Our Ref: PSM4240-004L REV2

5 February 2021

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

JBS&G
Level 1
50 Margaret Street
SYDNEY NSW 2000
SGunatunge@jbsg.com.au

Attention: Sahani Gunatunge

Dear Sahani

RE: TAFE NSW - WESTERN SYDNEY CONSTRUCTION HUB GEOTECHNICAL INVESTIGATION

1 Introduction

This report has been prepared to accompany a detailed State Significant Development Application (SSDA) SSD_ 8571481 for the development of an educational facility at the TAFE Nepean Kingswood Campus, located at 2-44 O'Connell Street, Kingswood (the site). The legal description of the site is Lot 1 in DP 866081. The site comprises a rectangular lot with an area of approximately 23 hectares. The SSDA seeks development consent for the construction and operation of the TAFE NSW Construction Centre of Excellence (TAFE CCoE) a multi-level, integrated educational facility designed to accommodate specialised training and education for construction-related TAFE NSW courses (the project).

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (SEARs) issued for the project. As per the "Plans and Documents" section of the SEARs, the Environmental Impact Statement (EIS) for the project must include a Geotechnical Report.

The purpose of this report is to present the results of the geotechnical investigation undertaken by Pells Sullivan Meynink (PSM) for the proposed development Figure 1 presents the locality plan of the site. The whole site area is 23 hectare shown by the red boundary in Inset 1, however, the geotechnical investigation area in this letter is the 'Construction Site – Zone 1', bound by the blue boundary shown in Inset 1 (9.5-hectare L-shaped site). It is noted that the north-western corner does not need to be addressed as there is no scope of works in this location as per Section 3.2 of the Request for quotation (RFQ).

Inset 1: : Site location and the site investigation zone bound by the blue dashed zone (left) and the proposed building footprint (right)

The work was undertaken in accordance with PSM proposal dated 7 October 2020 (Ref. PSM4240-001L).

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

- TAFE NSW Request for quotation (RFQ) – Part A to Part D documents
- Development plan drawing provided by Cadence Australia Pty Ltd (drawing Ref. SK0005).

The investigation has been targeted based on the proposed developments described in the RFQ – Part B – Scope of Works.

We understand the following about the proposed development within the 'Construction Site – Zone 1' of the RFQ, based on the documents provided:

- The site will be prepared by tree removal and excavation
- A 2-3 storey Construction Hub, accommodating approximately 9,200 m^2 of GFA, will be built to the east of the site
- Additional on-grade car parking will be developed to the south of the proposed Construction Hub with the associated vehicular access road and potential / reconfigured car park spaces to the south of the Project site
- Landscaping works.

The existing civil drawings indicate that there could be cuttings up to 5 m deep for the proposed civil works for the stormwater system, and up to approximately 3.5 m deep for the proposed "Construction Hub" building. The FFL is at RL 51.70 m. The Civil drawings also indicate that there will be up to 2 m fill associated with the proposed stormwater system works.

2 Geotechnical Site Investigation

2.1 Outline

Ten (10) boreholes were drilled over two (2) days (18th and 19th November 2020) using a track mounted geotechnical drill rig. The boreholes were drilled to a final depth of between 1 m and 14.5 m.

All boreholes were advanced to practical refusal using an auger with a V bit subsequently to practical refusal practical refusal or target depth using a TC bit. Two boreholes (BH01 and BH02) within the footprint of the proposed Construction Hub building, were advanced upon the TC bit refusal with NMLC triple tube coring to recover rock core within bedrock to a minimum depth of 8 m.

A standpipe piezometer was installed in borehole BH02 upon the completion of the drilling.

The fieldwork was undertaken under the full-time supervision of a PSM experienced geotechnical engineer, who undertook the following tasks:

- Preparing field logs of material encountered in the boreholes
- Collecting samples for laboratory and analytical testing
- Taking photographs of the site and recovered rock cores
- Performing point load strength index tests on recovered rock core at approximately 1 m intervals and Standard Penetration Testing (SPT) within the soil and/or residual units.

Each borehole location was measured using a handheld GPS unit with a horizontal accuracy of +/- 5m. The PSM borehole locations are shown on Figure 1. The borehole surface levels were estimated using the drawing Ref. SK0005 including the proposed site plan and contours of the ground surface RL, reproduced in this letter as Appendix A..

Following completion of the fieldwork the boreholes were backfilled with the cuttings and lightly tamped.

Engineering logs of the boreholes, including core photographs, are presented in Appendix B The results of the point load strength index tests are presented in Appendix C.

2.2 Laboratory Testing

Two (2) bulk disturbed soil samples were collected on site and sent to a NATA accredited geotechnical laboratory to complete California Bearing Ratio (CBR) testing. The CBR tests were undertaken on 4 day soaked samples with a 4.5 kg surcharge to 98% SMDD. Summary of the CBR test results are presented in Table 1

Table 1 – Summary of CBR test results

Borehole ID	Depth [m]	CBR [%]	Field Moisture Content [%]	Standard Maximum Dry Density [t/m^3]	Optimum Moisture Content [%]	Swell [%]
BH07	0.5 – 1.0	3	14.5	1.65	19.3	3.0
BH09	0.2 – 0.6	17	9.1	1.84	14.4	0.5

Three (3) disturbed soil samples from the boreholes within the proposed paved areas including carpark areas were collected on site and sent to a NATA accredited environmental laboratory to undertake analytical laboratory testing to assess the pH and presence of sulphates. Table 2 presents the results of these laboratory testing.

Table 2 – Summary of soil aggressivity (pH and Sulphate) test results

Borehole ID	Depth [m]	Soil pH	Resistivity* [ohm cm]	Moisture Content [%]	Soluble Sulphate ** [mg/kg]	Chloride by Discrete Analyser [mg/kg]
BH02	0.4 - 0.5	7.5	22200	14.8	10	<10
BH03	0.4 – 0.5	7.3	20400	13.8	<10	<100
BH09	0.4 – 0.5	8.9	5290	16.8	10	20

Notes: * Resistivity at 25°C

** Sulphate (as SO4) by method ED040S: Soluble Sulphate by ICPAES

Two (2) undisturbed soil samples were also taken during the borehole drilling, sealed immediately and sent to a NATA accredited geotechnical laboratory to complete shrink-swell index testing for soil reactivity based on AS1289.7.1.1. Table 3 presents the results of these laboratory tests.

Table 3 – Summary of shrink-swell test results

Borehole ID	Depth [m]	Shrink Swell Index [%/pF]
BH02	0.4	2.02
BH10	0.2	2.39

The analytical laboratory test reports are included in Appendix D..

3 Site Conditions

3.1 Geological Setting

The 1:100,000 Penrith Geological map (1991) indicates the site is underlain by:

- The Wianamatta Group formation (Bringelly Shale - *Rwb*) Shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal, and tuff.

Inset 2: Geological map of the site

3.2 Surface Conditions

The site is bounded by O'Connell Street to the West, the Great Western Highway to the North, and green areas to the East and South. At the time of the fieldwork, the following observations were made:

- The majority of the site (Construction Site – Zone 1) consisted of greenfield regions (grassy areas with some trees) with the southern areas covered mainly by existing buildings, paved on-grade car parking and access roads
- The surface elevation increased from west to east, and from north to south of the site.

Figures 2 to 4 present selected photos taken during the fieldwork.

3.3 Subsurface Conditions

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

Table 4 – Summary of inferred subsurface conditions encountered in PSM boreholes

Inferred Geotechnical Unit	Encountered depth to top of inferred unit [m]	Description
Topsoil	0.0	Sandy CLAY: low to medium plasticity, brown to dark brown, fine grained sand, trace gravel up to 5mm, sub-angular, with some rootlets
Natural Soil	0.1 to 0.2	CLAY: medium plasticity, brown and mottled orange-pale grey, minor rock fabric and shale fragments observed
Bedrock A	0.6 to 4.1	SHALE: Orange-grey and brown, extremely too highly weathered, very low strength.
Bedrock B	1.0 to 7.3	SHALE: grey to dark grey, thinly laminated, sub-horizontal, moderately weathered to fresh, low to medium strength

Table 5 presents the elevations of the inferred geotechnical units encountered in the PSM boreholes.

Table 5 - Inferred elevation of top of inferred geotechnical units encountered in PSM boreholes

Borehole ID	Inferred elevation of top of inferred geotechnical units [mRL]				
	TOPSOIL	NATURAL SOIL	BEDROCK A	BEDROCK B	EOH
BH01	51.0	50.8	46.9	45.5	42.5
BH02	54.4	54.3	51.5	47.1	39.9
BH03	49.0	48.8	47.4	N.E.	44.0
BH04	54.3	54.1	51.3	49.9	49.3
BH05	46.0	45.8	44.4	41.6	41.0
BH06	48.6	48.4	45.9	N.E.	43.6
BH07	55.0	54.8	53.1	51.4	50.0
BH08	58.1	58.0	57.5	57.1	57.1
BH09	62.0	61.9	61.3	60.2	60.0
BH10	49.5	49.3	47.1	N.E.	44.5

Note: EOH = End of hole
N.E. = Not Encountered

3.4 Groundwater

No groundwater seepage was observed during the auguring of the boreholes. We note that water was introduced during the coring, so no groundwater observations were possible in the cored boreholes.

The groundwater level in the standpipe piezometer at BH01 was measured on 26 November 2020. The measured groundwater level was at 3.46m depth below ground surface.

4 Discussion and Recommendations

4.1 Site Classification

The proposed development (multi storey building) is outside the scope of Australian Standard AS 2870 (2011) *Residential slabs and footings – Construction.* We recommend that structures within scope of AS2870 be designed for a site classification of Class "H1". The civil and structural engineers should consider likely heave or settlement due to the effect of climatic factors in their designs.

4.2 Soil Aggressivity and acid Sulphate Soils

Table 4.8.1 of AS3600 (2009) "Concrete Structures" provides criteria for exposure classification for concrete in sulphate soils based on sulphates in soil and groundwater, and pH of soil. On the basis of the sulphate and pH testing completed, we assess the exposure classification for concrete in sulphate soils to be A1.

Table 6.4.2(C) of Australian Standard AS2159 (2009), Piling – Design and Installation provides criteria for exposure classification for concrete piles in soil, and here the exposure classification for concrete piles in soil is "non-aggressive".

Table 6.5.2(C) of Australian Standard AS2159 (2009), Piling – Design and Installation provides criteria for exposure classification for steel piles 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".

We understand discussion regarding acid sulphate soils is included in the JBS&G environmental report. JBS&G Preliminary Site Investigation (PSI) did not identify the presence of acid sulphate soils at the site (based on desktop assessment). Based on our review, the site is not within the NSW government acid sulphate soil risk map.

4.3 Earthworks

We have prepared an earthworks specification for in the proposed development. The Specification is presented in Appendix E (PSM4240-005S).

4.4 Temporary and Permanent Batters

The batter slope angles shown in Table 6 are recommended for the design of batters up to a nominal 3 m height: subject to the following recommendations:

1. All batters shall be protected from erosion.
2. Permanent batters shall be drained.
3. Temporary batters shall not be left unsupported for more than 3 months without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events.
4. Where loads are imposed or structures/services are located within one batter height of the crest of the batter, further advice should be sought.

If the conditions above cannot be met, further advice should be sought.

Steeper batters may be possible subject to further advice, likely including inspection during construction.

Table 6 – Batter slope angles

Unit	Temporary	Permanent
ENGINEERED FILL / Natural Soil	1.5H : 1V	2H : 1V
Bedrock units (i.e. Unit A and B)	1H : 1V	1.5H : 1V

4.5 Retention

Cuts in the Soil and Bedrock unit's steeper than the recommended permanent batter slopes in Table 6 will need to be supported by some form of retaining structure.

The design of these structures should be based on the following geotechnical properties:

- Effective soil strength parameters in Table 7
- A lateral pressure of 10 kPa for vertical cuts in the BEDROCK unit. This is to allow for blocks and rock wedges formed due to adverse defects that may exist within the unit
- Surcharge loads behind the retention
- Water pressure (depending on the type of structure).

Note that design of retention systems may be based on either K_a or K_o earth pressures. Design using active earth pressures (K_a) provides the minimum lateral earth pressure that must be supported to avoid failure and requires a wall that can rotate or translate to allow the pressures to reduce to these values (vertical and lateral movements up to 2% of height may occur, typical movements will be much less).

Where the design is based on K_o pressures, construction should be carefully controlled to avoid unwanted effects. It should be noted that designing for K_o pressures does not, of itself, ensure that movement does not occur. Movements are controlled by the construction method, especially sequence.

Both surface and sub-surface drainage needs to be designed and constructed properly to prevent pore water pressures from building up behind the retaining walls or appropriate water pressures must be included in the design.

Where excavations are proposed in the vicinity of existing structures designers shall consider the effects of the excavation including horizontal and vertical deflections on the neighbouring structures. Excavation near existing building should not undermine the existing footings and structures.

4.6 Foundations

4.6.1 Shallow Footings

Pad footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads provided in Table 7.

We note that an allowable bearing pressure (ABP) is not a soil property. It depends on many factors such as the size of the footings, the embedment depth, the load direction and eccentricity, the stiffness of the footing, the adopted factor of safety (FOS), as well as the soil properties. As footings get bigger or deeper the capacity increases rapidly, as the load gains eccentricity or becomes inclined, the capacity reduces rapidly. Higher ABPs in the Natural Soil unit may be available, but these depend on the size, depth, loads, etc., and would be subject to specific advice.

Settlements in the NATURAL SOIL unit can be estimated using the elastic parameters provided in Table 7 Typically a footing founded on the NATURAL SOIL unit and sized for the ABP in Table 7 could be expected to settle between 1% and 2% of the minimum footing dimension.

Foundations conditions at the proposed shallow pad footings locations should be inspected by a suitable qualified geotechnical engineer prior to the pouring of concrete.

Table 7 - Foundation parameters of inferred geotechnical units

Inferred Unit	Bulk Unit Weight [kN/m^3]	Effective Soil Strength Parameters		Ultimate Bearing Pressure Under Vertical Centric Loading[3] [kPa]	Allowable Bearing Pressure (ABP) Under Vertical Centric Loading[4] [kPa]	Ultimate Shaft Adhesion [kPa]	Elastic Parameters	
		Effective cohesion, C′[kPa]	Effective friction angle, φ′ [deg]				Long Term Young Modulus [MPa]	poisson's Ratio
ENGINEERED FILL / Natural Soil	18	0	30	400	150[1]	N/A	10	0.3
				600	200[2]			
Bedrock A	24	N/A	N/A	3,000	700	150	50	0.3
Bedrock B	24	N/A	N/A	8,000	2,000	350	300	0.25

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 Pad footings (for ABP of 200 kPa) should have a minimum horizontal dimension of 1.5 m and a minimum embedment depth of 0.7 m.

3 Ultimate values occur at large settlement (>5% of minimum footing / pile dimensions).

4 End bearing pressure to cause settlement of <1% of minimum footing / pile dimensions.

4.6.2 Piles

We envisage that piles would be founded within the Bedrock A or Bedrock B units.

Piles should be designed in accordance with the requirements in AS 2159 (2009), *Piling – Design and Installation.* The parameters provided in Table 7 may be adopted in the design of piles founded in Bedrock A and Bedrock B units.

The designer should note the following with regards to the 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 Fill and Natural Soil should be ignored.

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. Should higher bearing capacities be required in Bedrock B, this may be available subject to further advice.

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 Clause 8.2.4 (b)).

4.6.3 Differential Settlement

The design of the foundation system and superstructure should consider total and differential settlements under the imposed loads. In particular where founding conditions or footing types vary, the designer shall need to consider the effect of these variations on differential settlements.

4.7 Slab on ground

The design of slabs on ground can be based on a subgrade with a long term Young's Modulus of 10 MPa. The subgrade will need to be prepared per the earthwork advice provided in Section 4.3

We note the following:

- Environmental effects (e.g. drying or wetting up of the finished surface) affecting the land prior to development should be taken into account by the designers of the development
- Normal mounding or sagging away from the perimeter of covered areas will still occur and perimeters, and open joints, will still respond to environmental changes
- Maintenance requirements of AS 2870 (2011) should be taken into account by the structural engineer and architect.

4.8 Pavements

Subgrade CBR for pavement design depends on the material at the finished subgrade levels. Based on the CBR tests undertaken by PSM (refer Table 1) and our experience with western Sydney clay, we advise that a CBR of 2% can be adopted for subgrade and fill formed in bulk earthworks constructed in accordance with the Specification. Higher values may be provided on completion of testing on the finished bulk earthworks or if, on request, the Specification is varied to obtain such higher values on fill.

We recommend that specific CBR testing be undertaken at subgrade level when pavement layouts are finalised.

If the pavement design requires a subgrade CBR of 3%, the following options can be considered.

- OPTION 1: Place material with a minimum CBR of 3% within the upper 1 m of subgrade

  This option comprises placement of material with a soaked CBR at least 3% within the upper 1 m of the formation; We expect the material will comprise imported shale fill, etc.

  As discussed above, the Earthworks Specification (Appendix E) will have to be updated to include CBR testing of the material (in stockpile / or at source) prior to import or placement. This may not be an economical option especially if the NATURAL SOIL subgrade following the proposed cut does not meet the design subgrade of at least 3%. Overcutting the NATURAL SOIL and placing imported fill up to 1 m may be required to achieve the design CBR.
- OPTION 2: Placement of 300 mm thick sandstone on upper subgrade.

  This option comprises placement of crushed sandstone within the upper 300 mm (minimum) of the pavement subgrade / formation to achieve an equivalent CBR of 3% over the upper 1m. The CBR of crushed sandstone shall be at least 20%. We expect this is readily achievable for typical crushed sandstone fill in Sydney.
- OPTION 3: Lime stabilisation.

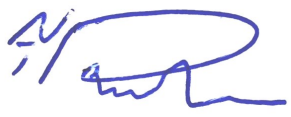
  In this option, lime stabilisation can be considered to treat the upper formation / subgrade to achieve an equivalent subgrade CBR of at least 3% at the top of the subgrade. The minimum treatment thickness is 300mm. This would need to be confirmed by means of specific testing on the on-site material. The amount of lime will depend on the result of trial mix, method of mixing on site, type of lime, etc. Typically 3% to 4% lime will be required. This may not be an economical option when compared to Option 2, as it will require different plants / machines and earthworks operation to blend/treat the fill with lime and place the fill.

5 General

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

Should there be any queries, please do not hesitate to contact the undersigned.

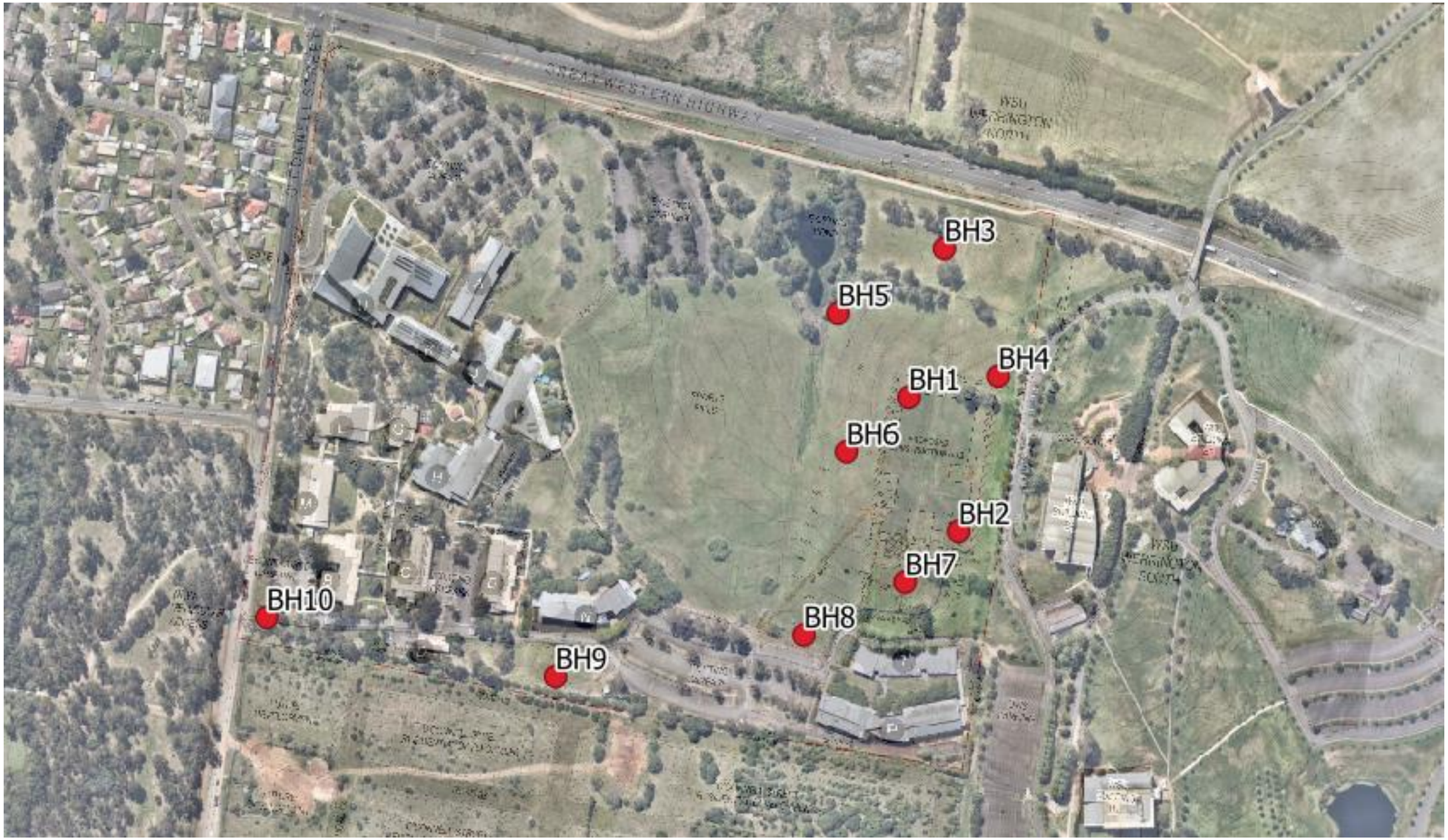
For and on behalf of
PELLS SULLIVAN MEYNINK



AMIN PASHA
SENIOR GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL

Encl:	Figure 1	Locality Plan
	Figures 2 to 4	Selected site photographs
	Appendix A	Proposed site plan and surface RLs. Drawing Ref. SK0005
	Appendix B	Engineering borehole logs and core photographs
	Appendix C	Point load strengths index test results
	Appendix D	Geotechnical & Analytical Laboratory Testing Results
	Appendix E	Bulk Earthworks Specification (PSM4240-005S)



Note

1. BH01 and BH02 are cored-holes and BH03 - BH10 are augered-holes.

0 50 100 150 200 250 m

N

P S M

JBS&G

TAFE - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

LOCATION OF BOREHOLES

PSM4240-004L	FIGURE 1

N:\PSM4240\Eng\Location\[A3 location.xlsx]A3 Landscape

Photo 1 - Drill rig setup at BH05 next to pond, facing south-west (18/11/2020)

Photo 2 - Drill rig setup and site conditions at BH02 facing north (19/11/2020)

JBS&G

TAFE - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

SELECTED SITE PHOTOGRAPHS (1 of 3)

PSM4240-004L	FIGURE 2

Photo 3 - Service locator at BH018 facing south-west (18/11/2020)

Photo 4 - Drillrig setup at BH01 facing south-east (18/11/2020)

JBS&G

TAFE - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

SELECTED SITE PHOTOGRAPHS (2 of 3)

PSM4240-004L	FIGURE 3

Photo 5 - Drill rig setup at CH02 facing north-east (19/11/2020)

Photo 6 - Standpipe piezometer at BH01 facing east (18/11/2020)

JBS&G

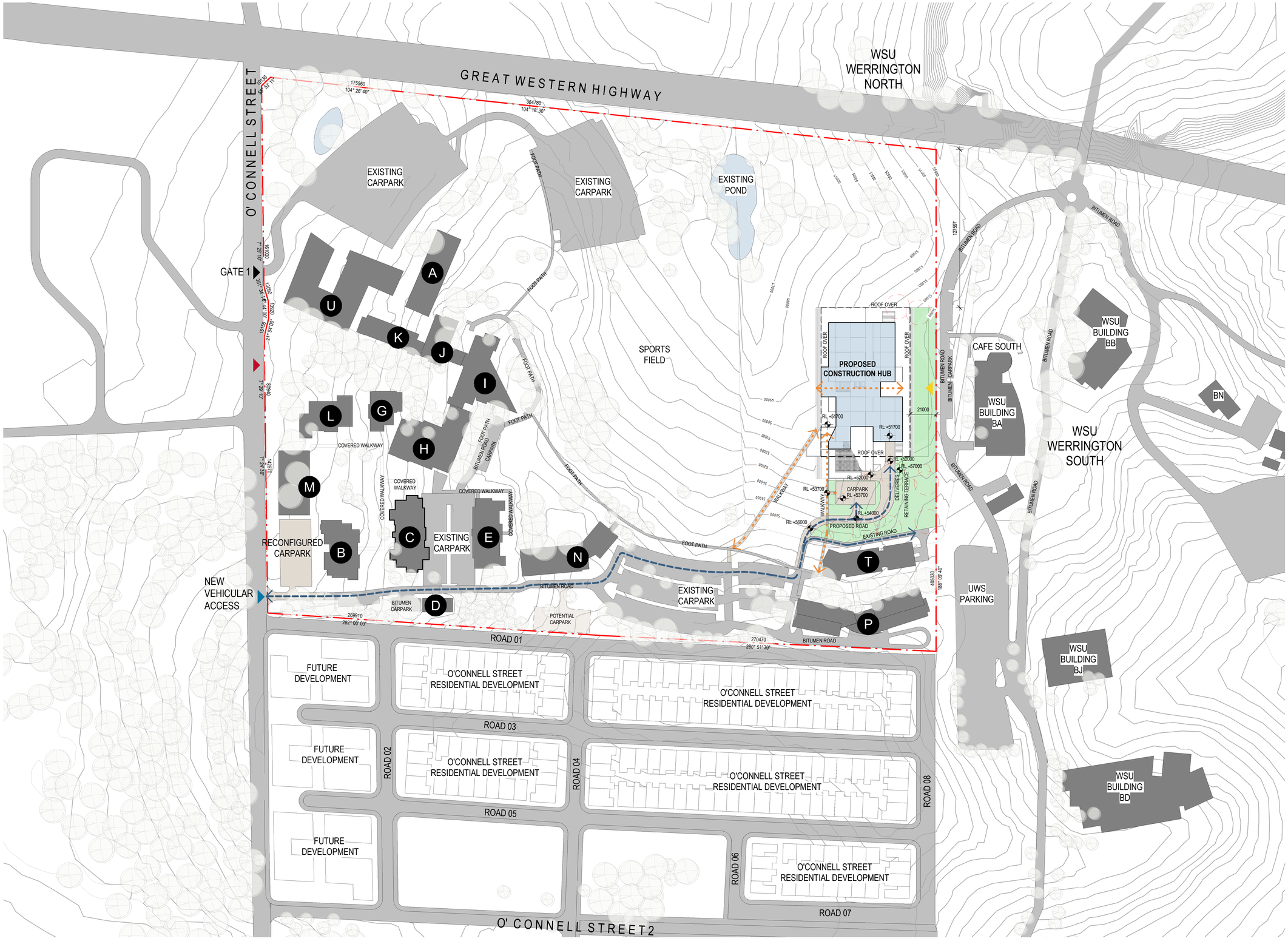
TAFE - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

SELECTED SITE PHOTOGRAPHS (3 of 3)

PSM4240-004L	FIGURE 4

Appendix A
Proposed site plan and surface RLs. Drawing Ref. SK0005



LEGEND

- EXISTING PEDESTRIAN ACCESS
- PROPOSED PEDESTRIAN ACCESS
- EXISTING VEHICULAR ACCESS
- PROPOSED VEHICULAR ACCESS
- POTENTIAL VEHICULAR ACCESS
- BOUNDARY LINE
- A — EXISTING BUILDING NAME
- PROPOSED VEHICULAR PATH
- PROPOSED PEDESTRIAN PATH
- EXISTING TREES TO BE REMOVED
- PROPOSED CONSTRUCTION HUB
- PROPOSED ROADS WALKWAYS AND RECONFIGURED CARPARK
- EXISTING ROADS, WALKWAYS AND CARPARKS

0 15000 37500 75000
1:1500

PROPOSED SITE PLAN

C:_Revit\220090_TAFE NSW WSCH_Site_C20_rdaz_GP.rvt

10/11/2020 7:07:37 PM

Appendix B
Engineering borehole logs and core photographs

Borehole ID

BH01

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290667.9 m E 6261623.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	51.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- SPT: 1.00 - 1.45 m 5, 8, 11 N=19		50.0	1		CL	Sandy CLAY: low plasticity, dark brown, fine grained sand, rootlets observed.	M	L		0.00: Topsoil.
									CI	CLAY: medium plasticity, brown, fine grained sand, carbonaceous material observed.		St		0.20: Natural Soil.
									CI	CLAY: medium plasticity, pale grey and orange.				1.00: SPT recovered: 450 / 450 mm
				- SPT: 2.00 - 2.45 m 6, 9, 12 N=21		49.0	2		CI	Becomes grey and orange. fragments of shale observed.	D	VSt		2.00: SPT recovered: 450 / 450 mm
				- SPT: 3.00 - 3.45 m 5, 7, 10 N=17		48.0	3							3.00: SPT recovered: 450 / 450 mm
AD/T		N		- SPT: 4.00 - 4.26 m 30, 35 Refusal at 4.26 m		47.0	4		CI	Becomes grey.				4.00: SPT recovered: 260 / 260 mm.
										SHALE: grey, extremely weathered, very low strength.				4.10: Inferred Bedrock. V-bit refusal.
										Continued on cored borehole sheet				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290667.9 m E 6261623.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	51.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Total Drilling

Drilling Information							***Rock Substance***			***Rock Mass Defects***	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral 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
					50.0	1						
					49.0	2						
					48.0	3						
					47.0	4						
			4.70m					Continued from non-cored borehole sheet				
NMLC		95	C-1 4.79m - Is(50) d=0.02 a=0.01 MPa	100				INTERBEDDED SHALE AND SANDSTONE: 70% shale, 30% sandstone, grey and brown, fine grained sandstone, indistnctly cross-bedded.				Highly fractured.

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
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
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.

Engineering Log - Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290667.9 m E 6261623.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	51.00 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Total Drilling

Drilling Information

Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)
NMLC	Not Observed	95	5.28m - Is(50) d=0.11 a=0.53 MPa	100		
			5.55m C-2		45.0	6
		81	6.25m - Is(50) d=0.01 a=0.24 MPa	100		
			7.15m C-3		44.0	7
		99	7.23m - Is(50) d=0.24 a=0.23 MPa	100		
			8.00m - Is(50) d=0.06 a=0.06 MPa		43.0	8
			8.50m		42.0	9

Rock Substance

Graphic Log

Material Description
ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components

Weathering: XW HW MW SW FR

Strength Is(50): ● - Axial ○ - Diametral; VL 0.1 L 0.3 M 1 H 3 VH 10 EH

INTERBEDDED SHALE AND SANDSTONE: 70% shale, 30% sandstone, grey and brown, fine grained sandstone, indistnctly cross-bedded.*(continued)*

SHALE: dark grey, iron staining observed.

Hole Terminated at 8.50 m
Target depth

Rock Mass Defects

Defect Spacing (mm): <20 60 200 600 1000

Defect Descriptions / Comments
Description, alpha/beta, infilling or coating, shape, roughness, thickness, other

- BP, 0°, FE SN, PR, S
- JT, 70°, FE SN, PR, S, Clay infill.
- BP, 5°, FE SN, CU, S
- BP, 0°, FE SN, PR, S, Clay infill.
- BP, 0°, FE SN, PR, S
- BP, 0°, FE SN, UN, S
- BP, 20°, FE SN, PR, S
- CS, 0°, FE SN, RF
- Highly fractured.
- BP, 0°, FE SN, PR, S
- BP, 0°, FE SN, CU, S
- BP, 0°, FE SN, UN, S
- BP, 5°, FE SN, UN, S
- Highly fractured.

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
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
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.

JOB NO:	PSM4240-004L	**BH ID:**	BH01
PROJECT:	TAFE NSW - Western Sydney Construction Hub	**FROM:**	4.7 m
LOCATION:	2-44 O'Connell Street, Kingswood, NSW 2747	**TO:**	8.5 m
DATE:	7/12/2020		

JBS&G

TAFE NSW - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

CORE PHOTOS BH01
(Core Photo 1 of 1)

PSM4240-004L	Appendix A

Borehole ID

BH02

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290706.0 m E 6261526.9 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	54.40 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- U 0.40 m - ES 0.50 m		53.4	1		CL CI	Sandy CLAY: low plasticity, dark brown, fine grained sand, rootlets observed. CLAY: medium plasticity, brown mottled grey, carbonaceous material observed.	M	L St		0.00: Topsoil. 0.10: Natural Soil.
				- SPT: 1.00 - 1.45 m 7, 6, 5 N = 11										1.00: SPT recovered: 450 / 450 mm.
									CI	CLAY: medium plasticity, grey and mottled orange.	D			
				- SPT: 2.00 - 2.45 m 6, 8, 10 N = 18		52.4	2							2.00: SPT recovered: 370 / 450 mm.
									CI	Becomes grey.		VSt		
AD/T		N		- SPT: 3.00 - 3.45 m 19, 17, 23 N = 40		51.4	3			SHALE: grey, extremely weathered, very low strength.				2.90: Inferred Bedrock. V-bit refusal. 3.00: SPT recovered: 450 / 450 mm.
						50.4	4							

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290706.0 m E 6261526.9 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	54.40 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/T		N	Not Observed	- SPT: 5.00 - 5.45 m 20, 24, 21 N = 45		48.4	6			SHALE: grey, extremely weathered, very low strength. *(continued)*				5.00: SPT recovered: 450 / 450 mm.
						47.4	7			Continued on cored borehole sheet				
						46.4	8							
						45.4	9							

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Engineering Log - Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290706.0 m E 6261526.9 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	54.40 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Total Drilling

Drilling Information							Rock Substance					Rock Mass Defects		
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering (XW HW MW SW FR)	Strength Is(50) ● - Axial ○ - Diametral (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
			6.50m		48.4	6		Continued from non-cored borehole sheet				
NMLC	Not Observed		C-1					NO CORE: 100 mm.				
		80	6.92m - Is(50) d=0.04 a=0.05 MPa	95	47.4	7		SHALE: grey, thinly laminated bedding.				JT, 90°, FE SN, IR, RF SM, 0°, FE SN, PR, RF, Clay infill. BP, 5°, FE SN, CU, S BP, 5°, FE SN, CU, S, 10 mm BP, 0°, FE SN, UN, S BP, 5°, FE SN, UN, S
			7.84m - Is(50) d=0.02 a=0.55 MPa		46.4	8		INTERBEDDED SANDSTONE AND SHALE: 80% sandstone, 20% shale, light brown and grey, iron staining and carbonaceous material observed, thinly laminated bedding.				BP, 5°, FE SN, CU, S BP, 5°, FE SN, CU, S BP, 0°, FE SN, PR, S BP, 0°, FE SN, ST, S
			8.55m C-2 8.57m Is(50) - d=0.41 a=1.3 MPa					SHALE: grey, thinly laminated bedding.				
		90	9.90 m Is(50) d=0.11 - a=0.45 MPa	100	45.4	9						BP, 10°, FE SN, PR, RF SM, FE SN, IR, S, Clay infill. BP, 0°, FE SN, UN, S

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
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
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.

Engineering Log - Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290706.0 m E 6261526.9 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	54.40 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Total Drilling

Drilling Information							Rock Substance					Rock Mass Defects	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	TCR (%)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral 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	Not Observed	90	10.85m - Is(50) d=0.24 a=0.22 MPa	100	43.4	11		SHALE: grey, thinly laminated bedding.*(continued)*				Highly fractured.
		11.60 m C-3	11.54m - Is(50) d=0.17 a=0.21 MPa									
			12.54m - Is(50) d=0.13 a=0.1 MPa		42.4	12						BP, 0°, CN, PR, S BP, 0°, FE SN, IR, S BP, 5°, FE SN, PR, S
		93		100	41.4	13						Highly fractured. Highly fractured.
			13.47m - Is(50) d=0.3 a=0.36 MPa									BP, 0°, FE SN, PR, S
		11.50 m	14.40m - Is(50) d=0.1 a=0.39 MPa		40.4	14		Hole Terminated at 14.50 m Target depth				

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
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
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.

JOB NO:	PSM4240-004L	**BH ID:**	BH02
PROJECT:	TAFE NSW - Western Sydney Construction Hub	**FROM:**	6.5 m
LOCATION:	2-44 O'Connell Street, Kingswood, NSW 2747	**TO:**	11.0 m
DATE:	7/12/2020		

JBS&G

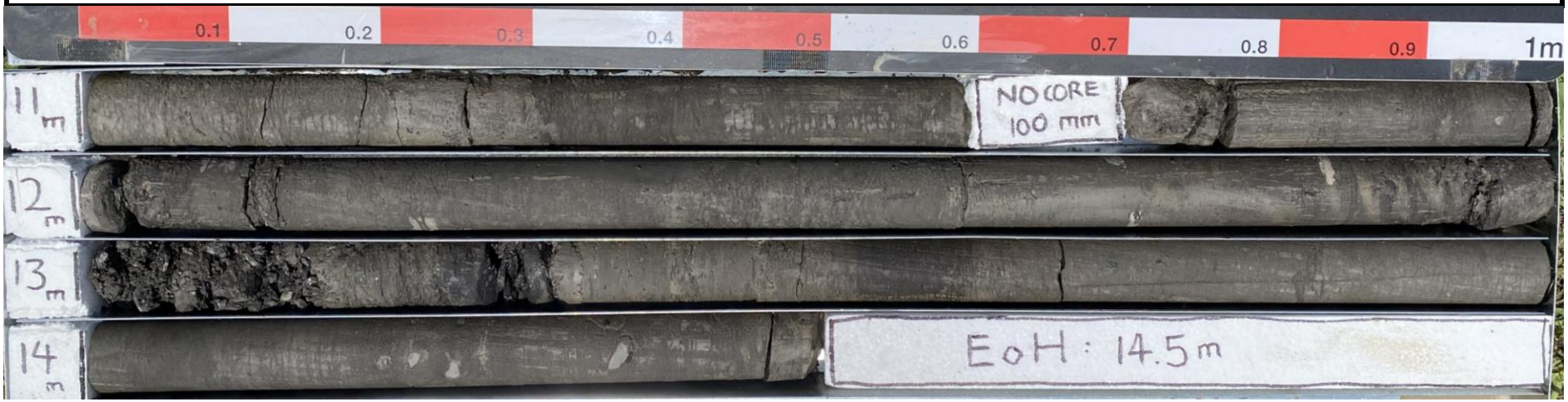
TAFE NSW - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

CORE PHOTOS BH02
(Core Photo 1 of 2)

PSM4240-004L	Appendix A

JOB NO:	PSM4240-004L	**BH ID:**	BH02
PROJECT:	TAFE NSW - Western Sydney Construction Hub	**FROM:**	11.0 m
LOCATION:	2-44 O'Connell Street, Kingswood, NSW 2747	**TO:**	14.5 m
DATE:	7/12/2020		



JBS&G

TAFE NSW - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

CORE PHOTOS BH02
(Core Photo 2 of 2)

PSM4240-004L	Appendix A

Borehole ID

BH03

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290694.5 m E 6261732.9 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	49.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- ES 0.40 m					CL	Sandy CLAY: low plasticity, dark brown, fine grained sand.	M	F		0.00: Topsoil.
									CI	CLAY: medium plasticity, brown and grey.				0.20: Natural Soil.
				- SPT: 1.00 - 1.45 m 3, 6, 6 N=12		48.0	1				D	St		1.00: SPT recovered: 450 / 450 mm.
									CI	Becomes grey.				
AD/T		N				47.0	2			SHALE: grey, extremely weathered, very low strength.				1.60: Inferred Bedrock. V-bit refusal.
						46.0	3							
						45.0	4			Hole Terminated at 5.00 m Target depth				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH04

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290734.5 m E 6261639.0 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	54.30 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- SPT: 1.00 - 1.45 m 5, 12, 16 N = 28		53.3	1		CL	Sandy CLAY with trace of gravel: low plasticity, dark brown, fine grained sand, up to 3 mm gravel, sub-angular, rootlets observed.	M	L		0.00: Topsoil.
									CL	CLAY: low plasticity, brown.				0.20: Natural Soil.
												St		
									CL	Carbonaceous material observed.	D			1.00: SPT recovered: 400 / 450 mm.
												VSt		
						52.3	2		CI	CLAY: medium plasticity, brown.				
				- SPT: 2.50 - 2.95 m 10, 11, 14 N = 25										2.50: SPT recovered: 450 / 450 mm.
						51.3	3			SHALE: grey, extremely weathered, very low strength.				3.00: Inferred Bedrock. V-bit refusal.
AD/T		N				50.3	4			Becomes low strength.				4.40: Inferred change of strength from drill rig push-in pressure.
										Hole Terminated at 5.00 m Target depth				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH05

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290616.4 m E 6261685.3 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	46.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- SPT: 1.00 - 1.45 m 4, 6, 8 N = 14		45.0	1		CL	Sandy CLAY: low plasticity, dark brown, fine grained sand, rootlets observed.	M	F		0.00: Topsoil.
									CL-Cl	CLAY: medium plasticity, light brown motlled orange and grey.				0.20: Natural Soil.
											D	St		1.00: SPT recovered: 450 / 450 mm.
									CL-Cl	Becomes orange and grey.				
AD/T		N		- SPT: 2.50 - 2.95 m 15, 22, 23 N = 45		44.0	2			SHALE: grey and orange, extremely weathered, very low strength.				1.60: Inferred Bedrock. V-bit refusal.
						43.0	3							2.50: SPT recovered: 450 / 450 mm.
						42.0	4			Becomes grey.				
										Becomes low strength.				4.40: Inferred change of strength from drill rig push-in pressure.
										Hole Terminated at 5.00 m Target depth				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH06

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290622.8 m E 6261583.5 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	48.60 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- SPT: 1.00 - 1.45 m 4, 4, 6 N = 10		47.6	1		SP	Sandy CLAY: low plasticity, dark brown, fine grained sand.	M	F		0.00: Topsoil.
									CL-Cl	CLAY: medium plasticity, orange and brown, carbonaceous material observed.				0.20: Natural Soil.
											D	St		1.00: SPT recovered: 450 / 450 mm.
						46.6	2							
AD/T		N				45.6	3			SHALE: grey and orange, extremely weathered, very low strength.				2.70: Inferred Bedrock. V-bit refusal.
						44.6	4			Hole Terminated at 5.00 m Target depth				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH07

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290665.2 m E 6261487.7 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	55.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- B 0.50-1.00 m		54.0	1		CL-Cl	Sandy CLAY: low to medium plasticity, dark brown, fine grained sand.	M	F		0.00: Topsoil.
									CL	CLAY: medium plasticity, brown and orange, carbonaceous material observed.				0.20: Natural Soil.
				- SPT: 1.00 - 1.45 m 6, 8, 15 N = 23							D	VSt		1.00: SPT recovered: 390 / 450 mm.
AD/T		N				53.0	2			SHALE, grey and orange, extremely weathered, very low strength.				1.90: Inferred Bedrock. V-bit refusal.
						52.0	3			Becomes low strength.				3.60: Inferred change of strength from drill rig push-in pressure.
						51.0	4			Hole Terminated at 5.00 m Target depth				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH08

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	18/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	18/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290591.1 m E 6261448.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	58.10 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed						CL	Sandy CLAY: low plasticity, dark brown, fine grained sand, rootlets observed.	M	F		0.00: Topsoil.
									CL-CI					0.10: Natural Soil.
										CLAY: low to medium plasticity, light brown.	D	VSt		
AD/T		N								SHALE: pale grey, extremely weathered, very low strength.				0.60: Inferred Bedrock. V-bit refusal.
				- SPT: 1.00 m 5 Refusal		57.1	1			Hole Terminated at 1.00 m Target depth				1.00: Tc-bit Refusal.
						56.1	2							
						55.1	3							
						54.1	4							

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH09

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290406.1 m E 6261418.3 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	62.00 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- B 0.20-0.60 m - ES 0.40 m					SP Cl	Clayey SAND with trace of gravel: low plasticity, brown, fine grained sand, up to 5 mm gravel, sub-angular.	M	F		0.00: Topsoil. 0.20: Natural Soil.
										CLAY: medium plasticity, orange and pale grey.	D	St		
AD/T		N		- SPT: 1.00 - 1.01 m 5 (10 mm) Refusal		61.0	1			SHALE: grey, extremely weathered, very low strength. Fragments of ironstone observed.				0.70: Inferred Bedrock. V-bit refusal. 1.00: SPT recovered: 0 / 10 mm.
						60.0	2			Becomes low strength. Hole Terminated at 2.00 m Target depth				1.80: Inferred change of strength from drill rig push-in pressure. 2.00: Tc-bit Refusal.
						59.0	3							
						58.0	4							

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

Borehole ID

BH10

Page 1 of 1

Engineering Log - Non Cored Borehole

Project No.: PSM4240

Client:	JBS&G	Commenced:	19/11/2020
Project Name:	TAFE NSW Western Sydney Construction Hub	Completed:	19/11/2020
Hole Location:	TAFE NSW	Logged By:	DT
Hole Position:	290191.0 m E 6261461.8 m N MGA94 Zone 56	Checked By:	AS

Drill Model and Mounting:	Hanjin DB8	Inclination:	-90°	RL Surface:	49.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Total Drilling

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, Zoning, Origin, Additional Observations
AD/V		N	Not Observed	- U 0.20 m					CL	Sandy CLAY with trace of gravel: low plasticity, brown, fine grained sand, up to 5 mm gravel, sub-angular.	M	F		0.00: Topsoil.
									CI	CLAY: medium plasticity, orange mottled grey.				0.20: Natural Soil.
												St		
				- SPT: 1.00 - 1.45 m 6, 8, 11 N = 19		48.5	1				D			1.00: SPT recovered: 400 / 450 mm.
												VSt		
						47.5	2							2.40: Inferred Bedrock. V-bit refusal.
AD/T		N								SHALE: grey, extremely weathered, very low strength.				
						46.5	3							
						45.5	4			Hole Terminated at 5.00 m Target depth				

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

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
LB - Large Disturbed Sample

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.

Soil and rock descriptions in accordance with AS 1726:2017

GEOTECHNICAL LOGGING EXPLANATION SHEET

This explanation document presents the definitions and details used on PSM borehole logs. It is not intended to replace the details in AS 1726: 2017.

Geotechnical logs are shown as either non-cored, for the soil component, or cored for the rock interval.

The document is divided into three parts: drilling information, soil logging and rock logging.

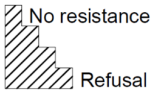
Drilling Information

General

Method	AD/T	Auger drilling TC bit
	AD/V	Auger drilling V bit
	WB	Washbore
	PT	Push tube
	DT	Diatube
	E	Excavator
	CT	Continuous tube
	NQ3	Wireline triple tube core (45.1 mm)
	HQ3	Wireline triple tube core (61.1 mm)
	NMLC	Triple barrel large core (51.2mm)
Core Quality	RQD	Rock Quality Designation (%)
Water	 Inflow	Indicates inflow of groundwater through the base of the borehole observed as net excess drilling fluid return.
	 Partial loss	Indicates an outflow of drilling fluid from the closed drilling system through the base of the borehole observed as net loss of drilling fluid return.
	 Complete loss	Indicates zero drilling fluid return from the borehole. Losses into the soil or rock mass through the base of the borehole.

Penetration

Penetration is a qualitative measure of how easily the auger advances. This varies from no resistance to refusal.



Support

Borehole wall support during drilling will either be listed as casing (C) or where no casing as was required no support (N) or left blank.

Water

Observations of water down the borehole as observed, not observed, not encountered or return as a percentage of the drilling fluid. If not noted then return was 100%.

Sampling and Field Testing

	Abbreviation	Description
Sample	U	Undisturbed tube sample
	D	Disturbed sample
	ES	Environmental sample
	TW	Thin walled
	LB	Large disturbed sample
	B	Bulk disturbed sample
Test	Is(50) – a	Axial point load test result (MPa)
	Is(50) – d	Diametral point load test result (MPa)
	SPT	Standard penetration test
	RW	Rod Weight
	HW	Hammer Weight
	HB	Hammer Bouncing

Hole Positioning

The following geodetic conventions are adopted.

- Map Grid of Australia 1994 (MGA94)
- Geocentric Datum of Australia 1994 (GDA94)
- Australian Height Datum (AHD)
- Bearings relate to magnetic north. Where required, magnetic values have been converted from grid using a magnetic declination of -12°.

Hole location relates to the street or project area the borehole was drilled on.

Depth is the downhole depth in metres below the borehole collar (i.e. surface level).

RL shows the elevation relative to AHD.

WPT (Lugeon)

The Water Pressure Test (usually using packers) measures water pressure and flow rate over time to assess the Lugeon value - an empirical measure of the hydraulic conductivity.

RQD

Rock quality designation is a measure of the quality of cored rock. The sum of intact intervals more than 100 mm in length are given as a percentage of the total drill run recovered.

Termination Details

Hole terminated means the hole was discontinued at a depth that corresponds to the downhole depth in metres. How the borehole was completed is also stated. This includes the following main categories:

- Grouted to surface using a cement grout mix.
- Instrumented by construction of groundwater (open standpipe, screened piezometer, grout in place vibrating wire piezometer (VWP)) or geotechnical (inclinometer, extensometer).
- Any other details such as if a hole was abandoned.

Soil Logging

General

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 is described in accordance with the Unified Soil Classification System (USCS) with the following prefix

O	organic soils
C	inorganic fine-grained soils behaving as clays
M	inorganic fine-grained soils behaving as silts
G	coarse grained soils behaving as gravel
S	coarse grained soils behaving as sand

These are defined by the particle size limits shown in the grading table below.

The above group symbols are appended with minor component modifiers, for coarse grained soils.

W	well graded, little or no fines
P	poorly graded, little or no fines
G	gap graded
M	silty mixtures
C	clayey mixtures

For fine grained soils, with plasticity or liquid limit

L	low plasticity or liquid limit
I	medium plasticity or liquid limit
H	high plasticity or liquid limit.

Material Description

Soil Name

Soil name is based on the identifiable primary component of the soil and is given in block letters, thereafter is a description based on secondary components.

Plasticity

Non-plastic	3 mm thread cannot be rolled at any moisture content (cannot conduct toughness or dry strength tactile tests), slow to rapid dilatancy.
Low plasticity silt/clay mixtures	A 3 mm thread can barely be rolled; lump cannot be formed when drier than plastic limit (PL); low to medium dry strength, medium toughness; none to slow dilatant behaviour
Medium plasticity silt/clay mixtures	3 mm thread is easy to roll, little time required to reach PL; thread cannot be rerolled after reaching PL; lump crumbles when drier than PL; medium to high dry strength, medium toughness; no to slow dilatant behaviour; slightly tacky feel when wet
High plasticity clays	It takes considerable time rolling and kneading to reach PL; thread can be rolled several times after reaching PL; high toughness, high to very high dry strength; non-dilatant; tacky/sticky feel when moisture content >PL.

Graphic Log

		ASPHALT
		CONCRETE
		FILL
	CH	High plasticity CLAY
	CI	Medium plasticity CLAY
	CL	Low plasticity CLAY
	GC	clayey GRAVEL
	GP	Poorly graded GRAVEL
	MH	High liquid limit SILT
	ML	Low liquid limit SILT
	OH	High plasticity ORGANIC CLAY and SILTS
	OL	Low plasticity ORGANIC CLAY and SILTS
	SC	Clayey SAND
	SM	Silty SAND
	SP	Poorly graded SAND
	SW	Well graded SAND

Grading (coarse grained soils)

Where possible for coarse grained soils, include particle shape: equidimensional - rounded, sub-rounded, sub-angular, angular; two- dimensional - flaky/ platy; one dimensional - elongated.

Well graded	Having good representation of all particle sizes from largest to smallest
Poorly graded	One or more intermediate sizes poorly represented
Gap graded	Absence of one or more intermediate sizes
Uniform	Most particles are about the same size

Particle Size Descriptive Terms

Fraction	Coarse-Grained								Fine-grained		Organic
	Boulders	Cobbles	Gravel			Sand			Silt	Clay	Organic soils
			Coarse	Medium	Fine	Coarse	Medium	Fine			
Particle size limits [mm]	200	60	20	6.0	2.0	0.6	0.2	0.06	0.002		
AS Sieve equivalent [mm]	-	63	19	6.7	2.36	0.6	0.15	0.075	-		

Colour

Described in a moist condition, using simple colour terms such as green, red, orange, etc. These may have been modified using 'pale', 'dark' or 'mottled'. 'Light' is avoided as it can be confused with mass.

Secondary Component Modifiers

Term	Coarse grained soil		Fine grained soil
	Percentage of fines in a granular soil	Percentage of coarse in a granular soil (i.e. other than the primary component)	Percentage of coarse grained component (sand or gravel) in a fine-grained soil
Add trace	≤ 5	≤ 15	≤ 15
Add with	> 5 and ≤ 12	> 15 and ≤ 30	> 15 and ≤ 30
Add prefix to name	> 12	> 30	> 30

Moisture Condition

Coarse grained soil	
Dry (D)	Looks and feels dry; dusty; dry to the touch, non-cohesive, free running
Moist (M)	Soil feels cool; soil tends to stick together; damp but no visible water, darkened in colour
Wet (W)	Visible free water when handled, soil feels cool, darkened in colour
Fine grained soil	
Judge based on the soil's moisture condition relative to the plastic limit or liquid limit for soils with high moisture contents, refer to plasticity table above	

Consistency/Relative Density

Consistency - Cohesive soils (fine grained)

Consistency	Field Guide to Consistency	Indicative Undrained Shear Strength (Su, kPa)
Very soft (VS)	Exudes between the fingers when squeezed in hand	≤ 12
Soft (S)	Moulded by light finger pressure	> 12 & ≤ 25
Firm (F)	Moulded by strong finger pressure	>25 & ≤ 50
Stiff (St)	Cannot be moulded by fingers	>50 & ≤ 100
Very stiff (VSt)	Readily indented by thumb nail	>100 & ≤ 200
Hard (H)	Indented with difficulty by thumbnail	>200
Friable (Fr)	Easily crumbled by hand	-
Compact (C)	Material readily disaggregated by physical means	-
Cemented (Ce)	Material cannot be disintegrated/remoulded in air or water	-

Relative density - Non-cohesive soils (coarse grained)

Term	Symbol	Density Index %
Very Loose	VL	<15
Loose	L	>15 & ≤ 35
Medium Dense	MD	>35 & ≤ 65
Dense	D	>65 & ≤ 85
Very Dense	VD	>85

The relative density of coarse-grained soils is inherently difficult to assess by visual or tactile means. Relative density assessment should be carried out using penetration test procedures.

Hand Penetrometer

Refers to pocket penetrometer tests, results shown in kPa.

Structure, Zoning

Soil *in situ* or in samples may consist of separate zones differing in colour, grain size or other properties.

Zoning[1]		Cementing[2]	
Layer	Continuous across exposure or sample	Weakly	Soil fractured by hand in air/water
Lens	Discontinuous layer with lenticular shape	Strongly	Difficulty fracturing by hand in air/water
Pocket	Irregular inclusion		
Homogenous	Same colour/texture/ structure throughout		

[1] Record the orientation, contact character (sharp regular/ irregular, gradual/ gradational). Use interlaminated or inter- bedded if too thin to describe individually

[2] If unable to be disaggregated, treat as rock. Note cementing agent by appearance, strength or reaction to water/acid.

Origin, Additional Observations

Where there is doubt, the terms 'possibly' or 'probably' are used (as per AS1726:2017).

Origin		
Anthorpogenic	Fill	placed by human activity (controlled versus uncontrolled)
Formed in place	Topsoil	upper surface layer of soil with high proportion of organic material
Transported	Alluvial	deposited by streams and rivers
	Colluvial	deposited on slopes chiefly by gravity
	Aeolian	deposited by wind
	Lacustrine	deposited in lakes/still bodies of water
	Marine	deposited in oceans, bays, beaches & estuaries
Formed in place	Residual soils	structure and fabric of parent rock not visible
	Extremely weathered	structure and fabric of parent rock visible

Rock Logging

General

Rock Substance is defined in engineering terms as 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.

Defects are defined as discontinuities or breaks in the continuity of a substance or substances

Rock mass is defined as 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

Rock substance and mass characteristics are shown on the logs as rock substance and rock mass defect categories and are presented in this document in the same order

Rock substance

Graphic Log


BRECCIA


CONCRETE


CONGLOMERATE


NO CORE


DOLERITE


INTERBEDDED SILTSTONE & SANDSTONE


SANDSTONE


SHALE


SHALE BRECCIA


SILTSTONE

Material Description

Rock Name	Simple rock names are used rather than precise geological classification		
Particle/grain Characteristics	Grains of rock described in terms of type, size and shape;		
	sedimentary rocks:	Coarse	0.6 - 2 mm
		Medium	0.2 - 0.6 mm
		Fine	0.06 - 0.2 mm
	igneous rocks	Coarse	>2 mm
		Medium	0.06 – 2 mm
		Fine	<0.06 mm (just visible)
Colour	Simple terms such as white, red, orange etc. modify using pale of sark; describe in moist condition; use combinations of these when necessary		
Inclusions/ Minor components	Record isolated inclusions within the rock substance such as vesicles, nodules, phenocrysts, concretions, veins, ironstone bands; Indicate proportion – trace or minor (include thickness)		

Texture/Fabric

Term	Description	Spacing
Massive	No stratification visible	-
Bedded	Very thickly bedded	>2 m
	Thickly bedded	0.6 m to 2 m
	Medium bedded	0.2 m to 0.6 m
	Thinly bedded	60 mm to 200 mm
	Very thinly bedded	20 mm to 60 mm
Laminated	Laminated	6 mm to 20 mm
	Thinly laminated	<6 mm

Bedding Development

Term	Description
Massive / poorly	No obvious development; rock homogeneous
Developed	Barely obvious; faint mineralogical layering or banding; planes poorly defined
Well developed	Apparent in outcrops or drill core as distinct layers/lines marked by mineralogical or grain-size layering
Very well developed	Often marked by distinct colour banding or mineralogical /grain size layering

Weathering

Term		Description
Residual Soil (RS)		Soil derived from insitu weathering of rock; structure and substance fabric of parent rock no longer evident; soil has not been transported; log using soil descriptive terms
Extremely Weathered (XW)		Rock exhibits soil properties; mass texture/structure of original rock still visible; log using soil descriptive terms
Highly weathered (HW)	(DW)[3]	Iron staining or bleaching affects the entire rock substance and parent rock colour no longer recognisable; porosity may be increased or less than original rock substance by leaching or deposition of minerals; substance strength altered by weathering. Primary minerals may have weathered to clay
Moderately weathered (MW)		Iron staining or bleaching extends throughout the entire rock substance; original rock colour of fresh rock no longer recognisable
Slightly weathered (SW)		Partial staining or bleaching along joints; colour and texture of fresh rock is recognisable; little or no change of strength from fresh rock
Fresh (FR)		No sign of mineral decomposition or colour change

[3] The terms Highly weathered (HW) or Moderately weathered (MW) are preferred to Distinctly weathered (DW).

Strength

Rock strength is based on UCS (MPa), point load strength index testing (Is(50) in MPa) and field estimated strengths. Is(50) values from axial and/or diametral point load tests and field estimated strengths are plotted in the strength column.

Term / Abbreviation		Point load index, Is(50) (UCS (MPa))	Field guide to strength
Very low	VL	0.03 to ≤0.1; (0.6-2)	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm thick can be broken by finger pressure.
Low	L	>0.1 to ≤0.3; (2-6)	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	>0.3 to ≤1.0; (6-20)	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
High	H	>1 to ≤3; (20-60)	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very high	VH	>3 to ≤10 (60-200)	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely high	EH	> 10 (>200)	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Rock Mass Defects

General

Sequence of terms: defect type, orientation, shape, roughness, infill type/width, number, spacing/length/aperture.

Defect Description

Symbol	Description
BF	bedding fabric
BP	Bedding parting – surface crack across which there is little to no tensile strength, parallel to bedding fabric, maybe open or closed
BSH	Bedding Shear
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
DB	Drilling Break – breaks caused by the drilling process, including handling breaks when boxing core
FL	Foliation
FT	Fault – fracture along which displacement is recognisable, may be open or closed
FZ	Fractured Zone – a zone of closely spaced defects comprising core lengths < 50 mm
IS	Infilled Seam – seam of soil substance formed by migration of soil into an open cavity or defect
JT	Joint – a single fracture across which rock has little or no tensile strength, is not obviously related to rock fabric and no shearing, maybe open or closed
SM	XW seam of soil material formed by weathering of the parent rock material in situ
SS	Sheared seam– fracture along which movement has taken place; no displacement recognisable; slickensides, polishing and/or clay gouge may suggest movement
SZ	Sheared Zone – zone of multiple closely spaced shears
VN	Vein – intrusion of tabular or sheet-like minerals
VO	void

Orientation

Field mapping: defect dip/dip direction recorded in degrees, noting datum.

Infill

CN	Clean	RF	Rock fragments
CA	Calcite	G	Gravel
X	Carbonaceous	S	Sand
FE	Iron	Z	Silt
QZ	Quartz	CL	Clay

For infills <1 mm thick:

Stained (SN) – no visible coating but defect surfaces are discoloured

Veneer (VR) – visible uniform or patchy coating too thin to measure

Coating (CO)

Shape

Planar (PR)	No variation in orientation
Curved (CU)	Gradual change in orientation
Undulating (UN)	Wavy surface shape
Stepped (ST)	One or more well defined steps
Irregular (IR)	Many sharp changes of orientation

Surface Roughness

Slickensided (SL)	Grooved or striated surface, usually polished
Polished (POL)	Shiny smooth surface
Smooth (S)	Smooth to touch, few or no surface irregularities
Rough (RF)	Many small surface irregularities (ampl. <1mm) feels like fine to coarse sandpaper
Very rough (VR)	Many large mall surface irregularities (ampl. >1mm) feels like (or coarser than) very coarse sandpaper

Appendix C
Point load strengths index test results

PSM

APPENDIX B - POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. ***PSM4240-004L*** **Sheet 1 of 1**

Project ***TAFE NSW - WESTERN SYDNEY CONSTRUCTION HUB***

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique	*HQ3*	Sampling Date	*18 - 19/11/2020*
		Storage History	*In Field*	Testing Date	*18 - 19/11/2020*
Test Machine	*HMA 6510*	Moisture Condition	*Natural*	Tested By	*DT*
Calibration Date	*16/08/2018, 28/08/2020*	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)		
Interbedded ST and SH	***BH01***	***4.79***	*50*	*59*	*0*	***0.02***	*Parallel to bedding*	*50*	*34*		*0*	*0*	***0.01***	*Through substance*	
Interbedded ST and SH	***BH01***	***5.28***	*50*	*86*	*0.3*	***0.11***	*Parallel to bedding*	*50*	*36*		*1.3*	*0.5*	***0.53***	*Through substance*	***VL***
Shale	***BH01***	***6.25***	*50*	*64*	*0*	***0.01***	*Along defect*	*50*	*29*		*0.5*	*0.3*	***0.24***	*Through substance*	***L***
Shale	***BH01***	***7.23***	*50*	*58*	*0.6*	***0.24***	*Parallel to bedding*	*50*	*30*		*0.5*	*0.2*	***0.23***	*Through substance*	***L***
Shale	***BH01***	***8.00***	*50*	*65*	*0.1*	***0.06***	*Along defect*	*50*	*36*		*0.1*	*0.1*	***0.06***	*Along defect*	***VL / L***
Shale	***BH02***	***6.92***	*50*	*59*	*0.1*	***0.04***	*Parallel to bedding*	*50*	*32*		*0.1*	*0*	***0.05***	*Through substance*	***L***
Sandstone	***BH02***	***7.84***	*50*	*51*	*0*	***0.02***	*Along defect*	*50*	*31*		*1.1*	*0.6*	***0.55***	*Through substance*	***M***
Sandstone	***BH02***	***8.57***	*50*	*76*	*1*	***0.41***	*Parallel to bedding*	*50*	*34*		*2.9*	*1.3*	***1.3***	*Through substance*	***M / H***
Shale	***BH02***	***9.90***	*50*	*71*	*0.3*	***0.11***	*Parallel to bedding*	*50*	*36*		*1.1*	*0.5*	***0.45***	*Through substance*	***L / M***
Shale	***BH02***	***10.85***	*50*	*53*	*0.6*	***0.24***	*Parallel to bedding*	*50*	*29*		*0.4*	*0.2*	***0.22***	*Through substance*	***L***
Shale	***BH02***	***11.54***	*50*	*68*	*0.4*	***0.17***	*Parallel to bedding*	*50*	*32*		*0.5*	*0.2*	***0.21***	*Through substance*	***L***
Shale	***BH02***	***12.54***	*50*	*56*	*0.3*	***0.13***	*Parallel to bedding*	*50*	*24*		*0.2*	*0.1*	***0.1***	*Along defect*	***VL / H***
Shale	***BH02***	***13.47***	*50*	*62*	*0.8*	***0.3***	*Parallel to bedding*	*50*	*29*		*0.7*	*0.4*	***0.36***	*Through substance*	***M***
Shale	***BH02***	***14.40***	*50*	*61*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*31*		*0.8*	*0.4*	***0.39***	*Through substance*	***VL / M***

By: ***DT*** **Checked:** ***AP*** **Date:** ***18 - 19/11/2020***

Appendix D
Geotechnical & Analytical Laboratory Testing 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

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: Pells Sullivan Meynink
PSM Job No.: PSM4240 - TAFE

Ref No: L4522E
Report: 1
Report Date: 3/12/2020
Page 1 of 1

BOREHOLE NUMBER	BH 7	BH 9
DEPTH (m)	0.50 - 1.00	0.20 - 0.60
Surcharge (kg)	4.5	4.5
Maximum Dry Density (t/m^3)	1.65 STD	1.84 STD
Optimum Moisture Content (%)	19.3	14.4
Moulded Dry Density (t/m^3)	1.62	1.79
Sample Density Ratio (%)	98	98
Sample Moisture Ratio (%)	100	100
Moisture Contents		
Insitu (%)	14.5	9.1
Moulded (%)	19.2	14.4
After soaking and		
After Test, Top 30mm(%)	27.9	17.6
Remaining Depth (%)	23.1	17.0
Material Retained on 19mm Sieve (%)	0	1*
Swell (%)	3.0	0.5
C.B.R. value: @2.5mm penetration	3.0	17

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

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 20/11/2020.
- * Denotes not used in test sample.

NATA

NATA Accredited Laboratory Number:1327

03/12/2020
Authorised Signature / Date
(D. Treweek)

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

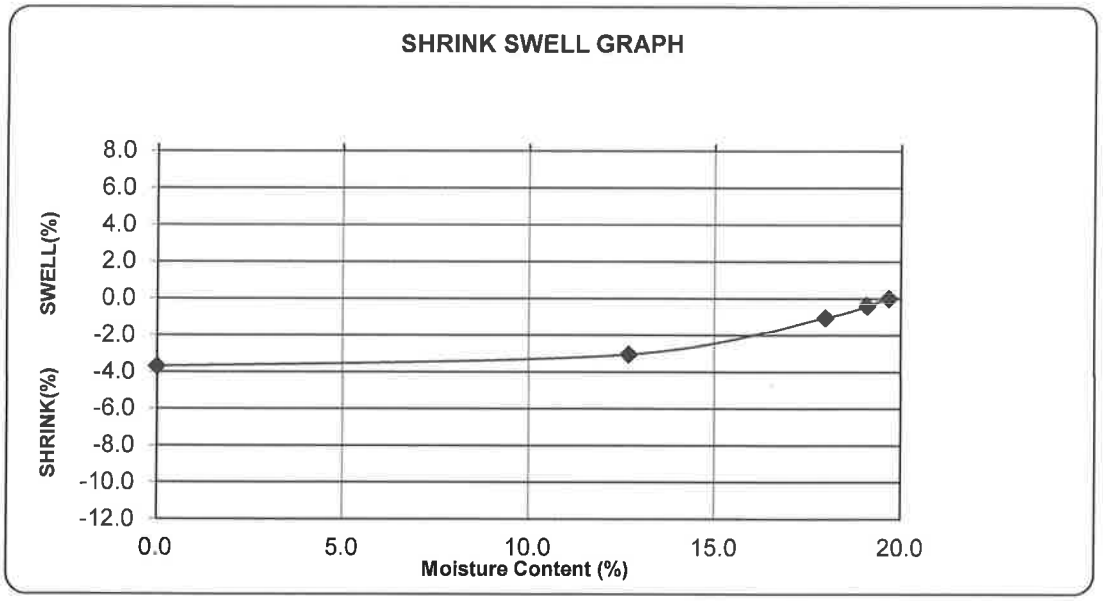
ABN 43 002 145 173

SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client: Pells Sullivan Meynink
PSM Job No.: PSM4240 - TAFE

STS Job No: L4522E
Report: 2
Report Date: 30/11/2020

Borehole No.: 2		Depth: 0.40m			
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH			
BEFORE TEST	AFTER TEST	BEFORE TEST		AFTER TEST	
39.3%	48.8%	>600	kPa	330,430	kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION		SWELL ON SATURATION		SHRINKAGE
25	-0.1%		0.2%		3.6%



SHRINK SWELL INDEX
2.02 %/pF

Notes: Sampled and supplied by client. Samples tested as received.
- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Inert Inclusions by volume = 0-5%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 20/11/2020.

NATA Accredited Laboratory Number:1327

Authorised Signature / Date (D. Treweek) 30/11/20

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

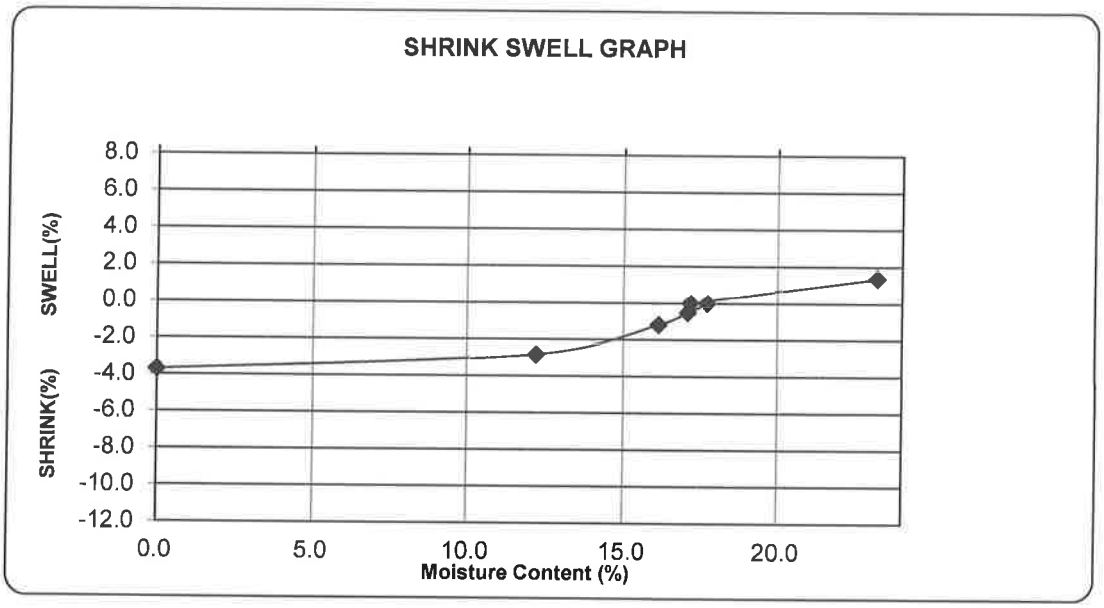
ABN 43 002 145 173

SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client: Pells Sullivan Meynink
PSM Job No.: PSM4240 - TAFE

STS Job No: L4522E
Report: 2
Report Date: 30/11/2020
Page 2 of 2

Borehole No.: 10		Depth: 0.2m	
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH	
BEFORE TEST	AFTER TEST	BEFORE TEST	AFTER TEST
17.2%	23.2%	>600 kPa	180,280 kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION	SWELL ON SATURATION	SHRINKAGE
25	-0.2%	1.4%	3.6%



SHRINK SWELL INDEX
2.39 %/pF

Notes: Sampled and supplied by client. Samples tested as received.
- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Inert Inclusions by volume = 0-5%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 20/11/2020.

NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025 - Testing.
This document shall not be reproduced except in full without approval of the laboratory. Results relate only to the items tested or sampled.

Authorised Signature / Date (D. Treweek) 30/11/20

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2041319**	Page	: 1 of 2
Client	: **PELLS SULLIVAN MEYNINK T/A PSM Admin PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: DANIEL TAN	Contact	: Customer Services ES
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: PSM4240	Date Samples Received	: 20-Nov-2020 17:30
Order number	: ----	Date Analysis Commenced	: 24-Nov-2020
C-O-C number	: ----	Issue Date	: 25-Nov-2020 16:28
Sampler	: DANIEL TAN		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

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
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- ED045G: LOR raised for Chloride on sample 2 due to sample matrix.

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Sample ID	**BH09 0.4-0.5m**	**BH03 0.4-0.5m**	**BH02 0.5m**	**----**	**----**
			Sampling date / time	18-Nov-2020 09:30	18-Nov-2020 16:00	19-Nov-2020 07:45	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES2041319-001**	**ES2041319-002**	**ES2041319-003**	**--------**	**--------**
				Result	Result	Result	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.9**	**7.3**	**7.5**	**----**	**----**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**16.8**	**13.8**	**14.8**	**----**	**----**
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**5290**	**20400**	**22200**	**----**	**----**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**10**	<10	**10**	**----**	**----**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**20**	<100	<10	**----**	**----**

Appendix E
Bulk Earthworks Specification (PSM4240-005S)

TAFE, NSW - Western Sydney Construction Hub

Bulk Earthworks Specification Filling, Cutting and Testing

PSM4240-005S 8 December 2020

Table of Contents

List of Appendices

1. Scope

This specification details the requirements for the bulk earthworks to be undertaken at TAFE, NSW. The area where this specification is applicable is shown in Figure 1. This includes areas where material is filled to bulk earthworks level (BEL) within the site.

Fill placed in accordance with this specification is denoted as Engineered Fill.

This specification does not address any environmental, contamination or erosion issues with respect to the fill material.

There is a HOLD POINT on placing fill in Section 2.4 of this specification.

2. Filling Works

2.1 Subgrade Preparation

The condition of the subgrade should be assessed immediately prior to the commencement of filling.

All Engineered Fill is to be placed on one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Engineered compacted fill placed in accordance with this or other approved specifications for which the Geotechnical Inspection and Testing Authority (GITA) has a Level 1 certificate certifying compliance with that approved specification AND of at least stiff consistency.
4. Existing fill and other materials as approved by PSM.

Proof rolling shall only be undertaken under the direction of PSM. PSM may also direct a bridging layer of Engineered Fill be placed and compacted to a Dry or Hilf Density Ratio (Standard Compaction) of between 95% and 102%. Any such layer shall be a Lot under Clause 5.3.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be moisture conditioned and compacted to be in accordance with Clauses 2.5 and 2.6 of this specification.

Engineered Fill shall be placed only on subgrade approved by the GITA as being in accordance with this specification.

2.2 Base Geometry and Permanent Batters

The slope of any buried batter shall be less than 2H:1V unless otherwise directed by PSM.

The contractor shall remove or flatten any geometrical obstructions (e.g. protrusions or holes) such that subsequent Engineered Fill can be placed to achieve the requirements of this specification.

Engineered Fill shall be placed only on areas where the base geometry has been approved by the GITA.

Permanent batters in fill shall be built by overfilling then cut back to the final slopes as shown in the bulk earthworks drawings, e.g. 2H:1V, or other method as approved by PSM.

2.3 Material

2.3.1 Imported Fill

Imported Engineered Fill is to conform to one of the following definitions:

1. “Virgin excavated natural material” (**VENM**) as defined by the Protection of the Environment Operations Act 1997 No 156, Schedule 1, on Page 209:

   “Virgin excavated natural material (e.g. clay, gravel, sand, soil and rock) that is not mixed with any other waste and that:

a. *has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphide ores or soils, or.*

b. *consists of excavated natural materials that meet such criteria as may be approved by the EPA".*

2. "Excavated natural material" (**ENM**) as defined under Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014:

"Excavated natural material is naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

a. *been excavated from the ground, and*

b. *contains at least 98% (by weight) natural material, and*

c. *does not meet the definition of Virgin Excavated Natural Material in the Act.*

Excavated Natural Material does not include material that has been located in a hotspot; that has been processed; or that contains asbestos, Acid Sulphate Soils (ASS), Potential Acid Sulphate soils (PASS) or sulfidic ores."

2.3.2 Site Won Material

Site won material shall comprise material won from excavations on site including natural and existing fill. Material needs to satisfy Clause 2.3.3.

2.3.3 All Fill

The Engineered Fill shall be approved by the GITA as suitable for use in a structural fill.

Engineered Fill shall not comprise unsuitable material as defined by Clause 4.3 of AS3798-2007 "Guidelines on earthworks for commercial and residential developments" as:

a. *"organic soils, such as many topsoils, severely root-affected subsoils and peat.*

b. *materials contaminated through past site usage which may contain toxic substances or soluble compounds harmful to water supply or agriculture.*

c. *materials containing substances which can be dissolved or leached out in the presence of moisture (e.g.: gypsum), or which undergo volume change or loss of strength when disturbed and exposed to moisture (e.g.: some shales and sandstones), unless these matters are specifically addressed in the design.*

d. *silts, or materials that have the deleterious engineering properties of silt.*

e. *other materials with properties that are unsuitable for the forming of structural fill; and.*

f. *fill that contains wood, metal, plastic, boulders or other deleterious material, in sufficient proportions to affect the required performance of the fill."*

The GITA shall assess that the proportion of deleterious material in each Lot is not greater than 1% by weight. Deleterious material is defined by Table 3015.3 of the RTA QA Specification 3051 (Edition 5 June 1998) as:

"Type III: Rubber, Plastic, Bitumen, Paper, Cloth, Paint, Wood and Other Vegetable Matter".

If the GITA is not able to visually assess the above criterion, the GITA shall arrange appropriate testing.

All Engineered Fill particles shall be able to be incorporated within a single layer. Further, less than 30% of particles shall be retained on the 37.5 mm sieve.

Engineered Fill shall be able to be tested in accordance with the Standard Compaction method (AS1289.5.4.1) or Hilf test method (AS1289.5.7.1). These methods require less than 20% retained on the 37.5 mm sieve. Where between 20% and 30% of particles are retained on the 37.5 mm sieve the above test methods shall still be adopted and test reports annotated appropriately.

These requirements should be met by the material after placement and compaction.

Only material approved by the GITA shall be placed as Engineered Fill.

2.4 Fill Zonation and Placement

HOLD POINT

Process Held	Placing of Fill
Submission detail	The Contractor / GITA submit to PSM a Weekly Certificate as defined in Clause 6.2.1 of this specification for the earthworks completed to the previous Saturday no later than 5 pm of the subsequent Wednesday.
Release of Hold Point	PSM to confirm receipt of Weekly Certificate and recommend release of Hold Point if initial assessment of the Weekly Certificate indicates it complies with requirements of this specification. The contract superintendent should then release the Hold Point if it considers appropriate.

2.5 Compaction

Engineered Fill shall be placed and compacted to a Dry or Hilf Density Ratios (Standard Compaction) of between 98% and 102%.

The insitu density shall be measured over the full depth of each layer placed.

2.6 Moisture Control

The placement moisture variation or Hilf moisture variation shall be controlled to be between 2% dry of optimum and 2% wet of optimum.

Placement moisture content of the Engineered Fill shall be measured.

3. Cutting

3.1 Subgrade Condition

The subgrade is to comprise one of the following materials:

1. Bedrock.
2. Natural insitu material of at least stiff consistency.
3. Existing fill and other materials as approved by PSM.

Proof rolling shall only be undertaken under the direction of PSM.

The GITA should satisfy itself that the subgrade has not been desiccated, affected by rain or disturbed. If the GITA cannot so satisfy itself, then the subgrade should be excavated and filled to the BEL in accordance with this specification.

4. Survey

4.1 Filling Areas

The survey requirements are as follows:

1. Any approved subgrade shall be surveyed prior to first filling such that subgrade levels are established to within ± 0.1 m. The area subject to approval shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
2. The Lot boundaries shall be assessed and shown on a plan drawing to an accuracy of at least +/- 5 m in plan.
3. The location of the field density tests shall be assessed and shown on the Lot boundary plan drawing to an accuracy of at least +/-5 m in plan.

4. The elevation of the field density tests shall be surveyed to an accuracy of +/-0.05 m.

The plan drawing shall show at the boundaries of the site and other identifiable site features, so as to allow the location of the lots and the test to be recoverable.

4.2 Cutting Areas

Any approved subgrade for cut areas shall be surveyed such that subgrade levels are established to within ± 0.1 m.

5. Inspection and Testing

5.1 Role of the GITA

The Geotechnical Inspection and Testing Authority (GITA) shall be contracted to document and certify that the works undertaken by the contractor has been completed in accordance with the relevant design and specifications.

5.2 Level 1 Control

The GITA shall adopt Level 1 responsibility as described in Section 8.2 of AS 3798-2007 "Guidelines on earthworks for commercial and residential developments":

> *"The primary objective of Level 1 Inspection and Testing is for the geotechnical inspection and testing authority (GITA) to be able to express an opinion on the compliance of the work. The GITA is responsible for ensuring that the inspection and testing are sufficient for this purpose.*
>
> *The geotechnical inspection and testing authority need to have competent personnel on site at all times while earthwork operations are undertaken. Such operations include:*
>
> - *Completion of removal of topsoil*
> - *Placing of imported or cut material*
> - *Compaction and adding/removal of moisture*
> - *Trenching and backfilling*
> - *Test rolling*
> - *Testing.*
>
> *The superintendent should agree a suitable inspection and testing plan prior to commencement of the works.*
>
> *On completion of the earthworks, the GITA will usually be required to provide a report setting out the inspections, sampling and testing it has carried out, and the locations and results thereof. Unless very unusual conditions apply, the GITA should also be able to express an opinion that the works (as far as it has been able to determine) comply with the requirements of the specification and drawings."*

For this particular contract, Level 1 responsibility includes:

1. Lot testing as per Clause 5.3 of this specification.
2. A frequency of compaction testing not less than that specified in Clause 5.4 of this specification.
3. The GITA documenting and reporting its activity in the terms required by Clause 6 of this specification.
4. The GITA undertaking adequate inspections and testing to comply with the above requirements and to be able to certify the fill in the terms required by Clause 6 of this specification.

5.3 Lot Testing

This specification requires lot testing to be undertaken.

A Lot is defined as a single layer of Engineered Fill consisting of uniform material which has undergone similar treatment.

Lot testing comprises the following:

1. A Lot shall be identified by the Contractor or the GITA with a Lot Number and presented for testing.

2. A Lot shall be deemed to be in accordance with the specification if all the tests undertaken within the Lot are in accordance with the specification, i.e. "a none to fail basis".
3. If any one test undertaken within a Lot fails, the whole of the Lot shall be reworked and retested.

Any portion of the placed Engineered Fill must be part of a single lot and all Lots will require approval by the GITA.

5.4 Testing Frequency (Compaction Testing)

The frequency of compaction testing for each lot shall not be less than the greater of:

1. For lot less than 50 m^3
   a. 1 test per lot.
2. For lot between 50 m^3 and 100 m^3
   a. 2 tests per lot.
3. For lot greater than 100 m^3
   a. 1 test per 500 m^3 of material placed.
   b. 3 tests per lot.

A laboratory moisture content test shall be undertaken for each field density test.

5.5 Proof Rolling and Plate Load Testing

Proof rolling, together with minor boxing out and refilling, of the upper surface of the bulk earthworks will be undertaken as directed by PSM. The plant to be adopted depends upon the design loads adopted by the structural engineers for each section of the site. Any remediation of soft spots identified during proof rolling shall be undertaken in accordance with this Specification (Cl 2.5 and 2.6).

Plate load testing shall be undertaken at the direction of PSM at the following stages:

1. At final bulk earthworks level (BEL). Expected test frequency is approximately a day of testing for each building pad.

The contractor is to make a suitable reaction (e.g. 20 tonne excavator) available for the tests.

5.6 Inspection and Testing

The GITA shall at least undertake the following tasks:

Cut areas

1. Identify the subgrade as one of the three (3) subgrade types listed in Clause 3.1 of this specification and assess that the subgrade condition of cut areas is in accordance with the subgrade condition requirements of Clause 3.1 of this specification. If the cut subgrade has been approved by PSM, the GITA will be required to reference the approval in its weekly report.
2. Should Engineered Fill be required to fill overcut areas, assess that filling has been placed in accordance with this specification.

Fill areas

1. For fill areas, identify the subgrade as one of the four (4) subgrade types listed in Clause 2.1 of this specification and assess that the subgrade condition of any area prior to placement of fill material is in accordance with the subgrade preparation requirements of Clause 2.1 of this specification. For the following subgrade types, GITA needs to include / refer to PSM approval in its weekly report:
   a. Existing fill and other materials as approved by PSM.
2. Assess that the base geometry of any area prior to placement of fill material is in accordance with the base geometry requirements of Clause 2.2 of this specification.
3. For each Lot, identify the material as either Site Won or Imported fill as defined in Clause 2.3 of this specification and assess that the material placed is in accordance with the fill material requirements of Clause 2.3 of this Specification.

4. Assess the proportion of deleterious material is in accordance with the requirements of Clause 2.3.3 of this Specification.
5. Assess that the Engineered Fill has been placed in accordance with the requirements for fill zonation and placement of Clause 2.4 of this specification.
6. Assess that each Lot as presented for approval by the contractor is in accordance with the requirements for Lot definition of Clause 5.3 of this specification.
7. Ensure that the survey requirements in Clause 5 of this specification have been completed.
8. Estimate the approximate volume of Engineered Fill placed in each Lot presented for approval.
9. Conduct Lot testing in accordance with the construction control testing requirements of Clauses 5.3 and 5.4 of this specification.
10. Assess that the compaction of each Lot is in accordance with the requirements of Clause 2.5 of this specification. The GITA shall select a depth of insitu density tests that allows the density of the full layer to be assessed.
11. Assess that the moisture variation of each Lot is in accordance with the requirements for moisture control in Clause 2.6 of this specification.
12. Conduct material property testing in accordance with the material testing requirements in this specification.

6. Reporting and Certification

6.1 Reporting

The GITA shall produce at least the following reports:

1. *VENM / ENM Validation Reports*. Such a report shall transmit the VENM or ENM validation certificates for the fill imported to site.
2. *Subgrade Approval Reports* (a sample is attached). Such a report shall:
   – Document assessments undertaken for tasks 1 and task 3 of Clause 5.6 including reporting the subgrade type
   – Document the subgrade survey that has been undertaken
   – Approve or reject the subgrade condition and base geometry for filling, based on tasks 3 and 4 of Clause 5.6
   – Approve or reject the subgrade condition for cut areas based on task 1.
3. *Lot Approval Reports* (a sample is attached). Such a report shall:
   – Document assessments, testing and survey undertaken for tasks 3 to 14 of Clause 5.6
   – Report material identification undertaken for task 5 of Clause 5.6
   – Report the assessed proportion of deleterious material for task 6 of Clause 5.6
   – Report the results of testing undertaken for task 11 of Clause 5.6
   – Approve or reject lots based on tasks 12 and 13 of Clause5.6
4. Material Testing Reports. Such a report shall:
   – Report the results of material property testing undertaken for task 14 of Clause 5.6.
5. *Daily Reports* (a sample is attached). Such a report shall be completed daily and shall:
   – Document time spent on site by the GITA personnel
   – List subgrade assessments and approvals undertaken each day with reference to relevant Subgrade Approval Report(s)
   – List Lots presented, accepted and approved or rejected each day, with reference to relevant Lot Approval Report(s)
   – List survey undertaken each day as for task 9 of Clause 5.6 and not already documented in the Subgrade or Lot Approval Reports

– Document other relevant activities undertaken on site that day (site instructions, breakdowns, compaction equipment used, etc.).

6.2 Certification

6.2.1 Weekly Certificate

The GITA shall produce a Weekly Certificate for any week in which earthworks are undertaken in accordance with this specification. The Weekly Certificate will cover all works from the previous Weekly Certificate until the end of work on a Saturday.

The Weekly Certificate shall transmit the following:

- Copy or reference to the complete specification document(s)
- Subgrade Approval Reports
- Lot Approval Reports
- Material property testing reports
- Daily Reports
- Survey of subgrade geometry prior to filling or in cut areas
- Plan survey drawing showing lot boundaries and location of density tests
- Survey documenting filling undertaken to date and showing location of testing
- Provide an Excel spreadsheet presenting the results of the week's acceptance testing completed by the GITA.

And certify that:

"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4240-005S dated 8 December 2020)."

6.2.2 Interim or Final Filling Certificate

At the completion of the bulk earthworks, or as requested by the Client, the GITA shall provide an Interim or Final Filling Certificate which shall:

1. Transmit a reference list of the Weekly Certificates.
2. Provide an Excel spreadsheet presenting the results of all the acceptance testing completed by the GITA.
3. Certify that *"All the earthworks undertaken and the subgrade condition in the cut areas [in the stated period] are documented in the above reports and have been undertaken in accordance with the Specification (Ref. PSM4240-005S dated 8 December 2020)."*

Brisbane

6A, Level 6
500 Queen St
Bowen Hills QLD 4006
+61 7 3220 8300

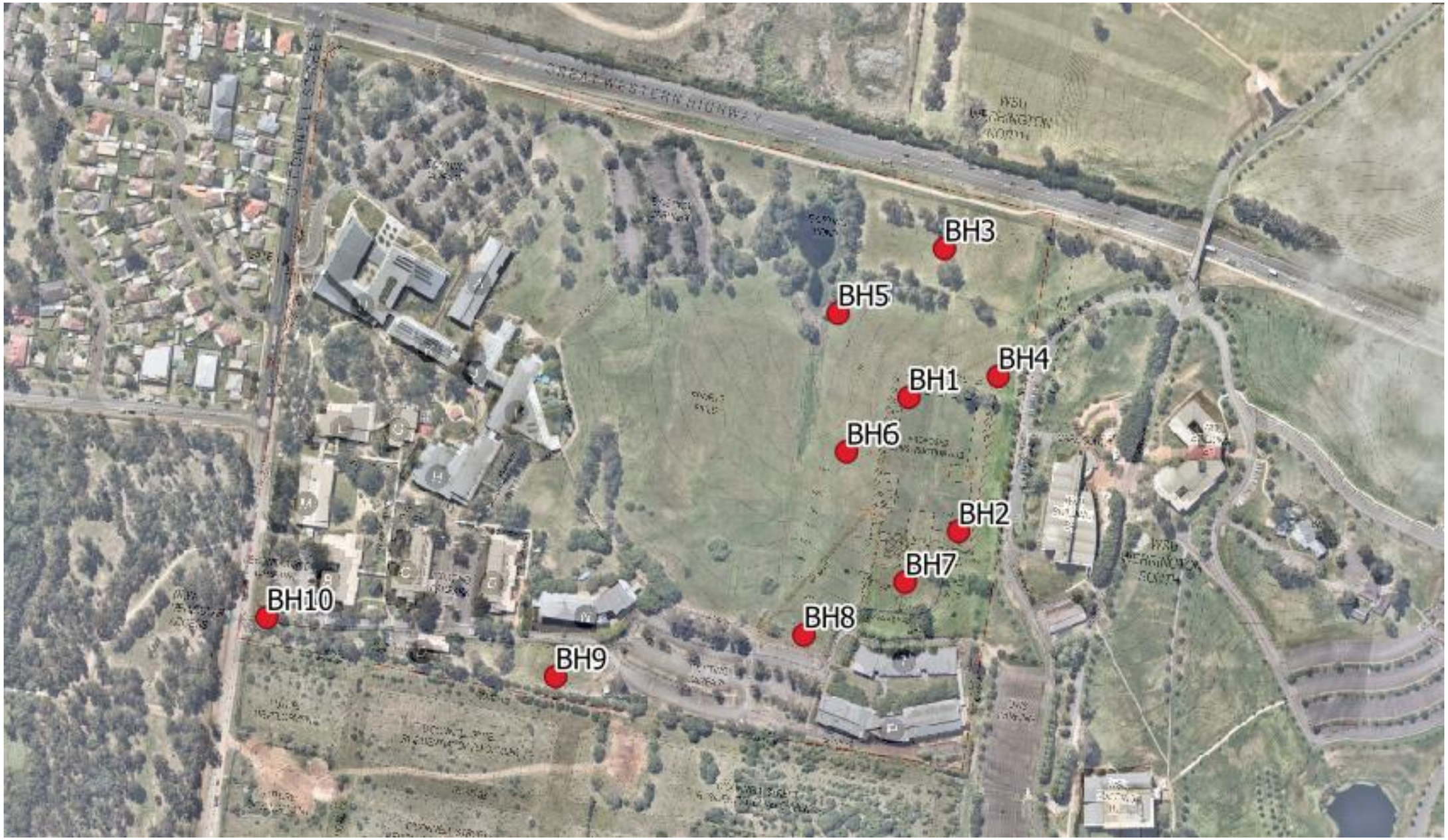
Sydney

G3-56 Delhi Road
North Ryde NSW 2113
+61 2 9812 5000

Perth

Level 3 22 Delhi Street
West Perth WA 6005
+61 8 9462 8400

Appendix A
Figure 1



Note

1. BH01 and BH02 are cored-holes and BH03 - BH10 are augered-holes.

0 50 100 150 200 250 m

N

P S M

JBS&G

TAFE - Western Sydney Construction Hub

2-44 O'Connell Street, Kingswood, NSW 2747

LOCATION OF BOREHOLES

PSM4240-004L	FIGURE 1

N:\PSM4240\Eng\Location\[A3 location.xlsx]A3 Landscape

Appendix B
Subgrade Approval Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

SUBGRADE APPROVAL REPORT

Client:	Contractor:
Job number:	Report number:
Project:	Technician:

Subgrade areas assessed:

Area ID	Date	Approximate extent	Subgrade description	Geometry summary	Specification reference	Compliance (Pass/Fail)	Survey reference	Approved (Yes/No)

COMMENTS:

Signed: Date:

Appendix C
Lot Approval Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

LOT APPROVAL REPORT

Client:	Report number:
Job number:	Report date:
Project:	Technician:
Contractor:	Test methods:

LOT ID:			**Sheet**	**of**
Retest (Yes/No)			Original test report number:	
Specification reference				
Location:				
Lot boundary survey reference/location:				
Materials description:	*(MATERIAL TYPE, colour, minor components, maximum particle size)*			
Material identification:	*(Identify the material as defined in Clause 2.3.1, Clause 2.3.2 or Clause 2.3.3 of the Specification)*			
Deleterious material assessment:	*(Report proportion of deleterious material)*			
Layer thickness:				
Accepted as Lot: (Yes/No)			Date:	
Approximate volume (m3)			Number of tests required:	

Test ID No.				
Test soil description				
Date tested:				
Grid reference				
Surveyed test locations (RL,E,N)				
Test depth (mm)				
Max size (mm)				
% Oversize material (wet)				
Field wet density (t/m^3)				
Field moisture content (%)				
PWCD (t/m^3)				
Compactive effort				
Moisture variation (%)				
HILF density ratio (%)				
TEST (Pass/Fail)				

LOT APPROVAL	(Pass/Fail)	Signed:	Date:

Appendix D
Daily Report

GEOTECHNICAL INSPECTION AND TESTING AUTHORITY

NATA accreditation number

DAILY REPORT

Client:	Report number:
Job number:	Report date:
Project:	
Location:	Level of testing: Level 1
Contractor	Technician:
Time on site:	
Time off site:	

1. Subgrade Approval

Areas ID	Subgrade Approval Report No:	Comments

2. Lot Approval

Lot ID	Lot Approval Report No:	Comments

3. Survey

Type of survey	Survey undertaken by:	Reference

4. Instructions received on site

5. Instructions given on site

COMMENTS:

Signed: Date:

Appendix E
Certification Letter (Sample Only)

Our Ref:

Date:

Addressed to: Earthwork Contractor

Attention: Earthwork Contractor Representative

Dear

RE: SAMPLE INTERIM (OR FINAL) FILLING CERTIFICATE
INDUSTRIAL DEVELOPMENT, BULK EARTHWORKS
CERTIFICATION OF EARTHWORKS
BETWEEN [DATE OF COMMENCEMENT] AND [DATE OF COMPLETION]

In the period between [date start] and [date finish] the contractor has undertaken earthworks in areas XXX and XXX.

During the above period:

- The GITA has prepared the following Subgrade Approval Reports:

1. Subgrade Approval Report No 1
2. ……

- The GITA has prepared the following Lot Approval Reports:

1. Lot Approval Report No 1
2. ……

- The GITA has prepared the following Daily Reports:

1. Daily Report No 1……
2. ……

- The following subgrade survey was undertaken:

1. Subgrade Survey reference……
2. ……

- The following weekly survey was undertaken:

1. Weekly survey of week ending …….reference……..
2. ……

Copies of all the above documents are attached.

The GITA certifies that all the earthworks undertaken in the above stated period are documented in the above reports and have been undertaken in accordance with the Specifications (ref. PSM4240-005S, dated XXX) a copy of which is attached, with the exception of:

1. List outstanding issues (not approved subgrade, lots, unsuitable material, failed tests etc.)
2. ……..

Signed

GITA