

Macquarie University Property  
**Macquarie University Central  
Courtyard Precinct (MUCCP)  
Redevelopment – State Significant  
Development Application**

**Geotechnical Report**

251278-PGL-GGE-GIR-0001

Issue | 20 October 2017

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 251278

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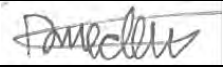
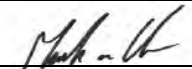


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# Document Verification

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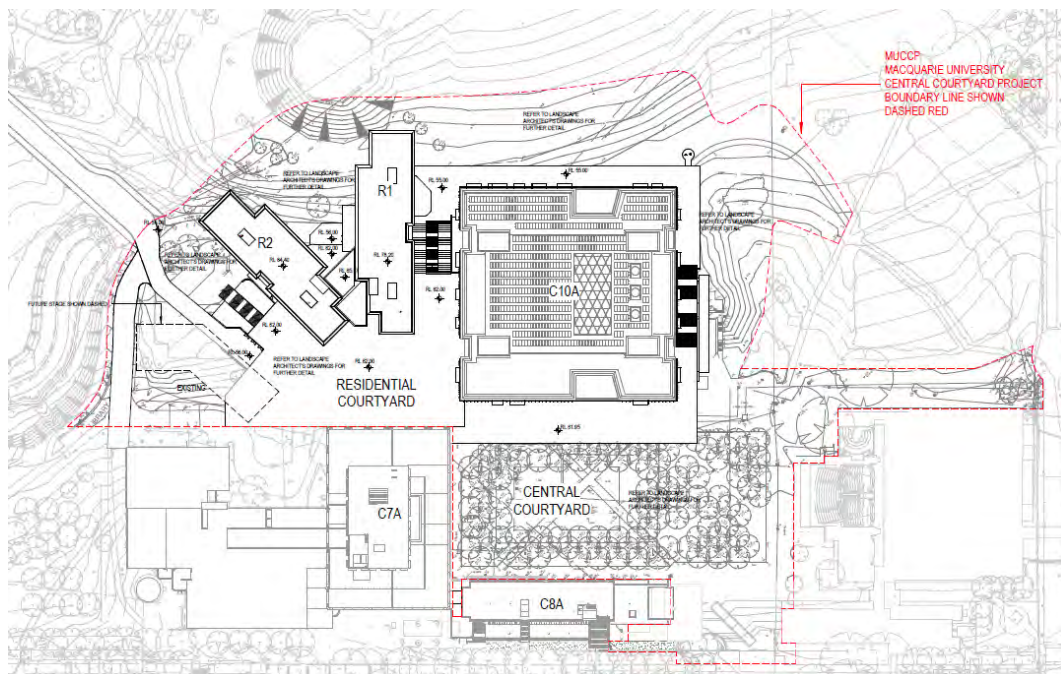
Exposure Classification

# 1 Introduction

This report supports a State Significant Development Application (SSDA) submitted to the Department of Planning and Environment (DP&E) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

Macquarie University (MU) is seeking development consent for the first phase of the Macquarie University Central Courtyard Precinct (MUCCP) redevelopment. Under this application consent is sought for redevelopment of Building C10A, construction of two student accommodation buildings (Buildings R1 and R2) and redevelopment of the landscaped Central Courtyard.

This geotechnical report has been prepared to cover the wider Macquarie University Central Courtyard Precinct, however the interest for this report is only the areas that form the SSDA application outlined by the red outline in this site plan.



## 2 Background

MU is a teaching and research institution of international, national and state significance. It is ranked among the top two per cent of universities in the world and holds a 5-star QS rating. MU is renowned for its innovative research and its commercial partnerships, with more than 100 leading companies located on Campus or in the surrounding Macquarie Park high-tech precinct.

The University was founded in 1964 and has since grown into a large research university with over 30,000 students and 3,000 staff. More than \$1 billion has

recently been invested in MU facilities and infrastructure to ensure students and staff can thrive in an inspiring and technologically advanced learning environment.

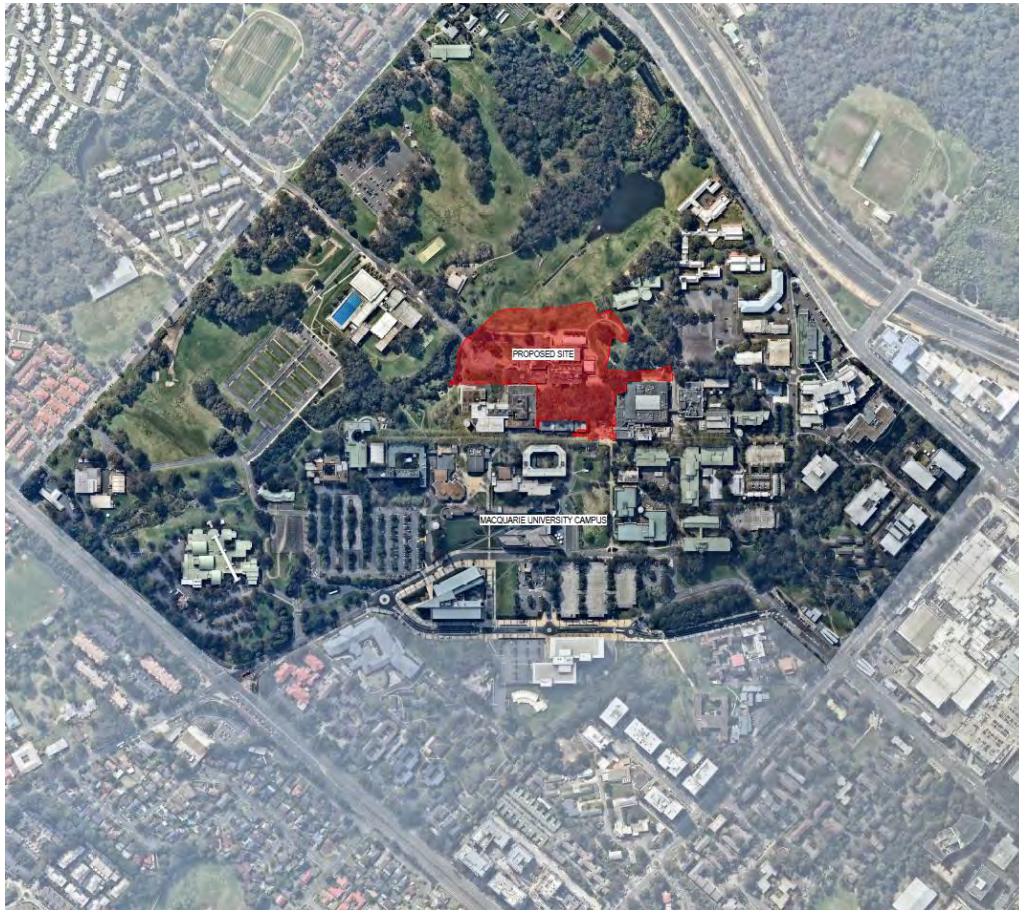
In March 2014, MU adopted the ‘Macquarie University Campus Master Plan 2014’. The Master Plan builds on the approved MU Concept Plan 2009 and sets out the physical framework to accommodate the University’s predicted needs, while ensuring flexibility into the future and enhancing the existing qualities of the University’s Campus. Ongoing changes in teaching methodologies, new course opportunities, a desire to increase industry engagement and the potential for commercial opportunities on the Campus were all key considerations in the development of the Master Plan.

### 3 Site Description

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The MUCCP is situated in the centre of the University campus, within Precinct A. The MUCCP currently contains Buildings C9A and C10A (the Student Hub) which are subject to a separate demolition DA to City of Ryde Council, Buildings C8A, C7A and the landscaped Central Courtyard. The MUCCP is a key component of the University campus.

Figure 1 shows the location of the MUCCP within the context of the University campus.



**Figure 1** - Location of the site

## 4 Overview of the Proposed Development

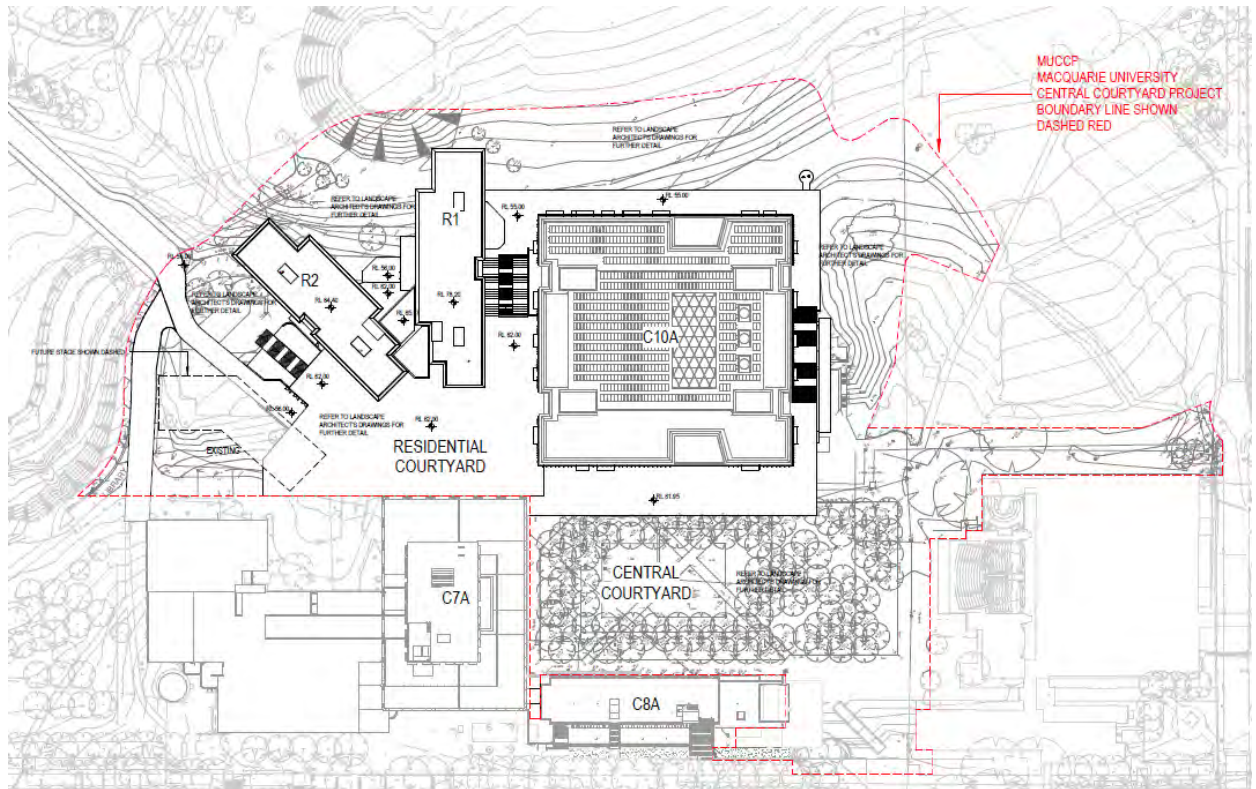
In accordance with the Master Plan, MU has identified the opportunity to move student accommodation to the heart of the campus. The Master Plan also acknowledges the importance of the MUCCP, and the need to retain the Precinct as a key focus of the University's civic and administrative functions, with active edges for retail, and food and beverage uses.

MU is seeking to secure development consent for the first phase of the MUCC precinct redevelopment. Consent is sought for redevelopment of Building C10A (known as 1 Central Courtyard), construction of two student accommodation buildings (R1 and R2) and redevelopment of the landscaped Central Courtyard. The proposal comprises:

- Construction of a new, multi-storey Student Hub (1 Central Courtyard) in place of existing Building C10A, with ancillary retail uses.
- Construction of two student accommodation buildings (Building R1 and R2) to provide approximately 340 student beds and integrated academic uses.
- Redevelopment of the landscaped Central Courtyard.

- Construction of a shared basement including plant, loading and waste management facilities, end of trip facilities and accessible parking.
- Installation of a new substation.
- Installation of utilities and services to accommodate the proposed development.
- Upgrade of the western extent of Science Road to accommodate fire brigade access.
- Tree removal and landscaping.

The extent of the SSDA works is shown in Figure 2.



**Figure 2** – Extent of the MUCCP SSDA

## 5 Purpose of this report

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As part of this engagement Arup is required to prepare a geotechnical interpretive report (GIR) based on the results of a Concept Stage geotechnical investigation undertaken by Arup.

This report has been prepared to support the concept design of the Macquarie University Central Courtyard Precinct project. The report also provides recommendations on additional site investigation to enable design progression from Concept to Detailed Phase.

### 5.1 Projection and Datum

For all positioning presented in this report, the following datums have been adopted:

- Horizontal datum: Geocentric Datum of Australia, GDA94
- Projection: Map Grid of Australia (MGA)
- Zone: 56
- Vertical datum: Australian Height Datum (AHD)

### 5.2 Disclaimer

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties that vary from place to place and can change through time. Geotechnical engineering involves gathering and assimilating the facts about these characteristics and properties in order to understand or predict the behaviour of the ground and groundwater on a particular site under certain conditions.

Arup may report such facts obtained by observation, excavation, probing and sampling, testing or by other means of investigation. If so, they are directly relevant only to the ground and groundwater at the place where, and the time when, the investigation was carried out, and are believed to be reported accurately.

Any interpretation or recommendation given by Arup shall be understood to be based on judgement and experience and not on greater knowledge of the facts than the reported investigations would imply. The information contained within this report shall be considered as for reference only.

This report has been prepared for the use of our Client in connection with the aforementioned project and takes into account particular requirements and instructions. It is not intended for use by any third party and no responsibility is undertaken to any third party.

## 6 Geotechnical desk study

This section presents the findings of a desktop review of the relevant published data and previous geotechnical investigation data provided by Macquarie University.

### 6.1 Sources of published information

The following sources of published information have been referred to during the desktop review:

- Topographical contour mapping with a contour interval of 2m from NSW Land and Property Information in 2008 (ref. [1]);
- Recent aerial imagery from the NSW Government Land and Property Information SIXMaps online database (ref. [2]);
- Sydney 1:100,000 Geological Map published by the Geological Survey of New South Wales (ref. [3]);
- Geology of the Sydney 1:100,000 Sheet 9130 published by the Geological Survey of New South Wales (ref. [4]);
- Soil Landscapes of the Sydney 1:100,000 Sheet map published by the Department of Environment, Climate Change and Water (ref. [5]);
- Soil Landscapes of the Sydney 1:100,000 Sheet report published by the Office of Environment and Heritage (ref. [6]);

Acid sulfate soil risk maps have been obtained from the NSW Office of Environment and Heritage website (ref. [7]), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Atlas of Australian Acid Sulphate Soils (ref. [8]) and the NSW Government Department of Planning and Environment website (ref. [9]).

### 6.2 Existing ground investigation data

The Client has provided the following historical geotechnical reports:

1. JK Geotechnics, April 2015. Proposed Expansion Fitout for Building E7A. Six boreholes were drilled, with soils and upper weak shale (Ashfield Shale of the Wianamatta Group) from surface to 4.12m to 5.30m depth, overlying shale and sandstone of at least very low strength. Sandstone (Hawkesbury Sandstone) was observed underlying the shale in five of the six boreholes, at depths from surface ranging from 5.50m to 7.90m. The boreholes were terminated at depths ranging from 7.50m to 11.14m.
2. Douglas Partners, April 2010. Proposed Australian Hearing Hub, corner University Avenue and Macquarie Drive. The investigation comprised a total of 16 boreholes: seven (7) cored boreholes drilled to depths of approximately 12.00m, nine (9) shallow augered boreholes drilled to depths

of 0.60m to 3.50m, and the installation of groundwater monitoring wells in three of the deeper boreholes.

3. Douglas Partners, October 2007. Proposed Library at Macquarie Drive. Twelve boreholes were completed, ranging from 8.70m to 11.75m depth. The ground profile was summarised as comprising less than 0.30m of filling / disturbed ground; residual soil (typically very stiff and hard silty clay) extending to depths between 1.00m to 3.00m; Ashfield Shale (extremely low to very low strength) extending to depths from 4.20m to 6.70m; Laminite of the Ashfield Shale (typically medium strength); sandstone interbedded with minor siltstone and laminate (of the Mittagong Formation) was intersected at depths ranging from 5.00m to 7.60m. The geological profile was described as variable and difficult to interpret and correlate across the site.
4. Arup, July 2001. Macquarie University Aquatic Centre. Thirteen boreholes were drilled, eight to assess the conditions for foundations, and four shallow boreholes to assess pavement conditions. Depths of the eight cored boreholes ranged from 5.00m to 8.56m. Residual soil (firm to very stiff clay) was encountered in all boreholes, and was between 0.25m and 0.80m thick. Interbedded shale and sandstone was intersected in borehole BH07 from 2.42m to 3.40m. Shale was intersected from 3.40m to 5.10m in borehole BH07. Sandstone was encountered in boreholes BH01 to BH08 at depths from ground surface of 0.50m to 2.10m.

Other geotechnical investigations noted but not obtained in the area include:

1. Douglas Partners, March 2008. Cochlear Global Headquarters to the southeast of the MUCCP site. The investigation included the installation of a groundwater monitoring well towards the south-eastern corner of the Hearing Hub site. Groundwater was not encountered within this 8.00m deep well at the time of the investigation.

## 6.3 Site description

The main Macquarie University campus is located about 17km to the northwest of the Sydney CBD. The Central Courtyard Precinct is in the centre of the campus area, and is serviced primarily by the internal campus road, Gymnasium Road, accessible from Culloden Road. A map of the general site location is shown in Figure 3.

## 6.4 Current land use

The site is currently used for university buildings and open space, including the Central Courtyard, old Library building, food and beverages retail, and an electricity substation and trigeneration plant. A services tunnel runs along the southern margin of the project site (beneath Wally's Walk), at an approximate depth of 2.00m below ground level.

A rail tunnel is indicated on the Dial Before You Dig (DBYD) plans from Sydney Trains North, at the south-western margin of the project site, buried to a depth of approximately 25.00m.

## 6.5 Site history

A high level review of historical aerial imagery has been undertaken using the SixMAPS online database (Ref. [2]). This indicates that the site was extensively cleared and used for orchards and small-scale farming.

The University was established in the early 1960s, and construction of buildings continued through the 1980s.

The Epping to Chatswood Rail Line began construction in 2002, and opened in 2009. A twin-bore tunnel connecting Macquarie University station and Epping station runs to the southeast of the project site.

## 6.6 Topography

The project site is situated in an area sloping to the north and northwest. The ground ranges in elevation from approximately RL 64.00m AHD at the southern edge of the project site immediately to the north of Wally's Walk, and to the west of building C7A and the cogeneration plant room. The site drops down to approximately RL 54.00m AHD at Mars Creek to RL 50.00m AHD at the flood basin. A map of the site topography is presented in Figure 4.

## 6.7 Utilities

A utilities search has been performed via DBYD service. Results of this survey indicated that numerous underground assets feed into the campus, including communications, electrical, water, and gas utilities.

In addition to public utilities, the University maintains a large network of utilities of its own. Utility plans were provided by DBA / Lockley's.

## 6.8 Published geology and geomorphology

According to the Sydney 1:100,000 Geological Sheet Map and Report (ref. [3] And [4]) the site is underlain by Hawkesbury Sandstone bedrock and Ashfield Shale (Figure 5). The Hawkesbury Sandstone bedrock is described as comprising medium to coarse grained quartz sandstone, with very minor shale and laminate lenses, while the Ashfield Shale is described as black to dark grey shale and laminate. There are no identified geological structures intersecting the site.

According to the Soil Landscapes of the Sydney 1:100,000 Sheet Map and Report (ref. [5] and [6]) the site is underlain by Lucas Heights Group Residual Sediment and Glenorie Group Erosional Sediment. This is shown in Figure 6.

The Lucas Heights Group landscape is described as comprising gently undulating crests and ridges on plateau surfaces of the Mittagong formation.

The Glenorie Group landscape is described as comprising undulating to rolling low hills on Wianamatta Group shales.

## 6.9 Groundwater

The National Groundwater Information System contains no information on groundwater levels in bores located in close proximity to the project site.

Groundwater was encountered in two groundwater monitoring wells installed in April 2010 by Douglas Partners near the Hearing Hub building. Groundwater was measured following development of the wells, at depths of RL 63.50m AHD in BH1, and RL 60.00m AHD in BH3.

On completion of coring, water was observed in all six boreholes reported in JK Geotechnics report on Building E7A. Water levels were between 2.90m to 3.40m below ground level. These levels are not representative of standing water levels as they were observed soon after coring (and associated use of drilling ‘muds’) was completed, but can provide an indication of the permeability of the soils in the borehole.

Based on the nearest groundwater level information from previous geotechnical investigations, the anticipated groundwater level at the site is expected to be between RL 63.5m AHD and RL 60.0m AHD.

## 6.10 Acid sulfate soils

The potential for Acid Sulfate Soils (ASS) at the site has been reviewed using the NSW Government Office of Environment and Heritage (ref [7]), the CSIRO (ref [8]) and the NSW Government Department of Planning and Environment mapping (ref [9]). A summary of the findings of this review is provided in Table 1, with mapping presented in Figure 7.

Table 1 Site Acid Sulfate Soil Classification

| Site                       | ASS Classification                             |                            |         | ASS Potential                              |
|----------------------------|------------------------------------------------|----------------------------|---------|--------------------------------------------|
|                            | CSIRO                                          | NSW OEH                    | NSW DPE |                                            |
| Central Courtyard Precinct | Extremely low probability of occurrence of ASS | No known occurrence of ASS | Class 5 | ASS are not expected to be present on site |

## 6.11 Epping to Chatswood railway

The Epping to Chatswood railway passes to the southwest of building C7A at a depth of about 25m. Plans from Sydney Trains indicated that the outermost extents of the railway easement are within 30m of the proposed locations for BH10 and BH11, however subsequent consultation with Eddie Blackwell and Peter Irvine of the Engineering and Maintenance Directorate of Sydney Trains confirmed that the planned investigations would not be within the zone of influence of the railway corridor.

## 7 Geotechnical site investigation

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### 7.1 General

The fieldwork was carried out between 10 October and 25 October 2016, and comprised the drilling of 16 vertical boreholes.

### 7.2 Boreholes

Auguring commenced at depths between ground level and 1.50m below ground level using solid flight augers with a Tungsten Carbide (TC) drill bit to auger or SPT refusal. Core Drilling was then commenced using NMLC diamond coring equipment with water flushing.

In six locations (BH06, BH07, BH08, BH10, BH16, and BH17), presence of pavement and asphalt required the use of a portable concrete corer, operated by the drilling sub-contractor BG Drilling.

Standard Penetration Testing (SPT) was completed at 1.50m centres whilst auguring and hand penetrometer readings were completed on cohesive samples recovered from undisturbed tube samples and the SPT split tube sampler.

The cored portion of the bedrock in the boreholes was assessed by visual examination of the recovered core and photographed. Point Load Strength Index testing (PLIT) was completed on recovered rock core at approximately 1.00m intervals, including Axial (A) and Diametral (D), by our geotechnical engineer on site during the fieldwork.

At the completion of the investigation Arup engaged David Cant Surveyors to survey the completed investigation locations, coordinates and reduced levels are presented in Table 2.

The borehole locations are shown in Figure 3. The borehole logs and core photographs for each borehole are presented in Appendix A. For more details of the investigation procedures, reference should be made to the Arup Explanatory Notes included in Appendix A.

The fieldwork was carried out under the direction and supervision of an Arup geotechnical engineer, who was present full-time on site, to direct the electromagnetic scanning and hydro excavation, set out the borehole locations,

direct the sub-contractors, log the encountered subsurface profile, and nominate sampling and testing. Each borehole was backfilled at the completion of drilling.

### 7.2.1 Utilities

Prior to the commencement of excavations, a 'Dial Before You Dig' services search was carried out and a specialist sub-consultant was engaged to scan the proposed borehole locations for buried utilities using an electromagnetic scanner and a ground penetrating radar scanner. At several of the proposed borehole locations the presence of utilities was positively identified.

Arup engaged Luke Bennet Maintenance to conduct hydro excavation to a depth of about 1.50m where the presence of utilities was positively identified at proposed borehole locations BH05, BH09, BH10, BH11, BH12 and BH17. As a result, BH09 was abandoned due to identification of a buried drainage pipe, and an inability to relocate within a suitable radius of the proposed location.

Hand augering was performed by the drilling sub-contractor BG Drilling at boreholes BH06, BH07 and BH08 for utilities identification and for collection of bulk samples for analysis of the California Bearing Ratio of the sub grade material.

### 7.2.2 Investigation Locations

Table 2 Investigation location coordinates, reduced level and termination depth

| Test location | Easting (m) | Northing (m) | Reduced level (mAHD) | Auger termination depth (mBGL) | Borehole termination depth (mBGL) |
|---------------|-------------|--------------|----------------------|--------------------------------|-----------------------------------|
| <b>BH01</b>   | 325221.33   | 6261427.14   | 54.82                | 7.13                           | 12.70                             |
| <b>BH02</b>   | 325259.83   | 6261425.44   | 55.38                | 4.86                           | 12.60                             |
| <b>BH03</b>   | 325291.87   | 6261427.01   | 55.47                | 4.20                           | 12.00                             |
| <b>BH04</b>   | 325324.89   | 6261435.21   | 55.49                | 2.90                           | 11.83                             |
| <b>BH05</b>   | 325366.72   | 6261421.50   | 57.19                | 4.25                           | 6.60                              |
| <b>BH06</b>   | 325357.45   | 6261337.53   | 61.38                | 4.60                           | 12.48                             |
| <b>BH07</b>   | 325292.36   | 6261334.36   | 61.44                | 5.20                           | 11.20                             |
| <b>BH08</b>   | 325288.94   | 6261312.78   | 61.49                | 3.96                           | 11.70                             |
| <b>BH10</b>   | 325237.59   | 6261262.09   | 65.67                | 6.00                           | 16.77                             |
| <b>BH11</b>   | 325177.53   | 6261266.10   | 64.39                | 9.32                           | 14.00                             |
| <b>BH12</b>   | 325159.96   | 6261324.12   | 59.66                | 9.40                           | 12.17                             |
| <b>BH13</b>   | 325181.40   | 6261372.57   | 56.12                | 5.65                           | 12.62                             |
| <b>BH14</b>   | 325235.18   | 6261351.50   | 58.37                | 3.48                           | 11.80                             |
| <b>BH15</b>   | 325236.68   | 6261380.66   | 56.47                | 1.49                           | 11.96                             |
| <b>BH16</b>   | 325265.53   | 6261373.92   | 57.17                | 2.94                           | 10.60                             |
| <b>BH17</b>   | 325229.07   | 6261314.65   | 60.96                | 5.57                           | 14.80                             |

### 7.3 Laboratory testing

Selected portions of rock core and soil samples were submitted to Macquarie Geotech Pty Ltd engaged by Arup, a NATA accredited laboratory to undertake geotechnical laboratory testing. A summary of the scheduled testing is presented in Table 3.

Table 3 Summary of geotechnical laboratory testing

| Material | Test                                                     | Abbreviation       | Number of tests |
|----------|----------------------------------------------------------|--------------------|-----------------|
| Soil     | Moisture content                                         | MC                 | 12              |
|          | Atterberg limits – Liquid limit                          | LL                 | 12              |
|          | Atterberg limits – Plastic limit                         | PL                 | 12              |
|          | Linear shrinkage                                         | LS                 | 11              |
|          | Shrink swell                                             | Shrink swell       | 1               |
|          | Particle size distribution (<19mm to 75micron)           | PSD                | 8               |
|          | Emerson crumb                                            | EC                 | 2               |
|          | Maximum dry density / Optimum moisture content           | MDD/OMC            | 3               |
|          | California bearing ratio (4.5kg surcharge, 4 day soak)   | CBR                | 3               |
|          | Aggressivity suite (pH, chloride, sulphate, resistivity) | Aggressivity suite | 7               |
| Rock     | Unconfined compressive strength                          | UCS                | 11              |

The lab certificates are presented in Appendix B.

### 7.4 Groundwater observations

Groundwater observations were made at boreholes BH01, BH05 and BH11 during augering and ranged from RL 50.02m AHD to RL 58.39m AHD. Whilst coring, water flush was used and groundwater was not observed.

## 8 Geotechnical model and design considerations

### 8.1 Geotechnical units

The subsurface soil has been grouped into geotechnical units to enable ground characterisation and for assessment of geotechnical parameters. The units have been classified based on the geomorphology and findings of the site investigation undertaken by Arup. A summary of the geotechnical units encountered at the project location is provided in Table 4.

Material properties for each unit and engineering advice will be discussed in Section 8.2 and Section 9 respectively.

Table 4 Summary of geotechnical units

| Geotechnical Unit      | Material Type     | Common Description                                                                                                                                                                                                                                                                                   | Top of layer (mBGL) | Thickness of layer (m) |
|------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------|
| -                      | Surface pavement  | Concrete paver, concrete slab and asphalt.                                                                                                                                                                                                                                                           | 0.00 to 0.15        | 0.10 to 0.30           |
| Unit 1 – Fill          | Uncontrolled Fill | Clay - Low to medium plasticity, brown. Sand is fine to coarse grained.<br><br>Gravel is fine to coarse grained, sub-angular to sub-rounded, brown.                                                                                                                                                  | 0.00 to 0.15        | 0.05 to 6.00           |
| Unit 2 – Residual Soil | SAND and CLAY     | Clay - Low to high plasticity, brown, orange brown, pale grey and pale red, stiff to hard, very soft to soft in some locations.<br><br>Sand - Fine to medium grained, yellow brown and pale grey, medium dense to dense. Fine to medium grained gravel encountered at some locations. Trace of silt. | 0.15 to 6.00        | 0.99 to 7.50           |
| Unit 3                 | SHALE             | Very low to medium strength, dark grey, fresh to distinctly weathered, with sandstone laminae bedded at 0° and 5°.                                                                                                                                                                                   | 7.35 to 13.65       | 0.07 to 2.35           |

|        |           |                                                                                                                                                                                                                           |               |                      |
|--------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------|
| Unit 4 | SANDSTONE | Typically medium to high strength with extremely low and very high strength in some locations, pale grey, red brown, orange. Typically fresh to distinctly weathered with extremely weathered sections in some locations. | 1.49 to 14.05 | Proved to 16.77 mBGL |
|--------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------|

## 8.2 Material properties

### 8.2.1 Surface pavement

Surface pavement was encountered in BH06, BH07, BH08, BH10, BH14, BH16 and BH17 from ground level. The type of surface pavement encountered included concrete pavers, reinforced concrete slab and asphalt. The thickness of surface paving ranged from 100mm to 300mm.

### 8.2.2 Unit 1 - Fill

Fill materials were encountered in all boreholes whilst augering except BH10, BH12, BH14 and BH17. Hydro excavation was used in BH10, BH12 and BH17 precluding the identification of any fill. Fill was not encountered in BH14.

Near the flood basin, uncontrolled fill material was encountered in BH01, BH02, BH03, BH04 at ground level, and at a depth of 1.50m BGL in BH05 following hydro excavation. The fill generally consisted of sandy clay, low to medium plasticity, with fine to medium grained sand and traces of silt, inferred to have a firm consistency.

In BH06, BH07 and BH08 located in the courtyard, the fill material underlying the concrete consisted of sandy gravel, fine to coarse grained, sub-angular to sub-rounded, with fine to coarse grained sand, the fill is inferred to have a loose consistency.

In BH11 located near Wally's walk, fill material was encountered at ground level, and consisted of sandy clay, medium plasticity, with fine to medium grained sand, with silt, inferred to have a stiff consistency.

Near proposed buildings R1, R2 and R3 (seen in Figure 3), fill material was encountered at ground surface in BH13 and BH15, and in BH16 directly beneath the asphalt layer. The fill generally consisted sandy clay, medium plasticity, with fine to coarse grained sand, with fine to medium grained gravel sub-angular to sub-rounded and trace of silt, the fill is inferred to have a firm to stiff consistency.

The thickness of fill encountered ranged from 0.05m to 6.00m thick across the site.

*In situ testing results – Unit 1*

SPT ‘N’ values recorded in the uncontrolled fill material ranged from 0 to 19 blows/ 300mm.

The hand penetrometer readings recorded in the uncontrolled fill material were greater than 220kPa.

A plot of SPT ‘N’ values versus reduced levels is given in Figure 28, the detailed results are provided on the borehole logs presented in Appendix A.

*Laboratory results – Unit 1*

Results of classification tests including moisture content, Atterberg limits, linear shrinkage, shrink swell and PSD tests on Unit 1 are summarised in Table 5. The classification test results are presented in Figure 16 to Figure 21.

Table 5 Summary of classification tests on Unit 1

| Borehole ID | Depth (mBGL) | Moisture content (%) | Plastic limit (%) | Liquid limit (%) | Plasticity index (%) | Linear shrinkage (%) | % Passing 75µm sieve |
|-------------|--------------|----------------------|-------------------|------------------|----------------------|----------------------|----------------------|
| BH01        | 4.50 – 4.95  | 25.90                | 19.00             | 42.00            | 23.00                | -                    | 78.00                |
| BH13        | 1.50 – 1.95  | 20.20                | 21.00             | 53.00            | 32.00                | 13.00                | -                    |

The LL ranges between 42.00% and 53.00% and PL ranges between 19.00% and 21.00% for Unit 1 (Figure 16 and Figure 17). PI values range between 23.00% and 32.00% which show the materials have a medium plasticity (Figure 18). The LS value obtained from a single Unit 1 sample was 13.00%.

The plasticity index test results for the samples tested indicate they have a high to very high swelling potential. The linear shrinkage results for the samples tested indicate a critical degree of soil expansion (ref[11]).

The PSD results on the single Unit 1 sample revealed that this material has a fines content of 78.00%. PSD test results can be seen in Figure 21.

*Moisture density tests – Unit 1*

No moisture density tests were conducted on Unit 1 material.

**8.2.3 Unit 2 - Residual soil**

Residual soil was encountered in all boreholes. The residual soil generally consisted sandy clay, medium to high plasticity, with fine to medium grained sand, trace of silt, fine to medium grained gravel was present at some locations, with a stiff to hard consistency.

The depth of the residual soil ranged from 0.15m to 6.00m BGL. The thickness of the residual soil ranged between 0.99m to 7.50m.

*In situ testing results – Unit 2*

SPT ‘N’ values recorded in the residual soil ranged from 2 to greater than 50 blows/ 300mm.

Some of the higher SPT ‘N’ values recorded in the boreholes can be attributed to the presence of shale, sandstone and ironstone encountered in that unit during testing.

The hand penetrometer readings recorded in the residual soil ranged from 200kPa to greater than 220kPa.

A plot of SPT ‘N’ values versus reduced levels is given in Figure 28, the detailed results are provided on the borehole logs presented in Appendix A.

### *Laboratory results – Unit 2*

Results of classification tests including moisture content, Atterberg limits, linear shrinkage, shrink swell and PSD tests on Unit 2 are summarised in Table 6. The classification test results are presented in Figure 16 to Figure 21.

Table 6 Summary of classification tests on Unit 2

| Borehole ID | Depth (mBGL) | Moisture content (%) | Plastic limit (%) | Liquid limit (%) | Plasticity index (%) | Linear shrinkage (%) | % Passing 75µm sieve |
|-------------|--------------|----------------------|-------------------|------------------|----------------------|----------------------|----------------------|
| BH02        | 1.00 – 1.45  | 16.00                | 19.00             | 61.00            | 42.00                | 17.50                | 61.00                |
| BH05        | 2.50 – 2.95  | 14.20                | 18.00             | 17.00            | 0.00                 | 1.50                 | 24.00                |
| BH06        | 0.18 – 0.50  | 17.40                | 21.00             | 45.00            | 24.00                | 11.00                | 39.00                |
| BH07        | 0.20 – 0.74  | 18.20                | 16.00             | 29.00            | 13.00                | 6.00                 | 26.00                |
| BH08        | 0.20 – 0.50  | 16.70                | 20.00             | 45.00            | 25.00                | 11.00                | 53.00                |
| BH10        | 1.50 – 1.95  | 11.10                | 19.00             | 35.00            | 16.00                | 9.00                 | -                    |
| BH11        | 4.50 – 4.95  | 10.60                | 20.00             | 27.00            | 7.00                 | 5.00                 | 33.00                |
| BH12        | 1.50 – 2.30  | 26.60                | 24.00             | 59.00            | 35.00                | 11.00                | -                    |
| BH16        | 1.00 – 1.45  | 14.50                | 16.00             | 34.00            | 18.00                | 7.00                 | -                    |
| BH17        | 2.00 – 2.45  | 9.20                 | 22.00             | 20.00            | 0.00                 | 1.50                 | 36.00                |

The LL ranges between 17% and 61% and PL ranges between 16.00% and 24.00% for Unit 2 (Figure 16 and Figure 17). PI values range between 0.00% and 42.00% which show the materials have a low to medium plasticity (Figure 18). LS values vary between 1.50% and 17.5% for Unit 2.

The plasticity index test results for the samples tested indicate they have a low to very high swelling potential. The linear shrinkage results for the samples tested indicate a non-critical to critical degree of soil expansion (ref [11]).

A shrink swell test was conducted on a single sample on BH02 at a depth of 1.5m to 1.9m BGL with a shrink swell index of 0.9.

The PSD results on granular Unit 2 samples revealed that this material has a fines content of 24.00%. PSD test results can be seen in Figure 21.

PSD results on cohesive Unit 2 samples showed that this material has a fines content ranging between 26.00% and 61.00%. PSD test results can be seen in Table 6 and Figure 21.

#### *Moisture density tests – Unit 2*

The compaction testing and field moisture testing conducted on Unit 2 are provided in Table 7. Figure 22 shows the Field Moisture Content (FMC) over Optimum Moisture Content (OMC) plotted for BH06, BH07 and BH08. Figure 23 shows the FMC plotted against OMC. Figure 24 shows MDD plotted against OMC.

The CBR results are presented Table 7 and in Figure 25 to Figure 27. Figure 25 shows CBR results plotted for BH06, BH07, BH08. Figure 26 shows swell plotted against CBR. Figure 27 shows PI plotted against CBR.

Three CBR tests were conducted on samples from Unit 2. Samples were prepared to 99% - 100% MDD using standard compactive effort and soaked for 4 days.

Table 7 Summary of moisture density tests on Unit 2

| Borehole ID | Depth (mBGL) | OMC (%) | MDD (t/m <sup>3</sup> ) | Field moisture content (%) | CBR (4 day soak) | CBR swell (%) |
|-------------|--------------|---------|-------------------------|----------------------------|------------------|---------------|
| BH06        | 0.18 – 0.50  | 17.70   | 1.747                   | 17.40                      | 6.00             | 0.70          |
| BH07        | 0.20 – 0.74  | 15.90   | 1.773                   | 18.20                      | 2.50             | 0.00          |
| BH08        | 0.20 – 0.50  | 16.30   | 1.853                   | 16.70                      | 6.00             | 0.70          |

The results show that the field moisture content of Unit 2 is generally higher than the optimum moisture content. Note that the number of test results are limited. The MDD for Unit 2 ranges between 1.747 t/m<sup>3</sup> and 1.853 t/m<sup>3</sup>. Refer to Figure 26.

#### **8.2.4 Emerson crumb**

A summary of the Emerson Crumb results based on the geotechnical units are presented in Table 8.

Table 8 Summary of Emerson Crumb testing

| Borehole ID | Unit | Depth (mBGL) | Emerson Class No. |
|-------------|------|--------------|-------------------|
| BH01        | 1    | 4.50 – 4.95  | 5                 |
| BH01        | 2    | 6.00 – 6.45  | 5                 |

### 8.2.5 Soil aggressivity

Soil aggressivity testing has been completed on seven soil samples as part of the site investigation. Including pH, resistivity, sulfate content and chloride content.

The test results are presented in Table 9.

Table 9 Laboratory soil aggressivity test results

| BH no. | Depth (mBGL) | pH (units) | Resistivity ( $\Omega$ .m) | Chloride (ppm) | Sulfate (ppm) |
|--------|--------------|------------|----------------------------|----------------|---------------|
| BH01   | 6.00 - 6.45  | 5.1        | 180                        | 68.7           | 37.1          |
| BH03   | 1.50 - 1.95  | 5.5        | 205                        | 66.5           | 22.7          |
| BH05   | 2.50 – 2.95  | 5.7        | 180                        | 70.9           | 22.7          |
| BH08   | 3.00 – 3.45  | 4.6        | 160                        | 68.7           | 24.7          |
| BH11   | 7.50 – 7.80  | 5.3        | 100                        | 84.2           | 45.3          |
| BH13   | 3.00 – 3.45  | 6.6        | 200                        | 79.8           | 18.5          |
| BH17   | 3.00 – 3.45  | 5.4        | 205                        | 75.3           | 16.5          |

## 8.3 Bedrock

### 8.3.1 Unit 3 - Shale

Shale was encountered in boreholes BH02, BH03, BH10 and BH11. The depth of shale varied between 8.70m and 13.65m BGL, with thickness varying between 0.07m 1.00m.

Shale was generally described as slightly weathered to extremely weathered, very low to medium strength. The logged defects typically comprised sub-horizontal bedding planes joints dipping at 5° to 70°, with clay and sand infill.

Laminite was encountered in BH10 at a depth of 7.35m below ground level, with a thickness of 1.35m.

Laminite was described as thinly to very thinly laminated and distinctly weathered, low to medium strength. The logged defects typically comprised sub-horizontal bedding planes, with clay infill.

### 8.3.2 Unit 4 - Sandstone

Sandstone bedrock was encountered in all boreholes. The depth varied between 1.49m and 14.05m below ground level, with thickness between 0.07m and 2.35m.

The sandstone was assessed as being generally distinctly weathered to fresh with occasional extremely weathered sections, and generally of medium to high strength with occasional low to extremely low strength sections. The following defects have been recorded:

- A number of undulating and planar joints typically dipping between 0° and 35°, a number of steeply inclined joints dipping between 45° and 85° were also recorded. The infill was generally clean or clay between 1mm to 35mm.
- Horizontal bedding plane partings and bedding plane partings dipping between 5° and 20°, typically with clay infill between 1mm and 30mm.
- Crushed seams dipping between 0° and 25°, generally with gravel infill between 5mm and 80mm.
- Weathered /decomposed zones dipping between 5° and 75°, generally with clay and sand infill between 2mm and 50mm with a number of thicker weathered/decomposed zones between 60mm and 290mm.
- Where core loss was encountered as indicated on the borehole logs, core loss may be interpreted as representing clay, weathered and crushed seams.

### 8.3.3 Point load strength index

Point load strength index tests were carried out on rock core samples for Unit 4 at approximately one metre intervals. Rock core samples were loaded until failure and the failure load recorded. Both diametral and axial test were undertaken. This test provides an indication of the  $Is(50)$  index strength of the rock.

A total of 254 point load index strength tests were carried out. The point load test results show that the  $Is(50)$  index strength ranged from 0.05MPa to 5.24MPa and 0.07MPa to 4.68MPa for diametral and axial tests respectively. A plot of  $Is(50)$  index strengths versus reduced level is presented as Figure 29. The profile of  $Is(50)$  at log scale with depth can be seen to be relative uniform with depth. The point load test results indicate that the rock cored was of very low to very high strength, but was typically medium to high strength.

### 8.3.4 Unconfined compressive strength tests

Unconfined Compressive Strength (UCS) tests were performed on eleven Unit 4 core samples at depths between 5.52m and 13.84m BGL. All samples were loaded to failure. The results show that the UCS values range from 12.90MPa to 32.40MPa. A plot of UCS versus reduced level is presented in Figure 30. These results are consistent with the results from the point load tests, indicating a typical strength of medium to high.

### 8.3.5 Point load correlation with UCS

The results of point load index tests can be used to estimate the UCS of Unit 4. Typically for sandstone the UCS is about 20 times the axial point load strength index  $Is(50)$ .

$$UCS = 20 \times Is(50)$$

This correlation was used to estimate UCS of Unit 4 from the point load test results and can be seen in Table 10. These suggest the UCS value of the sandstone ranges from about 10.40MPa to 43.40MPa, with the only outlier being BH02 which resulted in a UCS value of 93.60MPa, which was generally confirmed by the UCS test results.

Table 10 Point load correlation with UCS

| Borehole ID | Depth (mBGL)  | Is(50) | 20 x Is(50) (MPa) | UCS (MPa) |
|-------------|---------------|--------|-------------------|-----------|
| BH02        | 7.66 – 7.82   | 4.68   | 93.6              | 19.5      |
| BH03        | 8.82 – 9.00   | 1.09   | 21.8              | 24.3      |
| BH05        | 5.52 – 5.68   | 1.31   | 26.2              | 22.1      |
| BH06        | 8.00 – 8.14   | 0.84   | 16.8              | 16.8      |
| BH07        | 5.77 – 5.92   | 0.73   | 14.6              | 18.4      |
| BH08        | 6.00 – 6.18   | 0.52   | 10.4              | 12.9      |
| BH10        | 13.12 – 13.27 | 0.79   | 15.8              | 22        |
| BH11        | 13.84 – 14.00 | 0.98   | 19.6              | 16.3      |
| BH12        | 10.50 – 10.65 | 1.14   | 22.8              | 17.4      |
| BH15        | 9.00 – 9.15   | 2.17   | 43.4              | 32.4      |
| BH17        | 13.84 – 14.00 | 2.03   | 40.6              | 19.1      |

## 8.4 Groundwater

Groundwater observations were made at three boreholes BH11, BH05 and BH01, at depths of RL 58.39m AHD, RL 54.39m AHD and RL 50.02m AHD respectively during auger drilling. Wash boring and coring were subsequently conducted with water flush, rendering it impossible to determine the natural occurrence of groundwater on the day of drilling.

Groundwater was observed directly beneath the concrete slab at BH07 and BH08 prior to the commencement of drilling. It should be noted that water was introduced as part of the pavement coring process and the water levels may represent ponding of introduced water or perched groundwater. A large rainfall event also occurred during the morning of the drilling of these holes (22<sup>nd</sup> October 2016), the historical rainfall data is presented in Figure 31 and Figure 32. Due to the limited period of the investigation the water levels noted are not expected to be representative of the standing groundwater table. The pavement subgrade may be inundated during rainfall events due to rising groundwater or flooding.

## 9 Comments and recommendations

Based on the available geotechnical investigation and laboratory test results described above, the following sections present the geotechnical design parameters, and discuss options for construction and the associated engineering risks for the concept design.

### 9.1 Rock classification

The sandstone and shale has been classified in accordance with Pells et al (Ref. [17]) which utilises the rock strength and the nature, frequency, spacing and thickness of discontinuities to determine the “class” of rock. The rock mass was classified into units of similar characteristics.

The rock classification profile of the shale and sandstone is illustrated on the geotechnical long sections included in Figure 8 to Figure 15 and in Table 11.

Table 11 Bedrock classification

| Borehole ID | Expected sandstone class   |                             |                                        |
|-------------|----------------------------|-----------------------------|----------------------------------------|
|             | Depth (mRL) Top of Class V | Depth (mRL) Top of Class IV | Depth (mRL) Top of Class III or better |
| BH01        | 44.49                      | -                           | 47.13                                  |
| BH02        | 50.08                      | -                           | 50.52                                  |
|             |                            |                             | 49.05                                  |
| BH03        | -                          | 51.27                       | 46.17                                  |
| BH04        | -                          | -                           | 52.59                                  |
| BH05        | -                          | -                           | 52.94                                  |
| BH06        | -                          | 56.78                       | 53.51                                  |
|             |                            | 50.92                       |                                        |
| BH07        | 55.35                      | 52.54                       | 56.24                                  |
|             |                            |                             | 53.94                                  |
| BH08        | 57.53                      | -                           | 55.89                                  |
|             | 54.49                      |                             | 53.24                                  |
| BH10        | 59.67                      | -                           | 55.97                                  |
|             | 52.02                      |                             | 51.62                                  |
| BH11        | 54.32                      | -                           | 52.95                                  |
| BH12        | -                          | -                           | 50.26                                  |
| BH13        | -                          | 50.47                       | 49.62                                  |
| BH14        | 54.89                      | -                           | 49.72                                  |
| BH15        | 53.30                      | -                           | 54.98                                  |
|             |                            |                             | 49.92                                  |
| BH16        | -                          | 54.23                       | 49.37                                  |

| Borehole ID | Expected sandstone class   |                             |                                        |
|-------------|----------------------------|-----------------------------|----------------------------------------|
|             | Depth (mRL) Top of Class V | Depth (mRL) Top of Class IV | Depth (mRL) Top of Class III or better |
| BH17        | -                          | 55.39                       | 50.96                                  |
|             |                            | 48.76                       | 47.26                                  |

## 9.2 Earthworks

Excavation recommendations provided below should be completed by reference to the Safe Work Australia Code of Practice ‘Excavation Work’, and by reference to AS3798-2007 ‘Guidelines for Earthworks for Commercial and Residential Developments’.

### 9.2.1 Site preparation

For any areas where new lightly loaded on-grade floor slabs and/or new external paved areas are proposed the soil subgrade will need to be proof rolled to improve the near surface compaction and to check for any soft spots or unstable areas which, if detected, would need to be removed down to a sound base and replaced with engineered fill (outlined in section 9.3.2).

The proof rolling would need to be completed using a smooth drum vibratory roller of 8 tonnes static weight. Proof rolling should be carried out under the direction of an experienced earthworks superintendent or geotechnical engineer to assist in the detection of soft or unstable areas.

All earthworks to be in accordance with the project earthworks plan/specification.

### 9.2.2 Stability of temporary and permanent batters

Where cut slopes need to be formed below existing ground level in both soil and weathered rock, suitable batter angles should be cut to form stable slope for excavation.

Temporary cut batter of 1V:2H in fill and 1V:1.5H in residual soil and CLV/IV sandstone should be suitable for slopes up to 3m height in the absence of any surcharge or groundwater. It is recommended that the slopes are protected to avoid erosion or local instability due to rainfall. This assessment has been based on information from the ground investigation and past experience in similar materials. It may also be desirable to flatten these batters for environmental or maintenance reasons.

Permanent cut batters of 1V:3H in fill and 1V:2H in residual soil and CLV/IV sandstone should be adequate for slopes up to 3m height in the absence of any applied surcharge or groundwater. Permanent protection such as grassing, geosynthetic netting or shotcreting would be required to reduce the likelihood of long term degradation of the slopes due to erosion.

A geotechnical engineer shall be consulted to complete a slope stability analysis where there is a requirement for steeper slopes, slopes are greater than 3m height, slopes support a surcharge or shallow groundwater is present.

### 9.2.3 Vertical excavation

The proposed development may include the excavation of basements or tunnels. This would involve excavation in various materials such as fill, residual soil, shale and sandstone of different weathering grades. Excavations in the proximity of adjacent structures and utilities are likely to require a retaining system.

Vertical excavation can be achieved in Class III sandstone or better, localised permanent support (i.e. rock bolts or shotcrete) maybe be required depending on the orientation, frequency and spacing of rock defects present in the rock mass. Fractures are likely to interact with the three-dimensional geometry of the basement. The installation of any permanent support must consider the proximity to the property boundary, adjacent structures and utilities.

It is recommended that any excavated rock face be inspected by a Geotechnical Engineer or Engineering Geologist at 1.0m to 1.5m intervals as the excavation proceeds to identify potential joints or other features that may affect the stability of the excavation. Weathered zones and shale will need to be shotcreted during excavation to prevent future instability.

Lateral movement of the excavated rock face may occur during construction of the basement. These lateral movements may occur in response to in situ stress relief of the surrounding rock due to excavation.

### 9.2.4 Excavatability

Excavation in fill, residual soil and low strength sandstone should be possible using conventional earthmoving equipment such as tracked loaders, and hydraulic excavators.

For excavation at a greater depth where sandstone is expected to be medium to high strength, it is likely that heavy bulldozers, rock hammer or rock saws are used. Excavation for footings and trenches will also require the use of rock hammers or rock saws.

Selection of appropriate excavation techniques must consider noise limits and vibration restrictions.

Due to the shallow depth to bedrock, basement foundations are likely to encounter CLIII or better sandstone. The assessment of excavatability and rippability was based on the excavatability graph by Pettifer & Fookes 1994(Ref.[19]) and MacGregor et al 1994 (Ref. [20]), using the results of the PLIT presented in Figure 29, and defect spacings index presented on the borehole logs in Appendix A.

The results of the analysis indicate the following estimate of rippability:

Fill, residual soil and low strength sandstone are excavatable using Hard Digging (eg, CAT245 backhoe or face shovel);

Low to Medium strength sandstone with fracture spacing index (0.06 – 0.6) may be excavated using D6 and D7 and classify as easy ripping.

Medium to High strength sandstone (Class III or better) may be in the range of hard ripping (D8) to hydraulic breaking (D9), and may be assisted by blasting if permitted.

Further rippability assessment will be required by the earthworks contractor as assessing the rippability of the rock on the basis of Is(50) and continuity spacing may have the potential to overlook important factors such as orientation.

It should be recognised that the above excavatability estimates are based on the materials encountered in the geotechnical borehole investigations by Arup and that conditions may vary for excavatability between and beyond these borehole locations

## 9.2.5 Noise and vibration

Noise and vibration will be caused by excavation work on the site. The excavation is in close proximity to existing adjacent properties and utilities. Selection of the excavation equipment should be carefully considered by the earthworks contractor as part of their noise and vibration control plan. Techniques such as rotary milling heads or rotary rock saws may be a feasible option to minimise the lateral transmission of vibrations. Initial rock cutting carried out using rotary rock saws, will achieve both a more accurate excavation line and will isolate site vibrations from the adjacent structure.

If blasting is required and hydraulic rock hammers are used for fracturing of the high strength rock, the process will need to be carefully controlled and monitored to minimise the impacts to the nearby structures and underground services.

## 9.2.6 Retaining structures

Where excavation of the fill, residual soil and CLV/IV sandstone is required, retaining structures may be used to support the excavation or suitable batter angles cut to achieve a stable slope.

The following design parameters for temporary and permanent retaining structures are recommended in

Table 12 and have been derived from standard correlations. The following parameters may be used for the purpose of preliminary geotechnical design and are based on the Tomlinson 1997 (Ref. [16]) correlations and Pell et al (1998) (Ref. [17] and Ref. [18]) classification.

Table 12: Soil and rock properties for retaining structures

| Soil Origin   | Materials       | $\gamma$<br>(kN/m <sup>3</sup> ) | Cu<br>(kPa) | Eu<br>(MPa) | c'<br>(kPa) | $\Phi'$<br>(°) | E'<br>(Mpa) |
|---------------|-----------------|----------------------------------|-------------|-------------|-------------|----------------|-------------|
| Fill          | Sandy CLAY      | 18                               | -           | -           | 0           | 26             | 15          |
| Residual soil | Sandy CLAY/CLAY | 20                               | 50-100      | 30-45       | 0-5         | 26-28          | 26-40       |
| Sandstone     | CLV             | 24                               | -           | -           | 10          | 30             | 200         |
| Sandstone     | CLIV            | 24                               | -           | -           | 30          | 30             | 300         |

### 9.2.7 Retaining walls

The design of the retaining wall shall consider the retained ground profile, groundwater and any temporary and permanent surcharge to meet Australian standards. The presence of any current and future utilities shall be considered with particular attention to water infrastructure. The depth of the retaining wall foundation shall consider any future and unforeseen excavation in front of the wall.

Retaining wall backfill shall comprise free draining material granular. Material derived from argillaceous rocks or materials subject to break down on weathering and compaction shall not be used as backfill to retaining walls.

Drainage shall be considered at the rear of the structure, draining to a low point and away from the structure. The drainage system shall permit maintenance with inclusion of flushing points.

### 9.2.8 Basement retention options

Any basement excavation may be close to the boundaries of adjacent properties, structures and utilities, lateral support to the soils and poor quality rock (CLV/IV Sandstone) prior to excavation will be required. Lateral support is required both during construction and as part of the final structure. Care must be taken to fully support the soils and weak rock prior to any excavation to avoid loss of ground and surface subsidence.

Prior to proceeding with the excavation, the founding level and founding material of the adjacent properties is to be determined and considered in the selection of the retention system and whether underpinning of adjacent building foundations is required. The lateral support must consider surcharges from adjacent building foundations.

Lateral support for the excavation must be sufficiently stiff to limit both horizontal and vertical movements. The stiffness can be provided by pile walls keyed into the underlying CLIII sandstone at close spacing (or contiguous piles), increasing the diameter of the piles or by installing temporary anchors into the pile wall to provide temporary restraint until the permanent structural support has been constructed. Anchors can be stiffened by increasing the number of

prestressing strands in the anchor and by applying a suitable prestress to the anchor before excavation.

Ground movements will be greatly influenced by wall geometry, wall type and construction technique. Settlements and lateral movements will therefore need to be assessed on an individual case basis for each wall section.

Where perimeter walls founded above the floor of the basement are required to carry vertical loads, these should generally be founded on CLIII or better sandstone and a reduced end bearing capacity is to be considered in the design by the designer. The wall foundation should be assessed by a Geotechnical Engineer or Engineering Geologist as excavation approaches the founding level and immediately as excavation passes below the founding level to assess any additional support requirements.

### 9.2.9 Temporary anchors

The retaining structure may require temporary rock anchors to provide short term lateral support. Where rock anchors are to be used, allowable bond stresses may be adopted as per the allowable shaft friction provided in Table 13 below. The bond length of the rock anchors should be limited to 10m, and anchor inclinations typically vary between 20° to 45° below the horizontal. If anchors are to be used, consent should be sought from neighbouring properties where they cross property boundaries.

### 9.2.10 Groundwater

Groundwater was observed in three of the augured portion of the boreholes. Groundwater flow is expected to be low through the residual soil and rock fabric, and to move through rock fractures below this. The rate of groundwater flow is expected to be influenced by rainfall and downslope groundwater flows with potential for perched groundwater overlying the sandstone.

Groundwater inflow may occur through the fill, residual soil and weathered sandstone. Further seepage is likely to occur through the sandstone fractures. The design of the basement excavation may consider, a watertight solution against the fill, residual soil and Class V/IV sandstone, and grouting of fractures within the underlying sandstone. Intermittent pumping may be considered to control groundwater inflows during bulk excavation. Permanent drainage will need to be considered behind any perimeter retaining wall, any applied shotcrete surfaces and beneath the basement base slab.

Design groundwater level may be taken at the top of sandstone for serviceability analysis and 1m above Class V rock for ultimate limit state analysis. Allowance should be made for local dewatering of perched water tables during construction.

## 9.3 Foundations

Depending on the basement excavation level and the structural loadings, it is recommended that all foundations for the proposed development would either comprise of spread footings on sandstone or bored piles socketed into sandstone.

Construction of foundations on different strata will increase the risk of differential movements in foundations, and it is recommended that all foundations be founded in the same bearing stratum.

As the presence and depth of fill varies across the site. It has been assumed that fill materials, where encountered at the ground surface, will be removed or removed and replaced with engineered fill prior to the construction of any structural foundation, due to inherent variability.

The two founding options of spread footings and piled foundations have been considered.

### 9.3.1 Spread footings

Due to the high structural loads from the proposed structures it is recommended that in general all footings be founded on rock.

Only lightly loaded elements should be founded on the residual soil, in which case an allowable bearing pressure of 100kPa may be used where founded on horizontal ground. Due to the variable nature of the residual soil, the bases of these footing excavations are to be compacted and inspected by a Geotechnical Engineer to verify allowable bearing pressures. Appropriate movement joints should be allowed for where these elements are tied in to any structure founded on rock. Spread footings founded on fill are not recommended.

Where the foundation level is in excess of 1.2m below formation level, footing excavations will need to be shored or the sides of the excavation battered to allow for safe access. The size of footing will depend on the load imposed by the building structure and the founding material.

Spread footings founded on sandstone are considered to be a feasible foundation option for any proposed building. The size of footing will depend on the load imposed by the building structure. All footings must be socketed at least 0.3m into the design class of rock for end bearing. For footings founded on CLIII sandstone at least 33%, and for CL II/I sandstone at least 50% of the footing locations must be proof cored to a depth of twice the minimum footing width below the base of the footings to confirm the class of the rock. The design bearing pressure for different classes of sandstone based on the recommendation of Pell et al, 1998 (Ref. [17]) is provided in Table 13. The founding rock shall be classified by the designer for the selected foundation type and geometry.

All footings should be excavated, cleaned, inspected and poured with minimal delay (ie. Within the same day). All footings should be free from all loose or softened materials prior to pouring. If water ponds in the bases of the footing excavations it should first be pumped dry and then over excavated to remove all loose and softened materials.

A Geotechnical Engineer or Engineering Geologist should inspect all footings to determine that the founding rock meets the specification in terms of base cleanliness and rock quality.

For high level foundations located adjacent to the face of the excavation, the excavated face beneath the foundation may require permanent support and a reduced design bearing capacity may need to be considered by the designer

### 9.3.2 Piled foundations

Bored piles could be a viable foundation option to support the proposed building foundations. Piles may need to be cased over the depth of the fill and residual soil to prevent collapse of this material into the shaft during construction. Parameters for pile design are presented in Table 13.

It is recommended that a Geotechnical Engineer or Engineering Geologist should inspect all piles to determine that the rock socket meets the specification in terms of side wall roughness and cleanliness, base cleanliness and rock quality. Where groundwater inflow are encountered in the pile base, techniques such as the use of air lift pump may be employed to clean the sockets, concrete should be placed by tremie after cleaning the pile base to reduce the likelihood of aggregate segregation (within 24 hours of excavation of the socket). Piles must be socketed to at least one pile diameter into the design class of rock for end bearing.

For piles socketed into CLIII sandstone at least 33%, and for CL II/I sandstone at least 50% of the pile locations must be proof drilled to a depth of two pile diameters below the toe of the piles to confirm the class of rock. The piled rock socket and base shall be classified by the designer for the selected pile size, socket length and founding level.

Construction of piles through the sandstone and founding below the base of excavation level prior to the commencement of the basement excavation should be avoided or designed to consider any potential lateral movements from in situ stress relief of the sandstone caused by the basement excavation.

### 9.3.3 Rock parameters

Recommended bearing pressures and shaft friction for spread footings and piled foundations are given in Table 13 below for the various sandstone and shale rock classes in accordance with Pells et al (Ref [17]).

As outlined in Section 8.3.2, seams exist within the sandstone that may influence the rock classification and foundation parameters. For foundation purposes the rock class will require reclassification by the designer to allow for seams within the defined zone of influence for the chosen foundation type. For spread footings, the zone of influence is defined as 1.5 times the least footing dimension below founding level. For piled foundations, the zone includes the length of the rock socket plus a further depth equal to two times the pile diameter below the pile founding level.

Table 13: Recommended Foundation Design Parameters

| <b>Sandstone Class</b> | <b>Ultimate end bearing Pressure<sup>1</sup> (kPa)</b> | <b>Ultimate shaft adhesion<sup>2</sup> (kPa)</b> | <b>Allowable Bearing Pressure<sup>3</sup> (kPa)</b> | <b>Allowable Shaft Friction<sup>4</sup> (kPa)</b> |
|------------------------|--------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------|---------------------------------------------------|
| Class V                | 3,000                                                  | 150                                              | 1,000                                               | 50                                                |
| Class IV               | 4,000                                                  | 250                                              | 1,500                                               | 150                                               |
| Class III              | 20,000                                                 | 800                                              | 3,500                                               | 350                                               |
| Class II/I             | 60,000                                                 | 1,500                                            | 6,000                                               | 600                                               |

1. Ultimate value occur at large settlement (>5% of minimum footing dimension)
2. Settlements in the order of 1% of the pile diameter or minimum footing dimension can be anticipated when using the allowable bearing pressure. Settlement using the allowable bearing pressure to be independently checked by the designer.
3. Foundation and pile base to be cleaned and free of debris
4. Pile socket to be cleaned to roughness category R2 or better

The sidewall roughness is the measure of undulation down and around the sides of the rock socket caused by the excavation method or deliberately caused by a special construction tool or by hand. The roughness is quantified by the depths and widths of the grooves or undulations and by the average spacing of these grooves. The roughness R2 may be categorised as having grooves of depth 1-4mm, and with greater than 5mm, at spacing 50mm to 200mm (Ref. [21]).

## 9.4 Subgrade formation

The CBR values in Unit 2 material with courtyard is generally greater than 3%, Refer to Figure 25. The swell percentage obtained during the CBR testing for Unit 2 ranges between 0% and 0.7%, it should be noted that the Douglas Partners investigation comprised one four day soaked CBR within silty clay comprising a CBR value of 2% and swell value of 3.5%.

Unit 2 is a low to high plasticity sandy CLAY and may exhibit poor workability characteristics if the material is wet of optimum or if the soil has been overworked by compaction equipment. If this occurs it will be necessary to scarify the surface of the residual soil to allow it to dry and gain strength. Where this is not possible the material should be removed and replaced with a select engineered fill.

## 9.5 On-grade floor slabs

If any on-grade floor slabs are proposed the subgrade should be prepared as outlined in Section 9.2.1.

All soils are affected by water. Clays shrink and swell due to changes in moisture content. The site should be maintained at essentially stable moisture conditions and extremes of wetting and drying prevented. This will require careful attention

to the following activities in accordance with AS2870(Ref. [15]), that may cause changes to soil moisture content.

- Drainage of the site
- Placement and irrigation of gardens
- Planting and removal of trees and shrubs
- Repair of leaks

The level to which these measures need to be implemented are dependent on the reactivity of the site and the type of structure. It is recommended that a layer of non-moisture sensitive granular sub-base be placed to provide a sound working platform.

## 9.6 Exposure classification

The exposure classifications for structures below ground level has been assessed in accordance AS2159 [12], AS3600 [13], and AS5100 [14] based on the laboratory results presented in section 8.2.5 and is presented in Table 14 and Appendix C. The assessment has considered soil condition B, low permeability soils or all soils above groundwater.

Table 14 Soil exposure classifications

| Soil Unit | Exposure Classification       |                                                                              |                           |
|-----------|-------------------------------|------------------------------------------------------------------------------|---------------------------|
|           | AS3600<br>Concrete Structures | AS2159<br>Piling – Design and Installation                                   | AS5100.5<br>Bridge Design |
| 2         | A2 to A1                      | Non-aggressive to mild for concrete piles and non-aggressive for steel piles | B1                        |

## 9.7 Further geotechnical input

The following summarises the scope of further geotechnical investigation and inspections recommended within this report for future stages of design and construction beyond concept design. For specific details reference should be made to the relevant sections of this report.

- Geotechnical investigation and laboratory testing to meet the requirements of the detailed design and when access is available within the footprint of the proposed structures
- Assessment of in-situ stress relief in the rock and its impact on design where deep basement excavations are proposed
- Investigation of existing foundations proposed for reuse or incorporation into the design in conjunction with the structural engineer to determine structural properties and geometry of the existing foundations and the founding material

- Investigation of fill and residual soils for potential reuse
- Proof drilling of sandstone foundations, confirmation of soil properties for soil foundations and construction inspections to verify founding materials, base and shaft cleanliness
- Progressive geotechnical inspections throughout vertical excavations
- Witnessing installation and testing of rock anchors and bolts
- Observation of groundwater in all future investigations and during bulk excavation. Where required, installation and monitoring of standpipe piezometers
- Preparation of a project earthworks plan/specification and construction testing.

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## Appendix A

### Borehole Logs

## Appendix B

### Laboratory Certificates

## Appendix C

### Exposure Classification

Figure 1 Site Location Plan

Figure 2 Topographic Map

Figure 3 Geological Map

Figure 4 Soil Landscape Map

Figure 5 Acid Sulfate Soil Map

Figure 6 Geotechnical Long Section A-A'

Figure 7 Geotechnical Long Section B-B'

Figure 8 Geotechnical Long Section C-C'

Figure 9 Geotechnical Long Section D-D'

Figure 10 Geotechnical Long Section E-E'

Figure 11 Geotechnical Long Section F-F'

Figure 12 Geotechnical Long Section G-G'

Figure 13 Geotechnical Long Section H-H'

Figure 14 Liquid Limit (%) vs Relative Level (mOD) (by Unit)

Figure 15 Plastic Limit (%) vs Relative Level (mOD) (by Unit)

Figure 16 Plasticity Index (%) vs Relative Level (mOD) (by Unit)

Figure 17 Linear Shrinkage (%) vs Relative Level (mOD) (by Unit)

Figure 18 Casagrande's-Plasticity Chart -> Plasticity Index (%) vs Liquid Limit (%) (by Unit)

Figure 19 Particle Size Distribution Curves (by Unit)

Figure 20 Field Moisture Content / Optimum Moisture Content (%) vs Borehole ID (by Unit)

Figure 21 Optimum Moisture Content (%) vs Field Moisture Content (%) (by Unit)

Figure 22 Optimum Moisture Content (%) vs Maximum Dry Density (t/m<sup>3</sup>) (by Unit)

Figure 23 California Bearing Ratio (%) vs Borehole ID (by Unit and CBR Soaking Duration)

Figure 24 California Bearing Ratio (%) vs Swell (%) (by Unit and CBR Soaking Duration)

Figure 25 Plasticity Index (%) vs California Bearing Ratio (%) (by Unit and CBR Soaking Duration)

Figure 26 SPT Test Results

Figure 27 Point Load Test Results

Figure 28 UCS Test Results

Figure 29 Rainfall plot one month prior to the geotechnical investigation

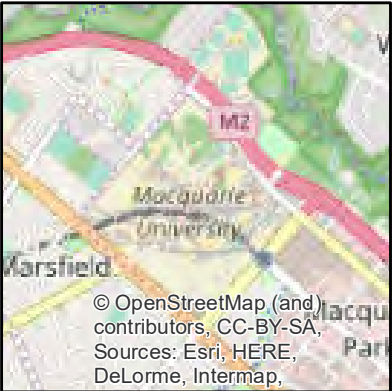
Figure 30 Rainfall during the month of the geotechnical investigation

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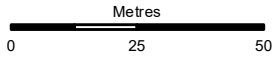
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- Boreholes as drilled
- Proposed



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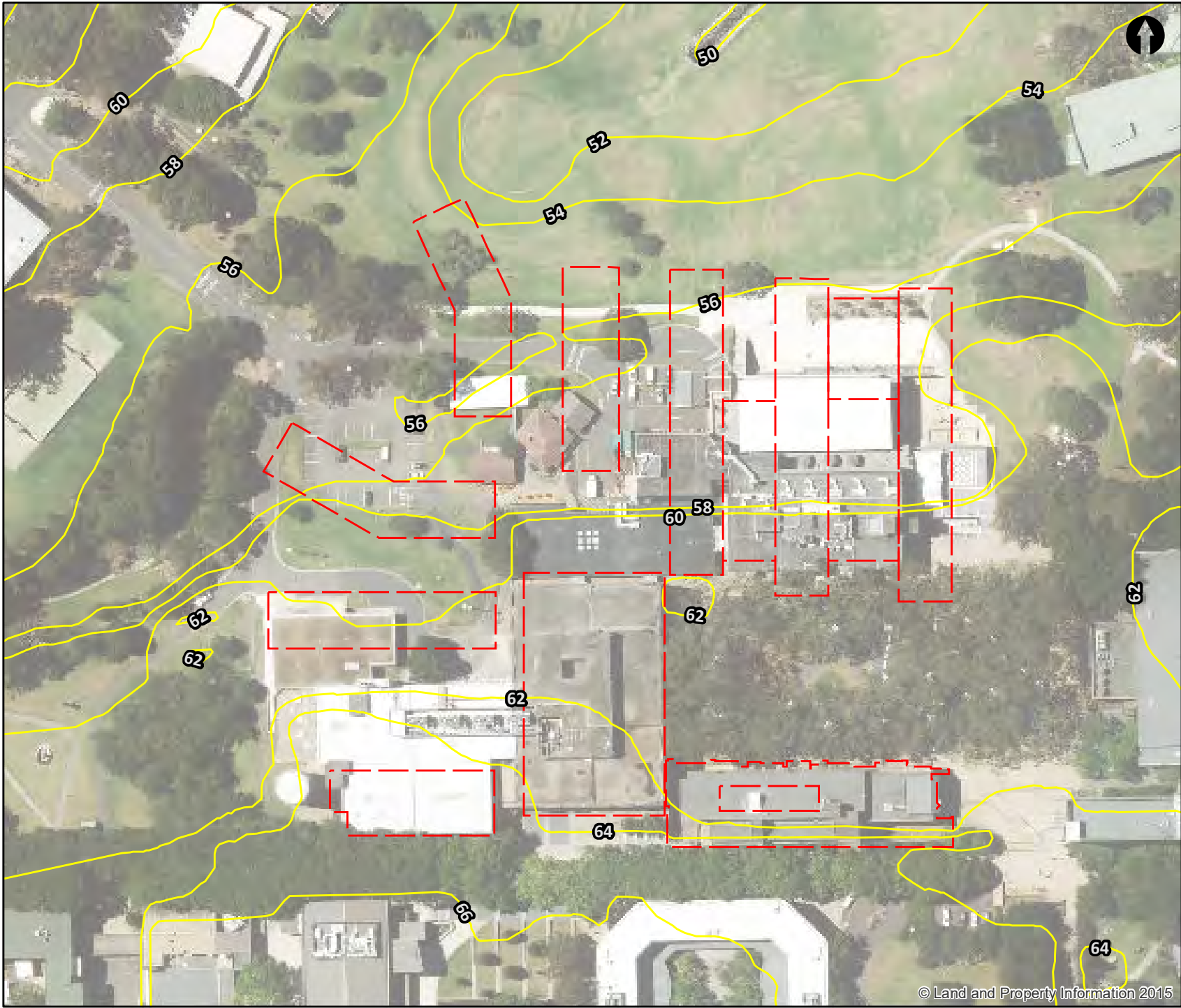
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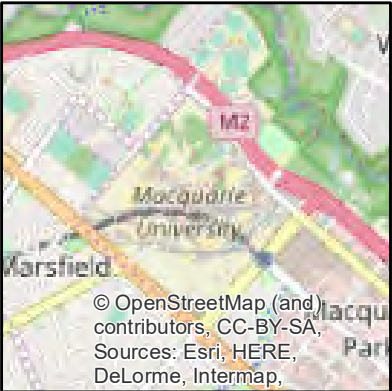
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**Figure 01**



**Legend**

- Proposed
- Contours 2m Interval



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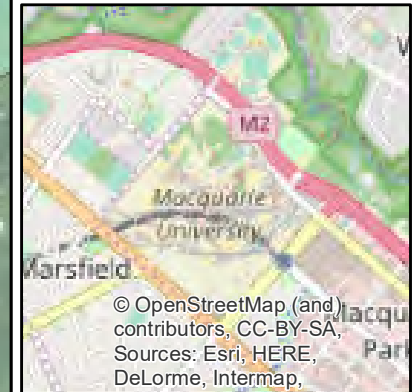
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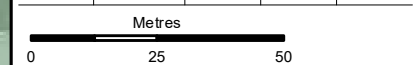
## Legend

- Proposed
- Ashfield Shale (Rwa)
- Hawkesbury Sandstone (Rh)



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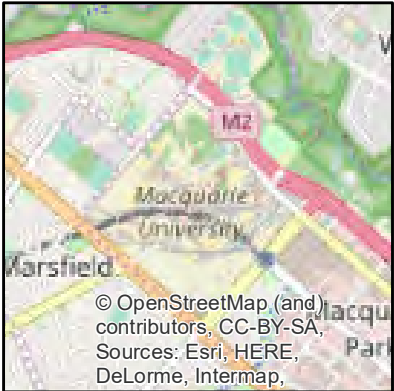
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**NAME**

GLENORIE

LUCAS HEIGHTS



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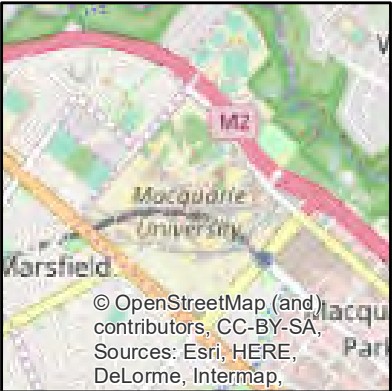


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Class 5



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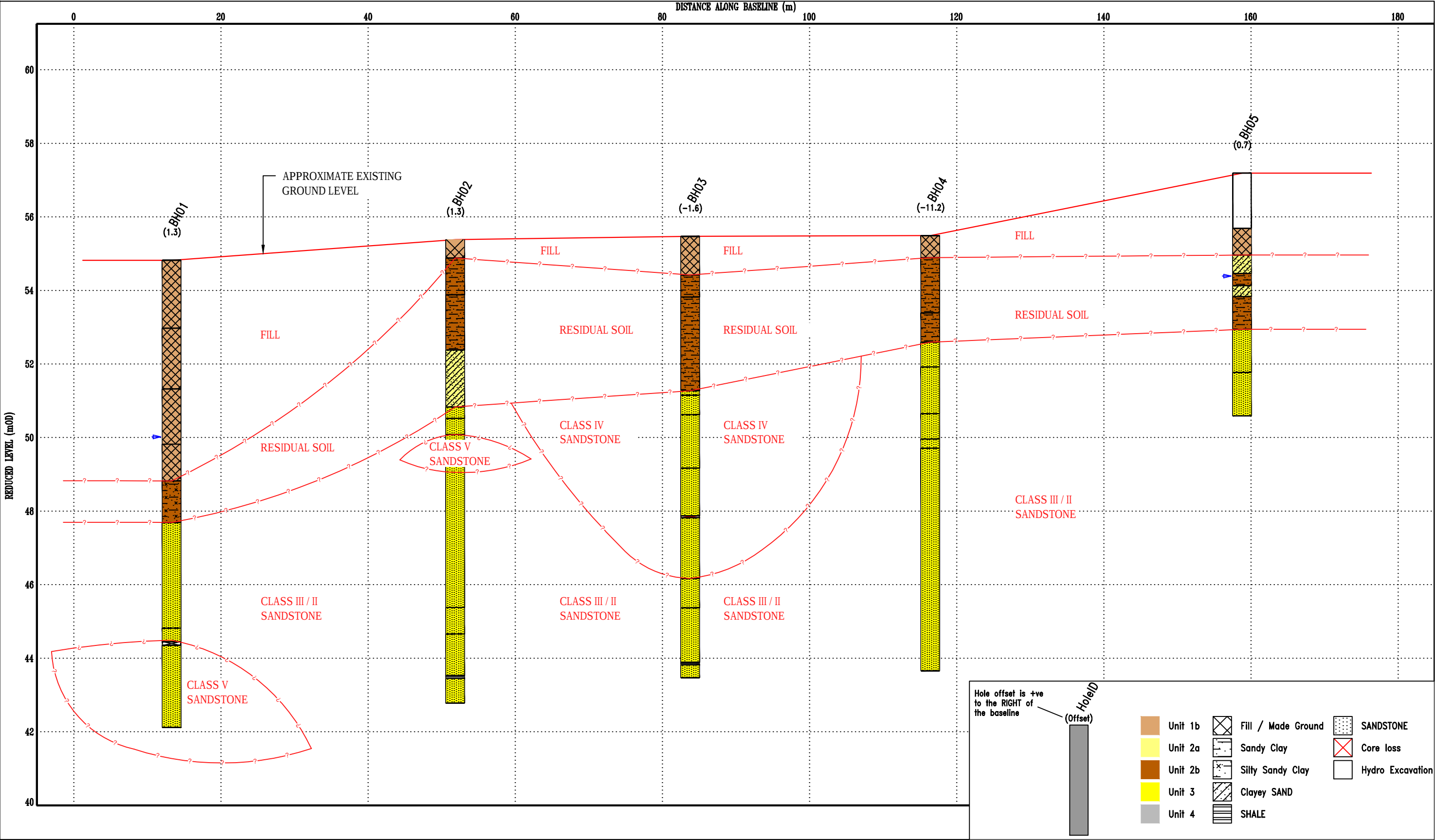
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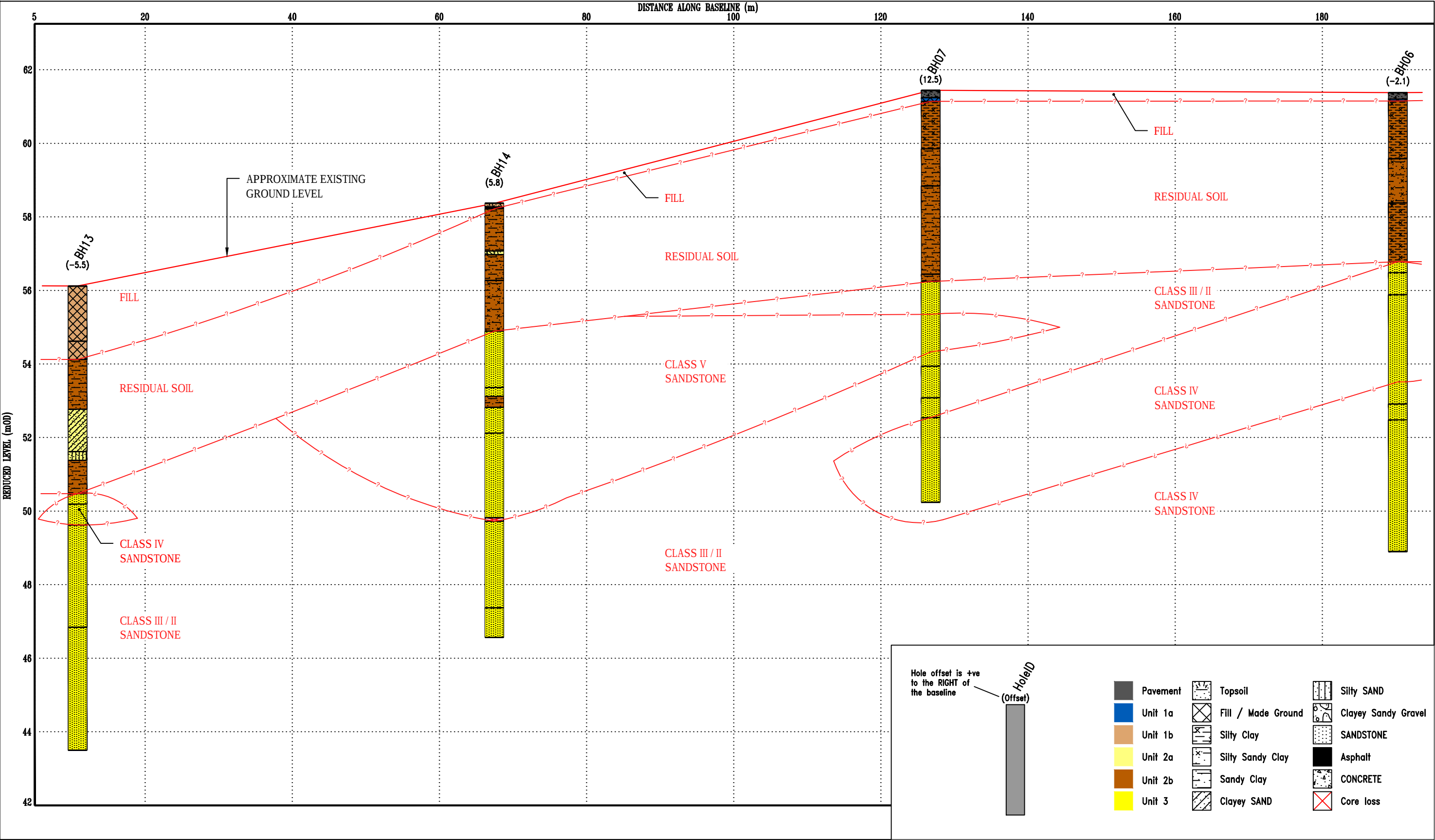
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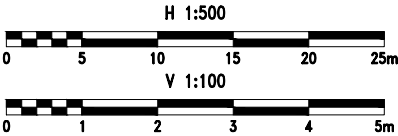
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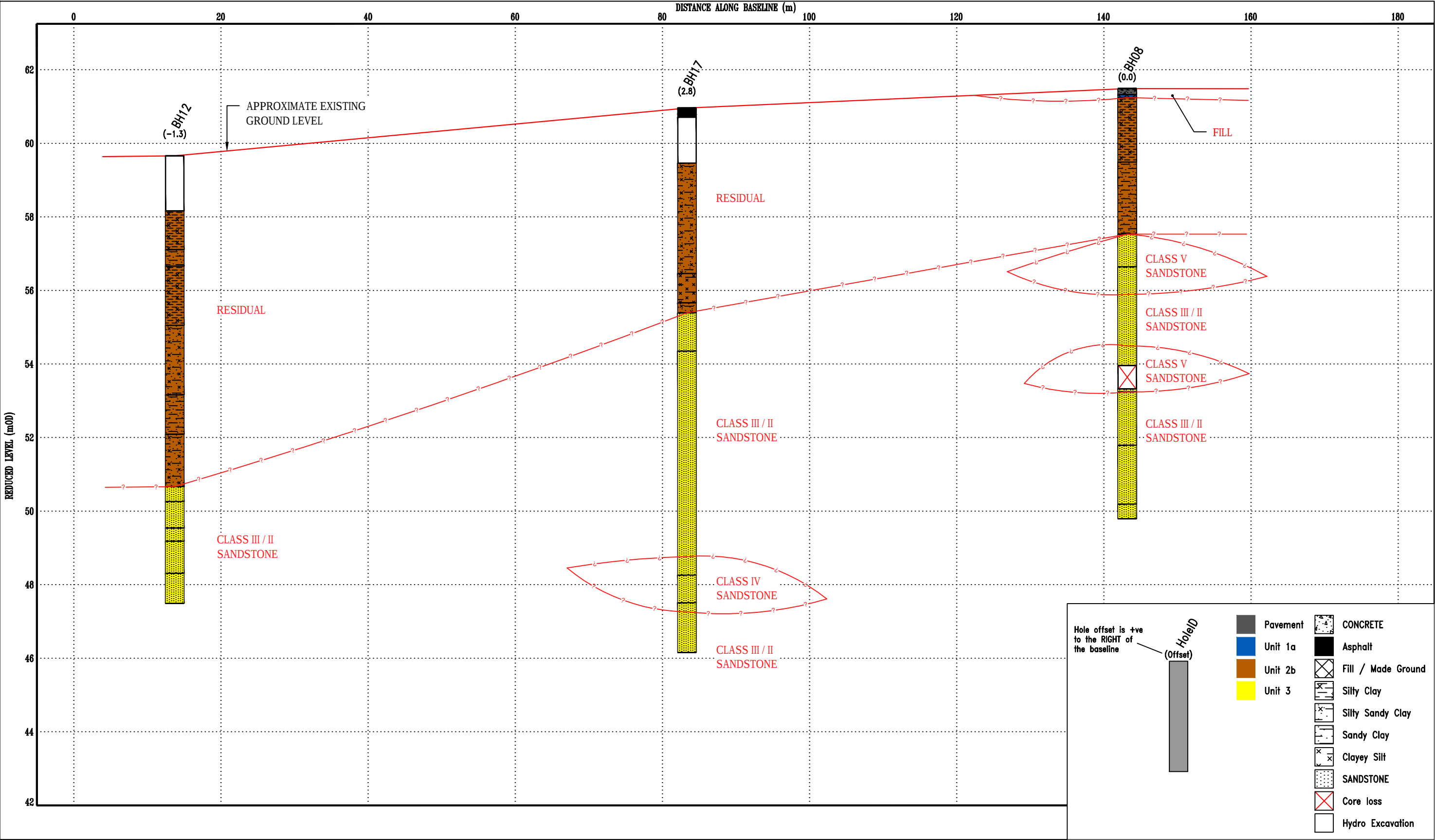


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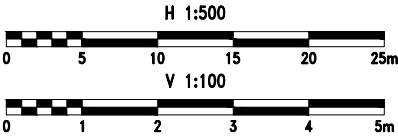


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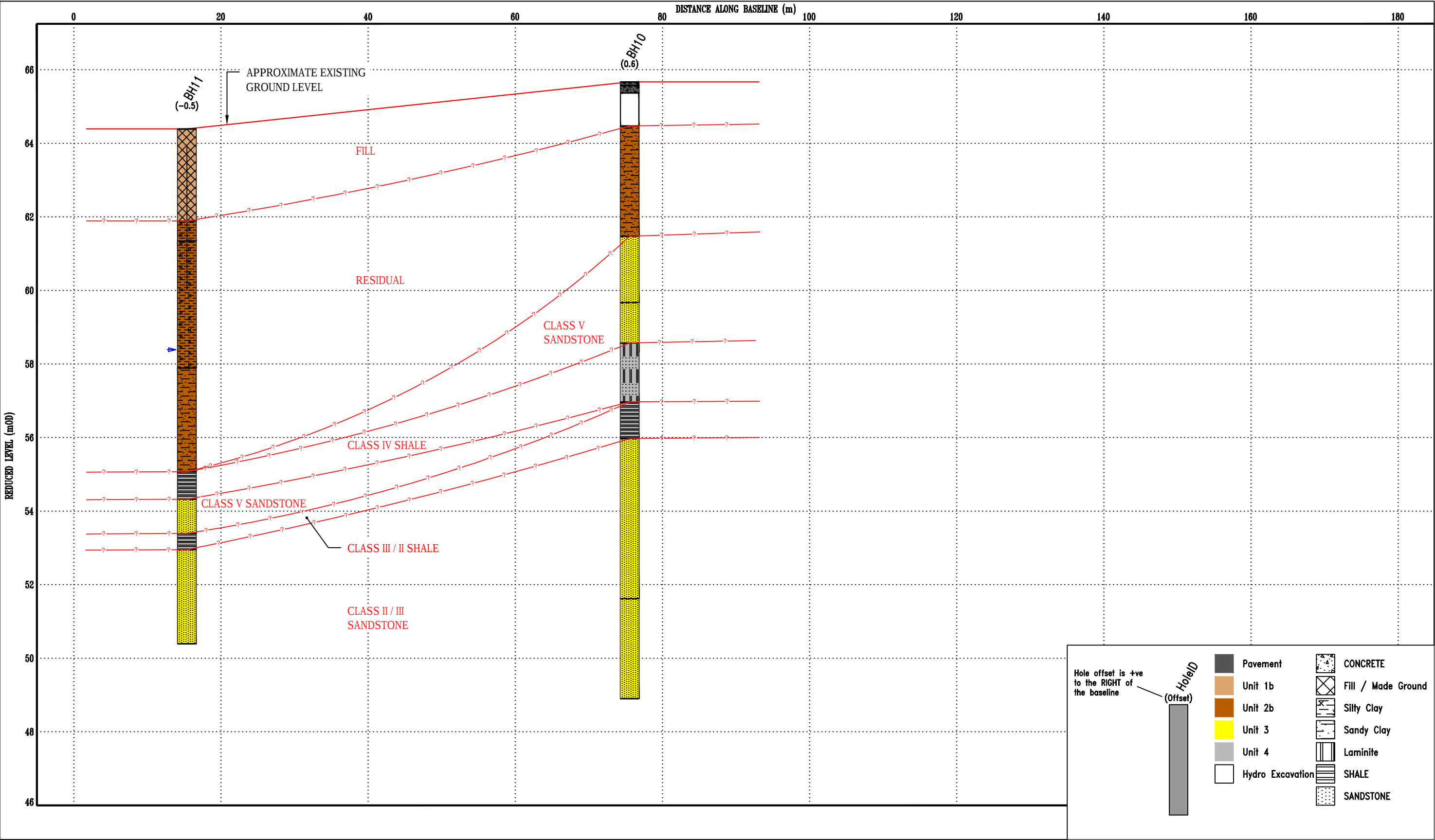


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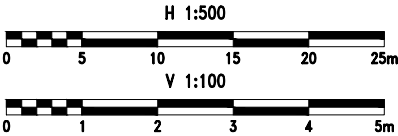


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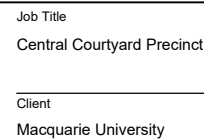
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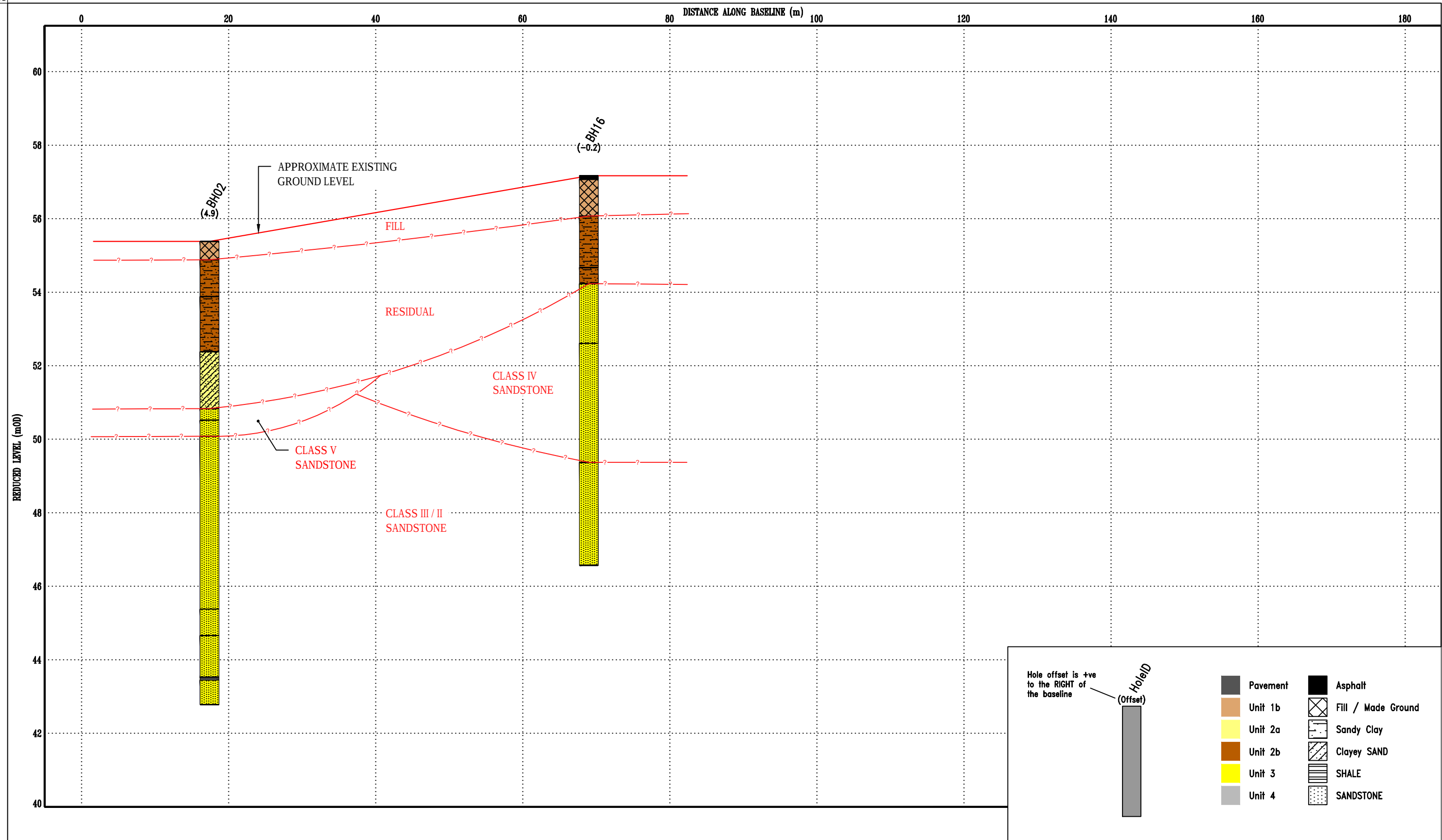


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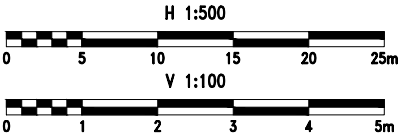


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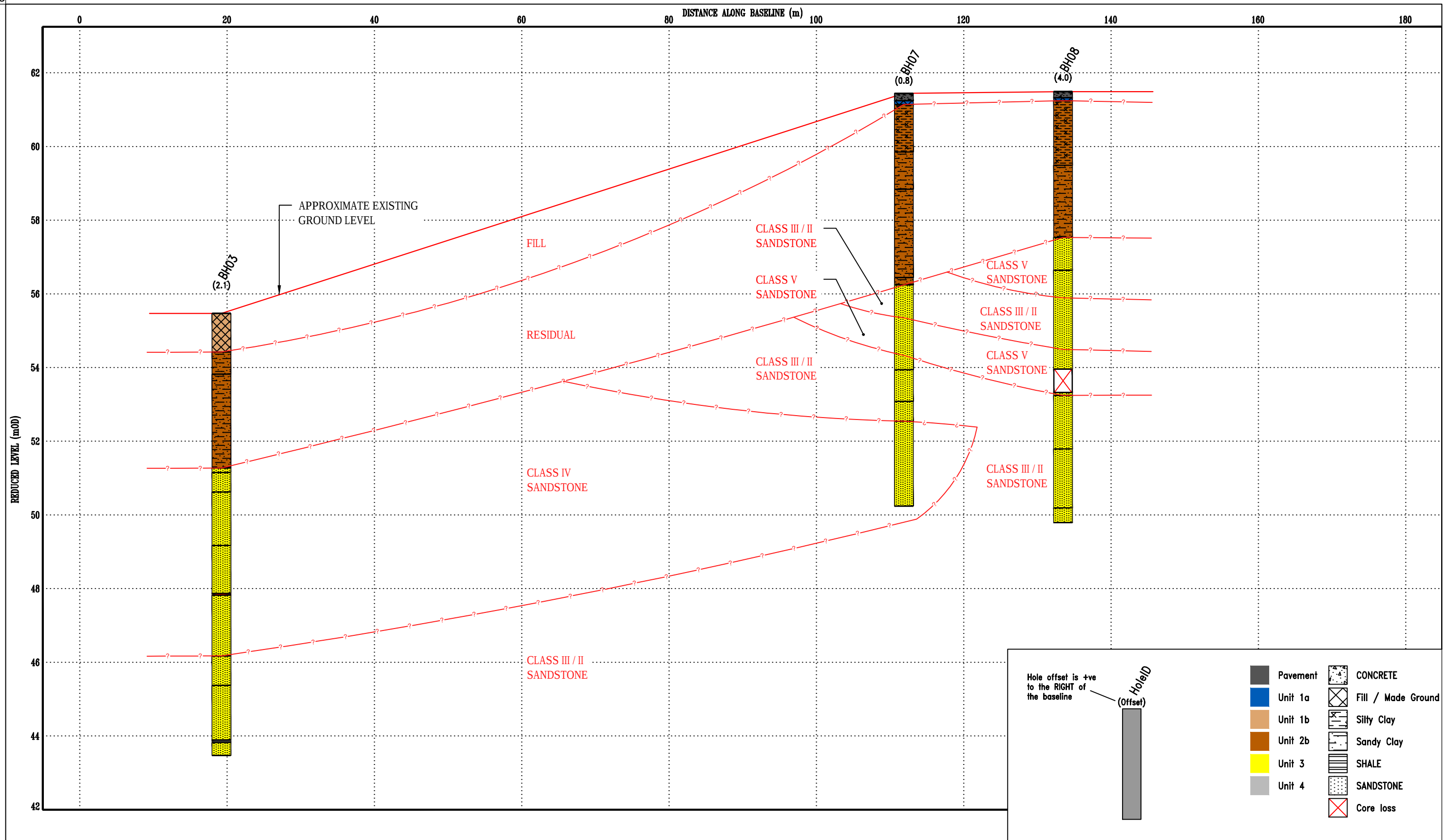
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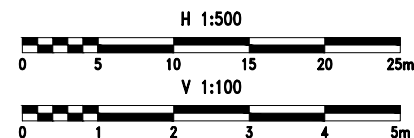
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| Discipline<br>Geotechnical                |                |
| Job No<br>251278-00                       | Drawing Status |
| Figure<br>11                              | Issue<br>D1    |



Notes:

1. Unit boundaries are approximate.

| Issue | Date       | By | Chkd | Appd |
|-------|------------|----|------|------|
| D1    | 15/12/2016 | DM |      |      |



Job Title  
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Section G-G'  
Geotechnical Long Section

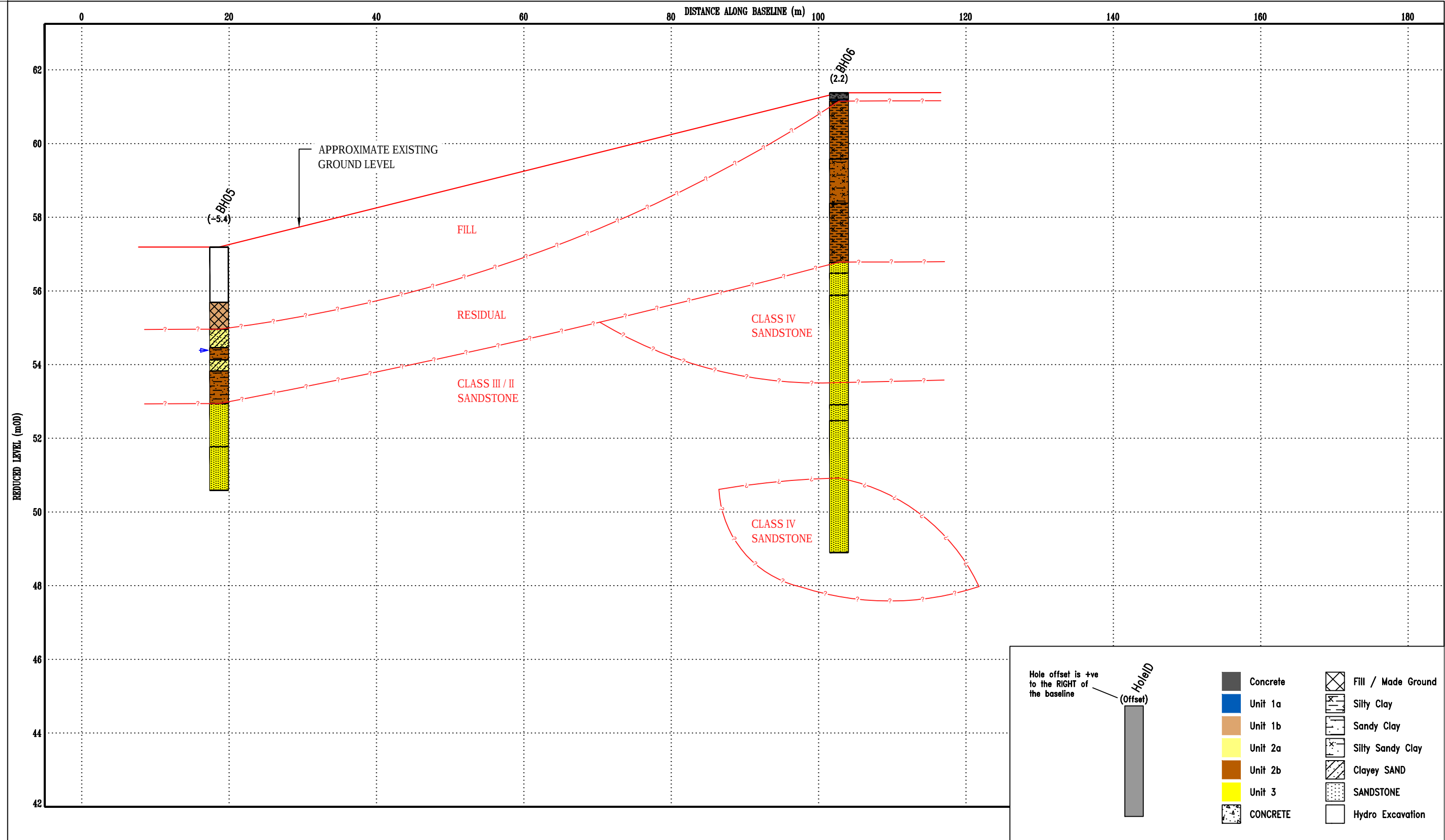
Discipline  
Geotechnical

Job No  
251278-00

|                |
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| Drawing Status |
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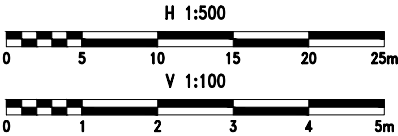
Figure 12

Issue  
01



Notes:  
1. Unit boundaries are approximate.

| Issue | Date       | By | Chkd | Appd |
|-------|------------|----|------|------|
| D1    | 15/12/2016 | DM |      |      |



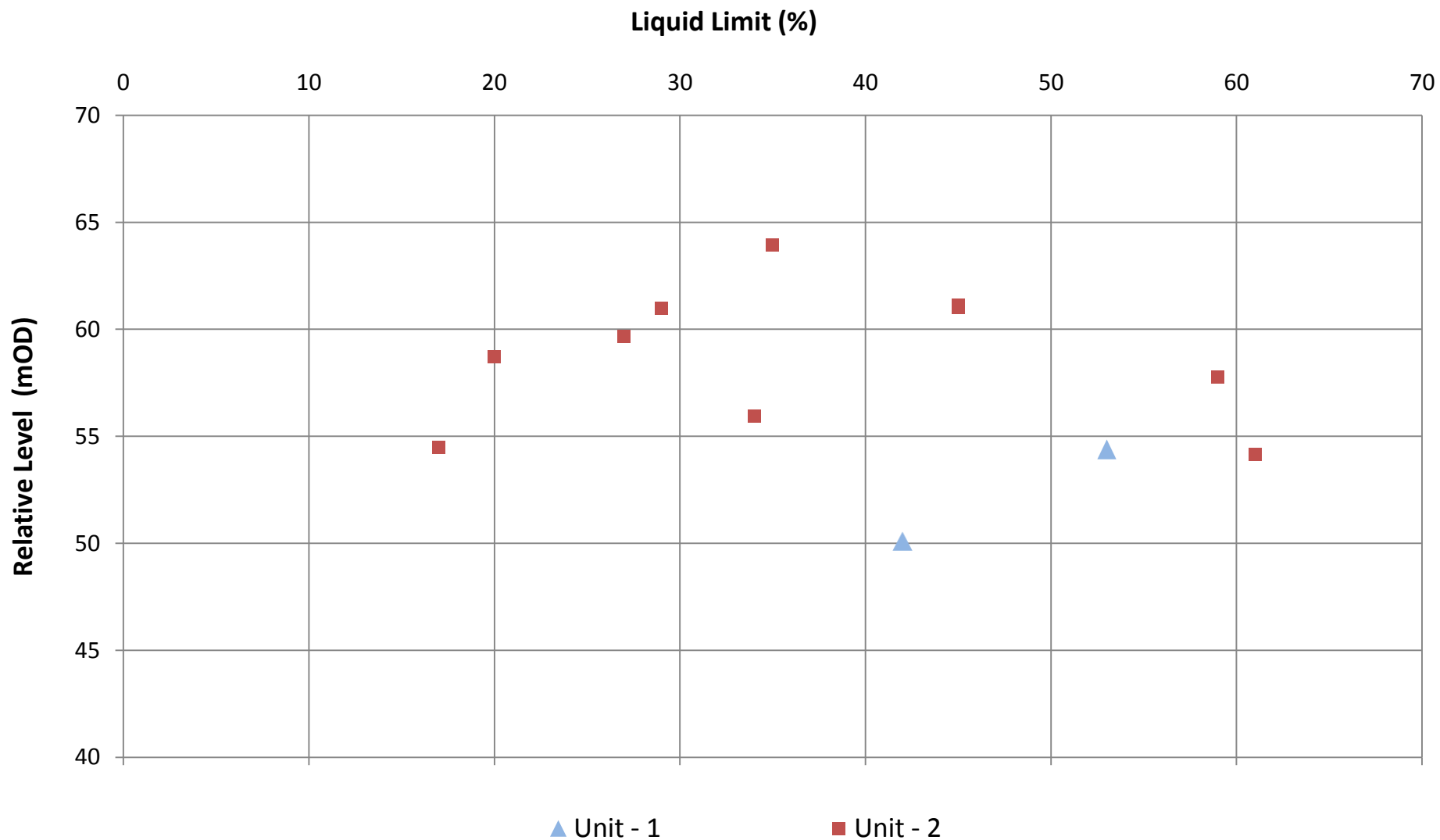
Job Title  
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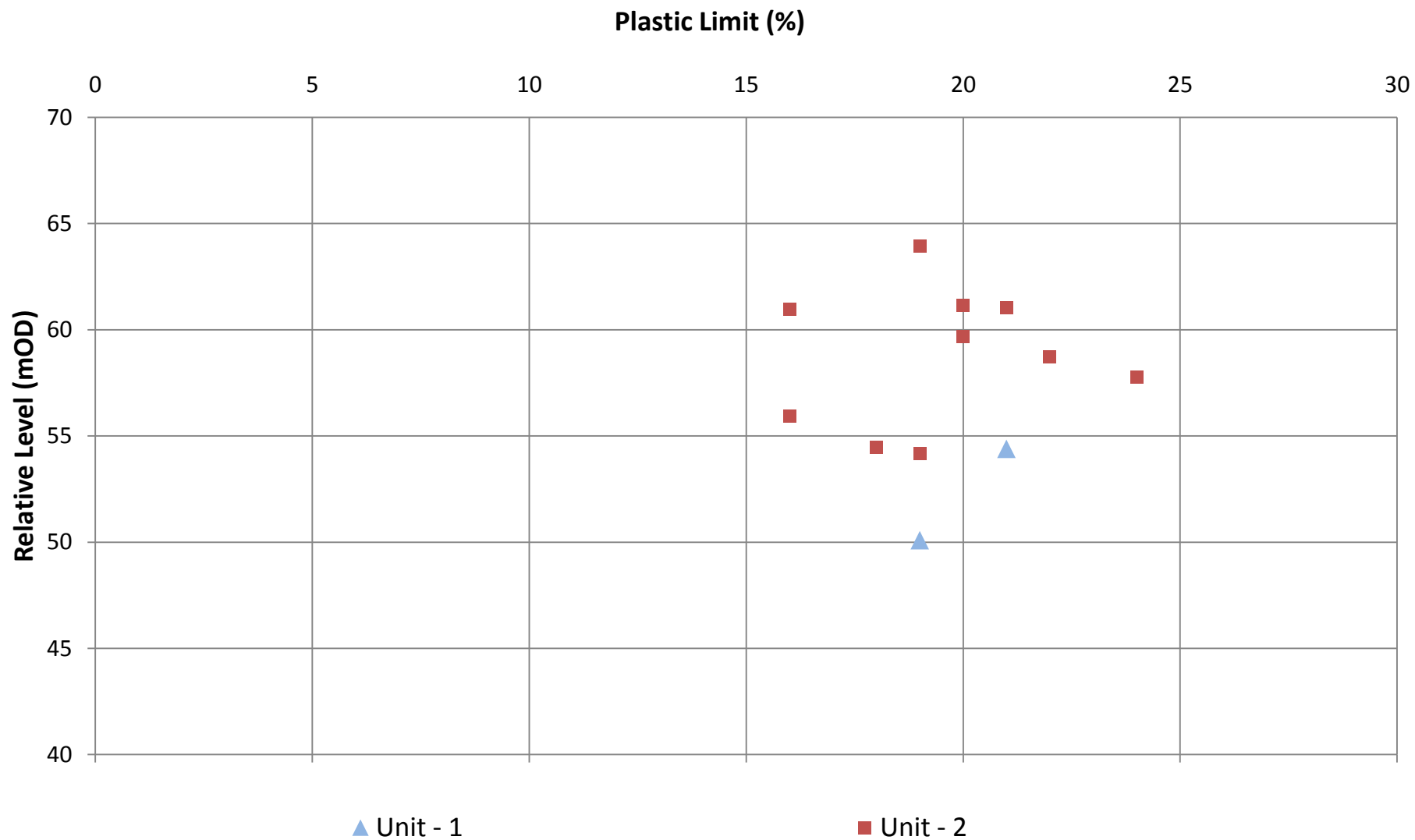
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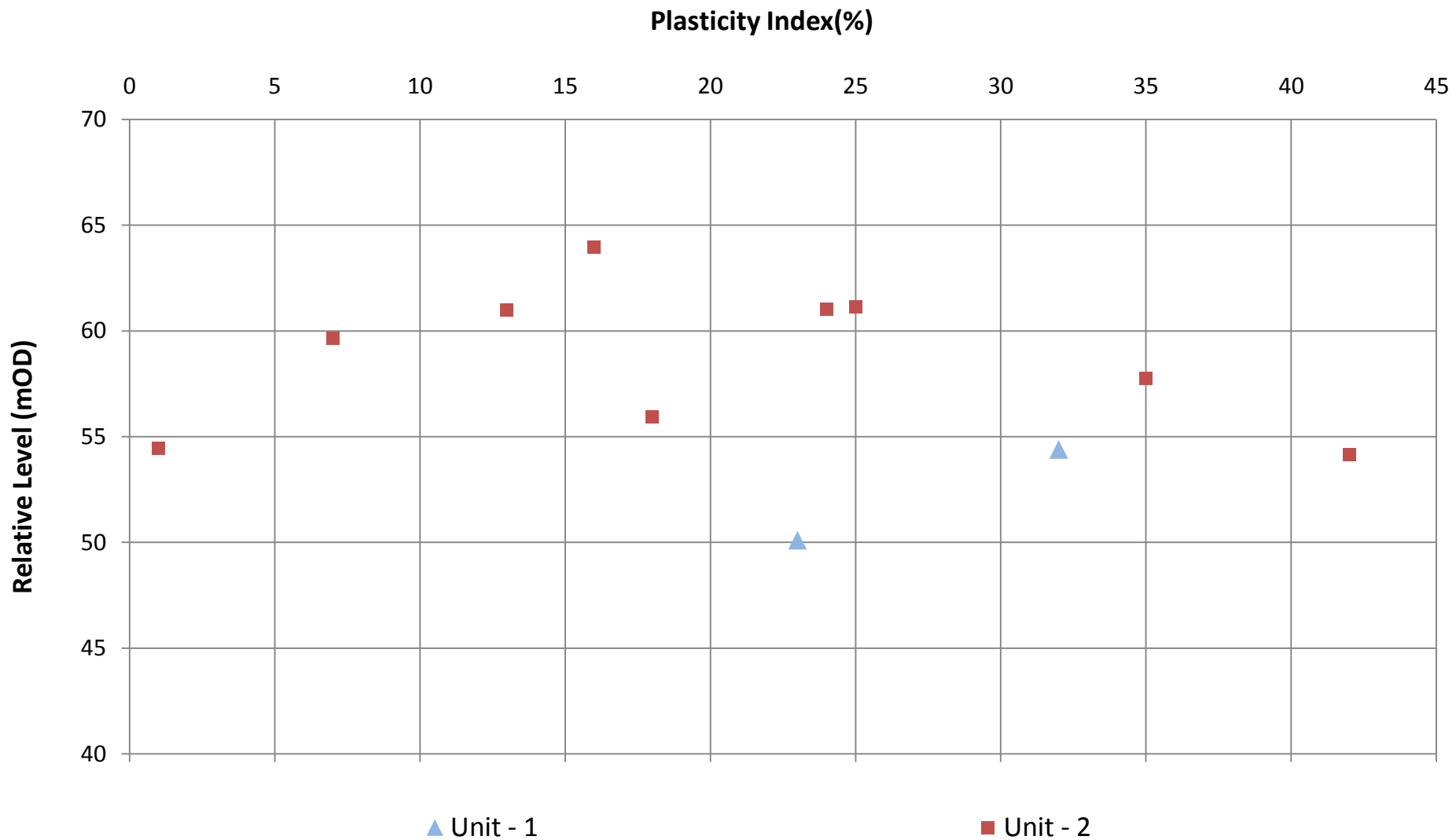
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| Discipline<br>Geotechnical                |                |
| Job No<br>251278-00                       | Drawing Status |
| Figure<br>13                              | Issue<br>D1    |



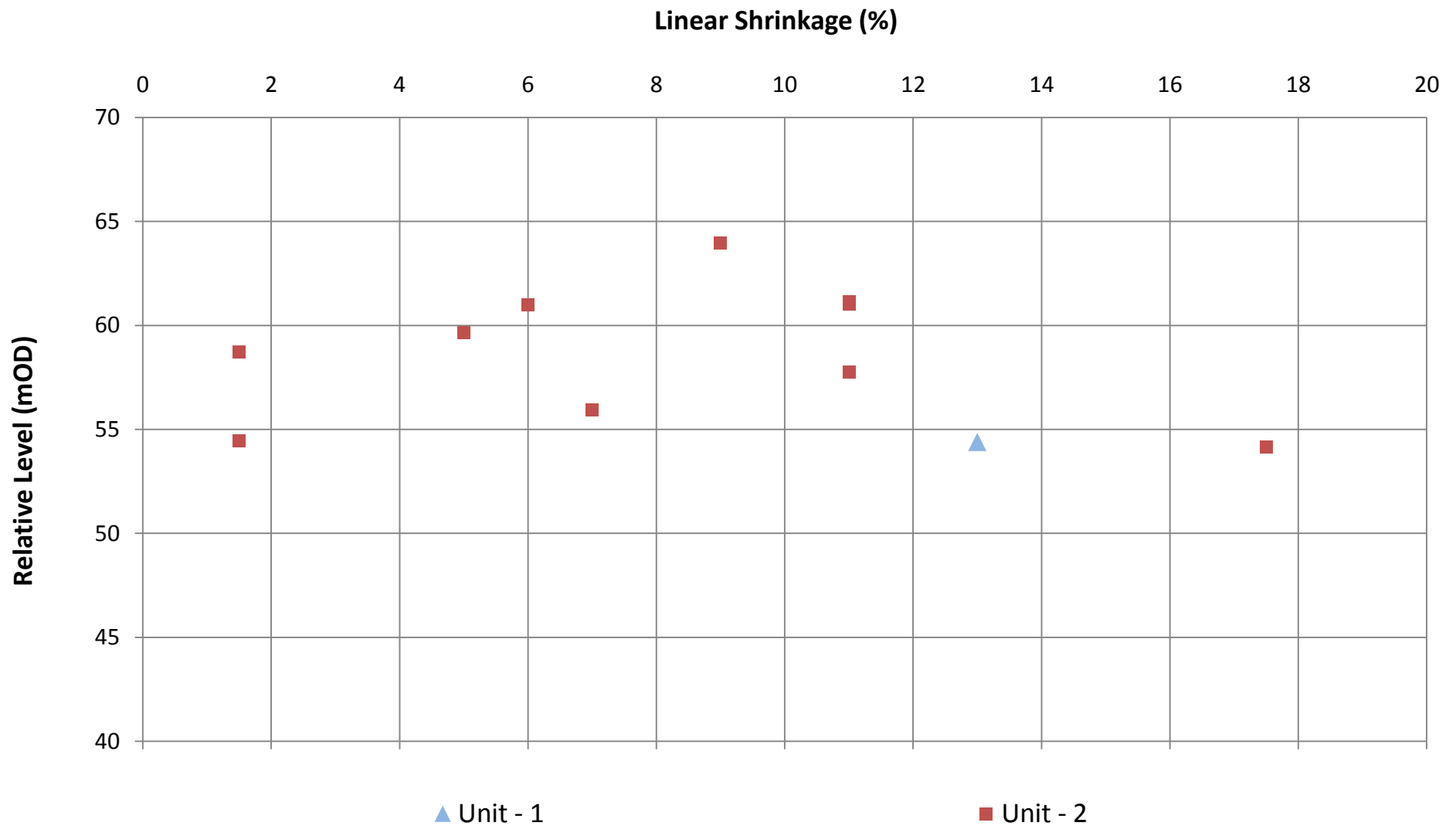
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| Date       | 12-Dec-16 | PROJECT NO: 251278-00                              |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                   |      |
| Figure No. | 14        | Liquid Limit (%) vs Relative Level (mOD) (by Unit) |      |



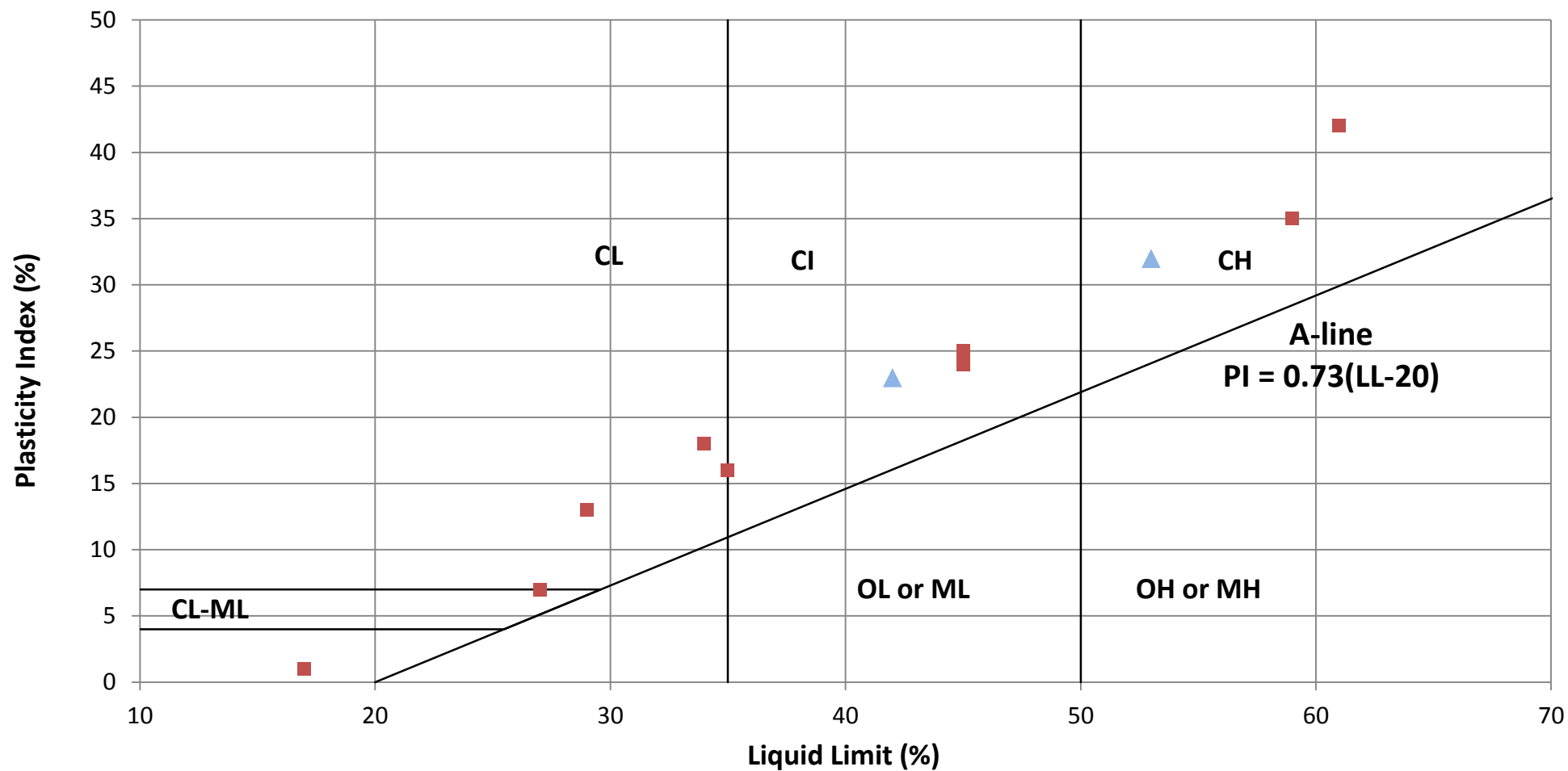
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| Drawn by   | DM        | Macquarie University Central Courtyard Precinct     | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                               |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                    |      |
| Figure No. | 15        | Plastic Limit (%) vs Relative Level (mOD) (by Unit) |      |



|            |           |                                                        |      |
|------------|-----------|--------------------------------------------------------|------|
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| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                  |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                       |      |
| Figure No. | 16        | Plasticity Index (%) vs Relative Level (mOD) (by Unit) |      |



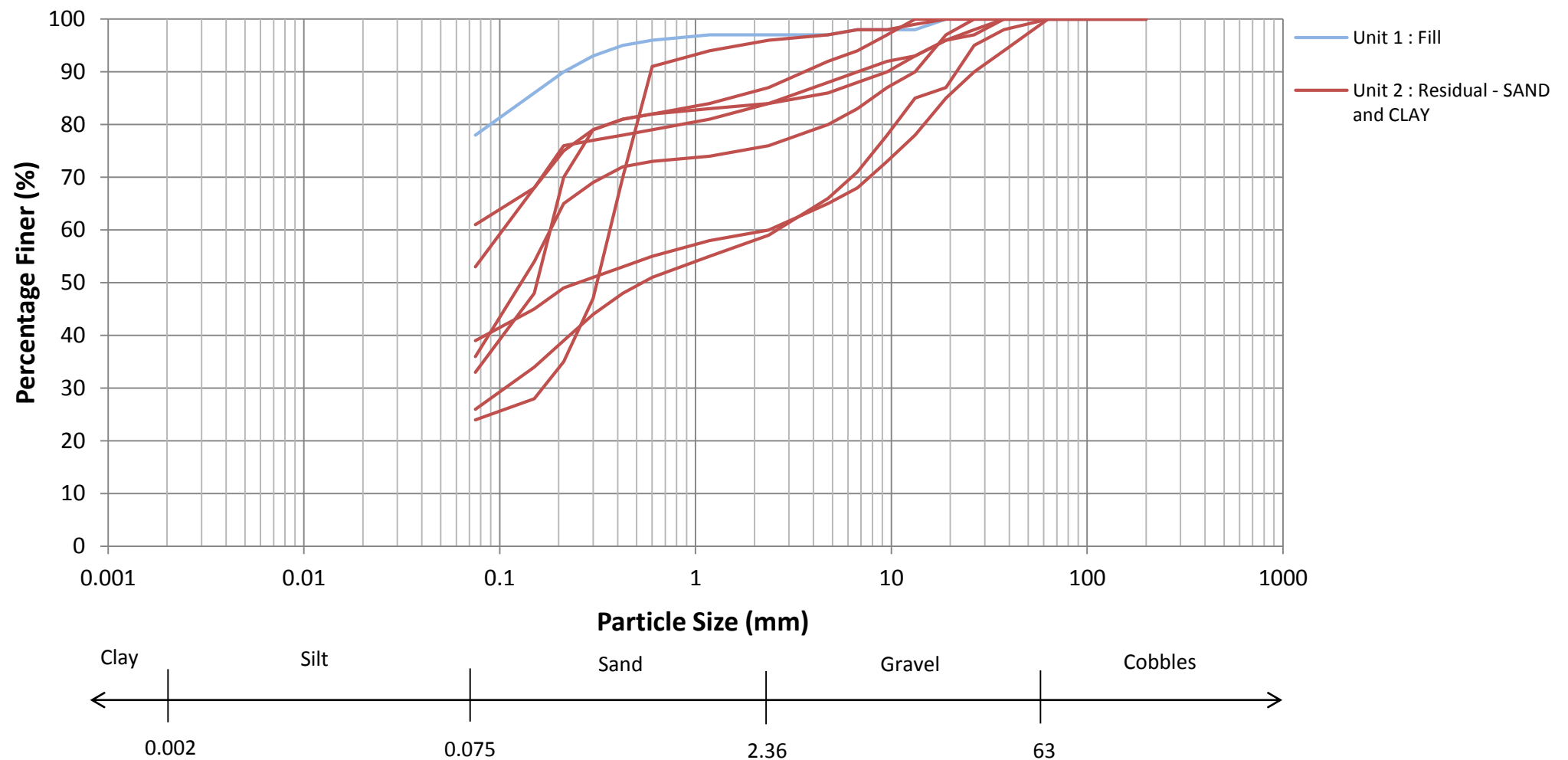
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| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                  |                 |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                       |                 |
| Figure No. | 17        | Linear Shrinkage (%) vs Relative Level (mOD) (by Unit) |                 |



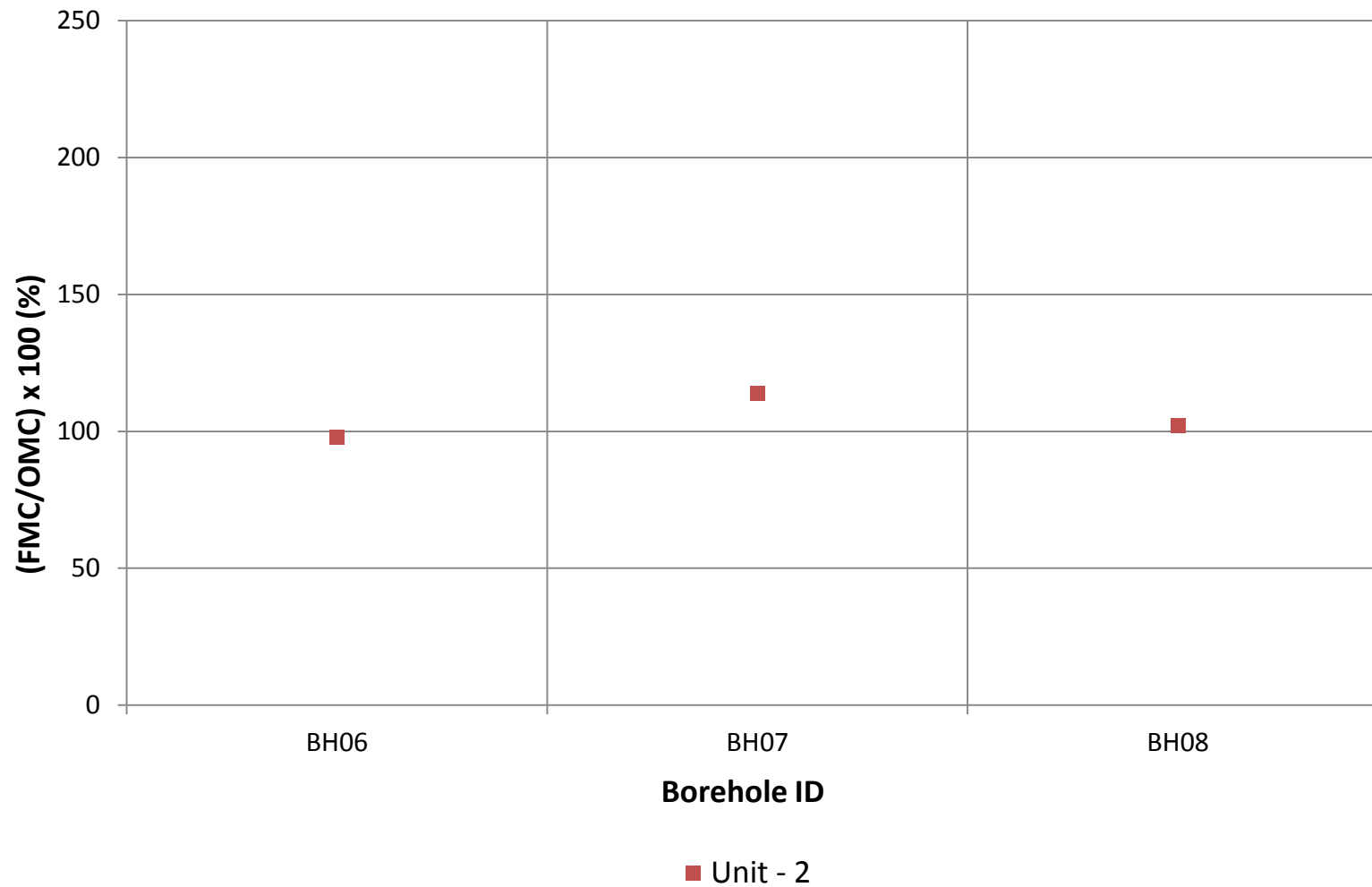
▲ Unit - 1

■ Unit - 2

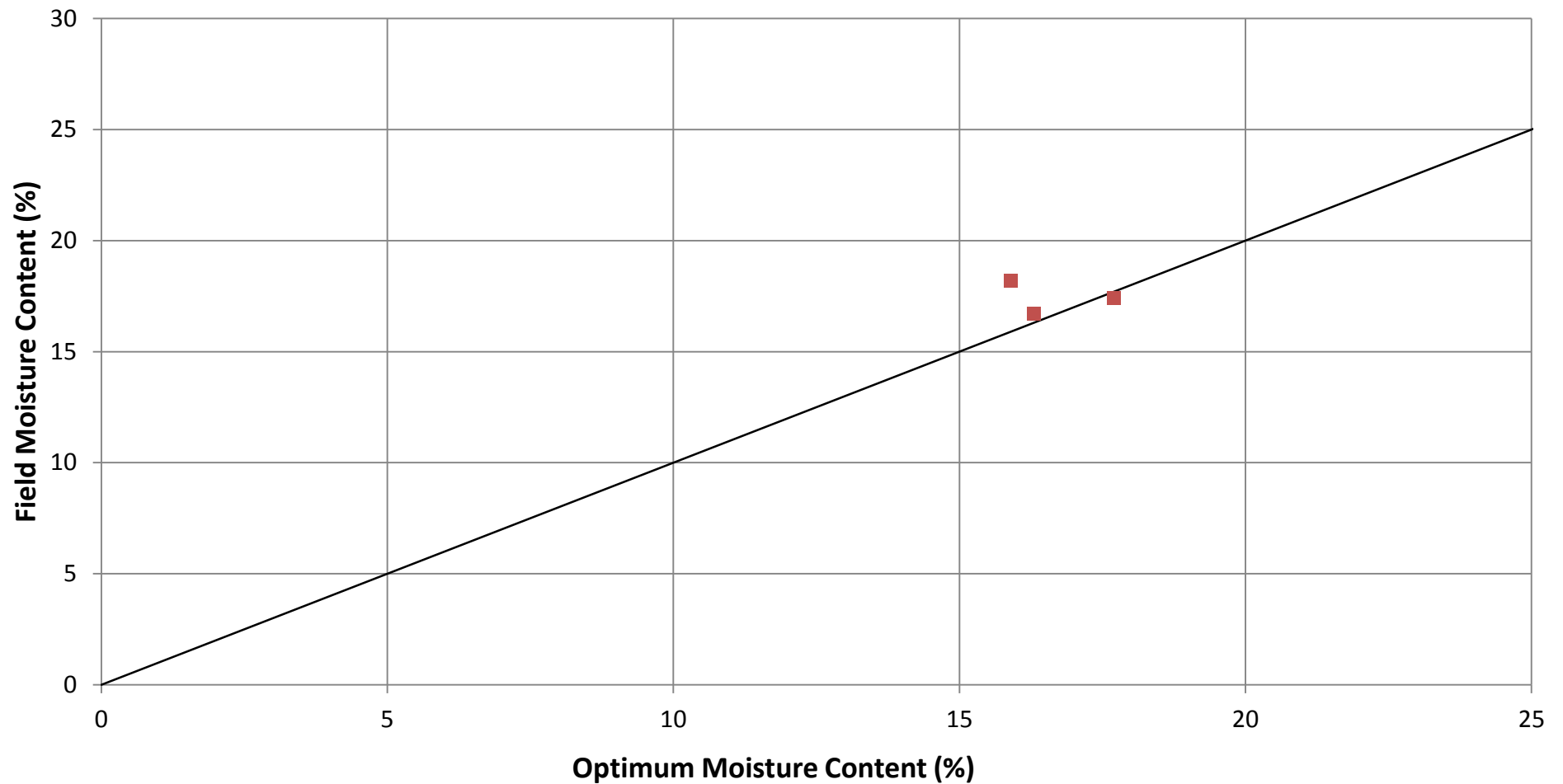
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| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                                                                                |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                                                                                     |      |
| Figure No. | 18        | Casagrande's-Plasticity Chart -> Plasticity Index (%) vs Liquid Limit (%) (by Unit)<br>(Soil Classification Markers as per AS1726.0) |      |



|            |           |                                                 |      |
|------------|-----------|-------------------------------------------------|------|
| Drawn by   | DM        | Macquarie University Central Courtyard Precinct | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                           |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                |      |
| Figure No. | 19        | Particle Size Distribution Curves (by Unit)     |      |

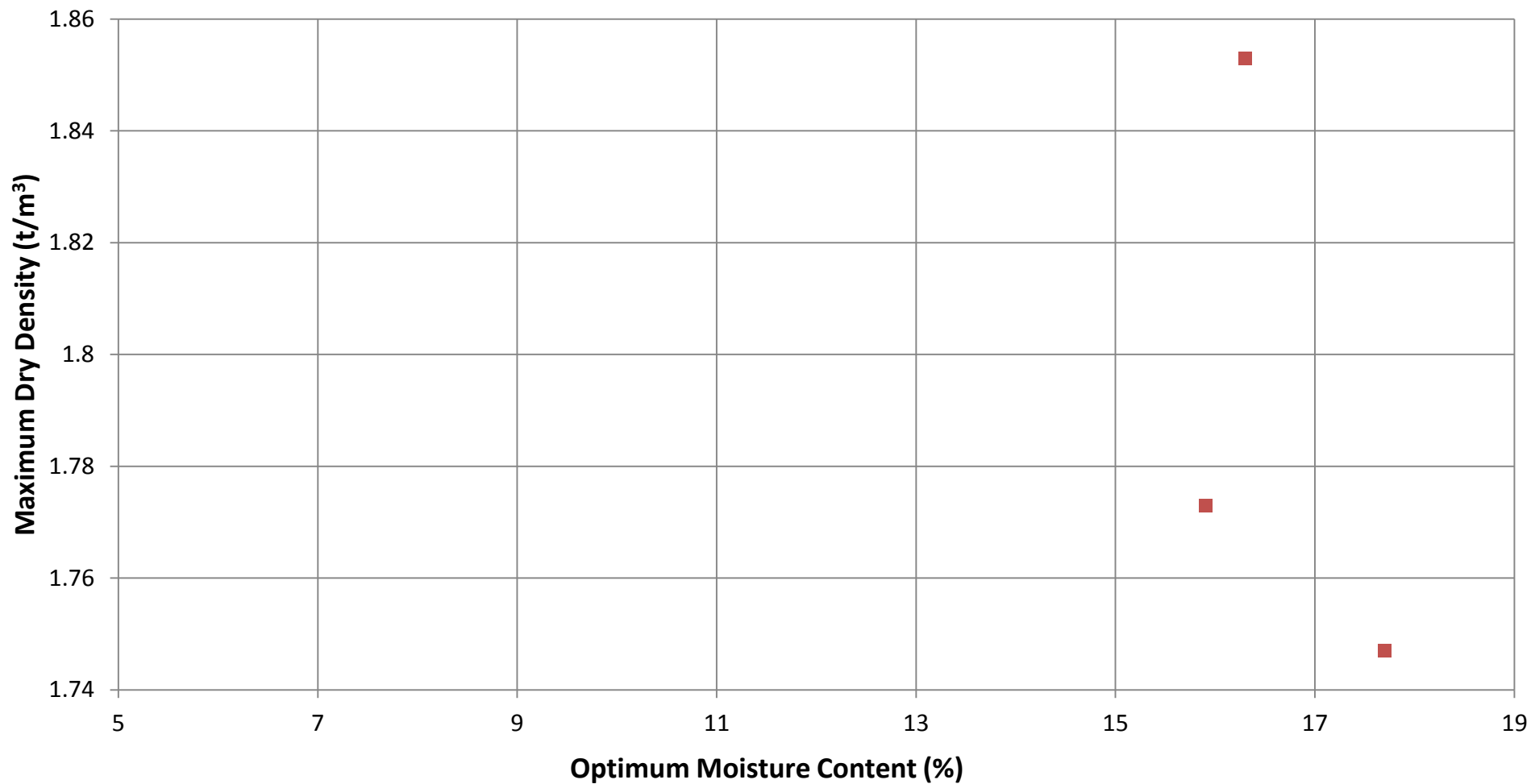


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| Drawn by   | DM        | Macquarie University Central Courtyard Precinct                                | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                          |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                               |      |
| Figure No. | 20        | Field Moisture Content / Optimum Moisture Content (%) vs Borehole ID (by Unit) |      |

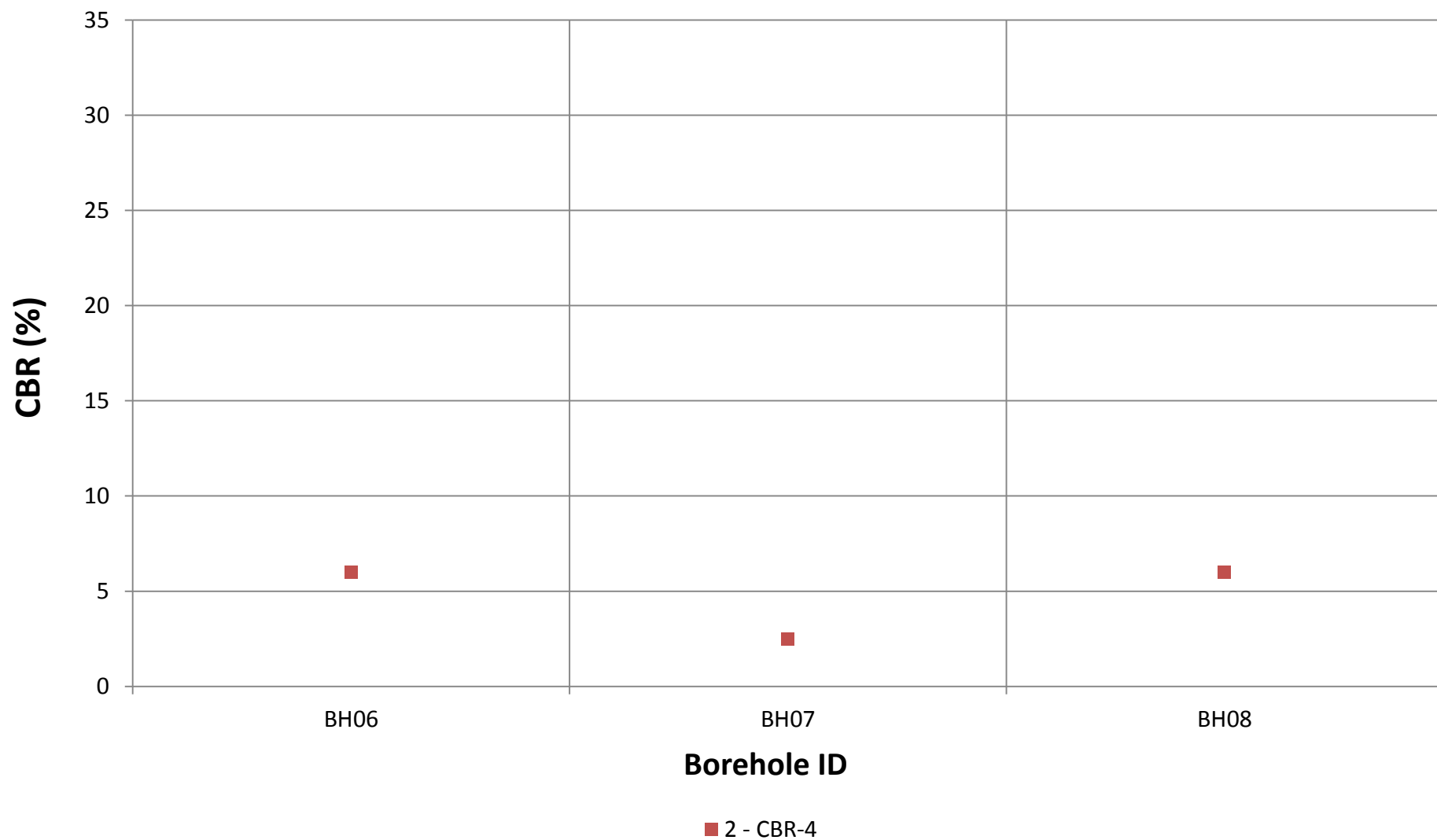


■ Unit - 2

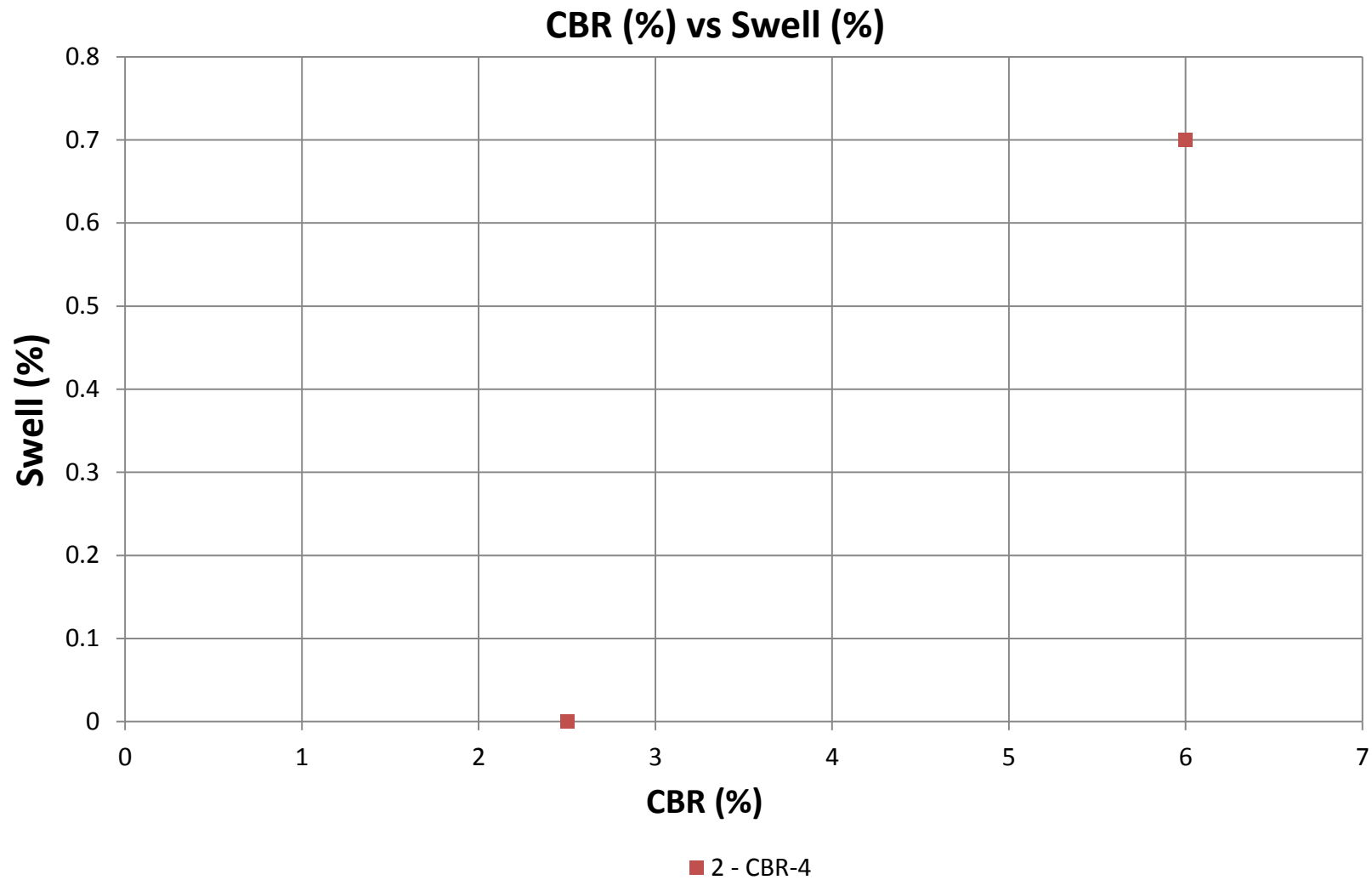
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| Drawn by   | DM        | Macquarie University Central Courtyard Precinct                      | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                     |      |
| Figure No. | 21        | Optimum Moisture Content (%) vs Field Moisture Content (%) (by Unit) |      |



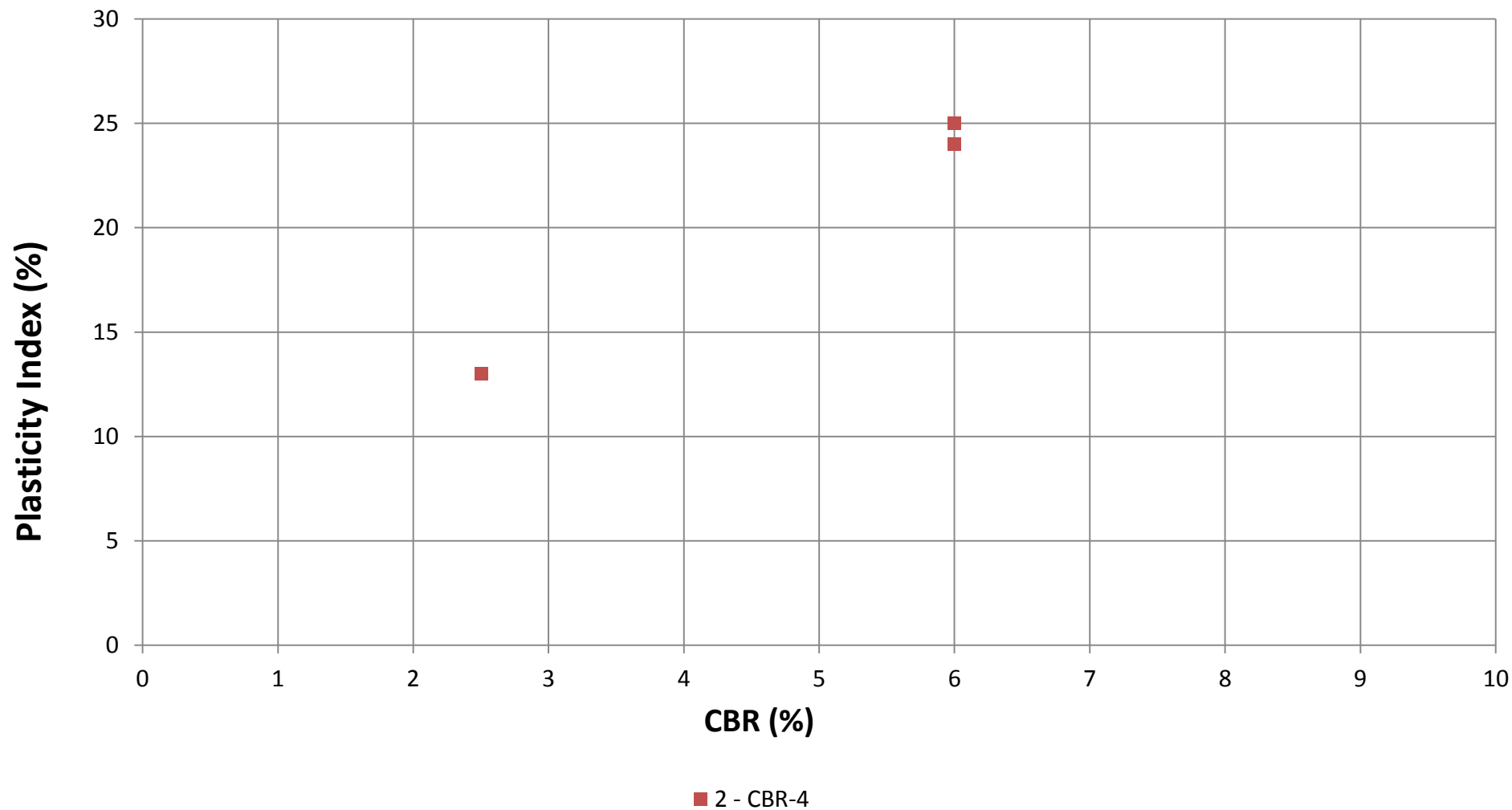
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| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                                |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                                     |      |
| Figure No. | 22        | Optimum Moisture Content (%) vs Maximum Dry Density (t/m <sup>3</sup> ) vs (by Unit) |      |



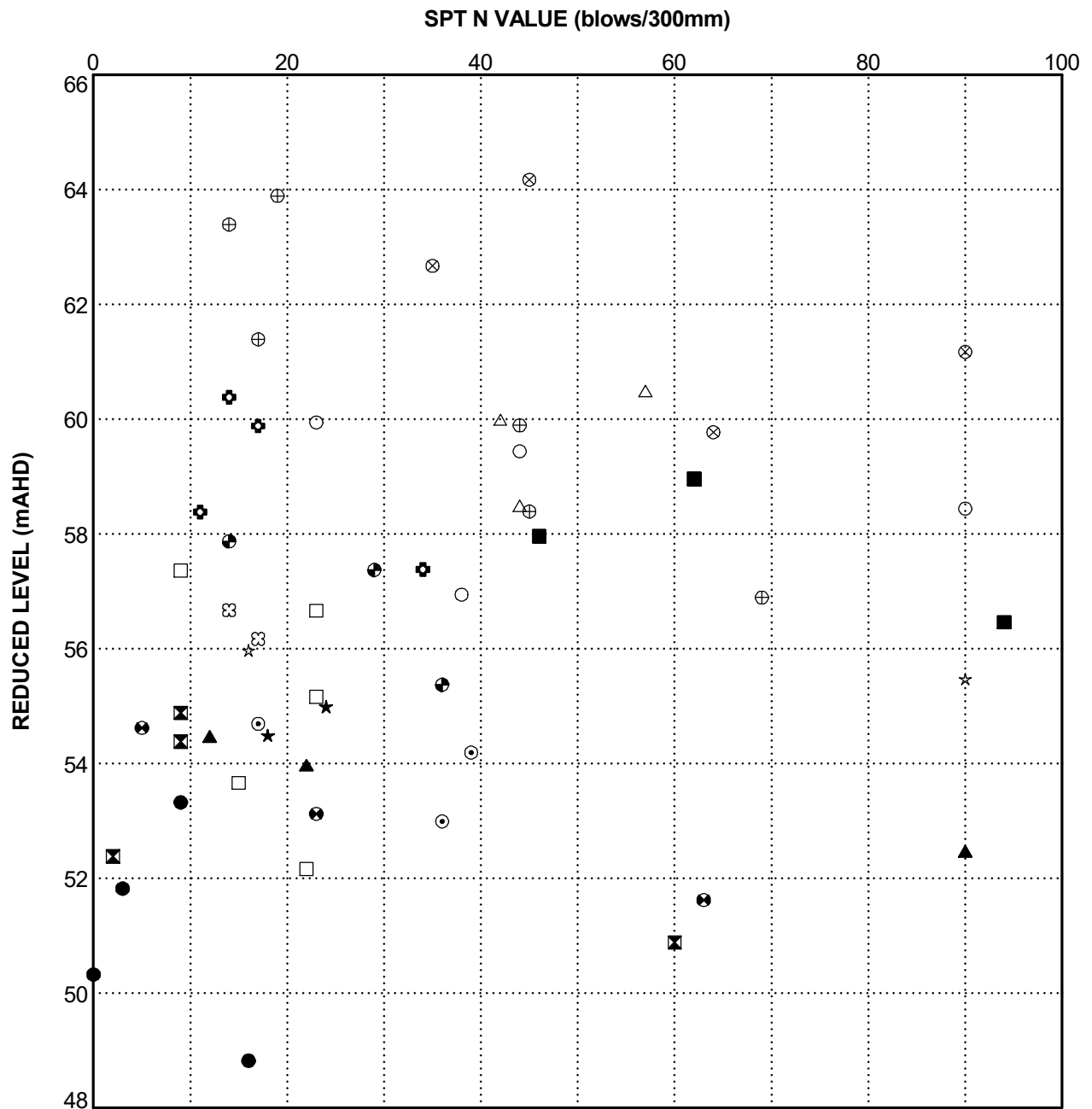
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| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                          |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                               |      |
| Figure No. | 23        | California Bearing Ratio (%) vs Borehole ID (by Unit and CBR Soaking Duration) |      |



|            |           |                                                                              |      |
|------------|-----------|------------------------------------------------------------------------------|------|
| Drawn by   | DM        | Macquarie University Central Courtyard Precinct                              | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                        |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                             |      |
| Figure No. | 24        | California Bearing Ratio (%) vs Swell (%) (by Unit and CBR Soaking Duration) |      |



|            |           |                                                                                         |      |
|------------|-----------|-----------------------------------------------------------------------------------------|------|
| Drawn by   | DM        | Macquarie University Central Courtyard Precinct                                         | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                                                   |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                                        |      |
| Figure No. | 25        | Plasticity Index (%) vs California Bearing Ratio (%) (by Unit and CBR Soaking Duration) |      |



**HOLE ID**

- |        |        |
|--------|--------|
| ● BH01 | ⊕ BH11 |
| ⊠ BH02 | □ BH12 |
| ▲ BH03 | ⊗ BH13 |
| ★ BH04 | ⊙ BH14 |
| ⊙ BH05 | ☆ BH15 |
| ⊕ BH06 | ⊗ BH16 |
| ○ BH07 | ■ BH17 |
| △ BH08 |        |
| ⊗ BH10 |        |

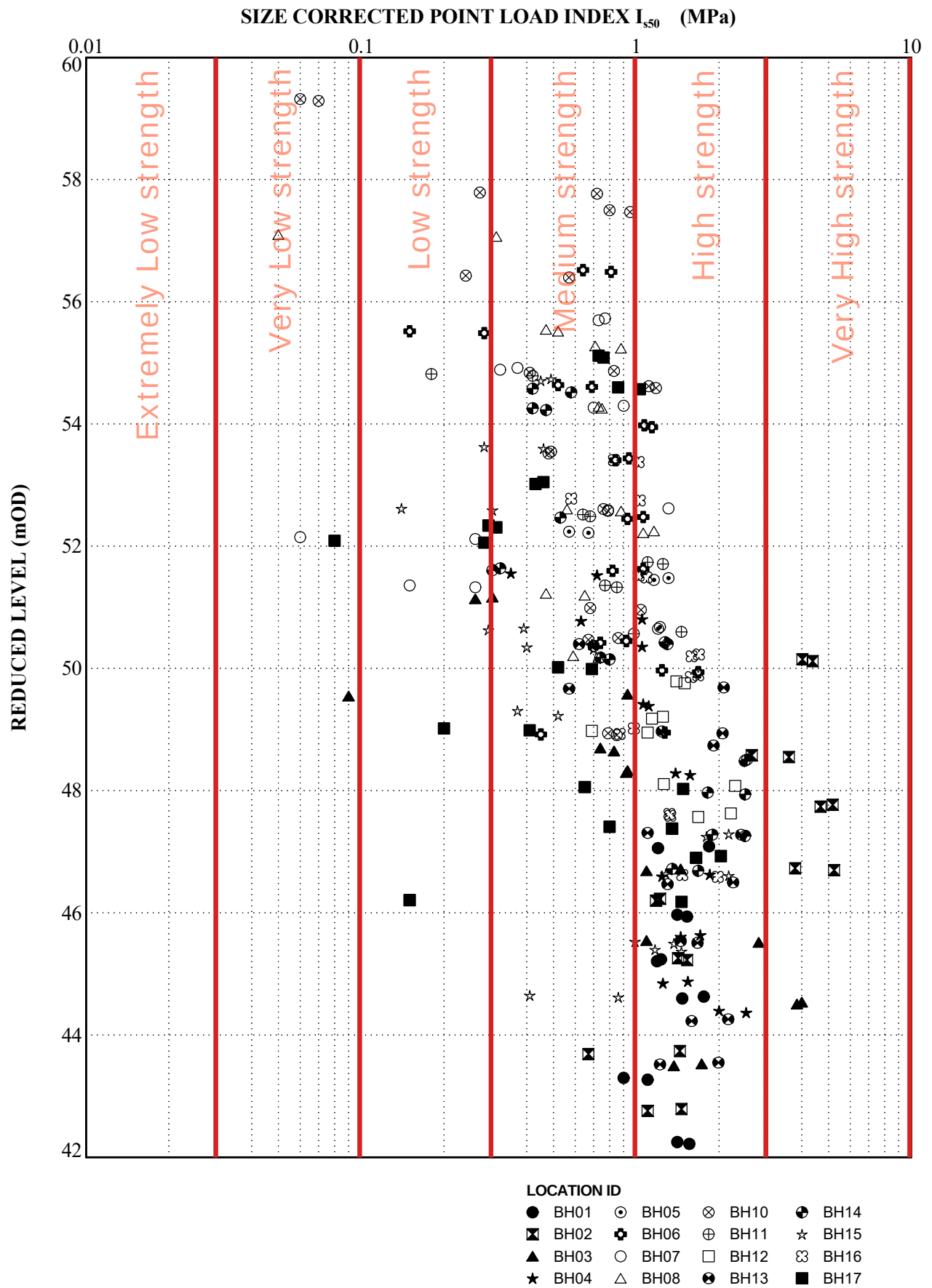
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**TITLE STANDARD PENETRATION TESTS**

|         |                                                 |
|---------|-------------------------------------------------|
| CLIENT  | Macquarie University                            |
| PROJECT | Macquarie University Central Courtyard Precinct |
| JOB No. | 251278                                          |

**Figure 26**

|             |            |
|-------------|------------|
| PREPARED BY | DM         |
| CHECKED BY  | MvU        |
| DATE        | 14/12/2016 |



**ARUP**

TITLE Point load index  $I_{s50}$

CLIENT Macquarie University

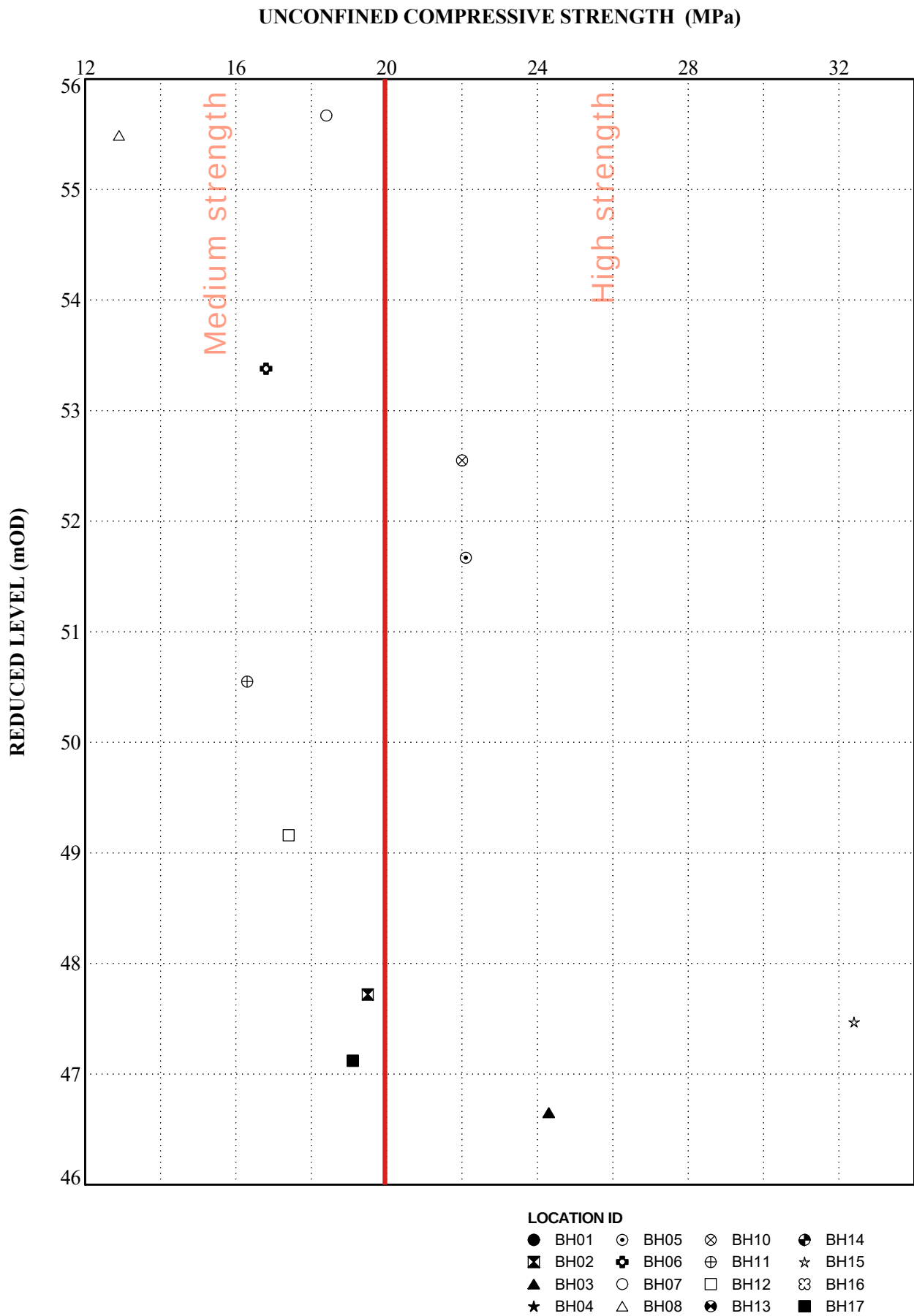
PROJECT her

JOB No. 251278

**Figure 27**

|             |            |
|-------------|------------|
| PREPARED BY | DM         |
| CHECKED BY  | MvU        |
| DATE        | 14/12/2016 |

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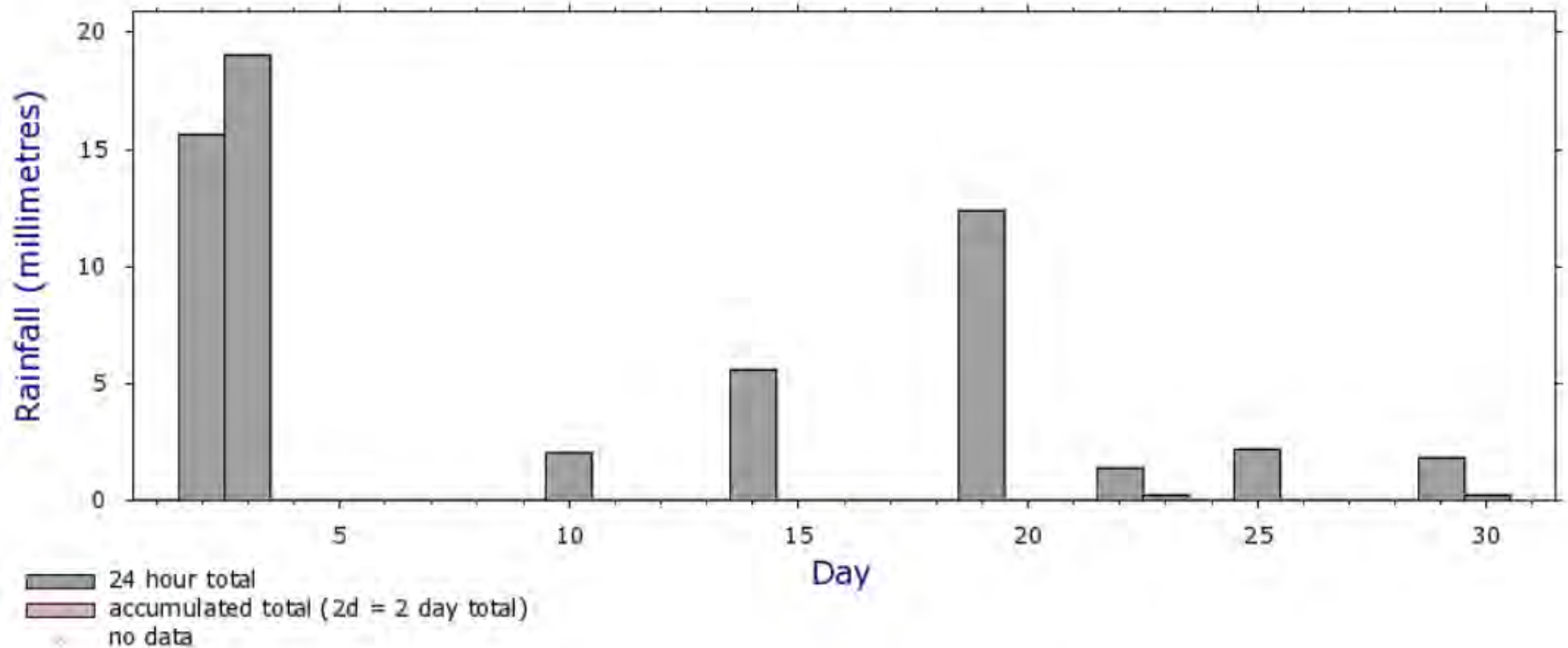
**ARUP**

|         |                                                 |
|---------|-------------------------------------------------|
| TITLE   | Unconfined compressive strength                 |
| CLIENT  | Macquarie University                            |
| PROJECT | Macquarie University Central Courtyard Precinct |
| JOB No. | 251278                                          |

**Figure 28**

|             |            |
|-------------|------------|
| PREPARED BY | DM         |
| CHECKED BY  | MvU        |
| DATE        | 14/12/2016 |

# Macquarie Park (Willandra Village) (066156) Sep 2016 rainfall



Note: Data may not have completed quality control.

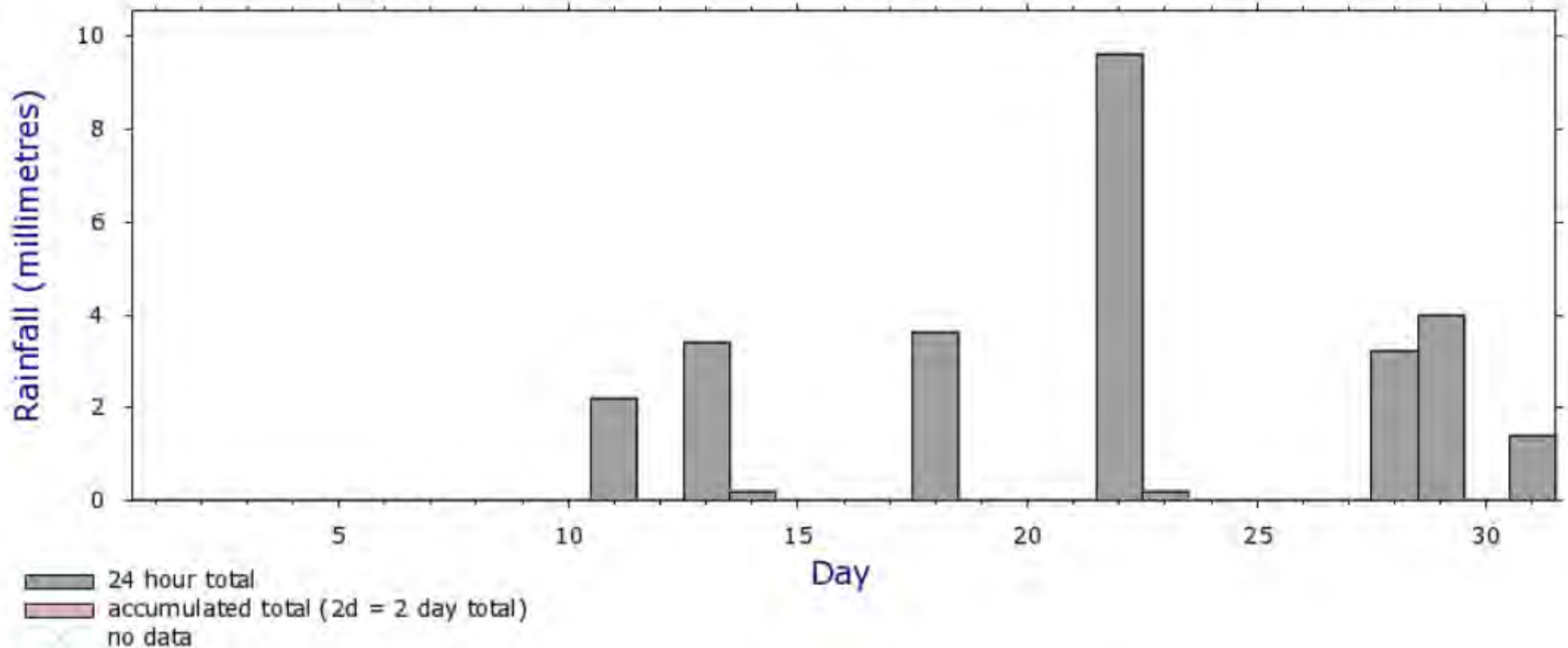
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Page created: Mon 12 Dec 2016 09:28:09 AM EST

|            |           |                                                                 |      |
|------------|-----------|-----------------------------------------------------------------|------|
| Drawn by   | DM        | Macquarie University Central Courtyard Precinct                 | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 251278-00                                           |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                |      |
| Figure No. | 29        | Rainfall Plot One Month Prior to the Geotechnical Investigation |      |

# Macquarie Park (Willandra Village) (066156) Oct 2016 rainfall



Note: Data may not have completed quality control.

Product Code: IDCJAC0009

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Page created: Mon 12 Dec 2016 09:28:10 AM EST

|            |           |                                                                  |      |
|------------|-----------|------------------------------------------------------------------|------|
| Drawn by   | DM        | Alexandria to Moore Park Connectivity Upgrade                    | ARUP |
| Date       | 12-Dec-16 | PROJECT NO: 248446-00                                            |      |
|            |           | GEOTECHNICAL INTERPRETIVE REPORT                                 |      |
| Figure No. | 30        | Rainfall Plot During the Month of the Geotechnical Investigation |      |

## Appendix A

### Borehole Logs

Draft

Draft

## DESCRIPTION AND CLASSIFICATION METHODS

Soil and rock descriptions are generally in accordance with the recommendations of Australian Standards AS 1726-1993 and cover the following properties:

| SOIL | Classification Group       | ROCK | Name                    |
|------|----------------------------|------|-------------------------|
|      | Soil Name                  |      | Grain Size              |
|      | Plasticity                 |      | Texture and Fabric      |
|      | Grain Size                 |      | Colour                  |
|      | Colour                     |      | Strength                |
|      | Texture and Fabric         |      | Weathering              |
|      | Secondary Components       |      | Structure               |
|      | Minor Components           |      | Defects                 |
|      | Moisture                   |      | Weathering of Rock Mass |
|      | Consistency                |      |                         |
|      | Structure                  |      |                         |
|      | Origin                     |      |                         |
|      | Other Relevant Information |      |                         |

Field tests have been used extensively to assess soil consistency, rock strength and grain size. Unless specifically stated otherwise, these assessments have been transferred directly to the record sheets and not modified to coincide with laboratory test results. Field descriptions may therefore be used as an independent estimate of material properties which can be correlated with other data.

## SOIL CLASSIFICATION SYMBOLS

The appropriate group symbol is given as shown on Sheet 2. This is based on the Unified Classification procedure - Visual Method for field identification in accordance with ASTM D 2487 - 83 and D 2488 - 84.

## COMPOSITE SOIL TYPE

As most natural soils are a mixture of basic soil types, the primary soil is described and modified by secondary constituents as follows:

| Coarse Grained Soils |                                            | Fine Grained Soils |                                              |
|----------------------|--------------------------------------------|--------------------|----------------------------------------------|
| % Fines              | Terms                                      | % Fines            | Terms                                        |
| ≤5                   | omit, or use 'trace'                       | ≤15                | omit, or use 'trace'                         |
| >5 ≤12               | describe as 'with clay/silt' as applicable | >15 ≤30            | describe as 'with sand/gravel' as applicable |
| >12                  | 'silty/clayey' preceding primary soil      | >30                | 'sandy/gravelly' preceding primary soil      |

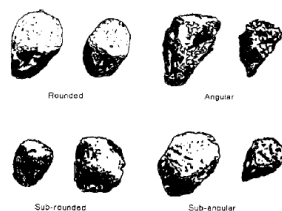
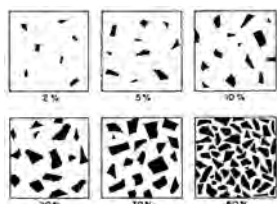
## GRAIN SIZE

|             |         |                             |      |                                       |            |             |          |                                      |            |     |                        |         |          |  |
|-------------|---------|-----------------------------|------|---------------------------------------|------------|-------------|----------|--------------------------------------|------------|-----|------------------------|---------|----------|--|
| FIELD TEST  | i       | Not visible with x10 lens   | i    | Particles >10µm visible with x10 lens |            |             | i        | Particles >75µm visible to naked eye |            |     | Visible identification |         |          |  |
|             | ii      | Does not dilate on shaking  | ii   | Dilates on shaking                    |            |             | ii       | Fine sand feels gritty in fingers    |            |     |                        |         |          |  |
|             | iii     | Adheres to fingers when dry | iii  | Does not adhere to fingers when dry   |            |             |          |                                      |            |     |                        |         |          |  |
|             | iv      | Feels gritty on teeth       |      |                                       |            |             |          |                                      |            |     |                        |         |          |  |
| DESIGNATION | CLAY    |                             | SILT |                                       |            | SAND        |          |                                      | GRAVEL     |     |                        | COBBLES | BOULDERS |  |
|             |         |                             |      | Fine (f)                              | Medium (m) | Coarse (c)  | Fine (f) | Medium (m)                           | Coarse (c) |     |                        |         |          |  |
| GRAIN SIZE  | 2       |                             | 75   | 200                                   | 600        | 2.36        | 6        | 20                                   | 63         | 200 |                        |         |          |  |
|             | microns |                             |      |                                       |            | millimetres |          |                                      |            |     |                        |         |          |  |

| GROUP SYMBOL                                                                          |                                                                                           | GENERAL DESCRIPTION                                 |                                                                      |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------|
| COARSE GRAINED SOILS<br>(MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE) | GRAVEL AND GRAVELLY SOILS<br><br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br>(LITTLE OR NO FINES)               | GW WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES   |
|                                                                                       |                                                                                           |                                                     | GP POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
|                                                                                       |                                                                                           | GRAVELS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) | GM SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES                      |
|                                                                                       |                                                                                           |                                                     | GC CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES                     |
|                                                                                       | SAND AND SANDY SOILS<br><br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE       | CLEAN SANDS<br>(LITTLE OR NO FINES)                 | SW WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES             |
|                                                                                       |                                                                                           |                                                     | SP POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES            |
|                                                                                       |                                                                                           | SANDS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES)   | SM SILTY SANDS, SAND - SILT MIXTURES                                 |
|                                                                                       |                                                                                           |                                                     | SC CLAYEY SANDS, SAND - CLAY MIXTURES                                |
|                                                                                       |                                                                                           |                                                     |                                                                      |
|                                                                                       |                                                                                           |                                                     |                                                                      |

| GROUP SYMBOL                                                                         |                                                     | GENERAL DESCRIPTIONS |                                                                                                                    |
|--------------------------------------------------------------------------------------|-----------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------|
| FINE GRAINED SOILS<br>(MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE) | SILTS AND CLAYS<br><br>LIQUID LIMIT LESS THAN 50    | ML                   | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
|                                                                                      |                                                     | CL                   | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS                  |
|                                                                                      |                                                     | OL                   | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY                                                            |
|                                                                                      | SILTS AND CLAYS<br><br>LIQUID LIMIT GREATER THAN 50 | MH                   | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS                                                |
|                                                                                      |                                                     | CH                   | INORGANIC CLAYS OF HIGH PLASTICITY                                                                                 |
|                                                                                      |                                                     | OH                   | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS                                                          |
|                                                                                      | HIGHLY ORGANIC SOILS                                | PT                   | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS                                                                |
|                                                                                      | FILL                                                |                      | FILL                                                                                                               |
|                                                                                      |                                                     |                      |                                                                                                                    |
|                                                                                      |                                                     |                      |                                                                                                                    |

## PERCENTAGE AND SHAPE CLASSIFICATION



Essentially two-dimensional particles with the third dimension small by comparison may be described as 'flaky' or 'platy'.

Essentially one-dimensional particles with the other two dimensions small by comparison may be described as 'elongated'.

## COLOUR

Individual assessment of colour has been made at field moisture condition, or as received using simple terms like **black, white, grey, red, brown, orange, yellow, green or blue**. No reference has been made to standard colour charts unless specifically stated. These may be modified where necessary using 'pale', or 'dark' or 'mottled'. Borderline colours shall be described as a combination of colours e.g. **red-brown** etc.

Mottling shall be described as '(Primary colour) mottled (secondary colour)'. Where a soil consists of two colours present in roughly equal proportions the colour description should be 'Mottled (first colour) and (second colour)'

## SOIL MOISTURE CONDITION

| Condition | Cohesive                                               | Granular                                  |
|-----------|--------------------------------------------------------|-------------------------------------------|
| DRY (D)   | Hard and friable or powdery, well dry of plastic limit | Cohesionless and free-running             |
| MOIST (M) | Cool, darkened in colour, can be moulded               | Cool, darkened in colour, tends to cohere |
| WET (W)   | Weakened. Free water forms on hands when handling      | Tends to cohere                           |

Moisture content (mc) may be compared to the plastic limit (PL), eg mc>PL means moisture content greater than the plastic limit. The presence of any water seepage may be noted on the borehole records.

## CONSISTENCY Cohesive Soils

| FIELD TEST                   | Exudes between fingers when squeezed | Moulded by light finger pressure | Moulded by strong finger pressure | Indented by thumb, cannot be moulded by fingers | Indented by thumbnail | Indented with difficulty by thumbnail |
|------------------------------|--------------------------------------|----------------------------------|-----------------------------------|-------------------------------------------------|-----------------------|---------------------------------------|
| DESIGNATION                  | Very Soft (VS)                       | Soft (S)                         | Firm (F)                          | Stiff (ST)                                      | Very Stiff (VST)      | Hard (H)                              |
| UNDRAINED SHEAR STRENGTH kPa | 12                                   | 25                               | 50                                | 100                                             | 200                   |                                       |

## CONSISTENCY Non-Cohesive Soils

| FIELD TEST                     | Easily excavated with a spade | Some resistance to a spade or penetration with a hand bar | Considerable resistance to spade or penetration with a hand bar | No penetration with a hand bar; requires pick for excavation | High resistance to a pick |
|--------------------------------|-------------------------------|-----------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------------|---------------------------|
| SPT 'N' VALUE (blows / 300 mm) | 4                             | 10                                                        | 30                                                              | 50                                                           |                           |
| DESIGNATION                    | Very loose (VL)               | Loose (L)                                                 | Medium Dense (MD)                                               | Dense (D)                                                    | Very Dense (VD)           |
| DENSITY INDEX %                | 15                            | 35                                                        | 65                                                              | 85                                                           |                           |

## DILATANCY Cohesive Soils

A positive reaction consists of the appearance of water on the surface of the pat which changes to livery consistency and becomes glossy. When the sample is squeezed the water and gloss disappear from the surface, the pat stiffens and finally cracks or crumbles.

The rapidity of appearance of water during shaking and its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

## SOIL STRUCTURE

Zoning: May consist of separate zone differing in colour, grain size or other properties. These should be describe d with the following descriptions:

- "Layer" i.e. zone is continuous across exposure or sample
  - "Lens" i.e. a discontinuous layer of different material, with lenticular shape
  - "Pocket" i.e. an irregular inclusion
- (the thickness, orientation and distinguishing features of the zones should be described).

Defects: described dimensions, orientation and spacing. Defects may include fissures, cracks, root-holes etc.

Cementing: Coarse grained soils may be cemented together by various agents. If the cementing agent allows the particle aggregations to be easily fractured by hand when the soil is saturated it is described as "**weakly**" cemented. If the cementing agent prevents fracturing by hand of the particle aggregations when saturated, it is described as "**strongly**" cemented.

## ORGANICS

The presence of organic material shall be described using proportion terms such as 'with' or 'trace' using the following terms: **fibrous peat; charcoal; wood fragments; roots** (greater than 2 mm diameter); or **root fibres** (less than 2 mm diameter).

## TYPICAL REPRESENTATION AND TERMS USED FOR CARBONATE ROCK

Classification of calcareous materials (modified from Clark and Walker)

| Soil Consistency and Rock Strength                                                              | <div> <div>Increasing grain size of particulate deposits</div> <div> <div>0.002 mm</div> <div>0.06 mm</div> <div>2 mm</div> <div>60 mm</div> </div> </div> |                                  |                              |                                          | Total Carbonate Content (%) |
|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------|------------------------------------------|-----------------------------|
|                                                                                                 |                                                                                                                                                            |                                  |                              |                                          |                             |
| Soil Density/Consistency used as per AS1726-1993                                                | CARBONATE CLAY                                                                                                                                             | CARBONATE SILT                   | CARBONATE SAND               | CARBONATE GRAVEL                         | 90-100                      |
|                                                                                                 |                                                                                                                                                            | Siliceous CARBONATE SILT         | Siliceous CARBONATE SAND     | Mixed carbonate and non-carbonate GRAVEL | 50-90                       |
|                                                                                                 | Calcareous CLAY                                                                                                                                            | Calcareous SILT                  | Calcareous silica SAND       |                                          | 10-50                       |
|                                                                                                 | CLAY                                                                                                                                                       | SILT                             | Silica SAND                  | GRAVEL                                   | 0-10                        |
| Extremely Low to Medium Strength<br>$I_s 50 < 1 \text{ MPa}$<br>$\text{UCS} < 12.5 \text{ MPa}$ | CALCILUTITE Clayey                                                                                                                                         | CALCISILTITE Siliceous           | CALCARENITE Siliceous        | CALCIRUDITE Conglomeratic                | 90-100                      |
|                                                                                                 | CALCILUTITE Calcareous                                                                                                                                     | CALCISILTITE Calcareous          | CALCARENITE Calcareous       | CALCIRUDITE Calcareous                   | 50-90                       |
|                                                                                                 | CLAYSTONE                                                                                                                                                  | SILTSTONE                        | SANDSTONE                    | CONGLOMERATE                             | 10-50                       |
|                                                                                                 | CLAYSTONE                                                                                                                                                  | SILTSTONE                        | SANDSTONE                    | CONGLOMERATE                             | 0-10                        |
| High to Very High Strength.<br>$I_s 50 > 1 \text{ MPa}$<br>$\text{UCS} > 12.5 \text{ MPa}$      | Fine-grained LIMESTONE                                                                                                                                     |                                  | Detrital LIMESTONE           | CONGLOMERATE LIMESTONE                   | 90-100                      |
|                                                                                                 | Fine-grained Argillaceous LIMESTONE                                                                                                                        | Fine-grained Siliceous LIMESTONE | Siliceous detrital LIMESTONE | Conglomeratic LIMESTONE                  | 50-90                       |
|                                                                                                 | Calcareous CLAYSTONE                                                                                                                                       | Calcareous SILTSTONE             | Calcareous SANDSTONE         | Calcareous LIMESTONE                     | 10-50                       |
|                                                                                                 | CLAYSTONE                                                                                                                                                  | SILTSTONE                        | SANDSTONE                    | CONGLOMERATE                             | 0-10                        |
| CRYSTALLINE LIMESTONE <sup>2</sup>                                                              |                                                                                                                                                            |                                  |                              |                                          |                             |

- The strength of rock was determined in the field based on visual identification in accordance with page 3 of the Arup Explanatory Notes and was subsequently confirmed by laboratory testing.
- Classification based upon rock displaying a crystalline fabric.

The term 'siliceous' replaces the term 'silica' when a secondary descriptor is used to indicate the presence of clay or silt fractions. These terms are as follows:

- Calcareous Siliceous Silty Sand
- Calcareous Siliceous Clayey Sand
- Siliceous Silty Sand
- Siliceous Clayey Sand

## ROCK STRENGTH Based on visual identification

|                                               |                                                                                                                             |                                                                                                                    |                                                                                               |                                                                                                            |                                                                                                                        |                                                                                  |                                                                                                             |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| FIELD TEST                                    | Easily remoulded by hand to a material with soil properties                                                                 | Material crumbles under firm blows with sharp end of pick. Pieces up to 3cm thick can be broken by finger pressure | Easily scored with knife. A piece of core 150mm long and 50mm diameter may be broken by hand. | Readily scored by knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty | A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with single firm blow | Hand specimen breaks with pick after more than one blow; rock rings under hammer | Specimen requires many blows with geological pick to break through intact material; rock rings under hammer |
| POINT LOAD STRENGTH INDEX<br>$I_s(50)$ MPa    | 0.03                                                                                                                        | 0.1                                                                                                                | 0.3                                                                                           | 1                                                                                                          | 3                                                                                                                      | 10                                                                               |                                                                                                             |
| DESIGNATION                                   | Extremely Low (EL)                                                                                                          | Very Low (VL)                                                                                                      | Low (L)                                                                                       | Medium (M)                                                                                                 | High (H)                                                                                                               | Very High (VH)                                                                   | Extremely High (EH)                                                                                         |
| UNCONFINED COMPRESSIVE STRENGTH ( $q_u$ ) MPa | The unconfined compressive strength is typically about 20 x $I_s(50)$ . The ratio may vary widely for different rock types. |                                                                                                                    |                                                                                               |                                                                                                            |                                                                                                                        |                                                                                  |                                                                                                             |

## ROCK WEATHERING Based on visual identification

|                  |                                                                                                                                                                                                  |                                                                                                                        |                                                                                                                                                                                                                          |                                                                                         |                                                 |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------|
| FIELD APPEARANCE | Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported | Rock is weathered to an extent that it has 'soil' properties, ie it either disintegrates or can be remoulded, in water | 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. | Rock is slightly discoloured but shows little or no change of strength from fresh rock. | Rock shows no sign of decomposition or staining |
| DESIGNATION      | Residual Soil (RS)                                                                                                                                                                               | Extremely weathered rock (XW)                                                                                          | Distinctly weathered rock (DW)                                                                                                                                                                                           | Slightly weathered rock (SW)                                                            | Fresh rock (FR)                                 |

## BEDDING STRATIFICATION

| Term                                        |           | Description         | Separation of Stratification Planes |
|---------------------------------------------|-----------|---------------------|-------------------------------------|
| Stratification not recognisable             |           | Massive             | -                                   |
| Stratification more than 20 mm apart        | Bedded    | Very thickly bedded | >2 m                                |
|                                             |           | Thickly bedded      | 0.6 - 2 m                           |
|                                             |           | Medium bedded       | 0.2 - 0.6 m                         |
|                                             |           | Thinly bedded       | 60 mm-0.2 m                         |
|                                             |           | Very thinly bedded  | 20 – 60 mm                          |
| Stratification planes less than 20 mm apart | Laminated | Thickly laminated   | 6 – 20 mm                           |
|                                             |           | Thinly laminated    | <6 mm                               |

Table based on Geological Society Engineering Group Working Party report on *The Logging of Rock Cores for Engineering Purposes* - Q JI Eng Geol Vol 3, 1970, pp1-24.

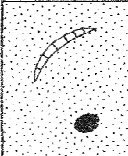
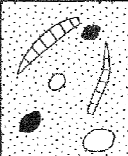
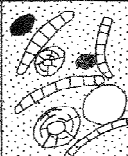
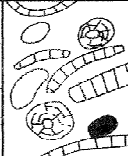
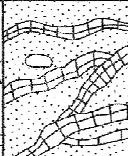
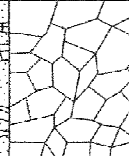
## DEVELOPMENT OF STRATIFICATION

| Term                | Description                                                                                                            |
|---------------------|------------------------------------------------------------------------------------------------------------------------|
| Poorly Developed    | Bedding is barely obvious as faint mineralogical layering or grain size banding, but bedding planes are poorly defined |
| Well Developed      | Bedding is apparent as distinct layers or lines marked by mineralogical or grain size layering                         |
| Very Well Developed | Bedding is often marked by a discrete colour banding as well as by mineralogical or grain size layering                |

## ROCK TEXTURE AND FABRIC

Texture of rock refers to individual grains. Terms used frequently are: Crystalline, porphyritic, granular, cryptocrystalline, amorphous, glassy.

The arrangement of the grains (fabric) should be described as massive or layered (bedded, foliated, cleaved) Calcareous rocks should be described using the table below.

| Depositional texture recognizable                                                   |                                                                                     |                                                                                     |                                                                                     |                                                                                     | Depositional texture not recognizable                                                |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Original components not bound together during deposition                            |                                                                                     |                                                                                     | Original components were bound together                                             |                                                                                     |                                                                                      |
| Contains mud (clay and fine silt-size carbonate)                                    |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                      |
| Mud-supported                                                                       |                                                                                     | Grain-supported                                                                     |                                                                                     |                                                                                     |                                                                                      |
| Less than 10% grains                                                                | More than 10% grains                                                                |                                                                                     | Lacks mud and is grain supported                                                    |                                                                                     |                                                                                      |
| Mudstone                                                                            | Wackestone                                                                          | Packstone                                                                           |                                                                                     | Grainstone                                                                          | Boundstone                                                                           |
|  |  |  |  |  |  |

Carbonate rock fabric descriptive terminology based on Dunham 1962.

## ROCK STRUCTURE

Sedimentary rocks – Bedded, laminated (<20 mm)

Metamorphic – Foliated, banded or cleaved

Igneous – massive, flow banded

## DEFECT DESCRIPTION

Order of description: type, angle, thickness, planarity, roughness, coating, infill.

### Defect Type

| Symbol | Description                                                                                                                                                                                                                                         |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sh     | Sheared Zone - zone of multiple closely spaced fracture planes with roughly parallel planar boundaries, usually forming blocks of lenticular or wedge-shaped intact material. Fractures are typically smooth, polished or slickensided; and curved. |
| Be     | Bedding plane parting - arrangement in layers of mineral grains of similar sizes, near parallel to surface of deposition along which a continuous observable parting occurs. Generally no microfractures.                                           |
| Fo     | Foliation Parting – As for bedding plane parting except discontinuous microfractures may be present near parallel to the layering.                                                                                                                  |
| Jo     | Joint - a fracture across which rock has little or no tensile strength and is not obviously related to rock fabric.                                                                                                                                 |
| Cr     | Crushed Seam - zone with roughly parallel, planar boundaries (commonly slickensided) containing disoriented usually angular rock fragments of variable size often in a soil matrix.                                                                 |
| Cl     | Dyke – Igneous intrusion - often weathered and altered to a clay-like substance.                                                                                                                                                                    |
| We     | Weathered/Decomposed Zone - zone of any shape but commonly with parallel planar boundaries containing moderately to gradational boundaries into fresher rock.                                                                                       |
| SC     | Solution cavity                                                                                                                                                                                                                                     |

### Inclination

For specific defects, the orientation of each individual defect is noted in degrees from core normal. If the orientation cannot be measured, a dash (-) is used.

## SPT SAMPLE DESCRIPTIONS

Where SPT tests are carried out in regions of core loss, a separate description of the SPT sample is provided. A separate description of the SPT sample is not however provided when core loss has not been recovered.

## SHAPE

| Symbol | Description                                                        |
|--------|--------------------------------------------------------------------|
| PL     | Planar - forms a continuous plane without variation in orientation |
| IR     | Irregular - has no clear orientation                               |
| CU     | Curved - has a gradual change in orientation                       |
| UN     | Undulating - has a wavy surface shape                              |
| ST     | Stepped - has one or more well-defined steps                       |

## ROUGHNESS

| Symbol | Description                                                |
|--------|------------------------------------------------------------|
| Ro1    | Slickensided or polished - very smooth, reflects light     |
| Ro2    | Smooth - roughness not detected with finger                |
| Ro3    | Defined ridges - Sandpaper feel (fine to medium sandpaper) |
| Ro4    | Small steps - sandpaper feel (medium to coarse sandpaper)  |
| Ro5    | Very rough - very well defined ridges and/or steps.        |

## INFILL TYPE

| Symbol | Description           |
|--------|-----------------------|
| CL     | Clean                 |
| CA     | Calcite               |
| CB     | Carbonaceous material |
| CH     | Chlorite              |
| CT     | Carbonate             |
| FE     | Iron oxide            |
| LM     | Limonite              |
| QZ     | Quartz                |
| SU     | Sulphides             |
| RF     | Rock fragments        |
| g      | gravelly              |
| s      | sandy                 |
| m      | silty                 |
| c      | clayey                |
| G      | Gravel                |
| S      | Sand                  |
| M      | Silt                  |
| C      | Clay                  |

Note: lower case letters are used as prefix

## INFILL THICKNESS

Where infilling is present, the thickness of infill is recorded using the following convention:

- ST Iron oxide staining less than 1mm
- VN Veneer coating less than 1mm

If the infilling is greater than 1mm, the actual thickness of infill is recorded in millimetres. If infill is not present, a dash (-) is recorded.

## SAMPLE CODES

| Symbol | Description                       |
|--------|-----------------------------------|
| C      | Core sample                       |
| SB     | Small bulk disturbed              |
| AMAL   | Amalgamated sample                |
| B      | Bulk disturbed                    |
| BLK    | Block                             |
| CBR    | CBR mould                         |
| CD     | Plastic tub for chemical analysis |
| D      | Small disturbed                   |
| DEN    | Denison Sampler                   |
| DENm   | Denison Sampler (modified)        |
| E      | Environmental                     |
| G      | Gas                               |
| J      | Jar                               |
| K      | Amber chemical jar                |
| LB     | Large bulk disturbed              |
| LDS    | Large disturbed                   |
| M      | Mazier type                       |
| P      | Piston                            |
| TW     | Thin walled push-in               |
| U      | Undisturbed – open drive          |
| U100   | 100mm diameter undisturbed        |
| U63    | 63mm diameter undisturbed         |
| U76    | 76mm diameter undisturbed         |
| W      | Water                             |

## STANDARD PENETRATION TEST REPORTING

The results of SPT's are reported on both borehole and cored borehole logs.

Typically the test is reported as the number of blows for the seating drive ; and the number of blows of the two increments of the main drive e.g. N 5;10,15

For a test which is terminated during the main drive, the blows for the seating drive are reported followed by a semi-colon (;) and then the total number of blows and the total distance driven (mm) is reported e.g. N 15;50/250

For a test which is terminated during the seating drive, the total number of blows and the distance driven (mm) is reported and the result is suffixed with an "s" to designate the test was terminated during the seating drive e.g. N 50/75s.

For a test that is terminated within the seating drive the N values is determined by extrapolation of the penetration and number of blows recorded and is denoted with "\*\*\*\*".

For a test that is terminated before achieving the full main drive penetration, the N values is determined by extrapolation of the penetration and number of blows recorded and is denoted with "\*\*\*".

HB – Hammer double bouncing

## POINT LOAD TESTING

$I_{s(50)}$  Diametral test results to be recorded on log as: **2.05 DI**

$I_{s(50)}$  Axial test results to be recorded on log as: **2.05 AX**

$I_{s(50)}$  Irregular test results to be recorded on log as: **2.05 IR**

# Geotechnical Explanatory Notes

## SYMBOLS & ABBREVIATIONS

### Drilling

| Method     |                                                        |
|------------|--------------------------------------------------------|
| AD         | Auger drilling (drilled depths shown (m))              |
| V bit      | Steel 'V' bit                                          |
| TC         | Tungsten carbide bit                                   |
| RR         | Tricone (rock roller) bit                              |
| W          | Washboring                                             |
| NMLC, BMLC | Triple tube rotary core drilling (52mm, 35mm diameter) |
| NH, HQ     | Wireline core drilling                                 |
| D          | Diatube coring                                         |

### Support

|   |             |
|---|-------------|
| W | Water       |
| M | Mud         |
| C | Casing      |
| T | Timbering   |
| U | Unsupported |

### Sample and Field Testing

|                     |                                                                                                                                        |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| D                   | Disturbed sample                                                                                                                       |
| U(x)                | Undisturbed sample x mm diameter                                                                                                       |
| U(x)+               | U(x) attempted, little or no recovery                                                                                                  |
| PT                  | Pressuremeter test                                                                                                                     |
| PL                  | Point load test (AX - axial, DI - diametral test)                                                                                      |
| Is(50)              | Point load strength index (MPa)                                                                                                        |
| q <sub>c</sub>      | Cone resistance (from CPT)                                                                                                             |
| q <sub>p</sub> , PP | Unconfined compressive strength estimated from pocket penetrometer (kPa)                                                               |
| RQD                 | Rock quality designation expressed as:<br><u>sum of lengths of sound core pieces &gt;100mm</u> total length of core section considered |
| SCR                 | Solid core recovery                                                                                                                    |
| TCR                 | Total core recovery                                                                                                                    |
| D/DD                | Dip/dip direction of rock discontinuity (degrees)                                                                                      |
| CPT                 | Cone penetration test                                                                                                                  |
| SPT                 | Standard penetration test                                                                                                              |
| N                   | SPT blow count (blows/300 mm)                                                                                                          |

|   |                                                       |
|---|-------------------------------------------------------|
| R | SPT refusal                                           |
| V | In situ vane test (showing peak/residual value (kPa)) |
| W | Water sample                                          |
| B | Bulk sample                                           |

### Water – Moisture

|             |                                     |
|-------------|-------------------------------------|
| W           | Wet                                 |
| M           | Moist                               |
| D           | Dry                                 |
| S           | Standpipe installed to depth shown  |
| P           | Piezometer installed at depth shown |
| -----►----- | Inflow                              |
| -----◄----- | Outflow (loss)                      |
| -----▼----- | Level (date)                        |
| -----◄----- | Partial loss                        |

### Soil Properties

|                |                                                 |
|----------------|-------------------------------------------------|
| CBR            | California Bearing Ratio                        |
| c'             | Effective shear strength                        |
| c <sub>c</sub> | Compressed index                                |
| c <sub>u</sub> | Undrained shear strength                        |
| c <sub>v</sub> | Coefficient of consolidation                    |
| c <sub>α</sub> | Coefficient of secondary compression            |
| DD             | Dry density                                     |
| D <sub>r</sub> | Dry density expressed                           |
| E              | Elastic modulus                                 |
| e              | Void ratio                                      |
| G              | Shear modulus                                   |
| G <sub>s</sub> | Specific gravity                                |
| k              | Coefficient of permeability                     |
| MDD            | Maximum dry density obtained in compaction test |
| m <sub>v</sub> | Coefficient of volume compressibility           |
| NDD            | Natural dry density                             |
| NMC            | Natural moisture content                        |
| OMC            | Optimum moisture content obtained in compaction |

|                                 |                                                                  |
|---------------------------------|------------------------------------------------------------------|
| LI                              | Liquidity index                                                  |
| LL                              | Liquidity limit                                                  |
| LS                              | Linear shrinkage                                                 |
| PI                              | Plasticity index                                                 |
| PL                              | Plastic limit                                                    |
| q <sub>u</sub> , UCS            | Unconfined compressive strength                                  |
| w                               | Moisture content (% of dry weight)                               |
| γ <sub>b</sub>                  | Bulk density                                                     |
| γ <sub>d</sub>                  | Dry density                                                      |
| γ <sub>w</sub>                  | Density of water                                                 |
| ν                               | Poisson's ratio                                                  |
| φ <sub>u</sub>                  | Apparent angle of friction from quick undrained triaxial test    |
| φ <sub>u</sub> φ <sub>u</sub> ' | Effective angles of friction in drained and undrained conditions |

### Design Parameters

|                                                  |                                    |
|--------------------------------------------------|------------------------------------|
| Ab                                               | Footing or pile base area          |
| B                                                | Footing or pile width or diameter  |
| D                                                | Footing or pile depth              |
| d                                                | Diameter of pile (m)               |
| K                                                | Coefficient of earth pressure      |
| K <sub>a</sub>                                   | Coefficient of active pressure     |
| K <sub>o</sub>                                   | Coefficient earth pressure at rest |
| K <sub>p</sub>                                   | Coefficient of passive pressure    |
| L                                                | Footing length                     |
| N <sub>c</sub> , N <sub>q</sub> , N <sub>γ</sub> | Bearing capacity factors           |
| NSF                                              | Negative skin friction             |
| P                                                | Load                               |
| P <sub>a</sub>                                   | Total active force                 |
| P <sub>b</sub>                                   | Pile base load                     |
| P <sub>p</sub>                                   | Total passive force                |
| P <sub>s</sub>                                   | Pile shaft load                    |
| P <sub>a</sub>                                   | Active earth pressure              |
| P <sub>b</sub>                                   | Pile base pressure                 |

|                      |                                              |
|----------------------|----------------------------------------------|
| P <sub>p</sub>       | Passive earth pressure                       |
| P <sub>s</sub>       | Pile shaft adhesion                          |
| S                    | Settlement                                   |
| T <sub>v</sub>       | Dimensionless time factor                    |
| t                    | Time                                         |
| U                    | Degree of consolidation                      |
| u                    | Pore water pressure                          |
| α                    | Shaft adhesion factor                        |
| δ                    | Angle of friction between soil and structure |
| σ                    | Total normal stress                          |
| σ'                   | Effective normal stress                      |
| τ                    | Shear stress                                 |
| <i>Subscript all</i> | Allowable or working                         |
| <i>Subscript h</i>   | Horizontal                                   |
| <i>Subscript r</i>   | Residual                                     |
| <i>Subscript ult</i> | Ultimate                                     |
| <i>Subscript v</i>   | Vertical                                     |

ARUP

## BOREHOLE RECORD

BH01

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT her

LOGGED BY DM

CHECKED BY AC, 24-Nov-16

DRILLED DATE 18-Oct-16

CONTRACTOR BG Drilling

DRILL MODEL Hanjin D&amp;B, D8

DRILLER Randall Smith

LOCATION Central Courtyard Precinct, Macquarie University

ANGLE Vertical

BEARING -

HOLE DIAMETER 110mm - SFA

GROUND LEVEL RL 54.82mOD

LOCATION 325221.3 E 6261427.1 N

ELEVATION DATUM Australian Height Datum (AHD)

COORDINATE SYSTEM National Grid

| DRILLING                                         |       | STRATA |              |        | MATERIAL DESCRIPTION                                                                                                                                              |                  | CONDITION   |               | OBSERVATION                 |    |     |              |    |    |
|--------------------------------------------------|-------|--------|--------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|---------------|-----------------------------|----|-----|--------------|----|----|
| SAMPLE, TEST, BIT, SUPPORT, ETC.                 | R.L.  | DEPTH  | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                                                    | WATER / MOISTURE | CONSISTENCY |               | Comments / Penetration Rate |    |     |              |    |    |
|                                                  | mOD   | m      |              |        |                                                                                                                                                                   |                  | COHESIVE    |               |                             |    |     | NON COHESIVE |    |    |
|                                                  |       |        |              |        |                                                                                                                                                                   |                  | VS          | SL            |                             | ST | VST | H            | VL | ML |
| ADT                                              |       |        |              |        | FILL: Sandy CLAY, low plasticity, brown, sand is fine to coarse grained, trace of root fibres.                                                                    | MC < PL          |             |               |                             |    |     |              |    |    |
| SPT<br>N=9<br>2:5,4<br>(Rec: 230mm)<br>PP>220kPa | 52.97 | 1.85   |              |        | FILL: Gravelly sandy CLAY, low plasticity, orange red-brown, sand is fine to coarse grained, gravel is fine to medium grained, sub-angular, trace of root fibres. | MC > PL          |             |               |                             |    |     |              |    |    |
| SPT<br>U75<br>N=3<br>1:1,2<br>(Rec: 300mm)       | 51.32 | 3.50   |              |        | FILL: Sandy CLAY, low to medium plasticity, dark brown, sand is fine grained.                                                                                     | MC > PL          |             |               |                             |    |     |              |    |    |
| SPT<br>N=0<br>(HW, Rec: 400mm)                   | 49.82 | 5.00   |              |        | ... 4.50m medium plasticity, orange-brown, trace of silt                                                                                                          |                  |             |               |                             |    |     |              |    |    |
| NOTES                                            |       |        |              |        | See explanatory notes for details of abbreviations and basis of descriptions                                                                                      |                  |             | JOB<br>251278 |                             |    |     |              |    |    |

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gINT output page 2 of 2. Made 15Dec16 13:44

|                                                           |  |                                                   |  |                                               |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
|-----------------------------------------------------------|--|---------------------------------------------------|--|-----------------------------------------------|------------------------------------------------------------------------------|--------------|-----------|--------------------------------------------------------------------------------------------|-----------------|------------------|-------------|--|-----------------------------|
| ARUP                                                      |  | BOREHOLE RECORD                                   |  |                                               |                                                                              |              | BH01      |                                                                                            | SHEET 2<br>OF 4 |                  |             |  |                             |
| CLIENT Macquarie University                               |  |                                                   |  |                                               | LOGGED BY DM                                                                 |              |           |                                                                                            |                 |                  |             |  |                             |
| PROJECT her                                               |  |                                                   |  |                                               | CHECKED BY AC, 24-Nov-16                                                     |              |           |                                                                                            |                 |                  |             |  |                             |
|                                                           |  |                                                   |  |                                               | DRILLED DATE 18-Oct-16                                                       |              |           |                                                                                            |                 |                  |             |  |                             |
| CONTRACTOR BG Drilling                                    |  | ANGLE Vertical                                    |  | GROUND LEVEL RL 54.82mOD                      |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
| DRILL MODEL Hanjin D&B, D8                                |  | BEARING -                                         |  | LOCATION 325221.3 E 6261427.1 N               |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
| DRILLER Randall Smith                                     |  | HOLE DIAMETER 110mm - SFA                         |  | ELEVATION DATUM Australian Height Datum (AHD) |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
| LOCATION Central Courtyard Precinct, Macquarie University |  |                                                   |  | COORDINATE SYSTEM National Grid               |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
| DRILLING                                                  |  | STRATA                                            |  | MATERIAL DESCRIPTION                          |                                                                              |              | CONDITION |                                                                                            | OBSERVATION     |                  |             |  |                             |
| SAMPLE, TEST, BIT, SUPPORT, ETC.                          |  | R.L.                                              |  | DEPTH                                         |                                                                              | GROUP SYMBOL | LEGEND    | SOIL TYPE                                                                                  |                 | WATER / MOISTURE | CONSISTENCY |  | Comments / Penetration Rate |
|                                                           |  | Plasticity / Grain Size, Colour, Minor Components |  | COHESIVE                                      |                                                                              |              |           | NON COHESIVE                                                                               |                 |                  |             |  |                             |
|                                                           |  | VS SL ST SH VL MD VD                              |  | VS SL ST SH VL MD VD                          |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
| ADT                                                       |  | 48.82                                             |  | 6 6.00                                        |                                                                              |              |           | FILL: Sandy CLAY, medium plasticity, orange-brown, sand is fine grained, trace of silt.    |                 |                  |             |  |                             |
| SPT N=16<br>6.8.8<br>(Rec: 360mm)<br>PP>220kPa            |  | 47.69                                             |  | 7 7.13                                        |                                                                              | CL           |           | Sandy CLAY, (CL) low plasticity, pale grey, sand is fine to medium grained, trace of silt. |                 |                  |             |  | Residual                    |
|                                                           |  |                                                   |  | 8                                             |                                                                              |              |           | Continued as cored borehole                                                                |                 |                  |             |  |                             |
|                                                           |  |                                                   |  | 9                                             |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
|                                                           |  |                                                   |  | 10                                            |                                                                              |              |           |                                                                                            |                 |                  |             |  |                             |
| NOTES                                                     |  |                                                   |  |                                               | See explanatory notes for details of abbreviations and basis of descriptions |              |           |                                                                                            |                 | JOB 251278       |             |  |                             |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|                                         |                                                |
|-----------------------------------------|------------------------------------------------|
| LOGGED BY<br>CHECKED BY<br>DRILLED DATE | DM<br>AC, 24-Nov-16<br>18-Oct-16               |
| GROUND LEVEL<br>LOCATION                | RL 54.82mOD<br>325221.3 E 6261427.1 N          |
| ELEVATION DATUM<br>COORDINATE SYSTEM    | Australian Height Datum (AHD)<br>National Grid |

|             |                                                  |               |             |
|-------------|--------------------------------------------------|---------------|-------------|
| CONTRACTOR  | BG Drilling                                      | ANGLE         | Vertical    |
| DRILL MODEL | Hanjin D&B, D8                                   | BEARING       | -           |
| DRILLER     | Randall Smith                                    | HOLE DIAMETER | 52mm (NMLC) |
| LOCATION    | Central Courtyard Precinct, Macquarie University |               |             |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

.JOB

251278

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|                                         |                                                |
|-----------------------------------------|------------------------------------------------|
| LOGGED BY<br>CHECKED BY<br>DRILLED DATE | DM<br>AC, 24-Nov-16<br>18-Oct-16               |
| GROUND LEVEL<br>LOCATION                | RL 54.82mOD<br>325221.3 E 6261427.1 N          |
| ELEVATION DATUM<br>COORDINATE SYSTEM    | Australian Height Datum (AHD)<br>National Grid |

|             |                                                  |               |             |
|-------------|--------------------------------------------------|---------------|-------------|
| CONTRACTOR  | BG Drilling                                      | ANGLE         | Vertical    |
| DRILL MODEL | Hanjin D&B, D8                                   | BEARING       | -           |
| DRILLER     | Randall Smith                                    | HOLE DIAMETER | 52mm (NMLC) |
| LOCATION    | Central Courtyard Precinct, Macquarie University |               |             |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

.JOB

251278

ARUP

## CORE PHOTO RECORD

BH01

SHEET 1

OF 1

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY AC, 24-Nov-16  
DRILLED DATE 18-Oct-16  
GROUND LEVEL RL 54.82mOD  
LOCATION 325221.3 E 6261427.1 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH01 Depth Range: 7.13 - 12.00 m



BH01 Depth Range: 12.00 - 12.70 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

ARUP

## BOREHOLE RECORD

BH02

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

LOGGED BY

DM

CHECKED BY

BCH, 25-Nov-16

DRILLED DATE

19-Oct-16

CONTRACTOR

BG Drilling

DRILL MODEL

Hanjin D&amp;B, D8

DRILLER

Randall Smith

LOCATION

Central Courtyard Precinct, Macquarie University

ANGLE

Vertical

BEARING

-

HOLE DIAMETER

110mm - SFA

GROUND LEVEL

RL 55.38mOD

LOCATION

325259.8 E 6261425.4 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid

| DRILLING                                             |       | STRATA |              |        | MATERIAL DESCRIPTION                                                                                                                                                     | CONDITION        |             | OBSERVATION   |    |    |              |    |    |    |                             |          |
|------------------------------------------------------|-------|--------|--------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|---------------|----|----|--------------|----|----|----|-----------------------------|----------|
| SAMPLE, TEST, BIT, SUPPORT, ETC.                     | R.L.  | DEPTH  | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                                                           | WATER / MOISTURE | CONSISTENCY |               |    |    |              |    |    |    | Comments / Penetration Rate |          |
|                                                      | mOD   | m      |              |        |                                                                                                                                                                          |                  | COHESIVE    |               |    |    | NON COHESIVE |    |    |    |                             |          |
|                                                      |       |        |              |        |                                                                                                                                                                          |                  | VS          | SL            | ST | SH | VL           | LL | MD | VD |                             |          |
| ADT                                                  |       |        |              |        | FILL: Sandy CLAY, low plasticity, brown, sand is fine to coarse grained, trace of silt, trace of root fibres.                                                            | MC < PL          |             |               |    |    |              |    |    |    |                             |          |
| SPT<br>N=9<br>3,5,4<br>(Rec: 310mm)<br><br>PP>220kPa | 54.88 | 0.50   | CL           |        | Gravelly sandy CLAY, (CL) low plasticity, brown mottled red mottled pale grey, sand is fine to coarse grained, gravel is fine to medium grained, angular, trace of silt. |                  |             |               |    |    |              |    |    |    |                             | Residual |
| SPT<br>N=9<br>4,3,6<br>(Rec: 370mm)<br>PP>220kPa     |       | 1      |              |        |                                                                                                                                                                          | MC > PL          |             |               |    |    |              |    |    |    |                             |          |
| U75 (Rec: 300mm)                                     | 53.88 | 1.50   | CH           |        | Gravelly sandy CLAY, (CH) high plasticity, red-brown, sand is fine to coarse grained, gravel is fine to medium grained, sub-angular.                                     |                  |             |               |    |    |              |    |    |    |                             |          |
|                                                      |       | 2      |              |        | ... 2.00m - 3.00m medium plasticity, dark brown, sand is fine grained, gravel is fine to coarse grained sub-angular to sub-rounded.                                      |                  |             |               |    |    |              |    |    |    |                             |          |
| SPT<br>N=2<br>3,1,1<br>(Rec: 300mm)                  | 52.38 | 3 3.00 | SC           |        | Clayey SAND, (SC) fine to medium grained, orange-brown, clay sections, medium plasticity, pale grey.                                                                     | M                |             |               |    |    |              |    |    |    |                             |          |
|                                                      |       | 4      |              |        |                                                                                                                                                                          |                  |             |               |    |    |              |    |    |    |                             |          |
| SPT<br>N=50*<br>16,10/50<br>(HB, Rec: 200mm)         | 50.83 | 4.55   |              |        | SANDSTONE, fine grained, red, distinctly weathered, very high strength.                                                                                                  | D                |             |               |    |    |              |    |    |    |                             |          |
|                                                      | 50.52 | 4.86   |              |        |                                                                                                                                                                          |                  |             |               |    |    |              |    |    |    |                             |          |
|                                                      |       | 5      |              |        | Continued as cored borehole                                                                                                                                              |                  |             |               |    |    |              |    |    |    |                             |          |
| NOTES                                                |       |        |              |        | See explanatory notes for details of abbreviations and basis of descriptions                                                                                             |                  |             | JOB<br>251278 |    |    |              |    |    |    |                             |          |

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|---------------------------------------------------------|---------------|----------------------------|---------------------------------------------|-----------------------|-------|-----------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------|-------------------------------|------------------------------------------------------------------------------|----------------------|---------------------------|-------|--------------------------|---------------------------------------|---------------------------------|-----------------|-----------------------------------------------|--|---------------------------------|--|--|
| ARUP                                                    |               | CORED BOREHOLE RECORD      |                                             |                       |       |                                                           |                                                                                |                            |                               |                                                                              |                      | BH02                      |       |                          | SHEET 2<br>OF 4                       |                                 |                 |                                               |  |                                 |  |  |
| CLIENT Macquarie University                             |               |                            |                                             |                       |       |                                                           |                                                                                |                            |                               | LOGGED BY DM                                                                 |                      |                           |       |                          | CHECKED BY BCH, 25-Nov-16             |                                 |                 |                                               |  |                                 |  |  |
| PROJECT Macquarie University Central Courtyard Precinct |               |                            |                                             |                       |       |                                                           |                                                                                |                            |                               | DRILLED DATE 19-Oct-16                                                       |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
| CONTRACTOR BG Drilling                                  |               | DRILL MODEL Hanjin D&B, D8 |                                             | DRILLER Randall Smith |       | LOCATION Central Courtyard Precinct, Macquarie University |                                                                                | ANGLE Vertical             |                               | BEARING -                                                                    |                      | HOLE DIAMETER 52mm (NMLC) |       | GROUND LEVEL RL 55.38mOD |                                       | LOCATION 325259.8 E 6261425.4 N |                 | ELEVATION DATUM Australian Height Datum (AHD) |  | COORDINATE SYSTEM National Grid |  |  |
| DRILLING                                                |               |                            |                                             | STRATA                |       |                                                           | MATERIAL DESCRIPTION                                                           |                            |                               |                                                                              |                      |                           |       |                          |                                       |                                 | DISCONTINUITIES |                                               |  |                                 |  |  |
| TCR % (Drill rate)                                      | SCR % (RQD %) | FLUSH RETURN % (TYPE)      | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                  | DEPTH | GRAPHIC LOG                                               | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components              | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa)                                                                  | FREQUENCY<br>(per m) | SPECIFIC                  |       |                          | GENERAL DESCRIPTION                   |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             | mOD                   | m     |                                                           |                                                                                |                            |                               |                                                                              |                      | TYPE                      | ANGLE | THICKNESS (mm)           | Planarity, Roughness, Coating, Infill |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             |                       | 1     |                                                           |                                                                                |                            |                               |                                                                              |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             |                       | 2     |                                                           |                                                                                |                            |                               |                                                                              |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             |                       | 3     |                                                           |                                                                                |                            |                               |                                                                              |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             |                       | 4     |                                                           |                                                                                |                            |                               |                                                                              |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             | 50.52                 | 4.86  |                                                           | Continued as cored borehole                                                    |                            |                               |                                                                              |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
|                                                         |               |                            |                                             |                       | 5     |                                                           | SANDSTONE, fine to coarse grained, red mottled pale grey, bedded at 5° to 25°. | DW                         |                               |                                                                              |                      |                           |       |                          |                                       |                                 |                 |                                               |  |                                 |  |  |
| NOTES                                                   |               |                            |                                             |                       |       |                                                           |                                                                                |                            |                               | See explanatory notes for details of abbreviations and basis of descriptions |                      |                           |       |                          |                                       |                                 |                 |                                               |  | JOB 251278                      |  |  |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
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| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 25-Nov-16 |
| DRILLED DATE | 19-Oct-16      |

|             |                                                  |               |             |
|-------------|--------------------------------------------------|---------------|-------------|
| CONTRACTOR  | BG Drilling                                      | ANGLE         | Vertical    |
| DRILL MODEL | Hanjin D&B, D8                                   | BEARING       | -           |
| DRILLER     | Randall Smith                                    | HOLE DIAMETER | 52mm (NMLC) |
| LOCATION    | Central Courtyard Precinct, Macquarie University |               |             |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 55.38mOD                   |
| ELEVATION DATUM       | 325259.8 E 6261425.4 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

.JOB

251278

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 25-Nov-16 |
| DRILLED DATE | 19-Oct-16      |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 55.38mOD                   |
| ELEVATION DATUM       | 325259.8 E 6261425.4 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

|             |                                                 |               |             |                   |                               |
|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 25-Nov-16                |
|             |                                                 |               |             | DRILLED DATE      | 19-Oct-16                     |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | GROUND LEVEL      | RL 55.38mOD                   |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | LOCATION          | 325259.8 E 6261425.4 N        |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | ELEVATION DATUM   | Australian Height Datum (AHD) |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | COORDINATE SYSTEM | National Grid                 |



BH02 Depth Range: 4.70 - 9.00 m



BH02 Depth Range: 9.00 - 12.60 m

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## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

ARUP

## BOREHOLE RECORD

BH03

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT her

LOGGED BY

DM

CHECKED BY

BCH, 25-Nov-16

DRILLED DATE

19-Oct-16

CONTRACTOR

BG Drilling

DRILL MODEL

Hanjin D&amp;B, D8

DRILLER

Randall Smith

LOCATION

Central Courtyard Precinct, Macquarie University

ANGLE

Vertical

BEARING

-

HOLE DIAMETER

110mm - SFA

GROUND LEVEL

RL 55.47mOD

LOCATION

325291.9 E 6261427.0 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid

| DRILLING                                       |       | STRATA    |              |        | MATERIAL DESCRIPTION                                                                                                                          |                  | CONDITION   |               | OBSERVATION                 |              |    |
|------------------------------------------------|-------|-----------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|---------------|-----------------------------|--------------|----|
| SAMPLE, TEST, BIT, SUPPORT, ETC.               | R.L.  | DEPTH     | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                                | WATER / MOISTURE | CONSISTENCY |               | Comments / Penetration Rate |              |    |
|                                                | mOD   | m         |              |        |                                                                                                                                               |                  | COHESIVE    |               |                             | NON COHESIVE |    |
|                                                |       |           |              |        |                                                                                                                                               |                  | VS          | SL            |                             | ST           | VS |
| ADT                                            |       |           |              |        | FILL: Sandy CLAY, low plasticity, dark brown, sand is fine to medium grained, trace of medium grained gravel sub-angular.                     | MC < PL          |             |               |                             |              |    |
| U75 (Rec: 100mm)                               |       |           |              |        |                                                                                                                                               | MC < PL          |             |               |                             |              |    |
| SPT N=12<br>5;7,5<br>(Rec: 500mm)<br>PP>220kPa | 54.42 | 1<br>1.05 | CI           |        | Gravelly sandy CLAY, (CI) medium plasticity, brown mottled red, sand is fine to coarse grained, gravel is fine to medium grained sub-angular. | MC > PL          |             |               | Residual                    |              |    |
| SPT N=22**<br>11/150s<br>(HB, Rec: 200mm)      | 53.82 | 1.65      | CL           |        | Sandy CLAY, (CL) low plasticity, pale red, sand is fine grained, trace of silt.                                                               | MC < PL          |             |               |                             |              |    |
|                                                |       | 2         |              |        | ... 2.00m becoming pale grey                                                                                                                  |                  |             |               |                             |              |    |
|                                                |       | 3         |              |        | ... 3.50m becoming pale red                                                                                                                   |                  |             |               |                             |              |    |
| SPT N>50**<br>6/20s<br>(HB, Rec: 20mm)         |       |           |              |        |                                                                                                                                               |                  |             |               |                             |              |    |
|                                                |       | 4         |              |        |                                                                                                                                               |                  |             |               |                             |              |    |
|                                                | 51.27 | 4.20      |              |        | Continued as cored borehole                                                                                                                   |                  |             |               |                             |              |    |
|                                                |       | 5         |              |        |                                                                                                                                               |                  |             |               |                             |              |    |
| NOTES                                          |       |           |              |        | See explanatory notes for details of abbreviations and basis of descriptions                                                                  |                  |             | JOB<br>251278 |                             |              |    |

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Log: 12.1 AUS ROTARY CORE LOG (rev 1 Nov16)  
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| ARUP               |                 |                       |                                             | CORED BOREHOLE RECORD                            |       |                      |                                                                            |                            |                                                                              | BH03              |                      |                 | SHEET 2<br>OF 4               |                     |                 |
|--------------------|-----------------|-----------------------|---------------------------------------------|--------------------------------------------------|-------|----------------------|----------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------|----------------------|-----------------|-------------------------------|---------------------|-----------------|
| CLIENT             |                 |                       |                                             | Macquarie University                             |       |                      |                                                                            |                            |                                                                              | LOGGED BY         |                      |                 | DM                            |                     |                 |
| PROJECT            |                 |                       |                                             | Macquarie University Central Courtyard Precinct  |       |                      |                                                                            |                            |                                                                              | CHECKED BY        |                      |                 | BCH, 25-Nov-16                |                     |                 |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              | DRILLED DATE      |                      |                 | 19-Oct-16                     |                     |                 |
| CONTRACTOR         |                 |                       |                                             | BG Drilling                                      |       | ANGLE                |                                                                            | Vertical                   |                                                                              | GROUND LEVEL      |                      |                 | RL 55.47mOD                   |                     |                 |
| DRILL MODEL        |                 |                       |                                             | Hanjin D&B, D8                                   |       | BEARING              |                                                                            | -                          |                                                                              | LOCATION          |                      |                 | 325291.9 E 6261427.0 N        |                     |                 |
| DRILLER            |                 |                       |                                             | Randall Smith                                    |       | HOLE DIAMETER        |                                                                            | 52mm (NMLC)                |                                                                              | ELEVATION DATUM   |                      |                 | Australian Height Datum (AHD) |                     |                 |
| LOCATION           |                 |                       |                                             | Central Courtyard Precinct, Macquarie University |       |                      |                                                                            |                            |                                                                              | COORDINATE SYSTEM |                      |                 | National Grid                 |                     |                 |
| DRILLING           |                 |                       |                                             | STRATA                                           |       | MATERIAL DESCRIPTION |                                                                            |                            |                                                                              |                   |                      | DISCONTINUITIES |                               |                     |                 |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                                             | DEPTH | GRAPHIC LOG          | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components          | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)       | FREQUENCY<br>(per m) | SPECIFIC        |                               | GENERAL DESCRIPTION |                 |
|                    |                 |                       |                                             | mOD                                              | m     |                      |                                                                            |                            |                                                                              |                   |                      | TYPE            | ANGLE                         |                     | THICKNESS (mm)  |
|                    |                 |                       |                                             |                                                  | 1     |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               |                     |                 |
|                    |                 |                       |                                             |                                                  | 2     |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               |                     |                 |
|                    |                 |                       |                                             |                                                  | 3     |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               |                     |                 |
|                    |                 |                       |                                             |                                                  | 4     |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               |                     |                 |
|                    |                 |                       |                                             | 51.27                                            | 4.20  |                      | Continued as cored borehole                                                | XW                         |                                                                              |                   |                      |                 |                               |                     |                 |
|                    |                 |                       |                                             | 51.15                                            | 4.32  |                      | SANDSTONE, fine grained, pale grey.                                        | DW                         |                                                                              | 0.30<br>A<br>0.26 |                      | We              | 5                             | 100                 | PL Ro3 c        |
|                    |                 |                       |                                             |                                                  |       |                      | SANDSTONE, fine to coarse grained, red, bedded at 5° to 20°.               |                            |                                                                              |                   |                      | Jo              | 85                            |                     | PL healed joint |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 5                             | 5                   | PL Ro3 s        |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 15                            | 5                   | PL Ro3 s        |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 75                            | 5                   | PL Ro3 s        |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 10                            | 2                   | PL Ro3 s        |
|                    |                 |                       |                                             | 50.62                                            | 4.85  |                      | SANDSTONE, fine to medium grained, pale grey, laminae bedded at 5° to 15°. | SW                         |                                                                              |                   |                      | We              | 5                             | 35                  | PL Ro3 s, g     |
|                    |                 |                       |                                             |                                                  | 5     |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 15                            | 5                   | PL Ro3 s        |
| NOTES              |                 |                       |                                             |                                                  |       |                      |                                                                            |                            | See explanatory notes for details of abbreviations and basis of descriptions |                   |                      |                 |                               | JOB                 |                 |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               | 251278              |                 |

ARUP

## CORED BOREHOLE RECORD

BH03

SHEET 3

OF 4

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

LOGGED BY

DM

CHECKED BY

BCH, 25-Nov-16

DRILLED DATE

19-Oct-16

CONTRACTOR

BG Drilling

DRILL MODEL

Hanjin D&amp;B, D8

DRILLER

Randall Smith

LOCATION

Central Courtyard Precinct, Macquarie University

ANGLE

Vertical

BEARING

-

HOLE DIAMETER

52mm (NMLC)

GROUND LEVEL

RL 55.47mOD

LOCATION

325291.9 E 6261427.0 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid

## DRILLING

## STRATA

## MATERIAL DESCRIPTION

## DISCONTINUITIES

| TCR % (Drill rate) | SCR % (RQD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.  | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                               | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa) | FREQUENCY<br>(per m) | SPECIFIC |       |                | GENERAL DESCRIPTION<br>Planarity, Roughness,<br>Coating, Infill |
|--------------------|---------------|-----------------------|---------------------------------------------|-------|-------|-------------|-------------------------------------------------------------------------------------------------|----------------------------|-------------------------------|-------------|----------------------|----------|-------|----------------|-----------------------------------------------------------------|
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | TYPE     | ANGLE | THICKNESS (mm) |                                                                 |
| 100                | 73(54)        | 100                   |                                             |       |       |             | SANDSTONE, fine to medium grained, pale grey, laminae bedded at 5° to 15°. (continued)          | SW                         |                               |             |                      | Jo       | 75    | 4              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 10    | 2              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 10    | 2              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             | ... 5.63m becoming orange mottled pale grey                                                     |                            |                               |             |                      | We       | 5     | 25             | PL Ro3 c, s                                                     |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 85    | -              | IR healed joint                                                 |
|                    |               |                       |                                             |       | 6     |             |                                                                                                 |                            |                               |             |                      | Jo       | 85    | -              | IR healed joint                                                 |
|                    |               |                       |                                             | 49.17 | 6.30  |             | SANDSTONE, fine to medium grained, pale grey, laminae bedded at 5° to 20°.                      | FR                         |                               |             |                      | Jo       | 10    | 2              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 20    | 2              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 5     | 5              | PL Ro3 c                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 10    | 3              | UN Ro3 c, s                                                     |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 5     | 3              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 5     | 3              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 5     | 5              | PL Ro3 s, silt concretions                                      |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 25    | 3              | PL Ro3 CN (series of 3 joints, between 7.23m & 7.3m)            |
|                    |               |                       |                                             | 47.87 | 7.60  |             | NO CORE 50mmt.                                                                                  |                            |                               |             |                      | Cr       | 5     | 70             | PL Ro3 g                                                        |
|                    |               |                       |                                             | 47.82 | 7.65  |             | SANDSTONE, fine to coarse grained, red mottled pale grey, mottled yellow, bedded at 10° to 20°. | DW                         |                               |             |                      | We       | 5     | 30             | PL Ro3 c                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 15    | 3              | PL Ro3 c                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 25    | 3              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 85    | 5              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 5     | 3              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 20    | 4              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 20    | 3              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 20    | 3              | PL Ro3 CN                                                       |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 15    | 4              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 5     | 3              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 15    | 2              | PL Ro3 s                                                        |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 15    | 5              | PL Ro3 c, s                                                     |
|                    |               |                       |                                             |       |       |             |                                                                                                 |                            |                               |             |                      | Jo       | 15    | 5              | PL Ro3 c, s                                                     |

UCS=24.3MPa

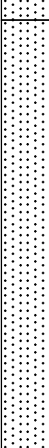
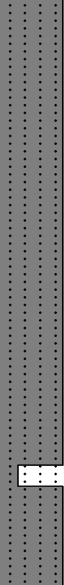
## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

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Log: 12.1 AUS ROTARY CORE LOG (rev 1 Nov16)  
gint output page 3 of 3. Made 15 Dec 16 15:53

| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |       |                                                                                    | BH03                                                                |                            | SHEET 4                                                                             |                               |                                                                                      |          |       |                     |                                           |  |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|------------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------|----------|-------|---------------------|-------------------------------------------|--|
| CLIENT             |                 | Macquarie University                             |                                             |                      |       |                                                                                    | LOGGED BY                                                           |                            | DM                                                                                  |                               |                                                                                      |          |       |                     |                                           |  |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |       |                                                                                    | CHECKED BY                                                          |                            | BCH, 25-Nov-16                                                                      |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    | DRILLED DATE                                                        |                            | 19-Oct-16                                                                           |                               |                                                                                      |          |       |                     |                                           |  |
| CONTRACTOR         |                 | BG Drilling                                      |                                             | ANGLE                |       | Vertical                                                                           |                                                                     | GROUND LEVEL               |                                                                                     | RL 55.47mOD                   |                                                                                      |          |       |                     |                                           |  |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             | BEARING              |       | -                                                                                  |                                                                     | LOCATION                   |                                                                                     | 325291.9 E 6261427.0 N        |                                                                                      |          |       |                     |                                           |  |
| DRILLER            |                 | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC)                                                                        |                                                                     | ELEVATION DATUM            |                                                                                     | Australian Height Datum (AHD) |                                                                                      |          |       |                     |                                           |  |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |       |                                                                                    | COORDINATE SYSTEM                                                   |                            | National Grid                                                                       |                               |                                                                                      |          |       |                     |                                           |  |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |                                                                                    |                                                                     |                            | DISCONTINUITIES                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG                                                                        | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components   | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                       | Is 50 (MPa)                   | FREQUENCY<br>(per m)                                                                 | SPECIFIC |       | GENERAL DESCRIPTION |                                           |  |
|                    |                 |                                                  |                                             | mOD                  | m     |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      | TYPE     | ANGLE |                     | THICKNESS (mm)                            |  |
| 100                | 62(57)          | 0                                                |                                             | 45.37                | 10.10 |  | SANDSTONE, fine to coarse grained, pale brown, bedded at 5° to 20°. | FR                         |  | D 4.60<br>A 3.54              |  | Jo       | 5     | 35                  | PL Ro3 s (series of 2 joints)<br>PL Ro3 s |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    | SW                                                                  | Be                         |                                                                                     |                               |                                                                                      | 5        | 5     |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     | Jo                         |                                                                                     |                               |                                                                                      | 75       | 5     | PL Ro3 s            |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     | Jo                         |                                                                                     |                               |                                                                                      | 75       | 5     | UN Ro3 s            |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     | Jo                         |                                                                                     |                               |                                                                                      | 80       | 1     | PL healed joint     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     | Jo                         |                                                                                     |                               |                                                                                      | 5        | 3     | UN Ro3 c, s         |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     | Jo                         |                                                                                     |                               |                                                                                      | 10       | 3     | PL Ro3 CN           |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     | Jo                         |                                                                                     |                               |                                                                                      | 70       | 5     | PL Ro3 s, g         |                                           |  |
|                    |                 |                                                  |                                             | 43.89                | 11.58 |                                                                                    | SHALE, fine grained, dark grey.                                     | DW                         |                                                                                     |                               |                                                                                      | Jo       | 15    | 3                   | CU Ro3 s                                  |  |
|                    |                 |                                                  |                                             | 43.82                | 11.65 |                                                                                    |                                                                     | SW                         |                                                                                     |                               |                                                                                      | Jo       | 5     | 20                  | PL Ro3 s, g                               |  |
|                    |                 |                                                  |                                             | 43.47                | 12.00 |                                                                                    | End of borehole at 12.00m                                           |                            |                                                                                     | D 1.73<br>A 1.37              |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |
|                    |                 |                                                  |                                             |                      |       |                                                                                    |                                                                     |                            |                                                                                     |                               |                                                                                      |          |       |                     |                                           |  |

|             |                                                 |               |             |                   |                               |
|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 25-Nov-16                |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | DRILLED DATE      | 19-Oct-16                     |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | GROUND LEVEL      | RL 55.47mOD                   |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | LOCATION          | 325291.9 E 6261427.0 N        |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | ELEVATION DATUM   | Australian Height Datum (AHD) |
|             |                                                 |               |             | COORDINATE SYSTEM | National Grid                 |



BH03 Depth Range: 4.20 - 9.00 m



BH03 Depth Range: 9.00 - 12.00 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

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Log: 1.0.1\AUS GENERAL BOREHOLE LOG (rev. 15Dec16)  
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|                                                           |       |                           |              |                                               |                                                                                                                                                       |                  |                            |                      |                 |          |                             |
|-----------------------------------------------------------|-------|---------------------------|--------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------|----------------------|-----------------|----------|-----------------------------|
| ARUP                                                      |       | BOREHOLE RECORD           |              |                                               |                                                                                                                                                       |                  | BH04                       |                      | SHEET 1<br>OF 4 |          |                             |
| CLIENT Macquarie University                               |       |                           |              |                                               | LOGGED BY DM                                                                                                                                          |                  |                            |                      |                 |          |                             |
| PROJECT her                                               |       |                           |              |                                               | CHECKED BY BCH, 25-Nov-16                                                                                                                             |                  |                            |                      |                 |          |                             |
|                                                           |       |                           |              |                                               | DRILLED DATE 20-Oct-16                                                                                                                                |                  |                            |                      |                 |          |                             |
| CONTRACTOR BG Drilling                                    |       | ANGLE Vertical            |              | GROUND LEVEL RL 55.49mOD                      |                                                                                                                                                       |                  | DM                         |                      |                 |          |                             |
| DRILL MODEL Hanjin D&B, D8                                |       | BEARING -                 |              | LOCATION 325324.9 E 6261435.2 N               |                                                                                                                                                       |                  |                            |                      |                 |          |                             |
| DRILLER Randall Smith                                     |       | HOLE DIAMETER 110mm - SFA |              | ELEVATION DATUM Australian Height Datum (AHD) |                                                                                                                                                       |                  |                            |                      |                 |          |                             |
| LOCATION Central Courtyard Precinct, Macquarie University |       |                           |              | COORDINATE SYSTEM National Grid               |                                                                                                                                                       |                  |                            |                      |                 |          |                             |
| DRILLING                                                  |       | STRATA                    |              | MATERIAL DESCRIPTION                          |                                                                                                                                                       |                  | CONDITION                  |                      | OBSERVATION     |          |                             |
| SAMPLE, TEST, BIT, SUPPORT, ETC.                          | R.L.  | DEPTH                     | GROUP SYMBOL | LEGEND                                        | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                                        | WATER / MOISTURE | CONSISTENCY                |                      |                 |          | Comments / Penetration Rate |
|                                                           | mOD   | m                         |              |                                               |                                                                                                                                                       |                  | COHESIVE                   |                      | NON COHESIVE    |          |                             |
|                                                           |       |                           |              |                                               |                                                                                                                                                       |                  | VS<br>SL<br>OL<br>ST<br>HS | VL<br>ML<br>DL<br>VD |                 |          |                             |
| ADT                                                       |       |                           |              |                                               | FILL: Gravelly sandy CLAY, medium plasticity, red-brown, sand is fine to coarse grained, gravel is fine to medium grained sub-angular to sub-rounded. | MC < PL          |                            |                      |                 |          |                             |
| SPT<br>N=24<br>4:13.11<br>(Rec: 370mm)                    | 54.89 | 0.60                      | CI           |                                               | ... 0.50m becoming white                                                                                                                              |                  |                            |                      |                 |          |                             |
| SPT<br>N=18*<br>3:9/150<br>(HB, Rec: 300mm)               |       | 1                         |              |                                               | Sandy CLAY, (CI) medium plasticity, orange red-brown, sand is fine to medium grained, trace of silt.                                                  | MC > PL          |                            |                      |                 | Residual |                             |
|                                                           |       |                           |              |                                               | ... 1.10m becoming pale grey                                                                                                                          |                  |                            |                      |                 |          |                             |
|                                                           |       |                           |              |                                               | ... 1.60m becoming orange (easily augered)                                                                                                            |                  |                            |                      |                 |          |                             |
|                                                           | 53.39 | 2.10                      | CL           |                                               | Sandy CLAY, (CL) low plasticity, pale red, sand is fine grained, trace of silt.                                                                       | MC < PL          |                            |                      |                 |          |                             |
| SPT<br>(HB, Rec: 0mm)                                     | 52.59 | 2.90                      |              |                                               | ... 2.80m becoming pale grey                                                                                                                          |                  |                            |                      |                 |          |                             |
|                                                           |       | 3                         |              |                                               | Continued as cored borehole                                                                                                                           |                  |                            |                      |                 |          |                             |
|                                                           |       | 4                         |              |                                               |                                                                                                                                                       |                  |                            |                      |                 |          |                             |
|                                                           |       | 5                         |              |                                               |                                                                                                                                                       |                  |                            |                      |                 |          |                             |
| NOTES                                                     |       |                           |              |                                               | See explanatory notes for details of abbreviations and basis of descriptions                                                                          |                  |                            |                      | JOB<br>251278   |          |                             |

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| ARUP               |                 |                       |                                             | CORED BOREHOLE RECORD                            |       |                      |                                                                            |                            |                                                                              | BH04              |                      |                 | SHEET 2                       |                     |                       |
|--------------------|-----------------|-----------------------|---------------------------------------------|--------------------------------------------------|-------|----------------------|----------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------|----------------------|-----------------|-------------------------------|---------------------|-----------------------|
| CLIENT             |                 |                       |                                             | Macquarie University                             |       |                      |                                                                            |                            |                                                                              | LOGGED BY         |                      |                 | DM                            |                     |                       |
| PROJECT            |                 |                       |                                             | Macquarie University Central Courtyard Precinct  |       |                      |                                                                            |                            |                                                                              | CHECKED BY        |                      |                 | BCH, 25-Nov-16                |                     |                       |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              | DRILLED DATE      |                      |                 | 20-Oct-16                     |                     |                       |
| CONTRACTOR         |                 |                       |                                             | BG Drilling                                      |       | ANGLE                |                                                                            | Vertical                   |                                                                              | GROUND LEVEL      |                      |                 | RL 55.49mOD                   |                     |                       |
| DRILL MODEL        |                 |                       |                                             | Hanjin D&B, D8                                   |       | BEARING              |                                                                            |                            |                                                                              | LOCATION          |                      |                 | 325324.9 E 6261435.2 N        |                     |                       |
| DRILLER            |                 |                       |                                             | Randall Smith                                    |       | HOLE DIAMETER        |                                                                            | 52mm (NMLC)                |                                                                              | ELEVATION DATUM   |                      |                 | Australian Height Datum (AHD) |                     |                       |
| LOCATION           |                 |                       |                                             | Central Courtyard Precinct, Macquarie University |       |                      |                                                                            |                            |                                                                              | COORDINATE SYSTEM |                      |                 | National Grid                 |                     |                       |
| DRILLING           |                 |                       |                                             | STRATA                                           |       | MATERIAL DESCRIPTION |                                                                            |                            |                                                                              |                   |                      | DISCONTINUITIES |                               |                     |                       |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                                             | DEPTH | GRAPHIC LOG          | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components          | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)       | FREQUENCY<br>(per m) | SPECIFIC        |                               | GENERAL DESCRIPTION |                       |
|                    |                 |                       |                                             | mOD                                              | m     |                      |                                                                            |                            |                                                                              |                   |                      | TYPE            | ANGLE                         |                     | THICKNESS (mm)        |
|                    |                 |                       |                                             |                                                  | 1     |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               |                     |                       |
|                    |                 |                       |                                             |                                                  | 2     |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               |                     |                       |
|                    |                 |                       |                                             | 52.59                                            | 2.90  |                      | Continued as cored borehole                                                |                            |                                                                              |                   |                      |                 |                               |                     |                       |
|                    |                 |                       |                                             |                                                  | 3     |                      | SANDSTONE, fine to medium grained, pale grey, laminae bedded at 5° to 20°. | SW                         |                                                                              |                   |                      | We              | 10                            | 5                   | PL Ro3 s              |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 10                            | 3                   | PL Ro3 s              |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | We              | 5                             | 40                  | PL Ro3 c, s           |
|                    |                 |                       |                                             | 51.92                                            | 3.57  |                      | SANDSTONE, fine to coarse grained, red-brown, bedded at 5° to 15°.         | DW                         |                                                                              |                   |                      | Jo              | 5                             | 3                   | PL Ro3 c, s, 2 joints |
|                    |                 |                       |                                             |                                                  | 4     |                      | ... 4.00m becoming red mottled pale grey                                   |                            |                                                                              |                   |                      | Jo              | 10                            | 3                   | PL Ro3 s              |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | We              | 5                             | 40                  | PL Ro3 c, s           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      | Jo              | 15                            | 4                   | PL Ro3 s              |
|                    |                 |                       |                                             | 50.65                                            | 4.84  |                      | SANDSTONE, fine to medium grained, pale grey, laminae bedded at 5° to 20°. | FR                         |                                                                              |                   |                      | Jo              | 5                             | 3                   | PL Ro3 s              |
|                    |                 |                       |                                             |                                                  | 5     |                      |                                                                            |                            |                                                                              |                   |                      | Be              | 5                             | 25                  | PL Ro3 c              |
| NOTES              |                 |                       |                                             |                                                  |       |                      |                                                                            |                            | See explanatory notes for details of abbreviations and basis of descriptions |                   |                      |                 |                               | JOB                 |                       |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                            |                            |                                                                              |                   |                      |                 |                               | 251278              |                       |

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| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |               |             |                                                                                           |                            | BH04                                                                         |                  | SHEET 3<br>OF 4               |          |       |                     |                      |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|---------------|-------------|-------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|------------------|-------------------------------|----------|-------|---------------------|----------------------|
| CLIENT             |                 | Macquarie University                             |                                             |                      |               |             |                                                                                           |                            | LOGGED BY                                                                    |                  | DM                            |          |       |                     |                      |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |               |             |                                                                                           |                            | CHECKED BY                                                                   |                  | BCH, 25-Nov-16                |          |       |                     |                      |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            | DRILLED DATE                                                                 |                  | 20-Oct-16                     |          |       |                     |                      |
| CONTRACTOR         |                 | BG Drilling                                      |                                             |                      | ANGLE         |             | Vertical                                                                                  |                            | GROUND LEVEL                                                                 |                  | RL 55.49mOD                   |          |       |                     |                      |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             |                      | BEARING       |             | -                                                                                         |                            | LOCATION                                                                     |                  | 325324.9 E 6261435.2 N        |          |       |                     |                      |
| DRILLER            |                 | Randall Smith                                    |                                             |                      | HOLE DIAMETER |             | 52mm (NMLC)                                                                               |                            | ELEVATION DATUM                                                              |                  | Australian Height Datum (AHD) |          |       |                     |                      |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |               |             |                                                                                           |                            | COORDINATE SYSTEM                                                            |                  | National Grid                 |          |       |                     |                      |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |               |             |                                                                                           |                            |                                                                              |                  | DISCONTINUITIES               |          |       |                     |                      |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH         | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                         | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)      | FREQUENCY<br>(per m)          | SPECIFIC |       | GENERAL DESCRIPTION |                      |
|                    |                 |                                                  |                                             | mOD                  | m             |             |                                                                                           |                            |                                                                              |                  |                               | TYPE     | ANGLE |                     | THICKNESS (mm)       |
| 100                | 96/(77)         | 100                                              | UCS                                         |                      |               |             | SANDSTONE, fine to medium grained, pale grey, laminae bedded at 5° to 20°. (continued)    | FR                         | EL<br>VL<br>ML<br>MH<br>VE                                                   | D 0.89<br>A 1.05 | 30<br>10<br>3<br>1            | Jo       | 15    | 3                   | PL Ro3 CN            |
|                    |                 |                                                  |                                             | 49.96                | 5.53          |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 10    | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             | SANDSTONE, fine to coarse grained, red mottled pale grey, bedded at 5° to 15°.            | DW                         |                                                                              |                  |                               | Jo       | 15    | 2                   | PL Ro3 CN            |
|                    |                 |                                                  |                                             | 49.71                | 5.78          |             |                                                                                           |                            |                                                                              |                  |                               |          |       |                     |                      |
|                    |                 |                                                  |                                             |                      |               |             | SANDSTONE, fine to medium grained, pale grey mottled yellow, laminae bedded at 5° to 20°. | SW                         |                                                                              |                  |                               | Jo       | 20    | 3                   | PL Ro3 s, 2 joints   |
|                    |                 |                                                  |                                             |                      | 6             |             |                                                                                           |                            |                                                                              | D 1.06<br>A 1.11 |                               | Jo       | 15    | 3                   | PL Ro3 c             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 5     | 3                   | PL Ro3 c, 2 joints   |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | We       | 10    | 5                   | PL Ro3 c, s          |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Cr       | 5     | 10                  | PL Ro3 g             |
|                    |                 |                                                  |                                             |                      | 7             |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 5     | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              | D 1.39<br>A 1.57 |                               | Jo       | 10    | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Cr       | 10    | 15                  | PL Ro3 g             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 25    | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 20    | 3                   | PL Ro3 CN            |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 25    | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      | 8             |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 25    | 3                   | PL Ro3 CN            |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 80    | 4                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 20    | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           | FR                         |                                                                              |                  |                               | Jo       | 20    | 3                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | We       | 5     | 60                  | PL Ro3 c, s          |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 5     | 4                   | PL Ro3 c, s          |
|                    |                 |                                                  |                                             |                      | 9             |             |                                                                                           |                            |                                                                              | D 1.85<br>A 1.24 |                               |          |       |                     |                      |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 75    | 4                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 75    | 4                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |               |             |                                                                                           |                            |                                                                              |                  |                               | Jo       | 5     | 3                   | PL Ro3 c, s 2 joints |
|                    |                 |                                                  |                                             |                      | 10            |             |                                                                                           |                            |                                                                              | D 1.71<br>A 1.45 |                               |          |       |                     |                      |
| NOTES              |                 |                                                  |                                             |                      |               |             |                                                                                           |                            | See explanatory notes for details of abbreviations and basis of descriptions |                  |                               |          | JOB   |                     | 251278               |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 25-Nov-16 |
| DRILLED DATE | 20-Oct-16      |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 55.49mOD                   |
| ELEVATION DATUM       | 325324.9 E 6261435.2 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

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|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 25-Nov-16                |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | DRILLED DATE      | 20-Oct-16                     |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | GROUND LEVEL      | RL 55.49mOD                   |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | LOCATION          | 325324.9 E 6261435.2 N        |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | ELEVATION DATUM   | Australian Height Datum (AHD) |
|             |                                                 |               |             | COORDINATE SYSTEM | National Grid                 |



BH04 Depth Range: 2.90 - 7.00 m



BH04 Depth Range: 7.00 - 12.83 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

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| ARUP                                               |       | BOREHOLE RECORD                                  |              |        |                                                                                 |                                                                              | BH05              |           | SHEET 1                       |             |                                                                                             |
|----------------------------------------------------|-------|--------------------------------------------------|--------------|--------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------|-----------|-------------------------------|-------------|---------------------------------------------------------------------------------------------|
| CLIENT                                             |       | Macquarie University                             |              |        |                                                                                 |                                                                              | LOGGED BY         |           | DM                            |             |                                                                                             |
| PROJECT                                            |       | her                                              |              |        |                                                                                 |                                                                              | CHECKED BY        |           | BCH, 25-Nov-16                |             |                                                                                             |
|                                                    |       |                                                  |              |        |                                                                                 |                                                                              | DRILLED DATE      |           | 20-Oct-16                     |             |                                                                                             |
| CONTRACTOR                                         |       | BG Drilling                                      |              |        | ANGLE                                                                           |                                                                              | Vertical          |           | GROUND LEVEL                  |             |                                                                                             |
| DRILL MODEL                                        |       | Hanjin D&B, D8                                   |              |        | BEARING                                                                         |                                                                              | -                 |           | RL 57.19mOD                   |             |                                                                                             |
| DRILLER                                            |       | Randall Smith                                    |              |        | HOLE DIAMETER                                                                   |                                                                              | 110mm - SFA       |           | 325366.7 E 6261421.5 N        |             |                                                                                             |
| LOCATION                                           |       | Central Courtyard Precinct, Macquarie University |              |        |                                                                                 |                                                                              | ELEVATION DATUM   |           | Australian Height Datum (AHD) |             |                                                                                             |
|                                                    |       |                                                  |              |        |                                                                                 |                                                                              | COORDINATE SYSTEM |           | National Grid                 |             |                                                                                             |
| DRILLING                                           |       | STRATA                                           |              |        | MATERIAL DESCRIPTION                                                            |                                                                              |                   | CONDITION |                               | OBSERVATION |                                                                                             |
| SAMPLE, TEST, BIT, SUPPORT, ETC.                   | R.L.  | DEPTH                                            | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                  | WATER / MOISTURE                                                             | CONSISTENCY       |           |                               |             | Comments / Penetration Rate                                                                 |
|                                                    | mOD   | m                                                |              |        |                                                                                 |                                                                              | COHESIVE          |           | NON COHESIVE                  |             |                                                                                             |
|                                                    |       |                                                  |              |        |                                                                                 |                                                                              | VS                | SL        | ST                            | HL          |                                                                                             |
| ADT                                                |       |                                                  |              |        | Hydro excavation NDD, no samples recovered.                                     |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    |       | 1                                                |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    | 55.69 | 1.50                                             |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    |       |                                                  |              |        | FILL: Sandy CLAY, medium plasticity, pale brown, sand is fine grained.          | MC > PL                                                                      |                   |           |                               |             |                                                                                             |
|                                                    |       |                                                  |              |        | ... 1.90m becoming pale grey                                                    |                                                                              |                   |           |                               |             |                                                                                             |
| U75 (Rec: 230mm)                                   |       | 2                                                |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    | 54.96 | 2.23                                             | SC           |        | Clayey SAND, (SC) fine to coarse grained, orange-brown, trace of silt.          | M                                                                            |                   |           |                               |             | Residual                                                                                    |
| SPT<br>N=17<br>8.5,12<br>(Rec: 330mm)<br>PP>220kPa |       | 2.73                                             | CH           |        | Sandy CLAY, (CH) high plasticity, pale grey, sand is fine to medium grained.    | MC > PL                                                                      |                   |           |                               |             |                                                                                             |
| 20/10/2016                                         |       |                                                  |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
| SPT<br>N=39**<br>13/100s<br>(HB, Rec: 160mm)       |       | 3.06                                             | SC           |        | Clayey SAND, (SC) fine to coarse grained, pale grey.                            | M                                                                            |                   |           |                               |             |                                                                                             |
|                                                    | 54.13 |                                                  |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    | 53.83 | 3.36                                             | CL           |        | Sandy CLAY, (CL) low plasticity, pale red, sand is fine grained, trace of silt. | MC < PL                                                                      |                   |           |                               |             | From 3.36m to 4.25m strength assessment based on visual and tactile examination of subsoil. |
|                                                    |       |                                                  |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    |       | 4                                                |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
| SPT<br>N=36**<br>6/50s<br>(HB, Rec: 50mm)          |       | 4.25                                             |              |        | ... 4.20m becoming pale grey                                                    |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    | 52.94 |                                                  |              |        | Continued as cored borehole                                                     |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    |       |                                                  |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    |       |                                                  |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
|                                                    |       | 5                                                |              |        |                                                                                 |                                                                              |                   |           |                               |             |                                                                                             |
| NOTES                                              |       |                                                  |              |        |                                                                                 | See explanatory notes for details of abbreviations and basis of descriptions |                   |           | JOB 251278                    |             |                                                                                             |

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gINT output page 1 of 2. Made 15 Dec 16 15:53

| ARUP               |                 |                       |                                             | CORED BOREHOLE RECORD                            |       |                      |                                                                                              |                                                                              |                               | BH05              |                      |                 | SHEET 2<br>OF 3               |                     |                              |
|--------------------|-----------------|-----------------------|---------------------------------------------|--------------------------------------------------|-------|----------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|-------------------|----------------------|-----------------|-------------------------------|---------------------|------------------------------|
| CLIENT             |                 |                       |                                             | Macquarie University                             |       |                      |                                                                                              |                                                                              |                               | LOGGED BY         |                      |                 | DM                            |                     |                              |
| PROJECT            |                 |                       |                                             | Macquarie University Central Courtyard Precinct  |       |                      |                                                                                              |                                                                              |                               | CHECKED BY        |                      |                 | BCH, 25-Nov-16                |                     |                              |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                              |                                                                              |                               | DRILLED DATE      |                      |                 | 20-Oct-16                     |                     |                              |
| CONTRACTOR         |                 |                       |                                             | BG Drilling                                      |       | ANGLE                |                                                                                              | Vertical                                                                     |                               | GROUND LEVEL      |                      |                 | RL 57.19mOD                   |                     |                              |
| DRILL MODEL        |                 |                       |                                             | Hanjin D&B, D8                                   |       | BEARING              |                                                                                              | -                                                                            |                               | LOCATION          |                      |                 | 325366.7 E 6261421.5 N        |                     |                              |
| DRILLER            |                 |                       |                                             | Randall Smith                                    |       | HOLE DIAMETER        |                                                                                              | 52mm (NMLC)                                                                  |                               | ELEVATION DATUM   |                      |                 | Australian Height Datum (AHD) |                     |                              |
| LOCATION           |                 |                       |                                             | Central Courtyard Precinct, Macquarie University |       |                      |                                                                                              |                                                                              |                               | COORDINATE SYSTEM |                      |                 | National Grid                 |                     |                              |
| DRILLING           |                 |                       |                                             | STRATA                                           |       | MATERIAL DESCRIPTION |                                                                                              |                                                                              |                               |                   |                      | DISCONTINUITIES |                               |                     |                              |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                                             | DEPTH | GRAPHIC LOG          | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                            | CEMENTATION/<br>WEATHERING                                                   | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa)       | FREQUENCY<br>(per m) | SPECIFIC        |                               | GENERAL DESCRIPTION |                              |
|                    |                 |                       |                                             | mOD                                              | m     |                      |                                                                                              |                                                                              |                               |                   |                      | TYPE            | ANGLE                         |                     | THICKNESS (mm)               |
|                    |                 |                       |                                             |                                                  | 1     |                      |                                                                                              |                                                                              |                               |                   |                      |                 |                               |                     |                              |
|                    |                 |                       |                                             |                                                  | 2     |                      |                                                                                              |                                                                              |                               |                   |                      |                 |                               |                     |                              |
|                    |                 |                       |                                             |                                                  | 3     |                      |                                                                                              |                                                                              |                               |                   |                      |                 |                               |                     |                              |
|                    |                 |                       |                                             |                                                  | 4     |                      |                                                                                              |                                                                              |                               |                   |                      |                 |                               |                     |                              |
|                    |                 |                       |                                             | 52.94                                            | 4.25  |                      | Continued as cored borehole                                                                  |                                                                              |                               |                   |                      |                 |                               |                     |                              |
|                    |                 |                       |                                             |                                                  |       |                      | SANDSTONE fine to coarse grained, red mottled pale grey mottled orange, bedded at 5° to 10°. | DW                                                                           |                               |                   |                      | Jo<br>Cr        | -5<br>-10                     | -4<br>-20           | -PL Ro3 c<br>-PL Ro3 g       |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                              |                                                                              |                               |                   |                      | We<br>We        | -5<br>-5                      | -35<br>-10          | -PL Ro3 c, s<br>-PL Ro3 c, s |
| NOTES              |                 |                       |                                             |                                                  |       |                      |                                                                                              | See explanatory notes for details of abbreviations and basis of descriptions |                               |                   |                      | JOB<br>251278   |                               |                     |                              |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 25-Nov-16 |
| DRILLED DATE | 20-Oct-16      |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 57.19mOD                   |
| ELEVATION DATUM       | 325366.7 E 6261421.5 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB

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## CORE PHOTO RECORD

BH05

SHEET 1

OF 1

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY BCH, 25-Nov-16  
DRILLED DATE 20-Oct-16

GROUND LEVEL RL 57.19mOD  
LOCATION 325366.7 E 6261421.5 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH05 Depth Range: 4.25 - 6.60 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

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## BOREHOLE RECORD

BH06

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT her

LOGGED BY

DM

CHECKED BY

BCH, 28-Nov-16

DRILLED DATE

23-Oct-16

CONTRACTOR

BG Drilling

DRILL MODEL

Hanjin D&amp;B, D8

DRILLER

Randall Smith

LOCATION

Central Courtyard Precinct, Macquarie University

ANGLE

Vertical

BEARING

-

HOLE DIAMETER

110mm - SFA

GROUND LEVEL

RL 61.38mOD

LOCATION

325357.5 E 6261337.5 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid

| DRILLING                         |                                             | STRATA       |              |        | MATERIAL DESCRIPTION                                                                                                                                                                                                 |                  | CONDITION   |    | OBSERVATION |               |              |    |    |                             |                            |
|----------------------------------|---------------------------------------------|--------------|--------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|----|-------------|---------------|--------------|----|----|-----------------------------|----------------------------|
| SAMPLE, TEST, BIT, SUPPORT, ETC. | R.L.                                        | DEPTH        | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                                                                                                       | WATER / MOISTURE | CONSISTENCY |    |             |               |              |    |    | Comments / Penetration Rate |                            |
|                                  | mOD                                         | m            |              |        |                                                                                                                                                                                                                      |                  | COHESIVE    |    |             |               | NON COHESIVE |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  | VS          | SL | ST          | VT            | HL           | VL | LL |                             | MD                         |
| ADT                              |                                             |              |              |        | Concrete slab (0.18mt), 10mmØ reo at 75mm top cover.                                                                                                                                                                 |                  |             |    |             |               |              |    |    |                             |                            |
| CBR                              | 61.20<br>61.15                              | 0.18<br>0.23 |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              | CI           |        | FILL: Sandy GRAVEL with clay, fine to medium grained sub-angular to sub-rounded, brown, sand is fine to coarse grained.<br>Silty CLAY, (CI) medium plasticity, red-brown mottled orange, trace of fine grained sand. | M<br>MC > PL     |             |    |             |               |              |    |    |                             | Drainage layer<br>Residual |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
| SPT                              | N=14<br>5;7,7<br>(Rec: 350mm)<br>PP>220kPa  | 1            |              |        | ... 1.30m as above but with coarse grained gravel angular to sub-angular                                                                                                                                             |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
| SPT                              | N=17<br>2;5,12<br>(Rec: 350mm)<br>PP>220kPa | 1.80         |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  | 59.58                                       |              | CL           |        | Silty sandy CLAY with gravel, (CL) low plasticity, brown, sand is fine to coarse grained, gravel is fine to medium grained sub-rounded.                                                                              |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             | 2            |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
| SPT                              | N=11<br>2;2,9<br>(Rec: 350mm)<br>PP>220kPa  | 3.00         | CI           |        | Silty CLAY, (CI) medium plasticity, red-brown mottled orange mottled pale grey, trace of fine to medium grained sand.                                                                                                |                  |             |    |             |               |              |    |    |                             |                            |
|                                  | 58.38                                       |              |              |        | ... 3.35m becoming pale grey                                                                                                                                                                                         | MC < PL          |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
| SPT                              | N=34**<br>8/70s<br>(HB, Rec: 70mm)          | 4            |              |        |                                                                                                                                                                                                                      | D                |             |    |             |               |              |    |    |                             |                            |
|                                  | 56.78                                       | 4.60         |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        | Continued as cored borehole                                                                                                                                                                                          |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             |              |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
|                                  |                                             | 5            |              |        |                                                                                                                                                                                                                      |                  |             |    |             |               |              |    |    |                             |                            |
| NOTES                            |                                             |              |              |        | See explanatory notes for details of abbreviations and basis of descriptions                                                                                                                                         |                  |             |    |             | JOB<br>251278 |              |    |    |                             |                            |

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|---------------------------------------------------------|---------------|----------------------------|---------------------------------------------|-----------------------|-------|-----------------------------------------------------------|-------------------------------------------------------------------|----------------------------|-------------------------------|------------------------------------------------------------------------------|----------------------|-----------------------------------------------|-----------------|-----------------|---------------------|--|
| ARUP                                                    |               | CORED BOREHOLE RECORD      |                                             |                       |       |                                                           |                                                                   |                            |                               |                                                                              |                      | BH06                                          |                 | SHEET 2<br>OF 4 |                     |  |
| CLIENT Macquarie University                             |               |                            |                                             |                       |       |                                                           |                                                                   |                            |                               |                                                                              |                      | LOGGED BY DM                                  |                 |                 |                     |  |
| PROJECT Macquarie University Central Courtyard Precinct |               |                            |                                             |                       |       |                                                           |                                                                   |                            |                               |                                                                              |                      | CHECKED BY BCH, 28-Nov-16                     |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       |       |                                                           |                                                                   |                            |                               |                                                                              |                      | DRILLED DATE 23-Oct-16                        |                 |                 |                     |  |
| CONTRACTOR BG Drilling                                  |               | DRILL MODEL Hanjin D&B, D8 |                                             | DRILLER Randall Smith |       | LOCATION Central Courtyard Precinct, Macquarie University |                                                                   | ANGLE Vertical             |                               | BEARING -                                                                    |                      | GROUND LEVEL RL 61.38mOD                      |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       |       |                                                           |                                                                   | HOLE DIAMETER 52mm (NMLC)  |                               |                                                                              |                      | LOCATION 325357.5 E 6261337.5 N               |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       |       |                                                           |                                                                   |                            |                               |                                                                              |                      | ELEVATION DATUM Australian Height Datum (AHD) |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       |       |                                                           |                                                                   |                            |                               |                                                                              |                      | COORDINATE SYSTEM National Grid               |                 |                 |                     |  |
| DRILLING                                                |               |                            |                                             | STRATA                |       |                                                           | MATERIAL DESCRIPTION                                              |                            |                               |                                                                              |                      |                                               | DISCONTINUITIES |                 |                     |  |
| TCR % (Drill rate)                                      | SCR % (RQD %) | FLUSH RETURN % (TYPE)      | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                  | DEPTH | GRAPHIC LOG                                               | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa)                                                                  | FREQUENCY<br>(per m) | SPECIFIC                                      |                 |                 | GENERAL DESCRIPTION |  |
|                                                         |               |                            |                                             | mOD                   | m     |                                                           |                                                                   |                            |                               |                                                                              |                      | TYPE                                          | ANGLE           | THICKNESS (mm)  |                     |  |
|                                                         |               |                            |                                             |                       | 1     |                                                           |                                                                   |                            |                               |                                                                              |                      |                                               |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       | 2     |                                                           |                                                                   |                            |                               |                                                                              |                      |                                               |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       | 3     |                                                           |                                                                   |                            |                               |                                                                              |                      |                                               |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       | 4     |                                                           |                                                                   |                            |                               |                                                                              |                      |                                               |                 |                 |                     |  |
|                                                         |               |                            |                                             | 56.78                 | 4.60  |                                                           | Continued as cored borehole                                       | DW                         |                               |                                                                              |                      |                                               |                 |                 |                     |  |
|                                                         |               |                            |                                             | 56.48                 | 4.90  |                                                           | SANDSTONE, fine grained, red-brown.                               |                            |                               |                                                                              |                      |                                               |                 |                 |                     |  |
|                                                         |               |                            |                                             |                       | 5     |                                                           | Description starts on next page                                   | SW                         |                               |                                                                              |                      |                                               |                 |                 |                     |  |
| NOTES                                                   |               |                            |                                             |                       |       |                                                           |                                                                   |                            |                               | See explanatory notes for details of abbreviations and basis of descriptions |                      |                                               |                 |                 | JOB 251278          |  |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
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|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 28-Nov-16 |
| DRILLED DATE | 23-Oct-16      |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 61.38mOD                   |
| ELEVATION DATUM       | 325357.5 E 6261337.5 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

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| ARUP               |               | CORED BOREHOLE RECORD                            |                                             |                      |       |             | BH06                                                                                                  |                            | SHEET 4                                                                      |             |                      |          |        |                     |                                       |              |
|--------------------|---------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|-------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------|----------------------|----------|--------|---------------------|---------------------------------------|--------------|
| CLIENT             |               | Macquarie University                             |                                             |                      |       |             | LOGGED BY                                                                                             |                            | DM                                                                           |             |                      |          |        |                     |                                       |              |
| PROJECT            |               | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             | CHECKED BY                                                                                            |                            | BCH, 28-Nov-16                                                               |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             | DRILLED DATE                                                                                          |                            | 23-Oct-16                                                                    |             |                      |          |        |                     |                                       |              |
| CONTRACTOR         |               | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                                                       | GROUND LEVEL               |                                                                              |             |                      |          |        |                     |                                       |              |
| DRILL MODEL        |               | Hanjin D&B, D8                                   |                                             | BEARING              |       | -           |                                                                                                       | LOCATION                   |                                                                              |             |                      |          |        |                     |                                       |              |
| DRILLER            |               | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                                                       | RL 61.38mOD                |                                                                              |             |                      |          |        |                     |                                       |              |
| LOCATION           |               | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             | ELEVATION DATUM                                                                                       |                            | Australian Height Datum (AHD)                                                |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             | COORDINATE SYSTEM                                                                                     |                            | National Grid                                                                |             |                      |          |        |                     |                                       |              |
| DRILLING           |               | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                                                       |                            | DISCONTINUITIES                                                              |             |                      |          |        |                     |                                       |              |
| TCR % (Drill rate) | SCR % (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                                     | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa) | FREQUENCY<br>(per m) | SPECIFIC |        | GENERAL DESCRIPTION |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      | TYPE     | ANGLE  |                     | THICKNESS (mm)                        |              |
|                    |               |                                                  |                                             | mOD                  | m     |             |                                                                                                       |                            | EL<br>VL<br>JL<br>ML<br>HL<br>VE                                             |             |                      |          |        |                     | Planarity, Roughness, Coating, Infill |              |
|                    |               |                                                  |                                             |                      | 11    |             | SANDSTONE, fine to coarse grained, pale grey mottled orange, laminae bedded at 5° to 25°. (continued) | SW                         |                                                                              |             |                      |          | We     | 5                   | 40                                    | PL Ro3 s, g. |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 5                   | 7                                     | PL Ro3 c, s  |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | We     | 10                  | 25                                    | PL Ro3 c, s  |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 10                  | 1                                     | PL Ro3 s     |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 5                   | 2                                     | PL Ro3 c, s  |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | We     | 10                  | 40                                    | PL Ro3 c, s  |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 15                  | 2                                     | PL Ro3 s     |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 85                  | 5                                     | PL Ro3 c, s  |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 10                  | 3                                     | ST Ro3 s     |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Cr     | 15                  | 15                                    | PL Ro3 s, g  |
|                    |               |                                                  |                                             |                      | 12    |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 5                   | 5                                     | PL Ro3 c, s  |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | Jo     | 10                  | 3                                     | PL Ro3 s     |
|                    |               |                                                  |                                             | 48.90                | 12.48 |             | End of borehole at 12.48m                                                                             |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      | 13    |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      | 14    |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
|                    |               |                                                  |                                             |                      | 15    |             |                                                                                                       |                            |                                                                              |             |                      |          |        |                     |                                       |              |
| NOTES              |               |                                                  |                                             |                      |       |             |                                                                                                       |                            | See explanatory notes for details of abbreviations and basis of descriptions |             |                      |          | JOB    |                     |                                       |              |
|                    |               |                                                  |                                             |                      |       |             |                                                                                                       |                            |                                                                              |             |                      |          | 251278 |                     |                                       |              |

ARUP

## CORE PHOTO RECORD

BH06

SHEET 1

OF 1

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

LOGGED BY

DM

CHECKED BY

BCH, 28-Nov-16

DRILLED DATE

23-Oct-16

CONTRACTOR

BG Drilling

ANGLE

Vertical

DRILL MODEL

Hanjin D&amp;B, D8

BEARING

-

DRILLER

Randall Smith

HOLE DIAMETER

52mm (NMLC)

LOCATION

Macquarie University Central Courtyard Precinct

GROUND LEVEL

RL 61.38mOD

LOCATION

325357.5 E 6261337.5 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid



BH06 Depth Range: 4.60 - 9.00 m



BH06 Depth Range: 9.00 - 12.48 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

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Log: 1.0.1AUS GENERAL BOREHOLE LOG (rev. 15Dec16)  
gint output page 1 of 2. Made 15Dec16 13:44

| ARUP                             |                                                    | BOREHOLE RECORD                                  |              |               |                                                                                                                                | BH07              |                           | SHEET 1                       |                                                                                                     |
|----------------------------------|----------------------------------------------------|--------------------------------------------------|--------------|---------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------|
| CLIENT                           |                                                    | Macquarie University                             |              |               |                                                                                                                                | LOGGED BY         |                           | DM                            |                                                                                                     |
| PROJECT                          |                                                    | her                                              |              |               |                                                                                                                                | CHECKED BY        |                           | AC, 28-Nov-16                 |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                | DRILLED DATE      |                           | 22-Oct-16                     |                                                                                                     |
| CONTRACTOR                       |                                                    | BG Drilling                                      |              | ANGLE         |                                                                                                                                | Vertical          |                           | GROUND LEVEL                  |                                                                                                     |
| DRILL MODEL                      |                                                    | Hanjin D&B, D8                                   |              | BEARING       |                                                                                                                                | -                 |                           | RL 61.44mOD                   |                                                                                                     |
| DRILLER                          |                                                    | Randall Smith                                    |              | HOLE DIAMETER |                                                                                                                                | 110mm - SFA       |                           | LOCATION                      |                                                                                                     |
| LOCATION                         |                                                    | Central Courtyard Precinct, Macquarie University |              |               |                                                                                                                                | ELEVATION DATUM   |                           | Australian Height Datum (AHD) |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                | COORDINATE SYSTEM |                           | National Grid                 |                                                                                                     |
| DRILLING                         |                                                    | STRATA                                           |              |               | MATERIAL DESCRIPTION                                                                                                           |                   | CONDITION                 |                               | OBSERVATION                                                                                         |
| SAMPLE, TEST, BIT, SUPPORT, ETC. | R.L.                                               | DEPTH                                            | GROUP SYMBOL | LEGEND        | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                 | WATER / MOISTURE  | CONSISTENCY               |                               | Comments / Penetration Rate                                                                         |
|                                  | mOD                                                | m                                                |              |               |                                                                                                                                |                   | COHESIVE                  | NON COHESIVE                  |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   | VS<br>WL<br>SH<br>ST<br>H | VL<br>ML<br>DL<br>VD          |                                                                                                     |
| ADT                              |                                                    |                                                  |              |               | Concrete slab (0.2mt), 5mmØ reo at 40mm top cover.                                                                             |                   |                           |                               |                                                                                                     |
| CBR                              | 61.24                                              | 0.20                                             |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  | 61.14                                              | 0.30                                             |              |               | FILL: Clayey sandy GRAVEL, coarse grained angular to sub-angular, brown, sand is fine to coarse grained, trace of silt.        | W                 |                           |                               | Drainage layer                                                                                      |
|                                  |                                                    |                                                  | CI           |               | Silty CLAY, (CI) medium plasticity, red-brown, trace of fine grained sand, trace of fine to coarse grained gravel sub-angular. | MC > PL           |                           |                               | Residual from 0.3m to 1.59m strength assessment based on visual and tactile examination of subsoil. |
|                                  |                                                    | 1                                                |              |               | ... 1.40m trace of tree roots                                                                                                  |                   |                           |                               |                                                                                                     |
| SPT                              | N=23<br>5.9,14<br>(Rec: 400mm)<br>PP>220kPa        | 1.59                                             |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  | CI           |               | Sandy CLAY, (CI) medium plasticity, red-brown mottled orange, sand is fine grained, trace of silt.                             |                   |                           |                               |                                                                                                     |
|                                  |                                                    | 2                                                |              |               | ... 2.00m becoming pale grey mottled orange                                                                                    |                   |                           |                               |                                                                                                     |
| SPT                              | N=44*<br>4.38/260<br>(HB, Rec: 430mm)<br>PP>220kPa |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  | 58.84                                              | 2.60                                             |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  | CI           |               | Sandy CLAY, (CI) medium plasticity, pale red, sand is fine grained, trace of silt.                                             | MC < PL           |                           |                               |                                                                                                     |
|                                  |                                                    | 3                                                |              |               | ... 3.10m becoming pale grey                                                                                                   |                   |                           |                               |                                                                                                     |
| SPT                              | N=50*<br>12.9/30<br>(HB, Rec: 220mm)               |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    | 4                                                |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
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|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
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|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
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|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
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|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
|                                  |                                                    |                                                  |              |               |                                                                                                                                |                   |                           |                               |                                                                                                     |
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 INT output page 2 of 2. Made 15Dec16 13:44

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|                                         |                                                |
|-----------------------------------------|------------------------------------------------|
| LOGGED BY<br>CHECKED BY<br>DRILLED DATE | DM<br>AC, 28-Nov-16<br>22-Oct-16               |
| GROUND LEVEL<br>LOCATION                | RL 61.44mOD<br>325292.4 E 6261334.4 N          |
| ELEVATION DATUM<br>COORDINATE SYSTEM    | Australian Height Datum (AHD)<br>National Grid |

|             |                                                  |               |             |
|-------------|--------------------------------------------------|---------------|-------------|
| CONTRACTOR  | BG Drilling                                      | ANGLE         | Vertical    |
| DRILL MODEL | Hanjin D&B, D8                                   | BEARING       | -           |
| DRILLER     | Randall Smith                                    | HOLE DIAMETER | 52mm (NMLC) |
| LOCATION    | Central Courtyard Precinct, Macquarie University |               |             |

## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

.JOB

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| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |       |             | BH07                                                                                         |                            | SHEET 4                       |                       |                      |          |       |                     |                |  |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|----------------------------------------------------------------------------------------------|----------------------------|-------------------------------|-----------------------|----------------------|----------|-------|---------------------|----------------|--|
| CLIENT             |                 | Macquarie University                             |                                             |                      |       |             | LOGGED BY                                                                                    |                            | DM                            |                       |                      |          |       |                     |                |  |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             | CHECKED BY                                                                                   |                            | AC, 28-Nov-16                 |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             | DRILLED DATE                                                                                 |                            | 22-Oct-16                     |                       |                      |          |       |                     |                |  |
| CONTRACTOR         |                 | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                                              | GROUND LEVEL               |                               |                       |                      |          |       |                     |                |  |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             | BEARING              |       | -           |                                                                                              | LOCATION                   |                               |                       |                      |          |       |                     |                |  |
| DRILLER            |                 | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                                              | ELEVATION DATUM            |                               |                       |                      |          |       |                     |                |  |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             | COORDINATE SYSTEM                                                                            |                            | National Grid                 |                       |                      |          |       |                     |                |  |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                                              |                            | DISCONTINUITIES               |                       |                      |          |       |                     |                |  |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                            | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa)           | FREQUENCY<br>(per m) | SPECIFIC |       | GENERAL DESCRIPTION |                |  |
|                    |                 |                                                  |                                             | mOD                  | m     |             |                                                                                              |                            |                               |                       |                      | TYPE     | ANGLE |                     | THICKNESS (mm) |  |
| 100                | 70(57)          | 100                                              |                                             |                      | 11    |             | SANDSTONE, fine to medium grained, pale grey, with laminae bedded at 10° to 35°. (continued) | FR                         | EL<br>VL<br>ML<br>HL<br>VE    | D<br>0.5<br>A<br>0.25 | 30<br>10<br>3<br>1   | Jo       | 20    | 3                   | PL Ro3 c, s    |  |
|                    |                 |                                                  |                                             | 50.24                | 11.20 |             |                                                                                              |                            |                               |                       |                      | We       | 5     | 120                 | PL Ro3 c       |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      | Jo       | 5     | 3                   | PL Ro3 s       |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      | Jo       | 10    | 10                  | PL Ro3 c, s    |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      | Jo       | 20    | 2                   | PL Ro3 s       |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      | Jo       | 75    | 3                   | PL Ro3 s       |  |
|                    |                 |                                                  |                                             |                      |       |             | End of borehole at 11.20m                                                                    |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
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|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
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|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
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|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
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|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
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|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
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|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                              |                            |                               |                       |                      |          |       |                     |                |  |

ARUP

## CORE PHOTO RECORD

BH07

SHEET 1

OF 1

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY AC, 28-Nov-16  
DRILLED DATE 22-Oct-16  
GROUND LEVEL RL 61.44mOD  
LOCATION 325292.4 E 6261334.4 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH07 Depth Range: 5.20 - 10.00 m



BH07 Depth Range: 10.00 - 11.20 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

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|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 28-Nov-16 |
| DRILLED DATE | 22-Oct-16      |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 61.49mOD                   |
| ELEVATION DATUM       | 325288.9 E 6261312.8 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB

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| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |       | BH08         |                                                                                                         | SHEET 3<br>OF 4                                                              |                               |                  |                   |          |       |                     |                 |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|--------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|------------------|-------------------|----------|-------|---------------------|-----------------|
| CLIENT             |                 | Macquarie University                             |                                             |                      |       | LOGGED BY    |                                                                                                         | DM                                                                           |                               |                  |                   |          |       |                     |                 |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |       | CHECKED BY   |                                                                                                         | BCH, 28-Nov-16                                                               |                               |                  |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       | DRILLED DATE |                                                                                                         | 22-Oct-16                                                                    |                               |                  |                   |          |       |                     |                 |
| CONTRACTOR         |                 | BG Drilling                                      |                                             | ANGLE                |       | Vertical     |                                                                                                         | GROUND LEVEL                                                                 |                               |                  |                   |          |       |                     |                 |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             | BEARING              |       | -            |                                                                                                         | LOCATION                                                                     |                               |                  |                   |          |       |                     |                 |
| DRILLER            |                 | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC)  |                                                                                                         | ELEVATION DATUM                                                              |                               |                  |                   |          |       |                     |                 |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |       |              |                                                                                                         | Australian Height Datum (AHD)                                                |                               |                  |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         | COORDINATE SYSTEM                                                            |                               |                  |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         | National Grid                                                                |                               |                  |                   |          |       |                     |                 |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |              |                                                                                                         | DISCONTINUITIES                                                              |                               |                  |                   |          |       |                     |                 |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG  | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                                       | CEMENTATION/<br>WEATHERING                                                   | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa)      | FREQUENCY (per m) | SPECIFIC |       | GENERAL DESCRIPTION |                 |
|                    |                 |                                                  |                                             | mOD                  | m     |              |                                                                                                         |                                                                              |                               |                  |                   | TYPE     | ANGLE |                     | THICKNESS (mm)  |
| 100                | 46/(23)         | 100                                              |                                             |                      |       |              | SANDSTONE, fine grained, pale grey mottled red mottled orange, laminae bedded at 5° to 20°. (continued) | XW                                                                           |                               |                  |                   | Jo       | 90    | 3                   | PL Ro3 s        |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | We       | 5     | 50                  | PL Ro3 c, s     |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | Jo       | 55    | 5                   | PL Ro3 c, s     |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | Jo       | 90    | 1                   | PL healed joint |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | We       | 75    | 65                  | PL Ro3 c, s, g  |
|                    |                 |                                                  | UCS=12.9MPa                                 |                      | 6     |              |                                                                                                         |                                                                              |                               | D 0.47<br>A 0.52 |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               | A 0.81<br>0.88   |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      | 7     |              |                                                                                                         |                                                                              |                               |                  |                   | Jo       | 75    | 5                   | UN Ro3 s        |
| 79                 | 72/(64)         | 100                                              |                                             |                      |       |              |                                                                                                         |                                                                              |                               | D 0.73<br>A 0.75 |                   | Jo       | 10    | 8                   | PL Ro3 c, s     |
|                    |                 |                                                  |                                             |                      | 53.96 | 7.53         | No core (0.64mt).                                                                                       |                                                                              |                               |                  |                   | We       | 5     | 110                 | PL Ro3 c        |
|                    |                 |                                                  |                                             |                      | 8     |              |                                                                                                         |                                                                              |                               |                  |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      | 53.32 | 8.17         | SANDSTONE, fine grained, pale grey mottled red mottled orange, laminae bedded at 5° to 10°.             | SW                                                                           |                               |                  |                   | We       | 20    | 10                  | PL Ro3 s        |
|                    |                 |                                                  |                                             |                      | 53.24 | 8.25         | SANDSTONE, fine to coarse grained, red mottled pale grey mottled orange, bedded at 5° to 20°.           | DW                                                                           |                               |                  |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | We       | 5     | 15                  | PL Ro3 c, g     |
|                    |                 |                                                  |                                             |                      | 9     |              |                                                                                                         | SW                                                                           |                               | D 0.56<br>A 0.88 |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | We       | 10    | 2                   | PL Ro3 c, s, g  |
| 100                | 91/(78)         | 100                                              |                                             |                      |       |              |                                                                                                         |                                                                              |                               | D 1.16<br>A 1.06 |                   |          |       |                     |                 |
|                    |                 |                                                  |                                             |                      | 51.79 | 9.70         | SANDSTONE, fine to coarse grained, pale grey, laminae bedded at 5° to 20°.                              | FR                                                                           |                               |                  |                   | We       | 20    | 20                  | PL Ro3 c, s     |
|                    |                 |                                                  |                                             |                      | 10    |              |                                                                                                         |                                                                              |                               |                  |                   |          |       |                     |                 |
| NOTES              |                 |                                                  |                                             |                      |       |              |                                                                                                         | See explanatory notes for details of abbreviations and basis of descriptions |                               |                  |                   | JOB      |       |                     |                 |
|                    |                 |                                                  |                                             |                      |       |              |                                                                                                         |                                                                              |                               |                  |                   | 251278   |       |                     |                 |

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| ARUP               |               | CORED BOREHOLE RECORD                            |                                             |                      |       |             |                                                                                        | BH08                       |                                                                              | SHEET 4                       |                      |          |       |                     |                |
|--------------------|---------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|----------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------------------|----------------------|----------|-------|---------------------|----------------|
| CLIENT             |               | Macquarie University                             |                                             |                      |       |             |                                                                                        | LOGGED BY                  |                                                                              | DM                            |                      |          |       |                     |                |
| PROJECT            |               | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             |                                                                                        | CHECKED BY                 |                                                                              | BCH, 28-Nov-16                |                      |          |       |                     |                |
| CONTRACTOR         |               | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                                        | DRILLED DATE               |                                                                              | 22-Oct-16                     |                      |          |       |                     |                |
| DRILL MODEL        |               | Hanjin D&B, D8                                   |                                             | BEARING              |       | -           |                                                                                        | GROUND LEVEL               |                                                                              | RL 61.49mOD                   |                      |          |       |                     |                |
| DRILLER            |               | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                                        | LOCATION                   |                                                                              | 325288.9 E 6261312.8 N        |                      |          |       |                     |                |
| LOCATION           |               | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             |                                                                                        | ELEVATION DATUM            |                                                                              | Australian Height Datum (AHD) |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        | COORDINATE SYSTEM          |                                                                              | National Grid                 |                      |          |       |                     |                |
| DRILLING           |               | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                                        |                            |                                                                              | DISCONTINUITIES               |                      |          |       |                     |                |
| TCR % (Drill rate) | SCR % (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                      | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)                   | FREQUENCY<br>(per m) | SPECIFIC |       | GENERAL DESCRIPTION |                |
|                    |               |                                                  |                                             | mOD                  | m     |             |                                                                                        |                            |                                                                              |                               |                      | TYPE     | ANGLE |                     | THICKNESS (mm) |
| 100                | 91/(78)       | 100                                              |                                             |                      | 11    |             | SANDSTONE, fine to coarse grained, pale grey, laminae bedded at 5° to 20°. (continued) | FR                         | EL<br>VL<br>JL<br>ML<br>HL<br>VE                                             | D 0.47<br>A 0.65              | 30<br>10<br>3<br>1   | Jo       | 15    | 3                   | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      | Jo       | 10    | 2                   | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      | Jo       | 15    | 4                   | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      | Jo       | 60    | 3                   | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      | Jo       | 15    | 3                   | PL Ro3 s       |
|                    |               |                                                  |                                             | 50.19                | 11.30 |             | SANDSTONE, fine grained, dark grey, laminae bedded at 5° to 15°.                       |                            |                                                                              | D 0.59<br>A 0.73              |                      | Jo       | 5     | 5                   | PL Ro3 c       |
|                    |               |                                                  |                                             | 49.79                | 11.70 |             |                                                                                        |                            |                                                                              |                               |                      | Jo       | 5     | 4                   | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             | End of borehole at 11.70m                                                              |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 12    |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 13    |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 14    |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 15    |             |                                                                                        |                            |                                                                              |                               |                      |          |       |                     |                |
| NOTES              |               |                                                  |                                             |                      |       |             |                                                                                        |                            | See explanatory notes for details of abbreviations and basis of descriptions |                               |                      |          | JOB   |                     | 251278         |

|             |                                                 |               |             |                   |                               |
|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 28-Nov-16                |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | DRILLED DATE      | 22-Oct-16                     |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | GROUND LEVEL      | RL 61.49mOD                   |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | LOCATION          | 325288.9 E 6261312.8 N        |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | ELEVATION DATUM   | Australian Height Datum (AHD) |
|             |                                                 |               |             | COORDINATE SYSTEM | National Grid                 |



BH08 Depth Range: 3.96 - 8.00 m



BH08 Depth Range: 8.00 - 11.70 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

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PROJECT her

|                   |                               |
|-------------------|-------------------------------|
| LOGGED BY         | BHC                           |
| CHECKED BY        | AC, 24-Nov-16                 |
| DRILLED DATE      | 22-Oct-16                     |
| GROUND LEVEL      | RL 65.67mOD                   |
| LOCATION          | 325237.6 E 6261262.1 N        |
| ELEVATION DATUM   | Australian Height Datum (AHD) |
| COORDINATE SYSTEM | National Grid                 |

|             |                                                  |               |             |
|-------------|--------------------------------------------------|---------------|-------------|
| CONTRACTOR  | BG Drilling                                      | ANGLE         | Vertical    |
| DRILL MODEL | Hanjin D&B, D8                                   | BEARING       | -           |
| DRILLER     | Luke Hedges                                      | HOLE DIAMETER | 110mm - SFA |
| LOCATION    | Central Courtyard Precinct, Macquarie University |               |             |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB

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|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

CHECKED BY AC, 24-Nov-16  
DRILLED DATE 22-Oct-16

|                       |                                       |
|-----------------------|---------------------------------------|
| GROUND LEVEL LOCATION | RL 65.67mOD<br>325237.6 E 6261262.1 N |
| ELEVATION DATUM       | Australian Height Datum (AHD)         |
| COORDINATE SYSTEM     | National Grid                         |

## NOTES

.JOB

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|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

DRILLED DATE 22-Oct-16

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 65.67mOD                   |
| ELEVATION DATUM       | 325237.6 E 6261262.1 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

NOTES

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| ARUP               |                 |                       |                                             | CORED BOREHOLE RECORD                            |       |                      |                                                                                  |                            |                                                                              | BH10              |                      |                 | SHEET 5                       |                     |                           |
|--------------------|-----------------|-----------------------|---------------------------------------------|--------------------------------------------------|-------|----------------------|----------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------|----------------------|-----------------|-------------------------------|---------------------|---------------------------|
| CLIENT             |                 |                       |                                             | Macquarie University                             |       |                      |                                                                                  |                            |                                                                              | LOGGED BY         |                      |                 | BHC                           |                     |                           |
| PROJECT            |                 |                       |                                             | Macquarie University Central Courtyard Precinct  |       |                      |                                                                                  |                            |                                                                              | CHECKED BY        |                      |                 | AC, 24-Nov-16                 |                     |                           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              | DRILLED DATE      |                      |                 | 22-Oct-16                     |                     |                           |
| CONTRACTOR         |                 |                       |                                             | BG Drilling                                      |       | ANGLE                |                                                                                  | Vertical                   |                                                                              | GROUND LEVEL      |                      |                 | RL 65.67mOD                   |                     |                           |
| DRILL MODEL        |                 |                       |                                             | Hanjin D&B, D8                                   |       | BEARING              |                                                                                  | -                          |                                                                              | LOCATION          |                      |                 | 325237.6 E 6261262.1 N        |                     |                           |
| DRILLER            |                 |                       |                                             | Luke Hedges                                      |       | HOLE DIAMETER        |                                                                                  | 52mm (NMLC)                |                                                                              | ELEVATION DATUM   |                      |                 | Australian Height Datum (AHD) |                     |                           |
| LOCATION           |                 |                       |                                             | Central Courtyard Precinct, Macquarie University |       |                      |                                                                                  |                            |                                                                              | COORDINATE SYSTEM |                      |                 | National Grid                 |                     |                           |
| DRILLING           |                 |                       |                                             | STRATA                                           |       | MATERIAL DESCRIPTION |                                                                                  |                            |                                                                              |                   |                      | DISCONTINUITIES |                               |                     |                           |
| TCR % (Drill rate) | SCR % / (RQD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                                             | DEPTH | GRAPHIC LOG          | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)       | FREQUENCY<br>(per m) | SPECIFIC        |                               | GENERAL DESCRIPTION |                           |
|                    |                 |                       |                                             | mOD                                              | m     |                      |                                                                                  |                            |                                                                              |                   |                      | TYPE            | ANGLE                         |                     | THICKNESS (mm)            |
| 100                | 100/(100)       | 100                   |                                             |                                                  | 16    |                      | SANDSTONE, medium to coarse grained, pale grey, bedded at 5° to 25°. (continued) | FR                         |                                                                              | 0.86<br>0.67      |                      | Be              | 15                            | 30                  | PL Ro3 c (pale grey clay) |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      | Jo              | 85                            | 1                   | ST VR CL                  |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      | We              | 15                            | 30                  | PL Ro3 c                  |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      | Jo              | 45                            | 1                   | IR Ro3 c                  |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      | We              | 30                            | 20                  | CU Ro3 c, s               |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      | Be              | 20                            | 10                  | IR Ro3 c                  |
|                    |                 |                       |                                             |                                                  |       |                      | ... 16.40m - 16.70m some cross bedding                                           |                            |                                                                              |                   |                      | Be              | 10                            | 5                   | IR Ro3 c                  |
|                    |                 |                       |                                             | 48.90                                            | 16.77 |                      |                                                                                  |                            |                                                                              | 0.79<br>0.65      |                      | Be              | 5                             | 5                   | PL Ro3 c                  |
|                    |                 |                       |                                             |                                                  |       |                      | End of borehole at 16.77m                                                        |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  | 17    |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  | 18    |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  | 19    |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
|                    |                 |                       |                                             |                                                  | 20    |                      |                                                                                  |                            |                                                                              |                   |                      |                 |                               |                     |                           |
| NOTES              |                 |                       |                                             |                                                  |       |                      |                                                                                  |                            | See explanatory notes for details of abbreviations and basis of descriptions |                   |                      |                 | JOB                           |                     | 251278                    |

ARUP

## CORE PHOTO RECORD

BH10

SHEET 1

OF 2

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Luke Hedges  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY BHC  
CHECKED BY AC, 24-Nov-16  
DRILLED DATE 22-Oct-16  
GROUND LEVEL RL 65.67mOD  
LOCATION 325237.6 E 6261262.1 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH10 Depth Range: 6.00 - 10.85 m



BH10 Depth Range: 10.85 - 15.80 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

A photograph of a geological sample core, likely a sediment core, with an ARUP label and a scale bar. The label contains the following information: PROJECT: MUCCP, LOCATION: BH10, DATE: 22 OCT '16, JOB NO. 251278-06, DEPTH: 15-80-16-77m, and EOH. A color calibration chart is visible on the right side of the label. Below the label is a scale bar with markings from 0 to 100 cm. The core itself is a long, cylindrical sample, with a section marked '15-80' and 'EOH' at the bottom. The core is surrounded by a metal casing. The background is a dark, textured surface.

22/10/2016

251278

ARUP

## BOREHOLE RECORD

BH11

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT her

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 25-Oct-16CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Central Courtyard Precinct, Macquarie University  
ANGLE Vertical  
BEARING -  
HOLE DIAMETER 110mm - SFAGROUND LEVEL RL 64.39mOD  
LOCATION 325177.5 E 6261266.1 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid

| DRILLING                                             |       | STRATA |              |        | MATERIAL DESCRIPTION                                                                               |                     | CONDITION   |    | OBSERVATION |               |    |    |                                |          |
|------------------------------------------------------|-------|--------|--------------|--------|----------------------------------------------------------------------------------------------------|---------------------|-------------|----|-------------|---------------|----|----|--------------------------------|----------|
| SAMPLE, TEST, BIT, SUPPORT, ETC.                     | R.L.  | DEPTH  | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                     | WATER /<br>MOISTURE | CONSISTENCY |    |             |               |    |    | Comments /<br>Penetration Rate |          |
|                                                      | mOD   | m      |              |        |                                                                                                    |                     | COHESIVE    |    |             | NON COHESIVE  |    |    |                                |          |
|                                                      |       |        |              |        |                                                                                                    |                     | VS          | SL | ST          | SH            | VL | ML |                                | DL       |
| ADT                                                  |       |        |              |        | FILL: Silty sandy CLAY, medium plasticity, brown, sand is fine to medium grained.                  | MC < PL             |             |    |             |               |    |    |                                |          |
| SPT<br>N=19<br>4;7,12<br>(Rec: 350mm)<br>PP>220kPa   |       |        |              |        | ... 0.70m with some fine to medium grained gravel, sub-angular to sub-rounded                      | MC > PL             |             |    |             |               |    |    |                                |          |
| SPT<br>N=14<br>4;7,7<br>(Rec: 350mm)<br>PP>220kPa    |       | 1      |              |        |                                                                                                    |                     |             |    |             |               |    |    |                                |          |
|                                                      |       | 2      |              |        |                                                                                                    |                     |             |    |             |               |    |    |                                |          |
|                                                      | 61.89 | 2.50   | CL           |        | Silty CLAY, (CL) low plasticity, red-brown.                                                        | MC > PL             |             |    |             |               |    |    |                                | Residual |
| SPT<br>N=17<br>7;8,9<br>(Rec: 450mm)<br>PP>220kPa    | 61.34 | 3.05   | CI           |        | Silty CLAY with some sand, (CI) medium plasticity, pale grey mottled orange, sand is fine grained. |                     |             |    |             |               |    |    |                                |          |
|                                                      |       | 4      |              |        | ... 3.85m - 3.95m trace of orange, medium grained ironstone gravel sub-angular                     |                     |             |    |             |               |    |    |                                |          |
| SPT<br>N=44<br>13;16,28<br>(Rec: 540mm)<br>PP>220kPa |       | 5      |              |        |                                                                                                    |                     |             |    |             |               |    |    |                                |          |
| NOTES                                                |       |        |              |        | See explanatory notes for details of abbreviations and basis of descriptions                       |                     |             |    |             | JOB<br>251278 |    |    |                                |          |

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|                                                           |            |                            |              |                           |                                                                                                                                       |                                                                              |                            |                 |              |             |                             |
|-----------------------------------------------------------|------------|----------------------------|--------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------|-----------------|--------------|-------------|-----------------------------|
| ARUP                                                      |            | BOREHOLE RECORD            |              |                           |                                                                                                                                       | BH11                                                                         |                            | SHEET 2<br>OF 4 |              |             |                             |
| CLIENT Macquarie University                               |            |                            |              |                           |                                                                                                                                       | LOGGED BY DM                                                                 |                            |                 |              |             |                             |
| PROJECT her                                               |            |                            |              |                           |                                                                                                                                       | CHECKED BY BCH, 28-Nov-16                                                    |                            |                 |              |             |                             |
|                                                           |            |                            |              |                           |                                                                                                                                       | DRILLED DATE 25-Oct-16                                                       |                            |                 |              |             |                             |
| CONTRACTOR BG Drilling                                    |            | DRILL MODEL Hanjin D&B, D8 |              | ANGLE Vertical            |                                                                                                                                       | GROUND LEVEL RL 64.39mOD                                                     |                            |                 |              |             |                             |
| DRILLER Randall Smith                                     |            |                            |              | BEARING -                 |                                                                                                                                       | LOCATION 325177.5 E 6261266.1 N                                              |                            |                 |              |             |                             |
| LOCATION Central Courtyard Precinct, Macquarie University |            |                            |              | HOLE DIAMETER 110mm - SFA |                                                                                                                                       | ELEVATION DATUM Australian Height Datum (AHD)                                |                            |                 |              |             |                             |
|                                                           |            |                            |              |                           |                                                                                                                                       | COORDINATE SYSTEM National Grid                                              |                            |                 |              |             |                             |
| DRILLING                                                  |            | STRATA                     |              | MATERIAL DESCRIPTION      |                                                                                                                                       |                                                                              |                            | CONDITION       |              | OBSERVATION |                             |
| SAMPLE, TEST, BIT, SUPPORT, ETC.                          | R.L.       | DEPTH                      | GROUP SYMBOL | LEGEND                    | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                        | WATER / MOISTURE                                                             | CONSISTENCY                |                 |              |             | Comments / Penetration Rate |
|                                                           | mOD        | m                          |              |                           |                                                                                                                                       |                                                                              | COHESIVE                   |                 | NON COHESIVE |             |                             |
|                                                           |            |                            |              |                           |                                                                                                                                       |                                                                              | VS<br>US<br>LL<br>ST<br>SH | VL<br>LD<br>VD  |              |             |                             |
| ADT                                                       |            |                            |              |                           | Silty CLAY with some sand, (CI) medium plasticity, pale grey mottled orange, sand is fine grained. (continued)                        |                                                                              |                            |                 |              |             |                             |
| SPT N=45*<br>10/24/160<br>(HB, Rec: 380mm)<br>PP>220kPa   | 25/10/2016 | 6                          |              |                           |                                                                                                                                       |                                                                              |                            |                 |              |             |                             |
|                                                           | 57.89      | 6.50                       | CL           |                           | Sandy CLAY, (CL) low plasticity, dark brown, sand is fine grained, trace of fine to coarse grained gravel sub-rounded, trace of silt. | MC < PL                                                                      |                            |                 |              |             |                             |
|                                                           |            | 7                          |              |                           |                                                                                                                                       |                                                                              |                            |                 |              |             |                             |
| SPT N=50*<br>41/30/130<br>(HB, Rec: 370mm)<br>PP>220kPa   |            |                            |              |                           | ... 7.70m becoming pale grey                                                                                                          | MC > PL                                                                      |                            |                 |              |             |                             |
|                                                           |            | 8                          |              |                           |                                                                                                                                       |                                                                              |                            |                 |              |             |                             |
|                                                           |            | 9                          |              |                           | ... 8.80m change to medium plasticity                                                                                                 |                                                                              |                            |                 |              |             |                             |
| SPT (HB, Rec: 0mm)                                        | 55.07      | 9.32                       |              |                           | Continued as cored borehole                                                                                                           |                                                                              |                            |                 |              |             |                             |
|                                                           |            | 10                         |              |                           |                                                                                                                                       |                                                                              |                            |                 |              |             |                             |
| NOTES                                                     |            |                            |              |                           |                                                                                                                                       | See explanatory notes for details of abbreviations and basis of descriptions |                            |                 |              | JOB 251278  |                             |

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Log: 12.1 AUS ROTARY CORE LOG (rev 1 Nov16)  
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|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
|---------------------------------------------------------|-----------------|----------------------------|---------------------------------------------|-----------------------|-------|-----------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------|-----------|---|-----------------------------------------------|-----------------|--------------------------|-------------------|------------|-------------------------|-------|---------------------|
| ARUP                                                    |                 | CORED BOREHOLE RECORD      |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | BH11                                          |                 |                          | SHEET 3<br>OF 4   |            |                         |       |                     |
| CLIENT Macquarie University                             |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | LOGGED BY DM                                  |                 |                          |                   |            |                         |       |                     |
| PROJECT Macquarie University Central Courtyard Precinct |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | CHECKED BY BCH, 28-Nov-16                     |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | DRILLED DATE 25-Oct-16                        |                 |                          |                   |            |                         |       |                     |
| CONTRACTOR BG Drilling                                  |                 | DRILL MODEL Hanjin D&B, D8 |                                             | DRILLER Randall Smith |       | LOCATION Central Courtyard Precinct, Macquarie University |                                                                                     | ANGLE Vertical                                                               |                         | BEARING - |   | HOLE DIAMETER 52mm (NMLC)                     |                 | GROUND LEVEL RL 64.39mOD |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | LOCATION 325177.5 E 6261266.1 N               |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | ELEVATION DATUM Australian Height Datum (AHD) |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   | COORDINATE SYSTEM National Grid               |                 |                          |                   |            |                         |       |                     |
| DRILLING                                                |                 |                            |                                             | STRATA                |       |                                                           | MATERIAL DESCRIPTION                                                                |                                                                              |                         |           |   |                                               | DISCONTINUITIES |                          |                   |            |                         |       |                     |
| TCR % (Drill rate)                                      | SCR % / (RQD %) | FLUSH RETURN % (TYPE)      | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                  | DEPTH | GRAPHIC LOG                                               | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                   | CEMENTATION/<br>WEATHERING                                                   | ESTIMATED ROCK STRENGTH |           |   |                                               |                 | Is 50 (MPa)              | FREQUENCY (per m) | SPECIFIC   |                         |       | GENERAL DESCRIPTION |
|                                                         |                 |                            |                                             | mOD                   | m     |                                                           |                                                                                     |                                                                              | EL                      | VL        | J | M                                             | H               |                          |                   | VE         | TYPE                    | ANGLE |                     |
|                                                         |                 |                            |                                             |                       | 6     |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       | 7     |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       | 8     |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       | 9     |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             | 55.07                 | 9.32  |                                                           | Continued as cored borehole                                                         |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           | SHALE, dark grey, with pale grey fine grained sandstone laminae bedded at 0° to 5°. | SW                                                                           |                         |           |   |                                               |                 |                          |                   |            | We -5 -135 -PL Ro3 c, s |       |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            | Jo -5 -4 -PL Ro3 c, s   |       |                     |
|                                                         |                 |                            |                                             |                       | 10    |                                                           |                                                                                     |                                                                              |                         |           |   |                                               |                 |                          |                   |            |                         |       |                     |
| NOTES                                                   |                 |                            |                                             |                       |       |                                                           |                                                                                     | See explanatory notes for details of abbreviations and basis of descriptions |                         |           |   |                                               |                 |                          |                   | JOB 251278 |                         |       |                     |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 28-Nov-16 |
| DRILLED DATE | 25-Oct-16      |

|                       |                               |
|-----------------------|-------------------------------|
| GROUND LEVEL LOCATION | RL 64.39mOD                   |
| ELEVATION DATUM       | 325177.5 E 6261266.1 N        |
| COORDINATE SYSTEM     | Australian Height Datum (AHD) |
|                       | National Grid                 |

## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

.JOB

251278

ARUP

## CORE PHOTO RECORD

BH11

SHEET 1

OF 1

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 25-Oct-16

GROUND LEVEL RL 64.39mOD  
LOCATION 325177.5 E 6261266.1 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH11 Depth Range: 9.32 - 14.00 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of  
abbreviations and basis of  
descriptions

JOB

251278

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| ARUP                                                      |        | BOREHOLE RECORD                                  |              |                      |                                                                                                                                             | BH12                                                                         |             | SHEET 1<br>OF 4               |               |    |                             |
|-----------------------------------------------------------|--------|--------------------------------------------------|--------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------|-------------------------------|---------------|----|-----------------------------|
| CLIENT                                                    |        | Macquarie University                             |              |                      |                                                                                                                                             | LOGGED BY                                                                    |             | DM                            |               |    |                             |
| PROJECT                                                   |        | her                                              |              |                      |                                                                                                                                             | CHECKED BY                                                                   |             | BCH, 28-Nov-16                |               |    |                             |
|                                                           |        |                                                  |              |                      |                                                                                                                                             | DRILLED DATE                                                                 |             | 17-Oct-16 to 18-Oct-16        |               |    |                             |
| CONTRACTOR                                                |        | BG Drilling                                      |              | ANGLE                |                                                                                                                                             | Vertical                                                                     |             | GROUND LEVEL                  |               |    |                             |
| DRILL MODEL                                               |        | Hanjin D&B, D8                                   |              | BEARING              |                                                                                                                                             | -                                                                            |             | RL 59.66mOD                   |               |    |                             |
| DRILLER                                                   |        | Randall Smith                                    |              | HOLE DIAMETER        |                                                                                                                                             | 110mm - SFA                                                                  |             | LOCATION                      |               |    |                             |
| LOCATION                                                  |        | Central Courtyard Precinct, Macquarie University |              |                      |                                                                                                                                             |                                                                              |             | 325160.0 E 6261324.1 N        |               |    |                             |
|                                                           |        |                                                  |              |                      |                                                                                                                                             | ELEVATION DATUM                                                              |             | Australian Height Datum (AHD) |               |    |                             |
|                                                           |        |                                                  |              |                      |                                                                                                                                             | COORDINATE SYSTEM                                                            |             | National Grid                 |               |    |                             |
| DRILLING                                                  | STRATA |                                                  |              | MATERIAL DESCRIPTION |                                                                                                                                             |                                                                              | CONDITION   |                               | OBSERVATION   |    |                             |
| SAMPLE, TEST, BIT, SUPPORT, ETC.                          | R.L.   | DEPTH                                            | GROUP SYMBOL | LEGEND               | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                              | WATER / MOISTURE                                                             | CONSISTENCY |                               |               |    | Comments / Penetration Rate |
|                                                           | mOD    | m                                                |              |                      |                                                                                                                                             |                                                                              | COHESIVE    |                               | NON COHESIVE  |    |                             |
|                                                           |        |                                                  |              |                      |                                                                                                                                             |                                                                              | VS          | SL                            | ST            | SH |                             |
| ADT                                                       |        |                                                  |              |                      | Hydro excavation NDD, no samples recovered.                                                                                                 |                                                                              |             |                               |               |    |                             |
| TW (Rec: 800mm)<br><br>PP>220kPa                          | 58.16  | 1.50                                             | CH           |                      | Silty CLAY, (CH) high plasticity, orange red-brown, trace of medium to coarse grained gravel angular.                                       | MC > PL                                                                      |             |                               |               |    | Residual                    |
| SPT<br>N=9<br>2;4,5<br>(Rec: 400mm)                       | 57.11  | 2.55                                             | CL           |                      | Sandy CLAY, (CL) low plasticity, dark brown, sand is fine grained.                                                                          |                                                                              |             |                               |               |    |                             |
| SPT<br>N=23<br>4;10,13<br>(Rec: 500mm)<br>PP>220kPa       | 56.66  | 3.00                                             | CH           |                      | Silty CLAY, (CH) high plasticity, orange red-brown, trace of medium to coarse grained gravel angular, trace of fine to medium grained sand. |                                                                              |             |                               |               |    |                             |
|                                                           |        | 4                                                |              |                      |                                                                                                                                             |                                                                              |             |                               |               |    |                             |
| SPT<br>N=23*<br>4;20/260<br>(HB, Rec: 410mm)<br>PP>220kPa | 55.05  | 4.61                                             | CL           |                      | Silty sandy CLAY, (CL) low plasticity, pale grey, sand is fine grained.                                                                     |                                                                              |             |                               |               |    |                             |
|                                                           |        | 5                                                |              |                      |                                                                                                                                             |                                                                              |             |                               |               |    |                             |
| NOTES                                                     |        |                                                  |              |                      |                                                                                                                                             | See explanatory notes for details of abbreviations and basis of descriptions |             |                               | JOB<br>251278 |    |                             |

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|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          |                                               |  |  |
|---------------------------------------------------------|-----------------|----------------------------|---------------------------------------------|-----------------------|-------|-----------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|-------------|----------------------|---------------------------|-----------------|--------------------------|-----------------------------------------------|--|--|
| ARUP                                                    |                 | CORED BOREHOLE RECORD      |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      | BH12                      |                 |                          | SHEET 3<br>OF 4                               |  |  |
| CLIENT Macquarie University                             |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          | LOGGED BY DM                                  |  |  |
| PROJECT Macquarie University Central Courtyard Precinct |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          | CHECKED BY BCH, 28-Nov-16                     |  |  |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          | DRILLED DATE 17-Oct-16 to 18-Oct-16           |  |  |
| CONTRACTOR BG Drilling                                  |                 | DRILL MODEL Hanjin D&B, D8 |                                             | DRILLER Randall Smith |       | LOCATION Central Courtyard Precinct, Macquarie University |                                                                        | ANGLE Vertical                                                               |                               | BEARING -   |                      | HOLE DIAMETER 52mm (NMLC) |                 | GROUND LEVEL RL 59.66mOD |                                               |  |  |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          | LOCATION 325160.0 E 6261324.1 N               |  |  |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          | ELEVATION DATUM Australian Height Datum (AHD) |  |  |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          | COORDINATE SYSTEM National Grid               |  |  |
| DRILLING                                                |                 |                            |                                             | STRATA                |       |                                                           | MATERIAL DESCRIPTION                                                   |                                                                              |                               |             |                      |                           | DISCONTINUITIES |                          |                                               |  |  |
| TCR % (Drill rate)                                      | SCR % / (RQD %) | FLUSH RETURN % (TYPE)      | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                  | DEPTH | GRAPHIC LOG                                               | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components      | CEMENTATION/<br>WEATHERING                                                   | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa) | FREQUENCY<br>(per m) | SPECIFIC                  |                 |                          | GENERAL DESCRIPTION                           |  |  |
|                                                         |                 |                            |                                             | mOD                   | m     |                                                           |                                                                        |                                                                              |                               |             |                      | TYPE                      | ANGLE           | THICKNESS (mm)           |                                               |  |  |
|                                                         |                 |                            |                                             |                       | 6     |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          |                                               |  |  |
|                                                         |                 |                            |                                             |                       | 7     |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          |                                               |  |  |
|                                                         |                 |                            |                                             |                       | 8     |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          |                                               |  |  |
|                                                         |                 |                            |                                             |                       | 9     |                                                           |                                                                        |                                                                              |                               |             |                      |                           |                 |                          |                                               |  |  |
|                                                         |                 |                            |                                             | 50.26                 | 9.40  |                                                           | Continued as cored borehole                                            |                                                                              |                               |             |                      |                           |                 |                          |                                               |  |  |
|                                                         |                 |                            |                                             |                       | 10    |                                                           | SANDSTONE, fine grained, pale grey, with laminae bedded at 10° to 15°. | FR                                                                           |                               |             |                      |                           |                 |                          |                                               |  |  |
| NOTES                                                   |                 |                            |                                             |                       |       |                                                           |                                                                        | See explanatory notes for details of abbreviations and basis of descriptions |                               |             |                      |                           | JOB 251278      |                          |                                               |  |  |

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| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |       |             |                                                                        | BH12                       |                                                                              | SHEET 4                       |                      |          |        |                     |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------------------|----------------------|----------|--------|---------------------|
| CLIENT             |                 | Macquarie University                             |                                             |                      |       |             |                                                                        | LOGGED BY                  |                                                                              | DM                            |                      |          |        |                     |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             |                                                                        | CHECKED BY                 |                                                                              | BCH, 28-Nov-16                |                      |          |        |                     |
|                    |                 |                                                  |                                             |                      |       |             |                                                                        | DRILLED DATE               |                                                                              | 17-Oct-16 to 18-Oct-16        |                      |          |        |                     |
| CONTRACTOR         |                 | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                        | GROUND LEVEL               |                                                                              | RL 59.66mOD                   |                      |          |        |                     |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             | BEARING              |       | -           |                                                                        | LOCATION                   |                                                                              | 325160.0 E 6261324.1 N        |                      |          |        |                     |
| DRILLER            |                 | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                        | ELEVATION DATUM            |                                                                              | Australian Height Datum (AHD) |                      |          |        |                     |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             |                                                                        | COORDINATE SYSTEM          |                                                                              | National Grid                 |                      |          |        |                     |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                        |                            |                                                                              | DISCONTINUITIES               |                      |          |        |                     |
| TCR % (Drill rate) | SCR % / (RQD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components      | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)                   | FREQUENCY<br>(per m) | SPECIFIC |        | GENERAL DESCRIPTION |
|                    |                 |                                                  |                                             | mOD                  | m     |             |                                                                        |                            |                                                                              |                               |                      | TYPE     | ANGLE  |                     |
|                    |                 |                                                  |                                             | 49.54                | 10.12 |             | SANDSTONE, fine to coarse grained, red, bedded at 10° to 20°.          | FR                         |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             | 49.18                | 10.48 |             | SANDSTONE, fine grained, pale grey, with laminae bedded at 10° to 20°. | FR                         |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             |                      | 11    |             |                                                                        |                            |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             | 48.31                | 11.35 |             | SANDSTONE, fine to coarse grained, red, bedded at 20° to 30°.          | DW                         |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             |                      | 12    |             |                                                                        |                            |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             | 47.49                | 12.17 |             | End of borehole at 12.17m                                              |                            |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             |                      | 13    |             |                                                                        |                            |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             |                      | 14    |             |                                                                        |                            |                                                                              |                               |                      |          |        |                     |
|                    |                 |                                                  |                                             |                      | 15    |             |                                                                        |                            |                                                                              |                               |                      |          |        |                     |
| NOTES              |                 |                                                  |                                             |                      |       |             |                                                                        |                            | See explanatory notes for details of abbreviations and basis of descriptions |                               |                      |          | JOB    |                     |
|                    |                 |                                                  |                                             |                      |       |             |                                                                        |                            |                                                                              |                               |                      |          | 251278 |                     |

|             |                                                 |               |             |                   |                               |
|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 28-Nov-16                |
|             |                                                 |               |             | DRILLED DATE      | 17-Oct-16 to 18-Oct-16        |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | GROUND LEVEL      | RL 59.66mOD                   |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | LOCATION          | 325160.0 E 6261324.1 N        |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | ELEVATION DATUM   | Australian Height Datum (AHD) |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | COORDINATE SYSTEM | National Grid                 |



BH12 Depth Range: 9.40 - 12.17 m

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## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

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|                                  |  |                                                  |       |               |                      |                                                                                                             |                   |                 |                 |                               |    |                                                                                            |
|----------------------------------|--|--------------------------------------------------|-------|---------------|----------------------|-------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-----------------|-------------------------------|----|--------------------------------------------------------------------------------------------|
| ARUP                             |  | BOREHOLE RECORD                                  |       |               |                      |                                                                                                             | BH13              |                 | SHEET 2<br>OF 4 |                               |    |                                                                                            |
| CLIENT                           |  | Macquarie University                             |       |               |                      |                                                                                                             | LOGGED BY         |                 | DM              |                               |    |                                                                                            |
| PROJECT                          |  | Macquarie University Central Courtyard Precinct  |       |               |                      |                                                                                                             | CHECKED BY        |                 | BCH, 28-Nov-16  |                               |    |                                                                                            |
|                                  |  |                                                  |       |               |                      |                                                                                                             | DRILLED DATE      |                 | 17-Oct-16       |                               |    |                                                                                            |
| CONTRACTOR                       |  | BG Drilling                                      |       | ANGLE         |                      | Vertical                                                                                                    |                   | GROUND LEVEL    |                 | RL 56.12mOD                   |    |                                                                                            |
| DRILL MODEL                      |  | Hanjin D&B, D8                                   |       | BEARING       |                      | -                                                                                                           |                   | LOCATION        |                 | 325181.4 E 6261372.6 N        |    |                                                                                            |
| DRILLER                          |  | Randall Smith                                    |       | HOLE DIAMETER |                      | 110mm - SFA                                                                                                 |                   | ELEVATION DATUM |                 | Australian Height Datum (AHD) |    |                                                                                            |
| LOCATION                         |  | Central Courtyard Precinct, Macquarie University |       |               |                      |                                                                                                             | COORDINATE SYSTEM |                 | National Grid   |                               |    |                                                                                            |
| DRILLING                         |  | STRATA                                           |       |               | MATERIAL DESCRIPTION |                                                                                                             |                   | CONDITION       |                 | OBSERVATION                   |    |                                                                                            |
| SAMPLE, TEST, BIT, SUPPORT, ETC. |  | R.L.                                             | DEPTH | GROUP SYMBOL  | LEGEND               | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                              | WATER / MOISTURE  | CONSISTENCY     |                 |                               |    | Comments / Penetration Rate                                                                |
|                                  |  | mOD                                              | m     |               |                      |                                                                                                             |                   | COHESIVE        |                 | NON COHESIVE                  |    |                                                                                            |
|                                  |  |                                                  |       |               |                      |                                                                                                             |                   | VS              | SL              | ST                            | SH |                                                                                            |
| ADT                              |  |                                                  |       |               |                      | Sandy CLAY, (CL) low plasticity, pale red-brown, sand is fine to medium grained, trace of silt. (continued) |                   |                 |                 |                               |    | from 4.74m to 5.5m strength assessment based on visual and tactile examination of subsoil. |
|                                  |  | 50.47                                            | 5.65  |               |                      | Continued as cored borehole                                                                                 |                   |                 |                 |                               |    |                                                                                            |
|                                  |  |                                                  | 6     |               |                      |                                                                                                             |                   |                 |                 |                               |    |                                                                                            |
|                                  |  |                                                  | 7     |               |                      |                                                                                                             |                   |                 |                 |                               |    |                                                                                            |
|                                  |  |                                                  | 8     |               |                      |                                                                                                             |                   |                 |                 |                               |    |                                                                                            |
|                                  |  |                                                  | 9     |               |                      |                                                                                                             |                   |                 |                 |                               |    |                                                                                            |
|                                  |  |                                                  | 10    |               |                      |                                                                                                             |                   |                 |                 |                               |    |                                                                                            |
| NOTES                            |  |                                                  |       |               |                      | See explanatory notes for details of abbreviations and basis of descriptions                                |                   |                 |                 | JOB<br>251278                 |    |                                                                                            |

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| ARUP               |               | CORED BOREHOLE RECORD                            |                                             |                      |       |             | BH13                                                                                                         |                            | SHEET 3<br>OF 4                                                              |                                      |                      |               |       |                                                              |
|--------------------|---------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|--------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|--------------------------------------|----------------------|---------------|-------|--------------------------------------------------------------|
| CLIENT             |               | Macquarie University                             |                                             |                      |       |             | LOGGED BY                                                                                                    |                            | DM                                                                           |                                      |                      |               |       |                                                              |
| PROJECT            |               | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             | CHECKED BY                                                                                                   |                            | BCH, 28-Nov-16                                                               |                                      |                      |               |       |                                                              |
|                    |               |                                                  |                                             |                      |       |             | DRILLED DATE                                                                                                 |                            | 17-Oct-16                                                                    |                                      |                      |               |       |                                                              |
| CONTRACTOR         |               | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                                                              | GROUND LEVEL               |                                                                              | RL 56.12mOD                          |                      |               |       |                                                              |
| DRILL MODEL        |               | Hanjin D&B, D8                                   |                                             | BEARING              |       |             |                                                                                                              | LOCATION                   |                                                                              | 325181.4 E 6261372.6 N               |                      |               |       |                                                              |
| DRILLER            |               | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                                                              | ELEVATION DATUM            |                                                                              | Australian Height Datum (AHD)        |                      |               |       |                                                              |
| LOCATION           |               | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             | COORDINATE SYSTEM                                                                                            |                            | National Grid                                                                |                                      |                      |               |       |                                                              |
| DRILLING           |               | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                                                              |                            | DISCONTINUITIES                                                              |                                      |                      |               |       |                                                              |
| TCR % (Drill rate) | SCR % (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                                            | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)                          | FREQUENCY<br>(per m) | SPECIFIC      |       | GENERAL DESCRIPTION<br>Planarity, Roughness, Coating, Infill |
|                    |               |                                                  |                                             | mOD                  | m     |             |                                                                                                              |                            |                                                                              |                                      |                      | TYPE          | ANGLE |                                                              |
|                    |               |                                                  |                                             | 50.47                | 5.65  |             | Continued as cored borehole                                                                                  |                            |                                                                              |                                      |                      |               |       |                                                              |
| 100                | 50/(50)       | 100                                              |                                             | 50.19                | 5.93  |             | SANDSTONE, medium to coarse grained, brown, bedded at 20° to 25°.                                            | DW                         |                                                                              | D 0.02<br>A 0.70                     |                      |               |       |                                                              |
|                    |               |                                                  |                                             |                      | 6     |             | SANDSTONE, medium to coarse grained, pale grey, laminae bedded at 5° to 20°.                                 | SW                         |                                                                              |                                      |                      |               |       |                                                              |
|                    |               |                                                  |                                             | 49.62                | 6.50  |             | SANDSTONE, medium to coarse grained, pale grey mottled orange mottled red, with laminae bedded at 5° to 20°. |                            |                                                                              | D 2.08<br>A 0.57                     |                      |               |       |                                                              |
|                    |               |                                                  |                                             |                      | 7     |             |                                                                                                              |                            |                                                                              |                                      |                      |               |       |                                                              |
|                    |               |                                                  |                                             |                      | 8     |             |                                                                                                              |                            |                                                                              | D 1.24<br>A 2.06<br>A 1.91           |                      |               |       |                                                              |
|                    |               |                                                  |                                             |                      | 9     |             |                                                                                                              |                            |                                                                              |                                      |                      |               |       |                                                              |
|                    |               |                                                  |                                             | 46.84                | 9.28  |             | SANDSTONE, medium to coarse grained, pale grey, with laminae bedded at 5° to 20°, trace of quartz.           | FR                         |                                                                              | D 1.10<br>A 2.41<br>D 2.25<br>A 1.30 |                      |               |       |                                                              |
|                    |               |                                                  |                                             |                      | 10    |             |                                                                                                              |                            |                                                                              |                                      |                      |               |       |                                                              |
| NOTES              |               |                                                  |                                             |                      |       |             |                                                                                                              |                            | See explanatory notes for details of abbreviations and basis of descriptions |                                      |                      | JOB<br>251278 |       |                                                              |

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 library : /global.arup.com/australis/aisys/projects/2510000251278-00\_mae\_uni\_central/work/internal/design/geotech/gint01\_library/arup\_aus\_v0.1.2.gbl  
 log : I.2.1 AUS ROTARY CORE LOG (rev. Nov16)  
 INT output page 2 of 2. Made 15Dec16 15:54

ARUP

## CORE PHOTO RECORD

BH13

SHEET 1

OF 1

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 17-Oct-16  
GROUND LEVEL RL 56.12mOD  
LOCATION 325181.4 E 6261372.6 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH13 Depth Range: 5.50 - 10.00 m



BH13 Depth Range: 10.00 - 12.60 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

<http://www.vic.gov.au>  
 project: vglobal.arup.com.au/australia/sydney/projects/251000/251278-00\_mac\_uni\_centralwork/internal/design/geotech/gint03\_project/mucp\_master.gpj  
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 log: 1.0.1 AUS GENERAL BOREHOLE LOG (rev 15Dec16)  
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Log: 12.1 AUS ROTARY CORE LOG (rev 1 Nov16)  
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| ARUP               |               | CORED BOREHOLE RECORD                            |                                             |                      |       |             |                                                                                        | BH14                                                                         |                               | SHEET 2                       |                      |          |       |                     |                |
|--------------------|---------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------|-------------------------------|----------------------|----------|-------|---------------------|----------------|
| CLIENT             |               | Macquarie University                             |                                             |                      |       |             |                                                                                        | LOGGED BY                                                                    |                               | DM                            |                      |          |       |                     |                |
| PROJECT            |               | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             |                                                                                        | CHECKED BY                                                                   |                               | BCH, 28-Nov-16                |                      |          |       |                     |                |
|                    |               | DRILLED DATE                                     |                                             |                      |       |             |                                                                                        | 23-Oct-16 to 24-Oct-16                                                       |                               |                               |                      |          |       |                     |                |
| CONTRACTOR         |               | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                                        | GROUND LEVEL                                                                 |                               | RL 58.37mOD                   |                      |          |       |                     |                |
| DRILL MODEL        |               | Hanjin D&B, D8                                   |                                             | BEARING              |       |             |                                                                                        | LOCATION                                                                     |                               | 325235.2 E 6261351.5 N        |                      |          |       |                     |                |
| DRILLER            |               | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                                        | ELEVATION DATUM                                                              |                               | Australian Height Datum (AHD) |                      |          |       |                     |                |
| LOCATION           |               | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             |                                                                                        | COORDINATE SYSTEM                                                            |                               | National Grid                 |                      |          |       |                     |                |
| DRILLING           |               | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                                        |                                                                              |                               | DISCONTINUITIES               |                      |          |       |                     |                |
| TCR % (Drill rate) | SCR % (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                      | CEMENTATION/<br>WEATHERING                                                   | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa)                   | FREQUENCY<br>(per m) | SPECIFIC |       | GENERAL DESCRIPTION |                |
|                    |               |                                                  |                                             | mOD                  | m     |             |                                                                                        |                                                                              |                               |                               |                      | TYPE     | ANGLE |                     | THICKNESS (mm) |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                                                                              |                               |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 1     |             |                                                                                        |                                                                              |                               |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 2     |             |                                                                                        |                                                                              |                               |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 3     |             |                                                                                        |                                                                              |                               |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             | 54.89                | 3.48  |             | Continued as cored borehole                                                            |                                                                              |                               |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 4     |             | SANDSTONE, fine to coarse grained, pale grey mottled red, laminae bedded at 5° to 15°. | FR                                                                           |                               |                               |                      | We       | 5     | 10                  | PL Ro3 c, s    |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                                                                              |                               |                               |                      | Jo       | 15    | 10                  | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                                                                              |                               |                               |                      | We       | 10    | 80                  | PL Ro3 c, s    |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                                                                              |                               |                               |                      | We       | 5     | 30                  | PL Ro3 c, s    |
|                    |               |                                                  |                                             |                      |       |             | ... 4.33m - 4.45m becoming yellow mottled red mottled pale grey                        | DW                                                                           |                               |                               |                      | Jo       | 10    | 2                   | PL Ro3 s       |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        | FR/SW                                                                        |                               |                               |                      | Cr       | 10    | 55                  | IR Ro3 c, s, g |
|                    |               |                                                  |                                             |                      |       |             | ... 4.70m becoming pale grey mottled red                                               |                                                                              |                               |                               |                      |          |       |                     |                |
|                    |               |                                                  |                                             |                      | 5     |             |                                                                                        |                                                                              |                               |                               |                      |          |       |                     |                |
| NOTES              |               |                                                  |                                             |                      |       |             |                                                                                        | See explanatory notes for details of abbreviations and basis of descriptions |                               |                               |                      | JOB      |       |                     |                |
|                    |               |                                                  |                                             |                      |       |             |                                                                                        |                                                                              |                               |                               |                      | 251278   |       |                     |                |

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Library: /global.arup.com/australiasia/sydney/projects/2510000/251278-00\_mae\_uni\_central/work/internal/design/geotech/light01\_library/arup\_aus\_v0.1.2.gpj  
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Library : \\global.arup.com\australasia\projects\251000\251278-00 mac uni central\work\internal\design\geotech\gint\03 project\mucpp\_master.gpj  
Log: 12.1 AUS ROTARY CORE LOG (rev 1 Nov16)  
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| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |          |             | BH14                                                                         |                            | SHEET 4                          |                               |                    |          |       |                     |                |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|----------|-------------|------------------------------------------------------------------------------|----------------------------|----------------------------------|-------------------------------|--------------------|----------|-------|---------------------|----------------|
| CLIENT             |                 | Macquarie University                             |                                             |                      |          |             | LOGGED BY                                                                    |                            | DM                               |                               |                    |          |       |                     |                |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |          |             | CHECKED BY                                                                   |                            | BCH, 28-Nov-16                   |                               |                    |          |       |                     |                |
|                    |                 |                                                  |                                             |                      |          |             | DRILLED DATE                                                                 |                            | 23-Oct-16 to 24-Oct-16           |                               |                    |          |       |                     |                |
| CONTRACTOR         |                 | BG Drilling                                      |                                             | ANGLE                |          | Vertical    |                                                                              | GROUND LEVEL               |                                  | RL 58.37mOD                   |                    |          |       |                     |                |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             | BEARING              |          |             |                                                                              | LOCATION                   |                                  | 325235.2 E 6261351.5 N        |                    |          |       |                     |                |
| DRILLER            |                 | Randall Smith                                    |                                             | HOLE DIAMETER        |          | 52mm (NMLC) |                                                                              | ELEVATION DATUM            |                                  | Australian Height Datum (AHD) |                    |          |       |                     |                |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |          |             | COORDINATE SYSTEM                                                            |                            | National Grid                    |                               |                    |          |       |                     |                |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |          |             |                                                                              |                            | DISCONTINUITIES                  |                               |                    |          |       |                     |                |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH    | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components            | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH    | Is 50 (MPa)                   | FREQUENCY (per m)  | SPECIFIC |       | GENERAL DESCRIPTION |                |
|                    |                 |                                                  |                                             | mOD                  | m        |             |                                                                              |                            |                                  |                               |                    | TYPE     | ANGLE |                     | THICKNESS (mm) |
| 100                | 88(74)          | 100                                              |                                             | 47.37                | 11 11.00 |             | SANDSTONE, fine grained, pale grey, laminae bedded at 5° to 15°. (continued) | FR                         | EL<br>VL<br>JL<br>ML<br>HL<br>VE | D 1.52<br>A 2.49              | 30<br>10<br>3<br>1 | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    | Jo       | 20    | 3                   | PL Ro3 s       |
|                    |                 |                                                  |                                             |                      |          |             |                                                                              |                            |                                  |                               |                    |          |       |                     |                |

|             |                                                 |               |             |                   |                               |
|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 28-Nov-16                |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | DRILLED DATE      | 23-Oct-16 to 24-Oct-16        |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | GROUND LEVEL      | RL 58.37mOD                   |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | LOCATION          | 325235.2 E 6261351.5 N        |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | ELEVATION DATUM   | Australian Height Datum (AHD) |
|             |                                                 |               |             | COORDINATE SYSTEM | National Grid                 |



BH14 Depth Range: 3.48 - 8.00 m



BH14 Depth Range: 8.00 - 11.80 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

ARUP

## BOREHOLE RECORD

BH15

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT her

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 21-Oct-16CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Central Courtyard Precinct, Macquarie University  
ANGLE Vertical  
BEARING -  
HOLE DIAMETER 110mm - SFAGROUND LEVEL RL 56.47mOD  
LOCATION 325236.7 E 6261380.7 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid

| DRILLING                                                  |       | STRATA |              |        | MATERIAL DESCRIPTION                                                                                                                 |                  | CONDITION   |    | OBSERVATION                 |    |    |              |    |    |    |  |  |  |          |
|-----------------------------------------------------------|-------|--------|--------------|--------|--------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|----|-----------------------------|----|----|--------------|----|----|----|--|--|--|----------|
| SAMPLE, TEST, BIT, SUPPORT, ETC.                          | R.L.  | DEPTH  | GROUP SYMBOL | LEGEND | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components                                                                       | WATER / MOISTURE | CONSISTENCY |    | Comments / Penetration Rate |    |    |              |    |    |    |  |  |  |          |
|                                                           | mOD   | m      |              |        |                                                                                                                                      |                  | COHESIVE    |    |                             |    |    | NON COHESIVE |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  | VS          | SL |                             | ST | SH | VL           | ML | DL | VD |  |  |  |          |
| ADT                                                       |       |        |              |        | FILL: Gravelly sandy CLAY, low plasticity, brown, sand is fine grained, gravel is fine to medium grained sub-angular to sub-rounded. | MC < PL          |             |    |                             |    |    |              |    |    |    |  |  |  |          |
| SPT<br>N=16*<br>3;11/210<br>(HB, Rec: 360mm)<br>PP=200kPa | 55.97 | 0.50   | CL           |        | Sandy CLAY, (CL) low plasticity, orange-brown, sand is fine to medium grained, trace of silt.                                        | MC > PL          |             |    |                             |    |    |              |    |    |    |  |  |  | Residual |
| SPT<br>N>50**<br>6/20s<br>(HB, Rec: 20mm)                 | 55.47 | 1 1.00 | SC           |        | Clayey SAND, (SC) fine to medium grained, orange, trace of silt.                                                                     | D                |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           | 54.98 | 1.49   |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        | Continued as cored borehole                                                                                                          |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |
|                                                           |       |        |              |        |                                                                                                                                      |                  |             |    |                             |    |    |              |    |    |    |  |  |  |          |

ARUP

## CORED BOREHOLE RECORD

BH15

SHEET 2

OF 4

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

LOGGED BY

DM

CHECKED BY

BCH, 28-Nov-16

DRILLED DATE

21-Oct-16

CONTRACTOR

BG Drilling

DRILL MODEL

Hanjin D&amp;B, D8

DRILLER

Randall Smith

LOCATION

Central Courtyard Precinct, Macquarie University

ANGLE

Vertical

BEARING

-

HOLE DIAMETER

52mm (NMLC)

GROUND LEVEL

RL 56.47mOD

LOCATION

325236.7 E 6261380.7 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid

## DRILLING

## STRATA

## MATERIAL DESCRIPTION

## DISCONTINUITIES

| TCR % (Drill rate) | SCR % (RQD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.  | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                                                         | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH | Is 50 (MPa) | FREQUENCY<br>(per m) | SPECIFIC |       |                | GENERAL DESCRIPTION         |
|--------------------|---------------|-----------------------|---------------------------------------------|-------|-------|-------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------|-------------|----------------------|----------|-------|----------------|-----------------------------|
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | TYPE     | ANGLE | THICKNESS (mm) |                             |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      |          |       |                |                             |
|                    |               |                       |                                             |       | 1     |             |                                                                                                                           |                            |                               |             |                      |          |       |                |                             |
|                    |               |                       |                                             | 54.98 | 1.49  |             | Continued as cored borehole                                                                                               |                            |                               |             |                      |          |       |                |                             |
|                    |               |                       |                                             |       | 2     |             | SANDSTONE, fine to coarse grained, pale grey mottled red mottled orange, bedded at 0° to 30°. (red between 1.5m & 1.62m). | SW                         |                               |             |                      | We       | 5     | 15             | PL Ro3 c, s                 |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | Jo       | 30    | 7              | CU healed joint<br>PL Ro3 s |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | Jo       | 5     | 3              | PL Ro3 c, s                 |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | Jo       | 15    | 4              | PL Ro3 s                    |
|                    |               |                       |                                             | 54.38 | 2.09  |             | SANDSTONE, fine to coarse grained, pale grey, laminae bedded at 5° to 20°.                                                | FR                         |                               |             |                      | We       | 5     | 5              | PL Ro3 c, s                 |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | We       | 5     | 5              | PL Ro3 c, s                 |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | We       | 5     | 5              | PL Ro3 c                    |
|                    |               |                       |                                             |       | 3     |             | ... 3.00m becoming pale grey mottled yellow                                                                               |                            |                               |             |                      |          |       |                |                             |
|                    |               |                       |                                             | 53.30 | 3.17  |             | SANDSTONE, fine to coarse grained, red, bedded at 0° to 25°.                                                              | DW/XV                      |                               |             |                      | Jo       | 5     | 4              | PL Ro3 c, s                 |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | We       | 10    | 85             | PL Ro3 c                    |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | We       | 35    | 135            | IR Ro3 s, g                 |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | Jo       | 15    | 4              | PL Ro3 c, s                 |
|                    |               |                       |                                             |       | 4     |             |                                                                                                                           |                            |                               |             |                      | Jo       | 10    | 3              | PL Ro3 s, (2 joints)        |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | Jo       | 5     | 5              | PL Ro3 s                    |
|                    |               |                       |                                             | 52.16 | 4.31  |             | NO CORE (100mm).                                                                                                          |                            |                               |             |                      | We       | 5     | 185            | PL Ro3 c                    |
|                    |               |                       |                                             | 52.06 | 4.41  |             | SANDSTONE, fine to coarse grained, red, bedded at 0° to 25°.                                                              | DW/XV                      |                               |             |                      | We       | 5     | 45             | PL Ro3 c                    |
|                    |               |                       |                                             |       |       |             |                                                                                                                           |                            |                               |             |                      | We       | 5     | 115            | PL Ro3 c, s                 |
|                    |               |                       |                                             |       | 5     |             |                                                                                                                           |                            |                               |             |                      |          |       |                |                             |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 28-Nov-16 |
| DRILLED DATE | 21-Oct-16      |

|                       |                                       |
|-----------------------|---------------------------------------|
| GROUND LEVEL LOCATION | RL 56.47mOD<br>325236.7 E 6261380.7 N |
| ELEVATION DATUM       | Australian Height Datum (AHD)         |
| COORDINATE SYSTEM     | National Grid                         |

## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

.JOB

251278

ARUP

## CORED BOREHOLE RECORD

BH15

SHEET 4

OF 4

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 21-Oct-16CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Central Courtyard Precinct, Macquarie University  
ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)GROUND LEVEL RL 56.47mOD  
LOCATION 325236.7 E 6261380.7 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid

| DRILLING           |               |                       |                                             | STRATA |       | MATERIAL DESCRIPTION |                                                                                                                                         |                            |                                                                              |             | DISCONTINUITIES      |          |       |                     |                                                              |
|--------------------|---------------|-----------------------|---------------------------------------------|--------|-------|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------|----------------------|----------|-------|---------------------|--------------------------------------------------------------|
| TCR % (Drill rate) | SCR % (RQD %) | FLUSH RETURN % (TYPE) | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.   | DEPTH | GRAPHIC LOG          | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                                                                       | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa) | FREQUENCY<br>(per m) | SPECIFIC |       | GENERAL DESCRIPTION |                                                              |
|                    |               |                       |                                             | mOD    | m     |                      |                                                                                                                                         |                            |                                                                              |             |                      | TYPE     | ANGLE | THICKNESS (mm)      | Planarity, Roughness, Coating, Infill                        |
| 100                | 94(77)        | 100                   |                                             |        | 11    |                      | SANDSTONE, fine to coarse grained, pale grey mottled red mottled orange, bedded at 5° to 25°, laminae bedded at 10° to 25°. (continued) | FR/SW                      |                                                                              |             |                      | Jo       | 25    | 4                   | PL Ro3 s (4 joints, 3 healed joints, between 10.1m & 10.22m) |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | Jo       | 20    | 3                   | PL Ro3 s                                                     |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | Jo       | 15    | 3                   | PL Ro3 s                                                     |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | We       | 20    | 35                  | PL Ro3 c, s                                                  |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | We       | 10    | 10                  | PL Ro3 c, s                                                  |
|                    |               |                       |                                             | 44.68  | 11.79 |                      |                                                                                                                                         |                            |                                                                              |             |                      | Jo       | 5     | 3                   | PL Ro3 s                                                     |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | Jo       | 5     | 5                   | PL Ro3 c, s                                                  |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | Jo       | 10    | 3                   | PL Ro3 c, s, g (2 joints)                                    |
|                    |               |                       |                                             |        |       |                      |                                                                                                                                         |                            |                                                                              |             |                      | We       | 5     | 40                  | PL Ro3 c, s                                                  |
|                    |               |                       |                                             | 44.51  | 11.96 |                      | SANDSTONE, fine to coarse grained, orange.                                                                                              | SW                         |                                                                              |             |                      | Jo       | 70    | ?                   | PL Ro3 s                                                     |
|                    |               |                       |                                             |        | 12    |                      | End of borehole at 11.96m                                                                                                               |                            |                                                                              |             |                      |          |       |                     |                                                              |
|                    |               |                       |                                             |        | 13    |                      |                                                                                                                                         |                            |                                                                              |             |                      |          |       |                     |                                                              |
|                    |               |                       |                                             |        | 14    |                      |                                                                                                                                         |                            |                                                                              |             |                      |          |       |                     |                                                              |
|                    |               |                       |                                             |        | 15    |                      |                                                                                                                                         |                            |                                                                              |             |                      |          |       |                     |                                                              |
| NOTES              |               |                       |                                             |        |       |                      |                                                                                                                                         |                            | See explanatory notes for details of abbreviations and basis of descriptions |             |                      |          |       | JOB 251278          |                                                              |

ARUP

## CORE PHOTO RECORD

BH15

SHEET 1

OF 2

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 21-Oct-16  
GROUND LEVEL RL 56.47mOD  
LOCATION 325236.7 E 6261380.7 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH15 Depth Range: 1.49 - 6.00 m



BH15 Depth Range: 6.00 - 11.00 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

ARUP

## CORE PHOTO RECORD

BH15

SHEET 2

OF 2

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

CONTRACTOR BG Drilling  
DRILL MODEL Hanjin D&B, D8  
DRILLER Randall Smith  
LOCATION Macquarie University Central Courtyard Precinct

ANGLE Vertical  
BEARING -  
HOLE DIAMETER 52mm (NMLC)

LOGGED BY DM  
CHECKED BY BCH, 28-Nov-16  
DRILLED DATE 21-Oct-16

GROUND LEVEL RL 56.47mOD  
LOCATION 325236.7 E 6261380.7 N  
ELEVATION DATUM Australian Height Datum (AHD)  
COORDINATE SYSTEM National Grid



BH15 Depth Range: 11.00 - 11.96 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

JOB

251278

ARUP

## BOREHOLE RECORD

BH16

SHEET 1

OF 4

CLIENT Macquarie University

PROJECT Macquarie University Central Courtyard Precinct

LOGGED BY

DM

CHECKED BY

BCH, 25-Nov-16

DRILLED DATE

21-Oct-16

CONTRACTOR

BG Drilling

DRILL MODEL

Hanjin D&amp;B, D8

DRILLER

Randall Smith

LOCATION

Central Courtyard Precinct, Macquarie University

ANGLE

Vertical

BEARING

-

HOLE DIAMETER

110mm - SFA

GROUND LEVEL

RL 57.17mOD

LOCATION

325265.5 E 6261373.9 N

ELEVATION DATUM

Australian Height Datum (AHD)

COORDINATE SYSTEM

National Grid

DRILLING

STRATA

MATERIAL DESCRIPTION

CONDITION

OBSERVATION

SAMPLE, TEST,  
BIT, SUPPORT,  
ETC.

R.L.

DEPTH

GROUP SYMBOL

LEGEND

SOIL TYPE  
Plasticity / Grain Size, Colour, Minor ComponentsWATER /  
MOISTURE

CONSISTENCY

COHESIVE

NON  
COHESIVEComments /  
Penetration Rate

mOD

m

VS

SL

ST

SH

VL

ML

VD

DL

NOTES

See explanatory notes for details of  
abbreviations and basis of  
descriptions

JOB

251278

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 28-Nov-16 |
| DRILLED DATE | 21-Oct-16      |

|                       |                                       |
|-----------------------|---------------------------------------|
| GROUND LEVEL LOCATION | RL 57.17mOD<br>325265.5 E 6261373.9 N |
| ELEVATION DATUM       | Australian Height Datum (AHD)         |
| COORDINATE SYSTEM     | National Grid                         |

## NOTES

See explanatory notes for details of abbreviations and basis of descriptions

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| ARUP               |                 | CORED BOREHOLE RECORD                            |                                             |                      |       |             |                                                                                               | BH16                       |                                                                              | SHEET 3<br>OF 4               |                      |          |               |                                                                     |                      |
|--------------------|-----------------|--------------------------------------------------|---------------------------------------------|----------------------|-------|-------------|-----------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------|-------------------------------|----------------------|----------|---------------|---------------------------------------------------------------------|----------------------|
| CLIENT             |                 | Macquarie University                             |                                             |                      |       |             |                                                                                               | LOGGED BY                  |                                                                              | DM                            |                      |          |               |                                                                     |                      |
| PROJECT            |                 | Macquarie University Central Courtyard Precinct  |                                             |                      |       |             |                                                                                               | CHECKED BY                 |                                                                              | BCH, 28-Nov-16                |                      |          |               |                                                                     |                      |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               | DRILLED DATE               |                                                                              | 21-Oct-16                     |                      |          |               |                                                                     |                      |
| CONTRACTOR         |                 | BG Drilling                                      |                                             | ANGLE                |       | Vertical    |                                                                                               | GROUND LEVEL               |                                                                              | RL 57.17mOD                   |                      |          |               |                                                                     |                      |
| DRILL MODEL        |                 | Hanjin D&B, D8                                   |                                             | BEARING              |       | -           |                                                                                               | LOCATION                   |                                                                              | 325265.5 E 6261373.9 N        |                      |          |               |                                                                     |                      |
| DRILLER            |                 | Randall Smith                                    |                                             | HOLE DIAMETER        |       | 52mm (NMLC) |                                                                                               | ELEVATION DATUM            |                                                                              | Australian Height Datum (AHD) |                      |          |               |                                                                     |                      |
| LOCATION           |                 | Central Courtyard Precinct, Macquarie University |                                             |                      |       |             |                                                                                               | COORDINATE SYSTEM          |                                                                              | National Grid                 |                      |          |               |                                                                     |                      |
| DRILLING           |                 | STRATA                                           |                                             | MATERIAL DESCRIPTION |       |             |                                                                                               |                            |                                                                              | DISCONTINUITIES               |                      |          |               |                                                                     |                      |
| TCR % (Drill rate) | SCR % / (ROD %) | FLUSH RETURN % (TYPE)                            | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                 | DEPTH | GRAPHIC LOG | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                             | CEMENTATION/<br>WEATHERING | ESTIMATED<br>ROCK<br>STRENGTH                                                | Is 50 (MPa)                   | FREQUENCY<br>(per m) | SPECIFIC |               | GENERAL DESCRIPTION<br><br>Planarity, Roughness,<br>Coating, Infill |                      |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               |                            |                                                                              |                               |                      | TYPE     | ANGLE         |                                                                     | THICKNESS (mm)       |
| 100                | 94/(91)         | 100                                              |                                             |                      |       |             | SANDSTONE, fine to coarse grained, pale grey mottled orange, bedded at 0° to 20°. (continued) | SW                         | EL<br>VL<br>ML<br>HL<br>HE                                                   |                               |                      | Jo       | 15            | 4                                                                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      | 6     |             |                                                                                               | FR/SW                      |                                                                              | D 1.02<br>A 1.09              |                      | Cr       | 10            | 5                                                                   | PL Ro3 s, g          |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               |                            |                                                                              |                               |                      | We       | 5             | 25                                                                  | PL Ro3 c             |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               |                            |                                                                              |                               |                      | We       | 5             | 145                                                                 | PL Ro3 c, s          |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               |                            |                                                                              |                               |                      | We       | 5             | 45                                                                  | PL Ro3 c, s          |
|                    |                 |                                                  |                                             |                      | 7     |             | ... 7.10m becoming pale grey mottled red                                                      |                            |                                                                              | D 1.69<br>A 1.59              |                      | Jo       | 20            | 3                                                                   | PL Ro3 s             |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               | SW                         |                                                                              | D 1.68<br>A 1.58              |                      | Jo       | 5             | 2                                                                   | PL Ro3 s             |
|                    |                 |                                                  |                                             | 49.37                | 7.80  |             | SANDSTONE, fine to coarse grained, pale grey, laminae bedded at 5° to 20°.                    | FR                         |                                                                              | D 0.98<br>A 0.87              |                      | We       | 15            | 95                                                                  | PL Ro3 c, s          |
|                    |                 |                                                  |                                             |                      | 8     |             |                                                                                               |                            |                                                                              |                               |                      | Jo       | 15            | 3                                                                   | PL Ro3 c             |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               |                            |                                                                              |                               |                      | Jo       | 15            | 3                                                                   | PL Ro3 s<br>PL Ro3 s |
|                    |                 |                                                  |                                             |                      |       |             |                                                                                               |                            |                                                                              |                               |                      | We       | 5             | 55                                                                  | PL Ro3 c, s          |
|                    | 92/(87)         | 100                                              |                                             |                      | 9     |             |                                                                                               |                            |                                                                              | D 1.32<br>A 1.33              |                      | Jo       | 15            | 5                                                                   | PL Ro3 CN            |
|                    |                 |                                                  |                                             |                      | 10    |             |                                                                                               |                            |                                                                              |                               |                      |          |               |                                                                     |                      |
| NOTES              |                 |                                                  |                                             |                      |       |             |                                                                                               |                            | See explanatory notes for details of abbreviations and basis of descriptions |                               |                      |          | JOB<br>251278 |                                                                     |                      |

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|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|---------------------------------------------------------|-----------------|----------------------------|---------------------------------------------|-----------------------|-------|-----------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------|-----------|----|---------------------------|----|--------------------------|-----------------------------------------------|----------|-------|----------------|---------------------|
| ARUP                                                    |                 | CORED BOREHOLE RECORD      |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    | BH16                      |    |                          | SHEET 4<br>OF 4                               |          |       |                |                     |
| CLIENT Macquarie University                             |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          | LOGGED BY DM                                  |          |       |                |                     |
| PROJECT Macquarie University Central Courtyard Precinct |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          | CHECKED BY BCH, 28-Nov-16                     |          |       |                |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          | DRILLED DATE 21-Oct-16                        |          |       |                |                     |
| CONTRACTOR BG Drilling                                  |                 | DRILL MODEL Hanjin D&B, D8 |                                             | DRILLER Randall Smith |       | LOCATION Central Courtyard Precinct, Macquarie University |                                                                                        | ANGLE Vertical                                                               |                         | BEARING - |    | HOLE DIAMETER 52mm (NMLC) |    | GROUND LEVEL RL 57.17mOD |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          | LOCATION 325265.5 E 6261373.9 N               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          | ELEVATION DATUM Australian Height Datum (AHD) |          |       |                |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          | COORDINATE SYSTEM National Grid               |          |       |                |                     |
| DRILLING                                                |                 |                            |                                             | STRATA                |       |                                                           | MATERIAL DESCRIPTION                                                                   |                                                                              |                         |           |    |                           |    | DISCONTINUITIES          |                                               |          |       |                |                     |
| TCR % (Drill rate)                                      | SCR % / (RQD %) | FLUSH RETURN % (TYPE)      | SAMPLES (CaCO <sub>3</sub> , SPT, UCS, etc) | R.L.                  | DEPTH | GRAPHIC LOG                                               | ROCK TYPE<br>Grain Size, Texture/Fabric, Colour, Minor Components                      | CEMENTATION/<br>WEATHERING                                                   | ESTIMATED ROCK STRENGTH |           |    |                           |    | Is 50 (MPa)              | FREQUENCY (per m)                             | SPECIFIC |       |                | GENERAL DESCRIPTION |
|                                                         |                 |                            |                                             | mOD                   | m     |                                                           |                                                                                        |                                                                              | EL                      | VL        | ML | HL                        | VE |                          |                                               | TYPE     | ANGLE | THICKNESS (mm) |                     |
| 100                                                     | 92/(87)         | 100                        |                                             | 46.57                 | 10.60 |                                                           | SANDSTONE, fine to coarse grained, pale grey, laminae bedded at 5° to 20°. (continued) | FR                                                                           |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       |       |                                                           | End of borehole at 10.60m                                                              |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       | 11    |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       | 12    |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       | 13    |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       | 14    |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
|                                                         |                 |                            |                                             |                       | 15    |                                                           |                                                                                        |                                                                              |                         |           |    |                           |    |                          |                                               |          |       |                |                     |
| NOTES                                                   |                 |                            |                                             |                       |       |                                                           |                                                                                        | See explanatory notes for details of abbreviations and basis of descriptions |                         |           |    |                           |    |                          | JOB 251278                                    |          |       |                |                     |

|             |                                                 |               |             |                   |                               |
|-------------|-------------------------------------------------|---------------|-------------|-------------------|-------------------------------|
| CLIENT      | Macquarie University                            |               |             | LOGGED BY         | DM                            |
| PROJECT     | Macquarie University Central Courtyard Precinct |               |             | CHECKED BY        | BCH, 28-Nov-16                |
| CONTRACTOR  | BG Drilling                                     | ANGLE         | Vertical    | DRILLED DATE      | 21-Oct-16                     |
| DRILL MODEL | Hanjin D&B, D8                                  | BEARING       | -           | GROUND LEVEL      | RL 57.17mOD                   |
| DRILLER     | Randall Smith                                   | HOLE DIAMETER | 52mm (NMLC) | LOCATION          | 325265.5 E 6261373.9 N        |
| LOCATION    | Macquarie University Central Courtyard Precinct |               |             | ELEVATION DATUM   | Australian Height Datum (AHD) |
|             |                                                 |               |             | COORDINATE SYSTEM | National Grid                 |



BH16 Depth Range: 2.94 - 7.00 m



BH16 Depth Range: 7.00 - 10.60 m

## NOTES

Marks indicate natural defects.

See explanatory notes for details of abbreviations and basis of descriptions

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|                                        |       |                                                  |              |                      |                                                                              |                     |                      |                               |                 |  |                                |
|----------------------------------------|-------|--------------------------------------------------|--------------|----------------------|------------------------------------------------------------------------------|---------------------|----------------------|-------------------------------|-----------------|--|--------------------------------|
| ARUP                                   |       | BOREHOLE RECORD                                  |              |                      |                                                                              | BH17                |                      | SHEET 2<br>OF 4               |                 |  |                                |
| CLIENT                                 |       | Macquarie University                             |              |                      |                                                                              | LOGGED BY           |                      | DM                            |                 |  |                                |
| PROJECT                                |       | her                                              |              |                      |                                                                              | CHECKED BY          |                      | BCH, 25-Nov-16                |                 |  |                                |
|                                        |       |                                                  |              |                      |                                                                              | DRILLED DATE        |                      | 24-Oct-16                     |                 |  |                                |
| CONTRACTOR                             |       | BG Drilling                                      |              | ANGLE                |                                                                              | Vertical            |                      | GROUND LEVEL                  |                 |  |                                |
| DRILL MODEL                            |       | Hanjin D&B, D8                                   |              | BEARING              |                                                                              | -                   |                      | RL 60.96mOD                   |                 |  |                                |
| DRILLER                                |       | Randall Smith                                    |              | HOLE DIAMETER        |                                                                              | 110mm - SFA         |                      | LOCATION                      |                 |  |                                |
| LOCATION                               |       | Central Courtyard Precinct, Macquarie University |              |                      |                                                                              | ELEVATION DATUM     |                      | Australian Height Datum (AHD) |                 |  |                                |
|                                        |       |                                                  |              |                      |                                                                              | COORDINATE SYSTEM   |                      | National Grid                 |                 |  |                                |
| DRILLING                               |       | STRATA                                           |              | MATERIAL DESCRIPTION |                                                                              | CONDITION           |                      | OBSERVATION                   |                 |  |                                |
| SAMPLE, TEST,<br>BIT, SUPPORT,<br>ETC. | R.L.  | DEPTH                                            | GROUP SYMBOL | LEGEND               | SOIL TYPE<br>Plasticity / Grain Size, Colour, Minor Components               | WATER /<br>MOISTURE | CONSISTENCY          |                               |                 |  | Comments /<br>Penetration Rate |
|                                        | mOD   | m                                                |              |                      |                                                                              |                     | COHESIVE             |                               | NON<br>COHESIVE |  |                                |
|                                        |       |                                                  |              |                      |                                                                              |                     | VS<br>SL<br>ST<br>SH | VL<br>ML<br>DL<br>VD          |                 |  |                                |
|                                        | 55.66 | 5.30                                             |              |                      | Clayey SILT, (CL) low plasticity, pale red. (continued)                      |                     |                      |                               |                 |  |                                |
|                                        |       |                                                  | CI           |                      | Silty sandy CLAY, (CI) medium plasticity, pale red, sand is fine grained.    |                     |                      |                               |                 |  |                                |
|                                        | 55.39 | 5.57                                             |              |                      | Continued as cored borehole                                                  |                     |                      |                               |                 |  |                                |
|                                        |       | 6                                                |              |                      |                                                                              |                     |                      |                               |                 |  |                                |
|                                        |       | 7                                                |              |                      |                                                                              |                     |                      |                               |                 |  |                                |
|                                        |       | 8                                                |              |                      |                                                                              |                     |                      |                               |                 |  |                                |
|                                        |       | 9                                                |              |                      |                                                                              |                     |                      |                               |                 |  |                                |
|                                        |       | 10                                               |              |                      |                                                                              |                     |                      |                               |                 |  |                                |
| NOTES                                  |       |                                                  |              |                      | See explanatory notes for details of abbreviations and basis of descriptions |                     |                      | JOB<br>251278                 |                 |  |                                |

|         |                                                 |
|---------|-------------------------------------------------|
| PROJECT | Macquarie University Central Courtyard Precinct |
|---------|-------------------------------------------------|

|              |                |
|--------------|----------------|
| LOGGED BY    | DM             |
| CHECKED BY   | BCH, 28-Nov-16 |
| DRILLED DATE | 24-Oct-16      |

|                       |                                       |
|-----------------------|---------------------------------------|
| GROUND LEVEL LOCATION | RL 60.96mOD<br>325229.1 E 6261314.7 N |
| ELEVATION DATUM       | Australian Height Datum (AHD)         |
| COORDINATE SYSTEM     | National Grid                         |

NOTES

See explanatory notes for details of abbreviations and basis of descriptions

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BH17 Depth Range: 10.00 - 14.80 m

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## Appendix B

### Laboratory Certificates

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# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                  |
|-----------------|-------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH01 6.0-6.45m   |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty sandy CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34061-SCP       |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34061           |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 37.1 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 68.7 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 5.1  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 180  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Brad Morris

28/11/2016

Date:



Macquarie Geotechnical  
Unit 8/10  
Bradford Street  
Alexandria NSW 2015

# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                  |
|-----------------|-------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH03 1.5-1.95m   |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty sandy CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34062-SCP       |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34062           |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 22.7 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 66.5 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 5.5  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 205  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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Brad Morris

28/11/2016

Date:



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Alexandria NSW 2015

# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                  |
|-----------------|-------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH05 2.5-2.95m   |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty sandy CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34063-SCP       |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34063           |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 22.7 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 70.9 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 5.7  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 180  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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Authorised Signatory:

Brad Morris

28/11/2016

Date:



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Bradford Street  
Alexandria NSW 2015

# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                  |
|-----------------|-------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH08 3.0-3.45m   |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty sandy CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34064-SCP       |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34064           |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 24.7 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 68.7 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 4.6  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 160  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                       |
|-----------------|-------------------------------------------|----------------------------|-----------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH11 7.5-7.8m         |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty CLAY: with sand |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34065-SCP            |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34065                |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 45.3 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 84.2 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 5.3  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 100  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                  |
|-----------------|-------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH13 3.0-3.45m   |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty sandy CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34066-SCP       |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34066           |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 18.5 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 79.8 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 6.6  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 200  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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# SOIL CHEMICAL PROPERTIES REPORT

|                 |                                           |                            |                       |
|-----------------|-------------------------------------------|----------------------------|-----------------------|
| <b>Client:</b>  | Arup                                      | <b>Source:</b>             | BH17 3.0-3.45         |
| <b>Address:</b> | Level 10, 201 Kent Street Sydney NSW 2000 | <b>Sample Description:</b> | Silty CLAY: with sand |
| <b>Project:</b> | MUCCP GI (251278-06)                      | <b>Report No:</b>          | B34067-SCP            |
| <b>Job No:</b>  | S16481                                    | <b>Lab No:</b>             | B34067                |

|                        |                                     |                    |                                                                                                                                       |
|------------------------|-------------------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> | AS1289 4.2.1       | Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method |
|                        | <input checked="" type="checkbox"/> | AS1289 4.3.1       | Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method                                                  |
|                        | <input checked="" type="checkbox"/> | AS 1289 4.4.1      | Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material                  |
|                        | <input type="checkbox"/>            | AS 1012.20         | Chloride and sulphate                                                                                                                 |
|                        | <input type="checkbox"/>            | RMS T123           | pH value of a soil (electrometric method)                                                                                             |
|                        | <input type="checkbox"/>            | RMS T185           | Resistivity of sands and granular road construction materials                                                                         |
|                        | <input type="checkbox"/>            | RMS T200           | Chloride content of roadbase                                                                                                          |
|                        | <input checked="" type="checkbox"/> | RMS T1010          | Quantitative determination of chlorides in soil                                                                                       |
|                        | <input type="checkbox"/>            | RMS T1011          | Quantitative determination of sulphates in soil                                                                                       |
|                        | <input type="checkbox"/>            | BS1377(1990 pt.3)  | Water soluble sulphate content                                                                                                        |
|                        | <input type="checkbox"/>            | APHA 4500 H+B      | pH                                                                                                                                    |
|                        | <input type="checkbox"/>            | APHA 4500 SO4 2-B  | Sulphate                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 4500 Cl-B     | Chloride                                                                                                                              |
|                        | <input type="checkbox"/>            | APHA 2510 & 2520-B | Electrical Conductivity                                                                                                               |
|                        | <input type="checkbox"/>            | TAI B117           | Sulphides Present (This service Not Covered by NATA Accreditation)                                                                    |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

|                                       |      |
|---------------------------------------|------|
| Sulphides Present                     | -    |
| Sulphur Peroxide (%)                  | -    |
| Sulphate content (ppm)                | 16.5 |
| Sulphate content (%)                  | 0.00 |
| Chloride ion content (ppm)            | 75.3 |
| Chloride ion content (%)              | 0.01 |
| pH                                    | 5.4  |
| Electrical Conductivity (uS/cm)       | -    |
| Mean Resistivity $\Omega$ .m          | 205  |
| (Resistivity) Density ratio ( $R_D$ ) | 90   |
| (Resistivity) Density index ( $I_D$ ) | -    |



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# EMERSON CLASS REPORT

|                 |                                                  |                            |                                        |
|-----------------|--------------------------------------------------|----------------------------|----------------------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH01: 4.5-4.95m                        |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty CLAY: with sand, trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19554-ECT                             |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19554                                 |

**Test Procedure:** ☒ AS1289 3.8.1 Soil classification tests - Dispersion - Determination of Emerson class number of a soil

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method

**"IMMERSION"**

|                                            |
|--------------------------------------------|
| <input type="checkbox"/> does not slake    |
| <input checked="" type="checkbox"/> slakes |

7

|                                         |
|-----------------------------------------|
| <input type="checkbox"/> swells         |
| <input type="checkbox"/> does not swell |

8

|                                         |
|-----------------------------------------|
| <input type="checkbox"/> swells         |
| <input type="checkbox"/> does not swell |

1

|                                                   |
|---------------------------------------------------|
| <input type="checkbox"/> complete dispersion      |
| <input type="checkbox"/> partial dispersion       |
| <input checked="" type="checkbox"/> no dispersion |

2.1

|                                   |
|-----------------------------------|
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

2.2

|                                   |
|-----------------------------------|
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

**"REMOULD ETC."**

|                                                       |
|-------------------------------------------------------|
| 3 <input type="checkbox"/> disperses                  |
| <input checked="" type="checkbox"/> does not disperse |

3.1

|                                   |
|-----------------------------------|
| <input type="checkbox"/> complete |
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

3.2

|                                   |
|-----------------------------------|
| <input type="checkbox"/> complete |
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

3.3

|                                   |
|-----------------------------------|
| <input type="checkbox"/> complete |
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

**"CARBONATE & GYPSUM"**

|                                            |
|--------------------------------------------|
| 4 <input type="checkbox"/> present         |
| <input checked="" type="checkbox"/> absent |

**"VIGOROUS SHAKING"**

|                                               |
|-----------------------------------------------|
| <input checked="" type="checkbox"/> disperses |
| <input type="checkbox"/> does not disperse    |

5

|                                               |
|-----------------------------------------------|
| <input checked="" type="checkbox"/> disperses |
| <input type="checkbox"/> does not disperse    |

6

|                                            |
|--------------------------------------------|
| <input type="checkbox"/> does not disperse |
|--------------------------------------------|

**Water Type**

|           |
|-----------|
| Distilled |
|-----------|

**Water Source**

|     |
|-----|
| Lab |
|-----|

**Water Temperature (°C)**

|    |
|----|
| 22 |
|----|

**RESULT:**

Emerson Class No. 5



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Date:



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# MOISTURE CONTENT TEST REPORT

|                 |                                                  |                   |           |
|-----------------|--------------------------------------------------|-------------------|-----------|
| <b>Client:</b>  | Arup                                             | <b>Job No:</b>    | S16481    |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Report No:</b> | S19554-MC |
| <b>Project:</b> | MUCCP GI (251278-06)                             |                   |           |

| Test Procedure:                     |                                                                                                                                    |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method) |
| <input type="checkbox"/>            | AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)    |
| <input type="checkbox"/>            | RMS T120 Moisture content of road construction materials (Standard method)                                                         |
| <input type="checkbox"/>            | RMS T262 Determination of moisture content of aggregates (Standard method)                                                         |

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

[illegible]

Notes:



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*Uzi*

12/12/2016

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Date:



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# SOIL CLASSIFICATION REPORT

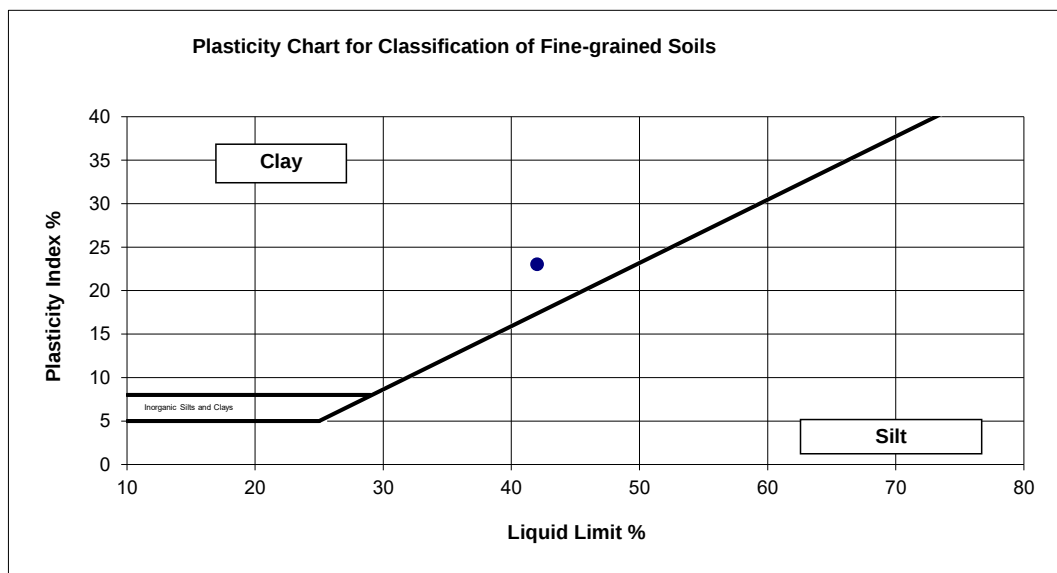
|                 |                                                  |                            |                                        |
|-----------------|--------------------------------------------------|----------------------------|----------------------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH01: 4.5-4.95m                        |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty CLAY: with sand, trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19554-PI                              |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19554                                 |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 42      **Linear Shrinkage (%):** -  
**Plastic Limit (%):** 19      **Field Moisture Content (%):** -  
**Plastic Index:** 23



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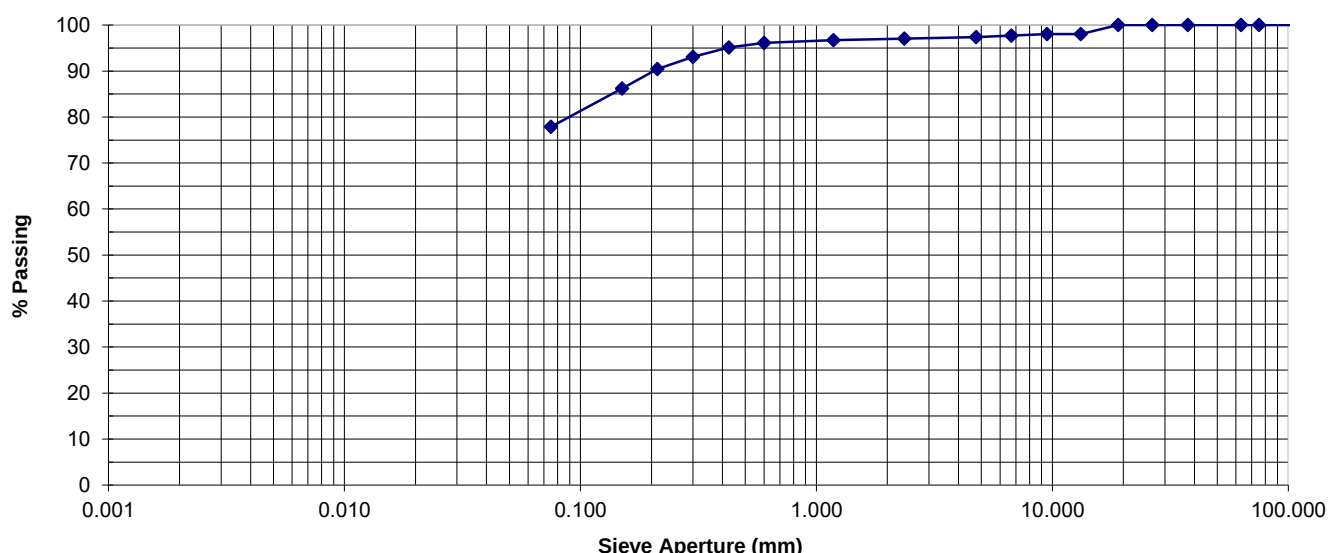
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                                        |
|-----------------|--------------------------------------------------|----------------------------|----------------------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH01: 4.5-4.95m                        |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty CLAY: with sand, trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19554-PSD                             |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19554                                 |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



|      |      |      |        |         |
|------|------|------|--------|---------|
| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 97        |                             |
| 75                   | 100       |                             | 2.36                 | 97        |                             |
| 63                   | 100       |                             | 1.18                 | 97        |                             |
| 37.5                 | 100       |                             | 0.600                | 96        |                             |
| 26.5                 | 100       |                             | 0.425                | 95        |                             |
| 19                   | 100       |                             | 0.300                | 93        |                             |
| 13.2                 | 98        |                             | 0.212                | 90        |                             |
| 9.5                  | 98        |                             | 0.150                | 86        |                             |
| 6.7                  | 98        |                             | 0.075                | 78        |                             |



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Date:



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# EMERSON CLASS REPORT

|                 |                                                  |                            |               |
|-----------------|--------------------------------------------------|----------------------------|---------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH01: 6-6.45m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty CLAY    |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19555-ECT    |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19555        |

**Test Procedure:** ☒ AS1289 3.8.1 Soil classification tests - Dispersion - Determination of Emerson class number of a soil

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method

**"IMMERSION"**

|                                            |
|--------------------------------------------|
| <input type="checkbox"/> does not slake    |
| <input checked="" type="checkbox"/> slakes |

7

|                                         |
|-----------------------------------------|
| <input type="checkbox"/> swells         |
| <input type="checkbox"/> does not swell |

8

|                                         |
|-----------------------------------------|
| <input type="checkbox"/> swells         |
| <input type="checkbox"/> does not swell |

1

|                                                   |
|---------------------------------------------------|
| <input type="checkbox"/> complete dispersion      |
| <input type="checkbox"/> partial dispersion       |
| <input checked="" type="checkbox"/> no dispersion |

2.1

|                                   |
|-----------------------------------|
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

2.2

|                                   |
|-----------------------------------|
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

**"REMOULD ETC."**

|                                                       |
|-------------------------------------------------------|
| 3 <input type="checkbox"/> disperses                  |
| <input checked="" type="checkbox"/> does not disperse |

3.1

|                                   |
|-----------------------------------|
| <input type="checkbox"/> complete |
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

3.2

|                                   |
|-----------------------------------|
| <input type="checkbox"/> complete |
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

3.3

|                                   |
|-----------------------------------|
| <input type="checkbox"/> complete |
| <input type="checkbox"/> moderate |
| <input type="checkbox"/> slight   |

**"CARBONATE & GYPSUM"**

|                                            |
|--------------------------------------------|
| 4 <input type="checkbox"/> present         |
| <input checked="" type="checkbox"/> absent |

**"VIGOROUS SHAKING"**

|                                               |
|-----------------------------------------------|
| <input checked="" type="checkbox"/> disperses |
| <input type="checkbox"/> does not disperse    |

5

|                                               |
|-----------------------------------------------|
| <input checked="" type="checkbox"/> disperses |
| <input type="checkbox"/> does not disperse    |

6

|                                            |
|--------------------------------------------|
| <input type="checkbox"/> does not disperse |
|--------------------------------------------|

**Water Type**

|           |
|-----------|
| Distilled |
|-----------|

**Water Source**

|     |
|-----|
| Lab |
|-----|

**Water Temperature (°C)**

|    |
|----|
| 22 |
|----|

**RESULT:**

Emerson Class No. 5



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# SOIL CLASSIFICATION REPORT

|                 |                                                  |                            |                                           |
|-----------------|--------------------------------------------------|----------------------------|-------------------------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH02: 1 - 1.45m                           |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | CLAY: with silt and sand, trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19556-PI                                 |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19556                                    |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

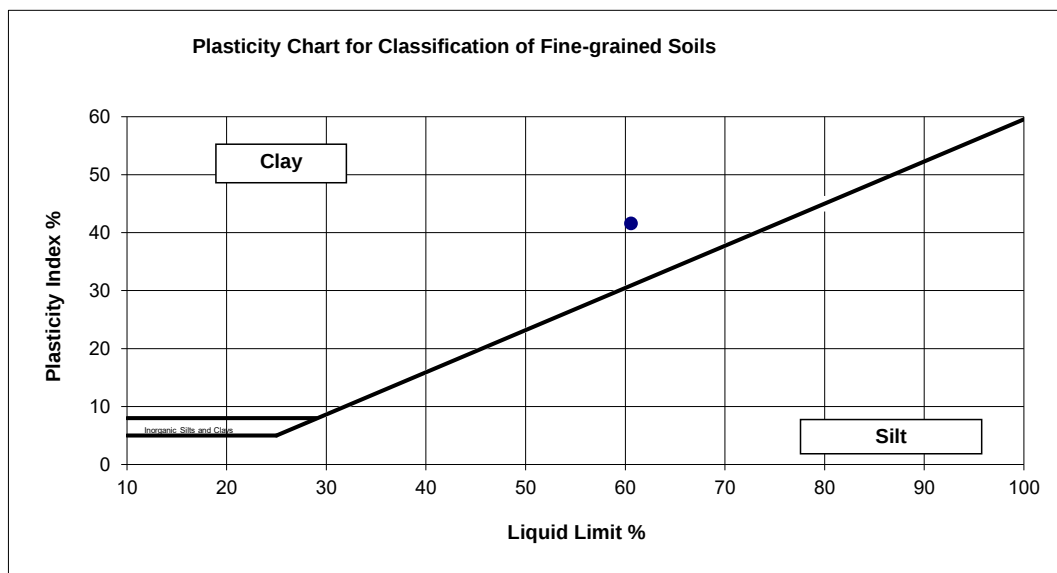
|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 
**Linear Shrinkage (%):**

**Plastic Limit (%):** 
**Field Moisture Content (%):**

**Plastic Index:**



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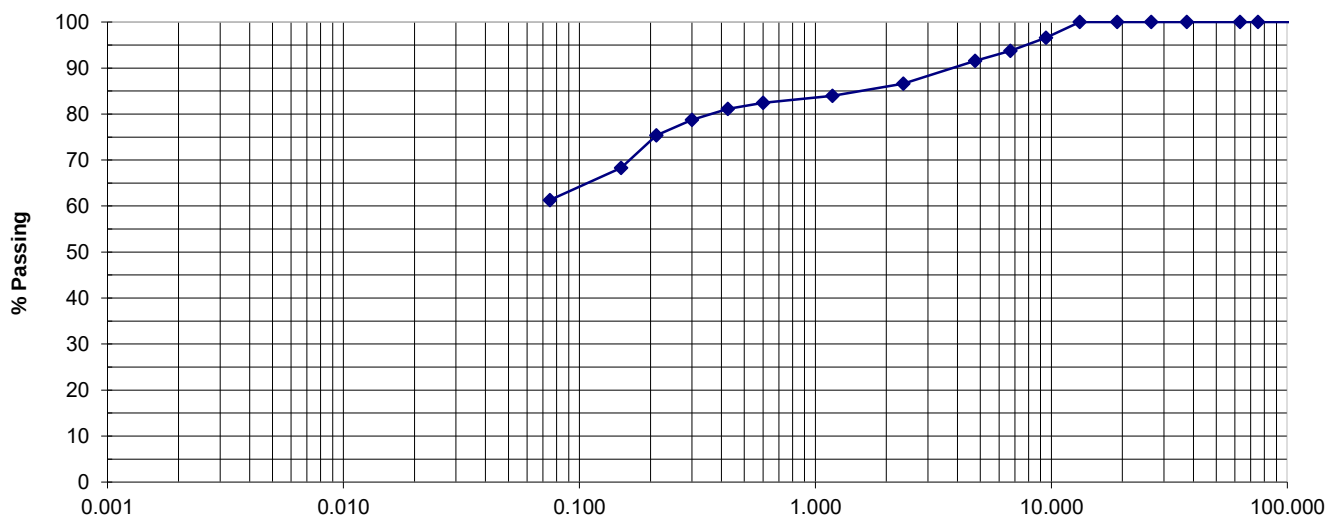
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                                           |
|-----------------|--------------------------------------------------|----------------------------|-------------------------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH02: 1 - 1.45m                           |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | CLAY: with silt and sand, trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19556-PSD                                |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19556                                    |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 92        |                             |
| 75                   | 100       |                             | 2.36                 | 87        |                             |
| 63                   | 100       |                             | 1.18                 | 84        |                             |
| 37.5                 | 100       |                             | 0.600                | 82        |                             |
| 26.5                 | 100       |                             | 0.425                | 81        |                             |
| 19                   | 100       |                             | 0.300                | 79        |                             |
| 13.2                 | 100       |                             | 0.212                | 75        |                             |
| 9.5                  | 97        |                             | 0.150                | 68        |                             |
| 6.7                  | 94        |                             | 0.075                | 61        |                             |



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# SHRINK SWELL INDEX REPORT

|                 |                                                  |                            |                  |
|-----------------|--------------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH02: 1.5-1.9m   |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy silty CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19557-SS        |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19557           |

|                 |                                                                                                                                             |               |         |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|
| Test Procedure: | <input checked="" type="checkbox"/> AS1289 7.1.1 Soil reactivity tests- Determination of the shrinkage index of a soil - Shrink-swell index |               |         |
| Sampling:       | Sampled by Client                                                                                                                           | Date Sampled: | Unknown |
| Preparation:    | Prepared in accordance with the test method                                                                                                 |               |         |

## Swell Test:

|                                   |      |
|-----------------------------------|------|
| Swell on Saturation( $E_{SW}$ ):  | 0    |
| Moisture Content Before Test (%): | 18.7 |
| Moisture Content After Test (%):  | 22.2 |

## Shrink Test:

|                                       |      |
|---------------------------------------|------|
| Shrinkage on Drying ( $E_{SH}$ %):    | 1.6  |
| Estimated Inert Material Present (%): | 5-10 |
| Extent of Crumbling During Shrinkage: | None |
| Extent of Cracking During Shrinkage:  | Mild |
| Moisture Content (%)                  | 21.2 |

## Shrink Swell Preparation:

Undisturbed

## Shrink Swell Index:

Iss: 0.9

Notes:



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# SOIL CLASSIFICATION REPORT

|                 |                                                  |                            |                             |
|-----------------|--------------------------------------------------|----------------------------|-----------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH05: 2.5-2.95m             |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty SAND: trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19559-PI                   |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19559                      |

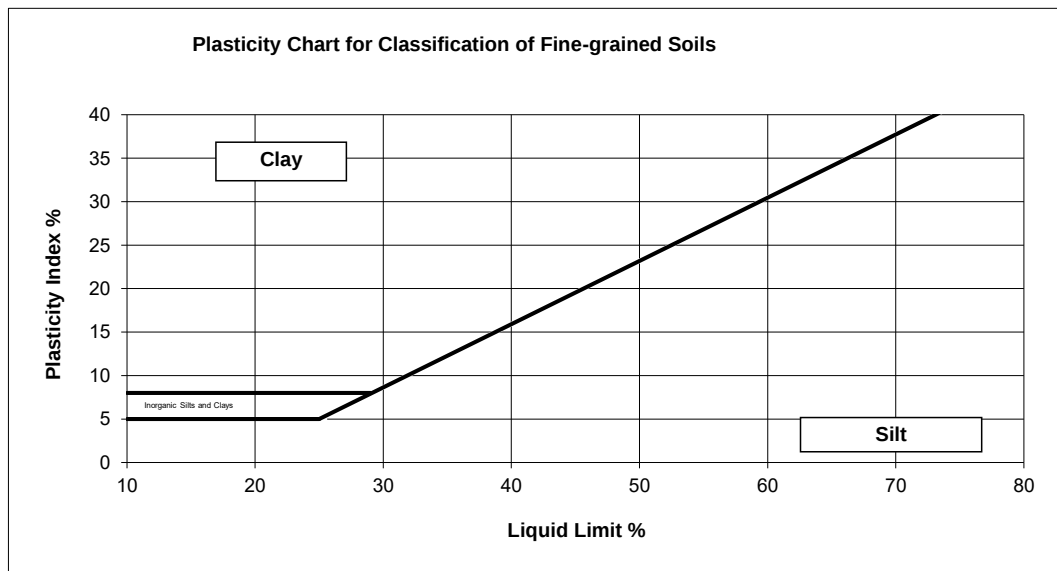
|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |

**Liquid Limit (%):** 
**Linear Shrinkage (%):**

**Plastic Limit (%):** 
**Field Moisture Content (%):**

**Plastic Index:**



Soil Preparation Method: Dry Sieved  
 Soil History: Air Dried  
 Soil Condition: Linear



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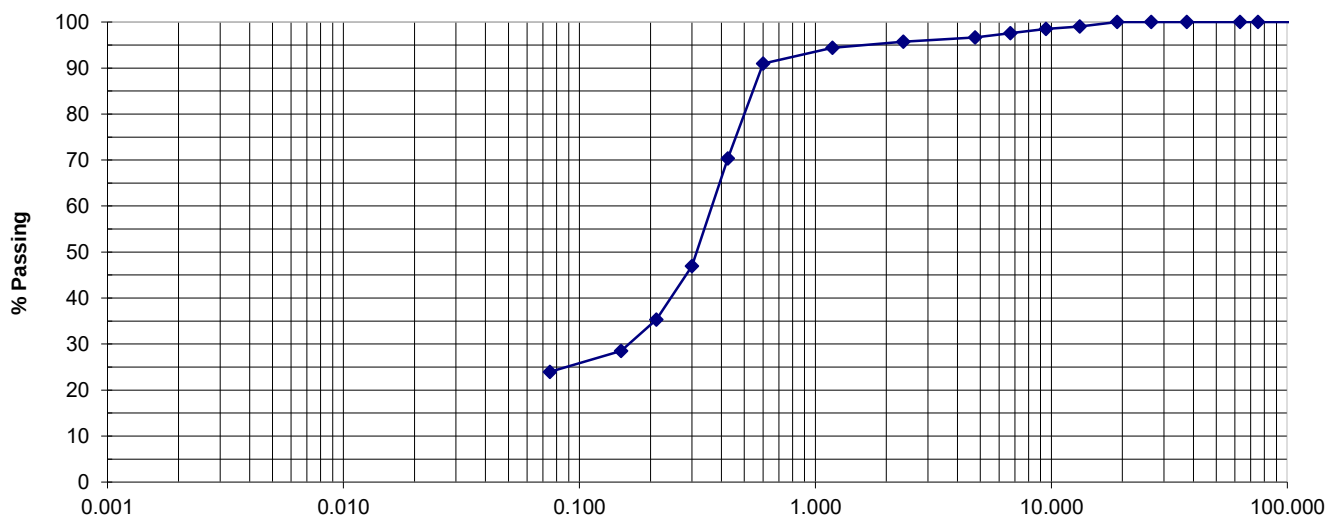
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                             |
|-----------------|--------------------------------------------------|----------------------------|-----------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH05: 2.5-2.95m             |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty SAND: trace of gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19559-PSD                  |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19559                      |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



|      |      |      |        |         |
|------|------|------|--------|---------|
| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 97        |                             |
| 75                   | 100       |                             | 2.36                 | 96        |                             |
| 63                   | 100       |                             | 1.18                 | 94        |                             |
| 37.5                 | 100       |                             | 0.600                | 91        |                             |
| 26.5                 | 100       |                             | 0.425                | 70        |                             |
| 19                   | 100       |                             | 0.300                | 47        |                             |
| 13.2                 | 99        |                             | 0.212                | 35        |                             |
| 9.5                  | 98        |                             | 0.150                | 28        |                             |
| 6.7                  | 98        |                             | 0.075                | 24        |                             |



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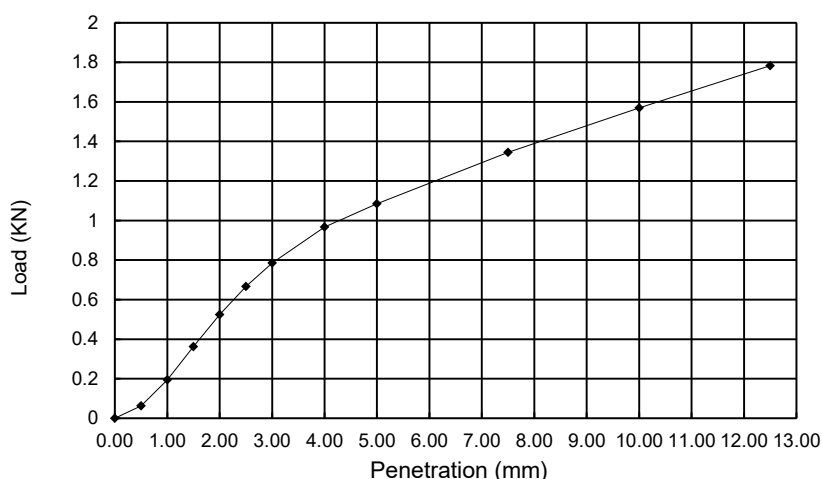
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# CALIFORNIA BEARING RATIO REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH06: 0.18-0.5m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy clayey GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19560-CBR          |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19560              |

|                        |                                                                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen |
|                        | <input checked="" type="checkbox"/> AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort         |
|                        | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method)                                  |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |



## Compaction and Placement Data

|                                      |          |                                  |                       |               |                    |
|--------------------------------------|----------|----------------------------------|-----------------------|---------------|--------------------|
| Compaction Used                      | Standard | Dry Density                      |                       |               |                    |
| Maximum Dry Density t/m <sup>3</sup> | 1.77     | At Compaction                    | 1.78 t/m <sup>3</sup> | 100.0 % Comp. |                    |
| Optimum Moisture Content %           | 15.9     | After Soaking                    | 1.77 t/m <sup>3</sup> | 100.0 % Comp. |                    |
| No. of Layers                        | 3        | Moisture Content                 |                       |               | Moisture Ratio (%) |
| Blows per Layer                      | 53       | At Compaction                    | %                     | 15.6          | 98                 |
| Drop of Rammer mm                    | 300      | After Soaking                    | %                     | 19.4          | 122                |
| Mass of Rammer kg                    | 2.7      | After Penetration (Top 30mm)     | %                     | 24.9          | 157                |
| Surcharge Used kg                    | 4.5      | After Penetration (Entire Depth) | %                     | 17.7          | 111                |
| % Ret. 19mm Sieve                    | 15       | Swell After 4 Days Soaking       | %                     | 0.7           |                    |

Note: material coarser than +19mm Sieve was discarded (as per test method)

## California Bearing Ratio

**CBR (4-day Soaked) = 6.0 % at 2.5 mm Penetration**

Notes:



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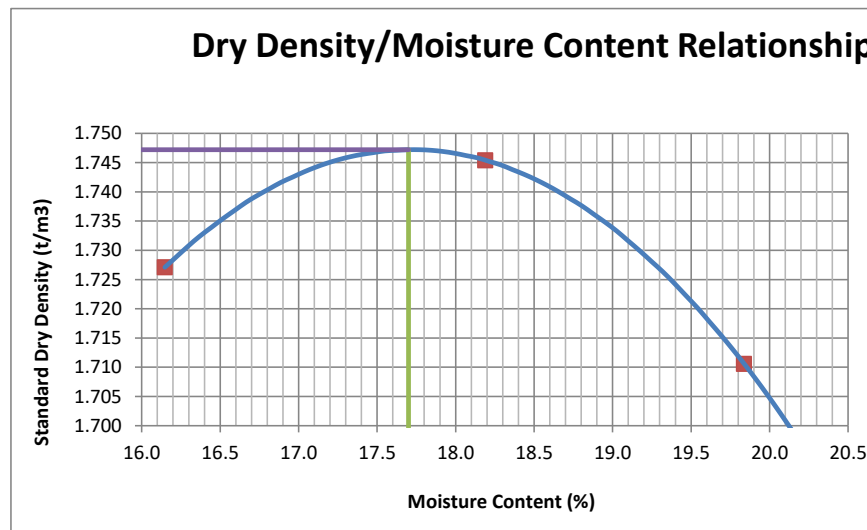
# DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH06: 0.18-0.5m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy clayey GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19560-MDD          |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19560              |

|                        |                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort |
|                        | <input checked="" type="checkbox"/> AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)                |

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|



|                                                |       |
|------------------------------------------------|-------|
| <b>Maximum Dry Density (t/m<sup>3</sup>)</b>   | 1.747 |
| <b>Optimum Moisture Content (%)</b>            | 17.7  |
| <b>Percentage Oversize on 19mm sieve (%)</b>   | 15    |
| <b>Percentage Oversize on 37.5mm sieve (%)</b> | 6     |



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# SOIL CLASSIFICATION REPORT

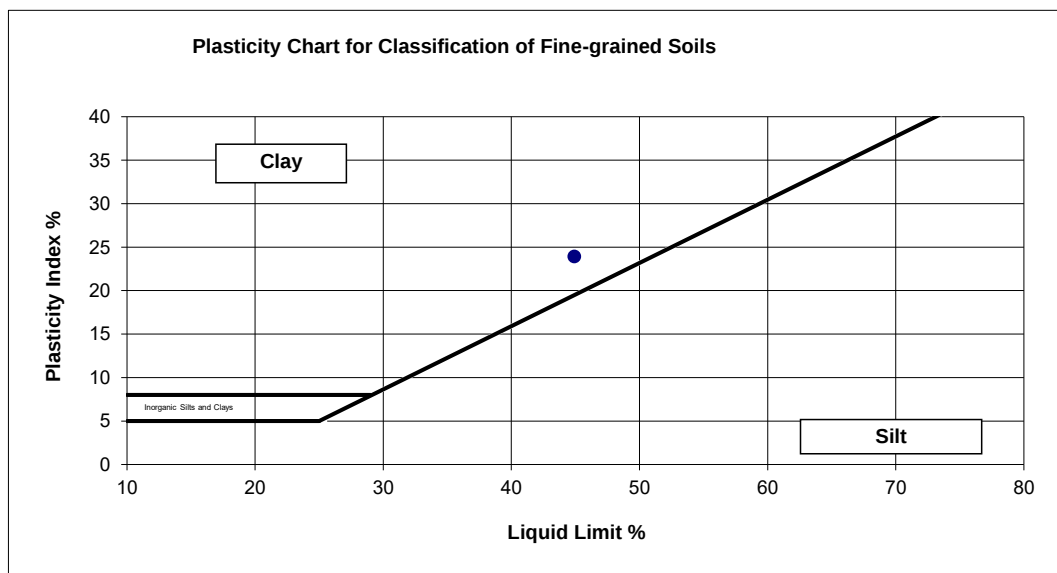
|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH06: 0.18-0.5m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy clayey GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19560-PI           |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19560              |

|                        |                                                                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)                                                                          |
|                        | <input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method                               |
|                        | <input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method) |
|                        | <input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method                                |
|                        | <input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil                                                 |
|                        | <input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method                             |

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 45      **Linear Shrinkage (%):** 11.0  
**Plastic Limit (%):** 21      **Field Moisture Content (%):** -  
**Plastic Index:** 24



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Authorised Signatory:

Chris Lloyd

7/12/2016

Date:



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Bradford Street  
Alexandria NSW 2015

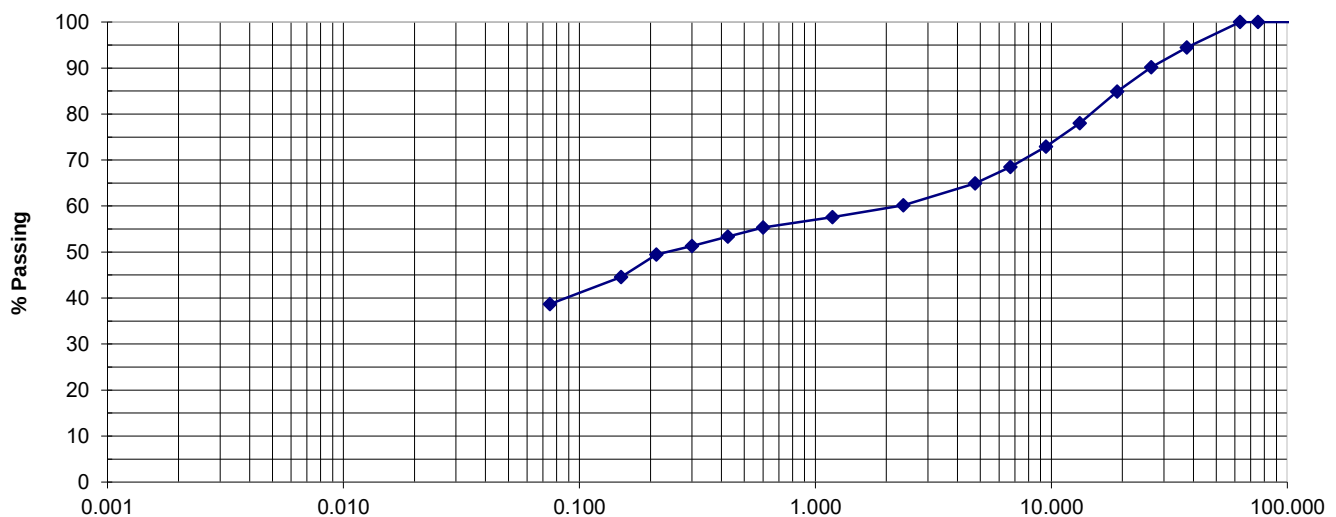
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH06: 0.18-0.5m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy clayey GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19560-PSD          |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19560              |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



|      |      |      |        |         |
|------|------|------|--------|---------|
| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 65        |                             |
| 75                   | 100       |                             | 2.36                 | 60        |                             |
| 63                   | 100       |                             | 1.18                 | 58        |                             |
| 37.5                 | 94        |                             | 0.600                | 55        |                             |
| 26.5                 | 90        |                             | 0.425                | 53        |                             |
| 19                   | 85        |                             | 0.300                | 51        |                             |
| 13.2                 | 78        |                             | 0.212                | 49        |                             |
| 9.5                  | 73        |                             | 0.150                | 45        |                             |
| 6.7                  | 68        |                             | 0.075                | 39        |                             |



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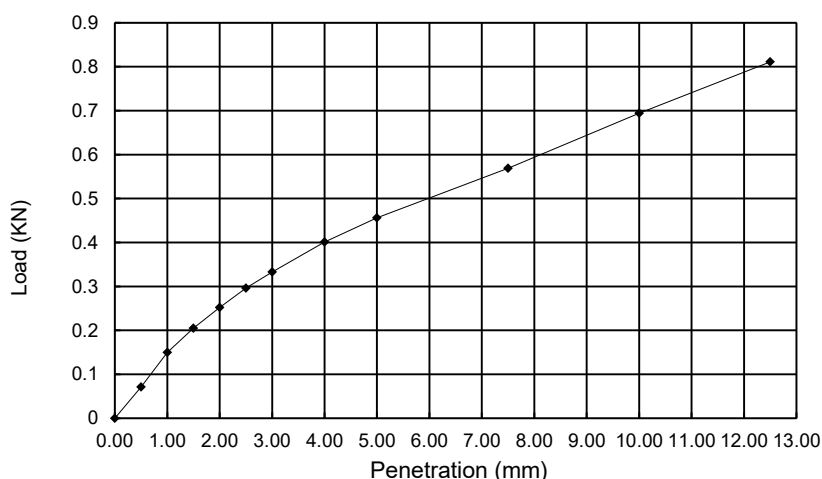
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# CALIFORNIA BEARING RATIO REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH07: 0.2-0.74m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | clayey sandy GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19561-CBR          |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19561              |

|                        |                                                                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen |
|                        | <input checked="" type="checkbox"/> AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort         |
|                        | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method)                                  |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |



## Compaction and Placement Data

|                                      |          |                                  |                       |               |                    |
|--------------------------------------|----------|----------------------------------|-----------------------|---------------|--------------------|
| Compaction Used                      | Standard | Dry Density                      |                       |               |                    |
| Maximum Dry Density t/m <sup>3</sup> | 1.77     | At Compaction                    | 1.79 t/m <sup>3</sup> | 101.0 % Comp. |                    |
| Optimum Moisture Content %           | 15.9     | After Soaking                    | 1.79 t/m <sup>3</sup> | 101.0 % Comp. |                    |
| No. of Layers                        | 3        | Moisture Content                 |                       |               | Moisture Ratio (%) |
| Blows per Layer                      | 53       | At Compaction                    | %                     | 15.9          | 100                |
| Drop of Rammer mm                    | 300      | After Soaking                    | %                     | 17.8          | 112                |
| Mass of Rammer kg                    | 2.7      | After Penetration (Top 30mm)     | %                     | 15.0          | 94                 |
| Surcharge Used kg                    | 4.5      | After Penetration (Entire Depth) | %                     | 15.2          | 96                 |
| % Ret. 19mm Sieve                    | 13       | Swell After 4 Days Soaking       | %                     | 0.0           |                    |

Note: material coarser than +19mm Sieve was discarded (as per test method)

## California Bearing Ratio

**CBR (4-day Soaked) = 2.5 % at 2.5 mm Penetration**

Notes:



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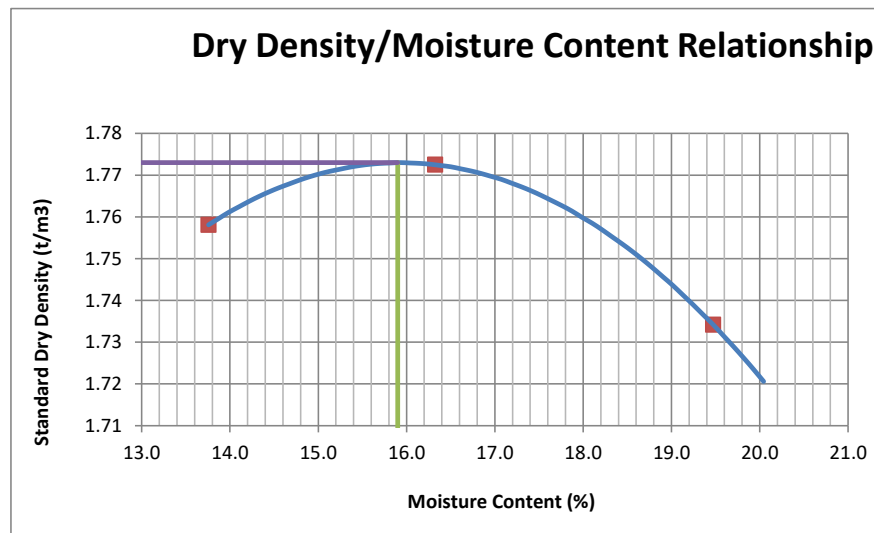
# DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH07: 0.2-0.74m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | clayey sandy GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19561-MDD          |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19561              |

|                        |                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort |
|                        | <input checked="" type="checkbox"/> AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)                |

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|



|                                                |       |
|------------------------------------------------|-------|
| <b>Maximum Dry Density (t/m³)</b>              | 1.773 |
| <b>Optimum Moisture Content (%)</b>            | 15.9  |
| <b>Percentage Oversize on 19mm sieve (%)</b>   | 13    |
| <b>Percentage Oversize on 37.5mm sieve (%)</b> | 2     |



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# SOIL CLASSIFICATION REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH07: 0.2-0.74m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | clayey sandy GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19561-PI           |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19561              |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

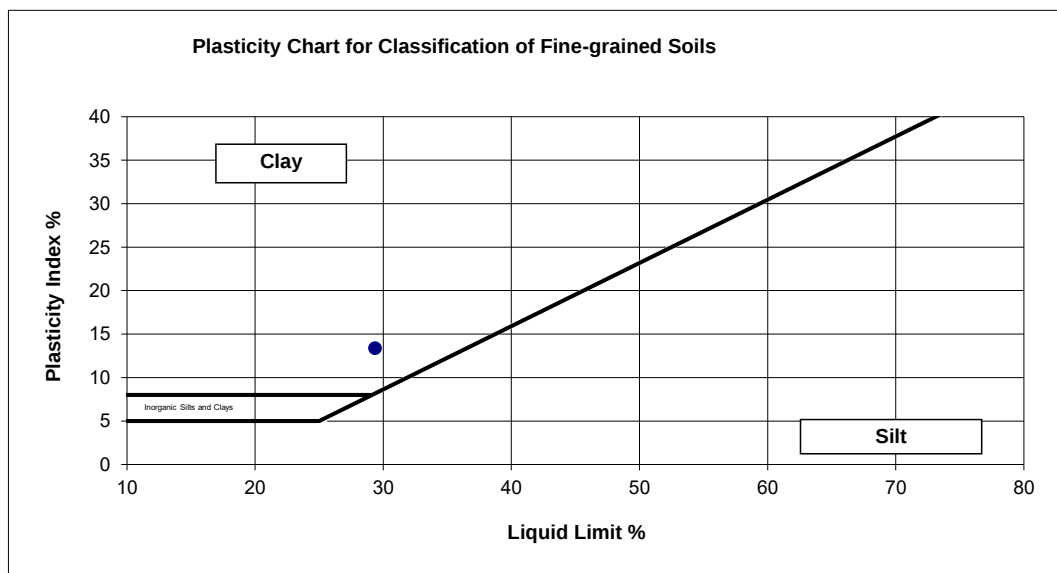
|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 
**Linear Shrinkage (%):**

**Plastic Limit (%):** 
**Field Moisture Content (%):**

**Plastic Index:**



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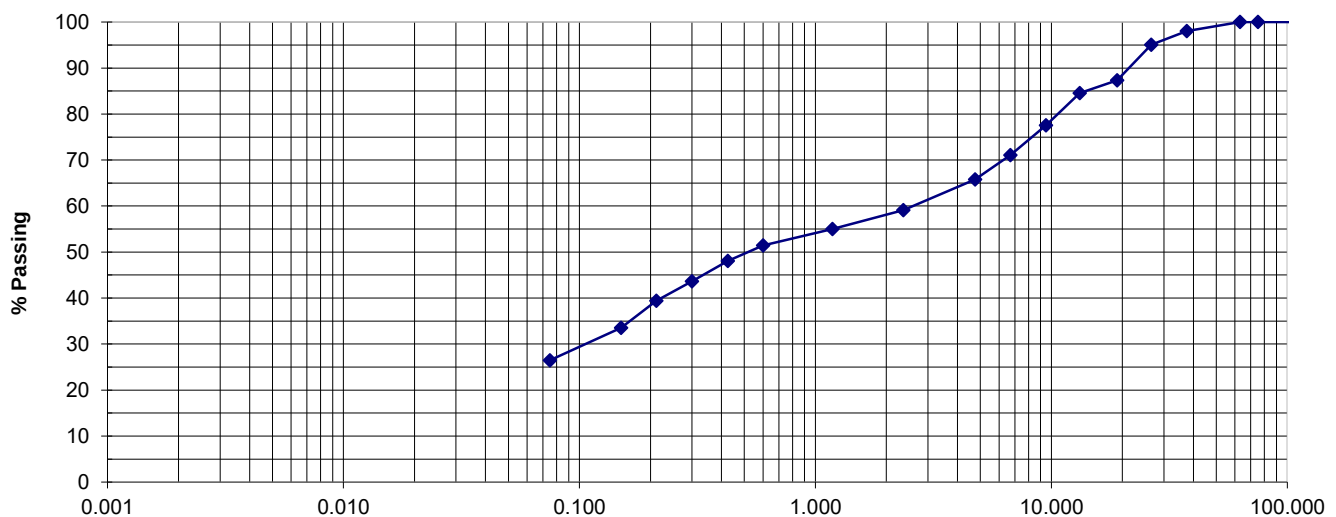
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH07: 0.2-0.74m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | clayey sandy GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19561-PSD          |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19561              |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 66        |                             |
| 75                   | 100       |                             | 2.36                 | 59        |                             |
| 63                   | 100       |                             | 1.18                 | 55        |                             |
| 37.5                 | 98        |                             | 0.600                | 51        |                             |
| 26.5                 | 95        |                             | 0.425                | 48        |                             |
| 19                   | 87        |                             | 0.300                | 44        |                             |
| 13.2                 | 85        |                             | 0.212                | 39        |                             |
| 9.5                  | 78        |                             | 0.150                | 34        |                             |
| 6.7                  | 71        |                             | 0.075                | 26        |                             |



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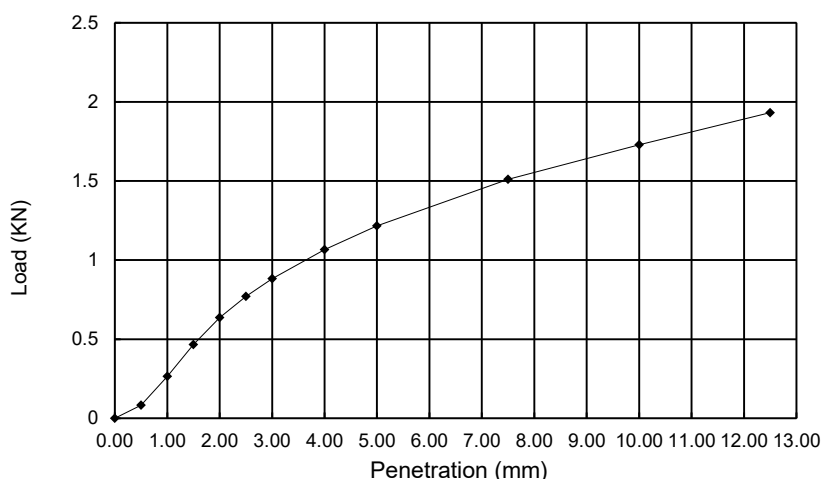
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# CALIFORNIA BEARING RATIO REPORT

|                 |                                                  |                            |                         |
|-----------------|--------------------------------------------------|----------------------------|-------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH08: 0.2-0.5m          |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy CLAY: with gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19562-CBR              |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19562                  |

|                        |                                                                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen |
|                        | <input checked="" type="checkbox"/> AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort         |
|                        | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method)                                  |

|                     |                                             |                      |         |
|---------------------|---------------------------------------------|----------------------|---------|
| <b>Sampling:</b>    | Sampled by Client                           | <b>Date Sampled:</b> | Unknown |
| <b>Preparation:</b> | Prepared in accordance with the test method |                      |         |



## Compaction and Placement Data

|                                      |          |                                  |                       |               |                    |
|--------------------------------------|----------|----------------------------------|-----------------------|---------------|--------------------|
| Compaction Used                      | Standard | Dry Density                      |                       |               |                    |
| Maximum Dry Density t/m <sup>3</sup> | 1.85     | At Compaction                    | 1.86 t/m <sup>3</sup> | 100.0 % Comp. |                    |
| Optimum Moisture Content %           | 16.3     | After Soaking                    | 1.85 t/m <sup>3</sup> | 100.0 % Comp. |                    |
| No. of Layers                        | 3        | Moisture Content                 |                       |               | Moisture Ratio (%) |
| Blows per Layer                      | 53       | At Compaction                    | %                     | 16.4          | 101                |
| Drop of Rammer mm                    | 300      | After Soaking                    | %                     | 17.1          | 105                |
| Mass of Rammer kg                    | 2.7      | After Penetration (Top 30mm)     | %                     | 22.6          | 139                |
| Surcharge Used kg                    | 4.5      | After Penetration (Entire Depth) | %                     | 16.6          | 102                |
| % Ret. 19mm Sieve                    | 4        | Swell After 4 Days Soaking       | %                     | 0.7           |                    |

Note: material coarser than +19mm Sieve was discarded (as per test method)

## California Bearing Ratio

**CBR (4-day Soaked) = 6.0 % at 2.5 mm Penetration**

Notes:



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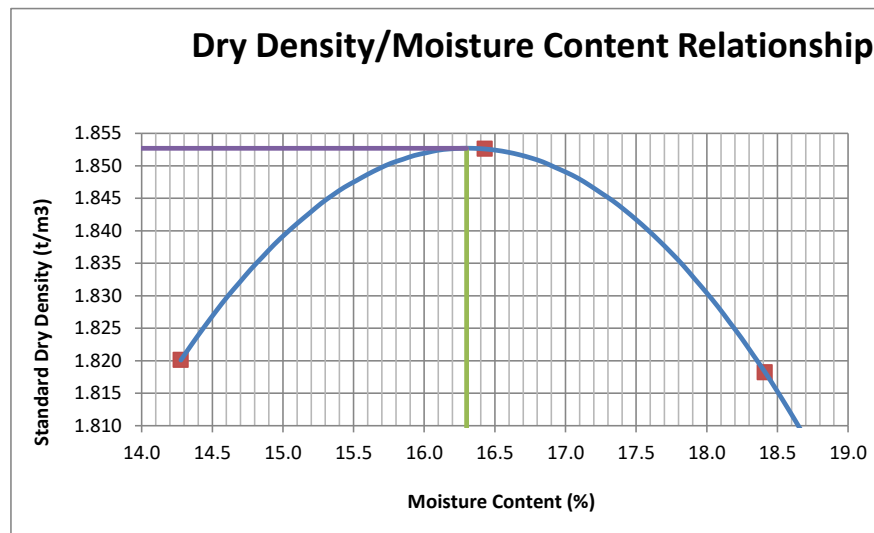
# DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

|                 |                                                  |                            |                         |
|-----------------|--------------------------------------------------|----------------------------|-------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH08: 0.2-0.5m          |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy CLAY: with gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19562-MDD              |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19562                  |

|                        |                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort |
|                        | <input checked="" type="checkbox"/> AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)                |

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|



|                                                |       |
|------------------------------------------------|-------|
| <b>Maximum Dry Density (t/m<sup>3</sup>)</b>   | 1.853 |
| <b>Optimum Moisture Content (%)</b>            | 16.3  |
| <b>Percentage Oversize on 19mm sieve (%)</b>   | 4     |
| <b>Percentage Oversize on 37.5mm sieve (%)</b> | 0     |



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# SOIL CLASSIFICATION REPORT

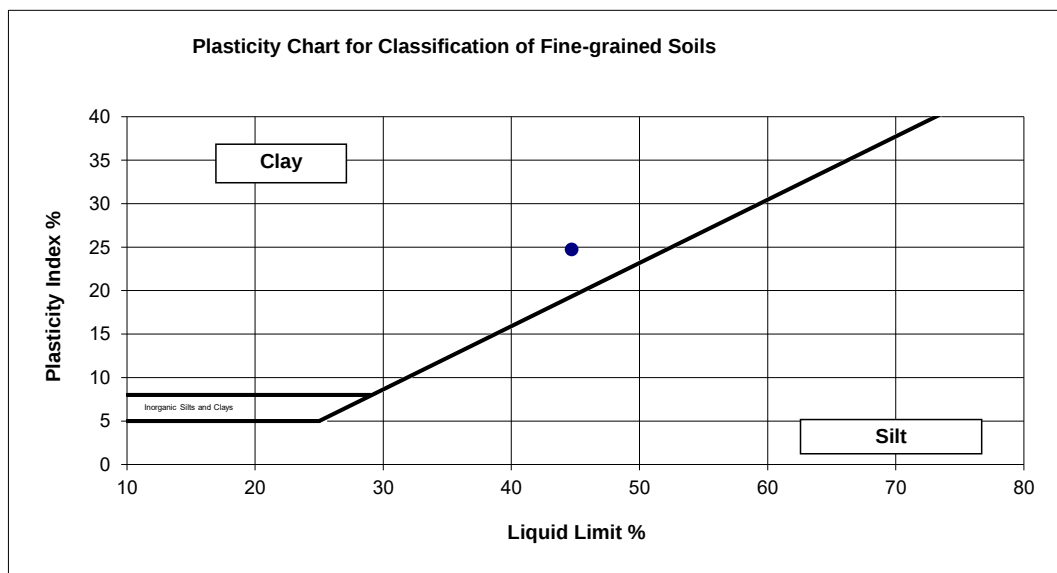
|                 |                                                  |                            |                         |
|-----------------|--------------------------------------------------|----------------------------|-------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH08: 0.2-0.5m          |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy CLAY: with gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19562-PI               |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19562                  |

|                        |                                                                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)                                                                          |
|                        | <input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method                               |
|                        | <input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method) |
|                        | <input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method                                |
|                        | <input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil                                                 |
|                        | <input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method                             |

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

**Preparation:** Prepared in accordance with the test method

**Liquid Limit (%):** 45      **Linear Shrinkage (%):** 11.0  
**Plastic Limit (%):** 20      **Field Moisture Content (%):** -  
**Plastic Index:** 25



Soil Preparation Method: Dry Sieved  
 Soil History: Air Dried  
 Soil Condition: Linear



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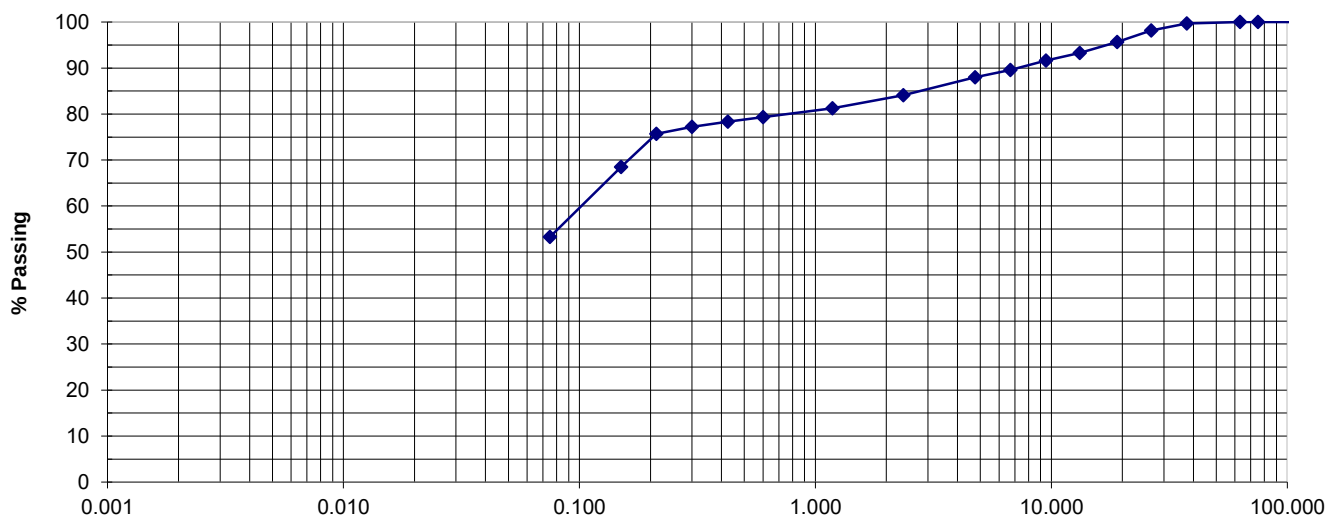
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                         |
|-----------------|--------------------------------------------------|----------------------------|-------------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH08: 0.2-0.5m          |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy CLAY: with gravel |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19562-PSD              |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19562                  |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 88        |                             |
| 75                   | 100       |                             | 2.36                 | 84        |                             |
| 63                   | 100       |                             | 1.18                 | 81        |                             |
| 37.5                 | 100       |                             | 0.600                | 79        |                             |
| 26.5                 | 98        |                             | 0.425                | 78        |                             |
| 19                   | 96        |                             | 0.300                | 77        |                             |
| 13.2                 | 93        |                             | 0.212                | 76        |                             |
| 9.5                  | 92        |                             | 0.150                | 68        |                             |
| 6.7                  | 90        |                             | 0.075                | 53        |                             |



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# SOIL CLASSIFICATION REPORT

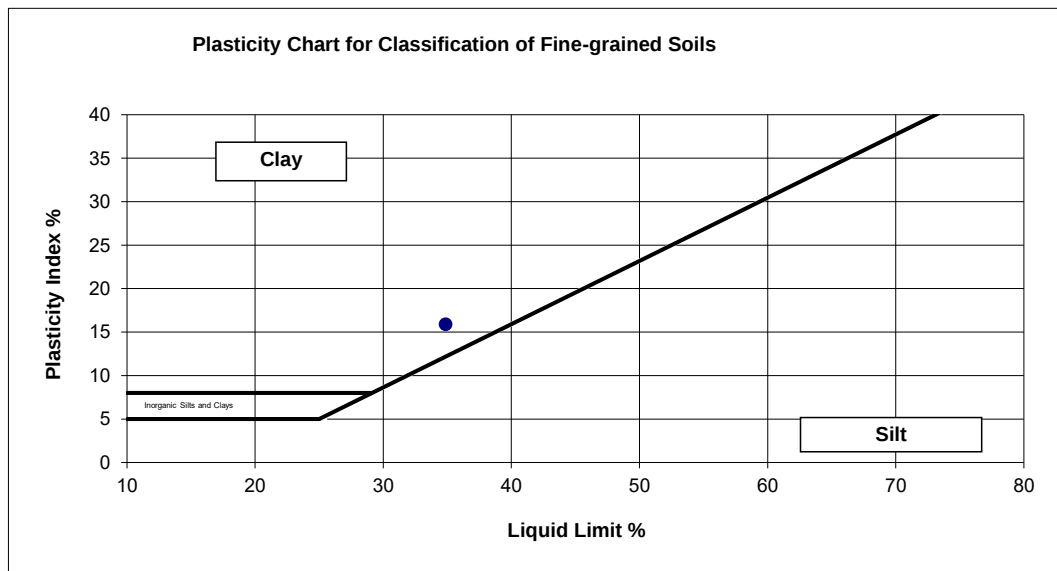
|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH10: 1.5-1.95m     |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy clayey GRAVEL |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19563-PI           |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19563              |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 35      **Linear Shrinkage (%):** 9.0  
**Plastic Limit (%):** 19      **Field Moisture Content (%):** -  
**Plastic Index:** 16



Soil Preparation Method: Dry Sieved  
 Soil History: Air Dried  
 Soil Condition: Linear



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7/12/2016

Date:



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# SOIL CLASSIFICATION REPORT

|                 |                                                  |                            |                      |
|-----------------|--------------------------------------------------|----------------------------|----------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH11: 4.5-4.95m      |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | gravelly clayey SAND |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19564-PI            |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19564               |

|                        |                                                                                                                                                                            |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)                                                                          |
|                        | <input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method                               |
|                        | <input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method) |
|                        | <input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method                                |
|                        | <input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil                                                 |
|                        | <input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method                             |

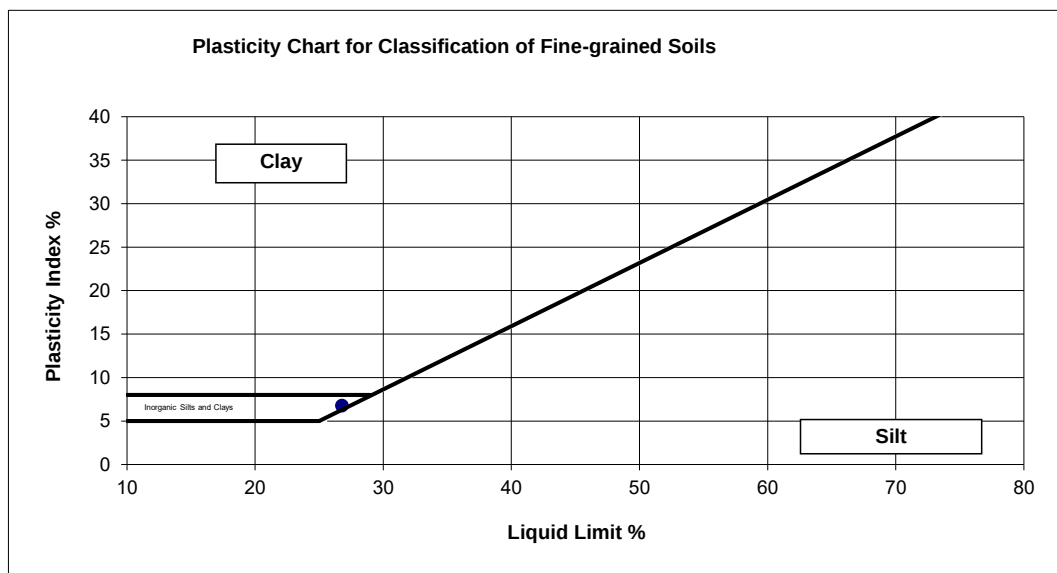
|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

**Preparation:** Prepared in accordance with the test method

**Liquid Limit (%):** 
**Linear Shrinkage (%):**

**Plastic Limit (%):** 
**Field Moisture Content (%):**

**Plastic Index:**



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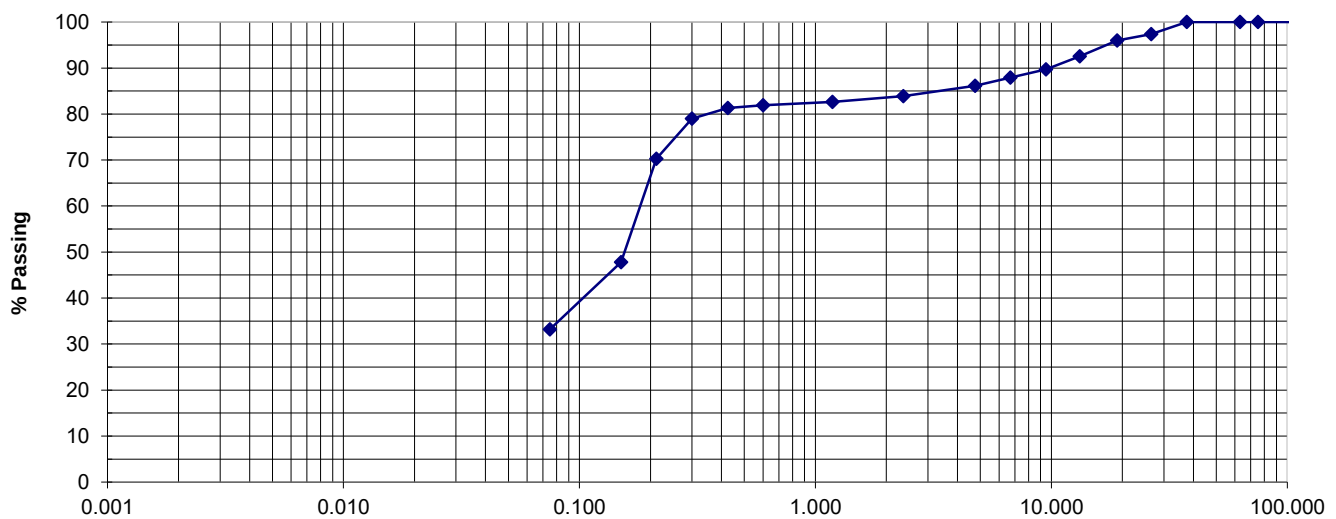
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                      |
|-----------------|--------------------------------------------------|----------------------------|----------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH11: 4.5-4.95m      |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | gravelly clayey SAND |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19564-PSD           |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19564               |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** Unknown

**Preparation:** Prepared in accordance with the test method



| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 86        |                             |
| 75                   | 100       |                             | 2.36                 | 84        |                             |
| 63                   | 100       |                             | 1.18                 | 83        |                             |
| 37.5                 | 100       |                             | 0.600                | 82        |                             |
| 26.5                 | 97        |                             | 0.425                | 81        |                             |
| 19                   | 96        |                             | 0.300                | 79        |                             |
| 13.2                 | 93        |                             | 0.212                | 70        |                             |
| 9.5                  | 90        |                             | 0.150                | 48        |                             |
| 6.7                  | 88        |                             | 0.075                | 33        |                             |



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# SOIL CLASSIFICATION REPORT

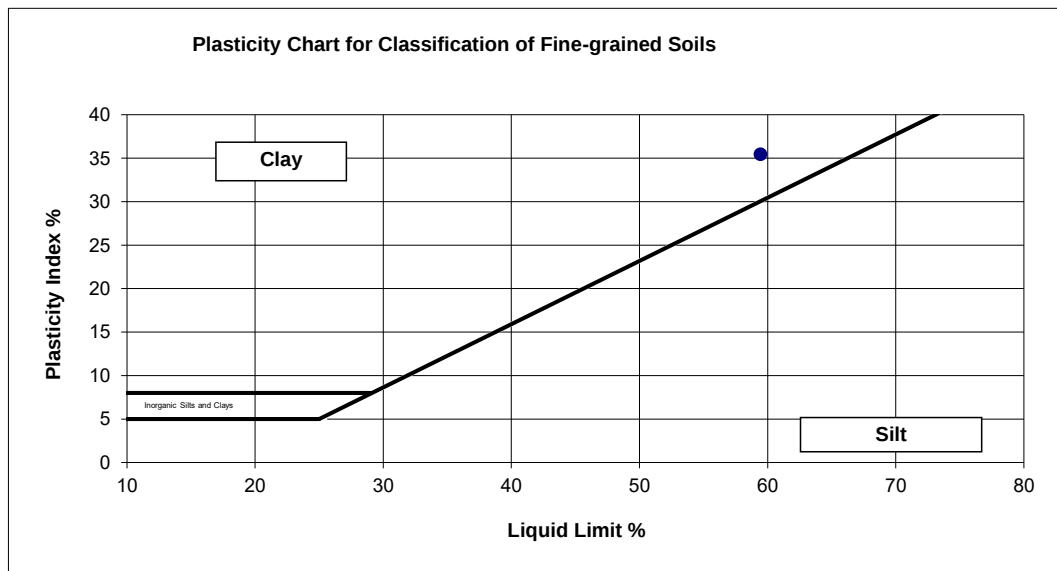
|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH12: 1.5-2.3m      |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | gravelly silty CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19567-PI           |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19567              |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 59      **Linear Shrinkage (%):** 11.0  
**Plastic Limit (%):** 24      **Field Moisture Content (%):** -  
**Plastic Index:** 35



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# SOIL CLASSIFICATION REPORT

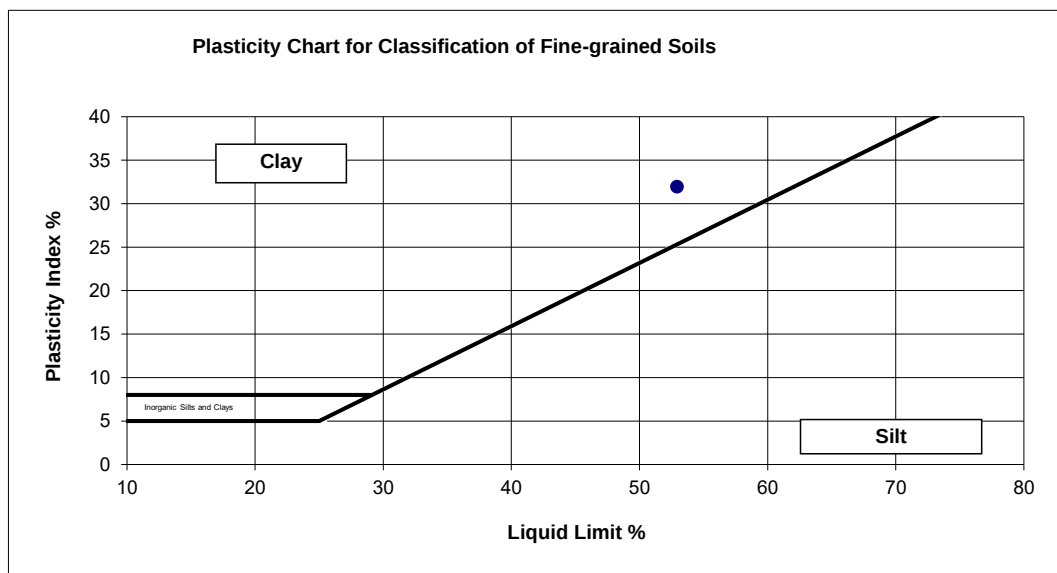
|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH13: 1.5-1.95m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | silty CLAY      |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19568-PI       |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19568          |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                  |                   |                      |         |
|------------------|-------------------|----------------------|---------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | Unknown |
|------------------|-------------------|----------------------|---------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 53      **Linear Shrinkage (%):** 13.0  
**Plastic Limit (%):** 21      **Field Moisture Content (%):** -  
**Plastic Index:** 32



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# MOISTURE CONTENT TEST REPORT

|                 |                                                  |                   |           |
|-----------------|--------------------------------------------------|-------------------|-----------|
| <b>Client:</b>  | Arup                                             | <b>Job No:</b>    | S16481    |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Report No:</b> | S19570-MC |
| <b>Project:</b> | MUCCP GI (251278-06)                             |                   |           |

| Test Procedure:                     |                                                                                                                                     |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method). |
| <input type="checkbox"/>            | AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)     |
| <input type="checkbox"/>            | RMS T120 Moisture content of road construction materials (Standard method)                                                          |
| <input type="checkbox"/>            | RMS T262 Determination of moisture content of aggregates (Standard method)                                                          |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

[illegible]

Notes:



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Authorized Signatory:

*uzid*

7/12/2016

Chris Lloyd

Date:



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# SOIL CLASSIFICATION REPORT

|                 |                                                  |                            |                  |
|-----------------|--------------------------------------------------|----------------------------|------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH16: 1-1.45m    |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | sandy silty CLAY |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19570-PI        |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19570           |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

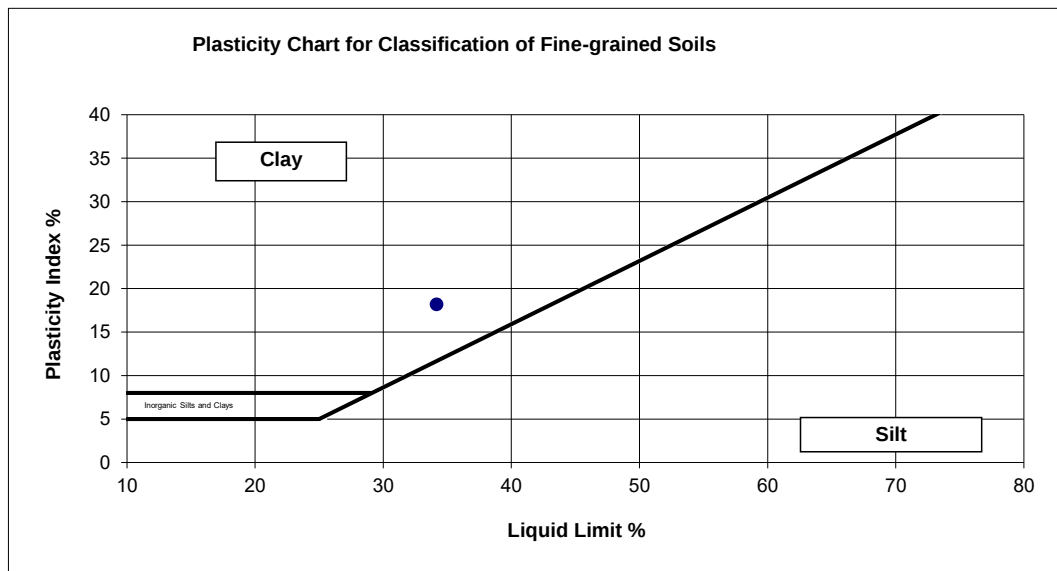
|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 
**Linear Shrinkage (%):**

**Plastic Limit (%):** 
**Field Moisture Content (%):**

**Plastic Index:**



Soil Preparation Method: Dry Sieved  
 Soil History: Air Dried  
 Soil Condition: Linear



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# SOIL CLASSIFICATION REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH17: 2-2.45m       |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | gravelly silty SAND |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No:</b>          | S19571-PI           |
| <b>Job No:</b>  | S16481                                           | <b>Lab No:</b>             | S19571              |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input checked="" type="checkbox"/> AS1289 2.1.1 Soil moisture content tests (Oven drying method)<br><input type="checkbox"/> AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method<br><input checked="" type="checkbox"/> AS1289 3.1.2 Soil classification tests - Determination of the liquid limit of a soil - One point Casagrande method (subsidiary method)<br><input checked="" type="checkbox"/> AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method<br><input checked="" type="checkbox"/> AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil<br><input checked="" type="checkbox"/> AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

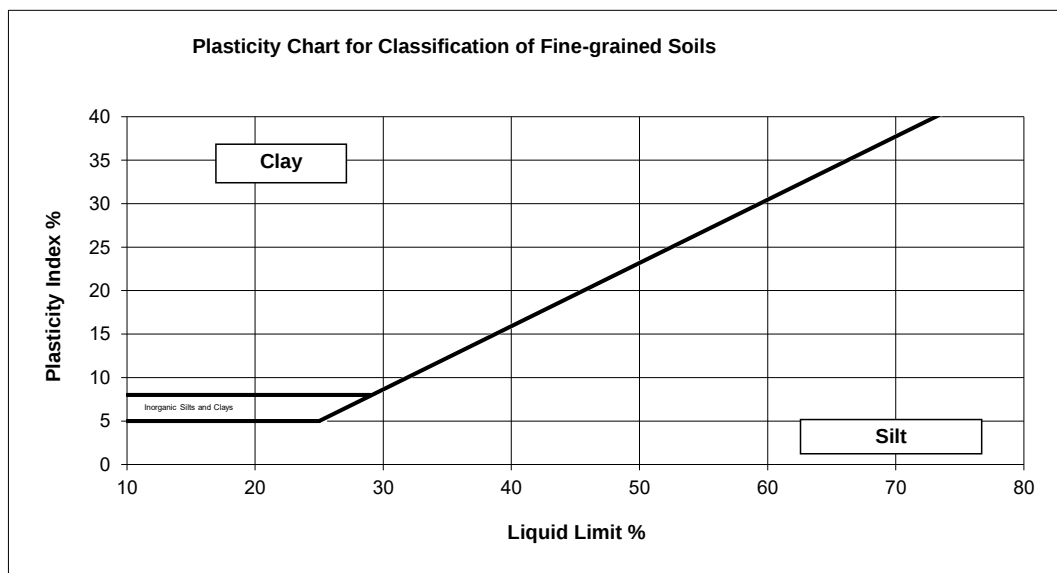
|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

**Liquid Limit (%):** 
**Linear Shrinkage (%):**

**Plastic Limit (%):** 
**Field Moisture Content (%):**

**Plastic Index:**



Soil Preparation Method: Dry Sieved  
 Soil History: Air Dried  
 Soil Condition: Linear



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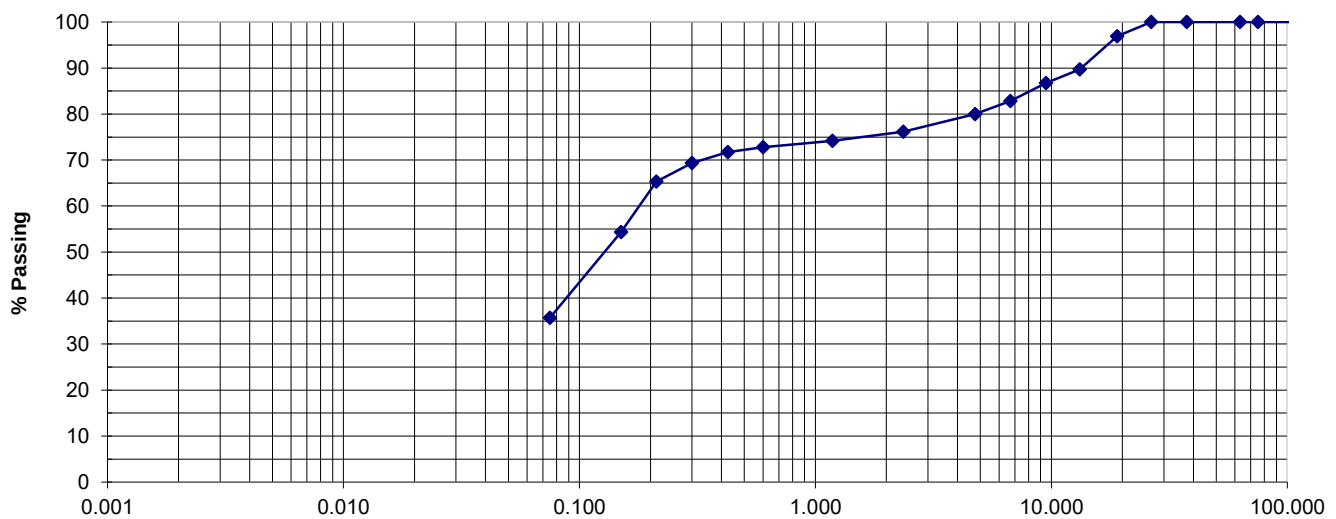
# PARTICLE SIZE DISTRIBUTION REPORT

|                 |                                                  |                            |                     |
|-----------------|--------------------------------------------------|----------------------------|---------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH17: 2-2.45m       |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | gravelly silty SAND |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19571-PSD          |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19571              |

**Test Procedure:** ☒ AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving

**Sampling:** Sampled by Client **Date Sampled:** 17-23.10.16

**Preparation:** Prepared in accordance with the test method



| Clay | Silt | Sand | Gravel | Cobbles |
|------|------|------|--------|---------|
|------|------|------|--------|---------|

| Sieve Aperture: (mm) | % Passing | Specification (..) Envelope | Sieve Aperture: (mm) | % Passing | Specification (..) Envelope |
|----------------------|-----------|-----------------------------|----------------------|-----------|-----------------------------|
| 200                  | 100       |                             | 4.75                 | 80        |                             |
| 75                   | 100       |                             | 2.36                 | 76        |                             |
| 63                   | 100       |                             | 1.18                 | 74        |                             |
| 37.5                 | 100       |                             | 0.600                | 73        |                             |
| 26.5                 | 100       |                             | 0.425                | 72        |                             |
| 19                   | 97        |                             | 0.300                | 69        |                             |
| 13.2                 | 90        |                             | 0.212                | 65        |                             |
| 9.5                  | 87        |                             | 0.150                | 54        |                             |
| 6.7                  | 83        |                             | 0.075                | 36        |                             |



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH02 7.66-7.82m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19573-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19573          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 52.00                 | 124.4                | 2.39                   | As Received        | Multiple Shear Plane   | 621                    | 41                   | 6.0                                  | 19.5                       |

Notes: Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH03 8.82-9.00m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19574-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19574          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 136.9                | 2.64                   | As Received        | Single Shear Plane     | 672                    | 51                   | 5.3                                  | 24.3                       |

Notes:



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Authorised Signatory:

Chris Lloyd

7/12/2016

Date:



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Unit 8/10  
Bradford Street  
Alexandria NSW 2015

# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH05 5.52-5.68m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19575-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19575          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 135.2                | 2.61                   | As Received        | Single Shear Plane     | 646                    | 47                   | 5.1                                  | 22.1                       |

Notes:



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH06 8.00-8.14m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19576-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19576          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 116                  | 2.24                   | As Received        | Single Shear Plane     | 611                    | 36                   | 4.7                                  | 16.8                       |

Notes: Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH07 5.77-5.92m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19577-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19577          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 132.6                | 2.55                   | As Received        | Single Shear Plane     | 716                    | 39                   | 5.2                                  | 18.4                       |

Notes:



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH08 6.00-6.18m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19578-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19578          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.70                 | 137.4                | 2.66                   | As Received        | Multiple Shear Plane   | 613                    | 27                   | 6.4                                  | 12.9                       |

Notes:



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                   |
|-----------------|--------------------------------------------------|----------------------------|-------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH10 13.12-13.27m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone         |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19579-UCS        |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19579            |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.80                 | 119.8                | 2.31                   | As Received        | Multiple Shear Plane   | 674                    | 46                   | 3.3                                  | 22.0                       |

Notes: Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                   |
|-----------------|--------------------------------------------------|----------------------------|-------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH11 13.84-14.00m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone         |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19580-UCS        |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19580            |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 133.3                | 2.57                   | As Received        | Multiple Shear Plane   | 652                    | 34                   | 8.3                                  | 16.3                       |

Notes:



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                   |
|-----------------|--------------------------------------------------|----------------------------|-------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH12 10.50-10.65m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone         |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19581-UCS        |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19581            |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 138                  | 2.66                   | As Received        | Multiple Shear Plane   | 608                    | 37                   | 6.8                                  | 17.4                       |

Notes:



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                 |
|-----------------|--------------------------------------------------|----------------------------|-----------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH15 9.00-9.15m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone       |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19582-UCS      |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19582          |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 137.5                | 2.65                   | As Received        | Single Shear Plane     | 744                    | 68                   | 5.2                                  | 32.4                       |

Notes:



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# UNIAXIAL COMPRESSIVE STRENGTH OF ROCK REPORT

|                 |                                                  |                            |                   |
|-----------------|--------------------------------------------------|----------------------------|-------------------|
| <b>Client:</b>  | Arup                                             | <b>Source:</b>             | BH17 13.84-14.00m |
| <b>Address:</b> | Level 10, 201 Kent Street, Sydney 2000 Australia | <b>Sample Description:</b> | Sandstone         |
| <b>Project:</b> | MUCCP GI (251278-06)                             | <b>Report No.:</b>         | S19583-UCS        |
| <b>Job No.:</b> | S16481                                           | <b>Lab No.:</b>            | S19583            |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Procedure:</b> | <input type="checkbox"/> AS4133 4.2.1 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength >50MPa              |
|                        | <input checked="" type="checkbox"/> AS4133 4.2.2 Rock strength tests - Determination of uniaxial compressive strength - Rock Strength < 50 Mpa |

|                  |                   |                      |             |
|------------------|-------------------|----------------------|-------------|
| <b>Sampling:</b> | Sampled by Client | <b>Date Sampled:</b> | 17-23.10.16 |
|------------------|-------------------|----------------------|-------------|

|                     |                                             |
|---------------------|---------------------------------------------|
| <b>Preparation:</b> | Prepared in accordance with the test method |
|---------------------|---------------------------------------------|

|                    |          |                     |        |                                  |          |
|--------------------|----------|---------------------|--------|----------------------------------|----------|
| <b>Date Tested</b> | 24.11.16 | <b>Machine Type</b> | Matest | <b>Sample Storage Conditions</b> | Core Box |
|--------------------|----------|---------------------|--------|----------------------------------|----------|



Before Test



After Test

## TEST RESULTS

| Average Diameter (mm) | Specimen Height (mm) | Length/ Diameter Ratio | Specimen Condition | Description of Failure | Duration of Test (Sec) | Load at Fracture (N) | Moisture Content at Time of Test (%) | Compressive Strength (MPa) |
|-----------------------|----------------------|------------------------|--------------------|------------------------|------------------------|----------------------|--------------------------------------|----------------------------|
| 51.90                 | 121.3                | 2.34                   | As Received        | Single Shear Plane     | 742                    | 40                   | 6.1                                  | 19.1                       |

Notes: Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.



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## Appendix C

### Exposure Classification

Draft

Draft

# Macquarie University Central Courtyard Precinct

## Soil Exposure Classification Summary

### AS2159-2009 Method

| Investigation Location | Location | Depth (m) |      | pH (units) | Conductivity (µS/cm) | Chloride (mg/kg) | Sulfate (mg/kg) | Resistivity (ohm.cm) | Material              | Soil Unit | Soil Condition | Exposure Classification for Concrete Piles |                |                |                         | Exposure Classification for Steel Piles |                        |                |                         |
|------------------------|----------|-----------|------|------------|----------------------|------------------|-----------------|----------------------|-----------------------|-----------|----------------|--------------------------------------------|----------------|----------------|-------------------------|-----------------------------------------|------------------------|----------------|-------------------------|
|                        |          | From      | To   |            |                      |                  |                 |                      |                       |           |                | By Sulfate (in soil)                       | By pH          | By Chlorides   | Exposure Classification | By pH                                   | By Chlorides (in soil) | By Resistivity | Exposure Classification |
| BH01                   | MUCCP    | 6.00      | 6.45 | 5.1        | 55.6                 | 69               | 37              | 18,000               | Silty sandy CLAY      | 2b        | B              | Non-aggressive                             | Mild           | Non-aggressive | Mild                    | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |
| BH03                   | MUCCP    | 1.50      | 1.95 | 5.5        | 48.8                 | 67               | 23              | 20,500               | Silty sandy CLAY      | 2b        | B              | Non-aggressive                             | Mild           | Non-aggressive | Mild                    | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |
| BH05                   | MUCCP    | 2.50      | 2.95 | 5.7        | 55.6                 | 71               | 23              | 18,000               | Silty sandy CLAY      | 2b        | B              | Non-aggressive                             | Non-aggressive | Non-aggressive | Non-aggressive          | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |
| BH08                   | MUCCP    | 3.00      | 3.45 | 4.6        | 62.5                 | 69               | 25              | 16,000               | Silty sandy CLAY      | 2b        | B              | Non-aggressive                             | Mild           | Non-aggressive | Mild                    | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |
| BH11                   | MUCCP    | 7.50      | 7.80 | 5.3        | 100.0                | 84               | 45              | 10,000               | Silty CLAY: with sand | 2b        | B              | Non-aggressive                             | Mild           | Non-aggressive | Mild                    | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |
| BH13                   | MUCCP    | 3.00      | 3.45 | 6.6        | 50.0                 | 80               | 19              | 20,000               | Silty sandy CLAY      | 2b        | B              | Non-aggressive                             | Non-aggressive | Non-aggressive | Non-aggressive          | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |
| BH17                   | MUCCP    | 3.00      | 3.45 | 5.4        | 48.8                 | 75               | 17              | 20,500               | Silty CLAY: with sand | 2b        | B              | Non-aggressive                             | Mild           | Non-aggressive | Mild                    | Non-aggressive                          | Non-aggressive         | Non-aggressive | Non-aggressive          |

Notes:

1. Soil condition (A or B) is based on AS2159 with A = high permeability soils in groundwater, B = low permeability soils or all soils above groundwater.

### AS3600-2009 Method

| Investigation Location | Location | Depth (m) |      | pH (units) | Conductivity (µS/cm) | Chloride (mg/kg) | Sulfate (mg/kg) | Resistivity (ohm.cm) | Material              | Soil Unit | Soil Condition | Exposure Classification for Concrete Structures in Sulfate Soils |       |                 |                         | Magnesium (mg/kg) |
|------------------------|----------|-----------|------|------------|----------------------|------------------|-----------------|----------------------|-----------------------|-----------|----------------|------------------------------------------------------------------|-------|-----------------|-------------------------|-------------------|
|                        |          | From      | To   |            |                      |                  |                 |                      |                       |           |                | By Sulfate (in soil)                                             | By pH | By Conductivity | Exposure Classification |                   |
| BH01                   | MUCCP    | 6.00      | 6.45 | 5.1        | 55.6                 | 69               | 37              | 18,000               | Silty sandy CLAY      | 2b        | B              | A1                                                               | A2    | A1              | A2                      | -                 |
| BH03                   | MUCCP    | 1.50      | 1.95 | 5.5        | 48.8                 | 67               | 23              | 20,500               | Silty sandy CLAY      | 2b        | B              | A1                                                               | A2    | A1              | A2                      | -                 |
| BH05                   | MUCCP    | 2.50      | 2.95 | 5.7        | 55.6                 | 71               | 23              | 18,000               | Silty sandy CLAY      | 2b        | B              | A1                                                               | A1    | A1              | A1                      | -                 |
| BH08                   | MUCCP    | 3.00      | 3.45 | 4.6        | 62.5                 | 69               | 25              | 16,000               | Silty sandy CLAY      | 2b        | B              | A1                                                               | A2    | A1              | A2                      | -                 |
| BH11                   | MUCCP    | 7.50      | 7.80 | 5.3        | 100.0                | 84               | 45              | 10,000               | Silty CLAY: with sand | 2b        | B              | A1                                                               | A2    | A1              | A2                      | -                 |
| BH13                   | MUCCP    | 3.00      | 3.45 | 6.6        | 50.0                 | 80               | 19              | 20,000               | Silty sandy CLAY      | 2b        | B              | A1                                                               | A1    | A1              | A1                      | -                 |
| BH17                   | MUCCP    | 3.00      | 3.45 | 5.4        | 48.8                 | 75               | 17              | 20,500               | Silty CLAY: with sand | 2b        | B              | A1                                                               | A2    | A1              | A2                      | -                 |

Notes:

1. Soil condition (A or B) is based on AS3600 with A = high permeability soils in groundwater, B = low permeability soils or all soils above groundwater.

### AS5100-2004 Method

| Investigation Location | Location | Depth (m) |      | pH (units) | Conductivity (µS/cm) | Chloride (mg/kg) | Sulfate (mg/kg) | Resistivity (ohm.cm) | Material              | Soil Unit | Soil Condition | Exposure Classification for Concrete Structures |            |
|------------------------|----------|-----------|------|------------|----------------------|------------------|-----------------|----------------------|-----------------------|-----------|----------------|-------------------------------------------------|------------|
|                        |          | From      | To   |            |                      |                  |                 |                      |                       |           |                | AS5100.5                                        | BTD2008/12 |
| BH01                   | MUCCP    | 6.00      | 6.45 | 5.1        | 55.6                 | 69               | 37              | 18,000               | Silty sandy CLAY      | 2b        | B              | B1                                              | Note 3     |
| BH03                   | MUCCP    | 1.50      | 1.95 | 5.5        | 48.8                 | 67               | 23              | 20,500               | Silty sandy CLAY      | 2b        | B              | B1                                              | Note 3     |
| BH05                   | MUCCP    | 2.50      | 2.95 | 5.7        | 55.6                 | 71               | 23              | 18,000               | Silty sandy CLAY      | 2b        | B              | B1                                              | Note 3     |
| BH08                   | MUCCP    | 3.00      | 3.45 | 4.6        | 62.5                 | 69               | 25              | 16,000               | Silty sandy CLAY      | 2b        | B              | B1                                              | Note 3     |
| BH11                   | MUCCP    | 7.50      | 7.80 | 5.3        | 100.0                | 84               | 45              | 10,000               | Silty CLAY: with sand | 2b        | B              | B1                                              | Note 3     |
| BH13                   | MUCCP    | 3.00      | 3.45 | 6.6        | 50.0                 | 80               | 19              | 20,000               | Silty sandy CLAY      | 2b        | B              | B1                                              | Note 3     |
| BH17                   | MUCCP    | 3.00      | 3.45 | 5.4        | 48.8                 | 75               | 17              | 20,500               | Silty CLAY: with sand | 2b        | B              | B1                                              | Note 3     |

Notes:

1. Soil condition (A or B) is based on AS5100 with A = high permeability soils in groundwater, B = low permeability soils or all soils above groundwater.

2. Aggressive soil classified when soil pH <4.0 and SO4 > 1000ppm.