REPORT TO

NSW DEPARTMENT OF EDUCATION

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED UPGRADE

AT

KOGARAH PUBLIC SCHOOL,
24B GLADSTONE STREET, KOGARAH, NSW

Date: 12 March 2025
Ref: 32976LT1rpt

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1 CLIENT-SUPPLIED INTRODUCTION

This geotechnical report been prepared by JK Geotechnics on behalf of the NSW Department of Education to support a Review of Environmental Factors (REF) for the proposed Kogarah Public School upgrade (the activity).

We understand that the purpose of the REF is to assess the potential environmental impact of the activity that is prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as "development permitted without consent" where carried out on land by or on behalf of a public authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37A of the T&I SEPP.

This report has been prepared to provide comments and recommendations on excavation, groundwater, retention, footings and ground floor slabs.

1.1 Summary of the Activity

The proposed Kogarah Public School upgrade works include the following:

- Demolition of existing playground facilities and Covered Outdoor Learning Area (COLA) in addition to footings and services associated with former demountable buildings;
- Tree removal;
- Construction of a new three storey Classroom building and attached amenities facilities;
- Construction of a single storey Hall with attached Covered Outdoor Learning Area;
- New pedestrian pathway connections providing access throughout the site;
- Service upgrades; and
- Site landscaping works.

Any works relating to the existing demountable buildings will be undertaken via a separate planning pathway. An extract of the proposed Site Plan is provided at Plate 1.

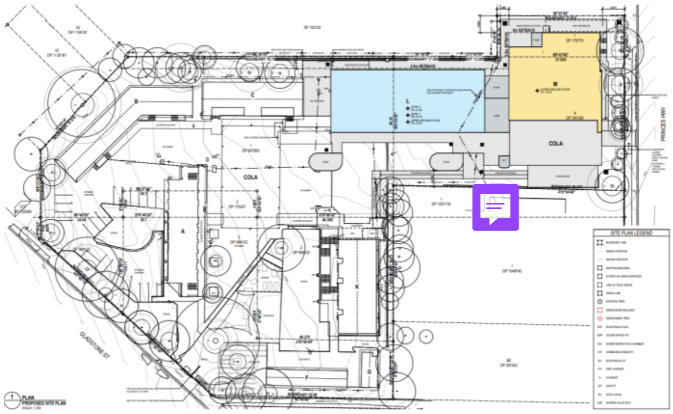

Plate 1. Extract of proposed Site Plan (Fulton Trotter, 2024)

2 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed upgrades at Kogarah Public School, 24B Gladstone Street, Kogarah, NSW. The location of the site is shown in Figure 1. The geotechnical investigation was commissioned by ~~School Infrastructure NSW (SINSW) on behalf of~~ the NSW Department of Education.

We have been supplied with the following documentation relating to the proposed development:

- Bulk Earthworks Plan prepared by Meinhardt (Project No. 132560, Drawing No. KOPS-MHT-00-00-DR-C-0070, Revision T1 dated 12 February 2025);
- Schematic structural drawings prepared by Meinhardt (Project No. 132560, Drawing Nos. OPS-MHT-B00L-GF-DR-S-2000, KOPS-MHT-B00L-GF-DR-S-2001, KOPS-MHT-B00L-GF-DR-S-2010 and KKOPS-MHT-B00L-GF-DR-S-2020, Revision P03 dated 30 September 2024);
- Pile load sketch, Version 0 prepared by Meinhardt dated 13 November 2024.

From the structural drawings and earthworks plan, we understand that the proposed activity will comprise the following:

- Construction of a three (3) storey building (Block L) within the western portion of the site. The proposed bulk excavation level (BEL) for this building is RL20.15m which will only require excavation within the south-western corner of the building footprint to no deeper than 0.5m, elsewhere the building will be above existing ground surface levels with filling increasing in height to a maximum of approximately 1.7m at the north-eastern corner. The building is to be supported on piles with ultimate (limit state) loads of up to 4600kN in compression, 2500kN in tension and 2600kN in shear.
- Construction of a hall (Block M) within the eastern portion of the site that will have a BEL of RL18.15m. To achieve the proposed BEL, excavation to approximately 1m deep in the south-western corner of the building, transitioning to filling within the north-eastern portion of the footprint up to a maximum height of approximately 0.5m.
- Construction of an OSD tank at the northern end of Block M, and adjacent to the northern site boundary. The proposed base level of the tank is RL15.7m which will require excavation to depths of approximately 2.5m below existing surface levels.

The purpose of the investigations was to obtain geotechnical information on the subsurface conditions as a basis for providing comments and recommendations on excavation, groundwater, retention, earthworks, footings, floor slabs and pavements.

A geotechnical investigation was previously completed in 2020 for a broader redevelopment of the school although no details regarding the proposed development were available at that time. The current investigation has been carried out to refine the subsurface model below the building footprints within the north-eastern portion of the school to allow additional assessment of geotechnical parameters to be made, particularly for the foundation design for Blocks L and M.

This geotechnical investigation was carried out in conjunction with an environmental site assessment by our environmental division, JK Environments (JKE). Reference should be made to the separate report by JKE, Ref: E32976PT1, for the results of the environmental site assessment.

3 INVESTIGATION PROCEDURE

3.1 2020 Investigation

The fieldwork comprised the auger drilling of ten boreholes (BH101 to BH110) using our track-mounted JK308 drilling rig to refusal depths ranging from 1.4m to 4.5m below the existing ground surface. The boreholes were drilled using spiral augers fitted with a Tungsten Carbide (TC) bit. The previous investigation was completed for a proposed broader scale redevelopment of the school, and as such only five of the ten boreholes (BH106 to BH110) are located within or adjacent to the current 'site' which is within the north-eastern portion of the school.

The borehole locations, as shown on Figure 2, and the surface levels, as shown on the borehole logs, were measured using a differential GPS unit. The height datum is the Australian Height Datum (AHD).

The apparent compaction of the fill and strength/relative density of the natural soils was assessed from the Standard Penetration Test (SPT) 'N' values, augmented by hand penetrometer tests completed on cohesive soils recovered in the SPT split tube sampler. The strength of the underlying weathered bedrock was assessed from the observation of the resistance to drilling of a TC bit attached to the augers, together with tactile inspection of rock chips recovered from the augers and subsequent correlation with laboratory moisture content test results. Rock strengths assessed in this way are approximate only, and variations of one strength order should not be unexpected.

Groundwater observations were made during and on completion of auger drilling. No longer term monitoring of groundwater levels was carried out.

Our geotechnical engineer was present full-time during the fieldwork to set out the borehole locations, nominate the testing and sampling and prepare the borehole logs. The borehole logs are attached, together with a set of Report Explanation Notes which define the logging terms and symbols used and describe the investigation techniques and their limitations.

Selected soil samples were returned to Soil Test Services Pty Ltd (STS) and Envirolab Services Pty Ltd, both NATA accredited laboratories. STS completed moisture content, Atterberg Limits, linear shrinkage, particle size distribution and CBR testing. These results are summarised in the attached STS Tables A to C. Envirolab completed a suite of soil aggression testing comprising pH, sulphate contents, chloride contents and soil resistivity. The results of the soil aggression tests are presented in the attached Envirolab Certificate of Analysis No. 239687.

Samples were also collected from the boreholes for testing as part of the investigation by JKE.

3.2 Current Investigation

The current investigation was completed during two establishments between 8 and 10 January 2025, and 10 and 12 February 2025, and comprised the drilling of eight boreholes (BH201 to BH208) with our track mounted JK305, JK308 and JK330 drilling rigs. BH203 to BH207 were drilled during the initial establishment with the remaining boreholes completed in February, following archaeological assessment of the areas outside the initially cleared area. On 31 January 2025 hand auger drilling was completed through the soil profile at BH201 and BH208 in the presence of the project archaeologist to check these locations for sensitive material prior to advancing the boreholes with the drilling rig. BH201, BH202 and BH208 were then drilled to their termination depths using drilling rigs during the establishment in February.

All boreholes were initially advanced through the soils and upper weathered bedrock using spiral auger drilling techniques with an attached Tungsten Carbide (TC) bit. Each of the boreholes were extended to their final depths (which ranged from 9.13m to 12.73m) by rotary diamond coring techniques using an NMLC triple tube core barrel and water flush.

The borehole locations were set out by taped measurements from existing surface features and are shown on Figure 2. The approximate surface levels, as shown on the borehole logs, were estimated by interpolation between contours and spot heights shown on the survey plan by LTS Lockley (Ref No. 50932 001DT dated 20 February 2020). The datum of the levels is the Australian Height Datum (AHD).

The apparent compaction of the fill and relative density of the natural sand was assessed from the Standard Penetration Test (SPT) 'N' values. The strength of the bedrock in the augered portion was assessed from observation of the drilling resistance using the TC drill bit attached to the augers and tactile examination of rock cuttings. It should be noted that strengths assessed in this way are approximate and variances of at least one strength order should not be unexpected.

For the cored portion of the borehole, the recovered core was returned to our laboratory for photographing and Point Load Strength Index (Is_{50}) testing. The Point Load Strength Index test results are summarised in the attached Table D and on the borehole logs.

Groundwater observations were recorded in all boreholes during and on completion of auger drilling. Monitoring wells were installed in BH203, BH207 and BH208 to allow for longer-term monitoring of groundwater levels and sampling of groundwater for testing by JKE. A return visit to site was completed on 13 February 2025 to measure the groundwater levels.

Our geotechnical engineer was present on a full-time basis during the fieldwork, to nominate testing and sampling and prepare the borehole logs. The borehole logs are attached, together with a set of Report Explanation Notes which define the logging terms and symbols used and describe the investigation techniques and their limitations.

Following the current investigation, selected soil samples were also returned to Envirolab to complete a suite of soil aggression testing. The results of the soil aggression tests are presented in the attached Envirolab Certificate of Analysis No. 370886.

4 RESULTS OF INVESTIGATION

4.1 Site History

A review of the historical aerial imagery obtained by JKE and historical records indicates that the site formerly comprised part of the property belonging to St Paul's Anglican Church which, prior to 1902, was partly in use as a graveyard. The church, which is located south of the subject site, was constructed in 1869. The aerial image from 1943 shows the existing church and hall with a third building (understood to be the original rectory) north of these within the subject site. A residential property appears to be located within the northern most portion of the site in the 1943 photo. Similar conditions are visible in the 1951 image, however the portion of the school property west of the site appears to have been cleared with the school commencing operation here in 1954. The 1956 image shows several school buildings within the western part of the school. Also visible within the 1956 image is what appears to be the existing rectory under construction on the southern side of the church. The 1961 image shows that the original rectory had been demolished however the residence adjacent to the northern boundary is still present (although this has been demolished in the 1965 image).

The first school building is visible within the south-western corner of the site in the 1965 image as well as a path extending diagonally through the site to the north-eastern corner. A second building appears to have been constructed on the eastern side of this building by 1970. The site appears to have remained largely unchanged between 1970 and 2018. The 2018 image shows demountable classrooms located adjacent to the western portion of the northern boundary. Several more demountable buildings were installed along the eastern portion of the northern boundary between 2020 and 2002. The existing COLA structure was constructed within the western portion of the site in 2023.

On the northern side of the site the buildings within the residential properties (No's. 71 to 97 Regent Street) were demolished leaving a vacant lot. Aerial imagery between 2019 and 2021 shows construction of the current two residential apartment towers over a common basement, part of which was visible during a walkover of the site in 2020.

4.2 Site Description

The site for the purposes of this report comprises the area, as shown in the attached Figure 1, which is within the north-eastern portion of Kogarah Public School.

The site is located in gently undulating topography on the eastern side of a north-south ridgeline, which is roughly aligned with the South Coast Railway. Surface levels over the site generally slope down towards the east at about 1° to 2°.

The site contains demountable school buildings within the north-western portion of the site, a metal-framed COLA south of the demountable buildings and two brick toilet blocks adjacent to the southern site boundary. The existing buildings generally appeared to be in good condition upon cursory external observation. Within the western portion of the site surfaces around the buildings and under the COLA are largely paved with asphaltic concrete or sprayed seal. Within the eastern portion of the site is a relatively level grassed outdoor play area. Medium to large trees are located along the eastern site boundary and within the central portion of the site.

North of the site are two properties, being No. 93 Regent Street and No. 45-47 Princes Highway, which generally extend along the western and eastern portions of the site respectively. The property at No. 93 Regent Street contains two multi-storey residential tower blocks over a common basement. The basement is understood to comprise two levels which from observations during our 2020 investigation is set back about 2m from the site boundary. During the 2020 inspection, the sidewalls of the basement excavation exposed a profile of relatively shallow residual clays overlying sandstone bedrock, which was visually assessed as extremely to highly weathered in the upper 2m to 3m (though extending deeper towards the east) overlying higher strength sandstone bedrock. Most of the excavation in the western half of this property was cut vertically through the sandstone bedrock, though a shotcrete panel was observed on the southern cut face. The property extending along the eastern portion of the northern boundary contains a one and two-storey rendered commercial building which abuts the common boundary. The floor level of this building appeared to be about 0.5m below the surface levels within the site. The building appeared in good condition based upon a cursory visual observation.

South of the site is the property of St. Paul’s Anglican Church (No. 53-57 Princes Highway). The existing sandstone block church building and brick hall are both heritage listed structures with the hall set back 3m from the site boundary. Both buildings appeared to be in good condition from cursory inspection from within the site. Surface levels across the boundary are similar.

The site has an eastern frontage with Princes Highway, a TfNSW State Road, which comprises a six-lane dual carriageway that slopes down to the north and south at approximately 1° from a crest located near the south-eastern corner of the site.

4.3 Subsurface Conditions

The NSW Seamless Geology Version 2.4 indicates that the site is underlain by Hawkesbury Sandstone comprising *“medium to coarse-grained quartz sandstone, with very minor shale and laminite lenses”*. The boreholes encountered a profile comprising fill and residual soils overlying weathered sandstone bedrock at relatively shallow depths. A summary of the subsurface conditions is provided below, however for a detailed description of the conditions at each location reference should be made to the attached borehole logs.

Pavements and Fill

Asphaltic concrete pavements were encountered at the surface in BH106, BH107, BH202 and BH203 and these pavements ranged from 20mm to 100mm thick. In BH204 and BH205 an approximately 5mm thick sprayed seal was encountered at the surface.

Underlying the asphalt or sprayed seal surfaces in the above boreholes, and from surface elsewhere, fill was encountered and extended to depths ranging from 0.2m to 1.5m. The fill generally comprised silty sand although layers of sandy silty clay and silty gravel were also encountered. The fill was generally assessed as being poorly compacted although the fill in BH208 appeared to be moderately compacted.

Residual Soils

Residual soils were encountered below the fill and pavements in BH106 to BH108, BH202 and BH204. The residual soil generally comprised either low to medium plasticity sandy silty clay of very stiff to hard strength or clayey/silty sand or sand of very loose to loose relative density. In BH106, the upper residual soils were assessed to be of only firm to stiff strength.

Sandstone Bedrock

Weathered sandstone bedrock was encountered at depths ranging from 0.2m to 3.1m with the surface of the bedrock generally grading down towards the north-east from approximately RL19.2m to RL16.3m. The sandstone was assessed as generally being of medium strength from initial contact with a thin layer of very low strength sandstone encountered in BH202. In BH106 and BH108 sandstone assessed as low to medium and low strength respectively was encountered within the upper profile however this may also be medium strength as strength assessments within augered boreholes are approximate. The sandstone increased in strength with depth to high strength.

Within the sandstone bedrock two 'marker layers' were encountered in each of the cored boreholes. The upper marker layer, which was encountered from depths ranging from 1.8m to 5.1m below existing surface levels comprised a seam of extremely weathered material within the sandstone bedrock. The top of the upper marker layer was generally at approximate levels ranging from RL16.3m to RL15.2m, although in BH207 the top of the upper marker layer was encountered at RL14.5m. The upper marker layer ranged from 0.25m to 1.3m thick, although was generally less than 0.75m thick. The second or lower 'marker layer' comprised a band of laminite or fine-grained sandstone with siltstone bands which was encountered at depths ranging from 6.0m to 7.6m, corresponding with levels ranging from RL12.9m to RL11.4m.

Table 1 provides our rock classification assessment for BH201 to BH208 inclusive. The classification was completed in general accordance with Pells et al (2019). A plot of the inferred surface contours for the top of sandstone bedrock and for Class II sandstone bedrock are also shown schematically on the attached Figures 3 and 4. The contours shown on Figure 3 should be treated as approximate, since the bedrock surface typically steps down in level rather than reducing gradationally as shown schematically in Figure 3. The rock classes are approximate only and will be dependent on footing/pile sizes particularly with regards to the upper marker layer which underlies better-quality bedrock in several boreholes. Some variability should be expected.

Table 1 – Rock Classification

Borehole Number	Depths (Reduced Levels) Class V Rock	Depths (reduced Levels) Class IV Rock	Depths (Reduced Levels) Class III Rock	Depths (Reduced Levels) Class II or Better Rock
201	Not encountered	Not encountered	1.1m to 5.6m (RL19.2 to RL14.7)[1]	5.6m to 10.4m (RL14.7 to RL9.9)
202	4.3m to 5.3m (RL14.3 to RL13.3)[2]	5.3m to 7.4m (RL13.3 to RL11.2)	Not encountered	7.4m to 11.8m (RL11.2 to RL6.8)
203	Not encountered	0.8m to 5.1m (RL19.1 to RL14.8)	Not encountered	5.1m to 12.2m (RL14.8 to RL7.7)
204	Not encountered	3.5m to 4.6m (RL15.0 to RL13.9)	Not encountered	4.6m to 11.3m (RL13.9 to RL7.2)
205	0.5m to 4.3m (RL18.3 to RL14.5)[4]	4.3m to 5.2m (RL14.5 to RL13.1)	Not encountered	5.2m to 12.7m (RL13.1 to RL6.1)
206	1.9m to 5.0m (RL17.1 to RL14.0)[2,4]	Not encountered	5.0m to 6.1m (RL14.0 to RL12.9)	6.1m to 9.1m (RL12.9 to RL9.9)
207	Not encountered	0.2m to 5.2m (RL17.7 to RL12.7)[3]	5.2m to 6.0m (RL12.7 to RL11.9)	6.0m to 12.7m (RL11.9 to RL5.2)
208	Not encountered	2.5m to 6.4m (RL15.6 to RL11.7)	Not encountered	6.4m to 12.0m (RL11.7 to RL6.1)

1. The upper bedrock in BH201 has been downgraded to Class III, due to the presence of a relatively thick extremely weathered seam towards the base of the upper bedrock profile.
2. Due to the presence of thick extremely weathered seams or 'no core' zones in the upper profile, the sandstone above the nominated depths/levels in BH202, BH204, BH206 and BH208 is not considered suitable as a founding stratum for footings.
3. The upper bedrock in BH202 and BH207 has been downgraded to Class IV, due to the presence of a thick extremely weathered seam towards the base of the upper bedrock profile.
4. The upper bedrock in BH205 and BH206 has been downgraded to Class V, due to the presence of a thick extremely weathered seam towards the base of the upper bedrock profile.

Groundwater

All boreholes except BH107 and BH110 were dry on completion of augering. Seepage was measured at about 1.0m and 3.5m in BH107 and BH110 respectively. Standing water levels were measured at depths of 1.55m and 2.8m, 19 and 23 hours after completion of drilling in BH108 and BH107 respectively. These depths are indicative of perched groundwater within the residual sandy soils overlying the relatively impermeable bedrock and therefore do not represent a true groundwater table.

Groundwater monitoring wells were installed in BH203, BH207 and BH208. The following table summarises the groundwater levels measured during a return visit to site on 13 February 2025.

Borehole Number	Depth to Groundwater (m)	Groundwater Level (mAHD)
203	5.0m	RL14.9
207	3.8m	RL14.1
208	6.3m	RL11.8

Each of the above groundwater levels are within the sandstone bedrock. The levels in BH203 and BH207 are within or close to the extremely weathered 'marker layer' in the upper bedrock profile and this may represent seepage through this seam which is anticipated to be of higher permeability than the sandstone bedrock above and below. The level in BH208 is located within the better-quality sandstone as this well was sealed from the upper extremely weathered seam. The groundwater in BH208 may comprise a perched aquifer within the sandstone bedrock.

4.4 Laboratory Test Results

The laboratory moisture content test results showed reasonably good correlation with our field assessment of rock strength.

The Atterberg Limits and particle size distribution tests confirmed our field assessment of the soils. The Atterberg Limits and linear shrinkage tests confirmed that the sample of sandy clay was of medium plasticity with a moderate potential for shrink-swell movements with variations in moisture content. The shrink-swell tests returned indices of 1.39%/pF and 0.30%/pF for the medium plasticity sandy clay. The lower value of 0.3%/pF is quite low when compared to the Atterberg limit test results from a similar soil sample, and it is possible that the test was affected by some gravel within the sample.

The four-day soaked CBR test on the samples of residual sandy silty clay from BH108 returned a soaked CBR value of 1.5% when compacted to 98% of their Standard Maximum Dry Density (SMDD). The in-situ moisture content of the residual clay was 0.5% 'dry' of its Standard Option Moisture Contents (SOMC). During soaking the samples swelled 3% indicating a reactivity of the clay soils to variations in moisture content.

The results of the particle size distribution test correlated well with our field assessment of the soil.

The soil aggression testing is summarised in Table 2.

Table 2 – Soil Aggression Test Results

Borehole No.	Sample Depth (m)	Soil Type	pH	Chloride Content (mg/kg)	Sulphate Content (mg/kg)	Resistivity (ohm.cm)
109	0.02-0.1	Clayey Sandy Gravel FILL	7.9	<10	98	9,600
204	1.5-1.75	RESIDUAL Sandy silty Clay	6.7	<10	20	52,000
206	0.0-0.05	Silty Sand FILL	9.7	30	230	4,700
207	0.4-0.5	Sandstone BEDROCK	6.8	<10	100	14,000

5 COMMENTS AND RECOMMENDATIONS

5.1 Geotechnical Considerations

From a geotechnical perspective, we consider the site will be suitable for the proposed activity. We consider that the main geotechnical considerations relating to this development will be as follows:

- The presence of existing uncontrolled fill which is considered unsuitable for structural loads. For slab on grade construction any existing fill will need to be excavated and replaced with engineered fill. Alternatively, suspended slab construction may be adopted.
- The depth and quality of the underlying bedrock for support of the expected moderately high loads. This will be important to enable the economical construction of footings.
- The presence of Sydney Water assets adjacent to the footprints of the proposed buildings and OSD tank excavation. Design of foundations and excavation will need to consider the impact on these assets and further analysis may be required by Sydney Water to confirm that the proposed loads will not adversely affect the pipes.

5.2 Site Classification

AS2870-2011 'Residential Slabs and Footings' sets out criteria for the design of residential slabs and footings, however the recommendations provided within the document may also be used as a guideline for other forms of construction which may occur on the site, though strictly the type of development proposed is beyond the scope of AS2870.

Due to the presence of existing buildings, pavements, and large trees, abnormal moisture conditions will be present on the site. In addition, there is also a moderate depth of fill exposed in some of the boreholes. Therefore, we consider that the site should be classified as 'Class P' in accordance with AS2870-2011.

For design considerations, the residual sandy silty clay encountered in some of the boreholes were of medium plasticity and will likely induce shrink/swell movements equivalent to that defined by a 'Class S' site although movements will be higher where reactive clay is placed as engineered fill. However, there are a number of mature trees across the site which will have an impact on the shrink-swell movements, particularly if trees are removed during redevelopment, and/or if new structures are located in close proximity to existing trees. Therefore, once the removal of existing trees in relation to new buildings and material proposed as fill is confirmed, specific advice should be obtained from the geotechnical engineers in regard to shrink-swell movements and the impact on any on-grade structures.

As discussed above additional shrink-swell movements will occur where reactive clays are utilised as engineered fill. Therefore, consideration should be given to whether the existing reactive clays are the most suitable material for re-use, as the use of such material will impact the structural design of any on grade slabs. Alternative materials, such as crushed sandstone, could be considered for re-use as engineered fill.

5.3 Excavation Conditions

Based on the generally limited depths of excavations, we anticipate that excavations will predominantly extend through the soils and upper weathered sandstone bedrock. The deeper excavation for the proposed OSD tank will predominantly extend through sandstone bedrock, generally of medium strength. Excavation of the soils and any extremely weathered sandstone should be achievable using bucket attachments on hydraulic excavators.

Excavation of sandstone bedrock of low or higher strength will require rock excavation techniques such as rock saws, rock grinders and/or hydraulic impact hammers. Any high strength sandstone bedrock will produce difficult excavation conditions. Full-time vibration monitoring is recommended where hydraulic impact hammers are used to excavate sandstone bedrock to confirm that vibrations on adjoining structures are within tolerable limits. The attached Vibration Emissions Design Goal sheet provides a guide to tolerable limits for varying classes of structures. The geotechnical engineer will then be able to provide advice on the suitability of the equipment being used and recommendations for the remaining portion of excavation. Any rock excavation within close proximity to the heritage-listed church structures to the south will need to maintain lower vibration levels than would be typical for standard buildings.

If it is found that transmitted vibrations are unacceptable, it will be necessary to change to lower energy equipment such as smaller rock breakers, rotary grinders, or grid sawing and ripping. When using a rock saw or rotary grinder, the resulting dust must be suppressed by spraying with water. It is possible that at least part of any excavation will require lower energy equipment, and therefore this should be allowed for by the excavation contractor.

Only excavation contractors with experience in similar work using a competent supervisor who is aware of vibration damage risks should be used. The contractor should have all appropriate insurances and be provided with a copy of this report.

Groundwater seepage may occur at the soil/rock interface or through joints and defects within the rock, particularly during or immediately following periods of wet weather. We expect that any seepage encountered will be able to be controlled using conventional sump and pump techniques.

For the proposed OSD tank, excavation will be completed adjacent to the Princes Highway, two Sydney Water mains, which are mapped as extending along the western side of the Princes Highway, and a proposed development within the property to the north. As the Princes Highway is a State Road, TfNSW may require further analysis and testing to confirm the proposed excavation works will have negligible impact on their assets. Similarly, depending on the proximity of the pipes to the excavation, Sydney Water may require further analysis. Monitoring during construction may be required by TfNSW and/or Sydney Water to confirm that any movements are within an acceptable range.

Excavated spoil for off-site disposal will need to be suitably classified for waste disposal purposes. Reference should be made to the preliminary environmental report prepared by JK Environments.

5.4 Excavation Support

Due to the minimal extent of excavation proposed and the relatively shallow depth to bedrock temporary batters should generally be feasible. An exception may be the proposed OSD tank adjacent to the northern site boundary where the depth to rock was 1m in BH208 and the current proposed setback is 1.2m from the boundary. As discussed in Section 5.4.3 below, if the proposed OSD tank is to remain in its current location then additional investigation should be completed, particularly on the northern and eastern sides of the proposed excavation to refine design of in-situ shoring systems and/or confirm that temporary batter slopes are feasible.

5.4.1 Temporary Batter Slopes

Temporary batters formed through fill, natural clayey soils and the upper weathered rock of up to very low strength, may be formed no steeper than 1 Vertical (V) in 1.5 Horizontal (H), subject to inspection by a geotechnical engineer. Sandstone bedrock of at least low strength may be temporarily cut vertically subject to inspection by a geotechnical engineer at vertical depth intervals of no more than 1.5m and provided it does not contain adverse defects. Inspection of vertically cut sandstone is necessary to identify any adverse defects present and provide remedial measures.

Surcharge loads such as construction traffic, site sheds etc. should be no closer than 2H from the crest of any temporary batter, where H is the vertical height of the batter. Surface drainage should not be allowed to flow over the crest of temporary batters, and should be directed and discharged in a manner which avoids concentrated flows and erosion.

Where retaining walls are to be constructed in front of temporary batters, care will need to be exercised in backfilling between the temporary batter slope and the new retaining wall. Uncontrolled backfilling will lead to large settlements which may adversely affect pavements, structures or landscaping areas. It is often difficult to achieve adequate compaction of backfill due to limited access and the need to use small hand compaction equipment. We recommend therefore the use of a single-sized durable gravel, such as “blue metal” gravel or crushed concrete (free of fines and with less than 10% brick), which do not require significant compactive effort. Such material should be nominally compacted using a hand operated vibrating plate (sled) compactor in 200mm thick loose layers. A non-woven geotextile filter fabric such as Bidim A34 should be placed as a separation layer immediately above the cut batter slope to control subsoil erosion. Provided the gravel backfill is placed as recommended above, density testing of the gravel backfill would not be required. The geotextile should then be wrapped over the surface of the gravel backfill and capped with at least a 0.5m thick compacted layer of clayey engineered fill.

There are also cost implications with excavating and disposing of additional soil to form temporary batters and importing large quantities of durable granular backfill. Therefore, it may be preferable to install shoring systems rather than form temporary batters.

5.4.2 Vertical Cuts in Sandstone

We expect that, where present, good quality sandstone of low or higher strength may be cut vertically subject to inspection by an experienced geotechnical engineer and no adverse defects being encountered. Where the rock is excessively weathered or adverse defects are present (such as inclined joints or beddings) stabilisation measures would likely be required which may include rock bolting, shotcreting, underpinning etc. We therefore recommend that any rock faces be progressively inspected by an experienced geotechnical engineer or engineering geologist at not greater than 1.5m depth intervals and on completion, to identify adverse defects and to propose appropriate stabilisation measures. A suitable budget should be allowed in the contract for these contingencies.

Footings should not be located within a distance from the crest equal to the height of the vertical rock cut, unless approval is provided by the geotechnical engineers.

5.4.3 In-situ Retention Systems

Where there is insufficient space for temporary batters, such as appears to possibly be the case on the northern (and possibly eastern) sides of the proposed OSD tank, excavations will need to be supported by fully engineered in situ retention systems installed prior to excavation commencing.

The type of retention system will depend on the height of material supported. Therefore, we recommend that if the OSD tank will remain in its current location that additional investigation comprising cored boreholes be completed to assess the depth and quality of the bedrock. Where the depth to bedrock is relatively shallow and it is proven to be of good quality, then a gravity retaining wall constructed by excavating a trench to the surface of bedrock and then backfilling may be suitable. If the depth to bedrock increases however, then support with a piled wall may required. Due to the sandy nature of the soils piled shoring walls would need to comprise contiguous walls. Where sandstone bedrock is encountered above bulk excavation level then it may be feasible to terminate piles above bulk excavation however this would require additional lateral support at the toe of the piles from rock bolts. Further advice on the design of in-situ shoring systems should be completed following additional investigation within the footprint of the OSD tank.

5.4.4 Retaining Wall Design

Where temporary batter slopes are adopted, we recommend that the following characteristic parameters may be adopted for preliminary shoring wall design. The following parameters are on the basis of either a properly placed and compacted engineered backfill or backfill comprising a uniform sized durable granular material which is surrounded in a geotextile fabric as discussed in Section 5.4.1 above.

- For cantilever or gravity walls where some movement can be tolerated we recommend a triangular lateral earth pressure distribution using an ‘active’ earth pressure coefficient (Ka) of 0.35.

- For cantilever or gravity walls which will be propped or where movements are to be reduced, we recommend a triangular lateral earth pressure distribution using an 'at rest' earth pressure coefficient (K_0) of 0.6.
- A bulk unit weight of 20kN/m^3 may be used for the backfill.
- All surcharge loads affecting the walls (e.g. nearby footings, construction loads and traffic etc.) are additional to the earth pressure recommendations above and should be included in the design.

5.5 Footings

5.5.1 Blocks L and M

Following any excavation and/or stripping of surface materials we anticipate this will primarily expose the existing fill or sandstone bedrock. Based on the supplied structural loads, footings for the new buildings will need to be uniformly founded within sandstone bedrock.

Given the relatively shallow depth to bedrock across the site pad/strip footings would be feasible where sandstone is at shallow depth, however such footings would generally be founded within the poorer-quality bedrock encountered within the upper profile of each of the cored boreholes and would therefore be relatively large, which would result in larger settlements. Further advice on footing sizes and settlements should be obtained from the geotechnical engineers if shallow pad/strip footings are being considered, particularly if they are being used with piled footings as differential settlements may be unacceptable between the two differing footing systems. Alternatively, piled foundations could be adopted to allow footings to found within the Class III or II sandstone bedrock encountered at depth. Bored piers should be feasible in the most part, though where groundwater seepage has been observed in the very loose soils above the rock this may not be possible e.g. near BH107 and BH108. In those circumstances the side walls of bored piles would likely collapse and alternative grout injected piles or the use of temporary pier liners would be required.

The bedrock ranges from very low to high strength. Therefore, considering the bedrock profile this will necessitate the use of moderate to large piling rigs with rock drilling equipment. We recommend that any potential piling contractors be provided with a copy of this geotechnical report and they be requested to confirm that their equipment is suitable to penetrate the rock and achieve the required depths.

The table in Section 4.3 provides our assessment of the depth and reduced levels for the various rock classes encountered within the boreholes. Based on the rock classification, the following table presents our recommendations on maximum allowable end bearing pressures, ultimate end bearing pressures, maximum allowable skin friction values and ultimate skin friction values for the various classes of rock.

Piles socketed at least 0.5m into the underlying bedrock may be designed for the allowable end bearing pressures and ultimate end bearing pressures presented in Table 3 below.

Table 3 - Allowable and Ultimate End Bearing Pressures

Siltstone Rock Classification	Allowable End Bearing Pressure in Compression (kPa)	Ultimate End Bearing Pressure in Compression (MPa)	Elastic Modulus, E (MPa)
Class V	800	3	100
Class IV	1,200	5	200
Class III	3,500	20	400
Class II	6,000	60	1,000

For the design of rock sockets, the following allowable and ultimate shaft adhesion values in Table 4 may be adopted:

Table 4 - Allowable and Ultimate Shaft Adhesion Values

Siltstone Rock Classification	Allowable Shaft Adhesion Value in Compression (kPa)	Allowable Shaft Adhesion Value in Tension (kPa)	Ultimate Shaft Adhesion Value in Compression (kPa)
Class V	80	40	150
Class IV	120	60	250
Class III	350	175	800
Class II	600	300	1,500

Class II or better bedrock was encountered at moderate depths in and around the proposed footprints of Blocks L and M. Considering the advised higher footing loads consideration could be given to uniformly supporting these buildings within Class II or better bedrock.

We recommend that all piles have a minimum embedment of 0.5m into the appropriate quality of bedrock. In addition to the maximum allowable and ultimate end bearing pressures, piles can also be designed for skin friction. In BH201 and BH203 bands of poorer quality rock were encountered within the Class II bedrock. For founding purposes, the toe of a single pile or footing must be terminated a minimum height of at least 1.5B (where B is the pile diameter or footing width) above any of these poorer bands in order to adopt such a rock class for the founding material. Where pile groups are necessary, a similar 1.5 factor would apply, however this would apply to the minimum width of the pile group. Pile groups would need to be further assessed on a case-by-case basis.

Where allowable bearing pressures and skin friction values are adopted, settlement of piles will typically be less than 1% of the pile diameter at the toe of the pile. However, where ultimate end bearing and skin friction values are adopted, settlements will be greater. Detailed settlement analysis of piles is recommended for adoption of ultimate geotechnical parameters to check that predicted settlements fall within acceptable limits.

Where ultimate end bearing and skin friction values are adopted, the ultimate values recommended in the table above must be reduced by an appropriate geotechnical reduction factor. The geotechnical reduction factor should be based on the risk assessment procedure set out in Table 4.3.2 (A) of AS2159-2009, but should not be greater than 0.4 unless the risk factors producing a higher geotechnical reduction factor can be fully justified e.g. by in-situ testing of a percentage of piles. Consideration should also be given to the pile testing requirements when determining a suitable geotechnical strength reduction factor. The use of ultimate values will result in higher settlements and therefore specific analysis of the footing settlements must be carried out to confirm that it is consistent with the required structural performance.

In order to achieve the recommended skin friction values nominated in the table above, it is essential that the rock sockets be free from any clay smear and suitably roughened using a side wall grooving tool, and that they be at least as rough as Roughness Class R2. We note that an R2 roughness is equivalent to grooves 1mm to 4mm deep and grooves 2mm wide, which are spaced at 50mm to 200mm down the socket length. It will be the responsibility of the piling contractor to ensure that they have the appropriate equipment and methodology to satisfy this roughness criteria.

A portion of the footings for Blocks L and M will be located adjacent to existing Sydney Water sewer assets along the northern site boundaries. Further analysis may be required by Sydney Water to confirm that footing loads from the proposed structures will not adversely impact their assets.

Where piling rigs are set up at bulk excavation level, where the subgrade comprises sandstone bedrock then no issues are anticipated with establishment of such plant. However, where the subgrade comprises the existing poorly compacted fill a working platform may be required. The specific requirements for any working platforms should be determined once the piling rig and the loading conditions are known. An inspection of the subgrade should be completed by the geotechnical engineer to confirm the suitability of the material and identify any soft spots requiring remediation.

5.5.2 Light-Weight Structures

Sandstone bedrock appears to be present at shallow depths across the site and thus where portions of footing excavations for a structure encounter sandstone bedrock then the entire structure should be uniformly supported on the sandstone. Furthermore, the residual sands appear to be of very loose to loose relative density and thus will only be suitable for low bearing pressures. In this regard, even for lightly loaded structures our recommendation is that these be uniformly founded on sandstone bedrock. Shallow pad/strip footings or stiffened raft slabs would be feasible, provided the structures are within the scope of AS2870-2011 'Residential Slabs and Footings'. These footing systems should then be designed in accordance with that code. Other structures outside the scope of AS2870-2011, will need to be designed on the basis of engineering principles, taking into account the strength and reactivity of the soils and the site conditions.

Where shallow footings are founded on or within the upper sandstone bedrock the parameters for Class V rock, as per Section 5.5.1, should be adopted.

5.5.3 Footing Inspections

During construction we recommend that where footings are designed to found within Class III or better sandstone bedrock then all footings (high-level and piled) be visually inspected by a geotechnical engineer to confirm that they are supported on a founding stratum consistent with these recommendations and structural design requirements. Where high-level pad/strip footings are adopted then depending on the design bearing pressure, spoon testing of a percentage of the footings should be carried out. As a guide for high-level footings designed for Class III parameters one-third of all footings should be spoon tested whilst for Class II parameters half of the footings should be spoon tested. Where footings for a structure are designed to found within Class V or IV sandstone then we consider that a reduced inspection regime will be suitable however it is important to note that the geotechnical engineer can only 'sign off' on piles or footings inspected. We note that if piles need to be drilled using grout injected techniques, inspection will essentially only be able to deduce that the pile is founded at a level consistent with nearby borehole logs.

5.6 Ground Floor Slabs

The investigation has encountered a varying depth of existing fill within the site. Records of the placement and compaction of this fill are unlikely to be available and therefore this material should be considered uncontrolled fill. The construction of on-grade ground floor slabs for the proposed buildings on this uncontrolled fill is not recommended due to the potential for greater-than-expected settlements. Therefore, our recommendation is that all ground floor slabs for Blocks L and M be suspended off footings founded within the sandstone bedrock. Should bulk excavation expose sandstone bedrock uniformly over a portion of the building footprints then slab on-grade construction would be feasible for that portion of the slab, however the extent of SOG should be confirmed following inspection of the exposed subgrade by the geotechnical engineer. Floor slabs constructed on a sandstone bedrock subgrade should be supported on a minimum 100mm thick layer of DGB20 to act as a separation layer from the rock below.

Should slab on-grade construction be preferred then all existing fill below the building footprints would need to be stripped to the surface of the underlying residual soils or sandstone bedrock. Filling will be required to achieve the design subgrade levels for both Blocks L and M with the maximum height of fill for each building being approximately 1.7m and 0.5m above existing levels respectively. The following subgrade preparation is recommended for slab on-grade construction.

- Strip off any existing grass, root affected material, and any existing fill materials. Where trees are removed then the root balls of any trees or shrubs should also be fully removed. Stripped materials will not be suitable for re-use as engineered fill and should be stockpiled separately. Such materials may be suitable for re-use within landscaped areas.
- In areas of existing pavements, we recommend stripping off the existing asphaltic concrete surface.
- Where the subgrade comprises the residual soils, the exposed subgrade should be proof rolled with 8 passes of a minimum 10 tonne smooth drum roller to detect any soft or heaving areas. The proof rolling should be carried out in the presence of a geotechnical engineer or experienced earthworks technician. The subgrade should be well graded to promote runoff and reduce the risk of water ponding on the surface. If the subgrade becomes wet it may become untrafficable.
- Where the subgrade comprises sandstone bedrock no proof rolling will be required.

- Any areas of heaving subgrade should be locally removed to a competent base and replaced with engineered fill. Furthermore, specific subgrade improvement may be required and this is best determined in consultation with the geotechnical engineers at the time of construction.
- Engineered fill should comprise a good quality granular material, such as crushed sandstone of not greater than 70mm size, or any existing granular road-base material, and should be compacted in horizontal layers with a maximum 200mm loose thickness to at least 98% of Standard Maximum Dry Density (SMDD). The weathered sandstone excavated from the site would be suitable for use as an engineered fill.
- The existing sandy fill and residual soils may be re-used as engineered fill. Sandy soils should be compacted to the specification provided above whilst clayey materials should be compacted to between 98% and 102% of Standard Maximum Dry Density (SMDD) and to within ±2% of Standard Optimum Moisture Content (SOMC). If the residual clay or clay fill are to be adopted for re-use as an engineered fill the following needs to be carefully considered.
  - (i) Where clays have moisture contents greater than the plastic limit they will require drying out prior to their re-use as engineered fill, and
  - (ii) Where reactive clays are used as an engineered fill, they will undergo greater shrink swell movements with changes in moisture content than the in situ reactive clays. Therefore, consideration needs to be given to the effect that greater shrink-swell movements will have on the performance of structures founded above.

Density testing should be regularly carried out on any engineered fill. Regular density testing in accordance with Level 1 supervision and testing, as defined by AS3798-2007 ‘Guidelines on Earthworks for Commercial and Residential Developments’, should be carried out where slab on-grade construction is proposed.

If slab on grade construction is being considered for internal slabs, then these slabs must be isolated form the structural footings and allowance for differential movements between the footings and the slabs must be made.

5.7 Earthquake Design

The following parameters can be adopted for earthquake design in accordance with AS1170.4-2024 ‘Structural Design Actions, Part 4: Earthquake Actions in Australia’:

- Hazard factor (Z) = 0.08
- Site Subsoil Class = Class Be

5.8 Exposure Classification

The soil aggression test results have indicated the fill, residual soils and sandstone ranges are generally alkaline and have low sulphate and chloride contents. In accordance with Table 4.8.1 of AS3600:2018 ‘Concrete structures’, the exposure classification to the concrete elements is ‘A1’. In accordance with

Table 6.4.2(C) of AS2159-2009 'Piling – design and installation' the exposure classification for concrete piles is 'Non-aggressive'. For steel piles an exposure classification of 'Mild' would be appropriate in accordance with Table 6.5.2(C) of AS2159-2009.

5.9 Further Geotechnical Input

No mitigation measures are required to mitigate environmental impacts arising from the proposed activity. Geotechnical recommendations are made throughout this report and should be considered and adopted where appropriate by the design team and contractor:

- Additional investigation to refine design of the retention system for the OSD tank excavation, if the OSD tank will remain in its currently proposed location.
- Analysis and monitoring may be required by TfNSW and/or Sydney Water for the proposed OSD tank excavation.
- Analysis may be required by Sydney Water for the proposed footings adjacent to sewer mains along the northern boundaries.
- Inspection of the subgrade at bulk excavation level, including proof rolling, for advice on working platforms.
- In-situ density testing of engineered fill to raise site levels for slab on-grade construction.
- Inspection of footing excavations/pile drilling by the geotechnical engineer.

6 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the design and construction phase of the project. In the event that any of the advice presented in this report is 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.

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 LIMIT AND LINEAR SHRINKAGE TEST REPORT

Client:	JK Geotechnics	**Ref No:**	32976LT-KPS
Project:	School Upgrades	**Report:**	A
Location:	Kogarah Public School, 24B Gladstone Street, Kogarah, NSW	**Report Date:**	9/04/2020
		Page 1 of 1	

AS 1289	**TEST METHOD**	**2.1.1**	**3.1.2**	**3.2.1**	**3.3.1**	**3.4.1**
BOREHOLE NUMBER	**DEPTH m**	**MOISTURE CONTENT %**	**LIQUID LIMIT %**	**PLASTIC LIMIT %**	**PLASTICITY INDEX %**	**LINEAR SHRINKAGE %**
101	1.50 - 1.95	3.8	-	-	-	-
102	0.30 - 0.70	15.2	37	14	23	10.5
102	1.00 - 1.50	6.0	-	-	-	-
102	2.00 - 2.50	7.3	-	-	-	-
102	4.00 - 4.50	7.0	-	-	-	-
103	1.30 - 1.50	3.5	-	-	-	-
103	2.10 - 2.70	4.4	-	-	-	-
104	1.00 - 1.40	18.1	48	19	29	8.5
104	1.50 - 2.00	10.5	-	-	-	-
104	3.50 - 3.90	4.6	-	-	-	-
105	2.10 - 2.80	4.9	-	-	-	-
106	2.00 - 2.20	4.4	-	-	-	-
108	4.00 - 4.50	7.4	-	-	-	-
109	1.10 - 1.30	5.1	-	-	-	-
110	0.30 - 0.50	5.0	-	-	-	-
110	1.30 - 1.50	5.6	-	-	-	-
110	4.00 - 4.50	11.3	-	-	-	-

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 25/03/2020.
- Sampled and supplied by client. Samples tested as received.

NATA
NATA Accredited Laboratory
Number:1327

09/04/2020
Authorised Signature / Date
(D. Treweek)

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TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client:	JK Geotechnics	**Ref No:**	32976LT-KPS
Project:	School Upgrades	**Report:**	B
Location:	Kogarah Public School, 24B Gladstone Street, Kogarah, NSW	**Report Date:**	6/04/2020
		Page 1 of 1	

BOREHOLE NUMBER	BH 102	BH 108
DEPTH (m)	0.30 - 0.70	0.20 - 1.00
Surcharge (kg)	4.5	4.5
Maximum Dry Density (t/m^3)	1.96 STD	1.66 STD
Optimum Moisture Content (%)	13.2	24.6
Moulded Dry Density (t/m^3)	1.91	1.60
Sample Density Ratio (%)	98	97
Sample Moisture Ratio (%)	98	99
Moisture Contents		
Insitu (%)	15.2	24.1
Moulded (%)	13.0	24.3
After soaking and After Test, Top 30mm(%)	20.7	36.5
Remaining Depth (%)	16.0	26.0
Material Retained on 19mm Sieve (%)	0	0
Swell (%)	2.0	3.0
C.B.R. value: @2.5mm penetration		1.5
@5.0mm penetration	2.5	

NOTES: Sampled and supplied by client. Samples tested as received.

- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 25/03/2020.

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the items tested or sampled.

06/04/2020
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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
PARTICLE SIZE DISTRIBUTION TEST REPORT

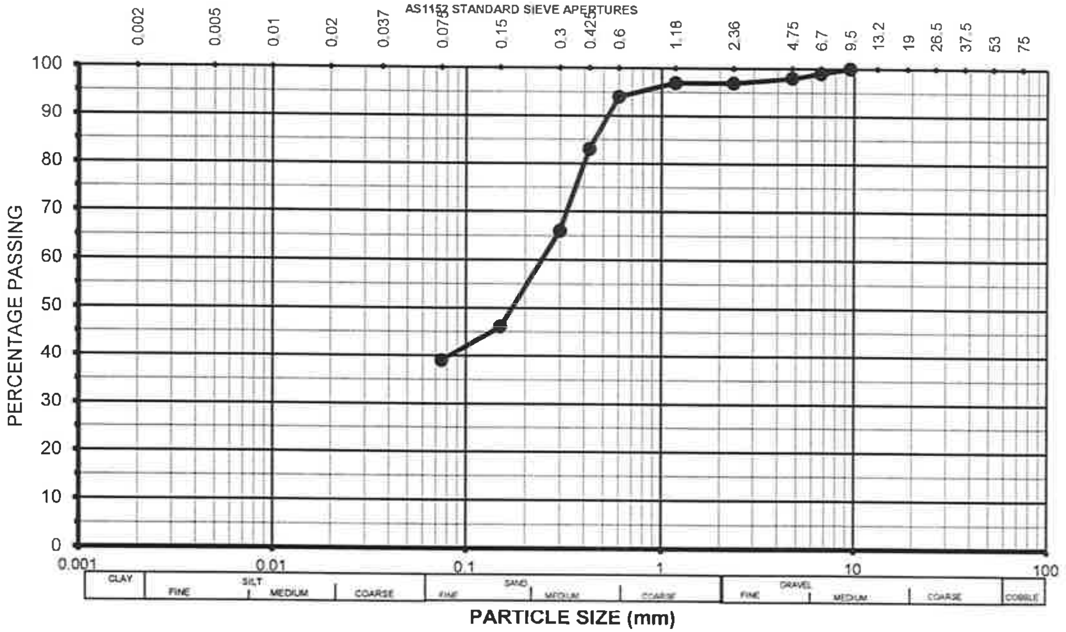
Client: JK Geotechnics
Project: School Upgrades
Location: Kogarah Public School, 24B Gladstone Street, Kogarah, NSW

Ref No: 32976LT-KPS
Report No: C
Report Date: 6/04/2020
Page 1 of 1

Borehole Number: 106
Depth (m) : 0.50 - 0.95

SIEVE ANALYSIS RESULTS

SIEVE SIZE	% PASSING
9.50 mm	100
6.70 mm	99
4.75 mm	98
2.36 mm	97
1.18 mm	97
600 µm	94
425 µm	83
300 µm	66
150 µm	46
75 µm	39



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: 25/03/2020.

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Approved Signatory / Date
(D. Treweek)

6/4/20

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client: School Infrastructure NSW

Ref No: 32976LT1

Project: Proposed Alterations and Additions

Report: D

Location: Kogarah Public School, 24B Gladstone Street.
KOGARAH, NSW

Report Date: 13/02/25

Page 1 of 8

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
201	1.39 - 1.43	1.1	22	A
	1.82 - 1.85	0.8	16	A
	2.72 - 2.75	1.1	22	A
	2.91 - 2.94	0.9	18	A
	3.25 - 3.29	0.9	18	A
	3.80 - 3.84	1	20	A
	4.16 - 4.20	0.6	12	A
	4.77 - 4.79	0.4	8	A
	4.92 - 4.94	0.3	6	A
	5.36 - 5.39	0.3	6	A
	5.71 - 5.74	1	20	A
	6.16 - 6.20	1	20	A
	6.79 - 6.82	1.4	28	A
	7.20 - 7.22	1	20	A
	7.74 - 7.77	2.3	46	A
	8.17 - 8.21	2.1	42	A
	8.79 - 8.83	1.5	30	A
	9.10 - 9.13	1.1	22	A
	9.54 - 9.57	1.6	32	A
	9.75 - 9.78	2.2	44	A
	10.22 - 10.26	1.1	22	A
202	2.72 - 2.75	0.6	12	A
	3.89 - 3.93	0.03	1	A
	4.35 - 4.38	0.07	1	A
	4.93 - 4.95	0.1	2	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25

BOREHOLE NUMBER	DEPTH (m)	$I_{S\ (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
202	5.28 - 5.31	0.4	8	A
	5.83 - 5.87	0.9	18	A
	6.25 - 6.28	0.7	14	A
	6.89 - 6.92	1.2	24	A
	7.13 - 7.16	0.9	18	A
	7.65 - 7.69	1.4	28	A
	8.16 - 8.20	1	20	A
	8.70 - 8.72	1.9	38	A
	9.21 - 9.25	1.4	28	A
	9.79 - 9.83	1.3	26	A
	10.16 - 10.20	1.5	30	A
	10.88 - 10.93	2	40	A
	11.24 - 11.28	2.9	58	A
	11.76 - 11.80	1.3	26	A
203	1.14 - 1.17	0.9	18	A
	1.74 - 1.78	0.7	14	A
	2.21 - 2.24	1.1	22	A
	2.88 - 2.92	0.8	16	A
	3.26 - 3.29	0.9	18	A
	3.73 - 3.77	1	20	A
	4.06 - 4.09	1.2	24	A
	4.54 - 4.57	0.7	14	A
	5.15 - 5.19	0.8	16	A
	5.73 - 5.77	0.4	8	A
	6.20 - 6.24	1.1	22	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25

Page 3 of 8

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
203	6.78 - 6.82	1	20	A
	7.19 - 7.23	1.6	32	A
	7.64 - 7.67	0.3	6	A
	8.10 - 8.14	1.4	28	A
	8.65 - 8.69	1.2	24	A
	9.33 - 9.37	1.6	32	A
	9.83 - 9.86	2.2	44	A
	10.21 - 10.25	1.8	36	A
	10.83 - 10.87	1.7	34	A
	11.31 - 11.34	1	20	A
	11.72 - 11.75	3.2	64	A
	12.05 - 12.08	1.1	22	A
204	2.54 - 2.58	0.3	6	A
	3.50 - 3.54	0.2	4	A
	3.90 - 3.93	0.2	4	A
	4.22 - 4.26	0.2	4	A
	4.79 - 4.83	0.8	16	A
	5.26 - 5.29	0.9	18	A
	5.92 - 5.95	0.8	16	A
	6.29 - 6.32	0.9	18	A
	6.75 - 6.79	1.9	38	A
	7.16 - 7.20	1.3	26	A
	7.71 - 7.75	0.9	18	A
	8.09 - 8.13	1.5	30	A
	8.86 - 8.90	1.4	28	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
204	9.18 - 9.22	2.1	42	A
	9.73 - 9.77	2.4	48	A
	10.19 - 10.22	3	60	A
	10.78 - 10.82	3.1	62	A
	11.15 - 11.18	2.8	56	A
205	0.79 - 0.82	0.8	16	A
	1.29 - 1.33	0.6	12	A
	1.87 - 1.91	0.7	14	A
	2.38 - 2.42	1	20	A
	2.84 - 2.87	1	20	A
	3.23 - 3.26	0.3	6	A
	4.28 - 4.32	0.5	10	A
	4.71 - 4.73	0.4	8	A
	4.78 - 4.82	0.3	6	A
	5.35 - 5.39	0.6	12	A
	5.84 - 5.87	0.8	16	A
	6.28 - 6.32	1.2	24	A
	6.75 - 6.79	1.2	24	A
	7.16 - 7.20	1.8	36	A
	7.70 - 7.74	0.9	18	A
	8.17 - 8.20	0.7	14	A
	8.82 - 8.85	1.6	32	A
	9.16 - 9.19	2.2	44	A
	9.81 - 9.84	2.2	44	A
	10.28 - 10.31	2.4	48	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25

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BOREHOLE NUMBER	DEPTH (m)	$I_{S\ (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
205	10.89 - 10.93	2.1	42	A
	11.27 - 11.31	1.7	34	A
	11.86 - 11.90	2.7	54	A
	12.19 - 12.23	1.4	28	A
	12.61 - 12.65	1	20	A
206	0.71 - 0.75	0.7	14	A
	0.91 - 0.94	0.6	12	A
	1.94 - 1.98	0.9	18	A
	2.25 - 2.29	1	20	A
	2.80 - 2.84	0.3	6	A
	3.11 - 3.15	0.8	16	A
	3.64 - 3.68	0.2	4	A
	4.37 - 4.40	0.09	2	A
	4.74 - 4.78	0.2	4	A
	5.09 - 5.14	0.6	12	A
	5.30 - 5.34	0.6	12	A
	5.83 - 5.85	0.8	16	A
	6.31 - 6.34	1.8	36	A
	6.50 - 6.54	1.8	36	A
	6.86 - 6.89	0.7	14	A
	7.10 - 7.14	1	20	A
	7.86 - 7.90	1	20	A
	8.02 - 8.06	1	20	A
	8.74 - 8.78	0.9	18	A
	9.04 - 9.07	1	20	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25

BOREHOLE NUMBER	DEPTH (m)	$I_{S\ (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
207	0.81 - 0.84	0.6	12	A
	1.21 - 1.25	0.6	12	A
	1.71 - 1.75	0.7	14	A
	2.16 - 2.19	0.9	18	A
	2.63 - 2.66	0.1	2	A
	2.91 - 2.94	0.2	4	A
	3.33 - 3.36	0.2	4	A
	3.87 - 3.90	0.3	6	A
	4.38 - 4.41	0.2	4	A
	4.81 - 4.84	0.2	4	A
	5.30 - 5.34	0.4	8	A
	5.88 - 5.90	0.6	12	A
	6.23 - 6.27	1.2	24	A
	6.53 - 6.57	0.9	18	A
	7.13 - 7.17	1.3	26	A
	7.73 - 7.77	1.1	22	A
	8.28 - 8.31	1.8	36	A
	8.84 - 8.87	1.7	34	A
	9.16 - 9.20	2.1	42	A
	9.77 - 9.80	1.4	28	A
	10.28 - 10.30	1	20	A
	10.81 - 10.84	1.3	26	A
	11.20 - 11.24	0.9	18	A
	11.47 - 11.51	1.1	22	A
	11.84 - 11.88	1.1	22	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25

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BOREHOLE NUMBER	DEPTH (m)	$I_{S\ (50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
207	12.14 - 12.18	1.4	28	A
	12.64 - 12.68	2.3	46	A
208	1.33 - 1.36	0.5	10	A
	1.81 - 1.84	0.2	4	A
	2.87 - 2.91	0.6	12	A
	3.14 - 3.17	1	20	A
	3.50 - 3.54	0.2	4	A
	3.78 - 3.82	0.08	2	A
	4.32 - 4.35	0.2	4	A
	4.78 - 4.80	0.2	4	A
	5.14 - 5.17	0.2	4	A
	5.71 - 5.75	0.3	6	A
	6.11 - 6.14	0.5	10	A
	6.54 - 6.57	0.7	14	A
	6.79 - 6.83	1	20	A
	7.19 - 7.22	0.6	12	A
	7.51 - 7.55	0.7	14	A
	7.91 - 7.94	0.3	6	A
	8.27 - 8.31	1	20	A
	8.46 - 8.49	2.2	44	A
	8.92 - 8.96	0.2	4	A
	9.14 - 9.17	0.8	16	A
	9.66 - 9.70	1.3	26	A
	10.20 - 10.24	2	40	A
	10.79 - 10.82	1.6	32	A

NOTE: SEE PAGE 8

TABLE D
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	School Infrastructure NSW	**Ref No:**	32976LT1
Project:	Proposed Alterations and Additions	**Report:**	D
Location:	Kogarah Public School, 24B Gladstone Street. KOGARAH, NSW	**Report Date:**	13/02/25
		Page 8 of 8	

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
208	11.14 - 11.17	1.8	36	A
	11.55 - 11.58	1	20	A
	11.87 - 11.89	2.3	46	A

NOTES

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

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CERTIFICATE OF ANALYSIS 239687

Client Details

Client	JK Geotechnics
Attention	Kartik Singh
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**32976LT, Kogarah**
Number of Samples	3 Soil
Date samples received	25/03/2020
Date completed instructions received	25/03/2020

Analysis Details

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

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

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

Report Details

Date results requested by	01/04/2020
Date of Issue	01/04/2020

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Results Approved By
Diego Bigolin, Team Leader, Inorganics

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil				
Our Reference		239687-1	239687-2	239687-3
Your Reference	UNITS	BH103	BH104	BH109
Depth		0.6-1.0	0.4-0.5	0.02-0.1
Date Sampled		24/03/2020	24/03/2020	24/03/2020
Type of sample		Soil	Soil	Soil
Date prepared	-	30/03/2020	30/03/2020	30/03/2020
Date analysed	-	30/03/2020	30/03/2020	30/03/2020
pH 1:5 soil:water	pH Units	5.7	6.0	7.9
Chloride, Cl 1:5 soil:water	mg/kg	49	44	<10
Sulphate, SO4 1:5 soil:water	mg/kg	34	120	98
Resistivity in soil*	ohm m	120	79	96

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity (non NATA). Resistivity (calculated) may not correlate with results otherwise obtained using Resistivity-Current method, depending on the nature of the soil being analysed.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			30/03/2020	[NT]	[NT]	[NT]	[NT]	30/03/2020	[NT]
Date analysed	-			30/03/2020	[NT]	[NT]	[NT]	[NT]	30/03/2020	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	100	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	103	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

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.

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CERTIFICATE OF ANALYSIS 370886

Client Details

Client	JK Geotechnics
Attention	Jacob Feng
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**32976LT1**
Number of Samples	3 Soil
Date samples received	20/01/2025
Date completed instructions received	20/01/2025

Analysis Details

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

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

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

Report Details

Date results requested by	28/01/2025
Date of Issue	24/01/2025

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Results Approved By
Diego Bigolin, Inorganics Supervisor

Authorised By
Nancy Zhang, Laboratory Manager

Client Reference: 32976LT1

Misc Inorg - Soil				
Our Reference		370886-1	370886-2	370886-3
Your Reference	UNITS	204	206	207
Depth		1.5-1.75	0.0-0.05	0.4-0.5
Date Sampled		17/01/2025	15/01/2025	16/01/2025
Type of sample		Soil	Soil	Soil
Date prepared	-	22/01/2025	22/01/2025	22/01/2025
Date analysed	-	22/01/2025	22/01/2025	22/01/2025
pH 1:5 soil:water	pH Units	6.7	9.7	6.8
Chloride, Cl 1:5 soil:water	mg/kg	<10	30	<10
Sulphate, SO4 1:5 soil:water	mg/kg	20	230	100
Resistivity in soil*	ohm m	520	47	140

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode. 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.

Client Reference: 32976LT1

QUALITY CONTROL: Misc Inorg - Soil					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			22/01/2025	[NT]	[NT]	[NT]	[NT]	22/01/2025	[NT]
Date analysed	-			22/01/2025	[NT]	[NT]	[NT]	[NT]	22/01/2025	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	103	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	[NT]	[NT]	107	[NT]
Resistivity in soil*	ohm m	1	Inorg-002	<1	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

JKGeotechnics

BOREHOLE LOG

Borehole No.
106
1 / 1

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT-KPS **Method:** SPIRAL AUGER **R.L. Surface:** 20.6 m
Date: 23/3/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■								-	ASPHALTIC CONCRETE: 20mm.t	M			
										FILL: Sandy clayey gravel, fine to coarse grained, grey, sub-angular, igneous.				
	■			■	N = 3 1,1,2	20	1		CL	Sandy silty CLAY: low plasticity, light grey mottled orange brown, fine to coarse grained sand, trace of fine grained ironstone gravel.	w~PL	S - F		RESIDUAL
				■	N=SPT 6/ 100mm REFUSAL	19	2		-	SANDSTONE: fine to coarse grained, light grey and orange brown.	DW	(L - M)		HAWKESBURY SANDSTONE LOW TO MODERATE 'TC' BIT RESISTANCE
												(H)		HIGH RESISTANCE 'TC' BIT RESISTANCE
						18 17 16 15 14	3 4 5 6			END OF BOREHOLE AT 2.20 m				

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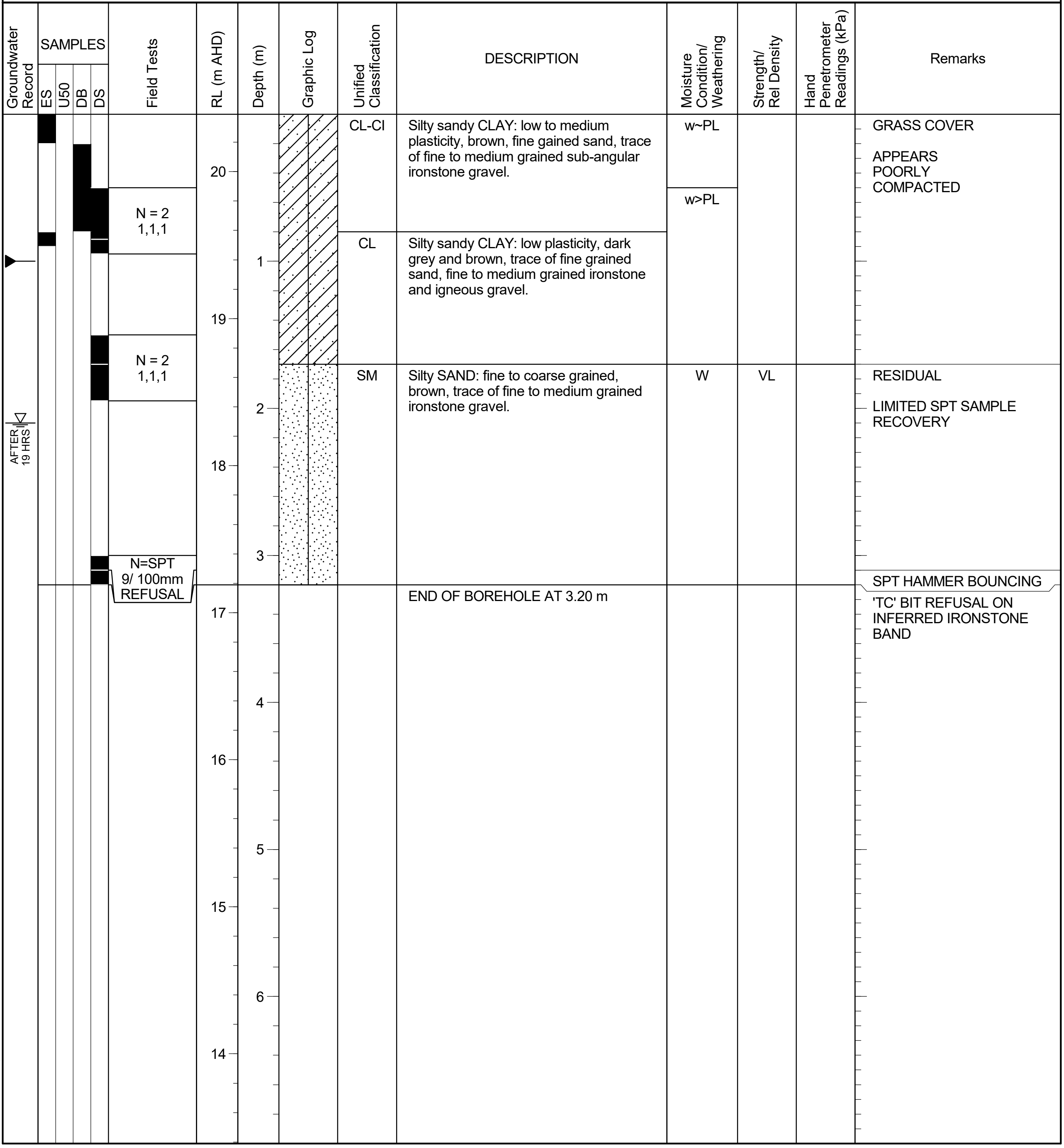
BOREHOLE LOG

Borehole No.
107
1 / 1

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT-KPS **Method:** SPIRAL AUGER **R.L. Surface:** 20.39 m
Date: 23/3/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.



Field Tests	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
N = 2 1,1,1	CL-CI	Silty sandy CLAY: low to medium plasticity, brown, fine gained sand, trace of fine to medium grained sub-angular ironstone gravel.	w~PL w>PL			GRASS COVER APPEARS POORLY COMPACTED
N = 2 1,1,1	CL	Silty sandy CLAY: low plasticity, dark grey and brown, trace of fine grained sand, fine to medium grained ironstone and igneous gravel.				
N=SPT 9/ 100mm REFUSAL	SM	Silty SAND: fine to coarse grained, brown, trace of fine to medium grained ironstone gravel.	W	VL		RESIDUAL LIMITED SPT SAMPLE RECOVERY SPT HAMMER BOUNCING
		END OF BOREHOLE AT 3.20 m				'TC' BIT REFUSAL ON INFERRED IRONSTONE BAND

BOREHOLE LOG

Borehole No.
108
1 / 1

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT-KPS **Method:** SPIRAL AUGER **R.L. Surface:** 17.91 m
Date: 23/3/20 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** K.K.S./A.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
	■			■						FILL: Sandy silt topsoil, low plasticity, dark brown, fine to medium grained sand, trace of root fibres and glass fragments.	w<PL			GRASS COVER
	■		■	■	N = 2 1,1,1	17	1		CL	Sandy silty CLAY: low plasticity, brown, fine grained sand, trace of fine grained sandstone gravel.	M	VL		RESIDUAL
	■								SC	Silty clayey SAND: fine to medium grained, brown, trace of roots and root fibres.	M			
AFTER 23 HRS				■	N=SPT 19/ 100mm REFUSAL					as above, but light grey and orange brown.				
				■		16	2		-	SANDSTONE: fine to coarse grained, light grey and orange brown.	DW	L		HAWKESBURY SANDSTONE LOW TO MODERATE 'TC' BIT RESISTANCE WITH VERY LOW BANDS
						15	3					VL		VERY LOW RESISTANCE
				■		14	4					L - M		MODERATE RESISTANCE WITH LOW BANDS
						13	5			END OF BOREHOLE AT 4.50 m				
						12	6							
						11								

BOREHOLE LOG

Borehole No.
109
1 / 1

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT-KPS
Method: SPIRAL AUGER
R.L. Surface: 19.24 m
Date: 23/3/20
Datum: AHD
Plant Type: JK308
Logged/Checked By: K.K.S./A.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	■			■						ASPHALTIC CONCRETE: 20mm.t				
									GC	Sandy clayey GRAVEL: fine to coarse grained, grey, sub-angular, igneous.	M			
	■			■		19	1		-	SANDSTONE: fine to coarse grained, light grey and orange brown.	DW	M		HAWKESBURY SANDTONE MODERATE TO HIGH 'TC' BIT RESISTANCE WITH VERY LOW BANDS
				■		18						H		HIGH RESISTANCE
						17 16 15 14 13	2 3 4 5 6			END OF BOREHOLE AT 1.40 m				'TC' BIT REFUSAL

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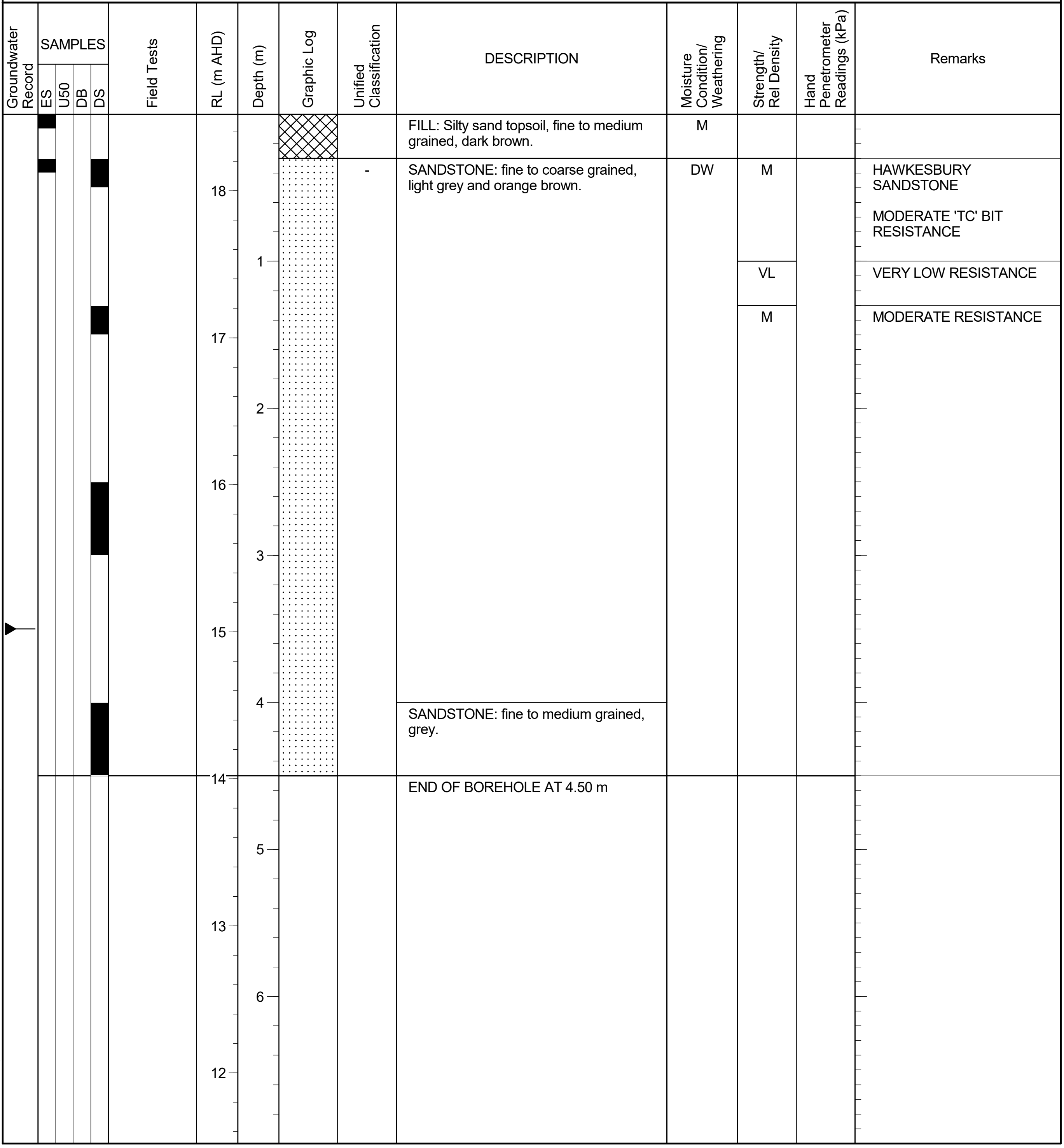
BOREHOLE LOG

Borehole No.
110
1 / 1

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT-KPS
Method: SPIRAL AUGER
R.L. Surface: 18.52 m
Date: 23/3/20
Datum: AHD
Plant Type: JK308
Logged/Checked By: K.K.S./A.B.



Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	FILL: Silty sand topsoil, fine to medium grained, dark brown.	M			
-	SANDSTONE: fine to coarse grained, light grey and orange brown.	DW	M		HAWKESBURY SANDSTONE MODERATE 'TC' BIT RESISTANCE
			VL		VERY LOW RESISTANCE
			M		MODERATE RESISTANCE
	SANDSTONE: fine to medium grained, grey.				
	END OF BOREHOLE AT 4.50 m				

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BOREHOLE LOG

Borehole No.
201
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Method: HAND AUGER / SPIRAL AUGER
R.L. Surface: ~20.3 m
Date: 31/1/25 TO 12/2/25
Datum: AHD
Plant Type: JK305
Logged/Checked By: J.F./A.B.

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	RL (m AHD)	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
ON COMPLETION OF AUGERING ▽	ES		20	0		FILL: Silty sand, fine to coarse grained, brown.	M			
	ES					FILL: Sandy gravel, fine to medium grained, grey, igneous, fine to coarse grained sand, trace of cemented sand nodules.	w>PL			
▶	ES					FILL: Sandy silty clay, low plasticity, dark brown, fine to coarse grained sand, trace of fine to medium grained ironstone gravel.				
	ES			1		FILL: Sandy silty clay, low plasticity, dark brown, fine to medium grained sand, trace of fine to medium grained ironstone gravel, and tile fragments.				HAND AUGER TO 1.05m
			19		-	SANDSTONE: fine to medium grained, light grey and orange brown.	MW	M - H		HAWKESBURY SANDSTONE MODERATE TO HIGH 'TC' BIT RESISTANCE
						REFER TO CORED BOREHOLE LOG				

RL (m AHD): 20, 19, 18, 17, 16, 15, 14
Depth (m): 1, 2, 3, 4, 5, 6

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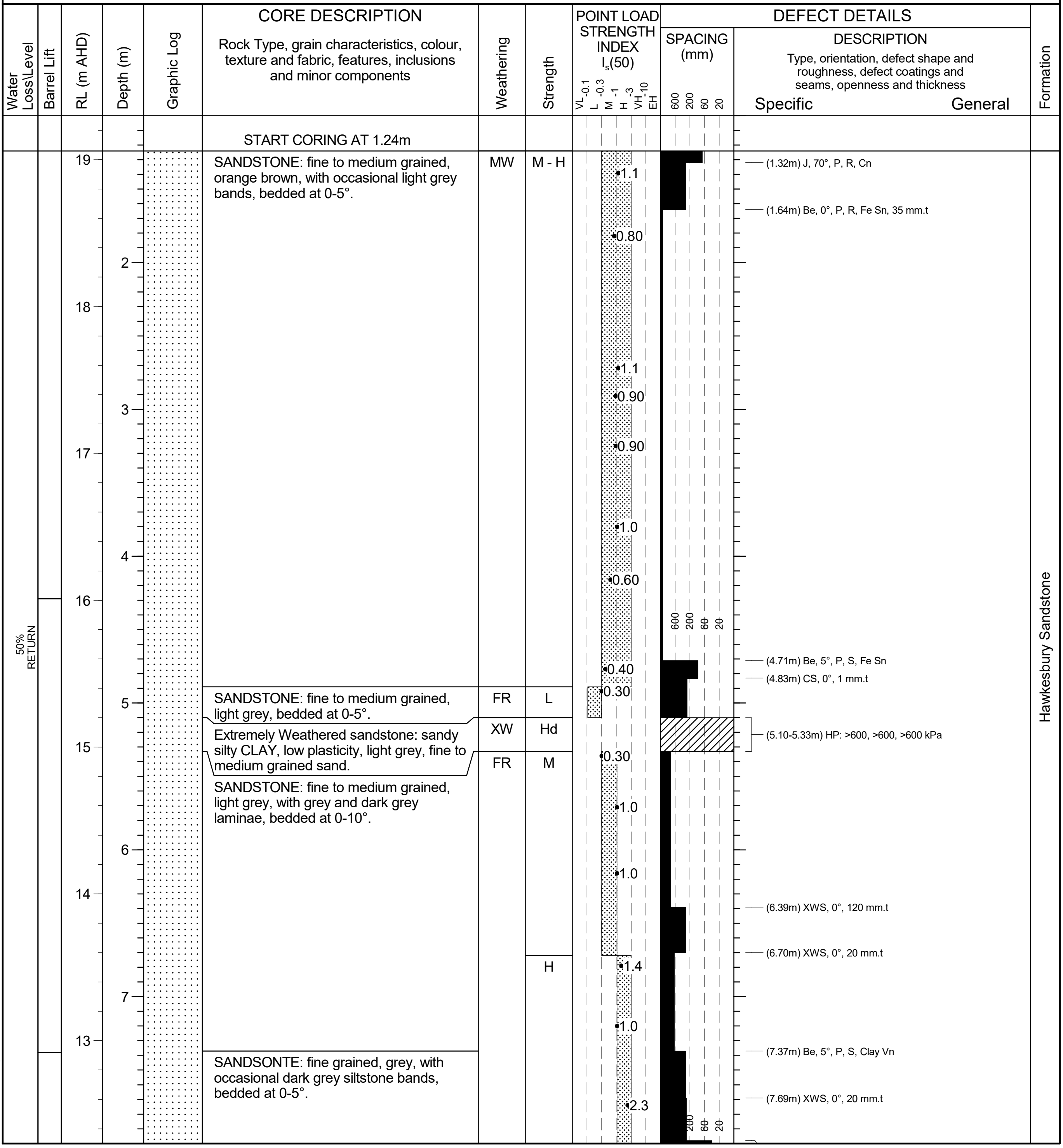
CORED BOREHOLE LOG

Borehole No.
201
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1	**Core Size:** NMLC	**R.L. Surface:** ~20.3 m
Date: 31/1/25 TO 12/2/25	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK305	**Bearing:** N/A	**Logged/Checked By:** J.F./A.B.



START CORING AT 1.24m

SANDSTONE: fine to medium grained, orange brown, with occasional light grey bands, bedded at 0-5°. — MW — M - H

SANDSTONE: fine to medium grained, light grey, bedded at 0-5°. — FR — L

Extremely Weathered sandstone: sandy silty CLAY, low plasticity, light grey, fine to medium grained sand. — XW — Hd

SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, bedded at 0-10°. — FR — M, H

SANDSONTE: fine grained, grey, with occasional dark grey siltstone bands, bedded at 0-5°.

(1.32m) J, 70°, P, R, Cn
(1.64m) Be, 0°, P, R, Fe Sn, 35 mm.t
(4.71m) Be, 5°, P, S, Fe Sn
(4.83m) CS, 0°, 1 mm.t
(5.10-5.33m) HP: >600, >600, >600 kPa
(6.39m) XWS, 0°, 120 mm.t
(6.70m) XWS, 0°, 20 mm.t
(7.37m) Be, 5°, P, S, Clay Vn
(7.69m) XWS, 0°, 20 mm.t

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Borehole No.
201
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~20.3 m
Date: 31/1/25 TO 12/2/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK305
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific	General	Formation
50% RETURN		12		SANDSONTE: fine grained, grey, with occasional dark grey siltstone bands, bedded at 0-5°.	FR	H	2.1	(7.98m) XWS, 0°, 30 mm.t (8.02m) XWS, 0°, 10 mm.t		Hawkesbury Sandstone
				SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, bedded at 0-10°.			1.5			
			9				1.1	(8.88m) CS, 5°, 2 mm.t		
		11						(9.42m) XWS, 0°, 20 mm.t (9.47m) Be, 0°, P, S, Clay Ct		
				SANDSTONE: fine to medium grained, light brown, bedded at 0-10°.	MW		1.6 2.2			
		10	10				1.1			
				END OF BOREHOLE AT 10.38 m						
		9	11							
		8	12							
		7	13							
		6	14							

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

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


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Job No: 32976LT1
Borehole No: BH201
Depth: 1.24m to 10.00m

32976LT1 BH201 START CORING AT 1.24 m

Job No: 32976LT1
Borehole No: BH201
Depth: 10.00m to 10.38m

END OF BOREHOLE AT 10.38m

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BOREHOLE LOG

Borehole No.
202
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1 **Method:** SPIRAL AUGER **R.L. Surface:** ~18.6 m
Date: 11/2/25 **Datum:** AHD
Plant Type: JK330 **Logged/Checked By:** J.F./A.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: 40mm.t	M			
										FILL: Silty sandy gravel, fine to medium grained, igneous, dark grey, fine to coarse grained sand.				
				■	N = 2 3,2,0	18	1		SP	SAND: fine to coarse grained, orange brown and light brown, trace of fine to medium grained sandstone gravel.	M	VL		RESIDUAL
				■	N=SPT 5/ 150mm REFUSAL	17				as above, but light grey mottled orange brown.				
						16	2		-	SANDSTONE: fine to medium grained, light grey and orange brown.	MW	VL M		HAWKESBURY SANDSTONE VERY LOW 'TC' BIT RESISTANCE MODERATE TO HIGH RESISTANCE
						15 14 13 12	3 4 5 6			REFER TO CORED BOREHOLE LOG				

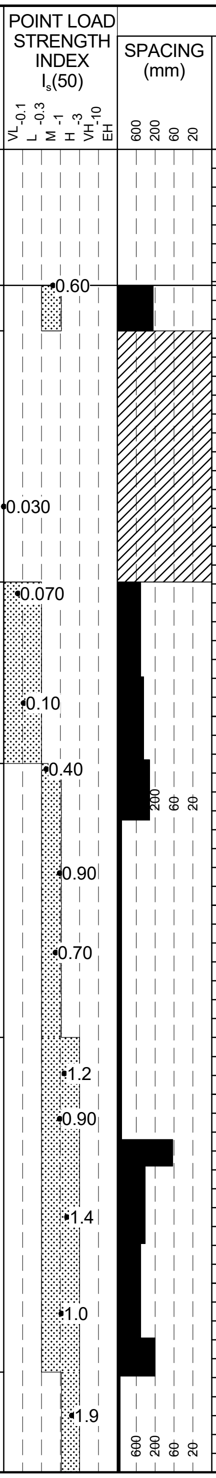
CORED BOREHOLE LOG

Borehole No.
202
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.6 m
Date: 11/2/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS – DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness	Formation
		16		START CORING AT 2.72m					
98% RETURN				SANDSTONE: fine to medium grained, light grey, bedded at 0-5°.	FR	M	0.60		Hawkesbury Sandstone
		15	3	Extremely Weathered sandstone: sandy silty CLAY, low plasticity, light grey, fine to medium grained sand, with very low strength sandstone bands.	XW	Hd	0.030	(2.96-4.29m) HP: >600, >600, >600 kPa (4.29m) Be, 0°, P, R, Fe Sn	
		14	4	SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-10°.	HW	VL - L	0.070 0.10	(4.79m) CS, 0°, 3 mm.t (5.23m) XWS, 0°, 40 mm.t	
		13	5		FR	M	0.40 0.90 0.70	(5.55m) XWS, 0°, 25 mm.t	
		12	6			M - H	1.2 0.90		
			7	as above, but grey and light grey, with dark grey siltstone bands.				(7.24m) XWS, 0°, 65 mm.t (7.31m) XWS, 0°, 25 mm.t (7.38m) XWS, 0°, 60 mm.t	
		11		SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 0-5°.			1.4 1.0	(7.79m) CS, 5°, 2 mm.t (8.29m) Jh, 60°, P	
		10	8	SANDSTONE: fine to medium grained, light brown and light grey, with red brown bands, bedded at 0-10°, and occasional siltstone clasts.	MW	H	1.9	(8.49m) Be, 0°, P, R, Fe Sn, 30 mm.t	



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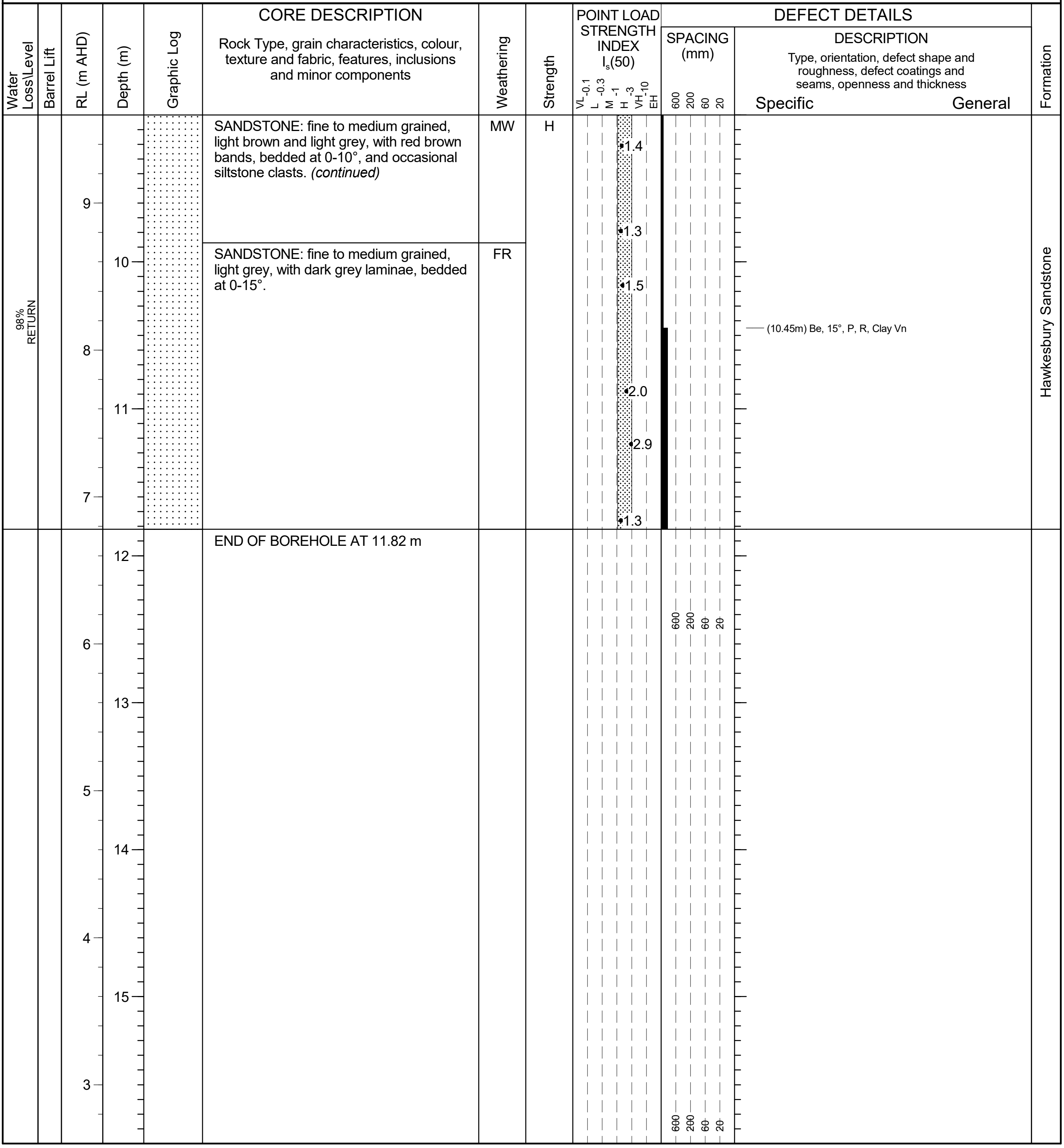
FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Borehole No.
202
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.6 m
Date: 11/2/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: J.F./A.B.



Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
98% RETURN					SANDSTONE: fine to medium grained, light brown and light grey, with red brown bands, bedded at 0-10°, and occasional siltstone clasts. *(continued)*	MW	H	1.4 1.3			Hawkesbury Sandstone
					SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 0-15°.	FR		1.5 2.0 2.9 1.3		(10.45m) Be, 15°, P, R, Clay Vn	
					END OF BOREHOLE AT 11.82 m						

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

Job No: 32976LT1
Borehole No: BH202
Depth: 2.72m to 11.82m

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BOREHOLE LOG

Borehole No.
203
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Method: SPIRAL AUGER
R.L. Surface: ~19.9 m
Date: 15/1/25
Datum: AHD
Plant Type: JK308
Logged/Checked By: J.F./A.B.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
DRY ON COMPLETION OF AUGERING										ASPHALTIC CONCRETE: 100mm.t				
	■			■					-	FILL: Silty sand, fine to medium grained, dark grey.	M			
	■			■	N > 3 1,3/ 150mm REFUSAL					FILL: Sandy silty clay, low plasticity, dark grey, fine to medium grained sand, trace of fine to medium grained sandstone gravel.	w>PL			
	■					19	1		-	SANDSTONE: fine to medium grained, light grey.	MW	M		HAWKESBURY SANDSTONE
										REFER TO CORED BOREHOLE LOG				MODERATE 'TC' BIT RESISTANCE
						18	2							GROUNDWATER MONITORING WELL INSTALLED TO 12.18m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 2.18m TO 12.18m. CASING 0.1m TO 2.18m. 2mm SAND FILTER PACK 0.85m TO 12.18m. BENTONITE SEAL 0.1m TO 3.85m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						17	3							
						16	4							
						15	5							
						14	6							
						13								

CORED BOREHOLE LOG

Borehole No.
203

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~19.9 m
Date: 15/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	RL (m AHD)	Depth (m)	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS – DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness – Specific	Formation
	19	0 – 1.00	START CORING AT 1.00m					
ON COMPLETION OF CORING	18	1.00	SANDSTONE: fine to medium grained, light grey, with orange brown bands, bedded at 0-15°.	MW	M - H	0.90 0.70	(1.35m) Be, 5°, P, R, Clay Vn	Hawkesbury Sandstone
98% RETURN 4 HRS AFTER COMPLETION	17 16	2 – 4	SANDSTONE: fine to medium grained, orange brown and light brown, with grey laminae, bedded at 0-15°.			1.1 0.80 0.90 1.0 1.2 0.70	(3.41m) XWS, 5°, 30 mm.t (4.44m) Be, 0°, P, R, Fe Vn	
			SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-5°.	FR				
ON 13/2/25	15	5	Extremely Weathered sandstone: sandy CLAY, low plasticity, light grey, fine to medium grained sand.	XW	Hd		(4.61-5.05m) HP: >600, >600, >600 kPa	
	14 13	6	SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, bedded at 0-10°.	FR	M - H	0.80 0.40 1.1 1.0	(5.67m) Be, 0°, P, R, Clay Vn (6.05m) XWS, 0°, 10 mm.t	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

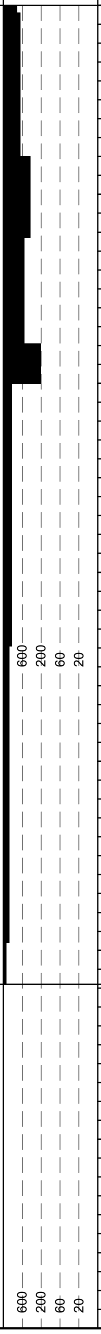
CORED BOREHOLE LOG

Borehole No.
203
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~19.9 m
Date: 15/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.

RL (m AHD)	Depth (m)	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	Formation
		SANDSTONE: as above	FR	M - H		(7.04m) XWS, 0°, 5 mm.t	Hawkesbury Sandstone
		SANDSTONE: fine grained, grey, with Siltstone, dark grey laminae, bedded at 0-5°.			1.6		
		LAMINITE: Sandstone, fine grained, grey, interlaminated with Siltstone, dark grey, bedded at 0-5°.		L - M	0.30	(7.80m) XWS, 0°, 10 mm.t	
12	8	SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-10°.		H	1.4 1.2	(8.23m) Be, 0°, P, S, Clay Ct (8.79m) Be, 0°, P, S, Clay Ct	
11 10 9 8	9 10 11 12	SANDSTONE: fine to medium grained, light brown and orange brown, bedded at 0-20°.	MW		1.6 2.2 1.8 1.7 1.0 3.2	(9.00m) Be, 0°, P, S, Fe Sn (10.39m) Be, 10°, P, R, Fe Sn (11.96m) Be, 0°, P, R, Clay Ct	
		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°.	FR		1.1		
7 6	13	END OF BOREHOLE AT 12.18 m					



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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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Job No: 32976LT1
Borehole No: 203
Depth: 1.00 to 10.00m

32976LT1 BH203 START CORING AT 1.00 m

Job No: 32976LT1

Borehole No: 203

Depth: 10.00 to 12.18m

JKGeotechnics

BOREHOLE LOG

Borehole No.
204
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1 **Method:** SPIRAL AUGER **R.L. Surface:** ~18.5 m
Date: 17/1/25 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** J.F./A.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									-	SPRAYED SEAL: 5mm.t	M			APPEARS POORLY COMPACTED
										FILL: Silty sandy gravel, fine to medium grained, dark grey, fine to coarse grained sand.	w>PL			
					N = 3 1,1,2	18				FILL: Sandy silty clay, low plasticity, dark grey, fine to medium grained sand.	M			
							1			FILL: Silty sand, fine to medium grained, grey, with fine to medium grained ironstone gravel.				
									CL	Sandy silty CLAY: low plasticity, orange brown, fine to medium grained sand.	w>PL	(St)		RESIDUAL
					N > 20 10,20/ 100mm REFUSAL	17						Hd		TOO FRIABLE FOR HP TESTING
									-	SANDSTONE: fine to medium grained, light grey and orange brown.	MW	M		HAWKESBURY SANDSTONE
							2			REFER TO CORED BOREHOLE LOG				MODERATE 'TC' BIT RESISTANCE
						16								
							3							
						15								
							4							
						14								
							5							
						13								
							6							
						12								

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 32976LT1 KOGARAH - JKG.GPJ <<DrawingFile>> 04/03/2025 14:42 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
204
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1	**Core Size:** NMLC	**R.L. Surface:** ~18.5 m
Date: 17/1/25	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** J.F./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
		17			START CORING AT 1.92m						
			2		NO CORE 0.33m						
		16			SANDSTONE: fine to medium grained, light brown and brown, massive.	MW	M	0.30		(2.37m) Be, 0°, P, R, Clay Ct (2.72m) J, 30°, P, R, Clay Ct	Hawkesbury Sandstone
			3		Extremely Weathered sandstone: sandy silty CLAY, low plasticity, light grey, fine to medium grained sand.	XW	Hd			(2.75-3.44m) HP: >600, >600, >600 kPa	
▽ ON COMPLETION OF CORING		15			SANDSTONE: fine to medium grained, light grey and red brown, bedded at 0-10°.	MW	L	0.20		(3.58m) XWS, 0°, 25 mm.t (3.70m) XWS, 0°, 25 mm.t (3.80m) XWS, 0°, 30 mm.t (3.82m) Be, 0°, P, R, Fe Sn	
70% RETURN		14	4		SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, bedded at 0-10°.	SW	L	0.20 0.20		(4.61m) Be, 0°, P, R, XW IN FILL, 10mm.t	
		13	5			FR	M	0.80 0.90			
		12	6					0.80 0.90		(6.42m) XWS, 0°, 80 mm.t	
							M - H	1.9			
			7		SANDSTONE: fine grained, grey, bedded at 0-5°.			1.3			
		11				SW		0.90		(7.39m) XWS, 5°, 10 mm.t (7.48m) Be, 0°, P, S, Clay Ct	
					SANDSTONE: as below	MW	H			(7.89m) Be, 0°, P, R, Fe Sn	

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Borehole No.
204
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

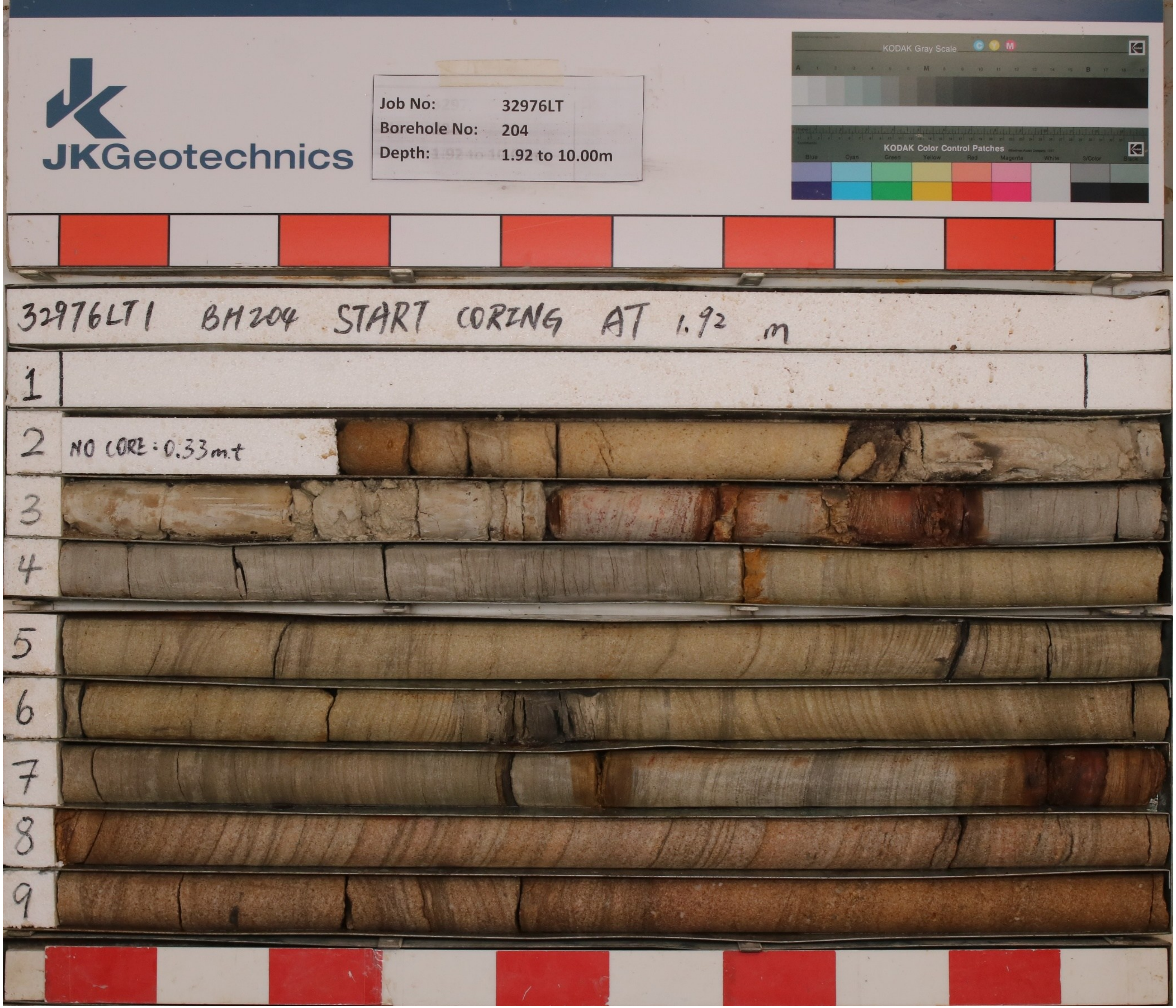
Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.5 m
Date: 17/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness — Specific	Formation
70% RETURN	SANDSTONE: fine to medium grained, orange brown, red brown and light grey, grey and dark grey laminae, with fine grained quartz gravel, bedded at 0-20°.	MW	H	1.5 1.4 2.1	(8.80m) Be, 10°, P, R, Cb	Hawkesbury Sandstone
	SANDSTONE: fine to medium grained, light brown, massive.			2.4 3.0		
	SANDSTONE: fine to medium grained, brown, with brown laminae, bedded at 5-20°.			3.1 2.8	(10.94m) Be, 20°, P, S, Clay Vn	
	END OF BOREHOLE AT 11.29 m					

RL (m AHD): 10, 9, 8, 7, 6, 5, 4
Depth (m): 9, 10, 11, 12, 13, 14

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

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS



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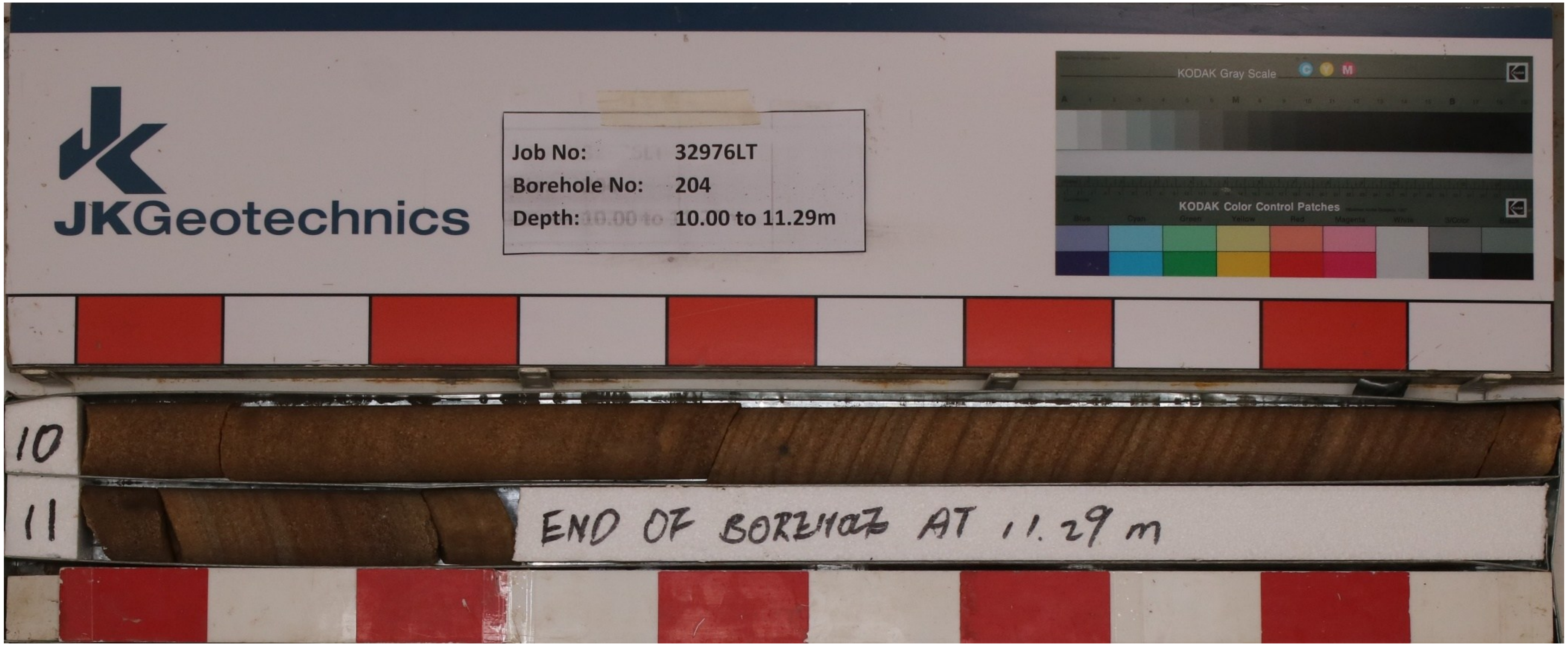
Job No: 32976LT
Borehole No: 204
Depth: 1.92 to 10.00m

32976LT1 BH204 START CORING AT 1.92 m

NO CORE: 0.33m.t



Job No: 32976LT
Borehole No: 204
Depth: 10.00 to 11.29m

END OF BOREHOLE AT 11.29 m

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BOREHOLE LOG

Borehole No.
205
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1 **Method:** SPIRAL AUGER **R.L. Surface:** ~18.8 m
Date: 16/1/25 TO 17/1/25 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** J.F./A.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	■			■ ■				▨	-	SPRAYED SEAL: 5mm.t	M			
								▨		FILL: Silty sandy gravel, fine to medium grained, dark grey, igneous, fine to medium grained sand.				
								⋯	-	FILL: Silty sand, fine to medium grained, dark grey, trace of igneous gravel.				
										SANDSTONE: fine to medium grained, orange brown.	MW	M		HAWKESBURY SANDSTONE MODERATE 'TC' BIT RESISTANCE
						18								
							1			REFER TO CORED BOREHOLE LOG				
						17								
							2							
						16								
							3							
						15								
							4							
						14								
							5							
						13								
							6							
						12								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
205
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.8 m
Date: 16/1/25 TO 17/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	Depth (m)	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS – DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness – Specific	Formation
	0–0.61	START CORING AT 0.61m					
98% RETURN	0.61–	SANDSTONE: fine to medium grained, orange brown and light brown, with light grey bands, indistinctly bedded at 0-10°.	MW	M	0.80 0.60 0.70 1.0	(0.75m) J, 25°, P, R, Cn (0.85m) Be, 5°, P, R, Clay Vn	Hawkesbury Sandstone
ON COMPLETION OF CORING							
		SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, bedded at 0-10°.	FR		1.0 0.30	(2.91m) XWS, 0°, 30 mm.t (2.95m) Be, 0°, P, S, Clay Ct (3.32m) XWS, 0°, 30 mm.t	
		Extremely Weathered sandstone: sandy silty CLAY, low plasticity, light grey, fine to medium grained sand.	XW	Hd		(3.52-4.25m) HP: 420, 430, 450 kPa	
		SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, indistinctly bedded at 0-20°.	FR	M	0.50 0.40 0.30 0.60 0.80	(4.88m) Be, 5°, P, S, Clay Vn (5.17m) Be, 0°, P, S, Clay Ct (6.16m) Be, 0°, P, S, Clay Ct	
		SANDSTONE: fine grained, grey, with dark grey laminae, bedded at 0-5°.		H	1.2	(6.66m) XWS, 0°, 20 mm.t	
		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-10°.			1.2		

RL (m AHD): 18, 17, 16, 15, 14, 13, 12
Depth (m): 1, 2, 3, 4, 5, 6
POINT LOAD STRENGTH INDEX: VL 0.1, L 0.3, M 1, H 3, VH 10, EH
SPACING (mm): 600, 200, 60, 20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

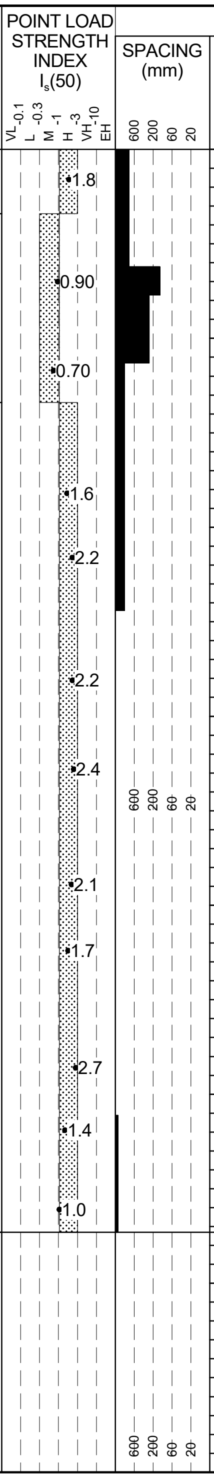
CORED BOREHOLE LOG

Borehole No.
205
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.8 m
Date: 16/1/25 TO 17/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	Formation
98% RETURN		11		SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, bedded at 0-15°.	FR	H M	Hawkesbury Sandstone
		10	8	SANDSTONE: fine to medium grained, orange brown and light brown, with grey and brown bands, bedded at 0-20°.	MW	H	
		9	9 10	SANDSTONE: fine to medium grained, light brown, massive, with occasional fine grained quartz gravel.			
		8 7	11	SANDSTONE: fine to medium grained, light brown, with brown laminae, bedded at 5-20°.			
			12	SANDSTONE: fine to medium grained, orange brown, massive.			
		6 5	13	END OF BOREHOLE AT 12.73 m			



DEFECT DETAILS
DESCRIPTION
Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness
Specific / General

- (7.62m) Be, 0°, P, S, Clay Ct
- (7.77m) Be, 0°, P, R, Clay FILLED, 5 mm.t
- (8.13m) Be, 0°, P, R, Fe Sn
- (9.44m) XWS, 0°, 5 mm.t
- (12.11m) XWS, 0°, 30 mm.t

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 32976LT1 KOGARAH - JKG.GPJ <<DrawingFile>> 04/03/2025 14:40 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: 32976LT1

Borehole No: 205

Depth: 0.61 to 9.00m

32976LT1 BH205 START CORING AT 0.61 m

Job No: 32976LT1
Borehole No: 205
Depth: 9.00 to 12.73m

BOREHOLE LOG

Borehole No.
206
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1 **Method:** SPIRAL AUGER **R.L. Surface:** ~19.0 m
Date: 15/1/25 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** J.F./A.B.

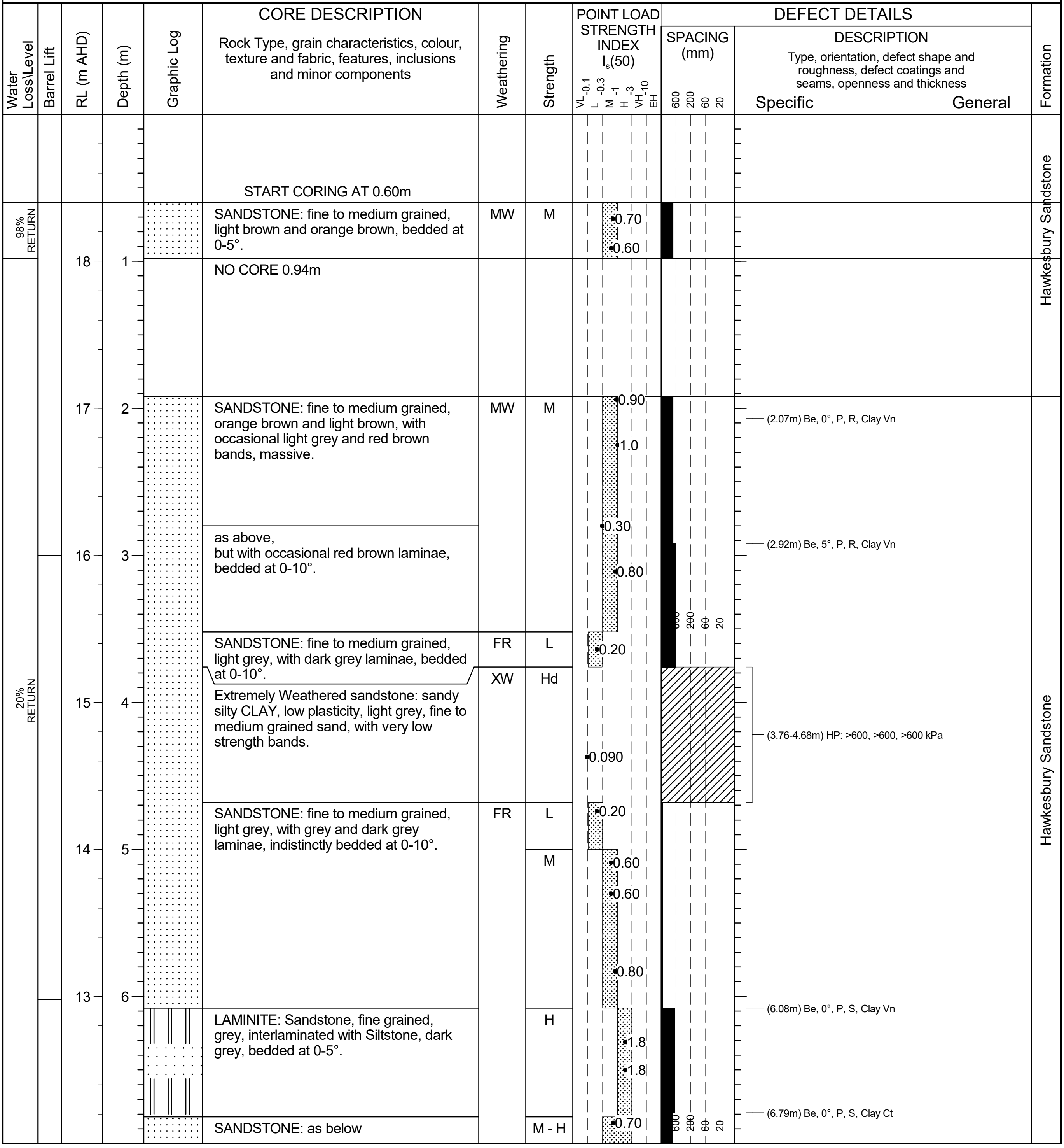
Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■			■					-	FILL: Silty sand, fine to coarse grained, dark brown, trace of rubber fragments and slag.	M			SYNTHETIC GRASS COVER
									-	CONCRETE: 50mm.t	M			NO OBSERVED REINFORCEMENT
									-	FILL: Silty sand, fine to medium grained, dark grey brown.				
										SANDSTONE: fine to medium grained, orange brown.	MW	M		HAWKESBURY SANDSTONE MODERATE 'TC' BIT RESISTANCE HIGH RESISTANCE 'TC' BIT REFUSAL
										REFER TO CORED BOREHOLE LOG				
						18	1							
						17	2							
						16	3							
						15	4							
						14	5							
						13	6							

CORED BOREHOLE LOG

Borehole No.
206
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~19.0 m
Date: 15/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.



Water Loss\Level	RL (m AHD)	Depth (m)	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS – DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness – Specific	Formation
			START CORING AT 0.60m					Hawkesbury Sandstone
98% RETURN			SANDSTONE: fine to medium grained, light brown and orange brown, bedded at 0-5°.	MW	M	0.70 0.60		
20% RETURN	18	1	NO CORE 0.94m					
	17	2	SANDSTONE: fine to medium grained, orange brown and light brown, with occasional light grey and red brown bands, massive.	MW	M	0.90 1.0	(2.07m) Be, 0°, P, R, Clay Vn	Hawkesbury Sandstone
	16	3	as above, but with occasional red brown laminae, bedded at 0-10°.			0.30 0.80	(2.92m) Be, 5°, P, R, Clay Vn	
			SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 0-10°.	FR	L	0.20		
	15	4	Extremely Weathered sandstone: sandy silty CLAY, low plasticity, light grey, fine to medium grained sand, with very low strength bands.	XW	Hd	0.090	(3.76-4.68m) HP: >600, >600, >600 kPa	
	14 13	5 6	SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, indistinctly bedded at 0-10°.	FR	L M	0.20 0.60 0.60 0.80	(6.08m) Be, 0°, P, S, Clay Vn	
			LAMINITE: Sandstone, fine grained, grey, interlaminated with Siltstone, dark grey, bedded at 0-5°.		H	1.8 1.8	(6.79m) Be, 0°, P, S, Clay Ct	
			SANDSTONE: as below		M - H	0.70		

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Borehole No.
206
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~19.0 m
Date: 15/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1 L -0.3 M -1 H -3 VH -10 EH	SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
20% RETURN				⁙	SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, and occasional siltstone bands, bedded at 0-20°.	FR	M - H	1.0				Hawkesbury Sandstone
										(7.73m) Be, 0°, P, S, Clay Ct		
								1.0				
		11	8					1.0				
								0.90				
		10	9					1.0				
					END OF BOREHOLE AT 9.13 m							
		9	10						600 200 60 20			
		8	11									
		7	12									
		6	13						600 200 60 20			

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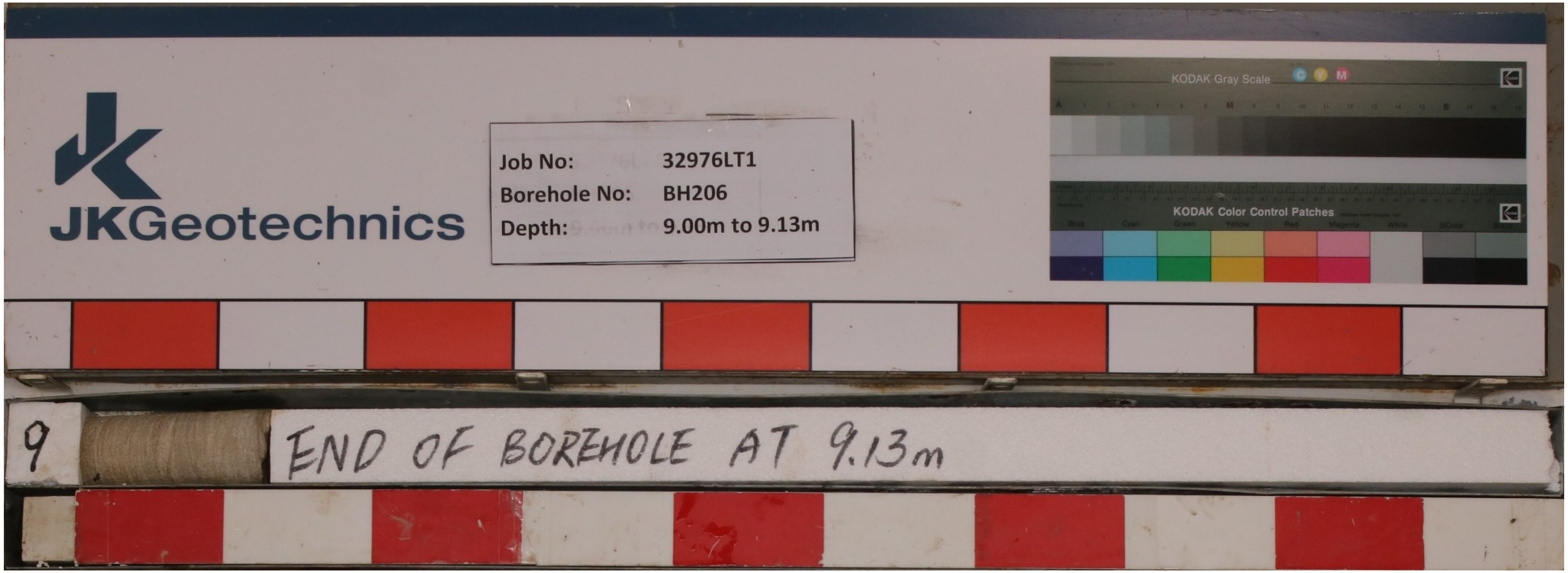
FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

Job No: 32976LT1
Borehole No: BH206
Depth: 0.60m to 9.00m

32976LT1 BH206 START CORING AT 0.60 m

NO CORE: 0.94m.+



Job No: 32976LT1

Borehole No: BH206

Depth: 9.00m to 9.13m

END OF BOREHOLE AT 9.13m

JKGeotechnics

BOREHOLE LOG

Borehole No.
207
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Method: SPIRAL AUGER
R.L. Surface: ~17.9 m
Date: 16/1/25
Datum: AHD
Plant Type: JK308
Logged/Checked By: J.F./A.B.

Groundwater Record	SAMPLES				Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
	ES	U50	DB	DS										
DRY ON COMPLETION OF AUGERING				■				▨		FILL: Silty sand, fine to coarse grained, dark brown, trace of rubber and plastic fragments.	M			SYNTHETIC GRASS COVER
				■				∴	-	SANDSTONE: fine to medium grained, light grey, red brown and orange brown.	MW	M		HAWKESBURY SANDSTONE MODERATE 'TC' BIT RESISTANCE
						17	1			REFER TO CORED BOREHOLE LOG				'TC' BIT REFUSAL GROUNDWATER MONITORING WELL INSTALLED TO 12.7m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 3.0m TO 12.7m. CASING 0.1m TO 3.5m. 2mm SAND FILTER PACK 1.8m TO 12.7m. BENTONITE SEAL 0.5m TO 1.8m. BACKFILLED WITH SAND AND CUTTINGS TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						16	2							
						15	3							
						14	4							
						13	5							
						12	6							
						11								

JK 9.02.4 LIB.GLB Log JK AUGERHOLE - MASTER 32976LT1 KOGARAH - JKG.GPJ <<DrawingFile>> 04/03/2025 14:42 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

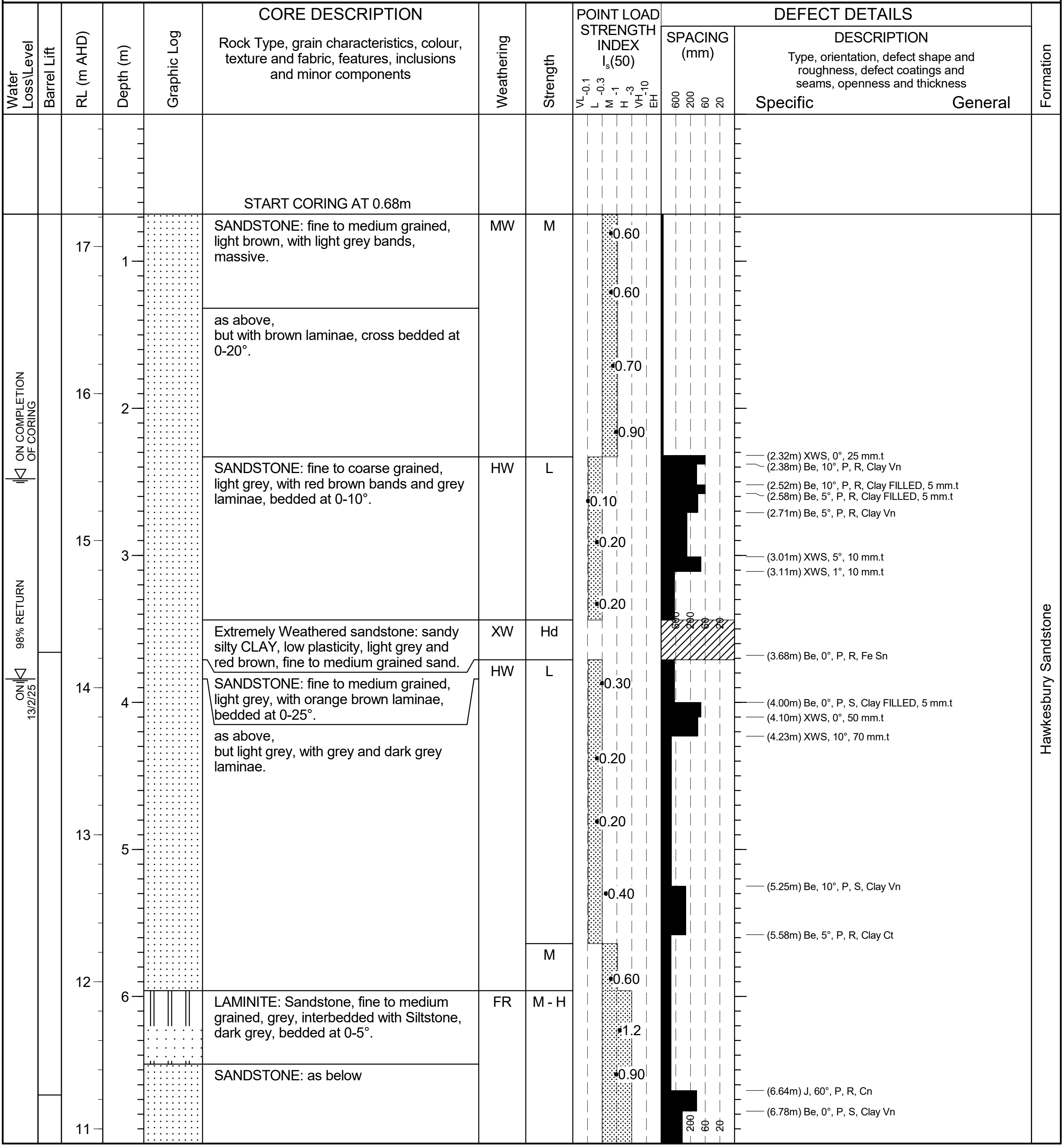
JKGeotechnics

CORED BOREHOLE LOG

Borehole No.
207
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1	**Core Size:** NMLC	**R.L. Surface:** ~17.9 m
Date: 16/1/25	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** J.F./A.B.



CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
START CORING AT 0.68m					
SANDSTONE: fine to medium grained, light brown, with light grey bands, massive.	MW	M	0.60 0.60		Hawkesbury Sandstone
as above, but with brown laminae, cross bedded at 0-20°.			0.70 0.90	(2.32m) XWS, 0°, 25 mm.t	
SANDSTONE: fine to coarse grained, light grey, with red brown bands and grey laminae, bedded at 0-10°.	HW	L	0.10 0.20 0.20	(2.38m) Be, 10°, P, R, Clay Vn (2.52m) Be, 10°, P, R, Clay FILLED, 5 mm.t (2.58m) Be, 5°, P, R, Clay FILLED, 5 mm.t (2.71m) Be, 5°, P, R, Clay Vn (3.01m) XWS, 5°, 10 mm.t (3.11m) XWS, 1°, 10 mm.t	
Extremely Weathered sandstone: sandy silty CLAY, low plasticity, light grey and red brown, fine to medium grained sand.	XW	Hd		(3.68m) Be, 0°, P, R, Fe Sn	
SANDSTONE: fine to medium grained, light grey, with orange brown laminae, bedded at 0-25°.	HW	L	0.30	(4.00m) Be, 0°, P, S, Clay FILLED, 5 mm.t (4.10m) XWS, 0°, 50 mm.t (4.23m) XWS, 10°, 70 mm.t	
as above, but light grey, with grey and dark grey laminae.		L M	0.20 0.20 0.40 0.60	(5.25m) Be, 10°, P, S, Clay Vn (5.58m) Be, 5°, P, R, Clay Ct	
LAMINITE: Sandstone, fine to medium grained, grey, interbedded with Siltstone, dark grey, bedded at 0-5°.	FR	M - H	1.2		
SANDSTONE: as below			0.90	(6.64m) J, 60°, P, R, Cn (6.78m) Be, 0°, P, S, Clay Vn	

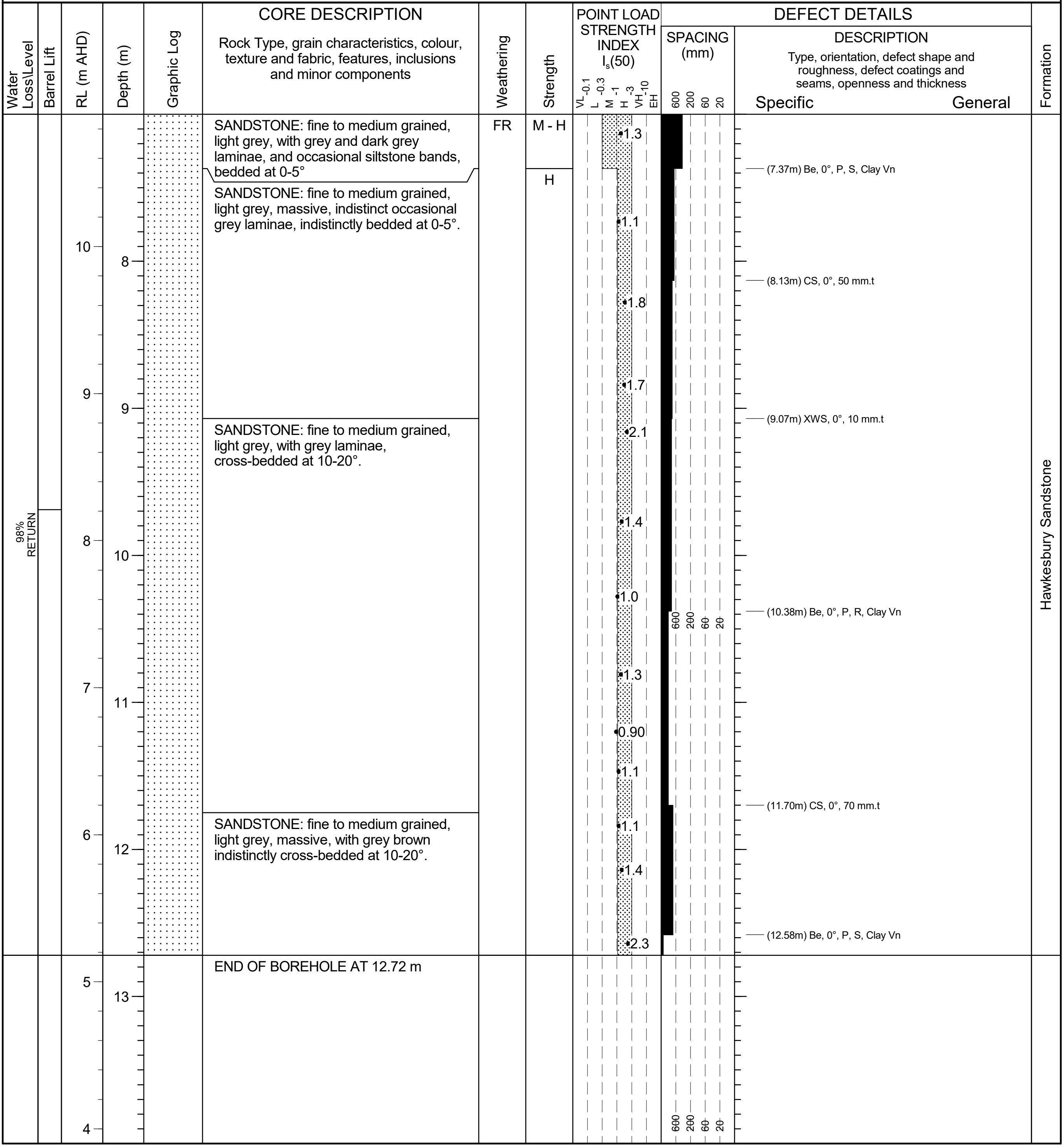
JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 32976LT1 KOGARAH - JKG.GPJ <<DrawingFile>> 04/03/2025 14:41 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~17.9 m
Date: 16/1/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: J.F./A.B.



SANDSTONE: fine to medium grained, light grey, with grey and dark grey laminae, and occasional siltstone bands, bedded at 0-5°

SANDSTONE: fine to medium grained, light grey, massive, indistinct occasional grey laminae, indistinctly bedded at 0-5°.

SANDSTONE: fine to medium grained, light grey, with grey laminae, cross-bedded at 10-20°.

SANDSTONE: fine to medium grained, light grey, massive, with grey brown indistinctly cross-bedded at 10-20°.

END OF BOREHOLE AT 12.72 m

Weathering: FR

Strength: M - H, H

Point load: 1.3, 1.1, 1.8, 1.7, 2.1, 1.4, 1.0, 1.3, 0.90, 1.1, 1.1, 1.4, 2.3

(7.37m) Be, 0°, P, S, Clay Vn
(8.13m) CS, 0°, 50 mm.t
(9.07m) XWS, 0°, 10 mm.t
(10.38m) Be, 0°, P, R, Clay Vn
(11.70m) CS, 0°, 70 mm.t
(12.58m) Be, 0°, P, S, Clay Vn

Hawkesbury Sandstone

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

Job No: 32976LT1
Borehole No: 207
Depth: 0.68 to 10.00m

Job No: 32976LT1
Borehole No: 207
Depth: 10.00 to 12.72m

BOREHOLE LOG

Borehole No.
208
1 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Method: HAND AUGER / SPIRAL AUGER
R.L. Surface: ~18.1 m
Date: 31/1/25 TO 10/2/25
Datum: AHD
Plant Type: JK330
Logged/Checked By: J.F./A.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	■					18		▨		FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained igneous gravel, plastic fragments, slag and root fibres.	M			GRASS COVER APPEARS MODERATELY COMPACTED
	■			■	N = 9 6,6,3			▨		FILL: Silty sandy clay, low to medium plasticity, dark grey brown, fine to medium grained sand, trace of plastic fragments and ash.	w<PL M			HAND AUGER TO 0.55m
				■		17	1	▨ ░	-	FILL: SIlty sand, fine to medium grained, dark grey brown. SANDSTONE: fine to medium grained, orange brown.	DW	M		HAWKESBURY SANDSTONE
										REFER TO CORED BOREHOLE LOG				MODERATE 'TC' BIT RESISTANCE GROUNDWATER MONITORING WELL INSTALLED TO 9.4m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 3.4m TO 9.4m. CASING 0.1m TO 3.4m. 2mm SAND FILTER PACK 2.9m TO 9.4m. BENTONITE SEAL 0.1m TO 2.9m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						16	2							
						15	3							
						14	4							
						13	5							
						12	6							

CORED BOREHOLE LOG

Borehole No.
208
2 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.1 m
Date: 31/1/25 TO 10/2/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: J.F./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL -0.1, L -0.3, M -1, H -3, VH -10, EH	SPACING (mm) 600 200 60 20	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific	General	Formation
		17			START CORING AT 1.32m							
98% RETURN					SANDSTONE: fine to medium grained, orange brown, with light grey bands, bedded at 0-5°.	MW	L - M	0.50 0.20		(1.57m) Be, 0°, P, R, Fe Vn (1.62m) Be, 5°, C, R, Fe Vn		
0% RETURN		16	2		NO CORE 0.55m							
		15	3		SANDSTONE: fine to medium grained, red brown, with light grey bands and laminae, bedded at 0-20°.	MW	M - H	0.60 1.0		(2.47m) Be, 0°, P, S, Clay Vn (3.24m) Be, 0°, P, R, Clay Ct		Hawkesbury Sandstone
					as above, but bedded at 0-10°.	HW	L VL	0.20 0.080		(3.38m) XWS, 5°, 40 mm.t (3.95m) XWS, 0°, 5 mm.t		
		14	4		NO CORE 0.05m							
					SANDSTONE: fine to medium grained, red brown and light grey, bedded at 0-10°.	MW	L	0.20				Hawkesbury Sandstone
		13	5		as above, but light grey, with dark grey laminae.	FR	L M	0.20 0.20 0.30 0.50 0.70 1.0 0.60 0.70		(4.97m) Be, 0°, P, S, Clay Ct (5.41m) Be, 5°, P, R, Fe Vn (5.77m) CS, 0°, 1 mm.t (6.37m) XWS, 0°, 60 mm.t (7.30m) Be, 0°, P, S, Clay Vn		
ON 13/2/25		12 11	6 7									
					SANDSTONE: as below.	MW	M - H	0.30		(7.73m) Be, 0°, P, R, Fe Ct (7.78m) XWS, 0°, 30 mm.t (7.88m) Be, 5°, P, S, Fe Ct		

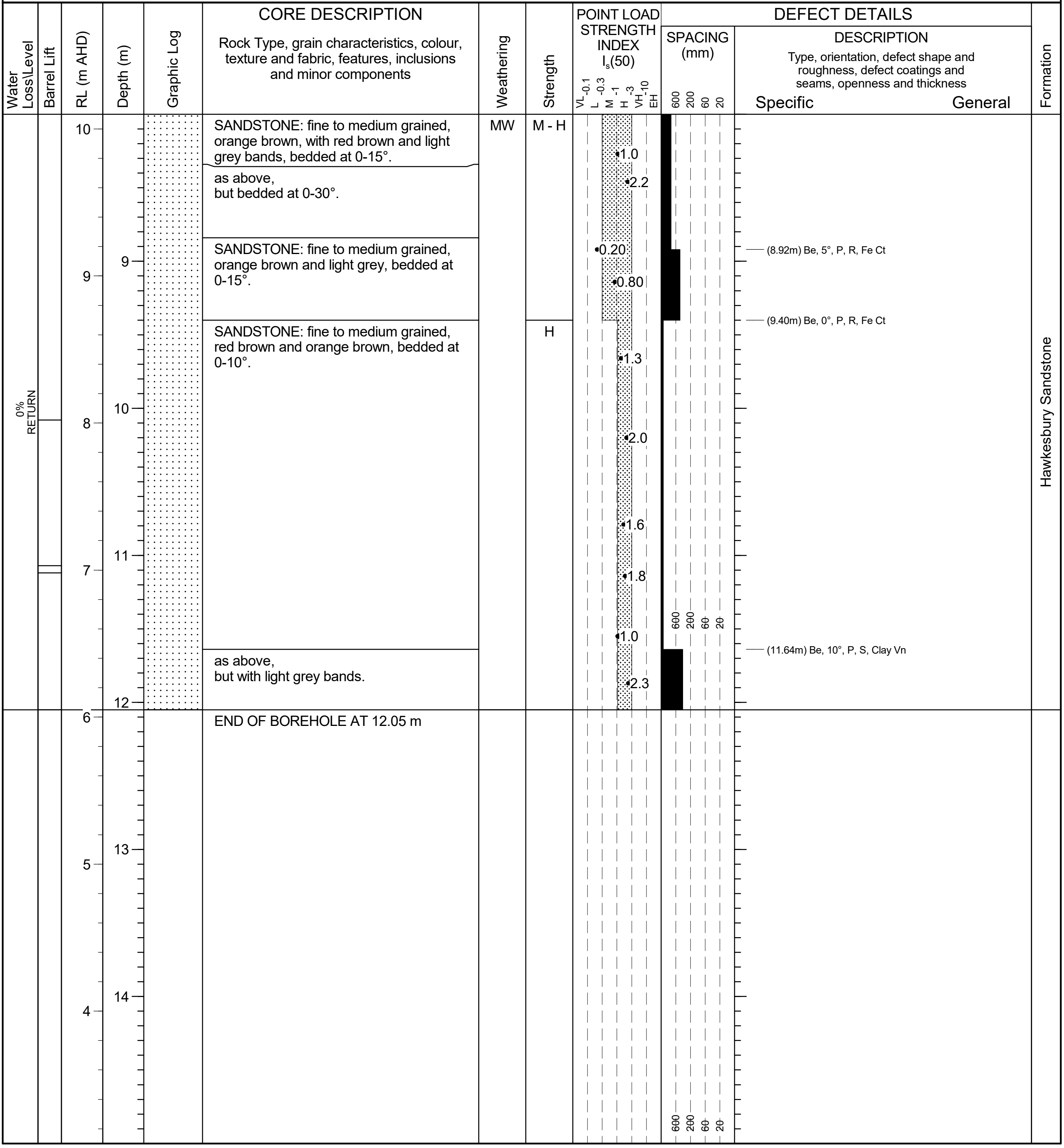
FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

CORED BOREHOLE LOG

Borehole No.
208
3 / 3

Client: NSW DEPARTMENT OF EDUCATION
Project: PROPOSED UPGRADES
Location: KOGARAH PUBLIC SCHOOL, 24B GLADSTONE STREET, KOGARAH, NSW

Job No.: 32976LT1
Core Size: NMLC
R.L. Surface: ~18.1 m
Date: 31/1/25 TO 10/2/25
Inclination: VERTICAL
Datum: AHD
Plant Type: JK330
Bearing: N/A
Logged/Checked By: J.F./A.B.



CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS – DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness – Specific	General
SANDSTONE: fine to medium grained, orange brown, with red brown and light grey bands, bedded at 0-15°.	MW	M - H	1.0		
as above, but bedded at 0-30°.			2.2		
SANDSTONE: fine to medium grained, orange brown and light grey, bedded at 0-15°.			0.20 0.80	(8.92m) Be, 5°, P, R, Fe Ct (9.40m) Be, 0°, P, R, Fe Ct	
SANDSTONE: fine to medium grained, red brown and orange brown, bedded at 0-10°.		H	1.3 2.0 1.6 1.8 1.0		
as above, but with light grey bands.			2.3	(11.64m) Be, 10°, P, S, Clay Vn	
END OF BOREHOLE AT 12.05 m					

JK 9.02.4 LIB.GLB Log JK CORED BOREHOLE - MASTER 32976LT1 KOGARAH - JKG.GPJ <<DrawingFile>> 04/03/2025 14:41 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: 32976LT1

Borehole No: BH208

Depth: 1.32m to 10.00m

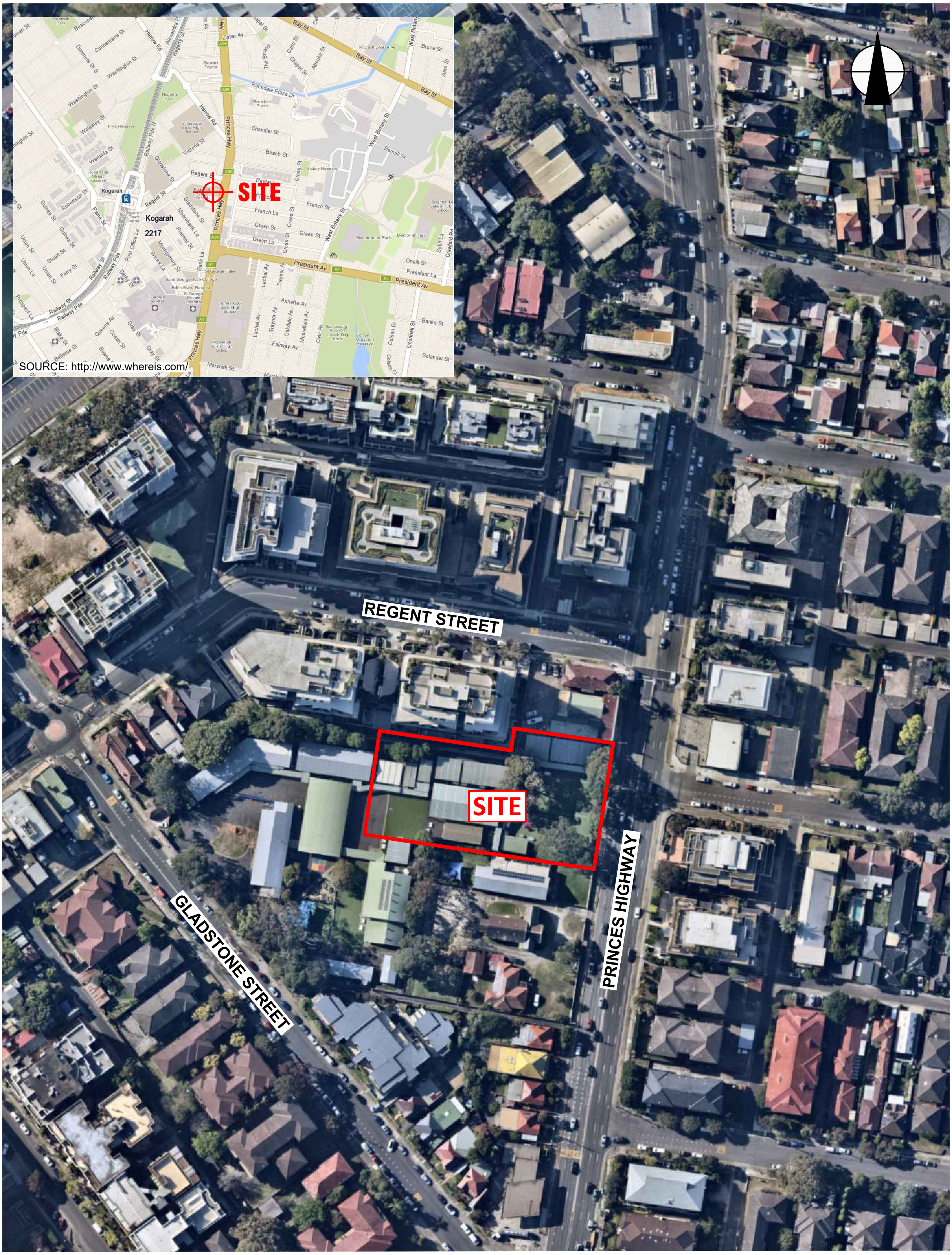
32976LT1 BH208 START CORING AT 1.32 m

NO CORE: 0.55m.t

NO CORE: 0.05m.t

Job No: 32976LT1
Borehole No: BH208
Depth: 10.00m to 12.05m

END OF BOREHOLE AT 12.05m



SOURCE: http://www.whereis.com/

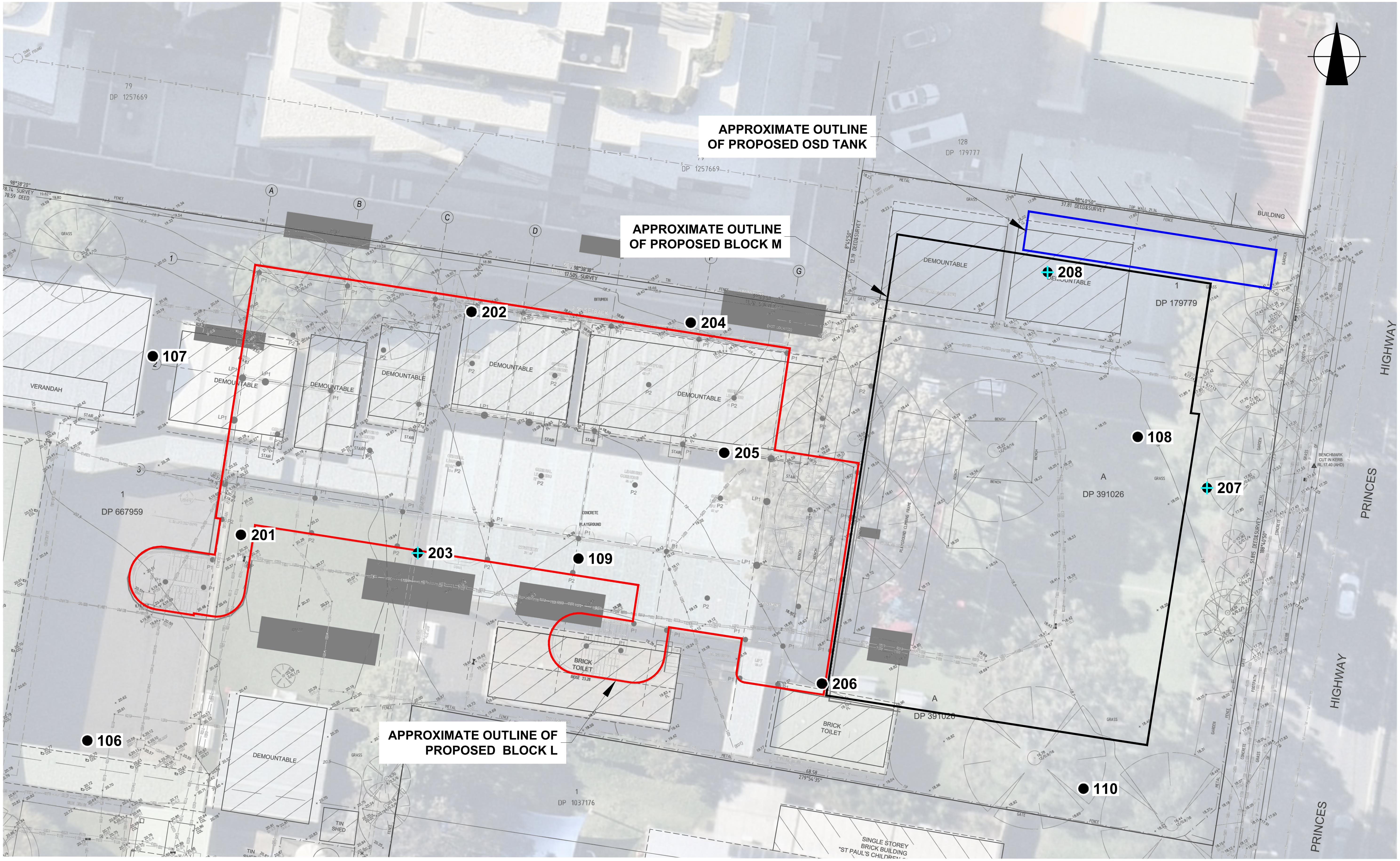
AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title:	**SITE LOCATION PLAN**
Location:	24B GLADSTONE STREET, KOGARAH, NSW
Report No: 32976LT1	Figure No: 1

JKGeotechnics

PLOT DATE: 25/02/2025 11:21:44 AM DWG FILE: J:\6F GEOTECHNICAL JOBS\32000'S\32976LT KOGARAH\CAD\32976LT1.DWG



LEGEND

● BOREHOLE

⊕ BOREHOLE AND GROUNDWATER MONITORING WELL

NOTES:

1. BH106 TO BH110 WERE DRILLED AS PART OF OUR 2020 INVESTIGATION, Ref: 32976LTrptRev2KPS.
2. BH201 TO 208 ARE FROM THE CURRENT INVESTIGATION.

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 3 6 9 12 15

SCALE 1:300 @A3 METRES

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

Title: **INVESTIGATION LOCATION PLAN**

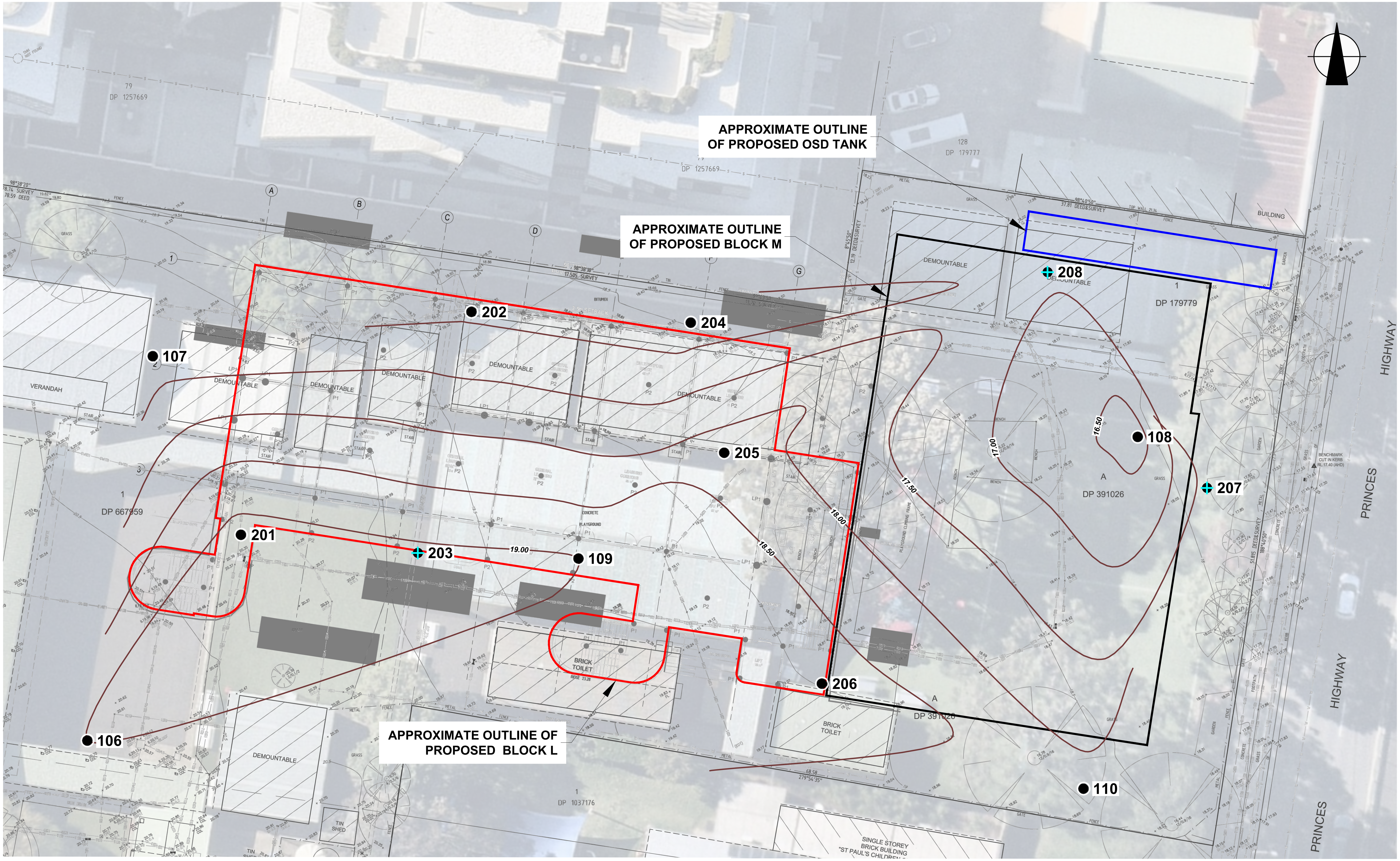
Location: 24B GLADSTONE STREET, KOGARAH, NSW

Report No: 32976LT1

Figure No: 2

JKGeotechnics

PLOT DATE: 27/02/2025 9:30:14 AM DWG FILE: J:\6F GEOTECHNICAL JOBS\32000'S\32976LT KOGARAH\CAD\32976LT1.DWG



LEGEND

●	BOREHOLE
⊕	BOREHOLE AND GROUNDWATER MONITORING WELL
16.0	TOP OF BEDROCK (RL mAHD)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 3 6 9 12 15
SCALE 1:300 @A3 METRES

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

Title:
TOP OF BEDROCK CONTOUR PLAN

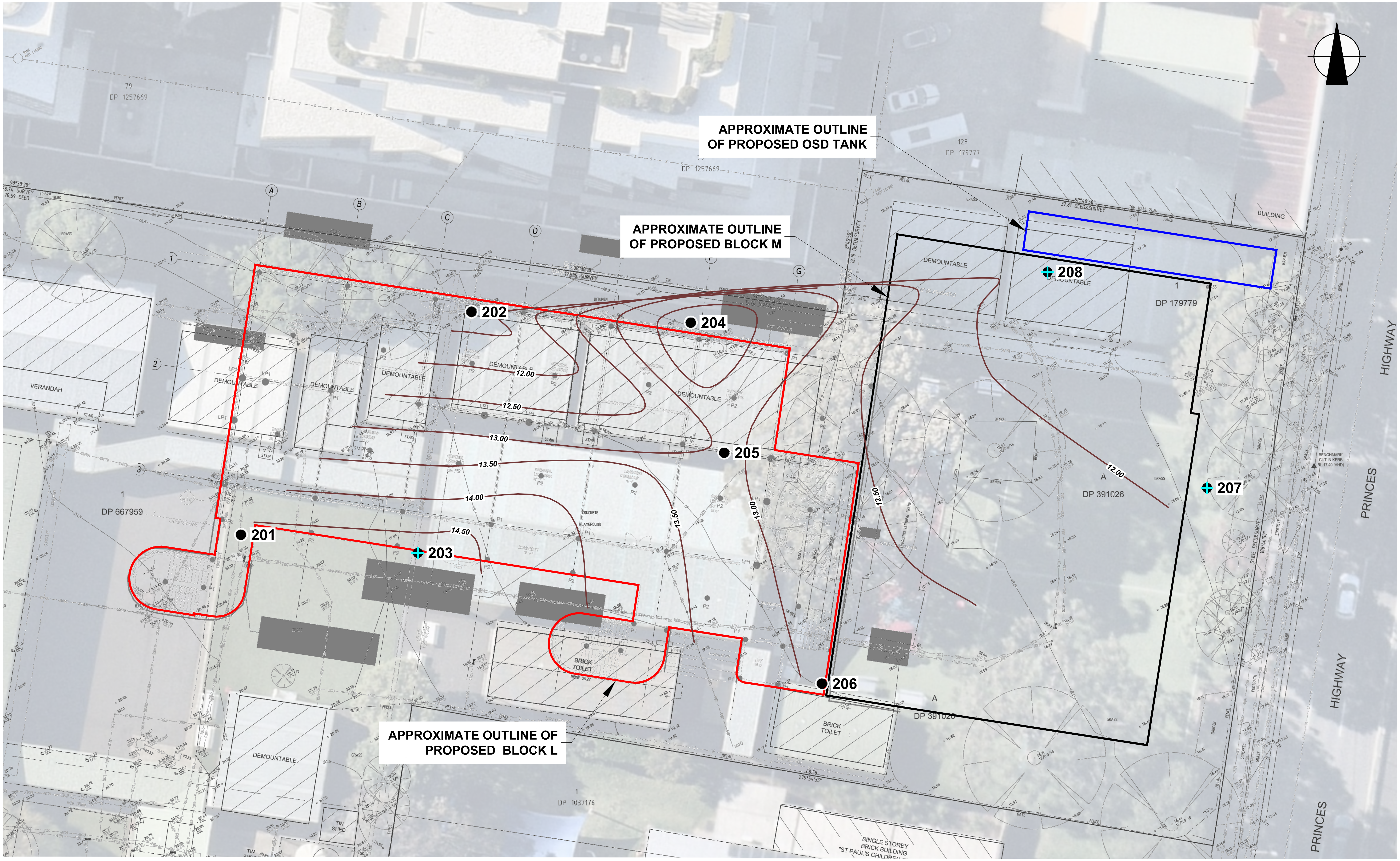
Location: 24B GLADSTONE STREET, KOGARAH, NSW

Report No: 32976LT1

Figure No: 3

JKGeotechnics

PLOT DATE: 25/02/2025 11:22:57 AM DWG FILE: J:\6F GEOTECHNICAL JOBS\32000'S\32976LT KOGARAH\CAD\32976LT1.DWG



LEGEND

●	BOREHOLE
⊕	BOREHOLE AND GROUNDWATER MONITORING WELL
13.0	CLASS II SANDSTONE BEDROCK (RL mAHD)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 3 6 9 12 15
SCALE 1:300 @A3 METRES

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

Title: **CLASS II OR BETTER SANDSTONE CONTOUR PLAN**

Location: 24B GLADSTONE STREET, KOGARAH, NSW

Report No: 32976LT1

Figure No: 4

JKGeotechnics

PLOT DATE: 4/03/2025 3:05:57 PM DWG FILE: J:\6F GEOTECHNICAL JOBS\32000'S\32976LT KOGARAH\CAD\32976LT1.DWG

VIBRATION EMISSION DESIGN GOALS

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

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

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

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

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

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

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

REPORT EXPLANATION NOTES

INTRODUCTION

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

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

DESCRIPTION AND CLASSIFICATION METHODS

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

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

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

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

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

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

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

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

SAMPLING

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

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

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

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

INVESTIGATION METHODS

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

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

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

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

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

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

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

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

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

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

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

  N = 13
  4, 6, 7

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

  N > 30
  15, 30/40mm

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

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

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

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

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

The information provided on the charts comprise:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

LOGS

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

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

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

GROUNDWATER

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

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

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

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

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

LABORATORY TESTING

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

ENGINEERING REPORTS

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

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

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

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

SITE ANOMALIES

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

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

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

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

REVIEW OF DESIGN

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

SITE INSPECTION

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

Requirements could range from:

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

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

iii) full time engineering presence on site.

SYMBOL LEGENDS

SOIL

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

ROCK

- ⁘ CONGLOMERATE
- ░ SANDSTONE
- ▤ SHALE/MUDSTONE
- ▥ SILTSTONE
- ▤ CLAYSTONE
- ■ COAL
- ▥ LAMINITE
- ▦ LIMESTONE
- ≋ PHYLLITE, SCHIST
- ▤ TUFF
- ⁘ GRANITE, GABBRO
- ⁘ DOLERITE, DIORITE
- ⌵ BASALT, ANDESITE
- ≋ QUARTZITE

OTHER MATERIALS

- ▦ BRICKS OR PAVERS
- ⁘ CONCRETE
- ■ ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

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

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

Laboratory **Classification** Criteria

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

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

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:

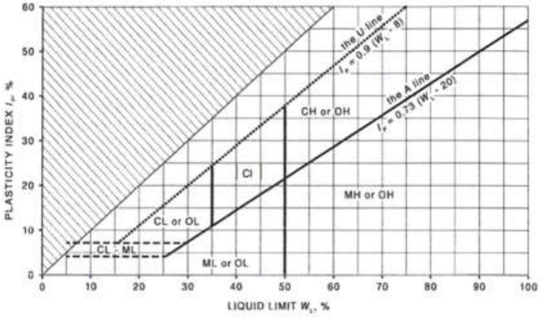
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

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.		
	C	Extent of borehole/test pit collapse shortly after drilling/excavation.		
	▶	Groundwater seepage into borehole or test pit noted during drilling or excavation.		
Samples	ES	Sample taken over depth indicated, for environmental analysis.		
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.		
	DB	Bulk disturbed sample taken over depth indicated.		
	DS	Small disturbed bag sample taken over depth indicated.		
	ASB	Soil sample taken over depth indicated, for asbestos analysis.		
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.		
	SAL	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	Vane shear reading in kPa of undrained shear strength.		
	PID = 100	Photoionisation detector reading in ppm (soil sample headspace test).		
Moisture Condition (Fine Grained Soils)	*w* > PL	Moisture content estimated to be greater than plastic limit.		
	w ≈ PL	Moisture content estimated to be approximately equal to plastic limit.		
	w < PL	Moisture content estimated to be less than plastic limit.		
	w ≈ LL	Moisture content estimated to be near liquid limit.		
	w > LL	Moisture content estimated to be wet of liquid limit.		
(Coarse Grained Soils)	D	DRY – runs freely through fingers.		
	M	MOIST – does not run freely but no free water visible on soil surface.		
	W	WET – free water visible on soil surface.		
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.		
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.		
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.		
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.		
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.		
	Hd	HARD – unconfined compressive strength > 400kPa.		
	Fr	FRIABLE – strength not attainable, soil crumbles.		
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.		
Density Index/ Relative Density (Cohesionless Soils)			**Density Index (I_D) Range (%)**	**SPT 'N' Value Range (Blows/300mm)**
	VL	VERY LOOSE	≤ 15	0 – 4
	L	LOOSE	> 15 and ≤ 35	4 – 10
	MD	MEDIUM DENSE	> 35 and ≤ 65	10 – 30
	D	DENSE	> 65 and ≤ 85	30 – 50
	VD	VERY DENSE	> 85	> 50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.		
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.		

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

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

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

Abbreviations Used in Defect Description

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