REPORT TO

HEALTH INFRASTRUCTURE

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED STAGE 2 REDEVELOPMENT, MULTI STOREY CAR PARK (MSCP)

AT

THE CHILDREN'S HOSPITAL AT WESTMEAD, HAWKESBURY ROAD, WESTMEAD, NSW

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JKGeotechnics
www.jkgeotechnics.com.au

T: +61 2 9888 5000
JK Geotechnics Pty Ltd
ABN 17 003 550 801

Report prepared by:

Daniel Bliss
Principal | Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO BOX 976
NORTH RYDE BC NSW 1670

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1 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed Multi Storey Car Park (MSCP) as part of the Stage 2 Redevelopment of The Children's Hospital at Westmead (CHW), Hawkesbury Road, Westmead, NSW. The location of the site is shown in Figure 1. The investigation was commissioned by Health Infrastructure (Contract No. HI9541) in consultation with the project manager, PwC.

This investigation was carried out in conjunction with investigation for other areas of the CHW Stage 2 redevelopment, namely a Paediatric Services Building (PSB), an Integrated Front Entry Building (iFEB/KIDSPARK) and an area known as Lot 3 where potential future development may occur. The results of the geotechnical investigation for the remaining areas within the CHW are provided in separate reports, Ref: 33303Brpt1 and 33303Brpt3. A desktop assessment of the site was previously completed as detailed in our report dated 6 August 2020 (Ref: 33303BTrptRev1) and the comments and recommendations contained herein supersede the comments and recommendations given in the desktop report.

From the supplied preliminary architectural drawings by Billrad Leece Partnership Pty Ltd (Project No. 19038, Drawing Nos CHW-AR-DG-MCP-DA000, DA003 to DA012, DA031, DA032, DA039 to DA041, DA050, and DA051, Rev. A to F, dated 15/12/20 and 21/12/20) we understand that a 7 storey car park structure is proposed at the corner of Redbank Road and Labyrinth Way. To allow construction of the MSCP the existing building known as "The Lodge" will be demolished, together with the surrounding playground areas, landscaping and paths. In addition, part of Redbank Road will be reconstructed to the north of its current alignment, with a entry road from the new section of Redbank Road providing access into the MSCP. An alternate entry road into the MSCP may also be constructed off Labyrith Way. The lowest level of the MSCP will be split, with the eastern side at RL17.1m and the western side at RL18.5m. These proposed levels are about 1.5m to 3m above the existing ground surface levels. We understand that fill will be placed to raise surface levels, but the fill will comprise fill excavated from other parts of the site so it is unlikely that it will be able to be placed as engineered fill and suspended floor slabs will need to be adopted.

The purpose of the investigation was to obtain geotechnical information on the subsurface conditions at 11 nominated borehole locations, and to use this as a basis for providing comments and recommendations on filling, retention, footings, floor slabs and pavements.

2 INVESTIGATION PROCEDURE

This geotechnical investigation was carried out in general accordance with the scope nominated by Arup on their plan dated 20 August 2020 (Rev 5). This involved the drilling of a total of 11 boreholes, with BH14 to BH20 and BH22 to be drilled to depths of 20m or at least 6m of Class II Rock and BH12, BH13 and BH21 to be drilled to depths of 1.5m in order to collect samples for soaked CBR testing.

The borehole locations were set out as close as possible to the locations nominated by Arup and are shown on Figure 2. Following drilling, the borehole locations were measured using a differential GPS unit to provide surface levels and coordinates, which are shown on the borehole logs. The datum of the levels is the Australian Height Datum (AHD).

BH14 to BH20 and BH22 were initially auger drilled to depths ranging from 1.42m to 8.55m and were then continued by diamond coring techniques using a HQ or NMLC core barrel with water flush to depths ranging from 20m to 20.95m. BH12, BH13 and BH21 were auger drilled to depths ranging from 1.6m to 1.95m. The boreholes were drilled using our track mounted JK305 and JK308 and truck mounted JK350 and JK500 drill rigs.

The apparent compaction of the fill and the strength of the natural clayey soils were assessed from Standard Penetration Test (SPT) 'N' values, augmented by hand penetrometer test results on cohesive samples recovered in the SPT split tube sampler. Within the augered portions of the boreholes, the strength of the weathered rock was assessed from observation of the resistance to drilling of a Tungsten Carbide (TC) bit attached to the augers, together with inspection of the recovered rock chip samples and subsequent correlation with laboratory moisture content test results. The strength of the cored rock was assessed from Point Loads Strength Index ($I_{S(50)}$) test results completed on the recovered core. These tests were carried out both in an axial and diametral direction and are summarised in the attached Table C2 and on the cored borehole logs.

Groundwater observations were made during and on completion of auger drilling. The use of water for core drilling limited further meaningful measurements of groundwater levels. Groundwater monitoring wells were installed in BH16 and BH20 to allow further groundwater readings to be made. Readings were taken within these wells while our crews were on site and then on 23 October 2020 prior to pumping of the water collected within the wells, and then during a subsequent site visit on 30 October 2020. No longer term monitoring of groundwater levels was carried out.

Our geotechnical engineers, set out the borehole locations, nominated the testing and sampling locations and logged the subsurface conditions encountered. The boreholes logs, including photographs of the recovered core, are attached, together with a set of Report Explanation Notes which describe the investigation techniques, and their limitations, and define the logging terms and symbols used.

Selected samples were returned to Soil Test Services Pty Ltd (STS), Macquarie Geotechnical and Envirolab Services Pty Ltd, all NATA accredited laboratories. STS tested soil and rock chip samples to determine moisture contents, Atterberg limits, linear shrinkages, standard compaction properties, and four day soaked CBR values, as shown in STS Tables A2 and B2. Macquarie Geotechnical tested rock cored samples to determine Unconfined Compressive Strengths, as shown in their report Nos. S63964 to S63966 and S64073 to S64076. Envirolab Services tested soil samples to determine pH, sulphate content, chloride content and resistivity, as shown in their Certificate of Analysis 253784.

Sampling and testing of soil and groundwater samples for potential contamination was outside the scope of this geotechnical investigation.

3 RESULTS OF INVESTIGATION

3.1 Site History

From a review of available historical aerial imagery and maps contained within previous reports completed within the hospital site it appears that the site comprised farmland up until the 1950s with development spreading across the site from Hawkesbury Road through the 1970s and 1980s as Westmead Hospital developed. Extensive construction, resulting in the building footprints largely present today, occurred in the late 1980s and early 1990s for the relocation of the children's hospital from Royal Alexandra at Camperdown to Westmead.

From the supplied geotechnical investigation report by Douglas Partners for the proposed Central Acute Services Building (CASB) (Ref: 73960.02, dated 23 March 2016) it is understood that during construction of the original hospital the area adjacent to the southern corner of the proposed PSB was used as a building waste pit. It is possible that other waste pits may have been used in other areas of the site.

3.2 Site Description

The children's Hospital at Westmead is located at the north-eastern end of the Westmead Hospital precinct. Generally surface levels across the Hospital slope down to the north at about 2° towards Toongabbie Creek and Parramatta River, which are located to the north and north-east of the Hospital. Surface levels have been altered in areas, particularly around buildings, through excavation and filling with the changes in levels generally supported by retaining walls.

The proposed MSCP site is located in the north-eastern corner of the Hospital, in an area occupied by a one and two-storey rendered brick structure ("The Lodge"), an overflow contractor's car park and surrounding gardens. The Lodge appeared to be in good external condition. The building is surrounded by pavements, lawns and garden beds. Surface levels across the area generally slope down to the north-east at about 2°, though have been formed in some areas by cut and fill with the changes in level supported by low height timber sleeper and concrete block retaining walls. The retaining walls appeared to be in good condition. Within the overflow contractor's car park, surface levels slope down to the north at approximately 6°. Along the southern edge of the proposed building is the existing George Gregan Playground and lawns and then the main three to four storey hospital building. On the northern side of Labyrinth Way, which bounds the site, is Toongabbie Creek, and further to the north-west is Ronald McDonald House.

3.3 Subsurface Conditions

The Penrith 1:100,000 Geological Series Sheet 9030 indicates that the site is underlain by Hawkesbury Sandstone, but close to a geological contact with the overlying Ashfield Shale to the south-west. This profile does not account for any filling or in-situ weathering that has occurred at the site.

In summary, the boreholes encountered pavements and fill covering residual silty clay that graded into weathered sandstone and interbedded siltstone and sandstone in the upper rock profile and sandstone bedrock of up to high strength encountered with depth. Further comments on the subsurface conditions encountered are provided below. Reference should be made to the borehole logs for detailed descriptions of the subsurface conditions encountered at each borehole location. Graphical summaries of the borehole information are provided as Figures 3 and 4.

Pavements

In BH12 to BH15, asphaltic concrete (AC) of 30mm to 50mm was initially encountered, underlain by sand or gravelly sand fill to depths ranging from 0.2m to 0.4m. This sand or gravelly sand fill contained igneous gravel and may represent base or subbase layers below the AC. In BH18, brick pavers were initially encountered of 100mm thickness.

Fill

Fill was encountered in all boreholes to depths ranging from 0.2m to 5.9m. There was no definite pattern to the depth of the fill within the MSCP site, with shallow fill of 0.2m to 0.7m depth encountered in BH13 to BH16, slightly deeper fill to depths of 1.7m to 1.95m in BH12, BH20, BH21 and BH22 (although BH12 was terminated within the fill at a depth of 1.95m) and deeper fill in BH17, BH18 and BH19, to depths of 2.5m, 2.4m, and 5.9m, respectively. Although the fill was generally deeper centrally to the southern portion of the site

The fill comprised a mixture of silty clay, gravelly clay, silty sand and sandy clay, with various inclusions comprising igneous, sandstone and siltstone gravel and concrete fragments. In BH16, what appeared to be cobble or boulders sized concrete fragments were encountered within the fill. Based on the SPT 'N' values, the fill was of variable compaction, but predominantly appeared to be poorly to moderately compacted, with some well compacted layers.

Natural Soils

The natural soils generally comprised what appeared to be a thin layer of alluvial clayey silt or silty clay of firm strength covering residual silty clay, with some clayey sand bands. The residual silty clay was assessed to be of medium plasticity and of very stiff to hard strength.

Weathered Bedrock

Weathered bedrock was encountered in BH13 to BH20 and BH22 at depths ranging from 0.5m to 5.9m. The rock was shallowest within the western portion of the site, BH13 to BH15 at depths of 0.5m to 1.3m, becoming deeper moving towards the centre, BH16, BH17, BH20 and BH22 at depths of 1.7m to 2.8m, and then deepest within the central portion, BH18 and BH19 at depths of 7.2m and 5.9m, respectively.

The rock predominantly comprised sandstone, with some laminite and interbedded siltstone within the upper rock profile. Generally, the upper bedrock was assessed to be extremely weathered sandstone and laminite, which graded into distinctly weathered rock of very low to low strength. With depth the rock was assessed to be slightly weathered and then fresh and of medium strength and then high strength.

Within BH14 to BH20 and BH22 we have classified the rock in general accordance with Pells et al "Classification of Sandstones and Shales in the Sydney Region: A Forty Year Review", Australian

Geomechanics, June 2019. The table below provides the depths and levels where each class of rock was encountered in each borehole. We note that the upper rock contains laminite and siltstone bands, but has been classified in general accordance with the "Sandstone" classification. The deeper sandstone would be considered Class I Rock, but we have not included this classification herein as the boreholes spacing is considered too wide to allow classification of such rock.

BH	Depth and Level To the Start of each Rock Class							
	Class V Rock		Class IV Rock		Class III Rock		Class II Rock	
	Depth	RL (AHD)	Depth	RL (AHD)	Depth	RL (AHD)	Depth	RL (AHD)
14	1.0m	13.1m	1.8m	12.3m	2.6m	11.5m	3.4m	10.7m
15	0.6m	13.7m	5.0m	9.3m	7.4m	6.9m	7.4m	6.9m
16	3.3m	10.9m	3.3m	10.9m	7.2m	7.0m	8.6m	5.6m
17	3.3m	13.8m	3.5m	13.6m	5.7m	11.4m	5.7m	11.4m
18	8.2m	7.7m	8.2m	7.7m	9.2m	6.7m	9.7m	6.2m
19	5.9m	11.4m	5.9m	11.4m	6.6m	10.7m	7.3m	10.0m
20	3.8m	13.6m	6.0m	11.4m	8.1m	9.3m	8.1m	9.3m
22	2.0m	15.0m	3.5m	13.5m	5.2m	11.8m	5.2m	11.8m

Groundwater

Groundwater seepage was encountered during auger drilling of BH18, BH19 and BH21 at depths of 2m, 4.9m and 1.7m, respectively, with groundwater measured on completion of BH18 at a depth of 7.6m and BH19 collapsed on completion of auger drilling at a depth of 5m. No groundwater seepage was encountered in the remaining boreholes during auger drilling. Within the well installed in BH16 the following groundwater readings were taken. Attempts were made to measure groundwater levels within the well in BH20, but a blockage of the well limited the readings that could be undertaken. An attempt was made on 23/10/20 to clear the blockage, but that was unsuccessful.

BH	Groundwater Depths and Levels Measured Within the Monitoring Well					
	20/10/20		23/10/20 (prior to pumping)		30/10/20	
	Depth	RL (AHD)	Depth	RL (AHD)	Depth	RL (AHD)
16	7.1m	7.3m	7.0m	7.2m	7.1m	7.1m

3.4 Laboratory Test Results

Based on the Atterberg limits a linear shrinkage test results, the residual silty clay samples tested from BH16 and BH18 are of medium plasticity. The moisture content test results on samples of the weathered rock recovered from the augered portions of the boreholes showed reasonably good correlation with our field assessment of rock strengths.

The four day soaked CBR tests on samples of the fill from BH12 and BH21 compacted to 98% of their Standard Maximum Dry Density (SMDD) gave CBR values of 2.5% and 3.5%. The sample of the silty clay from BH13 gave a CBR value of 2%.

The results of the point load strength index tests and the unconfirmed compressive strength tests on the recovered rock core correlated reasonably well with our field assessments of core strength. We note that for BH14 to BH20 and BH22 the ratio of the UCS results to the axial point load strength results for adjacent samples ranged from about 10 to 25, with an average of 19, with the average for all 24 cored boreholes drilled for this project being 18. This compares well with the relationship used in Table C2 of the UCS being 20 times the $I_{S(50)}$ result.

The pH values were 7.2 for a sample of the fill, 5.8 for a sample of the residual silty clay and 6.5 for a sample of the extremely weathered siltstone. The sulphate contents ranged from 20mg/kg to 27mg/kg, the chloride contents ranged from <10mg/kg to 28mg/kg and the resistivity ranged from 340ohm.m to 140ohm.m. Based on these results, the soils and weathered rock would be classified as 'non-aggressive' exposure classification for both concrete and steel piles in accordance with Tables 6.4.2(C) and 6.5.2(C) of AS2159-2009 'Piling – Design and Installation'.

4 COMMENTS AND RECOMMENDATIONS

4.1 Geotechnical Issues

The lowest level of the proposed car park is above the existing ground surface and so no excavation will be required. It is unknown if the site will be filled to allow construction of the lowest level or if a void will be left below a suspended floor slab. However, if fill is to be placed the presence of existing fill must be considered in the design of the earthworks.

Fill was encountered in the boreholes to variable depths, generally ranging from 0.2m to 2.5m, with deep fill encountered in BH19 to a depth of 5.9m. It is unknown if the deep fill encountered in BH19 is a local infilled pit or other localised feature or if the deeper fill extends for a significant extent of the proposed building footprint. We are unaware of any records of placement or compaction control of the fill and as such it must be considered 'uncontrolled' and is not suitable for support of footings or floor slabs.

To allow the use of floor slabs supported on the fill, all existing uncontrolled fill would need to be fully excavated and replaced within controlled, engineered fill. Where the fill is shallow this would be readily achievable, but where the fill is deep such excavations would be extensive and may not be practical, particularly since we understand that the fill is contaminated and disposal costs would be high. This would particularly be the case in the vicinity of BH19 where fill was encountered to a depth of 5.9m. We consider that such extensive earthworks are not practical, but if it is being considered we recommend that additional geotechnical advice be obtained. However, as part of that advice the extent of the deeper fill should be better determined by the drilling of additional boreholes following demolition of the existing building. Consideration would need to be given to the extent of the excavations required in relation to any existing structures that will remain so that those structures are not undermined or rendered instable. In addition, the stability of the temporary batters that will be quite high in the vicinity of BH19 will need to be considered and retention systems may be required to allow excavation.

Assuming that the existing fill will remain in place, there are two options for design of the lowest level of the proposed car park. If a concrete floor slab is to be adopted, then it should be designed as a fully suspended slab supported on the piled footing system founded within the underlying bedrock. Alternativity, if the risk of future settlement of the fill can be accepted and the lowest level is designed and constructed as a road pavement independent of the building structure then the pavement may be supported on the fill. This is on the understanding that where settlement of the fill occurs the pavement can be repaired or reconstructed or variations in the level of the pavement surface are acceptable. The acceptance of this must also consider the access inside the lowest parking level for such repair or reconstruction work. Suitable pavement types would comprise a flexible pavement with an asphaltic concrete wearing surface or segmental pavers as these can be repaired in patches easier than a concrete pavement. Advice on subgrade preparation and filling works for such pavements are provided in Section 4.2.

Another geotechnical issue identified is the variable depths to the surface and therefore, each class of rock encountered in the boreholes. A relatively shallow depth of rock were encountered in most boreholes (0.5m to 2.8m) but in BH18 and BH19 the rock was encountered deeper at depths of 7.2m and 5.9m, respectively. The change in the level of the rock surface occurs over relatively short distances, such as when comparing rock depths between BH16 and BH18 and between BH20 and BH19. Therefore, we recommend that additional boreholes be drilled following demolition when access to the entire site is possible for a drilling rig. Boreholes should be drilled in between the current boreholes to further profile the rock levels and if possible drilled at particular pile locations to confirm the required founding depth of the piles. It may be that the changes in rock levels occur as a series of steps within the rock and if that is the case some piles may need to be well socketed into the rock so that they are founded below the influence of any steps in the rock profile.

4.2 Earthworks

As discussed in Section 4.1 above the existing fill is uncontrolled and is not considered suitable to support footings or floor slabs. Excavation and replacement of the fill is not considered practical and the lowest level of the proposed car park should either be designed as a fully suspended floor slab or as a flexible pavement independent of the main structure.

Where a fully suspended floor slab is adopted no particular subgrade preparation would be required, but any vegetation and root affected soils or deleterious fill material should be stripped. Fill may then be placed as 'form fill' with only nominal compaction and without the need for density testing of the fill during placement.

Where pavements are to be constructed, either as the lowest level of the car park or for external pavements, the following subgrade preparation measures should be followed:

- Strip all vegetation, root affected soils or any deleterious fill material exposed.
- Proof roll the exposed subgrade with at least 8 passes of a minimum 12 tonne dead weight, smooth drum, vibratory roller. The final pass of the proof rolling should be carried out without vibration and in the presence of a geotechnical engineer to detect any weak subgrade areas.
- Care must be taken during proof rolling and fill compaction due to the vibrations generated by the roller. Where rolling is required close to existing structures or movement sensitive services the

vibrations may need to be reduced or ceased. If this is the case the layer thickness of any fill placed should also be reduced.

- Any weak subgrade areas detected during proof rolling should be locally excavated to a sound base and the excavated material replaced with controlled, engineered fill, or as directed by the geotechnical engineer during the proof rolling inspection. Where the unsuitable fill extends to significant depth the use of a bridging layer may be required to avoid excessive excavation. The bridging layer would need to be designed at the time, but we expect it would comprise good quality granular fill with geotextile layers of at least 0.5m to 0.6m thick.
- Following treatment of any weak layers engineered fill should be placed as required in thin horizontal layers to the design level.

We expect that some weak subgrade areas may be encountered due to the existing uncontrolled fill. The extent of the weak areas may be reduced if the earthworks are carried out during dry weather and adequate site drainage is provided and maintained. If the clay fill is exposed to prolonged periods of rainfall, softening will result and site trafficability will be poor. If soil softening occurs, the subgrade should be over-excavated to below the depth of moisture softening and the excavated material replaced with engineered fill. The placement of a layer of good quality granular material as the final fill layer is recommended to improve the trafficability of the site during construction.

Any fill to be removed from site should be appropriate classified for disposal prior to removal from site.

4.3 Engineered fill and Compaction Control

Engineered fill should preferably comprise well graded granular materials, such as ripped rock or crushed sandstone, free of deleterious substances and having a maximum particle size not exceeding 75mm. Such fill should be compacted in horizontal layers of not greater than 200mm loose thickness, to a density of at least 98% of Standard Maximum Dry Density (SMDD). For backfilling confined excavations such as service trenches, a similar compaction to engineered fill should be adhered to, but if light compaction equipment is used then the layer thickness should be limited to 100mm loose thickness.

Density tests should be regularly carried out on the fill to confirm the above specifications are achieved. The frequency of density testing should be at least one test per layer per $500m^2$ or three tests per visit, whichever requires the most tests. Preferably the geotechnical testing authority should be engaged directly on behalf of the client and not by the earthworks subcontractor.

4.4 Batters and Retaining Walls

Where fill is used to raise site levels it is expected to be required to depths of about 1.5m to 3m. Such fill may be formed at suitable batters or retaining walls constructed to support the fill.

Any temporary batters of no more than about 3m in height should be no steeper than 1 Vertical in 1 Horizontal (1V:1H). Such batters should remain stable in the short term provided all surcharge loads, including construction loads, are kept well clear of the crest of the batters.

Permanent batters should be no steeper than 1V:2H, but flatter batters of the order of 1V:3H may be preferred to allow access for maintenance of vegetation. All permanent batters should be covered with topsoil and planted with a deep rooted runner grass, or other suitable coverings, to reduce erosion. All stormwater runoff should be directed away from all temporary and permanent batters to also reduce erosion.

Where fill is placed to form permanent batters, the fill should be placed in horizontal layers that extend past the final geometry of the permanent batters. Following placement of the fill the batter should then be cut back to the final geometry so that the loose fill on the edge of the fill layers that cannot be adequately compacted is removed.

Permanent retaining walls supporting no more than about 3m may be designed as cantilevered walls based on a triangular earth pressure distribution using an active earth pressure coefficient, K_a, of 0.33 and a bulk unit weight of $20kN/m^3$, provided some resulting movements are acceptable. Where walls are restrained from some lateral movement by other structural elements in front of the wall, or where movements are to be kept low, an 'at rest' earth pressure coefficient, K_0, of 0.6 should be used.

The above coefficients assume horizontal backfill surfaces and where inclined backfill is proposed the coefficients should be increased or the inclined backfill taken as a surcharge load. All surcharge loads should be allowed for in the design, plus full hydrostatic pressures, unless measures are undertaken to provide complete and permanent drainage behind the wall.

4.5 Footings

The proposed structure will need to be supported on footings founded within the weathered bedrock. However, as discussed in Section 4.1, the depth of the rock throughout the site is variable, ranging from 0.5m to 7.2m, and we recommend that additional boreholes be drilled following demolition to better profile the rock levels throughout the site. The location and number of boreholes will depend on the footing design parameters adopted for the footings and so should be determined following preliminary design of the footing system. Preferably, boreholes should be drilled at actual pile locations to determine the founding level of the piles.

Where the depth to rock is shallow, say less than about 1m, and low design parameters are used, pad or strip footings could be used. However, for the majority of the building, and to reach the better quality rock, we expect that bored piers would be the most appropriate footing system. However, some difficulties due to collapse of the uncontrolled fill may be experienced requiring the use of temporary liners.

The design of footings founded within the rock may be based on the following parameters. We note that the serviceability parameters given are based on settlement of less than 1% of the pile diameter or footing width.

The ultimate parameters may be used for limit state design on the understanding that settlement of the footing may be up to 5% of the pile diameter or footing width. Differential settlements of about half the total settlements would be expected. The designer may use the modulus values given below to estimate the settlements of particular footings.

Rock Class	Allowable End Bearing Pressure	Allowable Shaft Adhesion in Compression	Ultimate End Bearing Pressure	Ultimate shaft Adhesion in Compression	Elastic Modulus
Class V	1000kPa	100kPa	3000kPa	150kPa	100MPa
Class IV	1500kPa	150kPa	5000kPa	400kPa	400MPa
Class III	4000kPa	400kPa	30,000kPa	1000kPa	1000MPa
Class II	8000kPa	800kPa	70,000kPa	1500kPa	1500MPa

Appropriate load factors and geotechnical reduction factors, in accordance with AS2159-2009, must be used in the design. The geotechnical strength reduction factor must be determined by the designer once all details of the design methods and installation requirements are known. It is not possible at this stage to accurately determine the geotechnical strength reduction factor as we have no knowledge of the design and installation factors.

All piles should be founded with a nominal socket of at least 0.3m into the appropriate class of rock. For the design of sockets into the rock, the shaft adhesion should be ignored within the 0.3m nominal socket. For the design of piles in uplift, shaft adhesions of half the shaft adhesions in compression may be used. The shaft adhesion values assume that adequate socket roughness and cleanliness is maintained.

Following the drilling of additional boreholes as recommended above, where footings are founded within Class V or Class IV Rock, we consider that at least the initial stages of footing excavation should be inspected by a geotechnical engineer to confirm that a suitable founding stratum has been achieved. The requirements for further inspections can be decided at that time, and the frequency will depend on the level of 'sign-off' required.

Where footings are founded within Class III Rock, targeted drilling of the additional boreholes at selected pile locations must be carried out and the drilling of all piles be inspected by a geotechnical engineer. Where footings are founded on Class II Rock we recommend that additional cored boreholes be drilled at a minimum of 50% of the pile locations and the drilling of all piles be inspected by a geotechnical engineer. The final extent of the boreholes should be determined once the footing layout has been determined.

Some groundwater seepage may occur into the bored piers and therefore we recommend that piles be drilled, inspected, and poured within minimal delay. Where seepage does occur it should be pumped from the pier holes prior to pouring of concrete and all concrete poured using tremie techniques, which should be used anyway given the expected depth of the piles.

Based on the subsurface conditions encountered, we consider that the site would be classified as Class C_e in accordance with AS1170.4-2007.

Due to the uncontrolled fill that will be present at the subgrade level a piling platform will need to be constructed to support the piling rig. The platform should be constructed using good quality granular material, but the thickness will depend on the piling rig and platform material used and will need to be determined once details of the piling rig are known.

4.6 Pavements

We understand that new pavements will be required for the realignment of Redbank Road, for the entry/exit driveway into the proposed car park and possible for the lowest level if a suspended slabs is not preferred. These pavements are expected to be formed on a variable subgrade predominantly comprising fill, with areas of residual silty clay and weathered rock. The placement of fill and the preparation of the pavement subgrade should be carried out in accordance with the recommendations provided in Section 4.2.

The CBR testing carried out as part of this investigation was on samples of the soils close to the locations of the proposed entry and exit roads. However, testing of samples of the subgrade for the proposed realigned Redbank Road has not been carried out. In addition, if the lowest level of the car park is to be constructed as a pavement testing of the fill used to achieve the design levels has not be undertaken. Therefore, we recommend that additional CBR tests be carried out once the subgrade soils have been determined. If granular fill is used to raise site level, then higher CBR values may be appropriate for such material.

Based on the limited testing carried out to date, preliminary design of the pavement thickness may be based on a soaked CBR of 2%, or a modulus of subgrade reaction of 18kPa/mm (750mm plate).

Surface and subsoil drainage should be provided on the high side of the pavements to prevent moisture ingress into the subgrade and pavement. The subsoil drains should have an invert level of at least 300mm below the adjacent subgrade level and be excavated with a uniform longitudinal fall to appropriate discharge points so as to reduce the risk of ponding in the base of the drain. In addition, the surface of the adjacent pavement subgrade should be provided with a uniform cross fall towards the subsoil drain to assist with drainage.

Concrete pavements should have a subbase layer of at least 100mm thickness of crushed rock to RMS QA Specification 3051 unbound base material (or similar 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.

4.7 Acid Sulfate Soils

A review of the 1:250,000 Acid Sulfate Soils (ASS) risk maps (Series 9130N3, Ed. 2) prepared by Department of Land and Water Conservation (1997) indicates that the site is not located within a risk area. A review of the Parramatta LEP indicates that the site is located on the western boundary of ASS risk Class 5 area. The Class 5 risk define works within 500m of adjacent Class 1, 2, 3, 4 land which are likely to lower the water table below 1m AHD on the adjacent land.

Based on the weight of evidence collected and evaluated for this assessment including the elevation of the site (RL14m to RL18m AHD), review of risk and planning maps and the presence of predominantly residual natural soils encountered during drilling, there is considered to be a low potential for ASS occurrence at the site. Therefore, the development poses a negligible risk of disturbing ASS materials. On this basis, an Acid Sulfate Soil Management Plan (ASSMP) is not considered necessary for the proposed development.

4.8 SALINITY

The site is located in an area where soil and groundwater salinity may occur. Salinity can affect the longevity and appearance of structures as well as causing adverse horticultural and hydrogeological effects. The local council has guidelines relating to salinity issues which should be checked for relevance to this project.

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 long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

Occasionally, 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 is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten 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) could be expected. We strongly recommend that this requirement 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.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES

ABN 43 002 145 173

TABLE A2

MOISTURE CONTENT, ATTERBERG LIMIT AND LINEAR SHRINKAGE TEST REPORT

Client:	JK Geotechnics	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	A2
Location:	Hawkesbury Road, Westmead, NSW	**Report Date:**	27/10/2020
		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 %**
14	1.00 - 1.20	4.7	-	-	-	-
15	5.00 - 5.30	7.1	-	-	-	-
16	1.50 - 1.95	13.9	45	14	31	12.5
16	3.30 - 4.00	6.1	-	-	-	-
17	3.50 - 4.50	5.1	-	-	-	-
18	4.20 - 4.65	17.4	42	16	26	12.5
20	3.80 - 4.20	6.3	-	-	-	-
22	3.50 - 4.20	4.3	-	-	-	-

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: 19/10/2020.
- Sampled and supplied by client. Samples tested as received.

NATA

NATA Accredited Laboratory Number:1327

27/10/2020

Authorised Signature / Date
(D. Treweek)

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES

ABN 43 002 145 173

TABLE B2
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client:	JK Geotechnics	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	B2
		Report Date:	29/10/2020
Location:	Hawkesbury Road, Westmead, NSW	**Page 1 of 1**	

BOREHOLE NUMBER	BH 12	BH 13	BH 21
DEPTH (m)	0.60 - 1.20	0.40 - 1.30	0.30 - 1.50
Surcharge (kg)	9.0	9.0	9.0
Maximum Dry Density (t/m^3)	1.79 STD	1.79 STD	1.83 STD
Optimum Moisture Content (%)	16.8	17.2	15.6
Moulded Dry Density (t/m^3)	1.76	1.76	1.79
Sample Density Ratio (%)	98	98	98
Sample Moisture Ratio (%)	104	97	101
Moisture Contents			
Insitu (%)	13.8	14.3	14.0
Moulded (%)	17.5	16.8	15.8
After soaking and			
Material Retained on 19mm Sieve (%)	1*	1*	3*
Swell (%)	2.0	3.5	1.0
C.B.R. value: @2.5mm penetration	2.5	2.0	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: 19/10/2020.
- * Denotes not used in test sample.
- BH 13 & 21 had insufficient sample provided, so material was recycled for the compaction curve.

NATA

NATA Accredited Laboratory Number:1327

29/10/2020

Authorised Signature / Date
(T. Finnegan)

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Health Infrastructure **Ref No:** 33303BT

Project: The Children's Hospital at Westmead Stage 2 Redevelopment **Report:** C2

Location: Hawkesbury Road, WESTMEAD, NSW **Report Date:** 26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
14	1.98	0.04	<1	D
	2.00 - 2.02	0.3	6	A
	2.57 - 2.61	1.1	22	A
	2.57	0.02	<1	D
	3.60 - 3.65	1.3	26	A
	3.60	0.5	10	D
	4.41 - 4.45	2.1	42	A
	4.41	0.9	18	D
	5.16 - 5.19	1.2	24	A
	5.16	0.6	12	D
	6.43 - 6.47	2.7	54	A
	6.43	1.7	34	D
	7.64 - 7.68	0.7	14	A
	7.64	0.2	4	D
	8.27	0.06	1	D
	8.29 - 8.33	0.5	10	A
	8.41 - 8.45	1.6	32	A
	8.41	1.1	22	D
	9.65 - 9.69	1.7	34	A
	9.65	1.5	30	D
	10.41 - 10.45	1.7	34	A
	10.41	1.4	28	D
	11.52 - 11.55	1.4	28	A
	11.52	1.2	24	D
	12.47 - 12.51	1.7	34	A

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Health Infrastructure
Ref No: 33303BT

Project: The Children's Hospital at Westmead Stage 2 Redevelopment
Report: C2

Location: Hawkesbury Road, WESTMEAD, NSW
Report Date: 26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
14	12.47	1.4	28	D
	13.50 - 13.54	1.8	36	A
	13.57	1.7	34	D
	14.51 - 14.55	1.6	32	A
	14.51	1.5	30	D
	15.42 - 15.46	1.4	28	A
	15.42	1.8	36	D
	16.66 - 16.70	1.5	30	A
	16.66	1	20	D
	17.10 - 17.13	1.3	26	A
	17.43 - 17.47	1.8	36	A
	17.43	0.5	10	D
	18.51 - 18.54	1.1	22	A
	18.51	1.3	26	D
	19.60 - 19.64	1.2	24	A
	19.6	0.7	14	D
15	5.82 - 5.85	1.5	30	A
	5.82	0.3	6	D
	6.20 - 6.23	0.8	16	A
	6.20	0.2	4	D
	6.43 - 6.45	0.3	6	A
	6.43	0.04	<1	D
	6.84	0.04	<1	D
	6.84 - 6.87	0.8	16	A
	7.48 - 7.51	1.6	32	A

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Health Infrastructure	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	C2
Location:	Hawkesbury Road, WESTMEAD, NSW	**Report Date:**	26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
15	7.48	1.3	26	D
	8.45 - 8.49	1.5	30	A
	8.45	0.8	16	D
	9.60	0.9	18	D
	9.60 - 9.64	0.9	18	A
	10.65 - 10.68	1.2	24	A
	10.65	1.4	28	D
	11.41	1.4	28	D
	11.41 - 11.45	1.6	32	A
	12.51 - 12.55	1.8	36	A
	12.51	2	40	D
	13.52 - 13.56	2	40	A
	13.52	1.8	36	D
	14.52 - 14.56	1.6	32	A
	14.52	1.7	34	D
	15.50 - 15.53	2.1	42	A
	15.50	1.8	36	D
	16.51	1.8	36	D
	16.51 - 16.55	2.6	52	A
	17.47 - 17.51	1.9	38	A
	17.47	1.4	28	D
	18.48	0.8	16	D
	18.48 - 18.52	1	20	A
	19.53 - 19.56	1.3	26	A
	19.53	1.4	28	D

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Health Infrastructure **Ref No:** 33303BT

Project: The Children's Hospital at Westmead Stage 2 Redevelopment **Report:** C2

Location: Hawkesbury Road, WESTMEAD, NSW **Report Date:** 26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
15	20.45	1.3	26	D
	20.45 - 20.49	1.5	30	A
16	7.48 - 7.53	1.6	32	A
	7.48	1.5	30	D
	8.50 - 8.54	2	40	A
	8.50	1.6	32	D
	9.43 - 9.46	1	20	A
	9.43	0.9	18	D
	10.50 - 10.55	1.5	30	A
	10.50	1.5	30	D
	11.59 - 11.63	1.8	36	A
	11.59	2.1	42	D
	12.51 - 12.55	1.7	34	A
	12.51	1.4	28	D
	13.50 - 13.55	2.2	44	A
	13.50	1.9	38	D
	14.55 - 14.59	2.4	48	A
	14.55	1.1	22	D
	15.48 - 15.52	1.9	38	A
	15.48	1.9	38	D
	16.55 - 16.59	1.8	36	A
	16.55	1	20	D
	17.45 - 17.49	1.7	34	A
	17.45	1.1	22	D
	18.53 - 18.57	1.6	32	A

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Health Infrastructure **Ref No:** 33303BT

Project: The Children's Hospital at Westmead Stage 2 Redevelopment **Report:** C2

Location: Hawkesbury Road, WESTMEAD, NSW **Report Date:** 26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
16	18.53	1.1	22	D
	19.53 - 19.57	1.2	24	A
	19.53	1.2	24	D
17	5.81 - 5.85	1.2	24	A
	5.81	0.5	10	D
	6.47 - 6.51	1.4	28	A
	6.47	0.8	16	D
	7.58 - 7.62	1	20	A
	7.58	0.8	16	D
	8.45	0.9	18	D
	8.45 - 8.49	2.4	48	A
	9.40 - 9.45	2.8	56	A
	9.40	0.6	12	D
	10.48 - 10.51	1.8	36	A
	10.48	0.3	6	D
	11.35 - 11.38	1.4	28	A
	11.35	0.9	18	D
	12.43 - 12.47	1.1	22	A
	12.43	0.3	6	D
	13.41 - 13.45	2	40	A
	13.41	1.2	24	D
	14.48 - 14.52	1.4	28	A
	14.48	1.2	24	D
	15.47 - 15.50	1.4	28	A
	15.47	1.9	38	D

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Health Infrastructure

Ref No: 33303BT

Project: The Children's Hospital at Westmead Stage 2 Redevelopment

Report: C2

Location: Hawkesbury Road, WESTMEAD, NSW

Report Date: 26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
17	16.44 - 16.48	1.7	34	A
	16.44	1.9	38	D
	17.49 - 17.53	1.5	30	A
	17.49	1.6	32	D
	18.51 - 18.55	1.4	28	A
	18.51	1.8	36	D
	19.56 - 19.60	2	40	A
	19.56	1.2	24	D
	20.07 - 20.11	1.5	30	A
	20.07	1.3	26	D
18	8.90 - 8.94	0.6	12	A
	8.90	0.5	10	D
	9.91 - 9.95	1.9	38	A
	9.91	1.3	26	D
	10.88 - 10.93	1.5	30	A
	10.88	1.1	22	D
	11.70 - 11.74	1.1	22	A
	11.70	1.2	24	D
	12.48 - 12.51	1.4	28	A
	12.48	1.1	22	D
	13.55 - 13.58	0.8	16	A
	13.55	1.1	22	D
	14.63 - 14.67	1	20	A
	14.63	1.2	24	D
	15.53 - 15.58	1.7	34	A

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Health Infrastructure	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	C2
Location:	Hawkesbury Road, WESTMEAD, NSW	**Report Date:**	26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
18	15.53	1.5	30	D
	16.36	1.5	30	D
	16.36 - 16.40	2	40	A
	16.50 - 16.54	1.8	36	A
	16.50	1.7	34	D
	17.54 - 17.58	1.9	38	A
	17.54	1.5	30	D
	18.55 - 18.60	2.3	46	A
	18.55	1.5	30	D
	19.47 - 19.52	1.8	36	A
	19.47	1.2	24	D
	20.21 - 20.25	1.7	34	A
	20.21	1.3	26	D
19	6.60 - 6.63	3.3	66	A
	6.60	2.6	52	D
	7.57 - 7.60	1.4	28	A
	7.57	0.7	14	D
	8.52 - 8.57	2.1	42	A
	8.52	0.8	16	D
	9.46 - 9.50	3.7	74	A
	9.46	0.8	16	D
	10.43 - 10.47	0.8	16	A
	10.43	0.4	8	D
	11.43 - 11.47	2.8	56	A
	11.43	1.1	22	D

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Health Infrastructure	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	C2
Location:	Hawkesbury Road, WESTMEAD, NSW	**Report Date:**	26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
19	12.40 - 12.44	2	40	A
	12.40	0.7	14	D
	13.66	0.6	12	D
	13.69 - 13.72	1.3	26	A
	14.58 - 14.62	2.2	44	A
	14.58	0.4	8	D
	15.48 - 15.51	1.8	36	A
	15.48	1.5	30	D
	16.40 - 16.44	2.1	42	A
	16.40	1.4	28	D
	17.55 - 17.58	0.7	14	A
	17.55	0.8	16	D
	18.51 - 18.55	1.4	28	A
	18.51	1.1	22	D
	19.45 - 19.48	1.8	36	A
	19.45	1	20	D
	20.40 - 20.43	2.1	42	A
	20.45	1.6	32	D
20	7.50 - 7.55	0.7	14	A
	7.50	0.2	4	D
	8.43 - 8.47	1.1	22	A
	8.43	0.2	4	D
	9.60 - 9.63	1.6	32	A
	9.60	1.4	28	D
	10.52 - 10.56	1.4	28	A

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Health Infrastructure	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	C2
Location:	Hawkesbury Road, WESTMEAD, NSW	**Report Date:**	26/10/20
		Page 9 of 11	

BOREHOLE NUMBER	DEPTH (m)	$I_{S (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
20	10.52	0.5	10	D
	11.57 - 11.61	1.9	38	A
	11.57	0.6	12	D
	12.81 - 12.85	1.8	36	A
	12.81	0.9	18	D
	13.77 - 13.80	2.1	42	A
	13.77	1.4	28	D
	14.72 - 14.75	1.5	30	A
	14.72	1.6	32	D
	15.56 - 15.59	1.4	28	A
	15.56	1.5	30	D
	16.60 - 16.64	1.3	26	A
	16.60	1.2	24	D
	17.35 - 17.39	0.9	18	A
	17.35	0.8	16	D
	18.88 - 18.91	1.6	32	A
	18.88	1.5	30	D
	19.30 - 19.33	2.1	42	A
	19.30	0.4	8	D
22	5.64 - 5.68	1.1	22	A
	5.64	0.8	16	D
	6.70 - 6.73	2.8	56	A
	6.70	1	20	D
	7.34	0.9	18	D
	7.36 - 7.40	2.1	42	A

NOTE: SEE PAGE 11

TABLE C2
POINT LOAD STRENGTH INDEX TEST REPORT

Client: Health Infrastructure

Ref No: 33303BT

Project: The Children's Hospital at Westmead Stage 2 Redevelopment

Report: C2

Location: Hawkesbury Road, WESTMEAD, NSW

Report Date: 26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
22	8.55 - 8.58	2.5	50	A
	8.55	0.8	16	D
	9.54 - 9.57	3.3	66	A
	9.54	0.5	10	D
	10.43 - 10.46	3.5	70	A
	10.43	1.4	28	D
	11.54 - 11.57	1.9	38	A
	11.54	0.6	12	D
	12.58 - 12.62	2.6	52	A
	12.58	0.6	12	D
	13.47 - 13.51	1.3	26	A
	13.47	1.3	26	D
	14.55 - 14.59	1.5	30	A
	14.55	1.1	22	D
	15.63 - 15.66	1.6	32	A
	15.63	1.7	34	D
	16.62 - 16.66	2.4	48	A
	16.62	1.6	32	D
	17.62 - 17.66	1.4	28	A
	17.62	0.4	8	D
	18.54 - 18.57	1.7	34	A
	18.54	1.6	32	D
	19.55 - 19.59	1	20	A
	19.55	1.6	32	D
	20.43 - 20.47	1.5	30	A

NOTE: SEE PAGE 11

TABLE C1
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	Health Infrastructure	**Ref No:**	33303BT
Project:	The Children's Hospital at Westmead Stage 2 Redevelopment	**Report:**	C1
Location:	Hawkesbury Road, WESTMEAD, NSW	**Report Date:**	26/10/20

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
22	20.43	1.4	28	D

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 IS(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 by the following approximate relationship and rounded off to the nearest whole number: U.C.S. = 20 $I_{S\,(50)}$

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH14 5.34-5.47m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone/Siltstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S64073-UCS
Job No.:	S20460-2	**Lab No.:**	S64073
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 27 MPa

Date Tested:	26/10/2020		Moisture Content:	2.0	%
Specimen Height:	128.1	mm	Duration of Test:	624	seconds
Average Specimen Diameter:	51.9	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					
Deviation from Standard:	Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.				

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

Date: 28/10/2020

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH15 11.53-11.67m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S64074-UCS
Job No.:	S20460-2	**Lab No.:**	S64074
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 28 MPa

Date Tested:	26/10/2020		Moisture Content:	8.3	%
Specimen Height:	147.3	mm	Duration of Test:	629	seconds
Average Specimen Diameter:	52.0	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Single shear plane				
Other Pertinent Observations:					

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Chris Lloyd

Date: 29/10/2020

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH16 10.26-10.45m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S64075-UCS
Job No.:	S20460-2	**Lab No.:**	S64075
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 31 MPa

Date Tested:	26/10/2020	Moisture Content:	7.9 %
Specimen Height:	175.8 mm	Duration of Test:	651 seconds
Average Specimen Diameter:	60.9 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Single shear plane		
Other Pertinent Observations:			

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Authorised Signatory:

Chris Lloyd

NATA Accredited Laboratory Number: 14874

Date: 29/10/2020

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH17 6.59-6.78m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone/Siltstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S63964-UCS
Job No.:	S20460-1	**Lab No.:**	S63964
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 26 MPa

Date Tested:	19/10/2020		Moisture Content:	2.3	%
Specimen Height:	178.8	mm	Duration of Test:	658	seconds
Average Specimen Diameter:	60.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

Date: 20/10/2020

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH18 14.39-14.57m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S63965-UCS
Job No.:	S20460-1	**Lab No.:**	S63965
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 25 MPa

Date Tested:	19/10/2020		Moisture Content:	9.4	%
Specimen Height:	176.7	mm	Duration of Test:	649	seconds
Average Specimen Diameter:	60.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Single shear plane				
Other Pertinent Observations:					

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Authorised Signatory:

Chris Lloyd

NATA Accredited Laboratory Number: 14874

Date: 20/10/2020

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Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH19 7.64-7.82m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Siltstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S64076-UCS
Job No.:	S20460-2	**Lab No.:**	S64076
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 30 MPa

Date Tested:	27/10/2020		Moisture Content:	2.0	%
Specimen Height:	178.0	mm	Duration of Test:	647	seconds
Average Specimen Diameter:	61.0	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

Date: 29/10/2020

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH20 13.40-13.59m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S63966-UCS
Job No.:	S20460-1	**Lab No.:**	S63966
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 32 MPa

Date Tested:	19/10/2020	Moisture Content:	7.5 %
Specimen Height:	179.7 mm	Duration of Test:	672 seconds
Average Specimen Diameter:	60.8 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			

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Authorised Signatory:

Chris Lloyd

Date: 20/10/2020

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client:	JK Geotechnics	**Sample Source:**	BH22 7.52-7.68m
Address:	PO Box 976, North Ryde BC, NSW 1670	**Sample Description:**	Sandstone/Siltstone
Project:	The Children's Hosptial at Westmead Stage 2 Redevelopment - Hawkesbury Road Westmead NSW (33303BT)	**Report No.:**	S63967-UCS
Job No.:	S20460-1	**Lab No.:**	S63967
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	**Sample Curing:**	-
Sampling Method:	Sampled by Client - results apply to the sample as received	**Date Sampled:**	Unknown
Storage History:	Sealed	**Storage Environment:**	Sealed at as received moisture condition

Uniaxial Compressive Strength 21 MPa

Date Tested:	19/10/2020		Moisture Content:	2.5	%
Specimen Height:	150.5	mm	Duration of Test:	619	seconds
Average Specimen Diameter:	51.7	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

Date: 20/10/2020

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

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

CERTIFICATE OF ANALYSIS 253784

Client Details

Client	JK Geotechnics
Attention	Arthur Billingham
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**33303BT, The Children's Hospital at Westmead**
Number of Samples	3 Soil
Date samples received	20/10/2020
Date completed instructions received	20/10/2020

Analysis Details

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

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

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

Report Details

Date results requested by	27/10/2020
Date of Issue	23/10/2020

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil				
Our Reference		253784-1	253784-2	253784-3
Your Reference	UNITS	15	18	19
Depth		4.0-4.5	5.9-6.15	2.0-2.7
Date Sampled		15/10/2020	12/10/2020	16/10/2020
Type of sample		Soil	Soil	Soil
Date prepared	-	21/10/2020	21/10/2020	21/10/2020
Date analysed	-	21/10/2020	21/10/2020	21/10/2020
pH 1:5 soil:water	pH Units	6.5	5.8	7.2
Chloride, Cl 1:5 soil:water	mg/kg	28	<10	10
Sulphate, SO4 1:5 soil:water	mg/kg	27	22	20
Resistivity in soil*	ohm m	140	340	320

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	-			21/10/2020	2	21/10/2020	21/10/2020		21/10/2020	[NT]
Date analysed	-			21/10/2020	2	21/10/2020	21/10/2020		21/10/2020	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	2	5.8	5.6	4	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	<10	<10	0	91	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	2	22	33	40	88	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	2	340	290	16	[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.

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.

JKGeotechnics

BOREHOLE LOG

Borehole No.
12
1 / 1

EASTING: 314110.11
NORTHING: 6258167.24

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 15.38 m
Date: 9/10/20 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** B.Z./D.B.

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
DRY ON COMPLETION				0			ASPHALTIC CONCRETE: 50mm.t.				
			15			-	FILL: Sand, fine to medium grained, dark brown, with fine to coarse grained, sub-angular igneous gravel.	M			APPEARS POORLY COMPACTED
		N = 29 6,13,16		1			FILL: Silty clay, medium plasticity, brown and dark brown, with fine to coarse grained, sub-angular and angular igneous, and ironstone gravel, trace of ash.	w<PL			APPEARS WELL COMPACTED
		N = 22 7,9,13	14								
			13	2			END OF BOREHOLE AT 1.95 m				
			12	3							
			11	4							
			10	5							
			9	6							

JKGeotechnics

BOREHOLE LOG

Borehole No. 13

1 / 1

EASTING: 314148.14
NORTHING: 6258175.91

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 13.97 m
Date: 9/10/20 **Datum:** AHD
Plant Type: JK350 **Logged/Checked By:** B.Z./D.B.

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION					-	ASPHALTIC CONCRETE: 50mm.t.				
						FILL: Sand, fine to medium grained, dark brown, with fine to coarse grained, sub-angular and angular igneous gravel.	M			APPEARS POORLY COMPACTED
		N > 17 5,9,8/ 50mm REFUSAL	13	1	CI	Silty CLAY: medium plasticity, grey and yellow brown, trace of fine to coarse grained, sub-angular and angular ironstone gravel.	w<PL	Hd	450 460 470	RESIDUAL
		N=SPT 11/ 0mm REFUSAL			-	Extremely Weathered Laminite: Silty CLAY, medium plasticity, grey mottled yellow brown, trace of fine grained sand.	XW	Hd		HAWKESBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE
			12	2		END OF BOREHOLE AT 1.60 m				
			11	3						
			10	4						
			9	5						
			8	6						

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 04/11/2020 18:28 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

BOREHOLE LOG

Borehole No. 14

EASTING: 314158.97
NORTHING: 6258178.04

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 14.12 m
Date: 15/10/20 **Datum:** AHD
Plant Type: JK500 **Logged/Checked By:** A.C.K./D.B.

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
DRY ON COMPLETION OF AUGERING			14			-	ASPHALTIC CONCRETE: 30mm.t	M			
						CI	FILL: Gravel, fine to medium grained, igneous, grey.	w~PL	(VSt - Hd)		
							FILL: Sandy clay, medium plasticity, grey brown, fine to medium grained sand, trace of fine to medium grained sandstone gravel.	w~PL			
		N > 18 7,15,3/ 0mm REFUSAL				-	Silty CLAY: medium plasticity, light grey and orange brown, with fine to medium grained sand, trace of fine to medium grained ironstone gravel.	XW	Hd	>600 >600	HAWKESBURY SANDSTONE BANDED 'TC' BIT RESISTANCE
			13	1			Extremely Weathered Laminite: silty Sandy Clay, medium plasticity, light grey and orange brown, with iron-indurated bands.	HW	VL - L		LOW RESISTANCE
			12	2			LAMINITE: Siltstone, brown, interlaminated with Sandstone, fine grained, grey brown, with iron indurated and extremely weathered bands.				
							REFER TO CORED BOREHOLE LOG				
			11	3							
			10	4							
			9	5							
			8	6							

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
14
2 / 4

EASTING: 314158.97
NORTHING: 6258178.04

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT	**Core Size:** NMLC	**R.L. Surface:** 14.12 m
Date: 15/10/20	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK500	**Bearing:** N/A	**Logged/Checked By:** A.C.K./D.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	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 – DESCRIPTION: Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness – Specific / General	Formation
		13		START CORING AT 1.42m					
100% RETURN				LAMINITE: Siltstone, grey, interlaminated with Sandstone, fine grained, light orange brown.	HW	VL - L			Hawkesbury Sandstone
				Sandy SIlty CLAY: medium plasticity, light grey mottled orange brown, fine grained sand.	RS	(VSt - Hd)			
		12	2	LAMINITE: Siltstone, grey and brown, interlaminated with Sandstone, fine grained, light orange brown.	HW	L	0.040 × • 0.30	(1.82m) XWS, 5°, 45 mm.t (1.89m) XWS, 5°, 20 mm.t (1.92m) XWS, 5°, 10 mm.t (2.07m) XWS, 5°, 20 mm.t (2.14m) XWS, 0°, 55 mm.t (2.23m) J, 70°, St, R, Cn (2.27m) CS, 10°, 5 mm.t (2.31m) XWS, 10°, 15 mm.t	
					MW	M	0.020 × • 1.1	(2.51m) XWS, 5°, 8 mm.t (2.54m) XWS, 5°, 4 mm.t	
		11	3	LAMINITE: Siltstone, light grey, interlaminated with Sandstone, fine grained, orange brown.				(2.83m) CS, 0°, 5 mm.t (3.11m) XWS, 0°, 25 mm.t	
				LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, light grey, with dark brown seams.	SW	H		(3.40m) XWS, 0°, 1 mm.t	
		10	4	LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, dark grey and light grey.	FR		0.50 × • 1.3 0.90 × • 2.1		
		9	5	LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, light grey.			0.60 × • 1.2		
		8	6	SANDSTONE: fine grained, light grey, with grey laminae.			1.7 × • 2.7		
		7	7	LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, light grey.		M	0.20 × • 0.70		

SPACING (mm): 600 200 60 20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 14

EASTING: 314158.97
NORTHING: 6258178.04

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT | **Core Size:** NMLC | **R.L. Surface:** 14.12 m
Date: 15/10/20 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK500 | **Bearing:** N/A | **Logged/Checked By:** A.C.K./D.B.

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 – Specific	Formation
100% RETURN		6			LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, light grey. *(continued)*	FR	M	0.060 / 0.50		Hawkesbury Sandstone
					SANDSTONE: medium to coarse grained, light grey, with grey laminae cross bedded at up to 25°.		H	1.1 / 1.6	(8.35m) XWS, 0°, 20 mm.t (8.47m) XWS, 15°, 5 mm.t	
		5	9					1.5 / 1.7		
		4	10					1.4 / 1.7	(10.83m) CS, 5°, 30 mm.t	
		3	11					1.2 / 1.4		
		2	12					1.4 / 1.7		
		1	13					1.7 / 1.8		
		0	14		SANDSTONE: medium to coarse grained, light grey, massive.			1.5 / 1.6		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 14

EASTING: 314158.97
NORTHING: 6258178.04

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT | **Core Size:** NMLC | **R.L. Surface:** 14.12 m
Date: 15/10/20 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK500 | **Bearing:** N/A | **Logged/Checked By:** A.C.K./D.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	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 Spacing (mm)	Defect Description – Specific	Defect Description – General	Formation
100% RETURN		-1		SANDSTONE: medium to coarse grained, light grey, massive. *(continued)*	FR	H	1.8 / 1.4				Hawkesbury Sandstone
		-2	16	SANDSTONE: medium to coarse grained, light grey, with grey laminae cross bedded at up to 35°.			1.0 / 1.5				
		-3	17				1.3				
				Siltstone seam, very high strength, 40mm.t.					(17.28m) XWS, 5°, 2 mm.t		
				SANDSTONE: fine to medium grained, light grey, with grey laminae.			0.50 / 1.8		(17.54m) XWS, 10°, 1 mm.t		
		-4	18	SANDSTONE: medium to coarse grained, light grey, with grey laminae cross bedded at up to 20°.			1.3 / 1.1				
		-5	19	As above, but with siltstone and sandstone clasts and carbonaceous seams. Siltstone seam, low strength, 20mm.t.							
				SANDSTONE: medium to coarse grained, light grey, with grey laminae.			0.70 / 1.2				
		-6	20	END OF BOREHOLE AT 20.00 m							
		-7	21								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 04/11/2020 18:29 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: 33033BT
Borehole No: BH14
Depth: 1.42m - 5.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT BH14 START CORING AT 1.42m
1
2
3
4


JKGeotechnics
Job No: 33033BT
Borehole No: BH14
Depth: 5.00m - 10.00m
KODAK Gray Scale
KODAK Color Control Patches
5
6
7
8
9


JKGeotechnics
Job No: 33033BT
Borehole No: BH14
Depth: 10.00m – 15.00m
KODAK Gray Scale
KODAK Color Control Patches
10
11
12
13
14

JKGeotechnics
Job No: 33033BT
Borehole No: BH14
Depth: 15.00m - 20.00m
KODAK Gray Scale
KODAK Color Control Patches
15
16
17
18
19
END OF BOREHOLE AT 20.00m

JKGeotechnics

BOREHOLE LOG

Borehole No.
15

EASTING: 314175.29
NORTHING: 6258195.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 14.35 m
Date: 15/10/20 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** B.S./D.B.

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
DRY ON COMPLETION OF AUGERING						-	ASPHALTIC CONCRETE: 30mm.t.	M			APPEARS WELL COMPACTED
			14				FILL: Sandy Gravel, dark brown, fine to coarse grained ironstone and igneous gravel, fine to medium grained sand, trace of silt.	w<PL			
		N = 36 9,26,10				-	FILL: Gravelly silty Clay, low plasticity, dark brown and orange brown, fine to medium grained ironstone and siltstone gravel, trace of fine grained sand.	DW	VL		HAWKSBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE
			13	1			Interbedded SANDSTONE and SILTSTONE: fine grained, grey sandstone interbedded with dark grey siltstone, with extremely weathered and iron indurated bands.				
							as above, but orange brown sandstone and dark grey and brown siltstone.		L		LOW RESISTANCE WITH MODERATE BANDS
			12	2					VL		VERY LOW RESISTANCE
			11, 10	3, 4							
			9	5			SANDSTONE: fine grained, grey, with very low strength and iron indurated bands.		L - M		LOW TO MODERATE RESISTANCE
									M		MODERATE RESISTANCE
			8	6			REFER TO CORED BOREHOLE LOG				

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 15

EASTING: 314175.29
NORTHING: 6258195.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT	**Core Size:** NMLC	**R.L. Surface:** 14.35 m
Date: 15/10/20	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK305	**Bearing:** N/A	**Logged/Checked By:** B.S./D.B.

START CORING AT 5.79m

Water Loss\Level	Core Description (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	Point Load Strength Index $I_s(50)$	Formation
75% RETURN	SANDSTONE: fine grained, grey and dark grey, with very low strength and laminite bands.	SW	M - H	0.30 × •1.5; 0.20 × •0.80	Hawkesbury Sandstone
	LAMINITE: Sandstone, fine grained, grey, interlaminated with Siltstone, dark grey.		L; M	0.040 × •0.30; 0.040 × •0.80	
	SANDSTONE: fine to coarse grained, orange brown and light grey, with dark grey laminae.	MW	H	1.6 × 1.3; 0.80 × •1.5	
100% RETURN	SANDSTONE: fine to medium grained, grey, with dark grey laminae.	SW; FR		0.90 • 0.90; 1.4 • 1.2	
	SANDSTONE: fine to medium grained, light grey, with grey laminae.			1.4 • 1.6	

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

Strength: 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)

- (5.89m) XWS, 0°, 30mm.t
- (5.96m) XWS, 0°, 10mm.t
- (6.04-6.12m) Cn, multile clay seams, 0°, 2mm.t.
- (6.15m) CS, 0°, 5 mm.t
- (6.88m) Be, 0°, Pl, R, Clay Ct
- (7.15m) XWS, 0°, 50mm.t
- (7.23m) CS, 0°, 10mm.t
- (7.28m) Be, 5°, Pl, R, Fe St
- (7.33m) CS, 10°, 3 mm.t
- (8.54m) Be, PL, R, Clay Vn
- (9.36m) Be, 5°, Un, R, Fe Sn
- (9.74m) XWS, 0°, 15mm.t
- (10.51m) XWS, 10°, 2 mm.t
- (10.57m) XWS, 0°, 4 mm.t
- (10.94m) J, 60 - 85°, C, R, Cn

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 15

EASTING: 314175.29
NORTHING: 6258195.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** NMLC **R.L. Surface:** 14.35 m
Date: 15/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK305 **Bearing:** N/A **Logged/Checked By:** B.S./D.B.

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 Spacing (mm)	Defect Description (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) – Specific / General	Formation
100% RETURN		2			SANDSTONE: fine to medium grained, light grey, with grey laminae. *(continued)*	FR	H	2.0 / 1.8			Hawkesbury Sandstone
		1	13					1.8 / 2.0			
		0	14		as above, but with carbonaceous lenses and siltstone clasts			1.7 / 1.6			
		-1	15		SANDSTONE: fine to coarse grained, light grey, with grey laminae, siltstone clasts, siltstone lenses, coarse grained bands and quartz inclusions.			1.8 / 2.1			
		-2	16					1.8 / 2.6			
		-3	17					1.4 / 1.9			
		-4	18							(18.38m) XWS, 2°, 2mm.t	
					SANDSTONE: fine to medium grained, light grey, with dark grey laminae and quartz inclusions.			0.80 / 1.0			

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
15

EASTING: 314175.29
NORTHING: 6258195.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** NMLC **R.L. Surface:** 14.35 m
Date: 15/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK305 **Bearing:** N/A **Logged/Checked By:** B.S./D.B.

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
100% RETURN		-5, -6	20		SANDSTONE: fine to medium grained, light grey, with dark grey laminae and quartz inclusions. *(continued)*	FR	H	1.4>1.3; 1.3>1.5		(19.50m) Be, 0°, Pl, R, Clay FILLED, 2 mm.t	Hawkesbury Sandstone
		-7, -8, -9, -10, -11	21, 22, 23, 24, 25		END OF BOREHOLE AT 20.80 m						

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 06/11/2020 10:06 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

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


KODAK Gray Scale
KODAK Color Control Patches
JKGeotechnics
Job No: 33303BT
Borehole No: BH15
Depth: 5.79m – 8.00m
33303BT BH15 START CORING AT 5.79m
5
6
7


JKGeotechnics
Job No: 33303BT
Borehole No: BH15
Depth: 8.00m - 12.00m
KODAK Gray Scale
KODAK Color Control Patches
8
9
10
11


JKGeotechnics
Job No: 33303BT
Borehole No: BH15
Depth: 12.00m - 16.00m
KODAK Gray Scale
KODAK Color Control Patches
12
13
14
15


JKGeotechnics
Job No: 33303BT
Borehole No: BH15
Depth: 16.00m – 20.80m
KODAK Gray Scale
KODAK Color Control Patches
16
17
18
19
20
EOH AT 20.8m

JKGeotechnics

BOREHOLE LOG

Borehole No.
16
1 / 4

EASTING: 314189.85
NORTHING: 6258213.05

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 14.19 m
Date: 15/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING		14	0		FILL: Silty sand, fine to medium grained, dark brown, with root fibres.	M			GRASS COVER APPEARS POORLY COMPACTED
	N = 3 1,2,1				as above, but with boulder or cobble size concrete fragments.				
				ML	FILL: Silty sand, fine to medium grained, dark brown, with root fibres.	w<PL	F	80 80	ALLUVIAL
		13	1	CI	Clayey SILT: low plasticity, brown, with fine grained sand.	w~PL	(St)		RESIDUAL
	N = 12 4,5,7				Silty CLAY: medium plasticity, brown mottled red brown, trace of fine to medium grained, sub-angular ironstone gravel.		VSt - Hd	350 440 530	
		12	2		as above, but grey and brown.	w<PL	Hd		
	N=SPT 10/ 0mm REFUSAL			-	Extremely Weathered Sandstone: silty CLAY: medium plasticity, grey and brown, with iron indurated bands, trace of fine grained sand.	XW	Hd		HAWKESBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE
		11	3		SANDSTONE: fine to medium grained, brown, with dark grey and brown siltstone bands, and iron indurated bands.	DW	L - M		LOW TO MODERATE RESISTANCE
		10	4						
		9	5		SANDSTONE: fine to medium grained, grey, with dark grey siltstone bands, and iron indurated bands.				
		8	6		SANDSTONE: medium to coarse grained, brown and light grey, with iron indurated bands.		M		MODERATE RESISTANCE

JKGeotechnics

BOREHOLE LOG

Borehole No.
16

EASTING: 314189.85
NORTHING: 6258213.05

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT | **Method:** SPIRAL AUGER | **R.L. Surface:** 14.19 m
Date: 15/10/20 | **Datum:** AHD
Plant Type: JK308 | **Logged/Checked By:** B.Z./D.B.

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: medium to coarse grained, brown and light grey, with iron indurated bands.	DW	M		
						7				REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 20.2m. CLASS 18 MACHINE SLOTTED 50mm dia. PVC STANDPIPE 20.2m TO 5m. CASING 5m TO 0.1m. 2mm SAND FILTER PACK 20.2m TO 4.5m. BENTONITE SEAL 4.5m TO 3m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							8							
						6								
							9							
						5								
							10							
						4								
							11							
						3								
							12							
						2								
							13							
						1								

CORED BOREHOLE LOG

Borehole No.
16

EASTING: 314189.85
NORTHING: 6258213.05

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT	**Core Size:** HQ	**R.L. Surface:** 14.19 m
Date: 15/10/20	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** B.Z./D.B.

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
			7		START CORING AT 7.10m						
100% RETURN		7			SANDSTONE: medium to coarse grained, light grey and brown, cross bedded at up to 25°, with iron indurated bands, and dark grey laminae.	MW	M - H	1.5×1.6		(7.16m) XWS, 10°, 22 mm.t (7.35m) Be, 5°, Un, R, Fe Sn	Hawkesbury Sandstone
		6	8		as above, but light brown and light grey, cross bedded at up to 20°.	SW		1.6×2.0		(7.92m) XWS, 15°, 28 mm.t (8.60m) Be, 3°, Un, R, Fe Sn	
		5	9		SANDSTONE: medium to coarse grained, light grey, with dark grey laminae.	FR	H	0.90×1.0			
		4	10		SANDSTONE: medium to coarse grained, light grey, massive, occasional dark grey laminae.			1.5×1.5 2.1×1.8 1.4×1.7		(10.16m) XWS, 0°, 13 mm.t	
		3, 2, 1	11, 12, 13		as above, but with siltstone clasts.			1.9×2.2			

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
16

EASTING: 314189.85
NORTHING: 6258213.05

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** HQ **R.L. Surface:** 14.19 m
Date: 15/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** B.Z./D.B.

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 $I_s(50)$	SPACING (mm)	DEFECT DETAILS – DESCRIPTION: Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness (Specific / General)	Formation
100% RETURN					as above, but with siltstone clasts. *(continued)*	FR	H	1.9		(13.73m) Be, 0°, P, R, Clay Ct (13.78m) Be, 0°, P, R, Clay Ct	Hawkesbury Sandstone
		0	14								
					SANDSTONE: medium to coarse grained, light grey, cross bedded at up to 30°, with dark grey laminae.			1.1 / 2.4		(14.72m) Be, 4°, P, R, Clay Vn	
		-1	15					1.9 / 1.9			
		-2	16					1.0 / 1.8			
		-3	17		as above, but with small siltstone clasts inclusions.			1.1 / 1.7			
					SANDSTONE: medium to coarse grained, light grey, cross bedded at up to 20°, with dark grey laminae.						
		-4	18					1.1 / 1.6		(18.46m) Be, 4°, P, R, Clay FILLED, 2 mm.t	
		-5	19					1.2 / 1.2			
		-6	20								
					END OF BOREHOLE AT 20.30 m						

Point load 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: 33303BT
Borehole No: BH16
Depth: 7.10m to 10.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT, BH16, CORING STARTS AT: 7.10m
7
8
9


JKGeotechnics
Job No: 33303BT
Borehole No: BH16
Depth: 10.00m - 14.00m
KODAK Gray Scale
KODAK Color Control Patches
10
11
12
13


JKGeotechnics
Job No: 33303BT
Borehole No: BH16
Depth: 14.00m to 18.00m
KODAK Gray Scale
KODAK Color Control Patches
14
15
16
17


JKGeotechnics
Job No: 33303BT
Borehole No: BH16
Depth: 18.00m to 20.30m
KODAK Gray Scale
KODAK Color Control Patches
18
19
20
END OF BOREHOLE 20.30m

JKGeotechnics

BOREHOLE LOG

Borehole No. 17

EASTING: 314184.68
NORTHING: 6258151.29

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 17.07 m
Date: 14/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

Groundwater Record	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING		17	0		FILL: Silty clay, medium plasticity, dark brown, trace of fine to medium grained, sub-angular ironstone and igneous gravel.	w<PL			GRASS COVER APPEARS MODERATELY COMPACTED
	N = 12 5,5,7	16	1		FILL: Gravelly clay, medium plasticity, dark brown, fine to coarse grained, sub-angular and angular sandstone, igneous and ironstone gravel, trace of ash.	w>PL			
	N = 5 2,3,2	15	2						APPEARS POORLY COMPACTED
					FILL: Silty clay, medium plasticity, dark brown, red brown and grey, with fine to coarse grained, sub-angular and angular sandstone, igneous and ironstone gravel.				
	N > 28 16,16,12/ 100mm REFUSAL	14	3	-	Extremely Weathered Sandstone: silty Sandy CLAY, medium plasticity, light grey and brown, fine grained sand, with iron indurated bands.	XW	Hd	>600 580 580	HAWKESBURY SANDSTONE VERY LOW TO LOW 'TC' BIT RESISTANCE
		13	4		Interbedded SANDSTONE and SILTSTONE: fine grained, grey Sandstone, dark grey and brown Siltstone, with iron-indurated bands.	DW	VL - L L		LOW RESISTANCE
		12	5		SANDSTONE: fine grained, grey and brown.	MW	M		LOW TO MODERATE RESISTANCE
		11	6		REFER TO CORED BOREHOLE LOG				

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CORED BOREHOLE LOG

Borehole No.
17

EASTING: 314184.68
NORTHING: 6258151.29

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT	**Core Size:** HQ	**R.L. Surface:** 17.07 m
Date: 14/10/20	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** B.Z./D.B.

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
		12			START CORING AT 5.65m						
100% RETURN		11	6		SANDSTONE: fine grained, grey, with dark grey laminae.	FR	H	0.50 × •1.2			Hawkesbury Sandstone
					LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, grey.			0.80 × •1.4		(6.26m) Be, 2°, P, R, Cb Sn	
		10	7					0.80 × •1.0		(7.76m) J, 52°, Ir, Vr, Fe Sn	
		9	8		SANDSTONE: fine to medium grained, grey, with dark grey laminae.			0.90 × •2.4			
		8	9					0.60 × •2.8			
		7	10		LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, grey.			0.30 × •1.8			
		6	11							(11.03m) Be, 0°, P, R, Cb Vn	
					SANDSTONE: medium to coarse grained, light grey, cross bedded at up to 20°, with dark grey laminae.			0.90 × •1.4		(11.17m) XWS, 0°, 18 mm.t	
										(11.66m) Be, 3°, P, R, Clay FILLED, 2 mm.t	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

EASTING: 314184.68
NORTHING: 6258151.29

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** HQ **R.L. Surface:** 17.07 m
Date: 14/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** B.Z./D.B.

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
100% RETURN		5			SANDSTONE: medium to coarse grained, light grey, cross bedded at up to 20°, with dark grey laminae. *(continued)*	FR	H				Hawkesbury Sandstone
								0.30 × •1.1		(12.33m) Be, 4°, Un, R, Cb Vn	
		4	13							(13.12m) Be, 5°, Un, Vr, Cb Ct	
								1.2 × •2.0			
		3	14					1.2 × •1.4			
		2	15					1.9 × •1.4		(15.59m) XWS, 12°, 12 mm.t	
					SANDSTONE: medium to coarse grained, light grey, massive, with dark grey laminae.						
		1	16					1.9 × •1.7			
		0	17					1.6 × •1.5			
		-1	18					1.8 × •1.4		(18.73m) Be, 2°, Un, R, Clay Ct	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
17

EASTING: 314184.68
NORTHING: 6258151.29

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** HQ **R.L. Surface:** 17.07 m
Date: 14/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** B.Z./D.B.

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
100% RETURN		-2			SANDSTONE: medium to coarse grained, light grey, massive, with dark grey laminae. *(continued)*	FR	H	1.2×2.0			Hawkesbury Sandstone
		-3	20		as above, but cross bedded at up to 20°.			1.5•1.3			
					END OF BOREHOLE AT 20.30 m						
		-4	21								
		-5	22								
		-6	23								
		-7	24								
		-8	25								

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 06/11/2020 10:06 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

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 33303BT
Borehole No: BH17
Depth: 5.65m - 8.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT, BH17, CORING STARTS AT: 5.65m
5
6
7


JKGeotechnics
Job No: 33303BT
Borehole No: BH17
Depth: 8.00m – 12.00m
KODAK Gray Scale
KODAK Color Control Patches
8
9
10
11


JKGeotechnics
Job No: 33303BT
Borehole No: BH17
Depth: 12.00m – 16.00m
KODAK Gray Scale
KODAK Color Control Patches
12
13
14
15


JKGeotechnics
Job No: 33303BT
Borehole No: BH17
Depth: 16.00m – 20.30m
KODAK Gray Scale
KODAK Color Control Patches
16
17
18
19
20
← 20.3m END

![JKGeotechnics]

BOREHOLE LOG

EASTING: 314223.56
NORTHING: 6258200.38

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 15.90 m
Date: 12/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

Groundwater Record	Samples (ES / U50 / DB / DS)	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
				0		BRICK PAVERS: 100mm.t.				
	DS				-	FILL: Silty clay, medium plasticity, dark brown and grey, with fine to coarse grained, angular siltstone and ironstone gravel.	w~PL			APPEARS MODERATELY TO WELL COMPACTED
		N = 17 3,7,10	15	1						
		N = 8 2,3,5	14				w>PL			APPEARS POORLY TO COMPACTED
▶				2						
					CI	Silty CLAY: medium plasticity, brown, trace of fine grained, sub-angular ironstone gravel and root fibres.	w>PL	F	70 80 80	ALLUVIAL
		N = 10 3,4,6	13	3		Silty CLAY: medium plasticity, brown and red brown, trace of fine grained, sub-angular ironstone gravel.	w>PL	VSt	200 200 210	RESIDUAL
			12	4	CI-CH	as above, but grey and red brown.				
		N = 15 5,7,8							250 300 320	
			11	5	CI / SC	as above, but with bands of clayey sand.		(VSt / MD)		
		N = 17 9,8,9	10	6	CI	Silty CLAY: medium plasticity, grey and brown, trace of fine grained sand.	w~PL	Hd	500 510 520	
			9							

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BOREHOLE LOG

EASTING: 314223.56
NORTHING: 6258200.38

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 15.90 m
Date: 12/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

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
						CI	Silty CLAY: medium plasticity, grey and brown, trace of fine grained sand.	w~PL	Hd		RESIDUAL
ON COMPLETION OF AUGERING	DS	N = 18 14,16,2	8	8		-	Extremely Weathered Sandstone: silty Clayey SAND, fine to medium grained, light grey, low plasticity clay and silt, with cemented sand nodules.	XW	D - VD		HAWKESBURY SANDSTONE VERY LOW TO LOW 'TC' BIT RESISTANCE
							SANDSTONE: fine to medium grained, grey and brown, with iron-indurated bands.	DW	L - M		LOW TO MODERATE RESISTANCE
			7	9			REFER TO CORED BOREHOLE LOG				
			6	10							
			5	11							
			4	12							
			3	13							
			2								

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CORED BOREHOLE LOG

EASTING: 314223.56
NORTHING: 6258200.38

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** HQ **R.L. Surface:** 15.90 m
Date: 12/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** B.Z./D.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Core Description	Weathering	Strength	Point Load Strength Index $I_s(50)$	Defect Details – Description (Specific)	Formation
				START CORING AT 8.55m					
100% RETURN		7	9	SANDSTONE: fine to medium grained, grey, with dark grey laminae.	SW	M	0.50×0.60	(8.64m) CS, 5°, 3 mm.t (8.82m) XWS, 8°, 2 mm.t (9.00m) Ji, 48°, Un, Fe Ct	Hawkesbury Sandstone
				Extremely Weathered Sandstone: clayey silty SAND, fine to medium grained, grey and dark grey, low plasticity clay and silt.	XW	VD			
		6, 5, 4, 3, 2	10, 11, 12, 13, 14	SANDSTONE: medium to coarse grained, grey, cross bedded at up to 20°, with dark grey laminae.	FR	M - H	1.3×1.9 1.1×1.5 1.2×1.1 1.1×1.4 1.1×0.80	(9.67m) Be, 18°, P, R, Cb FILLED, 2 mm.t (10.89m) XWS, 3°, 5 mm.t (11.10m) J, 70°, P, R, Cn (12.58m) CS, 13°, 3 mm.t (13.09m) Be, 12°, Un, Vr, Cb Sn (13.80-14.25m) Cr, Cn, containing numerous joints (65°, C, Vr, Cn).	
		1		SANDSTONE: medium to coarse grained, grey, massive, with dark grey laminae.		H	1.2×1.0		

Point load scale: VL -0.1, L -0.3, M -1, H -3, VH -10, EH
Spacing (mm): 600, 200, 60, 20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
18

EASTING: 314223.56
NORTHING: 6258200.38

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT | **Core Size:** HQ | **R.L. Surface:** 15.90 m
Date: 12/10/20 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK308 | **Bearing:** N/A | **Logged/Checked By:** B.Z./D.B.

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 SPACING (mm)	DEFECT DETAILS DESCRIPTION: Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness (Specific / General)	Formation
100% RETURN					SANDSTONE: medium to coarse grained, grey, massive, with dark grey laminae. *(continued)*	FR	H	1.5 / 1.7			Hawkesbury Sandstone
		0	16					1.5 / 2.0			
								1.7 / 1.8			
		-1	17					1.5 / 1.9			
		-2	18					1.5 / 2.3			
		-3	19					1.2 / 1.8			
		-4	20					1.3 / 1.7		(19.92m) Be, 2°, P, R, Clay Ct	
		-5	21		END OF BOREHOLE AT 20.40 m						
		-6									

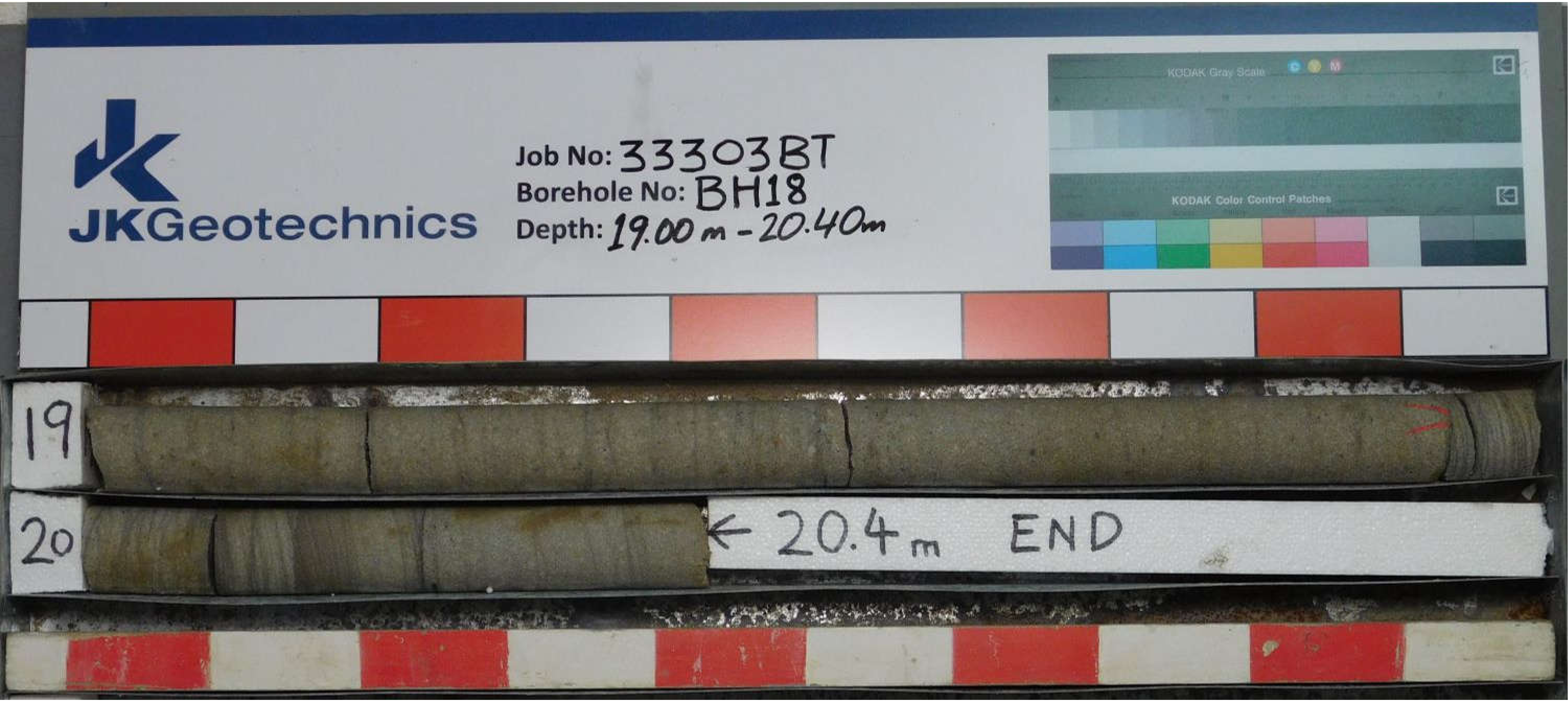
Point load scale: VL -0.1, L -0.3, M -1, H -3, VH -10, EH. Spacing scale: 600, 200, 60, 20.

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 33303BT
Borehole No: BH18
Depth: 8.55m - 11.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT, BH18, CORING STARTS AT: 8.55m
8
9
10


JKGeotechnics
Job No: 33303BT
Borehole No: BH18
Depth: 11.00m - 15.00m
KODAK Gray Scale
KODAK Color Control Patches
11
12
13
14


JKGeotechnics
Job No: 33303BT
Borehole No: BH18
Depth: 15.00m - 19.00m
KODAK Gray Scale
KODAK Color Control Patches
15
16
17
18


JKGeotechnics
Job No: 33303BT
Borehole No: BH18
Depth: 19.00m - 20.40m
KODAK Gray Scale
KODAK Color Control Patches
19
20
← 20.4m END

JKGeotechnics

BOREHOLE LOG

Borehole No. **19**

EASTING: 314228.13
NORTHING: 6258134.10

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 17.27 m
Date: 16/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

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
			17				FILL: Silty sand, fine to medium grained, yellow brown, with root fibres.	D			GRASS COVER APPEARS POORLY COMPACTED
		N = 9 7,5,4		1			FILL Silty clay, medium plasticity, brown mottled yellow brown and red brown, with fine to medium grained, sub-angular and angular siltstone and ironstone gravel.	w<PL w~PL			
		N = 5 3,2,3	16	2			as above, but brown and grey mottled dark grey.	w>PL			
		N = 2 1,1,1	15 14	3 4			as above, but with fine to coarse grained, sub-angular and angular siltstone, sandstone and ironstone gravel.				
COLLAPSED ON COMPLETION OF AUGERING		N = 5 2,2,3	13 12	5			FILL: Silty clay and Sand mixture, silty clay, medium plasticity, brown and grey, with fine to coarse grained, sub-angular and angular siltstone, sandstone and ironstone gravel, mixed with sand, medium to coarse grained, brown.	w~LL			
		N > 12 2,12/ 50mm REFUSAL		6		-	SANDSTONE: fine to medium grained, brown. REFER TO CORED BOREHOLE LOG	DW	L - M		HAWKESBURY SANDSTONE MODERATE 'TC' BIT RESISTANCE
			11								

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 04/11/2020 18:30 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

CORED BOREHOLE LOG

Borehole No.
19

EASTING: 314228.13
NORTHING: 6258134.10

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT
Date: 16/10/20
Plant Type: JK308
Core Size: HQ (6m to 9.8m) NMLC (9.8m to END)
Inclination: VERTICAL
Bearing: N/A
R.L. Surface: 17.27 m
Datum: AHD
Logged/Checked By: B.Z./D.B.

Water Loss\Level	RL (m AHD)	Depth (m)	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 – Description (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) – Specific	Formation
COLLAPSED ON COMPLETION OF AUGERING	12		START CORING AT 6.00m					
100% POLYMER RETURN	11	6	SANDSTONE: fine to medium grained, brown, with iron indurated bands and dark grey laminae.	MW	M		(6.00-6.15m) fractured zone including Be and XWS; (6.35m) Be, 0°, P, R, Fe Sn; (6.50-6.55m) Bex4, 0°, P, R, Fe Sn	Hawkesbury Sandstone
			as above, but grey.	SW	M - H	2.6×3.3	(6.78m) Be, 0°, P, R, Fe Vn; (6.81m) Be, 0°, P, R, Fe Vn; (6.93m) Be, 0°, P, R, Fe Ct	
	10	7	LAMINITE: Siltstone, dark grey interlaminated with Sandstone, fine grained, grey, with iron indurated bands.				(7.11m) Be, 0°, P, R, Fe Sn; (7.26m) Be, 0°, P, R, Fe Sn	
	9	8	LAMINITE: Siltstone, dark grey interlaminated with Sandstone, fine grained, grey.	FR	H	0.70×1.4; 0.80×2.1	(8.16m) Be, 0°, P, R, Clay Vn	
	8	9	SANDSTONE: fine to medium grained, brown, with dark grey laminae.			0.80×3.7	(9.97m) J, 45°, Ir, Vr, Cn	
	7	10	LAMINITE: Siltstone, dark grey interlaminated with Sandstone, fine grained, grey.			0.40×0.80		
	6	11	SANDSTONE: fine to medium, grey, with dark grey laminae.			1.1×2.8	(11.28m) Be, 0°, P, R, Cb Vn	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Borehole No. 19

EASTING: 314228.13
NORTHING: 6258134.10

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT
Date: 16/10/20
Plant Type: JK308
Core Size: HQ (6m to 9.8m) NMLC (9.8m to END)
Inclination: VERTICAL
Bearing: N/A
R.L. Surface: 17.27 m
Datum: AHD
Logged/Checked By: B.Z./D.B.

Columns: 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); DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General | Formation

Water Loss\Level: 100% POLYMER RETURN

Formation: Hawkesbury Sandstone

Depth (m)	Core Description	Weathering	Strength
12.0	SANDSTONE: fine to medium, grey, with dark grey laminae. *(continued)*	FR	H
14.7	LAMINITE: Siltstone, dark grey interlaminated with Sandstone, fine grained, grey.		
15.35	SANDSTONE: medium to coarse grained, grey, with dark grey laminae.		
15.6	as above, but fine to medium grained.		
16.1	SANDSTONE: medium to coarse grained, light grey, with dark grey laminae.		
16.8	as above, but with fine to medium grained bands.		
17.4	SANDSTONE: medium to coarse grained, light grey, cross bedded at up to 20°, with dark grey laminae.		
18.0	SANDSTONE: medium to coarse grained, light grey, massive, occasional dark grey laminae.		

Point load strength index results (axial × / diametral •):

0.70	2.0
0.60	1.3
0.40	2.2
1.5	1.8
1.4	2.1
0.80	0.70
1.1	1.4

Defect details (specific):

- (12.18m) J, 40°, Un, R, Cn
- (13.24m) XWS, 5°, 5 mm.t
- (13.39m) J, 70°, C, R, Cn
- (13.45-13.60m) Cr, asssociated with 3 J and Be
- (15.33m) Be, 2°, P, R, Cb Sn
- (16.10m) Be, 13°, P, R, Cb Vn
- (16.50m) J, 73°, Un, R, Cn
- (16.71m) Jx2, 80°, Un, R, Clay Ct
- (17.30m) Jx2, 83°, Ir, Vr, Cn
- (17.40m) XWS, 12°, 7 mm.t
- (17.90m) XWS, 13°, 5 mm.t

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

EASTING: 314228.13
NORTHING: 6258134.10

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT
Date: 16/10/20
Plant Type: JK308
Core Size: HQ (6m to 9.8m) NMLC (9.8m to END)
Inclination: VERTICAL
Bearing: N/A
R.L. Surface: 17.27 m
Datum: AHD
Logged/Checked By: B.Z./D.B.

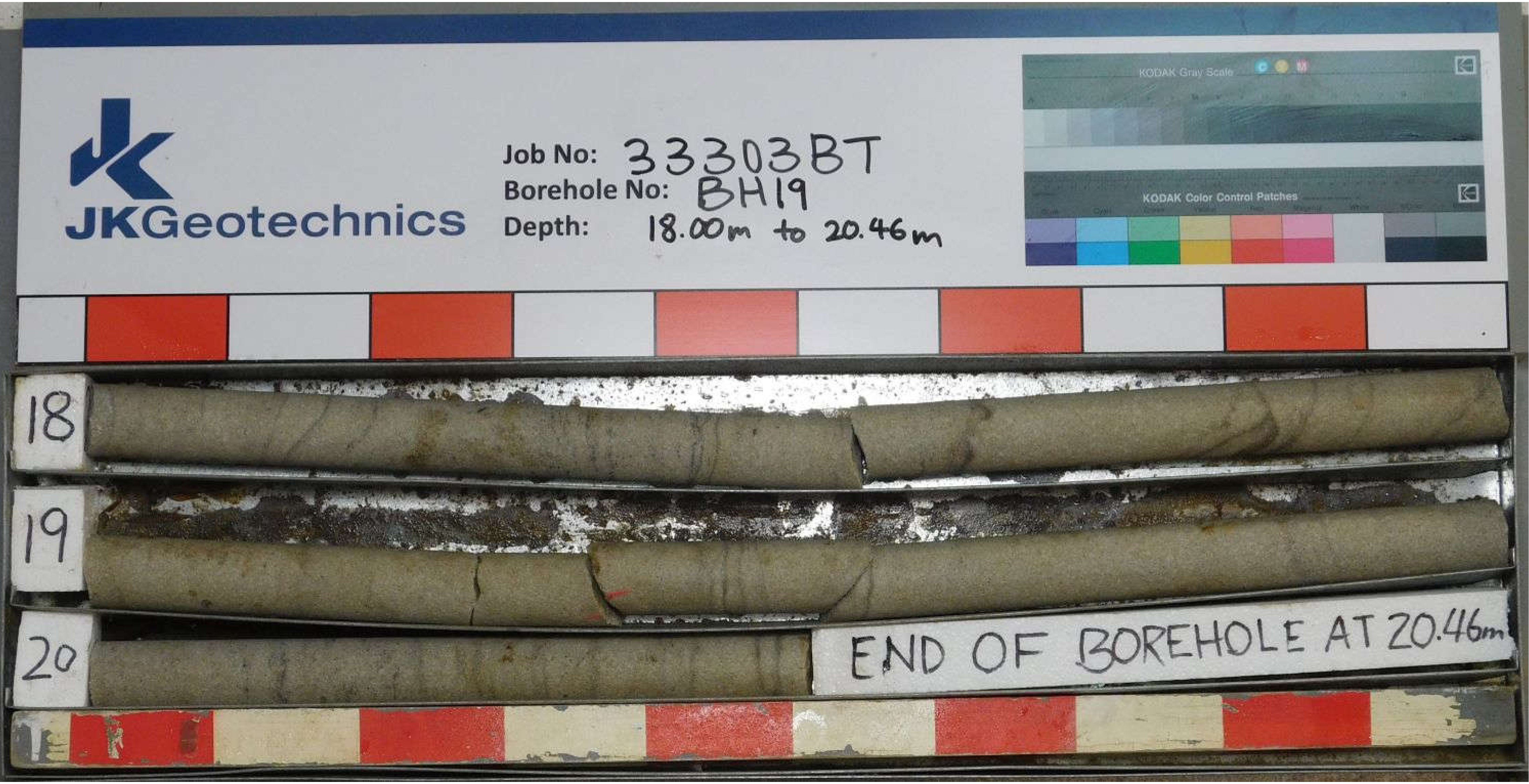
Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness (Specific / General)	Formation
100% POLYMER RETURN		-2, -3	20		SANDSTONE: medium to coarse grained, light grey, massive, occasional dark grey laminae. *(continued)*	FR	H	1.0×•1.8; 1.6×•2.1			Hawkesbury Sandstone
		-4, -5, -6, -7, -8	21, 22, 23, 24, 25		END OF BOREHOLE AT 20.46 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 33303BT
Borehole No: BH19
Depth: 6.00m to 9.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT . BH19 . CORING STARTS AT: 6.0m
6
7
8


JKGeotechnics
Job No: 33303BT
Borehole No: BH19
Depth: 9.00m to 13.00m
KODAK Gray Scale
KODAK Color Control Patches
9
10
11
12


JKGeotechnics
Job No: 33303BT
Borehole No: BH19
Depth: 13.00m to 18.00m
KODAK Gray Scale
KODAK Color Control Patches
13
14
15
16
17


JKGeotechnics
Job No: 33303BT
Borehole No: BH19
Depth: 18.00m to 20.46m
KODAK Gray Scale
KODAK Color Control Patches
18
19
20
END OF BOREHOLE AT 20.46m

JKGeotechnics

BOREHOLE LOG

Borehole No. 20

EASTING: 314243.81
NORTHING: 6258157.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 17.38 m
Date: 13/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.S./D.B.

Groundwater Record	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING			FILL: Silty sand, fine grained, brown, trace of root fibres and fine grained igneous gravel.	D			GRASS COVER APPEARS POORLY COMPACTED
	N = 3 2,1,2		FILL: Clayey sand, fine to medium grained, brown, with silt, and a trace root fibres and ash.	M			
	N = 6 2,2,4		FILL: Silty clay, low plasticity, dark grey, brown and orange brown, trace of fine to medium grained sand, root fibres, ash, slag fragments and fine to medium grained ironstone and igneous gravel.	w>PL			
		CI	Silty CLAY: medium plasticity, orange brown and brown, trace of fine to medium grained ironstone gravel and ash.	w>PL	VSt	310 290 300	RESIDUAL
	N > 11 8,11/ 75mm REFUSAL		Sandy CLAY: medium plasticity, red brown, orange brown and grey, fine to medium grained sand, trace of fine to coarse grained ironstone gravel and silt.	w~PL	(Hd)	410 450 400	
		-	Extremely Weathered sandstone: clayey SAND, fine to medium grained, light grey and red brown, with iron indurated bands.	XW	D	>600 >600 >600	HAWKESBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE
			as above, but with very low strength and siltstone bands.	XW - DW	Hd / VL		VERY LOW RESISTANCE WITH LOW BANDS
			LAMINITE: Sandstone, fine grained, grey and orange brown, interlaminated with Siltstone, dark grey.	DW	L - M		MODERATE RESISTANCE

BOREHOLE LOG

Borehole No.
20

EASTING: 314243.81
NORTHING: 6258157.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 17.38 m
Date: 13/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.S./D.B.

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
									-	LAMINITE: Sandstone, fine grained, grey and orange brown, interlaminated with Siltstone, dark grey.	DW	L - M		MODERATE RESISTANCE
						10				REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 20.95m. MACHINE SLOTTED CLASS 18 PVC 20.95m TO 8.95m, HAND SLOTTED CLASS 18 PVC TO 8.59m TO 5.95m, CASED 5.95m TO 0m. SAND FILTER PACKED 20.95m TO 5.95m, BENTONITE SEAL 5.95m TO 3m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
							8							
						9								
							9							
						8								
							10							
						7								
							11							
						6								
							12							
						5								
							13							
						4								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
20

EASTING: 314243.81
NORTHING: 6258157.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT	**Core Size:** HQ	**R.L. Surface:** 17.38 m
Date: 13/10/20	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** B.S./D.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	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: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) – Specific / General	Formation
				START CORING AT 7.25m					
50% RETURN		10		LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, grey.	SW	M	0.20 × •0.70	(7.37m) Be, 0°, Un, R, Fe Vn (7.73m) Be, 0°, Un, R, Fe Vn (7.79m) Be, 5°, Un, R, Clay FILLED, 5 mm.t (7.89m) XWS, 0°, 15 mm.t	Hawkesbury Sandstone
		9, 8, 7, 6	8, 9, 10, 11	SANDSTONE: fine grained, grey, with dark grey laminae.	FR	H	0.20 × •1.1 1.4 •1.6 0.50 × •1.4 0.60 × •1.9	(8.06m) XWS, 0°, 5 mm.t (9.06m) XWS, 5°, 10 mm.t (9.84m) XWS, 0°, 20 mm.t	
			12	LAMINITE: Siltstone, dark grey, interlaminated with Sandstone, fine grained, grey.				(12.09m) XWS, 0°, 40 mm.t	
		5	13	SANDSTONE: fine to medium grained, light grey and grey.			0.90 × •1.8	(12.25-12.60m) J, 75 - 90°, Ir, R, Cn	
		4		SANDSTONE: fine to medium grained, grey, cross bedded at up to 25°, with dark grey laminae and carbonaceous lenses.			1.4 × •2.1		

SPACING (mm): 600, 200, 60, 20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
20

EASTING: 314243.81
NORTHING: 6258157.66

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT | **Core Size:** HQ | **R.L. Surface:** 17.38 m
Date: 13/10/20 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK308 | **Bearing:** N/A | **Logged/Checked By:** B.S./D.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	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 – Description (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness)	Formation
50% RETURN		3 to 1	14.0 – 17.04	SANDSTONE: fine to medium grained, grey, cross bedded at up to 25°, with dark grey laminae and carbonaceous lenses. *(continued)*		H	1.6 / 1.5; 1.5 / 1.4; 1.2 / 1.3		Hawkesbury Sandstone
		0 to -1	17.04 – 19.35	SANDSTONE: fine to coarse grained, light grey, massive, occasional carbonaceous lenses			0.80 / 0.90; 1.5 / 1.6	(17.12m) J, 70°, Pl, R, Cn; (17.14m) J, 70°, Pl, R, Clay FILLED, 3 mm.t	
		-2 to -3	19.35 – 20.95	SANDSTONE: fine to coarse grained, light grey, cross bedded at up to 20° with dark grey laminae, coarse grained bands, quartz inclusions, siltstone clasts and occasional carbonaceous lenses.			0.40 / 2.1	(20.04m) J, 60°, Ir, R, Cn	

END OF BOREHOLE AT 20.95 m

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 33303BT
Borehole No: BH20
Depth: 7.25m - 10.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT, BH20, START CORING AT 7.25m
7
8
9


JKGeotechnics
Job No: 33303BT
Borehole No: BH20
Depth: 10.00m - 14.00m
KODAK Gray Scale
KODAK Color Control Patches
10
11
12
13


JKGeotechnics
Job No: 33303BT
Borehole No: BH20
Depth: 14.00m - 18.00m
KODAK Gray Scale
KODAK Color Control Patches
14
15
16
17


JKGeotechnics
Job No: 33303BT
Borehole No: BH20
Depth: 18.00m - 20.95m
KODAK Gray Scale
KODAK Color Control Patches
18
19
20
END OF BOREHOLE AT 20.95m

JKGeotechnics

BOREHOLE LOG

Borehole No.
21

EASTING: 314227.03
NORTHING: 6258216.07

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 14.60 m
Date: 9/10/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

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
							FILL: Silty sand, fine to medium grained, dark brown, with root fibres.	M			TIMBER MULCH COVER
	DB	N = 7 6,5,2	14				FILL: Gravelly clay, medium plasticity, brown and grey, fine to coarse grained, sub-angular and angular igneous, and ironstone gravel.	w<PL			APPEARS POORLY COMPACTED
				1			as above, but dark brown.	w~PL			
▶		N = 4 3,2,2	13			ML	Clayey SILT: low plasticity; brown and grey.	w>PL	(S - F)		ALLUVIAL
				2			END OF BOREHOLE AT 1.95 m				
			12	3							
			11	4							
			10	5							
			9	6							
			8								

JKGeotechnics

BOREHOLE LOG

Borehole No. 22

1 / 4

EASTING: 314197.71
NORTHING: 6258119.25

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Method:** SPIRAL AUGER **R.L. Surface:** 17.02 m
Date: 14/10/20 **Datum:** AHD
Plant Type: JK305 **Logged/Checked By:** B.S./D.B.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	DS			FILL: Silty sand, fine to medium grained, dark brown, with concrete fragments, trace of root fibres, fine grained igneous gravel and sandy clay bands.	M			GRASS COVER APPEARS MODERATELY TO WELL COMPACTED
	DS	N = 18 19,10,8		FILL: Silty sandy Clay, low plasticity, brown and orange brown, trace of fine grained igneous and ironstone gravel and concrete fragments.	w>PL			
	DS	N > 23 4,7,16/ 140mm REFUSAL		FILL: Silty clay, low plasticity, light grey, orange brown and brown, with fine to medium grained sand, fine to medium grained siltstone gravel, and a trace of fine grained igneous and ironstone gravel.				
			-	Extremely Weathered sandstone: clayey SAND, fine grained, light grey with extremely weathered siltstone and ironstone bands.	D	Hd	>600 >600 >600	HAWKESBURY SANDSTONE
	DS			Interbedded SANDSTONE and SILTSTONE: fine grained, grey and orange brown, sandstone, interbedded with grey siltstone, with iron indurated and extremely weathered bands.	DW	VL		VERY LOW 'TC' BIT RESISTANCE WITH LOW BANDS
	DS			Interbedded SILTSTONE and SANDSTONE: dark grey siltstone, interbedded with fine grained, grey and orange brown, sandstone.		L - M		LOW TO MODERATE RESISTANCE
	DS			SANDSTONE: fine grained, light grey and grey, with laminite bands.		M - H		HIGH RESISTANCE
				REFER TO CORED BOREHOLE LOG				

RL (m AHD): 16, 15, 14, 13, 12, 11
Depth (m): 1, 2, 3, 4, 5, 6

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. **22**

EASTING: 314197.71
NORTHING: 6258119.25

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** NMLC **R.L. Surface:** 17.02 m
Date: 14/10/20 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: JK305 **Bearing:** N/A **Logged/Checked By:** B.S./D.B.

START CORING AT 5.10m

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	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 – Description (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) – Specific	Formation
75% RETURN			5.10	SANDSTONE: fine grained, grey, with dark grey laminae and laminite bands.	SW	H		(5.19m) Be, 0°, Un, R, Fe Vn	Hawkesbury Sandstone
			~5.35	LAMINITE: Sandstone, fine grained, grey, interlaminated with Siltstone, dark grey.	FR	H	0.80 × • 1.1		
		11	6						
								(6.54m) Be, 0°, Pl, R, Cn	
							1.0 × • 2.8		
		10	7				0.90 × • 2.1		
								(7.85m) Be, 0°, Pl, R, Cn	
		9	8				0.80 × • 2.5		
100% RETURN		8	9						
			~9.45	SANDSTONE: fine grained, grey, with dark grey laminae and laminite and siltstone bands.		H - VH	0.50 × • 3.3		
		7	10				1.4 × • 3.5		
		6	11	LAMINITE: Sandstone, fine grained, grey, interlaminated with Siltstone, dark grey, with fine grained sandstone bands.		H		(11.31m) Be, 0°, Pl, R, Cn	
							0.60 × • 1.9		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

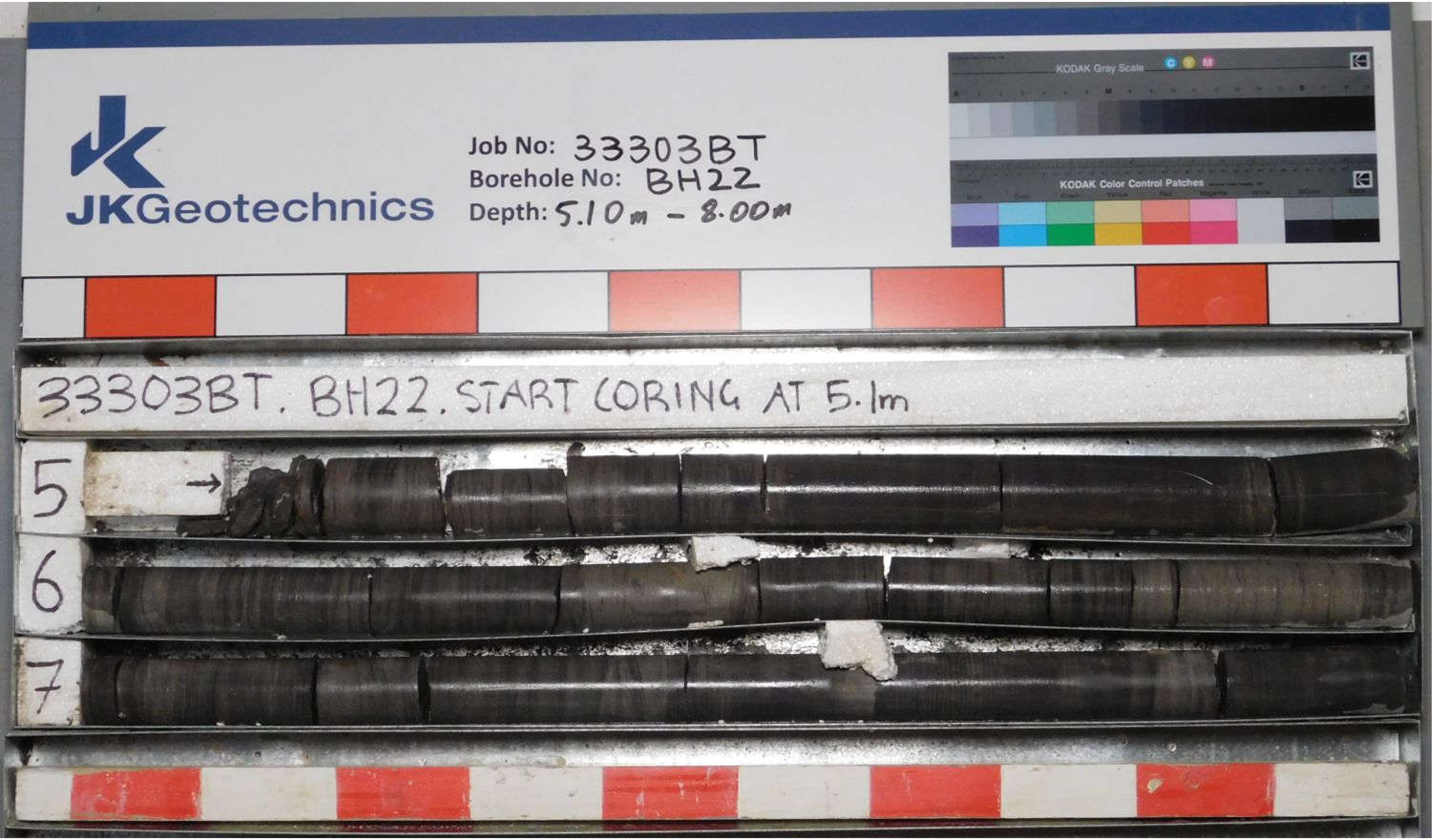
EASTING: 314197.71
NORTHING: 6258119.25

Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT | **Core Size:** NMLC | **R.L. Surface:** 17.02 m
Date: 14/10/20 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK305 | **Bearing:** N/A | **Logged/Checked By:** B.S./D.B.

Water Loss\Level	RL (m AHD)	Depth (m)	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 – DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) – Specific	Formation
100% RETURN			SANDSTONE: fine grained, grey, with dark grey laminae. *(continued)*	FR	H	0.60 / 2.6		Hawkesbury Sandstone
	4	13					(13.28m) XWS, 0°, 15 mm.t	
							(13.35m) J, 50°, Ir, R, Clay FILLED, 5 mm.t	
			SANDSTONE: fine to medium grained, grey, cross bedded at up to 20°, with dark grey laminae, carbonaceous lenses and laminite bands.			1.3 / 1.3		
	3	14				1.1 / 1.5	(14.67m) Be, 0°, Un, R, Vn	
	2	15	as above, but with siltstone and fine grained sandstone bands.			1.7 / 1.6		
	1	16	SANDSTONE: fine to medium grained, grey, cross bedded at up to 20°, with dark grey laminae, carbonaceous lenses and siltstone clasts.				(16.07m) Be, 8°, Un, R, Cb Sn	
						1.6 / 2.4		
	0	17				0.40 / 1.4	(17.73m) XWS, 10°, 2 mm.t	
	-1	18					(18.07m) XWS, 0°, 15 mm.t	
			SANDSTONE: fine to medium grained, light grey, massive, with dark grey laminae.			1.6 / 1.7		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 33303BT
Borehole No: BH22
Depth: 5.10m - 8.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT. BH22. START CORING AT 5.1m
5
6
7


JKGeotechnics
Job No: 33303BT
Borehole No: BH22
Depth: 8.00m - 12.00m
KODAK Gray Scale
KODAK Color Control Patches
8
9
10
11


JKGeotechnics
Job No: 33303BT
Borehole No: BH22
Depth: 12.00 m - 16.00 m
KODAK Gray Scale
KODAK Color Control Patches
12
13
14
15


JKGeotechnics
Job No: 33303BT
Borehole No: BH22
Depth: 16.00 m - 20.00 m
KODAK Gray Scale
KODAK Color Control Patches
16
17
18
19


JKGeotechnics
Job No: 33303BT
Borehole No: BH22
Depth: 20.00 m - 20.66 m
KODAK Gray Scale
KODAK Color Control Patches
20
END OF HOLE AT 20.66

PLOT DATE: 2/11/2020 3:21:51 PM DWG FILE: Y:\33000'S\33303BT WESTMEAD\CAD\33303BT.DWG

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:

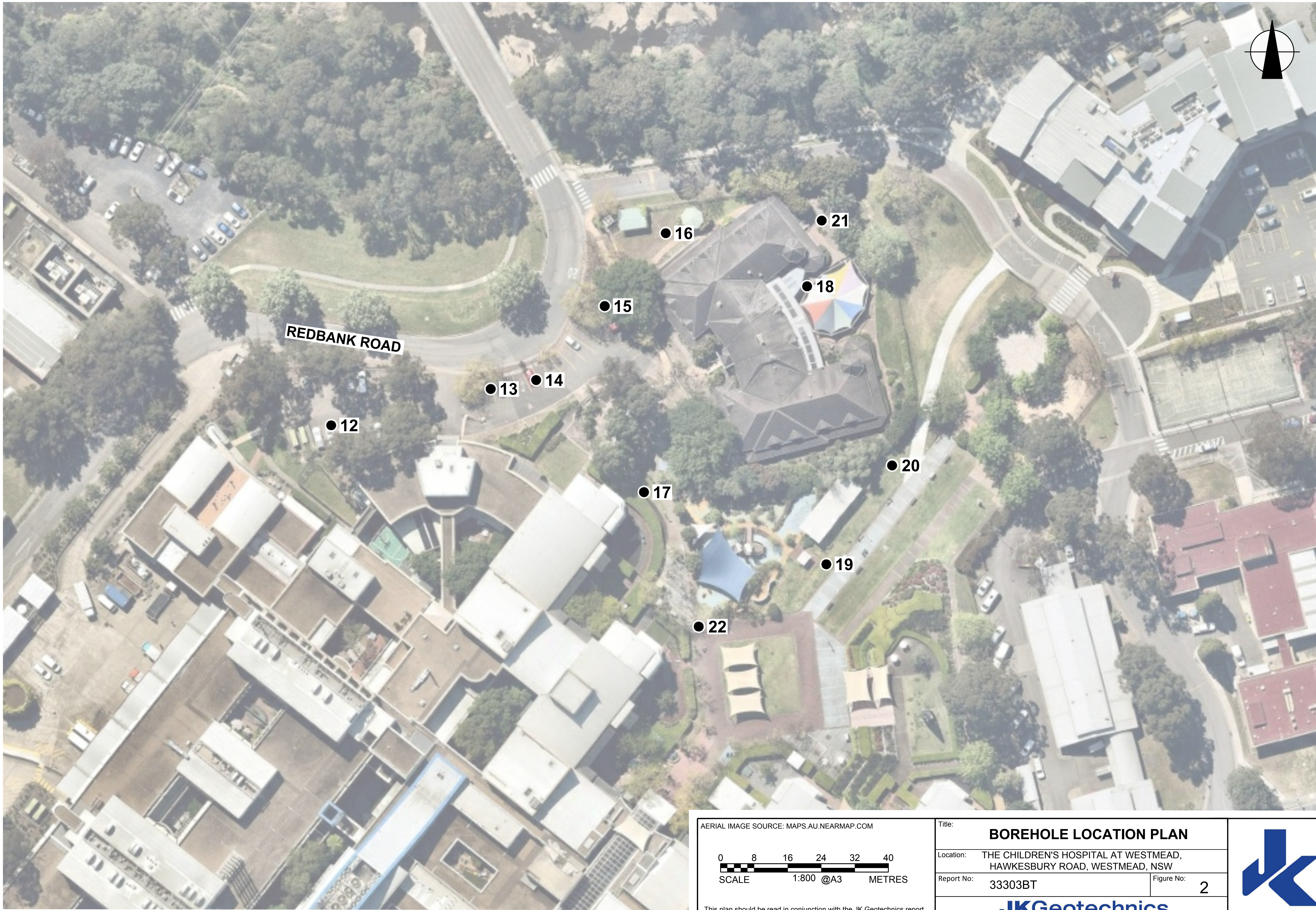
SITE LOCATION PLAN

Location: THE CHILDREN'S HOSPITAL AT WESTMEAD, HAWKESBURY ROAD, WESTMEAD, NSW

Report No: 33303BT

Figure No: 1

JKGeotechnics



AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 8 16 24 32 40

SCALE 1:800 @A3 METRES

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

Title: **BOREHOLE LOCATION PLAN**

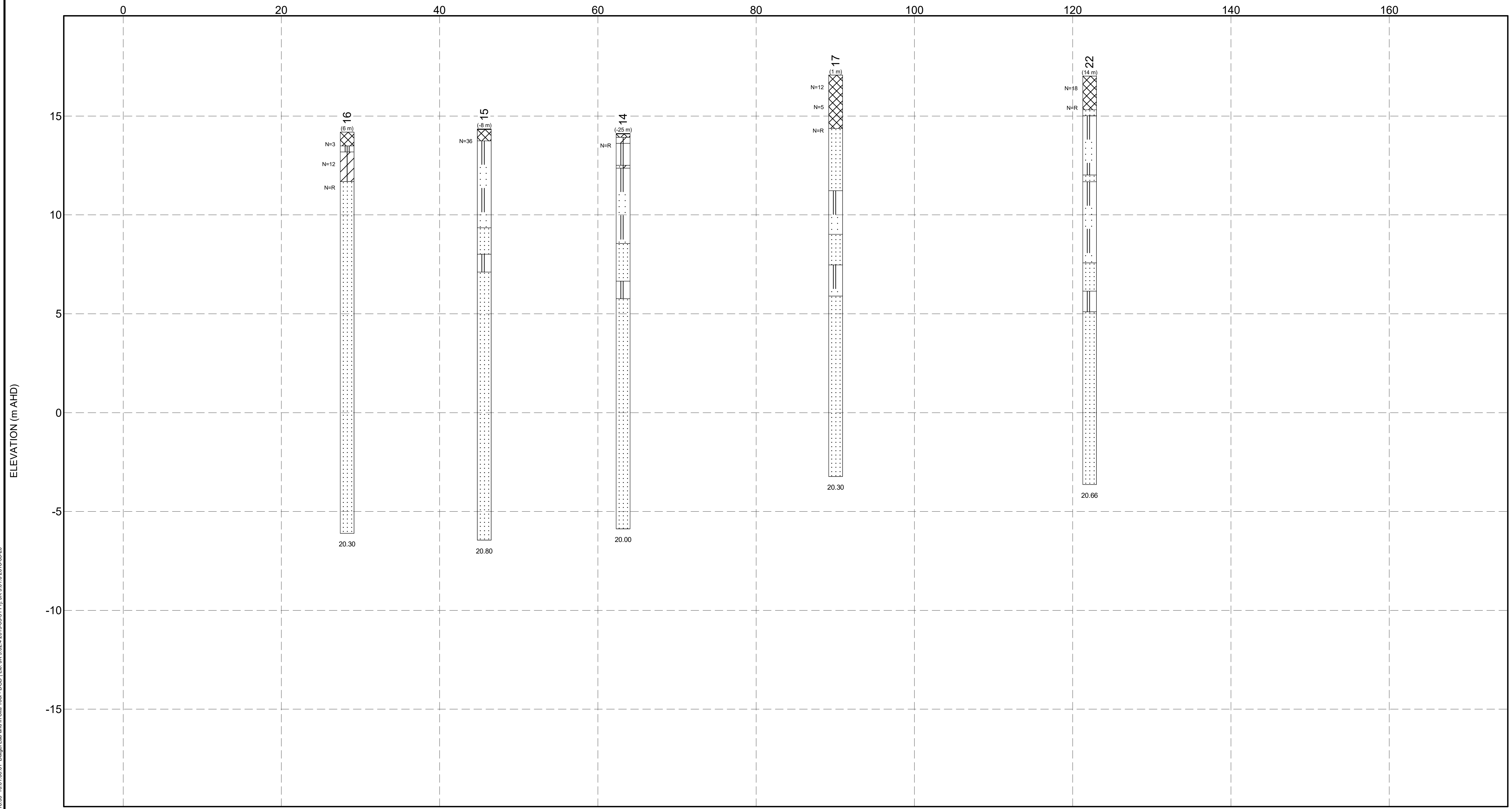
Location: THE CHILDREN'S HOSPITAL AT WESTMEAD, HAWKESBURY ROAD, WESTMEAD, NSW

Report No: 33303BT

Figure No: 2

JKGeotechnics

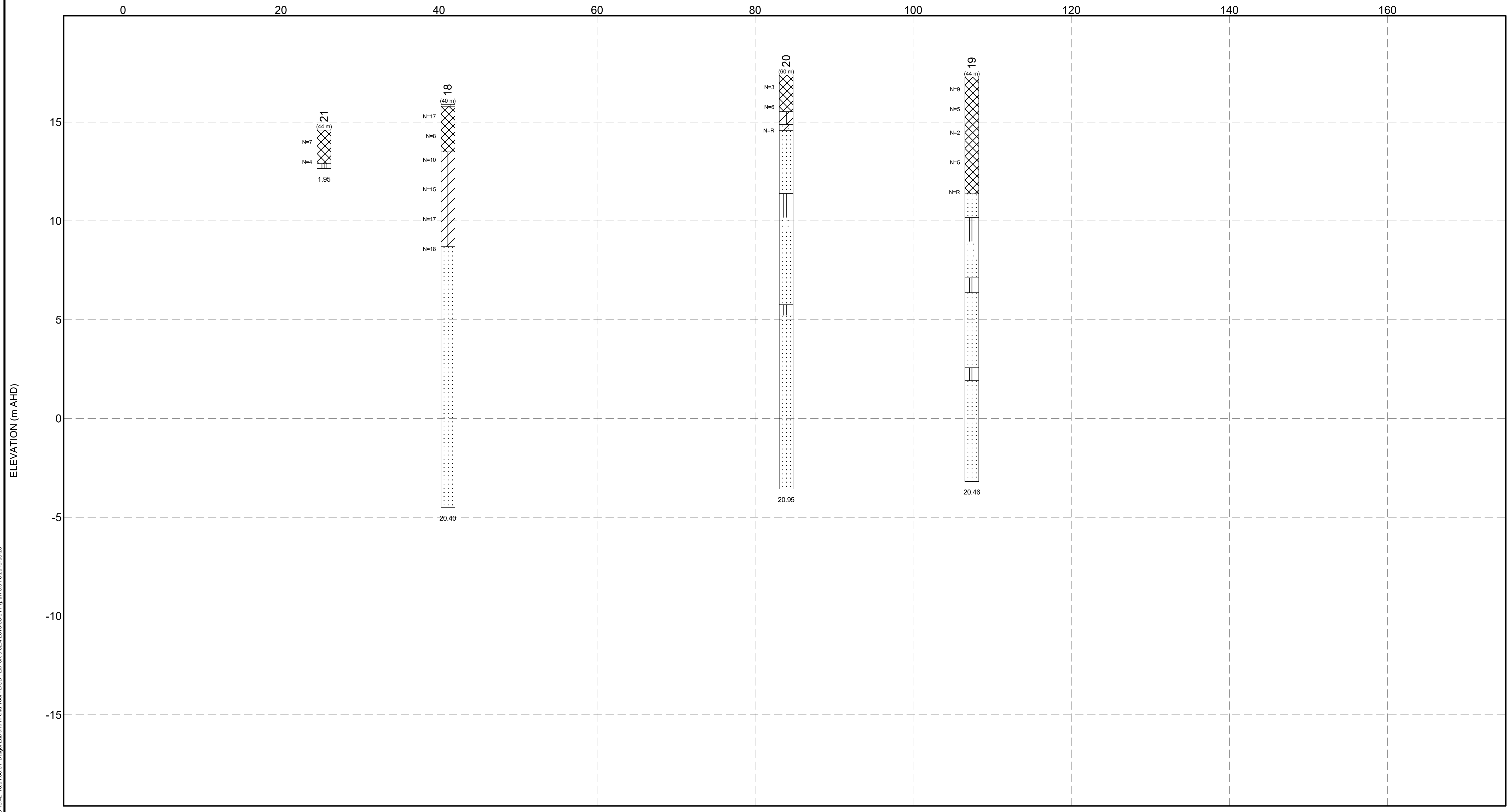
PLOT DATE: 26/10/2020 3:29:01 PM DWG FILE: Y:\33000'S\33303BT WESTMEAD\CAD\33303BT.DWG



MATERIAL GRAPHIC

- ASPHALTIC CONCRETE
- CLAYEY SILT (ML, MH)
- SANDY SILTY CLAY (CL, CI, CH)
- SILTY CLAY (CL, CI, CH)
- FILL
- LAMINITE (SILTSTONE, SANDSTONE)
- SANDSTONE

GRAPHICAL BOREHOLE SUMMARY HEALTH INFRASTRUCTURE HAWKESBURY ROAD, WESTMEAD, NSW THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT	DRAWN D.M.	DATE 4/11/2020	
	CHECKED D.B.	DATE 4/11/2020	
	SCALE H 1:500 V 1:200		A3
	PROJECT No 33303BT	FIGURE No 3	



MATERIAL GRAPHIC

- BRICK OR PAVERS
- CLAYEY SILT (ML, MH)
- SANDY CLAY (CL, CI, CH)
- SILTY CLAY (CL, CI, CH)
- FILL
- LAMINITE (SILTSTONE, SANDSTONE)
- SANDSTONE

GRAPHICAL BOREHOLE SUMMARY HEALTH INFRASTRUCTURE HAWKESBURY ROAD, WESTMEAD, NSW THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT	DRAWN D.M.	DATE 4/11/2020	
	CHECKED D.B.	DATE 4/11/2020	
	SCALE H 1:500 V 1:200		A3
	PROJECT No 33303BT	FIGURE No 4	

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 ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 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 or where only a limited investigation has been completed or 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:

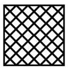
i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

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

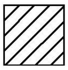
iii) full time engineering presence on site.

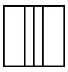
SYMBOL LEGENDS

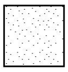
SOIL

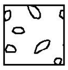
 FILL

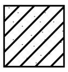
 TOPSOIL

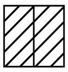
 CLAY (CL, CI, CH)

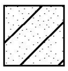
 SILT (ML, MH)

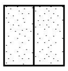
 SAND (SP, SW)

 GRAVEL (GP, GW)

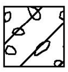
 SANDY CLAY (CL, CI, CH)

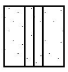
 SILTY CLAY (CL, CI, CH)

 CLAYEY SAND (SC)

 SILTY SAND (SM)

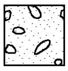
 GRAVELLY CLAY (CL, CI, CH)

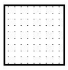
 CLAYEY GRAVEL (GC)

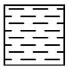
 SANDY SILT (ML, MH)

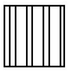
 PEAT AND HIGHLY ORGANIC SOILS (Pt)

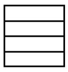
ROCK

 CONGLOMERATE

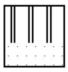
 SANDSTONE

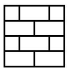
 SHALE/MUDSTONE

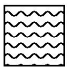
 SILTSTONE

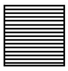
 CLAYSTONE

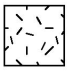
 COAL

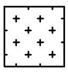
 LAMINITE

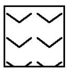
 LIMESTONE

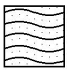
 PHYLLITE, SCHIST

 TUFF

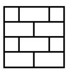
 GRANITE, GABBRO

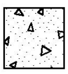
 DOLERITE, DIORITE

 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:

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

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:

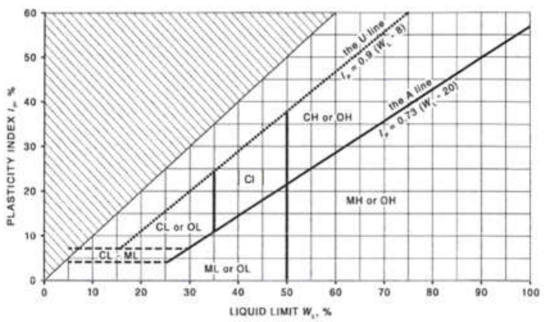
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

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



JKGeotechnics

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)	 VL L MD D VD ( )	**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)** VERY LOOSE ≤ 15 / 0 – 4 LOOSE > 15 and ≤ 35 / 4 – 10 MEDIUM DENSE > 35 and ≤ 65 / 10 – 30 DENSE > 65 and ≤ 85 / 30 – 50 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.

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 $Is_{(50)}$ (MPa)	Guide to Strength: 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