Pells Sullivan Meynink
Engineering Consultants
Rock-Soil-Water

G3 56 Delhi Road
North Ryde NSW 2113
P: 61-2 9812 5000
F: 61-2 9812 5001
mailbox@psm.com.au
www.psm.com.au

Our Ref: PSM3029-006R Rev1

10 August 2016

UNSW AUSTRALIA
UNSW
SYDNEY NSW 2052

ATTENTION: JANINE DESHON
By email: j.deshon@unsw.edu.au

Dear Janine

RE: UNSW CLIFFBROOK CAMPUS REDEVELOPMENT
GEOTECHNICAL INVESTIGATION

PSM are pleased to submit our geotechnical report for the proposed development at UNSW Cliffbrook Campus located at 45-51 Beach Street, Coogee.

Please do not hesitate to contact the undersigned if you have any queries.

For and on behalf of
PELLS SULLIVAN MEYNINK

GARRY MOSTYN
Principal

UNSW AUSTRALIA

CLIFFBROOK CAMPUS REDEVELOPMENT
GEOTECHNICAL INVESTIGATION

PSM3029-006R Rev1 AUGUST 2016

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1 INTRODUCTION

This report presents the results of the geotechnical investigation undertaken by Pells Sullivan Meynink (PSM) for the proposed development at Cliffbrook Campus.

The work was undertaken in accordance with the PSM proposal dated 13 April 2016 (Ref. PSM3029-001L).

Prior to the work, PSM was supplied with the following documents:

- UNSW Scope of Services for Geotechnical and Environmental Investigation Consultancy Services for the Cliffbrook Campus Redevelopment (CCR) Project, dated Monday 04 April 2016.
- Watson Buchan Consulting Surveyors, Cliffbrook Site Survey (Ref. 08/0409), dated 01 August 2008.
- An annotated plan from UNSW-CCR: Architectural Consultancy Services: Project Brief detailing proposed test locations.
- UNSW Facilities Management Cliffbrook Campus Consolidated Services Plan dated 3 June 2014.

PSM understands the following about the proposed Cliffbrook Campus Redevelopment, based on the documents provided:

- The campus is located at 45 to 51 Beach Street in a residential area.
- The site currently has four buildings. Two of these buildings, CC1 and CC3 are heritage listed and are protected from demolition.
- The site is zoned for educational purposes and has been used as office space since the late 1990s.
- Proposed works include the demolition of CC2 and CC4 to allow for the construction of a three storey building and associated access roads and parking. Details of the proposed buildings are not known to PSM.

PSM has engaged Environmental Consultant JBS&G to undertake preliminary site investigation environmental study for the site. Their report has been included as Appendix F.

2 GEOTECHNICAL INVESTIGATION

2.1 Fieldwork

The fieldwork was undertaken on 31 May to 2 June 2016 under the fulltime supervision of a PSM geotechnical engineer, who undertook the following tasks:

- Directing drilling / testing / sampling
- Preparing engineering logs

- Taking photographs of the site, soil samples and recovered rock cores
- Undertaking point load strength index tests on recovered rock core
- Collection of samples for testing in a geotechnical laboratory
- Collection of samples for testing in an environmental laboratory

The test locations were measured off site features and approximate surface elevations were inferred from the Cliffbrook Site Survey. Figure 1 presents the test locations.

A total of four (4) cored boreholes (BH01 to BH04) were drilled to a maximum depth of 12 m, until at least 3 m of rock core were recovered. These boreholes were drilled at or near to the locations as requested by TTW on behalf of UNSW. An additional four (4) augered boreholes (BH05 to BH08) were drilled to a maximum depth of 5.2 m. A TC bit auger was used within soils and NMLC triple tube coring was used within rock for the cored boreholes.

Engineering logs were prepared for each borehole and are presented in Appendix A, along with explanation sheets and core photography.

Point load tests on the core were performed at approximately metre intervals. Results are tabulated in Appendix B.

3 LABORATORY TESTING

3.1 Geotechnical laboratory test results

Five (5) soil samples recovered on site were sent to an NATA accredited geotechnical laboratory. The geotechnical laboratory testing undertaken is summarised in Table 1. The PSD Results are presented in Figure 2. The geotechnical laboratory test results are included in Appendix C.

TABLE 1
GOETECHNICAL TESTING RESULTS SUMMARY

SAMPLE ID	BOREHOLE	DEPTH (m)	TEST METHOD	CBR (%)	FMC (%)	MOISTURE RATIO (%)	COMPACTION RATIO (%)	SWELL (%)
Sample 1	BH06	0.20-1.50	California Bearing Ratio (CBR) AS1289.6.1.1	20	9.2	98	98	0
Sample 2	BH07	0.60-1.20	California Bearing Ratio (CBR) AS1289.6.1.1	25	6.3	98	98	0
Sample 3	BH07	0.03-0.25	Particle size distribution (PSD)[1] AS1289.3.6.1 & 3.6.3 Dry sieve (washed)	Not applicable				
Sample 4	BH08	0.90-1.50	California Bearing Ratio (CBR) AS1289.6.1.1	30	9.3	102	98	0
Sample 5	BH08	0.70-0.80	Atterberg Limits AS1289 3.1.2, 3.2.1, 3.3.1 and 3.4.1	Not applicable Note: Sample was non-plastic				

Notes: [1] See Figure 2 for PSD result

3.2 Salinity and Aggressivity laboratory test results

Three (3) disturbed soil samples recovered on site were sent to an NATA accredited environmental laboratory for aggressivity testing:

Table 2 presents a list of the tested samples. The environmental laboratory reports are provided in Appendix D.

TABLE 2
SALINITY AND AGGRESSIVITY LABORATORY TEST RESULTS

SAMPLE ID	BOREHOLE	DEPTH (m)	SOIL PH	ELECTRICAL CONDUCTIVITY [µS/cm]	MOISTURE CONTENT [%]	SOLUBLE SULPHATE BY ICPAES [mg/kg]	CHLORIDE BY DISCRETE ANALYSER [mg/kg]	EXCHANGEABLE CATIONS [meq/100g]					ESP [%]
								Ca	Mg	K	Na	CEC	
ES1	BH07	1.20-1.40	8.6	139	2.4	70	<10	1.0	<0.2	<0.2	<0.2	1.0	0
ES2	BH03	0.80-1.00	7.8	21	4.9	<10	<10	0.8	<0.2	<0.2	<0.2	0.8	0
ES3	BH05	0.20-0.40	6.6	11	2.4	<10	<10	0.6	0.1	<0.1	<0.1	0.8	0

4 SITE CONDITIONS

4.1 Geological setting

The 1:100,000 Sydney Geological map (1983) indicates the site is underlain by:

- Hawkesbury Sandstone and.
- Medium to fine-grained “marine” sand with podsols.

4.2 Surface conditions

Outside of the existing building envelopes, PSM observed that the site was covered by grassed areas, asphalt pavements, brick paved areas, concrete paths and garden areas.

Appendix E presents some selected photos taken during the fieldwork.

4.3 Subsurface conditions

The subsurface conditions encountered within the boreholes are summarised in Table 3 and Table 4. The encountered subsurface conditions were consistent with the published information in the geological map.

TABLE 3
SUMMARY OF INFERRED SUBSURFACE CONDITIONS ENCOUNTERED IN PSM BOREHOLES

INFERRED UNIT	ENCOUNTERED DEPTH TO TOP OF INFERRED UNIT (m)	DESCRIPTION
TOPSOIL	0.0	Fill/ Existing pavement SAND with trace gravel: dark brown, coarse grained, gravels 15 mm particle size, sub-angular, trace root fibres
SAND	0.0 to 0.6	SAND: grey, brown, yellow and red, coarse grained
SANDSTONE	1.1 to 8.0	SANDSTONE: yellow, brown, grey, red, highly weathered to fresh, low to high strength

Table 4 shows depths of the inferred geotechnical units encountered in PSM boreholes.

TABLE 4
APPROXIMATE REDUCED LEVELS OF TOP OF INFERRED GEOTECHNICAL UNITS ENCOUNTERED IN PSM BOREHOLES

BOREHOLE ID	APPROXIMATE LEVEL OF TOP OF INFERRED GEOTECHNICAL UNITS (m AHD)				
	EXISTING PAVEMENT*	TOP SOIL*	SAND*	SANDSTONE	EOH
BH01	29.7	NE	29.6	28.6	23.7
BH02	NE	NE	29.7	28.4	25.0
BH03	NE	27.4	27.2	21.6	18.2
BH04	NE	28.4	28.3	20.4	16.6
BH05	NE	31.5	31.3	26.5	26.3
BH06	32.0	NE	31.8	28.2	28.2
BH07	31.2	NE	30.6	NE	29.8
BH08	30.5	NE	30.1	NE	29.1

Note: * Surface RL's interpreted from Watson Buchan Consulting Surveyors, Cliffbrook Site Survey (Ref. 08/0409)
EOH = End of hole
NE = Not encountered

5 DISCUSSION AND RECOMMENDATIONS

5.1 Excavation conditions

Excavation within SAND unit should be achieved with conventional earthmoving equipment.

Excavation within SANDSTONE is likely to require rock breaking equipment. Heavy rock breaking equipment may not be suitable given the vibrations generated by such equipment.

Where required, it is recommended that rock saws and grinders are used to undertake the excavation. The use of "pre-split" cuts along the boundaries using a rock saw can provide a "buffer" for vibrations.

We note that an experienced contractor should make their own assessment of the appropriate excavation equipment. The contractor should recognise that there is a potential for damage to adjacent buildings and consider this in planning and executing its work. It is our experience that excavatability is heavily dependent on both the operator and the plant used.

5.2 Site classification

While the proposed development is out of scope of AS2870-2011 *"Residential slabs and footings"*, we assess that there would be little or no characteristic surface movement, y_s, and thus would classify the site as Class A. This assessment has been provided for the SAND encountered across the site during our site investigation. If during construction/earthworks clay soils or imported fill are encountered then further advice should be sought.

We have also classified the site in accordance with Section 4 of AS1170.4-2007 to be Class C_e "Shallow soil site".

5.3 Foundations

5.3.1 Shallow footings

Pad footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads provided in Table 6. Higher ABPs may be available, but these depend on the size, depth, loads, etc and would be subject to specific advice.

5.3.2 Piles

Piles should be designed in accordance with the requirements in AS 2159-2009, *Piling - Design and Installation*. The parameters provided in Table 6 may assist in the design of piles.

TABLE 6
ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS

INFERRED UNIT	BULK UNIT WEIGHT (kN/m^3)	SOIL EFFECTIVE STRENGTH PARAMETERS		ULTIMATE BEARING PRESSURE UNDER VERTICAL CENTRIC LOADING (kPa)	ALLOWABLE BEARING PRESSURE (ABP) UNDER VERTICAL CENTRIC LOADING (kPa)	ULTIMATE SHAFT ADHESION (kPa)	ELASTIC PARAMETERS	
		c' (kPa)	*ϕ'* (deg)				LONG TERM YOUNG MODULUS (MPa)	POISSON'S RATIO
SAND	18	0	30	420[1]	150[1]	NA	10	0.3
SANDSTONE	22	N.A.	N.A.	7500[2]	3500[3]	800	350	0.25

Note: 1. Pad footings (for ABP of 150 kPa) should have a minimum horizontal dimension of 1.0 m and a minimum embedment depth of 0.5 m.
2. Ultimate values occur at large settlement (>5% of minimum footing dimensions).
3. End bearing pressure to cause settlement of <1% of minimum footing dimensions.

Settlements in soil units can be estimated using the elastic parameters provided in Table 7.

The designer should note the following with regards to pile design:

- The ABP needs to be confirmed by a geotechnical engineer during a pile inspection.

- Under permanent load, the contribution of side adhesion for soils including SAND should be ignored.
- Short term uplift loading on piers in soil units should be designed for:
  - No resistance in the top 1 m.
  - Below the upper metre, the lesser of:
    - Side adhesion = 20 kPa, or
    - Cohesion, *c*', = 0 kPa, and friction angle, ϕ', = 30 deg.
- Deflection needs to be checked using the recommended elastic parameters in Table 7.

The bearing capacities provided are contingent on piles or footings being vertically and centrally loaded. Further advice should be sought if the footings are not vertically centrically loaded.

Inspections will be required during construction to confirm base cleanliness and rock conditions at the base of piles or footings and to confirm the advice provided in this letter.

With regards to the pile design we recommend that:

- A geotechnical strength reduction factor, Φ_g = 0.60 (AS2159 CL. 4.3.2) be adopted for a high redundancy system for an assessed average risk rating (ARR) between 2.5 and 3.0. This should be reviewed to suit the specific design and appropriate pile testing proposed by the structural designers in accord with the requirements of AS2159.
- It may be possible to increase the pile reduction factors, if the details of the proposed pile installation procedures indicate a high level of quality control with regards to concrete placement, base cleanliness, etc.
- If a geotechnical strength reduction factor, Φ_g = 0.40 is adopted then no pile testing will be required (AS2159 CL. 8.2.4 (b)).

5.4 Slab on ground

The design of slabs on ground on the SAND unit can be based on a subgrade with a long term Young's Modulus of 10 MPa. The short term Young's modulus can be taken to be 15 MPa.

The SAND subgrade will need to be prepared or compacted using a smooth drum vibratory roller e.g. with a 10 tonne roller.

5.5 Pavement

Subgrade CBR for pavement design depends on the material at the finished subgrade levels. Based on the CBR tests undertaken by PSM, we recommend a design subgrade CBR of 20% to be adopted.

5.5.1 Pavement thickness design

The design of the pavement has been based on the following design inputs:

1. No design traffic and/or wheel loads have been provided so PSM has adopted a design traffic of 10^5 ESAs for the car park and access areas. We consider this to be a suitable design traffic for the small car park area.
2. A design subgrade CBR of 20% has been adopted for SAND subgrade on the basis of the CBR tests results on the SAND subgrade.

We have referred to Austroad Pavement Design (2012). We recommend the sealed granular pavement described in Table 7.

TABLE 7
MINIMUM PAVEMENT THICKNESS (CLAY SUBGRADE) – SEALED GRANULAR PAVEMENT

LAYER	MATERIAL	MINIMUM THICKNESS (mm)
Wearing course	Asphaltic Concrete	50(1)
Base course	Unbound granular material eg. DGB20	125

Note: 1. Minimum thickness for sealed pavement

5.6 Durability

The following sections assess durability and exposure classification in accordance with the Australian Standards AS3600-2009, *Concrete Structures* and AS2159:2009, *Piling – Design and Installation.*

5.6.1 Salinity

Site Investigations for Urban Salinity (DLWC 2002) classify soil salinity based on electrical conductivity (EC_e) as per Richards (1954). The method of conversion from $EC_{1:5}$ to EC_e (electrical conductivity of saturated extract) is based on DLWC (2002) and given by $EC_e = EC_{1:5} \times M$, where M is the multiplication factor based on "Soil Texture Group".

The "Soil Texture Group" of the samples tested has been assessed as "Sands" with a corresponding M of 17. The salinity classification for the soil samples that were tested is presented in Table 8.

TABLE 8
SOIL SALINITY CLASSIFICATION

SAMPLE ID	$EC_{1:5}$ (dS/m)	SOIL TYPE	M	EC_e (dS/m)	SALINITY CLASS
ES1	0.139	Sands	17	2.363	Slightly saline
ES2	0.021	Sands	17	0.357	Non-saline
ES3	0.011	Sands	17	0.187	Non-saline

The soils on the site range from “non-saline” to “slightly saline”.

Table 4.8.2 of Australian Standard AS3600-2009, *Concrete Structures* provides an exposure classification for concrete structures in saline soils based on soil electrical conductivity (EC_e). When compared with this Table 4.8.2 of AS3600-2009 the soils encountered on site are not considered to be saline and have not been given an exposure classification.

5.6.2 Exposure classification

Table 6.4.2(C) of Australian Standard AS2159:2009, *Piling – Design and Installation* provides criteria for exposure classification for concrete piles in soil based on soil and groundwater pH, sulfates in soil and groundwater, and chlorides in groundwater. On the basis of the pH and sulfate testing completed we assess the exposure classification for concrete piles in soil to be mild.

Table 6.5.2(C) of Australian Standard AS2159:2009, *Piling – Design and Installation* provides criteria for exposure classification for steel piles in soil based on resistivity, soil and groundwater pH, and chlorides in soil and groundwater. On the basis of the resistivity, pH and chloride testing completed we assess the exposure classification for steel piles in the soil to be non-aggressive.

6 GENERAL

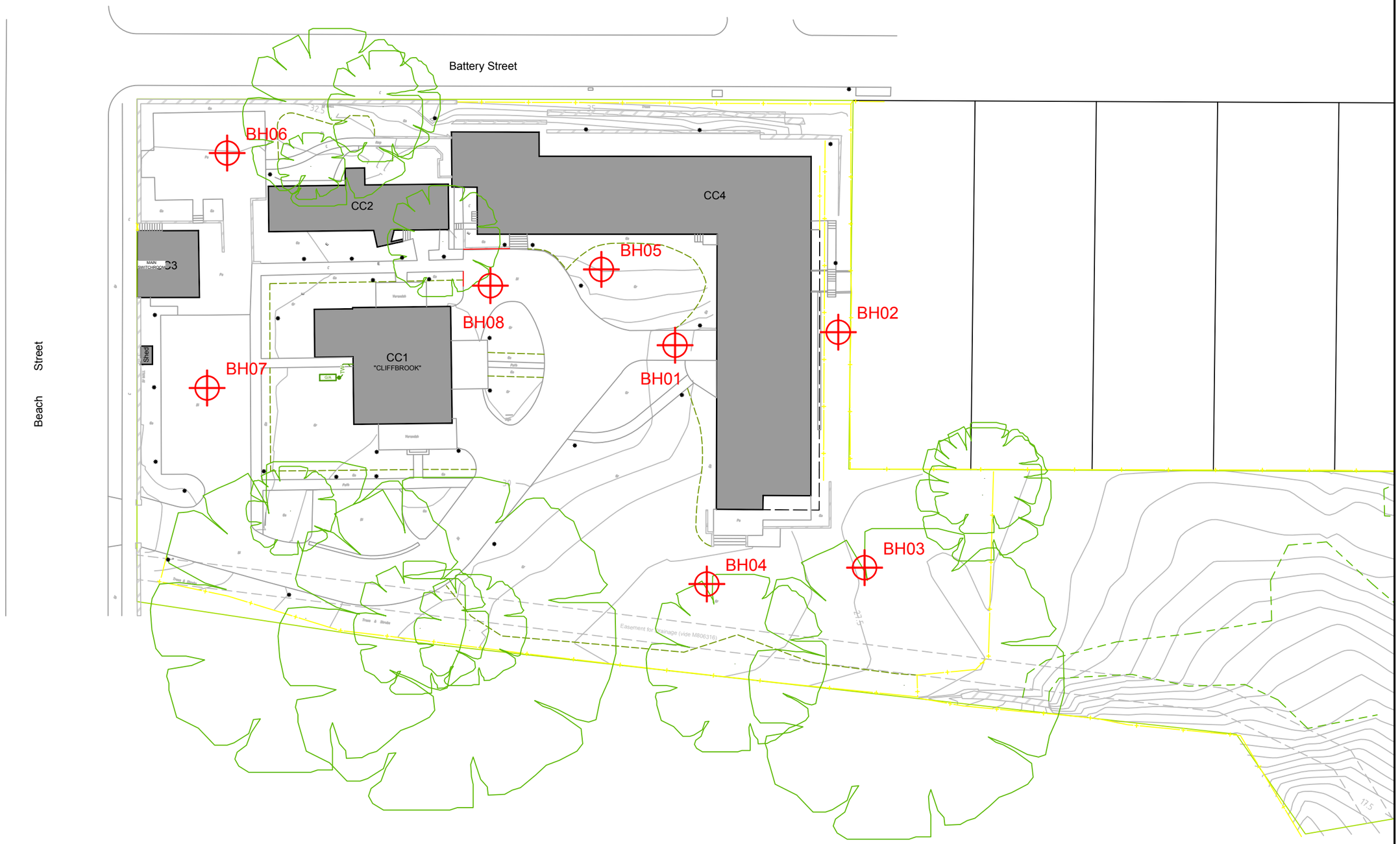
If at any time, the conditions are found to vary from those described in this report, further advice should be sought.

For and on behalf of
PELLS SULLIVAN MEYNINK

GARRY MOSTYN
Principal

REFERENCES

1. Austroad Pavement Design – *A Guide to the Structural Design of Road Pavements*, dated 2012
2. Australian Standard AS1170.4:2007 Structural design actions – Part 4: Earthquake actions in Australia
3. Australian Standard AS2159:2009, Piling – Design and Installation, Standards Australia
4. Australian Standard AS3600:2009, Concrete Structures, Standards Australia
5. Department of Land and Water Conservation (DLWC) 2002, *Site Investigations for Urban Salinity*



LEGEND

PSM Borehole

NOTE: Base plan taken from UNSW Facilities Managment, *UNSW Cliffbrook Campus, Consoliated Services plan* dated 3 June 2014

0 5 10 15 20

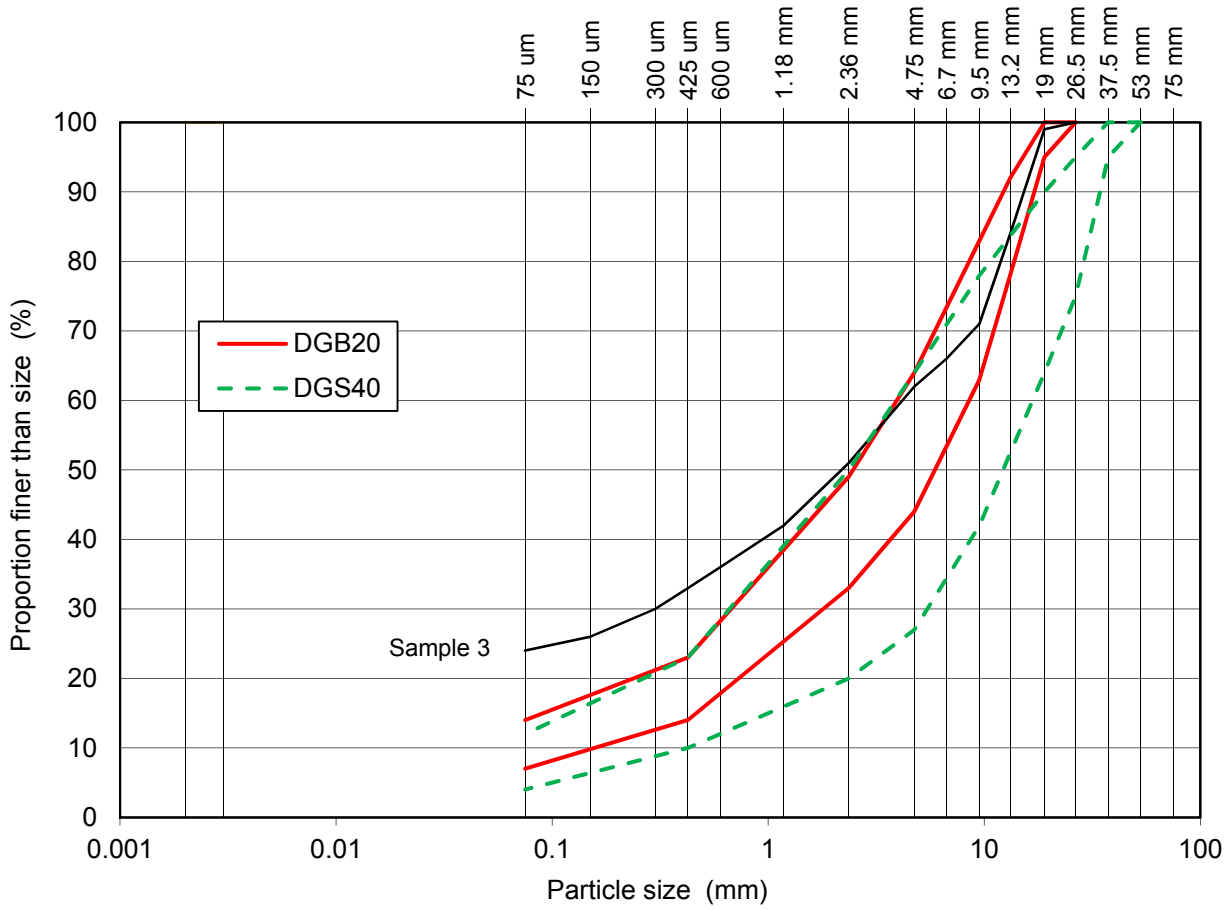
Scale (m)

Pells Sullivan Meynink

UNSW
UNSW Cliffbrook Campus
Coogee, NSW

GEOTECHNICAL INVESTIGATION
LOCALITY PLAN

PSM3029-006R	Figure 1



Notes:

1. Testing performed by Ground Technologies
2 DGB20 and DGS40 grading taken from RMS QA Specification 3051 (Table 3051.1)

Pells Sullivan Meynink

UNSW

UNSW Cliffbrook Campus

Coogee, NSW

SUMMARY OF LABORATORY TESTING

PARTICLE SIZE DISTRIBUTION (PSD)

PSM3029-006R	**FIGURE 2**

APPENDIX A

ENGINEERING LOGS AND CORE PHOTOGRAPHY

Borehole ID

BH01

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	31/05/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339187.0 m E 6246044.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	29.70 m		
Hole Diameter:	76 - 110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density / Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T						28.7	1			Asphaltic Concrete GRAVEL: grey, sub-angular, 20mm particle size SAND: light grey and brown, coarse grained	M	VD MD	
										SANDSTONE: yellow, low to medium strength			
						27.7	2			Continued on cored borehole sheet			
						26.7	3						
						25.7	4						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_NONCORE_BH_NZ_AU PSM3029 BOREHOLES.GPJ <<DrawingFile>> 19/06/2016 18:47 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	31/05/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339187.0 m E 6246044.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	29.70 m		
Barrel Type and Length:	NMLC 3.5 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW HW MW SW F	Strength Is(50) ● - Axial ○ - Diametral EL <0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					28.7	1		Continued from non-cored borehole sheet				
NMLC		98	85	Is(50) d=0.5 a=0.6 MPa	27.7	2		SANDSTONE: light brown, yellow brown, grey and red, coarse grained, laminated at 10° to 40°, distinct				BP 30° CN PR RF
				Is(50) d=0.3 a=0.3 MPa	26.7	3						BP 10° CN PR S BP 30° CN IR VR IS 0° CL & Rock fragments PR 10 mm
								NO CORE 30 mm				
				Is(50) d=1.4 a=1.1 MPa				SANDSTONE: light brown, yellow brown, grey and red, coarse grained, laminated at 10° to 40°, distinct				IS 0° CL & Rock fragments PR 15 mm IS 5° CL VN PR
								NO CORE 60 mm				
		92	92		25.7	4		SANDSTONE: light brown, yellow brown, grey and red, coarse grained, laminated at 10° to 40°, distinct				BP 30° CN PR RF
		100	100	Is(50) d=1.1 a=0.9 MPa				becomes grey with some yellow brown staining, laminations indistinct				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_CORE_BH_PSM PSM3029 BOREHOLES.GPJ <<DrawingFile>> 19/06/2016 18:49 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	31/05/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339187.0 m E 6246044.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	29.70 m		
Barrel Type and Length:	NMLC 3.5 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW HW MW SW F	Strength Is(50) ● - Axial ○ - Diametral EL <0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC		100	100	Is(50) d=0.6 a=0.9 MPa	23.7	6		SANDSTONE: grey with some yellow brown staining, coarse grained, laminated at 10° to 40°, indistinct				
								Hole Terminated at 6.00 m				
					22.7	7						
					21.7	8						
					20.7	9						

Method
- AD/T - Auger drilling TC bit
- AD/V - Auger drilling V bit
- WB - Washbore
- HQ3- Wireline core (63.5 mm)
- PQ3- Wireline core (85.0 mm)
- SPT- Standard penetration test
- PT - Push tube

Water
- Inflow
- Partial Loss
- Complete Loss

Graphic Log/Core Loss
- Core recovered (hatching indicates material)
- No core recovery

Weathering
- EW - Extremely Weathered
- HW - Highly Weathered
- MW - Moderately Weathered
- SW - Slightly Weathered
- F - Fresh

Strength
- EL - Extremely Low
- VL - Very Low
- L - Low
- M - Medium
- H - High
- VH - Very High
- EH - Extremely High

Defect Type
- FT - Fault
- SS - Shear Surface
- SZ - Shear Zone
- BP - Bedding parting
- SM - Seam
- IS - Infilled Seam
- JT - Joint
- CO - Contact
- CZ - Crushed Zone
- VN - Vein
- FZ - Fracture Zone
- BSH - Bedding Shear
- DB - Drilling Break

Infilling/Coating
- CN - Clean
- SN - Stain
- VN - Veneer
- CO - Coating
- RF - Rock fragments
- G - Gravel
- S - Sand
- Z - Silt
- CA - Calcite
- CL - Clay
- FE - Iron
- QZ - Quartz
- X - Carbonaceous

Roughness
- SL - Slickensided
- POL - Polished
- S - Smooth
- RF - Rough
- VR - Very Rough

Shape
- PR - Planar
- CU - Curved
- UN - Undulating
- ST - Stepped
- IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_CORE_BH_PSM PSM3029 BOREHOLES.GPJ <<DrawingFile>> 19/06/2016 18:49 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

UNSW

UNSW Cliffbrook Campus

Coogee, NSW

CORE PHOTOGRAPHY - BH01

Pells Sullivan Meynink

PSM3029-006R	Appendix A-1

Borehole ID

BH02

Page 1 of 2

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339208.0 m E 6246042.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	29.70 m		
Hole Diameter:	76 - 110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T						28.7	1			SAND: brown, coarse grained becomes light brown and yellow brown	M	MD		
										SANDSTONE: yellow brown, low to medium strength				
						27.7	2			Continued on cored borehole sheet				
						26.7	3							
						25.7	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_NONCORE_BH_NZ_AU PSM3029 BOREHOLES.GPJ <<DrawingFile>> 19/06/2016 18:47 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339208.0 m E 6246042.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	29.70 m		
Barrel Type and Length:	NMLC 3.5 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW HW MW SW F; Strength Is(50) ● - Axial ○ - Diametral EL <0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					28.7	1		Continued from non-cored borehole sheet			
NMLC		100	99	Is(50) d=0.2 a=0.3 MPa	27.7	2		SANDSTONE: grey, yellow and red, no distinct structure becomes laminated at 0° to 30°, distinct			IS 0° Rock fragments PR 40 mm
				Is(50) d=0.3 a=0.4 MPa	26.7	3		becomes grey and brown, laminated at 20°, distinct			
				Is(50) d=0.8 a=1.7 MPa	25.7	4		laminations indistinct			
				Is(50) a=2.2 MPa				Hole Terminated at 4.71 m			

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

See Explanatory Notes for details of abbreviations and basis of descriptions.

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

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UNSW

UNSW Cliffbrook Campus

Coogee, NSW

CORE PHOTOGRAPHY - BH02

Pells Sullivan Meynink

PSM3029-006R	Appendix A-2

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:		Logged By:	CF
Hole Position:		Checked By:	AS

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	27.40 m		
Hole Diameter:	76 - 110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T				ES2 0.80-1.00 m		26.4	1			SAND with trace gravel: dark brown, medium to coarse grained, gravel sub angular, 15 mm particle size, trace root fibres				0.00: Topsoil
										SAND with trace gravel: dark brown, medium to coarse grained, gravel sub angular, 15 mm particle size				
										becomes grey, coarse grained				
										becomes brown and yellow brown				
						25.4	2			becomes brown, yellow brown, orange brown, light brown and red	M	MD		
						24.4	3							
						23.4	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_NONCORE_BH_NZ_AU PSM3029 BOREHOLES.GPJ <<DrawingFile>> 24/06/2016 12:33 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:		Logged By:	CF
Hole Position:		Checked By:	AS

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	27.40 m		
Hole Diameter:	76 - 110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T										SAND: brown, yellow brown, orange brown, light brown and red, coarse grained	M	MD		
						21.4	6			SANDSTONE: red, brown and grey, extremely low strength low to medium strength				
										Continued on cored borehole sheet				
						20.4	7							
						19.4	8							
						18.4	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_NONCORE_BH_NZ_AU PSM3029 BOREHOLES.GPJ <<DrawingFile>> 24/06/2016 12:33 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339206.0 m E 6246012.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	27.40 m		
Barrel Type and Length:	NMLC 3.5 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW HW MW SW F; Strength Is(50) ● - Axial ○ - Diametral EL <0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					21.4	6		Continued from non-cored borehole sheet			
NMLC		95	98					NO CORE 150 mm			
				Is(50) d=0.3 a=0.6 MPa				SANDSTONE: red and grey, coarse grained, massive			IS 0° CL CO PR 50 mm
				Is(50) d=1.3 a=1.6 MPa	20.4	7		becomes brown, grey and red, laminated at 0° to 20°, distinct			
				Is(50) d=1.1 a=1.3 MPa				laminations become indistinct			
					19.4	8		laminations become distinct			BP 10° CN ST RF BP 10° CN PR RF
				Is(50) d=0.5 a=1.1 MPa							
				Is(50) d=1.3 a=1 MPa	18.4	9		Hole Terminated at 9.20 m			

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

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CORE PHOTOGRAPHY - BH03

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PSM3029-006R	Appendix A-3

Borehole ID

BH04

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339186.0 m E 6246013.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	28.40 m		
Hole Diameter:	76 - 110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T						27.4	1			SAND with trace gravel: dark brown, coarse grained, gravel sub angular, 15 mm particle size, trace root fibres top 100 mm				0.00: Topsoil/root fibres top 100 mm
										SAND: grey, coarse grained				
						26.4	2			becomes yellow brown and orange brown	M	MD		
						25.4	3							
						24.4	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_NONCORE_BH_NZ_AU PSM3029 BOREHOLES.GPJ <<DrawingFile>> 19/06/2016 18:48 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339186.0 m E 6246013.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	28.40 m		
Hole Diameter:	76 - 110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T						22.4	6			SAND: yellow brown and orange brown, coarse grained	M	MD		
						21.4	7					D		
						20.4	8			SANDSTONE: low to medium strength				
										Continued on cored borehole sheet				
						19.4	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_NONCORE_BH_NZ_AU PSM3029 BOREHOLES.GPJ <<DrawingFile>> 19/06/2016 18:48 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339186.0 m E 6246013.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	28.40 m		
Barrel Type and Length:	NMLC 3.5 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW HW MW SW F / Strength Is(50) ● - Axial ○ - Diametral EL <0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					22.4	6					
					21.4	7					
					20.4	8		Continued from non-cored borehole sheet			
NMLC		86	84	Is(50) d=1.2 a=1.1 MPa				SANDSTONE: brown and grey			JT 80° FE SN PR RF
					19.4	9		NO CORE 430 mm			
								SANDSTONE: brown and grey, coarse grained, laminated at 0° to 10°, distinct becomes massive			

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

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Engineering Log - Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339186.0 m E 6246013.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	28.40 m		
Barrel Type and Length:	NMLC 3.5 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW HW MW SW F / Strength Is(50) EL <0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH ● - Axial ○ - Diametral	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC		86	84	Is(50) d=1.3 a=1.1 MPa	17.4	11		SANDSTONE: grey, coarse grained, massive becomes laminated at 0° to 20°, indistinct			BP 20° CN IR RF BP 20° CN IR RF
				Is(50) d=1.5 a=1.8 MPa				brown staining, some shale and quartz clasts between 11.11m and 11.76 m			
					16.4	12		Hole Terminated at 11.76 m			
					15.4	13					
					14.4	14					

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

See Explanatory Notes for details of abbreviations and basis of descriptions.

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

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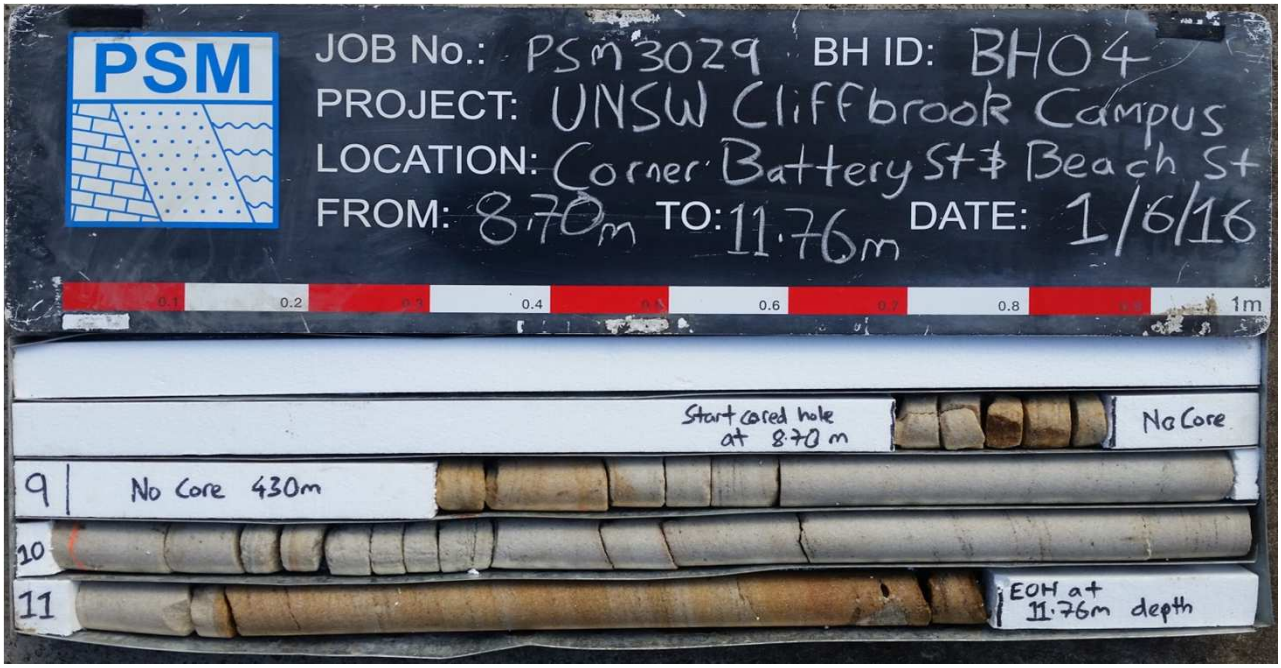

UNSW

UNSW Cliffbrook Campus

Coogee, NSW

CORE PHOTOGRAPHY - BH04

Pells Sullivan Meynink

PSM3029-006R	Appendix A-4

Borehole ID

BH05

Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339180.0 m E 6246055.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	31.50 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
HA				ES3 0.20-0.40 m						SAND: dark brown, coarse grained, trace root fibres				0.00: Topsoil
										SAND: yellow brown, coarse grained				
										becomes grey				
						30.5	1			becomes dark brown	M	MD		
										becomes yellow brown				
AD/T						29.5	2			SANDSTONE: grey and yellow brown, low to medium strength				
						28.5	3							
						27.5	4			low strength				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

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Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	01/06/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	01/06/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339180.0 m E 6246055.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	31.50 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T										SANDSTONE: grey and yellow brown, medium to high strength				
						25.5	6			Hole Terminated at 5.20 m				5.20: Refusal of TC bit auger
						24.5	7							
						23.5	8							
						22.5	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

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Borehole ID

BH06

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Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	31/05/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339135.0 m E 6246077.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	32.00 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density / Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T				Sample 1 B 0.20-1.50 m		31.0	1			Pavers SAND: yellow brown, coarse grained GRAVEL: grey, sub-angular, 20 mm particle size SAND: dark brown, coarse grained		MD D	
						30.0	2			becomes light grey, medium to coarse grained SAND with a trace of clay: light brown, coarse grained	M	MD	1.50: Glass returned to surface when auger removed from hole after drilling from 1.5 m to 2.0 m. Suspected drop in from higher within hole
						29.0	3			becomes grey and red	W		2.80: Sand returned to surface appears wet 3.00: Material below 3.0 m not returned to surface. Observations below this depth are from drilling. Sandstone assess from drilling resistance and particles at base of auger when removed form hole.
						28.0	4			SANDSTONE: medium strength Hole Terminated at 3.85 m			

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

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Borehole ID

BH07

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Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	31/05/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339128.0 m E 6246048.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	31.20 m		
Hole Diameter:	150 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T				Sample 3 B 0.03-0.25 m						Asphaltic Concrete				0.03: Roadbase
										GRAVEL with sand: grey, sub-angular, 20mm particle size, sand coarse grained		VD		0.24: Crushed sandstone within fill
										SAND with some gravel: brown, coarse grained, gravel sub rounded, 40 mm particle size		D		
				Sample 2 B 0.60-1.20 m						SAND: dark brown, coarse grained	M			
						30.2	1					MD		
				ES1 1.20-1.40 m						Brick fragments for 100 mm becomes grey and medium grained				
										Hole Terminated at 1.40 m				
						29.2	2							
						28.2	3							
						27.2	4							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

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Borehole ID

BH08

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Engineering Log - Non Cored Borehole

Project No.: PSM3029

Client:	UNSW	Commenced:	31/05/2016
Project Name:	UNSW Cliffbrook Campus	Completed:	31/05/2016
Hole Location:	45-51 Beach Street, Coogee, NSW	Logged By:	CF
Hole Position:	339165.0 m E 6246055.0 m N	Checked By:	

Drill Model and Mounting:	JK300	Inclination:	-90°	RL Surface:	30.50 m		
Hole Diameter:	150 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description				Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density; Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T				Sample 5 B 0.70-0.80 m Sample 4 B 0.90-1.50 m		29.5	1			Asphaltic Concrete GRAVEL: grey, sub-angular, 20mm particle size, sand coarse grained SAND with some gravel: brown, coarse grained, gravel sub rounded, 20 mm particle size SAND with some clay: light grey, light brown and orange brown, coarse grained no more clay, grey, brown and orange brown	M	VD MD	0.04: Roadbase
						28.5	2			Hole Terminated at 1.40 m			
						27.5	3						
						26.5	4						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

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EXPLANATION SHEET - SOIL DESCRIPTION

DEFINITIONS

Soil:
In engineering terms, soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

Classification symbol & soil name:
Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

Support:
C - Casing
T - Timbering

See rock description on Sheet 3 for method and samples / field test definitions.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

MOISTURE CONDITION

CONDITION	FIELD GUIDE
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere
Wet	As for moist but with free water forming on hands when handles

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH SU (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort
Soft	12 – 25	A finger can be pushed into the soil to about 25mm depth
Firm	25 – 50	The soil can be indented about 5mm with the thumb, but not penetrated
Stiff	50 – 100	The surface of the soil can be indented with the thumb, but not penetrated
Very Stiff	100 – 200	The surface of the soil can be marked, but not indented with thumb pressure
Hard	>200	The surface of the soil can be marked only with the thumbnail

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	<15
Loose	15 – 35
Medium Dense	35 – 65
Dense	65 – 85
Very Dense	>85

Where no SPT data, the following descriptions are used:

Loose: Can be removed from exposure by hand in a disaggregated form.

Compact (C) Only removed from exposure with an implement, material readily disaggregated by physical means.

Cemented (Ce) Only removed from exposure with an implement, material cannot be disintegrated / remoulded in air/ water.

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure of sample	**Weakly Cemented**	Easily broken up by hand in air or water
Lenses	Discontinuous layers of lenticular shape	**Moderately Cemented**	Effort is required to break up the soil by hand in air or water
Pockets	Irregular inclusions of different material	**Cemented**	Only removed from exposure by implement, material does not disaggregate
		Compact	Only removed from exposure by implement, material readily disaggregated by physical means

GEOLOGICAL ORIGIN

Weathered in place soils:

Extremely weathered — Structure and fabric of parent rock visible

Residual Soil — Structure and fabric of parent rock not visible

Transported soil:

Aeolian — Deposited by wind

Alluvium — Deposited by streams and rivers

Colluvium — Deposited on slopes (transported downslope by gravity)

Lacustrine — Deposited by lakes

Marine — Deposited in ocean basins, bays, beached and estuaries

Man Made:

Fill — Fill may be significantly more variable between tested locations than naturally occurring soils

EXPLANATION SHEET - SOIL DESCRIPTION

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 60 mm AND BASING FRACTIONS ON ESTIMATED MASS)*							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(About the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**Dry strength**	**Dilatancy**	**Toughness**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOIL Readily identified by colour, odour, spongy feel and frequently by fibrous texture							Pt	PEAT
• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.								

*Taken from AS1726 (1993)

COMMON DEFECTS IN SOIL

TERM	DEFINITION
Parting	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (e.g. bedding). May be open or closed.
Joint	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.
Sheared Zone	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.
Sheared Surface	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.
Softened Zone	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.
Tube	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter
Tube Cast	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases, the soil that makes up the tube cast is cemented.
Infilled Seam	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries that cuts through a soil mass. Formed by infilling of open joints.

EXPLANATION SHEET - ROCK DESCRIPTION

DEFINITIONS

Rock Substance:
In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material may be isotropic or anisotropic.

Defect:
Discontinuity or break in the continuity of a substance or substances.

Mass:
A body of material that is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

Method:

AD/T	Auger drilling with tcbit
AD/V	Auger drilling with vbit
AS	Auger screwing
AT	Air track
B	Dozer blade
BH	Backhoe bucket
CT	Cable tool
DB	Washbore drag bit
DT	Diatube
E	Excavator
EH	Excavator with hammer
HA	Hang auger
HMLC	HMLC core barrel
HQ3	Coring 63.5mm diameter, triple tube, wireline
MZ	Mazier
N	Natural exposure
NMLC	NMLC core barrel
NQ3	Coring 45.1mm diameter, triple tube, wireline
PQ3	Coring 83.1mm diameter, triple tube, wireline
Pushed SPT	Pushed SPT
PT	Push tube
R	Ripper
RR	Rock roller
SPT	Driven SPT
WB	Washbore
X	Existing excavation

Core Quality:

TCR	Total Core Recovered (%)
RQD	Rock Quality Designation (%)

Samples and Field Tests:

B	Bulk Disturbed Sample
BLK	Block sample
C	Core sample
CBR	CBR mould sample
D	Small disturbed sample
ES	Soil sample for environmental testing
EW	Water sample for environmental testing
G	Gas sample
LB	Large bulk disturbed sample
M	Mazier type sample
P	Piston sample
SPT	Standard Penetration Test
U	Undisturbed push in sample
W	Water sample

Rock Strength:

A	Axial point load test result (Is50)
D	Diametral point load test result (Is50)

Water:

▷ Inflow
◁ Partial Loss
◀ Complete Loss

SUBSTANCE DESCRIPTIVE TERMS

Rock name:
Simple rock names are used rather than precise geological classification

Particle size (for sandstone):
Coarse - Mainly 0.6mm to 2mm
Medium - Mainly 0.2mm to 0.6mm
Fine - Mainly 0.05mm (just visible) to 0.2mm

Fabric:
Massive - No layering or penetrative fabric
Indistinct - Layering or fabric visible. Little effect on properties
Distinct - Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric

Bedding:
Thinly Laminated - <6mm
Laminated - 6 – 20mm
Very Thinly Bedded - 20 – 60mm
Thinly Bedded - 60 – 200mm
Medium Bedded - 200 – 600mm
Thickly Bedded - 600 – 2000mm
Very Thickly Bedded - >2000mm

ROCK SUBSTANCE STRENGTH

ABBR	TERM	POINT LOAD INDEX, IS50 (MPA)	FIELD GUIDE
EL	Extremely Low	≤0.03	Easily remoulded by hand to a material with soil properties
VL	Very Low	>0.03≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
L	Low	>0.1≤0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	>0.3≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
H	High	>1≤3	A piece of core 150mm long by 50mm cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
VH	Very High	>3≤10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break; rock rings under hammer.

EXPLANATION SHEET - ROCK DESCRIPTION

CLASSIFICATION OF WEATHERING

ABBR	TERM	FIELD GUIDE
F	Fresh	Rock substance unaffected by weathering
SW	Slightly Weathered	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance
MW	Moderately Weathered	The whole of the rock substance is discoloured, usually by iron staining or bleaching, to the extent that the colour of the fresh rock is no longer recognisable.
HW	Highly Weathered	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
EW	Extremely Weathered	Material is weathered to such an extent that it has soil properties, i.e.; it either disintegrates or can be remoulded in water. Original rock fabric still visible.

COMMON DEFECTS IN ROCK MASS

ABBR	TERM	FIELD GUIDE
FT	Fault	Fracture long which displacement is recognisable
SS	Shear Seam	A fracture along which movement has taken place but no displacement is recognisable. Evidence for movement may be slickensides, polishing and/or clay gouge
SZ	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
BP	Bedding Parting	Arrangement in layers of mineral grains or crystals parallel to surface of deposition along which a continuous observable parting occurs
SM	Seam	Seam of soil substance, often with gradational boundaries. Formed by weathering of the rock substance in place
IS	Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface
JT	Joint	A single fracture across which rock has little or no tensile strength and is not obviously related to rock fabric
CO	Contact	Surface between two lithologies
CZ	Crushed Zone	Zone with roughly parallel, planar boundaries (commonly slickensided) containing disoriented usually angular rock fragments of variable size often in a soil matrix.
VN	Vein	Fracture in which a tabular or sheet-like body of minerals have been intruded
FZ	Fractured Zone	A zone of closely spaced defects (mainly joints, bedding, cleavage and/or schistosity) comprised of core lengths in the order of 50mm or less.
BSH	Bedding Shear	A shear formed along a bedding plane
DB	Drilling Break	Drilling induced break

SHAPE TERMS

ABBR	TERM	FIELD GUIDE
PR	Planar	The defect does not vary in orientation
CU	Curved	The defect has a gradual change in orientation
UN	Undulating	The defect has a wavy surface
ST	Stepped	The defect has one or more well defined steps
IR	Irregular	The defect has many sharp changes of orientation

ROUGHNESS TERMS

ABBR	TERM	FIELD GUIDE
SL	Slickensided	Grooved or striated surface, usually polished
POL	Polished	Shiny smooth surface
S	Smooth	Smooth to touch. Few or no surface irregularities
RF	Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
VR	Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

ABBR	TERM	FIELD GUIDE
CN	Clean	No visible coating
SN	Stained	No visible coating but surfaces are discoloured
VN	Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
CO	Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (e.g., infilled seam). Thicker rock strength material is usually described as a vein

INFILLING MATERIAL

ABBR	TERM
CA	Calcite
CL	Clay
Fe	Iron Oxide
Fe Clay	Iron Oxide Clay
KT	Chlorite
MS	Secondary Mineral
MU	Unidentified Mineral
Qz	Quartz
X	Carbonaceous
RF	Rock fragments
G	Gravel
S	Sand
Z	Silt

APPENDIX B

POINT LOAD INDEX TEST RESULTS

Pells Sullivan Meynink

POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. *PSM3029* **Sheet** 1 **of** 1

Project *Cliffbrook Campus Redevelopment*

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique		Sampling Date	*1/6/2016*
		Storage History	*North Ryde office indoor core storage area*	Testing Date	*2/06/2016*
Test Machine	*GSA 6500*	Moisture Condition		Tested By	*OS*
Calibration Date	*3/12/2012*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial, Block, and Irregular Lump Tests							AS 1726 Strength Class
			D	L	P	$I_{s(50)}$	Failure Mode	W	D	L	P	I_s	$I_{s(50)}$	Failure Mode	
		(m)	(mm)	(mm)	(kN)	(MPa)		(mm)	(mm)	(mm)	(kN)	(MPa)	(MPa)		
Sandstone	***BH01***	***1.70***	*50*	*80*	*1.2*	***0.5***	*Parallel to bedding*	*50*	*28*		*1.1*	*0.6*	***0.6***	*Through substance*	***M***
Sandstone	***BH01***	***2.82***	*50*	*80*	*0.8*	***0.3***	*Parallel to bedding*	*50*	*45*		*1*	*0.3*	***0.3***	*Through substance*	***M***
Sandstone	***BH01***	***3.50***	*50*	*140*	*3.4*	***1.4***	*Parallel to bedding*	*50*	*44*		*3.1*	*1.1*	***1.1***	*Through substance*	***H***
Sandstone	***BH01***	***4.58***	*50*	*160*	*2.7*	***1.1***	*Parallel to bedding*	*50*	*45*		*2.4*	*0.8*	***0.9***	*Through substance*	***M / H***
Sandstone	***BH01***	***5.45***	*50*	*125*	*1.6*	***0.6***	*Parallel to bedding*	*50*	*44*		*2.5*	*0.9*	***0.9***	*Through substance*	***M***
Sandstone	***BH02***	***1.68***	*50*	*55*	*0.6*	***0.2***	*Parallel to bedding*	*50*	*35*		*0.6*	*0.3*	***0.3***	*Through substance*	***L***
Sandstone	***BH02***	***2.60***	*50*	*70*	*0.7*	***0.3***	*Parallel to bedding*	*50*	*33*		*0.9*	*0.4*	***0.4***	*Through substance*	***L / M***
Sandstone	***BH02***	***3.57***	*50*	*95*	*2*	***0.8***	*Parallel to bedding*	*50*	*26*		*3.1*	*1.8*	***1.7***	*Through substance*	***M / H***
Sandstone	***BH02***	***4.50***	*50*	*80*	*2.5*	***1***	*Along defect*	*50*	*40*		*5.6*	*2.2*	***2.2***	*Through substance*	***H***
Sandstone	***BH03***	***6.60***	*50*	*68*	*0.7*	***0.3***	*Parallel to bedding*	*50*	*25*		*1*	*0.6*	***0.6***	*Through substance*	***L / M***
Sandstone	***BH03***	***6.90***	*50*	*115*	*3.3*	***1.3***	*Parallel to bedding*	*50*	*44*		*4.4*	*1.6*	***1.6***	*Through substance*	***H***
Sandstone	***BH03***	***7.70***	*50*	*230*	*2.6*	***1.1***	*Parallel to bedding*	*50*	*45*		*3.7*	*1.3*	***1.3***	*Through substance*	***H***
Sandstone	***BH03***	***8.36***	*50*	*120*	*1.4*	***0.5***	*Parallel to bedding*	*50*	*30*		*2.2*	*1.2*	***1.1***	*Through substance*	***M / H***
Sandstone	***BH03***	***9.05***	*50*	*75*	*3.3*	***1.3***	*Parallel to bedding*	*50*	*30*		*2*	*1.1*	***1***	*Through substance*	***H***
Sandstone	***BH04***	***9.40***	*50*	*1000*	*2.9*	***1.2***	*Parallel to bedding*	*50*	*30*		*2.3*	*1.2*	***1.1***	*Through substance*	***H***
Sandstone	***BH04***	***10.40***	*50*	*100*	*3.3*	***1.3***	*Parallel to bedding*	*50*	*45*		*3.1*	*1.1*	***1.1***	*Through substance*	***H***
Sandstone	***BH04***	***11.18***	*50*	*220*	*3.8*	***1.5***	*Parallel to bedding*	*50*	*45*		*5.1*	*1.8*	***1.8***	*Through substance*	***H***

By: ***OS*** **Checked:** ***CF*** **Date:** ***2/6/2016***

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

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

Client: PSM Admin Pty Ltd
Project: PSM 3029

Ref No: L3903
Report: A
Report Date: 15/06/2016
Page 1 of 1

AS 1289	TEST METHOD		2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
SAMPLE NUMBER	BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
05	8	NA	13.4	NP	NP	NA	NA

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 8/06/2016
- NP refers to Non Plastic
- NA refers to Not Applicable

NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025.
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Authorised Signature / Date
(A. Tatikonda) 15/6/16

All services provided by STS are subject to our standard terms and conditions. A copy is available on request.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: PSM Admin Pty Ltd
Project: PSM 3029

Ref No: L3903
Report: B
Report Date: 15/06/2016
Page 1 of 1

SAMPLE NUMBER	01	02	04
BOREHOLE NUMBER	6	7	8
DEPTH (m)	0.20 - 1.50	0.00 - 0.00	0.90 - 1.50
Surcharge (kg)	4.5	4.5	4.5
Maximum Dry Density (t/m^3)	1.79 STD	1.83 STD	1.79 STD
Optimum Moisture Content (%)	12.7	12.0	12.4
Moulded Dry Density (t/m^3)	1.76	1.80	1.75
Sample Density Ratio (%)	98	98	98
Sample Moisture Ratio (%)	98	98	102
Moisture Contents			
Insitu (%)	9.2	6.3	9.3
Moulded (%)	12.4	11.8	12.7
After soaking and			
After Test, Top 30mm(%)	13.9	13.7	14.0
Remaining Depth (%)	14.1	13.3	14.4
Material Retained on 19mm Sieve (%)	0	0	0
Swell (%)	0.0	0.0	0.0
C.B.R. value: @2.5mm penetration			30
@5.0mm penetration	20	25	

NOTES:

- Refer to appropriate notes for soil descriptions
- Test Methods :
  - (a) Soaked C.B.R. : AS 1289 6.1.1
  - (b) Standard Compaction : AS 1289 5.1.1
  - (c) Moisture Content : AS 1289 2.1.1
- Date of receipt of sample: 8/06/2016

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Authorised Signature / Date
(A. Tatikonda) 15/6/16

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115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001
Email: dtreweek@jkgroup.net.au

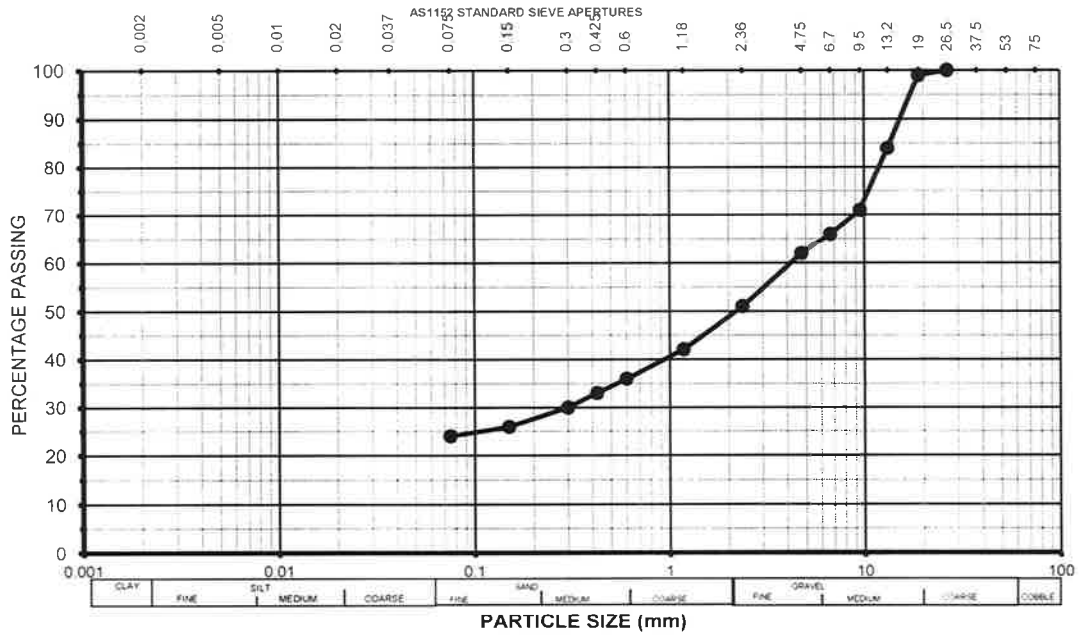
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION REPORT

Client: PSM Admin Pty Ltd
Project: PSM 3029

Ref No: L3903
Report No: C
Report Date: 15/06/2016
Page 1 of 1

Sample Number: 03



SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
26.5 mm	100
19.0 mm	99
13.2 mm	84
9.50 mm	71
6.70 mm	66
4.75 mm	62
2.36 mm	51
1.18 mm	42
600 µm	36
425 µm	33
300 µm	30
150 µm	26
75 µm	24

Test Method: AS1289.3.6.1 & 3.6.3 Dry Sieve (washed)

• Notes:

• Please refer to appropriate notes for soil descriptions

NATA
NATA Accredited Laboratory
Number:1327

Approved Signatory / Date
15/6/16
(A. Tatikonda)

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APPENDIX D

SALINITY AND AGGRESSIVITY LABORATORY TEST RESULTS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1612071**	Page	: 1 of 3
Client	: **PELLS SULLIVAN MEYNINK PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: CHRISTOPHER FERNANDEZ	Contact	:
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	:	Date Samples Received	: 06-Jun-2016 12:20
Order number	: PSM3029	Date Analysis Commenced	: 07-Jun-2016
C-O-C number	: ----	Issue Date	: 14-Jun-2016 13:23
Sampler	: CHRISTOPHER FERNANDEZ		
Site	: ----		
Quote number	: ----		
No. of samples received	: 3		
No. of samples analysed	: 3		

NATA Accredited Laboratory 825
Accredited for compliance with
ISO/IEC 17025.

NATA
WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW
RICHARD TEA	Lab technician	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	ES1	ES2	ES3	----	----
			Client sampling date / time	31-May-2016 10:50	01-Jun-2016 09:45	01-Jun-2016 12:20	----	----
Compound	CAS Number	LOR	Unit	ES1612071-001	ES1612071-002	ES1612071-003	--------	--------
				Result	Result	Result	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**8.6**	**7.8**	**6.6**	**----**	**----**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**139**	**21**	**11**	**----**	**----**
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	**451**	**69**	**37**	**----**	**----**
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	**2.4**	**4.9**	**2.4**	**----**	**----**
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	**1.0**	**0.8**	**----**	**----**	**----**
Exchangeable Magnesium	----	0.2	meq/100g	<0.2	<0.2	**----**	**----**	**----**
Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	**----**	**----**	**----**
Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	**----**	**----**	**----**
Cation Exchange Capacity	----	0.2	meq/100g	**1.0**	**0.8**	**----**	**----**	**----**
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**----**	**----**	**0.6**	**----**	**----**
Exchangeable Magnesium	----	0.1	meq/100g	**----**	**----**	**0.1**	**----**	**----**
Exchangeable Potassium	----	0.1	meq/100g	**----**	**----**	<0.1	**----**	**----**
Exchangeable Sodium	----	0.1	meq/100g	**----**	**----**	<0.1	**----**	**----**
Cation Exchange Capacity	----	0.1	meq/100g	**----**	**----**	**0.8**	**----**	**----**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**70**	<10	<10	**----**	**----**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	**----**	**----**

APPENDIX E

SELECTED SITE PHOTOS

Photo 1 - Looking south east at JK300 drill rig set up at BH01

Photo 2 - Looking east towards BH08 (Drill rig setting up at BH08)

UNSW

UNSW Cliffbrook Campus

Coogee, NSW

SELECTED PHOTOS (PAGE 1 OF 4)

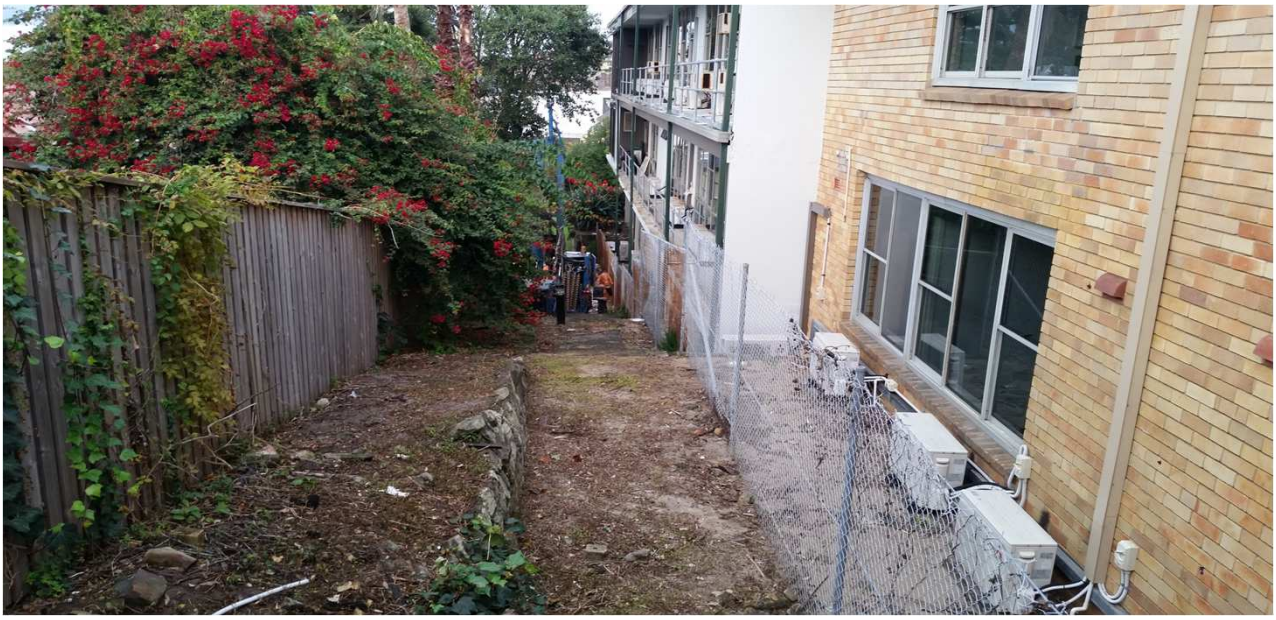

Photo 3 - Looking south towards BH02 with drill rig set up over hole

Photo 4 - Looking north towards BH02 location

UNSW

UNSW Cliffbrook Campus

Coogee, NSW

SELECTED PHOTOS (PAGE 2 OF 4)

Photo 5 - Looking west along the northern side of Building CC4

Photo 6 - Looking east towards BH03 and BH04 locations

UNSW
UNSW Cliffbrook Campus
Coogee, NSW

SELECTED PHOTOS (PAGE 3 OF 4)

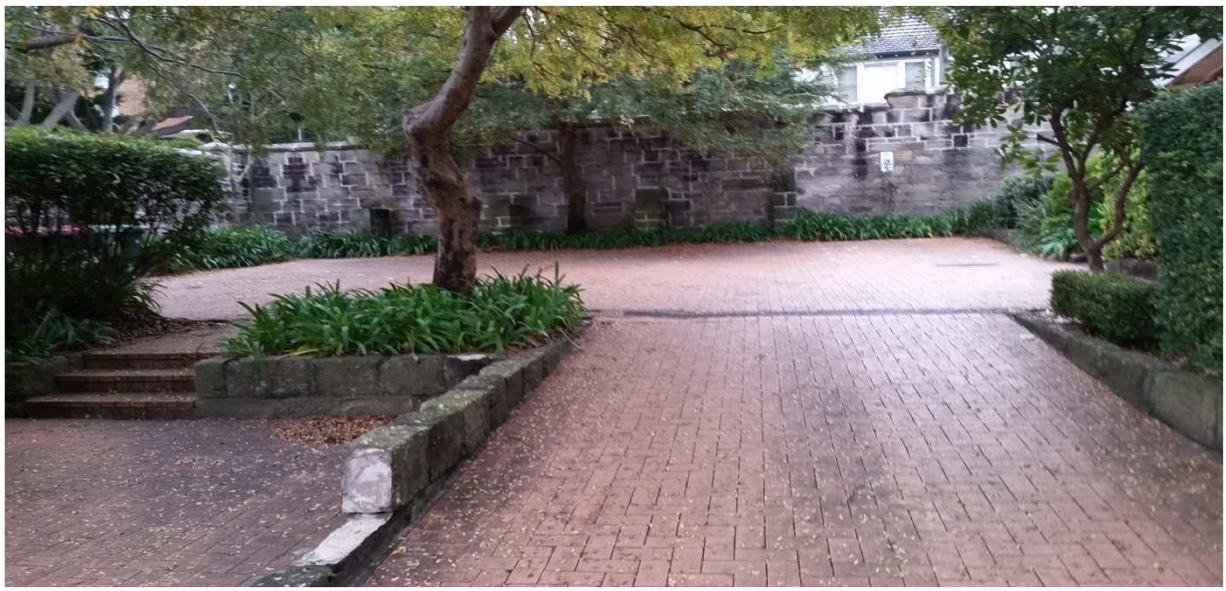

Photo 7 - Looking north towards BH06 location

Photo 8 - Looking south towards BH07 location

UNSW

UNSW Cliffbrook Campus

Coogee, NSW

SELECTED PHOTOS (PAGE 4 OF 4)

Pells Sullivan Meynink

PSM3029-006R	Appendix E - 4

APPENDIX F

JBS&G PRELIMINARY SITE INVESTIGATION

Pells Sullivan Meynink

Preliminary Site Investigation

UNSW's Cliffbrook Campus Redevelopment Project
Corner of Battery and Beach Streets,
Coogee, NSW

5 August 2016

51707-104373 (Rev 1)

JBS&G

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Pells Sullivan Meynink
Preliminary Site Investigation

UNSW's Cliffbrook Campus Redevelopment Project
Corner of Battery and Beach Streets,
Coogee, NSW

5 August 2016

51707-104373 (Rev 1) (Rev 1)
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