Douglas Partners
Geotechnics / Environment / Groundwater

Report on
Preliminary Geotechnical Investigation

Multi-Trades and Digital Technology Hub
See Street, Meadowbank TAFE

Prepared for
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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		04 October 2019
Reviewer		04 October 2019

Table of Contents

Report on Preliminary Geotechnical Investigation
Multi-Trades and Digital Technology Hub
See Street, Meadowbank TAFE

1. Introduction

This report presents the results of a preliminary geotechnical investigation undertaken for a proposed Multi-Trades and Digital Technology Hub at Meadowbank TAFE, at See Street, Meadowbank TAFE. The investigation was commissioned in an email dated 18 February 2019 by Ms Wendy Williams of The Technical and Further Education Commission (TAFE NSW) and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal SYD190020 dated 6 March 2019.

The scope of work and project nomenclature was revised by GHD following their receipt of the Planning Secretary's environmental assessment requirements ("SEARs") and again following a request for further information on groundwater seepage and shoring from Taylor Thomson Whitting Pty Ltd (TTW), structural engineers for the project. In particular, TTW requested further information on groundwater levels and seepage inflows to the basement during the probable maximum flood (PMF) level event. The additional comments and report updates were commissioned by GHD on behalf of TAFE NSW in emails dated 27 and 30 August 2019.

The construction of the Multi-Trades and Digital Technology Hub will include a six storey building with basement carparking. The original scope of work and geotechnical investigation, including the borehole depths was based on a maximum three-level basement.

Site investigation was carried out to provide preliminary information on the subsurface conditions for the design of excavations, shoring, retaining structures, basement drainage systems and foundations. The investigation included the drilling of seven boreholes, groundwater measurement and permeability testing. The details of the field work are presented in this report, together with relevant comments on design and construction practice.

The preliminary geotechnical investigation was carried out in conjunction with a detailed site investigation (DSI) for contamination with limited sampling locations. The DSI has been reported separately.

2. Site Description and Regional Geology

The proposed Hub site is located with the boundaries of the Meadowbank TAFE and is a trapezoidal shaped area with plan dimensions of some 90 m by 80 m as shown on Drawing 1 in Appendix B. The site is bounded to the south east by See Street, the north east by an electricity substation, the south west and north west by existing single and multistorey TAFE buildings.

At the time of the investigation, the site was an asphalt surfaced, on-grade carpark with numerous large eucalypts around the perimeter and between designated carparking areas. The site surface levels fall relatively uniformly from See Street at approximately reduced level RL 24 m relative to the Australian Height Datum (AHD) down to the west with the north western boundary at approximately RL 16 m AHD.

Reference to the Sydney 1:100 000 Geological Sheet indicates that the site is underlain by Hawkesbury Sandstone of Triassic Age. The Hawkesbury Sandstone comprises medium to coarse grained quartz sandstone, very minor shale and laminite lenses. The See Street boundary is close to a geological boundary with Ashfield Shale which comprises black to dark-grey shale and laminite.

Reference to the New South Wales 1:25 000 Acid Sulphate Soils (ASS) risk mapping indicates that the site is in an area not known for the occurrence of ASS.

Field work for this investigation confirmed the presence of Hawkesbury Sandstone.

The site is not in an area mapped as having any known soil salinity risk. It is not in an area where salinity processes operate and is therefore not expected to occur.

3. Field Work

3.1 Methods

The field investigation comprised seven boreholes (BH1 to BH7) drilled with a skid steer ('Bobcat') mounted auger/rotary drilling rig. A Dial-Before-You-Dig search was carried out for underground services on the site, then each proposed borehole location checked by an accredited underground services locator. The boreholes were drilled to depths of 1.0 - 1.9 m with 110 mm diameter continuous spiral flight augers. Standard penetration tests (SPT) were carried out from depths of 1 m, then at nominal 1.5 m depth intervals in soils and weathered rock. On reaching the underlying rock, core drilling was carried out in BH1, BH5 and BH6 using NMLC (50 mm diameter core) diamond drilling equipment to depths in the range 6.0 - 12.0 m. It is noted that these depths were based on the original concepts of a three-level basement.

Standpipes were installed in Boreholes BH1 and BH5 to depth of 12 m and 5.85 m, respectively. Details of the well construction are shown on the logs for these boreholes. DP returned to site on 20 September 2019 to undertake groundwater level measurements and permeability testing within BH1 and BH5. The water column in the well at BH1 was removed and then the rise in water level (i.e. rising head) was measured at regular time intervals. BH5 was dry at the time of the testing, so the well was filled with water instead and the fall in the water level (i.e. falling head) was measured at regular time intervals.

The locations of the boreholes are shown in Drawing 1 and levels shown in the logs at the surface were measured using a differential global position system (DGPS) with a stated accuracy of about 0.1 m in plan and elevation.

3.2 Results

The results of the boreholes are given in detail in Appendix C, together with notes defining classification methods and descriptive terms.

The typical subsurface profiles encountered in the boreholes can be summarised as follows:

PAVEMENT:	asphalt 30 – 50 mm thick over roadbase gravel to depths in the range 0.2 - 0.4 m;
FILLING:	sand and gravel filling to depths in the range 0.6 - 1.4 m;
CLAYEY SAND and IRONSTONE:	Clayey sand and ironstone gravel layers in BH2, BH3 and BH to depths in the range 0.8 – 1.25 m;
SANDSTONE:	Initially extremely low to very low strength, increasing to medium and high strength with depth. All three cored boreholes were terminated in high strength sandstone at depths in the range 6.0 - 12.0 m.

No free groundwater was observed in any of the boreholes whilst augering. Below the depth of augering, drilling fluids used for diamond coring precluded groundwater observations below the depths of auger drilling. A summary of the measured groundwater level in the monitoring wells installed in BH1 and BH5 are provided in Table 1.

Table 1: Summary of Groundwater Level Measurements

Borehole	Date Measured	Surface RL (m AHD)	Groundwater Depth (m)	Groundwater (RL (m AHD)
BH1	20 March 2019	22.5	5.5	17.0
	20 September 2019		7.7	14.8
BH5	20 March 2019	17.7	5.0(1)	12.7(1)
	20 September 2019		-(2)	-(2)

Notes: (1) water level was possibly remnant drilling fluids

(2) groundwater monitoring well was dry at the time of measurement.

A rising head permeability test was carried out in BH1, and a falling head permeability test was undertaken in BH5 on 20 September 2019. The rising head test was carried out, in BH1, using a ‘twister’ pump to remove water from the well and then measuring the rise in the water at regular time intervals. Similarly, a falling head (or ‘Slug’) test was undertaken, in BH5, where water was added and then the fall in the water was measured at regular time intervals. The results of the permeability test have been summarised in Table 2, with field measurements and permeability calculations presented in the Test Reports, in Appendix C.

Table 2: Summary of Permeability Test Results

Borehole	Date Measured	Material	Permeability (m/s)
BH1	20 September 2019	Sandstone	1.2×10^{-8}
BH5	20 September 2019	Sandstone	1.1×10^{-9}

It should be noted that groundwater levels and flows will fluctuate with climatic conditions, seasonal variation and other factors.

4. Proposed Development

The construction of the proposed Multi-Trades and Digital Technology Hub will include a six storey building with basement car parking. The lowest basement floor level (B03) is shown to be at RL 12.47 m AHD. Whilst no detailed plans were available at the time of reporting, bulk excavation to a depth in the range of 5 – 12 m are possible over virtually the entire development footprint.

Based on previous experience with similar developments, column loads of 2500 – 3500 kN are likely.

In an email dated 8 August 2019, TTW advised that although the proposed deepened basement level is above the 1 in 100 year flood event, it is below the probable maximum flood (PMF) level of RL 16.23 m AHD. It is understood that the PMF is a “flash flood event which will only exist for a duration of circa 30 minutes”. Consideration of the possible effects of elevated hydrostatic pressure and seepage into the basement during the PMF event is warranted.

5. Comments

5.1 Geotechnical Model

The subsurface conditions encountered in the boreholes were relatively uniform and the geotechnical model developed for the site comprises pavement materials then shallow filling and overburden soils with some iron-oxide cemented gravels or extremely weathered sandstone to depths of up to about 1.5 m, then sandstone bedrock. In most boreholes, the sandstone was initially extremely low to very low strength and extremely to highly weathered, grading to high strength (with some very high strength zones) with depth. High strength sandstone is also expected over the floor of the basement excavation.

A preliminary geotechnical model for the site is shown in the form of interpreted geological cross-sections (A-A’ and B-B’) through the site in Drawings 2 and 3 in Appendix B. It should be noted that the subsurface conditions are accurate at the borehole locations only and variations in the profile will occur between and outside the boreholes.

5.2 Site Classification

The results of the boreholes indicate that uncontrolled filling has been placed on the site to depths of up to 1.25 m. Therefore, when assessed in accordance with the requirements of AS 2870 - 2011 Residential Slabs and Footings, the site will be classified as Class "P".

5.3 Excavations

Excavation in soils and extremely to highly weathered sandstone to depths of 1.5 – 2 m is expected to be possible using conventional earthmoving equipment such as an excavator. Medium strength or higher strength sandstone below this depth will require the use of heavy ripping equipment, hydraulic hammers, grinders or rock saws. Rock saws may also be used to isolate areas of stronger sandstone to manage vibrations, create ‘smooth’ finishes on cut faces and to aid in the detailed excavation of footings, services trenches, lift pits etc. The presence of high strength (and some very high strength) sandstone with only minor defects and fracturing represents particularly difficult excavation conditions. Slow productivity and high tyne/bit wear should be expected by prospective earthworks contractors tendering for the bulk excavation work.

The use of heavy ripping plant and rock hammers will generally result in significant noise, dust and vibrations. Appropriate controls and management of the bulk excavation process will be required, particularly adjacent to the existing Ausgrid substation, where specific limits on vibration and dust may be appropriate.

It is noted that once excavation to 5 – 12 m is complete, sandstone, probably high strength will be exposed at the bulk excavation level (BEL).

5.3.1 Dilapidation Surveys

Detailed dilapidation surveys should be prepared for existing buildings and infrastructure near the proposed works prior to demolition and excavation commencing to provide an accurate record of the condition of buildings before the commencement of works.

5.3.2 Groundwater and Seepage Inflow to Basement

The results of the monitoring of water levels in the standpipes indicate water seepage may be encountered from approximately 5 to 8 m below ground level (RL 12.7 m AHD at the lower part of the site and RL 17 m AHD at the upper part of site). Seepage inflows may occur above these depths with water moving along the soil and bedrock interface or in rock excavations from bedding planes and defects. Based on the topography of the local area and observations in recent years of several basement excavations on the Meadowbank peninsula, it is inferred that the regional groundwater table is likely to be well below the likely BEL and the observed water in the standpipes is perched ephemeral water related to infiltration from rainfall and stormwater.

Based on previous experience, any inflow into the excavation should be readily controlled using sumps and pumps.

Inflow into the basement excavation should be monitored during the early stages of construction to provide detailed information for the design of the basement drainage system. A subfloor drainage system, comprising a nominal grid of gravel drains discharging to sump pits with activated pumps, should be sufficient to control and direct the expected relatively minor seepage inflows to the permanent basement structure.

During the PMF event, however, the seepage inflow is estimated to range from 200 to 500L per event. This is based on the very unlikely and conservative assumption that the regional groundwater table raises up to the PMF level of RL 16.23 m AHD is reached and is sustained for 30 minutes, despite the low permeability of the rock and unlikelihood of the groundwater level reaching the PMF levels within the 30 minute duration. The estimated volume of water entering the site should be adequately controlled by the subfloor drainage system, although it is expected that the drainage grid and sump layout will need to be 'scaled-up' from a 'nominal' system to cater for PMF event.

Further works such as 'grout-sealing' the interface between the shoring and exposed rock face below to cater for seepage inflows through the soil overburden during the PMF event are considered unnecessary.

Based on DP experience with deep basements in Hawkesbury Sandstone, it is expected that iron oxides will precipitate from the groundwater/seepage within the rock giving rise to a thick brown gelatinous sludge. This sludge has the potential to block up gravel drains and pump systems. A programme of regular inspection and maintenance should be implemented and gravel drains should allow regular 'rodding' to allow the break up and dispersion of the sludge. Pumps may need more regular servicing and maintenance than normal sub-floor pumping plant and equipment.

5.3.3 Batter Maximum Batter Slopes

Where space permits, it should be feasible to batter the faces of the excavations or filling. The suggested maximum temporary and permanent batter slopes are summarised in Table 3:

Table 3: Suggested Maximum Batter Slopes

Material	Height (m)	Safe Batter Slope (horizontal : vertical)	
		Temporary	Long Term
Sand, clayey sand, filling	<3	1.5(H):1(V)	2(H):1(V)
Sandstone, very low strength	<4	0.75(H):1(V)	1(H):1(V)
Sandstone, medium strength (or higher strength)	-	vertical*	vertical*

Notes * Depends on jointing. Progressive geotechnical inspections will be required during excavation and any adverse joints or discontinuities encountered will require support (probably with anchors or rock bolting).

These slopes assume a horizontal surface at the crest of the batter and no surcharge at the crest. Detailed stability analysis would be required for steeper slopes or different load conditions. Flatter slopes may also be required if erosion protection and access for maintenance is required (eg for permanent batter slopes).

An additional 'set-back' distance may be required for the Ausgrid substation and Ausgrid should be consulted to advise on this and any other potential restrictions upon excavation.

5.3.4 Retaining Structures

If steeper slopes or vertical excavations are required, temporary and permanent retaining structures could be designed based on the parameters in Table 4.

Based on the limited cored borehole data, it is anticipated that the sandstone beneath 1.5 – 2.5 m depth would be 'self-supporting' so depending on the proximity of the basement to boundaries or existing nearby structures, shoring may not be required, providing there is sufficient space to construct the maximum safe batter slopes in Table 3 for the upper soil and extremely to highly weathered sandstone layers.

Anchored soldier pile walls can be used to provide temporary retaining support to soils and weathered rock. The soldier piles are usually spaced at approximately 2 - 2.5 m centres, however, more closely spaced piles may be required to reduce wall movements, or prevent collapse of infill materials, particularly where pavements, structures or services are in close proximity to the excavation. It may also be feasible to terminate the shoring piles within unsupported medium strength or stronger sandstone above the bulk excavation level. In this case the stability of the rock directly beneath each pile must be assessed and the toe of the piles restrained with rock (toe) bolts or anchors. Toe-bolts or anchors should obviate the need for a rock shelf to maintain the stability of shoring piles for the permanent basement structure. The bolts/anchors may be for temporary and/or permanent restraint depending on whether the shoring piles are braced by the floor slabs in the 'final' situation. As a general rule, the piles will always require restraint at two levels (e.g. 'top and bottom') to remain stable. Shotcrete panels spanning between the soldier piles may also be used to prevent collapse of the soil overburden and weak rock materials.

The preliminary design of shoring/retaining walls restrained by one row of anchors or propping could be based on a triangular earth pressure distribution using the earth pressure coefficients provided in Table 4. 'Active' earth pressure coefficient (Ka) values may be used where some wall movement is acceptable, and 'at rest' earth pressure (Ko) values should be used where the wall movement needs to be reduced (i.e. adjacent to existing structures or utilities). As the shoring piles will terminate well above the bulk excavation level, it will generally not be appropriate to design the shoring piles as cantilevered piles and at least one row of temporary 'tie-back' ground anchors will be required for restraint in the temporary (construction- phase) situation.

Where multiple rows of anchors or propping are used it is suggested that preliminary design of shoring walls could be based a trapezoidal earth pressure distribution with a maximum pressure calculated based on 4H kPa where H is equal to the retained height of soil and extremely low to low strength rock. The maximum pressure should be increased to 6H or 8H where wall movement needs to be reduced. In each case the maximum pressure generally acts over the central 60% of the wall, reducing to zero at the top and base. As noted above, Ausgrid and any other stakeholders potentially affected by the excavation, including the TAFE Childcare Centre, should be consulted about the sensitivity of the structures to excavation induced ground movements.

The design of the shoring should allow for all surcharge loads, including building and wall footings, inclined slopes behind the wall, traffic, site sheds, and construction related activities.

Shoring walls should also be designed for hydrostatic pressures unless drainage of the ground behind impermeable walls can be provided. Drainage could comprise 150 mm wide strip drains pinned to the face at 1 m to 2 m centres behind shotcrete infill panels. The base of the strip drains should extend out from the shoring wall to allow any seepage to flow into a perimeter toe drain which is connected to the stormwater drainage system.

Table 4: Suggested Retaining Wall Design Parameters

Material	Bulk Unit Weight (kN/m³)	Drained Friction Angle (degrees)	Drained Cohesion c' (kPa)	Undrained Shear Strength su (kPa)	Coefficient of Earth Pressure at- rest (K₀)	Coefficient of Active Earth Pressure (Kₐ)	Coefficient of Passive Earth Pressure (Kₚ)
Filling	19	29	0	0	0.52	0.35	2.88
Clayey Sand	18	27	2	0	0.52	0.35	2.88
Sandstone, very low strength	22	30	5	-	0.5	0.33	3.00
Sandstone, medium strength or higher strength	24	-	-	-	*	*	3000 kPa

Notes * Uniform pressure provision of 10 kPa may be required if adverse joints or fractured rock is encountered. This value may be downgraded or deleted if adverse joints/fractured material are not identified during inspection of the faces during excavation, or the adverse joints are anchored.

5.3.5 Ground Anchors

The design of temporary and permanent ground anchors/rock bolts for the support of excavations and/or shoring systems may be carried out using the maximum bond stresses given in Table 5.

Table 5: Suggested Rock Anchor Design Parameters

Material Description	Maximum Allowable Bond Stress (kPa)	Maximum Ultimate Bond Stress (kPa)
Sandstone, very low strength	200	400
Sandstone, medium strength or higher strength	500	1000

These parameters assume that the drilled holes are clean and adequately flushed. The anchors should be bonded behind a line drawn up at 45 degrees from the base of the shoring or the top of free standing medium strength or stronger rock, and "lift-off" tests should be carried out to confirm the anchor capacities. It is suggested that ground anchors should be proof loaded to 125% of the design Working Load and locked-off at no higher than 80% of the Working Load.

Toe bolts or anchors would be adequate to provide stability to the shoring piles for both the temporary and permanent case. Unlike ‘tie-back’ ground anchors, toe bolts can be designed as fully grouted, passive bolts of 3 m length, or less.

5.3.6 Vibrations

Where rock hammers are required near adjacent structures (ie closer than 10 m) it would be prudent to monitor and limit vibrations on these structures. Based on previous experience and with reference to AS 2670, a maximum peak particle velocity (PPV) of 8 mm/sec (in any component direction) at the foundation level of adjacent structures is suggested for human comfort considerations although it is noted that a lower PPV criteria may be required by Ausgrid for working in close proximity to the substation. Vibration trials are suggested during initial excavation of rock to verify vibration levels. Rock saws should be considered to reduce potential ground vibrations and to achieve accurate excavations adjacent to the boundaries and for detailed excavations for footings, services and sub-slab drainage.

5.3.7 Disposal of Spoil Off-site

All excess excavated materials will need to be classified and disposed of in accordance with current NSW Environment Protection Authority (EPA) regulations. Classification should be undertaken with reference to NSW EPA (2014) Waste Classification Guidelines prior to disposal. This includes filling and virgin excavated natural materials (VENM), such as may be removed from this site. Accordingly, environmental testing will need to be carried out to classify spoil prior to disposal. The type and extent of testing undertaken will depend on the final use or destination of the spoil, and requirements of the receiving site. A DSI report has also been prepared in conjunction with the geotechnical investigation.

5.4 Footings

The proposed basement excavation will extend into medium and high strength sandstone and it is suggested that the main building structure found uniformly within sandstone of at least medium strength. The design of footings could be carried out using the Pels et al (Ref 1) derived parameters given in Table 5.

Table 5: Suggested Footing Design Parameters

Material	Ultimate Skin Friction (kPa)	Ultimate Base Bearing Pressure* (kPa)	Serviceability Base Bearing Pressure (kPa)	Drained Young’s Modulus, E’ (MPa)
Sandstone, medium strength or higher strength	1500	40000	6000	1200

Note: * Ultimate values occur at large settlements (>5% of minimum footing dimension).

Limit state design requires the selection of appropriate geotechnical strength reduction factors. The serviceability limit state often governs footings dimensions and must be considered in the design.

Higher allowable bearing pressures may be feasible in high strength sandstone with very minor fractures and defects (Class I). More extensive and possibly deeper investigation would be required to confirm the presence of the strata and a higher design pressure. The results would also be subject to further review and conformation (spoon) testing in all footings.

The serviceability bearing pressures are based total settlements being less than 1% of the footing width under the applied working load (Ref 1). Differential settlement between adjacent columns founding in a uniform stratum would typically be expected to be less than half of the calculated total settlement. Differential settlements for adjacent footings founding in differing strata must be confirmed as part of the detailed design process.

All footings should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters. Spoon testing should be carried out in 50% of all footings that are designed for an allowable end bearing pressure of 6000 kPa. The Spoon test requires the drilling of a 50 mm diameter hole below the base of the footing, to a depth of at least 1.5 times the footing width, followed by testing to check for the presence of weak/clay bands. If weak seams are detected then footing excavations may need to deepened to appropriate founding material.

5.5 Site Preparation and Earthworks

Whilst not expected to be required for most of the development area, if any filling is to be placed on the site, the following preparation is suggested:

- Strip all vegetation, organic topsoil and uncontrolled filling and remove to stockpile for re-use or disposal offsite
- Excavate to design levels then roll the exposed surface using at least 6 passes of a minimum 12 tonne smooth drum roller. The final pass should be accompanied by careful visual inspection to identify any weak or heaving areas requiring rectification works.
- Any areas requiring rectification should be excavated to a maximum depth of 0.5 m or as directed by a geotechnical engineer, then reinstated in layers using approved, engineered filling
- All engineered filling should be placed in layer of 250 mm maximum loose thickness and compacted to at least 98% relative to Standard maximum dry density with the moisture content maintained within 2% of the Standard optimum moisture content. Beneath pavements, the upper 0.5 m of filling should be compacted to at least 100% relative to Standard maximum dry density with the moisture content maintained within 2% of the Standard optimum moisture content.
- The filling should be free of oversize particles (>100 mm) and other deleterious material.

For structural filling, density testing should be carried out at Level 1 responsibility, as defined in AS 3798 - 2007 Guidelines for Earthworks for Commercial and Residential Developments.

If left in place, any existing uncontrolled filling should only be used for temporary formwork support and should not be used to support permanent structural loads. Therefore, any ground floor slabs over existing uncontrolled filling should be designed as suspended slabs.

5.6 Ground Floor Slabs and Pavements

Underfloor drainage will be required beneath floor slabs cast on the ground or within the base of the excavation. The drainage should connect to the perimeter drainage system and the water discharged to the stormwater system and, given the sloping site, it may be feasible to design a gravity system.

On-ground floor slabs and pavements could be designed using a CBR for clay soils of 3% and for exposed sandstone of 8% where appropriate. The CBR should be verified during construction by testing the actual slab or pavement subgrade materials.

The slab and pavement subgrades should be prepared in accordance with the recommendations in Section 5.5. Articulation must be provided for slab areas underlain by differing subgrade conditions that may include rock, natural soil and filling.

5.7 Seismic Classification

When assessed in accordance with AS 1170.4 - 2007 Structural design actions Part 4: Earthquake actions in Australia', the site will be classified as Class Be - rock site.

5.8 Acid Sulphate Soils

As noted in Section 2, the site is located in an area with no known occurrence of ASS. Also, given that the lowest ground surface level at the site is at approximately RL 17 m AHD and noting that ASS typically occur below RL 5 m AHD and rarely above this level and below RL 12 m AHD, it is considered that there is no risk of ASS at this site. Accordingly, there will be no need for any form of ASS management plan (ASSMP).

5.9 Soil Salinity

As noted in Section 2, the site is located in an area that is outside the known occurrence of soil salinity. Accordingly, if it is considered that there would be no requirement for a soil salinity management plan for this site or development.

6. References

1. Pells et al (1998), Foundations on Sandstone and Shale in the Sydney Region, Australian Geomechanics Society.

7. Limitations

DP has prepared this report for this project at Meadowbank TAFE in accordance with DP's proposal SYD190020 dated 6 March 2019 and acceptance received from The Technical and Further Education

Commission dated 18 February 2019. The work was carried out under a TAFE Professional Services Agreement dated 25 February 2019). This report is provided for the exclusive use of The Technical and Further Education Commission 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 sub-surface 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. Sub-surface 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.

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.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

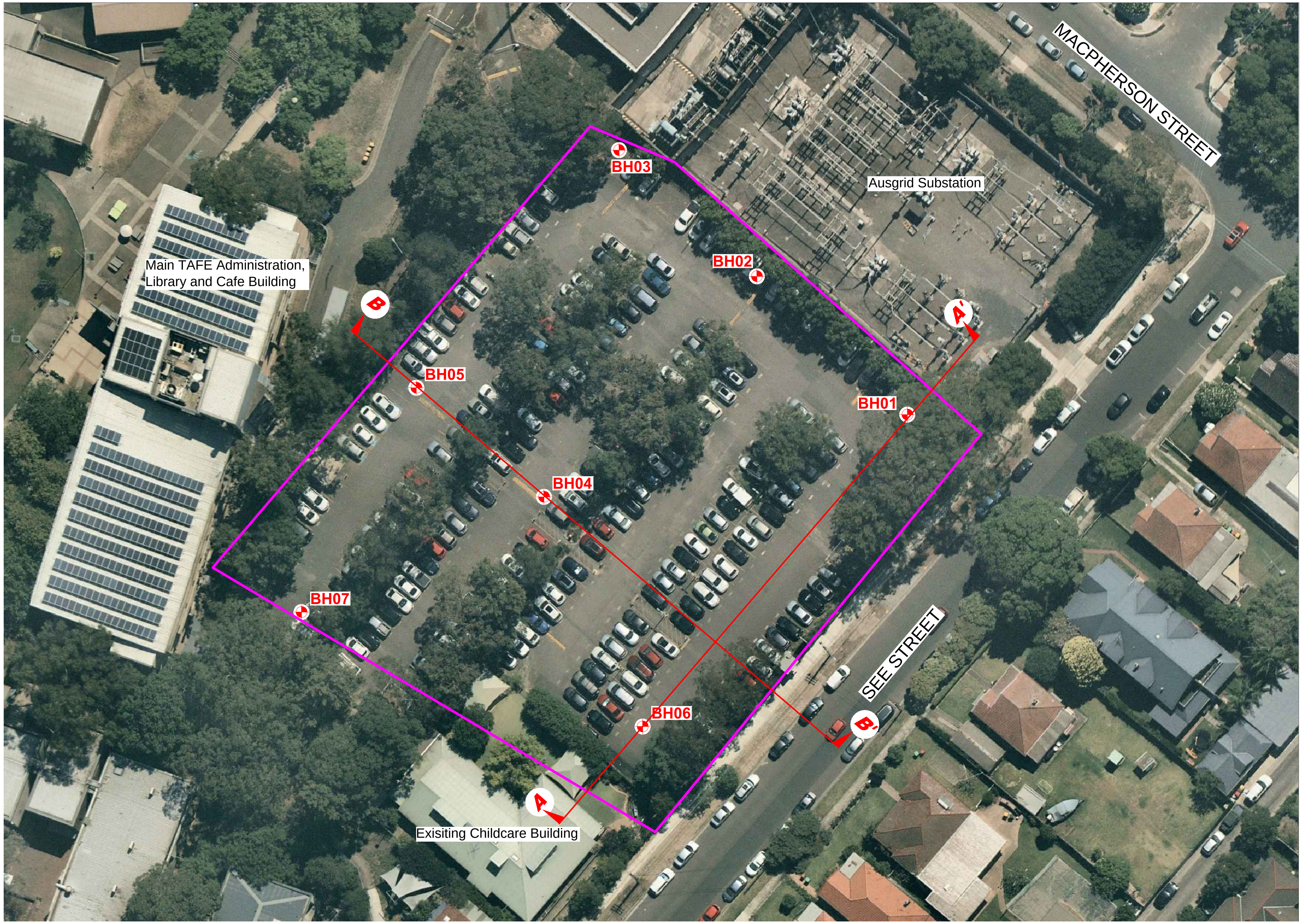
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

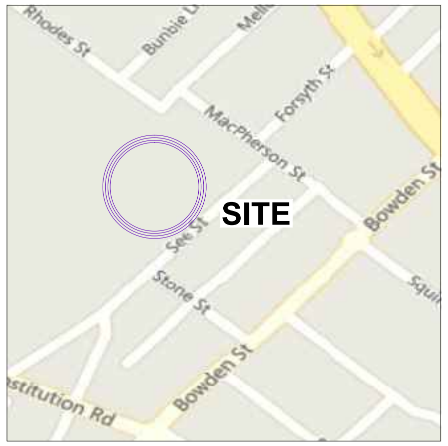
Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

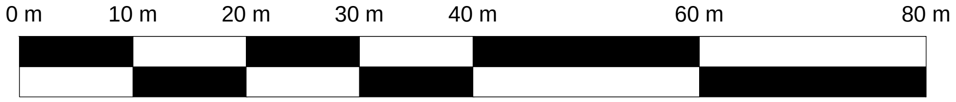
Drawings





Locality Plan

NOTE:
1: Base image from Nearmap.com
(Dated 4.3.2019)
2: Borehole coordinates measured using differential GPS



SCALE: 1:1500 @ A3

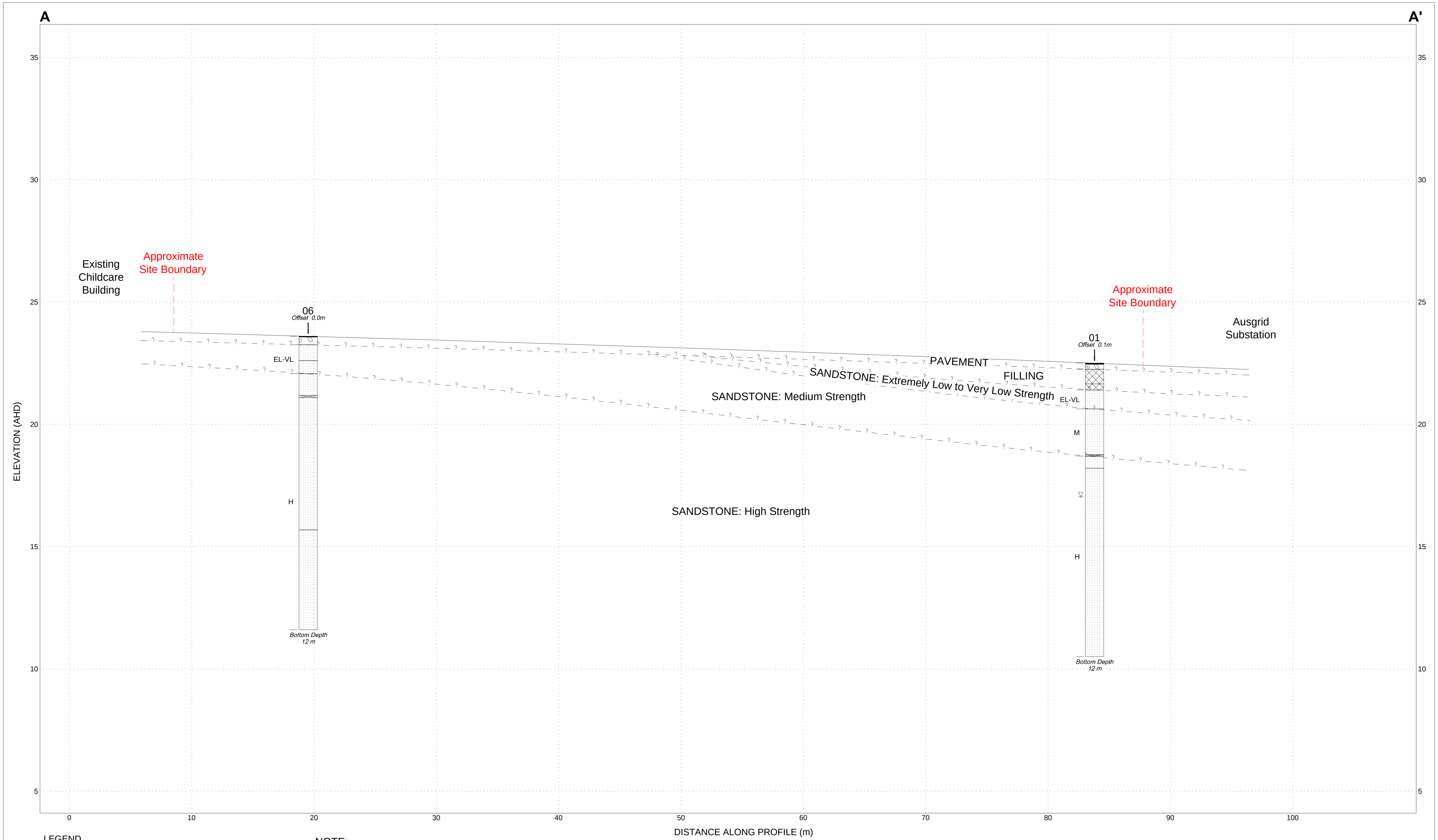
LEGEND

⊕	Borehole Location
A ⌐¬ A'	Geotechnical Cross-Section (see Drawings 2 and 3 for Cross-Sections A-A' and B-B' respectively)
—	Site Boundary

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: NSW TAFE		TITLE: **Borehole Location Plan**
OFFICE: Sydney	DRAWN BY: JDB	**Multi-Trades and Digital Technology Hub**
SCALE: 1:1500 @ A3	DATE: 11.04.2019	**See Street, Meadowbank TAFE**

PROJECT No: 86469.05
DRAWING No: 1
REVISION: 1



LEGEND

- ☒ Core Loss
- ■ Asphaltic Concrete
- ▨ Filling
- ▢ Roadbase
- ⬚ Sandstone

NOTE:

1. Subsurface conditions are accurate at borehole locations. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only. Should be read in conjunction with detailed logs.

ROCK STRENGTH
EL - Extremely low
VL - Very low
L - Low
M - Medium
H - High

SOIL STRENGTH/CONSISTENCY
f - Firm
st - Stiff
vst - Very stiff
h - Hard
l - Loose
md - Medium dense
d - Dense
vd - Very dense

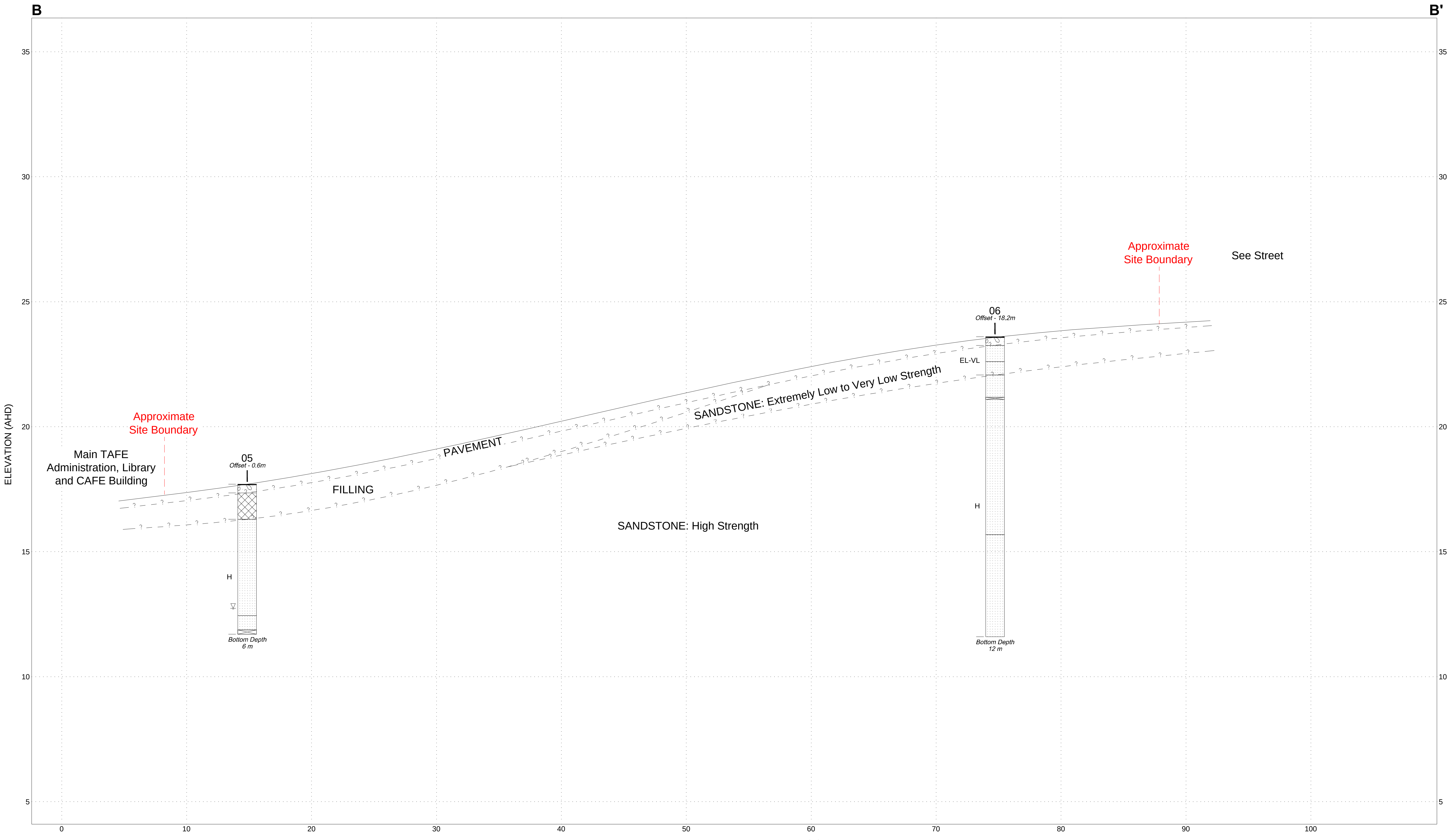
TESTS / OTHER
N - Standard penetration test value
▽ - Water level
– ? – - Inferred Geology

0 6
Horizontal Scale (metres)

Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: NSW TAFE		TITLE: Cross-section A-A'	PROJECT No: 86469.05
OFFICE: Sydney	DRAWN BY: JDB	Multi-Trades and Digital Technology Hub	DRAWING No: 2
SCALE: 1:300 (H) 1:150 (V) @ A3	DATE: 11.04.2019	See Street, Meadowbank TAFE	REVISION: 1



LEGEND

- ☒ Core Loss
- ■ Asphaltic Concrete
- ▨ Filling
- ☐ Roadbase
- ☐ Sandstone

NOTE:

1. Subsurface conditions are accurate at borehole locations. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
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N - Standard penetration test value
▽ - Water level
– ? — – - Inferred Geology

0 6
Horizontal Scale (metres)

Vertical Exaggeration = 2.0

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: NSW TAFE
OFFICE: Sydney
DRAWN BY: JDB
SCALE: 1:300 (H) 1:150 (V) @ A3
DATE: 11.04.2019

TITLE: Cross-section B-B'
Multi-Trades and Digital Technology Hub
See Street, Meadowbank TAFE

PROJECT No: 86469.05
DRAWING No: 3
REVISION: 1

Appendix C

Results of Field Work

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100\text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

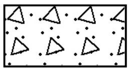
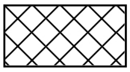
Other

fg	fragmented
bnd	band
qtz	quartz

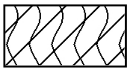
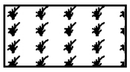
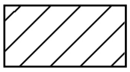
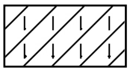
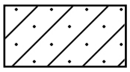
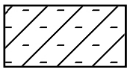
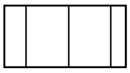
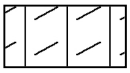
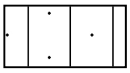
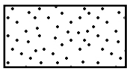
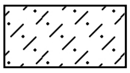
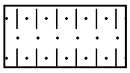
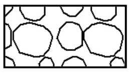
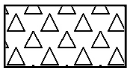
Symbols & Abbreviations

Graphic Symbols for Soil and Rock

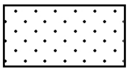
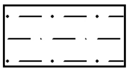
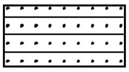
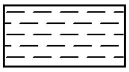
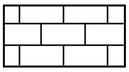
General

■	Asphalt
	Road base
	Concrete
	Filling

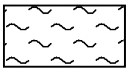
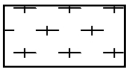
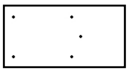
Soils

	Topsoil
	Peat
	Clay
	Silty clay
	Sandy clay
	Gravelly clay
	Shaly clay
	Silt
	Clayey silt
	Sandy silt
	Sand
	Clayey sand
	Silty sand
	Gravel
	Sandy gravel
	Cobbles, boulders
	Talus

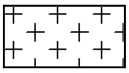
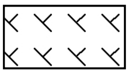
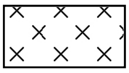
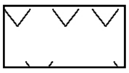
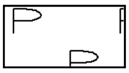
Sedimentary Rocks

	Boulder conglomerate
	Conglomerate
	Conglomeratic sandstone
	Sandstone
	Siltstone
	Laminite
	Mudstone, claystone, shale
■	Coal
	Limestone

Metamorphic Rocks

	Slate, phyllite, schist
	Gneiss
	Quartzite

Igneous Rocks

	Granite
	Dolerite, basalt, andesite
	Dacite, epidote
	Tuff, breccia
	Porphyry

May 2017

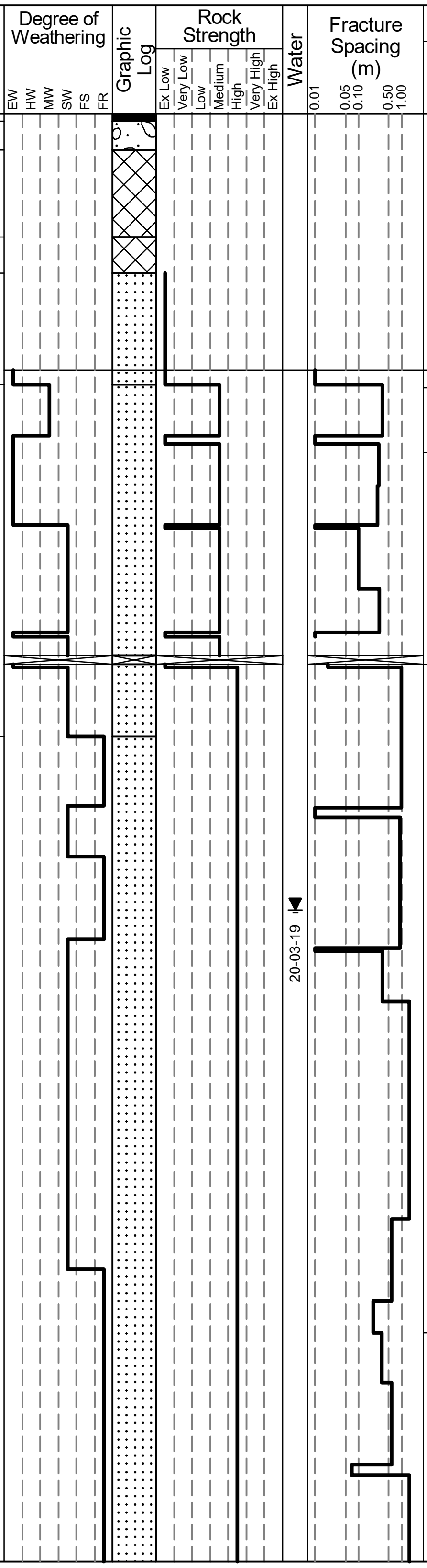
BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 22.5 AHD
EASTING: 323562.1
NORTHING: 6256839
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86469.04
DATE: 15-3-2019
SHEET 1 OF 2

Depth (m)	Description of Strata
0.05	ASPHALTIC CONCRETE: 50mm thick
0.25	ROADBASE: brown sandy gravel
0.85	FILLING: brown sand filling with fine to medium igneous gravel, trace of tile and charcoal
1.1	FILLING: red-brown clayey sand filling with fine to medium igneous gravel
1.87	SANDSTONE: extremely low to very low strength, extremely to highly weathered, yellow brown sandstone
3.8	SANDSTONE: extremely low strength then high strength, moderately then slightly weathered, fractured, red-brown, orange and grey, medium to coarse grained sandstone with some extremely low strength bands
4.3	SANDSTONE: high strength, fresh and slightly weathered, fractured and slightly fractured, orange and pale-grey, medium to coarse grained sandstone with some indistinct siltstone laminations



Discontinuities

B - Bedding J - Joint
S - Shear F - Fault

- 1.77-1.87m: Cs
- 1.89m: B, 0°-10°, un, ro, cln
- 2.22-2.28m: Cs
- 2.34-2.84m: J80°, pl, ro, cly/rootlets
- 2.84-2.84m: Cs
- 3.02-3.27m: B (x3) 0°-10°, pl, ro, cly
- 3.58-3.61m: Cs
- 3.74m: CORE LOSS: 60mm
- 3.80-3.82m: Cs
- 4.79-4.86m: B (x5) 0°-10°, pl, ro, fe
- 5.76-5.78m: B (x3) 0°-10°, pl, ro, fe
- 6.13m: B5°, pl, ro, cly, vn
- 7.65m: B15°, pl, ro, cly
- 8.2m: B0°, pl, ro, cly 10mm
- 8.42m: B0°, pl, ro, cly 5mm
- 8.76m: B0°, pl, ro, fg 10mm
- 9.33-9.40m: B5°, pl, ro, cly 5mm

Sampling & In Situ Testing

Type	Core Rec. %	RQD %	Test Results & Comments
A			PID=3 ppm
A			PID=2 ppm
S			8,7,10 N = 17 PID=1 ppm
A			PID=2.8 ppm
S			3,7,11 N = 18 PID=1.5 ppm
A			PID=2.5 ppm
C	100		PL(A) = 0.57 PL(A) = 0.73
C	98		PL(A) = 0.55 PL(A) = 1.71 PL(A) = 1.4
C	100	92	PL(A) = 1.52 PL(A) = 1.47 PL(A) = 1.76
C	100	100	PL(A) = 2.25

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/SB **CASING:** HW to 1.9m

TYPE OF BORING: Standard penetration test to 1.45m; Solid Flight Auger to 1.9m; HQ coring to 12m.

WATER OBSERVATIONS: No free groundwater observed during drilling. Groundwater measured at 5.5m on 20/3/2019

REMARKS: Location coordinates are in MGA94 Zone 56. Monitoring well installed to 12m depth; from 2.8m: 25% water loss; coordinates and GSL from DGPS.

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: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 22.5 AHD
EASTING: 323562.1
NORTHING: 6256839
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86469.04
DATE: 15-3-2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering EW HW MW SW FS FR	Graphic Log	Rock Strength Ex Low, Very Low, Low, Medium, High, Very High, Ex High	Water	Fracture Spacing (m) 0.01 0.05 0.10 0.50 1.00	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
12 11	11	SANDSTONE: high strength, fresh and slightly weathered, fractured and slightly fractured, orange and pale-grey, medium to coarse grained sandstone with some indistinct siltstone laminations *(continued)*						11.09m: B15°, pl, ro, cln	C	100	100	PL(A) = 2
10 9 8 7 6 5 4 3	12 12.0 13 14 15 16 17 18 19	Bore discontinued at 12.0m - Target depth										

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/SB **CASING:** HW to 1.9m

TYPE OF BORING: Standard penetration test to 1.45m; Solid Flight Auger to 1.9m; HQ coring to 12m.

WATER OBSERVATIONS: No free groundwater observed during drilling. Groundwater measured at 5.5m on 20/3/2019

REMARKS: Location coordinates are in MGA94 Zone 56. Monitoring well installed to 12m depth; from 2.8m: 25% water loss; coordinates and GSL from DGPS.

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

BORE: 1　　PROJECT: 86469.04　　APRIL 2019

1.77 – 6.00 m

BORE: 1　　PROJECT: 86469.04　　APRIL 2019

6.00 – 11.00 m

BORE: 1 PROJECT: 86469.04 APRIL 2019

11.00 – 12.00 m

BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

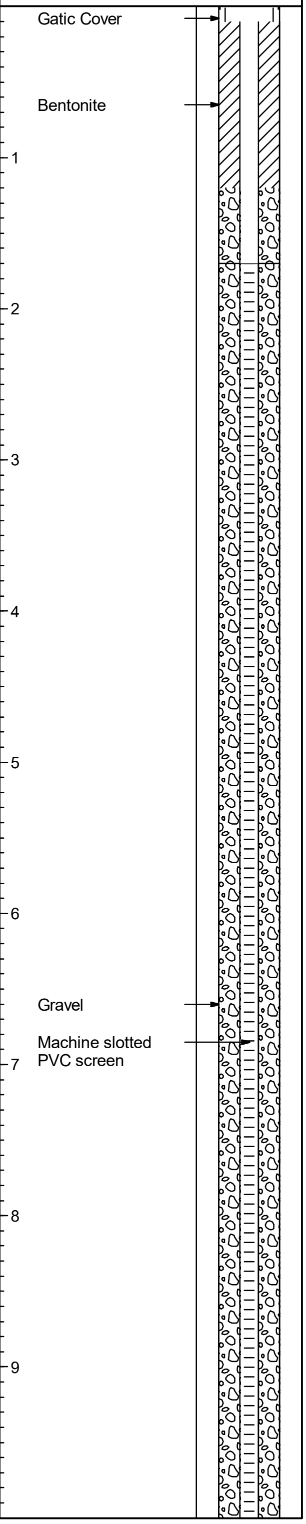
SURFACE LEVEL: 22.5 AHD
EASTING: 323562.1
NORTHING: 6256839
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86469.04
DATE: 15-3-2019
SHEET 1 OF 2

Depth (m)	Description of Strata
0.05	ASPHALTIC CONCRETE: 50mm thick
0.25	ROADBASE: brown sandy gravel
	FILLING: brown sand filling with fine to medium igneous gravel, trace of tile and charcoal
0.85	FILLING: red-brown clayey sand filling with fine to medium igneous gravel
1.1	SANDSTONE: extremely low to very low strength, extremely to highly weathered, yellow brown sandstone
1.87	SANDSTONE: extremely low strength then high strength, moderately then slightly weathered, fractured, red-brown, orange and grey, medium to coarse grained sandstone with some extremely low strength bands
3.8	
4.3	SANDSTONE: high strength, fresh and slightly weathered, fractured and slightly fractured, orange and pale-grey, medium to coarse grained sandstone with some indistinct siltstone laminations

Type	Depth	Results & Comments
A	0.1 0.2	PID=3 ppm
A	0.4 0.5	PID=2 ppm
S		8,7,10 N = 17 PID=1 ppm
A	0.9 0.95	PID=2.8 ppm
S	1.0	3,7,11 N = 18 PID=1.5 ppm
	1.45	
A	1.5 1.6	PID=2.5 ppm
C	1.77	
	1.87	PL(A) = 0.57
	1.96	
	2.95	PL(A) = 0.73
	3.52	
	3.95	PL(A) = 0.55
C	4.95	PL(A) = 1.71
	5.95	PL(A) = 1.4
	6.54	
	6.95	PL(A) = 1.52
C	7.95	PL(A) = 1.47
	8.95	PL(A) = 1.76
	9.56	
C	9.95	PL(A) = 2.25

Water: 20-03-19



RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/SB **CASING:** HW to 1.9m

TYPE OF BORING: Standard penetration test to 1.45m; Solid Flight Auger to 1.9m; HQ coring to 12m.

WATER OBSERVATIONS: No free groundwater observed during drilling. Groundwater measured at 5.5m on 20/3/2019

REMARKS: Location coordinates are in MGA94 Zone 56. Monitoring well installed to 12m depth; from 2.8m: 25% water loss; coordinates and GSL from DGPS.

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

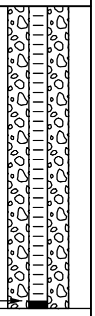
BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 22.5 AHD
EASTING: 323562.1
NORTHING: 6256839
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86469.04
DATE: 15-3-2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SANDSTONE: high strength, fresh and slightly weathered, fractured and slightly fractured, orange and pale-grey, medium to coarse grained sandstone with some indistinct siltstone laminations *(continued)*		C	10.95		PL(A) = 2		
	12.0	Bore discontinued at 12.0m - Target depth			12.0				End cap



RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/SB **CASING:** HW to 1.9m

TYPE OF BORING: Standard penetration test to 1.45m; Solid Flight Auger to 1.9m; HQ coring to 12m.

WATER OBSERVATIONS: No free groundwater observed during drilling. Groundwater measured at 5.5m on 20/3/2019

REMARKS: Location coordinates are in MGA94 Zone 56. Monitoring well installed to 12m depth; from 2.8m: 25% water loss; coordinates and GSL from DGPS.

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: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 20.2 AHD
EASTING: 323538.2
NORTHING: 6256859
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 86469.04
DATE: 15-3-2019
SHEET 1 OF 1

Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
0.05	ASPHALTIC CONCRETE: 50mm thick									
0.2	ROADBASE: sandy gravel						A			
0.6	FILLING: brown clayey sand filling with fine to medium igneous gravel, trace of medium to coarse sandstone gravel						A			PID<1 ppm
0.8	IRONSTONE: red ironstone layer									
1.5	SANDSTONE: extremely low to very low strength, extremely to highly weathered, orange brown sandstone						A			PID=1.6 ppm
	Bore discontinued at 1.5m - Target depth									

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL **CASING:** Uncased

TYPE OF BORING: Hand tools to 1.1m; Solid Flight Auger to 1.5m.

WATER OBSERVATIONS: No free groundwater observed during drilling

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and GSL from DGPS.

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: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 18.8 AHD
EASTING: 323515.9
NORTHING: 6256880
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 86469.04
DATE: 15-3-2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering EW HW MW SW FS FR	Graphic Log	Rock Strength Ex Low Very Low Low Medium High Very High Ex High	Water	Fracture Spacing (m) 0.01 0.05 0.10 0.50 1.00	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Sampling & In Situ Testing Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	ASPHALTIC CONCRETE: 50mm thick							A			PID<1 ppm
	0.4	ROADBASE: sandy gravel							A			PID=1.3 ppm
	0.7	FILLING: brown clayey sand filling with fine to medium igneous gravel										
	1.1	CLAYEY SAND: orange, red-brown clayey sand, trace of ironstone gravel							A			PID<1 ppm
	1.25	IRONSTONE: red ironstone							A			PID=0.3 ppm
	1.5	SANDSTONE: extremely low to very low strength, extremely to highly weathered, yellow sandstone										
		Bore discontinued at 1.5m - Target depth										

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL **CASING:** Uncased

TYPE OF BORING: Hand tools to 1.1m; Solid Flight Auger to 1.5m.

WATER OBSERVATIONS: No free groundwater observed during drilling

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and GSL from DGPS.

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: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 20.7 AHD
EASTING: 323505.5
NORTHING: 6256825
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 86469.04
DATE: 16-3-2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering EW HW MW SW FS FR	Graphic Log	Rock Strength Ex Low, Very Low, Low, Medium, High, Very High, Ex High	Water	Fracture Spacing (m) 0.01 0.05 0.10 0.50 1.00	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.03	ASPHALTIC CONCRETE: 30mm thick										
	0.2	ROADBASE: dark brown sandy gravel							A			PID=6 ppm
	0.6	FILLING: brown sand filling with fine to medium igneous gravel, trace of sandstone gravel							A			PID<1 ppm
20	0.8	IRONSTONE: red, ironstone										
	1.2	SANDSTONE: extremely low to very lwo strength, extremely to highly weathered, yellow brown sandstone							A			
19		Bore discontinued at 1.2m - Target depth										

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger to 1.2m.

WATER OBSERVATIONS: No free groundwater observed during drilling

REMARKS: Location coordinates are in MGA94 Zone 56. BD1/20190316 taken from 0.4-0.5m; coordinates and GSL from DGPS.

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)

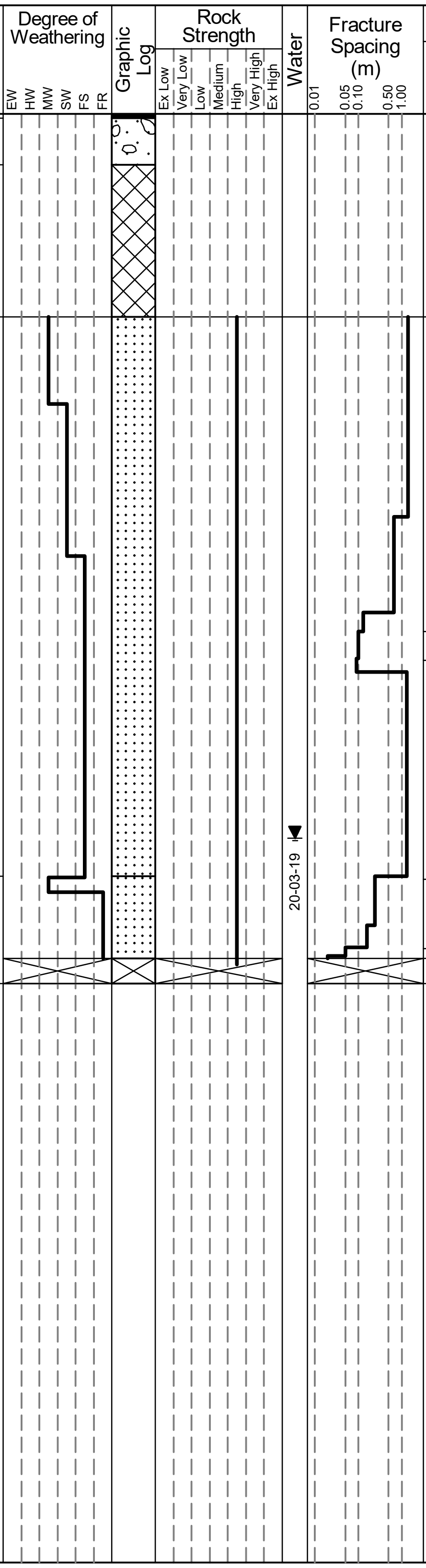
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 17.7 AHD
EASTING: 323486
NORTHING: 6256842
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 86469.04
DATE: 17-3-2019
SHEET 1 OF 1



Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
0.03	ASPHALTIC CONCRETE: 30mm thick		BD1-1, BD1-2			
0.35	ROADBASE: dark grey-brown sandy gravel. Fine to medium igneous gravel		S			18,20,19 N = 39
	FILLING: orange-brown crushed sandstone filling 0.8m: becoming slightly clayey with trace of fine to medium igneous gravel		S			7,7,11/80 refusal
1.4	SANDSTONE: high strength, moderately to slightly weathered, slightly fractured to unbroken, pale grey and brown, fine to medium grained sandstone with some high strength ironstained bands 3.05m: becomes fresh stained	2.78m: B10°, pl, ro, cly 2mm 3.44m: B10°, pl, ro, cly vn 3.57-3.76m: B (x3) 10°-20°, pl, ro, cln 3.77m: J70°, pl, ro, cly vn	C	100		~~PL(A) = 1.06~~ PL(A) = 1.61 PL(A) = 0.96 PL(A) = 1.64
			C	89		PL(A) = 1.15 PL(A) = 1.26
5.26	SANDSTONE: high strength, fresh, slightly fractured, grey, fine to medium grained sandstone with some carbonaceous laminations	5.26m: B0°, pl, fe, cly co 4mm 5.28-5.80m: J, sv, un, ti, partially fe stn, cly 5.76-5.81m: B (x2) 10°-20°, pl-un, ro, cbs vn 5.83m: CORE LOSS: 170mm				
6.0	Bore discontinued at 6.0m - Target depth					

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/JB **CASING:** HW to 1.4m

TYPE OF BORING: Standard penetration test to 1.3m; Solid Flight Auger to 1.4m; NMLC coring to 6m.

WATER OBSERVATIONS: No free groundwater observed during drilling. Groundwater measured at 5.0m on 20/3/2019

REMARKS: Location coordinates are in MGA94 Zone 56. BD1-1/BD1-2 taken from 0.2m; Monitoring well installed to 5.85m depth; coordinates and GSL from DGPS.

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

BORE: 5 PROJECT: 86469.04 APRIL 2019

1.40 – 6.00 m

BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 17.7 AHD
EASTING: 323486
NORTHING: 6256842
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 86469.04
DATE: 17-3-2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Sampling & In Situ Testing: Depth	Sampling & In Situ Testing: Sample	Sampling & In Situ Testing: Results & Comments	Water	Well Construction Details
	0.03	ASPHALTIC CONCRETE: 30mm thick		BD1-1, BD1-2	0.2				Gatic Cover
	0.35	ROADBASE: dark grey-brown sandy gravel. Fine to medium igneous gravel			0.4				
		FILLING: orange-brown crushed sandstone filling 0.8m: becoming slightly clayey with trace of fine to medium igneous gravel		S			18,20,19 N = 39		Bentonite
				S	0.95 1.0		7,7,11/80 refusal		
	1.4	SANDSTONE: high strength, moderately to slightly weathered, slightly fractured to unbroken, pale grey and brown, fine to medium grained sandstone with some high strength ironstained bands			1.38 1.4		PL(A) = 1.06		
					1.95		PL(A) = 1.61		
				C	2.9		PL(A) = 0.96		
		3.05m: becomes fresh stained							
					3.7		PL(A) = 1.64		Gravel Machine slotted PVC screen
					4.15				
					4.8		PL(A) = 1.15		
				C	5.15		PL(A) = 1.26	▼ 20-03-19	
	5.26	SANDSTONE: high strength, fresh, slightly fractured, grey, fine to medium grained sandstone with some carbonaceous laminations							End cap
	6.0	Bore discontinued at 6.0m - Target depth			6.0				

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/JB **CASING:** HW to 1.4m

TYPE OF BORING: Standard penetration test to 1.3m; Solid Flight Auger to 1.4m; NMLC coring to 6m.

WATER OBSERVATIONS: No free groundwater observed during drilling. Groundwater measured at 5.0m on 20/3/2019

REMARKS: Location coordinates are in MGA94 Zone 56. BD1-1/BD1-2 taken from 0.2m; Monitoring well installed to 5.85m depth; coordinates and GSL from DGPS.

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)

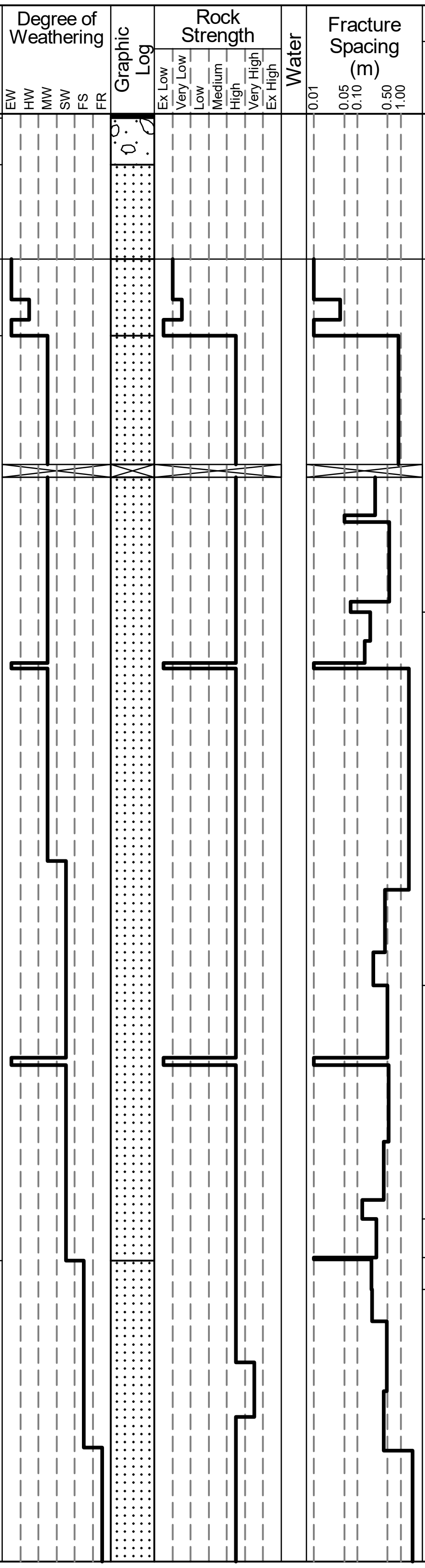
Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 23.6 AHD
EASTING: 323520.5
NORTHING: 6256790
DIP/AZIMUTH: 90°/--

BORE No: BH6
PROJECT No: 86469.04
DATE: 16-3-2019
SHEET 1 OF 2



RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
	0.03	ASPHALTIC CONCRETE: 30mm thick		A A			PID < 1 ppm
	0.35	ROADBASE: sandy gravel		A A			PID < 1 ppm 18,25/100
23		SANDSTONE: extremely low to very low strength, extremely to highly weathered, yellow sandstone		S			refusal PID < 1 ppm
	1 1.0			A			PID < 1 ppm
		SANDSTONE: extremely to very low strength then very low strength, extremely weathered to high weathered, fragmented and fractured, orange red-brown with pale grey, medium to coarse sandstone with some very low and extremely low strength bands					
22	1.53		1.42-1.53m: Cs	C	94	59	PL(A) = 2.37
	2						
		SANDSTONE: high strength, moderately weathered, fractured and slightly fractured, orange red-brown and pale grey, medium to coarse sandstone with some extremely low strength bands and indistinct siltstone laminations					
21	2.51		2.42m: CORE LOSS: 90mm				PL(A) = 1.42
			2.77-2.82m: J80°, pl , ro, cly				
	3			C	97	89	
20			3.37m: B0°, pl, ro, fe 3.44-3.65m: B (x2) 0°, pl, ro, cln 3.79-3.83m: Cs				PL(A) = 1.6
	4						
19							PL(A) = 2.36
	5						
18			5.36m: B10°, pl, ro, cly 10mm	C	100	98	PL(A) = 1.53
	6		5.79m: B10°, pl, ro, cly co 6.02m: J30°, pl, ro, cln				PL(A) = 2.1
17			6.52-6.57m: Cs				
	7		7.1m: J30°, pl, ro, cln				PL(A) = 2.53
16			7.5m: B15°, pl, ro, cln 7.63m: B0°, pl, ro, cly 5mm				
	7.92 8	SANDSTONE: high strength, fresh stained then fresh, slightly fractured, pale grey, medium to coarse grained sandstone	7.90-7.91m: B, 0°, pl, ro, fe 8.12m: J70°, pl, ro, cln				
15		7.92-9.24m: indistinct siltstone laminations		C	100	100	PL(A) = 4.38
	9		8.82m: B0°, pl, ro, cbs				
		9.24-11.00m: massive sandstone	9.23m: B0°, pl, ro, cly 10mm				
14							PL(A) = 1.1

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/SB **CASING:** Uncased

TYPE OF BORING: Standard penetration test to 0.95m; Solid Flight Auger to 1.0m.

WATER OBSERVATIONS: No free groundwater observed during drilling

REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and GSL from DGPS.

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

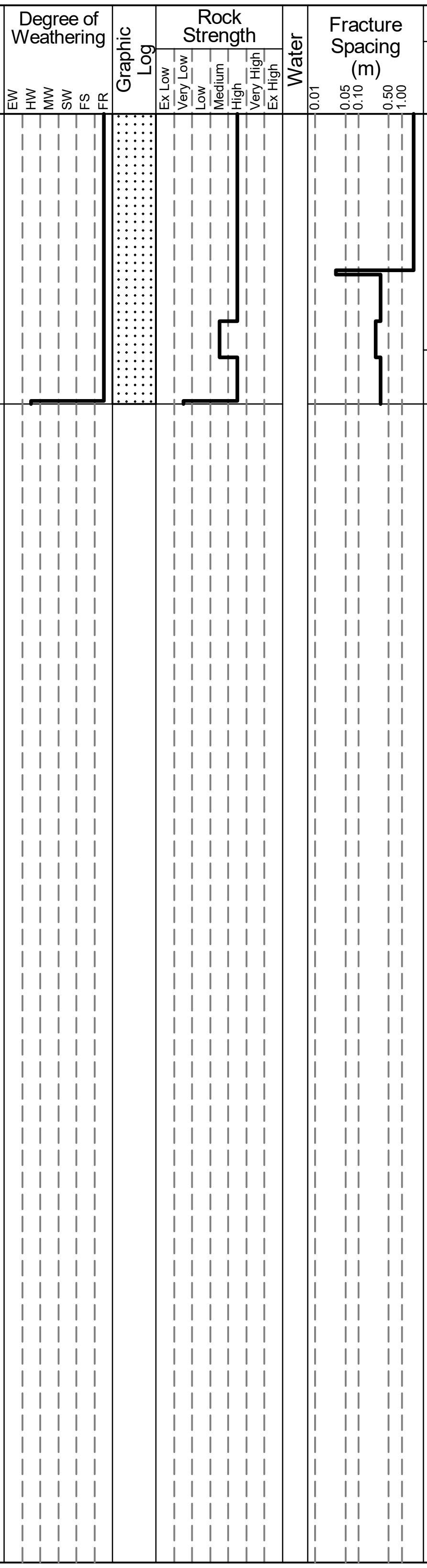
BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 23.6 AHD
EASTING: 323520.5
NORTHING: 6256790
DIP/AZIMUTH: 90°/--

BORE No: BH6
PROJECT No: 86469.04
DATE: 16-3-2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Discontinuities B - Bedding J - Joint S - Shear F - Fault	Type	Core Rec. %	RQD %	Test Results & Comments
13		SANDSTONE: high strength, fresh stained then fresh, slightly fractured, pale grey, medium to coarse grained sandstone *(continued)*					PL(A) = 1.49
	11	11.00m: with some siltstone clasts and inclusions in form of breccia	11.08-11.67m: B, 0°, pl, ro, cly var	C	100	99	
12			11.43-11.62m: B (x4) pl/cu, ro, 0°-10° 11.63-11.67m: J (x2) 70°, pl, ro, cly co				PL(A) = 0.34
	12 12.0	Bore discontinued at 12.0m - Target depth					
11	13						
10	14						
9	15						
8	16						
7	17						
6	18						
5	19						
4							



RIG: Bobcat **DRILLER:** GM **LOGGED:** CL/SB **CASING:** Uncased
TYPE OF BORING: Standard penetration test to 0.95m; Solid Flight Auger to 1.0m.
WATER OBSERVATIONS: No free groundwater observed during drilling
REMARKS: Location coordinates are in MGA94 Zone 56. Coordinates and GSL from DGPS.

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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BORE: 6 PROJECT: 86469.04 APRIL 2019

1.00 – 5.00 m

BORE: 6 PROJECT: 86469.04 APRIL 2019

5.00 – 10.00 m

BORE: 6 PROJECT: 86469.04 APRIL 2019

10.00 – 12.00 m

BOREHOLE LOG

CLIENT: The Technical & Further Education Commission
PROJECT: Multi-Trades and Digital Technology Hub
LOCATION: See Street, Meadowbank TAFE

SURFACE LEVEL: 17.2 AHD
EASTING: 323468.3
NORTHING: 6256807
DIP/AZIMUTH: 90°/--

BORE No: BH7
PROJECT No: 86469.04
DATE: 16-3-2019
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Type	Core Rec. %	RQD %	Test Results & Comments
17	0.03	ASPHALTIC CONCRETE							A*			PID <1 ppm
	0.3	ROADBASE: brown gravelly sand roadbase. Fine to medium igneous gravel, trace of fine to medium sandstone gravel							A			PID <1 ppm
	0.5	FILLING: red-brown sand filling with fine to medium igneous gravel										
16	1.0	FILLING: light brown sand filling with trace of fine to medium igneous gravel and ironstone gravel							A			PID <1 ppm
	1.5	SANDSTONE: extremely low to very low strength, extremely to highly weathered, yellow brown sandstone							A			PID <1 ppm
		Bore discontinued at 1.5m - Target depth										

Degree of Weathering: EW HW MW SW FS FR

Rock Strength: Ex Low, Very Low, Low, Medium, High, Very High, Ex High

Fracture Spacing (m): 0.01 0.05 0.10 0.50 1.00

Discontinuities: B - Bedding J - Joint S - Shear F - Fault

RIG: Bobcat **DRILLER:** GM **LOGGED:** CL **CASING:** Uncased

TYPE OF BORING: Solid Flight Auger to 1.5m.

WATER OBSERVATIONS: No free groundwater observed during drilling

REMARKS: Location coordinates are in MGA94 Zone 56. BD2/20190316 taken from 0.1-0.2m; coordinates and GSL from DGPS.

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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Permeability Testing - Rising Head Test Report

Client: TAFE NSW
Project: Multi-Trades & Digital Technology Hub
Location: P Block Car park, See St, Meadowbank

Project No: 86469.05
Test date: 20-Sep-19
Tested by: AT

Test Location

Description: BH1
Material type: Sandstone

Test No. BH1
Easting: 323562 m
Northing: 6256839 m
Surface Level: 22.5 m AHD

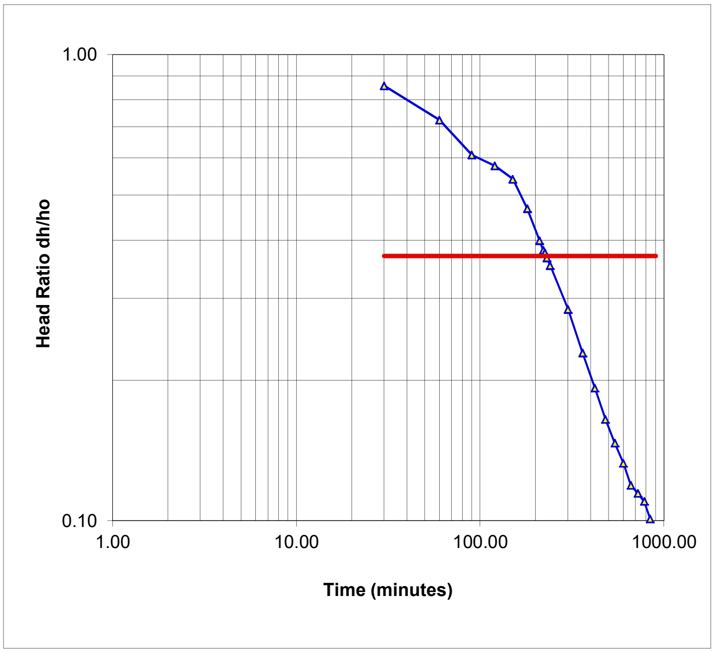
Details of Well Installation

Well casing diameter (2r) 50 mm
Well screen diameter (2R) 76 mm
Length of well screen (Le) 10.7 m

Depth to water before test 7.82 m
Depth to water at start of test 10 m

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0.00	10	2.18	1.000
30.00	9.69	1.87	0.858
60.00	9.4	1.58	0.725
90.00	9.15	1.33	0.610
120.00	9.08	1.26	0.578
150.00	9	1.18	0.541
180.00	8.84	1.02	0.468
210.00	8.69	0.87	0.399
220.00	8.65	0.83	0.381
225.00	8.64	0.82	0.376
230.00	8.62	0.80	0.367
240.00	8.59	0.77	0.353
300.00	8.44	0.62	0.284
360.00	8.32	0.50	0.229
420.00	8.24	0.42	0.193
480.00	8.18	0.36	0.165
540.00	8.14	0.32	0.147
600.00	8.11	0.29	0.133
660.00	8.08	0.26	0.119
720.00	8.07	0.25	0.115
780.00	8.06	0.24	0.110
840.00	8.04	0.22	0.101
900.00	8.03	0.21	0.096



To = 227 mins
13620 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity k = **1.2E-08** m/sec
= **0.00435** cm/hour

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au

Permeability Testing - Falling Head Test Report

Client: TAFE NSW
Project: Multi-Trades & Digital Technology Hub
Location: P Block Car park, See St, Meadowbank

Project No: 86468.09
Test date: 20-Sep-19
Tested by: AT

Test Location

Description: BH5
Material type: Sandstone

Test No. BH5
Easting: 323486 m
Northing 6256842 m
Surface Level: 17.7 m AHD

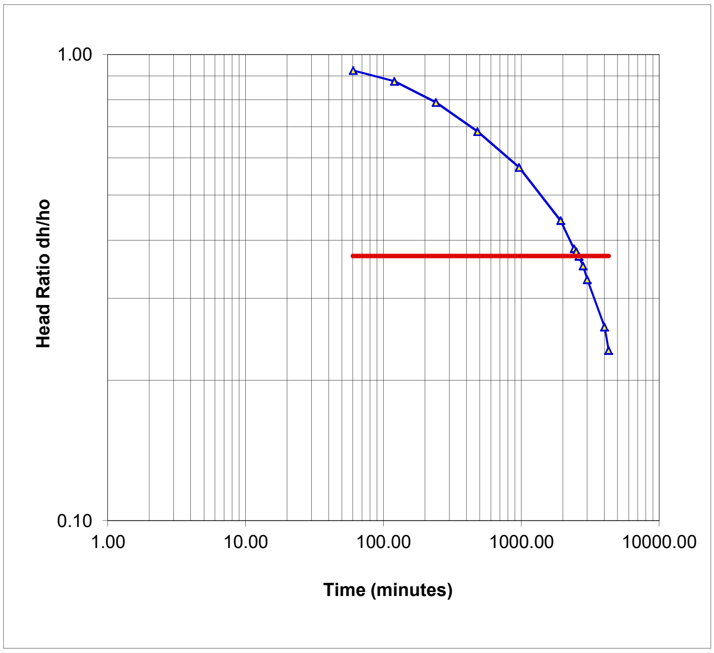
Details of Well Installation

Well casing diameter (2r) 50 mm
Well screen diameter (2R) 76 mm
Length of well screen (Le) 10.7 m

Depth to water before test 5.8 m
Depth to water at start of test 2.31 m

Test Results

Time (min)	Depth (m)	Change in Head: δH (m)	δH/Ho
0.00	2.31	3.49	1.000
60.00	2.57	3.23	0.926
120.00	2.74	3.06	0.877
240.00	3.04	2.76	0.791
480.00	3.41	2.39	0.685
960.00	3.8	2.00	0.573
1920.00	4.26	1.54	0.441
2400.00	4.46	1.34	0.384
2500.00	4.48	1.32	0.378
2600.00	4.51	1.29	0.370
2800.00	4.57	1.23	0.352
3000.00	4.65	1.15	0.330
4000.00	4.89	0.91	0.261
4288.00	4.99	0.81	0.232



To = 2600 mins
156000 secs

Theory: Falling Head Permeability calculated using equation by Hvorslev

$k = [r^2 \ln(Le/R)]/2Le\ To$

where r = radius of casing
R = radius of well screen
Le = length of well screen
To = time taken to rise or fall to 37% of initial change

Hydraulic Conductivity k = **1.1E-09** m/sec
= **0.00038** cm/hour