Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Student Housing Development
90-102 Regent Street, Redfern

Prepared for
The Trust Company (Australia) Limited ATF WH
Regent Trust

Project 86852.00
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Douglas Partners
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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
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Report on Geotechnical Investigation
Student Housing Development
90-102 Regent Street, Redfern

1. Introduction

This report presents the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed student housing development at 90-102 Regent Street, Redfern. The investigation was commissioned by The Trust Company (Australia) Limited ATF WH Regent Trust and was undertaken in accordance with DPs proposal SYD190418.P.001.Rev2 dated 29 August 2019. The work was undertaken in consultation with Allen Jack & Cottier Pty Ltd (AJC), the architects for the project.

It is understood that the proposed development on the site will include an 18-storey student housing building, with an extension of the existing split-level basement towards the north to give a basement floor level at RL 22.8 m. Excavation to depths of up to 3.5 m is anticipated for the basement.

The investigation included the drilling of seven boreholes, three groundwater monitoring wells and laboratory testing of selected samples. This report provides the results of the investigation and geotechnical information as part of a submission for State Significant Development (SSD) application number SSD 10382 and Secretary's Environmental Assessment Requirements (SEARs) dated 30 November 2019.

Baseline data of existing geological and hydrogeological conditions are provided in Sections 5 and 6 of this report.

The geotechnical issues associated with the construction of this development (as required under Section 15 of the SEARs) are outlined within Section 8 of this report. In summary, the key geotechnical issues that will need to be managed for this development include:

- temporary and permanent excavation support;
- ground Vibrations during demolition and excavation;
- subgrade preparation for slabs and pavements;
- foundations; and
- potential impact to nearby rail infrastructure.

DP conducted a detailed site (contamination) investigation (DSI) on the site in conjunction with this geotechnical investigation, the details of which are reported separately (ref: DP Report 86852.01.R.001.Rev0, dated December 2019).

2. Site Description

The approximately rectangular-shaped site has dimensions of about 32 m x 42 m and slopes gently down towards the south-west. The site is currently occupied by a number of two-storey buildings with car ports off the rear William Lane and a four-storey building (i.e. the southern-most building) over a split-level basement car park. Access into the existing basement car park is also from William Lane and the basement covers about one-third of the total site footprint.

The site is bordered by Marian Street to the north, Regent Street to the east, a two-storey building followed by a service (petrol) station to the south and William Lane to the west. On the northern side of Marian Street there is a vacant site for a new development. A former Council Depot was located on the western side of William Lane, and is currently under construction for an 18-storey affordable housing building.

The site is underlain by two rail tunnels, which are part of the new Sydney Metro rail line that was under construction at the time of this investigation. Based on a survey plan (ref: Drawing No. 506700048BH, by LTS Lockley Pty Ltd, dated 30 July 2019), the "First and Second Reserves" extend approximately north-south below the site, with the tunnel crown at least 34 m below the ground surface. The LTS survey drawing showing the Sydney Metro tunnels relative to the site is included in Appendix B.

3. Regional Geology

Reference to the Sydney 1:100 000 Geological Series Sheet 9130 indicates that the site is located within Quaternary-aged transgressive dunes typically comprising medium to fine-grained sand. The boundary with Triassic-aged Ashfield Shale occurs about 140 m to the west of the site. Ashfield Shale typically comprises black to dark grey shale and laminite and weathers to residual clay.

The 1:25 000 Acid Sulphate Soil Risk map for Botany Bay indicates that the site does not lie within an area known for acid sulphate soils. The site also does not occur within an area mapped for known soil salinity issues.

4. Field Work Methods

The field work for the investigation included:

- three rock cored boreholes (BH1 to BH3) to depths of 12.9 m to 20.0 m, together with the installation of groundwater monitoring wells within these boreholes for sampling of groundwater and measurement of water levels;
- two boreholes (BH4 and BH5) to depths of 7.3 m and 6.2 m, respectively; and
- two hand-augered boreholes (BH6 and BH7) to depths of 0.9 m and 2.0 m, respectively, primarily for contamination sampling purposes.

The borehole locations are shown on Drawing 1 in Appendix B. Boreholes BH1 and BH5 were located within the existing basement. Small, tight-access drill rigs were used to drill all boreholes except for BH3 and the two hand-augered boreholes. Standard penetration tests (SPTs) were undertaken to assess the soil strength at BH3 only, given the use of a large (i.e. Hanjin) drill rig.

The boreholes were logged and sampled by an experienced geotechnical engineer.

The ground surface levels (relative to Australian height datum) and coordinates for the boreholes are shown on the borehole logs and were obtained by a surveyor (LTS Lockley Pty Ltd).

5. Field Work Results

5.1 Subsurface Profile

Details of the subsurface conditions encountered in the boreholes are given in the borehole logs in Appendix C, together with notes explaining descriptive terms and classification methods used.

The subsurface materials encountered at the borehole locations may be summarised as follows:

FILL:	Fill extended to depths of between 0.3 m and 1.4 m in BH1 to BH5, and at least 2.0 m in BH6 with the borehole discontinued in fill. In BH7, fill extended to at least 0.9 m with auger refusal occurring possibly on a concrete slab. The fill was mostly granular material including a mixture of silt, clay, sand and gravel, with a trace of concrete, glass, brick, sandstone, tile, PVC and timber fragments; over
Sandy CLAY	Generally firm sandy clay (possibly alluvial) but soft at BH3 to depths of up to about 2 m; overlying
Silty CLAY:	Mostly stiff and very stiff silty clay (residual) to depths of between 5.3 m and 9.7 m. Extremely weathered shale of hard consistency was encountered over the lower few metres; over
Laminite and Siltstone: (Ashfield Shale)	Laminite and siltstone bedrock below depths of between 5.3 m and 9.7 m and continuing to the bottom of the boreholes. The rock profile generally includes very low and low strength, fractured laminite about 1 m to 3 m thick underlain by medium and high strength, fresh and slightly fractured laminite or siltstone. A thrust fault was encountered in BH3 at a depth of about 10.3 m to 10.5 m.

5.2 Groundwater

No free groundwater was measured during auger drilling of the boreholes. The use of water during rock coring precluded the measurement of any groundwater during rock coring in BH1 to BH3.

Groundwater levels were measured within the monitoring wells with the results summarised in Table 1.

Table 1: Summary of Groundwater Depths

During Well Development					
Location	Ground Level (m AHD)	Depth (m)	Reduced Level (m AHD)	Depth (m)	Reduced Level (m AHD)
		24 September 2019		19 November 2019	
BH1	22.9	6.7	16.2	6.6	16.3
BH2	24.5	6.9 *	17.6 *	8.5	16.0
BH3	26.0	8.1 *	17.9 *	9.6	16.4
During Well Sampling					
		27 September 2019		26 November 2019	
BH1	22.9	10.7 #	12.2 #	6.6	16.3
BH2	24.5	8.2	16.3	8.3	16.2
BH3	26.0	9.8	16.2	9.8	16.2

Notes:

* Possibly remnant drilling fluid led to shallower water levels

Possibly deeper water level due to insufficient time between well development and sampling for water recharge

6. Laboratory Testing Results

6.1 Soil Aggressivity

Two soil samples were analysed to assess the aggressivity of the soil to buried concrete and steel elements. A summary of the results is provided in Table 2. The laboratory test reports are included in Appendix D.

Table 2: Summary of Soil Aggressivity Results

Sample / Depth	Description	pH (pH units)	EC (µS/cm)	Chloride (mg/kg)	Sulphate (mg/kg)
BH2 / 2.0 - 2.1 m	sand	7.8	30	<10	22
BH3 / 4.0 - 4.45 m	clay	6.7	63	10	88

Notes: EC = electrical conductivity; All samples mixed at a ratio of 1(soil):5(water) prior to testing

6.2 Rock Strength

Selected samples of the rock core were tested in the laboratory to determine the Point Load Strength Index (Is_{50}) values to assist with the rock strength classification. The results of the testing are shown on the borehole logs at the appropriate depth. The Is_{50} values for the rock ranged from 0.2 MPa to 2.9 MPa.

Using a typical correlation factor of 16 to convert Is_{50} values to unconfined compressive strength (UCS) for Ashfield Shale suggests a range of UCS between 3 MPa and 46 MPa, indicating low to high strength rock.

7. Proposed Development

It is understood that the proposed development will include the demolition of the existing buildings to allow for the construction of an 18 storey student housing building, with an extension of the existing split-level basement towards the north to give a basement floor level at RL 22.8 m. The new basement walls will be setback from the property boundaries. Excavation to depths of up to 3.5 m is anticipated for the basement.

No column loads were available at the time of writing this report. For an 18-storey building, however, column (working) loads could be in the order of 6,000 kN to 8,000 kN.

8. Comments

8.1 Geotechnical Model

Geotechnical cross-sections (Sections A-A' and B-B') showing the interpreted subsurface profile between selected boreholes are presented in Drawings 2 and 3 in Appendix B. The sections show the interpreted geotechnical divisions of underlying soil and rock, which are accurate at the borehole locations only.

The subsurface conditions generally included variable depths of fill that is likely to be uncontrolled and variable, underlain by a relatively thin layer of sandy clay (alluvium), residual clay and extremely weathered bedrock at about RL 19 m to RL 21 m.

The rock profile generally initially includes very low and low strength, fractured laminite about 1 m to 3 m thick underlain by medium and high strength, fresh and slightly fractured laminite or siltstone. A thrust fault was encountered in BH3 at a depth of about 10.3 m to 10.5 m, above medium strength rock.

Groundwater is expected between about RL 16.0 to RL 16.5 m within the more fractured and weathered rock, well below the lower level of the existing basement (about RL 23.0 m). Groundwater levels should be expected to fluctuate with climatic conditions and may temporarily rise following periods of prolonged rainfall.

8.2 Geotechnical Considerations Relating to the Rail Corridor

The twin TBM rail tunnels of "Sydney Metro – City" line, which is currently under construction, pass below the site such that the "First and Second Reserves" extend approximately north-south, with the tunnel crown at least 34 m below the ground surface. The proposed development is required to take

these tunnels into consideration in accordance with “Transport for NSW (TfNSW) and Sydney Metro – Technical Services, Sydney Metro Underground Corridor Protection, Technical Guidelines”.

The above-mentioned guideline document (ref: Document No. NWRLSRT-PBA-SR-TU-REP-000008 Revision 1, dated 16 October 2017) provides the technical requirements to assess and manage the risks associated with developments near existing and future underground Metro infrastructure. It defines and uses the tunnel protection reserve zones to provide restrictions to the adjacent development activities such as basement excavation and the construction of new building foundations. The protection reserve zones are categorised into “First Reserve” and “Second Reserve”.

The “First Reserve” comprises the ground that immediately surrounds of the underground metro infrastructure, and represents the area that must not be encroached upon by any future construction or development. Beneath the project site, the uppermost extent of the First Reserve is at RL -2.2 m, which appears to be defined by the extent of the Sydney Metro substratum, based on the LTS survey drawing in Appendix B. The First Reserve is not expected to be encroached upon by any of the construction activities for the proposed development.

The “Second reserve” surrounds First Reserve and covers the areas where future development works have the potential to impact on the performance of the support elements of underground infrastructure, Metro operations or the feasibility of planned Metro infrastructure. The uppermost extent of Second Reserve is defined as 25 m above First Reserve (ie. at RL 22.8 m), which coincides with the basement floor level. Therefore, the bulk excavation for the proposed basement is expected to only extend slightly into the top of the Second Reserve. However, further encroachment upon Second Reserve is envisaged to be required for localised deepened excavations, shallow footings, piled foundations and for the embedment of basement shoring walls.

Based on previous experience, all the above activities will generally be acceptable by TfNSW and Sydney Metro but a geotechnical impact assessment (possibly including 2D or 3D numerical modelling) of basement excavation and building foundation will be required, together with ground movement and vibration monitoring, and dilapidation surveys of the tunnels to assess and monitor the impact of the proposed development on the underground Metro infrastructure. The extent of assessment and monitoring required at various project stages is subject to discussion and agreement from TfNSW/Sydney Metro.

8.3 Excavation Conditions

It is expected that the proposed basement extension will require excavation of pavement materials, fill, sandy clay or silty clay, which should be achievable using conventional earthmoving equipment (e.g. hydraulic excavator).

The groundwater table is likely to occur between RL 16 m and RL 16.5 m, within or a few metres above the underlying bedrock. Excavations are likely to be located well above the groundwater table, although some groundwater seepage may occur and this should be readily managed using sump and pump techniques.

8.4 Disposal of Excavated Material

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the *Waste Classification Guidelines* (EPA, 2014). Further reference should be made to the current DSI report by DP (Ref. 86852.01.R.001.Rev0).

8.5 Vibration Monitoring

Given that excavations will be within soil, it is expected that vibrations from the construction works will be relatively minor.

However, based on previous experience and as noted in Section 8.2, TfNSW usually requires vibration monitoring within existing tunnels when construction works are carried out within the second rail reserve. It will be necessary to use appropriate methods and equipment to keep ground vibrations within the rail tunnel and at adjacent buildings and structures within acceptable limits. The level of acceptable vibration is dependent on various factors including the type of building structure (e.g. reinforced concrete, brick, etc.), its structural condition, founding conditions, the frequency range of vibrations produced by the construction equipment, the natural frequency of the building and the vibration transmitting medium.

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s peak particle velocity (PPV). This is generally much lower than the vibration levels required to cause structural damage to most buildings. The Standard AS/ISO 2631.2 – 2014 “Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Vibration in buildings (1 Hz to 80 Hz)” suggests an acceptable daytime limit of 8 mm/s PPVi for human comfort.

The Sydney Metro Underground Corridor Protection Technical Guidelines suggests a maximum acceptable vibration limit of 15 mm/s PPVi for the rail tunnels with cast in situ concrete linings that are in good condition and 20 mm/s PPVi for rail tunnels supported using precast concrete segment lining, however this is subject to confirmation by TfNSW/Sydney Metro.

Based on the DP’s experience and with reference to AS/ISO 2631.2, it is suggested that a maximum PPVi of 8 mm/s (measured at the first occupied level of existing buildings) be provisionally employed at this site for both architectural and human comfort considerations, although this vibration limit may need to be reduced if there are sensitive structures or equipment in the area.

As the magnitude of vibration transmission is site specific, it is recommended that a vibration trial be carried out at the commencement of construction. These trials may indicate that smaller or different types of construction equipment or approaches to demolition are required to reduce vibration to acceptable levels.

8.6 Dilapidation Surveys

Dilapidation surveys should be carried out on surrounding buildings, pavements and sensitive structures that may be affected by the construction works. The dilapidation surveys should be undertaken before the commencement of any construction work in order to document any existing defects so that any claims for damage due to construction related activities can be accurately

assessed. As mentioned in Section 8.2, a dilapidation assessment of the tunnels may be required by TfNSW.

8.7 Subgrade Preparation

Subgrade preparation for lightly loaded pavements, slabs-on-ground and/or raising site levels should incorporate the following:

- stripping of uncontrolled fill and any obvious unsuitable material (vegetation, organic topsoil, deleterious material, oversize material larger than 100 mm diameter) to natural soil or to a maximum depth of 0.5 m below design subgrade level;
- rolling of the exposed subgrade with at least 8 passes of a smooth drum roller with a minimum static weight of 10 tonnes, subject to vibration concerns (e.g. for the Metro tunnels). The final pass (test roll) of the subgrade should be inspected by a geotechnical engineer to detect any soft spot or heaving areas. Any soft spots defected during test rolling would generally need to be stripped to a stiffer base or to a depth of approximately 0.5 m, subject to confirmation by a geotechnical engineer, and replaced with engineered fill;
- engineered fill for replacing soft spots or raising site levels should be placed in layers of 300 mm maximum loose thickness (although dependent upon the size of the compaction equipment) and compacted to a dry density ratio of between 98% and 102% relative to Standard compaction with moisture contents strictly within 2% of Standard optimum moisture content (OMC). The existing fill and sandy/clayey soils on site should generally be suitable for re-use as engineered fill provided it has a maximum particle size of 100 mm and moisture content within 2% of Standard OMC. Reuse of material should also consider the contamination status of the soil, which may require further assessment; and
- density testing of each layer of fill should be undertaken in accordance with AS 3798-2007 “Guidelines for Earthworks for Commercial and Residential Developments” to verify that the specified density ratios have been achieved.

8.8 Excavation Support

Vertical excavations within fill and natural soil will require both temporary and permanent support during and after construction. It is expected that temporary batters will be possible for excavation works set back a sufficient distance from the site boundaries. If temporary batters are not possible, then shoring should be used to provide the required excavation support.

8.8.1 Batter Slopes

Suggested temporary and permanent batter slopes for unsupported excavations above the water table, up to a maximum height of 3 m are shown in Table 3. If surcharge loads are applied near the crest of the slope, then further geotechnical review and probably flatter batters or soil stabilisation may be required.

Table 3: Recommended Batter Slopes

Exposed Material	Max. Temporary Batter Slope (H : V)	Max. Permanent Batter Slope (1) (H : V)
Granular Fill	1.5 : 1	2 : 1
Clayey Natural Soil	1 : 1	2 : 1

Notes: (1) Provided batter slope is protected from erosion (e.g. shotcrete and dowel support)

8.8.2 Retaining Walls

It is likely that at the southern-most property, the existing floor slabs are providing lateral support to the existing basement retaining walls. If the floor slabs are to be removed then retention of the existing basement retaining walls will require some form of temporary support (e.g. anchoring, bracing or propping) until such time as the new ground floor slab provides permanent lateral support for the walls. Retaining walls will also be required for new sections of the basement.

Table 4 outlines material and strength parameters that could be used for the design of new shoring/retaining walls and to design propping systems for the existing retaining wall.

Table 4: Parameters for Retaining Wall Design

Material	Dry Unit Weight (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure*
Fill	20	0.4	0.6	N/A
Natural Soil (at least stiff)	20	0.3	0.5	100 kPa
Very Low and Low Strength Rock	22	0.2	0.3	400 kPa
Medium Strength (or stronger) Rock	22	0.1	0.15	2000 kPa

Notes: *Ultimate values and only below bulk excavation level. May need to be reduced where batter slopes are located nearby

Unless the material behind the existing basement walls is effectively free draining, hydrostatic pressure should be assumed to act on the full height of the basement walls to account for increases in groundwater levels caused by significant rainfall events and flooding. Surcharge pressures from adjacent structures, construction machinery and traffic should also be incorporated into the design of retaining walls as necessary.

8.9 Foundations

For an 18 storey building, relatively high column loads are expected. It is considered that structural loads should be transferred into the underlying bedrock using piles socketed into at least medium strength (or better) rock.

Continuous flight auger (CFA) or bored piles are likely to be suitable for this site, however, casing through the upper fill should be expected to prevent the upper section of the holes from collapsing, if bored piles are adopted. Groundwater should be expected within the open piles holes and therefore allowance for pumping to remove water or the use of tremmie methods to place concrete should be considered. Relatively high seepage flows can sometimes occur within the fractured laminite.

Recommended maximum design pressures for the various rock strata are presented in Table 5. For piles shaft adhesion values for uplift (tension) may be taken as being equal to 70% of the values for compression.

Consistent, high strength rock was generally encountered below RL 12 m to RL 14 m in BH1 to BH3. The higher design parameters provided in Table 5 may be adopted for the high strength rock, however further investigation would generally be required to confirm the depth to this rock across the site and to assess the consistency of this rock strength below the proposed pile toe level.

The foundation design parameters given in Table 5 assume that the pile excavations are clean and free of loose debris, with pile sockets free of smear and adequately roughed immediately prior to concrete placement.

Settlement of a pile is dependent on the loads applied to the pile and the foundation conditions in the socket zone and below the pile toe. The total settlement of bored pile designed using the 'allowable' parameters provided in Table 5 should be less than 1% of the pile diameter upon application of the design load.

By way of example, a 1.2 m diameter bored piles socketed 3 m within medium strength rock would safely support a (Working) column load of about 7000 kN, based on the parameters given in Table 5.

An appropriate geotechnical strength reduction factor should be applied when using the limit-state approach as outlined in AS 2159 – 2009 Piling – Design and installation.

Table 5: Parameters for Foundation Design

Foundation Stratum	Maximum Allowable Pressure		Maximum Ultimate Pressure		Young's Modulus (MPa)
	End Bearing (kPa)	Shaft Adhesion(1) (Compression) (kPa)	End Bearing (kPa)	Shaft Adhesion(1) (Compression) (kPa)	
Extremely Low to Very Low Strength Rock	-	70	-	100	-
Low to Medium Strength Rock	-	150	-	300	-
Medium Strength Rock	3,500	300	15,000	500	500
High Strength Rock	*6,000*	*500*	*40,000*	*1000*	*1500*

Notes: (1) Shaft adhesion applicable for the design of bored piers, uncased over rock socket length, or CFA piles where adequate sidewall cleanliness and roughness is achieved.

8.10 Soil Aggressivity

Based on the two soil aggressivity test results, the exposure classification for buried concrete and steel structures was assessed as being 'non-aggressive' in accordance with Australian Standard AS 2159 – 2009 *Piling – Design and installation*.

8.11 Acid Sulphate Soils

Based on published mapping for acid sulphate soils, the site topography, the presence of a relatively thin alluvial layer above RL 22 m and the groundwater table, and DP's experience on subsurface conditions at nearby development sites, acid sulphate soils are not considered to be an issue for this development.

8.12 Seismicity

In accordance with AS1170-2007 "Structural Design Actions, Part 4: Earthquake Actions in Australia" a hazard factor (Z) of 0.08 and a site subsoil Class C_e is considered to be appropriate for the site.

8.13 Further Investigation

It is recommended that additional rock-cored boreholes be undertaken following demolition of existing buildings to further assess the rock depth and strength across the site, particularly given the heavily-loaded foundation piles expected.

As noted, it is expected that TfNSW and Sydney Metro will require numerical modelling of the impact of the new building loads on the rail infrastructure. In some cases, boreholes to below the invert level of the rail tunnel will be necessary, as an input to the modelling and analyses.

The additional geotechnical investigation and analysis will further de-risk and manage the geotechnical issues associated with this development, and also facilitate compliance with the SEARs requirements.

9. Limitations

Douglas Partners (DP) has prepared this report for this project at 90-102 Regent Street, Redfern in accordance with DP's proposal SYD190418.P.001.Rev2 dated 29 August 2019 and acceptance received from Allen Jack + Cottier Architects Pty Ltd dated 2 July 2019 on behalf of the client, The Trust Company (Australia) Limited ATF WH Regent Trust. The work was carried out under DP's Conditions of Engagement (with added Trustee Limitation of Liability Clause). This report is provided for the exclusive use of The Trust Company (Australia) Limited ATF WH Regent Trust for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site 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. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes 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. Reference should be made to DP's DSI (contamination) Report (ref: 86852.01.R.001.Rev0, dated December 2019) for further comments on contamination and hazardous 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

Douglas Partners

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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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.

About this Report

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

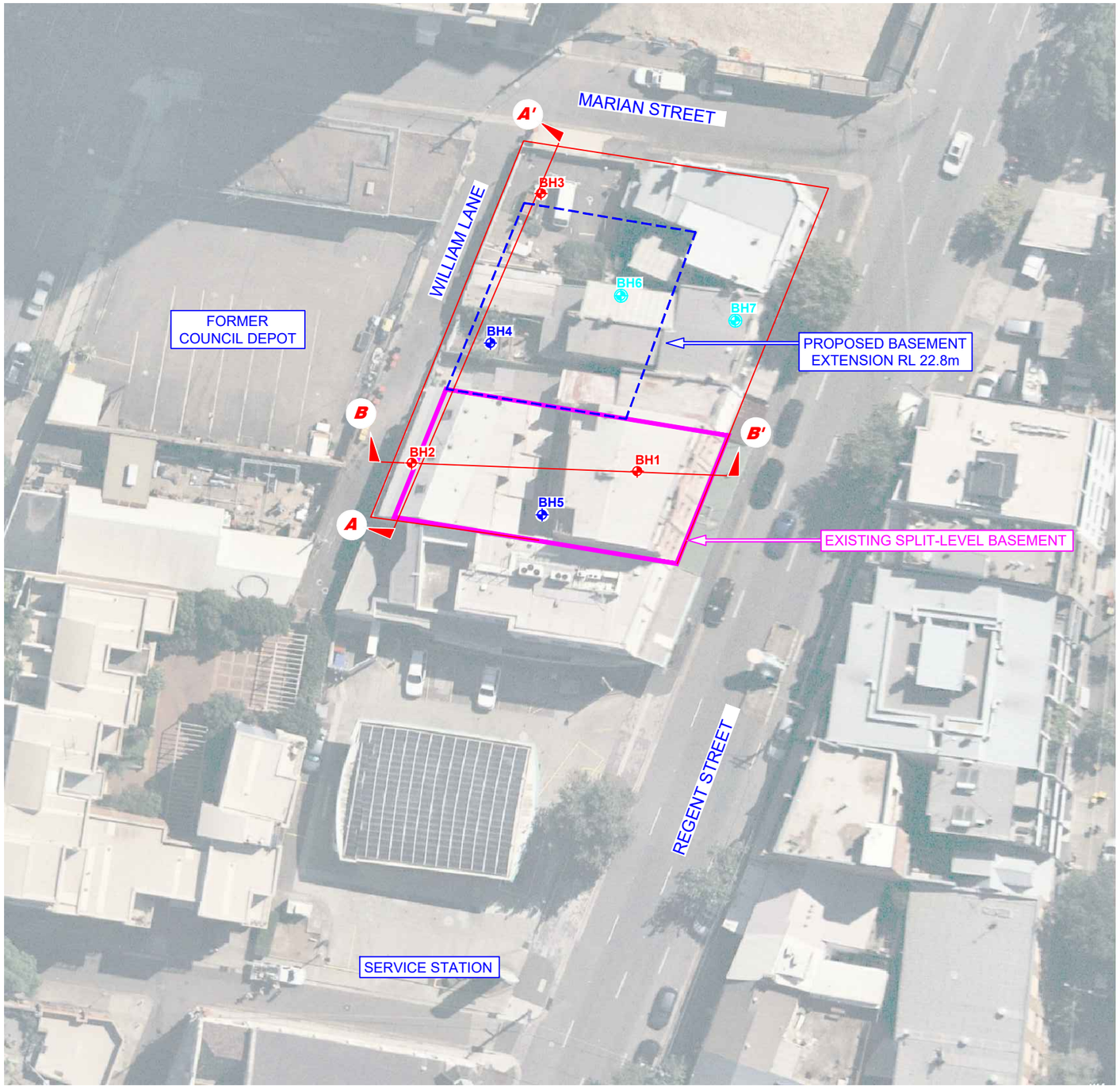
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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.

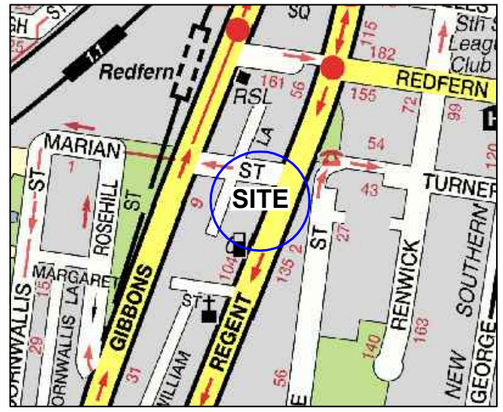
Site Inspection

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 04.03.2019)

0 5 10 15 20 30 40 50m

1:500 @ A3

LEGEND

- Auger borehole to rock
- Rock cored borehole/ Groundwater well
- Shallow hand auger borehole
- A — A' Geotechnical Cross Section A-A'

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: The Trust Company (Australia) Limited ATF WH Regent Trust		
OFFICE: Sydney	DRAWN BY: PSCH / IT	
SCALE: 1:500 @ A3	DATE: 6.12.2019	

TITLE: **Test Locations**
Proposed Student Housing Development
90-102 Regent Street, REDFERN

N

PROJECT No:	86852.00
DRAWING No:	1
REVISION:	1

A

A'

116 REGENT STREET / SERVICE STATION

MARIAN STREET

BH2
Offset 0.5m

BH4
Offset - 1.8m

BH3
Offset - 0.2m

EXISTING BASEMENT (UPPER LEVEL)

EXISTING BASEMENT (LOWER LEVEL)

RL 23.0m

PROPOSED BASEMENT EXTENSION RL 22.8m

PAVEMENT MATERIALS / FILL

SANDY CLAY: Generally Firm

SILTY CLAY: Very Stiff and Hard

LAMINITE: Very Low and Low Strength

LAMINITE AND SILTSTONE: Medium and High Strength

VL-L

M-H

VL

M

H

H

H

N = 1

s

st

N = 14

N = 26

vst

N = 26

refusal

h

N = 33

VL

EL & VL

M

H

H

Bottom Depth 13.69 m

Bottom Depth 7.3 m

Bottom Depth 20 m

ELEVATION (AHD)

DISTANCE ALONG PROFILE (m)

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. 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 included only and should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Bricks
- Concrete
- Fill
- Laminite
- Sandy Clay
- Siltstone
- Silty Clay

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

SOIL STRENGTH
vl - Very loose
l - Loose
md - Medium dense
d - Dense
vd - Very dense
s - Soft
f - Firm
st - Stiff
vst - Very stiff
h - Hard

TESTS / OTHER
N - Standard penetration test value
- Water level
- Existing Basement (Upper Level)
- Existing Basement (Lower Level)
- Proposed Basement Extension
- Interpreted geological boundary

0 3
Horizontal Scale (metres)

Vertical Exaggeration = 1.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: The Trust Company (Australia) Limited ATF WH Regent Trust		TITLE: **Interpreted Geotechnical Cross-section A-A'** **Proposed Student Housing Development** **90-102 Regent Street, REDFERN**	PROJECT No: 86852.00
OFFICE: Sydney	DRAWN BY: IT		DRAWING No: 2
SCALE: 1:150 (H) 1:100 (V) @ A3	DATE: 29.09.2020		REVISION: 1

B

B'

REGENT STREET

WILLIAM LANE

BH2
Offset - 0.1m

BH5
Offset - 4.8m

BH1
Offset - 0.1m

EXISTING BASEMENT (UPPER LEVEL)

CONCRETE / FILL

PROPOSED BASEMENT EXTENSION RL 22.8m

EXISTING BASEMENT (LOWER LEVEL)

RL. 23.0m

SANDY CLAY: Generally Firm

CONCRETE / FILL

SILTY CLAY:
Appears Stiff to Hard

LAMINITE:
Very Low and Low to Medium Strength

LAMINITE AND SILTSTONE:
Medium and High Strength

LAMINITE:
Low to Medium Strength

Bottom Depth
6.2 m

Bottom Depth
13.69 m

Bottom Depth
12.9 m

ELEVATION (AHD)

DISTANCE ALONG PROFILE (m)

NOTES:
1. Subsurface conditions are accurate at the borehole locations only. 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 included only and should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Concrete
- Fill
- Laminite
- Sandy Clay
- Siltstone
- Silty Clay

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

SOIL STRENGTH
vl - Very loose
l - Loose
md - Medium dense
d - Dense
vd - Very dense
s - Soft
f - Firm
st - Stiff
vst - Very stiff
h - Hard

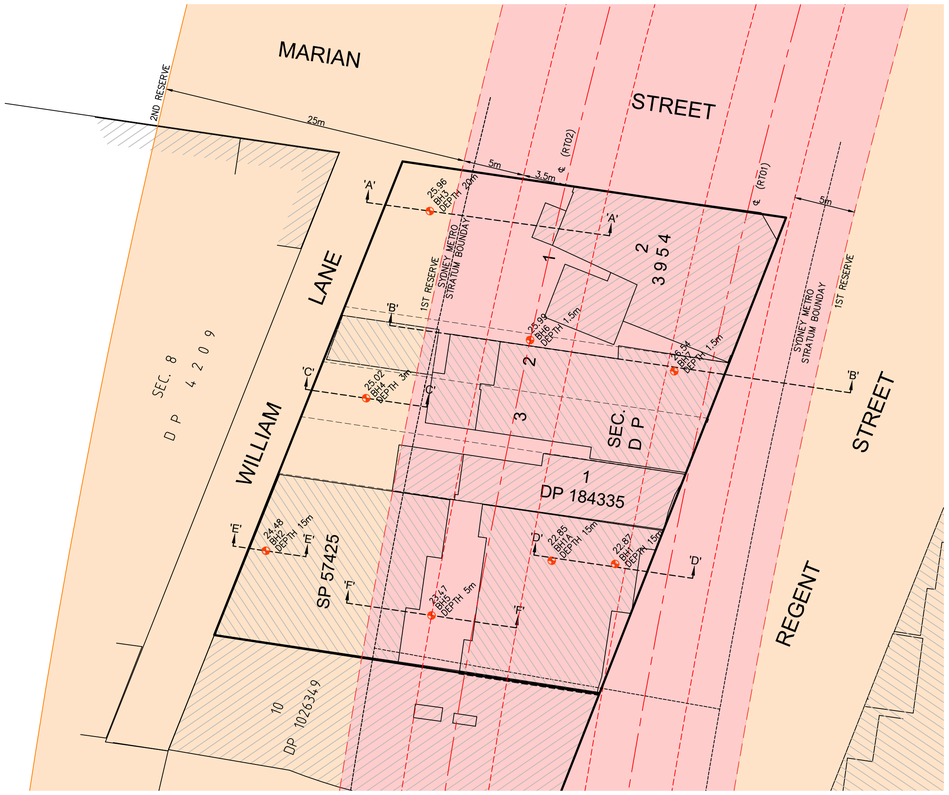
TESTS / OTHER
N - Standard penetration test value
- Water level
- Existing Basement (Upper Level)
- Existing Basement (Lower Level)
- Proposed Basement Extension
- Interpreted geological boundary

Horizontal Scale (metres)

Vertical Exaggeration = 1.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: The Trust Company (Australia) Limited ATF WH Regent Trust		TITLE: **Interpreted Geotechnical Cross-section B-B'**	PROJECT No: 86852.00
OFFICE: Sydney	DRAWN BY: IT	**Proposed Student Housing Development**	DRAWING No: 3
SCALE: 1:150 (H) 1:100 (V) @ A3	DATE: 29.09.2020	**90-102 Regent Street, REDFERN**	REVISION: 1

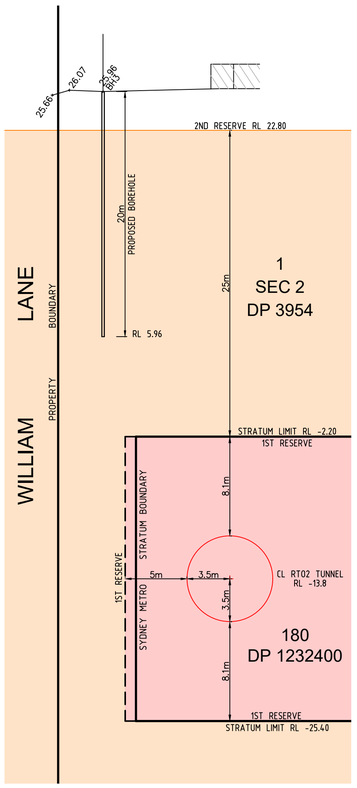


SITE PLAN

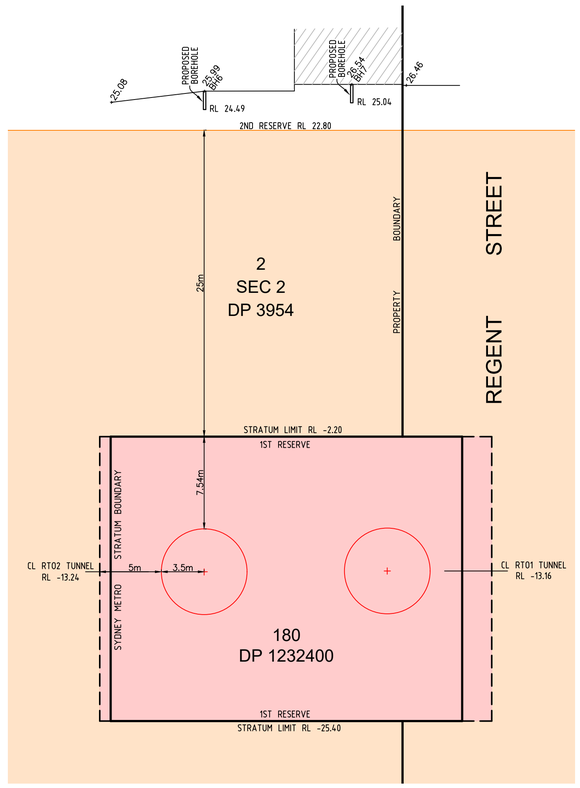
MGA

TN

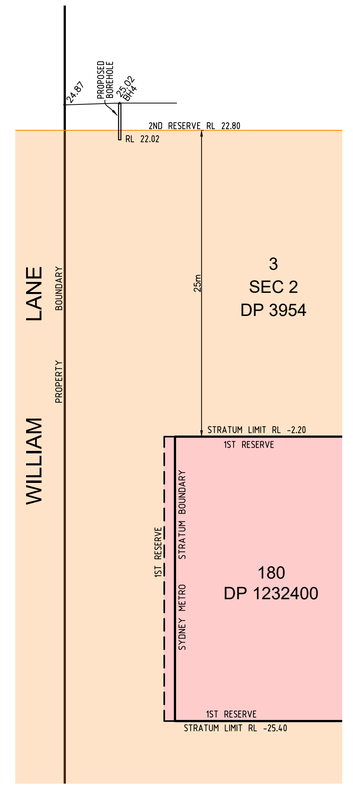
100 APPROX.



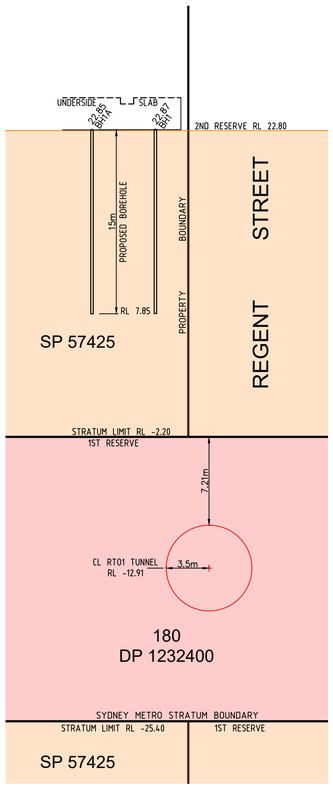
SECTION A-A



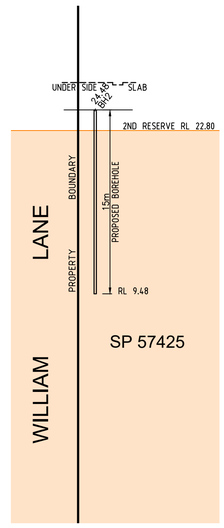
SECTION B-B



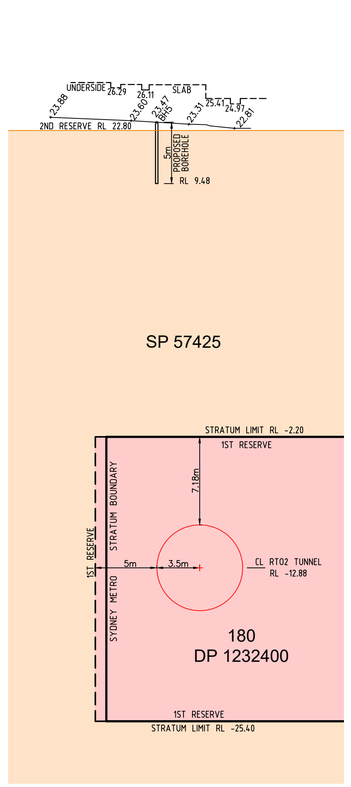
SECTION C-C



SECTION D-D



SECTION E-E



SECTION F-F

PROPOSED BOREHOLE MGA COORDINATE SCHEDULE

BOREHOLE	EASTING	NORTHING
BH1	333537.217	6248202.946
BH1A	333532.035	6248203.212
BH2	333508.703	6248204.026
BH3	333522.090	6248231.750
BH4	333516.892	6248216.480
BH5	333522.233	6248198.753
BH6	333530.278	6248221.222
BH7	333542.044	6248218.682

LEGEND

BOREHOLE	BH
1ST RESERVE	
2ND RESERVE	

NOTES

1. THE BOUNDARIES HAVE NOT BEEN MARKED
2. BOUNDARIES HAVE BEEN COMPILED FROM PLANS MADE AVAILABLE BY THE OFFICE of LAND & PROPERTY INFORMATION (NSW) AND ARE SUBJECT TO FINAL SURVEY
3. ORIGIN OF LEVELS ON A.H.D. IS TAKEN FROM BENCHMARK IN KERB FROM LINKER SURVEY PLAN REFERENCE 170638 R.L. **24.35** (A.H.D.) IN GIBBONS STREET
4. NO INVESTIGATION OF UNDERGROUND SERVICES HAS BEEN MADE. ALL RELEVANT AUTHORITIES SHOULD BE NOTIFIED PRIOR TO ANY EXCAVATION ON OR NEAR THE SITE
5. METRO TUNNEL RT01 & RT02 HORIZONTAL & VERTICAL POSITION BASED ON COORDINATES PROVIDED BY SYDNEY METRO (DENISE THORNTON) ON 29/07/19 AND 21/08/19

DIAL BEFORE YOU DIG www.1100.com.au

REFER TO NOTES AND LEGEND

0 5 7.5 10 15 20 25

SCALE 1: 250 @ A1

Revision	Date	Description	Reference
D	00/00/00	-	00
C	00/00/00	-	00
B	00/00/00	-	00
A	21/08/19	RT02 TUNNEL ALIGNMENT UPDATED FOLLOWING HORIZONTAL COORDINATE SUPPLY	001

THIS IS THE PLAN REFERRED TO IN MY LETTER DATED:

.....

Registered Surveyor NSW

LTS LOCKLEY
Registered Surveyors NSW
www.ltsl.com.au
Suite 1, Level 1
810 Pacific Highway
Gordon NSW 2072
Locked Bag 5
Gordon NSW 2072
P 1300 587 000
F 02 9499 7760

Client THE TRUST COMPANY (AUSTRALIA) LIMITED ATF HW REGENT TRUST

Drawing title

PLAN OF PROPOSED BOREHOLE LOCATIONS OVER LOTS 1-3 SECTION 2 IN DP 3954, LOT 1 IN DP 184335 AND SP 57425 KNOWN AS No 90-102 REGENT STREET, REDFERN

datum AHD
site Area N/A
LGA SYDNEY

reference number 50670 004BH
scale 1:250 @A1
date of survey 30/07/19
SHEET 1 OF 1

Appendix C

Results of Field Work

Sampling Methods

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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.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. 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	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

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

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

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
Friable	Fr	-

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	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

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;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it 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 Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

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

* 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
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

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 occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or stronger. 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

Douglas Partners

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

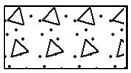
Symbols & Abbreviations

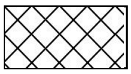
Graphic Symbols for Soil and Rock

General

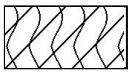

Asphalt

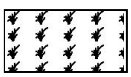

Road base

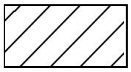

Concrete

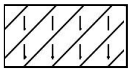

Filling

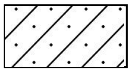
Soils


Topsoil

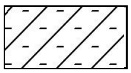

Peat

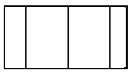

Clay

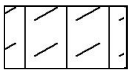

Silty clay

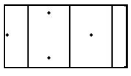

Sandy clay

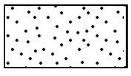

Gravelly clay

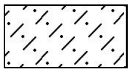

Shaly clay

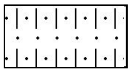

Silt


Clayey silt


Sandy silt

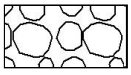

Sand

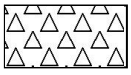

Clayey sand


Silty sand


Gravel

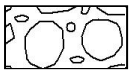

Sandy gravel


Cobbles, boulders

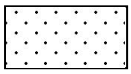

Talus

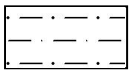
Sedimentary Rocks

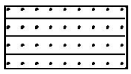

Boulder conglomerate

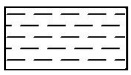

Conglomerate


Conglomeratic sandstone

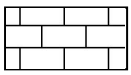

Sandstone


Siltstone

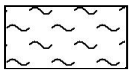

Laminite

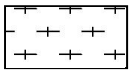

Mudstone, claystone, shale

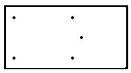

Coal


Limestone

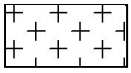
Metamorphic Rocks

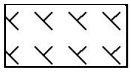

Slate, phyllite, schist

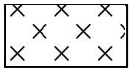

Gneiss

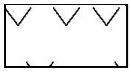

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 22.9 AHD
EASTING: 333532
NORTHING: 6248203.2
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86852.00
DATE: 17 - 20/9/2019
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00	B - Bedding J - Joint S - Shear F - Fault				
	0.15	CONCRETE										
	0.3	FILL/Silty CLAY: low plasticity, brown - grey, trace rounded concrete gravel, moist							A/E			
22	1	Silty CLAY CL: low plasticity, brown - red, trace fine sand, w>PL, appears stiff, residual							A/E*			
		1.0m brown mottled grey							A/E			
21	2								A/E			
	2.0	Silty CLAY CL: low plasticity, pale grey - brown, w>PL, appears very stiff, residual							A/E			
20	3											
19	4								A			
	4.5	Silty CLAY CL: low plasticity, grey - brown, trace angular highly weathered shale gravel, w>PL, appears hard, residual (extremely weathered rock)						Note: Unless otherwise stated, discontinuities are bedding, planar, rough, iron coated to 1mm thick, dipping 0-2°	A			
18	5											
	5.35	LAMINITE: dark grey - pale grey and brown grey, 60% siltstone and 40% sandstone laminations, low to medium strength, slightly weathered, fractured, Ashfield Shale						5.48m: Ds, 8mm 5.59m: Ds, 5mm 5.67m: Ds, 5mm 5.72m: Ds, 10mm 5.87m: Cs, 1mm 6.18m: Cs, 1mm 6.38m: Ds, 20mm 6.4m: J20°, pl, sm 6.43m: Ds, 20mm 6.56m: Ds, 40mm 6.67m: J60°, pl, ro	C	100	57	PL(A) = 0.4
17	6								C	80	27	PL(A) = 0.4
16	7											
	7.1	LAMINITE: dark grey - pale grey, 60% siltstone and 40% sandstone laminations, low to medium strength, fresh, slightly fractured, Ashfield Shale						6.81m: CORE LOSS: 290mm 7.41m: J45°, pl, ro, fe, co 7.54m: J45°, pl, ro, fe, co 7.61m: J40°, pl, ro, fe, co 7.68m: Ds, 4mm 8.08-8.47m: B(x4) 8.36m: J30°, pl, ro, fe, co 8.41m: Ds,10mm 8.64m: B, sm, cly, vn 8.8m: B, sm, cly, vn	C	100	60	PL(A) = 0.2
15	8											
	8.6	LAMINITE: dark grey - pale grey, 60% siltstone and 40% sandstone laminations, medium and high strength, fresh, slightly fractured, Ashfield Shale						9.36m: J25°, pl, ro 9.8-9.96m: J50-90°, ir,	C	100	100	PL(A) = 1.4
14	9											
13	10.0											

RIG: Rig 1 (CE150) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** HQ to 5m

TYPE OF BORING: Diacore to 0.15m; solid flight auger (TC-bit) to 5.35m; NMLC-coring to 12.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed to 10.9m (screen 3-10.9m; gravel 2-12.9m; bentonite seal 0.2-2m; gatic cover); *BD1/200919 is replicate of 0.5-0.6m sample

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 Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 22.9 AHD
EASTING: 333532
NORTHING: 6248203.2
DIP/AZIMUTH: 90°/--

BORE No: BH1
PROJECT No: 86852.00
DATE: 17 - 20/9/2019
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	SILTSTONE: dark grey - pale grey, 90% siltstone and 10% sandstone laminations, medium and high strength, fresh, slightly fractured to unbroken, Ashfield Shale						cly, vn 10.15m: B5-10°, cu, sm, cly, vn 10.58m: B, sm, cly, vn				PL(A) = 0.4
									C	100	100	
									C	100	100	PL(A) = 1.7
11	12								C	100	95	PL(A) = 2.4
									C	100	100	
10	12.9											PL(A) = 2
	13	Bore discontinued at 12.9m										
9	14											
8	15											
7	16											
6	17											
5	18											
4	19											
3												

RIG: Rig 1 (CE150) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** HQ to 5m

TYPE OF BORING: Diacore to 0.15m; solid flight auger (TC-bit) to 5.35m; NMLC-coring to 12.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed to 10.9m (screen 3-10.9m; gravel 2-12.9m; bentonite seal 0.2-2m; gatic cover); *BD1/200919 is replicate of 0.5-0.6m sample

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: 1 PROJECT: REDFERN SEPTEMBER 2019

5.35-10.0m

BORE: 1 PROJECT: REDFERN SEPTEMBER 2019

10.0-12.9m

BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 24.5 AHD
EASTING: 333508.7
NORTHING: 6248204
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 86852.00
DATE: 19/9/2018 - 20/9/2019
SHEET 1 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
24	0.15	CONCRETE										
		FILL/Gravelly SAND: fine to medium sand and fine gravel, dark grey, trace brick fragments, moist, appears moderately to well compacted							A/E			
	0.8								A/E			
23	1	Sandy CLAY CL: low plasticity, orange brown, fine sand, w>PL, appears firm, possibly alluvial							A/E			
									A/E			
	2								A/E			
22	2.1	Silty CLAY CL: low plasticity, brown-orange, trace fine sand, w>PL, stiff, residual							A/E			
	3											
21												
	4											
	4.0	Silty CLAY CL: low plasticity, pale grey-red, trace angular highly weathered shale gravel, w>PL, appears hard, residual (extremely weathered rock)							A			
20												
	5								A			
19												
	6											
18												
	7											
17	7.5	LAMINITE: brown - grey, very low to low strength, Ashfield Shale						Note: Unless otherwise stated, discontinuities are bedding, planar, rough, iron coated to 1mm thick, dipping 0-2°				
	8											
16												
	9											
15	9.62	LAMINITE: see over						9.77m: Ds, 20mm	C	100	0	PL(A) = 0.6

RIG: Rig 5 (Trailer Mounted) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** HQ to 8m

TYPE OF BORING: Diacore to 0.15m; solid flight auger (TC-bit) to 9.62m; NMLC-coring to 13.69m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed to 12.3m (screen 5-12.3m; gravel 4-13.69m; bentonite seal 0.15-4m; gatic cover)

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 Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 24.5 AHD
EASTING: 333508.7
NORTHING: 6248204
DIP/AZIMUTH: 90°/--

BORE No: BH2
PROJECT No: 86852.00
DATE: 19/9/2018 - 20/9/2019
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
14	10.43	LAMINITE: dark grey - pale grey, 60% siltstone and 40% sandstone laminations, medium and high strength, slightly weathered, slightly fractured, Ashfield Shale							C	100	0	PL(A) = 0.8
13	11	LAMINITE: dark grey - pale grey, 60% siltstone and 40% sandstone laminations, medium and high strength, fresh, slightly fractured to unbroken, Ashfield Shale							C	93	93	PL(A) = 2
12	12.2	LAMINITE: dark grey - pale grey, 80% siltstone and 20% sandstone laminations, high strength, fresh, slightly fractured to unbroken, Ashfield Shale						12.09m: CORE LOSS: 110mm	C	100	95	PL(A) = 1.7
11	13											PL(A) = 1.3
10	13.69	Bore discontinued at 13.69m						13.61m: J45°, pl, sm				
9	14											
8	15											
7	16											
6	17											
5	18											
	19											

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

RIG: Rig 5 (Trailer Mounted) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** HQ to 8m

TYPE OF BORING: Diacore to 0.15m; solid flight auger (TC-bit) to 9.62m; NMLC-coring to 13.69m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed to 12.3m (screen 5-12.3m; gravel 4-13.69m; bentonite seal 0.15-4m; gatic cover)

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BORE: 2 PROJECT: REDFERN SEPTEMBER 2019

9.62-13.69m

BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 26.0 AHD
EASTING: 333522.1
NORTHING: 6248231.8
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 86852.00
DATE: 20/9/2018
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
26	0.05	ASPHALTIC CONCRETE							A/E			
		FILL/Silty SAND: fine to medium, dark grey with ash/charcoal, moist, appears poorly and variably compacted							A/E			
25	1	1.0m: trace ash							A/E			
	1.2	Sandy CLAY CL: low plasticity, orange brown, fine sand, w>PL, appears soft, possibly alluvial							S			0,0,1 N = 1
									A/E*			
24	2	2.0 Silty CLAY CL: low plasticity, brown - red, trace fine sand, w>PL, stiff, residual							S			4,6,8 N = 14
23	3											
	3.5	Silty CLAY CL: low plasticity, pale grey - red, trace ironstone gravel, w>PL, very stiff, residual							S			7,12,14 N = 26
22	4											
21	5								S			7,12,14 N = 26
20	6	6m: pale grey, hard										
19	7								S			9,17, 20/80mm refusal
	7.4	Silty CLAY CL: low plasticity, brown - dark red, with ironstone gravel, w>PL, hard, residual (extremely weathered rock)										
18	8											
								Note: Unless otherwise stated, discontinuities are bedding, planar, rough, iron coated to 1mm thick, dipping 0-2°	S			8,15,18 N = 33
17	9											
	9.1	Silty CLAY CL: low plasticity, brown - dark red, with ironstone gravel, w > PL, hard, residual (extremely weathered rock)							C	100	0	
	9.67	LAMINITE: see over										

RIG: Rig 12 (Hanjin) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** HQ to 8m

TYPE OF BORING: Solid flight auger (TC-bit) to 9.1m; NMLC-coring to 20.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed to 13m (screen 7-13m; gravel 6-20m; bentonite seal 0.2-6m; gatic cover); *BD4/200919 is replicate of 1.5-1.6m sample

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 26.0 AHD
EASTING: 333522.1
NORTHING: 6248231.8
DIP/AZIMUTH: 90°/--

BORE No: BH3
PROJECT No: 86852.00
DATE: 20/9/2018
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
16			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00					
		LAMINITE: brown - grey, 80% siltstone and 20% sandstone with hard clay bands, very low strength, highly weathered, fractured, Ashfield Shale						9.91m: J80°, pl, ro, fe, co	C	100	0	
	10.55	10.33m: thrust fault						10.05m: Ds, 30mm 10.15m: Ds, 40mm 10.23m: Ds, 60mm 10.33-10.50m fault zone, folded				PL(A) = 0.4
15	11	LAMINITE: dark grey - pale grey, 60% siltstone and 40% sandstone laminations, medium strength, slightly weathered to fresh, fractured, Ashfield Shale						10.89m: Cs, 5mm 11.21m: Ds, 5mm 11.41m: Cs, 2mm	C	100	77	PL(A) = 0.5
14	12 12.0	LAMINITE: dark grey - pale grey, 80% siltstone and 20% sandstone laminations, high strength, fresh, slightly fractured, Ashfield Shale						11.9m: J80° closed				PL(A) = 2.3
13	13							13.31m: J45°, pl, sm 13.57m: J45°, pl, sm				PL(A) = 2.9
12	14							14.06m: J20°, pl, sm 14.2m: J60°, pl, ro				PL(A) = 2.5
11	15							15.11m: J40°, pl, sm	C	100	100	PL(A) = 2.8
10	16							15.60-16.40m: J80°, pl, sm				PL(A) = 2.7
	16.3	SILTSTONE: dark grey, 95% siltstone and 5% sandstone thin laminations, high strength, fresh, slightly fractured to unbroken, Ashfiled Shale						16.5-16.90m: J75°, pl, ro				PL(A) = 2.1
9	17							17.35m: J40°, pl, sm 17.37m: J50°, pl, sm	C	100	100	
8	18											PL(A) = 1
7	19								C	100	100	
	20.0	Bore discontinued at 20.0m										PL(A) = 1.2

RIG: Rig 12 (Hanjin) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** HQ to 8m

TYPE OF BORING: Solid flight auger (TC-bit) to 9.1m; NMLC-coring to 20.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Groundwater monitoring well installed to 13m (screen 7-13m; gravel 6-20m; bentonite seal 0.2-6m; gatic cover); *BD4/200919 is replicate of 1.5-1.6m sample

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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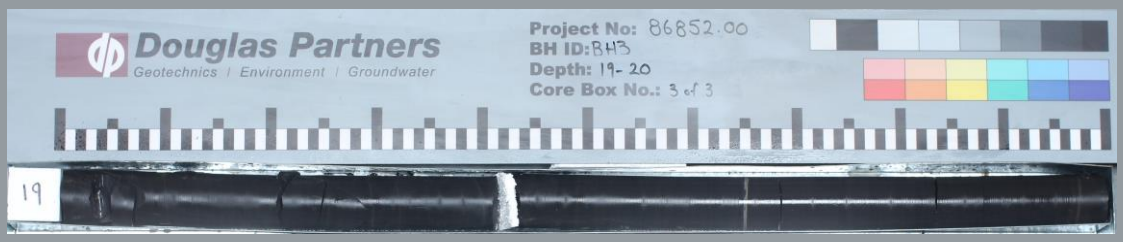
BORE: 3 PROJECT: REDFERN SEPTEMBER 2019

9.1-14.0m

BORE: 3 PROJECT: REDFERN SEPTEMBER 2019

14.0-19.0m

BORE: 3 PROJECT: REDFERN SEPTEMBER 2019



19.0-20.0m

BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 25.0 AHD
EASTING: 333516.9
NORTHING: 6248216.5
DIP/AZIMUTH: 90°/--

BORE No: BH4
PROJECT No: 86852.00
DATE: 23/9/2016
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
25	0.1	BRICK PAVERS							A/E			
		FILL/Gravelly SAND: fine tomedium sand and fine gravel, dark grey, trace glass fragments, moist, appears moderately to well compacted							A/E			
24	0.6 / 1	FILL/SAND: fine, pale grey, moist, appears moderately compacted							A/E			
	1.4	Sandy CLAY CL: low plasticity, orange brown, fine sand, w>PL, appears firm, possibly alluvial							A/E			
23	2 / 2.0	Silty CLAY CL: low plasticity, brown - red, trace fine sand, w>PL, appears stiff, residual										
22	3								A			
21	4 / 4.0	Silty CLAY cl: low plasticity, pale grey - red, trace ironstone gravel, w>PL, appears stiff to very stiff, residual							A			
20	5								A			
19	6											
18	7 / 7.3	Bore discontinued at 7.3m - limit of investigation							A			
17	8											
16	9											

RIG: Rig 5 (Trailer Mounted) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.5m; Solid flight auger (TC-bit) to 7.3m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 23.5 AHD
EASTING: 333522.2
NORTHING: 6248198.8
DIP/AZIMUTH: 90°/--

BORE No: BH5
PROJECT No: 86852.00
DATE: 23/9/2016
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
23	0.15	CONCRETE SLAB										
	0.3	FILL/Silty GRAVEL: fine, dark grey, with medium sand, moist, apparently well compacted							A/E			
		Silty CLAY CL: low plasticity, brown - orange, trace fine sand, w>PL, appears stiff, residual							A/E			
22	1								A/E			
									A/E			
21	2								A/E			
	3.0	Silty CLAY CL: low plasticity, pale grey - red, trace ironstone gravel, w>PL, appears very stiff, residual										
20	3											
	4								A			
19	5											
18	6											
	6.2	Bore discontinued at 6.2m - limit of investigation							A			
17	7											
16	8											
15	9											
14												

RIG: Rig 5 (Trailer Mounted) **DRILLER:** BG Drilling **LOGGED:** NB **CASING:** Uncased
TYPE OF BORING: Diacore to 0.15m; Solid flight auger (TC-bit) to 6.2m
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 26.0 AHD
EASTING: 333530.3
NORTHING: 6248221.2
DIP/AZIMUTH: 90°/--

BORE No: BH6
PROJECT No: 86852.00
DATE: 17 - 19/9/2019
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
26	0.12	CONCRETE SLAB							E			
		FILL/Clayey SAND: fine to medium, grey and dark brown, low plasticity fines, trace sandstone gravel, moist										
	0.72	FILL/Sandy CLAY: low plasticity, brown, fine sand, trace tile and PVC fragments, w>PL							E			
25	1											
	1.3	FILL/Sandy CLAY: low plasticity, orange-brown, fine sand, trace sandstone gravel, w>PL, appears moderately compacted, possibly alluvial							E			
24	2	2.0 Bore discontinued at 2.0m - limit of investigation										
23	3											
22	4											
21	5											
20	6											
19	7											
18	8											
17	9											

RIG: Hand tools **DRILLER:** CLN **LOGGED:** CLN **CASING:** Uncased

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: See Remarks below

REMARKS: Borehole completed over 2 days due to wet weather, borehole filled with rain water, precluded observation of groundwater

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: The Trust Company (Australia) Limited
PROJECT: Student Housing Development
LOCATION: 90-102 Regent Street, Redfern

SURFACE LEVEL: 26.5 AHD
EASTING: 333542
NORTHING: 6248218.7
DIP/AZIMUTH: 90°/--

BORE No: BH7
PROJECT No: 86852.00
DATE: 17/9/2019
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
26	0.45	VOID BELOW FLOOR										
		FILL/SAND: fine to medium, dark brown, with clay, timber fragments, concrete gravels and terracota, trace charcoal and brick fragments, moist							E*			
	0.9	Bore discontinued at 0.9m Refusal possibly on concrete slab										
25	1											
24	2											
23	3											
22	4											
21	5											
20	6											
19	7											
18	8											
17	9											

RIG: Hand tools **DRILLER:** CLN **LOGGED:** CLN **CASING:** Uncased

TYPE OF BORING: Hand auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *BD2/2170919

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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Appendix D

Results of Laboratory Tests

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 226937

Client Details

Client	Douglas Partners Pty Ltd
Attention	Peter Valenti
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**86852.00, 90-102 Regent Street, Redfern**
Number of Samples	2 Soil
Date samples received	25/09/2019
Date completed instructions received	25/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	02/10/2019
Date of Issue	01/10/2019

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Soil Aggressivity			
Our Reference		226937-1	226937-2
Your Reference	UNITS	BH3	BH2
Depth		4.0-4.45	2.0-2.1
Date Sampled		20/09/2019	20/09/2019
Type of sample		Soil	Soil
pH 1:5 soil:water	pH Units	6.7	7.8
Electrical Conductivity 1:5 soil:water	µS/cm	63	30
Chloride, Cl 1:5 soil:water	mg/kg	10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	88	22

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Soil Aggressivity					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	98	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	103	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Douglas Partners
Geotechnics - Environment - Groundwater

CHAIN OF CUSTODY

Project Name: 90-102 Regent Street, Redfern .....
Project No: 86852.00..... Sampler: ...NB..... .....
Project Mgr: PAV.....Mob. Phone: 0422 000 438 .....
Email: peter.valenti@douglaspartners.com.au.....
Date Required: ...standard ..... Lab Quote No. .....

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Attn: Tania Notaras
Phone: 02 9910 6200 Fax: 02 9910 6201
Email: tnotaras@envirolabservices.com.au

				Sample Type								
	Sample ID	Sample Depth (m)	Lab ID	Sampling Date	S - soil W – water	Container type	Aggressivity (pH, sulfate, chloride, Electrical Conductivity)					Notes
1	BH3	4.0-4.45		20-9	S	Plastic	X					SHY CLAY
2	BH2	2.0-2.1		20.9	S	Plastic	X					SANDY CLAY

ENVIROLAB
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 226937
Date Received: 25/09/19
Time Received: 14:32
Received by: KS
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Lab Report No. .....
Send Results to: Douglas Partners Address: 96 Hermitage Road, West Ryde 2114
Phone: (02) 9809 0666
Fax: (02) 9809 4095

Relinquished by:	Signed:	Date & Time:	Received By: DGLS Syd	Date & Time:
Relinquished by:	Signed:	Date & Time:	Received By: KSpringer	Date & Time: 25/09/19 14:32