Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Sports and Health Centre of Excellence
Goldsmith Avenue, Macarthur Heights
Campbelltown, NSW

Prepared for
Campbelltown City Council

Project 34255.25
February 2018

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	34255.25	Document No.	R.001.Rev0
Document title	Report on Geotechnical Investigation Proposed Sports and Health Centre of Excellence		
Site address	Goldsmith Avenue, Macarthur Heights, Campbelltown, NSW		
Report prepared for	Campbelltown City Council		
File name	34255.25.R.001.Rev0		

Document status and review

Status	Prepared by	Reviewed by	Date issued
Revision 0	Rasoul Machiani	Michael J Thom	1 February 2018

Distribution of copies

Status	Electronic	Paper	Issued to
Revision 0	1	0	Ares Liu, Turner & Townsend Thinc c/- Campbelltown City Council

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		1 February 2018
Reviewer	for MJT	1 February 2018

bsi. ISO 9001 Quality Management

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Report on Geotechnical Investigation
Proposed Sports and Health Centre of Excellence
Goldsmith Avenue, Macarthur Heights, Campbelltown, NSW

1. Introduction

This report presents the results of a geotechnical investigation undertaken for a proposed sports and health centre of excellence at Goldsmith Avenue, Macarthur Heights, Campbelltown, NSW. The investigation was commissioned in an email dated 15 December 2017 by Ares Liu of Turner & Townsend Thinc (the project managers) on behalf of Campbelltown City Council (the client) and was undertaken in accordance with Douglas Partners Pty Ltd's proposal MAC170409 dated 5 December 2017.

It is understood that the development of the site will include the construction of a sport hall and associated facilities, as well as on-grade carparks.

The investigation comprised borehole drilling and test pit excavation and was followed by laboratory testing of selected samples, engineering analysis and reporting. Details of the work undertaken and the results obtained are given in this report together with comments relating to design and construction practice.

A site contour map showing the indicative site boundary and footprint of proposed building and carpark within the site was provided for the investigation. The geotechnical investigation was undertaken concurrently with a Contamination Assessment (Project 34255.26.P.001) which will be reported separately.

2. Site Description

The site comprises an irregularly shaped area of approximately 3.5 ha with maximum north-south and east-west dimensions of approximately 240 m and 190 m, respectively. It is located within the Western Sydney University Campbelltown campus and is bounded by Goldsmith Avenue to the north and Bow Bowing Creek to the south and vacant floodplains of the creek to the east and west of the site. The site is located within the floodplains along the northern side of the creek and is covered with a mixture of grass, creeping plants and small trees.

There was an existing building (previously used as a sports centre) and basketball field in the central portion of the site. An asphaltic concrete sealed carpark towards the northern portion of the building was observed at the time of the investigation. The building and existing facilities are located on a building platform elevating the site from the surrounding low lying areas. The proposed carpark area is located to the north and west of the existing building. There was an embankment approximately 3 m high in the southern portion of the site which occupies almost the entire extent of the southern portion.

The embankment and building platform are typically battered between 1V:2H to 1V:3H and were covered with dense grass.

Natural surface levels across the site generally fall to the south and east at grades of approximately 1 in 30 to 1 in 65, with an overall difference in level of approximately 8 m from the highest part of the site to the lowest.

3. Regional Geology

Reference to the Wollongong – Port Hacking 1:100 000 Geological Series Sheet (Ref 1) indicates that the site is located at the boundary of two distinct geological formations namely Bringelly Shale and Ashfield Shale of the Wianamatta group of Triassic age. Bringelly Shale (mapping unit Rwb) typically comprises shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff which typically weather to form clays of intermediate to high plasticity. Ashfield Shale (mapping unit Rwa) comprises laminite and dark grey siltstone. The results of the investigation were consistent with the geological mapping with siltstone or shale of variable weathering conditions were encountered in five of the eight boreholes.

4. Field Work

4.1 Methods

The field work comprised the drilling of eight boreholes (Bores 1 – 8) to depths of 6.0 m across the site and excavation of three test pits (Pits 102, 105 and 116) to depths of 0.3 – 2.0 m within the proposed carpark area. The boreholes were drilled with a Hanjin DB8 drill rig and the test pits were excavated with a Hyundai 60 CR-9 6t excavator fitted with a 300 mm wide bucket. All boreholes and test pits were logged on site by a geotechnical engineer. Disturbed and bulk samples were collected to assist in strata identification and for laboratory testing. Dynamic cone penetrometer tests (DCP were undertaken adjacent to all test locations to depths up to 1.2 m to assess the penetration resistance of the near-surface soils. Standard penetration tests (AS 1289.6.3.1) were also carried out at a depth of 1.0 m and then at 1.5 m depth intervals within all boreholes whilst augering. The standard penetration test (SPT) procedure is given in the attached notes and the penetration 'N' value obtained during testing is shown on the borehole logs.

The locations of the field tests are shown on Drawing 1 in Appendix A. The borehole locations were nominated by Client. The test pit locations were nominated by DP and all were located on site prior to the investigation using a differential GPS unit for which an accuracy of ± 20 mm is typical. The surface levels to Australian Height Datum (AHD) and coordinates to Map Grid of Australia (MGA) were obtained using the differential GPS unit.

4.2 Results

The borehole and test pit logs are included in Appendix B, together with notes defining classification methods and descriptive terms.

The boreholes and test pits encountered variable subsurface conditions underlying the site, with the succession of strata encountered broadly summarised as follows:

ROAD BASE:	silty clay with basaltic gravel to a depth of 0.1 m in Pit 105;
TOPSOIL:	clayey silt with rootlets to depths of 0.1 – 0.3 m in Bores 1 and 3 – 8 (filling topsoil in Bores 1, 4 and 6) ;
FILLING:	silty clay with gravel and/or cobbles to depths of 0.2 – 2.0 m in Bores 2 – 4 and 6 and Pits 102 and 116;
CLAY:	firm to very stiff sandy and/or silty clay to depths of 2.0 – 6.0 m in all boreholes (the termination depths in Bores 2, 4 and 6) and to a depth of 1.5 m in Pit 116;
ROCK:	variably extremely low to medium strength siltstone or shale first encountered at depths of 3.0 – 5.5 m in Bores 1, 3, 5, 7 and 8 and at depths of 0.1 – 1.5 m in the test pits. Pits 102 and 105 were terminated in weathered rock prior to bucket refusal at depths of 1.7 m and 0.5 m respectively.

Free groundwater was encountered at depths in the range of 2.0 – 5.0 m in Bores 3 – 8. It is noted that the pits were immediately backfilled following excavation and sampling which precluded longer term monitoring of groundwater levels. It is also noted that groundwater levels are influenced by preceding climatic conditions and soil permeability, and can therefore fluctuate with time.

5. Laboratory Testing

Seven samples from the boreholes/test pits were tested in the laboratory for measurement of Atterberg limits, linear shrinkage, moisture content and California bearing ratio (CBR). The CBR tests were carried out on samples collected from the test pits, with each sample compacted to nominally 100% dry density ratio (Standard compaction) at optimum moisture content. The samples were then soaked for four days under surcharge loadings of 4.5 kg. The detailed laboratory test report sheets are included in Appendix C, with the results summarised in Table 1 and Table 2.

Table 1: Results of CBR Testing

Pit No.	Depth (m)	W_F (%)	OMC (%)	MDD (t/m^3)	CBR (%)	Swell (%)	Material
102	0.3 – 0.5	9.5	14.0	1.84	4.5	2.0	Filling
105	0.2 – 0.3	2.8	6.0	2.02	18	0.0	Shale
116	0.5 – 0.7	14.3	19.5	1.73	3.5	1.0	Silty Clay

Where: W_F = Field moisture content; OMC = Optimum moisture content; MDD = Maximum dry density; CBR = California bearing ratio

Table 2: Results of Atterberg Limits Testing

Bore No.	Depth (m)	W_F (%)	W_L (%)	W_P (%)	PI (%)	LS (%)	Material
2	2.5 – 2.9	14.4	45	14	31	13.0	Filling
3	0.5 – 0.9	6.2	32	15	17	8.5	Silty Clay
6	4.0 – 4.2	22.2	45	15	30	13.5	Sandy Silty Clay
7	1.0 – 1.3	16.9	42	15	27	12.0	Silty Clay

Where W_F = Field moisture content W_P = Plastic limit W_L = Liquid limit
PI = Plasticity Index LS = Linear shrinkage

6. Proposed Development

It is understood that the proposed development will comprise the construction of a sports centre of excellence, including a sports hall, as well as support facilities (amenities, offices, cafe, etc) and associated on-grade carparks. Based on the information provided by the client, a suspended structure would likely be considered for the main building (ie: sports hall) which allows flood waters to flow under the building. Detail design of the proposed development is yet to be undertaken. As such, cut and fill plans, finished design levels and design loads are not known at this time.

7. Comments

7.1 General

The following comments are based on the surface and subsurface profiles encountered in the boreholes and test pits. Comments are provided in the following sections on development constraints related to geotechnical factors to assist in the assessment of site suitability for the proposed development and to provide subsurface information for preliminary design purposes. As detailed design of the proposed redevelopment works has not been undertaken, the comments given must also be considered as being preliminary in nature. Once details are available, they should be forwarded to DP for review to determine if comments given within this report require revision.

7.1 Subsurface Conditions

The investigation undertaken indicates that the subsurface conditions comprise topsoil to depths of 0.1 – 0.3 m and filling to depths of 0.2 – 2.0 m overlying generally stiff to hard sandy and/or silty clay to depths within the range 2.0 m to in excess of 6.0 m in the boreholes and a depth of 1.5 m in Pit 116. Extremely weathered to moderately weathered rock (shale and siltstone) were encountered at depths of 4.4 – 6.0 m in Bores 1, 3, 5, 7 and 8 and at depths of 0.1 – 0.6 m in Pits 102 and 105. Free groundwater was encountered in Bores 3 – 8 at depths of 2.0 – 5.0 m.

7.2 Site Classification

Based on the surface and subsurface conditions encountered during the investigation and laboratory measured Atterberg limits and linear shrinkage, an estimation of characteristic surface movements (y_s) using the methods outlined in AS 2870 – 2011 (Ref 2) was undertaken, taking account a crack depth of zero. The topsoil has been assumed to be not subject to shrink-swell movements. Characteristic surface movements (y_s) of up to 35 mm have been estimated for the investigation area. However, due to existing structures and presence of uncontrolled filling deeper than 0.4 m, the site would be classified as Class P in accordance with AS 2870 (Ref 2).

It is inferred that fill material found throughout the site was not placed in accordance with recognised engineering standards and shall be considered 'uncontrolled' in accordance with the requirements of AS 3798 (Ref 3) unless an earthworks quality report (EQR) is provided by the client certifying the filling has been placed in accordance with the Level 1 testing requirements.

7.3 Earthworks

It is anticipated that the proposed main building would be constructed over the existing embankment and the footings would possibly to be extended into suitable material on the lower slopes of the embankment or extended through the filling into natural material.

In the absence of detailed design information and earthworks plans, it is not known whether additional filling will be placed on the sides of the embankment and/or over the existing platform for associated buildings and carpark.

Similarly, there is no information available regarding the excavation requirements of the proposed development. As a minimum excavation of moisture affected material and pavements within the footprint of existing building and carparks would be required.

7.3.1 Site Preparation

It is recommended that any filling required on the site should be placed and compacted as defined AS 3798 – 2007 (Ref 3). To prepare the site for the construction of on-grade carpark and pavements, the following procedures are suggested.

- Stripping of vegetation, and organic topsoils (to expected maximum depths of 0.3 m) and separately stockpiled for use in landscaping or removed off site;
- Stripping of uncontrolled fill and unsuitable and moisture affected material and inspection of the stripped surface by a geotechnical engineer;
- Compaction of the exposed surface with at least of 8 passes of a 12 tonne (minimum deadweight) roller, followed by test rolling in the presence of a geotechnical engineer. All filling should be placed in 250 mm (loose thickness) layers and compacted with placement moisture contents within the range of -2% to +2% of OMC in order to limit surface deflection during proof rolling;
- Surface drainage should be maintained at all times by adopting appropriate cross-falls across the site. Surface drainage should be installed as soon as is practicable in order to capture and remove surface flows to prevent erosion and softening of the exposed surface.

Filling delivered to site must be approved by the geotechnical consultant prior to delivery to site.

Laboratory test results have indicated that extremely weathered rock encountered in the boreholes are of high plasticity with potential for severe shrink/swell movement. Whilst these materials are typically of a stiff to very stiff consistency when dry, they can be adversely affected by inclement weather once exposed or used as general backfill at near surface levels.

Conventional sediment and erosion control measures should be implemented during the construction phase, with exposed surfaces to be topsoiled and vegetated as soon as practicable following the completion of earthworks.

7.3.2 Excavation

All topsoil, filling, natural soils and bedrock up to very low to low strength should be readily removed using a conventional medium sized excavator with a toothed bucket.

All the boreholes continued to the nominated depth of investigation (6.0 m). However, Pits 102 and 105, excavated within the proposed carpark footprint, were terminated due to bucket refusal on weathered rock at depths of 1.7 m and 0.3 m respectively. In an event that low to medium strength rock is encountered within the bulk excavation depth, these areas would be adequately removed using a large excavator with some light to medium ripping. However, larger plant may provide greater excavation efficiency particularly during drilling of pier foundations.

As the proximity of surrounding buildings and railway would be more than 40 m away, the vibration resulting from the excavation is unlikely to be of concern. However, the impact on sensitive structures and underground services will need to be determined on site once the details of the bulk earthworks and proposed excavation equipment are known.

Anticipated equipment required for excavations are given as a guide only. Additional drilling investigation within the footprint of proposed structures is recommended to provide quantitative information on the rock material properties where deep foundations (eg: bored piles) within the rock profiles are expected.

For information on soil and rock types and indicative strength, reference must be made to the individual logs which are included in Appendix B. Tenderers must make their own assessment of excavation conditions with the information given on the borehole logs provided as preliminary information only.

7.3.3 Reuse of Excavated Materials

Generally, natural clays and bedrock of up to low strength encountered during the investigation would be suitable for reuse as engineered filling within the site. Existing filling may be considered suitable following removal of deleterious material and subject to the results of the contamination assessment report. Topsoil is not suitable for use as general filling.

Filling material should not contain any particle sizes greater than 150 mm as these may cause inadequate compaction, and should not contain silts due to their propensity for saturation and erosion. Topsoil and other deleterious materials will not be suitable as a fill material but could be stockpiled for potential use in landscaping or alternatively, removal from site.

7.3.4 Batter Slopes

While cut slopes within the clays may often stand vertically and unsupported (provided no nearby structures are present) for short periods of time, they will rapidly lose strength upon exposure to weather. The excavations could be constructed to the safe batter slopes suggested in Table 4.

Table 4: Suggested Safe Batter Slopes

Material	Temporary	Permanent
Controlled Filling	2H:1V	3H:1V
Stiff to very stiff clay or greater	1H:1V	2H:1V
Extremely low strength rock	1H:1V	2H:1V

* These batter slope angles are subject to inspection and verification by a qualified geotechnical engineer or engineering geologist.

Where construction of permanent batters at recommended slopes is not feasible due to insufficient space, shoring may be required for some deep excavations.

Where engineer-designed retaining walls are proposed, the following measures should be incorporated into the design:

- Backfilling of the void between the wall and the slope using imported, free draining granular material connected into a drainage pipe at the base of the wall;
- Capping of the backfill (where exposed) with compacted clay or concrete to prevent surface runoff entering the backfill;
- Provision of an open drain to collect and divert surface runoff from ponding above the wall;
- For horizontal backfill or retained soils, retaining wall design could be based on an average bulk unit weight for retained material of 20 kN/m^3 and a triangular earth pressure distribution using an active earth pressure coefficient of (K_a) 0.3 for compacted filling and natural clay where no movement sensitive structures are located within a horizontal distance of 2H (where H is the vertical height of the retained zone) of the rear of the wall;
- Where there are movement sensitive structures located within the abovementioned critical zone, an at rest pressure coefficient (K_0) of 0.6 should be adopted;

If an adequate drainage medium is not provided behind the retaining wall, then hydrostatic pressures must be incorporated within the design with soil parameters reduced to the submerged unit weight.

7.4 Footings

It is recommended that footing systems be designed and constructed in accordance with AS 2870 (Ref 2), engineering principles and the additional requirements given in this report.

The proposed development is understood to comprise a couple of single storey buildings. The results of the investigation indicate that, whilst bands of very low to low strength rock were encountered at depths of 4.4 – 5.0 m (RLs 70.4 – 73.0 m AHD) in Bores 1, 3, 5, 7 and 8, the remaining boreholes

(Bores 2, 4 and 6) were terminated on stiff to very stiff silty clay. Hence, pending the required excavation depth and final column loads, both pad footing or deep foundations (bored /screw piles) may be suitable options to support the main building.

Lightly loaded structures (eg: amenities, offices, etc) could be founded on controlled filling or stiff clays provided they are of sufficient depths and dimensions to accommodate vertical loads and overturning moments. The structures should be of flexible nature or well-articulated so that any movement resulting from moisture variations and/or settlements will not affect serviceability.

Design of footings for the structures can only be undertaken once the final design loads and finished levels have been determined. As a guide however and based on the results of the subsurface investigation and the range of soils encountered, preliminary footing design of buildings and retaining walls could be based on the parameters presented in Table 5. The footing recommendations and design parameters for any given strata will need to be confirmed following the completion of design stage when the final excavation depth and design loads are known.

Table 5: Preliminary Footing Design Parameters

Material	Allowable Base Bearing Pressures (kPa)	Allowable Shaft Adhesion Pressure (kPa)
Controlled filling	150	-
Very stiff clays or stronger	200	30
Very low strength Shale/Siltstone (ie: Class V)	700	70

Reference should be made to the borehole logs (Appendix B) with respect to the levels of the various bearing strata.

7.5 Subgrade Conditions

The results of laboratory testing on the selected bulk samples recovered from the test pits are given in Table 1. The laboratory testing gave CBR values of 3.5% and 4.5% for the clay subgrade and filling respectively. The bulk sample of weathered shale recovered from Pit 105 returned a CBR value of 18%.

Based on the results of laboratory testing and to allow for variations in the consistency of material, design CBR values of 3.5% for clays and filling and 15% for weathered rock could be adopted for preliminary pavement design. Based on the relationship with CBR, it is suggested that modulus of subgrade reaction values of 30 kPa/mm (for a CBR 3.5%) and 60 kPa/mm (for a CBR 15%) could be adopted for design of slabs.

Surface drainage should be maintained by incorporating appropriate cross-falls during the construction. Surface drainage should be installed as soon as is practicable in order to capture and remove surface flows to prevent erosion and softening of the exposed soils.

It should be noted that the sampling was undertaken in the absence of the design information including finished subgrade levels and pavement footprints. As such, the subgrade material along the pavements and within the carparks may vary in quality and depth. Subgrade inspection and/or laboratory testing at the time of the construction would be required to confirm the provided preliminary design subgrade.

7.6 Earthquake Actions – Sub-soil Class

The site stratigraphy comprises filling or topsoil underlain by very stiff to hard silty clays to depths in excess of 6 m, overlying bedrock. Therefore, the site's sub-soil class when assessed in accordance with AS 1170.4 - 2007 (Ref 4) is considered a shallow soil site and a classification of Class C_e is suggested.

8. Summary

The investigation included the drilling of eight boreholes (Bores 1 – 8) to a depth of 6.0 m within the proposed site and three test pits (Pits 102, 105 and 116) to depths of 0.3 – 2.0 m within the proposed carpark area and laboratory testing on selected samples of underlying material

The boreholes have indicated that subsurface conditions underlying the site generally comprise variable depths of filling and topsoil overlying silty clay and clay of very stiff to hard consistency. Extremely low strength rock underlying by low strength rock was encountered in five boreholes at depths within the range 4.4 m to 5.5 m and at depths of 0.1 – 1.5 m in the test pits.

The site preparation and earthworks are to be undertaken in accordance with Section 7.4. The site has been classified Class P due to presence of uncontrolled filling deeper than 0.4 m and existing structures. The preliminary bearing capacity parameters for the design of footings are given in Section 7.5.

Consideration must be given to the preliminary nature of the investigation and potential for variability in the subsurface condition across the site. Once design is suitably advanced, DP must review the plans to determine if the comments given within are appropriate or if additional investigations are required.

9. References

1. Geology of 1:100 000 Wollongong – Port Hacking Geological Series Sheet No 9029 – 9129, Dept of Mines, (1985)
2. Australian Standard AS 3798 – 2007 *Guidelines on Earthworks for Commercial and Residential Developments.*
3. Australian Standard AS 2870 – 2011 *Residential Footings and Slabs.*
4. AS 1170.4 - 2007, "Structural Design Actions - Part 4: Earthquake Actions in Australia".

10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report (or services) for the proposed Sports and Health Centre of Excellence at Macarthur Heights, Campbelltown in accordance with DP's proposal dated 5 December 2017 and acceptance received on 15 December 2017 from Ares Liu of Turner & Townsend Thinc (Project Managers) on behalf of Campbelltown City Council. This report is provided for the exclusive use of Campbelltown City Council for this project only and for the purposes as described in the report. It should not be used for other projects or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the subsurface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report
Drawing 1

Site Locality Map

0 150.0

metres

Legend

- Indicative Site Boundary
- Approximate Borehole Locations
- Approximate Test Pit Locations

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Campbelltown City Council		
OFFICE: Macarthur	DRAWN BY: IKA	
SCALE: As shown	DATE: 3.01.2017	

TITLE: **Test Pit and Borehole Locations**
Proposed Sports and Health Centre of Excellence
Goldsmith Avenue, Campbelltown NSW

N
MGA

PROJECT No:	34255.25
DRAWING No:	1
REVISION:	0

Appendix B

Borehole Logs (Bores 1 – 8)
Test Pit Logs (Pits 102, 105 and 116)

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 76.7 mAHD
EASTING: 295750
NORTHING: 6227551
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 34255.25
DATE: 8/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
76	0.3	FILLING - light brown silty clay with a trace of rootlets, MC<PL							
		SILTY CLAY - very stiff, red mottled grey silty clay with some ironstone gravel, MC~PL		D	0.5				
	1				1.0				
		- becoming grey mottled light brown with a trace of ironstone gravel below 1.25m		S			pp >600 6,14,17 N = 31		
75					1.45				
	2	- becoming red mottled grey with some ironstone gravel below 2.0m							
					2.5				
74				S			pp >600 2,9,15 N = 24		
	3				2.95				
73		- becoming light brown mottled grey, slightly sandy below 3.7m							
	4				4.0				
				S			pp = 200-300 5,8,12 N = 20		
72					4.45				
	5	5.0 SHALE - very low to low strength, moderately to highly weathered, grey shale							
71				S	5.5 5.52		20/100mm,-,- refusal		
	6	6.0 Bore discontinued at 6.0m - limit of investigation							
70	7								
69	8								
68	9								
67									

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** IKA **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Water poured to clean borehole at 1.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 80.0 mAHD
EASTING: 295805
NORTHING: 6227604
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 34255.25
DATE: 8/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
80		FILLING - red, grey and brown silty clay with some ironstone gravel and shale gravel, MC<PL		D	0.5		pp >600		
79	1			S	1.0		pp >600 6,8,11 N = 19		
					1.45				
78	2	2.0 SILTY CLAY - very stiff, light brown mottled red silty clay with some ironstone gravel, MC~PL		S	2.5		pp >600 3,9,15 N = 24		
77	3				2.95				
76	4	- becoming light brown mottled grey, slightly sandy below 3.8m		S	4.0		pp >600 7,10,12 N = 22		
					4.45				
75	5	- becoming grey mottled red and light brown with a trace of ironstone gravel below 5.2m		S	5.5		pp >600 5,9,14 N = 23		
74	6	6.0 Bore discontinued at 6.0m - limit of investigation			5.95				
73	7								
72	8								
71	9								

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** IKA **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Water poured to clean borehole at 1.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 77.5 mAHD
EASTING: 295780
NORTHING: 6227516
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 34255.25
DATE: 8/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
77	0.2	FILLING - brown silty clay with a trace of cobbles, MC<PL							
		SILTY CLAY - very stiff, light brown mottled grey slightly sandy silty clay with a trace of ironstone gravel, MC~PL		D	0.5				
				U_{50}	0.9				
	1				1.0		pp >600 5,8,11 N = 19		
				S	1.45				
76	2								
75		- becoming stiff, grey mottled light brown below 2.5m		S	2.5		pp = 200-300 3,4,7 N = 11		
	3				2.95			08-01-18	
74									
	4			S	4.0		3,5,18 N = 23		
73	4.4	SILTSTONE - very low to low strength, moderately weathered, grey siltstone with extremely low strength, extremely weathered bands			4.45				
	5								
72		- becoming low strength, slightly to moderately weathered with medium strength bands below 5.2m							
	6								
	6.0	Bore discontinued at 6.0m - limit of investigation							
71	7								
70									
	8								
69									
	9								
68									

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** IKA **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 3.0m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 77.0 mAHD
EASTING: 295838
NORTHING: 6227555
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 34255.25
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
77	0.2	TOPSOIL - brown clayey silt with rootlets							
		FILLING - light brown silty clay, dry		S	1.5		3,8,15 N = 23		
76	1				1.95				
75	2	2.0 SILTY CLAY - very stiff, light brown mottled grey silty clay, moist		S	2.5		3,7,10 N = 17		
74	3				2.95				
73	4	4.0 SANDY SILTY CLAY - stiff, grey mottled brown sandy silty clay		S	4.0		2,7,6 N = 13	▼ 09-01-18	
					4.45				
72	5	- with a trace of low strength, extremely weathered siltstone below 5.5m		S	5.5		4,7,13 N = 20		
71	6	6.0 Bore discontinued at 6.0m - limit of investigation			5.95				
70	7								
69	8								
68	9								

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** RMM **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 4.0m

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 76.4 mAHD
EASTING: 295819
NORTHING: 6227476
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 34255.25
DATE: 8/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
76	0.2	TOPSOIL - brown clayey silt with some rootlets, dry							
		SILTY CLAY - very stiff, light brown mottled grey silty clay with a trace of ironstone gravel, MC~PL		D	0.5				
	1				1.0				
		- becoming grey mottled light brown below 1.0m		S			pp >600 5,10,13 N = 23		
75					1.45				
	2								
74					2.5				
				S			pp = 300-400 7,8,9 N = 17		
	3				2.95				
73									
	4				4.0			▼	
		- with low strength, moderately weathered sandstone band (approx. 500mm thick) at 4.0m		S	4.17		10,20/130mm,- refusal	08-01-18	
72									
	5								
	5.0	SILTSTONE - low strength, slightly weathered, grey siltstone with moderately weathered bands							
71									
	6								
	6.0	Bore discontinued at 6.0m - limit of investigation							
70									
	7								
69									
	8								
68									
	9								
67									

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** IKA **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 4.0m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 76.5 mAHD
EASTING: 295864
NORTHING: 6227515
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 34255.25
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
76.5	0.2	TOPSOIL - brown clayey silt with rootlets							
		FILLING - light brown and grey silty clay with gravel and cobbles, dry							
	1.0	SANDY SILTY CLAY - stiff, light brown mottled grey sandy silty clay							
				S	1.5		3,7,11 N = 18		
					1.95				
				S	2.5		6,7,5 N = 12		
					2.95				
				S	4.0		3,4,5 N = 9		
					4.45				
				S	5.5		2,2,4 N = 6		
					5.95				
	6.0	Bore discontinued at 6.0m - limit of investigation						09-01-18	

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** RMM **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 5.0m

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 76.1 mAHD
EASTING: 295852
NORTHING: 6227439
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 34255.25
DATE: 8/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
76	0.1	TOPSOIL - brown clayey silt with a trace of rootlets, dry							
		SILTY CLAY - hard, light brown mottled grey slightly sandy silty clay, MC<PL		D	0.5				
75	1	- becoming very stiff, MC~PL below 0.8m		S	1.0		pp = 300-400 4,8,11 N = 19		
					1.45				
74	2	- becoming firm, MC>PL below 2.0m						08-01-18	
		- with some gravel below 2.5m		S	2.5		pp <50 2,2,3 N = 5		
73	3				2.95				
72	4	- becoming stiff, grey mottled red with some ironstone gravel below 4.0m		S	4.0		pp <50 2,5,7 N = 12		
					4.45				
71	5								
	5.5	SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone		S	5.5 5.67		11,20/75mm,- refusal		
70	6	Bore discontinued at 6.0m - limit of investigation							
69	7								
68	8								
67	9								

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** IKA **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 2.0m

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Campbelltown City Council
PROJECT: Proposed Sports and Health Centre of Excellence
LOCATION: Macarthur Heights, Campbelltown, NSW

SURFACE LEVEL: 75.4 mAHD
EASTING: 295896
NORTHING: 6227470
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 34255.25
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
75	0.2	TOPSOIL - brown clayey silt with rootlets							
		SILTY CLAY - hard, light brown and grey silty clay with gravel and cobbles		S	1.5		3,7,14 N = 21		
					1.95				
74	2.0	SANDY CLAY - stiff, grey and brown sandy clay with a trace of gravel		S	2.5		3,3,5 N = 8		
73	3.0				2.95			09-01-18	
		SILTSTONE - very low strength, extremely weathered, grey mottled brown siltstone with fine grained sandstone bands, dry		S	4.0		12,30/30mm,- refusal		
72					4.18				
71	5.0	SILTSTONE - very low strength, highly to moderately weathered, grey siltstone		S	5.5		30/100mm,-,- refusal		
70					5.53				
69	6.0	Bore discontinued at 6.0m - limit of investigation							
68									
67									
66									

RIG: Hanjin DB8 **DRILLER:** Rockwell **LOGGED:** RMM **CASING:**

TYPE OF BORING: 100mm auger to 6.0m

WATER OBSERVATIONS: Free groundwater observed whilst augering at 3.0m

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

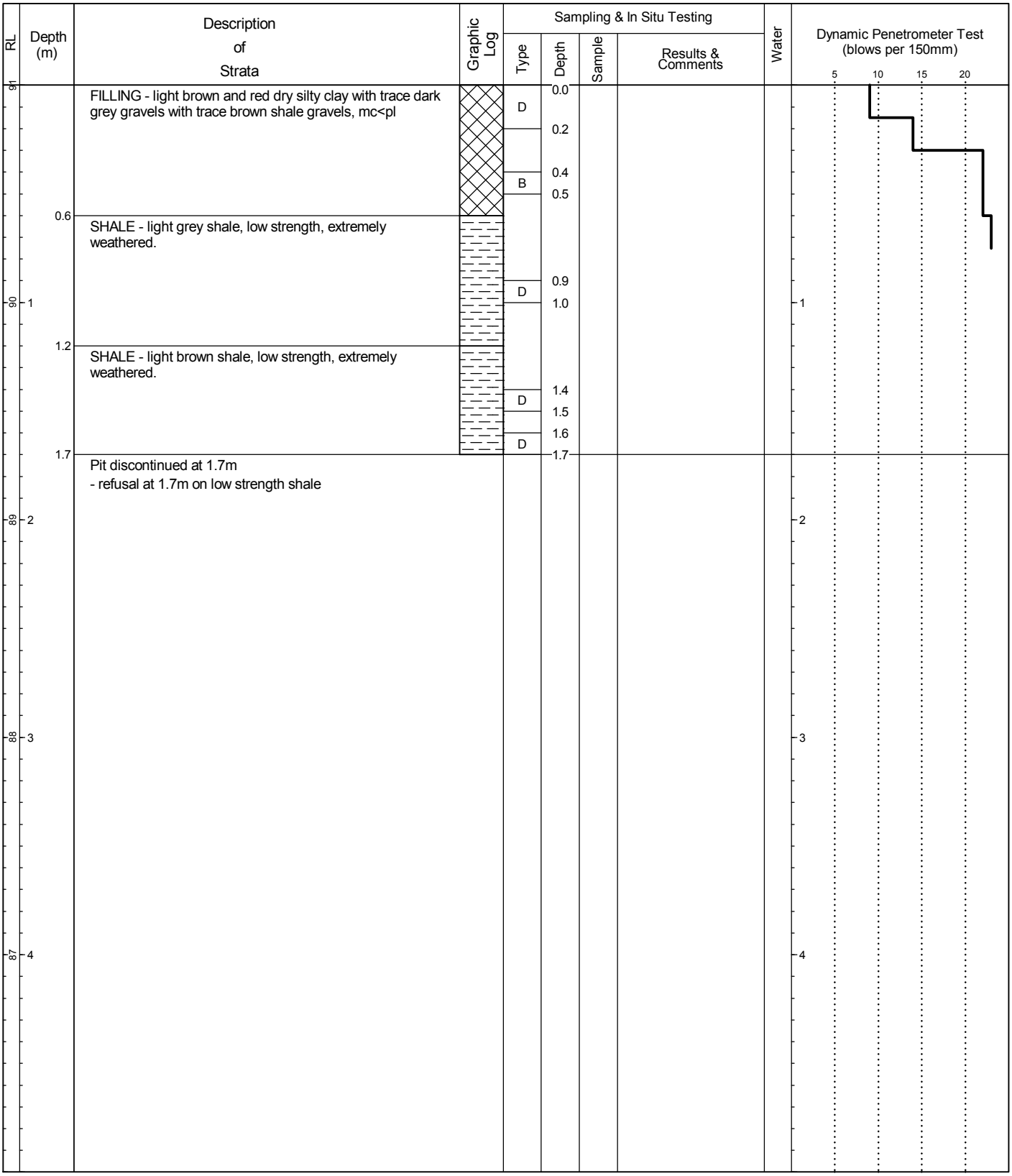
Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Campbelltown City Council
PROJECT: Sports & Health Centre of Excellence
LOCATION: Goldsmith Avenue, Campbelltown

SURFACE LEVEL: 91 AHD
EASTING: 295739
NORTHING: 6227615

PIT No: 102
PROJECT No: 34255.26
DATE: 8/1/2018
SHEET 1 OF 1



RIG: Hyundai 60 CR-96 excavator - 450mm bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: * Replicate sample BD2/080118 collected. No odour, no staining.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Campbelltown City Council
PROJECT: Sports & Health Centre of Excellence
LOCATION: Goldsmith Avenue, Campbelltown

SURFACE LEVEL: 82 AHD
EASTING: 295687
NORTHING: 6227519

PIT No: 105
PROJECT No: 34255.26
DATE: 8/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 50mm)
82	0.1	FILLING - (roadbase) light brown silty clay with basaltic gravels		D	0.0 0.05				
		SHALE - slightly weathered brown grey medium strength shale		B	0.2 0.3				
81	1								1
80	2								2
79	3	3.0 Pit discontinued at 3.0m - refusal at 0.25m on shale							3
78	4								4

Dynamic Penetrometer Test (blows per 50mm): 5, 10, 15, 20

RIG: Hyundai 60 CR-96 excavator - 450mm bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: No odour, no staining.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Campbelltown City Council
PROJECT: Sports & Health Centre of Excellence
LOCATION: Goldsmith Avenue, Campbelltown

SURFACE LEVEL: 82 AHD
EASTING: 295725
NORTHING: 6227571

PIT No: 116
PROJECT No: 34255.26
DATE: 9/1/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
82	0.2	FILLING - dry brown clayey silt with trace rootlets							
	0.5	FILLING - dry brown silty clay with trace rootlets and gravels							
		CLAY - red clay mottled orange, dry with trace rootlets, mc<pl		B	0.5 0.7				
81	1								1
	1.5	SHALE - light grey, low strength, extremely weathered shale							
80	2	2.0 Pit discontinued at 2.0m - limit of investigation							2
79	3								3
78	4								4

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60 CR-96 excavator - 450mm bucket

LOGGED: LOC

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: No odour, no staining.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C

Laboratory Test Report

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager

NATA Accredited Laboratory Number: 828

Report Number: **34255.25-1**
Issue Number: 1
Date Issued: 30/01/2018
Client: Campbelltown City Council
PO Box 57, Campbelltown NSW 2560
Contact: Ares Liu
Project Number: 34255.25
Project Name: Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location: Macarthur Heigths, Campbelltown
Work Request: 278
Sample Number: 18-278A
Date Sampled: 09/01/2018
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 6.2 %
Sample Location: **Macarthur Heights, Campbelltown (0.5 - 0.9m)**
Lot No: **BH 3**
Material: SILTY CLAY - light brown mottled grey silty clay. Slightly sandy with a trace of gravel

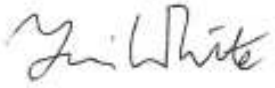
Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Air Dried		
Liquid Limit (%)	32		
Plastic Limit (%)	15		
Plasticity Index (%)	**17**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	8.5		
Cracking Crumbling Curling	None		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Tim White
Lab manager

NATA Accredited Laboratory Number: 828

Report Number: **34255.25-1**
Issue Number: 1
Date Issued: 30/01/2018
Client: Campbelltown City Council
PO Box 57, Campbelltown NSW 2560
Contact: Ares Liu
Project Number: 34255.25
Project Name: Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location: Macarthur Heigths, Campbelltown
Work Request: 278
Sample Number: 18-278B
Date Sampled: 09/01/2018
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 14.4 %
Sample Location: **Macarthur Heights, Campbelltown (2.5 - 2.9m)**
Lot No: **BH 2**
Material: FILLING - red grey and brown silty clay with some gravel and shale gravel filling

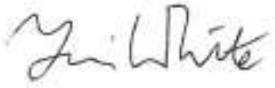
Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Air Dried		
Liquid Limit (%)	45		
Plastic Limit (%)	14		
Plasticity Index (%)	**31**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	Curling		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing



Approved Signatory: Tim White
Lab manager

NATA Accredited Laboratory Number: 828

Report Number: **34255.25-1**
Issue Number: 1
Date Issued: 30/01/2018
Client: Campbelltown City Council
PO Box 57, Campbelltown NSW 2560
Contact: Ares Liu
Project Number: 34255.25
Project Name: Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location: Macarthur Heigths, Campbelltown
Work Request: 278
Sample Number: 18-278C
Date Sampled: 09/01/2018
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 22.2 %
Sample Location: **Macarthur Heights, Campbelltown (4.0 - 4.2m)**
Lot No: **BH 6**
Material: SANDY SILTY CLAY - light brown mottled grey sandy, silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Air Dried		
Liquid Limit (%)	45		
Plastic Limit (%)	15		
Plasticity Index (%)	**30**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	13.5		
Cracking Crumbling Curling	None		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager

NATA Accredited Laboratory Number: 828

Report Number:	**34255.25-1**
Issue Number:	1
Date Issued:	30/01/2018
Client:	Campbelltown City Council PO Box 57, Campbelltown NSW 2560
Contact:	Ares Liu
Project Number:	34255.25
Project Name:	Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location:	Macarthur Heigths, Campbelltown
Work Request:	278
Sample Number:	18-278D
Date Sampled:	09/01/2018
Sampling Method:	Sampled by Engineering Department
Remarks:	Field moisture content = 16.9 %
Sample Location:	**Macarthur Heights, Campbelltown (1.0 - 1.3m)**
Lot No:	**BH 7**
Material:	SILTY CLAY - light brown mottled grey. Slightly sandy

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Preparation Method	Dry Sieve		
Sample History	Air Dried		
Liquid Limit (%)	42		
Plastic Limit (%)	15		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	12.0		
Cracking Crumbling Curling	None		

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
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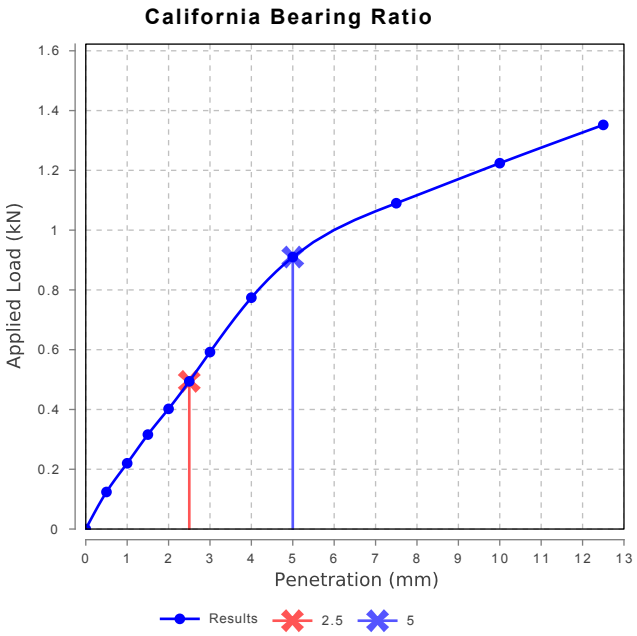
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager
NATA Accredited Laboratory Number: 828

Report Number: **34255.25-1**
Issue Number: 1
Date Issued: 30/01/2018
Client: Campbelltown City Council
PO Box 57, Campbelltown NSW 2560
Contact: Ares Liu
Project Number: 34255.25
Project Name: Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location: Macarthur Heigths, Campbelltown
Work Request: 278
Sample Number: 18-278E
Date Sampled: 19/01/2018
Sampling Method: Sampled by Others
Sample Location: **Macarthur Heights, Campbelltown (0.3 -0.5m)**
Lot No: **102**
Material: FILLING - Clay with cobbles

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS1289.5.1.1		
Maximum Dry Density (t/m^3)	1.84		
Optimum Moisture Content (%)	14.0		
Laboratory Density Ratio (%)	99.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.79		
Field Moisture Content (%)	9.5		
Moisture Content at Placement (%)	14.3		
Moisture Content Top 30mm (%)	19.8		
Moisture Content Rest of Sample (%)	17.2		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	2.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

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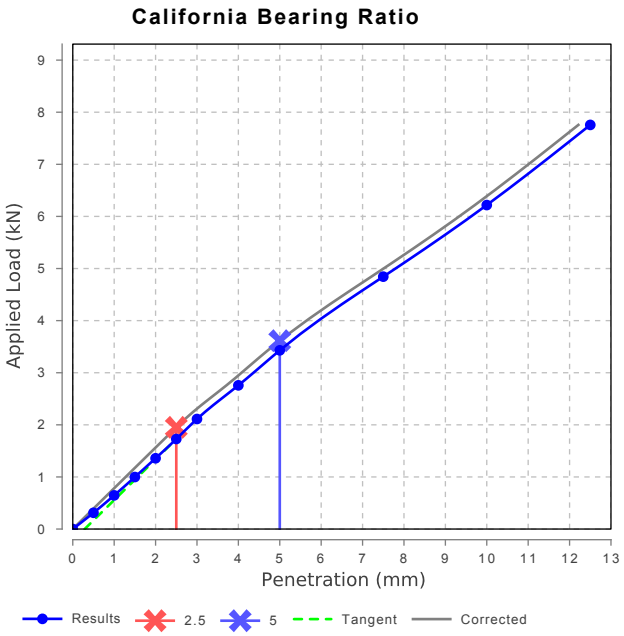
PO Box 57, Campbelltown NSW 2560
Contact: Ares Liu
Project Number: 34255.25
Project Name: Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location: Macarthur Heigths, Campbelltown
Work Request: 278
Sample Number: 18-278F
Date Sampled: 19/01/2018
Sampling Method: Sampled by Others
Sample Location: **Macarthur Heights, Campbelltown (0.2 - 0.3m)**
Lot No: **105**
Material: SHALE - Moderately weathered shale

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**18**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289.5.1.1		
Maximum Dry Density (t/m^3)	2.02		
Optimum Moisture Content (%)	6.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	98.5		
Dry Density after Soaking (t/m^3)	2.01		
Field Moisture Content (%)	2.8		
Moisture Content at Placement (%)	6.1		
Moisture Content Top 30mm (%)	9.5		
Moisture Content Rest of Sample (%)	8.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

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Report Number: **34255.25-1**
Issue Number: 1
Date Issued: 30/01/2018
Client: Campbelltown City Council
PO Box 57, Campbelltown NSW 2560
Contact: Ares Liu
Project Number: 34255.25
Project Name: Proposed Sports and Health Centre of Excellence, Geotechnic
Project Location: Macarthur Heigths, Campbelltown
Work Request: 278
Sample Number: 18-278G
Date Sampled: 19/01/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **Macarthur Heights, Campbelltown (0.5 - 0.7m)**
Lot No: **116**
Material: CLAY - Silty clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**3.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289.5.1.1		
Maximum Dry Density (t/m^3)	1.73		
Optimum Moisture Content (%)	19.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.72		
Field Moisture Content (%)	14.3		
Moisture Content at Placement (%)	19.2		
Moisture Content Top 30mm (%)	22.0		
Moisture Content Rest of Sample (%)	16.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	8