of the proposed basement. Excavation to such depths will encounter clayey fill, and residual soils. Based on the borehole results we do not expect that weathered siltstone will be encountered.

Excavation of the soils and upper rock of up to very low strength, if encountered, should be achievable using conventional excavation equipment, such as the buckets of hydraulic excavators. Some ripping of higher strength bands may be necessary if rock is encountered within the depth of excavation.

No groundwater seepage was encountered during auger drilling of the boreholes and no groundwater was measured within the monitoring well installed in BH103 after 6 days. However, groundwater was measured within the previous wells at levels ranging from RL56.3m in BH1 to RL60.3m in BH13, showing the level generally falling towards the west and is likely to represent flow across the soil/rock interface and through joints within the rock. As such we do not consider that groundwater will be a significant issue for the proposed development. Some seepage may occur into the excavation for the basement, particularly during and following rainfall, but it should be able to be controlled during construction using gravity drainage and conventional sump and pump techniques. In the long term, drainage should be provided behind all retaining walls and possibly below the basement floor slab. The completed excavation should be inspected by the hydraulic consultant to confirm that the designed drainage system is adequate for the actual seepage flows.

4.3 Subgrade Preparation and Filling

As discussed in Section 4.1 the fill is considered ‘uncontrolled’ and is not suitable to support footings or floor slabs. We consider that the most practical option is to design the main building floor slab as a fully suspended slab and to leave the existing fill in place. Where this is carried out no particular subgrade preparation would be required other than stripping of root affect soils. If this is not the case and earthworks are to be carried out involving excavation of the existing fill and replacement to allow the use of a slab-on-ground construction additional geotechnical advice on such earthworks should be obtained.

If a slab-on-ground is proposed for the basement slab all existing uncontrolled fill should be fully excavated and replaced with controlled engineered fill. Such earthworks should be carried out as recommended below.

Where pavements are proposed adequate subgrade preparation should be carried out, but the existing fill may remain in place provided it performs satisfactorily during proof rolling. If fill is to be placed below suspended floor slabs, we recommend that the same subgrade preparation measures be undertaken as the pavement areas, with the fill compacted to allow formation of permanent batters, but density testing of the fill would not be required.

Within areas where floor slabs are proposed below the basement slab, all existing fill should be fully stripped to expose the residual silty clay. Within pavement areas or where fill is to be placed below suspended slabs the existing vegetation and root affected soils should be stripped. This root affected fill is not suitable to reuse as engineered fill, but may be reused within landscaped areas subject to environmental considerations.

Following stripping, the exposed subgrade should be proof rolled with at least 7 passes of a minimum 10 tonne dead weight, smooth drum, vibratory roller. The final pass of the proof rolling should be carried out without vibration and in the presence of a geotechnical engineer to detect any weak subgrades areas. Care must be taken during rolling due to the risk of damage to adjoining structures from the vibrations generated by the roller. If vibrations are of concern the rolling may need to be carried out with a static roller only.

Any weak or unstable areas detected during proof rolling should be locally excavated to a sound base and the excavated material replaced with controlled, engineered fill, or as directed by the geotechnical engineer during proof rolling. Some weak subgrade areas may be experienced where the existing fill is poorly compacted or where the clays are allowed to soften due to water ponding. Following treatment of weak areas, engineered fill should be placed in thin horizontal layers as recommended in section 4.3.1 below.

Where fill batters are to be formed each fill layer should extend past the final alignment of the batters in order to achieve adequate compaction of the full fill layer and then the loose material on the edge of the batter cut back to the final geometry.

In view of the high reactivity potential of some of the existing fill and residual clays, particular attention should be given to providing adequate drainage both during construction and for long term site maintenance. The principal aim of the drainage should be to promote run-off and reduce ponding. Placement of a blinding layer of durable granular fill or subbase material to provide a trafficable surface during construction may be necessary or desirable. The earthworks should be carefully planned and scheduled to maintain cross-falls during construction. If the clay is exposed to prolonged periods of rainfall, softening will result and site trafficability will be poor. If soil softening occurs, the subgrade should be over-excavated to below the depth of moisture softening and the excavated material replaced with engineered fill.

4.3.1 Engineered Fill and Compaction Control

Engineered fill should preferably comprise well graded granular materials, such as ripped rock or crushed sandstone, free of deleterious substances and having a maximum particle size not exceeding 75mm. Such fill should be compacted in horizontal layers of not greater than 200mm loose thickness, to a density of at least 98% of Standard Maximum Dry Density (SMDD). For backfilling confined excavations such as service trenches, a similar compaction to engineered fill should be adhered to, but if light compaction equipment is used then the layer thickness should be limited to 100mm loose thickness.

The excavated material may be reused as engineered fill (subject to environmental considerations), provided it is free of deleterious materials and particles greater than 75mm in size. All excavated material should be inspected and approved by a geotechnical engineer prior to reuse. Any clay fill should be compacted in maximum 200mm loose thickness layers to a density strictly between 98% and 102% of SMDD and at moisture contents within 2% of Standard Optimum Moisture Content (SOMC).

Density tests should be regularly carried out on the fill to confirm the above specifications are achieved, unless the fill is placed as 'form fill' below suspended floor slabs. The frequency of density testing should be at least one test per layer per 500m² or three tests per visit, whichever requires the most tests. Where fill is

to support footing loads it should be placed under Level 1 control as defined by AS3798-2007, but this would also require excavation and replacement of the existing uncontrolled fill which is unlikely to be practical. Preferably the geotechnical testing authority should be engaged directly on behalf of the client and not by the earthworks subcontractor.

4.4 Batters and Retaining Walls

Excavation for the proposed Basement 2 (B2) level will have sufficient setbacks on the southern, western and eastern sides of the excavation to allow temporary batters to be formed.

Temporary batters of no more than 4m in height should be no steeper than 1 Vertical in 1 Horizontal (1V:1H) through the fill and residual soils. Such batters should remain stable in the short term provided all surcharge loads, including construction loads, are kept well clear of the crest of the batters. Permanent batters should be no steeper than 1V:2H, but flatter batters of the order of 1V:3H may be preferred to allow access for maintenance of vegetation. All permanent batters should be covered with topsoil and planted with a deep rooted runner grass, or other suitable coverings, to reduce erosion. All stormwater runoff should be directed away from all temporary and permanent batters to also reduce erosion.

Where temporary batters are not preferred or insufficient space is available, a full depth retention system may be adopted. If a full depth retention system is required then further geotechnical advice should be sought.

Permanent retaining walls constructed at the base of the batters may be designed as cantilevered walls based on a triangular earth pressure distribution using an active earth pressure coefficient, K_a , of 0.33 and a bulk unit weight of 20kN/m³. Where walls are restrained from some lateral movements, such as by other structural elements in front of the wall, or where movements are to be kept low, an 'at rest' earth pressure coefficient, K_0 , of 0.6 should be used. Retaining walls may be founded on the underlying residual silty clays of at least very stiff strength or weathered siltstone bedrock. Retaining walls founded on such materials can be designed based on the bearing pressures outlined in Section 4.5 below.

Where batters are used, the space between the batters and the permanent retaining walls will need to be carefully backfilled to reduce future settlement of the backfill. Only light compaction equipment should be used for compaction behind retaining walls so that excessive lateral pressures are not placed on the walls. This will require the backfill to be placed in thin layers, say 100mm loose thickness, appropriate to the compaction equipment being used. The excavated clay will be difficult to properly compact within the limited space available behind the walls and consideration should be given to the use of more readily compactable materials, such as ripped or crushed rock or gravel. The compaction specification for the backfill will depend on whether paving or structures are to be supported on the fill. If the fill is to support paved areas it should be compacted to a density of at least 98% of Standard Maximum Dry Density (SMDD) for granular fill materials, but if it is only to support landscaped areas a lower compaction specification, say 95% of SMDD, may be appropriate, provided the risk of future settlement and maintenance can be accepted. If clay fill is to be used a greater control of fill compaction and moisture control will be required and further geotechnical advice on the use of such material should be obtained. An alternative for backfill would also be to use a

uniform granular material, such as crushed concrete of 30mm to 70mm in size, surrounded in a geofabric, with a capping layer of clay to reduce infiltration behind the wall.

4.5 Footings

Following completion of the proposed excavation, we expect that variable conditions will be exposed, ranging from areas of fill to residual silty clay of very stiff strength. As discussed above, the existing fill could be excavated and replaced with controlled engineered fill to allow the use of slab-on-ground construction or footings founded within the fill. Alternatively, a fully suspended floor slab could be adopted, with footings founded below the uncontrolled fill. For the main building we assume that excavation and replacement of the fill will not be practical and fully suspended floor slabs will be adopted supported on footings founded below the fill.

Where all existing fill is excavated and replaced with controlled fill or where the residual silty clays are exposed, shallow footings founded within the soils may be used, such as pad/strip footings or a stiffened raft slab. Such footings may be designed based on an allowable bearing pressure of 100kPa for engineered fill or 200kPa for residual silty clay of at least very stiff strength. Such footings must be designed to accommodate shrink/swell movements of the soils, which will depend on the reactivity of the material used for any fill placed. We expect that movements similar to a Class H2, as defined by AS2870-2011 would be appropriate, but this must be confirmed following completion of any earthworks.

Where the existing fill is not excavated and replaced with controlled fill, piles will be required so that footings are founded below the existing uncontrolled fill. Although piles could be founded within the residual silty clays, given that the weathered rock will only be a short distance below the surface of the clay we recommend that piles be uniformly founded within the rock in order to optimise bearing pressures and provide uniform support and reduce the risk of differential settlements.

Where rock is at shallow depths of less than about 1m, such as possibly within the basement excavation, pad or strip footings may be used. Where the depth of rock is more than about 1m, which should be expected for the majority, if not all, of the site, bored piers would be more practical.

Footings founded within the upper extremely weathered siltstone (Shale) may be designed based on an allowable bearing pressure of 800kPa. Where piles are drilled deeper to found within siltstone of at least very low strength, the design may be based on an allowable bearing pressure of 1000kPa. Piles should be drilled to achieve a nominal socket of at least 0.3m into the appropriate quality rock. Where piers are used, an allowable shaft adhesion of 10% of the above allowable bearing pressures may be used for the design of piles in compression, or 5% for uplift loads, provided socket cleanliness and roughness is maintained.

Higher bearing pressures may be possible within the deeper siltstone, but additional cored boreholes would need to be drilled to assess the quality of the rock. The depth of better quality rock may be quite deep as the cored rock encountered within our previous boreholes contained extremely weathered bands and any piles design for higher bearing pressures would need to be founded below such bands and into more consistent rock.

At least the initial stages of footing excavation or pile drilling should be inspected by a geotechnical engineer to ascertain that the recommended foundation has been reached and to check initial assumptions about foundation conditions and possible variations that may occur between borehole locations. The need for further inspections can be assessed following the initial visit.

Where fully suspended slabs are adopted, void formers will need to be placed below all ground beams and slabs unless a void is left below the slabs. Based on the potential reactive nature of the silty clay fill and residual soils we recommend that void formed be at least 100mm thick.

4.6 Pavements

The pavement subgrade should be prepared as recommended in Section 4.3 above. We recommend that the proposed pavements be designed based on a soaked CBR of 1.5%, or an estimated modulus of subgrade reaction of 15kPa/mm (750mm plate).

Where fill is used to raise site levels, or replace unsuitable subgrade by the appropriate depth, pavement design may reflect the thickness and four day soaked CBR value of the imported material.

A CBR value of 1.5% is low and consideration should be given to some form of subgrade improvement to reduce the thickness of the overlying pavement materials. A select layer of good quality granular material could be used to replace the upper subgrade soils for a depth of about 0.3m to 0.5m. This would be able to be achieved as part of the earthworks where fill is required by the placement of the select material in the final fill layers. The select material should comprise a good quality granular material, such as crushed sandstone, with a soaked CBR of at least 10%. The design of the pavement could take the thickness and quality of this select layer into account to reduce the thickness of the pavement materials.

Alternatively, lime stabilisation of the subgrade could be carried out, but testing would need to be undertaken to determine the amount of lime required and the resulting benefit. In addition, lime stabilisation would need to be carried out with care as airborne lime may damage existing structures or cars present during the work.

Concrete pavements should have a subbase layer of at least 100mm thickness of crushed rock to TfNSW QA specification 3051 unbound base material (or similar good quality and durable fine crushed rock), which is compacted to at least 100% of SMDD. Concrete pavements should be designed with an effective shear transmission at all joints by way of either doweled or keyed joints.

Surface and subsoil drainage should be provided on the high side of the pavements to prevent moisture ingress into the subgrade and pavement materials. The subsoil drains should have an invert level of at least 300mm below the adjacent subgrade level and be excavated with a uniform longitudinal fall to appropriate discharge points so as to reduce the risk of ponding in the base of the drain. In addition, the surface of the adjacent pavement subgrade should be provided with a uniform cross fall towards the subsoil drain to assist with drainage.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. As an example, special treatment of soft spots may be required as a result of their discovery during proof-rolling, etc. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those 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 for the 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.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

TABLE A
MOISTURE CONTENT, ATTERBERG LIMIT AND LINEAR SHRINKAGE TEST
REPORT

| | | | |
|--------------------|--|---------------------|------------|
| Client: | JK Geotechnics | Ref No: | 34067BC |
| Project: | Proposed Additions | Report: | A |
| Location: | 65 Huntingwood Drive, Huntingwood, NSW | Report Date: | 10/06/2021 |
| Page 1 of 1 | | | |

| AS 1289 BOREHOLE NUMBER | TEST METHOD DEPTH m | 2.1.1 | 3.1.2 | 3.2.1 | 3.3.1 | 3.4.1 |
|-----------------------------------|----------------------------------|--------------------------|----------------------|-----------------------|--------------------------|--------------------------|
| | | MOISTURE CONTENT % | LIQUID LIMIT % | PLASTIC LIMIT % | PLASTICITY INDEX % | LINEAR SHRINKAGE % |
| 101 | 1.50 - 1.95 | 18.2 | 51 | 12 | 39 | 14.0 * |
| 101 | 4.00 - 4.50 | 10.7 | - | - | - | - |
| 101 | 5.50 - 6.00 | 7.7 | - | - | - | - |
| 102 | 4.00 - 4.30 | 9.7 | - | - | - | - |
| 102 | 5.50 - 6.00 | 8.4 | - | - | - | - |
| 103 | 0.50 - 0.95 | 5.6 | 30 | 14 | 16 | 7.5 |
| 103 | 4.00 - 4.50 | 10.5 | - | - | - | - |
| 103 | 5.90 - 6.00 | 5.9 | - | - | - | - |
| 105 | 1.50 - 1.95 | 16.6 | 58 | 20 | 38 | 14.5 * |
| 105 | 5.20 - 5.50 | 12.7 | - | - | - | - |
| 105 | 5.80 - 6.30 | 8.8 | - | - | - | - |
| 106 | 6.70 - 7.00 | 7.8 | - | - | - | - |
| 106 | 8.50 - 9.00 | 8.0 | - | - | - | - |

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 19/05/2021.
- Sampled and supplied by client. Samples tested as received.
- * Denotes Linear Shrinkage slightly curled.



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 the items tested or sampled.

Authorised Signature / Date
 (D. Trewick)

10/06/2021

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

| | | | |
|--------------------|--|---------------------|------------|
| Client: | JK Geotechnics | Ref No: | 34067BC |
| Project: | Proposed Additions | Report: | B |
| Location: | 65 Huntingwood Drive, Huntingwood, NSW | Report Date: | 17/06/2021 |
| Page 1 of 1 | | | |

| BOREHOLE NUMBER | BH 101 | BH 104 | BH 105 |
|---|--------------------|-------------|-------------|
| DEPTH (m) | 0.00 - 0.80 | 0.00 - 1.30 | 0.40 - 1.50 |
| Surcharge (kg) | 9.0 | 9.0 | 9.0 |
| Maximum Dry Density (t/m ³) | 1.72 STD | 1.71 STD | 1.71 STD |
| Optimum Moisture Content (%) | 17.7 | 16.5 | 20.0 |
| Moulded Dry Density (t/m ³) | 1.68 | 1.68 | 1.69 |
| Sample Density Ratio (%) | 98 | 98 | 98 |
| Sample Moisture Ratio (%) | 103 | 100 | 97 |
| Moisture Contents | | | |
| Insitu (%) | 15.4 | 13.7 | 18.7 |
| Moulded (%) | 18.2 | 16.5 | 19.4 |
| After soaking and | | | |
| After Test, Top 30mm(%) | 27.4 | 27.0 | 34.5 |
| Remaining Depth (%) | 19.3 | 21.1 | 20.7 |
| Material Retained on 19mm Sieve (%) | 0 | 0 | 0 |
| Swell (%) | 2.0 | 2.5 | 3.0 |
| C.B.R. value: | @2.5mm penetration | 1.5 | 1.5 |

NOTES: Sampled and supplied by client. Samples tested as received.

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 19/05/2021.
- Report supersedes the previously issued report 34067BC Table B dated 26/05/2021.



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 the items tested or sampled.


 17/06/2021
 Authorised Signature / Date
 (T. Finnegan)

CERTIFICATE OF ANALYSIS 269508

Client Details

| | |
|------------------|--------------------------------------|
| Client | JK Geotechnics |
| Attention | Arthur Kourtesis |
| Address | PO Box 976, North Ryde BC, NSW, 1670 |

Sample Details

| | |
|---|-----------------------------|
| Your Reference | <u>34067BC, Huntingwood</u> |
| Number of Samples | 6 Soil |
| Date samples received | 20/05/2021 |
| Date completed instructions received | 20/05/2021 |

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
 Samples were analysed as received from the client. Results relate specifically to the samples as received.
 Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details

| | |
|---|------------|
| Date results requested by | 27/05/2021 |
| Date of Issue | 27/05/2021 |
| NATA Accreditation Number 2901. This document shall not be reproduced except in full. | |
| Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with * | |

Results Approved By

Diego Bigolin, Team Leader, Inorganics

Authorised By



Nancy Zhang, Laboratory Manager

| Misc Inorg - Soil | | | | | | |
|------------------------------|----------|------------|------------|------------|------------|------------|
| Our Reference | | 269508-1 | 269508-2 | 269508-3 | 269508-4 | 269508-5 |
| Your Reference | UNITS | BH201 | BH202 | BH203 | BH204 | BH205 |
| Depth | | 0.5-0.95 | 3.0-3.45 | 1.5-1.8 | 1.5-1.95 | 0.0-0.4 |
| Date Sampled | | 14/05/2021 | 14/05/2021 | 14/05/2021 | 14/05/2021 | 14/05/2021 |
| Type of sample | | Soil | Soil | Soil | Soil | Soil |
| Date prepared | - | 24/05/2021 | 24/05/2021 | 24/05/2021 | 24/05/2021 | 24/05/2021 |
| Date analysed | - | 24/05/2021 | 24/05/2021 | 24/05/2021 | 24/05/2021 | 24/05/2021 |
| pH 1:5 soil:water | pH Units | 6.6 | 5.9 | 5.5 | 7.4 | 8.2 |
| Chloride, Cl 1:5 soil:water | mg/kg | 180 | 930 | 250 | 270 | 24 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 280 | 360 | 250 | 190 | 21 |
| Resistivity in soil* | ohm m | 31 | 12 | 31 | 27 | 58 |

| Misc Inorg - Soil | | |
|------------------------------|----------|------------|
| Our Reference | | 269508-6 |
| Your Reference | UNITS | BH206 |
| Depth | | 6.0-3.35 |
| Date Sampled | | 14/05/2021 |
| Type of sample | | Soil |
| Date prepared | - | 24/05/2021 |
| Date analysed | - | 24/05/2021 |
| pH 1:5 soil:water | pH Units | 5.8 |
| Chloride, Cl 1:5 soil:water | mg/kg | 880 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 170 |
| Resistivity in soil* | ohm m | 14 |

| Method ID | Methodology Summary |
|------------------|---|
| Inorg-001 | pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times. |
| Inorg-002 | Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed. |
| Inorg-081 | Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser. |

| QUALITY CONTROL: Misc Inorg - Soil | | | | | | Duplicate | | | Spike Recovery % | |
|------------------------------------|----------|-----|-----------|------------|------|-----------|------|------|------------------|------|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-1 | [NT] |
| Date prepared | - | | | 24/05/2021 | [NT] | [NT] | [NT] | [NT] | 24/05/2021 | [NT] |
| Date analysed | - | | | 24/05/2021 | [NT] | [NT] | [NT] | [NT] | 24/05/2021 | [NT] |
| pH 1:5 soil:water | pH Units | | Inorg-001 | [NT] | [NT] | [NT] | [NT] | [NT] | 100 | [NT] |
| Chloride, Cl 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | [NT] | [NT] | [NT] | [NT] | 93 | [NT] |
| Sulphate, SO4 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | [NT] | [NT] | [NT] | [NT] | 94 | [NT] |
| Resistivity in soil* | ohm m | 1 | Inorg-002 | <1 | [NT] | [NT] | [NT] | [NT] | [NT] | [NT] |

Result Definitions

| | |
|-------------|---|
| NT | Not tested |
| NA | Test not required |
| INS | Insufficient sample for this test |
| PQL | Practical Quantitation Limit |
| < | Less than |
| > | Greater than |
| RPD | Relative Percent Difference |
| LCS | Laboratory Control Sample |
| NS | Not specified |
| NEPM | National Environmental Protection Measure |
| NR | Not Reported |

Quality Control Definitions

| | |
|--|--|
| Blank | This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples. |
| Duplicate | This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable. |
| Matrix Spike | A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist. |
| LCS (Laboratory Control Sample) | This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample. |
| Surrogate Spike | Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples. |
| Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011. | |
| The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016. | |
| Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2 | |

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

pH run outside of recommended holding time

| Client: | | FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | |
|--------------------|-----------------------|--|-----------|-------------|--------------------------------|---|-------------------------------|-----------------------|----------------------------------|--|
| Project: | | PROPOSED ADDITIONS | | | | | | | | |
| Location: | | 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | |
| Job No.: | | 34067BC | | | Method: SPIRAL AUGER | | R.L. Surface: \approx 62.3m | | | |
| Date: | | 14/05/2021 | | | Logged/Checked by: A.C.K./T.C. | | Datum: AHD | | | |
| Groundwater Record | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/Weathering | Strength/Rel. Density | Hand Penetrometer Readings (kPa) | Remarks |
| DRY ON COMPLETION | ES U50 DB DS | N = 16 4,9,7 | 0 | | CH | FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained sandstone gravel. | w<PL | | | APPEARS WELL COMPACTED |
| | | N = 14 5,6,8 | 1 | | CH | Silty CLAY: high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel. | w>PL | Hd | 425 420 465 | RESIDUAL |
| | | | 2 | | - | SILTSTONE: dark grey brown, with iron indurated seams and clay seams. | DW | VL-L | | BRINGELLY SHALE VERY LOW TO LOW 'TC' BIT RESISTANCE |
| | | | 3 | | | SILTSTONE: dark grey. | | L | | LOW TO MODERATE RESISTANCE |
| | | | 4 | | | | | | | MODERATE TO HIGH RESISTANCE |
| | | | 5 | | | | | | | |
| | | | 6 | | | END OF BOREHOLE AT 6.0m | | | | |
| | | | 7 | | | | | | | |

| | | | | | | | | | | | |
|------------------------------------|----|--|--------------------------------|-------------|----|-----------|-------------|-------------------------------|--|--------------------------------|----------------------------------|
| Client: | | FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | | |
| Project: | | PROPOSED ADDITIONS | | | | | | | | | |
| Location: | | 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | | |
| Job No.: | | | Method: SPIRAL AUGER | | | | | R.L. Surface: \approx 59.3m | | | |
| Date: | | | Logged/Checked by: A.C.K./T.C. | | | | | Datum: AHD | | | |
| Plant Type: | | JK305 | | Field Tests | | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/ Weathering | Strength/ Rel. Density |
| Groundwater Record | ES | SAMPLES | U50 | DB | DS | | | | | | Hand Penetrometer Readings (kPa) |
| DRY ON COMPLETION | | | | | | 0 | | | FILL: Silty sand, fine to medium grained, dark brown. | M | |
| | | | | | | 1 | | | FILL: Gravel, medium grained igneous, with clay fines and nodules. | w>PL | |
| | | | | | | 2 | | | FILL: Silty clay, medium to high plasticity, grey brown mottled various colours, trace of fine to medium grained ironstone gravel. | w<PL | |
| | | | | | | 3 | | CH | Silty CLAY: high plasticity, light grey, trace of fine to medium grained ironstone gravel. | w<PL | Hd |
| | | | | | | 4 | | | SILTSTONE: dark grey brown. | DW | L |
| | | | | | | 5 | | | SILTSTONE: dark grey, with very low strength seams. | | M |
| | | | | | | 6 | | | END OF BOREHOLE AT 6.0m | | |
| 7 | | | | | | | | | | | |
| Remarks | | | | | | | | | | | |
| GRASS COVER | | | | | | | | | | | |
| APPEARS MODERATELY COMPACTED | | | | | | | | | | | |
| RESIDUAL | | | | | | | | | | | |
| 410 | | | | | | | | | | | |
| 580 | | | | | | | | | | | |
| 570 | | | | | | | | | | | |
| BRINGELLY SHALE | | | | | | | | | | | |
| LOW 'TC' BIT RESISTANCE | | | | | | | | | | | |
| MODERATE RESISTANCE WITH LOW BANDS | | | | | | | | | | | |

| Client: FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | | | |
|--|-----------------------|-------------------------------------|--------------|-------------|------------------------|---|-------------------------------|-----------------------|-----------------------------------|---|
| Project: PROPOSED ADDITIONS | | | | | | | | | | |
| Location: 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | | | |
| Job No.: | 34067BC | Method: | SPIRAL AUGER | | | | | | | |
| Date: | 14/05/2021 | R.L. Surface: | ≈ 62.4m | | | | | | | |
| Plant Type: | JK305 | Logged/Checked by: | A.C.K./T.C. | | | | | | | |
| Groundwater Record | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/Weathering | Strength/Rel. Density | Hand Penetrometer Readings (kPa.) | Remarks |
| DRY ON COMPLETION AND AFTER 6 DAYS | ES U50 DB DS | N = 16 8,8,8 | 0 | | CH | FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained ironstone gravel and igneous gravel and root fibres. | w<PL | | | GRASS COVER APPEARS WELL COMPACTED |
| | | N > 14 9,14/ 150mm REFUSAL | 1 | | CH | Silty CLAY: high plasticity, light grey mottled orange brown and red brown, trace of fine grained sand and fine to medium grained ironstone gravel. | w<PL | Hd | | RESIDUAL |
| | | | 2 | | - | SILTSTONE: dark grey brown, with iron indurated seams and clay bands. | DW | VL-L | | BRINGELLY SHALE LOW 'TC' BIT RESISTANCE WITH VERY LOW BANDS Groundwater monitoring well installed to 6.0m. Class 18 machine slotted 50mm dia. PVC standpipe 3.2m to 6.0m. Casing 0.0m to 3.2m. 2mm sand filter pack 3.0m to 6.0m. Bentonite seal 2.2m to 3.0m. Backfilled with sand and cuttings to the surface. Completed with a concreted gatic cover |
| | | | 3 | | | SILTSTONE: dark grey, with extremely weathered seams and iron indurated seams. | | L-M | | LOW TO MODERATE RESISTANCE |
| | | | 4 | | | SILTSTONE: dark grey, with iron indurated seams. | | | | |
| | | | 5 | | | | | | | |
| | | | 6 | | | END OF BOREHOLE AT 6.0m | SW | H | | MODERATE TO HIGH RESISTANCE |
| | | | 7 | | | | | | | |

| | | | | | | | | | | |
|--------------------------------|-----------------------|--|--------------------------------|-------------|------------------------|---|--------------------------------|------------------------|-----------------------------------|--------------------------------------|
| Client: | | FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | |
| Project: | | PROPOSED ADDITIONS | | | | | | | | |
| Location: | | 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | |
| Job No.: | | | Method: SPIRAL AUGER | | | R.L. Surface: \approx 62.5m | | | | |
| Date: | | | Logged/Checked by: A.C.K./T.C. | | | Datum: AHD | | | | |
| Groundwater Record | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/ Weathering | Strength/ Rel. Density | Hand Penetrometer Readings (kPa.) | Remarks |
| DRY ON COMPLETION | ES U50 DB DS | | 0 | | | FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained ironstone gravel. | w~PL | | | GRASS COVER |
| | | | 1 | | | FILL: Silty clay, medium plasticity, grey brown, trace of fine to medium grained siltstone gravel. | | | 300 530 >600 | APPEARS MODERATELY TO WELL COMPACTED |
| | | | 2 | | | | | | | |
| | | | 3 | | | | | | | APPEARS POORLY COMPACTED |
| | | | 4 | | CH | Silty CLAY: high plasticity, light grey mottled orange brown, and red brown, trace of fine to medium grained ironstone gravel. | w<PL | Hd | | RESIDUAL |
| | | | 5 | | | | | | >600 | |
| | | | 6 | | - | Extremely Weathered siltstone: silty CLAY, medium to high plasticity, light grey mottled red brown, with very low strength bands. | XW | Hd | | BRINGELLY SHALE |
| | | | 7 | | | END OF BOREHOLE AT 6.1m | | | | |
| N = SPT 13/100mm REFUSAL | | | | | | | | | | |

| Client: | | FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | |
|--------------------|-----------------------|--|-----------|-------------|--------------------------------|---|-------------------------------|-----------------------|----------------------------------|--------------------------------------|
| Project: | | PROPOSED ADDITIONS | | | | | | | | |
| Location: | | 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | |
| Job No.: | | 34067BC | | | Method: SPIRAL AUGER | | R.L. Surface: \approx 65.6m | | | |
| Date: | | 14/05/2021 | | | Datum: AHD | | | | | |
| Plant Type: | | JK305 | | | Logged/Checked by: A.C.K./T.C. | | | | | |
| Groundwater Record | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/Weathering | Strength/Rel. Density | Hand Penetrometer Readings (kPa) | Remarks |
| DRY ON COMPLETION | ES U50 DB DS | | 0 | | | FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained ironstone gravel and root fibres. | w<PL | | | GRASS COVER |
| | | | 1 | | | FILL: Silty clay, high plasticity, light grey brown mottled various colours, trace of fine to medium grained igneous gravel and ironstone gravel. | | | 310 400 360 | APPEARS MODERATELY TO WELL COMPAKTED |
| | | | 2 | | CH | Silty CLAY: high plasticity, light grey mottled orange brown and red brown, trace of fine to medium grained ironstone gravel. | w≈PL | VSt-Hd | 430 350 580 | RESIDUAL |
| | | | 3 | | | | | | 430 270 340 | |
| | | | 4 | | | | | | | |
| | | | 5 | | | | w<PL | Hd | >600 >600 >600 | |
| | | | 6 | | | | | | | |
| | | | 7 | | - | SILTSTONE: grey brown, with iron indurated seams and extremely weathered seams. as above, but dark grey. | DW | VL | | BRINGELLY SHALE |
| | | | | | | | | L | | VERY LOW TO LOW 'TC' BIT RESISTANCE |
| | | | | | | | | L-M | | LOW RESISTANCE WITH VERY LOW BANDS |
| | | | | | | | | | | MODERATE RESISTANCE WITH LOW BANDS |

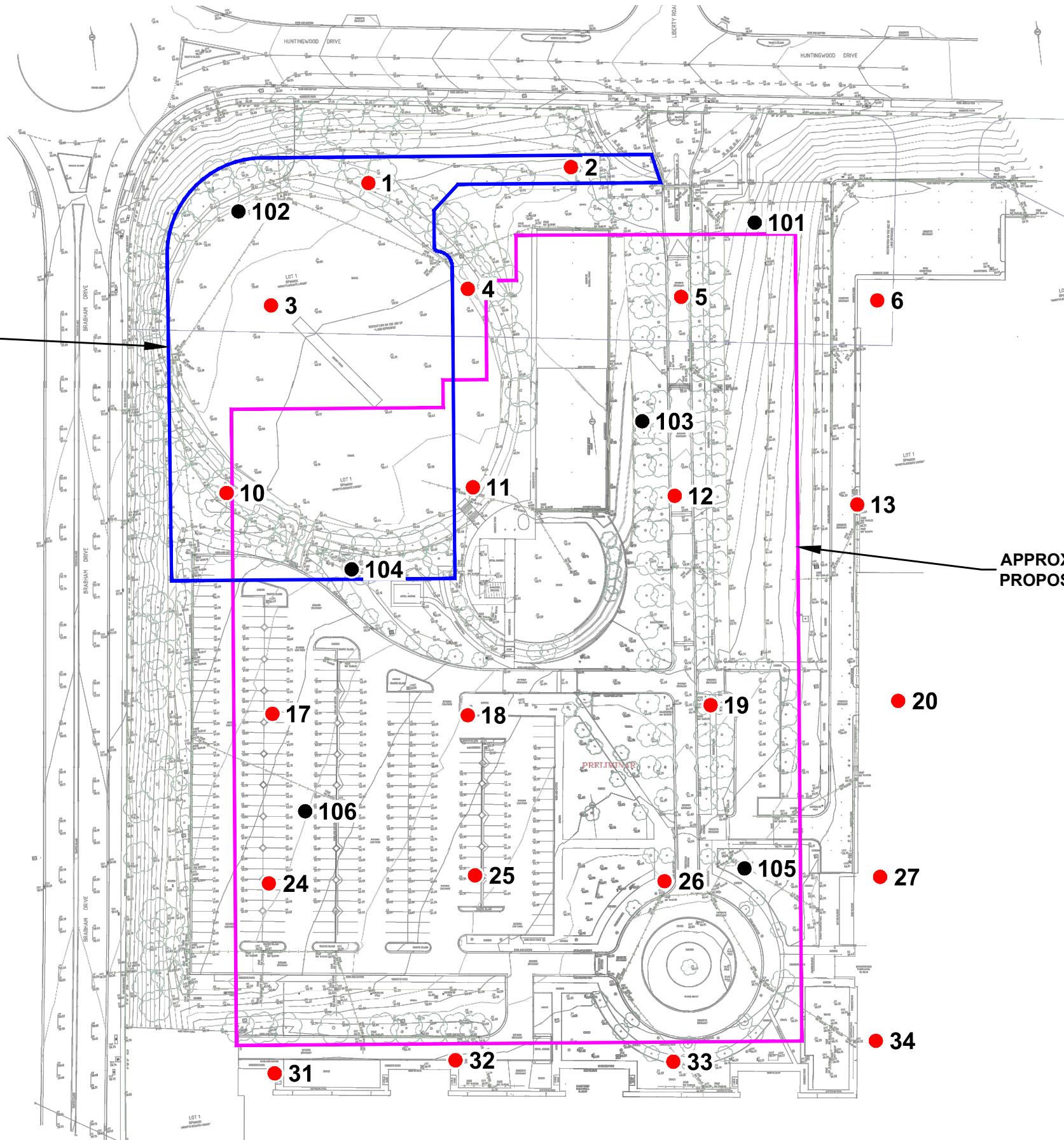
| Client: FDC CONSTRUCTION (NSW) PTY LTD Project: PROPOSED ADDITIONS Location: 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | | | | |
|--|-----------------------|---------|---------------------------------------|-----------|-------------|------------------------------|--|-----------------------------------|---------------------------|----------------------------------|---------|
| Job No.: 34067BC | | | Method: SPIRAL AUGER | | | R.L. Surface: ≈ 65.6m | | | | | |
| Date: 14/05/2021 | | | | | | Datum: AHD | | | | | |
| Plant Type: JK305 | | | Logged/Checked by: A.C.K./T.C. | | | | | | | | |
| Groundwater Record | ES U50 DB DS | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/ Weathering | Strength/ Rel. Density | Hand Penetrometer Readings (kPa) | Remarks |
| | | | | | | | SILTSTONE: dark grey, with iron indurated seams and extremely weathered seams. | DW | L-M | | |
| | | | | | | | END OF BOREHOLE AT 7.5m | | | | |
| | | | | 8 | | | | | | | |
| | | | | 9 | | | | | | | |
| | | | | 10 | | | | | | | |
| | | | | 11 | | | | | | | |
| | | | | 12 | | | | | | | |
| | | | | 13 | | | | | | | |
| | | | | 14 | | | | | | | |

| Client: | | FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | |
|--------------------|-----------------------|--|--------------------|---|------------------------|--|--------------------------------|------------------------|--|--------------------------|
| Project: | | PROPOSED ADDITIONS | | | | | | | | |
| Location: | | 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | |
| Job No.: | | | Method: | | | R.L. Surface: \approx 62.4m | | | | |
| Date: | | | Datum: | | | AHD | | | | |
| Plant Type: | | | Logged/Checked by: | | | A.C.K./T.C. | | | | |
| Groundwater Record | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/ Weathering | Strength/ Rel. Density | Hand Penetrometer Readings (kPa.) | Remarks |
| DRY ON COMPLETION | ES U50 DB DS | | 0 |  | - | ASPHALTIC CONCRETE: 30mm.t FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained ironstone and sandstone gravel. FILL: Silty clay, low to medium plasticity, light grey brown mottled various colours, trace of fine to medium grained igneous and ironstone gravel. | w≈PL w>PL w<PL | | | APPEARS POORLY COMPACTED |
| | | N = 5 3,2,3 | 1 |  | | | | | | |
| | | N = 15 5,6,9 | 2 | | | | | | | |
| | | N = 25 6,8,17 | 3 | | | | | | | |
| | | N = 14 3,5,9 | 4 | | CH | Silty CLAY: high plasticity, light grey and mottled orange brown and red brown, trace of fine to medium grained ironstone gravel. | w≈PL w<PL | VSt- Hd Hd | 425 580 600 420 420 345 >600 >600 | RESIDUAL |
| | | N > 24 16,8/50mm | 5 | | | | | | | |
| | | REFUSAL | 6 | | | | | | | |
| | | | 7 | | - | SILTSTONE: grey brown, with iron indurated seams. | DW | L-M | | BRINGELLY SHALE |

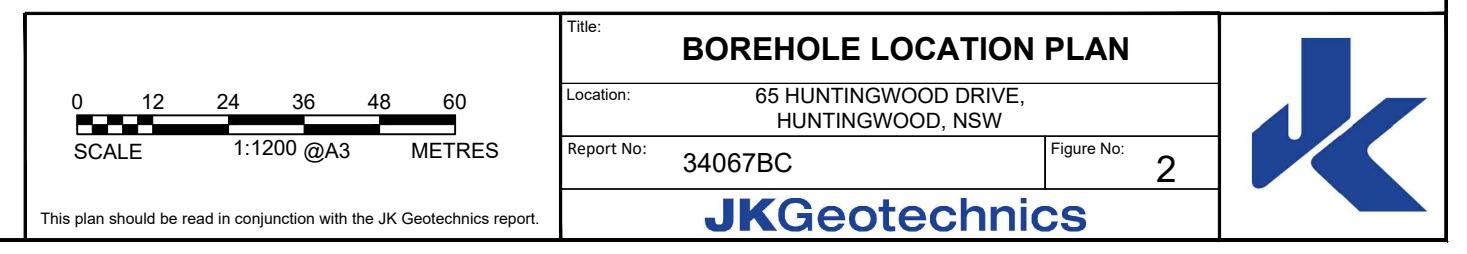
| Client: FDC CONSTRUCTION (NSW) PTY LTD | | | | | | | | | | |
|---|-----------------------|-------------|-----------|-------------|------------------------|---|-------------------------------|-----------------------|----------------------------------|---|
| Project: PROPOSED ADDITIONS | | | | | | | | | | |
| Location: 65 HUNTINGWOOD DRIVE, HUNTINGWOOD, NSW | | | | | | | | | | |
| Job No.: 34067BC | | | | | | | | | | |
| Method: SPIRAL AUGER | | | | | | | | | | |
| Date: 14/05/2021 | | | | | | | | | | |
| Plant Type: JK305 | | | | | | | | | | |
| Logged/Checked by: A.C.K./T.C. | | | | | | | | | | |
| Groundwater Record | SAMPLES | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition/Weathering | Strength/Rel. Density | Hand Penetrometer Readings (kPa) | Remarks |
| | ES U50 DB DS | | | | | SILTSTONE: grey brown, with iron indurated seams. | DW | L-M | | LOW 'TC' BIT RESISTANCE LOW RESISTANCE WITH MODERATE BANDS |
| | | | 8 | | | | | | | |
| | | | 9 | | | END OF BOREHOLE AT 9.0m | | | | |
| | | | 10 | | | | | | | |
| | | | 11 | | | | | | | |
| | | | 12 | | | | | | | |
| | | | 13 | | | | | | | |
| | | | 14 | | | | | | | |



APPROXIMATE OUTLINE OF PROPOSED BASEMENT LEVEL 2



LEGEND
 ● CURRENT INVESTIGATION BOREHOLE
 ● PREVIOUS INVESTIGATION BOREHOLE



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 1726:2017 '*Geotechnical Site Investigations*'. 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 soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

| Soil Classification | Particle Size |
|---------------------|------------------|
| Clay | < 0.002mm |
| Silt | 0.002 to 0.075mm |
| Sand | 0.075 to 2.36mm |
| Gravel | 2.36 to 63mm |
| Cobbles | 63 to 200mm |
| Boulders | > 200mm |

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

| Relative Density | SPT 'N' Value (blows/300mm) |
|-------------------|-----------------------------|
| Very loose (VL) | < 4 |
| Loose (L) | 4 to 10 |
| Medium dense (MD) | 10 to 30 |
| Dense (D) | 30 to 50 |
| Very Dense (VD) | > 50 |

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

| Classification | Unconfined Compressive Strength (kPa) | Indicative Undrained Shear Strength (kPa) |
|------------------|---|---|
| Very Soft (VS) | < 25 | < 12 |
| Soft (S) | > 25 and ≤ 50 | > 12 and ≤ 25 |
| Firm (F) | > 50 and ≤ 100 | > 25 and ≤ 50 |
| Stiff (St) | > 100 and ≤ 200 | > 50 and ≤ 100 |
| Very Stiff (VSt) | > 200 and ≤ 400 | > 100 and ≤ 200 |
| Hard (Hd) | > 400 | > 200 |
| Friable (Fr) | Strength not attainable – soil crumbles | |

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 fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) is referred to as 'laminite'.

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. Bulk samples are similar but of greater volume required for some test procedures.

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 shrink-swell behaviour, 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 methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock 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 a large 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 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and 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 by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

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 assessed 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. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT 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 low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, 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 NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) 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 1289.6.3.1-2004 (R2016) '*Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)*'.

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 63.5kg 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

$$\begin{aligned} N &= 13 \\ &4, 6, 7 \end{aligned}$$

- 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

$$\begin{aligned} N &> 30 \\ &15, 30/40 \text{mm} \end{aligned}$$

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

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT 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 SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as ' N_c ' on the borehole logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing (CPT) and Interpretation:

The cone penetrometer is sometimes referred to as a Dutch Cone. The test is described in Australian Standard 1289.6.5.1-1999 (R2013) 'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Static Cone Penetration Resistance of a Soil – Field Test using a Mechanical and Electrical Cone or Friction-Cone Penetrometer'.

In the tests, a 35mm or 44mm 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 a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm or 165mm 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. The CPT does not provide soil sample recovery.

As penetration occurs (at a rate of approximately 20mm per second), the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa. There are two scales presented for the cone resistance. The lower scale has a range of 0 to 5MPa and the main scale has a range of 0 to 50MPa. For cone resistance values less than 5MPa, the plot will appear on both scales.
- 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.

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 cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between CPT and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of CPT 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.

There are limitations when using the CPT in that it may not penetrate obstructions within any fill, thick layers of hard clay and very dense sand, gravel and weathered bedrock. Normally a 'dummy' cone is pushed through fill to protect the equipment. No information is recorded by the 'dummy' probe.

Flat Dilatometer Test: The flat dilatometer (DMT), also known as the Marchetti Dilometer comprises a stainless steel blade having a flat, circular steel membrane mounted flush on one side.

The blade is connected to a control unit at ground surface by a pneumatic-electrical tube running through the insertion rods. A gas tank, connected to the control unit by a pneumatic cable, supplies the gas pressure required to expand the membrane. The control unit is equipped with a pressure regulator, pressure gauges, an audio-visual signal and vent valves.

The blade is advanced into the ground using our CPT rig or one of our drilling rigs, and can be driven into the ground using an SPT hammer. As soon as the blade is in place, the membrane is inflated, and the pressure required to lift the membrane (approximately 0.1mm) is recorded. The pressure then required to lift the centre of the membrane by an additional 1mm is recorded. The membrane is then deflated before pushing to the next depth increment, usually 200mm down. The pressure readings are corrected for membrane stiffness.

The DMT is used to measure material index (I_D), horizontal stress index (K_D), and dilatometer modulus (E_D). Using established correlations, the DMT results can also be used to assess the 'at rest' earth pressure coefficient (K_0), over-consolidation ratio (OCR), undrained shear strength (C_u), friction angle (ϕ), coefficient of consolidation (C_v), coefficient of permeability (K_h), unit weight (γ), and vertical drained constrained modulus (M).

The seismic dilatometer (SDMT) is the combination of the DMT with an add-on seismic module for the measurement of shear wave velocity (V_s). Using established correlations, the SDMT results can also be used to assess the small strain modulus (G_0).

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod with a 20mm diameter cone end with a 9kg hammer dropping 510mm. The test is described in Australian Standard 1289.6.3.2-1997 (R2013) 'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – 9kg Dynamic Cone Penetrometer Test'.

The results are used to assess the relative compaction of fill, the relative density of granular soils, and the strength of cohesive soils. Using established correlations, the DCP test results can also be used to assess California Bearing Ratio (CBR).

Refusal of the DCP can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Vane Shear Test: The vane shear test is used to measure the undrained shear strength (C_u) of typically very soft to firm fine grained cohesive soils. The vane shear is normally performed in the bottom of a borehole, but can be completed from surface level, the bottom and sides of test pits, and on recovered undisturbed tube samples (when using a hand vane).

The vane comprises four rectangular blades arranged in the form of a cross on the end of a thin rod, which is coupled to the bottom of a drill rod string when used in a borehole. The size of the vane is dependent on the strength of the fine grained cohesive soils; that is, larger vanes are normally used for very low strength soils. For borehole testing, the size of the vane can be limited by the size of the casing that is used.

For testing inside a borehole, a device is used at the top of the casing, which suspends the vane and rods so that they do not sink under self-weight into the 'soft' soils beyond the depth at which the test is to be carried out. A calibrated torque head is used to rotate the rods and vane and to measure the resistance of the vane to rotation.

With the vane in position, torque is applied to cause rotation of the vane at a constant rate. A rate of 6° per minute is the common rotation rate. Rotation is continued until the soil is sheared and the maximum torque has been recorded. This value is then used to calculate the undrained shear strength. The vane is then rotated rapidly a number of times and the operation repeated until a constant torque reading is obtained. This torque value is used to calculate the remoulded shear strength. Where appropriate, friction on the vane rods is measured and taken into account in the shear strength calculation.

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 terms and symbols used in preparation of the logs are defined in the following pages.

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 reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised 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 determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification 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 assess 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 Soils for Engineering Purposes' or appropriate NSW Government Roads & Maritime Services (RMS) test methods. Details of the test procedure used are given on the individual report forms.

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.

Reasonable 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.
- Details of the development that the Company could not reasonably be expected to anticipate.

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 rather than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

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.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. Licence to use the documents may be revoked without notice if the Client is in breach of any obligation to make a payment to us.

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 an experienced geotechnical engineer/engineering geologist.

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 and appropriate footing or pile founding depths, or
- iii) full time engineering presence on site.

SYMBOL LEGENDS

SOIL

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

ROCK

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

OTHER MATERIALS

| | |
|---|--------------------|
|  | BRICKS OR PAVERS |
|  | CONCRETE |
|  | ASPHALTIC CONCRETE |

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

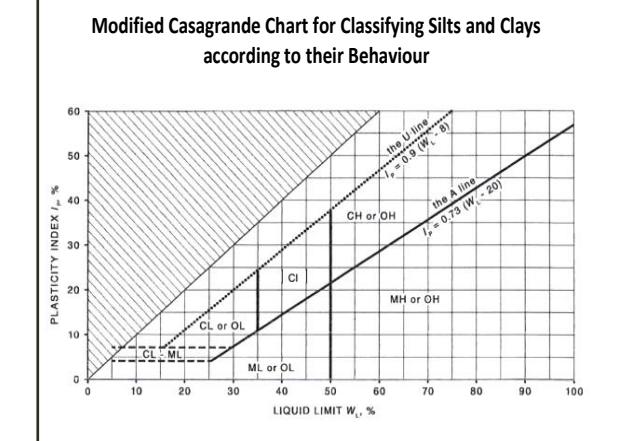
| Major Divisions | | Group Symbol | Typical Names | Field Classification of Sand and Gravel | | Laboratory Classification | |
|---|--|--------------|--|--|-------------------------------------|----------------------------|--|
| Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm) | GRAVEL (more than half of coarse fraction is larger than 2.36mm) | GW | Gravel and gravel-sand mixtures, little or no fines | Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength | $\leq 5\%$ fines | $C_u > 4$ $1 < C_c < 3$ | |
| | | GP | Gravel and gravel-sand mixtures, little or no fines, uniform gravels | Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength | $\leq 5\%$ fines | Fails to comply with above | |
| | | GM | Gravel-silt mixtures and gravel-sand-silt mixtures | 'Dirty' materials with excess of non-plastic fines, zero to medium dry strength | $\geq 12\%$ fines, fines are silty | Fines behave as silt | |
| | | GC | Gravel-clay mixtures and gravel-sand-clay mixtures | 'Dirty' materials with excess of plastic fines, medium to high dry strength | $\geq 12\%$ fines, fines are clayey | Fines behave as clay | |
| | SAND (more than half of coarse fraction is smaller than 2.36mm) | SW | Sand and gravel-sand mixtures, little or no fines | Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength | $\leq 5\%$ fines | $C_u > 6$ $1 < C_c < 3$ | |
| | | SP | Sand and gravel-sand mixtures, little or no fines | Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength | $\leq 5\%$ fines | Fails to comply with above | |
| | | SM | Sand-silt mixtures | 'Dirty' materials with excess of non-plastic fines, zero to medium dry strength | $\geq 12\%$ fines, fines are silty | N/A | |
| | | SC | Sand-clay mixtures | 'Dirty' materials with excess of plastic fines, medium to high dry strength | $\geq 12\%$ fines, fines are clayey | | |

| Major Divisions | | Group Symbol | Typical Names | Field Classification of Silt and Clay | | | Laboratory Classification |
|---|--|--------------|--|---------------------------------------|-------------------|---------------|---------------------------|
| | | | | Dry Strength | Dilatancy | Toughness | |
| In grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm) | SILT and CLAY (low to medium plasticity) | ML | Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity | None to low | Slow to rapid | Low | Below A line |
| | | CL, CI | Inorganic clay of low to medium plasticity, gravelly clay, sandy clay | Medium to high | None to slow | Medium | Above A line |
| | | OL | Organic silt | Low to medium | Slow | Low | Below A line |
| | SILT and CLAY (high plasticity) | MH | Inorganic silt | Low to medium | None to slow | Low to medium | Below A line |
| | | CH | Inorganic clay of high plasticity | High to very high | None | High | Above A line |
| | | OH | Organic clay of medium to high plasticity, organic silt | Medium to high | None to very slow | Low to medium | Below A line |
| | Highly organic soil | Pt | Peat, highly organic soil | — | — | — | — |

| Laboratory Classification Criteria |
|--|
| A well graded coarse grained soil is one for which the coefficient of uniformity $C_u > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by: |
| $C_u = \frac{D_{60}}{D_{10}}$ and $C_c = \frac{(D_{30})^2}{D_{10} D_{60}}$ |

Where D_{10} , D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

| NOTES: |
|---|
| 1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM. |
| 2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve. |
| 3 Clay soils with liquid limits $> 35\%$ and $\leq 50\%$ may be classified as being of medium plasticity. |
| 4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils. |



LOG SYMBOLS

| Log Column | Symbol | Definition |
|--|--|--|
| Groundwater Record | ▼ — G — ► | <p>Standing water level. Time delay following completion of drilling/excavation may be shown.</p> <p>Extent of borehole/test pit collapse shortly after drilling/excavation.</p> <p>Groundwater seepage into borehole or test pit noted during drilling or excavation.</p> |
| Samples | ES U50 DB DS ASB ASS SAL | <p>Sample taken over depth indicated, for environmental analysis.</p> <p>Undisturbed 50mm diameter tube sample taken over depth indicated.</p> <p>Bulk disturbed sample taken over depth indicated.</p> <p>Small disturbed bag sample taken over depth indicated.</p> <p>Soil sample taken over depth indicated, for asbestos analysis.</p> <p>Soil sample taken over depth indicated, for acid sulfate soil analysis.</p> <p>Soil sample taken over depth indicated, for salinity analysis.</p> |
| Field Tests | N = 17 4, 7, 10 N _c = 5 7 3R VNS = 25 PID = 100 | <p>Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.</p> <p>Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.</p> <p>Vane shear reading in kPa of undrained shear strength.</p> <p>Photoionisation detector reading in ppm (soil sample headspace test).</p> |
| Moisture Condition (Fine Grained Soils) | w > PL w ≈ PL w < PL w ≈ LL w > LL | <p>Moisture content estimated to be greater than plastic limit.</p> <p>Moisture content estimated to be approximately equal to plastic limit.</p> <p>Moisture content estimated to be less than plastic limit.</p> <p>Moisture content estimated to be near liquid limit.</p> <p>Moisture content estimated to be wet of liquid limit.</p> |
| (Coarse Grained Soils) | D M W | <p>DRY – runs freely through fingers.</p> <p>MOIST – does not run freely but no free water visible on soil surface.</p> <p>WET – free water visible on soil surface.</p> |
| Strength (Consistency) Cohesive Soils | VS S F St VSt Hd Fr () | <p>VERY SOFT – unconfined compressive strength \leq 25kPa.</p> <p>SOFT – unconfined compressive strength $>$ 25kPa and \leq 50kPa.</p> <p>FIRM – unconfined compressive strength $>$ 50kPa and \leq 100kPa.</p> <p>STIFF – unconfined compressive strength $>$ 100kPa and \leq 200kPa.</p> <p>VERY STIFF – unconfined compressive strength $>$ 200kPa and \leq 400kPa.</p> <p>HARD – unconfined compressive strength $>$ 400kPa.</p> <p>FRIABLE – strength not attainable, soil crumbles.</p> <p>Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.</p> |
| Density Index/ Relative Density (Cohesionless Soils) | VL L MD D VD () | <p>Density Index (I_D) Range (%)</p> <p>VERY LOOSE \leq 15 0 – 4</p> <p>LOOSE > 15 and \leq 35 4 – 10</p> <p>MEDIUM DENSE > 35 and \leq 65 10 – 30</p> <p>DENSE > 65 and \leq 85 30 – 50</p> <p>VERY DENSE > 85 > 50</p> <p>Bracketed symbol indicates estimated density based on ease of drilling or other assessment.</p> |
| Hand Penetrometer Readings | 300 250 | Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise. |

| Log Column | Symbol | Definition |
|------------|--|---|
| Remarks | 'V' bit 'TC' bit T₆₀ | Hardened steel 'V' shaped bit. Twin pronged tungsten carbide bit. Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers. |
| | Soil Origin | The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil. |

Classification of Material Weathering

| Term | Abbreviation | Definition | | | | |
|----------------------|-------------------------------|--|----|---|--|--|
| Residual Soil | RS | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported. | | | | |
| Extremely Weathered | XW | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible. | | | | |
| Highly Weathered | Distinctly Weathered (Note 1) | HW | DW | The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. | | |
| Moderately Weathered | | MW | | The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock. | | |
| Slightly Weathered | SW | Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock. | | | | |
| Fresh | FR | Rock shows no sign of decomposition of individual minerals or colour changes. | | | | |

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: '*Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores*'. There is some change in rock strength.

Rock Material Strength Classification

| Term | Abbreviation | Uniaxial Compressive Strength (MPa) | Guide to Strength | |
|-------------------------|--------------|-------------------------------------|---|---|
| | | | Point Load Strength Index $Is_{(50)}$ (MPa) | Field Assessment |
| Very Low Strength | VL | 0.6 to 2 | 0.03 to 0.1 | Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure. |
| Low Strength | L | 2 to 6 | 0.1 to 0.3 | Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling. |
| Medium Strength | M | 6 to 20 | 0.3 to 1 | Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty. |
| High Strength | H | 20 to 60 | 1 to 3 | A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer. |
| Very High Strength | VH | 60 to 200 | 3 to 10 | Hand specimen breaks with pick after more than one blow; rock rings under hammer. |
| Extremely High Strength | EH | > 200 | > 10 | Specimen requires many blows with geological pick to break through intact material; rock rings under hammer. |

Abbreviations Used in Defect Description

| Cored Borehole Log Column | Symbol Abbreviation | Description |
|---------------------------|---------------------|---|
| Point Load Strength Index | • 0.6 | Axial point load strength index test result (MPa) |
| | x 0.6 | Diametral point load strength index test result (MPa) |
| Defect Details – Type | Be | Parting – bedding or cleavage |
| | CS | Clay seam |
| | Cr | Crushed/sheared seam or zone |
| | J | Joint |
| | Jh | Healed joint |
| | Ji | Incipient joint |
| | XWS | Extremely weathered seam |
| | Degrees | Defect orientation is measured relative to normal to the core axis (ie. relative to the horizontal for a vertical borehole) |
| – Orientation | P | Planar |
| | C | Curved |
| | Un | Undulating |
| | St | Stepped |
| | Ir | Irregular |
| – Shape | Vr | Very rough |
| | R | Rough |
| | S | Smooth |
| | Po | Polished |
| | Sl | Slickensided |
| – Roughness | Ca | Calcite |
| | Cb | Carbonaceous |
| | Clay | Clay |
| | Fe | Iron |
| | Qz | Quartz |
| – Infill Material | Py | Pyrite |
| | Cn | Clean |
| | Sn | Stained – no visible coating, surface is discoloured |
| | Vn | Veneer – visible, too thin to measure, may be patchy |
| | Ct | Coating \leq 1mm thick |
| – Coatings | Filled | Coating $>$ 1mm thick |
| | mm.t | Defect thickness measured in millimetres |
| – Thickness | | |



APPENDIX A

Previous Borehole Logs



BOREHOLE LOG



Borehole No.

2

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|---------------------|---------|--------------------|-----------|-------------|------------------------|--|--------------------|---------------------------|---------------------------------|--|
| | DS | | | | | FILL: silty clay medium plasticity brown with traces of rippled shale & ash. | MC < PL | | | GROSS COVER. APPEARS MODERATELY COMPACTED. |
| | DS | N = 8 3, 3, 5 | | | CH. | CLAY: high plasticity, orange brown with a trace of ironstone gravel | MC > PL | Vst. | 340 270 220 | |
| | USO | | | | | as above but pale grey mottled red brown. | | H. | 420 440 | |
| | DS | N = 18 3, 8, 10 | 2 | | | SHALY CLAY/SHALE extremely weathered, extremely weak, brown & grey with few bands of ironstone. (Soil properties only) | | H (Clay) | | VERY LOW TC' BIT RESISTANCE. (SOIL PROPERTIES ONLY) |
| | DS | | 3 | | | | | | | |
| | DS | | 4 | | | SANDSTONE: fine grained grey, moderately weathered, weak to medium strong. SHALE: extremely weathered extremely weak, grey brown with few bands of medium strong ironstone. | | | | MODERATE RESISTANCE. |
| | DS | | 5 | | | as above but highly weathered, very weak to weak. | | | | LOW RESISTANCE |
| | DS | | 6 | | | END OF BOREHOLE AT 60m. | | | | LOW TO MODERATE RESISTANCE. |
| MOIST ON COMPLETION | | | 7 | | | | | | | |

Borehole No.

3

1/2.

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|---------------------------------|---------|--------------------------|------------|-------------|------------------------|---|--------------------|---------------------------|------------------------------------|--------------------------|
| DRY ON COMPLETION OF AUGER-ING. | | | | | CH. | FILL: Silty clay, low plasticity, grey brown with some sand, ash, ironstone, gravel and fine roots. | MC > PL | Vst. | | APPEARS POORLY COMPACTED |
| | DS | $N = 7$ 2, 3, 4 | 1 | | | CLAY: high plasticity, light grey mottled red. | MC > PL | | 260 250 210 220. | |
| | DS | | 2 | | | SANDSTONE: fine grained, brown, extremely weathered, extremely weak. | | | | (SOIL PROPERTIES) |
| | DS | $N > 30$ 18, 12/100mm | 3 | | | SHALE: grey brown, highly weathered, very weak. | | | | 'V' BIT REFUSAL. |
| | | REFUSAL | 4 | | | REFER TO CORED BOREHOLE LOG | | | | LOW 'TC' BIT RESISTANCE. |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |

 Jeffery & Katauskas

JOB No. 9292WH BH3 START AT 4.03m

4

5

6

7 END OF BOREHOLE 3 AT 6.91m

6.91m

CORED BOREHOLE LOG

NOTE: DEFECTS NOT LABELLED ARE BEDDING PARTINGS, D-10°, PLANAR, SMOOTH.

Borehole No.

4

BOREHOLE LOG

Client:

Project: ARNOTT'S BISCUIT DEVELOPMENT

Location: CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.

Job No. 9292 WH.

Method: SPIRAL AUGER

R.L. Surface: 60.12m

Date: 15 - 12 - 92.

BCD 450 RIG.

Datum: AHD

| Groundwater record | Samples | Field Test(s) | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|-------------------------------------|------------|-------------|------------------------|--|--------------------|---------------------------|---------------------------------|---|
| DRY ON COMPLETION | | | | | | | | | | |
| | DS | N = 6 2, 3, 3 | | | | FILL: Silty Clay, medium plasticity brown with a trace of ironstone gravel & ash. | MC > PL | | | GRASS COVER. Root zone 100mm. APPEARS MODERATELY COMPACTED. |
| | DS | | 1 | | CH. | CLAY: high plasticity, pale grey mottled red brown with a trace of ironstone gravel. | | (1st) | 160 120. | |
| | DS | | 1.5 | | CL-CH | SILTY CLAY: medium to high plasticity, pale grey & red brown with some bands of ironstone gravel. | MC < PL | H. | | |
| | DS | N = 21 10, 21/150mm BOUNCING. | 2 | | | SHALE: extremely weathered, extremely weak, pale grey & brown with clay bands & fine grained sandstone bands. | | | >600 >600. | |
| | DS | | 3 | | | | | | | LOW 'TC' BIT RESISTANCE. |
| | DS | | 4 | | | INTERBEDDED SHALE & SANDSTONE: fine grained sandstone, highly to moderately weathered weak to medium strong, brown & grey. | | | | |
| | DS | | 5 | | | SHALE: moderately weathered, weak to medium strong, grey & dark grey. | | | | MODERATE RESISTANCE. |
| | DS | | 6 | | | END OF BOREHOLE AT 6.0m | | | | |
| | | | 7 | | | | | | | |

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Ref. Density | Hand Penetrometer Readings kPa. | Remarks |
|---------------------------------|---------|-------------------------|------------|-------------|------------------------|---|--------------------|---------------------------|---------------------------------|------------------------------------|
| DRY ON COMPLETION OF AUGER-ING. | | | | | CH. | TOPSOIL: Silty clay, medium plasticity, brown. CLAY: high plasticity, orange & yellow brown. — as above but pale grey mottled red brown with some ironstone gravel. — as above but mottled orange and red brown. | MC>PL | st. | 190 210 180. | Gross cover Roots to 100mm. |
| | DS | N = 7 2, 2, 5 | 1 | | | | | | | |
| | DS | N = 23 4, 9, 14 | 2 | | | | | | | |
| | DS | N > 19 5, 11, 8/50mm | 3 | | | | | | | |
| | DS | BOUNCING ON SHALE. | 4 | | | SHALE: extremely to highly weathered, extremely to very weak, grey & brown. — as above but with weak to medium strong grey bands. | MC<PL | H. | >600 >600. | LOW TO BIT RESISTANCE |
| | DS | | 5 | | | REFER TO CORED BOREHOLE LOG. | | | | LOW RESISTANCE WITH MODERATE BANDS |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |

JK Jeffery & Katauskas

JOB No. 9292WH BOREHOLE 5 Start coring at 5.1m

5 Core loss 0.9m

6

7

8

9

END OF BH AT 9.5m

Borehole No.

4

2/2

CORED BOREHOLE LOG

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|--------------------------|------------|-------------|------------------------|--|--------------------|---------------------------|---------------------------------|------------------------------|
| DRY ON COMPLETION | | | | | | | | | | |
| | DS | N = 7 5, 4, 3 | | | CL-CH | TOPSOIL: SILTY CLAY, low to medium plasticity, brown. | MC < PL | st. to vst. | 180 220 400. | Gross cover Roots to 100 mm. |
| | DS | N = 15 5, 6, 9 | 1 | | CL | SILTY CLAY: medium to high plasticity, pale grey & orange brown with some ironstone gravel. | MC > PL | vst. to H. | 350 460 510. | |
| | DS | N > 26 5, 10, 16/10mm | 2 | | CL-CH | — as above but medium plasticity with a trace of sand. | | | | |
| | | BOUNCING | 3 | | CL-CH | SILTY CLAY: medium to high plasticity, pale grey mottled red brown with zones of ironstone gravel. | | | 420 500 >600. | |
| | | | 4 | | | END OF BOREHOLE AT 4.3m | | | | 'V' BIT REFUSAL. |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |



BOREHOLE LOG

Client:

Project: *ARNOTT'S BISCUIT DEVELOPMENT*

Location: *CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.*

Job No. 9292 WH.

Method: *SPIRAL AUGER*

R.L. Surface: 59.04m.

Date: 15 - 12 - 92.

BCD 450 RIG.

Datum: *AHD.*

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Densify | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|---------------------|------------|-------------|------------------------|---|--------------------|---------------------------|------------------------------------|--|
| DRY ON COMPLETION | | | | | | | | | | |
| | DS | N = 5 2, 2, 3 | | | CH. | FILL: Miscellaneous mix of clay & rippled shale grey. | MC < PL | st. | | |
| | DS | N = 26 4, 11, 15 | | | | CLAY: high plasticity, orange brown with a trace of ironstone gravel | MC > PL | | 140 120 160. | |
| | DS | | | | | as above but pale grey, mottled red brown. | | | | |
| | DS | | | | | as above but with some silt. | | H. | | |
| | DS | | | | | as above but pale grey and orange brown with few extremely weathered shale bands. | | | > 600 > 600. | |
| | DS | | | | | SHALE: highly weathered, very weak to weak, brown & grey with few bands of fine grained sandstone | | | | LOW 'TC' BIT RESISTANCE WITH MODERATE BANDS. |
| | DS | | | | | as above but extremely to highly weathered, extremely to very weak. | | | | LOW RESISTANCE. |
| | DS | | | | | END OF BOREHOLE AT 6.0m. | | | | |



BOREHOLE LOG

| Groundwater Record | | | | | | | | |
|--------------------|---------------------|-------------|------------|-------------|------------------------|--|--------------------|---------------------------|
| | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density |
| DRY ON COMPLETION | | | | | | TOPSOIL: Silty Clay, medium plasticity, brown. | MC > PL | |
| DS | N = 9 3, 3, 6 | | 1 | CH. | | CLAY: high plasticity, orange brown with a trace of ironstone gravel. | (st) | |
| DS | N = 32 6, 10, 22 | | 2 | CH. | | SILTY CLAY: high plasticity, pale grey mottled red brown with a trace of ironstone gravel. | H. | Vst. 220 230 220. |
| DS | | | 3 | | | SHALE: highly to moderately weathered, weak to medium strong, brown. | | >600 >600 >600. |
| DS | | | 4 | | | as above but extremely to highly weathered, extremely to very weak. | | |
| DS | | | 5 | | | as above but moderately weathered, weak to medium strong, grey. | | |
| DS | | | 6 | | | END OF BOREHOLE AT 6.0m. | | |
| | | | 7 | | | | | |

Borehole No.

12

1/2

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings | Remarks |
|---------------------------------|---------|--------------------|------------|-------------|------------------------|--|--------------------|---------------------------|----------------------------|----------------------------|
| DRY ON COMPLETION OF AUGER-ING. | | | | | CH. | TOPSOIL: Silty Clay, medium plasticity, brown. | MC < PL | | | GROSS COVER |
| | DS | N = 9 3, 4, 5 | | | CH. | CLAY: high plasticity, orange brown with a trace of ironstone gravel. | MC > PL | st. | | |
| | DS | N = 20 3, 6, 24 | 1 | | CH. | SILTY CLAY: high plasticity, pale grey mottled red brown with bands of ironstone gravel. | | | 1st 220 240 | |
| | | | 2 | | CL-CH. | SILTY CLAY: medium to high plasticity, pale grey mottled red brown with zones of ironstone gravel. | | H. | | |
| | | | 3 | | | SHALE: extremely weathered, extremely weak, brown with hard clay bands. | | | 400 550 > 600 | VERY LOW TC BIT RESISTANCE |
| | DS | | 4 | | CL-CH. | SHALY CLAY: medium to high plasticity, pale grey & yellow brown with bands of extremely weathered shale. | MC > PL | (H) | | |
| | | | 5 | | | SHALE: highly weathered, very weak to weak, brown. | | | | LOW RESISTANCE |
| | | | 6 | | | REFER TO CORED BOREHOLE LOG. | | | | |
| COPYRIGHT | | | 7 | | | | | | | |

JK Jeffery & Katauskas

Job No. 9292WH BOREHOLE 12

5 Start coring at 5.5 m

6

7

8

END AT 838 m

CORED BOREHOLE LOG

Borehole No.

12
2/2

Client:

Project: *ARNOTT'S BISCUITS DEVELOPMENT*

Location: CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.

Job No: 9292 WH.

Date Drilled: 12-1-93

Drill Type: *BCD 450*

Core Size: *NMLC*

Inclination: 90°

Bearing: —

R. L. Surface: 62.76 m.

Datum: *AHD*

| Core Log and Defect Analysis | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|-------------|-----------|-------------|--|------------|----------|-------------------------------------|---------------------|----------------|----|----|-----|-----|-----|----|----|----|-------------|--|--|--|--|
| 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 | | | | | | | | | | | | | |
| | | | | | | | VW | W | MS | VS | ES | 300 | 200 | 100 | 50 | 30 | 10 | Description | | | | |
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BOREHOLE LOG

Borehole No.

17

1/2

BOREHOLE LOG

| BOREHOLE LOG | | | | | | | | | | |
|--|---------|------------------------------|------------|-------------|-----------------------------------|---|--------------------|---------------------------|------------------------|-----------------------------|
| Project: ARNOTT'S BISCUIT DEVELOPMENT Location: CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD, N.S.W. | | | | | | | | | | |
| Job No. 9292 WH. | | Method: SPIRAL AUGER GCH RIG | | | R.L. Surface: 58.66 m Datum: AHD. | | | | | |
| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Densily | Hand Penetrometer kPa. | Remarks |
| DRY ON COMPLETION OF AUGER-ING. | DS | | | | | TOPSOIL: Silty sandy clay, low plasticity, grey brown with some fine gravels. | MC > PL | | | Grass cover Roots to 150mm. |
| | | | | | CL. | SANDY SILTY CLAY: medium plasticity, pale grey and orange brown. | | st. | 120 110 150. | |
| | DS | N=5 1, 2, 3 | | | CL. | SILTY CLAY: medium plasticity, pale grey mottled red brown with a trace of sand. as above but medium to high plasticity with few ironstone gravel bands. | | 1st to H. | 410 330 350. | |
| | | | | | | SHALE: highly weathered, very weak to weak, grey brown with clay bands as above but weak. | | | | LOW 'TC' BIT RESISTANCE |
| | DS | N=17 4, 7, 10 | | | | as above but weak. | | | | LOW TO MODERATE RESISTANCE. |
| | | | | | | REFER TO CORED BOREHOLE LOG. | | | | |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |

JK Jeffery & Katauskas

JOB NO. 9292WH BOREHOLE 17 Start coring at. 4.0 m

4

5

6

7

END AT 7.8m



CORED BOREHOLE LOG

Client:

Project: *ARNOTT'S BISCUITS DEVELOPMENT*

Project: ~~ANNUAL ASSESSMENT STATEMENT~~ Location: **CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.**

Job No: 9292 WH.
Date Drilled: 7-1-93
Drill Type: GCH RIG.

Core Size: $NMLC$
Inclination: 90°
Bearing: —

R. L. Surface: 58.66 m
Datum: AHD.

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|--------------------------|------------|-------------|------------------------|---|--------------------|---------------------------|---------------------------------|----------------------------------|
| DRY ON COMPLETION. | DS | | | | CL-CH. | TOPSOIL: Silty Clay medium to high plasticity, brown with a trace of ash. | MC > PL | (F) | | Grass cover Roots to 100mm. |
| | DS | N = 7 2, 3, 4 | 1 | | CH. | CLAY: medium to high plasticity, brown and yellow brown. | st. | | 140 170 190. | |
| | DS | N > 27 4, 15, 12/10mm | 2 | | | CLAY: high plasticity, orange brown with a trace of ironstone gravel. | | (Vst) | | |
| After 140hs | DS | BOUNCING | 3 | | | as above but pale grey mottled red brown. | MC > PL | H. | > 600 > 600 | |
| after 13hs | DS | | 4 | | | SHALE: extremely weathered, extremely weak, brown with few clay bands. | | | | LOW 'TC' BIT RESISTANCE. |
| | DS | | 5 | | | as above but highly weathered, very weak, with medium strong bands. | | | | LOW TO MODERATE RESISTANCE |
| | DS | | 6 | | | as above but weak | | | | MODERATE RESISTANCE. |
| | | | | | | END OF BOREHOLE AT 6.0m | | | | PVC STANDPIPE INSTALLED TO 5.7m. |

BOREHOLE LOG

| Soil Test Log | | | | | | | | |
|--------------------|---------|------------------------------------|------------|-------------|------------------------|--|--------------------|---------------------------|
| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density |
| DRY ON COMPLETION | | | | | | | | |
| | DS | N = 6 1, 2, 4 | | | CH. | TOPSOIL: Clayey silt / Silty Clay, low plasticity, brown, 200mm t. | MC > PL | st. |
| | DS | | | | | CLAY: high plasticity, light grey and red with some ironstone gravel. | MC > PL | |
| | DS | N = 12 3, 5, 7 | 1 | | | as above but light grey with a trace of red mottling. | | 200 140 180. |
| | DS | | 2 | | | | | 1st. |
| | DS | N > 21 15.6 / 20mm. REFUSAL. | 3 | | | as above but with bands of sandstone, fine grained, grey brown, highly weathered, very weak | | 910 320 330 310. |
| | DS | | 4 | | | SHALE: grey brown, highly weathered, very weak to weak with ironstone bands | | |
| | DS | | 5 | | | INTERBEDDED SHALE: grey brown, highly weathered, weak & SANDSTONE: fine grained, brown, highly weathered, weak with occasional medium strong bands | | |
| | DS | | 6 | | | END OF BOREHOLE AT 6.0m | | |
| | | | 7 | | | | | |

BOREHOLE LOG

Client:

Project: ARNOTT'S BISCUIT DEVELOPMENT...

Location: CNR HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.

Job No. 9292 WH.

Method: SPIRAL AUGER

R.L. Surface: 65.72m.

Date: 7-1-93

GCH RIG.

Datum: AHD

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|-------------------|------------|-------------|------------------------|---|--------------------|---------------------------|---------------------------------|--|
| DRY ON COMPLETION | | | | | | | | | | |
| | DB DS | N=17 3, 7, 10 | | | CH. | TOPSOIL: Silty Clay medium plasticity brown. | MC > PL | (st) | | Grass cover Roots to 100mm. |
| | DB | | | | CL | CLAY: high plasticity, orange brown. | | | | |
| | DS | N=26 5, 10, 16 | | | CL-CH | SILTY CLAY: medium plasticity, pale grey & orange brown with some sand & ironstone gravel. | | Vst to H. | 490 >600 590. | |
| | | | | | | as above but medium to high plasticity, pale grey mottled red brown with a trace of sand. Zones of ironstone gravel | | | 310 390 370. | |
| | | | | | | SHALE: highly weathered, very weak, brown. | | | | ESTIMATED 'V' BIT REFUSAL LOW 'T' BIT RESISTANCE. |
| | | | | | | END OF BOREHOLE AT 34m | | | | |
| | | | 4 | | | | | | | |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|-------------------------|------------|-------------|------------------------|---|--------------------|---------------------------|---------------------------------|--|
| DRY ON COMPLETION | | | | | | | | | | |
| | DS | N = 7 3, 4, 3 | | | CH. | TOPSOIL: Silty Clay, medium to high plasticity, brown. | MC > PL | Vst | 240 260 300 | Grass cover. Roots to 100 mm. |
| | DS | N = 20 4, 7, 13 | | | | CLAY: high plasticity, orange brown with a trace of ironstone gravel & a trace of sand. | | | 300 440 410 | |
| ▼ after 140hs | | | | | | — as above but pale grey mottled orange brown with some ironstone gravel. | | H. | | |
| | DS | N > 19 5, 10, 9/50mm | | | | — as above but with abundant ironstone gravel. Trace of sand. | | | 480 > 600 | |
| ▼ after 19hs | | | | | | SHALE: highly weathered, very weak to weak, grey and brown. | | | | LOW 'TC' BIT RESISTANCE WITH MODERATE BANDS. |
| | DS | | | | | — as above but highly to moderately weathered, weak with medium strong bonds, grey. | | | | LOW TO MODERATE RESISTANCE. |
| | | | | | | END OF BOREHOLE AT 6.0m. | | | | PVC STANDPIPE INSTALLED TO 5.5m. |
| COPYRIGHT | | | 7 | | | | | | | |

Borehole No.

25

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|------------------------|-----------|----------------------|--|-------------|--------------------|---------------------------|------------------------------------|--|
| DRY ON COMPLETION. | | | | | | | | | | |
| | | | | | | | | | | |
| | DS | $N = 7$ 3, 3, 4 | 1 | Wavy lines CL-CH. | TOPSOIL: Silty Clay, low to medium plasticity, brown. CLAY: high plasticity, brown. | MC < PL | st. | | | Grass cover Roots to 100mm. NO SAMPLE RECOVERED. |
| | DS | $N = 28$ 12, 13, 15 | 2 | CL-CH. | SILTY CLAY: medium to high plasticity, pale grey mottled red brown with some ironstone gravel. | MC > PL | (1st.) | | | |
| | DS | | 3 | | SHALE: extremely weathered, extremely weak, brown. | MC = PL | H. | | | |
| | DS | | 4 | | as above but with highly weathered, very weak bands and occasional clay bands. | | | | | VERY LOW 'C' BIT RESISTANCE |
| | DS | | 5 | | as above but highly weathered, very weak to weak, grey brown. | | | | | LOW RESISTANCE. |
| | DS | | 6 | | END OF BOREHOLE AT 6.0m. | | | | | |
| | | | 7 | | | | | | | |

BOREHOLE LOG

Borehole No.

26

1/2

Client:

Project: *ARNOTT'S BISCUIT DEVELOPMENT*

Location: *CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W*

Job No. 9292 WH.

Method: SPIRAL AUGER

R.L. Surface: 62.14m.

Date: 6-1-93.

GCH RIG.

Datum: AHD

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|---------------------------------|---------|-----------------------|------------|-------------|------------------------|---|--------------------|---------------------------|------------------------------------|-----------------------------|
| DRY ON COMPLETION OF AUGER-ING. | | | | | CL. | TOPSOIL: Silty Sandy clay, low plasticity, grey. / SILTY SANDY CLAY: medium plasticity, orange brown & pale grey with a trace of ash. | MC > PL | st to Vst. | 160 280 310. | Grass cover Roots to 100mm. |
| | DS | N=14 3, 4, 10 | 1 | | CL-CH | SILTY CLAY: medium to high plasticity, pale grey mottled red brown with abundant ironstone gravel | | (Vst to H) | | |
| | DS | N=29 7, 18, 9/50mm | 2 | | | | MC < PL | H | >600 >600. | REMNANT SHALE STRUCTURE. |
| | | BOUNCING | 3 | | | SHALE: highly weathered, very weak, grey brown & brown. | | | | LOW 'TC' BIT RESISTANCE. |
| | | | 4 | | | REFER TO CORED BOREHOLE LOG. | | | | |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |

 Jeffery & Katauskas

JOB NO. 9292WH BOREHOLE 26

3 Start coring at 3.5 m

4

5

6

END AT 6.50 m

CORED BOREHOLE LOG

BOREHOLE LOG

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|---------|------------------------------------|------------|-------------|------------------------|--|--------------------|---------------------------|---------------------------------|--|
| DRY ON COMPLETION. | | | | | | | | | | |
| | USO | | | | CH. | FILL: Silty clay, medium plasticity, brown with a trace of gravel. | MC < PL | | | APPEARS MODERATELY COMPACTED. Roots to 50mm. |
| | DS | N = 24 18, 24/150mm BOUNCING | | | CL | CLAY: high plasticity, orange brown. | MC > PL | (st) | | |
| | DS | N = 26 5, 11, 15 | | | CH. | SILTY CLAY: medium plasticity, pale grey and brown with bands of extremely weathered shale. | MC < PL | H | >600 >600 | FRIABLE. |
| | | | 2 | | CH. | SILTY CLAY: high plasticity, pale grey mottled red brown with some ironstone gravel. | MC > PL | (Vst to H) | | |
| | | | 3 | | | | MC < PL | H. | 460 530 >600. | |
| | DS | | 4 | | | SHALY CLAY/SHALE: extremely weathered, extremely weak, pale grey and brown; medium plasticity. | MC < PL | (H) | | BANDED LOW 'C' BIT RESISTANCE. |
| | | | 5 | | | SHALE: highly weathered, very weak to weak, brown and grey brown. | | | | |
| | DS | | 6 | | | as above but with extremely weathered bands and few fine grained sandstone bands. | | | | LOW RESISTANCE |
| | | | 7 | | | END OF BOREHOLE AT 6.0m. | | | | |

BOREHOLE LOG

Client:

Project: ARNOTT'S BISCUIT DEVELOPMENT

Location: CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.

Job No. 9292 WH.

Method: SPIRAL AUGER

R.L. Surface: 60.48m

Date: 16 - 12 - 92.

GCH RIG

Datum: AHD.

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings kPa. | Remarks |
|--------------------|------------------------------------|-------------|------------|-------------|------------------------|--|--------------------|---------------------------|---------------------------------|--------------------------|
| | | | | | CH. | TOPSOIL: Silty Clay, low plasticity, brown with some fine roots, 250mm t. | MC > PL | H. | | GROSS COVER. |
| DS | N = 10 2, 4, 6 | | 1 | | CL - CH | SILTY CLAY: high plasticity, grey and red. | MC > PL | | 410 460 470 330 | |
| DS | | | | | | as above but medium to high plasticity. | | | | |
| DS | N > 30 16, 14/150mm REFUSAL. | | 2 | | | SANDSTONE: fine grained, light grey and red, extremely weathered, extremely weak. | | | >600 >600 | (SOIL PROPERTIES) |
| DS | | | 3 | | | SANDSTONE: fine grained, brown, highly weathered, very weak to weak with occasional clay bonds | | | | LOW 'TC' BIT RESISTANCE. |
| | | | | | | REFER TO CORED BOREHOLE LOG. | | | | |
| | | | 4 | | | | | | | |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |

 Jeffery & Katauskas

JOB No. 9292WH . BH31 START AT 2.95m

3

4

5

6

7

END OF BOREHOLE 31 AT 7.95m

2.95

7.95m

CORED BOREHOLE LOG

Client:

Project: ARNOTT'S BISCUITS DEVELOPMENT.

Project: ~~YARRA~~ Location: CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.

Job No: 9292 WH.

Date Drilled: 16-12-92

Drill Type: *GCH RIG*

Core Size: *NMLC*

Inclination: 90°

Bearing: —

R. L. Surface: 60.48m

Datum: *AHD*

| Water Loss/Level | Barrel Lift | Depth (m) | Graphic Log | CORE DESCRIPTION | | Weathering | POINT LOAD INDEX STRENGTH $I_s(50)$ | DEFECT DETAILS | | | | | | | | | | |
|-----------------------|-------------|-----------|--|---------------------|-----------|------------|-------------------------------------|----------------|----|-------------|-----|-----|----|----|----|----|---|--|
| | | | | DEFECT SPACING (mm) | | | | | | DESCRIPTION | | | | | | | | |
| | | | | VW | W | WS | S | V3 | ES | 300 | 200 | 100 | 50 | 30 | 20 | 10 | 5 | General |
| START CORING AT 2.95m | | | | | | | | | | | | | | | | | | |
| 3 | | | SHALE: grey brown with bands of sandstone, fine grained, grey brown. | MW to HW | MS | | | | | X | | | | | | | | 3 CLAY SEAMS N-10°, 80mm, 38mm & 12mm thick. |
| 4 | | | | | IN- MS | | | | | X | | | | | | | | B.P.s 0-10° PLANAR SMOOTH, AT 30mm SPACINGS |
| 5 | | | | EW | XW /VW | | | | | X | | | | | | | | FRAGMENTED ZONE 0°, 90mm. JOINT 20° PLANAR, SMOOTH, IRON STAINED. |
| 6 | | | | MW | MS | | | | | X | | | | | | | | JOINT, SUB VERTICAL, IRREGULAR, SMOOTH. JOINT 30° PLANAR, SMOOTH. FRAGMENTED ZONE 0° 20mm. |
| 7 | | | SHALE: dark grey. | HW | VW /W | | | | | X | | | | | | | | FRAGMENTED ZONE 0°, 30mm |
| 8 | | | END OF BOREHOLE AT 7.95m. | | | | | | | X | | | | | | | | FRAGMENTED ZONE 0°, 40mm |

BOREHOLE LOG

Client:

Project: ARNOTT'S BISCUIT DEVELOPMENT

Location: CNR. HORSLEY ROAD & HUNTINGWOOD DRIVE, HUNTINGWOOD. N.S.W.

Job No. 9292 WH.

Method: SPIRAL AUGER
BCD 450 RIG

R.L. Surface: 61.96 m

Date: 11-1-93

Datum: AHD

| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/ Rel. Density | Hand Penetrometer Readings | Remarks |
|--------------------|---------|-----------------------|------------|-------------|------------------------|--|--------------------|---------------------------|----------------------------|-----------------------------|
| DRY ON COMPLETION. | | | | | | TOPSOIL: Silty clay, low plasticity, brown with a trace of sand. | MC>PL | | | GRASS COVER Roots to 150mm. |
| | DS | N = 7 2, 2, 5 | | | CL-CH. | SILTY CLAY: medium to high plasticity, brown & grey with a trace of sand. | | Vst. | 250 220 210. | |
| | DS | N = 17 6, 9, 8 | 1 | | | — as above but pale grey mottled red brown with occasional ironstone gravel zones. No sand. | | Vst to H. | | |
| | DS | N > 24 7, 24/150mm | 2 | | | — as above but pale grey mottled red brown with occasional ironstone gravel zones. No sand. | | | 380 450 510. | |
| | DS | | 3 | | | SHALY CLAY/SHALE: extremely weathered, extremely weak, brown and pale grey. Clay, medium plasticity. | MC<PL | H | | |
| | DS | | 4 | | | SHALE: extremely weathered, extremely weak, yellow brown. | | | > 600 | FRIABLE |
| | DS | | 5 | | | — as above but highly weathered, very weak to weak, grey brown with medium strong bands. | | | | LOW 'TC' BIT RESISTANCE |
| | DS | | 6 | | | END OF BOREHOLE AT 6.0m | | | | LOW TO MODERATE RESISTANCE |
| | | | 7 | | | | | | | |

BOREHOLE LOG

| Groundwater Record | | | | | | | | | |
|--------------------|---------|---------------------|------------|-------------|------------------------|---|--------------------|--------------------------|------------------------------------|
| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/Rel. Density | Hand Penetrometer Readings KPa. |
| Dry on completion. | | | | | | TOPSOIL: Silty clay, medium plasticity, brown. | MC > PL | Vst. | Grass cover Roots to 100mm. |
| | DS | N = 20 5, 10, 10 | | | CH. | CLAY: high plasticity, orange brown. | | | |
| | DS | | | | CL. | SILTY SANDY CLAY: medium plasticity, grey and red brown, with some ironstone gravel. | MC > PL | H. | 420 >600 >600. |
| | DS | N = 17 4, 7, 10 | | | CL-CH. | SILTY CLAY: medium to high plasticity, pale grey. | | | >600 >600. |
| | DS | | | | | SHALE: extremely weathered, extremely weak brown and grey brown with hard clay bands. | | | VERY LOW 'TC' BIT RESISTANCE. |
| | DS | | | | | as above but extremely to highly weathered, extremely to very weak. | | | LOW RESISTANCE. |
| | DS | | | | | as above but with few medium strong bands of fine grained sandstone. | | | |
| | | | 6 | | | END OF BOREHOLE AT 60m. | | | |
| | | | 7 | | | | | | |

BOREHOLE LOG

| BOREHOLE LOG | | | | | | | | | | |
|--------------------|------------------------|-------------|------------|-------------|------------------------|---|--------------------|--------------------------|----------------------------|-----------------------------|
| Groundwater record | Samples | Field Tests | Depth (m.) | Graphic Log | Unified Classification | DESCRIPTION | Moisture Condition | Consistency/Rel. Density | Hand Penetrometer Readings | Remarks |
| DRY ON COMPLETION | | | | | CH. | TOPSOIL: Silty Clay, low plasticity, brown with a trace of sand. CLAY: high plasticity, orange brown with a trace of sand. | MC>PL | st to Vst. | 130 210 350. | Grass cover Roots to 100mm. |
| | DS N = 8 2, 2, 6 | | | | CL-CH | SILTY CLAY: medium to high plasticity, pale grey mottled red brown with some ironstone gravel. | MC=PL | (Vst) | | 'V' BIT REFUSAL. |
| | DB | | 1 | | | END OF BOREHOLE AT 1.8m. | | | | |
| | | | 2 | | | | | | | |
| | | | 3 | | | | | | | |
| | | | 4 | | | | | | | |
| | | | 5 | | | | | | | |
| | | | 6 | | | | | | | |
| | | | 7 | | | | | | | |