SPECIALIST ADVICE TO

RTL INVESTMENTS 2 PTY LTD AS TRUSTEE FOR RTL MARRICKVILLE PROPERTY TRUST ('RTL CO.')

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED MIXED USE DEVELOPMENT

AT

FARR STREET, MITCHELL STREET, VICTORIA ROAD, & SYDENHAM ROAD, MARRICKVILLE, NSW

Date: 14 November 2024
Ref: 36478YCrpt2rev1

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DOCUMENT REVISION RECORD

Report Reference	Report Status	Report Date
36478YCrpt2	Final	4 July 2024
36478YCrpt2rev1	Rev 1	14 November 2024

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1 INTRODUCTION

This specialist advice report presents the results of a geotechnical investigation for a mixed-use development at Farr Street, Mitchell Street, Victoria Road & Sydenham Road, Marrickville, NSW. The location of the site is shown in Figure 1. The investigation was commissioned by Gary Eckersall of Scape Australia Management Pty Ltd and carried out in accordance with our fee proposal dated 5 February 2024, (Ref: P59666YCrev3).

1.1 Project Description

This specialist advice report has been prepared on behalf of The Trustee for Australian RTL Fund Property Trust (‘RTL Co.’) (the Applicant) to support a State Significant Development Application (SSDA) for the proposed *Timberyards* development. The SSDA (SSD-76927247) seeks consent for a diverse rental housing precinct comprising build-to-rent (BTR), co-living and affordable housing. The precinct development comprises seven buildings ranging from eight to thirteen storeys, with open space that includes a pocket park, through site links and communal open spaces. Specifically, consent is sought for the following:

- Site preparation (including remediation), demolition and bulk excavation for basement parking;
- Residential accommodation (shop top housing, residential flat buildings and mixed use buildings) that includes BTR, co-living and affordable housing;
- Retail premises on the ground floor within the MU1 zoned land and extending up to 25m into the R4 zoned land;
- Publicly accessible recreation area (pocket park) and through site links;
- Neighbourhood shop (within the R4 zoned land);
- Associated landscaping and public domain works; and
- Augmentation of, and connection to, existing utilities as required.

A detailed description of the proposal is provided in the Environmental Impact assessment (EIS) by Ethos Urban. The development is declared State Significant by virtue of being a BTR development on land in Greater Sydney with an Estimated Development Cost (EDC) of greater than $50 million, with the tenanted component representing greater than 60% of the EDC (Schedule 1, *State Environmental Planning Policy (Planning Systems) 2021*).

1.2 Project Vision

RTL Co. aim to deliver Sydney's premier neo-industrial residential neighbourhood - a global benchmark for imaginative urbanism. The Timberyards aims to seamlessly integrate diverse residential offerings into the distinctive character of Marrickville, fostering a sense of pride among residents and the local community. The project will deliver a wide range of rental living solutions, complemented by recreation spaces and local retail, all underpinned by Connection to Country and environmentally sustainable design principles.

1.3 Proposed Basement

Further to the above, from review of the supplied architectural drawings by Turner (Project No: 23068, Drawing No. DA-110-006 to DA-110-010, DA-110-020 to DA-110-120, DA-110-200 all Rev J and DA-210-101[Rev01], DA-210-201[Rev01], DA-210-301[Rev01], DA-210-401[Rev01], DA-220-101[Rev01], DA-220-201[Rev01], DA-220-301[Rev01], DA-220-401[Rev01], DA-220-501[Rev01], DA-220-601[Rev01], DA-220-701[Rev01], DA-220-801[Rev01]) we understand that the proposed multi-storey buildings will partially extend over two levels of car parking (Ground Floor and Basement Level). The ground floor and basement will typically extend over northern corner of the site and will be set back between about 85m from the south-western site boundary and about 50m from the south-eastern site boundary. However, the basement will be setback between 3m and 10m along the north-western and north-eastern site boundaries. The proposed basement level will have a finished floor level of RL0.58m and will require excavation to a maximum depth of about 6.5m.

The purpose of the investigation was to obtain geotechnical information on the subsurface conditions at the test locations. Based on this we have provided comments and recommendations on excavation, hydrogeology, retention, footings, on-grade floor slabs, earthquake site factor and soil aggression.

This geotechnical investigation was carried out in conjunction with an environmental site assessment by our environmental division, JK Environments (JKE).

This report provides specialist advice for use by the structural and civil designers in preparing their designs. No part of this report is considered a regulated design in accordance with the Design and Building Practitioners Act 2020.

2 INVESTIGATION PROCEDURE

2.4 Previous Investigation

JK Geotechnics previously carried out a geotechnical investigation of the site in November 2023 which comprised the drilling of six boreholes (BH1 to BH6) using spiral auger techniques. The information relevant to the geotechnical design issues addressed in this report have been utilised herein. Groundwater monitoring wells were installed within boreholes (BH2, BH3, BH5 and BH6).

2.5 Current Investigation

The current investigation was completed between 26 February and 5 March 2024 and comprised the drilling of five boreholes (BH201 to BH205). The boreholes were initially advanced using spiral auger techniques with an attached tungsten carbide (TC) bit. Once competent bedrock was encountered the boreholes were extended to depths ranging from 9.67m (BH204) to 15.05m (BH201) using diamond coring techniques with water flush.

The borehole locations, as shown on Figure 2, were set out by tape measurements from existing surface features. The approximate surface levels on the borehole logs were interpolated from spot heights shown on the survey plan prepared by JBW Surveyors Pty Ltd (Ref: 125155, dated 1 June 2020). The height datum is Australian Height Datum (AHD).

The strength of the clay and degree of compaction of the fill were assessed from the Standard Penetration Test (SPT) ‘N’ values, which were augmented by hand penetrometer readings completed on cohesive samples recovered from the SPT split tube sampler. The strength of the bedrock in the augered portion of the boreholes was assessed from observation of drilling resistance and examination of rock cuttings recovered from the auger. It should be noted that rock strengths assessed in this way are approximate and variation of say one order of strength or more should not be unexpected. The recovered bedrock core was photographed and point load strength index (I_{s50}) tests completed. Using established correlations, the Unconfined Compressive Strength (UCS) of the bedrock was then calculated. Photographs of the core are presented with the borehole logs while the Point Load Strength Index test results are summarised on the borehole logs and presented in Table A.

Groundwater observations were made in the boreholes during and on completion of drilling. Groundwater monitoring wells were installed in BH201, BH202 and BH203 and comprised a twin system with one well installed within the sandstone bedrock and one within the soil, i.e. two wells at each borehole location. Data loggers were installed in BH201, BH201a, BH202, BH6, BH203, BH203a to allow continuous monitoring of groundwater levels over a three-month period. A return trip to site was made on 19 March 2024 (14 days after completion of drilling) to measure the groundwater levels.

Selected soil and rock samples were returned to Soil Test Services Pty Ltd (STS) and Envirolab, both NATA registered laboratories, for four-day soaked CBR, standard compactions, moisture content, Atterberg Limits, linear shrinkages, pH, chloride content, sulphate content and resistivity. The results of this testing are presented in the STS Tables A, B and Envirolab Certificate of Analysis 339671.

Our geotechnical engineer was present full-time during the fieldwork to set out the borehole locations, direct the buried service scan, log the encountered subsurface profile and nominate in-situ testing and sampling. The borehole logs (which include groundwater observations) are attached, together with a glossary of logging terms and symbols used. Further details of the methods and procedures employed in the investigation are presented in the attached Report Explanation Notes.

3 RESULTS OF INVESTIGATION

3.6 Site Description

The site is known as the ‘Timberyards’, located in Marrickville within the Inner West Local Government Area (LGA). The site comprises 39 lots with legal identification listed in the table below, and has a total area of 22,564m^2 (excluding the Victoria Road widening land, presently within the site boundary). The site is located within Precinct 47: Victoria Road in the *Marrickville Development Control Plan 2011* (MDCP 2011). The site is primarily contained in the Timber Yards sub-precinct of Precinct 47, with the lots fronting Victoria Road falling within the Victoria Road Corridor sub-precinct.

The site is approximately 700m walking distance to the newly opened Sydenham Metro Station, with 7-minute travel time to the Sydney CBD.

The site currently comprises primarily industrial and light industrial uses, with residential dwellings to a minor portion of the site on Farr Street (western boundary) and Victoria Road (eastern boundary). The site also has frontage to Sydenham Road to the south and Mitchell Street to the north (and encompassing a small lane off Mitchell Street). An aerial map is provided at **Figure 1** below.

Lot/DP	Property Address	Lot/DP	Property Address	Lot/DP	Property Address
1/724487	119A Sydenham Rd	1/572829	35 Farr St	3/252507	19 Farr St
1/972534	121 Sydenham Rd	12/4590	14 Mitchell St	4/252507	21 Farr St
B/439802	129 Sydenham Rd	13/4590	10 Mitchell St	5/252507	23 Farr St
A/439802	131 Sydenham Rd	14/4590	8 Mitchell St	6/252507	25 Farr St
D/377270	133 Sydenham Rd	15/4590	183 Victoria Rd	7/252507	27 Farr St
1/700223	135 Sydenham Rd	16/4590	4 Mitchell St	8/252507	29 Farr St
B/343286	7 Farr St	17/4590	2 Mitchell St	9/252507	31 Farr St
A/304426	9 Farr St	3/4590	165 Victoria Rd	1/583801	33 Farr St
A/304426	11 Farr St	2/4590	167 Victoria Rd	C/301985	175 Victoria Rd
1/78883	13 Farr St	1/4590	169 Victoria Rd	D/301985	183 Victoria Rd
1/252507	15 Farr St	A/301985	171 Victoria Rd	E/301985	175 Victoria Rd
2/252507	17 Farr St	B/301985	173 Victoria Rd	A/166330	183 Victoria Rd
345/587262	191 Victoria Rd	1/315293	183 Victoria Rd	20/667441	183 Victoria Rd

Figure 1 Aerial site map

3.6.1 Geotechnical Site Description

The site is located within gently undulating, low lying regional topography. The ground surface within the site slopes gently to the south-east at about 3°.

The site is occupied by a mix of residential, commercial and industrial properties. The central and southern portions of the site are occupied by concrete hardstands with industrial warehouse structures to the south-west and north-east. The warehouses are a mixture of brick, steel framed and metal/fibro clad construction and appear to be in fair condition, based on a cursory inspection. Stockpiles of timber and brick (building supplies) are present across the concrete hardstand areas. Along the street frontages of Farr Street, Mitchell Street, Victoria Road and Sydenham Road are various residential and commercial buildings. The residential buildings are one storey and of brick construction with small paved courtyards, lawns or garden areas present to the front and rear of the residential buildings. The commercial properties are generally two storey and of brick construction with concrete paved car parks at the frontages. Both the residential and commercial buildings range in condition from fair to good, based on a cursory inspection.

Victoria Road and Farr Street bound the site to the south-east and north-west, respectively. Sydenham Road occupies the western portion of the south-western boundary, whilst single storey brick residential and two storey brick commercial buildings occupy the eastern portion of the south-western boundary. Both the residential and commercial buildings abut the common boundary. Mitchel Street runs along most of the length of the north-eastern boundary with the northernmost of this boundary abutting a two-storey commercial building which abuts the common boundary.

The ground surface levels across the site boundaries are similar and fall to the south-east.

3.7 Subsurface Conditions

The 1:100,000 series Geological Map of Sydney indicates the site is underlain by Ashfield Shale of the Wianamatta Group. However, the geological boundary between the Ashfield Shale and Quaternary alluvial deposits runs through the southern corner of the site and just to the south-west of this Hawkesbury Sandstone is shown to outcrop. The boreholes generally encountered fill overlying clayey soils that in turn overlay sandstone bedrock, which is interpreted to be Hawkesbury Sandstone. Over the south-western portion of the site it appears that a thin layer of alluvial silty clay overlies the residual silty clay, while over the remainder of the site residual clays were encountered directly below the fill. For a more detailed description of the subsurface conditions encountered at a particular location, reference should be made to the attached borehole logs. A summary of the encountered subsurface conditions is provided below:

Pavement

Concrete pavements were encountered at the surface of all boreholes and ranged in thickness from 50mm to 180mm. Steel reinforcement was only encountered within BH1, BH2, BH203 and BH205. In BH205 a 100m thick brick paver was encountered below the concrete.

Fill

Fill was encountered in all boreholes to depths ranging from 0.4m to 1.8m. The fill comprised silty clay, silty sand and sandy clay and contained inclusions of igneous, sandstone and ironstone gravel and fragments of concrete, brick, plastic, shell, tile, ceramic, slag, ash, glass and clay nodules. Based on SPT 'N' values the fill was assessed to be poorly to moderately compacted.

Alluvial Soils

A thin layer of alluvial soils were encountered over the south-western portion of the site below the fill in BH1 to BH3, BH202 and BH203 and extended to depths ranging from 1.1m to 1.2m. These silty clays ranged from low to high plasticity and firm to stiff strength, although they were more typically of stiff strength.

Residual Soil

Residual silty clay was encountered within all boreholes at depths ranging from 0.5m to 1.2m, either underlying the alluvial silty clay or the fill. This ranged from low to high plasticity and soft to hard strength, although they were more typically in range of stiff to hard. With the exception of BH203, where the clay immediately overlying the bedrock at a depth of 7.0m to 7.6m was soft, with depth the strength of the clay typically increases.

Weathered Bedrock

Weathered sandstone bedrock was encountered in all boreholes at depths ranging from 2.7m (BH2) at the north-western corner of the site to 7.8m (BH6) at the south-eastern corner of the site. The bedrock was initially assessed to be extremely weathered and of hard (soil strength) improving to distinctly weathered and low or medium strength with depth. Within the cored portions of the boreholes, at depths below between 6.5m to 9.95m (approximately RL-2.6m and RL-7.25m), the strength of the bedrock increased to medium to high or high strength. Defects within the cored sandstone comprised extremely weathered seams of generally less than 40mm thickness, sub-horizontal bedding partings and joints that ranged in inclination from 30^{o} to 90°. Core loss zone of 0.14m thickness was encountered in BH204 and likely represent clay or poor-quality bedrock that has been washed away during the coring process.

The following table summarises the rock levels and the rock classification in the cored boreholes in accordance with Classification of Sandstone and Shales in the Sydney Region: Forty Year Review by Pells et al 2019.

Borehole	Approx. Surface RL (m) AHD	Depth (m)/ RL (mAHD) Class V	Depth (m)/ RL (mAHD) Class IV	Depth (m)/RL (mAHD) Class III or better
BH1	7.21	3.7/RL3.51	4.2/RL3.01	-
BH2	7.28	2.7/RL4.58	3.2/RL4.08	-
BH3	6.0	3.0/RL3.0	4.1/RL1.9	-
BH4	5.19	3.0/RL2.19	3.3/RL1.89	-
BH5	3.95	2.6/RL1.35	2.9/RL1.05	-
BH6	3.22	7.8/RL-4.58	8.1/RL-4.88	-
BH201	4.6	3/RL1.6	4/RL0.6	7.02/RL-2.42

Borehole	Approx. Surface RL (m) AHD	Depth (m)/ RL (mAHD) Class V	Depth (m)/ RL (mAHD) Class IV	Depth (m)/RL (mAHD) Class III or better
BH202	2.7	7.5/RL-4.3	9/RL-5.8	10.04/RL-6.84
BH203	4.5	-	7.6/RL-3.1	8.03/RL-3.53
BH204	5.6	2/RL3.6	5/RL0.6	5.9/RL-0.3
BH205	3.9	2.2/RL1.7	3/RL0.9	5.9/RL-2.0

Groundwater

Groundwater seepage was encountered in BH1 to BH6 and BH201 to BH205 during auger drilling at depths ranging from 1.5m (BH201) to 6m (BH202). The use of water during the coring process prohibited meaningful measurement of groundwater levels on completion of drilling. Longer term groundwater monitoring in BH2, BH4, BH6 and BH201 to BH203 is currently underway. A return trips to site were made after completion of drilling to measure the groundwater levels with the results tabulated below;

Results of Groundwater Monitoring				
Borehole	Date	Surface RL (mAHD)	Depth to Groundwater	Groundwater RL (mAHD)
201	19/3/24	4.6	3.09	1.51
202	19/3/24	3.2	2.86	0.34
203	19/3/24	4.5	2.47	2.03
2	5/12/23	7.2	1.91	5.29
3	5/12/23	6.0	2.55	3.45
5	5/12/23	3.9	2.24	1.66
6	5/12/23	3.2	2.29	0.91

3.8 Laboratory Test Results

The results of the point load strength index tests indicated that the unconfined compressive strength (UCS) of the bedrock ranged from 8MPa to 70MPa, but was more typically in the range of about 20MPa to 38MPa.

The Atterberg Limits and Linear Shrinkage tests on the residual clays indicated the silty clay soils range from medium to high plasticity while the four day soaked CBR tests completed on samples taken from BH202 and BH205 returned values of 2.5% and 3.5% respectively.

The pH values on samples of the clayey fill, residual clays and extremely weathered bedrock ranged from 5.6 to 7.6 indicating neutral to slightly acidic soil conditions. The sulphate contents ranged from 23mg/kg to 42mg/kg while the chloride contents were all 10mg/kg and the resistivity ranged from 14,000ohm.cm to 20,000ohm.cm.

4 COMMENTS AND RECOMMENDATIONS

4.1 Geotechnical Issues

The key issues facing the proposed development are:

- Retention and support of the excavation through both the soils and bedrock, and
- Whether the basement must be designed as a drained or tanked basement

4.2 Excavation

Excavation will be required to depths ranging from about 6.5m over the north-western part of the site to about 2m over the south-eastern portion and are expected to encounter clayey fill, alluvial soils, residual soils and weathered sandstone bedrock.

Excavation of the soils and upper rock of up to very low strength should be achievable using conventional excavation equipment, such as the buckets of hydraulic excavators. Some ripping of higher strength bands may be necessary if they are encountered within the weaker rock.

Excavation of bedrock of low strength or higher will represent "hard rock" excavation conditions. "Hard rock" excavation techniques may comprise the use of percussive or non-percussive excavation techniques. Percussive excavation techniques include the use of hydraulic rock hammers while non-percussive techniques include the use of ripping hooks, rotary grinders, rock saws, rock splitting etc. Due to the size of the site consideration could also be given to using large dozers (e.g., The Cat D10 Dozer) with rippers or surface miners, which are both also non-percussive excavation techniques.

Where percussive rock excavation techniques are adopted, we recommend that considerable caution be taken as there will be direct transmission of ground vibrations to adjoining buildings and structures. Prior to excavation commencing, dilapidation reports should be completed on adjoining structures located within about 20m of the basement excavation. A copy of these reports should be provided to the respective property owners and they should be asked to confirm, in writing, that the reports present a fair record of existing conditions. The dilapidation reports may then be used as a benchmark against which to assess possible future claims for damage resulting from the works. In this manner the reports protect the builder from unfounded claims relating to damage existing prior to the commencement of work.

Excavation procedures and the dilapidation reports should be carefully reviewed prior to excavation commencing, so that appropriate equipment is used.

Where percussive excavation techniques are adopted, there is the risk that transmitted vibrations may damage nearby movement sensitive structures. Consequently, we recommend that the following measures be taken:

- During percussive excavation quantitative vibration monitoring must be completed. This monitoring may be continuous and will provide feedback to the excavation contractor on the suitability of the excavation equipment adopted. Vibration monitors should ideally be attached to the adjoining structures closest to the location of the percussive excavation. Where non-percussive excavation techniques are adopted no vibration monitoring is required,
- Percussive excavation should be completed so that the excavation is progressively enlarged by breaking small wedges out of the face,
- Rock hammers should only be operated in short bursts to prevent amplification of vibrations.
- Where transmitted vibrations exceed prescribed limits, excavation techniques must be altered to reduce transmitted vibrations to within acceptable limits. This may mean that the size of percussive equipment used may need to be reduced, or non-percussive techniques adopted. Whether reducing the size of the percussive equipment is effective in controlling transmitted vibrations must be confirmed by quantitative vibration monitoring.

Alternatively, non-percussive excavation techniques may be adopted. Due to the strength of the sandstone bedrock, should ripping tynes on excavators be used it is anticipated that closely spaced saw cuts will be required to aid in the ripping process. Care must also be taken to ensure that the tyne is not hammered into the rock in an attempt to break or dislodge the bedrock as this action will result in the creation of possibly damaging transmitted vibrations. Where non-percussive excavation techniques are adopted we consider that vibration monitoring will not be necessary.

The prescribed vibration limits that should be adopted on this site where percussive excavation techniques are adopted are set out in the Vibration Emission Design Goals attached to the rear of this report.

4.3 Hydrogeology

Based on the groundwater monitoring to date, the groundwater appears to be flowing approximately north-west to south-east across the site. Within the northern part of the site the groundwater monitoring wells (BH201, BH2, BH3, BH5 and BH6) show the groundwater to be close to the soil/bedrock interface while the boreholes to the south (BH202, BH203 and BH6) show groundwater to be predominantly within the residual silty clay profile.

Groundwater seepage into the excavation is expected to occur, particularly following periods of inclement weather. We anticipate that these flows will be concentrated at the interface between the fill and natural clays, soil and bedrock and through defects present within the bedrock. Intact bedrock is essentially impermeable and as a result all groundwater flows through the rock mass will occur through defects present within it, such as bedding partings, joints etc. As a result, the permeability of the rock mass is defined by the distribution, continuity and degree of openness of the defects. In many cases groundwater inflows through bedrock are characterised by a small number of open defects. It is anticipated that during construction groundwater inflows may be adequately controlled by sump and pump.

From a geotechnical perspective it appears that a drained basement will be suitable for this site. However, from a regulatory perspective permission for a drained basement must be sought from WaterNSW to allow ongoing dewatering. Should WaterNSW allow a drained basement, permission will also need to be sought from Council to dispose all extracted groundwater into their stormwater system. Should Council not allow the disposal of groundwater to their stormwater system, all extracted groundwater will need to be disposed of on site, either by irrigating soft landscaping areas, using the water in toilets etc.

Groundwater monitoring is ongoing and following the completion of monitoring, further advice should be sought on the potential feasibility of the adoption of a drained basement. Where a drained basement is adopted, groundwater inflows must be measured during excavation to confirm that the predicted and actual flow rates correlate. On completion of bulk excavation, the hydraulic engineer must inspect the excavation and review the pump out rates to confirm that their drainage system will be appropriate. Monitoring of water quality and the impact of dewatering on the groundwater table will need to be completed over the life of the building.

4.4 Retention

While space may exist for the formation of temporary batters over sections of the site, in other portions sufficient space is not present. In addition, should there be significant seepage (as may occur), temporary batters are unlikely to be suitable or feasible. Notwithstanding this, the backfilling of temporary batters is often completed in confined spaces and generally poorly executed, leading to future ongoing surface settlements and damage to any structures supported on the fill. Consequently, we recommend that retention of the soils and sandstone bedrock be installed prior to the commencement of excavation and that temporary batters not be adopted.

Due to the clayey nature of the soil a soldier pile wall with infill shotcrete and mesh panels may be considered to retain the excavation. However, groundwater levels have been recorded across the site at depths ranging from about 2m to 3m, which will be above bulk excavation level. While both the clay and bedrock are anticipated to be of generally low permeability, it is possible that more permeable seams are present within the clay and defects present within the bedrock that allow higher than expected flows into the site. Consequently, where a soldier pile wall is adopted, provision must be made for the dewatering of the site and the subsequent disposal of this water. In this regard, allowance must be made for the dewatering of higher than expected inflows. Where groundwater inflows are concentrated, problems may also be experienced in the unsupported faces between the piles which may suffer loss of clayey materials while the shotcrete may be washed from the face whilst still wet. Consequently, much consideration should be given to how the risk of greater than anticipated groundwater inflows may be mitigated

Alternatively, a secant pile wall could be adopted. While the installation of a secant pile wall is likely to be considerably more expensive than the installation of a soldier pile, over the construction period the costs saved in terms of lower groundwater inflows and associated dewatering costs, remedial stabilisation measures and construction delays may outweigh the greater upfront cost and will certainly help manage the risks posed by the excavation. In addition, where it is proposed to adopt a drained basement, it is likely that a secant pile wall installed to some depth below bulk excavation level will be required to help reduce the magnitude of groundwater inflows. While it is expected that due to the proposed size of the basement footprint it is likely that the greatest inflows will be experienced through the floor of the excavation rather than from the walls, installation of a secant pile wall is likely to have an appreciable impact on inflows. Numerical analysis will be required to provide a better understanding of the predicted inflow volumes that will be experienced should a soldier or secant pile wall be adopted and the depth to which the secant pile wall should be installed.

While the cohesive nature of the soils and bedrock suggests that bored piers may be suitable for the site, the presence of groundwater may cause construction delays should significant groundwater seepage be encountered. Pier holes may either need to be dewatered and re-cleaned prior to pouring concrete or tremie methods required to place concrete. Therefore, to mitigate this risk it may be more economical to drill all piles using continuous flight auger piling (CFA) techniques.

Where a secant pile wall is adopted the overlap between piles must be maintained with increasing depth so as to limit the flow of water through the wall above and below the bulk excavation level. The shoring contractor must provide assurance that the methods used will be sufficient to eliminate gaps in the shoring system. Consideration could be given to the use of cased, double rotary drilling methods.

The retained height of material will vary across the site from about 2m to 6.5m. In this regard the following retention systems may be adopted:

- Where the retained height is less than about 3m a cantilevered retention system may be adopted.
- Where the retained height is greater than about 3m an anchored or internally propped system will need to be adopted.

Where cantilevered retaining walls are adopted, the following parameters may be used in their design:

- A triangular earth pressure distribution,
- Where movement sensitive structures or services are not located within the zone of influence of the cantilevered wall (defined by a horizontal distance 2H extending perpendicularly back from the crest of the wall where H is the retained height) a coefficient of active earth pressure, k_a, of 0.35.
- Where movement sensitive structures are present within the zone of influence of the excavation, a coefficient of lateral earth pressure, k, of 0.55 should be adopted.
- A unit weight of 20kN/m^3 for the soil and 23kN/m^3 for the poor-quality bedrock.

Where an anchored or internally propped wall is adopted, the following parameters may be used in their design:

- A trapezoidal earth pressure distribution that is constant over the middle 50% of the distribution and uniformly decreases to 0% at the top and bottom of the distribution should be adopted for the soils and bedrock of low strength or poorer.

- Where the piles extend below the low strength bedrock, a uniform pressure distribution of 10kPa should be adopted to allow for small wedges and clay/poor quality bands of rock that may be present within the better-quality bedrock and require support
- Where movement sensitive structures or services are not located within the zone of influence of the wall, adopt a uniform earth pressure of 6H kPa applied over the central portion of the pressure distribution.
- Where movement sensitive structures or services are located within the zone of influence of the wall, adopt a uniform earth pressure of 8H kPa applied over the central portion of the pressure distribution.
- It should be noted that where a secant pile wall is adopted for the control of groundwater inflows the wall is likely to extend below bulk excavation level. Where this is the case, we will be unable to inspect the cut face to confirm that the bedrock is free from adverse defects. In this instance we recommend that the retained height for the purposes of determining the design back of wall pressures is taken as the full excavated height and not just the height of the soil and poorer quality bedrock.
- All anchors should have minimum free and bond lengths of 3m with the bond length starting below a line drawn upwards from the base of the excavation at no steeper than 1V:1H.
- Anchors formed within sandstone bedrock of at least low strength may be designed for an allowable bond stress of 200kPa. Where anchors are bonded within the medium to high strength sandstone bedrock, higher bond stresses of around 500kPa would be appropriate.
- All anchors should be proof loaded to a minimum 1.3 times the design load.
- While the geometry of the development and proposed depth of excavation suggests that sufficient space exists for the installation of temporary anchors is feasible, should anchors extend beyond the site boundaries, permission must be sought from the property owners prior to their installation. The location of surrounding basements, piled footings etc. should be determined prior to the commencement of anchoring so that they are not affected by the anchor installation.
- The contract for the installation of the anchors should be on a design and construct basis so that should anchors fail on proof loading there is no dispute over whether the design parameters or the installation methods are the cause of the failure.

Irrespective of whether a cantilevered or anchored/propped retention system is adopted, the following must be included in their design:

- Where piles extend below bulk excavation level and are socketed within silty clay of at least stiff strength or extremely weathered bedrock, a triangular earth pressure distribution and a coefficient of passive earth pressure, k_p, of 3 may result. However, as appreciable movements are required to mobilise this full value, we recommend that a factor of safety of 2 be adopted and a design k_p of 1.5 be used.
- Where piles are socketed into the underlying sandstone bedrock of at least very low strength a uniform lateral restraint of 200kPa may be adopted.
- When calculating the required socket depth, the first 0.5m of the socket below bulk excavation level and all localised excavations in front of the wall should be ignored.

- All surcharge loads and appropriate hydrostatic pressures should be added to the above back of wall pressures.
- The above coefficients and lateral pressures assume horizontal backfill surfaces. Where inclined backfill is proposed the coefficients either need to be increased or the inclined backfill taken as a surcharge load.

More economical design for the retaining walls is likely to be achieved using more sophisticated finite element analysis which will require collaboration between the structural and geotechnical engineers.

4.5 Footings

We expect variable soil and bedrock conditions to be exposed at the bulk excavation level. While the excavation will expose sandstone bedrock of at least low strength over much of the basement, within the southern portion of the site the depth to sandstone bedrock is approximately 3.7m to 5m below the proposed assumed bulk excavation level of RL0.58m. Therefore, all footings should be founded within the weathered sandstone bedrock to provide uniform support and reduce the risk of differential settlement. Where rock is exposed or is at depths of less than about 1m, pad or strip footings may be used. Where the depth of rock is more than about 1m (southern portion of the site) bored piers will be more practical, though the comments in Section 4.4 above should be noted regarding likely difficulties in constructing bored piers and the benefits of using CFA piles.

Where the above ground portions of the buildings extend outside of the basement footprint these structures will also need to be supported on piles founded within the underlying sandstone bedrock. In addition, the piles would need to be founded at sufficient depth as not to surcharge the basement shoring walls. In this case piles should be founded below a line drawn upwards at 1V:1H from bulk excavation level. Where piles are founded above bulk excavation level on bedrock of greater than low strength that is free from adverse defects, the bearing pressures recommended below should be halved.

The following table provides bearing pressures for both serviceability and limit state design in accordance with Classification of Sandstones and Shales in the Sydney Region: Forty Year Review by Pells et al 2019.

Rock Class	**Serviceability**		**Limit State Design**		
	Allowable Bearing Pressure (MPa)	**Allowable Shaft Adhesion (kPa)**	**Ultimate End Bearing (MPa)**	**Ultimate Shaft Adhesion (kPa)**	**Elastic Modulus (MPa)**
V	0.8	80	>3	150	100
IV	1	100	>4	250	250
III	3.5	350	20	800	600

Where piles extend below bulk excavation level or below a line drawn upwards from the base of the excavation at 1V:1H the above shaft adhesions may be adopted. The pile sockets must be satisfactorily cleaned and roughened to Roughness Class R2 or rougher. The designer must note that the allowable bearing pressures provided above are based on serviceability criteria of settlements at the footing base/pile toe of less than or equal to 1% of the footing width/pile diameter. Consequently, differently sized footings will experience greater or lesser settlements. We note that if ultimate values are adopted, settlements in excess of 5% of the footing width/pile diameters can be expected.

If limit state design is to be adopted, then ultimate end bearing values with an appropriate geotechnical reduction factor calculated in accordance with the methodology presented in AS2159-2009 must be adopted.

4.6 Basement Slabs and Slabs On Grade

Following bulk excavation, sandstone is expected to be exposed over much of the footprint of the building. Where sandstone bedrock is exposed at bulk excavation no particular subgrade preparation is required, although underfloor drainage should be provided where a drained basement is adopted. Where a tanked basement is constructed a debonding layer will be required. The underfloor drainage should comprise a strong, durable single sized washed aggregate, such as 'blue metal' gravel. The underfloor drainage should collect groundwater seepage and direct it by gravity flow to the stormwater system.

Where a soil subgrade is exposed, the following subgrade preparation should be carried out;

- Proof rolling of the exposed subgrade using a smooth drum roller with a minimum dead weight of 5 tonnes. A minimum of eight passes should be completed with the final pass completed in the presence of a geotechnical engineer.
- The purpose of the proof rolling is to identify any soft spots or heaving materials and to increase the density of the near surface soils.
- Where soft or heaving areas are identified they must be excavated down to a sound base and replaced with engineered fill. It should be noted that the high water table means that the clay subgrade may be substantially affected and that over excavation and replacement of water softened areas with granular fill maybe necessary.
- Engineered fill must be free from all organic or otherwise deleterious materials. The existing clean ripped sandstone bedrock on site may be used as engineered fill. The material should be placed in loose layer thicknesses of no greater than about 100mm, although depending on the compaction equipment used, layer thicknesses may be varied provided the compaction specification outlined below is achieved. Maximum particle sizes should be limited to no greater than 35mm. Engineered fill must be compacted to between 98% and 102% of Standard Maximum Dry Density (SMDD) and within +/- 2% of Standard Optimum Moisture Content (SOMC).
- Earthworks testing should be completed at a frequency of 1 test/50m^2/2 layers. Where movement sensitive structures are to be supported on the engineered fill, Level 1 earthworks testing in accordance with AS3798-2007 should be completed. The Geotechnical Inspection and Testing Authority (GITA) should be engaged directly by the end client and not the earthworks contractor. The guidelines set out in AS3798 should be adopted for this site.

For the design of trafficable on grade slabs formed over a clayey subgrade, an estimated modulus of subgrade reaction of 20kPa/mm (750mm plate) should be adopted. For soils with low CBR values it is generally economic to undertake some form of treatment to improve the subgrade, either by lime stabilisation, the introduction of a select layer or by the use of a 150mm lean mix layer below rigid pavements. Further advice can be provided on potential stabilisation measures although for lime stabilisation further testing will be required to determine design CBR values. Subsoil drains that extend a minimum of 0.3m below the subgrade and drain to Council's stormwater system should be installed on the high side of the pavement.

Where on grade slabs will be trafficked by vehicles, they should have a sub-base layer of at least 100mm thickness of crushed rock to TfNSW QA specification 3051 (1994) unbound base material (or equivalent good quality and durable fine crushed rock), which is compacted to at least 100% of SMDD. Concrete pavements should be designed with an effective shear transmission at all joints by way of either doweled or keyed joints. Where pavements extend over both sandstone bedrock and soils a movement joint should be incorporated in the pavement design at the interface between the bedrock and soil. Similarly, all slabs should be isolated from structural elements such as walls and columns such that they can more differentially.

If a tanked basement is adopted, the basement slab would need to be designed to resist groundwater uplift pressures. Further geotechnical investigation will be required to allow appropriate hydrostatic uplift pressures to be nominated for design purposes.

4.7 Aggressivity

Based on these results, the clayey fill, residual clays and extremely weathered bedrock would classify as non-aggressive exposure classification for both concrete piles in accordance with Table 6.4.2(C) of AS2159-2009 'Piling – Design and Installation' and steel piles in accordance with Table 6.5.2(C) of AS2159-2009.

4.8 Further Work

As detailed above, we believe that the following further geotechnical work will be required:

- Further advice on groundwater levels and potential groundwater inflow rates.
- Vibration monitoring during percussive excavation.
- Inspection of shoring piles
- Proof loading of all anchors to at least 1.3 times the working load.
- Inspection of all unsupported vertical cuts formed through sandstone bedrock of greater than low strength by a geotechnical engineer so that should adverse defects be present they may be identified and remedial measures initiated.
- Inspection of all footings by the geotechnical engineer to confirm that the design bearing pressures are achieved.
- Where bearing pressures of 3,500kPa are adopted, spoon tests will be required in a third of all footing excavations evenly spread across the site.
- Further advice on subgrade improvement, if considered necessary.
- Witnessing of proof rolling of the subgrade by an experience geotechnical engineer or geotechnician and the placement and insitu testing of engineered fill, where necessary.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification will need to be assigned to any soil excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), General Solid, Restricted Solid or Hazardous Waste. Analysis takes seven to 10 working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) should be expected. We strongly recommend that this issue is addressed prior to the commencement of excavation on site.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

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SOIL TEST SERVICES

ABN 43 002 145 173

TABLE A

MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client:	JK Geotechnics	**Report No.:**	36478YC - A
Project:	Proposed Mixed Use Development	**Report Date:**	21/03/2024
Location:	Farr St, Mitchell St, Victoria Rd & Sydenham Rd, Marrickville, NSW	**Page 1 of 1**	

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	**DEPTH m**	**MOISTURE CONTENT %**	**LIQUID LIMIT %**	**PLASTIC LIMIT %**	**PLASTICITY INDEX %**	**LINEAR SHRINKAGE %**
201	7.00 - 7.10	10.8	-	-	-	-
202	1.50 - 1.95	24.8	61	20	41	18.5
202	9.50 - 10.00	11.7	-	-	-	-
203	7.55 - 7.60	8.8	-	-	-	-
204	5.00 - 5.50	12.5	-	-	-	-
204	5.50 - 5.70	12.7	-	-	-	-
205	1.50 - 1.95	21.7	49	19	30	11.0
205	3.00 - 3.50	7.7	-	-	-	-
205	4.20 - 4.50	13.3	-	-	-	-
205	5.00 - 5.50	14.1	-	-	-	-

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 12/03/2024.
- Sampled and supplied by client. Samples tested as received.

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21/03/2024
Authorised Signature / Date
(D. Treweek)

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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE B
TEN DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client:	JK Geotechnics	**Report No.:**	36478YC - B
Project:	Proposed Mixed Use Development	**Report Date:**	2/04/2024
Location:	Farr St, Mitchell St, Victoria Rd & Sydenham Rd, Marrickville, NSW	**Page 1 of 1**	

BOREHOLE NUMBER		BH 202	BH 205
DEPTH (m)		1.00 - 1.70	1.40 - 2.00
Surcharge (kg)		9.0	9.0
Maximum Dry Density (t/m^3)		1.65 STD	1.72 STD
Optimum Moisture Content (%)		20.7	17.5
Moulded Dry Density (t/m^3)		1.61	1.68
Sample Density Ratio (%)		98	98
Sample Moisture Ratio (%)		101	101
Moisture Contents			
Insitu (%)		21.7	21.5
Moulded (%)		20.9	17.7
After soaking and			
After Test, Top 30mm(%)		25.8	23.2
Remaining Depth (%)		20.7	20.8
Material Retained on 19mm Sieve (%)		0	0
Swell (%)		0.5	0.5
C.B.R. value:	@2.5mm penetration	2.5	
	@5.0mm penetration		3.5

NOTES: Sampled and supplied by client. Samples tested as received.
- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 12/03/2023.
- BH 205 dried back prior to testing as it was too saturated.

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02/04/2024
Authorised Signature / Date
(D. Treweek)

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Australian RTL Fund Property Trust
Ref No: 36478YC

Project: Proposed Mixed-Use Development
Report: A

Location: Farr St, Mitchell St, Victoria Rd & Sydeham Rd, MARRICKVILLE, NSW
Report Date: 22/03/24

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
201	7.24 - 7.27	3.3	66	A
	7.93 - 7.97	1.7	34	A
	8.13 - 8.17	1.8	36	A
	8.81 - 8.84	1.6	32	A
	9.57 - 9.61	1.7	34	A
	10.13 - 10.18	1.2	24	A
	10.70 - 10.73	1.9	38	A
	11.20 - 11.25	1.1	22	A
	11.75 - 11.78	1.5	30	A
	12.15 - 12.19	1	20	A
	12.38 - 12.42	1.4	28	A
	12.62 - 12.66	1.9	38	A
	13.28 - 13.32	1.5	30	A
	13.86 - 13.89	1.4	28	A
	14.28 - 14.31	1.8	36	A
	14.90 - 14.95	2.1	42	A
202	10.18 - 10.21	1.3	26	A
	10.72 - 10.76	2	40	A
	11.12 - 11.17	1.4	28	A
	11.86 - 11.88	2.1	42	A
	12.13 - 12.17	1.6	32	A
	12.75 - 12.80	1.8	36	A
203	8.27 - 8.31	1	20	A
	8.61 - 8.63	1.9	38	A
	9.11 - 9.15	1.9	38	A

NOTE: SEE PAGE 2

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Australian RTL Fund Property Trust
Ref No: 36478YC

Project: Proposed Mixed-Use Development
Report: A

Location: Farr St, Mitchell St, Victoria Rd & Sydeham Rd, MARRICKVILLE, NSW
Report Date: 22/03/24

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
203	9.75 - 9.79	1.3	26	A
	10.70 - 10.75	1.1	22	A
	10.72 - 10.76	1	20	A
	11.03 - 11.08	1.8	36	A
204	6.06 - 6.09	0.4	8	A
	6.83 - 6.87	1.6	32	A
	7.23 - 7.26	2.9	58	A
	7.71 - 7.76	1.7	34	A
	8.13 - 8.17	1.4	28	A
	8.55 - 8.59	1.4	28	A
	8.79 - 8.84	1.1	22	A
	9.11 - 9.13	2.6	52	A
	9.59 - 9.62	1.8	36	A
205	5.96 - 5.99	1	20	A
	6.06 - 6.09	0.4	8	A
	6.52 - 6.54	1.5	30	A
	6.90 - 6.92	1.8	36	A
	7.17 - 7.21	3.5	70	A
	7.61 - 7.65	2.2	44	A
	7.93 - 7.96	1.2	24	A
	8.13 - 8.17	1.5	30	A
	8.50 - 8.53	1.4	28	A
	8.86 - 8.89	1.6	32	A
	9.14 - 9.18	1.5	30	A
	9.59 - 9.63	1.9	38	A

NOTES

1. In the above table, testing was completed in test direction A for the axial direction, D for the diametral direction, B for the block test and L for the lump test.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the $I_{S(50)}$ has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa.
5. The estimated Unconfined Compressive Strength was calculated from the Point Load Strength Index based on the correlation provided in AS1726:2017 'Geotechnical Site Investigations' and rounded off to the nearest whole number: U.C.S. = 20 $I_{S(50)}$.

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CERTIFICATE OF ANALYSIS 339671

Client Details

Client	JK Geotechnics
Attention	Keagan Rousseau
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**36478YC, Due Diligence - Marrickville**
Number of Samples	3 Soil
Date samples received	07/12/2023
Date completed instructions received	07/12/2023

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.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	14/12/2023
Date of Issue	14/12/2023

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Results Approved By
Diego Bigolin, Inorganics Supervisor

Authorised By
Nancy Zhang, Laboratory Manager

Misc Inorg - Soil				
Our Reference		339671-1	339671-2	339671-3
Your Reference	UNITS	BH3	BH6	BH5
Depth		3.6-4.0	0.65-0.95	1.5-1.8
Date Sampled		30/11/2023	01/12/2023	01/12/2023
Type of sample		Soil	Soil	Soil
Date prepared	-	13/12/2023	13/12/2023	13/12/2023
Date analysed	-	13/12/2023	13/12/2023	13/12/2023
pH 1:5 soil:water	pH Units	5.6	7.6	5.7
Chloride, Cl 1:5 soil:water	mg/kg	10	10	10
Sulphate, SO4 1:5 soil:water	mg/kg	23	32	42
Resistivity in soil*	ohm m	200	140	160

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 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
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: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			13/12/2023	[NT]	[NT]	[NT]	[NT]	13/12/2023	[NT]
Date analysed	-			13/12/2023	[NT]	[NT]	[NT]	[NT]	13/12/2023	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	102	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	98	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[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.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

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 (not SPOCAS); 60-140% for organics/SPOCAS (+/-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.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

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.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Samples were out of the recommended holding time for this analysis pH.

JKGeotechnics

BOREHOLE LOG

Borehole No. 1
1/1

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD
Project: DUE DILIGENCE
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 7.21m
Date: 1/12/23 **Datum:** AHD
Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 180mm.t				7mm DIA. REINFORCEMENT, 140mm TOP COVER
	N = 6 4,3,3		-	FILL: Silty clay, low plasticity, brown and grey, trace of fine to medium grained sandstone and ironstone gravel, fine to medium grained sand, and ash.	w>PL			APPEARS POORLY COMPACTED
		1	CL-CI	Silty CLAY: low to medium plasticity, light brown, trace of root fibres and ash.	w≈PL	St	120 150 100	ALLUVIAL
	N = 11 3,5,6		CH	Silty CLAY: high plasticity, light grey mottled red brown.	w<PL	Hd	550 510 510	RESIDUAL
15 MINS AFTER COMPLET-ION		2		as above, but light grey.				
	N = 28 5,13,15	3	CL	Silty CLAY: low plasticity, light grey, with fine to medium grained sand.			>600 >600 >600	
		4	-	Extremely Weathered sandstone: silty CLAY, medium plasticity, light grey.	XW	Hd		HAWKESBURY SANDSTONE
				SANDSTONE: fine to medium grained, light grey and red brown, with iron indurated bands.	DW	L		LOW TO MODERATE 'TC' BIT RESISTANCE
		5				M		MODERATE RESISTANCE
						M-H		MODERATE TO HIGH RESISTANCE
				END OF BOREHOLE AT 5.5m				
		6						
		7						

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BOREHOLE LOG

Borehole No. 2

1/1

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD
Project: DUE DILIGENCE
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 7.28m
Date: 30/11/23 **Datum:** AHD
Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 170mm.t				7mm DIA. REINFORCEMENT
			-	FILL: Silty clay, low plasticity, brown and grey, trace of fine to medium grained ironstone and igneous gravel, plastic fragments and ash.	w>PL			
	N = 6 2,3,3		CL-CI	Silty CLAY: low to medium plasticity, orange brown, trace of ash and root fibres.	w≈PL	St	150 110 120	ALLUVIAL
		1	CI	Silty CLAY: medium plasticity, light brown mottled red brown, trace of fine to medium grained sub-rounded ironstone gravel.				
ON 5/12/23	N = 22 7,11,11	2	CI-CH	Silty CLAY: medium to high plasticity, light grey mottled red brown.	w<PL	Hd	550 560 550	RESIDUAL
		3	-	Extremely Weathered sandstone: silty CLAY, low plasticity, light grey, with fine to medium grained ironstone gravel.	XW	Hd		HAWKESBURY SANDSTONE
				SANDSTONE: fine to medium grained, light grey and red brown, with iron indurated bands.	DW	L		LOW 'TC' BIT RESISTANCE WITH MODERATE RESISTANCE BANDS
		4		as above, but brown and red brown.		M-H		MODERATE TO HIGH RESISTANCE GROUNDWATER MONITORING WELL INSTALLED TO 5.5m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.7m TO 5.5m. CASING 0m TO 0.7m. 2mm SAND FILTER PACK 0.6m TO 5.5m. BENTONITE SEAL 0.3m TO 0.6m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
		5						
		6		END OF BOREHOLE AT 5.5m				
		7						

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BOREHOLE LOG

Borehole No. 3

1/1

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD
Project: DUE DILIGENCE
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 6.0m
Date: 30/11/23 **Datum:** AHD
Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 130mm.t				NO REINFORCEMENT OBSERVED
			-	FILL: Silty clay, medium plasticity, light brown, trace of fine to medium grained sandstone, igneous and ironstone gravel, brick fragments and ash.	w>PL			
	N = 3 0,1,2		CL-CI	Silty CLAY: low to medium plasticity, orange brown, trace of ash and root fibres.	w≈PL	St	110 130 100	ALLUVIAL
	N = SPT 7, BOUNCING	1	CI-CH	Silty CLAY: medium to high plasticity, light grey mottled red brown, trace of fine to medium grained ironstone gravel.	w<PL	Hd	>600 >600 >600	RESIDUAL GROUNDWATER MONITORING WELL INSTALLED TO 6.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.0m TO 6.0m. CASING 0m TO 1. 0m. 2mm SAND FILTER PACK 0.5m TO 6.0m. BENTONITE SEAL 0.3m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
ON 5/12/23		2		as above, but light grey.				
	N = SPT BOUNCING	3	-	Extremely Weathered sandstone: silty CLAY, low plasticity, light grey, with fine to medium grained sand.	XW	Hd		HAWKESBURY SANDSTONE
				Extremely Weathered sandstone: silty CLAY, low plasticity, light grey, trace of fine to medium grained ironstone gravel.				VERY LOW 'TC' BIT RESISTANCE
		4		SANDSTONE: fine to medium grained, light grey and red brown, with iron indurated bands.	DW	L		LOW RESISTANCE
		5				M		MODERATE RESISTANCE
				as above, but brown and red brown.		M-H		MODERATE TO HIGH RESISTANCE
		6		END OF BOREHOLE AT 6.0m				
		7						

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BOREHOLE LOG

Borehole No. 4

1/1

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD

Project: DUE DILIGENCE

Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 5.19m

Date: 30/11/23 **Datum:** AHD

Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 100mm.t				NO REINFORCMENT OBSERVED
			-	FILL: Silty clay, low plasticity, dark grey, trace of fine to medium grained ironstone and igneous gravel, fine to medium grained sand, shell fragments and hydrocarbon odour.	w>PL			APPEARS POORLY COMPACTED
	N = 4 4,2,2	1		FILL: Silty sand, fine to medium grained, dark grey and grey, trace of fine to medium grained sandstone and igneous gravel, clay nodules, glass fragments, slag and ash.	M			
ON 5/12/23	N = 18 5,6,12	2	CL-CI	Silty CLAY: low to medium plasticity, light grey, with fine to medium grained sand, trace of fine to medium grained ironstone gravel.	w<PL	Hd	450 410 410	RESIDUAL
		3	-	Extremely Weathered sandstone: silty CLAY, low plasticity, light grey, trace of fine to medium grained ironstone gravel.	XW	Hd		HAWKESBURY SANDSTONE
		4		SANDSTONE: fine to medium grained, light grey and red brown, with iron indurated bands.	DW	M		MODERATE 'TC' BIT RESISTANCE
				SANDSTONE: fine to medium grained, brown and grey/		L-M		LOW TO MODERATE RESISTANCE
		5				M		MODERATE RESISTANCE
		6		END OF BOREHOLE AT 6.0m				
		7						

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BOREHOLE LOG

Borehole No.
5
1/1

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD
Project: DUE DILIGENCE
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 3.95m
Date: 1/12/23 **Datum:** AHD
Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 130mm.t				NO REINFORCMENT OBSERVED
				FILL: Silty clay, low plasticity, dark grey, trace of fine to medium grained sand, fine to medium grained igneous gravel, glass fragments and ash.	w>PL			APPEARS POORLY COMPACTED
	N = 6 1,3,3		CL	Silty CLAY: low plasticity, light grey mottled red brown.	w<PL	VSt	250 230 230	RESIDUAL
	N = 14 4,7,7	1					300 290 340	GROUNDWATER MONITORING WELL INSTALLED TO 5.4m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.2m TO 5.4m. CASING 0m TO 1.2m. 2mm SAND FILTER PACK 0.8m TO 5.4m. BENTONITE SEAL 0.5m TO 0.8m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
ON 5/12/23		2	CI-CH	Silty CLAY: medium to high plasticity, light grey mottled red brown and orange brown, trace of fine to medium grained sand, and fine to medium grained ironstone gravel.	w<PL	Hd	450 500 410	
			-	Extremely Weathered sandstone: silty CLAY, low plasticity, light grey.	XW	Hd		
		3		SANDSTONE: fine to medium grained, light grey and red brown, with iron indurated bands.	DW	L-M		HAWKESBURY SANDSTONE LOW TO MODERATE 'TC' BIT RESISTANCE
		4		SANDSTONE: fine to medium grained, brown and grey.		M		MODERATE RESISTANCE
						M-H		MODERATE TO HIGH RESISTANCE
		5		as above, but light grey.				
				END OF BOREHOLE AT 5.4m				'TC' BIT REFUSAL
		6						
		7						

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD

Project: DUE DILIGENCE

Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 3.22m

Date: 1/12/23 **Datum:** AHD

Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		CONCRETE: 100mm.t				NO OBSERVED REINFORCEMENT
	N = 4 1,2,2		-	FILL: Silty clay, low plasticity, dark grey, trace of fine to medium grained igneous gravel, fine to medium grained sand, ceramic and tile fragments and ash.	w>PL		110 120 110	APPEARS POORLY COMPACTED
		1		FILL: Silty clay, medium plasticity, grey brown and red brown.	w≈PL		130 100 110	
	N = 15 4,6,9		CI-CH	Silty CLAY: medium to high plasticity, grey mottled red brown.	w≈PL	VSt	210 230 210	RESIDUAL NO SPT SAMPLE RECOVERED
ON 5/12/23		2		as above, but red brown mottled light grey.	w<PL			
				Silty CLAY: medium to high plasticity, grey mottled red brown and orange brown.			370 370 390	HP TEST ON REMOULDED SAMPLE
	N = 16 5,7,9	3		as above, but with fine to medium grained ironstone gravel.		Hd	510 500 470	
		4						
	N = 20 5,10,10	5			w≈PL		>600 >600 >600	
	N = 22 5,11,11	6					450 490 500	
			CI		w<PL		>600 >600 >600	
		7						

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BOREHOLE LOG

Borehole No. **6**

Client: SCAPE AUSTRALIA MANAGEMENT PTY LTD

Project: DUE DILIGENCE

Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDENHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** 3.22m

Date: 1/12/23 **Datum:** AHD

Plant Type: JK400 **Logged/Checked by:** K.R./T.C.

Groundwater Record	SAMPLES (ES / U50 / DB / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
30 MINS AFTER COMPLET-ION ▼						Silty CLAY: medium to high plasticity, grey mottled red brown and orange brown, with fine to medium grained ironstone gravel.	w<PL	Hd		
			8		-	Extremely Weathered sandstone: silty CLAY, low plasticity, light grey.	XW	Hd		HAWKESBURY SANDSTONE
						SANDSTONE: fine to medium grained, light grey and light brown.	DW	L		LOW 'TC' BIT RESISTANCE
			9 10 11 12 13 14			END OF BOREHOLE AT 8.5m				GROUNDWATER MONITORING WELL INSTALLED TO 8.5m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.0m TO 8.5m. CASING 0m TO 2.0m. 2mm SAND FILTER PACK 1.5m TO 2.0. BENTONITE SEAL 1.2m TO 1.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.

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BOREHOLE LOG

Borehole No. 201

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~4.6 m
Date: 26/2/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** S.W./T.C.

Groundwater Record	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
			CONCRETE: 110mm.t				NO OBSERVED REINFORCEMENT
		-	FILL: Silty sand, fine to medium grained, purple brown, with fine to medium grained sandstone gravel.	M			
	N = 16 9,9,7		FILL: Silty sandy clay, low plasticity, dark grey, fine to medium grained sand, trace of fine to coarse grained sandstone and igneous gravel.	w>PL			ORGANIC ODOUR APPEARS WELL COMPACTED
	N = 3 1,1,2						APPEARS POORLY COMPACTED
		CI-CH	Silty CLAY: medium to high plasticity, light brown mottled orange brown and light grey, trace of fine to coarse grained ironstone gravel.	w>PL	F	50 50 80	RESIDUAL
ON 19/3/24	N = 25 7,13,12	-	Extremely Weathered sandstone: silty CLAY, low plasticity, light grey, trace of fine to coarse grained ironstone gravel.	XW	Hd		HAWKESBURY SANDSTONE
			SANDSTONE: fine to coarse grained, light brown and grey.	DW	L		LOW 'TC' BIT RESISTANCE WITH MODERATE TO HIGH BANDS

Samples: ES, U50, DB, DS
RL (m AHD): 4, 3, 2, 1, 0, -1, -2
Depth (m): 1, 2, 3, 4, 5, 6

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BOREHOLE LOG

Borehole No.
201

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~4.6 m
Date: 26/2/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** S.W./T.C.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										SANDSTONE: fine to medium grained, grey. *(continued)*	DW	M		HIGH RESISTANCE 'TC' BIT REFUSAL ON SANDSTONE
										REFER TO CORED BOREHOLE LOG				
						-3								GROUNDWATER MONITORING WELL INSTALLED TO 15.05m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 7.0m TO 15.05m. CASING 0.05m TO 7.0m. 2mm SAND FILTER PACK 6.5m TO 15.05m. BENTONITE SEAL 5.5m TO 6.5m AND 0m TO 1.0m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							8							
						-4								
							9							
						-5								GROUNDWATER MONITORING WELL INSTALLED TO 7.0m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.0m TO 7.0m. CASING 0.05m TO 1.0m. 2mm SAND FILTER PACK 0.5m TO 7.0m. BENTONITE SEAL 0m TO 0.5m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							10							
						-6								
							11							
						-7								
							12							
						-8								
							13							
						-9								

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 36478YC MARRICKVILLE.GPJ <<DrawingFile>> 24/06/2024 12:43 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

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CORED BOREHOLE LOG

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC | **Core Size:** HQ | **R.L. Surface:** ~4.6 m
Date: 26/2/24 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK330 | **Bearing:** N/A | **Logged/Checked By:** S.W./T.C.

Water Loss\Level: 90% RETURN
Formation: Hawkesbury Sandstone

RL (m AHD): -3, -4, -5, -6, -7, -8, -9
Depth (m): 8, 9, 10, 11, 12, 13

POINT LOAD STRENGTH INDEX $I_s(50)$: VL 0.1, L 0.3, M 1, H 3, VH 10, EH
SPACING (mm): 600, 200, 60, 20

CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	Point Load $I_s(50)$	DEFECT DETAILS – DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) – Specific
START CORING AT 7.02m				
SANDSTONE: fine to medium grained, grey, with dark grey lenses, bedded at 0-5°.	FR	H	3.3	(7.06m) J, 90°, P, R, Ca Ct (7.09m) Be, 10°, P, R, Cb Vn
as above, but light grey, bedded at 10-30°.			1.7 1.8	(7.80m) Be, 0°, P, R, Cb Ct
SILTSTONE: dark grey, with fine grained sandstone bands, bedded at 0-5°.			1.6	(8.74m) Be, 0°, P, S, Cn (9.15m) J, 85°, P, R, Cn
SANDSTONE: fine to medium grained, light grey, with occasional dark grey carbonaceous laminae, bedded at 0-20°.			1.7 1.2 1.9 1.1 1.5	(9.37m) Be, 0°, P, R, Cn (11.70m) Be, 0°, P, R, Cn
as above, but medium to coarse grained.			1.0 1.4 1.9 1.5 1.4	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

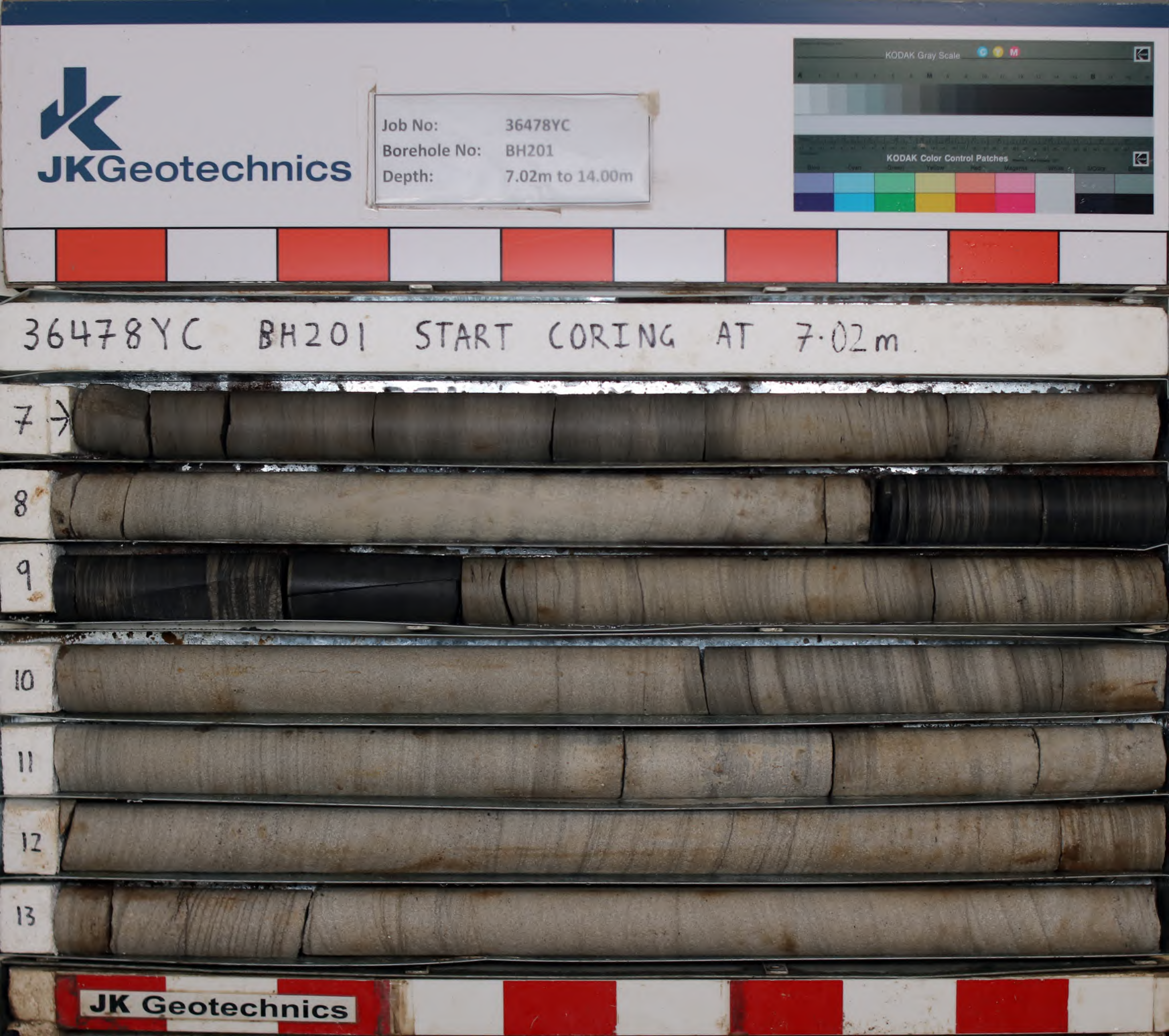
Borehole No.
201

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Core Size:** HQ **R.L. Surface:** ~4.6 m
Date: 26/2/24 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK330 **Bearing:** N/A **Logged/Checked By:** S.W./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
90% RETURN		-10	15		as above, but medium to coarse grained. *(continued)*	FR	H	1.8 2.1		(14.21m) XWS, 0°, 10 mm.t	Hawkesbury Sandstone
		-11 -12 -13 -14 -15 -16	16 17 18 19 20		END OF BOREHOLE AT 15.05 m						

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 36478YC MARRICKVILLE.GPJ <<DrawingFile>> 24/06/2024 12:43 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20


JKGeotechnics
Job No: 36478YC
Borehole No: BH201
Depth: 7.02m to 14.00m
KODAK Gray Scale
KODAK Color Control Patches
36478YC BH201 START CORING AT 7·02m
7
8
9
10
11
12
13
JK Geotechnics


JKGeotechnics
Job No: 36478YC
Borehole No: BH201
Depth: 14.00m to 15.05m
KODAK Gray Scale
KODAK Color Control Patches
14
15
END OF HOLE AT 15·05m
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BOREHOLE LOG

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~3.2 m
Date: 28/2/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** S.W./T.C.

Depth (m)	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
0			CONCRETE: 50mm.t				NO OBSERVED REINFORCEMENT
0.05	N = 8 4,3,5	-	FILL: Silty sand, fine to coarse grained, purple brown, with fine to coarse grained sandstone gravel, trace of clay.	M			APPEARS MODERATELY TO WELL COMPACTED
1.0		CI	Silty CLAY: medium plasticity, light brown.	w~PL	(St)		ALLUVIAL
1.2		CI-CH	Silty CLAY: medium to high plasticity, red brown mottled grey, trace of fine grained ironstone gravel.				RESIDUAL
1.5	N = 17 5,7,10	CH	Silty CLAY: high plasticity, grey mottled red brown, trace of fine grained ironstone gravel.		VSt	290 300 340	
2.2			as above, but grey mottled purple brown and orange brown, without ironstone gravel.				
3.0	N = 21 6,9,12		Silty CLAY: high plasticity, light grey mottled purple brown and orange brown, trace of fine to medium grained ironstone gravel.			340 350 370	
4.5	N = 26 6,11,15					230 250 280	
6.0	N = 32 10,14,18				Hd	440 410 400	

Groundwater Record: ON 19/3/24

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BOREHOLE LOG

Borehole No.
202
2 / 3

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~3.2 m
Date: 28/2/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** S.W./T.C.

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
			-4			CH	Silty CLAY: high plasticity, light grey mottled purple brown and orange brown, trace of fine to medium grained ironstone gravel. *(continued)*	w>PL	Hd		
		N > 9 14,9/ 50mm REFUSAL	-5	8		-	Extremely Weathered sandstone: silty CLAY, medium to high plasticity, light grey and red brown, trace of fine grained sand.	XW	Hd	450 420 440	HAWKESBURY SANDSTONE
			-6	9			SANDSTONE: fine to medium grained, light grey and light brown.	DW	L - M		LOW TO MODERATE 'TC' BIT RESISTANCE
									M - H		MODERATE TO HIGH RESISTANCE
			-7 -8 -9 -10	10 11 12 13			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 12.85m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 9.35m TO 12.85m. CASING 0.05m TO 9.35m. 2mm SAND FILTER PACK 8.5m TO 12.85m. BENTONITE SEAL 7.5m TO 8.5m AND 0.05m TO 1.0m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.

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CORED BOREHOLE LOG

Borehole No.
202

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC | **Core Size:** HQ | **R.L. Surface:** ~3.2 m
Date: 28/2/24 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK330 | **Bearing:** N/A | **Logged/Checked By:** S.W./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS SPACING (mm)	DEFECT DETAILS DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
		-6			START CORING AT 9.95m						
90% RETURN		-7	10		SANDSTONE: fine to coarse grained, light grey, with occasional dark grey carbonaceous laminae, bedded at 0-30°.	FR	H	1.3, 2.0, 1.4		(10.00m) XWS, 0°, 40 mm.t (10.05m) Be, 0°, P, R, Cn (10.41m) Be, 5°, P, R, Clay Ct	Hawkesbury Sandstone
		-8	11		SILTSTONE: dark grey, with fine grained sandstone bands, bedded at 5-10°.					(11.24m) Be, 5°, P, R, Clay FILLED, 5 mm.t	
		-9	12		SANDSTONE: fine to coarse grained, light grey, with occasional dark grey carbonaceous laminae, bedded at 0-30°.			2.1, 1.6, 1.8		(11.74m) Be, 5°, P, R, Clay FILLED, 4 mm.t	
		-10	13		END OF BOREHOLE AT 12.85 m						
		-11	14								
		-12	15								

Strength scale: VL -0.1, L -0.3, M -1, H -3, VH -10, EH. Spacing scale: 600, 200, 60, 20.

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 36478YC
Borehole No: BH202
Depth: 9.95m to 12.85m
KODAK Gray Scale
KODAK Color Control Patches
36478YC BH202 START CORING AT: 9.95m.
10
11
12
EOH AT 12.85m.
JK Geotechnics

JKGeotechnics

BOREHOLE LOG

Borehole No. **203**

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~4.5 m
Date: 4/3/24 TO 5/3/24 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** S.K. & S.W./T.C.

Groundwater Record	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
			CONCRETE: 130mm.t				5mm DIA. REINFORCEMENT, 70mm TOP COVER
		-	FILL: Silty sand, fine to medium grained, dark grey, trace of fine to medium grained igneous gravel.	M			
	N = 3 1,1,2	CI-CH	Silty CLAY: medium to high plasticity, brown and orange brown, trace of fine to medium grained sand.	w>PL	F - St	130 100 90	ALLUVIAL
ON 19/3/24	N = 11 2,4,7 N = 12 3,6,6		Silty CLAY: medium to high plasticity, grey mottled brown and red brown, trace of fine to medium grained ironstone gravel, and root fibres.		VSt	380 380 410	RESIDUAL
			Silty CLAY: medium to high plasticity, grey mottled red brown, trace of fine to medium grained sand.		St	150 180 180	
	N = 18 7,8,10 N > 8 22,8/ 50mm REFUSAL		Silty CLAY: medium to high plasticity, grey mottled red brown, with fine to medium grained sand, medium grained ironstone gravel.		St - VSt	250 240 150	

RL (m AHD): 4, 3, 2, 1, 0, -1, -2
Depth (m): 1, 2, 3, 4, 5, 6

SAMPLES: ES, U50, DB, DS

JKGeotechnics

BOREHOLE LOG

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~4.5 m
Date: 4/3/24 TO 5/3/24 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** S.K. & S.W./T.C.

Groundwater Record	SAMPLES ES / U50 / DB / DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
			-3			CI-CH	Silty CLAY: medium to high plasticity, grey mottled red brown, with fine to medium grained sand, medium grained ironstone gravel. *(continued)*	w>PL	S		
		N=SPT 7/ 50mm REFUSAL				CL-CI	Sandy CLAY: low to medium plasticity, red brown, fine to medium grained sand, trace of fine to medium grained ironstone gravel.			30 30 40	
						-		DW	M		HAWKESBURY SANDSTONE
				8			SANDSTONE: fine to medium grained, red brown.				MODERATE 'TC' BIT RESISTANCE
			-4				REFER TO CORED BOREHOLE LOG				HIGH RESISTANCE
				9							GROUNDWATER MONITORING WELL INSTALLED TO 11.11m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 8.11m TO 11.11m. CASING 0.05m TO 8.11m. 2mm SAND FILTER PACK 7.5m TO 11.11m. BENTONITE SEAL 6.5m TO 7.5m AND 0.05m TO 1.0m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
			-5								
				10							GROUNDWATER MONITORING WELL INSTALLED TO 7.6m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.0m TO 7.6m. CASING 0m TO 1.0m. 2mm SAND FILTER PACK 0.5m TO 7.6m. BENTONITE SEAL 0m TO 0.5m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
			-6								
				11							
			-7								
				12							
			-8								
				13							
			-9								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
203
3 / 3

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC | **Core Size:** HQ | **R.L. Surface:** ~4.5 m
Date: 4/3/24 TO 5/3/24 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK308 | **Bearing:** N/A | **Logged/Checked By:** S.K. & S.W./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components. START CORING AT 8.03m	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS DESCRIPTION: Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness — Specific / General	Formation
100% RETURN		-4, -5, -6	9, 10, 11		SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 0-20°.	SW / FR	M - H	1.0, 1.9, 1.9, 1.3, 1.1, 1.0, 1.8		(8.06m) J, 90°, P, R, Fe Sn (8.20m) Be, 0°, P, R, Fe Sn (8.50m) J, 30°, P, R, Fe Sn	Hawkesbury Sandstone
		-7, -8, -9, -10	12, 13, 14		END OF BOREHOLE AT 11.11 m				600 200 60 20		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 36478YC
Borehole No: BH203
Depth: 8.03m to 11.11m
KODAK Gray Scale
KODAK Color Control Patches
36478YC BH203 START CORING AT: 8·03m.
8
9
10
11.
EOH AT 11·11m
JK Geotechnics

JKGeotechnics

BOREHOLE LOG

Borehole No.
204

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~5.6 m
Date: 29/2/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** S.W./T.C.

Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	0		CONCRETE: 125mm.t				NO OBSERVED REINFORCEMENT
		-	FILL: Silty sand, fine to medium grained, dark brown, with fine to medium grained igneous gravel, trace of slag.	M			APPEARS MODERATELY COMPACTED
N = 5 5,3,2			FILL: Silty clay, medium to high plasticity, orange brown mottled red brown and light grey, trace of fine to medium grained sand, fine to coarse grained sandstone gravel, and fine to medium grained ironstone gravel.	w>PL		100 90 100	
N = 8 3,3,5		CI-CH	Silty CLAY: medium to high plasticity, light grey mottled purple brown and orange brown, trace of fine to coarse grained ironstone gravel.	w~PL	VSt	270 280 240	RESIDUAL
	2	-	Extremely Weathered sandstone: silty CLAY, medium plasticity, light grey and light brown, with fine to medium grained sand, trace of fine to medium grained ironstone gravel.	XW	Hd		HAWKESBURY SANDSTONE VERY LOW TO LOW 'TC' BIT RESISTANCE IRON INDURATED BANDS
	5		SANDSTONE: fine to medium grained, light brown and grey.	DW	L		LOW RESISTANCE
					L - M		MODERATE TO HIGH RESISTANCE
			REFER TO CORED BOREHOLE LOG				

RL (m AHD) scale: 5, 4, 3, 2, 1, 0, -1
Depth (m) scale: 1, 2, 3, 4, 5, 6

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CORED BOREHOLE LOG

Borehole No.
204
2 / 2

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC	**Core Size:** HQ	**R.L. Surface:** ~5.6 m
Date: 29/2/24	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK330	**Bearing:** N/A	**Logged/Checked By:** S.W./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
		0			START CORING AT 5.80m						
					NO CORE 0.14m						
90% RETURN			6		SANDSTONE: medium to coarse grained, light grey and grey, with occasional dark grey carbonaceous laminae, bedded at 0-10°.	SW	M	0.40			Hawkesbury Sandstone
		-1								(6.66m) Be, 0°, P, R, Cb Ct	
					SANDSTONE: fine to medium grained, grey and dark grey, with siltstone bands.		H	1.6			
0% RETURN			7			FR		2.9			
		-2						1.7			
			8					1.4			
		-3						1.4			
					SILTSTONE: dark grey, with fine grained sandstone bands, bedded at 0-5°.			1.1		(8.65m) Be, 0°, P, R, Cn	
			9		SANDSTONE: fine to medium grained, grey and dark grey, with siltstone bands.			2.6		(9.09m) Be, 5°, P, R, Cn	
		-4						1.8			
					END OF BOREHOLE AT 9.67 m						
			10								
		-5									
			11								
		-6									


JKGeotechnics
Job No: 36478YC
Borehole No: BH204
Depth: 5.80m to 9.67m
KODAK Gray Scale
KODAK Color Control Patches
36478YC BH204 START CORING AT: 5·80m
NO CORE 0·14m
6
7
8
9
EOH AT 9·67m.
JK Geotechnics

JKGeotechnics

BOREHOLE LOG

Borehole No.
205
1 / 2

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC **Method:** SPIRAL AUGER **R.L. Surface:** ~3.9 m
Date: 4/3/24 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** S.W./T.C.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
							CONCRETE: 130mm.t				8mm DIA. REINFORCEMENT, 50mm TOP COVER
							BRICK PAVER: 100mm.t				
						-	FILL: Silty sandy clay, low to medium plasticity, dark grey, with fine to medium grained sandstone and igneous gravel.				
		N = 8 5,4,4	3	1		CI	Silty CLAY: medium plasticity, orange brown mottled red brown and light grey, trace of fine to medium grained ironstone gravel.	w>PL	F - St St	70 90 100 180 190 200	RESIDUAL
		N = 15 5,5,10	2	2		CI-CH	Silty CLAY: medium to high plasticity, light grey mottled red brown and orange brown, trace of fine to coarse grained ironstone gravel.	w~PL	VSt	250 260 270	
			1			-	Extremely Weathered sandstone: silty CLAY, low to medium plasticity, light grey.	XW	Hd		HAWKESBURY SANDSTONE
				3			SANDSTONE: fine to medium grained, grey and brown, with iron indurated bands.	DW	L		LOW 'TC' BIT RESISTANCE
			0	4			SILTSTONE: dark grey.		L - M		LOW TO MODERATE RESISTANCE
							SANDSTONE: fine to medium grained, brown and grey.				MODERATE RESISTANCE
▶			-1	5			as above, but light grey.				
			-2	6			REFER TO CORED BOREHOLE LOG				
			-3								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
205

Client: AUSTRALIAN RTL FUND PROPERTY TRUST
Project: PROPOSED MIXED-USE DEVELOPMENT
Location: FARR ST, MITCHELL ST, VICTORIA RD & SYDEHAM RD, MARRICKVILLE, NSW

Job No.: 36478YC | **Core Size:** HQ | **R.L. Surface:** ~3.9 m
Date: 4/3/24 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK330 | **Bearing:** N/A | **Logged/Checked By:** S.W./T.C.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS DESCRIPTION: Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness — Specific / General	Formation
					START CORING AT 5.82m						
90% RETURN		-2 to -5	6 to 9		SANDSTONE: fine grained, light grey, bedded at 0-10°, with siltstone bands and occasional carbonaceous.	FR	M	1.0, 0.40		(6.30m) Be, 5°, C, R, Cb Ct	Hawkesbury Sandstone
							H	1.5, 1.8, 3.5, 2.2, 1.2, 1.5		(6.86m) Be, 5°, C, R, Clay FILLED, 2 mm.t (7.25m) Be, 10°, C, R, Clay FILLED, 1 mm.t (7.87m) Be, 10°, Ir, R, Cb Ct (8.36m) Be, 10°, C, R, Cn	
					SANDSTONE: fine to coarse grained, light grey and grey, bedded at 0-15°.			1.4, 1.6, 1.5, 1.9		(9.38m) Be, 5°, P, R, Cn	
		-6 to -8	10 to 11		END OF BOREHOLE AT 9.77 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 36478YC
Borehole No: BH205
Depth: 5.82m to 9.77m
KODAK Gray Scale
KODAK Color Control Patches
36478YC BH205 START CORING AT: 5.82m
5
6
7
8
9
EOH AT 9.77m
JK Geotechnics

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the JK Geotechnics report.

Title:	**SITE LOCATION PLAN**
Location:	FARR STREET, SYDENHAM ROAD, MITCHELL STREET, AND VICTORIA ROAD, MARRICKVILLE, NSW
Report No: 36478YC	Figure No: 1

JKGeotechnics

PLOT DATE: 11/03/2024 4:30:27 PM DWG FILE: J:\6F GEOTECHNICAL JOBS\36000'S\36478YC MARRICKVILLE\CAD\36478YC.DWG

PLOT DATE: 15/11/2024 2:46:32 PM DWG FILE: J:\6F GEOTECHNICAL JOBS\36000'S\36478YC MARRICKVILLE\CAD\36478YC.DWG

LEGEND

- BOREHOLE
- BOREHOLE AND GROUNDWATER MONITORING

NOTES:
1. BOREHOLES 1 TO 6 ARE FROM OUR PREVIOUS INVESTIGATION.
2. BOREHOLES 201 TO 205 ARE FROM OUR CURRENT INVESTIGATION.

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 10 20 30 40 50
SCALE 1:1000 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **INVESTIGATION LOCATION PLAN**

Location: FARR STREET, SYDENHAM ROAD, MITCHELL STREET, AND VICTORIA ROAD, MARRICKVILLE, NSW

Report No: 36478YC

Figure No: 2

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VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity in mm/s			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Note: For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and $\leq$ 50	> 12 and $\leq$ 25
Firm (F)	> 50 and $\leq$ 100	> 25 and $\leq$ 50
Stiff (St)	> 100 and $\leq$ 200	> 50 and $\leq$ 100
Very Stiff (VSt)	> 200 and $\leq$ 400	> 100 and $\leq$ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) is referred to as 'laminite'.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shrink-swell behaviour, strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm 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 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

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

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing (CPT) and Interpretation: The cone penetrometer is sometimes referred to as a Dutch Cone. The test is described in Australian Standard 1289.6.5.1–1999 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Static Cone Penetration Resistance of a Soil – Field Test using a Mechanical and Electrical Cone or Friction-Cone Penetrometer'*.

In the tests, a 35mm or 44mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm or 165mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck. The CPT does not provide soil sample recovery.

As penetration occurs (at a rate of approximately 20mm per second), the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa. There are two scales presented for the cone resistance. The lower scale has a range of 0 to 5MPa and the main scale has a range of 0 to 50MPa. For cone resistance values less than 5MPa, the plot will appear on both scales.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between CPT and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of CPT values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

There are limitations when using the CPT in that it may not penetrate obstructions within any fill, thick layers of hard clay and very dense sand, gravel and weathered bedrock. Normally a 'dummy' cone is pushed through fill to protect the equipment. No information is recorded by the 'dummy' probe.

Flat Dilatometer Test: The flat dilatometer (DMT), also known as the Marchetti Dilometer comprises a stainless steel blade having a flat, circular steel membrane mounted flush on one side.

The blade is connected to a control unit at ground surface by a pneumatic-electrical tube running through the insertion rods. A gas tank, connected to the control unit by a pneumatic cable, supplies the gas pressure required to expand the membrane. The control unit is equipped with a pressure regulator, pressure gauges, an audio-visual signal and vent valves.

The blade is advanced into the ground using our CPT rig or one of our drilling rigs, and can be driven into the ground using an SPT hammer. As soon as the blade is in place, the membrane is inflated, and the pressure required to lift the membrane (approximately 0.1mm) is recorded. The pressure then required to lift the centre of the membrane by an additional 1mm is recorded. The membrane is then deflated before pushing to the next depth increment, usually 200mm down. The pressure readings are corrected for membrane stiffness.

The DMT is used to measure material index (I_D), horizontal stress index (K_D), and dilatometer modulus (E_D). Using established correlations, the DMT results can also be used to assess the 'at rest' earth pressure coefficient (K_o), over-consolidation ratio (OCR), undrained shear strength (C_u), friction angle (ϕ), coefficient of consolidation (C_h), coefficient of permeability (K_h), unit weight (γ), and vertical drained constrained modulus (M).

The seismic dilatometer (SDMT) is the combination of the DMT with an add-on seismic module for the measurement of shear wave velocity (V_s). Using established correlations, the SDMT results can also be used to assess the small strain modulus (G_o).

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod with a 20mm diameter cone end with a 9kg hammer dropping 510mm. The test is described in Australian Standard 1289.6.3.2–1997 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – 9kg Dynamic Cone Penetrometer Test'*.

The results are used to assess the relative compaction of fill, the relative density of granular soils, and the strength of cohesive soils. Using established correlations, the DCP test results can also be used to assess California Bearing Ratio (CBR).

Refusal of the DCP can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Vane Shear Test: The vane shear test is used to measure the undrained shear strength (C_u) of typically very soft to firm fine grained cohesive soils. The vane shear is normally performed in the bottom of a borehole, but can be completed from surface level, the bottom and sides of test pits, and on recovered undisturbed tube samples (when using a hand vane).

The vane comprises four rectangular blades arranged in the form of a cross on the end of a thin rod, which is coupled to the bottom of a drill rod string when used in a borehole. The size of the vane is dependent on the strength of the fine grained cohesive soils; that is, larger vanes are normally used for very low strength soils. For borehole testing, the size of the vane can be limited by the size of the casing that is used.

For testing inside a borehole, a device is used at the top of the casing, which suspends the vane and rods so that they do not sink under self-weight into the 'soft' soils beyond the depth at which the test is to be carried out. A calibrated torque head is used to rotate the rods and vane and to measure the resistance of the vane to rotation.

With the vane in position, torque is applied to cause rotation of the vane at a constant rate. A rate of 6° per minute is the common rotation rate. Rotation is continued until the soil is sheared and the maximum torque has been recorded. This value is then used to calculate the undrained shear strength. The vane is then rotated rapidly a number of times and the operation repeated until a constant torque reading is obtained. This torque value is used to calculate the remoulded shear strength. Where appropriate, friction on the vane rods is measured and taken into account in the shear strength calculation.

LOGS

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

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.
- 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 be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soils for Engineering Purposes'* or appropriate NSW Government Roads & Maritime Services (RMS) test methods. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.
- Details of the development that the Company could not reasonably be expected to anticipate.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

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, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Where information obtained from this investigation 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. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. Licence to use the documents may be revoked without notice if the Client is in breach of any obligation to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed <u>or</u> where only a limited investigation has been completed <u>or</u> where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves an experienced geotechnical engineer/engineering geologist.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types and appropriate footing or pile founding depths, or

iii) full time engineering presence on site.

SYMBOL LEGENDS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CI, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CI, CH)
- SILTY CLAY (CL, CI, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CI, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML, MH)
- PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE/MUDSTONE
- SILTSTONE
- CLAYSTONE
- COAL
- LAMINITE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

OTHER MATERIALS

- BRICKS OR PAVERS
- CONCRETE
- ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory **Classification** Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity *Cu* > 4 and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \quad and \quad C_C = \frac{(D_{30})^2}{D_{10}\,D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

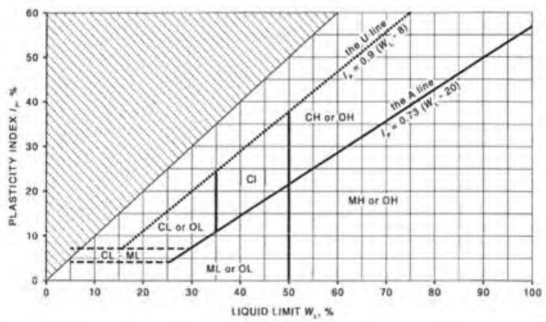
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



Classification of Material Weathering

<table>
<tr><th colspan="2">Term</th><th colspan="2">Abbreviation</th><th>Definition</th></tr>
<tr><td colspan="2">Residual Soil</td><td colspan="2">RS</td><td>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.</td></tr>
<tr><td colspan="2">Extremely Weathered</td><td colspan="2">XW</td><td>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.</td></tr>
<tr><td>Highly Weathered</td><td rowspan="2">Distinctly Weathered (Note 1)</td><td>HW</td><td rowspan="2">DW</td><td>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.</td></tr>
<tr><td>Moderately Weathered</td><td>MW</td><td>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.</td></tr>
<tr><td colspan="2">Slightly Weathered</td><td colspan="2">SW</td><td>Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.</td></tr>
<tr><td colspan="2">Fresh</td><td colspan="2">FR</td><td>Rock shows no sign of decomposition of individual minerals or colour changes.</td></tr>
</table>

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'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 weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

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

Abbreviations Used in Defect Description

Cored Borehole Log Column		Symbol Abbreviation	Description
Point Load Strength Index		• 0.6	Axial point load strength index test result (MPa)
		x 0.6	Diametral point load strength index test result (MPa)
Defect Details	– Type	Be	Parting – bedding or cleavage
		CS	Clay seam
		Cr	Crushed/sheared seam or zone
		J	Joint
		Jh	Healed joint
		Ji	Incipient joint
		XWS	Extremely weathered seam
	– Orientation	Degrees	Defect orientation is measured relative to normal to the core axis (ie. relative to the horizontal for a vertical borehole)
	– Shape	P	Planar
		C	Curved
		Un	Undulating
		St	Stepped
		Ir	Irregular
	– Roughness	Vr	Very rough
		R	Rough
		S	Smooth
		Po	Polished
		Sl	Slickensided
	– Infill Material	Ca	Calcite
		Cb	Carbonaceous
		Clay	Clay
		Fe	Iron
		Qz	Quartz
		Py	Pyrite
	– Coatings	Cn	Clean
		Sn	Stained – no visible coating, surface is discoloured
		Vn	Veneer – visible, too thin to measure, may be patchy
		Ct	Coating ≤ 1mm thick
		Filled	Coating > 1mm thick
	– Thickness	mm.t	Defect thickness measured in millimetres

LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
	C	Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES U50 DB DS ASB ASS SAL	Sample taken over depth indicated, for environmental analysis. Undisturbed 50mm diameter tube sample taken over depth indicated. Bulk disturbed sample taken over depth indicated. Small disturbed bag sample taken over depth indicated. Soil sample taken over depth indicated, for asbestos analysis. Soil sample taken over depth indicated, for acid sulfate soil analysis. Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL $w \approx$ PL w < PL $w \approx$ LL w > LL	Moisture content estimated to be greater than plastic limit. Moisture content estimated to be approximately equal to plastic limit. Moisture content estimated to be less than plastic limit. Moisture content estimated to be near liquid limit. Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D M W	DRY – runs freely through fingers. MOIST – does not run freely but no free water visible on soil surface. WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS S F St VSt Hd Fr ( )	VERY SOFT – unconfined compressive strength ≤ 25kPa. SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa. FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa. STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa. VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa. HARD – unconfined compressive strength > 400kPa. FRIABLE – strength not attainable, soil crumbles. Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	VERY LOOSE ≤ 15 / 0 – 4
	L	LOOSE > 15 and ≤ 35 / 4 – 10
	MD	MEDIUM DENSE > 35 and ≤ 65 / 10 – 30
	D	DENSE > 65 and ≤ 85 / 30 – 50
	VD	VERY DENSE > 85 / > 50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.