Report on Additional Geotechnical Investigation

Proposed New High School for Googong

200 Wellsvale Drive, Googong NSW

Prepared for Department of Education

Project 224779.01

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

Executive Summary

This report presents the results of two intrusive geotechnical investigations (Douglas, 2023b and this current additional geotechnical investigation) undertaken for the proposed new high school for Googong. It is understood that the proposed development would include a three to four-storey building (Building A), a three-storey building (Building B), a school hall / gymnasium and canteen (Building C), outdoor recreation areas and a car park. It is anticipated that the bulk earthworks would include site cut up to 3 m depth, and bulk fill up to 3.5 m depth.

Each investigation comprised the drilling of six boreholes, rock coring and laboratory testing of selected samples.

The subsurface conditions were highly variable and generally characterised by three zones:

- Northern boreholes (Bores 201 – 203 and 304 – 306) encountered deep very low strength to very low / low strength rock only with extremely weathered / residual seams;
- Very low strength rock that increased in strength to medium or stronger rock with depth, was encountered in the south-western and south-eastern parts of the site (in Bores 204 – 206 and 301 and 302);
- Interbedded tuff and limestone, with voids was encountered in Bore 303.

No free groundwater was encountered during the auger drilling of the boreholes.

The laboratory testing indicated that the site soils tested ranging from medium to high plasticity (with one result indicating low plasticity).

Relatively straightforward conditions are anticipated for dry excavations into natural site soils, with difficulties to be expected in excavating medium or greater strength rock, for which large excavators fitted with toothed buckets, single tyne rippers and potentially rock hammers would be required. Short term temporary batter slopes of 1H:1V are suggested for dry excavations within natural soils/controlled fill and very low strength rock up to 3 m depth. The site clays, clayey silts and weathered rock could be re-used as structural fill once moisture conditioned to within 2% of optimum moisture contents, however care must be taken with the high plasticity clays due to their anticipated reactive nature.

Characteristic surface movements (y_s) of between 20 mm to 60 mm have been estimated for the proposed building areas in its current state. On this basis, a site classification of "Class M* to Class H1/H1*) would be appropriate.

A piered footing system would be most appropriate for the buildings with 3 or more storeys. For buildings with 2 storeys or less, the suitable footings could comprise either piers, pad or strip footings.

It is understood that bore piers founding on medium strength rock was preferred for Buildings A and B. However, it is not practical due to the absence of medium strength rock within the northern portion of the site up to the investigation depths of 18.75 m. Large diameter bored piers founding in very low to low strength rock would be recommended.

In the area where limestone with voids was encountered (i.e. Bore 303), due to the uncertainty of the continuity of limestone, design of bored pier foundations based on end bearing is not recommended. Instead, the foundation options recommended include large diameter friction piles, small diameter friction pile groups, driven piles, or bored piers with pile load testing.

A design subgrade CBR of 3% for the silty clay and silty clay fill at the site, subject to good compaction and moisture control, and depending on proposed pavement thickness.

This report is provided for the exclusive use of Department of Education for this project only and for the purposes as described in the report.

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Report on Additional Geotechnical Investigation
Proposed New High School for Googong
200 Wellsvale Drive, Googong NSW

1. Introduction

This geotechnical investigation report has been prepared by Douglas Partners Pty Ltd (Douglas) on behalf of the NSW Department of Education (DoE) to inform a Review of Environment Factors (REF) for the proposed construction of a new high school for Googong (the activity) located at 200 Wellsvale Drive, Googong, NSW (the site).

The activity relates to the construction and operation of a new educational establishment to serve the needs of the growing Googong township by accommodating up to 700 students from years 7 – 12. Specifically, the activity includes the following:

- Building A, a three to four-storey building in the northern portion of the site, fronting Glenrock Drive, which will accommodate learning spaces and administrative functions of the school.
- Building B, a three-storey building in the north-west portion of the site, fronting Observer Street, which will accommodate learning spaces and administrative functions of the school.
- Building C, fronting Glenrock Drive, which will accommodate a school hall / gymnasium and canteen.
- Outdoor recreation areas, cricket nets, playing court and playing field.
- Main pedestrian entry established from Glenrock Drive.
- Car park and accessible pedestrian entry from Wellsvale Drive.
- Service entry from Observer Street.
- Associated civil works, earthworks, servicing and landscaping.
- Associated off-site works such as the construction of pedestrian crossings, drop off and pick up bays and a bus stop.
- School identification and wayfinding signage.

The REF describes the activity, documents the examination and consideration of all matters affecting, or are likely to affect, the environment, and details safeguards to be implemented to mitigate impacts.

The Department of Education is the determining authority for the project under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report presents the results of an additional geotechnical investigation undertaken for a proposed new high school for Googong. The investigation was commissioned by a Variation Approval Letter (Contract No. DDWO05264/23) dated 4 December 2024 from Colliers International Pty Ltd (Colliers) on behalf of Department of Education and was undertaken in accordance with Douglas' proposal 224779.01.P.001.Rev0 dated 16 October 2024.

A preliminary geotechnical desktop assessment and an intrusive geotechnical investigation have been undertaken for the entire Lot 829, DP1277372 by Douglas in 2023. An additional geotechnical investigation was required to provide additional subsurface information between previous investigations and to assess the depths to medium strength rock across the proposed high school building areas, in order to advise the design and construction team.

It is understood that the scope of work is to provide additional subsurface profiles and to provide comment on the following:

- Subsurface conditions including depths to medium strength rock in the northern portion of the site (at the investigation locations);
- Highly reactive soils and shrink-swell mitigation options;
- Suitable foundation systems for the proposed development; and
- Modulus of subgrade reaction for raft slab foundation (for Block C – School Hall only).

This report also consolidates the results of the previous investigations, and provide comments on:

- Site preparation measures;
- Excavation conditions;
- Temporary and permanent support measures with preliminary design parameters;
- Site classification based on AS 2870:2011 ‘Residential Slabs and Footings’;
- Pavement design parameters;
- Soil aggressivity; and
- Earthquake considerations.

The current investigation included the drilling of six (6) boreholes and laboratory testing of selected samples. The details of the field work are presented in this report, together with comments and recommendations on the items listed above.

This report must be read in conjunction with all appendices including the notes provided in Appendix A.

2. Site Description

The site is identified in Figure 1 and the activity is shown in Figure 2.

Figure 1: Site Location Plan

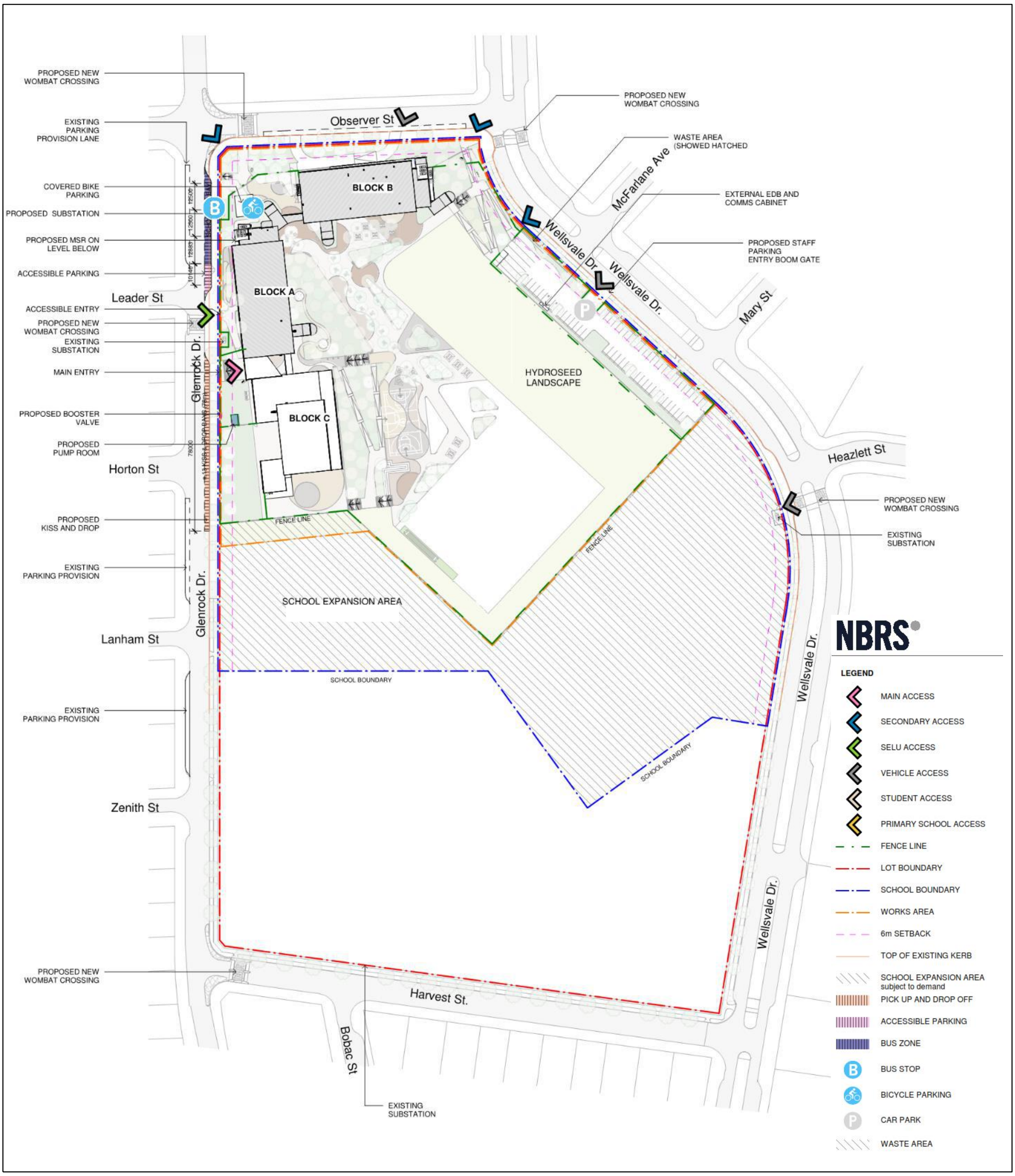

Figure 2: New High School for Googong Proposal – indicative only, subject to detailed design (Source: NBRS, 29/11/2024)

Googong is a new release area within the Queanbeyan-Palerang Local Government Area (LGA), located approximately eight kilometres south of Queanbeyan and 17 kilometres southeast of the Canberra Central Business District (CBD). Googong Reservoir, a significant waterbody, is located approximately 3 kilometres east of the subject site. Canberra Airport is located approximately 12 kilometres north of the subject site.

The site is legally described as Lot 829 in Deposited Plan 1277372. The proposed new high school site within this Lot has an area of approximately 5.84 hectares.

The site is currently zoned as R1 General Residential in the Queanbeyan Palerang Local Environmental Plan (LEP) 2022 and is located within Neighbourhood 2 of the Googong Masterplan, within the Googong DCP 2010.

The site is surrounded by low-density residential development, recreational areas and a future local centre adjoining the site to the north.

The site is currently vacant with no existing structures and has been cleared of all trees and native vegetation. The site has an approximately 12 metre fall from the southwest corner of the site at RL ~763.550m Australian Height Datum AHD to the northeast at RL ~751.570m AHD.

At the time of site investigation, the entire lot was fenced on all boundaries with chain link fencing, and a gate restricting unauthorized access. Majority of the site was covered by long grass except the site entrance and the south-eastern corner. An Essential Energy substation was located to the south of the site entrance on Glenrock Drive. A possible drainage channel (appeared to be dry) with silt fences was located in the north-eastern corner of the site. No stockpiles were located on site at the time of the most recent investigation. Figure 3 to Figure 7 below show the general site conditions at the time of the current site investigation.

Figure 3: General site conditions looking south from Bore 304

Figure 4: General site conditions looking northwest from Bore 301

Figure 5: General site conditions looking southeast from the site entrance.

Figure 6: Essential Energy substation located to the south of the site entrance.

Figure 7: Possible former drainage channel with silt fences in the north-eastern corner of the site, looking east/southwest.

3. Previous Douglas Involvement – Data Review

3.1 Douglas 2023 Geotechnical Investigation

Douglas previously completed a geotechnical desktop assessment and an intrusive geotechnical investigation for the entire lot (Douglas, 2023a and 2023b). The intrusive investigation comprised drilling of six (6) boreholes (Bores 201 – 206) to depths of 5.6 – 7.0 m using a truck mounted drilling rig. The bores were drilled with 110 mm diameter solid flight augers with the incorporation of standard penetration tests (SPT's) at depths of 0.5 m and 2.0 m (where soils were present to these depths) and were then continued with NMLC coring equipment through the bedrock to the termination depths.

Details of the conditions encountered in the boreholes are given in the logs included in Appendix C. These must be read in conjunction with the accompanying standard notes which define classification methods and descriptive terms. The principal succession of strata encountered in the boreholes are summarised below.

- TOPSOIL FILL: silty clay, clayey silt or sandy silt topsoil fill to depths of 0.2 m to 0.3 m in all bores excluding Bore 205.
- FILL (CONTROLLED): low to medium plasticity, hard silty clay fill to 1.1 m depth in Bore 205. Possible medium to high plasticity silty clay fill was logged in Bores 202 – 204 to depths of 0.7 m to 1.1 m.
- SILTY CLAY: stiff to hard, medium to high plasticity silty clay to depths of 1.5 m to 3.8 m in all bores excluding Bore 204. Some low plasticity silty clay seams were encountered within the bedrock in some of the boreholes.
- SHALE: variably very low to high strength, highly to slightly weathered shale in all boreholes below depths of 0.7 m to 3.8 m. The rock encountered in Bores 201 – 203 was very low strength, highly weathered with extremely weathered (clay seams) to the limit of the investigation. The rock in Bores 205 and 206 was initially very low to low strength and increased to medium to high and high strength with depth while the rock in Bore 204 was mostly low to medium strength.

No free groundwater was observed during auger drilling of the boreholes. The use of water as a drilling lubricant in the rock coring process prevented further groundwater monitoring. However, the bores were backfilled immediately following drilling, precluding longer term monitoring of groundwater levels. Groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability. For these reasons, it is noted that the moisture condition of the site soils may vary considerably from the time of the investigation compared to at the time of construction. Should groundwater be encountered during construction, a qualified geotechnical engineer must be consulted for remediation recommendations which can only be determined at the time of construction for the same reasoning as above.

3.2 Douglas 2016 Geotechnical Investigation

Douglas previously conducted a pre-development geotechnical investigation (Douglas, 2016) for the broader Googong Township development area of which the current lot is part of. The investigation comprised excavation of 185 test pits (including 18 locations within the current site boundary and the surrounding roads) followed by laboratory testing, engineering analysis and reporting. The test pits were excavated using a Volvo CT210 excavator fitted with either a 600 mm or 900 mm wide bucket to depths of 0.6 – 5.0 m. The subsurface conditions encountered within the vicinity of the proposed site generally comprised topsoil, silt and clay up to 1.4 m depth, overlying very low strength to high/very high strength shale and tuff up to 5 m depth.

No free groundwater was observed during the excavation of test pits within the vicinity of the proposed site. It is noted that the test pits were backfilled immediately following excavation precluding longer term monitoring of groundwater levels. Groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability. For these reasons, it is noted that the moisture condition of the site soils may vary considerably from the time of the investigation compared to at the time of construction.

The results of the previously excavated test pits within the site are provided below:

Pit 90: Topsoil to 0.1 m depth, very stiff, low plasticity silt to 0.3 m depth then hard, medium to high plasticity clay to 1.4 m depth overlying very low to low strength tuff rock becoming medium strength from 2.5 m to the limit of investigation of 5.0 m.

Pit 100: Topsoil to 0.05 m depth, then medium to high strength, moderately weathered shale bedrock becoming high strength, slightly weathered to fresh from 0.4 m depth. Bucket refusal was encountered at 0.9 m depth and the test pit was terminated at the ripper refusal depth of 2.0 m.

Pit 102: Topsoil to 0.1 m depth, hard, low plasticity silt to 0.4 m depth, then very dense silty clayey gravel to 0.6 m depth overlying high strength, moderately to slightly weathered tuffaceous shale rock, becoming high to very high strength, slightly weathered to fresh from 0.9 m depth. Bucket refusal occurred at 1.0 m depth and the test pit was terminated at the ripper refusal depth of 1.4 m.

Pit 103: Topsoil to 0.1 m depth, then medium to high strength, moderately weathered shale bedrock becoming high strength, slightly weathered from 0.5 m depth. Bucket refusal was encountered at 1.2 m depth and the test pit was terminated at the ripper refusal depth of 1.7 m.

Pit 104: Topsoil to 0.1 m depth, very stiff, low plasticity silt to 0.2 m depth, then very stiff, high plasticity clay to 1.0 m depth overlying extremely low to very low strength shale bedrock, becoming low to medium strength, highly to moderately weathered from 2.4 m depth to the limit of investigation depth of 5.0 m.

Pit 185: Topsoil to 0.1 m depth, very stiff low plasticity silt to 0.3 m then low strength, highly weathered shale from 0.3 m, becoming medium strength, moderately weathered from 1.1 m depth to the limit of investigation depth of 4.0 m.

Pit 186: Topsoil to 0.1 m depth, very stiff, low plasticity silt to 0.2 m depth, then very stiff, high plasticity clay to 1.0 m depth overlying low to medium strength, highly to moderately weathered shale bedrock, becoming medium to high strength, moderately to slightly weathered from 1.9 m depth then high strength from 4.2 m depth to the bucket refusal depth of 4.5 m.

3.3 Bulk Earthworks

Based on Douglas Partners records, between February 2021 and September 2022, controlled fill up to 4 m depth was placed within southwestern, western, and northern portions of the lot in conjunction with bulk earthworks for the adjacent subdivision stages under Level 1 control as defined in AS 3798:2007 during subdivision construction (Douglas, 2021a and 2021b) as shown in Figure 8 below. The material used for the controlled fill was sourced from existing onsite material and mainly comprised rock of varying strength and fracturing, with some residual / alluvial soils.

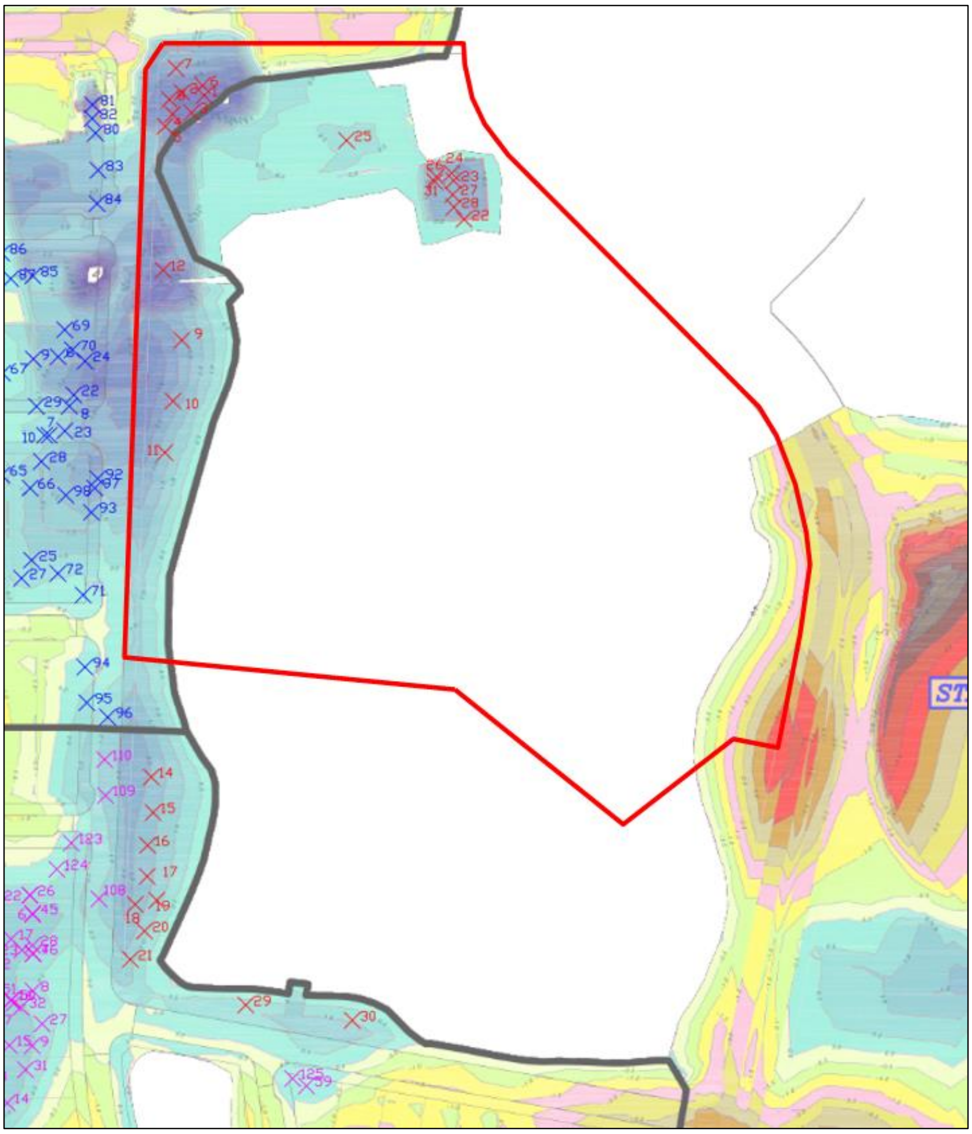

Figure 8: Approximate extent of bulk earthworks.

4. Published Data

4.1 Regional Geology

Reference to the NSW Seamless Geology (GSNSW, 2019) digital mapping indicates the site is underlain by Colinton Volcanics comprising tuffaceous shale and dacitic tuff of Silurian age as shown on Figure 9. These volcanics generally comprise foliated dacite and tuff, with interbedded siltstone lenses. A fault is mapped as running through the site orientated in a north-east to south-west direction.

Further reference to BMR (1992) indicates that the fault is mapped as containing iron concentrations which may lead to difficult excavation conditions. It is noted, however iron cemented rock was not encountered during both previous and current geotechnical investigations within the approximate vicinity of the fault line.

An extract of the geological map is shown in Figure 9 below.

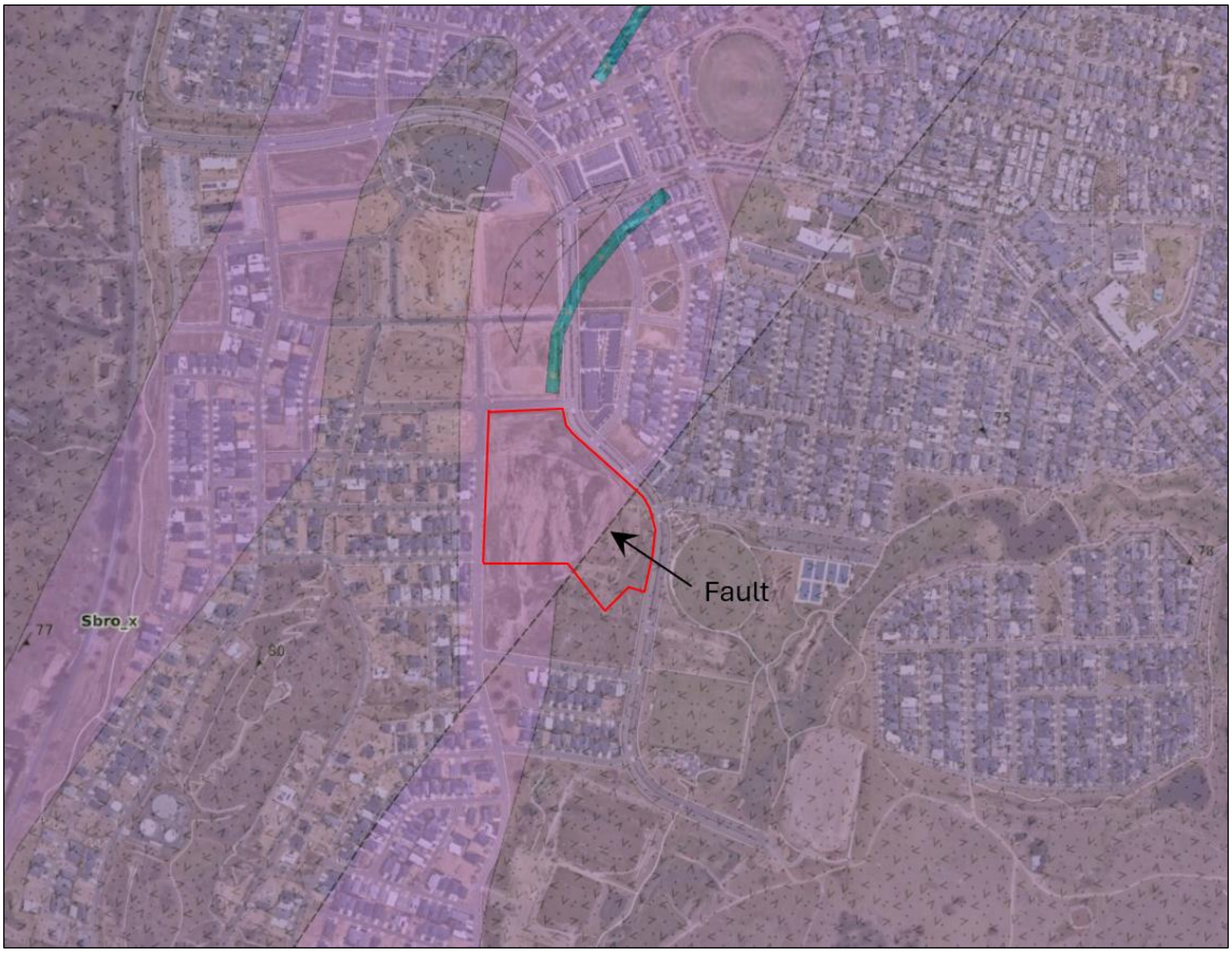

Figure 9: Geological setting (GSNSW, 2019)

4.2 Soil Landscape

Reference to the Soil Landscapes of Eastern and Central Australia v2 Map (Office of Environment and Heritage, 2019) indicates that the site is located within the Burra Soil Landscape which is characterised by undulating to rolling hills and alluvial fans formed on Silurian volcanics.

4.3 Acid Sulfate Soils

Reference to the NSW Department of Environment and Climate Change Acid Sulfate Soil Risk Mapping digital dataset (NSW DECC, 2008) indicates that the site is located in an area mapped as "*No known occurrence*" of acid sulfate soils (ASS).

4.4 Soil Salinity

Data for the site is not available within contemporary soil salinity mapping, including within NSW Government data, however salinity is not listed as an explicit risk within the Burra soil landscape data sheet.

5. Field Work

5.1 Field Work Methods

The current field work consisted of drilling of six (6) boreholes (Bores 301- 306) using a Hanjin D&B 08D truck mounted drilling rig. The boreholes were drilled through overburden soils and upper weathered rock with 110 mm diameter solid flight augers to depths of 1.1 – 14.65 m, then continued into the rock with NMLC coring techniques to the limit of investigation depths of 5.6 – 18.75 m.

The boreholes were logged onsite by a geotechnical engineer. Disturbed samples were collected to assist in strata identification and laboratory testing.

The borehole coordinates (MGA2020) and reduced level (AHD) were determined on site using an Emlid Reach RS2 dGPS, typically accurate to ±0.5 m. However, it is noted that Douglas are not registered surveyors, and as such all coordinates must be considered approximately only. The test locations are shown on Drawing 1 in Appendix B.

5.2 Field Work Results

Details of the conditions encountered in the boreholes are given in the logs included in Appendix C. These must be read in conjunction with the accompanying standard notes which define classification methods and descriptive terms. The principal succession of strata encountered in the boreholes are highly variable, which are summarised below.

- TOPSOIL FILL: silty sandy clay topsoil fill in Bores 302 and 303 only to depths of 0.1 – 0.2 m;
- FILL (CONTROLLED): silty clay/silty sandy clay fill, variably low plasticity to medium/high plasticity, firm/stiff to hard in all boreholes, except Bore 302 to depth of 0.7 – 2.6 m;
- NATURAL CLAY: silty clay/silty sandy clay, variably low plasticity to medium/high plasticity, firm/stiff to very stiff/hard to depths of 1.2 – 8.7 m;

- BEDROCK: variably very low strength to very high strength tuff/shale/limestone/tuffaceous shale, highly weathered to slightly weathered, with bands of extremely weathered/residual materials and occasional core loss, from depths of 0.7 – 8.7 m to the limit of investigation depths of 5.6 – 18.75 m. Medium strength or stronger rock was not encountered in Bores 304 – 306. The rock encountered in Bores 304 and 306 was of very low strength and very low strength to very low/low strength with extremely weathered/residual bands. The rock in Bore 305 was initially very low/low strength and increasing to low/medium strength with depths.

It must be noted that limestone with voids was encountered in Bore 303 only.

No free groundwater was encountered during the auger drilling of the boreholes. The use of water as a drilling lubricant in the rock coring process prevented further groundwater monitoring. However, the bores were backfilled immediately following drilling, precluding longer term monitoring of groundwater levels. Groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability. For these reasons, it is noted that the moisture condition of the site soils may vary considerably from the time of the investigation compared to at the time of construction.

It is noted that 100% drilling water loss was observed during the drilling of Bore 302 from 12.5 m depth onwards, and of Bore 303 between depths of 13.5 – 14.6 m and 16.0 - 17.5 m.

The depths to medium strength rock (where encountered) for the current and previous boreholes are shown on Drawing 1 (Appendix B). Two cross-sections based on the current and previous boreholes are shown in Drawings 2 and 3 (Appendix B).

6. Laboratory Testing

6.1 Geotechnical Testing

The following laboratory testing was performed on selected samples during the Douglas 2023 investigation (Douglas, 2023b):

- Six tests for Atterberg limits, linear shrinkage tests and moisture content; and
- Six tests for aggressivity (pH, electrical conductivity, chloride and sulfate).

The results of the laboratory testing are provided in detail in the test report sheets in Appendix E and are summarised in Table 1 below.

Table 1: Results of Laboratory Testing - Moisture Content Determination, Atterberg Limits and Linear Shrinkage

Bore	Depth (m)	Description	FMC (%)	LL (%)	PL (%)	PI (%)	LS (%)
201	0.4-0.5	Silty Clay	18.0	54	24	30	11.0
202	0.4-0.5	Silty Clay	21.6	48	21	27	12.0
203	0.5-0.95	Silty Clay	23.5	74	28	46	18.5
204	1.0-1.44	EW Shale	9.2	31	18	13	5.0
205	1.0-1.45	Silty Clay	6.9	37	20	17	6.0
206	0.5-0.95	Silty Clay	11.6	45	18	27	12.0

Notes to table
FMC - Field Moisture Content
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
LS - Linear Shrinkage from liquid limit condition (Mould length 250mm)
EW – Extremely Weathered

The Atterberg limits test results indicate that most of the clay soils tested ranged from medium (35% <LL<50%) plasticity to high plasticity (LL>50%), with one result indicating low plasticity (LL<35%).

During current geotechnical investigation, selected samples of the rock core were tested for measurement of point load strength index ($Is_{[50]}$). The results are given on the borehole log and indicate $Is_{[50]}$ values in the range 0.01 – 7.4 MPa reflecting extremely weathered material to very high strength of the rock. These values equate to uniaxial compressive strengths (UCS) of 0.2 – 148 MPa, adopting a correlation factor of 20. It must be noted that some of the rock samples failed along a plane of pre-existing weakness during point load tests, which may underestimate the rock strength matrix at that location.

It is noted that point load testing was attempted for Bore 305. However, due to the poor quality and highly fractured nature of the rock core, suitable sample was not identified for testing.

6.2 Chemical Testing

Soil and rock samples were tested for aggressivity by Envirolab Services Pty Ltd. The results from both investigations are summarised in Table 2 below, and the result sheets are attached within Appendix D.

Table 2: Results of Laboratory Testing – Soil/Rock Aggressivity

Bore No.	Depth (m)	Field Description	pH	Chloride (mg/kg)	Sulfate, as SO^4 (mg/kg)	Electrical Conductivity* (µS/cm)	Resistivity[(2)] (ohm.cm)
201	0.4 – 0.5	Silty Clay	6.6	<10	<10	11	90,900
202	0.4 – 0.5	Fill/Silty Clay	7.8	<10	42	140	7,100
203	0.4 – 0.5	Silty Clay	7.0	<10	10	24	46,600
204	0.9 – 1.0	EW Shale	8.5	50	78	130	7,700
205	0.4 – 0.5	Fill/Silty Clay	8.4	<10	30	140	7,100
206	0.4 – 0.5	Silty Clay	6.7	<10	<10	32	31,200
301	2.6-2.7	Tuff	8.7	<10	<10	29	34,400
302	4-4.28	Shale	8.9	<10	10	79	12,600
303	10.5-10.6	Tuff	8.5	31	20	200	5,000
304	8.6-8.7	Tuffaceous Shale	8.8	<10	<10	34	29,400
305	15-15.2	Tuffaceous Shale	8.5	<10	<10	13	76,900
306	17.7-17.8	Tuffaceous Shale	8.3	20	67	78	12,800
Criteria for “Non-aggressive” Soil Conditions (low permeability soils or soils above the groundwater table) (1)			>5.5 (concrete) >5.0 (steel)	<5,000 (steel)	<5,000 (concrete)	-	>2,000 (steel)

Note: *EC in 1:5 soil:water solution
(1) In accordance with AS 2159:2009
(2) Resistivity (ohm.cm) is the inverse of Electrical Conductivity (S/cm)

The results of the aggressivity testing indicate that based on the low permeability soils above the water table the exposure classification for concrete and steel piles is *Non-Aggressive*.

7. Geotechnical Model

Based on the results of both intrusive investigation and previous investigations undertaken by Douglas, the geotechnical model for the proposed new high school site is summarised as follows:

- TOPSOIL: topsoil to an average depth of 0.1 m to 0.3 m.
- CONTROLLED FILL: present at the western and northern portions of the site. The fill encountered during the investigation comprised low plasticity to medium/high plasticity clay to depths of 0.7 m - 2.6 m. However, based on Douglas, 2021a, 2021b and 2023, fill should be expected up to a depth of 4 m (near the western boundary) and could comprise a mixture of rock of varying strength and silty clayey alluvial / residual soils.
- SILTY CLAY: firm/stiff to hard, low plasticity to high plasticity natural silty clay of depth of 1.2 m - 8.7 m in all bores excluding Bores 204 and 301.
- BEDROCK: variably very low strength to high strength rock below depths of 0.7 m – 8.7 m. The northernmost boreholes (Bores 201 – 203, and 304 - 306) encountered very low strength to very low/low strength rock only with extremely weathered (silty clay)/residual seams to the investigation depths of 6 – 18.75 m. Bore 204 encountered low and medium strength rock and Bores 205, 206, 301 and 302 at the south-western corner and south-eastern end of the site encountered very low strength rock that increased with depth to medium/high and high strength. Bore 303 encountered interbedded tuff and limestone with voids.

It is considered that the presence of the very low strength to very low/low strength rock with extremely weathered/residual seams to the depths of investigation (6.0 m to 18.75 m) in Bores 201 – 203 and 304 - 306 is likely associated with the presence of a historic fault crossing through the site (refer Figure 9 in Section 4.1).

Although no free groundwater was observed during the current investigations and within the vicinity of the proposed site during the Douglas 2016 investigation, given Douglas' experience at the overall Googong site, groundwater conditions can vary rapidly and the local geology (shale and tuff belonging to the Colinton Volcanics), regional groundwater is considered to most likely be hosted in low-permeability fractured rock aquifers. It is also noted that groundwater conditions rarely remain constant and can change seasonally due to variations in rainfall, temperature and soil permeability.

8. Comments

8.1 Preliminary Site Classification

A preliminary site classification was undertaken based on the subsurface conditions encountered during both previous and current investigations, and in accordance with AS 2870:2011. The Buildings A and B sites are classified as highly reactive or highly reactive/filled site (Class H1/H1*) with characteristic surface movements between 40 mm and 60 mm anticipated. The area of the proposed hall structure (Building C) is classified as moderately reactive/filled sites (Class M*) with characteristic surface movements between 20 mm and 40 mm anticipated. However additional testing should be undertaken at these sites to confirm no variation in subsurface conditions and these site classifications. Alternatively, it would be considered prudent to also assume a classification of H* for all buildings.

It is noted that the site classifications in accordance with AS 2870:2011 are only appropriate for residential or similar type buildings (i.e. up to light weight 2 storeys or less and less than 30 m in length, such as Building C). The site classifications may be applicable to Buildings A (three to four-storey) and B (three-storey).

The classification must be reassessed should the subsurface profile change by either cutting or filling and/or if the presence of service trenches, retaining walls or submerged structures are within the zone of influence of the proposed footings. The classification must be reviewed once confirmation of design levels and earthworks methods is completed.

8.2 Highly Reactive Soils and Shrink-Swell Mitigation Options

Based on the Bulk Earthworks and Longitudinal Section Plan provided to Dougals (Drawing No. CV-2100 Revision G, dated 29 November 2024), cut depths up to 3 m are proposed to the southeast of Building C, and in the southeast corner of the site (near Bore 301 area). Fill depths up to 3.5 m are proposed to the east/southeast of Building A and in the north-eastern corner of the site. Should lesser characteristic surface movements be desired (e.g. Class M/M*), the following preliminary guidance is provided based on the investigation results:

- **Areas of greater than 1.5 m of fill**

Following stripping works to remove the existing topsoil fill, should areas require placement of 1.5 m or a greater thickness of fill, low to medium plasticity soils should be used as the fill material source. Any medium to high plasticity clay soils won from site cuts will need to be stockpiled and removed from site or else placed at 1.5 m or greater depth below finished level.

- **Areas of 1.0 m to 1.5 m of fill**

In these areas, low to medium plasticity soils could be used if the exposed material is low to medium or medium in plasticity. Where medium to high or greater plasticity clays are exposed, the above fill could be used to 0.3 m below finished level and then an volcanic imported material (Iss <0.5% and discussed further below) would need to be placed in the upper 0.3 m such that any shallow foundation would bear directly on the volcanic imported material (apart from a thin layer of bedding sand or crusher dust).

- **Areas of 0.5 m to 1.0 m of fill**

In these areas, low to medium plasticity soil could be used if the exposed foundation material is low to medium or medium in plasticity. Where medium to high or greater plasticity clays are exposed, the material would need to be over-excavated such that a minimum of 700 mm of imported volcanic material (as described above) can be over placed.

- **Areas of cut with medium to high and/or high plasticity clay exposed**

In these areas, the medium to high/high plasticity clay exposed would need to be over-excavated a minimum of 700 mm below finished level and replaced with imported volcanic material (as described above).

It is noted that the above is provided as a guide, and all areas of the site (including cut areas) would need to be assessed by a Geotechnical Engineer to confirm the classification of the foundation soils and the suitability of proposed fill material based on the fill thickness.

In order to reduce the required over-excavation to 0.7 m, Dougals suggests an alternative source, preferably volcanic in origin which breaks down to low plasticity clayey gravelly sand material rather than gravelly silty clay that sedimentary siltstones break down to.

8.3 Site Preparation and Earthworks

8.3.1 Stripping

Site preparation for the construction of pavement areas and structures should include the removal of, topsoil, vegetation, moisture affected soils (including existing controlled fill) and other deleterious materials such as organic matter and/or tree affected soils from the proposed construction areas. Based on the results of the investigation, an average topsoil stripping depth of around 0.2 m to 0.3 m is expected. Pending preceding weather conditions, stripping depths may be required to be deeper than anticipated if the upper soils become moisture affected.

8.3.2 Excavation Conditions

Based on the Bulk Earthworks and Longitudinal Section Plan provided, the fill, natural soils and up to low strength rock could be expected to be excavated using conventional earthmoving plant and as such no major difficulties are anticipated with this material should it be encountered to the proposed site cut depth of up to 3 m.

Excavation of the medium and high strength rock expected to be encountered in the Bore 301 area below depths of 2.85 m will require ripping and rock hammering at slow production rates. Should piles be required to be installed in medium and high strength rock (in Bores 204 – 206 and 302 and 302, below depths of 2.85 – 10.6 m), a purpose built, heavy duty piling rig would be required to penetrate this rock with any piling in limestone to be significantly more challenging. It must be noted that excavation within the rock will largely be dependent on the degree of fracturing/jointing within the bedrock relative to the excavation.

Bulk excavation in the limestone zone (if required) will likely encounter varied excavation conditions. Depends on their size, most limestone boulders should be able to be worked out by a large excavator. Large limestone boulders and more massive limestone will require persistent rock hammering to break to a suitable size for removal. Pre-splitting by mechanical means or expanding agent, or even prior to bulk excavation by explosive charges, could then be needed. The latter option would require the advice of an explosive contractor as to the applicability of the method given the possible discrete and scattered natured of the limestone, and the groundmass of residual soil which may have a considerable damping effect on blast energy. The limestone is microcrystalline with no obvious planes of weakness such as beds or fracture lines and is at least up to high/very high strength and could potentially have compressive strengths as high as 200 MPa.

Based on experience in the Googong area, groundwater seepages into excavations are likely to occur from fractures in the bedrock after periods or rain. Most of these seepage flows are likely to be temporary (pending prior weather conditions) and readily controllable by gravity draining to a collection sump or pond. Groundwater springs have been encountered within the Googong area during earthworks of the subdivision. Consideration should be given to installation of diversion drains across the site to minimise surface and subsurface water entering into the site.

If subsurface drainage is required, it can only be determined at the time of construction.

8.3.3 Excavation Batters

For permanent excavations in controlled fill and natural soils, a suggested preliminary maximum gradient of 2.5H:1V (horizontal:vertical) is recommended for excavations up to 3 m in depth. Excavation batters in very low strength bedrock could be formed steeper at say 1.5-2.0H:1V, however, this should be assessed on-site by a geotechnical engineer for presence/orientation of fracturing and condition of the excavation face at the time of construction.

Depending on the height of proposed batters and the presence of discontinuities within the rock, intermediate benches and/or support measures may be required. Such support could include nails or passive anchors, dental concrete in seams or rock bolts and meshing, though this can only be assessed at the time of construction.

For temporary batter less than 3 m in height, maximum gradients of 1H:1V are suggested for natural soils/controlled fill and very low strength rock. Temporary batters 3 m or greater in height must be assessed by a geotechnical engineer.

8.3.4 Retaining Walls

Where retaining structures are proposed, it is suggested that earth pressures on retaining walls due to the retained soils be based on a triangular pressure distribution calculated as follows:

$$h_z = \gamma k_a z$$

where, h_z = horizontal pressure at depth z

γ = unit weight of retained soil

= 20 kN/m^3 for soils

= 22 kN/m^3 for weathered rock

k_a = active earth pressure coefficient

= 0.3 for compacted fill, very stiff silty clay

= 0.25 for weathered rock (fractured)

Drainage behind all retaining walls should be provided or, alternatively, full hydrostatic pressure allowed for in design. In the event that hydrostatic pressures are allowed, densities of the retained soils can be appropriately reduced to the buoyant values.

Where applicable, superimposed surcharge loads due to adjacent roadways, inclined surfaces etc should also be accommodated in the design of such structures.

8.3.5 Re-use of Excavated Material as Fill

The fill and natural soils underlying the topsoil generally comprise low to high plasticity clays. Low to medium plasticity silty clays (likely to be won from cuts from within controlled fill areas as shown in Figure 6) would be considered suitable for re-use in controlled fill applications. However, the high plasticity clays are susceptible to shrink/swell movements with a change in moisture conditions and their use in controlled fill applications should be avoided where possible or else carefully planned or used in landscape/non structure fill areas. Should they be required/desired to be re-used, they should be placed at depth (preferable deeper than 1.5 m than design surface level so as to not exacerbate surface movements), or alternatively they should be blended with weathered rock or low plasticity clays.

Very low and low strength rock would likely remould to a low to medium plasticity silty clay and would also be considered suitable for re-use in controlled fill applications. Any excavated medium or high strength rock could be re-used provided that the material is broken down to less than 100 mm particle size and blended with site clays to ensure a well-graded material. Any larger, high strength boulder sized (>200 mm) rocks would be unlikely to break down easily and would be best discarded or placed in landscaped areas.

8.3.6 **Fill Placement and Compaction**

In areas that require fill, the stripped surfaces should be inspected and test rolled in the presence of a geotechnical engineer. Any areas exhibiting deflections under test rolling should be treated in accordance with the directions of a geotechnical engineer and site superintendent. Depending on prior weather conditions it may also be necessary to use a geofabric or bridging layer of rock fill to stabilise the subgrade.

All controlled fill should be placed in horizontal layers of maximum 250 mm loose thickness and compacted to a minimum 98% standard maximum dry density. Moisture content should be within the range ±2% of standard optimum or other range deemed appropriate by a geotechnical engineer.

All constructed fill batters should be constructed no steeper than 2.5:1 (horizontal:vertical), protected against erosion by vegetating the exposed surface and construction of toe and spoon drains as a means of controlling surface water flows on the batters. Should grass mowing of fill batters be required flatter slopes will be required most likely 4:1 (horizontal:vertical).

To validate the fill quality for structural loading/site classification purposes, field inspections and in-situ testing of future earthworks must be undertaken in order to satisfy the requirements of a Level 1 inspection and testing service as defined in AS 3798:2007.

8.4 Foundations

8.4.1 General

The subsurface conditions encountered during the previous investigations and current investigation are highly variable, which are summarised in Table 3 below.

Table 3: Depth to Various Stratum

Bore	Depth to Very Stiff Clay (m)	Depth to at Least Very Low Strength Rock (m)	Depth to at Least Low Strength Rock (m)	Depth to at Least Medium Strength Rock (m)
201	0.3	3.8	NE	NE
202	0.8	2.7	NE	NE
203	1.1	3.7	NE	NE
204	NE	0.7	2.9	4.6
205	1.1	3.0	4.0	4.8
206	0.3	1.5	2.5	5.3
301	From Surface	0.7	1.1	2.85
302	0.1	2.7	NE	10.6
303	NE	8.2**	NE	11.5**
304	5.3	7.2	NE	NE
305	0.7	2.3	18.2	NE
306	From Surface	1.2	NE	NE

NE = Not encountered.
**limestone with voids

It is considered that for the school buildings with 3 or more storeys, a piered footing system would be most appropriate. For buildings with 2 storeys or less, the footings could comprise either piers, pad or strip footings. Pad and bored piers can be designed on the parameters provided in Table 4 and Table 5 , with reference made to Table 3 above for guidance on depth to rock and rock strength. The project structural engineers should design the structures based on current accepted practices for earthquake loading for the area.

Table 4: Recommended Allowable End Bearing Pressures

Foundation Type	Allowable End Bearing Pressure Values		
	Pad Footings	Bored Cast In-Situ Piles	
	End Bearing	End Bearing	Shaft Adhesion
Controlled Fill	100 kPa	100 kPa	10 kPa
Very Stiff Clay	150 kPa	150 kPa	15 kPa
Very Low Strength Rock	600 kPa	600 kPa	60 kPa
Low Strength Rock*	1000 kPa	1000 kPa	100 kPa
Medium Strength Rock*	2000 kPa	2000 kPa	200 kPa

*The higher bearing capacities would only be suitable for bored piers for the buildings in the southern part of the site (i.e. in the vicinity of Bores 204 – 206, 301 and 302).

Table 5: Recommended Ultimate End Bearing Pressures

Foundation Type	Ultimate End Bearing Pressure Values		
	Pad Footings	Bored Cast In-Situ Piles	
	End Bearing	End Bearing	Shaft Adhesion
Controlled Fill	300 kPa	300 kPa	30 kPa
Very Stiff Clay	450 kPa	450 kPa	45 kPa
Very Low Strength Rock	1800 kPa	1800 kPa	180 kPa
Low Strength Rock*	3000 kPa	3000 kPa	300 kPa
Medium Strength Rock*	6000 kPa	6000 kPa	600 kPa

*The higher bearing capacities would only be suitable for bored piers for the buildings in the southern part of the site (i.e. in the vicinity of Bores 204 – 206, 301 and 302).

The above shaft adhesion values are for compressive loading, should shaft adhesion values in tension be required, these values can be taken as 50% of the compression values.

A basic geotechnical strength reduction factor (Φ_{gb}) of 0.4 in accordance with AS 2159 (2009) be applied to all the ultimate strength values given in Table 5. This value is based on the data presented in this report; the method of strength assessment used in this investigation; assuming no pile testing will be undertaken and after assessment of the overall design average risk rating (ARR) for the site (AS 2159 (2009).

All footings for individual structures must found within a uniform bearing stratum and should be inspected by a suitably qualified engineer prior to placement of reinforcing steel and pouring of concrete to verify design assumptions. Due to the variability in depth to rock and strength across the site, some deepening of foundations should be anticipated to ensure a uniform bearing stratum and reduce risks of differential settlements.

8.4.2 Raft Foundation for School Hall (Building C)

As a guide, Douglas provides estimated pad footing widths and settlement for the School Hall (Building C) in Table 6 and Table 7 below, based on the approximate loads provided by Enstruct and various allowable bearing pressures.

Table 6: Estimated Pad Footing Sizing (Square).

Approximate Load (kN)	Pad Footing on 100 kPa	Pad Footing on 150 kPa	Pad Footing on 600 kPa	Pad Footing on 1000 kPa	Pad Footing on 2000 kPa
500	2.3 m	1.9 m	1.0 m	0.8 m	0.5 m
1000	3.2 m	2.6 m	1.3 m	1.0 m	0.8 m

Table 7: Estimated Settlements for Pad Footing

Approximate Load (kN)	Pad Footing on 100 kPa	Pad Footing on 150 kPa	Pad Footing on 600 kPa	Pad Footing on 1000 kPa	Pad Footing on 2000 kPa
500	20 – 25 mm	15 – 20 mm	5 – 15 mm	~ 10mm	< 5 mm
1000	20 – 25 mm	15 – 20mm	5 – 15 mm	~ 10 mm	< 5 mm

The moduli of subgrade reaction for pad footing (as shown in Table 8) are estimated based on the pad footing sizes and settlement estimates in Table 6 and Table 7 above.

Table 8: Estimated Moduli of Subgrade Reaction for Pad Footing

Approximate Load (kN)	Pad Footing on 100 kPa	Pad Footing on 150 kPa	Pad Footing on 600 kPa	Pad Footing on 1000 kPa	Pad Footing on 2000 kPa
500	4 – 5 kPa/mm	7.5 – 10 kPa/mm	40 – 120 kPa/mm	~ 100 kPa/mm	400 kPa/mm
1000	4 – 5 kPa/mm	7.5 – 10 kPa/mm	40 – 120 kPa/mm	~ 100 kPa/mm	400 kPa/mm

A preliminary elastic settlement analysis was undertaken for the ribs of the waffle slab. The following inputs provided by Enstruct were applied for the analysis:

- Rib dimensions:
    - 3 m x 0.3 m;
    - 4 m x 0.3 m; and
    - 5 m x 0.3 m
- Blanket loads:
    - 10 kPa for stage area; and
    - 6.5 kPa for Gymnasium.

The analysis indicates that the total settlement along the ribs would be less than 1 mm. A modulus of subgrade reaction of 400 kPa/mm could be adopted for the preliminary design of the waffle slab footing.

8.4.3 Bored Pier Foundation

It is understood that bored piers founding on medium strength rock was preferred for the multi storey buildings. This is considered suitable for buildings within the southern portion of the site (within the vicinity of Bores 204 – 206, and 301), where medium strength rock was encountered within relatively shallow depths (up to 5.3 m depth).

However, it is noted that medium strength or stronger rock was not encountered in the northern portion of the site (Bores 201 – 203 and 304 – 305) where the investigation depths were up to 18.75 m. Bored piers founding on medium strength rock are considered not practical within those areas.

In addition, limestone with voids was encountered in Bore 303. Due to the uncertainty of the continuity of limestone, bored pier foundations where the structural loading is transferred via end bearing is not recommended and that shaft adhesion only should be relied on for structural support purposes.

To assist the foundation design, Douglas has estimated the bored pier socket lengths (600 mm diameter pier using the shaft adhesion values above) for founding materials with varied end bearing pressures, as shown in Table 9. More foundation options for the northern portion of the site will be discussed in Section 8.4.4 below.

The socket length detailed in Table 9 are based on socket material being the same as the end bearing material, therefore additional shaft adhesion will be afforded by overlaying soil and rock and will need to be separately calculated and included.

Table 9: Estimated Bored Pier Socket Length for Various End Bearing Stratum (600 mm Diameter Pier).

Approximate Load (kN)	Pier on 100 kPa*	Pier on 150 kPa*	Pier on 600 kPa	Pier on 1000 kPa	Pier on 2000 kPa
500	Not Practical		3 m	1.5 m	0.3 m
1000			7.5 m	4.0 m	1.5 m
1500			Not Practical	6.5 m	3.0 m
2000				9.5 m	4 0 m
2500				12 m	5.5 m
3000				14.5 m	6.5 m
3500				17.5 m	8 m
4000				20 m	9.5 m
4500				Not Practical	10.5 m
5000					12 m
5500					13.5 m

*Piers intended to be found on controlled fill or very stiff clay will likely intersect weathered rock prior to the required socket lengths being achieved.

As a guide, piles designed using the allowable parameters outlined above can expect settlements of less than 1% of the pile diameter under serviceability loads. All footings for individual structures must found within a uniform bearing stratum and should be inspected by a suitably qualified engineer prior to placement of reinforcing steel and pouring of concrete to verify design assumptions. Due to the variability in depth to rock and strength across the site, some deepening of foundations should be anticipated to ensure a uniform bearing stratum and reduce risks of differential settlements. Should detailed settlement analysis be required (both total and differential settlements), a finite element analysis is highly recommended with pile parameters and layout required.

It is suggested that bored piers have a minimum spacing of 2.5 pier diameter such that they can be considered as independent elements.

Design of footings must take into consideration the influence of any adjacent service trenches, retaining walls or submerged structures.

Should inclement weather precede construction, use of temporary casing for pier installation may be required to alleviate risks of side wall collapse and tremie pouring may be required should water pool at the base of the piers from influx of groundwater from fractures within the rock.

8.4.4 Other Foundation Options

As discussed in Section 8.4.3 above, bored piers found on medium strength rock are not practical for the buildings in the northern portion of the site (i.e. Buildings A and B). The bored piers would likely be founded in very low to low strength rock. The estimated socket lengths for a 1.2 m diameter bored pier for various end bearing stratum are presented in Table 10 below.

Table 10: Estimated Bored Pier Socket Length (1.2 m Diameter Pier).

Approximate Load (kN)	Pier on 100 kPa*	Pier on 150 kPa*	Pier on 600 kPa	Pier on 1000 kPa
500	Not Practical	6 m	0.1 m*	0.1 m*
1000		15 m	1.5 m	0.1 m*
1500		Not Practical	4 m	1 m
2000			6 m	2.5 m
2500			8.5 m	4 m
3000			10.5 m	5 m
3500			12.5 m	6.5 m
4000			15 m	8 m
4500			17 m	9 m
5000			19.5 m	10.5 m
5500			21.5 m	12 m

*Smaller diameter piers would be suitable where a low column load is applied (e.g. 600 mm diameter pier as suggested in Table 9 above)

It is also advised in Section 8.4.3 above, limestone with voids was encountered in Bore 303. Due to the uncertainty of the continuity of limestone, design of bored pier foundations based on end bearing is not recommended. The following foundation options should be considered instead:

- Large diameter friction piles;
- Small diameter friction pile groups;
- Driven pile; and
- Bored piers with pile load testing.

Large diameter friction piles could be considered as the most cost-effective option.

Should small diameter pile group be preferred, a finite element analysis is highly recommended for the detailed design to assess the interference among the individual piles in a group and the group effect.

Driven pile could be also considered for the footings given each pile is essentially load tested. It is suggested that the final selection of driven pile type be based on discussions with experienced piling contractors as to the availability of equipment suited to the ground conditions and the estimated costs. It is suggested that driven piles have a minimum spacing of 2.5 pile diameter.

Driven piling systems may cause issues with vibrations and noise particularly to the surrounding residential homes. Whilst the damage effects of vibrations on nearby homes (some 80 m away) is expected to be minor, human perception of vibrations and noise can be disturbing even at low levels. It is recommended that dilapidation surveys be undertaken on all nearby homes to document existing damage to mitigate against any potential claims for damage compensation as a result of piling works. Furthermore, vibration monitoring would be suggested to determine the level of vibrations induced by piling equipment and if measured as being above the best practice levels (say 5 mm/sec), piling works should be superseded and re-evaluated.

At the time of reporting, the proposed development within the vicinity of the Bore 303 was not available to Douglas. Should pile analysis be required, Douglas would be happy to work with Enstruct to provide more geotechnical advice on the pile design.

8.5 **Pavement Design Considerations**

Based on Douglas' experience in the area, we suggest a design subgrade CBR of 3% for the silty clay and silty clay fill at the site. Should a higher design CBR be desired, subgrade replacement or improvement (in any proposed areas of fill) could be assessed by Douglas and an 'effective CBR' provided. This would likely require importing of suitable rocky material to the site.

All earthworks should be undertaken under close supervision and consultation with the geotechnical consultant in order to avoid any unnecessary over excavation. The standard of construction, the selection of materials and quality of workmanship for the roads should satisfy the requirements of the latest Council specifications.

Surface and subsoil drainage must be installed and maintained to protect the pavement and subgrade including inside any traffic/parking islands. Subsoil drains should be located at a minimum of 0.5 m depth below the subgrade level.

8.6 **Soil Aggressivity**

The soil aggressivity test results are included in Appendix E and are summarised in Table 2 in Section 6.2. The results indicate that based on the Soil Conditions B and with reference to the AS 2159:2009 Tables 6.4.2(C) and 6.5.2(C) that the exposure classification for concrete piles and steel piles is *Non-Aggressive*.

8.7 **Earthquake Class**

When reference is made to AS 1170.4: 2007 an appropriate site sub-soil class and hazard factor would be Class Ce and 0.08 respectively.

9. Risks and Mitigation Measures

The following potential risks for the proposed development have been identified as engineering risks based on a geotechnical assessment of the risk. Items 2. 5 and 6 are also identified as potential *'risks to the protection of the natural environment and residential amenity'*. Corresponding mitigation measures that would be suggested are summarised in Table 11 below. It is noted that this is not an extensive list of potential risks, but only those that can be made based on observations from our investigation.

Table 11: Identified potential risks and mitigation measures

Item	Identified Risks	Mitigation Measures
1	Highly reactive soils	• Shrink-swell mitigation options as discussed in Section 8.2
2	Hard rock excavation	• Ripping and rock hammering at slow production rates to be anticipated • Bulk excavation in limestone (where encountered) will require persistent rock hammering, or pre-splitting by mechanical means or expanding agent, or even by explosive charges, as discussed in Section 8.3.2
3	Reuse of oversized excavated rock material	• Rock crushing plant would be required if excavated rock is of medium or greater strength
4	Groundwater seepage / spring	• Geotechnical inspection at time of construction • Installation of diversion drains, subsoil drains/blankets, rubble drains
5	Bored piers in medium strength or stronger rock	• Purposely built, heavy duty pile rig • Allow for slow drilling with high bit wear for auger heads • Piling difficulties will be further exacerbated in limestone
6	Driven pile	• Noise and vibration as discussed in Section 8.4.4

10. Conclusion

This assessment report has examined and taken into account to the likely geotechnical matters affecting the construction and operation of the proposed new high school for Googong. The assessment found the activity would be unlikely to cause a significant impact on the environment subject to the implementation of appropriate mitigation measures as contained in this report.

11. References

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12. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at 200 Wellsvale Drive, Googong NSW in line with Douglas' proposal 224779.01.P.001.Rev0 dated 16 October 2024 and acceptance received from Colliers on behalf of Department of Education dated 4 December 2024. The work was carried out under the SINSW Due Diligence Panel Work Order DDWO05264/23. This report is provided for the exclusive use of Department of Education for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed.

Douglas' advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction. The scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

Appendix A

About this Report

About this Report

October 2024

Introduction

These notes have been provided to amplify Douglas' report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

Douglas' reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Engagement Terms for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

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

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

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

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

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, Douglas will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, Douglas will be pleased to assist with investigations or advice to resolve the matter.

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

Information for Contractual Purposes

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

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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Appendix B

Drawing 1 – Test Location Plan

Drawing 2 – Section A-A’

Drawing 3 – Section B-B’

SITE LOCATION

LEGEND

46285.30 Test Pit Location (2016)

Approximate Previous Borehole Locations (2023)

Approximate Current Borehole Location

Approximate Site Boundary

(NE) Depth to at Least Medium Strength Rock

** With Voids and Very Low/Low Strength Bands

Approximate Cross Section

0 25 50 m

NOTE:
1. Drawing projection in GDA2020 / MGA zone 55, adapted from aerial imagery from MetroMap dated 05.09.2024, Client supplied drawing titled "Site Plan" (Drawing reference: GGHS-NBRS-ZZ-ZZ-DR-A-000201, Rev 1 dated 29.11.2024
2. Test locations are approximate only and were located using differential GPS typically accurate to ± 0.5 m depending on satellite coverage.

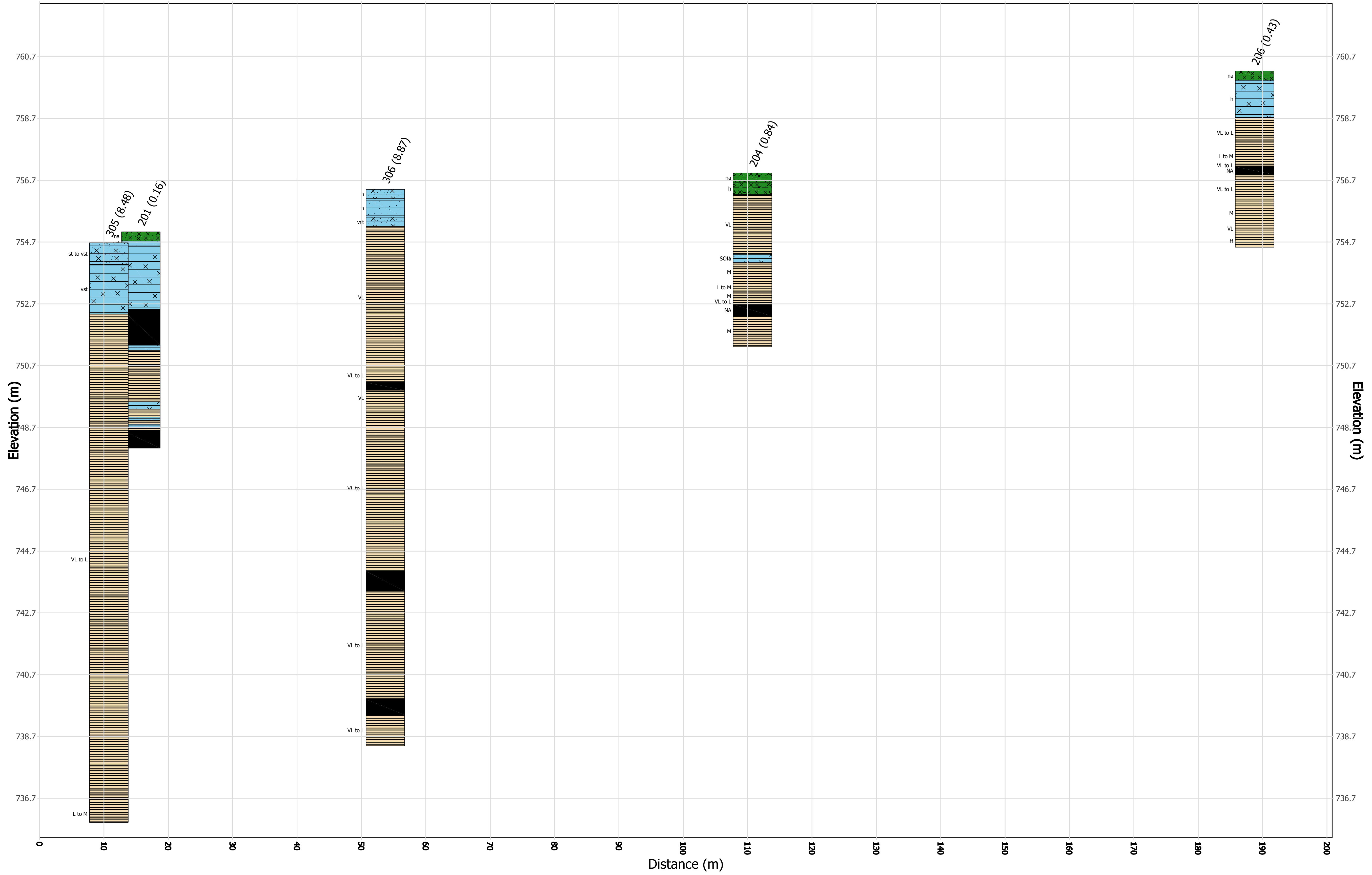
Douglas
PARTNERS

CLIENT: Department of Education
OFFICE: Canberra
DRAWN BY: GM
SCALE: 1:1500 @A3
DATE: 20.January.2025

TITLE: **Test Location Plan**
Proposed New High School for Googong
200 Wellsvale Drive, Googong

N

PROJECT: 224779.01
DRAWING NO: 1
REVISION: 0



0 6 12 18 24 30 36 42 48 54 60 H (1:600)
0 6 12 V (1:125)
Section Length: 200.79m

LEGEND

- ▨ Sandy CLAY
- ▨ Silty sandy CLAY
- ▨ Silty CLAY
- ■ NO CORE
- ▤ Shale
- 🟩 Clayey SILT
- 🟩 Clayey sandy SILT
- 🟩 Sandy SILT

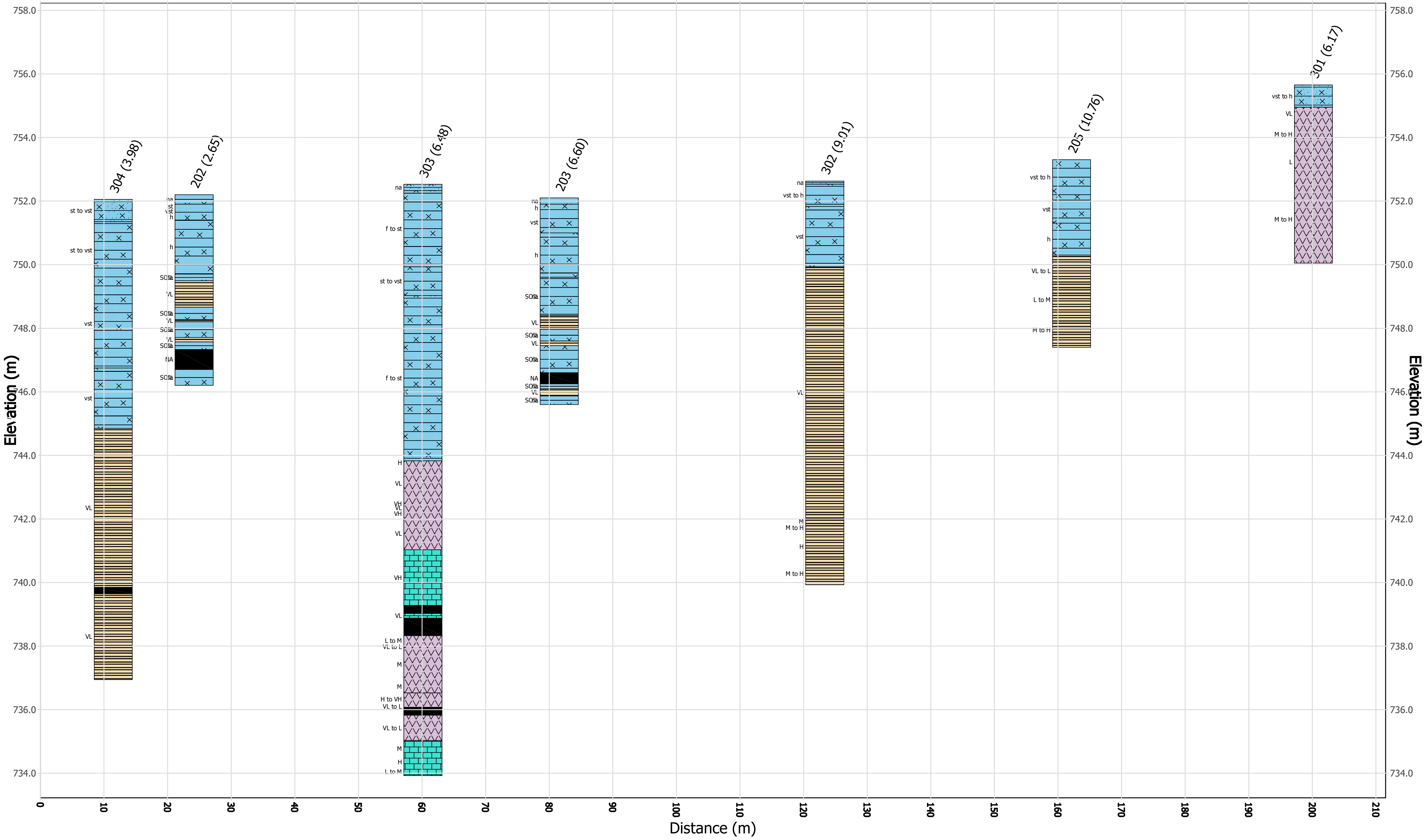
Douglas PARTNERS

TITLE:

Cross Section A-A`
Proposed New High School for Googong
200 Wellsvale Drive, Googong

DRAWN: BKM
DATE: 21-01-25
CHECKED: GM
DATE: 21-01-25
SCALE: H 1:600 V 1:125
A3
PROJECT No: 224779.01
FIGURE No: D.002.Rev0

File: \\DPCANNAS01\Projects\224779.01 - GOOGONG, 200 Wellsvale Drive (Addi. Geo)\7.0 Drawings\7.2 Out\Sections\224779.01 Sections A-A` and B-B` .mdlz - Template: 61da2092-e317-4580-bd30-5db58e1f613a - Generated By: DOUGLAS\Belinda.Merton - 21/01/2025 11:40:34



0 7 14 21 28 35 42 49 56 63 70 H (1:700)

0 7 14 V (1:140)

Section Length: 211.52m

LEGEND

- ▨ Silty sandy CLAY
- ▨ Silty CLAY
- ■ NO CORE
- ▦ LIMESTONE
- ▤ Shale
- ▨ TUFF

Douglas PARTNERS

TITLE:

Cross Section B-B`
Proposed New High School for Googong
200 Wellsvale Drive, Googong

DRAWN: BKM		DATE: 21-01-25	
CHECKED: GM		DATE: 21-01-25	
SCALE: H 1:700 V 1:140			A3
PROJECT No: 224779.01		FIGURE No: D.003.Rev0	

File: \\DPCANNAS01\Projects\224779.01 - GOOGONG, 200 Wellsvale Drive (Addi. Geo)\7.0 Drawings\7.2 Out\Sections\224779.01 Sections A-A` and B-B`.mdlz - Template: 61da2092-e317-4580-bd30-5db58e1f613a - Generated By: DOUGLAS\Belinda.Merton - 21/01/2025 11:42:29

Appendix C

Explanatory Notes

Previous Borehole Logs (Bores 201 – 206)

Current Borehole Logs (Bores 301 – 306)

Terminology, Symbols and Abbreviations

November 2020

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style `XW`. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	`KL`
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	`UK`
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	`ND`
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	`NA`

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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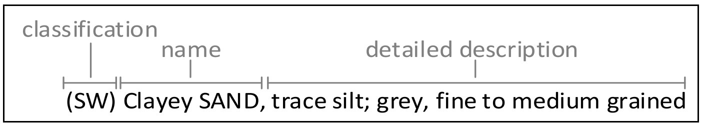
Introduction

All materials which are not considered to be “in-situ rock” are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:



The “classification” comprises a two character “group symbol” providing a general summary of dominant soil characteristics. The “name” summarises the particle sizes within the soil which most influence it’s behaviour. The detailed description presents more information about the soil’s composition, condition, structure, and origin.

Classification, naming and description of soils requires the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either “fine grained” (also known as “cohesive” behaviour) or “coarse grained” (“non cohesive” behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Fraction	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as “oversize”	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer “component proportions” below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a “Sandy CLAY”, this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a “primary”, “secondary”, or “minor” component of the soil mixture, depending on its influence over the soils behaviour.

Component Proportion Designation	Definition[1]	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to it’s engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub categories. Refer “identification of minor components” below

Composite Materials

In certain situations a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example “INTERBEDDED Silty CLAY AND SAND”.

Classification

The soil classification comprises a two character group symbol. The first symbol identifies the primary component. The second symbol identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component[1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters `(?)`, with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description.

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterize due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular particle size with the range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

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Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	`<PL`
	Near plastic limit	Can be moulded	`≈PL`
	Wet of plastic limit	Water residue remains on hands when handling	`>PL`
	Near liquid limit	“oozes” when agitated	`≈LL`
	Wet of liquid limit	“oozes”	`>LL`
Coarse	Dry	Non-cohesive and free running	`D`
	Moist	Feels cool, darkened in colour, particles may stick together	`M`
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	`W`

The abbreviation code `NDF`, meaning “not-assessable due to drilling fluid use” may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Rock

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the “consistency” describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented “strength” is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered rock origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description

Quantitative engineering performance of these materials may be determined by laboratory testing, or estimated by correlated field tests (for example penetration or shear vane testing). In some cases performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example `(VS)`.

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	`VS`
Soft	Mouldable with light finger pressure	>12 - ≤25	`S`
Firm	Mouldable with strong finger pressure	>25 - ≤50	`F`
Stiff	Cannot be moulded by fingers	>50 - ≤100	`ST`
Very stiff	Indented by thumbnail	>100 - ≤200	`VST`
Hard	Indented by thumbnail with difficulty	>200	`H`
Friable	Easily crumbled or broken into small pieces by hand	-	`FR`

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	`VL`
Loose	>15-≤35	`L`
Medium dense	>35-≤65	`MD`
Dense	>65-≤85	`D`
Very dense	>85	`VD`

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	`WC`
Poorly compacted	`PC`
Moderately compacted	`MC`
Variably compacted	`VC`

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	`MCE`
Weakly cemented	`WKCE`
Cemented	`CE`
Strongly bound	`SB`
Weakly bound	`WB`
Unbound	`UB`

Extremely Weathered Rock

AS1726-2017 considers weathered rock material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. very low strength rock). These materials may be identified as “extremely weathered rock” in reports and by the abbreviation code `XWR` on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	`RES`
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than ‘very low’ as per as1726 but retains the structure or fabric of the parent rock.	`XWM`
Alluvial	Deposited by streams and rivers	`ALV`
Estuarine	Deposited in coastal estuaries	`EST`
Marine	Deposited in a marine environment	`MAR`
Lacustrine	Deposited in freshwater lakes	`LCS`
Aeolian	Carried and deposited by wind	`AEO`
Colluvial	Soil and rock debris transported down slopes by gravity	`COL`
Topsoil	Mantle of surface soil, often with high levels of organic material	`TOP`
Fill	Any material which has been moved by man	`FILL`
Littoral	Deposited on the lake or sea shore	`LIT`
Unidentifiable	Not able to be identified	`UID`

Cobbles and Boulders

The presence of particles considered to be “oversize” may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with “MIXTURE OF”.

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Rock Descriptions

Terminology
Symbols
Abbreviations

November 2021

Rock Strength

Rock strength is defined by the unconfined compressive strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

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

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

[1] Assumes a ratio of 20:1 for UCS to $I_{s(50)}$. It should be noted that the UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site.

On investigation logs only, the following data contiguity codes may be in rock strength tables for layers or seams of material "within rock", but for which the equivalent UCS strength is less than 0.6 MPa.

Scenario	Abbreviation Code
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the "Description of Strata" and soil properties columns.	`SOIL`
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column.	`SEAM`

Degree of Weathering

The degree of weathering of rock is classified as follows:

Weathering Term	Description	Abbreviation Code
Residual Soil[1,2]	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.	`RS`
Extremely weathered[1,2]	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	`XW`
Highly weathered	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.	`HW`
Moderately weathered	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.	`MW`
Slightly weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	`SW`
Fresh	No signs of decomposition or staining.	`FR`
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.	`DW`

[1] AS1726-2017 6.1.9 provides similar definitions for "residual soil" and "extremely weathered material" as soil origins. Generally, the soil origin terms would be used above the depth at which very low strength or stronger rock material is first encountered, while both soil origin and weathering should may be stated for soil encountered below the first contact with rock material, where appropriate.

[2] The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

Term	Description	Abbreviation Code
Extremely altered	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.	XA
Highly altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching, or may be decreased due to precipitation of secondary materials in pores.	HA
Moderately altered	The whole of the rock material is discoloured, usually by 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.	MA
Slightly altered	Rock is slightly discoloured but shows little or no change of strength from fresh rock	SA
Note: If HA and MA cannot be differentiated use DA (see below)		
Distinctly altered	Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching, or may be decreased due to precipitation of secondary minerals in pores.	DA

Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Clay seam	CS
Cleavage	CV
Crushed zone	CZ
Decomposed seam	DS
Fault	F
Joint	J
Lamination	LAM
Parting	PT
Sheared zone	SZ
Vein	VN
Drilling/handling break	DB , HB
Fracture	FCT

Rock Defect Orientation

Term	Abbreviation Code
Horizontal	H
Vertical	V
Sub-horizontal	SH
Sub-vertical	SV

Rock Defect Coating

Term	Abbreviation Code
Clean	CLN
Coating	CO
Healed	HE
Infilled	INF
Stained	STN
Tight	TI
Veneer	VEN

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLY
Iron oxide	FE
Manganese	MN
Silty	SLT

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Rock Defect Shape/Planarity

Term	Abbreviation Code
Curved	CU
Irregular	IR
Planar	PL
Stepped	ST
Undulating	UN

Rock Defect Roughness

Term	Abbreviation Code
Polished	PO
Rough	RO
Slickensided	SL
Smooth	SM
Very rough	VR

Other Rock Defect Attributes

Term	Abbreviation Code
Fragmented	FG
Band	BND
Quartz	QTZ

Defect Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

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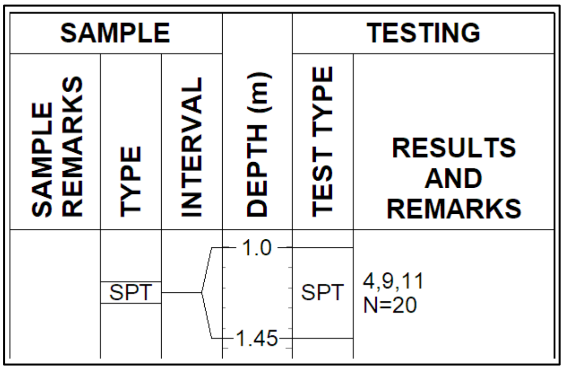
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

November 2020

Sampling and Testing

A record of samples retained and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Sample from SPT test	SPT
Environmental sample	E
Gas sample	G
Jar sample	J
Undisturbed tube sample	U^1
Water sample	W
Piston sample	P
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =*x* blows for *y* mm penetration HB = hammer bouncing	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	Observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Excavator/backhoe bucket	B^1
Toothed bucket	TB^1
Mud/blade bucket	MB^1
Ripping tyne/ripper	RT
Rock breaker/hydraulic hammer	RB
Hand auger	HA^1
NMLC series coring	NMLC
HMLC series coring	HMLC
NQ coring	NQ
HQ coring	HQ
PQ coring	PQ
Push tube	PT ^{1}
Rock roller	RR^1
Solid flight auger. Suffixes: (TC) = tungsten carbide tip, (V) = v-shaped tip	SFA^1
Sonic drilling	SON^1
Vibrocore	VC^1
Wash bore (unspecified bit type)	WB^1
Existing exposure	X
Hand tools (unspecified)	HT
Predrilled	PD
Specialised bit (refer report)	SPEC^1
Diatube	DT^1
Hollow flight auger	HFA^1
Vacuum excavation	VE

[1] – numeric suffixes indicate tool diameter/width in mm

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 755 AHD
COORDINATE E:702169 **N:** 6077526
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 201
PROJECT No: 224779.04
DATE: 27/09/23
SHEET: 1 of 2

CONDITIONS ENCOUNTERED

GROUNDWATER: 27/09/23, No free groundwater observed

RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	SOIL: ORIGIN[#]	SOIL: CONSIS.[*] / DENSITY.[*]	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m)	ROCK: DEFECTS & REMARKS
	0.0	TOPSOIL/FILL/ (ML) Sandy SILT, with clay, with gravel; brown; sand fraction fine to coarse; gravel fraction fine to medium	TOP and FILL	NA	<PL							
	0.3	(CH) Silty CLAY, trace sand; pale yellow brown; clay fraction high plasticity; sand fraction fine	RES becoming XWM	VST	<PL to =PL							
	0.43	(CH) Silty CLAY, with sand; orange pink brown; clay fraction high plasticity; sand fraction fine; with extremely weathered shale, with highly weathered, very low strength seams	XWM	H	<PL							
754	1											
753	2											
	2.5	CORE LOSS					2.5		61	0		
752	3											
	3.67	(CI) Silty CLAY, trace sand; orange brown; clay fraction medium plasticity; sand fraction fine	XWM	XWR	NDF	XW	3.67	SOIL			SOIL	
	3.84	SHALE; orange brown; fine; highly fractured, dry to moist				HW	3.84	VL				3.84-4.0m: fragmented

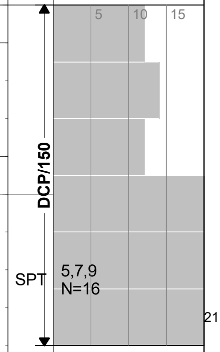
STRENGTH: VL L M H VH EH
FRACTURE SPACING (m): 0.01 0.05 0.10 0.50 1.00 5.00

SAMPLE

SAMPLE REMARKS	TYPE	INTERVAL / DEPTH (m)
	E	0.1
	A	0.4 - 0.5
	E	0.5
	SPT	0.5 - 0.95
	E	1.0
	A	1.4 - 1.5
	E	1.5
	A	1.9 - 2.0
	E	2.0
	SPT	2.0 - 2.45

TESTING

DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
0.0 - 0.9	DCP/150	
0.5 - 0.95	SPT	5,7,9 N=16
2.0 - 2.45	SPT	12,17,20 N=37



NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.5m, then NMLC to 7.0m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.5m

LOGGED: HS

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 755 AHD
COORDINATE E:702169 **N:** 6077526
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 201
PROJECT No: 224779.04
DATE: 27/09/23
SHEET: 2 of 2

CONDITIONS ENCOUNTERED														SAMPLE				TESTING	
					SOIL			ROCK											
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] DENSITY.[*]	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			SHALE; orange brown; fine; highly fractured, dry to moist *(continued)*					HW		VL	61	0		4.0-4.12m: fragmented 4.12-4.25m: J 80°-85° PL, SM, CLY CO 4.25-4.37m: fragmented 4.37-4.42m: PL, SM, FE STN, fragmented						
	750	5						HW	4.7	L				4.42-5.5m: fragmented				5		
		5.5	(CI) Silty CLAY, trace sand; orange brown; clay fraction medium plasticity; sand fraction fine		XWM	XWR	NDF	XW	5.5	SOIL			SOIL							
		5.74	SHALE; orange brown; fine; highly fractured, dry to moist					HW	5.74	VL				5.74-6.0m: fragmented						
	749	6.0	(CI) Silty CLAY, trace sand; orange brown; clay fraction medium plasticity; sand fraction fine		XWM	XWR	NDF	XW-HW	6.0	SOIL			SOIL					6		
		6.1	SHALE; orange brown; fine; highly fractured, dry to moist					XW	6.1	VL				6.1-6.13m: J 10°-15° IR, RO, FE STN 6.13-6.23m: fragmented						
		6.23	(CI) Silty CLAY, trace sand; orange brown; clay fraction medium plasticity; sand fraction fine		XWM	XWR	NDF	XW-HW	6.23	SOIL	58	0	SOIL							
		6.34	SHALE; orange brown; fine; highly fractured, dry to moist					XW	6.34	VL				6.34-6.42m: J 85°-90° PL, SM, FE STN						
		6.42	CORE LOSS						6.42											
	748	7.0	Borehole discontinued at 7.00m depth Limit of investigation						7.0									7		

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.5m, then NMLC to 7.0m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.5m

LOGGED: HS

Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PRELIMINARY GEOTECHNICAL INVESTIGATION
200 WELLSVALE DRIVE, GOOGONG
BORE: 201 DEPTH: 2.5 m – 7.0 m PROJECT: 224779.00 November 2023

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 752.2 AHD
COORDINATE E:702242 **N:** 6077524
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 202
PROJECT No: 224779.04
DATE: 27/09/23
SHEET: 1 of 2

CONDITIONS ENCOUNTERED

GROUNDWATER: 27/09/23, No free groundwater observed

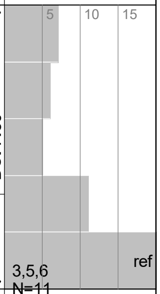
DEPTH (m)	RL (m)	DESCRIPTION OF STRATA	GRAPHIC	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY.(*)	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m)	ROCK: DEFECTS & REMARKS
0.0	752	TOPSOIL/FILL/ (CL) Silty CLAY, with sand, with gravel; brown; clay fraction low plasticity; sand fraction fine to coarse; gravel fraction fine to medium; with rootlets		TOP and FILL	NA	<PL							
0.3		FILL(?)/ (CI-CH) Silty CLAY, with sand, trace gravel; grey brown mottled orange mottled grey; clay fraction medium to high plasticity; sand fraction fine to medium; gravel fraction fine; trace rootlets		possibly FILL	(ST) (VST) (H)	=PL <PL <PL							
0.8	751 750	(CH) Silty CLAY, trace sand; pale yellow brown; clay fraction high plasticity; sand fraction fine		XWM	H	<PL							
2.5		(CL-CI) Silty CLAY, trace gravel; orange brown; clay fraction low to medium plasticity; gravel fraction fine		XWM	XWR	NDF	XW	2.5	SOIL	100	18	SOIL	
2.71	749	SHALE; yellow brown; fine; dry; highly fractured					HW	2.71	VL				2.71-2.76m: J 10°-15° PL, RO, FE STN 2.76-2.8m: J 10°-15° PL, RO, FE STN 2.8-3.09m: HB 3.09m: J x2 60°-80° PL, UN/RO, CLY/FE INF/STN 3.12m: J 10°-20° PL, UN/RO, CLY/FE INF/STN 3.2-3.27m: J fragmented
3.54		(CL-CI) Silty CLAY, trace gravel, trace sand; orange brown; clay fraction low to medium plasticity; gravel fraction fine; sand fraction fine		XWM	XWR	NDF	XW	3.54	SOIL			SOIL	
3.93		SHALE; yellow brown; fine; dry;					HW	3.93	VL				3.93-4.0m:

SAMPLE

TYPE	INTERVAL / DEPTH (m)
E	0.1
A	0.4–0.5
E	0.5
SPT	0.5–0.95
E	1.0
A	1.4–1.5
E	1.5
E	2.0
SPT	2.0–2.45
E	2.5

TESTING

DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
0.0	DCP/150	
0.5	SPT	3,5,6 N=11
2.0	SPT	14,11,25 N=36



NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.5m, then NMLC to 6.0m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.5m

LOGGED: SK/HS

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 752.2 AHD
COORDINATE E:702242 **N:** 6077524
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 202
PROJECT No: 224779.04
DATE: 27/09/23
SHEET: 2 of 2

CONDITIONS ENCOUNTERED															SAMPLE				TESTING	
					SOIL			ROCK												
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] DENSITY.[*]	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
		4.0	highly fractured						4.0					fragmented						
	748		(CL-CI) Silty CLAY, trace gravel, trace sand; yellow brown; clay fraction low to medium plasticity; gravel fraction fine; sand fraction fine		XWM	XWR	NDF	XW		SOIL			SOIL							
		4.49	SHALE; yellow brown; fine; dry; highly fractured					HW	4.49	VL				4.49-4.63m: fragmented						
		4.63	(CL-CI) Silty CLAY, trace gravel, trace sand; yellow brown; clay fraction low to medium plasticity; gravel fraction fine; sand fraction fine		XWM	XWR	NDF	XW	4.63	SOIL	57	0	SOIL							
		4.87	CORE LOSS						4.87					4.87-5.5m: core loss						
		5																5		
	747																			
		5.5	(CL-CI) Silty CLAY, trace gravel, trace sand; orange brown; clay fraction low to medium plasticity; gravel fraction fine; sand fraction fine		XWM	XWR	NDF	XW	5.5	SOIL	33	0	SOIL							
		6.0	Borehole discontinued at 6.00m depth Limit of investigation						6.0									6		
	746																			
		7																7		
	745																			

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.5m, then NMLC to 6.0m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.5m

LOGGED: SK/HS

Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PRELIMINARY GEOTECHNICAL INVESTIGATION
200 WELLSVALE DRIVE, GOOGONG
BORE: 202 DEPTH: 2.5 m – 6.0 m PROJECT: 224779.00 November 2023

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 752.1 AHD
COORDINATE E:702286 **N:** 6077486
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 203
PROJECT No: 224779.04
DATE: 28/09/23
SHEET: 1 of 2

CONDITIONS ENCOUNTERED

GROUNDWATER: 27/09/23, No free groundwater observed

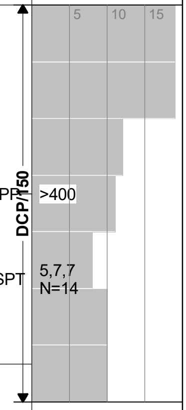
RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	SOIL: ORIGIN[#]	SOIL: CONSIS.[*] DENSITY.[*]	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH (VL L M H VH EH)	ROCK: RECOVERY (%)	ROCK: RQD	ROCK: FRACTURE SPACING (m) (0.01 0.05 0.10 0.50 1.00 5.00)	ROCK: DEFECTS & REMARKS
752	0.0	TOPSOIL/FILL/ (CL-CI) Silty CLAY, with sand, trace gravel; brown; clay fraction low to medium plasticity; sand fraction fine to coarse; gravel fraction fine; with rootlets	TOP and FILL	NA	<PL							
	0.2	FILL(?)/ (CH) Silty CLAY, trace sand, trace gravel; brown mottled orange to brown; clay fraction high plasticity; sand fraction fine to coarse; gravel fraction fine	possibly FILL possibly RES	H (VST)	<PL <PL to =PL							
751	1.1	(CI-CH) Silty CLAY; brown; medium to high plasticity; with extremely weathered shale, with highly weathered, very low strength seams	XWM	H	<PL							
750	2.5	(CI) Silty CLAY, trace sand, trace gravel; yellow brown; clay fraction medium plasticity; sand fraction fine; gravel fraction fine	XWM	XWR	NDF	XW	2.5	SOIL	100	0	SOIL	3.5m: DB
749	3.7	SHALE; yellow brown mottled orange brown; fine				HW	3.7	VL	100	0		

SAMPLE

TYPE	INTERVAL / DEPTH (m)	SAMPLE REMARKS
E	0.1	
A	0.4–0.5	
E	0.5	
SPT	0.5–0.95	
E	1.0	
A	1.4–1.5	
E	1.5	
E	2.0	
SPT	2.0–2.45	
E	2.5	

TESTING

DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
0.0–1.05	DCP/150	
0.5	PP	>400
0.5	SPT	5,7,7 N=14
2.0	SPT	6,12,22 N=34



NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
OPERATOR: RMX Drilling
LOGGED: HS
METHOD: SFA to 2.5m, then NMLC to 6.5m
CASING: HQ to 2.5m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 752.1 AHD
COORDINATE E:702286 **N:** 6077486
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 203
PROJECT No: 224779.04
DATE: 28/09/23
SHEET: 2 of 2

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN[#]	CONSIS.[*] DENSITY.[*]	MOISTURE	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	748		SHALE; yellow brown mottled orange brown; fine *(continued)*				HW		VL	100	0		4.0m: HB						
		4.14	(CL-CI) Silty CLAY, trace sand, trace gravel; orange brown; clay fraction low to medium plasticity; sand fraction fine; gravel fraction fine	XWM	XWR	NDF	XW	4.14	SOIL			SOIL							
		4.5	SHALE; yellow brown mottled orange brown; fine				XW-HW	4.5	VL	100	0		4.5m: DB						
	747	4.65	(CL-CI) Silty CLAY, trace sand, trace gravel; orange brown; clay fraction low to medium plasticity; sand fraction fine; gravel fraction fine	XWM	XWR	NDF	XW	4.65	SOIL			SOIL					5		
		5.5	CORE LOSS					5.5		65	0		5.5-5.85m: core loss						
		5.85	(CL-CI) Silty CLAY, trace sand, trace gravel; orange brown; clay fraction low to medium plasticity; sand fraction fine; gravel fraction fine	XWM	XWR	NDF	XW	5.85	SOIL			SOIL							
	746	6.0	SHALE; yellow brown mottled orange; fine				XW-HW	6.0	VL								6		
		6.23	(CL-CI) Silty CLAY, trace sand, trace gravel; orange brown; clay fraction low to medium plasticity; sand fraction fine; gravel fraction fine	XWM	XWR	NDF	XW	6.23	SOIL			SOIL							
		6.5	Borehole discontinued at 6.50m depth Limit of investigation					6.5											
	745	7															7		

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

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PLANT: Scout 6
METHOD: SFA to 2.5m, then NMLC to 6.5m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.5m

LOGGED: HS

Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

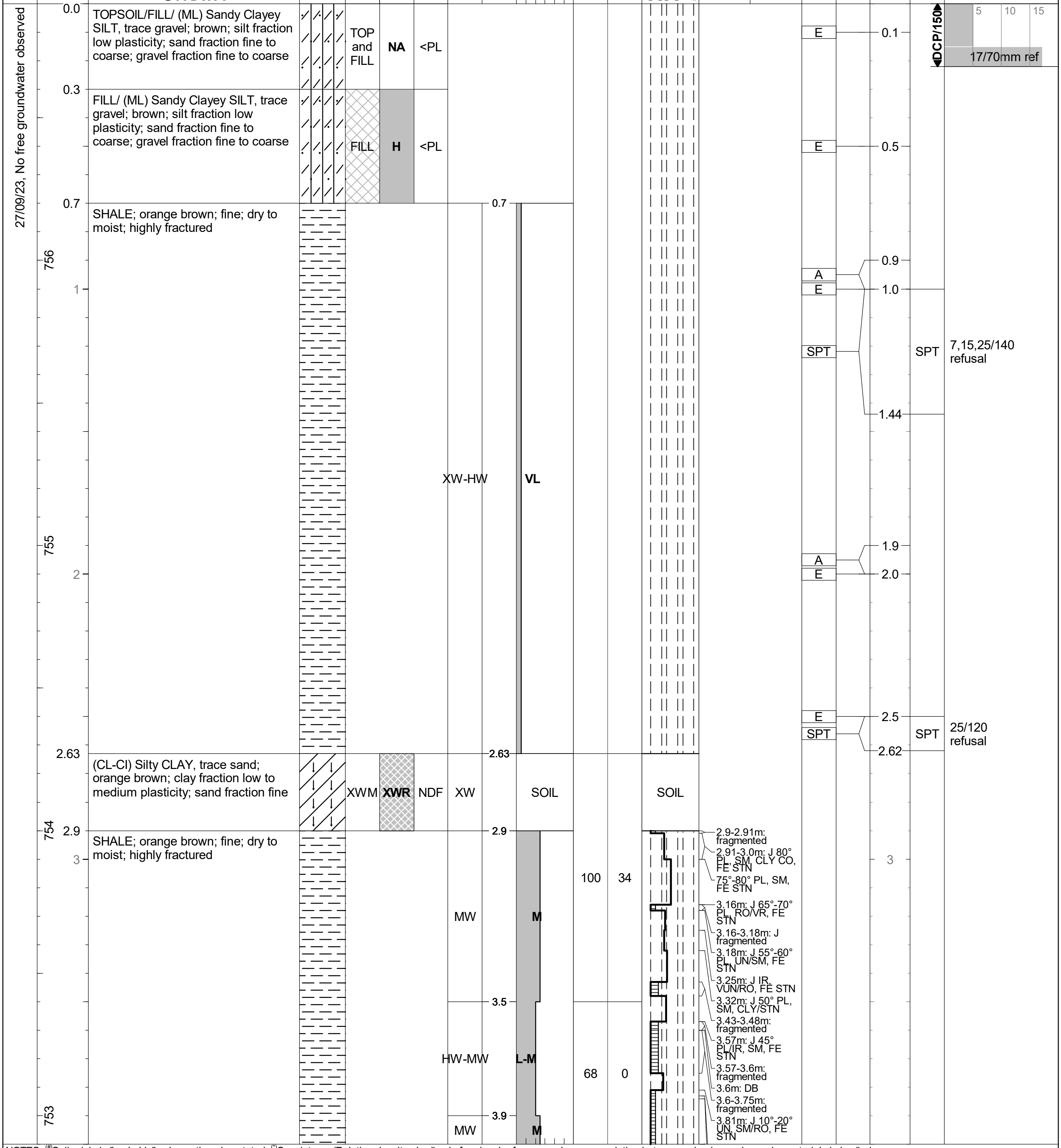
PRELIMINARY GEOTECHNICAL INVESTIGATION
200 WELLSVALE DRIVE, GOOGONG
BORE: 203 DEPTH: 2.5 m – 6.5 m PROJECT: 224779.00 November 2023

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 756.9 AHD
COORDINATE E:702170 **N:** 6077431
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 204
PROJECT No: 224779.04
DATE: 28/09/23
SHEET: 1 of 2



CONDITIONS ENCOUNTERED | **SAMPLE** | **TESTING**

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
27/09/23, No free groundwater observed		0.0	TOPSOIL/FILL/ (ML) Sandy Clayey SILT, trace gravel; brown; silt fraction low plasticity; sand fraction fine to coarse; gravel fraction fine to coarse	TOP and FILL	NA	<PL								E	0.1	DCP/150	17/70mm ref
		0.3	FILL/ (ML) Sandy Clayey SILT, trace gravel; brown; silt fraction low plasticity; sand fraction fine to coarse; gravel fraction fine to coarse	FILL	H	<PL								E	0.5		
	756	0.7	SHALE; orange brown; fine; dry to moist; highly fractured				XW-HW	0.7	VL					A E SPT	0.9 1.0 1.0-1.44	SPT	7,15,25/140 refusal
	755													A E	1.9 2.0		
														E SPT	2.5 2.5-2.62	SPT	25/120 refusal
		2.63	(CL-CI) Silty CLAY, trace sand; orange brown; clay fraction low to medium plasticity; sand fraction fine	XWM	XWR	NDF	XW	2.63	SOIL			SOIL					
	754	2.9	SHALE; orange brown; fine; dry to moist; highly fractured				MW	2.9	M	100	34	2.9-2.91m: fragmented 2.91-3.0m: J 80° PL, SM, CLY CO, FE STN 75°-80° PL, SM, FE STN 3.16m: J 65°-70° PL, RO/VR, FE STN 3.16-3.18m: J fragmented 3.18m: J 55°-60° PL, UN/SM, FE STN 3.25m: J IR, VUN/RO, FE STN 3.32m: J 50° PL, SM, CLY/STN 3.43-3.48m: fragmented			3		
							HW-MW	3.5	L-M	68	0	3.57m: J 45° PL/IR, SM, FE STN 3.57-3.6m: fragmented 3.6m: DB 3.6-3.75m: fragmented 3.81m: J 10°-20° UN, SM/RO, FE STN					
	753						MW	3.9	M								

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.63m, then NMLC to 5.62m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.63m

LOGGED: SK/HS

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 756.9 AHD
COORDINATE E:702170 **N:** 6077431
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 204
PROJECT No: 224779.04
DATE: 28/09/23
SHEET: 2 of 2

CONDITIONS ENCOUNTERED															SAMPLE				TESTING	
					SOIL			ROCK												
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] ▨ DENSITY.[*] ▦	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			SHALE; orange brown; fine; dry to moist; highly fractured *(continued)*					MW HW	4.07	M VL-L				3.83m: FCT 43°-H PL, SM, CLY/FE VN/STN 3.84m: J x2 50°-60° IR, RO, FE STN 4.0m: HB 4.04m: HB 4.05m: J 40°-45° IR, RO, FE STN 4.13m: J 30°-40° IR/UN, RO, FE STN 4.13-4.25m: fragmented fragmented						
		4.25	CORE LOSS						4.25		68	0		4.25-4.63m: core loss						
	752	4.63 5	SHALE; orange brown; fine; dry to moist; highly fractured					MW	4.63	M	100	28		4.63m: DB 4.73m: J 30°-45° UN/IR, RO, FE STN 4.93m: J x2 45°-50° SM, CLY INF, FE STN 5.0-5.06m: fragmented 5.06m: J 45°-50° PL, SM, CLY/FE VN/STN 5.17m: J 10°-20° UN, RO, CLY/FE CO/STN 5.3m: FCT 20°-30° UN, RO, FE STN 5.47m: J 60°-70° PL, SM, FE STN				5		
	751 750 749	5.62 6 7	Borehole discontinued at 5.62m depth Limit of investigation						5.62					5.62m: J 10°-20° UN/IR, RO, CLY/FE CO/STN				6 7		

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.63m, then NMLC to 5.62m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 2.63m

LOGGED: SK/HS

Refer to explanatory notes for symbol and abbreviation definitions

DOUGLAS PARTNERS PTY LTD

PRELIMINARY GEOTECHNICAL INVESTIGATION
200 WELLSVALE DRIVE, GOOGONG
BORE: 204 DEPTH: 2.63 m – 5.6 m PROJECT: 224779.00 November 2023

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 753.3 AHD
COORDINATE E:702341 **N:** 6077427
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 205
PROJECT No: 224779.04
DATE: 28/09/23
SHEET: 1 of 2

CONDITIONS ENCOUNTERED

GROUNDWATER: 27/09/23, No free groundwater observed

RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE
	0.0	FILL/ (CL-CI) Silty CLAY, with sand, trace gravel; brown; clay fraction low to medium plasticity; sand fraction fine to coarse; gravel fraction fine to coarse 0.7m: grey brown	FILL	VST TO H	<PL
753					
	1.1	(CI) Silty CLAY; grey; medium plasticity	RES	VST	<PL
752					
	2.0	(CH) Silty CLAY, trace sand; brown; clay fraction high plasticity; sand fraction fine	XWM	H	<PL
751					
	3.0	SHALE; grey; fine			
750					

ROCK

WEATH.	DEPTH (m)	STRENGTH (VL L M H VH EH)	RECOVERY (%)	RQD	FRACTURE SPACING (m) (0.01 0.05 0.10 0.50 1.00 5.00)
HW	3.0	VL-L	100	33	SEAM SEAM

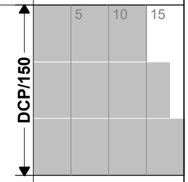
DEFECTS & REMARKS:
- 3.0-3.02m: CS
- 3.06-3.09m: CS
- 3.09m: J 60°-70° PL, RO
- 3.3m: J 80°-85° PL, SM, CLY CO
- 3.42m: J 80°-85° IR, SM, CLY VN
- 3.5m: J 80°-85° PL, SM, FE STN
- 3.58m: J 80°-85° PL, SM
- 3.63m: J 80°-85° PL, SM, CLY CO
- 3.66m: J 80°-85° PL/IR, SM, CLY INF
- 3.73m: J 80°-85° PL, SM
- 3.81m: J 80°-85° PL, SM
- 3.86m: J 80°-85° PL, SM

SAMPLE

SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)
	E		0.1
	A	0.4–0.5	0.4
	E		0.5
	E		1.0
	SPT	1.0–1.45	1.45
	E		1.5
	A	1.9–2.0	1.9
	E		2.0
	E		2.5
	SPT	2.5–2.95	2.95
	E		3.0

TESTING

TEST TYPE	RESULTS AND REMARKS
DCP/150	
SPT	8,13,16 N=29
SPT	8,15,21 N=36



NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 3.0m, then NMLC to 5.9m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 3.0m

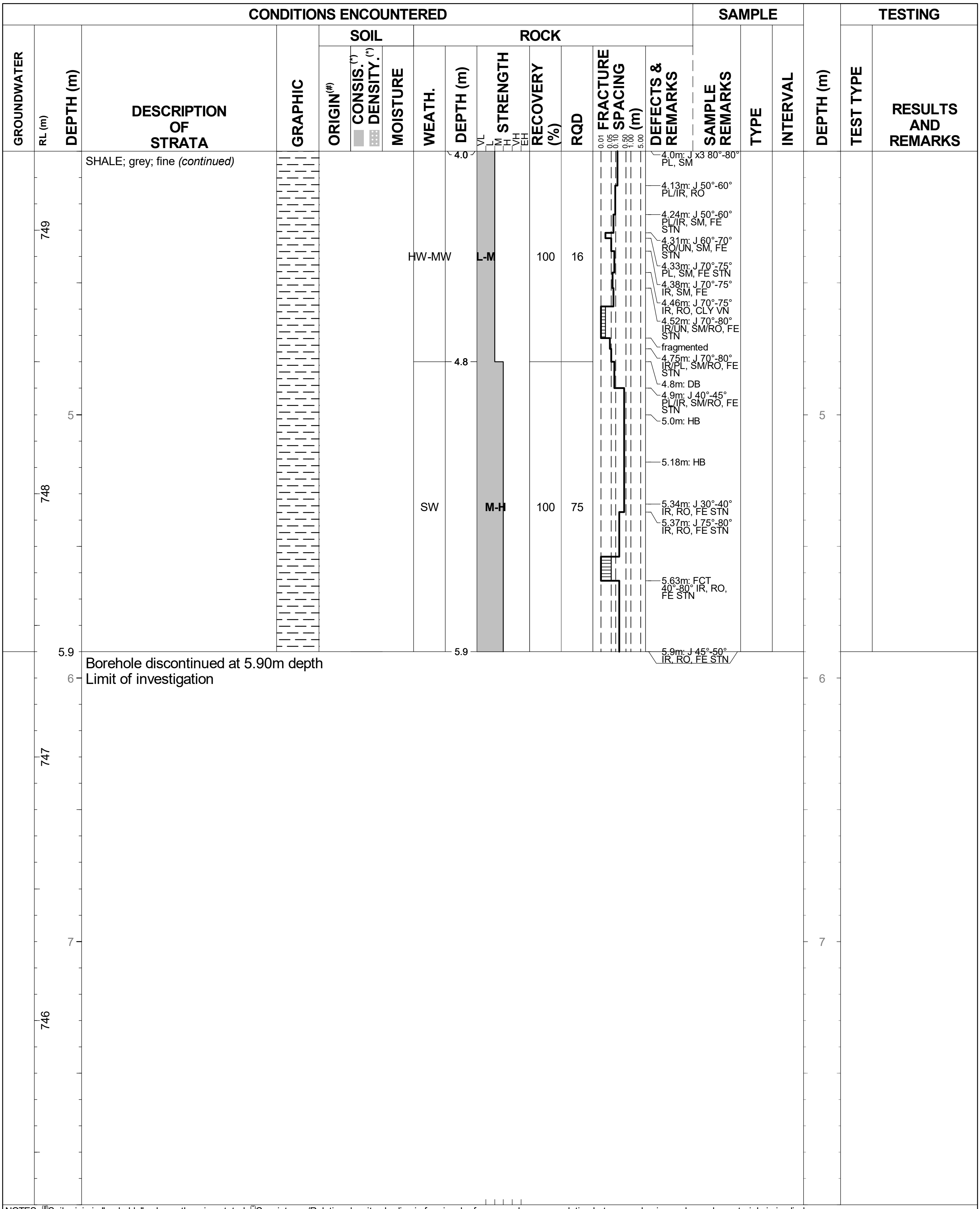
LOGGED: SK/HS

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 753.3 AHD
COORDINATE E:702341 **N:** 6077427
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 205
PROJECT No: 224779.04
DATE: 28/09/23
SHEET: 2 of 2



CONDITIONS ENCOUNTERED					SOIL			ROCK							SAMPLE				TESTING	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] DENSITY.[*]	MOISTURE	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD	FRACTURE SPACING (m)	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			SHALE; grey; fine *(continued)*					HW-MW	4.0	L-M	100	16		4.0m: J x3 80°-80° PL, SM 4.13m: J 50°-60° PL/IR, RO 4.24m: J 50°-60° PL/IR, SM, FE STN 4.31m: J 60°-70° RO/UN, SM, FE STN 4.33m: J 70°-75° PL, SM, FE STN 4.38m: J 70°-75° IR, SM, FE 4.46m: J 70°-75° IR, RO, CLY VN 4.52m: J 70°-80° IR/UN, SM/RO, FE STN fragmented 4.75m: J 70°-80° IR/PL, SM/RO, FE STN						
								SW	4.8	M-H	100	75		4.8m: DB 4.9m: J 40°-45° PL/IR, SM/RO, FE STN 5.0m: HB 5.18m: HB 5.34m: J 30°-40° IR, RO, FE STN 5.37m: J 75°-80° IR, RO, FE STN 5.63m: FCT 40°-80° IR, RO, FE STN						
		5.9	Borehole discontinued at 5.90m depth Limit of investigation						5.9					5.9m: J 45°-50° IR, RO, FE STN						

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 3.0m, then NMLC to 5.9m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX Drilling
CASING: HQ to 3.0m

LOGGED: SK/HS

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Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PRELIMINARY GEOTECHNICAL INVESTIGATION
200 WELLSVALE DRIVE, GOOGONG
BORE: 205 DEPTH: 3.0 m – 5.9 m PROJECT: 224779.00 November 2023

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 760.2 AHD
COORDINATE E:702169 **N:** 6077353
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 206
PROJECT No: 224779.04
DATE: 29/09/23
SHEET: 1 of 2

GROUNDWATER: 27/09/23, No free groundwater observed

DEPTH (m)	RL (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD
0.0	760	TOPSOIL/FILL/ (ML) Clayey SILT, with sand, trace gravel; pale grey brown; gravel fraction fine to coarse; sand fraction fine to coarse	TOP and FILL	NA	<PL					
0.3	759	(CI) Silty CLAY, with sand; grey brown mottled yellow brown; clay fraction medium plasticity; sand fraction fine; with extremely weathered shale, with highly weathered, very low strength seams	XWM	H	<PL					
1.5	758	SHALE; grey brown mottled yellow; fine; highly fractured; dry to moist				HW	1.5	VL-L		
						HW-MW	2.5	L-M	100	0
							3.01	VL-L		
3.1	757	CORE LOSS					3.1			
3.35		SHALE; grey brown mottled yellow; fine; dry to moist				HW	3.35	VL-L	79	0

DEFECTS & REMARKS
- 2.5-2.52m: CS
- 2.63m: J 70° PL, SM, CLY/FE INF/STN
- 2.71m: J 60° PL/IR, RO, FE STN
- 2.8-2.83m: CS
- 2.83-2.88m: fragmented
- 2.88m: J 70°-80° PL, SM, CLY/FE INF/STN
- 3.0m: J x2 10°-75° PL, SM/RO, CLY/FE CO/STN
- 2.49-3.56m: fragmented
- 3.1m: DB
- 3.1-3.35m: KL fragmented
- 3.46m: J CU, RO, FE STN
- 3.49m: J 60° PL, SM, FE STN
- 3.56m: J 50°-60° PL, RO, CLY/FE CO/STN
- 3.65m: J 15°-20° PL/IR, RO, FE STN
- 3.73-3.8m: fragmented
- 3.8-3.9m: extremely weathered material

Fracture spacing: SEAM at 2.5-2.52m, 2.8-2.83m, 3.73-3.8m

TYPE	INTERVAL / DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
E	0.1	DCP/150	20/100mm
A	0.4-0.5		
E	0.5		
SPT	0.5-0.95	SPT	8,13,24 N=37
E	1.0		
A	1.4-1.5		
E	1.5		
E	2.0		
SPT	2.0-2.07	SPT	25/70 refusal
A	2.4-2.5		
E	2.5		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
OPERATOR: RMX drilling
LOGGED: HS
METHOD: SFA to 2.5m, then NMLC to 5.7m
CASING: HQ to 2.5m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

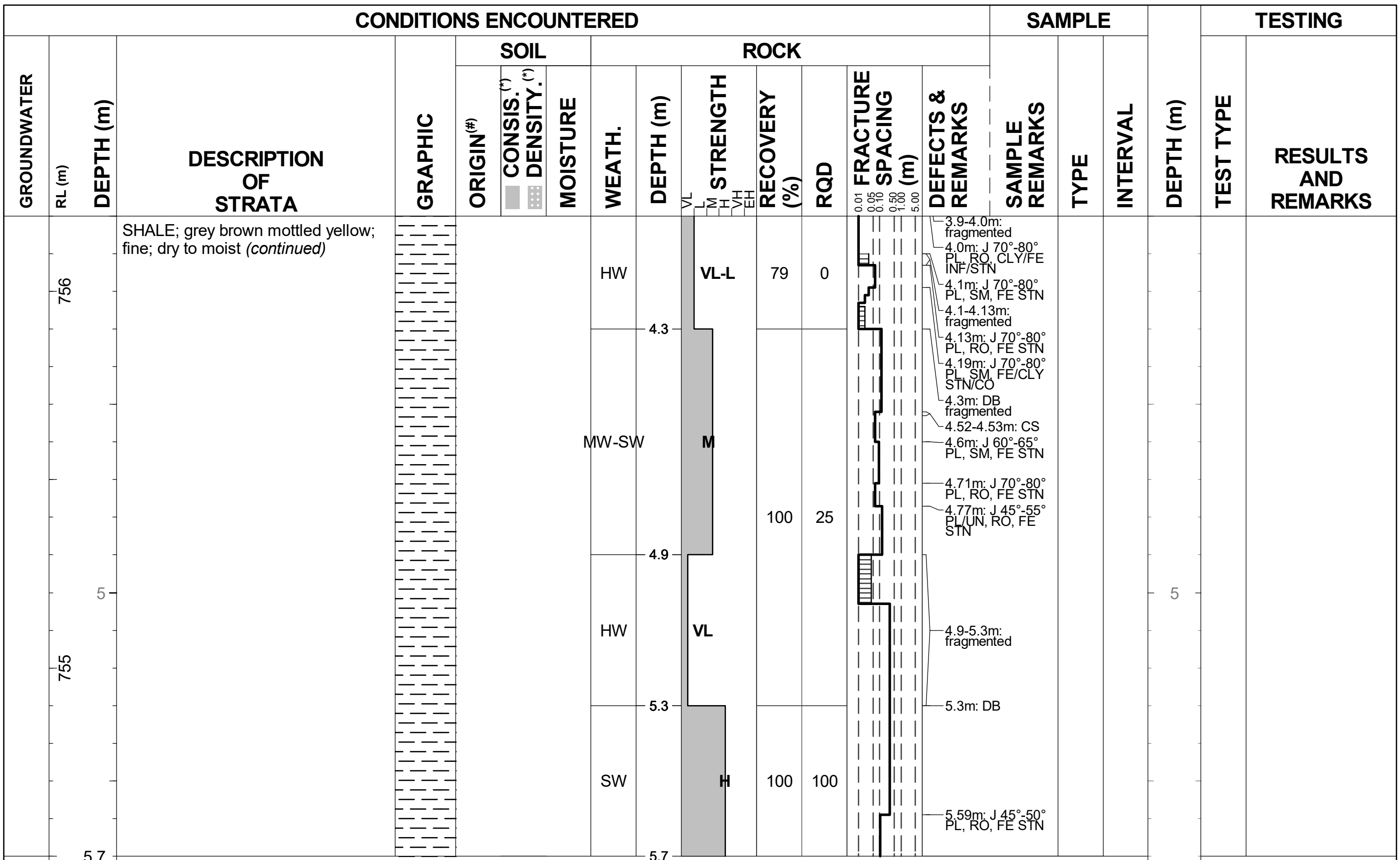
Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed New Public School
LOCATION: 200 Wellsvale Drive, Googong

SURFACE LEVEL: 760.2 AHD
COORDINATE **E:**702169 **N:** 6077353
DATUM/GRID: MGA94 Zone 55
DIP/AZIMUTH: 90°/---

LOCATION ID: 206
PROJECT No: 224779.04
DATE: 29/09/23
SHEET: 2 of 2



Depth (m)	Description of strata	Weath.	Depth (m)	Strength	Recovery (%)	RQD	Defects & remarks
	SHALE; grey brown mottled yellow; fine; dry to moist *(continued)*	HW		VL-L	79	0	3.9-4.0m: fragmented 4.0m: J 70°-80° PL, RO, CLY/FE INF/STN 4.1m: J 70°-80° PL, SM, FE STN 4.1-4.13m: fragmented 4.13m: J 70°-80° PL, RO, FE STN 4.19m: J 70°-80° PL, SM, FE/CLY STN/CO 4.3m: DB fragmented
		MW-SW	4.3	M	100	25	4.52-4.53m: CS 4.6m: J 60°-65° PL, SM, FE STN 4.71m: J 70°-80° PL, RO, FE STN 4.77m: J 45°-55° PL/UN, RO, FE STN
		HW	4.9	VL			4.9-5.3m: fragmented 5.3m: DB
		SW	5.3	H	100	100	5.59m: J 45°-50° PL, RO, FE STN
5.7			5.7				

Borehole discontinued at 5.70m depth
Limit of investigation

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Scout 6
METHOD: SFA to 2.5m, then NMLC to 5.7m
REMARKS: Surface levels and coordinates are approximate only and must not be relied upon.

OPERATOR: RMX drilling
CASING: HQ to 2.5m

LOGGED: HS

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Refer to explanatory notes for symbol and abbreviation definitions

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PRELIMINARY GEOTECHNICAL INVESTIGATION
200 WELLSVALE DRIVE, GOOGONG
BORE: 206 DEPTH: 2.5 m – 5.7 m PROJECT: 224779.00 November 2023

Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style `XW`. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	`KL`
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	`UK`
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	`ND`
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	`NA`

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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Soil Descriptions

Introduction

All materials which are not considered to be “in-situ rock” are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The “classification” comprises a two character “group symbol” providing a general summary of dominant soil characteristics. The “name” summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either “fine grained” (also known as “cohesive” behaviour) or “coarse grained” (“non cohesive” behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	**Particle Size (mm)**	**Behaviour Model**	
		Behaviour	**Approximate Dry Mass**
Boulder	>200	Excluded from particle behaviour model as “oversize”	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer “component proportions” below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a “Sandy CLAY”, this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a “primary”, “secondary”, or “minor” component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	**Definition[1]**	**Relative Proportion**	
		In Fine Grained Soil	**In Coarse Grained Soil**
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer “identification of minor components” below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, “INTERBEDDED Silty CLAY AND SAND”.

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component [1]	**Prominence in Soil Name**
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	**Relative Proportion**	
	In Fine Grained Soil	**In Coarse Grained Soil**
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	**Laboratory liquid limit range**	
	Silt	**Clay**
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		**Particle size (mm)**
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	**Particle size (mm)**
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	“oozes” when agitated	w=LL
	Wet of liquid limit	“oozes”	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning “not-assessable due to drilling fluid use” may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the “consistency” describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented “strength” is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Soil Descriptions

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as “extremely weathered material” in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than ‘very low’ as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be “oversize” may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with “MIXTURE OF”.

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Rock Descriptions

March 2024

Rock Strength

Rock strength is defined by the unconfined compressive strength, and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

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

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

[1] Rock strength classification is based on UCS. The UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site. The point load Index ranges shown above are as suggested in AS1726 and should not be relied upon without supporting evidence.

The following abbreviation codes are used for soil layers or seams of material "within rock" but for which the equivalent UCS strength is less than 0.6 MPa.

Scenario	Abbreviation Code
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the "Description of Strata" and soil properties columns.	SOIL
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column.	SEAM

Degree of Weathering

The degree of weathering of rock is classified as follows:

Weathering Term	Description	Abbreviation Code
Residual Soil[1]	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.	RS
Extremely weathered[1]	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	XW
Highly weathered	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.	HW
Moderately weathered	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.	MW
Slightly weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	SW
Fresh	No signs of decomposition or staining.	FR
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.	DW

[1] The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

Rock Descriptions

Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

Term	Description	Abbreviation Code
Extremely altered	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.	XA
Highly altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching or may be decreased due to precipitation of secondary materials in pores.	HA
Moderately altered	The whole of the rock material is discoloured, usually by 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.	MA
Slightly altered	Rock is slightly discoloured but shows little or no change of strength from fresh rock	SA
Note: If HA and MA cannot be differentiated use DA (see below)		
Distinctly altered	Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching or may be decreased due to precipitation of secondary minerals in pores.	DA

Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e., drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Rock Descriptions

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Cleavage	CL
Crushed seam	CS
Crushed zone	CZ
Drilling break	DB
Decomposed seam	DS
Drill lift	DL
Extremely Weathered seam	EW
Fault	F
Fracture	FC
Fragmented	FG
Handling break	HB
Infilled seam	IS
Joint	JT
Lamination	LAM
Shear seam	SS
Shear zone	SZ
Vein	VN
Mechanical break	MB
Parting	P
Sheared Surface	S

Rock Defect Orientation

Term	Abbreviation Code
Horizontal	H
Vertical	V
Sub-horizontal	SH
Sub-vertical	SV

Rock Defect Coating

Term	Abbreviation Code
Clean	CN
Coating	CT
Healed	HE
Infilled	INF
Stained	SN
Tight	TI
Veneer	VNR

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLAY
Iron oxide	FE
Manganese	MN
Pyrite	Py
Secondary material	MS
Silt	M
Quartz	Qz
Unidentified material	MU

Rock Defect Shape/Planarity

Term	Abbreviation Code
Curved	CU
Discontinuous	DIS
Irregular	IR
Planar	PR
Stepped	ST
Undulating	UN

Rock Defect Roughness

Term	Abbreviation Code
Polished	PO
Rough	RF
Smooth	SM
Slickensided	SL
Very rough	VR

Defect Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

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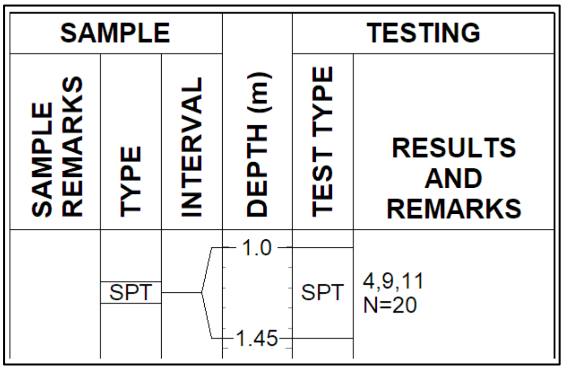
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

October 2024

Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Driven Tube sample	DT
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =*x* blows for *y* mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP9/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 755.7 AHD
COORDINATE: E:702352.5, N:6077387.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 301
PROJECT No: 224779.01
DATE: 09/12/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED

GROUNDWATER: 09/12/24 No free groundwater observed

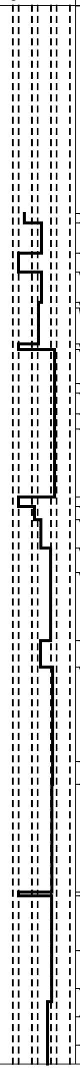
RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE
		FILL / Silty Sandy CLAY (CL), trace gravel: brown; low plasticity; fine to coarse sand; fine to medium gravel.	possibly FILL	(VSt) to (H)	w<PL
755	0.70	TUFF: yellow brown mottled grey, fine to medium grained 1.10m: TC bit refusal From 3.30m: yellow brown mottled white			
	5.60	Borehole discontinued at 5.60m depth. Limit of investigation.			

RL scale: 755, 754, 753, 752, 751. Depth scale: 1, 2, 3, 4, 5, 6, 7.

ROCK

WEATH.	DEPTH (m)	STRENGTH	RECOVERY (%)	RQD
XW	0.70 – 1.10	VL		
HW to MW	1.10 – 2.00	M to H	100	95
HW	2.00 – 2.85	L		
SW	2.85 – 5.60	M to H	100	95

Strength scale: VL L M H VH EH. Fracture spacing scale (m): 0.005 0.01 0.05 0.10 0.50 1.00 5.00



DEFECTS & REMARKS

- 1.10-1.15m : FG, 45°, PR, SN Fe, RF, UN
- 1.31m: JT, 35°, PR, SN Fe, RF, UN Clay CT
- 1.41m : JT, 60°, PR, SN Fe, RF, UN
- 1.57m: JT, 60°, PR, SN Fe, RF, UN
- 1.60m: JT
- 1.79-1.82m: DS
- 2.00m: HB
- 2.05m: HB
- 2.16m : HB
- 2.24m: HB
- 2.60m : DB
- 2.65m: FG
- 2.72m: JT, 15°, PR, CT Clay, RF, UN
- 2.87m: JT, 25°, PR, RF
- 3.00m: HB
- 3.36m: JT, 80°, PR, CT Clay, RF, UN Fe SN
- 3.50m: JT x2x, 60° /15°, PR, SN Fe, RF, UN
- 4.00m : HB
- 4.12m: JT, 30°, PR, RF, UN
- 4.69-4.71m: DS
- 5.00m: HB
- 5.20-5.35m: JT, 70°, PR, SN Fe, RF
- 5.50m: JT, IR, SN Fe, RF

SAMPLE

SAMPLE REMARKS	TYPE	DEPTH (m)
	A	0.10
	A	0.50
	SPT	1.00 – 1.09
	A	

TESTING

DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
1.00 – 1.09	SPT	13/90 (HB)
~1.9	PLT	PL(D)=1.3MPa
~2.95	PLT	PL(D)=0.34MPa *
~3.9	PLT	PL(D)=2.2MPa
	PLT	PL(A)=1.6MPa
	PLT	PL(D)=1.3MPa
~5.5	PLT	PL(D)=0.75MPa *

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Samuval
METHOD: AD to 1.1m, then NMLC to 5.6m
CASING: HQ to 1.1m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

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Douglas Partners
Geotechnics / Environment / Groundwater
Project No: 224779.01
BH ID: Bore 301
Depth: 1.1 - 5.6m
Core Box No.: 1
224779.01
BORE 301 START @ 1.1m
2.0
3.0
4.0
5.0
BORE 301 ENDS @ 5.6m

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.6 AHD
COORDINATE: E:702300.9, N:6077444.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 302
PROJECT No: 224779.01
DATE: 09/12/24
SHEET: 1 of 2

CONDITIONS ENCOUNTERED

GROUNDWATER	DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH
09/12/24 No free groundwater observed	0.10	TOPSOIL / Silty Sandy CLAY (CL): pale brown; low plasticity; fine to medium sand; trace rootlets. FILL.		NA	w<PL			
		Silty CLAY (CH), trace sand: red brown; high plasticity; fine to coarse sand.	RS	(VSt) to (H)	w<PL			
	0.80	Silty CLAY (CI): yellow brown mottled black; medium plasticity; trace weathered rock fragments. From 2.00m: grading to very low strength rock	XWM	VSt	w<PL			
	2.70	SHALE: yellow brown, fine grained; laminated From 5.60m: with iron staining, with bands of extremely weathered/residual material				HW	2.70	VL

RL (m): 752, 751, 750, 749, 748, 747, 746, 745

SAMPLE / TESTING

TYPE	INTERVAL DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
A	0.50		
A	1.00		
SPT	1.00 – 1.45	SPT	4,7,10 N=17
A	2.00		
A	2.50		
SPT	2.50 – 2.95	SPT	14,17,24 N=41
SPT	4.00 – 4.28	SPT	15,30/130 (HB) Bouncing on quartz gravel
A	5.50		
SPT	5.50 – 5.95	SPT	8,13,22 N=35
A	7.00		
SPT	7.00 – 7.45	SPT	9,20,28 N=48

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Samuval
METHOD: AD to 10.6m, then NMLC to 12.7m
CASING: to 10.6m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.6 AHD
COORDINATE: E:702300.9, N:6077444.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 302
PROJECT No: 224779.01
DATE: 09/12/24
SHEET: 2 of 2

CONDITIONS ENCOUNTERED															SAMPLE				TESTING	
					SOIL			ROCK												
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.005 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			[CONT] SHALE: yellow brown, fine grained; laminated					HW		VL						A		8.50		
	744															SPT	8.50–8.95		SPT	10,16,21 N=37
		9																8.95		
	743																			
		10														A		10.00		
																SPT	10.00–10.45	10.45	SPT	7,12,14 N=26
	742		10.60m: TC bit refusal. From 10.6m: yellow brown mottled grey, trace very high strength bands.					HW to MW	10.60	M	100	36		10.60-10.80m : FG		A		10.60		
								MW	10.80	M to H				10.90m: JT, 60°, PR, RF						
		11						SW	11.00	H	100	78		11.00m: JT, 10°, PR, RF, UN 11.08m: JT, 85°, PR, RF, UN 11.15m : DB 11.26m: JT, 85°, PR, SN Fe, RF, UN 11.32m: JT, 20°, UN, RF, IR 11.50m : JT, 65°, PR, RF, UN 11.73m: JT 11.80m: JT, 0°/70°, PR, SM 11.82m: HB 11.94m: HB				11	PLT	PL(D)=1.7MPa
	741																		PLT	PL(A)=3.3MPa
		12						MW	12.00	M to H	100	46		12.00m : HB 12.06-12.15m: FC 12.15m: DB 12.36m : JT, 70°, PR, SM, UN 12.50m: JT, 70°, PR, CT Clay, RF, UN; 100% water loss 12.54m: JT, 70°, PR 12.61m: JT, 70°, PR, RF, UN 12.64-12.70m: FC				12	PLT	PL(D)=0.35MPa *
	0+		12.50m-12.70m: 100% water loss																	
		13	Borehole discontinued at 12.70m depth. Limit of investigation.																	
		14																		
		15																		

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

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PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Samuval
METHOD: AD to 10.6m, then NMLC to 12.7m
CASING: to 10.6m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS


Douglas Partners
Geotechnics | Environment | Groundwater
Project No: 224779.01
BH ID: Bore 302
Depth: 10.6-12.7m
Core Box No.: 1
224779.01, BORE 302 CORING STARTED @ 10.6m
11.0
12.0
BORE 302, ENDS @ 12.7m

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.5 AHD
COORDINATE: E:702262.2, N:6077494.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 303
PROJECT No: 224779.01
DATE: 09/12/24 - 10/12/24
SHEET: 1 of 3

CONDITIONS ENCOUNTERED

GROUNDWATER: 09/12/24 No free groundwater observed

DEPTH (m)	RL (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE
0.20		TOPSOIL / Silty Sandy CLAY (CL): pale grey brown; low plasticity; fine to medium sand.	TOP and FILL	NA	w<PL to w=PL
2.60	750	FILL / Silty CLAY (CI-CH), with sand, trace gravel: yellow brown mottled grey mottled orange; medium to high plasticity; fine to medium sand; fine gravel.	FILL	F to St	w<PL to w=PL
3.50	749	Silty CLAY (CL), trace sand: dark brown mottled yellow; low plasticity; fine to medium sand; with iron staining.	XWM	St to VSt	w<PL to w=PL
		Silty CLAY (CL), trace sand: dark brown mottled orange; fine sand. From 7.00m: trace quartz gravel	XWM	F to St	w=PL

RL (m) scale: 752, 751, 750, 749, 748, 747, 746, 745. Depth scale: 1, 2, 3, 4, 5, 6, 7.

SAMPLE / **TESTING**

TYPE	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
A	0.50		
A	1.00		
SPT	1.00 – 1.45	SPT	2,3,4 N=7
A	2.00		
A	2.50		
SPT	2.50 – 2.95	SPT	3,7,9 N=16
SPT	4.00 – 4.45	SPT	3,5,6 N=11
A	5.00		
SPT	5.50 – 5.95	SPT	2,2,3 N=5
A	6.50		
SPT	7.00 – 7.45	SPT	1,5,4 N=9

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Samuval
METHOD: NMLC to 17.5m, then NMLC to 18.6m
CASING: HWT to 7.1m, then HQ to 14.6m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

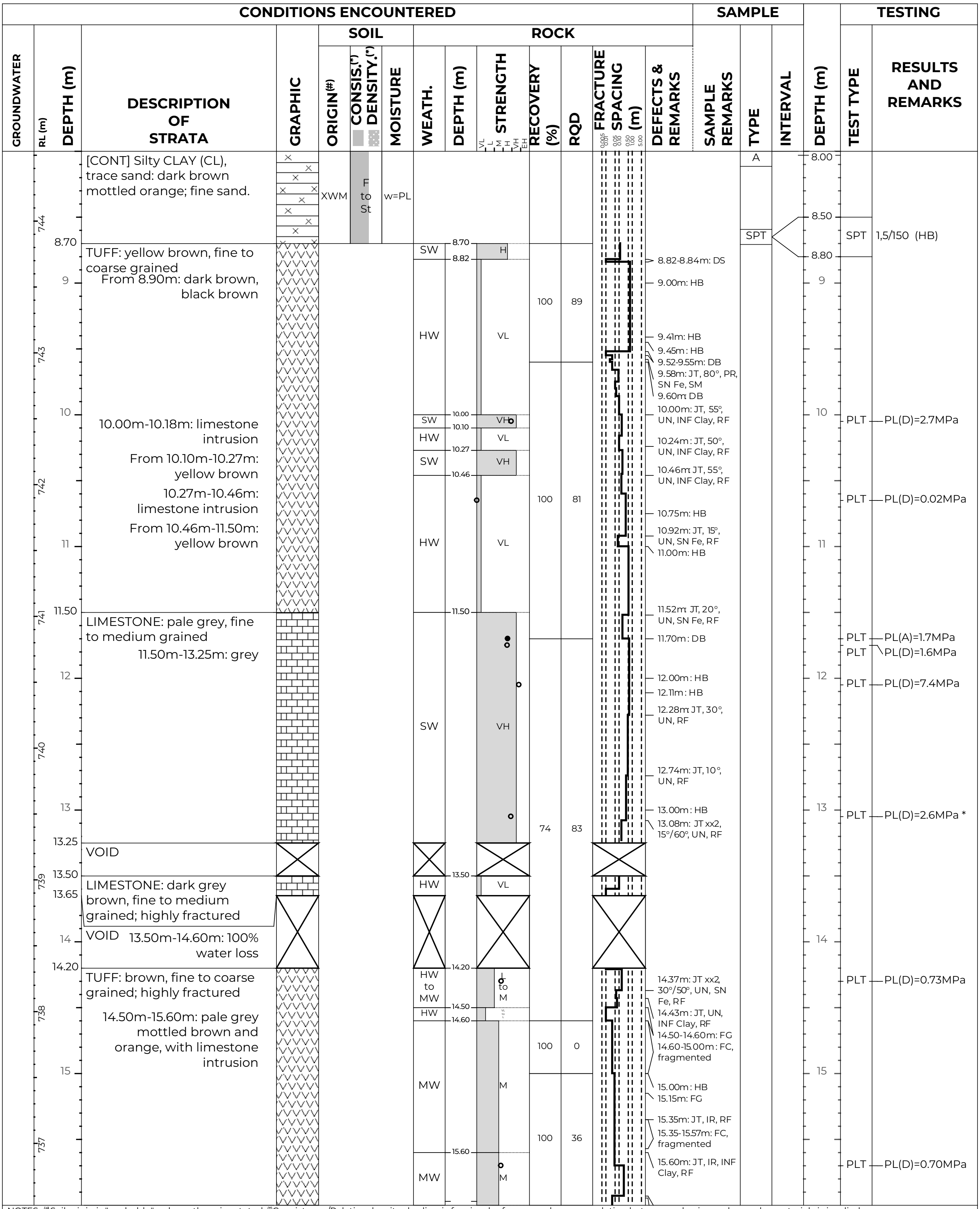
Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.5 AHD
COORDINATE: E:702262.2, N:6077494.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 303
PROJECT No: 224779.01
DATE: 09/12/24 - 10/12/24
SHEET: 2 of 3



DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN	CONSIS. DENSITY	MOISTURE
	[CONT] Silty CLAY (CL), trace sand: dark brown mottled orange; fine sand.	XWM	F to St	w=PL
8.70	TUFF: yellow brown, fine to coarse grained From 8.90m: dark brown, black brown 10.00m-10.18m: limestone intrusion From 10.10m-10.27m: yellow brown 10.27m-10.46m: limestone intrusion From 10.46m-11.50m: yellow brown			
11.50	LIMESTONE: pale grey, fine to medium grained 11.50m-13.25m: grey			
13.25	VOID			
13.50	LIMESTONE: dark grey brown, fine to medium grained; highly fractured			
13.65	VOID 13.50m-14.60m: 100% water loss			
14.20	TUFF: brown, fine to coarse grained; highly fractured 14.50m-15.60m: pale grey mottled brown and orange, with limestone intrusion			

WEATH.	DEPTH (m)	STRENGTH
SW	8.70	H
HW	8.82	VL
SW	10.00	VH
HW	10.10	VL
SW	10.27	VH
HW	10.46	VL
SW	11.50	VH
HW	13.50	VL
HW to MW	14.20	L to M
HW	14.50	
MW	14.60	M
MW	15.60	M

RECOVERY (%)	RQD
100	89
100	81
74	83
100	0
100	36

DEFECTS & REMARKS

- 8.82-8.84m: DS
- 9.00m: HB
- 9.41m: HB
- 9.45m: HB
- 9.52-9.55m: DB
- 9.58m: JT, 80°, PR, SN Fe, SM
- 9.60m: DB
- 10.00m: JT, 55°, UN, INF Clay, RF
- 10.24m: JT, 50°, UN, INF Clay, RF
- 10.46m: JT, 55°, UN, INF Clay, RF
- 10.75m: HB
- 10.92m: JT, 15°, UN, SN Fe, RF
- 11.00m: HB
- 11.52m: JT, 20°, UN, SN Fe, RF
- 11.70m: DB
- 12.00m: HB
- 12.11m: HB
- 12.28m: JT, 30°, UN, RF
- 12.74m: JT, 10°, UN, RF
- 13.00m: HB
- 13.08m: JT xx2, 15°/60°, UN, RF
- 14.37m: JT xx2, 30°/50°, UN, SN Fe, RF
- 14.43m: JT, UN, INF Clay, RF
- 14.50-14.60m: FG
- 14.60-15.00m: FC, fragmented
- 15.00m: HB
- 15.15m: FG
- 15.35m: JT, IR, RF
- 15.35-15.57m: FC, fragmented
- 15.60m: JT, IR, INF Clay, RF

TYPE	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
A	8.00		
SPT	8.50 - 8.80	SPT	1,5/150 (HB)
		PLT	PL(D)=2.7MPa
		PLT	PL(D)=0.02MPa
		PLT	PL(A)=1.7MPa
		PLT	PL(D)=1.6MPa
		PLT	PL(D)=7.4MPa
		PLT	PL(D)=2.6MPa *
		PLT	PL(D)=0.73MPa
		PLT	PL(D)=0.70MPa

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Combined Log

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Samuval
METHOD: NMLC to 17.5m, then NMLC to 18.6m
CASING: HWT to 7.1m, then HQ to 14.6m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.5 AHD
COORDINATE: E:702262.2, N:6077494.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 303
PROJECT No: 224779.01
DATE: 09/12/24 - 10/12/24
SHEET: 3 of 3

CONDITIONS ENCOUNTERED

RL (m)	DEPTH (m)	DESCRIPTION OF STRATA
	16.00	TUFF: pale grey mottled brown and orange, fine to coarse grained; limestone intrusion. 16-17.5m: 100% water loss
736	16.45	CORE LOSS
	16.70	TUFF: brown, fine to coarse grained; highly fractured
735	17.50	LIMESTONE: dark brown mottled grey, fine to medium grained; slightly fractured From 18.05m: pale grey mottled yellow
34		
		Borehole discontinued at 18.60m depth. Limit of investigation.

ROCK

WEATH.	DEPTH (m)	STRENGTH
MW to SW	16.00	H to VH
HW	16.40	
	16.45	
HW	16.70	VL to L
MW	17.50	M
SW	18.00	H
HW to MW	18.35	L to M

RECOVERY (%)	RQD
100	36
83	0
100	0
100	61

DEFECTS & REMARKS

- 15.93-16.07m: FG
- 15.95m: JT, UN, INF Clay, RF
- 16.05m: JT, IR, SN Fe, RF
- 16.25m: FC, 0°/90°, ST, SN Fe, RF
- 16.36-16.45m: DS, fragmented
- 16.70-17.00m: DS, fragmented
- 17.20m: JT, IR, SN Fe, RF
- 17.20-17.23m: CS
- 17.30-17.50m: FG
- 17.65m: JT, IR, SN Fe, RF
- 17.70m: JT, UN, SN Fe, RF
- 17.80m: JT, UN, SN Fe, RF
- 17.81m: HB
- 17.92-18.03m: FG
- 18.55-18.60m: FG

TESTING

TEST TYPE	RESULTS AND REMARKS
PLT	PL(D)=3.4MPa
PLT	PL(D)=2.2MPa *
PLT	PL(D)=0.24MPa *
PLT	PL(D)=3.5MPa

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Samuval
METHOD: NMLC to 17.5m, then NMLC to 18.6m
CASING: HWT to 7.1m, then HQ to 14.6m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions


Douglas Partners
Geotechnics | Environment | Groundwater
Project No: 224779.01
BH ID: 303
Depth: 8.7-18.6m
Core Box No.: 1
224779.01, BORE 303, START DEPTH @ 8.7m →
9.0
10.0
11.0
12.0
13.0
CORE LOSS / VOID
VOID / CORE LOSS
14.0
VOID/CORE LOSS
15
16
16.45 Core Loss 16.7m
17
18
224779.01 Core finish @ 18.6m Bore 303

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.1 AHD
COORDINATE: E:702238.9, N:6077538.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 304
PROJECT No: 224779.01
DATE: 12/12/24
SHEET: 1 of 2

CONDITIONS ENCOUNTERED

GROUNDWATER: 12/12/24 No free groundwater observed

RL (m)	DEPTH (m)
752	0
751	1
750	2
749	3
748	4
747	5
746	6
745	7

DEPTH (m)	DESCRIPTION OF STRATA	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY.(*)	SOIL: MOISTURE	ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH
0.00–0.70	FILL / Silty Sandy CLAY (CI-CH), trace gravel: brown and red; medium to high plasticity; fine to coarse sand; fine to coarse gravel.	FILL	(St) to (VSt)	w=PL to w<PL			
0.70	Silty CLAY (CL-CI): orange brown; low to medium plasticity; with very low strength rock fragments.	RS becoming XWM	St to VSt	w=PL to w<PL			
2.50			VSt				
3.20	3.20m-3.70m: red brown						
3.70	From 3.70m: black red brown, with low strength rock fragments						
5.30	Silty CLAY (CL-CI): red brown white; low to medium plasticity.	XWM	VSt	w=PL to w<PL			
7.20	TUFFACEOUS SHALE: yellow brown mottled red, fine to medium grained; laminated, with bands of extremely weathered and residual material				HW	7.20	VL

Strength scale: VL L M H VH EH

Fracture spacing (m): 0.005 0.01 0.05 0.10 0.50 1.00 5.00

SAMPLE / TESTING

DEPTH (m)	TYPE	TEST TYPE	RESULTS AND REMARKS
0.40–0.50	A		
0.90–1.00	A		
1.00–1.45	SPT	SPT	7,8,8 N=16
1.90–2.00	A		
2.40–2.50	A		
2.50–2.95	SPT	SPT	5,8,10 N=18
3.40–3.50	A		
3.90–4.00	A		
4.00–4.45	SPT	SPT	6,10,14 N=24
5.50–5.95	SPT	SPT	7,10,16 N=26
7.00–7.30	SPT	SPT	10,19/150 (HB)

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 8.6m, then NMLC to 15.1m
CASING: HQ to 8.65m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Combined Log

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 752.1 AHD
COORDINATE: E:702238.9, N:6077538.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 304
PROJECT No: 224779.01
DATE: 12/12/24
SHEET: 2 of 2

RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	WEATH.	STRENGTH	RECOVERY (%)	RQD	DEFECTS & REMARKS	TEST TYPE	RESULTS AND REMARKS
744		[CONT] TUFFACEOUS SHALE: yellow brown mottled red, fine to medium grained; laminated, with bands of extremely weathered and residual material 8.60m: auger refusal	HW	VL	100	0	8.60-8.80m: DS, INF Clay 8.80-8.90m: FG		
743	9	From 9.20m: black mottled red and brown			100	31	8.90m: DB 9.00m: HB 9.05m: JT, 45-50°, UN, INF Clay, RF 9.15-9.25m: FG 9.35-9.45m: FG 9.55m: P, IR, SN Fe, RF 9.80m: P, IR, SN Fe, RF 9.80-9.95m: JT, 60°, SN Fe, RF 10.00-10.10m: DB	PLT	PL(D)=0.01MPa
742	10	From 10.10m: red brown and orange brown			100	71	10.45m: P, IR, SN Fe, RF 10.60m: P, IR, RF 10.90-11.00m: JT, 70-90°, UN, SM 11.00m: P, 10°, UN, RF 11.15m: JT, 30°, UN, RF 11.20m: JT, 20°, PR, RF 11.25m: JT, RF 11.40m: JT, ST, SM 11.50m: JT, IR, RF	PLT PLT	PL(D)=0.01MPa PL(A)=0.02MPa
741	11	From 11.45m: red From 11.84m: red brown and orange brown							
740	12				100	50	11.80-12.05m: FG 11.85m: DB	PLT	PL(D)=0.02MPa
	12.20	CORE LOSS			0	0			
	12.40	TUFFACEOUS SHALE: red brown and orange brown, fine to medium grained; laminated, with bands of extremely weathered and residual material	HW	VL	100	73	12.40-12.45m: DS 13.00m: HB 13.05-13.15m: JT, UN, SM, fragmented 13.30-13.55m: FC, 50°, PR, SM, fractured 5-10 mm spacing		
739	13								
738	14				100	64	13.55m: DB 13.55-13.85m: FC, 45-60°, PR, SM, fractured 30-40 mm spacing 13.95-14.05m: FG 14.65m: P, IR, SN Fe, RF 14.85m: JT, IR, RF 14.90m: JT, IR, RF 15.00-15.10m: FG	PLT PLT	PL(D)=0.01MPa PL(D)=0.01MPa
7	15								
		Borehole discontinued at 15.10m depth. Limit of investigation.							

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 8.6m, then NMLC to 15.1m
CASING: HQ to 8.65m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions


Douglas Partners
Geotechnics | Environment | Groundwater
Project No: 224779.01
BH ID: 304
Depth: 8.6–15
Core Box No.: 1
224779.01 Googong School Bore 304 12/12/24 Core Start @ 8.6m →
9
10
11
12
12.2 Core loss 12.4
13
14
15
224779.01 Googong School Bore 304 12/12/24 Core finished @ 15.1m

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 754.6 AHD
COORDINATE: E:702177.3, N:6077531.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 305
PROJECT No: 224779.01
DATE: 11/12/24
SHEET: 1 of 3

CONDITIONS ENCOUNTERED

GROUNDWATER: 11/12/24 No free groundwater observed

DEPTH (m)	DESCRIPTION OF STRATA	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH
0.00–0.70	FILL / Silty Sandy CLAY (CI-CH), trace gravel: dark brown; medium to high plasticity; fine to coarse sand; fine to coarse gravel; with rootlets.	FILL	(St) to (VSt)	w=PL to w>PL			
0.70–2.30	Silty CLAY (CL-CI): pale red and white; low to medium plasticity; trace weathered rock fragments.	RS becoming XWM	VSt	w=PL			
2.30–	TUFFACEUS SHALE: brown mottled pink, fine grained; highly fractured, with bands of residual/extremely weathered material				HW	2.30	VL to L

RL (m): 754 at approx. 0.6 m; 753 at 1.6 m; 752 at 2.6 m; 751 at 3.6 m; 750 at 4.6 m; 749 at 5.6 m; 748 at 6.6 m; 747 at 7.6 m

STRENGTH scale: VL L M H VH EH
FRACTURE SPACING (m): 0.005 0.01 0.05 0.10 0.50 1.00 5.00

RECOVERY (%), RQD, DEFECTS & REMARKS: not recorded on this sheet

SAMPLE / TESTING

TYPE	INTERVAL DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
A	0.40–0.50		
A	0.90–1.00		
SPT	1.00–1.45	SPT	7,12,11 N=23
A	1.90–2.00		
SPT	2.50–2.95	SPT	17,19,25 N=44
SPT	4.00–4.28	SPT	21,25/125 (HB)
SPT	5.50–5.63	SPT	19/130 (HB)
SPT	7.00–7.13	SPT	20/130 (HB)

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 2.2m, then AT to 14.65m, then HMLC to 18.75m
CASING: HWT to 8.75m, then HQ to 14.6m
REMARKS: Rock core is too fractured for point load testing. Surface levels and coordinates are approximate only and must not be relied upon.

Refer to explanatory notes for symbol and abbreviation definitions

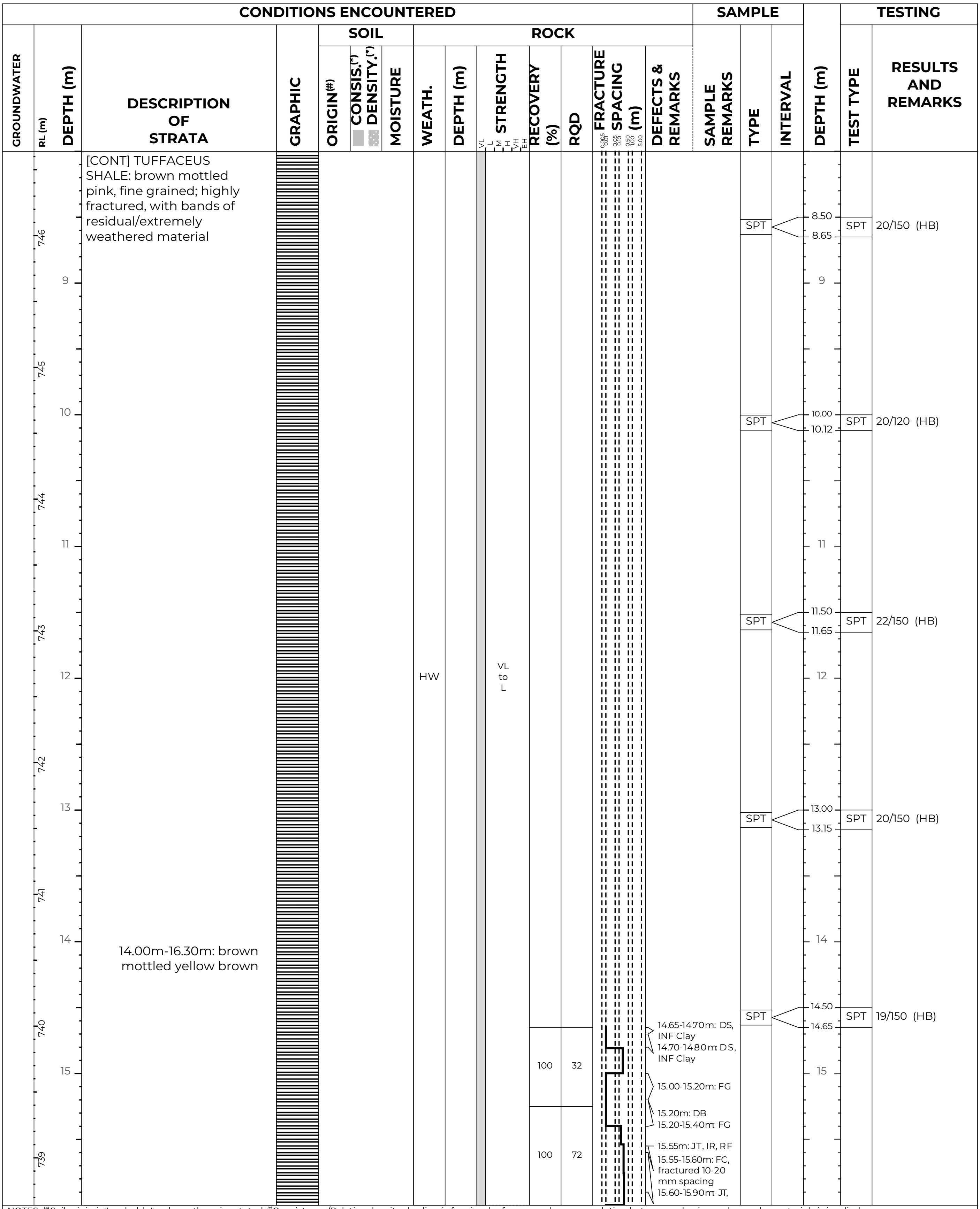
Douglas PARTNERS

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 754.6 AHD
COORDINATE: E:702177.3, N:6077531.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 305
PROJECT No: 224779.01
DATE: 11/12/24
SHEET: 2 of 3



[CONT] TUFFACEUS SHALE: brown mottled pink, fine grained; highly fractured, with bands of residual/extremely weathered material

14.00m-16.30m: brown mottled yellow brown

WEATH.: HW

STRENGTH: VL to L

RECOVERY (%)	RQD
100	32
100	72

14.65-14.70m: DS, INF Clay
14.70-14.80m: DS, INF Clay
15.00-15.20m: FG
15.20m: DB
15.20-15.40m: FG
15.55m: JT, IR, RF
15.55-15.60m: FC, fractured 10-20 mm spacing
15.60-15.90m: JT,

TYPE	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
SPT	8.50 8.65	SPT	20/150 (HB)
SPT	10.00 10.12	SPT	20/120 (HB)
SPT	11.50 11.65	SPT	22/150 (HB)
SPT	13.00 13.15	SPT	20/150 (HB)
SPT	14.50 14.65	SPT	19/150 (HB)

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 2.2m, then AT to 14.65m, then HMLC to 18.75m
CASING: HWT to 8.75m, then HQ to 14.6m
REMARKS: Rock core is too fractured for point load testing. Surface levels and coordinates are approximate only and must not be relied upon.

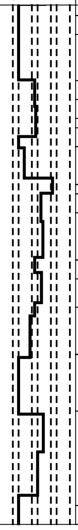
Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 754.6 AHD
COORDINATE: E:702177.3, N:6077531.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 305
PROJECT No: 224779.01
DATE: 11/12/24
SHEET: 3 of 3

CONDITIONS ENCOUNTERED															SAMPLE				TESTING	
					SOIL			ROCK												
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.005 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	738 737 736	17 18	[CONT] TUFFACEOUS SHALE: brown mottled pink, fine grained; highly fractured, with bands of residual/extremely weathered material 16.30m-16.70m: brown mottled pink 16.70m-17.30m: red mottled white 17.30m-18.00m: red 18.00m-18.75m: brown mottled yellow brown, fractured	▤				HW		VL to L	100 100 100	72 0 46		70-90°, INF Clay, SM 16.00m: HB 16.00-16.10m: FG 16.10m: DB 16.10-16.40m: FG 16.50-16.60m: JT x2, 50°, PR, RF 16.65-16.75m: FG 16.75-16.95m: FC, fractured 10-20 mm spacing 16.95-17.00m: FG 17.00-17.10m: JT, 60°, PR, SN Fe, SM 17.10-17.35m: JT, 60°, PR, SN Fe, SM 17.35m: IS 17.45m: DB, IR, INF CBS, RF 17.60m: B, IR, INF Clay, RF 17.60-17.85m: JT x2, 70-80°, CU, SN, RF 17.85m: P, IR, INF Clay, RF 17.85-18.15m: FG 18.15-18.65m: JT, 70°, PR, SM 18.65-18.75m: FG				17 18		
								HW to MW	18.20	L to M										
		19 20 21 22 23	Borehole discontinued at 18.75m depth. Limit of investigation.																	

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 2.2m, then AT to 14.65m, then HMLC to 18.75m
CASING: HWT to 8.75m, then HQ to 14.6m
REMARKS: Rock core is too fractured for point load testing. Surface levels and coordinates are approximate only and must not be relied upon.

Refer to explanatory notes for symbol and abbreviation definitions

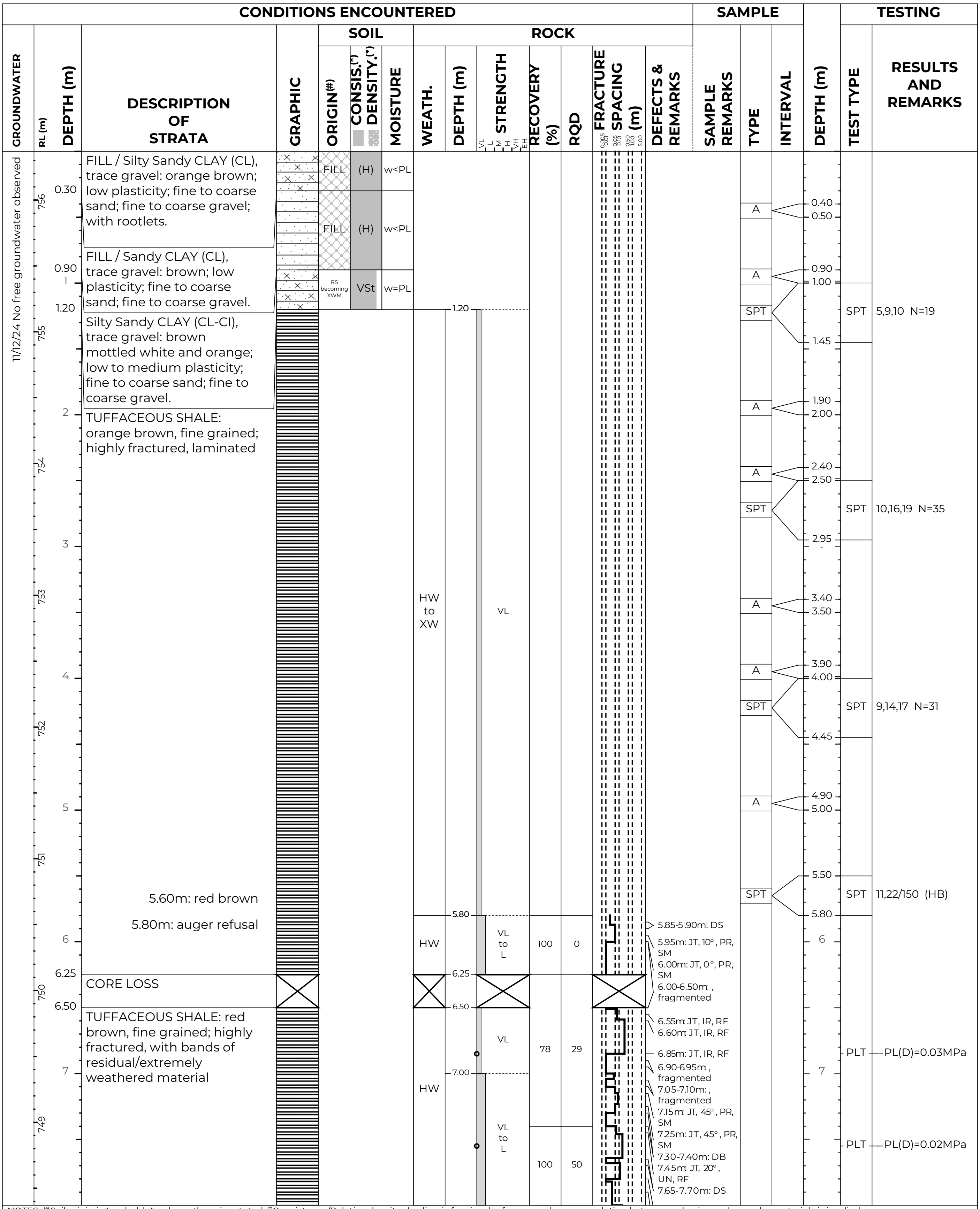

Douglas Partners
Geotechnics | Environment | Groundwater
Project No: 224779.01
BH ID: 305
Depth: 14.65-18.75
Core Box No.: 1
224779.01 Googong School Bore 305 Core Start @ 14.65m →
15
16
17
18
Core finish @ 18.75

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 756.4 AHD
COORDINATE: E:702160.1, N:6077488.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 306
PROJECT No: 224779.01
DATE: 11/12/24
SHEET: 1 of 3



CONDITIONS ENCOUNTERED

GROUNDWATER: 11/12/24 No free groundwater observed

RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	SOIL: ORIGIN(#)	SOIL: CONSIS.(*) DENSITY(*)	SOIL: MOISTURE
756	0.30	FILL / Silty Sandy CLAY (CL), trace gravel: orange brown; low plasticity; fine to coarse sand; fine to coarse gravel; with rootlets.	FILL	(H)	w<PL
	0.90	FILL / Sandy CLAY (CL), trace gravel: brown; low plasticity; fine to coarse sand; fine to coarse gravel.	FILL	(H)	w<PL
	1.20	Silty Sandy CLAY (CL-CI), trace gravel: brown mottled white and orange; low to medium plasticity; fine to coarse sand; fine to coarse gravel.	RS becoming XWM	VSt	w=PL
755		TUFFACEOUS SHALE: orange brown, fine grained; highly fractured, laminated 5.60m: red brown 5.80m: auger refusal			
750	6.25	CORE LOSS			
	6.50	TUFFACEOUS SHALE: red brown, fine grained; highly fractured, with bands of residual/extremely weathered material			

RL (m): 756, 755, 754, 753, 752, 751, 750, 749
DEPTH (m): 1, 2, 3, 4, 5, 6, 7

ROCK: WEATH.	ROCK: DEPTH (m)	ROCK: STRENGTH (VL L M H VH EH)	ROCK: RECOVERY (%)	ROCK: RQD	DEFECTS & REMARKS
HW to XW	1.20	VL			
HW	5.80	VL to L	100	0	5.85-5.90m: DS 5.95m: JT, 10°, PR, SM 6.00m: JT, 0°, PR, SM 6.00-6.50m: , fragmented
	6.25				
HW	6.50	VL	78	29	6.55m: JT, IR, RF 6.60m: JT, IR, RF 6.85m: JT, IR, RF 6.90-6.95m: , fragmented
	7.00	VL to L	100	50	7.05-7.10m: , fragmented 7.15m: JT, 45°, PR, SM 7.25m: JT, 45°, PR, SM 7.30-7.40m: DB 7.45m: JT, 20°, UN, RF 7.65-7.70m: DS

FRACTURE SPACING (m): 0.005, 0.01, 0.05, 0.10, 0.50, 1.00, 5.00

SAMPLE: TYPE	SAMPLE: INTERVAL DEPTH (m)	TESTING: TEST TYPE	TESTING: RESULTS AND REMARKS
A	0.40 - 0.50		
A	0.90 - 1.00		
SPT	1.00 - 1.45	SPT	5,9,10 N=19
A	1.90 - 2.00		
A	2.40 - 2.50		
SPT	2.50 - 2.95	SPT	10,16,19 N=35
A	3.40 - 3.50		
A	3.90 - 4.00		
SPT	4.00 - 4.45	SPT	9,14,17 N=31
A	4.90 - 5.00		
SPT	5.50 - 5.80	SPT	11,22/150 (HB)
		PLT	PL(D)=0.03MPa
		PLT	PL(D)=0.02MPa

NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

Generated with CORE-GS by Geroc - Combined Log

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 5.8m, then HMLC to 18m
CASING: HWT to 5.6m

REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: Department of Education
PROJECT: Proposed New High School for Googong
LOCATION: 200 Wellsvale Drive, Googong, NSW

SURFACE LEVEL: 756.4 AHD
COORDINATE: E:702160.1, N:6077488.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 306
PROJECT No: 224779.01
DATE: 11/12/24
SHEET: 2 of 3

CONDITIONS ENCOUNTERED

DEPTH (m)	DESCRIPTION OF STRATA	WEATH.	STRENGTH
	[CONT] TUFFACEOUS SHALE: red brown, fine grained; highly fractured, with bands of residual/extremely weathered material	HW	VL to L
12.35	CORE LOSS		
13.00	TUFFACEOUS SHALE: red bown, fine grained; highly fractured	HW	VL to L

RECOVERY (%)	RQD
100	35
100	34
100	72
100	50
100	45
54	0
100	0
100	18
70	22

DEFECTS & REMARKS

7.80m: JT, IR, RF, fragmented
7.90m: JT, 20°, PR, SM, fragmented
8.15m: JT x2, 20-45°, PR, SN Fe, SM
8.20-8.30m: JT x2, 20°, PR, SM
8.50m: JT, IR, RF
8.55-8.80m: , fragmented
8.90-9.00m: FC
9.00-9.05m: DB, fragmented
9.15m: JT, 20°, UN, SM
9.50-9.55m: FC, fragmented
9.65-10.05m: FC, fragmented
10.15m: JT, 45°, PR, INF Clay, RF
10.20m: JT, IR, INF Clay, RF
10.30m: FC, fragmented
10.50m: P, IR, RF
10.75m: P, 0°, UN, RF
10.95m: JT, 45°, UN, RF
11.00-11.10m: DB, fragmented
11.20-11.30m: DS
11.45m: JT, 50°, UN, RF
11.60m: JT, 40°, PR, SM
11.70-11.85m: DB, fragmented
12.00m: HB
12.05m: P, IR, RF
12.15m: JT, 40°, PR, SM
12.30-12.35m: FC
13.00-13.35m: FC, fragmented
13.35-13.45m: JT x3, 10°, PR, SM
13.45-14.05m: FC, fragmented
14.05-14.75m: FC, 10-20°, PR, SM, 20-100mm spacing
14.75-14.85m: DB, fragmented
14.95-15.00m: , fragmented
15.10m: JT, 50°, UN, RF
15.25-15.30m: DB, WC4
15.50-15.70m: DS
15.80-15.90m: DS, fragmented

TESTING

TEST TYPE	RESULTS AND REMARKS
PLT	PL(D)=0.02MPa
PLT	PL(D)=0.01MPa
PLT	PL(D)=0.02MPa
PLT	PL(D)=0.01MPa
PLT	PL(A)=0.03MPa
PLT	PL(D)=0.01MPa

NOTES: [#]Soil origin is "probable" unless otherwise stated. [*]Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Hanjin D&B 8D truck mounted drilling rig
OPERATOR: Haddad Drilling
LOGGED: Miller
METHOD: AT to 5.8m, then HMLC to 18m
CASING: HWT to 5.6m
REMARKS: *Rock failed along plane of pre-existing weakness during point load test. Surface levels and coordinates are approximate only and must not be relied upon

Refer to explanatory notes for symbol and abbreviation definitions

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CLIENT: Department of Education
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COORDINATE: E:702160.1, N:6077488.0
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 306
PROJECT No: 224779.01
DATE: 11/12/24
SHEET: 3 of 3

CONDITIONS ENCOUNTERED															SAMPLE				TESTING	
					SOIL			ROCK												
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) DENSITY.(*)	MOISTURE	WEATH.	DEPTH (m)	STRENGTH VL L M H VH EH	RECOVERY (%)	RQD	FRACTURE SPACING (m) 0.005 0.01 0.05 0.10 0.50 1.00 5.00	DEFECTS & REMARKS	SAMPLE REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	740	16.50	[CONT] TUFFACEOUS SHALE: red bown, fine grained; highly fractured					HW		VL to L	70	22		16.10 -16.20m : FC x2, 60°, PR, SN Fe, RF 16.40- 16.50m : CZ, fragmented						
		17.00	CORE LOSS						17.00									17		
	739	18	TUFFACEOUS SHALE: red brown, fine grained; highly fractured					HW		VL to L	100	72		17.70m : P, IR, RF 17.80-18.00m: , fragmented						
		19 20 21 22 23	Borehole discontinued at 18.00m depth. Limit of investigation.																	

Generated with CORE-GS by Geroc - Combined Log

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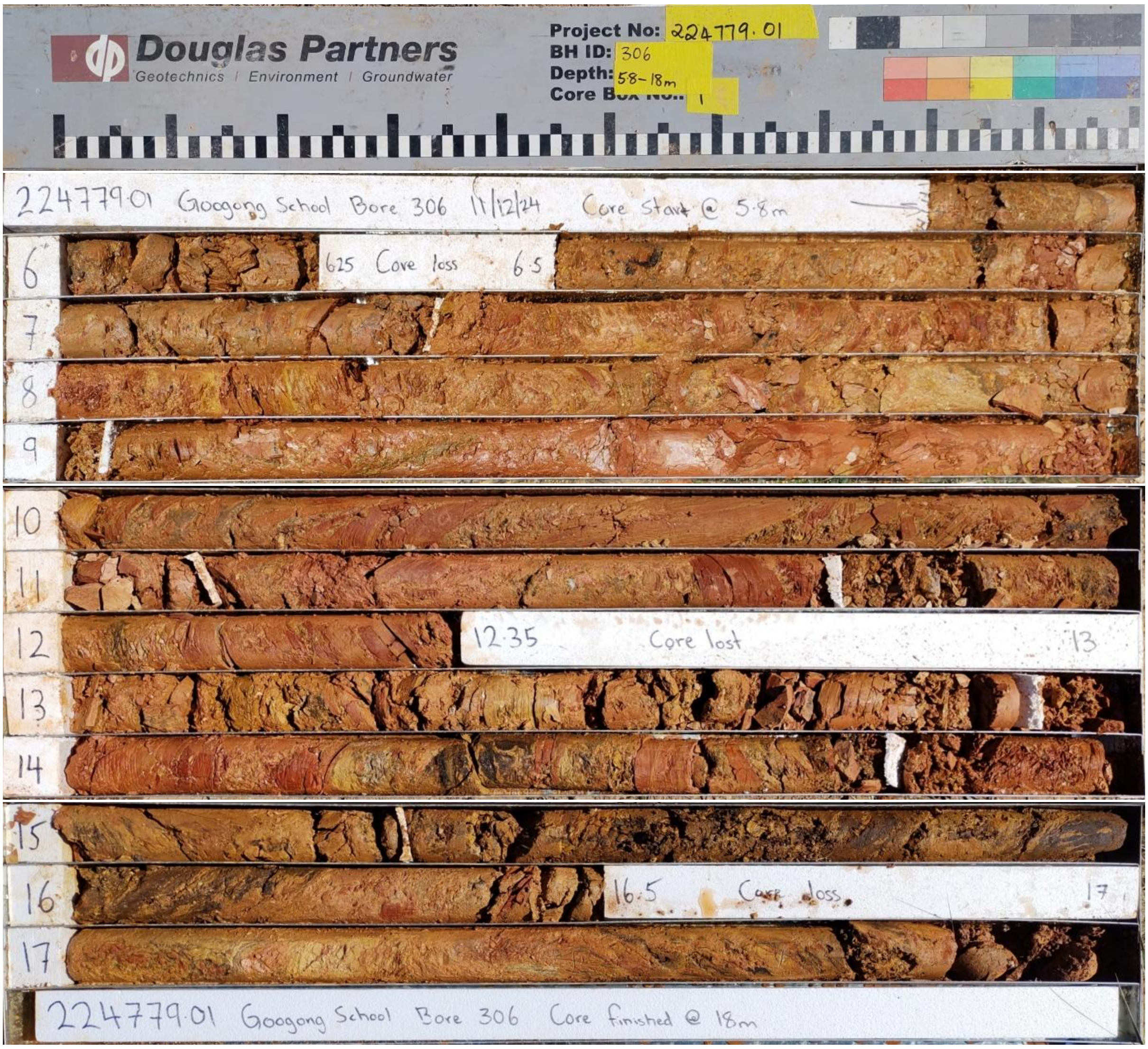
Douglas PARTNERS


Douglas Partners
Geotechnics / Environment / Groundwater
Project No: 224779.01
BH ID: 306
Depth: 58-18m
Core Box No.: 1
224779.01 Googong School Bore 306 11/12/24 Core Start @ 5.8m
6
625 Core loss 6.5
7
8
9
10
11
12
12.35 Core lost 13
13
14
15
16
16.5 Core loss 17
17
224779.01 Googong School Bore 306 Core finished @ 18m

Appendix D

Laboratory Test Results

Material Test Report

Report Number: **224779.00-1**
Issue Number: 1
Date Issued: 14/11/2023
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Yusra Hadi
Project Number: 224779.00
Project Name: Proposed New High School
Project Location: 200 Wellsvale Drive, Googong NSW
Work Request: 9574
Sample Number: GU-9574A
Date Sampled: 27/10/2023
Dates Tested: 31/10/2023 - 07/11/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **201 , Depth: 0.4-0.5m**
Material: Silty Clay

Douglas Partners Pty Ltd
Goulburn Laboratory
54 Sinclair Street Goulburn NSW 2580
Phone: 02 4822 8395
Email: Nicole.Purton@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nicole Purton
Laboratory Manager
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	54		
Plastic Limit (%)	24		
Plasticity Index (%)	**30**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**11.0**		
Cracking Crumbling Curling	Curling		

Material Test Report

Report Number:	**224779.00-1**
Issue Number:	1
Date Issued:	14/11/2023
Client:	School Infrastructure NSW Level 8, SYDNEY NSW 2000
Contact:	Yusra Hadi
Project Number:	224779.00
Project Name:	Proposed New High School
Project Location:	200 Wellsvale Drive, Googong NSW
Work Request:	9574
Sample Number:	GU-9574B
Date Sampled:	27/10/2023
Dates Tested:	31/10/2023 - 07/11/2023
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**202 , Depth: 0.4-0.5m**
Material:	Silty Clay

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Laboratory Manager
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	48		
Plastic Limit (%)	21		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	Curling		

Material Test Report

Report Number: **224779.00-1**
Issue Number: 1
Date Issued: 14/11/2023
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Yusra Hadi
Project Number: 224779.00
Project Name: Proposed New High School
Project Location: 200 Wellsvale Drive, Googong NSW
Work Request: 9574
Sample Number: GU-9574C
Date Sampled: 27/10/2023
Dates Tested: 31/10/2023 - 07/11/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **203 , Depth: 0.5-0.95m**
Material: Silty Clay

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Laboratory Manager
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	74		
Plastic Limit (%)	28		
Plasticity Index (%)	**46**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**18.5**		
Cracking Crumbling Curling	Cracking		

Material Test Report

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Report Number:	**224779.00-1**
Issue Number:	1
Date Issued:	14/11/2023
Client:	School Infrastructure NSW Level 8, SYDNEY NSW 2000
Contact:	Yusra Hadi
Project Number:	224779.00
Project Name:	Proposed New High School
Project Location:	200 Wellsvale Drive, Googong NSW
Work Request:	9574
Sample Number:	GU-9574D
Date Sampled:	27/10/2023
Dates Tested:	31/10/2023 - 08/11/2023
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**204 , Depth: 1.0-1.44m**
Material:	Shale

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	31		
Plastic Limit (%)	18		
Plasticity Index (%)	**13**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**5.0**		
Cracking Crumbling Curling	None		

Material Test Report

Report Number: **224779.00-1**
Issue Number: 1
Date Issued: 14/11/2023
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Yusra Hadi
Project Number: 224779.00
Project Name: Proposed New High School
Project Location: 200 Wellsvale Drive, Googong NSW
Work Request: 9574
Sample Number: GU-9574E
Date Sampled: 27/10/2023
Dates Tested: 31/10/2023 - 10/11/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **205 , Depth: 1.0-1.45m**
Material: Shale

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Laboratory Manager
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Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	37		
Plastic Limit (%)	20		
Plasticity Index (%)	**17**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**6.0**		
Cracking Crumbling Curling	None		

Material Test Report

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Report Number: **224779.00-1**
Issue Number: 1
Date Issued: 14/11/2023
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Yusra Hadi
Project Number: 224779.00
Project Name: Proposed New High School
Project Location: 200 Wellsvale Drive, Googong NSW
Work Request: 9574
Sample Number: GU-9574F
Date Sampled: 27/10/2023
Dates Tested: 31/10/2023 - 09/11/2023
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **206 , Depth: 0.5-0.95m**
Material: Shale

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	45		
Plastic Limit (%)	18		
Plasticity Index (%)	**27**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.0**		
Cracking Crumbling Curling	None		

Material Test Report

Report Number:	**224779.00-1**
Issue Number:	1
Date Issued:	14/11/2023
Client:	School Infrastructure NSW Level 8, SYDNEY NSW 2000
Contact:	Yusra Hadi
Project Number:	224779.00
Project Name:	Proposed New High School
Project Location:	200 Wellsvale Drive, Googong NSW
Work Request:	9574
Date Sampled:	27/10/2023
Dates Tested:	31/10/2023 - 02/11/2023
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Preparation Method:	AS 1289.1.1 - Sampling and preparation of soils
Location:	200 Wellsvale Drive, Googong

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Approved Signatory: Nicole Purton
Laboratory Manager
Laboratory Accreditation Number: 828

Moisture Content AS 1289 2.1.1

Sample Number	Sample Location	Moisture Content (%)	Min	Max	Material
GU-9574A	201 , Depth: 0.4-0.5m	18.0 %	**	**	Silty Clay
GU-9574B	202 , Depth: 0.4-0.5m	21.6 %	**	**	Silty Clay
GU-9574C	203 , Depth: 0.5-0.95m	23.5 %	**	**	Silty Clay
GU-9574D	204 , Depth: 1.0-1.44m	9.2 %	**	**	Shale
GU-9574E	205 , Depth: 1.0-1.45m	6.9 %	**	**	Shale
GU-9574F	206 , Depth: 0.5-0.95m	11.6 %	**	**	Shale

Envirolab Services Pty Ltd
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 336685

Client Details

Client	Douglas Partners Canberra
Attention	Kenton Horsley
Address	Unit 2, 73 Sheppard St,, HUME, ACT, 2620

Sample Details

Your Reference	**224779.00, Googong**
Number of Samples	6 Soil
Date samples received	01/11/2023
Date completed instructions received	01/11/2023

Analysis Details

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

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

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

Report Details

Date results requested by	08/11/2023
Date of Issue	07/11/2023

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Results Approved By
Diego Bigolin, Inorganics Supervisor

Authorised By
Nancy Zhang, Laboratory Manager

Soil Aggressivity						
Our Reference		336685-1	336685-2	336685-3	336685-4	336685-5
Your Reference	UNITS	201	202	203	204	205
Depth		0.4-0.5	0.4-0.5	0.4-0.5	0.9-1	0.4-0.5
Date Sampled		27/10/2023	27/10/2023	28/10/2023	28/10/2023	28/10/2023
Type of sample		Soil	Soil	Soil	Soil	Soil
pH 1:5 soil:water	pH Units	6.6	7.8	7.0	8.5	8.4
Electrical Conductivity 1:5 soil:water	µS/cm	11	140	24	130	140
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10	50	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10	42	10	76	30

Soil Aggressivity		
Our Reference		336685-6
Your Reference	UNITS	206
Depth		0.4-0.5
Date Sampled		29/10/2023
Type of sample		Soil
pH 1:5 soil:water	pH Units	6.7
Electrical Conductivity 1:5 soil:water	µS/cm	32
Chloride, Cl 1:5 soil:water	mg/kg	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10

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

QUALITY CONTROL: Soil Aggressivity					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	336685-2
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	6.6	6.5	2	100	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	11	12	9	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	108	108
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	108	108

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.

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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 369178

Client Details

Client	Douglas Partners Canberra
Attention	Guanghui Meng
Address	Unit 2, 73 Sheppard St,, HUME, ACT, 2620

Sample Details

Your Reference	**224779.01 Googong**
Number of Samples	6 Soil
Date samples received	17/12/2024
Date completed instructions received	17/12/2024

Analysis Details

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

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

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

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

Report Details

Date results requested by	24/12/2024
Date of Issue	20/12/2024

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

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		369178-1	369178-2	369178-3	369178-4	369178-5
Your Reference	UNITS	Bore 301	Bore 302	Bore 303	Bore 304	Bore 305
Depth		2.6-2.7	4-4.28	10.5-10.6	8.6-8.7	15-15.2
Date Sampled		09/12/2024	09/12/2024	10/12/2024	12/12/2024	12/12/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	18/12/2024	18/12/2024	18/12/2024	18/12/2024	18/12/2024
Date analysed	-	18/12/2024	18/12/2024	18/12/2024	18/12/2024	18/12/2024
pH 1:5 soil:water	pH Units	8.7	8.9	8.5	8.8	8.5
Electrical Conductivity 1:5 soil:water	µS/cm	29	79	200	34	13
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	31	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10	10	20	<10	<10

Misc Inorg - Soil		
Our Reference		369178-6
Your Reference	UNITS	Bore 306
Depth		17.7-17.8
Date Sampled		11/12/2024
Type of sample		Soil
Date prepared	-	18/12/2024
Date analysed	-	18/12/2024
pH 1:5 soil:water	pH Units	8.3
Electrical Conductivity 1:5 soil:water	µS/cm	78
Chloride, Cl 1:5 soil:water	mg/kg	20
Sulphate, SO4 1:5 soil:water	mg/kg	67

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.
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	369178-2
Date prepared	-			18/12/2024	3	18/12/2024	18/12/2024		18/12/2024	18/12/2024
Date analysed	-			18/12/2024	3	18/12/2024	18/12/2024		18/12/2024	18/12/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	3	8.5	8.5	0	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	3	200	200	0	93	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	3	31	26	18	102	78
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	3	20	20	0	104	76

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.
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Report Comments

MISC_INORG_DRY: pH/EC
Samples were out of the recommended holding time for this analysis.