Geotechnical Investigation Report

Project

Proposed Lift and Lift Access Corridor
80 Mona Vale Rd, Mona Vale NSW

Prepared for

Pittwater RSL Club C/O Linked Project Management

Date

8 January 2025

Report No

18412-GR-1-1

alliance
geotechnical & environmental solutions

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DOCUMENT CONTROL

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Contents

Appendices

1 INTRODUCTION

This report presents the findings of a geotechnical investigation carried out by Alliance Geotechnical Pty Ltd (Alliance) for Pittwater RSL Club C/O Linked Project Management (the Client) for the Proposed Lift and Lift Access Corridor at 80 Mona Vale Rd, Mona Vale NSW (the Site). The geotechnical investigation was undertaken in accordance with Alliance's fee proposal Estimate No. 10940, dated 12 September 2024.

The objectives of this geotechnical investigation report (GIR) are to address the subsurface conditions encountered and provide comments and recommendations regarding:

- Existing geotechnical and groundwater conditions.
- Groundwater management (if encountered).
- Excavation, shoring, and retaining wall recommendations.
- Pad and pile foundation recommendations.
- Foundation conditions of existing column footings (type and bearing pressure at base of footings).
- Proposed temporary footing support and underpinning recommendations.
- Subgrade and pavement thickness design.
- Site preparation recommendations regarding subgrade and building foundations.

Details of the field investigation are presented in this report, together with the results of laboratory testing and geotechnical design parameters for the proposed development.

2 PROPOSED WORKS

Alliance received a request for a fee proposal from Linked Project Management Pty Ltd on 12 September 2024. The request for quotation (RFQ) included a geotechnical brief with a prescribed scope of work, along with the following architectural drawings:

- Proposed Carpark Basement B1 Floor Plan, prepared by Bergstrom Architects Pty Ltd, dated July 2024.
- Proposed Lower Ground Floor Plan, prepared by Bergstrom Architects Pty Ltd, dated July 2024.
- Existing Ground Floor Plan with markup of height clearance, prepared by Bergstrom Architects Pty Ltd, dated 6 November 2024.

Based on the supplied RFQ document and further correspondence with the client, it is understood that the client requires geotechnical data to inform their design for a new lift and lift access corridor below the existing ground slab level and new carpark pavement at the current ground level. Alliance understands that the proposed excavation for the lift is to extend below the existing basement level, adjacent to existing structural concrete building columns.

3 SITE DESCRIPTION & REGIONAL GEOLOGY

3.1 Site Description

The site is located on the existing ground level car parking area of the Pittwater RSL Club at Lot 2 in Deposited Plan (DP) 1237461, in the suburb of Mona Vale, within the Northern Beaches City Council local government area. The lot is bounded by Mona Vale Road to the north (oriented north to east) and Foley Street to the southeast. An aerial view of the site is shown in Figure 1 below.

The geotechnical investigation was conducted at the existing ground-level car park, covering the footprint of the proposed new car park pavement and part of the proposed lift corridor footprint.

Based on the site observations made during the site walkover, the site is situated on relatively flat ground, with minor grading towards stormwater lines and a gentle slope southward, leading to the entrance/exit point of the ground-level car park and the adjacent outside parking area.

Figure 1 - The Site Location & Aerial Image (extracted from NearMaps)

3.2 Regional Geology

The New South Wales Seamless Geology dataset, version 2.4/2024 [Digital Dataset], published by the Geological Survey of New South Wales, indicates that the site is underlain mostly by the Newport Formation unit. This unit is described as *interbedded laminite, shale and sandstone; white quartz to quartz-lithic, very fine- to medium-grained sandstone; minor shale breccia and pebble polymictic conglomerate (at base of sandstone units); minor red clays.*

The subsurface materials encountered during the geotechnical investigation comprised fill and residual clayey sands over sandstone and are corresponding to the geological units expected at the site.

The site overlaying NSW Seamless Geology map with 10m contours are presented in Figure 2 below.

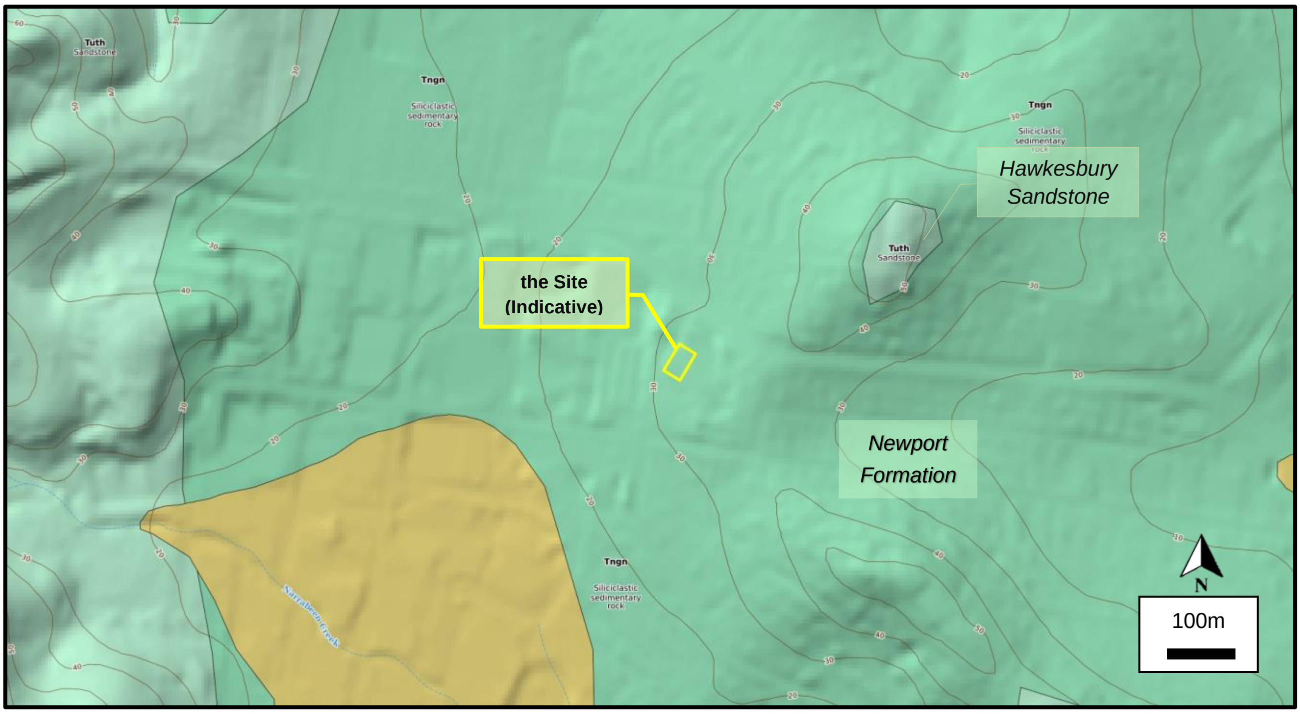

Figure 2 - The Site Location with NSW Seamless Geology and 10m Contours

4 FIELDWORK

4.1 Methods

The geotechnical investigation was undertaken by Alliance on the 20th of November 2024 and included:

- Reviewing Before You Dig Australia (BYDA) plans as part of borehole clearance.
- Site walkover and underground service locating by an accredited service locator prior to intrusive works.
- Drilling of four (4) boreholes, at locations nominated by Alliance and approved by the client, using a subcontracted track-mounted drilling rig.
- BH01 – auger and core drilling at proposed extent of lift excavation.
- BH02, BH03 and BH04 – auger drilling (for CBR sampling) at existing ground level car park.
- Boreholes were advanced through the soil profile using 110-mm diameter solid flight augers fitted with a tungsten carbide (TC) bit until prior refusal on inferred bedrock.
- At BH01, upon encountering TC-bit refusal in bedrock, NMLC coring was undertaken to advance through the bedrock profile up to a depth of 10m below ground level (BGL).
- Standard Penetration Testing (SPT) were conducted initially at 0.5m BGL, then at nominally 1.5m intervals.
- Excavating test pits adjacent to existing columns at the basement carpark and undercroft area to expose and assess the dimensions and type of footings near the extent of the excavation for the lift.
- The recovered soil and rock samples were transported to Alliance's NATA accredited materials testing laboratory for further testing and storage.

- Upon completion, the boreholes and test pits were backfilled with drilling and excavation spoil. The borehole location and sealed with concrete mix and made flush with the surrounding surface.

Borehole drilling and test pit excavations were supervised by a geotechnical engineer from Alliance, and the encountered soil and rock profiles were documented in accordance with *AS 1726-2017 Geotechnical Site Investigations*.

Selected site photographs taken during the fieldwork are presented in Appendix A.

5 RESULTS

5.1 Subsurface Conditions

Summarised descriptions of the encountered subsurface geotechnical units are provided in Table 1 below.

Table 1 - Summary of Encountered Subsurface Profiles

Ground Profile	Apparent Fill Compaction/ Soil Relative Density/ Rock Strength	Depth below ground level (m) [1]			
		BH01	BH02	BH03	BH04
Pavement **Asphalt**	-	0.0 – 0.04	0.0 – 0.04	0.0 – 0.04	0.0 – 0.04
Fill **Gravelly/Silty Sand**	Appears Well Compacted	0.04 – 0.5	0.04 – 1.0 [1] [2]	0.04 – 1.0 [1] [2]	0.04 – 1.0 [1] [2]
Residual Soil **Clayey Sand**	Medium Dense	0.5 – 1.0	Not Penetrated	Not Penetrated	Not Penetrated
Extremely Weathered Sandstone, recovered as **Sand**	Dense	1.0 – 2.2			
Bedrock **Sandstone**	(Inferred) Very Low to Low Strength [5]	2.2 – 2.9			
	Very Low to Low Strength [6]	2.9 – 3.85 [3] [4]			
	Low to Medium Strength	3.85 – 5.90; 6.60 – 9.2 [7]			
	Medium Strength	9.20 – 10.09 [2]			

Notes:

[1] The depths are based on the information from the test locations only and do not necessarily represent the maximum and minimum values across the site.

[2] Target depth.

[3] With core losses 100mm.

[4] With extremely weathered seam.

[5] Retrieved from auger drilling.

[6] Retrieved from rock coring.

[7] With 100mm core loss and extremely weathered layers between 5.9m and 6.6m bgl.

The borehole logs are provided in Appendix C. Reference to the individual borehole log sheets attached in Appendix C should be made for a full description of the subsurface conditions encountered at each borehole location.

These results should be read in conjunction with the attached Explanatory Notes which explain the terms, abbreviations, and symbols used, together with the interpretation and limitation of the logging procedure.

5.2 Existing Footing Conditions

Footing inspections were carried out on two (2) existing building column footings adjacent to the proposed excavation zone of the proposed lift pit and corridor (one at the undercroft area and one at the basement car park). The objective of the footing inspection was to assess the footing type (shallow pad or pier foundations) and material type at the base of the foundation.

The footing inspections were limited to manually excavating a test pit adjacent to the footing to the bottom of the base to avoid digging beyond the zone of influence (a 1H:1V line drawn from the toe of the excavation to the surface) and compromising the foundation's integrity.

Consideration should be given to the possibility of the exposed footing to be a pile cap. As the existing foundations were not undermined, the extent of the footing below the exposed levels are unknown and confirmation of the type of foundation and founding depth should be further assessed by an experienced geotechnical engineer during the lift shaft excavation at construction phase.

5.3 Groundwater

Groundwater seepage was not encountered during the auger drilling during the investigation period. The introduction of drilling fluid during rock coring prevented Alliance from assessing groundwater seepage within the bedrock. Groundwater seepage may still occur at the soil and bedrock interface or through the rock defects. It should be noted that groundwater seepage condition is subject to seasonal and climatic conditions and may vary across the site.

6 LABORATORY TESTING

Laboratory tests were carried out on selected soil and rock core samples collected from the boreholes during the site investigation. The following tests were carried out by Alliance's NATA-accredited laboratory and subcontracted environmental laboratory:

- California Bearing Ratio Test
- Point Load Strength Index Test

A summary of laboratory test results is provided in the following sections. The laboratory test reports are presented in Appendix D.

6.1 California Bearing Ratio (CBR)

CBR testing was conducted in accordance with AS 1289 6.1.1 test methods on the recovered soil samples which have been soaked for 4 days. The results of the laboratory tests are summarised in Table 2 below, and the laboratory test reports are provided in Appendix D.

Table 2 - Summary of CBR Test Results

Sample Source	Material	FMC (%)	OMC (%)	MDD (%)	CBR (%)	Swell (%)
BH02 0.0 – 1.0m	SAND with gravels	10.7	12.5	1.95	19	0.0
BH03 0.0 – 1.0m	SAND with gravels	14.0	14.0	1.86	19	0.0
BH04 0.0 – 1.0m	SAND with gravels	6.6	10.0	1.99	25	0.5

Legend:
FMC – Field Moisture Content
OMC – Optimum Moisture Content
MDD – Maximum Dry Density
CBR – California Bearing Ratio

6.2 Point Load Strength Index Testing

Point Load Strength Index testing was carried out at approximately 1m intervals. The results are presented in Table 3 below.

Table 3 - Summary of Point Load Strength Index Test Results

Borehole ID	Sample Depth (m BGL)	Diametral		Axial	
		Is_{50}	Interpreted Rock Strength	Is_{50}	Interpreted Rock Strength
BH01	3.38	0.08	Very Low	0.14	Low
	3.95	1.13	High [1]	0.52	Medium
	4.43	0.23	Low	0.24	Low
	5.65	1.83	High [1]	1.35	High [1]
	6.66	0.34	Medium	0.35	Medium
	7.30	0.08	Very Low	0.18	Low
	8.40	0.27	Low	0.24	Low
	9.30	0.43	Medium	0.36	Medium

Note:

1 High strength test results are assessed to be associated with interbedded layers of iron-indurated sandstone.

7 CONCLUSIONS & RECOMMENDATIONS

7.1 Preliminary Geotechnical Design Parameters

Based on the subsurface materials encountered, in-situ soil tests (SPT), ang laboratory tests carried out, the preliminary material strength parameters are provided in Table 4 below.

Table 4 - Recommended Preliminary Material Strength Parameters

Material	γ [1] (kN/m³)	c' [2] (kPa)	Φ' [3] (degrees)	K_a [4]	K_0 [5]	K_P [6]	E [7] (MPa)	v' [8]
Well compacted granular fill	18	-	30	0.33	0.50	3.00	10	0.3
Medium Dense residual clayey sand	19	-	32	0.31	0.47	3.25	25	0.3
Extremely weathered sandstone, recovered as dense sand	20	-	37	0.25	0.40	4.02	50	0.3
Very low to low strength sandstone	22	50	28	0.36	0.53	2.77	150	0.3
Low to medium strength sandstone	22	100	33	N/A	N/A	N/A	300	0.25
Medium strength sandstone	24	200	34	N/A	N/A	N/A	500	0.25

Note:

1: Material in-situ weight, based on visual assessment (±10 %).
2: Effective Cohesion, assuming normally consolidated clay (±10 %).
3: Effective Friction Angle (±2˚) assuming drained conditions; may be dependent on defect conditions.
4: Active earth pressure.
5: Earth pressure at rest.

Material	γ [1] (kN/m³)	c' [2] (kPa)	Φ' [3] (degrees)	K_a [4]	K_0 [5]	K_P [6]	E [7] (MPa)	v' [8]

6: Passive earth pressure.
7: Elasticity (Young's) Modulus.
8: Poisson's Ratio.

7.2 Excavation Conditions

All earthworks including preparation, excavation, and filling activities, should be undertaken in accordance with *AS 3798-2007* and the latest version of the NSW Government Code of Practice Excavation Work.

Prior to the commencement of any excavation, dilapidation surveys of nearby structures and pavement surfaces within the zone of influence (a 1H:1V line drawn from the toe of the excavation to the surface) would be prudent. Internal CCTV inspection of any existing adjacent underground services may also be undertaken prior to construction to identify any pre-existing damage and avoid potential future claims.

7.2.1 General Excavation Conditions

The proposed finished floor level (FFL) for the lift pit is not known at the time of writing this report. Based on the supplied documents and the proposed FFL of the basement B1 level, the maximum anticipated depth of excavation for the construction of the proposed lift is 7m BGL. Based on the results of the investigation, the excavation will extend through sandy soils to a depth of 2.2m BGL, followed by very low to low strength sandstone underlain by low to medium and medium strength sandstone. It is noted that interbedded layers of iron-indurated high strength sandstone are present with the bedrock, which should be considered in adopting an appropriate excavation methodology / equipment. The base of the excavation is expected to be on medium strength sandstone

The proposed excavation methodology has not been provided at the time of writing this report. Due to the proximity of the excavation to the existing RSL building and its structural elements, all excavations are recommended to be carried out using a combination of saw-cutting, manual jack hammering, and manual scaling to minimise vibrations and avoid vibration-induced damage to the existing structures.

The existing adjacent building foundations should be adequately supported to allow for excavation and construction at the proposed area. If the existing footings are shallow pads, underpinning should be considered during the excavation works and should be designed by a structural engineer. The underpinning should be founded on sandstone bedrock, which based on BH01, is expected to be found at approximately 2.2m BGL in the undercroft area.

7.2.2 Vibrations

To limit the transmission of vibrations along the adjacent structures and footings, it is recommended that the bedrock excavation be done via saw-cutting. Blocks of the saw-cut rock mass can then be progressively dislodged using small rock hammers and lifted out without generating large vibrations.

Vibration monitoring may be required as excavation of medium strength (and interbedded high strength) sandstone bedrock is expected to be undertaken in proximity to the existing structures. Vibrations should be monitored throughout the excavation process using a vibration monitoring system installed at critical points of the building to ensure compliance with acceptable thresholds. Any signs of cracking, settlement, or structural movement should prompt an immediate review of the excavation methodology.

Generally, the ground vibration Peak Particle Velocity (PPV) should be limited to 5 mm/s at the regular property boundaries and 3mm/s along sensitive properties. The maximum 5 mm/s vibration limit is not expected to be exceeded provided that excavation methods are restricted as indicated in Table 5 below.

Table 5 - Recommendations for Rock Breaking Equipment

Distance from Adjacent Structure (m)	Maximum Peak Particle Velocity 5 mm/s	
	Equipment	**Operating Limit (% of Maximum Capacity)**
1.5 to 2.5	hand-operated jack-hammer only	100
2.5 to 5.0	300 kg rock hammer	50
5.0 to 10.0	300 kg rock hammer or 600 kg rock hammer	100 50

It is recommended that vibration monitoring be considered as part of the geotechnical monitoring program.

A dilapidation survey on nearby structures and infrastructure (within the zone of influence of the proposed excavation works) is recommended to be undertaken by a structural engineer prior to the commencement of any site excavations. The report should include precise measurements of the existing defects and cracks presented with the relevant photos

7.2.3 Excavation Stability

The footprint of the proposed bulk excavation is located within the Pittwater RSL Club building, with existing structures and foundations adjacent to the proposed excavation area. Since temporary batter slopes cannot be accommodated due to the excavation footprint's proximity to existing structures, Alliance recommends that the excavation be undertaken through one of the following:

- Stabilising the soil layers of the excavation using soil nails and shotcrete: The excavation should be undertaken progressively and an inspection by a geotechnical engineer should be carried out to confirm the stability of the excavation walls at each stage (i.e., excavate 1m of material, followed by an excavation inspection by a geotechnical engineer, then excavation support with engineered soil nails and shotcrete) until bedrock is encountered. Upon encountering bedrock, hold points for geotechnical inspections are still recommended to be undertaken due to the excavation's proximity to existing structures.
- If spatial limitations allow for plants to be utilised onsite, construction and installation of contiguous pile walls may be adopted as permanent retention system. In addition to lateral support, these piles may be used as a load bearing structure, if required, and may be used as cut-off walls to mitigate any groundwater inflows into the excavation.

Any temporary shoring system or permanent retaining wall should be designed in accordance with *AS 4678* and other relevant standards and guidelines. The selection of an appropriate shoring system is a design matter which needs to consider several geotechnical and non-geotechnical factors. Recommended parameters for the design of temporary and permanent support are provided in Table 4 above.

The lateral deflection of the retaining system should be determined by the design engineers with consideration to the adjacent structures. Survey monitoring should be carried out during the excavation to check and confirm that deflections are within tolerable limits specified in the structural design.

Piles for the shoring system (if adopted) should be socketed at least 1.0m below bulk excavation level, including allowances for nearby footings and services. Greater embedment may be required for lateral stability of the shoring system. The shoring systems may need to penetrate medium and high strength sandstone bedrock, which will require the use of large capacity piling rigs. Advice should be sought from piling contractors to obtain the suitability of their equipment. Moreover, access to the site has limited vertical clearance, and suitability of equipment should also be consulted with the piling contractors.

The specific requirements set out above for excavation support within the soil layers and the stability of the cut face should be assessed by an experienced geotechnical engineer as the excavation proceeds, prior to shotcreteing.

Should contiguous piled walls be adopted, weep holes comprising 40mm diameter PVC pipes with geofabric filter on the back end should be used to provide drainage. Weep holes are recommended to be spaced at 1.5m centres vertically and horizontally with the last row just above the bulk excavation level.

Permanent supports of the shoring system would otherwise be provided by bracing or propping from the floor slabs.

7.2.4 Groundwater Management

Groundwater was not encountered within the soil profile during the investigation; however, no groundwater monitoring has been conducted to confirm the presence of groundwater within the rock profile.

Sandstone is not typically highly permeable, hence the permeability of the rock mass is determined by joints, bedding planes, and other defects. Minor flows can likely be managed using conventional sump and pump techniques, subject to regulatory approvals. Higher flows should be expected at the soil-rock interface and along rock joints after periods of wet weather. Any seepage may need treatment before disposal into stormwater systems, and environmental and hydraulic consultants should be consulted for additional requirements.

7.3 Foundation System & Design Parameters

Proposed Lift Footings

Following completion of the excavation, it is expected that the base of the excavation would generally comprise medium strength sandstone. Therefore, the proposed lift may be supported on shallow footings founded on the rock stratum.

Alternatively, should contiguous piles be adopted as a permanent retaining system, these piles socketed into at least medium strength sandstone bedrock can be incorporated into the permanent foundation and can provide adequate bearing capacity to support the anticipated loads for the structure, in addition to their excavation support.

The recommended design parameters for both pad footings and pile foundations are presented in Table 6 below.

Table 6 - Recommended Geotechnical Design Parameters for Foundations

Material Description	Allowable Bearing Capacity [1,2] (kPa)	Allowable Shaft Adhesion [1] (kPa)
Very low to low strength sandstone	1,000	100
Low to medium strength sandstone	2,500	250
Medium strength sandstone	3,500	350

Notes:

1 These parameters are to be confirmed during the construction works.

2 Allowable end bearing capacities provided considering a factor of safety of 3.

The allowable bearing capacity should be adopted based on the tolerable settlement, following finalising of the footings' dimensions based on the applied structural loads. Where bearing pressures of greater than 3500 kPa are required, it is recommended that at least 50% of all footings be quality verified by either spoon testing or proof coring to a depth of at least 1.5 times the footing width.

Existing Footings

Footing sizes and estimated allowable bearing capacity of the founding layers are presented in Table 7 based on the assumption that the existing footings are in the form of shallow pads.

Photographs and sketches of the existing footings are provided in Appendix E.

Table 7 – Existing Column Footing Dimensions and Allowable Bearing Capacity

Location	Column Diameter (m)	Edge of column to Edge of footing base (m)	Depth of Footing Base (m)	Founding Material	Ultimate Bearing Capacity
					Shallow Pad Foundation [1,2]
Undercroft	0.4	0.3	0.3	Residual clayey sand (Medium Dense)	240 kPa
Basement car park	0.4	0.3	0.3	Medium Strength Sandstone	3000 kPa

Note:
1 Ultimate bearing capacity of shallow footings is based on the encountered founding material, subject to inspection and confirmation during the construction phase by a geotechnical engineer.
2 Confirmation of whether the type of foundation is pile should be consulted and further assessed during the construction phase by a geotechnical engineer.

7.4 Pavement Thickness Design

7.4.1 Subgrade Preparation & Design CBR

All earthworks including preparation, excavation, and filling activities should be undertaken in accordance with AS3798-2007 "*Guidelines on Earthworks for Commercial and Residential Developments*" and the latest version of the *NSW Government Code of Practice Excavation Work* (current version dated January 2020).

During excavation, any rubble, structural elements, or unsuitable materials encountered should be promptly removed. Topsoil and organic-rich materials are considered unsuitable for use in pavement construction. Buried services must be either removed, rerouted or protected as necessary.

Materials encountered within the subgrade zone comprised gravelly sand and sand fill.

CBR testing for the fill material from the investigation boreholes returned laboratory CBR values ranging from 19% to 25%. Field moisture content of the in-situ soils was found to be between 1.8% to 3.4% dry of standard Optimum Moisture Content (OMC) and CBR swell readings of between 0% and 0.5% were recorded.

At the time of writing this report, it is anticipated that the finished surface levels of the proposed car parking area are to approximately match the existing pavement levels. As such, excavation works are anticipated to involve excavation to subgrade level (generally expected to be less than 1.0m bgl), any additional excavation required to remove unsuitable materials if encountered, and for installation of any services.

Considering the above information, some minor subgrade remedial works should be anticipated to address any excessively wet subgrade soils, and presence of any loose/soft residual soil within the subgrade. Accordingly, the following recommendations are provided to guide subgrade preparation:

- Strip existing pavement materials and stockpile separately for later re-use as fill where required, or for removal from site.
- Following excavation to subgrade levels, the exposed subgrade surface should be compacted using suitable compaction equipment to achieve the required density (100% Standard compaction). Over-dry materials should be moisture conditioned to a depth of 300mm and increased in moisture to within ±2% SOMC prior to recompacting to 100% Standard.
- Proof rolling of the subgrade should then be conducted, accompanied by visual inspection by a geotechnical engineer to identify and address any weak or compressible areas.

Where shallow services are present below the subgrade, it is recommended that these be removed, relocated or protected as appropriate. Asset owners are to be consulted regarding minimum cover to finished pavement levels, and potential impacts of static or vibratory rolling in the vicinity.

Excavated fill materials and residual sands, if moisture conditioned to within ±2% SOMC, could be utilised as general fill. Existing bituminous seal and granular pavement materials, if effectively blended, could be used as select subgrade fill, subject to laboratory testing to confirm minimum CBR 15%.

Based on visual-tactile assessment of existing granular pavement layers, excavated granular pavement materials may be suitable for use as new pavement subbase layer, provided they are kept separate from other materials, blended to a uniform consistency and subsequently subjected to an appropriate suite of confirmatory laboratory testing to assess their conformance against the pavement material specifications. If required, the stockpiled material may be blended with an appropriate imported quarry material to correct any non-conformances.

Any waste soils being removed from the site must be classified in accordance with current regulatory authority requirements to enable appropriate reuse or disposal to an appropriately licensed landfill facility. Re-use of site-won materials onsite may be subject to environmental contamination assessments, and any controls identified by the environmental consultant should be addressed and discussed with Alliance.

7.4.2 Pavement Design Parameters & Flexible Pavement Thickness Design

In lieu of any pavement design specifications provided by the client, the following recommendations should be read in conjunction with Northern Beaches Council Engineering Design Code (NBCEDC) and *Austroads Guide to Pavement Technology Part 2* (AGTPT2).

Based on the results of the CBR testing and based on successful subgrade preparation as described in Section 7.4.1 including any required remedial works, it is recommended to adopt a design CBR of 19%.

Based on the intended use of the pavement, a minimum design traffic loading in equivalent standard axles (ESAs) of 5×10^5 has been adopted based on the NBCEDC in line with the "Access Street" street type for a 50-year design life. The design traffic loading is to be confirmed by the client and/or the road authority as appropriate for the proposed development. Using the above design traffic loading and design subgrade CBR, and utilising NBCEDC and AGTPT2 Figure 12.2, it is assessed that at least 300mm of granular material is required overlying the subgrade inclusive of thin bituminous wearing course, exclusive of any subgrade replacement or select filling that may be required. The recommended pavement thickness design is summarised in Table 8below.

Table 8 - Pavement Thickness Design based on CBR 19%

Layer	Thickness (mm)	Material	Compaction (AS1289.5.2.1 – 1997)
Wearing Course	50	Densely graded asphaltic concrete in accordance with Northern Beaches Council Engineering Design Code	-
Basecourse	150	DGB20 in accordance with Northern Beaches Council Engineering Design Code	98% Modified
Subbase	150	DGS20 or DGS40 in accordance with Northern Beaches Council Engineering Design Code	
Subgrade	-	CBR min 19%	100% Standard

8 LIMITATIONS

Alliance Geotechnical Pty Ltd (Alliance) has prepared this report for the site located at 80 Mona Vale Road, Mona Vale NSW in accordance with Alliance's fee proposal and Terms of Engagement. This geotechnical report has been prepared for Pittwater RSL Club C/O Linked Project Management for this project and for the purposes outlined in this report. This report cannot be relied upon for other projects, other parties on this site or any other site. The comments and recommendations provided in this report are based on the assumption that the geotechnical recommendations contained in this report will be fully complied with during the design and construction of the proposed development.

The borehole investigation, in-situ tests, and laboratory test results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths excavated at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from Alliance.

9 REFERENCES

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AS 1726-2017 – Geotechnical Site Investigations.

AS 2159-2009 – Piling – Design & Installation

AS 3600-2009 – Concrete Structures

AS 4678-2002 – Earth Retaining Structures

AS 1170.4-2007 – Structural design actions, Part 4: Earthquake actions in Australia

Pells et al "Foundations on Sandstone and Shale in the Sydney Region" AGJ, 1978.

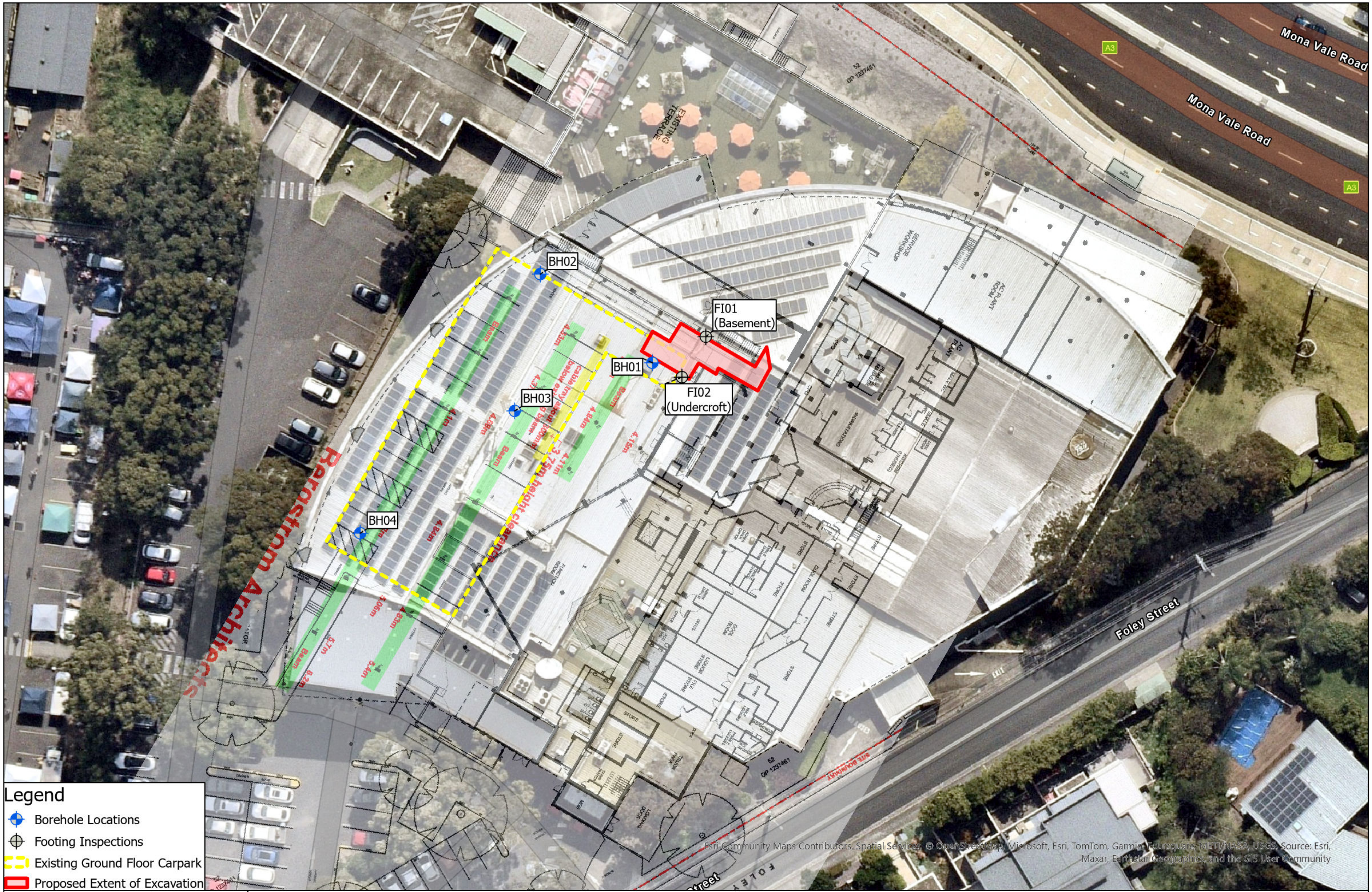
Austroads Guide to Pavement Technology Part 2: Pavement Structural Design

APPENDIX A – Site Photographs

Photo 1 – Overview of drill rig set up at Borehole BH02

Photo 2 – Subsurface soil samples retrieved from the boreholes during the investigation

APPENDIX B – Geotechnical Investigation Plan (Drawing 18412-GR-1-1-B)



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Site Plan Scale 1:400 on A3

Client Name:	Pittwater RSL Club c/o Linked Project Management	Figure Number:	18412-GR-1-1-B
Project Name:	Proposed Lift and Lift Access	Figure/Drawing Date:	21/11/2024
Project Location	80 Mona Vale Road, Mona Vale NSW	Report Number:	18412-GR-1-1

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APPENDIX C – Explanatory Notes, Borehole Logs, and SPT and Core Box Photos

GENERAL

Information obtained from site investigations is recorded on log sheets. Soils and very low strength rock are commonly drilled using a combination of solid-flight augers with a Tungsten-Carbide (TC) bit. Descriptions of these materials presented on the "Borehole Log" are based on a combination of regular sampling and in-situ testing. Rock coring techniques commences once material is encountered that cannot be penetrated using a combination of solid-flight augers and Tungsten-carbide bit. The "Cored Borehole Log" presents data from drilling where a core barrel has been used to recover material - commonly rock.

The "Excavation – Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits or trenches.

The heading of the log sheets contains information on Project Identification, Hole or Test Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The scale is presented in the depth column as metres below ground level.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is included in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures, and geological unit. Material description and classifications are based on Australian Standard Geotechnical Site Investigations: AS 1726 - 2017 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

DRILLING

Drilling, Casing and Excavating

Drilling methods deployed are abbreviated as follows

Abbreviation	Method
AS	Auger Screwing
ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
BH	Backhoe
E	Excavator
HA	Hand Auger
HQ	HQ core barrel (~63.5 mm diameter core) *
HMLC	HMLC core barrel (~63.5 mm diameter core) *
NMLC	NMLC core barrel (~51.9 mm diameter core) *
NQ	NQ core barrel (~47.6 mm diameter core) *
RR	Rock Roller
WB	Wash-bore drilling
* Core diameters are approximate and vary due to the strength of material being drilled.	

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage. It is introduced to assist with the drill process, in particular, when core drilling. The introduction of drill fluid/water does not allow for accurate identification of water seepages.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

Abbreviation	Description
VE	Very Easy
E	Easy
F	Firm
H	Hard
VH	Very Hard

GROUNDWATER LEVELS

Date of measurement is shown.

▼ Standing water level measured in completed borehole

▽ Level taken during or immediately after drilling

► Groundwater inflow water level

SAMPLES/TESTS

Samples collected and testing undertaken are abbreviated as follows

Abbreviation	Test
ES	Environmental Sample
DS	Disturbed Sample
BS	Bulk Sample
U50	Undisturbed (50 mm diameter)
C	Core Sample
SPT	Standard Penetration Test
N	Result of SPT (*sample taken)
VS	Vane Shear Test
IMP	Borehole Impression Device
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test
HB	Hammer Bouncing

EXCAVATION LOGS

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added. Photos are recommended.

MATERIAL DESCRIPTION – SOIL

Material Description - In accordance with AS 1726-2017

Classification Symbol - In accordance with the Unified Classification System (AS 1726-2017).

Abbreviation	Typical Name
GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands, gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sands, sand-clay mixtures.
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL	Organic silts and organic silty clays of low plasticity. *
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, clastic silts.
CH	Inorganic clays of high plasticity, fat clays.
OH	Organic clays of medium to high plasticity, organic silts. *
Pt	Peat and other highly organic soils. *
* Additional details may be provided in accordance with the Von Post classification system (1922).	

Organic Soils – Identification using laboratory testing:

Material	Organic Content - % of dry mass
Inorganic	<2
Organic Soil	<2 ≤ 25
Peat	> 25

Organic Soils – Descriptive terms for the degree of decomposition of peat:

Term	Decomposition	Remains	Squeeze
Fibrous	Little or none	Clearly recognizable	Only water No solid
Pseudo-fibrous	Moderate	Mixture of fibrous and amorphous	Turbid water < 50% solids
Amorphous	Full	Not recognizable	Paste > 50% solids

Particle Characteristics – Definitions are as follows:

Fraction	Component (& subdivision)		Size (mm)
Oversize	**Boulders**		> 200
	Cobbles		> 63 ≤ 200
Coarse grained soils	**Gravel**	Coarse	> 19 ≤ 63
		Medium	> 6.7 ≤ 19
		Fine	> 2.36 ≤ 6.7
	Sand	Coarse	> 0.6 ≤ 2.36
		Medium	> 0.2 ≤ 0.6
		Fine	> 0.075 ≤ 0.21
Fine grained soils	**Silt**		0.002 ≤ 0.075
	Clay		< 0.002

Secondary and minor soil components

In coarse grained soils – The proportions of secondary and minor components are generally estimated from a visual and tactile assessment of the soils. Descriptions for secondary and minor soil components in coarse grained soils are as follows.

Designation of components	Percentage fines	Terminology (as applicable)	Percentage accessory coarse fraction	Terminology (as applicable)
Minor	≤ 5	Trace clay / silt	≤ 5	Trace sand / gravel
	> 5 ≤12	With clay / silt	> 5 ≤12	With sand / gravel
Secondary	> 12	Silty or clayey	> 30	Sandy or gravelly

Descriptions for secondary and minor soil components in fine grained soils are as follows.

Designation of components	Percentage coarse grained soils	Terminology (as applicable)
Minor	≤ 5	Trace sand / gravel / silt / clay
	> 5 ≤12	With sand / gravel / silt / clay
Secondary	> 30	Sandy / gravelly / silty / clayey

Plasticity Terms - Definitions for fine grained soils are as follows:

Descriptive Term	Range of Liquid Limit for silt	Range of Liquid Limit for clay
Low Plasticity	≤ 50	≤ 35
Medium Plasticity	N/A	> 35 ≤50
High Plasticity	> 50	> 50

Particle Characteristics

Particle shape and angularity are estimated from a visual assessment of coarse-grained soil particle characteristics. Terminology used includes the following:

Particle shape – spherical, platy, elongated,

Particle angularity – angular, sub-angular, sub-rounded, rounded.

Moisture Condition – Abbreviations are as follows:

D	Dry, looks and feels dry.
M	Moist, No free water on remoulding.
W	Wet, free water on remoulding.

Moisture content of fine-grained soils is based on judgement of the soils moisture content relative to the plastic and liquid limit as follows:

MC < PL	Moist, dry of plastic limit.
MC ≈ PL	Moist, near plastic limit.
MC > PL	Moist, wet of plastic limit.
MC ≈ LL	Wet, near liquid limit.
MC > LL	Wet of liquid limit.

Consistency - of cohesive soils in accordance with AS 1726-2017, Table 11 are abbreviated as follows:

Consistency Term	Abbreviation	Indicative Undrained Shear Strength Range (kPa)
Very Soft	**VS**	< 12
Soft	**S**	12 ≤ 25
Firm	**F**	25 ≤ 50
Stiff	**St**	50 ≤ 100
Very Stiff	**VSt**	100 ≤ 200
Hard	**H**	≥ 200
Friable	**Fr**	-

Density Index (%) of granular soils is estimated or is based on SPT results. Abbreviations are as follows:

Description	Abbreviation	Relative Density	SPT N
Very Loose	**VL**	< 15%	0 - 4
Loose	**L**	15 - 35%	4 - 10
Medium Dense	**MD**	35 - 65%	10 - 30
Dense	**D**	65 - 85%	30 - 50
Very Dense	**VD**	> 85%	> 50

Structures – Fissuring and other defects are described in accordance with AS 1726-2017 using the terminology for rock defects

Origin – Where practicable an assessment is provided of the probable origin of the soil, e.g. fill, topsoil, alluvium, colluvium, residual soil.

MATERIAL DESCRIPTION - ROCK

Material Description – In accordance with AS 1726-2017

Rock Naming – Where possible conventional geological names are used within the logs. Engineering properties cannot be inferred directly from the rock names in the table, but the use of a particular name provides an indicative range of characteristics to the reader. Lithological identification of rock is provided to appreciate the geology of an area, to correlate geological profiles seen in boreholes or to distinguish boulders from bedrock.

Grain Size – Grain size is done in accordance with AS1726-2017 as follows:

For sedimentary rock:

Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mmto 0.6mm
Fine grained	Mainly 0.06mm to 0.2mm

For igneous and metamorphic rock:

Coarse grained	Mainly greater than 2 mm
Medium grained	Mainly 0.6mm to 2mm
Fine grained	Mainly less than 2mm

Colour - Rock colour is described in the moist condition.

Texture and Fabric

Frequently used terms:

Sedimentary Rock	Metamorphic Rock	Igneous
Bedded	Banded	Amorphous
Cross-bedded	Cleaved	Crystalline
Folded	Folded	Flow banded
Graded	Foliated	Folded
Interbedded	Gneissose	Lineated
Laminated	Lineated	Massive
Massive	Schistose	Porphyritic

Bedding and fabric:

Description	Spacing
Very Thickly Bedded	> 2m
Thickly Bedded	0.6m to 2m
Medium Bedded	0.2m to 0.6m
Thinly Bedded	60mm to 200mm
Very Thinly Bedded	20mm to 60mm
Thickly Laminated	6mm to 20mm
Thinly Laminated	< 6mm

Degree of development:

Massive	No layering or fabric. Rock is homogeneous.
Indistinct	Layering or fabric just visible, There is little effect on strength properties.
Distinct	Layering or fabric obvious. The rock may break more easily parallel to the fabric.

Features, inclusions, and minor components - Features, inclusions and minor components within the rock material shall be described where those features could be significant such as gas bubbles, mineral veins, carbonaceous material, salts, swelling minerals, mineral inclusions, ironstone or carbonate bands, cross-stratification, or minerals the readily oxidise upon atmospheric exposure.

Moisture content - Where possible descriptions are made by the feel and appearance of the rock using one according to following terms:

Dry	Looks and feels dry.
Moist	Feels cool, darkened in colour, but no water is visible on the surface.
Wet	Feels cool, darkened in colour, water film or droplets visible on the surface.

The moisture content of rock cored with water may not be representative of its in-situ condition.

Durability – Descriptions of the materials durability such as tendency to develop cracks, break into smaller pieces or disintegrate upon exposure to air or in contact with water are provided where observed.

Rock Material Strength – The strength of the rock material is based on uniaxial compressive strength (UCS). The following terms are used:

Term / Abbreviation		Description	UCS (MPa)	Point Load Strength Index (MPa)
Very Low	**VL**	Crumbles under firm blow with sharp end of pick, can be peeled with a knife; too hard to cut a triaxial by hand; 30mm pieces can be broken by hand.	0.6 – 2	0.03 – 0.1
Low	**L**	Easily scored with a knifed; indentations 1-3mm show with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	2 – 6	0.1 – 0.3
Medium	**M**	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.	6 – 20	0.3 – 1
High	**H**	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	20 – 60	1 – 3
Very High	**VH**	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	60 – 200	3 – 10
Extremely High	**EH**	Specimen requires many blows with geological pick to break into intact materials; rock rings under hammer.	> 200	> 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical logs as follows:

D	Diametral Point Load Test
A	Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown. Point Load Strength Index test results are presented as $I_{s\,(50)}$ values in MPa.

Weathering – Weathering classification assists in identification but does not imply engineering properties. Descriptions are as follows:

Term / Abbreviation		Description
Residual Soil	**RS**	Material has soil properties. Mass structure and material texture and fabric of original rock not visible, but the soil has not been significantly transported.
Extremely Weathered	**EW**	Material has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Highly Weathered	**HW**	Material is completely discoloured, significant decrease in strength from fresh rock.
Moderately Weathered	**MW**	Material is `completely discoloured, little or no change of strength from fresh rock.
Slightly Weathered	**SW**	Partly stained or discoloured, little or no change to strength from fresh rock.
Fresh	**FR**	No signs of mineral decomposition or colour change.

Alteration – Physical and chemical changes of the rock material due to geological processes by fluids at depth at pressures and temperatures above atmospheric conditions. Unlike weathering, alteration shows no relationship to topography and may occur at any depth. When altered materials are recognized, the following terms are used:

Term / Abbreviation				Description
Extremely Altered		**XA**		Material has soil properties. Structure, texture, and fabric of original rock are still visible. The rock name is replaced with the name of the parent material, e.g., Extremely Altered basalt. Soil descriptive terms are used.
Highly Altered	**Distinctly altered**	**HA**	**DA**	The whole of the rock material is discoloured. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be higher or lower due to loss of minerals or precipitation of secondary minerals in pores.
Moderately Altered	**Distinctly altered**	**MA**	**DA**	The whole of the rock material is discoloured. Little or no change of strength from fresh rock. The term 'Distinctly Altered' is used where it is not practicable to distinguish between 'Highly Altered' and 'Moderately Altered'. Distinctly Altered is defined as follows: - The rock may be highly discoloured; - Porosity may be higher due to mineral loss; or may be lower due to precipitation of secondary minerals in pores; and - Some change of rock strength.
Slightly Altered		**S**		Rock is slightly discoloured. Little or no change of strength from fresh rock.

Alteration is only described in the context of the project where it has relevance to the civil and structural design.

Defect Descriptions

General and Detailed Descriptions – Defect descriptions are provided to suit project requirements. Generalized descriptions are used for some projects where it is unnecessary to describe each individual defect in a rock mass, or where multiple similar defects are present which are too numerous to log individually. The part of the rock mass to which this applies is delineated.

Detailed descriptions are given of defects judged to be particularly significant in the context of the project. For example, crushed seams in an apparently unstable slope. As a minimum, general descriptions outlining the number of defect sets within the rock mass and their broad characteristics are provided where it is possible to do so.

Defect Type – Defect abbreviations are as follows:

BP	Bedding parting	**SSM**	Sheared seam	**DB**	Drilling break
JT	Joint	**CS**	Crushed seam	**HB**	Handling break
SS	Shear surface	**SM**	Infilled seam		
SZ	Sheared zone	**EWS**	Extremely weathered seam		

Sheared surfaces, sheared zones, sheared seams, and crushed seams are generally faults in geological terms.

Defect Orientation

<u>For oriented core:</u> The dip and dip direction are recorded as a two-digit and three-digit number separated by a slash, are collected e.g., 50°/240° and there is not core loss that could obscure core orientation. If alternative measurements are made, such as dip and strike or dip direction relative to magnetic north this shall be documented.

<u>For non-oriented core:</u> The dip is recorded as a two-digit number, e.g., 10°. In vertical boreholes the dip is generally measured relative to the horizontal plan. If the borehole is inclined the dip is generally measured from the core axis.

Surface Roughness – Defect surface roughness is described as follows:

VR	**Very rough**	Many large surface irregularities with amplitude generally more than 1 mm.
RO	**Rough**	Many small surface irregularities with amplitude generally less than 1 mm.
SO	**Smooth**	Smooth to touch. Few or no surface irregularities.
PO	**Polished**	Shiny smooth surface
SK	**Slickensided**	Grooved or striated surface, usually polished.

Surface Shape – Defect surface roughness is described as follows:

PL	**Planar**	The defect does not vary in orientation.
CU	**Curved**	The defect has a gradual change in orientation
UN	**Undulating**	The defect has a wavy surface.
ST	**Stepped**	The defect has one or more well defined steps
IR	**Irregular**	The defect has many sharp changes of orientation

Defect Infilling – Common abbreviation as follows:

Ca	Calcite	**Fe**	Iron Oxide	**Qz**	Quartz
Cy	Clay	**MS**	Secondary mineral	**X**	Carbonaceous

Defect Coatings and Seam Composition - Coatings are described using the following terms:

CN	**Clean**	No visible coating.
SN	**Stained**	No visible coating but surfaces are discoloured.
VN	**Veneered**	A visible coating of soil or mineral, too thin to measure; may ne patchy.
CO	**Coating**	A visible coating up to 1 mm thick. Soil in-fill greater than 1 mm shall be described using defect terms (e.g., infilled seam). Defects greater than 1 mm aperture containing rock material great described as a vein.

Defect Spacing, Length, Openness and Thickness – Described directly in millimetres and metres. In general descriptions, half order of magnitude categories is used, e.g. joint spacing typically 100 mm to 300 mm, sheared zones 1m to 3m thick.

Depending on project requirements and the scale of observation, spacing may be described as the mean spacing within a set of defects, or as the spacing between all defects within the rock mass. Where spacing is measured within a specific set of defects, measurements shall be made perpendicular to the defect set.

Where significant, the nature of the defect end condition is recorded in the context of the scale of the exposure.

Block Shape – Where it is considered significant, block shape should be described using terms given in Table 23, AS 1725:2017.

Stratigraphic Unit – Geological maps related to the project are used for the designation of lithological formation name and, where possible geological unit name, e.g., Bringelly Shale, Potts Hill Sandstone Member.

Core Loss – Core loss occurs when material is lost during the drilling process It is shown at the bottom of the run unless otherwise indicated where core loss is known.

Total Core Recovery – The percentage of rock recovered excluding core loss per core run.

Defect Spacing – The spacing of successive defects or the mean spacing for relatively broken core.

Fracture Index – Which is the number defects per metre of core.

Rock Quality Designation (RQD) – The percentage of sound core pieces of 100mm or greater per core run and is calculated using Deere et al. (1989) method.

Rock Classification System – For design purpose, Sydney Rock Mass Classification System (Pells et al. 1998, 2019) is adopted.

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BH No: BH01

Job No: 18412

Borehole Log

Client: Pittwater RSL Club
Project: Proposed Lift and Lift Access
Location: 80 Mona Vale Road, Mone Vale NSW
Started: 20/11/2024
Finished: 20/11/2024
Borehole Size 110 mm

Rig Type: CE180 **Hole Location:** Refer to 18412-GR-1-1-B **Driller:** BG **Logged:** MB
RL Surface: m **Contractor:** BG Drilling **Bearing:** --- **Checked:** AT

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT	Not Encountered				-	Asphalt, 40mm thickness.		-	-	PAVEMENT
					-	FILL: Gravelly SAND, fine to coarse grained, fine to coarse angular to subangular igneous gravel.		M	-	FILL
					-	FILL: Silty SAND, fine to coarse grained, dark grey to brown, trace clay, with fine to coarse angular to subangular igneous gravel.				
					SC	Clayey SAND, fine to medium grained, orange red/red and pale grey.	SPT 3, 7, 10 N=17; 0.5-1.0 BS		MD	RESIDUAL SOIL
			1		SW	Extremeley Weathered Sandstone, recovered as SAND, fine to medium grained, red mottled grey, with clay.	1.0 DS; 1.0-1.5 DS	D - M	D	EXTREMELY WEATHERED MATERIAL
						At 1.5m: becoming pale yellow grey.	1.5-2.0 DS; SPT 11, 17/50mm HB N=R			
			2		-	SANDSTONE, fine to medium grained, red-brown and grey, highly weathered, inferred very low to low strength.	2.0-2.5 DS	-	-	BEDROCK
			3			Borehole BH01 continued as cored hole				
			4							
			5							
			6							

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Cored Borehole Log

Client: Pittwater RSL Club
Project: Proposed Lift and Lift Access
Location: 80 Mona Vale Road, Mone Vale NSW **Hole Location:** Refer to 18412-GR-1-1-B
Started: 20/11/2024
Finished: 20/11/2024
Borehole Size: 110 mm

Rig Type: CE180 **Hole Coordinates** E, N **Driller:** BG **Logged:** MB
RL Surface: m **Contractor:** BG Drilling **Bearing:** --- **Checked:** AT

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (● - Axial, O - Diametral; EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	$Is_{(50)}$ MPa (D- diametral, A- axial)	RQD %	Defect Spacing mm (30, 100, 300, 1000, 3000)	Additional Data
			1								
			2								
					Continued from non-cored borehole						2.9 - DB.
NMLC			3		SANDSTONE, fine to coarse grained, dark red brown and pale grey, massive.	MW		D 0.08 A 0.14	66		3.0 - HB. 3.09 - EWS, SC, 30mm. 3.12 - BP, 0°, PL, RO, CY, VN. 3.12 - BP, 10°, PL, RO, CY, VN. 3.18 - DB. 3.26 - BP, 5°, PL, RO, CN. 3.33 - BP, 0°, PL, RO, CN. 3.43 - BP, 20°, PL, RO, CY, VN.
					Core Loss, 100mm.	-					3.84 - EWS, SC, 10mm.
			4		SANDSTONE, fine to coarse grained, dark red brown and pale grey, massive.	MW		D 1.13 A 0.52 D 0.23 A 0.24	83		4.0 - HB. 4.03 - HB. 4.2 - BP, 20°, PL, RO, FE, SN. 4.38 - HB. 4.7 - BP, 10°, UN, RO, CY, VN. 4.87 - JT, 45°, CU, RO, CY, VN. 4.95 - BP, 15°, PL, RO, X, SN.
			5			HW MW			35		5.0 - HB. 5.18 - BP, 20°, PL, RO, FE, SN. 5.31 - BP, 10°, PL, RO, FE, SN. 5.35 - BP, 0°, PL, RO, FE, SN.
					At 5.43-5.48m: with siltstone clasts.			D 1.83 A 1.35			5.39 - BP, 0°, PL, RO, CY, VN. 5.45 - BP, 10°, PL, RO, FE, SN. 5.55 - BP, 5°, ST, RO, FE, SN. 5.72 - BP, 10°, ST, RO, FE, SN. 5.72 - BP, 0°, ST, RO, FE, SN. 5.86 - BP, 5°, PL, RO, FE, SN. 5.89 - BP, 10°, IR, RO, FE, SN.
			6		Clayey SAND, fine to coarse grained, grey.	EW					

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Cored Borehole Log

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BH No: BH01

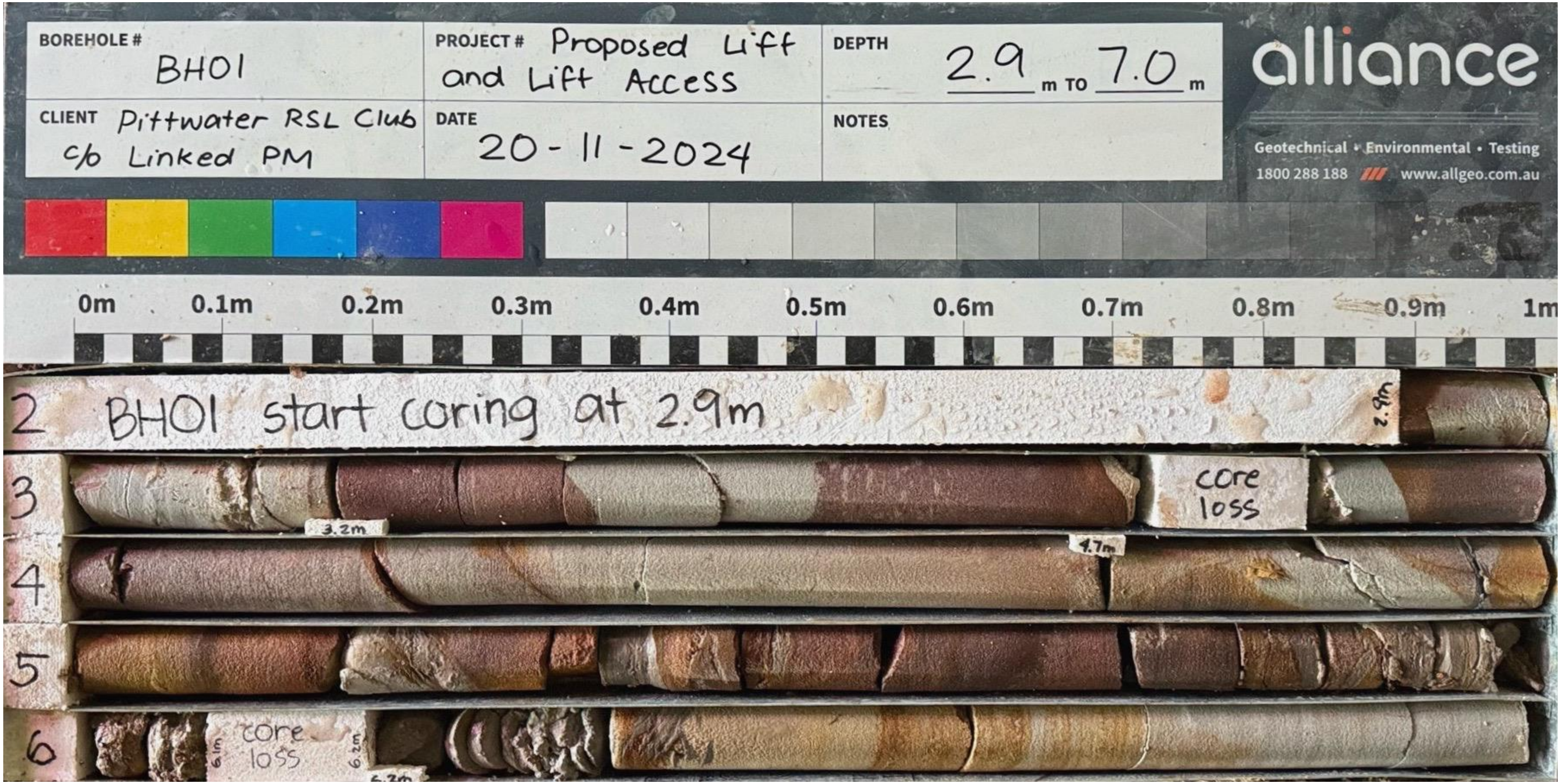
Job No: 18412

Client: Pittwater RSL Club
Project: Proposed Lift and Lift Access
Location: 80 Mona Vale Road, Mone Vale NSW
Hole Location: Refer to 18412-GR-1-1-B
Started: 20/11/2024
Finished: 20/11/2024
Borehole Size: 110 mm
Rig Type: CE180
Hole Coordinates E, N
Driller: BG
Logged: MB
RL Surface: m
Contractor: BG Drilling
Bearing: ---
Checked: AT

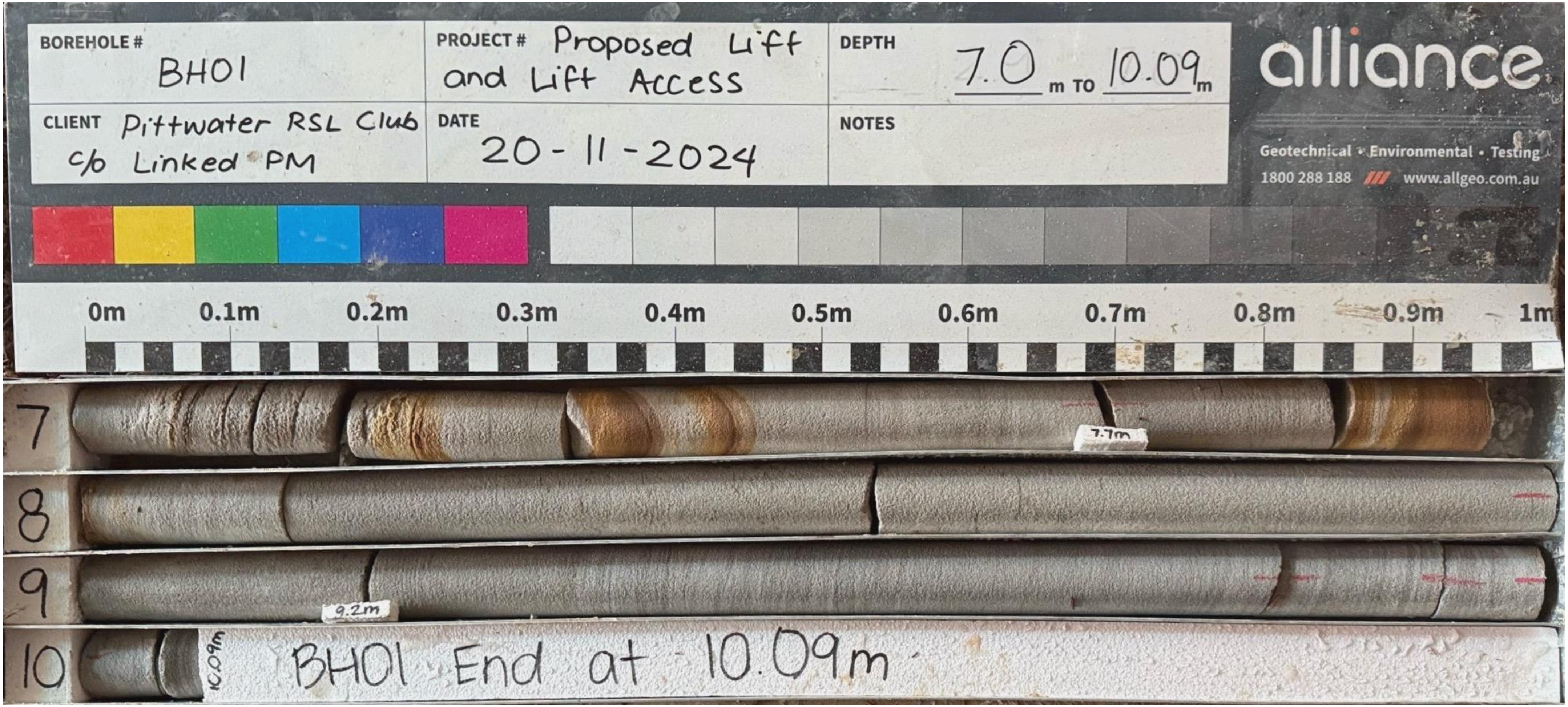
Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (● - Axial, O - Diametral; EL, VL, L, M, H, VH, EH)	$Is_{(50)}$ MPa (D- diametral, A- axial)	RQD %	Defect Spacing mm (30, 100, 300, 1000, 3000)	Additional Data
NMLC					Clayey SAND, fine to coarse grained, grey. *(continued)*	EW			35		
					Core Loss, 100mm.	-					
					Clayey SAND, fine to coarse grained, grey and orange brown.	EW					
			7		SANDSTONE, fine to coarse grained, pale grey with orange brown, with ironstaining, with carbonaceous laminations at 0-15°.	SW		D 0.34, A 0.35; D 0.08, A 0.18	85		6.61 - BP, 15°, ST, RO, FE, SN. 6.72 - BP, 15°, PL, RO, CN. 6.9 - BP, 10°, PL, RO, CN. 7.0 - HB. 7.11 - BP, 15°, PL, RO, X, SN. 7.16 - CS, gravel, 10mm. 7.22 - BP, 5°, PL, RO, FE, SN. 7.32 - BP, 5°, PL, RO, CN. 7.7 - DB. 7.84 - BP, 50°, IR, RO, CN. 7.96 - EWS, SC, 40mm.
			8 9		SANDSTONE, fine to coarse grained, pale grey, massive, with carbonaceous flecks.	FR		D 0.27, A 0.24	97		8.14 - BP, 0°, PL, RO, CN. 8.91 - BP, 10°, UN, RO, CN. 9.0 - HB. 9.2 - DB.
			10		SANDSTONE, fine to coarse grained, pale grey, with carbonaceous laminations at 0-15°.			D 0.43, A 0.36	97		9.36 - BP, 5°, PL, RO, X, SN. 9.81 - HB. 9.92 - HB. 10.0 - HB. 10.05 - CS, gravel, 5mm.
			11 12		Target depth. BH01 terminated at 10.09m						End of Borehole.

BH01		SPT 0.5 – 0.95m	N = 17	
alliance	Client Name	Pittwater RSL Club C/O Linked Project Management	Photo Date	20 November 2024
	Project Name	Proposed Lift and Lift Access		
	Project Location	80 Mona Vale Rd, Mona Vale NSW 2103		

BH01		SPT 2.00 – 2.20m	N = R	
alliance	Client Name	Pittwater RSL Club C/O Linked Project Management	Photo Date	20 November 2024
	Project Name	Proposed Lift and Lift Access		
	Project Location	80 Mona Vale Rd, Mona Vale NSW 2103		



BH01		Box 1/2	2.9m – 7.0m	
alliance	Client Name	Pittwater RSL Club C/O Linked Project Management	Photo Date	20 November 2024
	Project Name	Proposed Lift and Lift Access		
	Project Location	80 Mona Vale Rd, Mona Vale NSW 2103		



BH01		Box 2/2	7.0m – 10.09m	
alliance	Client Name	Pittwater RSL Club C/O Linked Project Management	Photo Date	20 November 2024
	Project Name	Proposed Lift and Lift Access		
	Project Location	80 Mona Vale Rd, Mona Vale NSW 2103		

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Borehole Log

Alliance Geotechnical Pty Ltd
T: 1800 288 188
E: office@allgeo.com.au
W: www.allgeo.com.au

BH No: BH02
Sheet: 1 of 1
Job No: 18412

Client: Pittwater RSL Club
Project: Proposed Lift and Lift Access
Location: 80 Mona Vale Road, Mone Vale NSW
Started: 20/11/2024
Finished: 20/11/2024
Borehole Size 150 mm

Rig Type: CE180
Hole Location: Refer to 18412-GR-1-1-B
Driller: BG
Logged: MB
RL Surface: m
Contractor: BG Drilling
Bearing: ---
Checked: AT

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
	Not Encountered				-	Asphalt, 40mm thickness.		-	-	PAVEMENT
					-	FILL: Gravelly SAND, fine to coarse grained, fine to coarse angular to subangular igneous gravel, with silt.		M	-	FILL
			0.5 1.0		-	FILL: SAND, fine to coarse grained, dark brown to brown, with fine to coarse igneous and ironstone subangular to subrounded gravel, trace silt.	0.04-1.0 BS			
			1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0			Target depth. Borehole BH02 terminated at 1m				

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Borehole Log

Alliance Geotechnical Pty Ltd
T: 1800 288 188
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BH No: BH03
Sheet: 1 of 1
Job No: 18412

Client: Pittwater RSL Club
Project: Proposed Lift and Lift Access
Location: 80 Mona Vale Road, Mone Vale NSW
Started: 20/11/2024
Finished: 20/11/2024
Borehole Size 150 mm

Rig Type: CE180
Hole Location: Refer to 18412-GR-1-1-B
Driller: BG
Logged: MB
RL Surface: m
Contractor: BG Drilling
Bearing: ---
Checked: AT

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
	Not Encountered				-	Asphalt, 40mm thickness.		-	-	PAVEMENT
					-	FILL: Gravelly SAND, fine to coarse grained, fine to angular to subangular igneous gravel, with silt.		M	-	FILL
			0.5		-	FILL: SAND, fine to coarse grained, dark brown to pale brown, with fine to coarse igneous and ironstone gravel, with Sandy CLAY nodules.	0.04-1.0 BS			
			1.0			Target depth. Borehole BH03 terminated at 1m				
			1.5							
			2.0							
			2.5							
			3.0							
			3.5							
			4.0							
			4.5							
			5.0							

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Borehole Log

Alliance Geotechnical Pty Ltd
T: 1800 288 188
E: office@allgeo.com.au
W: www.allgeo.com.au

BH No: BH04
Sheet: 1 of 1
Job No: 18412

Client: Pittwater RSL Club
Project: Proposed Lift and Lift Access
Location: 80 Mona Vale Road, Mone Vale NSW

Started: 20/11/2024
Finished: 20/11/2024
Borehole Size 150 mm

Rig Type: CE180
Hole Location: Refer to 18412-GR-1-1-B
Driller: BG
Logged: MB
RL Surface: m
Contractor: BG Drilling
Bearing: ---
Checked: AT

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
	Not Encountered				-	Asphalt, 40mm thickness.		-	-	PAVEMENT
					-	FILL: Gravelly SAND, fine to coarse grained, fine to angular to subangular igneous gravel.		M	-	FILL
			0.5		-	FILL: SAND, fine to coarse grained, pale brown, with fine to coarse subangular to subrounded igneous and ironstone gravel, trace Sandy CLAY nodules.	0.04-1.0 BS			
			1.0			Target depth. Borehole BH04 terminated at 1m				
			1.5							
			2.0							
			2.5							
			3.0							
			3.5							
			4.0							
			4.5							
			5.0							

APPENDIX D – Laboratory Test Certificates

Material Test Report

Report Number: **18412-1**
Issue Number: 1
Date Issued: 05/12/2024
Client: Alliance Geotechnical Pty Ltd
8 to 10 Welder Rd, Seven Hills NSW 2147
Contact: Monica Baduria
Project Number: 18412
Project Name: Pittwater RSL
Project Location: 80 Mona Vale Rd, Mona Vale
Work Request: 41753
Sample Number: 24-41753B
Date Sampled: 20/11/2024
Dates Tested: 22/11/2024 - 29/11/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location: **BH02, Depth: 0.0-1.0m**
Material: SAND; fine to coarse, dark brown to brown, with fine to coarse gravel, trace silt

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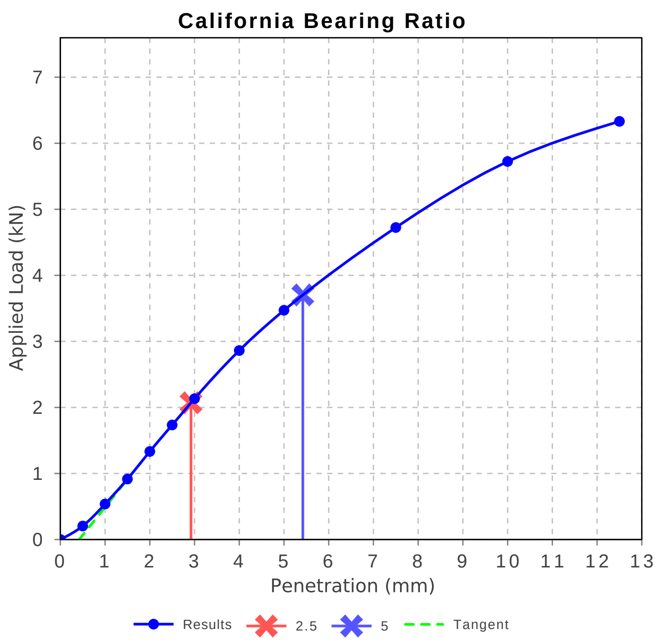
Alliance Geotechnical Pty Ltd
10 Welder Road Seven Hills NSW 2147
PO Box 275, Seven Hills NSW 1730
Phone: 1800 288 188
Email: brett@allgeo.com.au

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Brett Bellingham
Conformance Testing Manager
NATA Accredited Laboratory Number: 15100

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**19**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Tactile		
Maximum Dry Density (t/m^3)	1.95		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.94		
Field Moisture Content (%)	10.7		
Moisture Content at Placement (%)	12.8		
Moisture Content Top 30mm (%)	13.7		
Moisture Content Rest of Sample (%)	13.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	46.2		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	6.5		



Material Test Report

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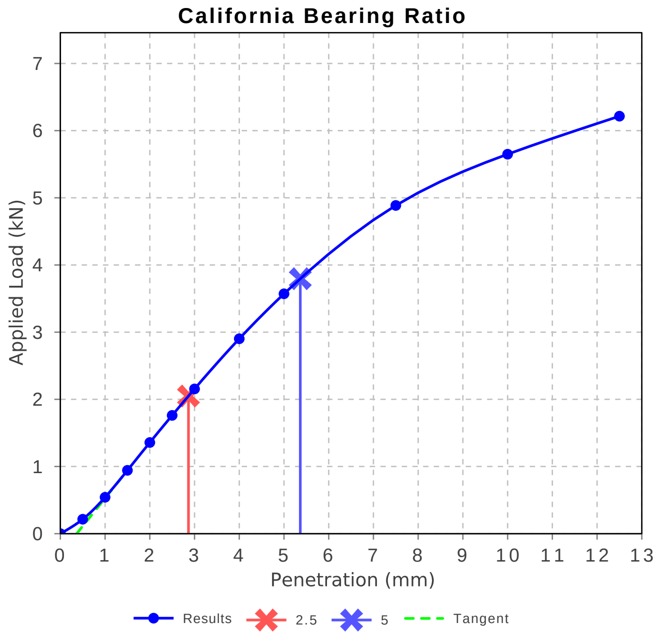
geotechnical & environmental solutions
Alliance Geotechnical Pty Ltd
10 Welder Road Seven Hills NSW 2147
PO Box 275, Seven Hills NSW 1730
Phone: 1800 288 188
Email: brett@allgeo.com.au

Report Number: **18412-1**
Issue Number: 1
Date Issued: 05/12/2024
Client: Alliance Geotechnical Pty Ltd
8 to 10 Welder Rd, Seven Hills NSW 2147
Contact: Monica Baduria
Project Number: 18412
Project Name: Pittwater RSL
Project Location: 80 Mona Vale Rd, Mona Vale
Work Request: 41753
Sample Number: 24-41753C
Date Sampled: 20/11/2024
Dates Tested: 22/11/2024 - 29/11/2024
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location: **BH03, Depth: 0.0-1.0m**
Material: SAND; fine to coarse, dark brown to pale brown, with fine to coarse gravel, with clay

NATA WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing
Approved Signatory: Brett Bellingham
Conformance Testing Manager
NATA Accredited Laboratory Number: 15100

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**19**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Tactile		
Maximum Dry Density (t/m^3)	1.86		
Optimum Moisture Content (%)	14.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	102.5		
Dry Density after Soaking (t/m^3)	1.86		
Field Moisture Content (%)	14.0		
Moisture Content at Placement (%)	14.6		
Moisture Content Top 30mm (%)	15.5		
Moisture Content Rest of Sample (%)	14.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	46.8		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	3.7		



Material Test Report

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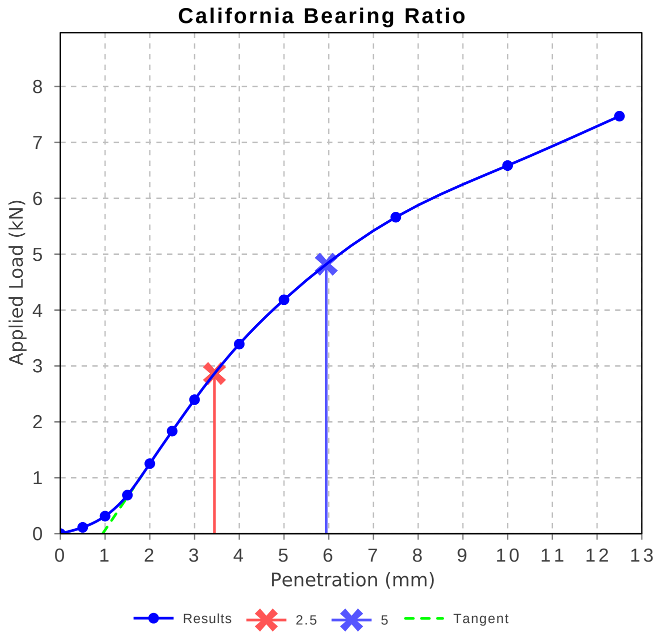
Accredited for compliance with ISO/IEC 17025 - Testing

NATA WORLD RECOGNISED ACCREDITATION

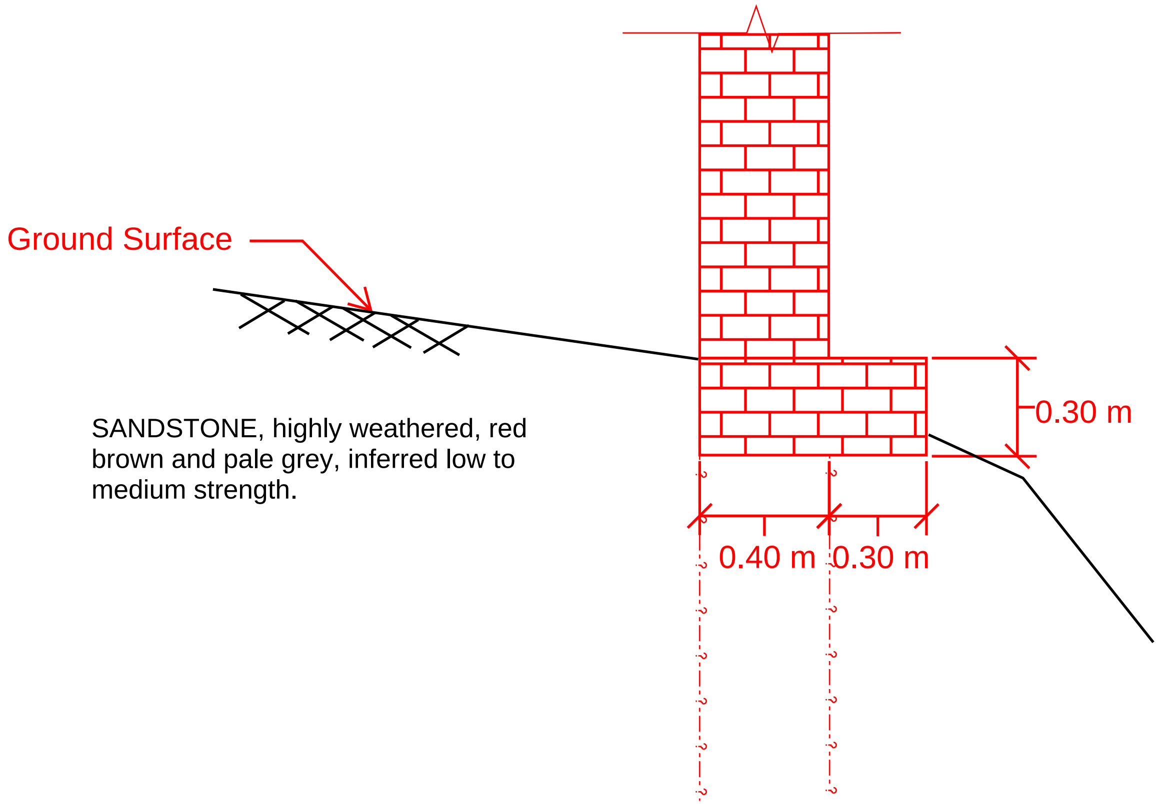
Approved Signatory: Brett Bellingham
Conformance Testing Manager
NATA Accredited Laboratory Number: 15100

Report Number:	**18412-1**
Issue Number:	1
Date Issued:	05/12/2024
Client:	Alliance Geotechnical Pty Ltd 8 to 10 Welder Rd, Seven Hills NSW 2147
Contact:	Monica Baduria
Project Number:	18412
Project Name:	Pittwater RSL
Project Location:	80 Mona Vale Rd, Mona Vale
Work Request:	41753
Sample Number:	24-41753D
Date Sampled:	20/11/2024
Dates Tested:	22/11/2024 - 29/11/2024
Sampling Method:	Sampled by Client *The results apply to the sample as received*
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location:	**BH04, Depth: 0.0-1.0m**
Material:	SAND; fine to coarse, pale brown, with fine to coarse gravel, trace clay

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**25**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Tactile		
Maximum Dry Density (t/m^3)	1.99		
Optimum Moisture Content (%)	10.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	98.0		
Dry Density after Soaking (t/m^3)	1.98		
Field Moisture Content (%)	6.6		
Moisture Content at Placement (%)	9.8		
Moisture Content Top 30mm (%)	12.1		
Moisture Content Rest of Sample (%)	11.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours (h)	46.4		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	7.3		

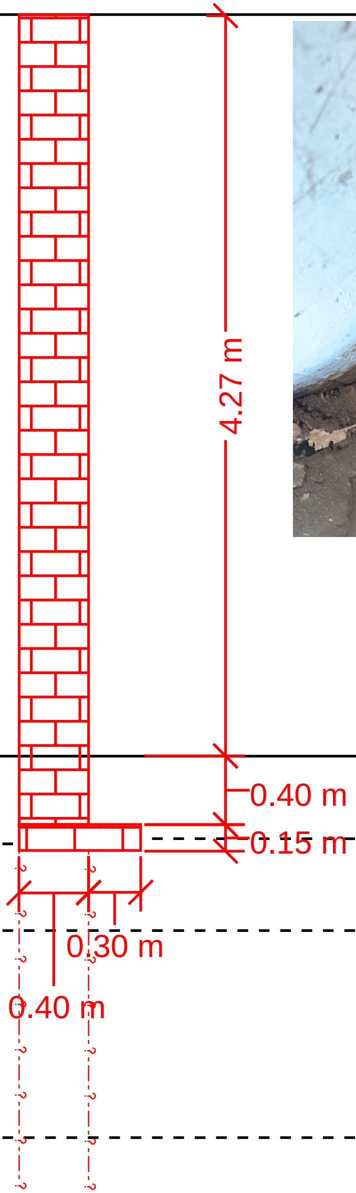


APPENDIX E – Footing Inspection Layout



Foundation Inspection - Basement

alliance	Client Name:	Pittwater RSL Club C/O Linked Project Management	Figure / Drawing Number:	18412-GR-1-1-E	
	Project Name:	Proposed Lift and Lift Access	Figure / Drawing Date:	22/11/2024	
	Project Location:	80 Mona Vale Road, Mona Vale NSW	Report Number:	18412-GR-1-1	



Ground Surface

0 m BGL

FILL: SAND, fine to coarse grained, dark grey to brown, moist, with rounded cobbles, appears moderately compacted.

0.5 m BGL

Clayey SAND, fine to medium grained, orange red and pale grey, moist, medium dense, residual.

1.0 m BGL

Extremely weathered sandstone recovered as SAND, fine to medium grained, pale light red and grey, dry to moist, with clay, medium dense.

2.2 m BGL

SANDSTONE, highly weathered, red brown and grey, inferred very low strength.

Foundation Inspection - Undercroft

alliance	Client Name:	Pittwater RSL Club C/O Linked Project Management	Figure / Drawing Number:	18412-GR-1-1-E
	Project Name:	Proposed Lift and Lift Access	Figure / Drawing Date:	22/11/2024
	Project Location:	80 Mona Vale Road, Mona Vale NSW	Report Number:	18412-GR-1-1