REPORT TO

NSW HEALTH INFRASTRUCTURE

ON

GEOTECHNICAL INVESTIGATION

FOR

EARLY WORKS - INTEGRATED MENTAL HEALTH COMPLEX

AT

WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

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1 INTRODUCTION

This report has been prepared as part of a Review of Environmental Factors for the Early Works Project at Westmead Hospital which proposes a series of infrastructure improvements to accommodate the future development of the Integrated Mental Health Complex (proposed separately as part of State Significant Development Application SSD-44034342).

The purpose of this report is to assess the potential impacts which could arise from the proposed works, which include:

- Demolition of the existing Brain Injury Rehabilitation Unit building, Casuarina Lodge and office buildings;
- Diversion of existing in-ground sewer and water services;
- Construction of a new access way to the P14 staff car park;
- Flood mitigation works; and
- Bulk earthworks and tree removal to accommodate the carrying out of the above works.

The proposed works will be carried out within the boundaries of Westmead Hospital, which is located approximately 1.5km north-west of the Parramatta Central Business District (CBD), the primary metropolitan centre of Western Sydney. The site is legally described as Lot 1 DP1194390 and Lot 4 DP 1077852, with works proposed in the central part of the precinct.

This report presents the results of a geotechnical investigation for the proposed Early Works on the Integrated Mental Health Complex (IMHC) at Westmead Hospital, Dragonfly Drive, Westmead, NSW. The location of the site is shown in Figure 1. The investigation was commissioned by Health Infrastructure (Contract No. HI21219) in consultation with the project manager, CBRE.

We understand an early works package has been prepared for the project which will require bulk earthworks to allow for demolition, new accessways and other infrastructure related items. We expect up to about 1m of filling above the existing ground surface to achieve proposed subgrade level, although the majority of the area will remain at or close to the existing grade. There may be localised excavations up to 4m deep.

The purpose of the investigation was to obtain geotechnical information on the subsurface conditions at the nominated borehole locations, and to use this as a basis for providing comments and recommendations on the relevant geotechnical aspects.

2 INVESTIGATION PROCEDURE

This geotechnical investigation was carried out in general accordance with the scope nominated by Arup. The Arup Scope recommended the drilling of a total of eight boreholes (BH1 to BH8 inclusive). BH1 to BH7 were to be drilled to depths of 20m or at least 4.5m into medium strength bedrock, and BH8 was to be drilled to at least 1.5m depth in order to collect samples for soaked CBR testing.

The geotechnical investigation was carried out between 19 October 2021 and 25 October 2021. The borehole locations were set out as close as possible to the locations nominated by Arup and are shown on the attached Figure 2. Prior to commencement of drilling, either a borehole or a trench on two sides of the boreholes were vacuum excavated to a minimum depth of 1.5m or until natural material was encountered, whichever was shallower. Where vacuum excavation of the borehole itself was carried out, this portion was logged based upon our visual observations of the vacuum excavation side walls from the top of the excavation and therefore was limited. Furthermore, asbestos management controls were in place throughout the investigation in accordance with the Asbestos Management Plan prepared by JK Environments due to the known presence of asbestos within the fill present over the site. Following drilling, the 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).

BH1 to BH7 were initially auger drilled to depths ranging from 5.90m to 9.54m and were then continued by diamond coring techniques using an NMLC core barrel with water flush to depths ranging from 11.10m to 16.09m. BH8 was auger drilled to a termination depth of 3.45m. The boreholes were drilled using our track mounted JK308 drill rig.

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 ($I_{S(50)}$) tests and Unconfined Compressive Strength (UCS) tests completed on the recovered core. The Point Load Strength Index tests are summarised in the attached Table D. The UCS test results sheets are also attached.

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 BH2, BH4 and BH6 to allow further groundwater readings to be made. Data loggers were installed into the wells on 5 November 2021 with groundwater monitoring occurring between 5 November 2021 and 6 February 2022.

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, four day soaked CBR values and particle size distribution, as shown in STS Tables A, B and C. Macquarie Geotechnical tested rock core samples to determine Unconfined Compressive Strengths, as shown in their report Nos. S72188 to S72201. Envirolab Services tested soil samples to determine pH, sulphate content, chloride content and resistivity, as shown in their Certificate of Analysis 281608.

We also reviewed previous geotechnical reports by others, of which two reports were relevant to the proposed development, and are as follows. The relevant borehole logs have been included as Appendix A to this report.

- Geotechnical Investigation report prepared by JK Geotechnics for the proposed PSB building to the south-east of the subject site, Ref: 33303Brpt1 dated 20 January 2021. The relevant borehole logs include PSB1 and PSB2.
- Geotechnical investigation report prepared by Douglas Partners, Ref: 73960.01, Revision 1 dated 19 May 2015. The relevant borehole logs include DP17 and DP21.

We note additional testing was carried out than those detailed above, however typically comprised shallow investigations, say less than 3m deep, and therefore provide little to no additional information. 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 the supplied 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 it is understood that during construction of the original hospital, the area was potentially utilised as a building waste pit. Primarily for contaminated fill and is therefore known to contain widespread asbestos materials.

3.2 Site Description

The subject site is located in the north, central part of the Health Precinct. Generally surface levels across the precinct 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 precinct. 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 site is located to the north-west of the Children's Hospital at the corner of Dragonfly Drive and Redbank Road. The site is currently occupied by the Brain Injury Unit (BIRS) over the northern two thirds of the south-eastern half of the site, site sheds within the southern corner of the south-eastern half and external car parking covering the remaining north-western side of the site. The BIRS building consists of a one to two storey brick building that generally appeared in good condition based upon a cursory external inspection. The existing external car park comprised an asphaltic concrete (AC) pavement that generally appeared in moderate to good condition with occasional longitudinal cracking observed, typically less than 2mm wide.

The site is bounded by Redbank Road and Dragonfly Drive to the south-east and south-west, respectively, which both comprise of AC pavements that appear in good condition with no observed damage based on a cursory inspection from the footpaths. To the north, the site is bounded by a continuation of the external car park present over the north-western side of the subject site. The site is bounded to the north-west by landscape areas and one to two storey buildings, known to form part of Casuarina Lodge.

The site is bounded by an external carpark to the north-east, with a single storey childcare centre present beyond the carpark. The pavements were AC and generally appeared in moderate condition with some crocodile and longitudinal cracking observed. The child care building comprised a single storey brick building that generally appeared in good condition based upon a cursory external inspection.

3.3 Subsurface Conditions

The Penrith 1:100,000 Geological Series Sheet 9030 indicates that the site is mapped to be located within the Hawkesbury Sandstone geological unit but is also within close proximity to the boundary with Ashfield Shale towards the south-east portion of the site. 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 overlying residual silty clay that graded into weathered siltstone, laminite and interbedded siltstone and sandstone within the upper rock profile, with sandstone bedrock 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. We have also included information of boreholes from previous investigations, where relevant, and primarily in relation to the underlying bedrock.

Pavements and Fill

In BH3, asphaltic concrete (AC) of 50mm thickness was initially encountered, underlain by clayey gravel to 0.2m depth. The clayey gravel comprised igneous gravel and may represent base or subbase layers below the AC.

Fill was encountered in all boreholes from the either the surface, or from below the pavement (in BH3) and extended to depths ranging from 1.4m to 4.4m. The fill depth was relatively similar over the majority of the site and was typically less than 1.7m deep, however approaching the northern end of the site the depth of fill appears to deepen, as was evident in BH5 and BH7 where the fill was 4.4m and 3.9m deep, respectively.

The fill was predominantly clayey fill but contained varying amounts of sands, gravels and other deleterious materials, such as concrete and brick fragments and slag. The fill also occasionally contained cobble sized ironstone and sandstone inclusions. Based on the limited SPT 'N' values, the fill was of variable compaction, but predominantly appeared to be poorly to moderately compacted. We note that in some boreholes, observations and testing of the fill was limited due to the boreholes being vacuum excavated to at least 1.5m depth and therefore logging of the fill was based upon visual observations made from the side walls of the vacuum excavation.

Residual Silty Clay

Residual silty clay was encountered in all boreholes below the fill and was assessed to be of medium to high plasticity and generally of very stiff to hard strength.

Weathered Bedrock

Weathered bedrock was encountered in BH1 to BH7, PSB1, PSB2, DP17 and DP21 at depths ranging from 4.3m to 7.8m. The level of the surface of the rock ranged from RL14.8m to RL10.0m and typically graded down towards the north and north-west. Generally, the upper bedrock comprised extremely weathered siltstone, that graded into siltstone and laminite (interlaminated siltstone and sandstone) assessed to be distinctly weathered and of very low, low and medium strength. With depth, the rock was assessed to be slightly weathered and then fresh and of medium to high strength, and even very high strength in some boreholes. In some boreholes the rock graded from siltstone to sandstone.

Within BH1 to BH7, as well as PSB1, PSB2, DP17 and DP21 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. Table 1 provides the depths and levels where each class of rock was encountered in each borehole. We note that the rock encountered would be initially classified as "Shale" and then with depth would be "Sandstone" and so there is some interpretation of the rock classes between the two rock types, with the shallowest rock classes being more like "Shale" and the deeper rock classes more like "Sandstone". 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. It should be noted that the bedrock in DP17 and DP21 was logged as "Shale" which was considered acceptable in accordance with the previous version of AS1726-1993 and was used as a generalised description to incorporate several types of bedrock, such as mudstone, siltstone, claystone, etc. However, based on the latest AS1726-2017 version, the use of "Shale" no longer applies to the bedrock encountered on this site and instead the use of "Siltstone" is used which is considered a more accurate description. Notwithstanding, for

the purposes of the report the "Shale" logged in DP17 and DP21 may be considered the same as "Siltstone" as logged in the other boreholes.

We note we have undertaken a rock classification of the relevant boreholes on the basis of this proposed development and therefore the rock classification may vary slightly than those provided in the previous reports.

Table 1: Showing Assessed Rock Classification

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)
1	4.7m (Siltstone)	11.9m	-	-	5.7m (Siltstone)	10.9m	6.3m (Siltstone)	10.3m
2	4.5m (Siltstone)	13.4m	-	-	6.9m (Siltstone)	11.0m	7.6m (Siltstone)	10.3m
3	6.6m (Siltstone)	11.1m	-	-	-	-	7.6m (Siltstone)	10.4m
4	6.0m (Siltstone)	10.9m	7.6m (Siltstone)	9.3m	9.1m (Laminite)	7.8m	10.5m (Laminite)	6.4m
5	7.6m (Siltstone)	10.1m	-	-	8.7m (Siltstone)	9.0m	9.1m (Siltstone) 10.3 (Sandstone)	8.6m 7.35m
6	7.5m (Siltstone) 9.5 (Sandstone)	9.9m 7.5m	-	-	-	-	12.4m (Sandstone)	5.0m
7	7.6m (Siltstone) 10.5m (Sandstone)	10.0m 7.1m	-	-	-	-	12.1m (Sandstone)	5.5m
PSB1	9.2m (Siltstone)	11.1m	9.2m (Laminite)	11.1m	10.0m (Laminite)	10.3m	10.5m (Laminite) 12.2m (Sandstone)	9.8m 8.1m
PSB2	8.6m (Siltstone)	11.3m	8.9m (Siltstone)	11.0m	9.4m (Sandstone)	10.6m	10.4m (Sandstone) 11.4m (Laminite) 13.1m (Sandstone)	9.5m 8.5m 6.8m
DP17	5.3m (Siltstone)	14.8m	7.4m (Siltstone)	12.7m	9.0m (Siltstone)	11.1m	10.8m (Laminite)	9.3m
DP21	8.4m (Laminite)	12.6m	-	-	9.5m (Laminite)	11.5m	10.2m (Laminite) 14.9m (Sandstone)	10.8m 6.1m

Groundwater

Groundwater seepage was only encountered during auger drilling in BH7 at 4.5m depth with groundwater measured on completion of BH4 and BH6 at depths of 4.1m. No groundwater seepage was encountered in

the remaining boreholes during auger drilling. Data loggers installed into the monitoring wells recorded groundwater levels between 5 November 2022 and installed into recorded groundwater levels between 5 November and 9 February 2022.

The groundwater monitoring indicates a groundwater gradient towards the north. The groundwater was measured at the soil-rock interface or within the extremely weathered bedrock profile in BH2 and BH4, however within BH6 the groundwater was within the residual soil profile. The groundwater levels in BH2 and BH4 appear to generally be unresponsive to rainfall, however BH6 appears to be more responsive to rainfall with relatively quick rises in the groundwater level in response, likely due to being within the soil profile. Reference should be made to the attached Figures 5, 6 and 7 for the groundwater monitoring plots.

The following table summarises the basic statistics of the groundwater monitoring based on the information obtained from the data loggers:

Borehole	Basic Statistics			
	Minimum	Average	Median	Maximum
BH2	2.7m (RL15.1m)	3.0m (RL14.9m)	2.9m (RL15.0m)	3.5m (RL14.4m)
BH4	5.1m (RL11.9m)	5.3m (RL11.6m)	5.3m (RL11.6m)	5.6m (RL11.4m)
BH6	3.6m (RL13.8m)	4.5m (RL12.9m)	4.5m (RL12.9m)	4.8m (RL12.6m)

3.4 Laboratory Test Results

Based on the Atterberg limits and linear shrinkage test results, the clayey fill appears to be of medium plasticity and the residual silty clay sample tested from BH1 is of high 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. Reference should be made to the attached STS Table A for further details.

The four day soaked CBR test on a sample of the residual clay from BH8 compacted to 98% of their Standard Maximum Dry Density (SMDD) returned a CBR value of 8%. The additional CBR tests on samples of the fill returned a CBR value of 25%. We consider that these values are likely artificially elevated due to the inclusions in the fill, such as gravels. Reference should be made to the attached STS Table B for further details.

The results of the particle size distribution test results correlated well with our field logging. The results indicated that the tested samples are predominantly fine grained soils with between 20% and 43% of granular inclusions. Reference should be made to the attached STS Table C for further details.

The results of the point load strength index tests and the unconfirmed compressive strength tests on the recovered rock core correlated well with our field assessments of rock strength. We note that for BH1 to

BH7 the ratio of the UCS results to the axial point load strength results for adjacent samples typically ranged from about 13 to 23 (ignoring three outlier results), with an average of approximately 20. If the outlier results are included the average only marginally increases to 20.5. This compares well with the relationship used in Table C of the UCS being 20 times the $I_{S(50)}$ result. Reference should be made to the attached Table C and UCS reports for further details.

The following table summarises the soil chemistry test results from Envirolab Services. Reference should be made to the attached Certificate of Analysis No. 281608 for further details.

Sample	Soil Type	pH	Chloride mg/kg	Sulphate mg/kg	Resistivity ohm.cm
BH1 5.7-5.8m	Siltstone	6.8	190	27	5,900
BH2 0.1-0.2m	Fill: Silty Clay	9.9	28	210	4,600
BH3 6.6-7.1	Siltstone	6.3	52	63	11,000
BH4 3.0-3.45	Silty Clay	5.1	10	81	8,100
BH5 4.5-5.0m	Silty Clay	5.9	24	73	15,000
BH7 3.0-3.45m	Fill: Silty clay	7.9	59	280	3,100

4 COMMENTS AND RECOMMENDATIONS

4.1 Excavation

We understand that excavations will be required for the proposed lift core and will be to a maximum depth of about 4m. Such excavations are expected to encounter fill and residual silty clay. We do not expect that weathered rock will be encountered within these excavations. Excavation of such soils will be achievable using conventional excavation equipment, such as the buckets of hydraulic excavators.

Care must be taken during any excavation that existing structures are not undermined or rendered unstable. Since the excavations are proposed centrally within the site it is unlikely that existing structures will be present.

Groundwater was measured within the wells below the base of any such excavations and is not expected to be an issue for this site. However, some perched water may be encountered trapped within the fill, but if that is the case, it should drain quickly and be able to be controlled using gravity or sump and pump drainage.

4.2 Earthworks and Filling

The existing fill is uncontrolled and is not considered suitable to support footings or floor slabs. Excavation and replacement of the fill may be possible below the proposed Level 0 and Level 1 slabs. A slab on ground would likely only be feasible if additional boreholes show that the fill is uniformly shallow. Where not considered practical, the slabs should be designed as a fully suspended floor slab.

Where a fully suspended floor slab is adopted no particular subgrade preparation would be required, but any vegetation, 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. Void formers below the suspended slab of at least 40mm thickness would be required to account for the potential shrink-swell reactivity of the underlying clayey soils.

If excavation and replacement of the fill is practical or for preparation of pavement subgrades external to the building, the following subgrade preparation measures should be followed:

- Strip all vegetation, root affected soils or any deleterious fill material exposed.
- Where excavation and replacement of the fill is practical below the building, remove all existing fill to expose the residual soils.
- Proof roll the exposed subgrade with at least 6 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.
- Within pavement areas, if 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 levels.

We expect that some weak subgrade areas may be encountered where the existing uncontrolled fill is left in place in pavement areas. 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 or residual silty clay 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 crushed sandstone, free of deleterious substances and having a maximum particle size not exceeding 75mm. From a geotechnical perspective, the existing fill generally appears suitable for re-use as engineered fill, although some larger particles may need to be removed prior to re-use. Notwithstanding, given the known contamination of the fill, further assessment of the existing fill should be carried out to assess it suitability, such as test pits and further advice also obtained from a contamination specialist on the potential for the existing fill to be re-used.

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 Retention Systems

Given that the proposed excavations appear to be sufficiently away from site boundaries, the use of temporary batters appears feasible to allow construction of permanent retaining walls at the base of the batters. If this is not the case then retention systems may need to be installed prior to the start of excavation and additional advice on such walls should be obtained once the extent of any such walls are known.

Temporary batters should be no steeper than 1 Vertical in 1 Horizontal (1V:1H). Where batter heights exceed 3m, further advice should be sought from the geotechnical engineers. However typically a 2m wide bench at about mid height of the batter slope should be allowed. 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 at least 1.5m 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 Pavements

We understand that the existing on-grade car park north of the site will remain, however a new access road connecting the north-eastern side of the existing car park will be constructed. New external pavements around the proposed IMHC building will also be constructed. Any pavement subgrade should be prepared as recommended in Section 4.2.

The CBR testing of a sample from BH8 returned a CBR value of 8%. The other tests carried out from samples in BH2 and BH5 returned high CBR values of 25%. All these values appear to be higher than expected for

similar materials. Therefore we recommend that once the extent and level of any pavements are known that testing of samples of the actual pavement subgrade be carried out to assess the appropriate design parameters. If granular fill is used to raise site levels, then higher CBR values may be appropriate for such material.

Based on the limited testing carried out to date, we consider that preliminary design of the pavement thickness may be based on a soaked CBR of 5%, or a modulus of subgrade reaction of 30kPa/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 effective shear transmission at all joints by way of either doweled or keyed joints.

4.6 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 (RL16m to RL23m 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, in our opinion 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.

4.7 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.

4.8 Further Geotechnical Input

The following is a summary of the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

- Additional cored boreholes as deemed required;
- Proof roll inspections;
- Density tests.
- Further soaked CBR testing

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.

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SOIL TEST SERVICES

ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client:	JK Geotechnics	**Report No.:**	34294LF - A
Project:	Relocation of CWMHSR	**Report Date:**	12/11/2021
Location:	Westmead Hospital, Dragonfly Drive, Westmead, NSW	**Page 1 of 1**	

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
1	1.60 - 1.95	16.4	68	25	43	13.0
2	0.10 - 0.20	10.1	28	16	12	4.0
3	1.00 - 1.50	18.1	37	16	21	7.5*
3	2.00 - 2.50	19.0	49	19	30	8.5
3	7.30 - 7.50	6.1	-	-	-	-
5	1.00 - 1.50	13.1	40	18	22	9.5
5	8.00 - 8.50	5.8	-	-	-	-
5	8.70 - 9.00	3.6	-	-	-	-
6	7.50 - 8.00	6.5	-	-	-	-
8	1.50 - 2.50	17.9	35	15	20	9.5

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: 01/11/2021.
- Sampled and supplied by client. Samples tested as received.
- * Denotes Linear Shrinkage cracked.

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12/11/2021
Authorised Signature / Date
(D. Treweek)

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SOIL TEST SERVICES

ABN 43 002 145 173

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client:	JK Geotechnics	**Report No.:**	34294LF - B
Project:	Relocation of CWMHSR	**Report Date:**	11/11/2021
Location:	Westmead Hospital, Dragonfly Drive, Westmead, NSW	**Page 1 of 1**	

BOREHOLE NUMBER		BH 2	BH 5	BH 8
DEPTH (m)		0.10 - 0.20	0.10 - 0.25	1.50 - 2.50
Surcharge (kg)		9.0	9.0	9.0
Maximum Dry Density (t/m^3)		1.79 STD	1.91 STD	1.80 STD
Optimum Moisture Content (%)		14.5	13.4	16.5
Moulded Dry Density (t/m^3)		1.75	1.88	1.77
Sample Density Ratio (%)		98	98	98
Sample Moisture Ratio (%)		102	97	101
Moisture Contents				
Insitu (%)		11.4	9.8	18.4
Moulded (%)		14.8	12.9	16.7
After soaking and				
After Test, Top 30mm(%)		18.1	16.0	21.2
Remaining Depth (%)		16.9	13.2	18.8
Material Retained on 19mm Sieve (%)		5*	3*	0
Swell (%)		0.0	0.0	0.0
C.B.R. value:	@2.5mm penetration			8
	@5.0mm penetration	25	25	

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: 01/11/2021.
- * Denotes not used in test sample.

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11/11/2021

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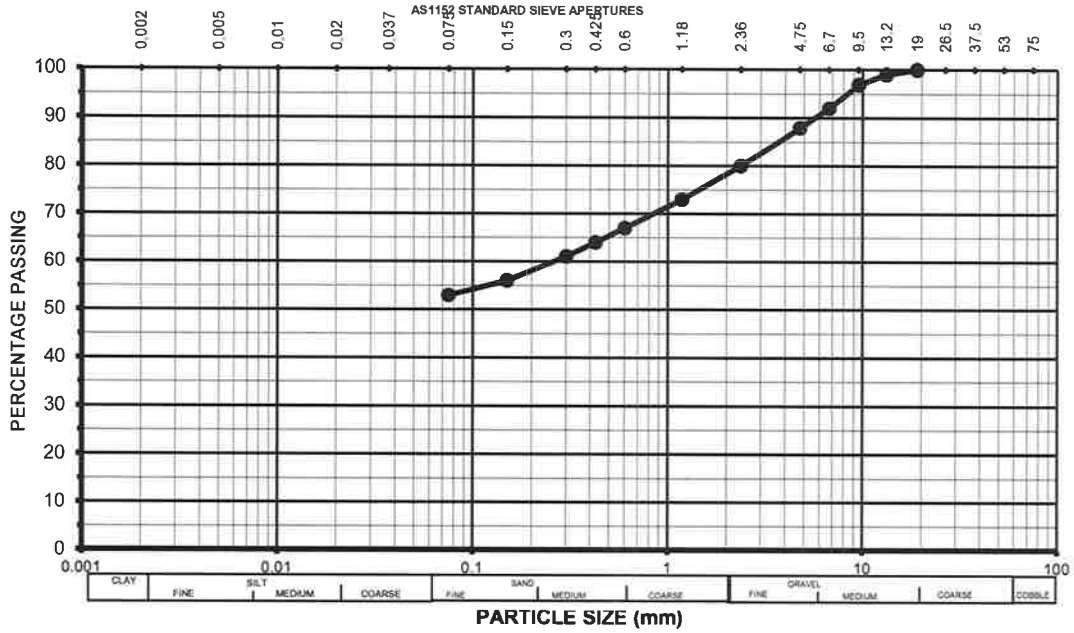
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client: JK Geotechnics
Project: Relocation of CWMHSR
Location: Westmead Hospital, Dragonfly Drive, Westmead, NSW

Report No: 34294LF - C
Report Date: 8/11/2021
Page 1 of 3



Borehole Number: 1
Depth (m): 0.50 - 0.95

SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
19.0 mm	100
13.2 mm	99
9.50 mm	97
6.70 mm	92
4.75 mm	88
2.36 mm	80
1.18 mm	73
600 µm	67
425 µm	64
300 µm	61
150 µm	56
75 µm	53

Test Method: AS1289.3.6.1 & 3.6.3 Dry Sieve (washed)

- **Notes:** Sampled and supplied by client. Sample tested as received.
- Please refer to appropriate notes for soil descriptions
- Date of receipt of sample: 01/11/2021.

NATA Accredited Laboratory Number:1327

Approved Signatory / Date
(D. Treweek)
8/11/21

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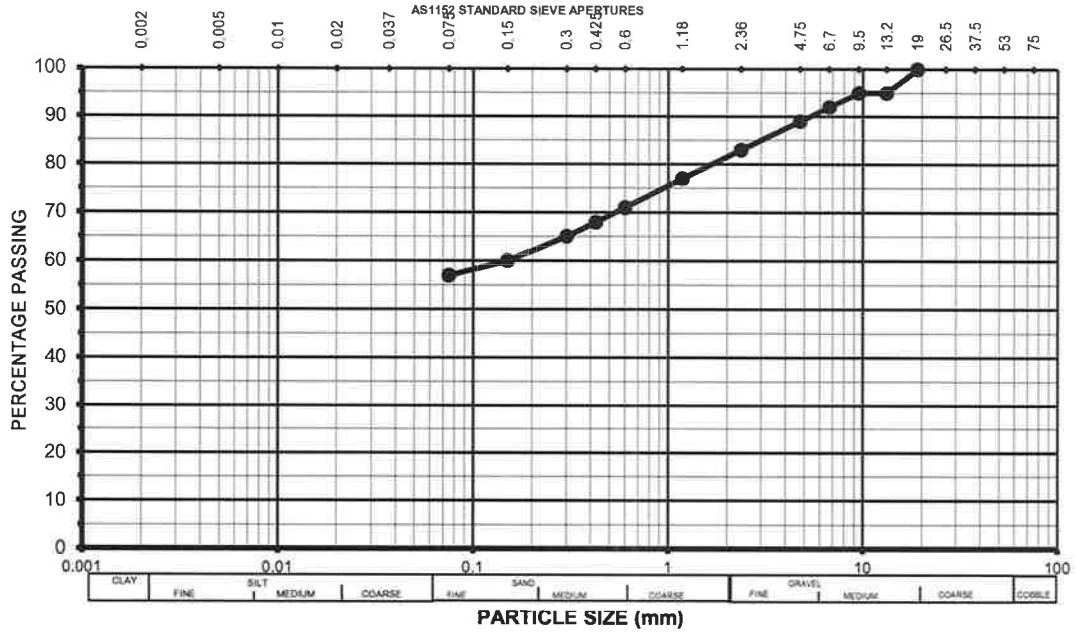
SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client: JK Geotechnics
Project: Relocation of CWMHSR
Location: Westmead Hospital, Dragonfly Drive, Westmead, NSW

Report No: 34294LF - C
Report Date: 8/11/2021
Page 2 of 3



Borehole Number: 6
Depth (m): 1.30 - 1.50

SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
19.0 mm	100
13.2 mm	95
9.50 mm	95
6.70 mm	92
4.75 mm	89
2.36 mm	83
1.18 mm	77
600 µm	71
425 µm	68
300 µm	65
150 µm	60
75 µm	57

Test Method: AS1289.3.6.1 & 3.6.3 Dry Sieve (washed)

- **Notes:** Sampled and supplied by client. Sample tested as received.
- Please refer to appropriate notes for soil descriptions
- Date of receipt of sample: 01/11/2021.

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NATA Accredited Laboratory Number:1327

Approved Signatory / Date
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SOIL TEST SERVICES
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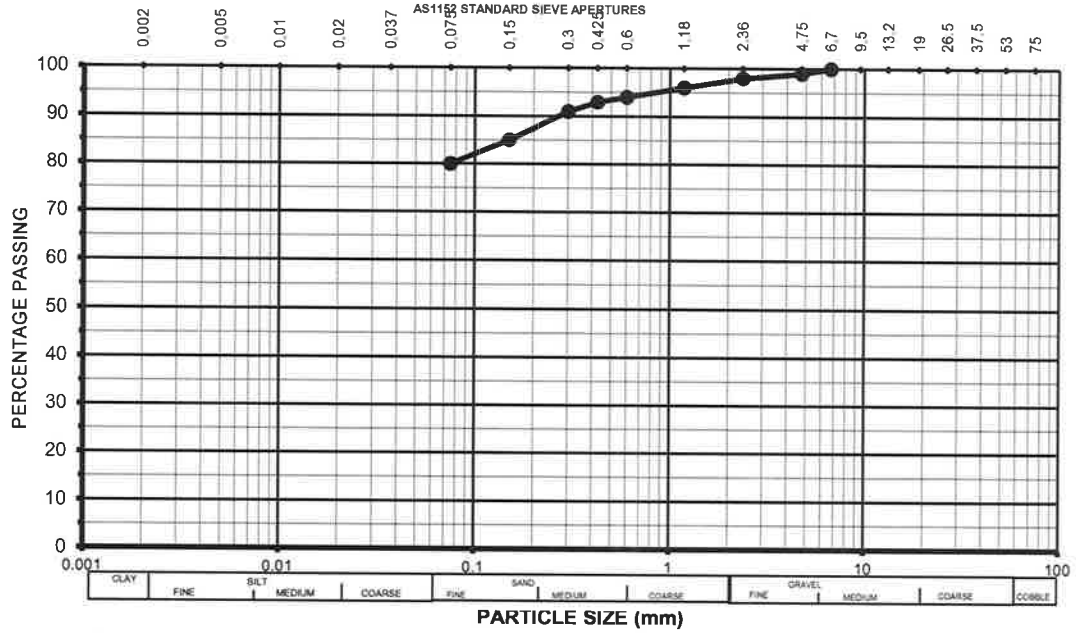
TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

Client: JK Geotechnics
Project: Relocation of CWMHSR
Location: Westmead Hospital, Dragonfly Drive, Westmead, NSW

Report No: 34294LF - C
Report Date: 8/11/2021
Page 3 of 3



Borehole Number: 8
Depth (m): 1.50 - 2.50

SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
6.70 mm	100
4.75 mm	99
2.36 mm	98
1.18 mm	96
600 µm	94
425 µm	93
300 µm	91
150 µm	85
75 µm	80

Test Method: AS1289.3.6.1 & 3.6.3 Dry Sieve (washed)

- **Notes:** Sampled and supplied by client. Sample tested as received.
- Please refer to appropriate notes for soil descriptions
- Date of receipt of sample: 01/11/2021.

NATA Accredited Laboratory Number:1327

Approved Signatory / Date (D. Treweek) 8/11/21

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client: NSW Health Infrastructure **Ref No:** 34294LF

Project: Relocation of CWMHSR **Report:** D

Location: Westmead Hospital, Dragonfly Drive, WESTMEAD, NSW **Report Date:** 2/11/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
1	5.96 - 5.99	0.5	10	A
	6.29 - 6.33	1.4	28	A
	6.69 - 6.72	1.2	24	A
	6.94 - 6.96	1.4	28	A
	7.16 - 7.19	2.2	44	A
	7.81 - 7.84	3.6	72	A
	8.22 - 8.25	3	60	A
	8.83 - 8.87	5.7	114	A
	9.39 - 9.42	2.1	42	A
	9.79 - 9.82	3.3	66	A
	10.23 - 10.26	2.8	56	A
	10.51 - 10.54	3.4	68	A
	10.89 - 10.92	2.8	56	A
	11.10 - 11.14	1.9	38	A
2	6.52 - 6.56	0.6	12	A
	6.93 - 6.96	1.3	26	A
	7.13 - 7.15	0.3	6	A
	7.33 - 7.35	0.8	16	A
	7.71 - 7.74	1.5	30	A
	8.22 - 8.26	1.5	30	A
	8.83 - 8.87	2.6	52	A
	9.41 - 9.44	2.3	46	A
	9.78 - 9.81	2.6	52	A
	10.20 - 10.23	2.1	42	A
	10.46 - 10.50	3.2	64	A

NOTE: SEE PAGE 4

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client: NSW Health Infrastructure **Ref No:** 34294LF

Project: Relocation of CWMHSR **Report:** D

Location: Westmead Hospital, Dragonfly Drive, WESTMEAD, NSW **Report Date:** 2/11/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
2	10.77 - 10.81	2.6	52	A
	11.07 - 11.11	1.9	38	A
3	7.74 - 7.77	3	60	A
	8.05 - 8.09	2.8	56	A
	8.76 - 8.79	1.5	30	A
	9.00 - 9.04	2.1	42	A
	9.67 - 9.70	1.9	38	A
	10.17 - 10.20	3.6	72	A
	10.87 - 10.90			A
	11.17 - 11.21	2.9	58	A
	11.71 - 11.74	4.5	90	A
	11.96 - 12.00	1.8	36	A
	12.18 - 12.21	2.9	58	A
	12.80 - 12.84	1.7	34	A
4	9.12 - 9.15	2.6	52	A
	9.32 - 9.35	1.4	28	A
	9.73 - 9.76	1.6	32	A
	10.35 - 10.39	1.4	28	A
	10.82 - 10.86	2.6	52	A
	11.23 - 11.27	2.8	56	A
	11.75 - 11.78	2.6	52	A
	12.13 - 12.17	1.7	34	A
	12.62 - 12.66	1.8	36	A
	13.21 - 13.25	1.2	24	A
	13.45 - 13.48	2.9	58	A

NOTE: SEE PAGE 4

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client: NSW Health Infrastructure **Ref No:** 34294LF

Project: Relocation of CWMHSR **Report:** D

Location: Westmead Hospital, Dragonfly Drive, WESTMEAD, NSW **Report Date:** 2/11/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
4	13.66 - 13.70	0.5	10	A
	14.22 - 14.26	3.1	62	A
	14.46 - 14.49	2	40	A
5	9.44 - 9.47	1.3	26	A
	9.64 - 9.66	1.8	36	A
	9.91 - 9.95	1.4	28	A
	10.34 - 10.38	1.9	38	A
	10.77 - 10.80	3.4	68	A
	11.13 - 11.16	1.4	28	A
	11.69 - 11.72	2.7	54	A
	12.30 - 12.34	2.7	54	A
	12.82 - 12.85	3.1	62	A
	13.32 - 13.36	0.7	14	A
	13.97 - 14.00	1.5	30	A
	14.23 - 14.26	1.5	30	A
	14.43 - 14.46	1.2	24	A
6	9.88 - 9.92	2.1	42	A
	10.16 - 10.20	1.6	32	A
	11.63 - 11.67	1.2	24	A
	12.60 - 12.63	1.3	26	A
	13.30 - 13.34	1	20	A
	13.91 - 13.94	1.2	24	A
	14.12 - 14.16	1.2	24	A
	14.80 - 14.83	1.2	24	A
	15.00 - 15.04	1.5	30	A

NOTE: SEE PAGE 4

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	NSW Health Infrastructure	**Ref No:**	34294LF
Project:	Relocation of CWMHSR	**Report:**	D
Location:	Westmead Hospital, Dragonfly Drive, WESTMEAD, NSW	**Report Date:**	2/11/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
6	15.14 - 15.18	1.1	22	A
	15.42 - 15.45	1.4	28	A
7	9.50 - 9.53	0.1	2	A
	9.90 - 9.92	0.7	14	A
	10.08 - 10.11	0.2	4	A
	10.79 - 10.83	0.4	8	A
	11.14 - 11.18	0.7	14	A
	11.70 - 11.73	0.2	4	A
	12.25 - 12.30	1.4	28	A
	12.62 - 12.65	1.4	28	A
	12.87 - 12.90	1.8	36	A
	13.29 - 13.32	1.3	26	A
	13.81 - 13.84	0.5	10	A
	14.21 - 14.25	0.9	18	A
	14.79 - 14.82	0.9	18	A
	15.44 - 15.49	0.5	10	A
	15.67 - 15.71	0.7	14	A
	16.04 - 16.08	0.9	18	A

NOTES

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

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH1 6.72-6.94m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72188-UCS
Job No.	S21410-1	**Lab No.**	S72188
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**	19/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 28 MPa

Date Tested:	8/11/2021		Moisture Content:	2.7	%
Specimen Height:	148.2	mm	Duration of Test:	679	seconds
Average Specimen Diameter:	51.7	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

NATA Accredited Laboratory Number: 14874

Authorised Signatory: Chris Lloyd

Date: 11/11/2021

MACQUARIE GEOTECH

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH1 10.26-10.51m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72189-UCS
Job No.	S21410-1	**Lab No.**	S72189
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**	19/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 41 MPa

Date Tested:	8/11/2021		Moisture Content:	2.0	%
Specimen Height:	146.1	mm	Duration of Test:	704	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
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Date 11/11/2021

Chris Lloyd

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH2 7.15-7.33m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72190-UCS
Job No.	S21410-1	**Lab No.**	S72190
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**	22/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 16 MPa

Date Tested:	8/11/2021		Moisture Content:	3.3	%
Specimen Height:	146.5	mm	Duration of Test:	654	seconds
Average Specimen Diameter:	51.7	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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Chris Lloyd

Date

11/11/2021

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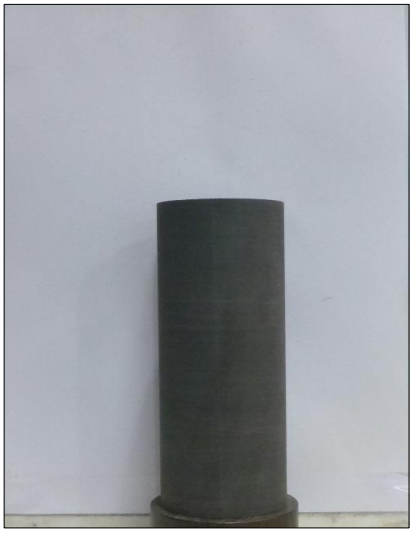
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH2 10.23-10.46m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72191-UCS
Job No.	S21410-1	**Lab No.**	S72191
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**	22/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition



Uniaxial Compressive Strength 29 MPa

Date Tested:	8/11/2021		Moisture Content:	2.5	%
Specimen Height:	146.8	mm	Duration of Test:	680	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH3 8.80-8.99m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72192-UCS
Job No.	S21410-1	**Lab No.**	S72192
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**	22/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 19 MPa

Date Tested:	8/11/2021		Moisture Content:	2.5	%
Specimen Height:	146.8	mm	Duration of Test:	660	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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This document shall not be reproduced, except in full.
Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory

Chris Lloyd

Date

11/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH3 12.00-12.18m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72193-UCS
Job No.	S21410-1	**Lab No.**	S72193
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**	22/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 31 MPa

Date Tested:	8/11/2021		Moisture Content:	2.4	%
Specimen Height:	146.3	mm	Duration of Test:	685	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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Authorised Signatory: Chris Lloyd

Date: 11/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH4 9.15-9.32m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72194-UCS
Job No.	S21410-1	**Lab No.**	S72194
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**	20/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 13 MPa

Date Tested:	8/11/2021		Moisture Content:	3.5	%
Specimen Height:	147.7	mm	Duration of Test:	650	seconds
Average Specimen Diameter:	51.7	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory: Chris Lloyd

Date: 11/11/2021

MACQUARIE GEOTECH
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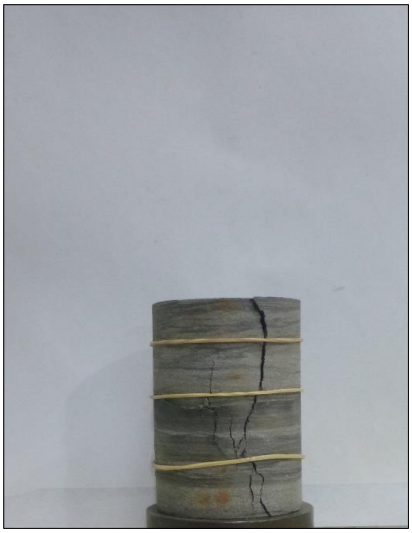
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH4 13.48-13.66m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Sandstone/Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72195-UCS
Job No.	S21410-1	**Lab No.**	S72195
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**	20/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition



Uniaxial Compressive Strength 20 MPa

Date Tested:	11/11/2021		Moisture Content:	2.3	%
Specimen Height:	89.5	mm	Duration of Test:	665	seconds
Average Specimen Diameter:	51.8	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.				

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory

Chris Lloyd

Date

12/11/2021

MACQUARIE GEOTECH

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH5 9.47-9.64m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Siltstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72196-UCS
Job No.	S21410-1	**Lab No.**	S72196
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**	21/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 24 MPa

Date Tested:	8/11/2021		Moisture Content:	3.0	%
Specimen Height:	148.5	mm	Duration of Test:	672	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory

Chris Lloyd

Date

11/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH5 14.00-14.22m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Sandstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72197-UCS
Job No.	S21410-1	**Lab No.**	S72197
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**	21/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 27 MPa

Date Tested:	8/11/2021		Moisture Content:	7.9	%
Specimen Height:	148.5	mm	Duration of Test:	678	seconds
Average Specimen Diameter:	51.9	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Single shear plane				
Other Pertinent Observations:					

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory: Chris Lloyd

Date: 11/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH6 15.18-15.42m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Sandstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72198-UCS
Job No.	S21410-1	**Lab No.**	S72198
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**	25/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 25 MPa

Date Tested:	8/11/2021		Moisture Content:	5.8	%
Specimen Height:	147.2	mm	Duration of Test:	673	seconds
Average Specimen Diameter:	51.7	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory: Chris Lloyd

Date: 11/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH6 12.76-13.00m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Sandstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72199-UCS
Job No.	S21410-1	**Lab No.**	S72199
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**	25/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 30 MPa

Date Tested:	8/11/2021		Moisture Content:	6.8	%
Specimen Height:	148.2	mm	Duration of Test:	684	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Mixed mode				
Other Pertinent Observations:					

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory

Chris Lloyd

Date

11/11/2021

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Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH7 12.63-12.67m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Sandstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72200-UCS
Job No.	S21410-1	**Lab No.**	S72200
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**	21/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 31 MPa

Date Tested:	11/11/2021		Moisture Content:	4.2	%
Specimen Height:	122.0	mm	Duration of Test:	691	seconds
Average Specimen Diameter:	51.8	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.				

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory

Chris Lloyd

Date

12/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

Uniaxial Compressive Strength

Client	JK Geotechnics	**Sample Source**	BH7 15.50-15.68m
Address	115 Wicks Rd, Macquarie Park, NSW, 2113	**Sample Description**	Sandstone
Project	Relocation of CWMHSR (34294LF)	**Report No.**	S72201-UCS
Job No.	S21410-1	**Lab No.**	S72201
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**	21/10/2021
Storage History	Sealed	**Storage Environment**	Sealed at as received moisture condition

Uniaxial Compressive Strength 18 MPa

Date Tested:	8/11/2021		Moisture Content:	8.2	%
Specimen Height:	147.6	mm	Duration of Test:	658	seconds
Average Specimen Diameter:	51.8	mm	Rate of Displacement:	< 0.1	mm/min
Failure Type:	Single shear plane				
Other Pertinent Observations:					

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory: Chris Lloyd

Date: 11/11/2021

Macquarie Geotechnical
U7/8 10 Bradford Street
Alexandria NSW 2015

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ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 281608

Client Details

Client	JK Geotechnics
Attention	O Fraser, Arthur Kourtesis
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**34294LF, Westmead**
Number of Samples	6 Soil
Date samples received	29/10/2021
Date completed instructions received	29/10/2021

Analysis Details

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

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

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

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

Report Details

Date results requested by	05/11/2021
Date of Issue	04/11/2021

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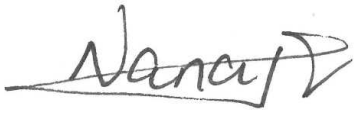
Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		281608-1	281608-2	281608-3	281608-4	281608-5
Your Reference	UNITS	BH1	BH2	BH4	BH5	BH3
Depth		5.7-5.8	0.1-0.2	3.0-3.45	4.5-5.0	6.6-7.1
Date Sampled		19/10/2021	22/10/2021	20/10/2021	21/10/2021	22/10/2021
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/11/2021	02/11/2021	02/11/2021	02/11/2021	02/11/2021
Date analysed	-	02/11/2021	02/11/2021	02/11/2021	02/11/2021	02/11/2021
pH 1:5 soil:water	pH Units	6.8	9.9	5.1	5.9	6.3
Chloride, Cl 1:5 soil:water	mg/kg	190	28	10	24	52
Sulphate, SO4 1:5 soil:water	mg/kg	27	210	81	73	63
Resistivity in soil*	ohm m	59	46	180	150	110

Misc Inorg - Soil		
Our Reference		281608-6
Your Reference	UNITS	BH7
Depth		3.0-3.45
Date Sampled		20/10/2021
Type of sample		Soil
Date prepared	-	02/11/2021
Date analysed	-	02/11/2021
pH 1:5 soil:water	pH Units	7.9
Chloride, Cl 1:5 soil:water	mg/kg	59
Sulphate, SO4 1:5 soil:water	mg/kg	280
Resistivity in soil*	ohm m	31

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	281608-6
Date prepared	-			02/11/2021	3	02/11/2021	02/11/2021		02/11/2021	02/11/2021
Date analysed	-			02/11/2021	3	02/11/2021	02/11/2021		02/11/2021	02/11/2021
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	3	5.1	5.0	2	100	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	3	10	10	0	110	101
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	3	81	81	0	113	#
Resistivity in soil*	ohm m	1	Inorg-002	<1	3	180	170	6	[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.

Report Comments

MISC_INORG_DRY
Percent recovery is not applicable due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

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

JKGeotechnics

BOREHOLE LOG

Borehole No. 1

EASTING: 313769.53
NORTHING: 6258002.84

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 16.61 m

Date: 19/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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										FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained sandstone and siltstone gravel.	w<PL			GRASS COVER TOO FRIABLE FOR HP TESTING
					N = 9 2,4,5	16	1							
					N = 23 6,10,13	15	2		CH	Silty CLAY: high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel.	w<PL	Hd	>600 >600	RESIDUAL
						14				Silty CLAY: high plasticity, light grey and orange brown, with extremely weathered seams and iron indurated bands.				VERY LOW BANDED 'TC' BIT RESISTANCE
					N > 29 3,13,16/ 100mm REFUSAL	13	3						>600 >600	
						12	4		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey brown, with iron indurated bands.	XW	Hd		ASHFIELD SHALE LOW RESISTANCE
						11	5			as above, but dark grey.				
										SILTSTONE: dark grey.	MW	M		MODERATE RESISTANCE
						10	6			REFER TO CORED BOREHOLE LOG				

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 1 **2 / 2**

EASTING: 313769.53
NORTHING: 6258002.84

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 16.61 m

Date: 19/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.

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 (Specific / General)	Formation
		11			START CORING AT 5.90m						
70% RETURN		10	6		SILTSTONE: dark grey, bedded at 0-5°.	FR	M - H	0.50		(5.93m) XWS, 5°, 5 mm.t (5.96m) XWS, 0°, 5 mm.t	Ashfield Shale
					as above, but with interlaminated fine grained light grey sandstone seams.		H - VH	1.4			
			7					1.2			
		9						1.4			
								2.2		(7.41m) J, 65°, P, S, Cn (7.51m) J, 65°, P, S, Cn	
			8					3.6			
		8						3.0		(8.37m) XWS, 5°, 3 mm.t (8.38m) XWS, 0°, 3 mm.t (8.42m) XWS, 0°, 5 mm.t (8.43m) XWS, 0°, 2 mm.t (8.44m) XWS, 5°, 5 mm.t (8.45m) XWS, 5°, 3 mm.t (8.76m) J, 80°, Ir, R, Cn	
			9					5.7			
		7						2.1		(9.16m) XWS, 5°, 10 mm.t (9.22m) XWS, 0°, 5 mm.t (9.27m) XWS, 0°, 4 mm.t (9.29m) XWS, 0°, 2 mm.t (9.35m) XWS, 0°, 1 mm.t	
			10					3.3			
								2.8			
		6						3.4			
			11					2.8			
								1.9			
		5			END OF BOREHOLE AT 11.32 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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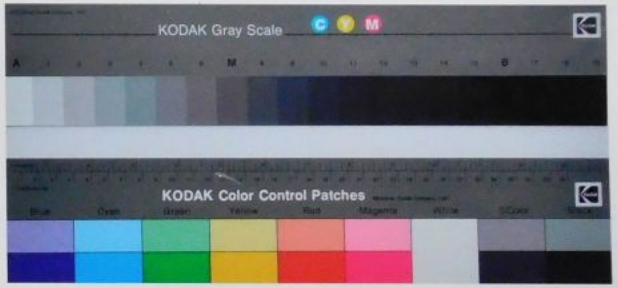
Job No: 34294LF
Borehole No: 01
Depth: 5.90m - 11.32m



34294LF BH1 START CORING AT 5.90m

5

6

7

8

9

10

11

END OF BOREHOLE AT 11.32m

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BOREHOLE LOG

Borehole No. 2
1 / 2

EASTING: 313788.97
NORTHING: 6257982.50

Client: NSW HEALTH INFRASTRUCTURE
Project: RELOCATION OF CWMHSR
Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.87 m
Date: 22/10/21 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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				■		17	1			FILL: Silty clay, medium plasticity, dark grey brown, with medium grained sand, and concrete fragments.	w<PL			VACUUM EXCAVATED TO 1.4m DEPTH SOIL PROFILE ASSESSED BY VISUAL OBSERVATION OF EXCAVATION SIDEWALLS
						16	2		CI-CH	Silty CLAY: medium to high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel.	w<PL	(Hd)		RESIDUAL
ON 26/10/21 ▽						15	3		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, light grey brown, with iron indurated bands.	XW	(Hd)		ASHFIELD SHALE
ON 24/11/21 ▽						14	4							LOW 'TC' BIT RESISTANCE WITH MODERATE BANDS
						13	5			SILTSTONE: dark grey brown, with extremely weathered sands and iron indurated bands.	HW	(L)		MODERATE RESISTANCE WITH LOW BANDS
						12	6			SILTSTONE: dark grey.	SW	M		MODERATE RESISTANCE
						11				REFER TO CORED BOREHOLE LOG				

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CORED BOREHOLE LOG

Borehole No. 2 **2 / 2**

EASTING: 313788.97
NORTHING: 6257982.50

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 17.87 m

Date: 22/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.

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 (Specific / General)	Formation
					START CORING AT 6.10m						
50% RETURN AFTER BAILING		11 10 9 8 7	7 8 9 10 11		SILTSTONE: dark grey, with grey laminae and fine grained sandstone seams, bedded at 0-5°.	MW XW SW	M - H Hd M - H H - VH	0.60 1.3 0.30 0.80 1.5 1.5 2.6 2.3 2.6 2.1 3.2 2.6 1.9		(6.10-6.29m) Fractured Zone, 0° (6.50m) XWS, 5°, 30 mm.t (6.58m) XWS, 5°, 35 mm.t (6.64m) J, 89°, P, R, Cn (6.65m) XWS, 0°, 10 mm.t (6.69m) XWS, 0°, 10 mm.t (6.88m) XWS, 0°, 15 mm.t (7.57m) J, 80°, Ir, R, Cn (7.84m) J, 60°, P, R, Cn (7.96m) J, 30°, Ir, R, Cn (10.96m) J, 80°, P, R, Cn	Ashfield Shale
		6 5	12		END OF BOREHOLE AT 11.10 m					GROUNDWATER MONITORING WELL INSTALLED TO 11.1m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 5.1m TO 11.1m. CASING 0m TO 5.1m. 2mm SAND FILTER PACK 3.5m TO 11.1m. BENTONITE SEAL 0.5m TO 3.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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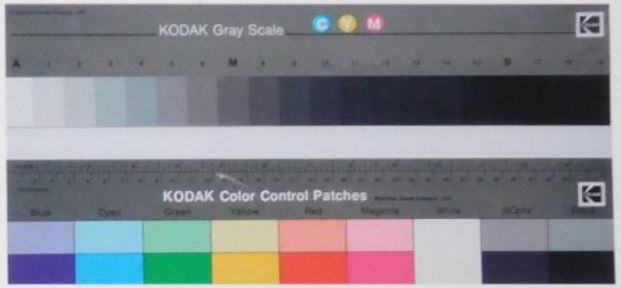
Job No: 34294LF
Borehole No: 02
Depth: 6.10m - 11.10m



34294LF BH2 START CORING AT 6.10m

6

7

34294LF BH2

8

9

10

34294LF BH2
10.23-10.46

11

END OF BOREHOLE AT 11.10m

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BOREHOLE LOG

Borehole No. 3
1 / 3

EASTING: 313814.21
NORTHING: 6258003.20

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.71 m

Date: 22/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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						17	1		-	ASPHALTIC CONCRETE: 50mm.t FILL: Clayey gravel, medium grained, igneous. FILL: Silty clay, medium plasticity, dark grey brown, trace of fine to medium grained ironstone gravel.	M w>PL			ROADBASE
						16	2		CI-CH	Silty CLAY: medium to high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel.	w~PL	VSt - Hd		RESIDUAL
						15	3				w<PL	Hd		
									CI	Silty CLAY: medium plasticity, grey brown, with extremely weathered siltstone seams and iron indurated bands.				LOW BANDED 'TC' BIT RESISTANCE
						14	4							
						13	5							
						12	6							
						11			-	SILTSTONE: grey brown, with fine grained sandstone seams, iron indurated seams and extremely	HW	L - M		ASHFIELD SHALE MODERATE RESISTANCE WITH LOW BANDS

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BOREHOLE LOG

Borehole No. 3
2 / 3

EASTING: 313814.21
NORTHING: 6258003.20

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.71 m

Date: 22/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
				■					-	weathered bands.	HW	L - M		ASHFIELD SHALE MODERATE RESISTANCE WITH LOW BANDS
										SILTSTONE: as above				
				■						SILTSTONE: dark grey, with fe grained sandstone seams, low strength seams and iron indurated bands.	MW	M		MODERATE RESISTANCE
						10				REFER TO CORED BOREHOLE LOG				
							8							
						9								
							9							
						8								
							10							
						7								
							11							
						6								
							12							
						5								
							13							
						4								

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CORED BOREHOLE LOG

Borehole No. 3 — 3 / 3

EASTING: 313814.21
NORTHING: 6258003.20

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF | **Core Size:** NMLC | **R.L. Surface:** 17.71 m

Date: 22/10/21 | **Inclination:** VERTICAL | **Datum:** AHD

Plant Type: JK308 | **Bearing:** N/A | **Logged/Checked By:** A.C.K./O.F.

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 (Specific / General)	Formation
					START CORING AT 7.60m						
50% RETURN		10	8		LAMINITE: siltstone, dark grey, and sandstone, fine to medium grained, light grey, interlaminated, bedded at 0-5°.	FR	H - VH	3.0			Ashfield Shale
		9	9					2.8			
		8	10					1.5			
		7	11					2.1			
		6	12					1.9			
		5	13					3.6			
								2.9			
								4.5			
								1.8			
								2.9			
								1.7			
		4			END OF BOREHOLE AT 12.97 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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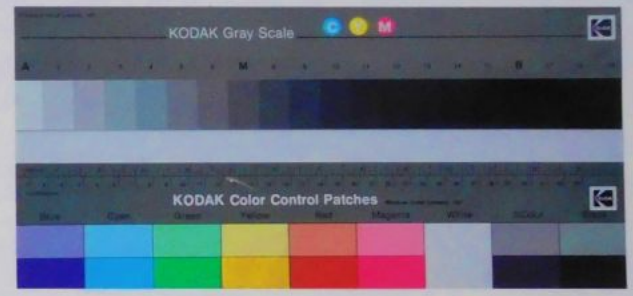
Job No: 34294LF
Borehole No: 03
Depth: 7.60m – 12.97m



34294LF BH3 START CORING AT 7.60m

7

8

9

10

11

12

13 END OF BOREHOLE AT 12.97m

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BOREHOLE LOG

Borehole No. 4
1 / 3

EASTING: 313813.61
NORTHING: 6258050.13

Client: NSW HEALTH INFRASTRUCTURE
Project: RELOCATION OF CWMHSR
Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 16.92 m
Date: 20/10/21 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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						16	1			FILL: Silty clay, medium plasticity, dark grey brown, trace of fie to medium grained siltstone gravel and cobbles.				VACUUM EXCAVATED TO 1.7m DEPTH SOIL PROFILE ASSESSED BY VISUAL OBSERVATION OF EXCAVATION SIDEWALLS
						15	2		CI-CH	Silty CLAY: medium to high plasticity, light grey, orange brown and red brown, trace of fine to medium grained ironstone gravel.	w<PL	Hd		RESIDUAL
					N = 27 5,10,17	14	3							
ON COMPLETION OF CORING						13	4							
									-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey brown, with iron indurated seams.	XW	Hd		ASHFIELD SHALE LOW 'TC' BIT RESISTANCE
						12	5							
ON 24/11/21						11	6			as above, but with very low to low strength bands.				LOW RESISTANCE WITH MODERATE BANDS
						10								

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BOREHOLE LOG

Borehole No. 4 **2 / 3**

EASTING: 313813.61
NORTHING: 6258050.13

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 16.92 m

Date: 20/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
AFTER BAILING						9	8		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey brown, with iron indurated seams and very low to low strength bands.	XW	Hd		
										SILTSTONE: dark grey, with low strength bands.	MW	M		MODERATE RESISTANCE WITH LOW BANDS
						8	9							
						7	10			REFER TO CORED BOREHOLE LOG				
						6	11							
						5	12							
						4	13							
						3								

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CORED BOREHOLE LOG

Borehole No. 4 3 / 3

EASTING: 313813.61
NORTHING: 6258050.13

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 16.92 m

Date: 20/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components START CORING AT 9.10m	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		7	10		SILTSTONE: dark grey, with light grey laminae, bedded at 0-5°. LAMINITE: siltstone, dark grey, and sandstone, fine to medium grained, light grey, interlaminated, bedded at 0-5°, with occasional very low to low strength seams.	SW	M	2.6, 1.4, 1.6, 1.4		(9.39m) XWS, 0°, 5 mm.t (9.49m) XWS, 0°, 20 mm.t (9.51m) XWS, 5°, 7 mm.t (9.63m) XWS, 0°, 8 mm.t (10.33m) XWS, 5°, 10 mm.t (10.41m) XWS, 10°, 10 mm.t (10.48m) XWS, 10°, 5 mm.t	Ashfield Shale
		6	11		as above, but without very low to low strength bands.	FR	H	2.6, 2.8, 2.6, 1.7, 1.8			
		5	12								
		4	13		as above, but with fine to medium grained sandstone bands.			1.2, 2.9, 0.50, 3.1, 2.0		(13.75m) J, 45°, P, R, Clay Infill (13.78m) CS, 0°, 8 mm.t (13.84m) J, 50°, P, R, Cn (13.88m) Be, 15°, Un, R, Cn (13.92m) CS, 20°, 15 mm.t (14.13m) J x 3, 70 - 85°, C, R, Cn (14.35m) Be, 15°, Ir, R, Clay Ct	
		3	14								
		2	15		END OF BOREHOLE AT 14.51 m					GROUNDWATER MONITORING WELL INSTALLED TO 14.51m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 8.51m TO 14.51m. CASING 0m TO 8.51m. 2mm SAND FILTER PACK m TO m. BENTONITE SEAL m TO m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.	
		1									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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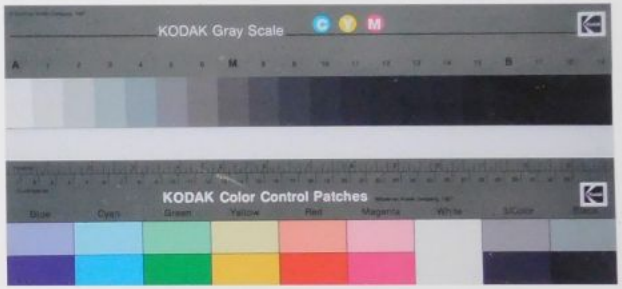
Job No: 34294LF
Borehole No: 04
Depth: 9.10-14.51m



34294LF BH4 START CORING AT 9.10m

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BOREHOLE LOG

Borehole No. 5 **1 / 3**

EASTING: 313859.35
NORTHING: 6258054.26

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.65 m

Date: 21/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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			■			17	1			FILL: Silty clay, medium plasticity, dark grey brown, with sandstone cobbles and boulders, and fine to medium grained igneous and ironstone gravel.	w>PL			RAPID AUGER DRILLING TO ENCOUNTER BEDROCK - SPT'S OMITTED
				■		16	2							
						15	3							
						14	4							
				■		13	5		CI-CH	Silty CLAY: medium to high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel.	w~PL	(VSt - Hd)		RESIDUAL
						12	6							
						11								

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BOREHOLE LOG

Borehole No. 5

EASTING: 313859.35
NORTHING: 6258054.26

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.65 m

Date: 21/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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-CH	Silty CLAY: medium to high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel. *(continued)*	w~PL	(VSt - Hd)		
						10	8		-	SILTSTONE: dark grey, with iron indurated seams and extremely weathered seams.	HW	VL - L		ASHFIELD SHALE LOW TO MODERATE 'TC' BIT RESISTANCE
						9	9			SILTSTONE: dark grey.	SW	M		MODERATE RESISTANCE
						8	10			REFER TO CORED BOREHOLE LOG				
						7	11							
						6	12							
						5	13							
						4								

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CORED BOREHOLE LOG

Borehole No. 5 3 / 3

EASTING: 313859.35
NORTHING: 6258054.26

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 17.65 m

Date: 21/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.

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 (Specific / General)	Formation
					START CORING AT 9.10m			VL -0.1, L -0.3, M -1, H -3, VH -10, EH	600, 200, 60, 20		
50% RETURN		8	10		SILTSTONE: dark grey, with light grey laminae and fine grained sandstone seams, bedded at 0-10°.	SW	M - H	1.3, 1.8, 1.4		(9.24m) Be, 0°, P, R, Fe Sn	Ashfield Shale
						FR				(10.11m) Be, 10°, P, R, Fe Sn (10.15m) Be, 10°, P, R, Fe Sn	
		7	11		SANDSTONE: fine grained, light grey, with dark grey siltstone laminae, bedded at 0-10°.			1.9, 3.4, 1.4		(11.35m) XWS, 0°, 15 mm.t	Hawkesbury Sandstone
		6	12					2.7, 2.7			
		5	13					3.1		(13.24m) XWS, 0°, 6 mm.t	
		4	14		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-10°, cross bedded up to 30°.			0.70, 1.5, 1.5, 1.2		(13.52m) XWS, 0°, 25 mm.t	
		3	15		END OF BOREHOLE AT 14.49 m						
		2									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

Job No: 34294LF
Borehole No: 05
Depth: 9.10 - 14.49m

34294LF BH5 START CORING AT 9.10m

JK Geotechnics

JKGeotechnics

BOREHOLE LOG

Borehole No. 6 **1 / 3**

EASTING: 313902.29
NORTHING: 6258041.68

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.42 m

Date: 25/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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						17	0		-	ASPHALTIC CONCRETE: 40mm.t FILL: Gravelly sandy clay, medium plasticity, dark grey brown, fine to medium grained sand, fine to medium grained igneous gravel.	w~PL			HAND AUGER DRILLED TO 1.1m DEPTH
						16	1							
										FILL: Silty clay, medium to high plasticity, grey brown and orange brown, trace of fie to medium grained ironstone gravel.				
						15	2		CI-CH	Silty CLAY: medium to high plasticity, light grey and orange brown, trace of fine to medium grained ironstone gravel.	w~PL	VSt - Hd		RESIDUAL
ON 24/11/21						14	3							
						13	4							
						12	5				w>PL	VSt		
						11	6							

JKGeotechnics

BOREHOLE LOG

Borehole No. 6

EASTING: 313902.29
NORTHING: 6258041.68

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.42 m

Date: 25/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						10	8		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, grey brown, with iron indurated seams.	XW	Hd		ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE
						9	9			SILTSTONE: dark grey brown, with iron indurated seams and extremely weathered seams.	MW	L		LOW RESISTANCE WITH LOW BANDS
						8								
						7	10			REFER TO CORED BOREHOLE LOG				
						6	11							
						5	12							
						4	13							

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 6 **3 / 3**

EASTING: 313902.29
NORTHING: 6258041.68

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 17.42 m

Date: 25/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.

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)	Formation
		8			START CORING AT 9.54m						
			10		SANDSTONE: fine to medium grained, light grey, with dark grey siltstone seams, bedded at 0-5°.	SW	M - H	2.1, 1.6		(9.57m) XWS, 5°, 10 mm.t (9.60m) XWS, 5°, 5 mm.t (9.62m) XWS, 3°, 5 mm.t (9.63m) XWS, 3°, 5 mm.t (9.64m) Be, 5°, Ir, R, Fe Sn (9.68m) XWS, 5°, 15 mm.t (9.75m) Shear, 80°, Ir, R, Fe Sn	Hawkesbury Sandstone
		7				HW	VL			(10.15m) CS, 0°, Cn, 15 mm.t (10.21m) XWS, 0°, 12 mm.t (10.27m) XWS, 0°, 10 mm.t (10.37m) XWS, 0°, 50 mm.t	
			11			SW	M - H			(10.48m) XWS, 0°, 50 mm.t (10.56m) XWS, 0°, 10 mm.t (10.61m) XWS, 5°, 7 mm.t (10.62m) XWS, 5°, 2 mm.t (10.64m) XWS, 5°, 5 mm.t (10.66m) XWS, 5°, 7 mm.t (10.75m) XWS, 0°, 4 mm.t (10.84m) XWS, 0°, 20 mm.t (10.88m) J, 20°, P, R, Cn (10.90m) XWS, 0°, 8 mm.t (10.93m) XWS, 10°, 10 mm.t (11.01m) Jh, 80°, Ir	
		6				HW	VL				
			12			SW	M - H	1.2			
		5			SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 10°, cross bedded up to 30°.					(11.04m) XWS, 0°, 15 mm.t (11.08m) XWS, 0°, 20 mm.t (11.13m) J, 45°, Ir, R, Cn (11.16m) XWS, 45°, 5 mm.t (11.19m) XWS, 0°, 3 mm.t (11.21m) XWS, 0°, 3 mm.t (11.22m) XWS, 0°, 3 mm.t (11.23m) XWS, 0°, 3 mm.t (11.26m) XWS, 0°, 5 mm.t (11.29m) XWS, 0°, 1 mm.t (11.31m) XWS, 0°, 1 mm.t (11.35m) XWS, 0°, 2 mm.t (11.45m) XWS, 0°, 8 mm.t (11.54m) XWS, 0°, 2 mm.t (11.57m) XWS, 0°, 1 mm.t (11.60m) XWS, 0°, 1 mm.t (11.68m) XWS, 0°, 10 mm.t (11.94m) XWS, 0°, 7 mm.t (12.04m) XWS, 0°, 40 mm.t (12.11m) XWS, 0°, 5 mm.t (12.23m) XWS, 0°, 90 mm.t (12.43m) XWS, 5°, 7 mm.t	
			13					1.3			
		4						1.0			
			14					1.2			
		3						1.2			
			15					1.2			
		2						1.5, 1.1, 1.4			
					END OF BOREHOLE AT 15.56 m					GROUNDWATER MONITORING WELL INSTALLED TO 14.2m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 8.2m TO 14.2m. CASING 0m TO 8.2m. 2mm SAND FILTER PACK 7.0m TO 14.2m. BENTONITE SEAL 6.0m TO 7.0m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETE SATIG COVER.	

JK 9.02.4 LIB:GLB Log JK CORED BOREHOLE - MASTER 34294LF WESTMEAD.GPJ <<DrawingFile>> 29/11/2021 10:45 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: 34294LF
Borehole No: 06
Depth: 9.54m to 15.56m

34294LF BH6 START CORING AT 9.54 m

9

10

11

12

34294LF BH6
13.00

13

14

15

END OF BOREHOLE AT 15.56 m

JKGeotechnics

BOREHOLE LOG

Borehole No. 7 **1 / 4**

EASTING: 313854.92
NORTHING: 6258068.05

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.63 m

Date: 20/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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						17	0			FILL: Silty clay, medium plasticity, dark grey brown, light gey and orange brown, trace of fine to medium grained ironstone gravel and cobbles.	w~PL			VACUUM EXCAVATED TO 1.1m DEPTH SOIL PROFILE ASSESSED BY VISUAL OBSERVATION OF EXCAVATION SIDEWALLS
					N = 14 3,8,6	16	1						460 >600 190	
							2			FILL: Silty clay, medium plasticity, grey brown, trace of fine to medium grained sand, fine to medium grained siltstone gravel, crushed brick, and slag.	w>PL			
					N = 4 5,2,2	15	3						70 120 100	
						14	4		CI-CH	Silty CLAY: medium to high plasticity, orange brown, red brown and light grey, trace of fine to medium grained ironstone gravel.	w~PL	VSt - Hd		RESIDUAL
					N = 22 5,9,13	13	5						380 460 320	
						12						VSt		
					N > 17 12,17/ 150mm REFUSAL	11	6						340 250	

JKGeotechnics

BOREHOLE LOG

Borehole No. 7 **2 / 4**

EASTING: 313854.92
NORTHING: 6258068.05

Client: NSW HEALTH INFRASTRUCTURE
Project: RELOCATION OF CWMHSR
Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 17.63 m
Date: 20/10/21 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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-CH	Silty CLAY: medium to high plasticity, orange brown, red brown and light grey, trace of fine to medium grained ironstone gravel. *(continued)*	w~PL	VSt		
				■	N=SPT 18/ 100mm REFUSAL	10			-	SILTSTONE: dark grey, with medium strength bands.	HW	VL - L		ASHFIELD SHALE LOW 'TC' BIT RESISTANCE
						9	8							
							9							
										REFER TO CORED BOREHOLE LOG				
						8	10							
						7	11							
						6	12							
						5	13							
						4								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 7 **3 / 4**

EASTING: 313854.92
NORTHING: 6258068.05

Client: NSW HEALTH INFRASTRUCTURE

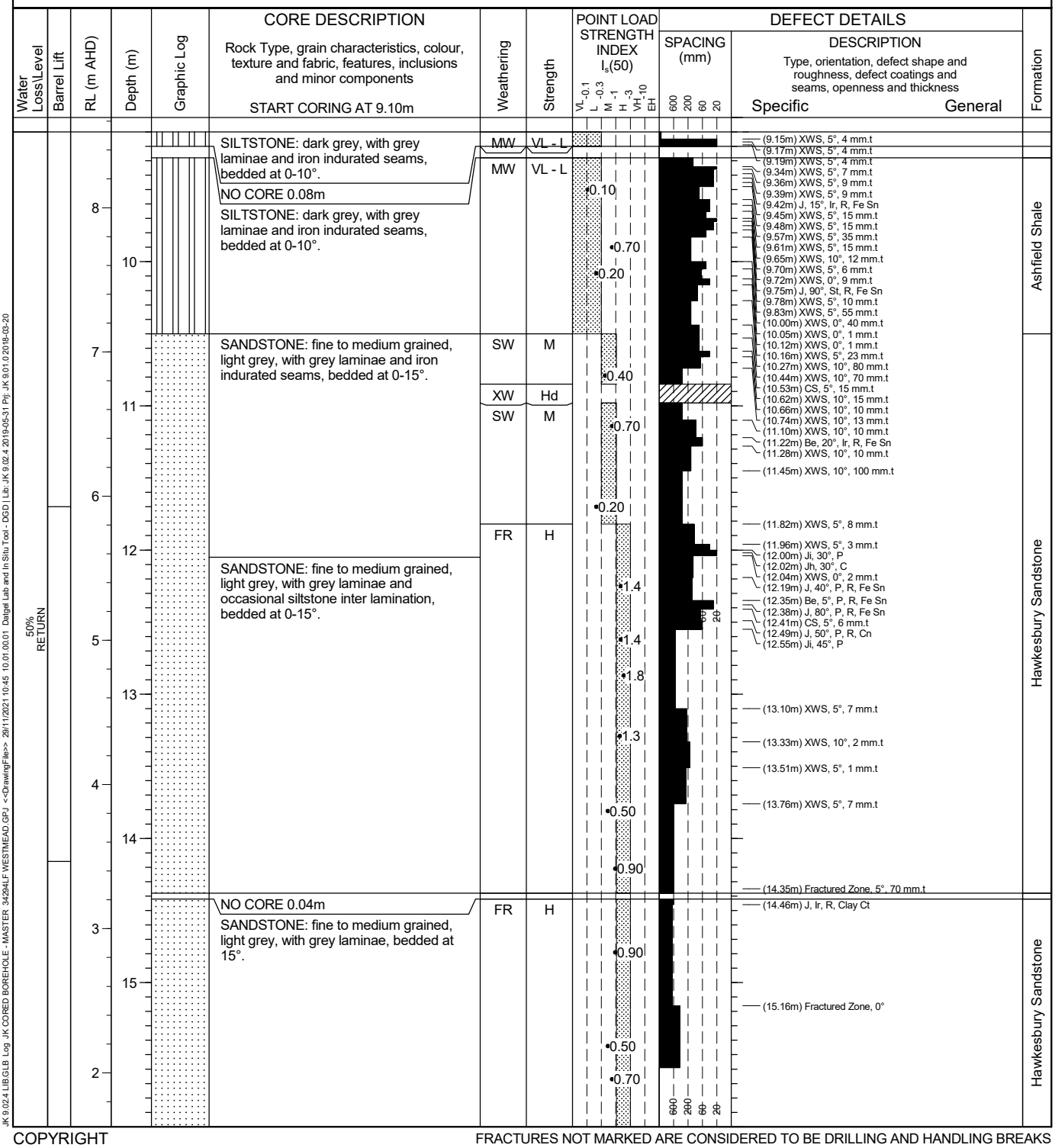
Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 17.63 m

Date: 20/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.



FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 7 **4 / 4**

EASTING: 313854.92
NORTHING: 6258068.05

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Core Size:** NMLC **R.L. Surface:** 17.63 m

Date: 20/10/21 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** A.C.K./O.F.

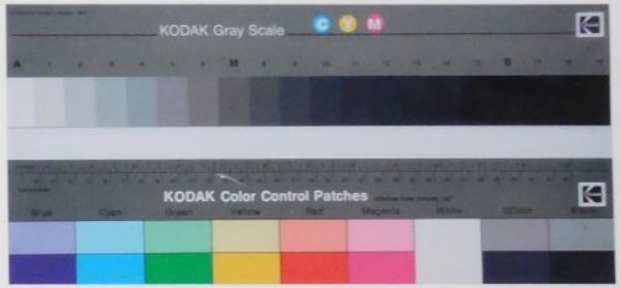
Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1 L 0.3 M 1 H 3 VH 10 EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
					SANDSTONE: as above			0.90			
					END OF BOREHOLE AT 16.09 m						
		1	17								
		0	18								
		-1	19								
		-2	20								
		-3	21								
		-4	22								
		-5									

JK 9.02.4 LIB:GLB Log JK CORED BOREHOLE - MASTER 34294LF WESTMEAD.GPJ <<DrawingFile>> 29/11/2021 10:45 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: 34294LF
Borehole No: 07
Depth: 9.10m - 16.09m



34294LF BH7 START CORING AT 9.10m

9 NO CORE 0.08m

10

11

12

13

14 NO CORE

15 15.50-15.68

16 END OF BOREHOLE AT 16.09m

JK Geotechnics

JKGeotechnics

BOREHOLE LOG

Borehole No. 8 **1 / 1**

EASTING: 313904.67
NORTHING: 6258168.39

Client: NSW HEALTH INFRASTRUCTURE

Project: RELOCATION OF CWMHSR

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Job No.: 34294LF **Method:** SPIRAL AUGER **R.L. Surface:** 15.73 m

Date: 25/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** A.C.K./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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						15	1			FILL: Sandy silty clay, low to medium plasticity, dark grey brown, fine to medium grained sand, with fine to medium grained ironstone gravel.	w~PL			VACUUM EXCAVATED TO 1.5m DEPTH SOIL PROFILE ASSESSED BY VISUAL OBSERVATION OF EXCAVATION SIDEWALLS
					N = 8 1,3,5	14	2		CI-CH	Silty CLAY: medium to high plasticity, orange brown and light grey.	w>PL	VSt	310 360 300	RESIDUAL
					N = 24 10,12,12	13	3						375 260 270	
						12	4			END OF BOREHOLE AT 3.45 m				
						11	5							
						10	6							
						9								

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title: **SITE LOCATION PLAN**

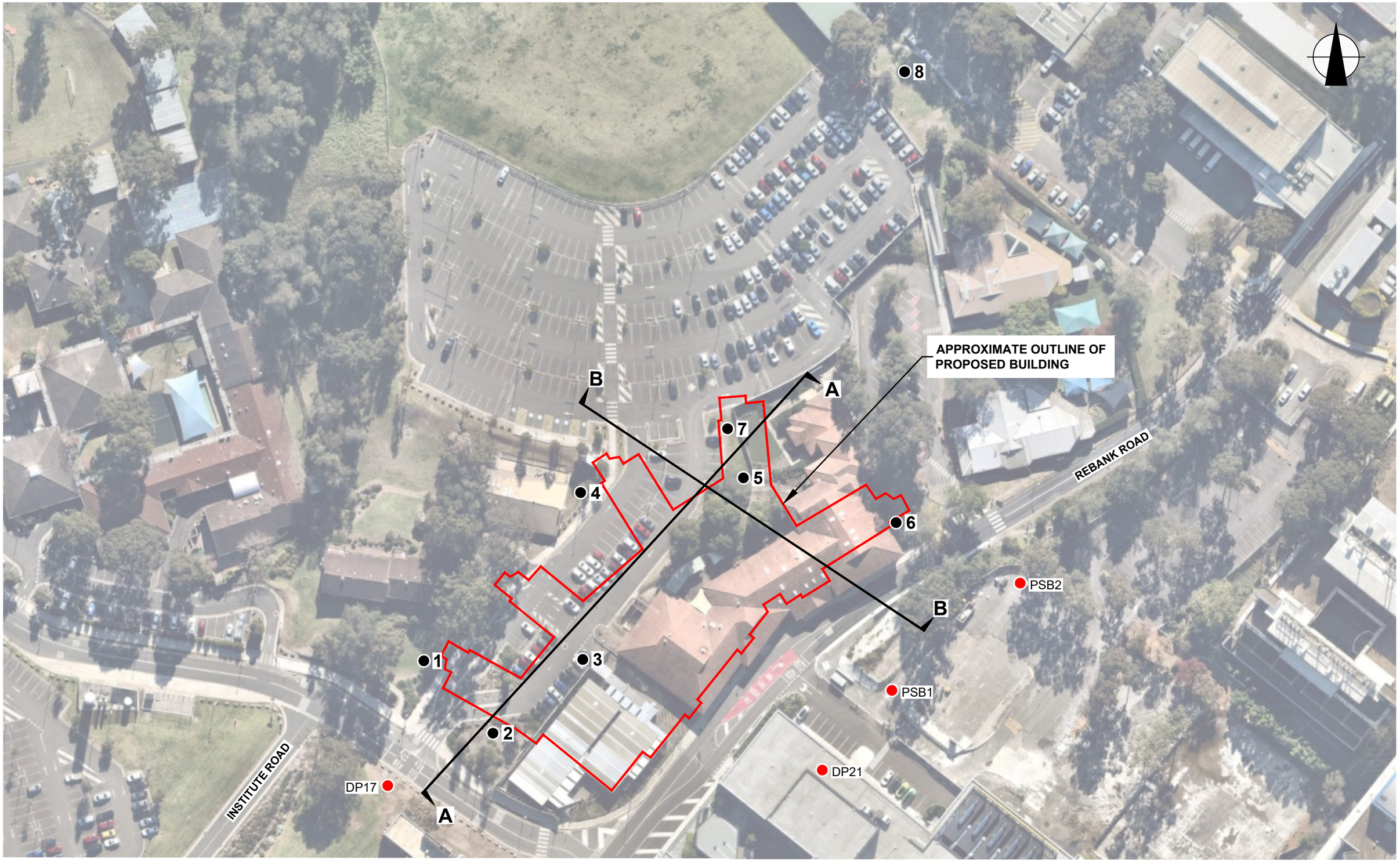
Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Report No: 34294LF

Figure No: 1

JKGeotechnics

PLOT DATE: 3/11/2021 8:57:20 AM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34294LF WESTMEAD\CAD\34294LF.DWG



LEGEND

- BOREHOLE
- BOREHOLE FROM PREVIOUS INVESTIGATIONS

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 10 20 30 40 50

SCALE 1:1000 @A3 METRES

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

Title: **BOREHOLE LOCATION PLAN**

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Report No: 34294LF

Figure No: 1

JKGeotechnics

PLOT DATE: 15/11/2021 10:35:37 AM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34294LF WESTMEAD\CAD\34294LF.DWG

DISTANCE (m)

0 20 40 60 80 100 120 140 160

ELEVATION (m AHD)

16 14 12 10 8 6 4 2 0

2 (-8 m) 3 (-11 m) 5 (-7 m) 7 (-6 m)

FILL

RESIDUAL CLAY

CLASS V

CLASS III

CLASS II

11.10

12.97

14.49

16.09

N=14 N=4 N=22 N=8 N=9

MATERIAL GRAPHIC

- ASPHALTIC CONCRETE
- NO CORE
- SILTY CLAY (CL, CI, CH)
- FILL
- LAMINITE (SILTSTONE, SANDSTONE)
- SANDSTONE
- SILTSTONE

H: SCALE 0 5 10 15 20 25 METRES 1:500 @A3

V: SCALE 0 1 2 3 4 5 METRES 1:100 @A3

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

Title: **SECTION A-A**
GRAPHICAL BOREHOLE SUMMARY

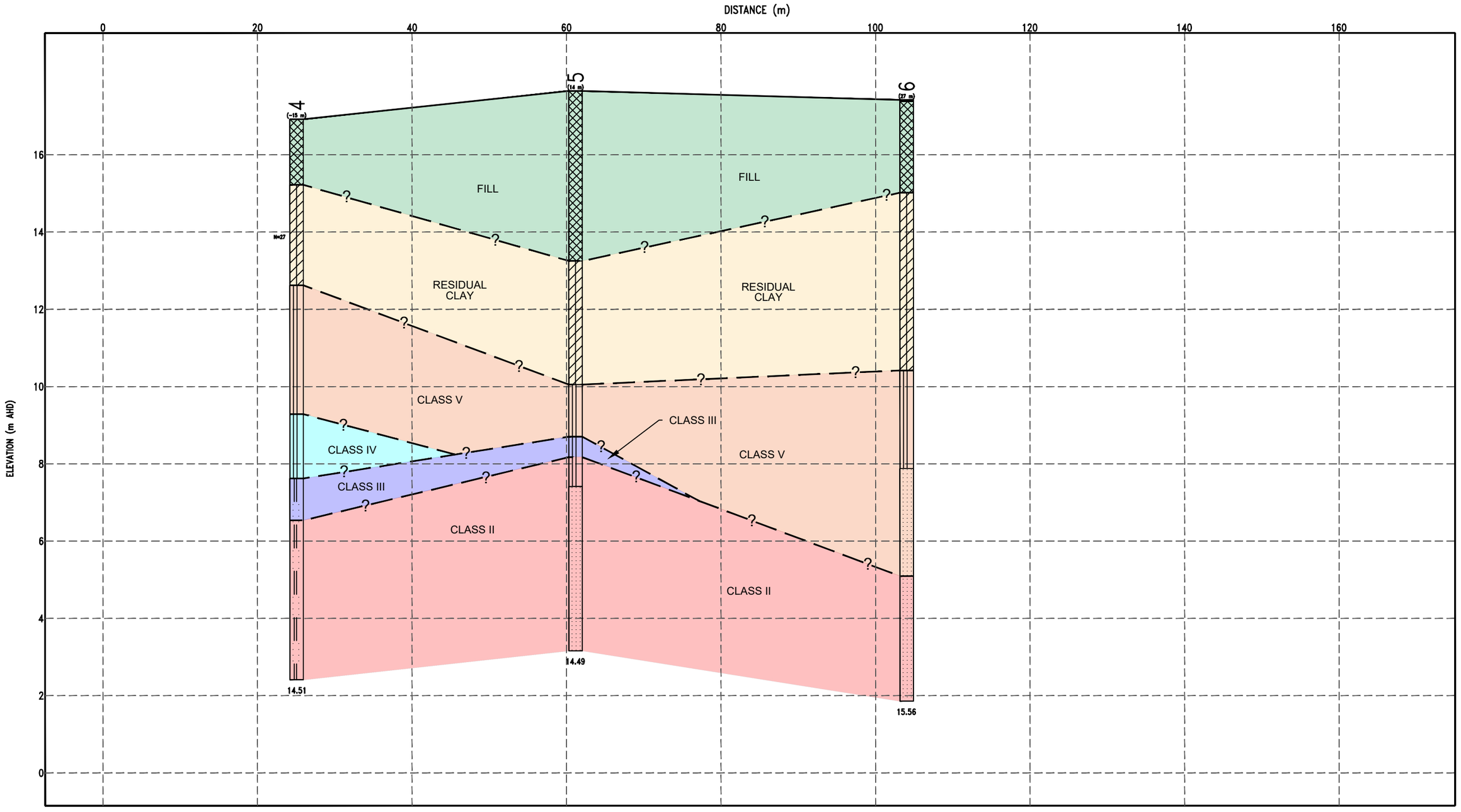
Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Report No: 34294LF

Figure No: 3

JKGeotechnics

PLOT DATE: 30/11/2021 9:55:48 AM DWG FILE: J:\6F GEOTECHNICAL JOBS\34000'S\34294LF WESTMEAD\CAD\34294LF.DWG



MATERIAL GRAPHIC

- ASPHALTIC CONCRETE
- SILTY CLAY (CL, CI, CH)
- FILL
- LAMINITE (SILTSTONE, SANDSTONE)
- SANDSTONE
- SILTSTONE

H: SCALE 0 5 10 15 20 25 METRES 1:500 @A3

V: SCALE 0 1 2 3 4 5 METRES 1:100 @A3

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

Title: **SECTION B-B**
GRAPHICAL BOREHOLE SUMMARY

Location: WESTMEAD HOSPITAL, DRAGONFLY DRIVE, WESTMEAD, NSW

Report No: 34294LF

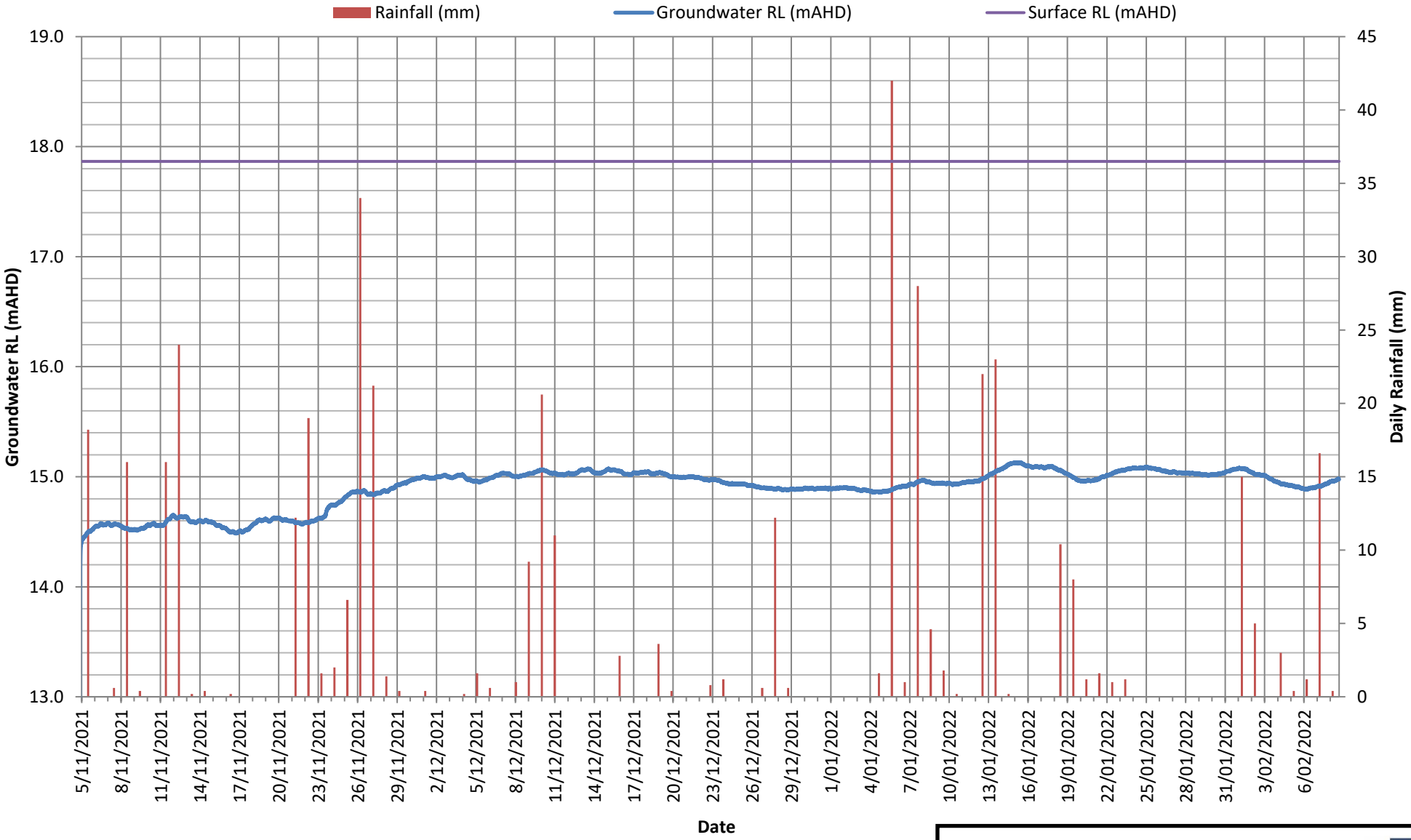
Figure No: 4

JKGeotechnics

PLOT DATE: 30/11/2021 9:55:58 AM DWG FILE: J:\6F GEOTECHNICAL JOBS\34000S\34294LF WESTMEAD\CAD\34294LF.DWG

File Name: 34294LF Groundwater Plot_BH2 (22.02.09)
Date Printed: 9/02/2022

Groundwater Level and Daily Rainfall -v- Time Plot
BH2



Rainfall data from Parramatta North (Masons Drive), 66124

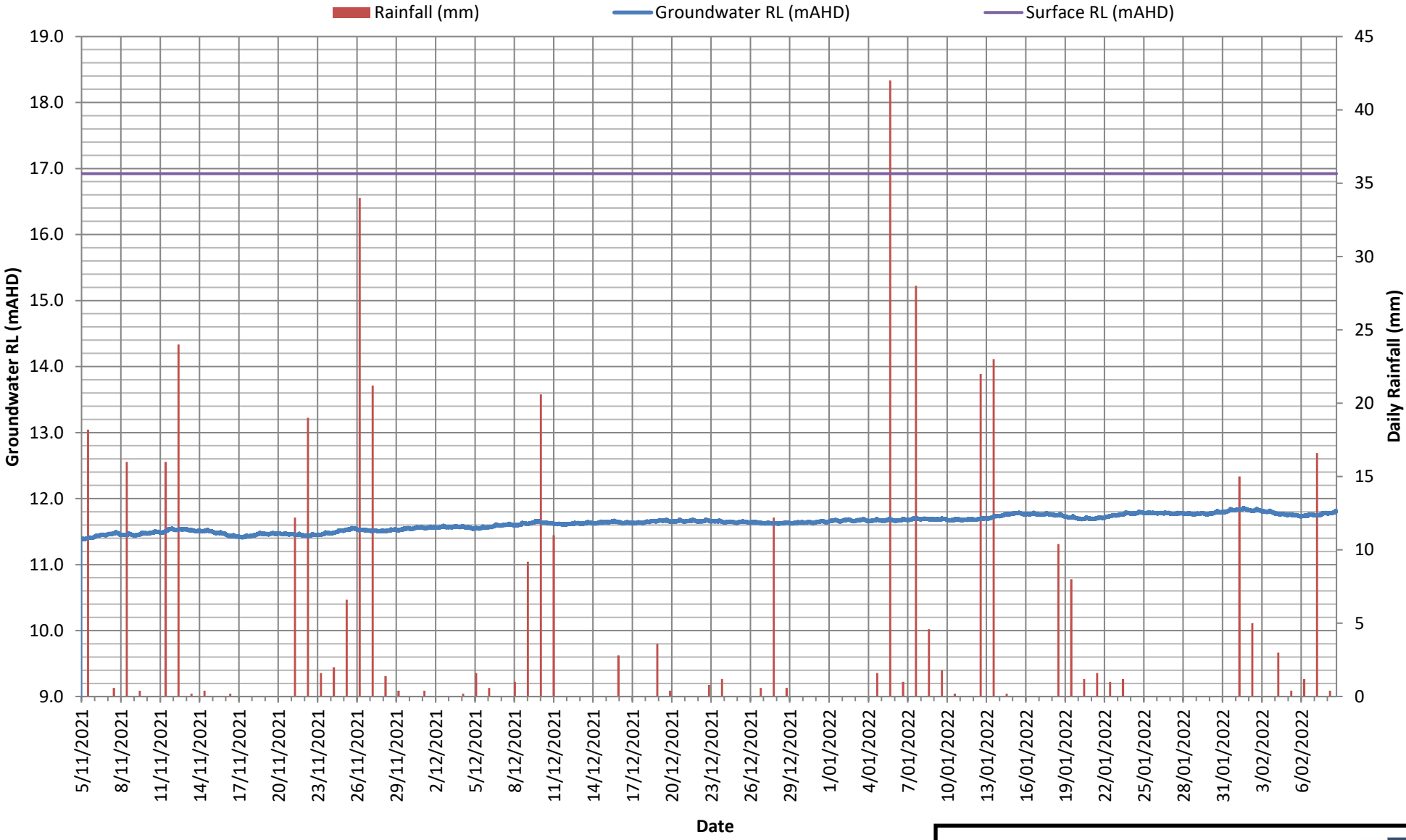
JKGeotechnics

Report No. 34294LF Figure No. 3

File Name: 34294LF Groundwater Plot_BH4 (22.02.09)
Date Printed: 9/02/2022

Groundwater Level and Daily Rainfall -v- Time Plot

BH4



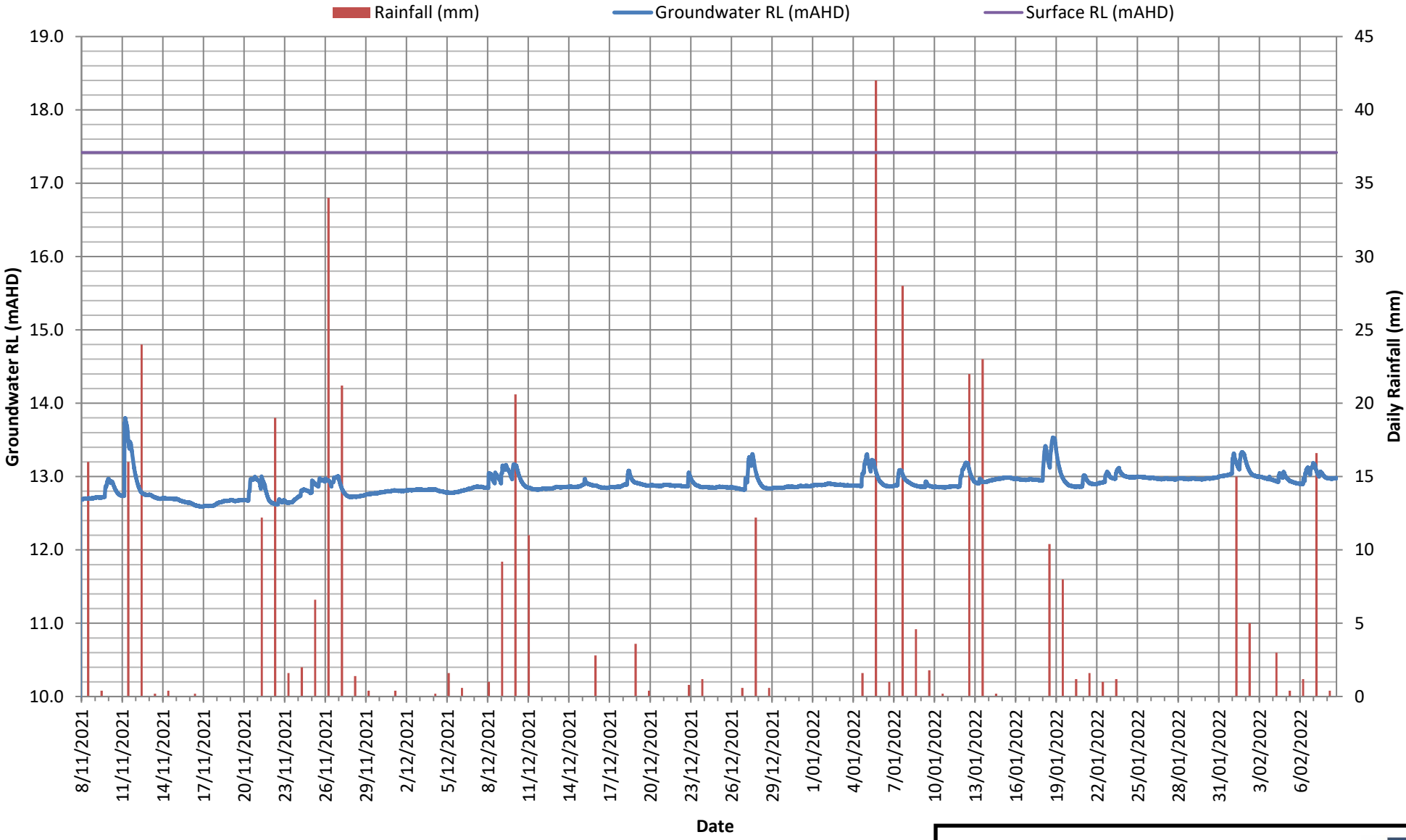
Rainfall data from Parramatta North (Masons Drive), 66124

JKGeotechnics

Report No. 34294LF Figure No. 4

File Name: 34294LF Groundwater Plot_BH6 (22.02.09)
Date Printed: 9/02/2022

Groundwater Level and Daily Rainfall -v- Time Plot
BH6



Rainfall data from

JKGeotechnics

Report No. 34294LF Figure No. 5

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.

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:

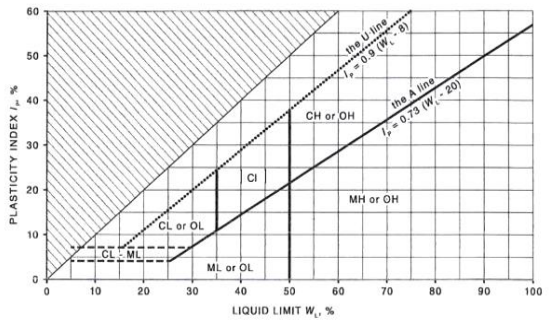
$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

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.

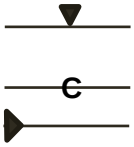
NOTES:

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



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown. 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

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

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)	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

APPENDIX A

Relevant Borehole Logs

from Previous Investigations

JKGeotechnics

BOREHOLE LOG

Borehole No. 1

EASTING: 313898.74
NORTHING: 6257991.95

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:** 20.32 m

Date: 8/10/20 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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: 70mm.t.				
									-	FILL: Sand, fine to medium grained, dark brown, with fine to coarse grained, sub-angular igneous gravel.	M w<PL			APPEARS MODERATELY COMPACTED
					N=SPT 14/ 150mm REFUSAL	20				FILL: Silty clay, low to medium plasticity, dark brown and grey, with fine to coarse grained, sub-angular and angular siltstone, igneous and sandstone gravel, ash, slag and fine to medium grained sand.	w~PL			
						19	1			as above, but with fragments of fibro, tile and brick.				
					N = 16 5,8,8					FILL: Gravelly clay, low to medium plasticity, brown and grey, fine to coarse grained, sub-angular and angular siltstone, igneous and sandstone gravel, with ash and slag.				
					N = 8 4,4,4	18	2							
						17	3				w>PL			
					N = 10 4,4,6	16	4			FILL: Silty clay, medium plasticity, brown and dark grey, with fine to medium grained, sub-angular ironstone and siltstone gravel.				
							5		CI	Silty CLAY: medium plasticity, brown and grey, with fine to medium grained, sub-angular ironstone gravel.	w~PL	(St - VSt)		RESIDUAL
					N = 23 8,11,12	15	6					VSt	300 320 360	
						14			-	Extremely Weathered Siltstone: as below	XW	Hd		ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE

JKGeotechnics

BOREHOLE LOG

Borehole No. 1 **2 / 4**

EASTING: 313898.74
NORTHING: 6257991.95

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:** 20.32 m

Date: 8/10/20 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** B.Z./D.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									-	Extremely Weathered Siltstone: silty CLAY, low plasticity, grey and yellow brown, with iron indurated bands.	XW	Hd		
						13				REFER TO CORED BOREHOLE LOG				
							8							
						12								
							9							
						11								
							10							
						10								
							11							
						9								
							12							
						8								
							13							
						7								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 1 **3 / 4**

EASTING: 313898.74
NORTHING: 6257991.95

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:** 20.32 m

Date: 8/10/20 **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 (Specific / General)	Formation
					START CORING AT 7.30m						
100% RETURN		13	8		Extremely Weathered Siltstone: silty CLAY, medium plasticity, grey and yellow brown, with iron indurated bands.	XW	Hd				Ashfield Shale
		12	9								
		11	10		LAMINITE: Siltstone, dark grey and brown interlaminated with Sandstone, fine grained, grey, with iron indurated bands and extremely weathered siltstone bands.	MW - HW	L - M			(9.15-9.40m) Cr, gravelly clay and clay, 250mm.t.	
										(9.54m) XWS, 2°, 22 mm.t	
								0.30 × 0.40			
					LAMINITE: Siltstone, dark grey and brown interlaminated with Sandstone, fine grained, grey, with iron indurated bands.	MW - SW	M - H			(9.77m) Be, 0°, P, R, Fe Vn (9.79m) Be, 0°, P, R, Fe Vn (9.89m) Be, 8°, Un, R, Fe Sn (9.95m) Be, 8°, Un, R, Fe Vn (10.00m) Be, 0°, P, R, Fe Vn	
		10	10							(10.40m) XWS, 0°, 20 mm.t	
					LAMINITE: Siltstone, dark grey interlaminated with Sandstone, fine grained, grey, with iron indurated bands.	FR	H	0.60 × 1.9			Hawkesbury Sandstone
		9	11					0.20 × 2.1		(11.14m) Be, 0°, P, R, Cb Vn	
		8	12		SANDSTONE: fine to medium grained, grey, with dark grey laminae.					(12.20m) Be, 0°, Un, R, Cb Ct	
										(12.39m) XWS, 0°, 22 mm.t	
								1.8 × 2.9			
		7	13					1.1 × 2.4			

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 1 **4 / 4**

EASTING: 313898.74
NORTHING: 6257991.95

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:** 20.32 m

Date: 8/10/20 **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	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
100% RETURN		6	14		SANDSTONE: fine to medium grained, grey, with dark grey laminae. *(continued)*	FR	H	1.4×2.3			Hawkesbury Sandstone
			15		LAMINITE: Siltstone, dark grey interlaminated with Sandstone, fine grained, grey, with iron indurated bands.					(14.63m) J, 40°, Un, Vr, Clay FILLED, 3 mm.t (14.72m) J, 45°, Un, R, Cn	
		5			SANDSTONE: medium to coarse grained, light grey, cross bedded at 25°.			0.50×0.80		(15.15m) XWS, 0°, 14 mm.t	
		4	16							(15.79m) Be, 10°, Un, R, Cb Ct	
		3	17		as above, but massive.			1.3×1.2		(17.74m) Be, 0°, P, R, Clay Ct	
		2	18					0.80×1.0		(18.51m) Be, 3°, Un, R, Cb Vn	
		1	19					0.80×1.1			
		0	20					1.3×1.4			
					END OF BOREHOLE AT 20.70 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JKGeotechnics
Job No: 33303BT
Borehole No: BH1
Depth: 7.3m - 10.0m
KODAK Gray Scale
KODAK Color Control Patches
33303BT, BH1, CORING STARTS AT: 7.3m
7
7.3 →
8
9


JKGeotechnics
Job No: 333038T
Borehole No: BH1
Depth: 10.0m - 14.0m
KODAK Gray Scale
KODAK Color Control Patches
10
11
12
13


JKGeotechnics
Job No: 33303BT
Borehole No: BH1
Depth: 14.0m - 18.0m
KODAK Gray Scale
KODAK Color Control Patches
14
15
16
17


JKGeotechnics
Job No: 33303BT
Borehole No: BH1
Depth: 18.0m - 20.7m
KODAK Gray Scale
KODAK Color Control Patches
18
19
20
← 20.70m END

JKGeotechnics

BOREHOLE LOG

Borehole No. 2

1 / 4

EASTING: 313935.56
NORTHING: 6258023.37

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:** 19.93 m

Date: 1/10/20 **Datum:** AHD

Plant Type: JK305 **Logged/Checked By:** B.S./D.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
									-	ASPHALTIC CONCRETE: 60mm.t	M			APPEARS MODERATELY COMPACTED
										FILL: Gravelly sand, fine to medium grained, dark grey and grey, fine to coarse grained igneous gravel and trace of silt.	w~PL			
					N = 12 4,5,7	19	1			FILL: Silty clay, low plasticity, grey, orange brown and dark brown, with fine to medium grained igneous and ironstone gravel, trace of fine to medium grained sand.			250 210 310	
										FILL: Silty clay, low to medium plasticity, orange brown and brown, trace of fine to medium grained igneous and siltstone gravel and plastic fragments.				
					N = 11 5,5,6	18	2			FILL: Gravelly silty clay, low plasticity, dark brown, fine to coarse grained igneous and ironstone gravel, with organic materials, trace of metal, slag, plastic and concrete fragments, and coarse grained sandstone gravel.	w<PL			
					N = 11 5,6,5	17	3							
ON COMPLETION OF AUGERING						16	4							
					N = 4 3,2,2	15	5				w>PL			APPEARS POORLY COMPACTED
					N = 19 5,6,13	14	6		CI	Silty CLAY: medium plasticity, light grey and orange brown, trace of fine grained sand and fine to medium grained ironstone gravel	w>PL	VSt	310 340 310	RESIDUAL
						13								

JK 9.02.4 LIB:GLB Log JK AUGERHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 30/10/2020 13:34 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. 2

2 / 4

EASTING: 313935.56
NORTHING: 6258023.37

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:** 19.93 m

Date: 1/10/20 **Datum:** AHD

Plant Type: JK305 **Logged/Checked By:** B.S./D.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES 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, light grey and orange brown, trace of fine grained sand and fine to medium grained ironstone gravel.	w>PL	VSt		RESIDUAL
									CI-CH			VSt - Hd		
					N > 16 7,11,5/ 50mm REFUSAL					Silty CLAY: medium to high plasticity, light grey, trace of iron indurated bands.			370 410 350	
						12	8		-	Extremely Weathered siltstone: silty CLAY, medium plasticity, light grey, trace of iron indurated bands and very low strength bands.	XW - DW	Hd - VL		ASHFIELD SHALE VERY LOW 'TC' BIT RESISTANCE
										REFER TO CORED BOREHOLE LOG				
						11	9							
						10	10							
						9	11							
						8	12							
						7	13							
						6								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 2 **3 / 4**

EASTING: 313935.56
NORTHING: 6258023.37

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:** 19.93 m
Date: 1/10/20 **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 (Specific / General)	Formation
					START CORING AT 8.47m						
0% RETURN		11	9		NO CORE 0.08m SILTSTONE: dark grey and brown, with iron indurated bands.	HW	VL L	0.020× •0.10		(8.70m) XWS, 0°, 25mm.t (8.78m) XWS, 0°, 10mm.t	Ashfield Shale
		10	10		SANDSTONE: fine to medium grained, orange brown.	MW	M - H	1.0× •2.2		(9.14m) CS, 0°, 30mm.t (9.25m) CS, 0°, 60mm.t	
		9	11		SANDSTONE: fine to medium grained, light grey, with dark grey laminations at 0°-10°.	FR		0.10× •2.7		(9.72m) XWS, 0°, 25mm.t (9.82m) XWS, 0°, 15mm.t (10.38m) XWS, 0°, 5mm.t	Hawkesbury Sandstone
20% RETURN		8	12		LAMINATE: Sandstone, fine to medium grained, grey, interbedded with Siltstone, dark grey.	M M - H		0.50× •1.0 0.70× •1.3			
		7	13		SANDSTONE: fine to medium grained, light grey, with dark grey laminations and occasional siltstone bands.	H		0.50× •2.2		(13.18m) XWS, 0°, 5mm.t	
80% RETURN		6	14		SANDSTONE: fine to medium grained, light grey, with dark grey laminations, carbonaceous lenses and trace of quartz gravel inclusions.			0.20× •1.8			
		5									

JK 9.02.4 LIB:GLB Log JK CORED BOREHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 03/11/2020 11:09 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

CORED BOREHOLE LOG

Borehole No. 2 **4 / 4**

EASTING: 313935.56
NORTHING: 6258023.37

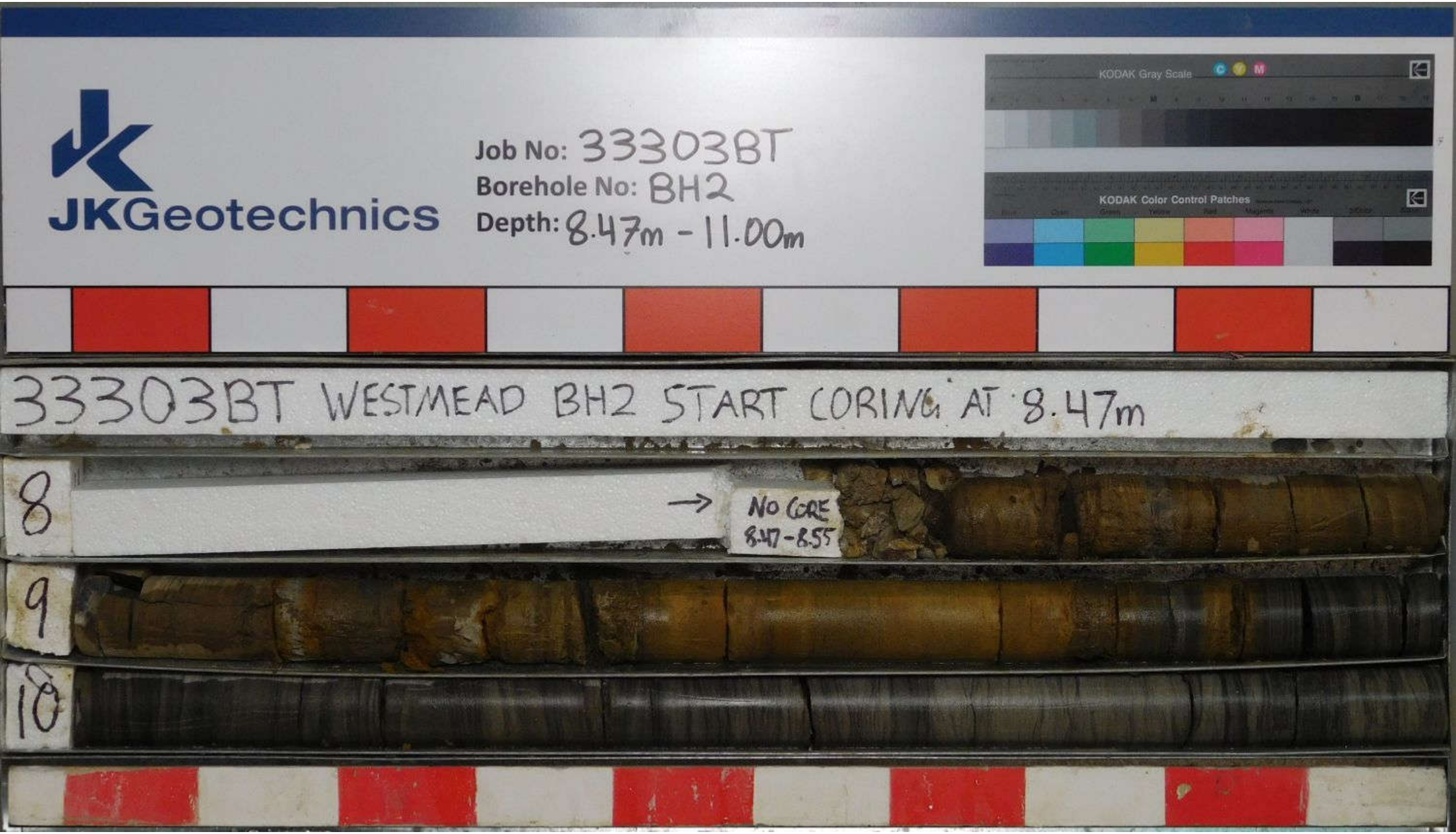
Client: HEALTH INFRASTRUCTURE
Project: THE CHILDREN'S HOSPITAL AT WESTMEAD STAGE 2 REDEVELOPMENT
Location: HAWKESBURY ROAD, WESTMEAD, NSW

Job No.: 33303BT **Core Size:** HQ **R.L. Surface:** 19.93 m
Date: 1/10/20 **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 $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
80% RETURN		4	16		SANDSTONE: fine to medium grained, light grey, with dark grey laminations, carbonaceous lenses and trace of quartz gravel inclusions. *(continued)*	FR	H	1.3, 1.9		(16.09m) XWS, 0°, 5mm.t	Hawkesbury Sandstone
					as above, but without quartz gravel inclusions.			1.2, 1.3		(16.93m) Be, 0°, Ir, R, Clay Ct	
100% RETURN		3	17					1.4, 1.1		(17.60m) Be, 0°, Ir, R, Cn	
		2	18								
		1	19					1.0, 1.3			
		0	20					1.4, 1.4			
								1.4, 1.5			
		-1	21		END OF BOREHOLE AT 20.25 m						
		-2									

JK 9.02.4 LIB:GLB Log JK CORED BOREHOLE - MASTER 33303BT WESTMEAD.GPJ <<DrawingFile>> 03/11/2020 11:09 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: BH2
Depth: 8.47m - 11.00m
KODAK Gray Scale
KODAK Color Control Patches
33303BT WESTMEAD BH2 START CORING AT 8.47m
8
9
10
NO CORE
8.47 - 8.55

JKGeotechnics

Job No: 33303BT
Borehole No: BH2
Depth: 11.00m - 15.00m

JKGeotechnics

Job No: 33303BT
Borehole No: BH2
Depth: 15.00m - 19.00m


JKGeotechnics
Job No: 33303BT
Borehole No: BH2
Depth: 19.00m - 20.25m
KODAK Gray Scale
KODAK Color Control Patches
19
20
END OF HOLE AT 20.25m

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Westmead Hospital Redevelopment
LOCATION: Westmead

SURFACE LEVEL: 20.1 AHD
EASTING: 313755
NORTHING: 6257969
DIP/AZIMUTH: 90°/--

BORE No: 17
PROJECT No: 73960.01
DATE: 21/11/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
20	0.1	TOPSOIL - dark brown, silty clay topsoil with some fine to medium grained sand (rootlets to 100mm)							D/E			PID<1
		FILLING - brown, silty clay filling with some fine to coarse grained sand and fine to coarse sandstone gravel and fibre-cement sheeting							D/E			PID<1
19	1								D/E			PID<1
		1.4m: slightly gravelly, with a trace of plastic pieces										
18	2								D/E			PID<1
		2.5m: slightly sandy, with a trace of gravel										
17	3								D/E			PID<1
16	4								D/E			PID<1
									S			12,12,17 N = 29
								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				PID<1
15	5											
	5.3	SHALE - extremely low and very low strength, extremely to highly weathered, fragmented to highly fractured, light grey and red-brown, shale with some medium and high strength iron-cemented bands						5.3m: CORE LOSS: 660mm				
14	5.96											PL(A) = 2.1
	6							6.1-6.88m: fg, fe, cly				
13	7							6.88-7.0m: B0°, fe, cly 7m: CORE LOSS: 200mm	C	75	0	
	7.2											
	7.35	SHALE - low to medium and medium strength, moderately to slightly weathered, fragmented to fractured, grey-brown shale with some clay bands										PL(A) = 0.3
12	8							7.48-8.25m: B's 0°- 5°, fe, he 8.25-8.38m: J85°, un, ro, fe, cly 8.48 & 8.54m: J35°, pl, ro, fe, cly				PL(A) = 0.3
								8.65m: CORE LOSS: 350mm				
11	9							9.02-9.08m: cly J30°- 45°, cu, sm, cln 9.3-9.8m: fg, fe	C	91	0	
	9.0							9.55 & 9.6m: J30° & 45°, pl, ro, fe 9.8m: J35°, pl, ro, fe				PL(A) = 0.7

RIG: DT 100 **DRILLER:** SM **LOGGED:** JE/SI **CASING:** HW to 5.2m

TYPE OF BORING: Solid flight auger to 5.2m; Rotary to 5.3m; NMLC-Coring to 16.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Westmead Hospital Redevelopment
LOCATION: Westmead

SURFACE LEVEL: 20.1 AHD
EASTING: 313755
NORTHING: 6257969
DIP/AZIMUTH: 90°/--

BORE No: 17
PROJECT No: 73960.01
DATE: 21/11/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
10		SHALE - low to medium and medium strength, moderately to slightly weathered, fragmented to fractured, grey-brown shale with some clay bands *(continued)*						10.15-10.48m: J (x4) 30°- 50°, pl, ro, cln				PL(A) = 0.3
	10.85							10.58-10.7m: J, sv (85°-90°) pl, ro, fe, he				
9	11	LAMINITE - high strength, fresh, slightly fractured and unbroken, light grey to grey, laminite with approximately 50% fine grained sandstone laminations and bands						10.72m: J45°- 70°, cu, ro, fe 10.82m: J's 50°, pl, ro, fe 11.1 & 11.2m: J's 45°-50°, un, ro, cln	C	100	94	PL(A) = 1.4
8	12											PL(A) = 1.8
												PL(A) = 1.7
7	13							12.8-12.9m: B (x3) 5°-10°, cly co, 3-5mm				
								13.16m: J70° & 30°, st, ro, cln				PL(A) = 1.6
								13.6m: J35° & 70°, st, ro, cln				
6	14											PL(A) = 1.8
									C	100	97	
								14.72m: J70°, un, ro, cly				
5	15											PL(A) = 1.6
								15.4m: J50°, he				
												PL(A) = 1.2
	16	15.96-16.05m: very low strength						15.96-16.05m: Sz				
4	16.05	Bore discontinued at 16.05m										
	17											
3												
	18											
2												
	19											
1												

RIG: DT 100 **DRILLER:** SM **LOGGED:** JE/SI **CASING:** HW to 5.2m

TYPE OF BORING: Solid flight auger to 5.2m; Rotary to 5.3m; NMLC-Coring to 16.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

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BORE 17 PROJECT 73960.01 NOV 2014

5.3 – 10.0m

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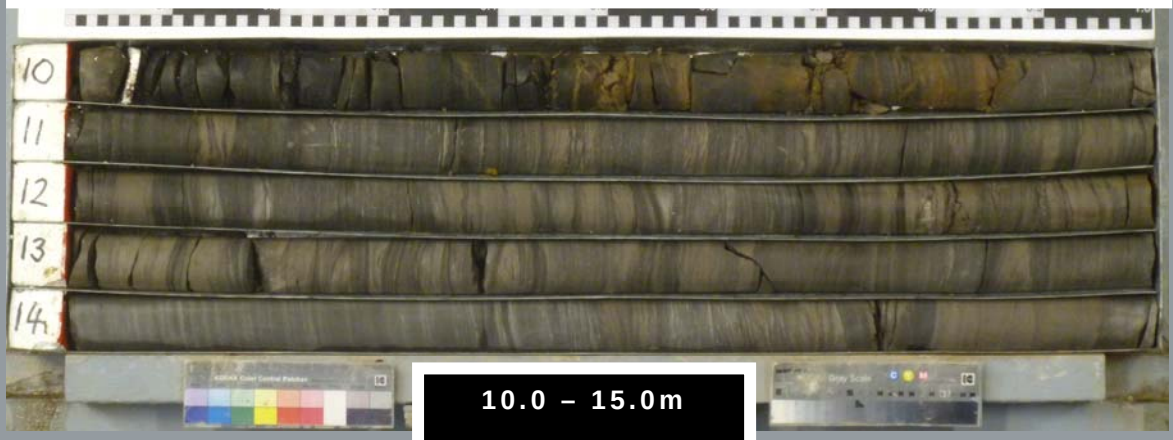

10.0 – 15.0m

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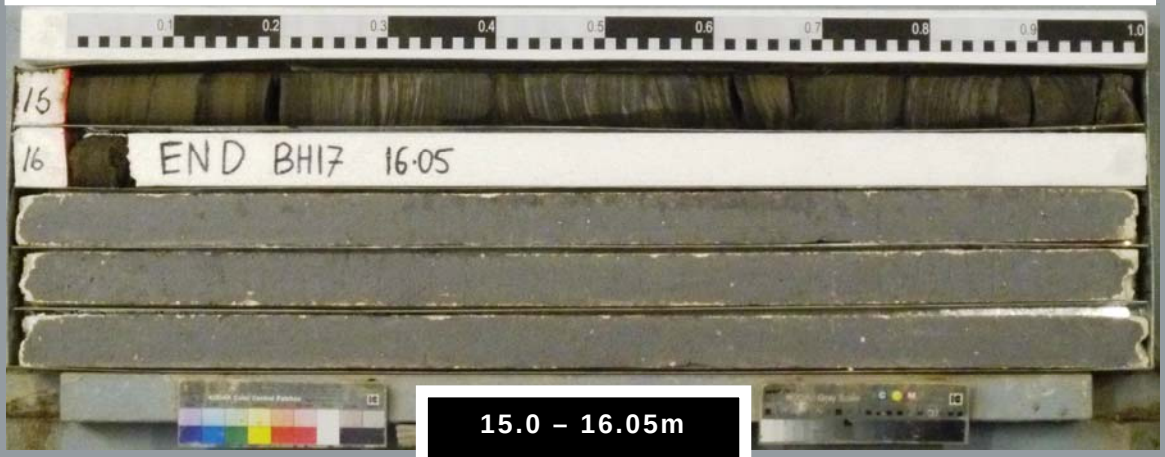

15.0 – 16.05m

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Westmead Hospital Redevelopment
LOCATION: Westmead

SURFACE LEVEL: 21 AHD
EASTING: 313884
NORTHING: 6257972
DIP/AZIMUTH: 90°/--

BORE No: 21
PROJECT No: 73960.01
DATE: 26/11/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
21	0.2	FILLING - dark brown, silty, fine to coarse grained sand filling (topsoil) with a trace of clay, humid							D/E			PID<1
		FILLING - brown-grey, sandy silty clay filling with a trace of ironstone gravel, fibre-cement sheeting and fibrous material							D/E			PID<1
20	1								S			7,9,12 N = 21 PID<1
19	2	2.0m: with some sand							D/E			PID<1
									S			3,5,6 N = 11 PID<1
18	3											
17	4	3.9m: gravelly (500mm)										
16	5											
		5.8m: slightly sandy, green-brown							D/E			PID<1
15	6								S			3,5,13 N = 18 PID<1
		6.7m: red, sandy, fine to coarse grained										
14	7								S			8,9,11 N = 20
	7.5	LAMINITE - extremely low strength, grey-brown and orange laminite						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 5°	D/E			PID<1 PID<1
13	8											
	8.4	LAMINITE - extremely low strength, extremely weathered, light grey-brown, laminite with some ironstone bands							C	100	0	
12	9											
	9.5	LAMINITE - *see next page*						9.5-10.17m: B's 0°- 5°, fe				PL(D) = 0.7

RIG: DT 100 **DRILLER:** SM **LOGGED:** JE/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 8.45m; NMLC-Coring to 15.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 15.9m (screen 0.9-15.9m; gravel 0.8-15.9m; bentonite 0.3-0.8m; backfill to GL with gatic cover)

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Westmead Hospital Redevelopment
LOCATION: Westmead

SURFACE LEVEL: 21 AHD
EASTING: 313884
NORTHING: 6257972
DIP/AZIMUTH: 90°/--

BORE No: 21
PROJECT No: 73960.01
DATE: 26/11/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
11		LAMINITE - medium then high strength, moderately then slightly weathered, fractured and slightly fractured, grey-brown laminite with approximately 40% fine sandstone laminations and beds *(continued)*						10.6 & 10.73m: B0°, fe				PL(D) = 2.5
10	10.9	LAMINITE - high strength, fresh, slightly fractured and unbroken, light grey to grey, laminite with approximately 50% fine sandstone laminations						11.26m: J20°, un, ro, cln	C	100	86	PL(D) = 1.2
9	12											PL(D) = 2.2
								12.57m: B10°, cly vn				
8	13											PL(D) = 2.3
7	14							14.2m: B15°, cly vn, ti	C	100	100	PL(D) = 1.6
	14.85											
6	15	SANDSTONE - high strength, fresh, slightly fractured, light grey, fine grained sandstone with a trace of carbonaceous laminations										PL(D) = 2.7
								15.51m: B5°, cly co				
5	15.9 16	Bore discontinued at 15.9m										
4	17											
3	18											
2	19											

RIG: DT 100 **DRILLER:** SM **LOGGED:** JE/SI **CASING:** HW to 5.5m

TYPE OF BORING: Solid flight auger to 5.5m; Rotary to 8.45m; NMLC-Coring to 15.9m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 15.9m (screen 0.9-15.9m; gravel 0.8-15.9m; bentonite 0.3-0.8m; backfill to GL with gatic cover)

SAMPLING & IN SITU TESTING LEGEND

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

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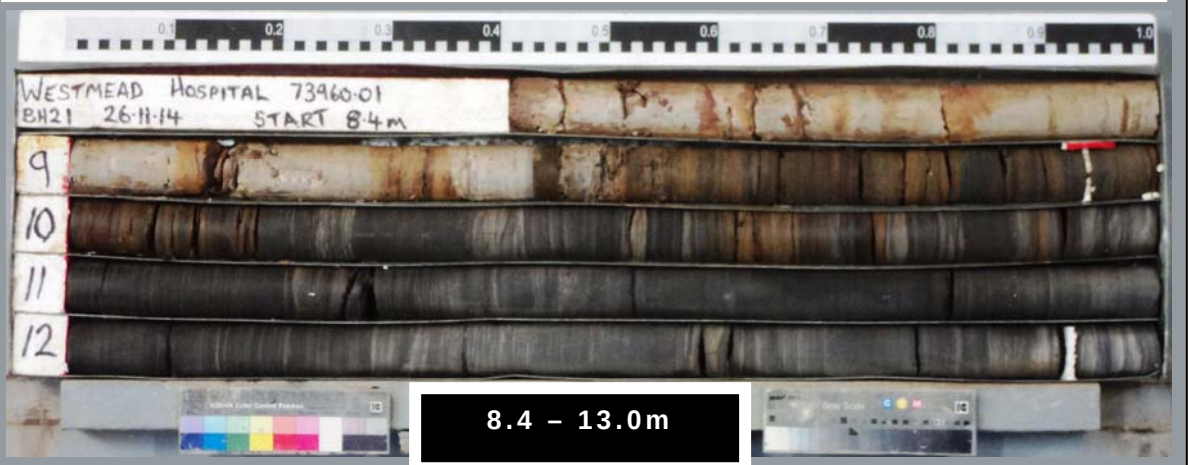

8.4 – 13.0m

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13.0 – 15.9m