Geotechnical Investigation Report

GEOTECHNICAL REPORT FOR

3 & 4 LLANYFOYST STREET, RANDWICK NSW

Prepared for:

PARSEH LLANFOYST PTY LTD

Reference: P2110_04

13 December 2023

Morrow Geotechnics Pty Ltd | ABN 42 605 892 126
2/5-7 Malta Street, Fairfield East NSW 2165 | 79/6 Bellambi Lane, Bellambi NSW 2518
P: 02 8599 7579 | E: info@morrowgeo.com.au

1 PROJECT BACKGROUND

Morrow Geotechnics Pty Ltd has undertaken a Geotechnical Investigation to provide geotechnical advice and recommendations for the proposed development at 3-4 Llanfoyst Street, Randwickl NSW (the site).

The following reports have been previously prepared for the site:

- Morrow Geotechnics Pty Ltd, *Residential Development, 4 Llanfoyst Street, Randwick, NSW,* Ref. P2110_01, dated 8 December 2020 (MG 2020)
- Morrow Geotechnics Pty Ltd, *Geotechnical Letter, 3 & 4 Llanfoyst Street, Randwick, NSW,* Ref. P2110_03 rev1, dated 30 November 2020 (MG 2023)

Architectural drawings for the proposed development have been prepared by OROSI Architecture, *Project: 3 & 4 LLANFOYST STREET RANDWICK,* Project No. 2301, ISSUE J dated 17 November 2023. From the drawings provided, Morrow Geotechnics understands that the proposed development involves construction of a four storey, multi-dwelling structure over two levels of basement parking requiring excavation to a depth of approximately 10.5 metres below ground level (mBGL).

1.1 Investigation Intent

The purpose of the investigation is to provide geotechnical advice and recommendations for structural design. These recommendations include:

- Building foundation options, including design parameters;
- Excavation support options, including lateral earth pressures and pile design parameters;
- Lot classification in accordance with AS2870;
- Earthquake site classification in accordance with AS1170.4;
- Advice on possible seepage water associated with basement construction; and
- Advice on geotechnical construction constraints.

1.2 Published Geological Mapping

The Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9029-9130 (DMR 1985) indicates the site to be underlain by Hawkesbury Sandstone, which comprises medium to coarse grained quartz sandstone.

1.3 Published Soil Landscapes

The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 indicates that the residual landscape at the site is located within the Newport Landscape. The Newport landscape type typically includes gently undulating plains of Holocene sands to rolling rises over other soils or bedrock. Soils are generally shallow (< 0.5 m) siliceous sands overlaying moderately deep buried sands (< 1.5m) yellow podzolic soil with sandy topsoil on crests and deep (> 2.0m) podzols in depressions earthy sands. These soils are noted present high soil erosion hazards, localized steep slopes, very low soil fertility and non-cohesive topsoil.

2 OBSERVATIONS

2.1 Investigation Methods

Fieldwork was undertaken by Morrow Geotechnics on 30 November to 1 December 2023. Work carried out as part of this investigation includes:

- Review of publicly available information from previous reports in the project area, published geological and soil mapping and government agency websites;
- Site walkover inspection by an experienced Engineering Geologist to assess topographical features, condition of surrounding structures and site conditions;
- Drilling of two boreholes (BH1 to BH2) were drilled using a man-portable drill with NMLC coring techniques to depths of 15.0 and 10.0 metres below ground level (mBGL) respectively. Rock core was boxed and photographed, and point load tests were undertaken on selected core sample to assess rock strength;
- Groundwater observations within boreholes during drilling and installation of two groundwater monitoring wells within BH1 & BH2 immediately following drilling.

Borehole locations are shown on **Figure 1** and borehole logs are presented in **Appendix A.**

2.2 Subsurface Conditions

The stratigraphy at the site is characterized by fill overlying sandstone bedrock. Observations taken during the investigation have been used to produce a stratigraphic model of the site. The observed stratigraphy has been divided into five geotechnical units.

A summary of the subsurface conditions across the site, interpreted from the investigation results, are presented in **Table 1**. More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs presented in **Appendix A**. The details of the method of soil and rock classification, explanatory notes and abbreviations adopted in the borehole logs are also presented in **Appendix A**.

TABLE 1 SUMMARY OF INFERRED SUBSURFACE CONDITIONS

Unit	Material	Approx. Depth Range of Unit [1] mBGL (RL)			Comments
		BH1	BH2	BH1 (2017)	
1	Fill/Topsoil	0.0 to 0.4 (62.2 to 61.8)	0.0 to 0.33 (58.6 to 58.3)	0.0 to 1.5 (61.5 to 60.0)	Gravelly sandy FILL/TOPSOIL, loose to medium dense, medium grained, fine to medium sized gravel, trace low plasticity clay, moist. Fill within Unit 1 was inferred to be uncontrolled and poorly compacted.
2	Class IV Sandstone	0.4 to 0.8 (61.8 to 61.4)	-	-	Distinctly to Highly weathered SANDSTONE, very low to low strength, fine to medium grained, iron stained.
3	Class III Sandstone	0.8 to 15.0 (61.4 to 47.2)	0.33 to 10.0 (58.3 to 48.6)	1.5 + (sub 60.0)	Moderately to Slightly weathered SANDSTONE, generally medium strength with some medium to high strength sections, fine to medium grained with minor low strength seams of 2cm to 5cm

Notes:

1 Depths shown are based on material observed within test locations and will vary across the site

2.3 Groundwater Observations

Two monitoring wells were installed within BH1 and BH2 as part of the investigation. No regional groundwater table was encountered during the investigation. Minor seepage is to be expected between the soil and rock interfaces following rainfall.

3 RECOMMENDATIONS

3.1 Excavation Retention

Temporary batter slopes of 1H:1V will be possible for Unit 1 material provided that surface water is diverted away from the batter faces and batter heights are kept to less than 3 m. Units 2 & 3 Sandstone may be cut vertically without support provided that geotechnical inspections are undertaken during construction to ensure that isolated blocks and wedges are not present within the rock cutting. If blocks and wedges are present isolated spot bolting or shotcreting may be required as support.

Where excavations extend beneath the zone of influence of nearby structures, services or pavements, or where site constraints such as site boundaries do not allow the construction of temporary batters, excavation retention will be required. For design of cantilevered shoring systems a triangular pressure distribution may be employed using the parameters presented in **Table 2**. For design of rigid anchored or braced walls such as top-down construction, a trapezoidal earth pressure distribution should be used with a maximum pressure of 0.65.Ka.γ.H (kPa), where 'H' is the effective vertical height of the wall in metres.

TABLE 2 EARTH PRESSURE PARAMETERS

Material		Unit 1 Fill/Topsoil	Unit 2 Class IV Sandstone	Unit 3 Class III Sandstone
Unit Weight (kN/m^3)		18	23	24
Earth Pressure Coefficients	At Rest, K_o	0.53	0.47	0.36
	Passive, K_p	2.77	3.25	4.60
	Active, K_a	0.36	0.31	0.22
Drained Cohesion, c' (kPa)		0	35	250
Friction Angle, ϕ' (^{o})		28	35	40
Elastic Modulus (MPa)		5	100	600
Poisson's Ratio		0.30	0.22	0.20

Notes:

1 Unit Weight is based on visual assessment only and may vary by ±10%.

2 Earth pressures are provided on the assumption that the ground behind the retaining wall is flat and drained.

In addition, design of retaining walls should consider the following:

- Appropriate surcharge loading from construction equipment, vehicular traffic and neighbouring structures at finished surface level should be taken into account in the retention design. Surcharge loads on retention structures may be calculated using a rectangular stress block with an earth pressure coefficient of 0.5 applied to surcharge loads at ground surface level.
- Anchor design should ignore the contribution of any bonded length within a wedge which extends upwards at 45^{o} from the base of the excavation to account for a failure wedge forming behind the shoring system.
- If the shoring system is to be tanked slab on ground design must allow for groundwater uplift pressures and shoring must allow for hydrostatic pressures from approximately 2.0 mBGL.

Earth pressure coefficients with **Table 2** are provided on the assumption that the ground behind the retaining wall is flat and drained. For cases where the ground profile rises at more than 5° behind the retaining system detailed design input should be sought from a geotechnical engineer.

Surcharge loads on retention structures may either be modelled directly through finite element inputs in programs such as Plaxis or Wallap, or they may be calculated using a rectangular stress block with an earth pressure coefficient of 0.5 applied to surcharge loads at ground surface level. The retaining walls should be designed to withstand hydrostatic pressure from 3 mBGL unless permanent drainage is incorporated in the wall design.

3.2 Soil and Rock Excavatability

The expected ability of equipment to excavate the soil and rock encountered at the site is summarised in **Table 3**. This assessment is based on available site investigation data and guidance on the assessment of excavatability of rock by Pettifer and Fookes (1994). The presence of medium to high strength bands in lower strength rock and the discontinuity spacing may influence the excavatability of the rock mass.

TABLE 3 SOIL AND ROCK EXCAVATABILITY

Unit	Material	Excavatability
1	**Topsoil/Fill**	Easy digging by 20t Excavator
2	**Class IV Sandstone**	Hydraulic hammering will be required for Excavation within units 1 and 2
3	**Class III Sandstone**	

The excavation methodology may also be affected by the following factors:

- Scale and geometry of the excavation;
- Availability of suitable construction equipment;
- Potential reuse of material on site; and
- Acceptable excavation methods, noise, ground vibration and other environmental criteria.

3.3 Excavation Vibration Considerations

As a guide, safe working distances for typical items of vibration intensive plant are listed in **Table 4**. The safe working distances are quoted for both "cosmetic" damage (refer British Standard BS 7385:1993) and human comfort (refer NSW Environmental Protection Agency Vibration Guideline).The safe working distances should be complied with at all times, unless otherwise mitigated to the satisfaction of the relevant stakeholders.

TABLE 4 RECOMMENDED SAFE WORKING DISTANCES FOR VIBRATION INTENSIVE PLANT

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385:1993) [1]	Human Response (EPA Vibration Guideline)
Vibratory Roller	< 50 kN (typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (typically 2-4 tonnes)	6 m	20 m
	< 200 kN (typically 4-6 tonnes)	12 m	40 m
	< 300 kN (typically 7-13 tonnes)	15 m	100 m
	< 300 kN (typically 13-18 tonnes)	20 m	100 m
	< 300 kN (typically >18 tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Med Hydraulic Hammer	900 kg – 12 to 18 t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Notes:

1 More stringent conditions may apply to heritage buildings or other sensitive structures.

In relation to human comfort (response), the safe working distances in **Table 4** relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are permitted, as discussed in British Standard BS 6472-1:2008.

The safe working distances provided in **Table 5** are given for guidance only. Monitoring of vibration levels may be required to ensure vibrations levels remain below threshold values during the construction period.

3.4 Foundation Design

It is not recommended that shallow footings or slabs found within Unit 1 material due to the potential for differential settlement caused by footings bridging between materials of varying stiffness. Shallow footings and slabs at the site should be designed in accordance with AS2870:2011 based on a Site Classification of 'M.' The site classification has been provided on the basis that the performance expectations set out in Appendix B of AS2870–2011 are acceptable and that future site maintenance will be undertaken in accordance with CSIRO BTF 18.

The parameters given in **Table 5** may be used for the design of pad footings and bored piles. Morrow Geotechnics recommends that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.4 is used for the design of piles in accordance with AS 2159:2009 if no allowance is made for pile testing during construction. Should pile testing be nominated, the GSRF may be reviewed and a value of 0.55 to 0.65 may be expected.

Ultimate geotechnical strengths are provided for use in limit state design. Allowable bearing pressures are provide for serviceability checks. These values have been determined to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing dimension.

TABLE 5 PAD FOOTING AND PILE DESIGN PARAMETERS

Material		Unit 1 Fill/Topsoil	Unit 2 Class IV Sandstone	Unit 3 Class III Sandstone
Allowable Bearing Pressure (kPa)		N/A	1500	3500
Ultimate Vertical End Bearing Pressure (kPa)		N/A	4500	10500
Elastic Modulus (MPa)		5	150	600
Ultimate Shaft Adhesion (kPa)	In Compression	0	200	800
	In Tension	0	100	400
Susceptibility to Liquefaction		Medium	Low	Low

Notes:

1 Side adhesion values given assume there is intimate contact between the pile and foundation material. Design engineer to check both 'piston' pull-out and 'cone' pull-out mechanics in accordance with AS4678-2002 Earth Retaining Structures.

2 Susceptibility to liquefaction during an earthquake is based on the following definition:
- Low - Medium to very dense sands, stiff to hard clays, and rock
- Medium - Loose to medium dense sands, soft to firm clays, or uncontrolled fill below the water table
- High - Very loose sands or very soft clays below the water table

3 Allowable Bearing Pressure provided for Unit 5 Class II/I Sandstone will require on site verification of rock quality by spoon testing of a minimum of 50% of the pad footings to 2 times the minimum pad footing width.

To adopt these parameters we have assumed that the bases of all pile excavations are cleaned of loose debris and water and inspected by a suitably qualified Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremmie system could be used.

Selection of footing types and founding depth will need to consider the risk of adverse differential ground movements within the foundation footprint and between high level and deeper footings. Unless an allowance for such movement is included in the design of the proposed development we recommend that all new structures found on natural materials with comparable end bearing capacities and elastic moduli.

3.5 AS1170 Earthquake Site Risk Classification

Assessment of the material encountered during the investigation in accordance with the guidelines provided in AS1170.4-2007 indicates an earthquake subsoil class of Class B_e – Rock for the site.

4 STATEMENT OF LIMITATIONS

The adopted investigation scope was limited by site access restrictions due to presence of structures and services at the site at the time of our investigation and by the investigation intent. Further geotechnical inspections should be carried out during construction to confirm both the geotechnical model and the design parameters provided in this report.

Your attention is drawn to the document "Important Information", which is included in **Appendix B** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

5 REFERENCES

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

Chapman, G.A. and Murphy, C.L. (1989), Soil Landscapes of the Sydney 1:100000 sheet. Soil Conservation Services of NSW, Sydney.

NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

NSW Department of Mineral Resources (1985) Sydney 1:100,000 Geological Series Sheet 9129 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

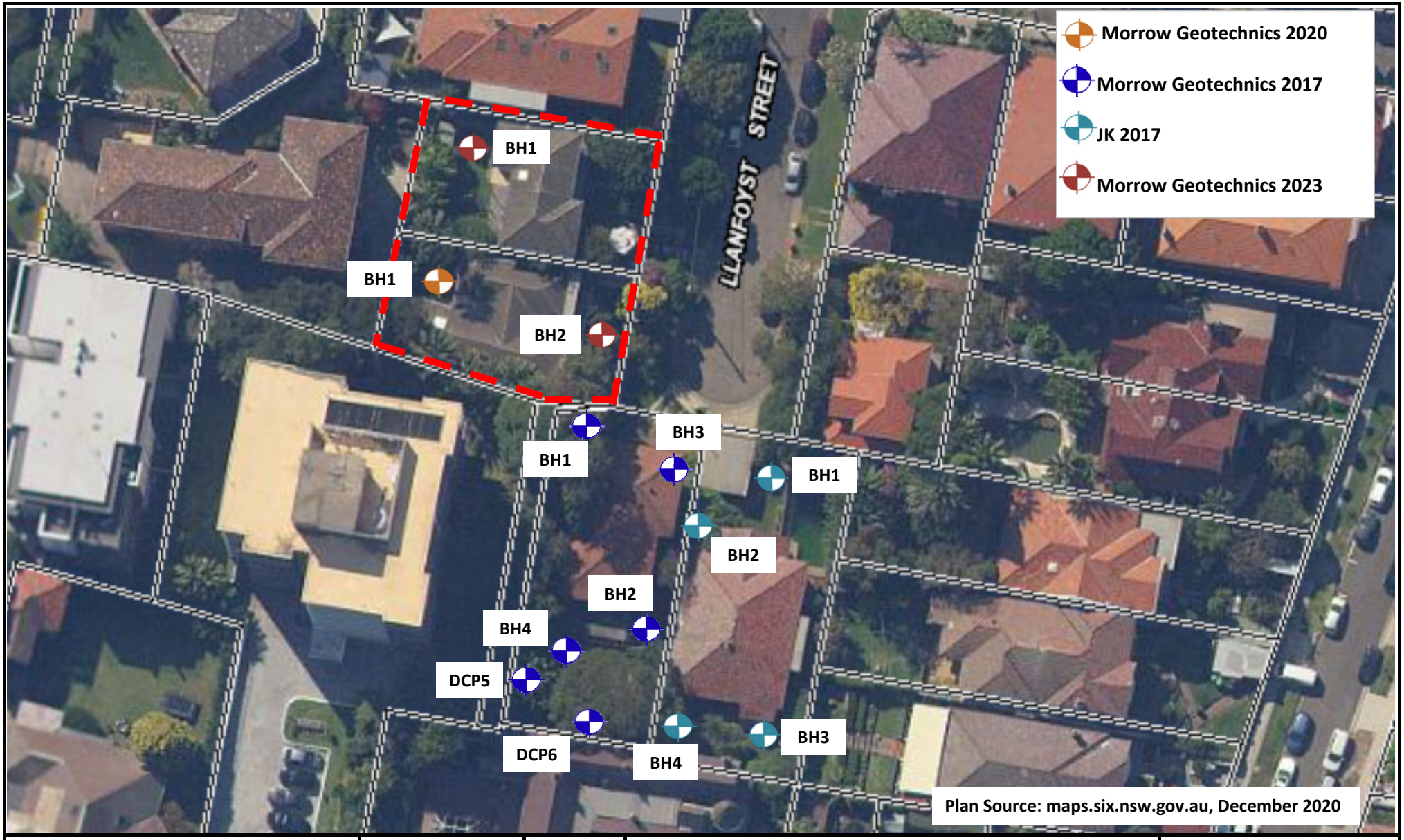
6 CLOSURE

Please do not hesitate to contact Morrow Geotechnics if you have any questions about the contents of this report.

For and on behalf of Morrow Geotechnics Pty Ltd,

Mark Peach
Geotechnical Engineer

Alan Morrow
Principal Geotechnical Engineer



morrow
PO Box 4069, Carlton NSW 2218
P: 0405 843 933 | E: info@morrowgeo.com.au

Drawn	AB
Approved	AM
Date	13/12/2023
Scale	NTS

4 Llanfoyst Street, Randwick NSW
Geotechnical Investigation
Borehole Location Plan

Figure:
1

Project: P2110

Appendix A

BOREHOLE LOGS AND EXPLANATORY NOTES

Morrow Geotechnics
Bellambi, NSW
Phone: 0405 843 933

Geotechnical Log - Borehole

BH1

UTM	: 56H	Drill Rig	: Man-Portable	Job Number	: P2110
Easting (m)	: 337575.1967010294	Driller Supplier	: TIGHT Site	Client	: Parseh Llanfoyst Pty Ltd
Northing (m)	: 6245944.3632496875	Logged By	: Andrew Butel	Project	: Randwick
Ground Elevation	: 62.2 (m)	Reviewed By	: Mark Peach	Location	: 3 & 4 Llanfoyst Street, Randwick NSW
Total Depth	: 15 m BGL	Date	: 05/12/2023	Loc Comment	:

Drilling Method	Water	Well Diagram	Testing	Soil Origin	Graphic Log	Classification Code	Depth (m)	Material Description	Elevation (m)	Consistency/Density	Moisture
Hand Auger	GWNE	Backfill 50mm PVC Solid		Topsoil		CL-CI		Topsoil Sandy CLAY (CL-CI) : soft, low to medium plasticity, brown, fine to medium grained sand, trace fine sized gravel, inorganic, w < pl.	62.2	S	w < PL
								0.4m : Commenced NMLC Coring;			
							1		61.2		
							2		60.2		
							3		59.2		
							4		58.2		

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Geotechnical Log - Borehole

BH1

UTM	: 56H	**Drill Rig**	: Man-Portable	**Job Number**	: P2110
Easting (m)	: 337575.1967010294	**Driller Supplier**	: TIGHT Site	**Client**	: Parseh Llanfoyst Pty Ltd
Northing (m)	: 6245944.3632496875	**Logged By**	: Andrew Butel	**Project**	: Randwick
Ground Elevation	: 62.2 (m)	**Reviewed By**	: Mark Peach	**Location**	: 3 & 4 Llanfoyst Street, Randwick NSW
Total Depth	: 15 m BGL	**Date**	: 05/12/2023	**Loc Comment**	:

Drilling Method	Water	Well Diagram	RQD% and TCR%	Testing Is(50)	Estimated Strength (VLS, LS, MS, HS, VHS, EHS)	Weathering	Depth (m)	Graphic Log	Classification Code	Material Description	Elevation (m)	Defect Spacing (mm) (30, 100, 300, 1000, 3000)	Defect Depth	Defect Description (type, inclination, planarity, roughness, coating, thickness)
		Backfill									62.2			
NMLC Coring	0% Water Loss	Bentonite; 50mm PVC Solid; 2mm Sand; 50mm PVC Slotted	RQD = 95.59% TCR = 100% RQD = 100% TCR = 100% RQD = 100% TCR = 100%	d: 0.21, a: 0.21 d: 0.01, a: 0.03 d: 0.47, a: 0.52 d: 0.22, a: 0.71 d: 0.50, a: 0.54		DW-HW DW-HW SW	0.8 3.55		SST SST SST	Rock SANDSTONE: distinctly to highly weathered, very low strength, orange red grey, fine to medium grained, massive, iron stained. As above, but low to medium strength. Rock SANDSTONE: slightly weathered, medium strength, grey light grey, fine to medium grained, massive, minor carbonaceous laminations.	61.2 60.2 59.2 58.2		1 2 3 4	0.64, P, 7°, VR, PL, CL, OP 0.85, P, carbonaceous staining, 5°, VR, PL STN, C 1.23, P, carbonaceous staining, 3°, VR, PL STN, OP 1.72-1.76, XWS, extremely weathered sandstone seam, 3°, VR, PL, CL, OP 1.9, P, iron staining, 7°, VR, PL, STN, O 2.05, P, iron staining, 7°, VR, PL STN, OP 4.12, P, 2°, RO, PL, CL, OP 4.52, P, 4°, VR, STR CL, OP 4.85, P, 2°, RO, PL, CL, OP

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Geotechnical Log - Borehole

BH1

UTM	: 56H	**Drill Rig**	: Man-Portable	**Job Number**	: P2110
Easting (m)	: 337575.1967010294	**Driller Supplier**	: TIGHT Site	**Client**	: Parseh Llanfoyst Pty Ltd
Northing (m)	: 6245944.3632496875	**Logged By**	: Andrew Butel	**Project**	: Randwick
Ground Elevation	: 62.2 (m)	**Reviewed By**	: Mark Peach	**Location**	: 3 & 4 Llanfoyst Street, Randwick NSW
Total Depth	: 15 m BGL	**Date**	: 05/12/2023	**Loc Comment**	:

Drilling Method	Water	Well Diagram	RQD% and TCR%	Testing Is(50)	Estimated Strength (VLS, LS, MS, HS, VHS, EHS)	Weathering	Depth (m)	Graphic Log	Classification Code	Material Description	Elevation (m)	Defect Spacing (mm) (30, 100, 300, 1000, 3000)	Defect Depth	Defect Description (type, inclination, planarity, roughness, coating, thickness)
NMLC Coring	0% Water Loss	2mm Sand 50mm PVC Slotted	RQD = 92.03% TCR = 100%	d: 0.93, a: 0.50	MS	MW-S	5		SST	As above, but moderately to slightly weathered, yellow grey, generally massive, with sub-horizontal carbonaceous laminations.	57.2			5.32, P, 6°, RO, PL, CL, OP 5.41-5.42, IS, low strength sandstone seam, 2°, RO, PL, CL, OP
							6				56.2		6	
			RQD = 97.42% TCR = 100%	d: 0.89, a: 0.84										6.83, P, 2°, VR, PL, CL, OP
							7				55.2		7	7.18-7.19, XWS, infilled extremely weathered sandstone, 2°, VR, PL, CL, OP
							7.5							
				d: 0.72, a: 1.53		MW-S			SST	As above, but medium to high strength.				7.51, P, carbonaceous staining, 2°, VR, UN STN, OP
			RQD = 99.38% TCR = 100%				8				54.2		8	
				d: 0.83, a: 0.99										8.14, P, carbonaceous staining, 6°, RO, PL STN, OP
							9				53.2		9	
			RQD = 98.51% TCR = 100%	d: 0.53, a: 1.08										9.17-9.19, XWS, infilled extremely weathered sandstone, 6°, VR, PL, CL, OP

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Geotechnical Log - Borehole

BH1

UTM	: 56H	**Drill Rig**	: Man-Portable	**Job Number**	: P2110
Easting (m)	: 337575.1967010294	**Driller Supplier**	: TIGHT Site	**Client**	: Parseh Llanfoyst Pty Ltd
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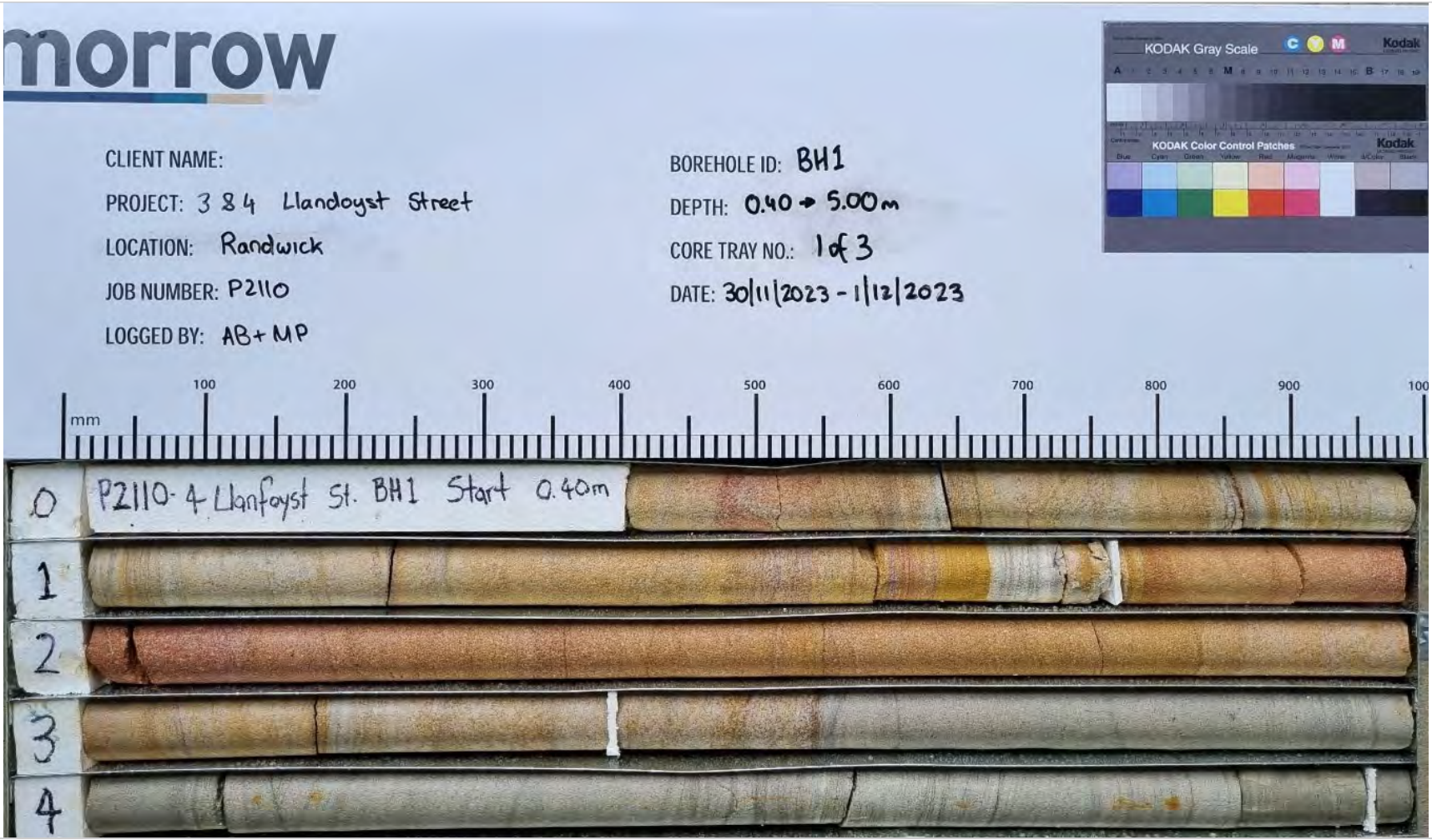
Drilling Method	Water	Well Diagram	RQD% and TCR%	Testing Is(50)	Estimated Strength (VLS, LS, MS, HS, VHS, EHS)	Weathering	Depth (m)	Graphic Log	Classification Code	Material Description	Elevation (m)	Defect Spacing (mm) (30, 100, 300, 1000, 3000)	Defect Depth	Defect Description (type, inclination, planarity, roughness, coating, thickness)
NMLC Coring	0% Water Loss	2mm Sand 50mm PVC Slotted	RQD = 98.51% TCR = 100% RQD = 91.62% TCR = 100% RQD = 94.84% TCR = 100% RQD = 100% TCR = 100%	d: 0.76, a: 0.72 d: 0.35, a: 0.84 d: 0.26, a: 0.84 d: 0.95, a: 1.02 d: 0.89, a: 0.83	MS	MW	10 11 12 13 14		SST	As above, but moderately weathered, medium strength.	52.2 51.2 50.2 49.2 48.2		11 12 13 14	10.08-10.11, XWS, infilled extremely weathered sandstone, 3°, VR, PL, CL, OP 11.28, P, 5°, VR, PL CL, OP 11.62, P, carbonaceous staining, 3°, VR, UN STN, OP 11.76-11.89, IS, infilled siltstone seam, 30°, VR, UN STN, C 12.39, P, 3°, RO, PL CL, OP 13.66, P, 3°, RO, PL CL, OP 13.74, IS, organic matter, 2°, RO, PL, STN, C 14.08, P, carbonaceous staining, 2°, RO, PL STN, OP 14.85, P, 2°, RO, PL CL, OP



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0405 843 933
Bellambi. NSW
info@morrowgeo.com.au

Photo description	BH1 Box 1 of 3		
Client	Paresh Llanfoyst Pty Ltd		
Location	3 & 4 Llanfoyst Street, Randwick NSW		
Project name	Randwick		
Project No	P2110	**Scale**	Not to Scale
BH No	BH1	**BH Depth**	CorePhoto

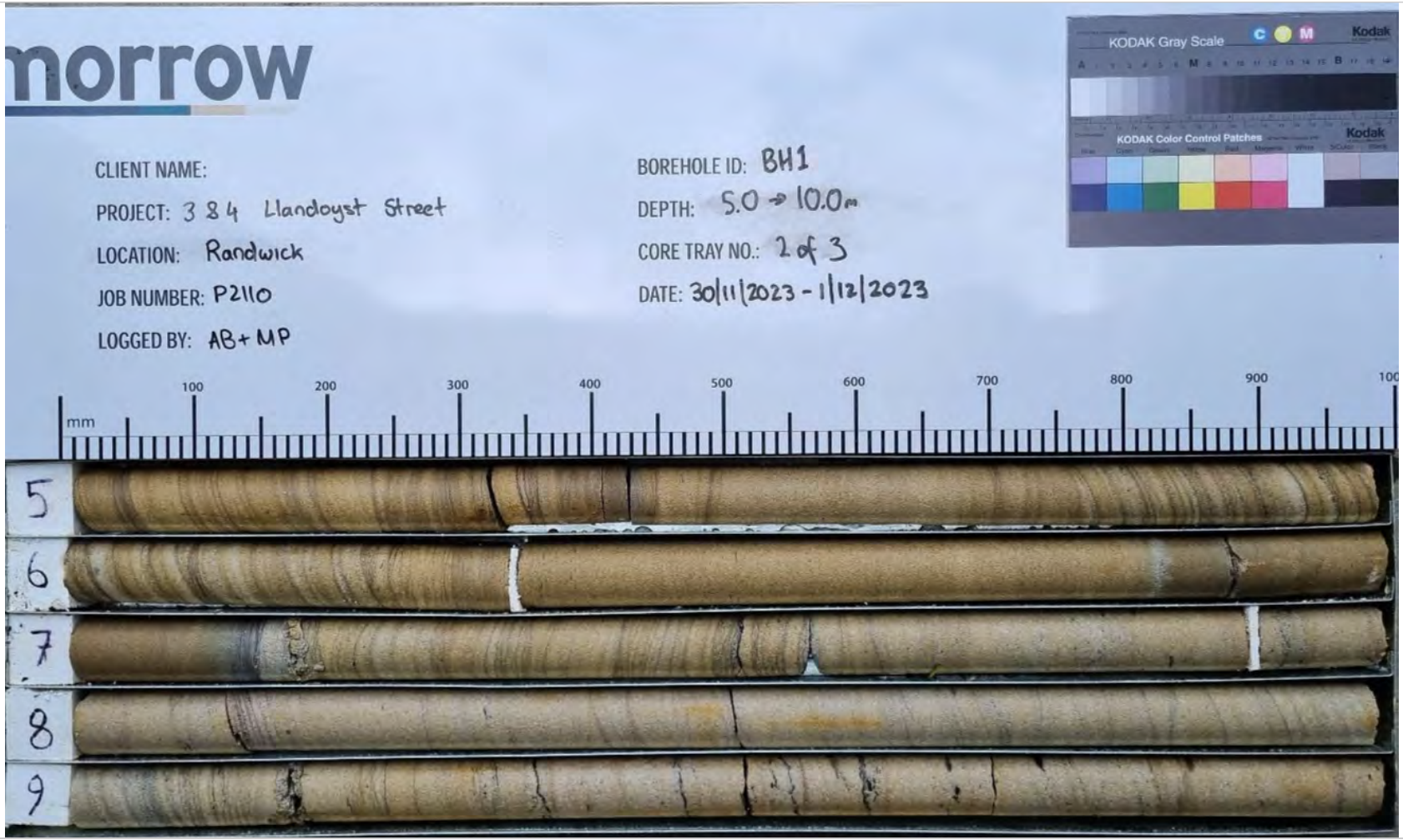

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Photo description	BH1 Box 2 of 3		
Client	Paresh Llanfoyst Pty Ltd		
Location	3 & 4 Llanfoyst Street, Randwick NSW		
Project name	Randwick		
Project No	P2110	**Scale**	Not to Scale
BH No	BH1	**BH Depth**	CorePhoto

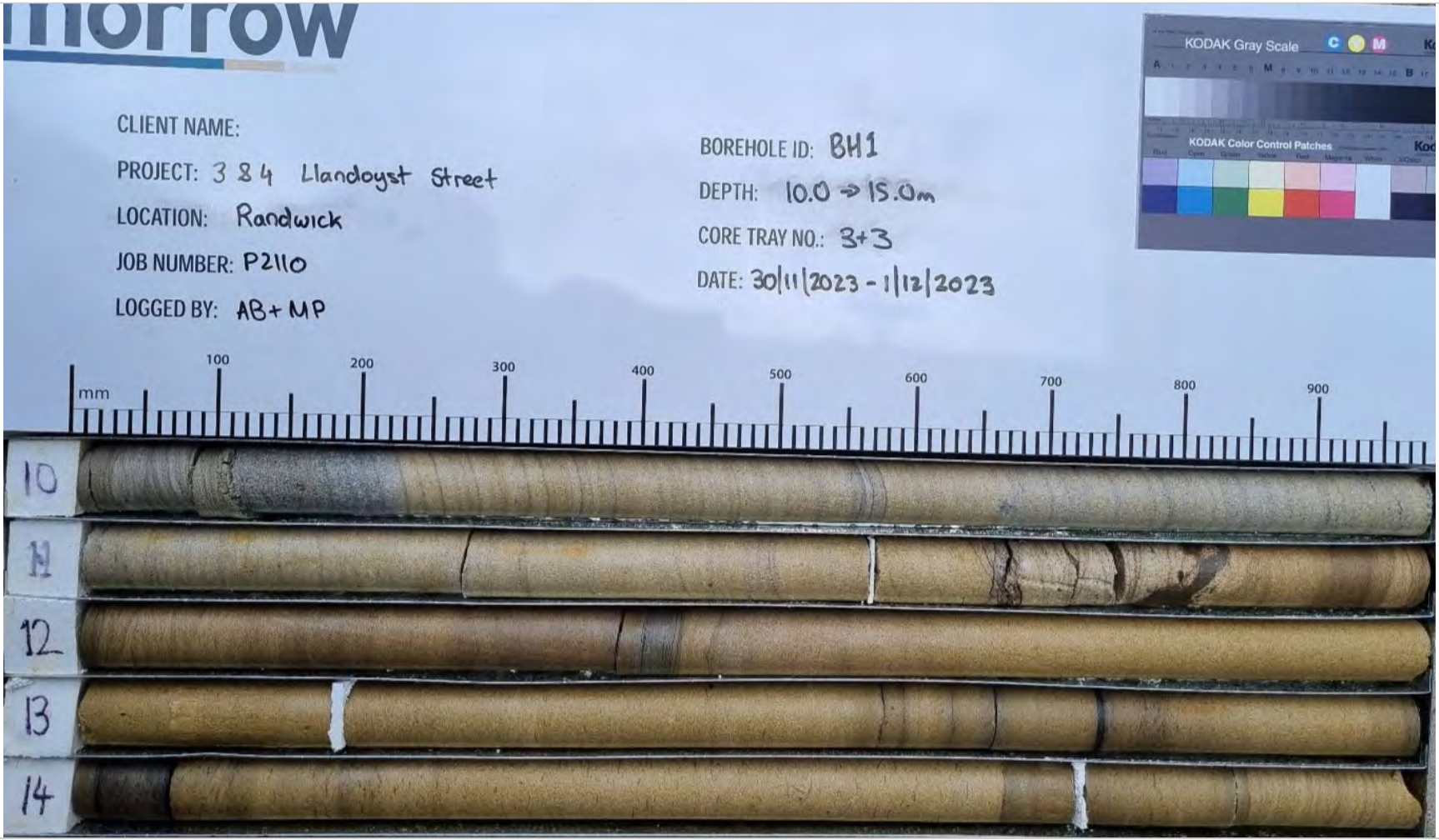

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Photo description	BH1 Box 3 of 3		
Client	Paresh Llanfoyst Pty Ltd		
Location	3 & 4 Llanfoyst Street, Randwick NSW		
Project name	Randwick		
Project No	P2110	**Scale**	Not to Scale
BH No	BH1	**BH Depth**	CorePhoto

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Geotechnical Log - Borehole

BH2

UTM	**: 56H**	**Drill Rig**	**: Man-Portable**	**Job Number**	**: P2110**
Easting (m)	**: 337589.53537604085**	**Driller Supplier**	**: TIGHT Site**	**Client**	**: Parseh Llanfoyst Pty Ltd**
Northing (m)	**: 6245922.386213075**	**Logged By**	**: Andrew Butel**	**Project**	**: Randwick**
Ground Elevation	**: 58.6 (m)**	**Reviewed By**	**: Mark Peach**	**Location**	**: 3 & 4 Llanfoyst Street, Randwick NSW**
Total Depth	**: 10 m BGL**	**Date**	**: 04/12/2023**	**Loc Comment**	**:**

Drilling Method	Water	Well Diagram	Testing	Soil Origin	Graphic Log	Classification Code	Depth (m)	Material Description	Elevation (m)	Consistency/Density	Moisture
Diatube		B Backfill 50mm PVC Solid		Non-Soil		CCT	0.15	Concrete	58.6		
Hand Auger	GWNE	Bentonite		Fill		SW		Fill Gravelly SAND (SW) : loose, grey, fine to medium grained, fine to medium sized gravel, with low to medium plasticity clay, moist, low resistance.		L	M
								0.33m : Commenced NMLC Coring;			
							1		57.6		
							2		56.6		
							3		55.6		

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Bellambi, NSW
Phone: 0405 843 933

Geotechnical Log - Borehole

BH2

UTM	: 56H	**Drill Rig**	: Man-Portable	**Job Number**	: P2110
Easting (m)	: 337589.53537604085	**Driller Supplier**	: TIGHT Site	**Client**	: Parseh Llanfoyst Pty Ltd
Northing (m)	: 6245922.386213075	**Logged By**	: Andrew Butel	**Project**	: Randwick
Ground Elevation	: 58.6 (m)	**Reviewed By**	: Mark Peach	**Location**	: 3 & 4 Llanfoyst Street, Randwick NSW
Total Depth	: 10 m BGL	**Date**	: 04/12/2023	**Loc Comment**	:

Drilling Method	Water	Well Diagram	RQD% and TCR%	Testing Is(50)	Estimated Strength (VLS, LS, MS, HS, VHS, EHS)	Weathering	Depth (m)	Graphic Log	Classification Code	Material Description	Elevation (m)	Defect Spacing (mm) (30, 100, 300, 1000, 3000)	Defect Depth	Defect Description (type, inclination, planarity, roughness, coating, thickness)
		B Backfill									58.6			
NMLC Coring	0% Water Loss	Bentonite 50mm PVC Solid 2mm Sand 50mm PVC Slotted	RQD = 93.81% TCR = 100% RQD = 90.6% TCR = 100% RQD = 100% TCR = 100% RQD = 100% TCR = 100%	d: 0.51, a: 0.46 d: 0.05, a: 0.56 d: 0.67, a: 1.01 d: 0.89, a: 0.72 d: 0.97, a: 1.20		HW MW-SW MW MW-SW	1 1.3 1.75 1.89 2 3 4		SST SST SST SST	Rock SANDSTONE: highly weathered, medium strength, orange light grey, fine to medium grained, massive, iron staining. As above, but moderately to slightly weathered, medium to high strength, yellow light grey. Rock SANDSTONE: moderately weathered, very low to low strength, grey, fine grained, low strength seam. Rock SANDSTONE: moderately to slightly weathered, medium to high strength, yellow grey, fine to medium grained, massive.	57.6 56.6 55.6 54.6		1 2 3 4	1.1, P, 5°, VR, PL, CL, OP 1.24, P, 3°, VR, PL, CL, OP 1.75, P, clay coating, 2°, VR, PL, CT, OP 1.78-1.8, IS, very low strength sandstone, clay coating, 2°, RO, PL CT, OP 1.82, P, clay coating, 2°, VR, PL, CL, OP 1.89, P, clay coating, 2°, VR, PL, CL, OP 3.13, P, 4°, VR, PL, CL, OP 3.51, P, 2°, VR, PL, CL, OP 4.74, P, 3°, RO, PL, CL, OP 4.78-4.79, IS, coating, 2°,RO, PL,

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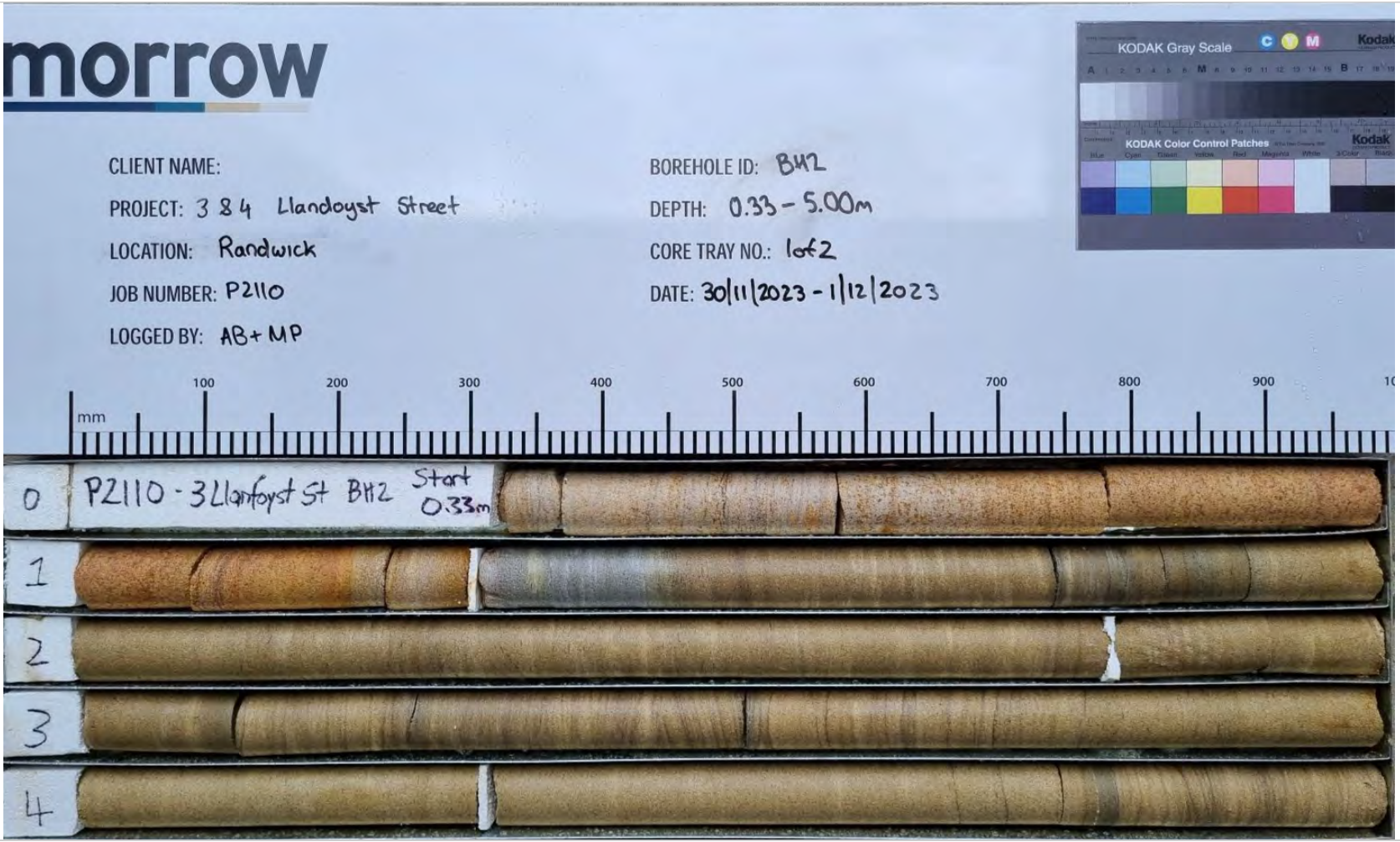
Bellambi, NSW
Phone: 0405 843 933

Geotechnical Log - Borehole

BH2

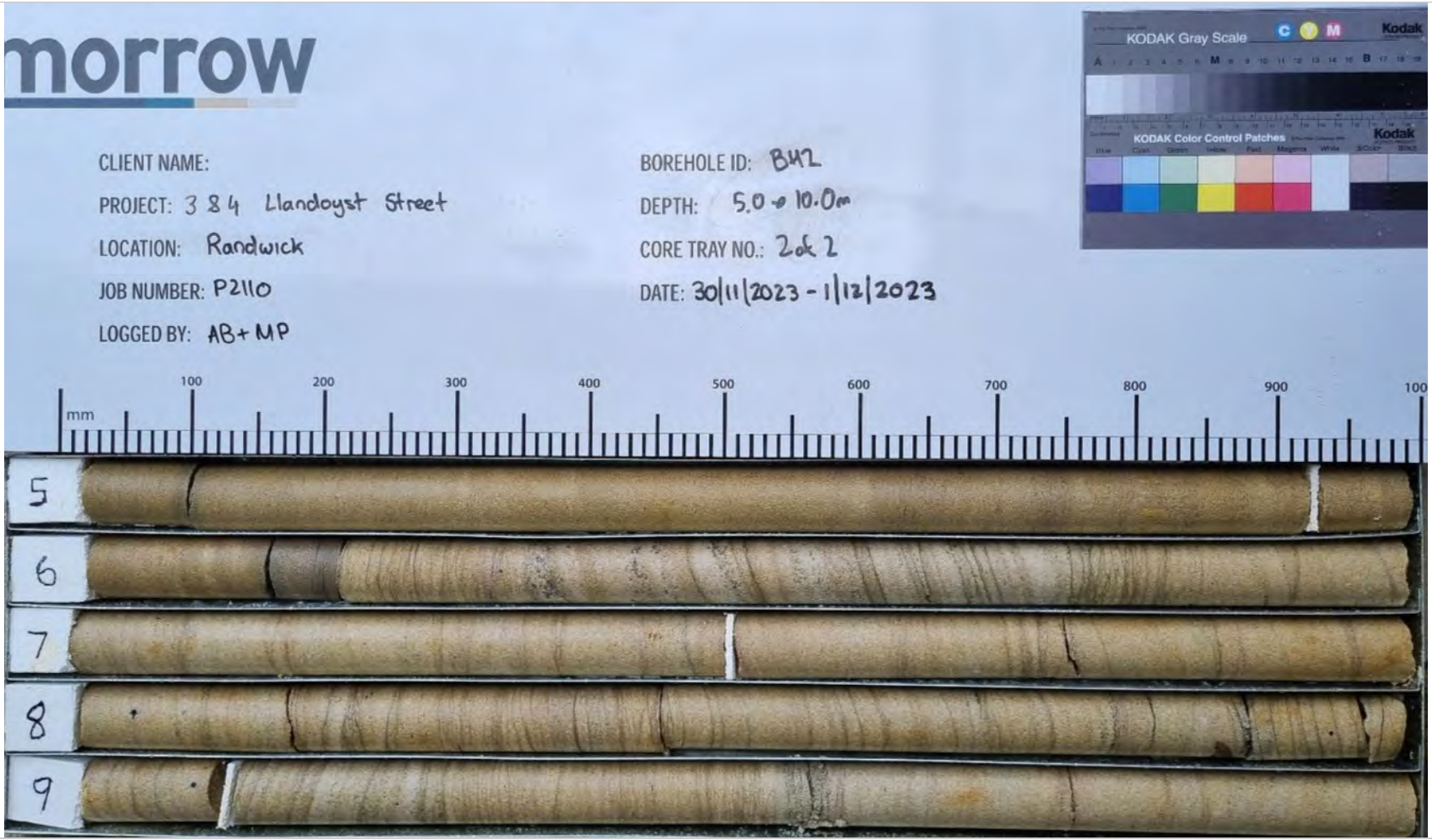
UTM	: 56H	**Drill Rig**	: Man-Portable	**Job Number**	: P2110
Easting (m)	: 337589.53537604085	**Driller Supplier**	: TIGHT Site	**Client**	: Parseh Llanfoyst Pty Ltd
Northing (m)	: 6245922.386213075	**Logged By**	: Andrew Butel	**Project**	: Randwick
Ground Elevation	: 58.6 (m)	**Reviewed By**	: Mark Peach	**Location**	: 3 & 4 Llanfoyst Street, Randwick NSW
Total Depth	: 10 m BGL	**Date**	: 04/12/2023	**Loc Comment**	:

Drilling Method	Water	Well Diagram	RQD% and TCR%	Testing Is(50)	Estimated Strength (VLS, LS, MS, HS, VHS, EHS)	Weathering	Depth (m)	Graphic Log	Classification Code	Material Description	Elevation (m)	Defect Spacing (mm) (30, 100, 300, 1000, 3000)	Defect Depth	Defect Description (type, inclination, planarity, roughness, coating, thickness)
NMLC Coring	0% Water Loss	2mm Sand 50mm PVC Slotted	RQD = 100% TCR = 100%	d: 0.53, a: 0.99		MW-S			SST	Rock SANDSTONE: moderately to slightly weathered, medium to high strength, yellow grey, fine to medium grained, massive.	53.6			5.1, P, 3°, RO, PL, CL, OP
			RQD = 100% TCR = 100%	d: 0.45, a: 0.70		MW MW-S	6 6.15 6.22		SST SST	Rock SANDSTONE: moderately weathered, very low to low strength, grey, fine grained, low strength seam. Rock SANDSTONE: moderately to slightly weathered, medium to high strength, light grey yellow, fine to medium grained, massive, with minor carbonaceous laminations and coarse grained bands.	52.6		6	6.15, P, 5°, VR, CV, CL, OP 6.2, P, clay coating, 2°, VR, PL, CL, OP
			RQD = 92.5% TCR = 100%	d: 0.54, a: 1.45 d: 1.09, a: 1.10			7				51.6		7	
							8				50.6		8	8.86, IS, Low strength Sandstone nodule, 1cmx3cm, fine grained, RO, PL, CL, OP 8.88, P, 5°, VR, PL, CL, OP
			RQD = 98.89% TCR = 100%	d: 0.86, a: 0.99			9				49.6		9	8.96, P, 5°, VR, PL, CL, OP 9.56-9.57, XWS, 5° VR, PL, CL, OP 9.76, XWS, 3°, VR, PL, CL, OP



morrow
0405 843 933
Bellambi, NSW
info@morrowgeo.com.au

Photo description	BH2 Box 1 of 2		
Client	Paresh Llanfoyst Pty Ltd		
Location	3 & 4 Llanfoyst Street, Randwick NSW		
Project name	Randwick		
Project No	P2110	**Scale**	Not to Scale
BH No	BH2	**BH Depth**	CorePhoto



morrow
0405 843 933
Bellambi, NSW
info@morrowgeo.com.au

Photo description	BH2 Box 2 of 2		
Client	Paresh Llanfoyst Pty Ltd		
Location	3 & 4 Llanfoyst Street, Randwick NSW		
Project name	Randwick		
Project No	P2110	**Scale**	Not to Scale
BH No	BH2	**BH Depth**	CorePhoto

Soil and Rock Logging Explanatory Notes

GENERAL

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance 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 common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable 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. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 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

ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
WB	Wash-bore drilling
RR	Rock Roller
NMLC	NMLC core barrel
NQ	NQ core barrel
HMLC	HMLC core barrel
HQ	HQ core barrel

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

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:

VE	Very Easy
E	Easy
M	Medium
H	High
VH	Very High

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

D	Disturbed
B	Bulk
U	Undisturbed
SPT	Standard Penetration Test
N	Result of SPT (sample taken)
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test

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.

MATERIAL DESCRIPTION - SOIL

Classification Symbol - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

Material Description - In accordance with AS 1726-1993, Appendix A2.3

Moisture Condition

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

Consistency - In accordance with AS 1726-1993, Appendix A2.5

VS	Very Soft	< 12.5 kPa
S	Soft	12.5 – 25 kPa
F	Firm	25 – 50 kPa
St	Stiff	50 – 100 kPa
VSt	Very Stiff	100 – 200 kPa
H	Hard	> 200 kPa

Strength figures quoted are the approximate range of undrained shear strength for each class.

Density Index. (%) is estimated or is based on SPT results.

VL	Very Loose	< 15 %
L	Loose	15 – 35 %
MD	Medium Dense	35 – 65 %
D	Dense	65 – 85 %
VD	Very Dense	> 85 %

MATERIAL DESCRIPTION -ROCK

Material Description

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

Core Loss

Is shown at the bottom of the run unless otherwise indicated.

Bedding

Thinly Laminated	< 6 mm
Laminated	6 - 20
Very Thinly Bedded	20 - 60
Thinly Bedded	60 - 200
Medium Bedded	200 – 600
Thickly Bedded	600 – 2000
Very Thickly Bedded	> 2000

Weathering - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

Fresh (F)	Rock substance unaffected by weathering
Slightly Weathered (SW)	Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable.
Moderately Weathered (MW)	Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable.
Highly Weathered (HW)	Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained.
Extremely Weathered (EW)	Rock texture evident but material has soil properties and can be remoulded.

Strength - The following terms are used to described rock strength:

Rock Strength Class	Abbreviation	Point Load Strength Index, Is(50) (MPa)
Extremely Low	EL	< 0.03
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	≥ 10

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

° Diametral Point Load Test

Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

MATERIALS STRUCTURE/FRACTURES

ROCK

Natural Fracture Spacing - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

Visual Log - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

Defects	———	Defects open in-situu or clay sealed
	– – – – –	Defects closed in-situ
	.....	Breaks through rock substance

Additional Data - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

Orientation - angle relative to the plane normal to the core axis.

Type	BP	Bedding Parting
	JT	Joint
	SM	Seam
	FZ	Fracture Zone
	SZ	Shear Zone
	VN	Vein
	FL	Foliation
	CL	Cleavage
	DL	Drill Lift
	HB	Handling Break
	DB	Drilling Break
Infilling	CN	Clean
	X	Carbonaceous
	Clay	Clay
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
	MS	Secondary Mineral
	MU	Unidentified Mineral
Shape	PR	Planar
	CU	Curved
	UN	Undulose
	ST	Stepped
	IR	Irregular
	DIS	Discontinuous
Rougness	POL	Polished
	SL	Slickensided
	S	Smooth
	RF	Rough
	VR	Very Rough

SOIL

Structures - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

Origin - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.

Appendix B

IMPORTANT INFORMATION

Important Information

This Document has been provided by Morrow Geotechnics Pty Ltd subject to the following limitations:

This Document has been prepared for the particular purpose outlined in Morrow Geotechnics' proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

The scope and the period of Morrow Geotechnics' Services are as described in Morrow Geotechnics' proposal, and are subject to restrictions and limitations. Morrow Geotechnics did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. The scope of services may have been limited by such factors as time, budget, site access or other site conditions. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Morrow Geotechnics in regards to it. Any advice given within this document is limited to geotechnical considerations only. Other constraints particular to the project, including but not limited to architectural, environment, heritage and planning matters may apply and should be assessed independently of this advice.

Conditions may exist which were undetectable given the limited nature of the enquiry Morrow Geotechnics was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required. No geotechnical investigation can provide a full understanding of all possible subsurface details and anomalies at a site.

In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Morrow Geotechnics' opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Morrow Geotechnics to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

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Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Morrow Geotechnics be notified of any variations and be provided with an opportunity to review the recommendations of this report.

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