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Landmark Group Australia Pty Ltd

Proposed Mixed-use Development
4 Delmar Parade & 812 Pittwater Road, Dee Why NSW

Geotechnical Investigation

Our ref: 6561-G1
25 November 2021

Your trusted engineering professionals

Document Authorization

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Prepared for Landmark Group Australia Pty Ltd

Our ref: 6561-G1
25 November 2021

For and on behalf of
AssetGeoEnviro

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1. Introduction

1.1 General

This report presents the results of a geotechnical investigation for a Proposed Mixed-use Development at 4 Delmar Parade & 812 Pittwater Road, Dee Why NSW (the Site). The investigation was commissioned on 13 September 2021 by Joseph Scuderi of Landmark Group Australia Pty Ltd, on behalf of Dee Why 3 Pty Ltd, Dee Why 4 Pty Ltd, Greenwich Road Pty Ltd, and Anglo Road Pty Ltd. The work was carried out in accordance with the proposal by AssetGeoEnviro (Asset) dated 28 July 2021, reference 6561-P1 Rev 1.

Documents supplied to us for this investigation comprised:

- Geotechnical Investigation Report for 2 Delmar Parade (prepared by: Douglas Partners Pty Ltd; ref: 85260.00; dated: January 2016).
- Geotechnical Investigation Report for 2 Delmar Parade (prepared by: Alliance Geotechnical; ref: 10753-GR-1-1 Rev A; dated: 20 July 2020).
- Architectural plans (prepared by: Rothelowman; ref: 22030; dwg nos as follows; dated: 18 November 2020):

SK01.00	P7	SK01.05	P12	SK04.03	P2	TP06.01	P15
SK01.01	P8	SK01.06	P15	SK04.04	P3	TP07.02	P5
SK01.02	P16	SK01.07	P12	TP00.05	P2	TP10.01	P15
SK01.03	P15	SK01.08	P12	TP00.06	P2		
SK01.04	P15	SK03.01	P6	TP03.05	P3		

- Survey plan showing partial detail and levels (prepared by: Norton Survey Partners; ref: 53046; dated: 11 March 2021).
- Project brief (by: Willow Frank Consulting Pty Ltd; unreferenced; dated: 17 May 2021; version: 1).
- Email brief (by: Willow Frank Consulting Pty Ltd; unreferenced; dated: 7 June 2021).

Based on your email brief (7 June 2021), we understand that the project involves "…demolition of existing industrial buildings and associate site clearing, and construction of a multi-storey shop top housing development comprising approximately 230 residential apartments with associated basement parking and landscaping." The supplied concept architectural plans indicate up to two basement levels below ground (finished floor level RL 22.5m AHD) and up to seven stories above ground. Excavation of between 5.5m (northwest corner) and about 10m (southeast corner) depth below ground level (bgl) is anticipated.

1.2 Scope of Work

The main objectives of the investigation were to assess the surface and subsurface conditions and to provide comments and recommendations relating to:

- Key geotechnical constraints to the development.
- Assess requirements of part E10 of the Warringah DCP 2011
- Excavation conditions, methodology and monitoring.
- Subgrade preparation and earthworks.
- Suitable foundation options.
- Allowable bearing pressure and shaft adhesion for piles.

- Settlement.
- Excavation support methodology and design parameters.
- Maximum allowable permanent and temporary batter slopes.
- Groundwater levels.
- Site classification – earthquake actions, as per AS1170.4.

The following scope of work was carried out to achieve the project objectives:

- A review of existing regional maps and reports relevant to the Site held within our files.
- Clearance of underground services at proposed test locations.
- Visual observations of surface features.
- Subsurface investigation at eight locations to sample and assess the nature and consistency of subsurface soils and bedrock at selected areas of the Site.
- Carrying out laboratory tests on the recovered soil and rock samples to provide engineering data.
- Engineering assessment and reporting.

This report must be read in conjunction with the attached "Important Information about your Geotechnical Report" in Appendix A. Attention is drawn to the limitations inherent in site investigations and the importance of verifying the subsurface conditions inferred herein.

2. Site Description

The Site is located on the southern side of Delmar Parade in Dee Why as shown in Figure 1. It is approximately L-shaped with a total area of about 7,800m^2, a street frontage about 52m along Delmar Parade, about 21m along Pittwater Road, and is about 100m long by 130m wide. The Site is bounded to the north by Delmar Parade, to the east by residential dwellings, to the south by a park and car parking area, to the west by Pittwater Road, and to the north-west by a residential development under construction at 2 Delmar Parade and a single storey commercial development at 816 Pittwater Road.

Topographically, the Site is located on gently to moderately sloping terrain. The overall ground surface slopes in the region are less than about 5º. Locally, the ground surface slopes down from a high point in the south-eastern part to the northwest at an overall slope of about 3º.

At the time of the investigation, the Site was occupied by two storey commercial developments with associated concrete pavements. The existing developments generally appear to be in overall good condition with no obvious signs of cracking or movement. Photographs of existing site conditions are provided in Appendix D.

The adjacent development at 2 Delmar Parade is currently at about bulk excavation level about 6m below the original ground level. The excavation is supported by Cement Slurry Mix (CSM) anchored shoring that has been socketed below bedrock level.

Site drainage is to the northwest following the ground surface slope.

Vegetation is limited to isolated garden beds within the commercial development. Sandstone rock outcrop was observed in the south-eastern part of the site.

2.1 Slope Instability Risk – Warringah DCP Requirements

The site is located partially within "Area A" – Slope less than 5 degrees and partially within "Area B" – Flanking Slopes from 5 to 25 degrees on the Warringah DCP Landslip Risk Map, as shown in **Plate 1**.

Plate 1 – Land Instability Risk Mapping (Source: Warringah Landslip Risk Map)

We note that the scope of work was limited to preliminary commentary on slope risk assessment.

A site inspection was conducted on 1 September 2020 by a geotechnical engineer from Asset to assess slope instability hazards within and in the vicinity of the site area. A series of photographs were taken as records and / or evidence of potential slope instability hazards on-site.

As the project site is partially located within Landslip Risk Class B (Warringah Council Local Environmental Plan 2011), a preliminary assessment of site conditions is required to determine whether a full geotechnical report (with respect to slope risk assessment) is required.

Completion of the Checklist for Council's assessment of site conditions and flowchart is provided in **Appendix D**.

The subsurface investigation established that soil is at least 1.5m thick at the site, and bedrock level varied from 0.75m depth to 11.5m depth. We note that the proposed development involves excavation of up to 10m depth. The excavation is to be provided with engineered temporary support by shoring walls and permanent support by the basement structure. Temporary batter slopes are proposed for construction of capping beams and potentially where rock is at relatively shallow depth below ground surface. These temporary batter slopes are to be inspected by geotechnical engineer during construction with appropriate remedial support provided if required. Therefore, we consider that a full AGS Landslide Risk Assessment is not required.

3. Fieldwork & Laboratory Testing

3.1 Borehole & CPT Investigation

The fieldwork was undertaken on 1 September and 14 to 17 September 2021 inclusive under the full-time supervision of a Geotechnical Engineer from Asset. On 1 September, Cone Penetration Testing (CPT) was carried out at five locations, and on 14 to 17 September cored boreholes were drilled at the CPT locations plus another three locations.

The test locations are shown in the attached Figure 2 and were set out by our Geotechnical Engineer by measurements relative to existing site features. Surface levels at the test locations were estimated by interpolation from levels shown on the supplied survey plan.

Buried metallic services and utilities within the Site boundaries near the test locations were cleared by an accredited service location subcontractor and by referring to DBYD utility maps.

The CPT soundings were carried out using a track mounted rig with reaction provided by anchoring into the existing concrete pavement. CPT soundings were continued to refusal at depths of up to 11.22m, with one of the CPTs terminated at about 1m (CPT5) due to excessive deviation off vertical. CPT4 terminated on rock at shallow depth (about 0.4m) below the conrete slab so this data was not reported.

The boreholes were auger drilled to refusal at depths of 0.2m to 15m depths bgl and then continued by NMLC coring techniques to termination for additional depths of up to 16m. No insitu soil testing was carried out in the boreholes. Assessment of soil type and condition is based on the CPT soundings.

Selected soil samples and recovered rock core were retained for laboratory testing.

The subsurface conditions encountered were logged during drilling and testing. On completion of logging and sampling, a groundwater monitoring well was installed in three of the boreholes for subsequent groundwater assessment by Reditus Consulting Pty Ltd, and the remaining boreholes were backfilled with the drilling spoil.

Engineering logs are provided in Appendix B together with their explanatory notes.

3.2 Laboratory Testing

Soil and rock samples recovered during the fieldwork were delivered to a NATA registered laboratory. The following tests were carried out on selected samples:

- Soil aggressivity testing (chloride, sulfate, resistivity, and pH).

- Point load strength index testing of rock core.

Test results will be included in Appendix C in the final report.

4. Subsurface Conditions

4.1 Geology

The 1:100,000 Sydney Geological Map indicates the Site is underlain by Hawkesbury Sandstone, which typically comprises medium to coarse grained quartz sandstone with some shale or siltstone beds. These rocks typically weather to form residual clay soils of medium to high plasticity and residual sandy soils. It is believed that the geological sequence at the Site is close to the base of the Hawkesbury Sandstone which is underlain by the Newport Formation of the Narrabeen Group. The Newport formation tends to be more variable in lithology with interbedded lithic-quartz sandstone, siltstone, shale, claystone, sandstone and laminite.

4.2 Subsurface Conditions

A summary of the subsurface profile at each test location has been developed is shown in Table 1. Interpreted contours of the top of Class 5 or better Sandstone bedrock are shown on Figure 2. Interpreted Sections A and B are shown in Figures 3 and 4 respectively. For a detailed description of the subsurface conditions, refer the attached engineering logs and explanatory notes. For specific design input, reference should be made to the logs and/or the specific test results, in place of the following summary.

Table 1 – Summary Subsurface Profile

Borehole / CPT	**BH1 / CPT1**	**BH2**	**BH3 / CPT4**	**BH4**
Surface Level (m AHD)	**29.0**	**29.5**	**30.1**	**31.9**
Geotechnical Units	**Depth [1] bgl (m) / [RL top of unit] (m AHD)**			
CONCRETE	0.0 – 0.2	0.0 – 0.2	0.0 – 0.2	0.0 – 0.2
FILL: SAND and Silty SAND, loose to medium dense, over ALLUVIUM: SAND and Silty SAND, medium dense, with some thin CLAY and Silty CLAY beds, stiff to very stiff	0.2 – 5.5	0.2 – 3.5	0.2 – 1.0	– –
RESIDUAL: CLAY, Silty CLAY, Sandy CLAY, stiff to very stiff	5.5 – 6.0	3.5 – 4.2	1.0 – 1.5	0.2 – 1.0
BEDROCK[2]: SANDSTONE, fine to medium grained, extremely weathered, extremely low strength, assessed Class 5 Sandstone (typically auger drilled through this layer)	6.0 – 6.5 [23.0]	3.7 – 4.7 [25.8]	– –	– –
BEDROCK[2]: SANDSTONE, medium-grained, brown, highly to slightly weathered, medium to high strength, assessed Class 4 to 3 Sandstone	6.5 – 13.9 [22.5]	4.7 – 13.95 [24.8]	1.5 – 14.2 [28.6]	1.0 – 11.0 [30.9]

Table 1 continued – Summary Subsurface Profile

Borehole / CPT	BH5	BH6 / CPT5	BH7 / CPT2	BH8 / CPT3
Surface Level (m AHD)	32.8	32.1	31.8	30.5
Geotechnical Units	**Depth [1] bgl (m) / [RL] (m AHD)**			
CONCRETE	0.0 – 0.2	0.0 – 0.2	0.0 – 0.2	0.0 – 0.2
FILL: SAND and Silty SAND over ALLUVIUM: SAND and Silty SAND, medium dense, with some thin CLAY and Silty CLAY beds, stiff to very stiff	– –	0.2 – 4.0	0.2 – 8.6	0.2 – 10.7
RESIDUAL: CLAY, Silty CLAY, Sandy CLAY, stiff to very stiff	– –	4.0 – 4.5	8.6 – 9.0	10.7 – 11.5
BEDROCK[2]: SANDSTONE, fine to medium grained, extremely weathered, extremely low strength, assessed Class 5 Sandstone (typically auger drilled through this layer)	0.2 – 0.75 [32.46]	4.5 – 5.0 [27.6]	9.0 – 9.7 [22.8]	11.5 – 15.0 [19.3]
BEDROCK[2]: SANDSTONE, medium-grained, brown, highly to slightly weathered, medium to high strength, assessed Class 4 to 3 Sandstone	0.75 – 15.0 [31.91]	5.0 – 14.0 [27.1]	9.7 – 15.06 [22.1]	15.0 – 16.0 [15.55]

Notes:

1. The depths are approximate only and based on the information from the test locations only and do not necessarily represent the maximum and minimum values across the Site.
2. Rock classification to Pells, P.J.N., Mostyn, G. & Walker, B.F., Foundations on Sandstone and Shale in the Sydney Region, Australian Geomechanics Journal, December 1998.

4.3 Groundwater

Groundwater was not observed in the CPT soundings and was typically not observed in the boreholes during auger drilling. Due to the introduction of water whilst coring, observation of groundwater inflow/levels below auger termination depths was not possible during the fieldwork.

Three groundwater monitoring wells were installed for subsequent measurement and testing by Reditus Consulting Pty Ltd. Refer to groundwater assessment and dewatering management plan prepared by Reditus Consulting.

Geotechnical investigation for 2 Delmar Parade, Dee Why, by Douglas Partners and Alliance Geotechnical, included groundwater monitoring. Three wells installed in that site indicated groundwater at about RL 25.4m AHD in the south-eastern part falling to the northwest. This data suggests a water table within the deeper alluvial soils. It is expected that the fractured bedrock would permit this groundwater to permeate beneath the Site. For the purposes of this report, we have considered a groundwater level at about RL 25.5m beneath the Site.

4.4 Laboratory Test Results

Results from the laboratory testing undertaken on selected soil samples and recovered rock core are included in Appendix C. Soil test results are summarised in Table 2.

Table 2 – Laboratory Test Results: Aggressivity Assessment

Test Location & Depth (m)	Chloride (mg/kg)	pH	Resistivity (Ω.cm)	Sulfate (mg/kg)	Soil Condition (A* or B†)	Exposure Classification (Concrete) AS 2159-2009	Exposure Classification (Steel) AS 2159-2009
BH1-5.8m	11	5.1	36000	<10	B	Mild	Non-aggressive
BH2-3.0m	<10	7.2	48000	<10	B	Non-aggressive	Non-aggressive
BH4-(0.7-0.8m)	70	8.0	5700	26	B	Non-aggressive	Non-aggressive
BH6-2.3m	<10	5.5	79000	<10	B	Mild	Non-aggressive
BH7-5.3m	16	5.0	27000	15	B	Mild	Non-aggressive
BH7-8.3m	13	4.7	31000	13	A	Moderate	Mild
BH8-2.8m	<10	5.8	35000	14	B	Non-aggressive	Non-aggressive
BH8-15.0m	13	5.3	33000	<10	A	Moderate	Non-aggressive

Notes:

1 Ω.m x 100 = Ω.cm

* Soil conditions A – high permeability soils (e.g. sands and gravels) that are in groundwater

† Soil conditions B – low permeability soils (e.g. silts and clays) or all soils above groundwater

5. Discussions & Recommendations

5.1 Key Geotechnical Site Constraints

Based on a two-basement finished floor level of RL 22.5m AHD, and from the results of this investigation, it is assessed that the basement level will be within Sandstone bedrock over the south-eastern portion with the remainder within residual clays and alluvial sands. Groundwater should be expected beneath the site, assumed at RL 25.5m AHD for the purposes of this report. It is noted that the development at 2 Delmar Parade has adopted a permanently drained basement. The basement walls would have much lower permeability than the surrounding soils, and therefore will act as a dam to the natural groundwater flow, resulting in elevated groundwater upslope of the shoring. This situation will be repeated for the basement for the Site, with the basement shoring expected to result in mounding of the groundwater table up-gradient.

Key geotechnical constraints to the development include groundwater control (during construction and long-term), temporary shoring, permanent retaining, and foundation conditions.

Recommendations for design and construction of the development are provided in the following sections. The presence of groundwater and the variable depth to bedrock (greater than about 8.5m depth) will need to be carefully considered with respect to design and construction sequencing of the development.

5.2 Construction Sequence

The following construction sequence is suggested for the basement level for the development:

1. Demolish existing buildings.
2. Remove existing pavements / concrete slabs.

3. Install temporary shoring around the basement perimeter.
4. Install temporary dewatering system (external or internal to the basement)
5. Excavate to bulk excavation level.
6. Construct working platform over basement excavation where required.
7. Install pile footings for internal column loads.
8. Carry out detail excavations (e.g., for lift pits) – additional localised dewatering may be required.
9. Construct the lower basement ground floor.
10. Pour lower basement roof and continue up to existing ground surface level to provide permanent support to the excavation.
11. Decommission temporary dewatering system or convert to permanent dewatering system as applicable.

5.3 Temporary Shoring

The proposed depth of excavation, the presence of groundwater, and the lack of clearance between the basement and boundary would preclude temporary batters, and therefore temporary shoring will be required. Depending on the design of the shoring, it could also be incorporated into the permanent foundation and retaining works.

Several possible shoring systems could be considered for the Site. These are summarised in Table 3 together with a brief description of the advantages and disadvantages of each.

Table 3 – Summary of Shoring Options

Option	Method	Advantages	Disadvantages
1	Conventional shoring with soldier piles and shotcrete infill panels	Relatively low cost. May be suitable for south-western part of site where rock levels are relatively shallow.	Risk of instability and loss of ground unless adequate external dewatering is provided. Forms a poor seal against groundwater. Greater amount of dewatering required. Potential drawdown of groundwater levels outside of the Site with possible adverse effects on adjacent structures.
2a or 2b	Contiguous or Secant bored piles	Can form part of the permanent structure. Minimum noise and vibration. Can maximise site building space as no temporary wall is required. Permanent waterproofing can be incorporated. Low permeability water barrier (secant piling very low permeability compared to contiguous piling)	For secant piles, ensuring complete contact of all piles over full pile length may be difficult. Additional finishing may be required following excavation if a 'smooth' internal wall is required. Relatively high cost. Will require soil anchors. Contiguous piles may require additional waterproofing where close contact not achieved. Risk of 'flighting' in deeper alluvial soils where rock socket is required, causing excessive settlement around the site.

Option	Method	Advantages	Disadvantages
3	Cutter Soil Mix (CSM) or Diaphragm wall	Practically impervious. Can be used as a permanent wall. Minimise settlement and ground disturbance of adjacent ground and properties.	Expensive. Close supervision of contractors required. May require soil anchors along boundaries where high-level footings are located.

Based on the advantages and disadvantages listed in Table 3, we recommend a CSM wall where deeper alluvial soils are encountered (within northern and western part). Option 2a or 2b could be considered for the south-eastern part where rock levels are relatively high, but is not recommended for the deeper alluvial soils due to the risk of 'flighting' where rock sockets are required (i.e. soil loss around the piling causing excessive settlement).

From the point of view of groundwater control, penetration into the sandstone bedrock would be preferred. Discussion and recommendations for groundwater control are provided in Section 5.6.

Design of temporary shoring for carrying vertical loading should be in accordance with Section 5.5, and for lateral pressures, it should be in accordance with Section 5.8.

Detailed construction supervision, monitoring and inspections will be required during the piling and subsequent bulk excavation to ensure an adequate standard of workmanship and to minimise potential problems.

5.4 Earthworks

5.4.1 Excavation

The excavation for the proposed development is anticipated to be partially within soils, and partially within sandstone bedrock. Excavation within the soils and extremely weathered bedrock would be achievable using conventional earthmoving equipment (i.e. hydraulic excavator bucket).

Excavation within the less weathered bedrock will likely require the use of ripper tooth fitted to a hydraulic excavator bucket, a dozer fitted with ripper tooth, or a hydraulic hammer fitted to an excavator, possibly supplemented by rock saw and rock splitting techniques.

5.4.2 Vibration Management

Australian Standard AS 2187: Part 2-2006 recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they "are applicable to Australian conditions". The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where the minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

For residential structures, BS 7385 recommends vibration criteria of 7.5 mm/s to 10 mm/s for frequencies between 4 Hz and 15 Hz, and 10 mm/s to 25 mm/s for frequencies between 15 Hz to 40 Hz and above. These values would normally be applicable for new residential structures or residential structures in good condition. Higher values would normally apply to commercial structures, and more conservative criteria would normally apply to heritage structures.

However, structures can withstand vibration levels significantly higher than those required to maintain comfort for their occupants. Human comfort is therefore likely to be the critical factor in vibration management.

Excavation methods should be adopted which limit ground vibrations at the adjoining developments to not more than 10mm/sec. Vibration monitoring is recommended to verify that this is achieved. However, if the contractor adopts methods and/or equipment in accordance with the recommendations in Table 4 for a ground vibration limit of 5mm/sec, vibration monitoring may not be required.

The limits of 5mm/sec and 10mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 4.

Table 4 – Recommendations for Rock Breaking Equipment

Distance from adjoining structure (m)	Maximum Peak Particle Velocity 5mm/sec		Maximum Peak Particle Velocity 10mm/sec*	
	Equipment	**Operating Limit (% of Maximum Capacity)**	**Equipment**	**Operating Limit (% of Maximum Capacity)**
1.5 to 2.5	Hand operated jackhammer only	100	300 kg rock hammer	50
2.5 to 5.0	300 kg rock hammer	50	300 kg rock hammer or 600 kg rock hammer	100 50
5.0 to 10.0	300 kg rock hammer or 600 kg rock hammer	100 50	600 kg rock hammer or 900 kg rock hammer	100 50

* Vibration monitoring is recommended for 10mm/sec vibration limit.

At all times, the excavation equipment must be operated by experienced personnel, per the manufacturer's instructions, and in a manner, consistent with minimising vibration effects.

Use of other techniques (e.g., chemical rock splitting, rock sawing), although less productive, would reduce or possibly eliminate risks of damage to adjoining property through vibration effects transmitted via the ground. Such techniques may be considered if an alternative to rock breaking is necessary. If rock sawing is carried out around excavation boundaries in not less than 1m deep lifts, a 900kg rock hammer could be used at up to 100% maximum operating capacity with an assessed peak particle velocity not exceeding 5 mm/sec, subject to observation and confirmation by a Geotechnical Engineer at the commencement of excavation.

It is pointed out that the rock classification system used in Table 1 is intended primarily for use in the design of foundations and is not intended to be used to directly assess rock excavation characteristics. Excavation contractors should refer to the detailed engineering logs, core photographs, laboratory

strength tests, and inspection of rock core, and should not rely solely on the rock classifications presented in geotechnical engineering reports when assessing the suitability of their excavation equipment for the proposed development. Further geotechnical advice must be sought if rock excavation characteristics are critical to the proposed development.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments. Rock excavation methodology should also consider acceptable noise limits as per the "Interim Construction Noise Guideline" (NSW EPA).

5.4.3 Subgrade Preparation

The following general recommendations are provided for subgrade preparation for earthworks, pavements, slab-on-ground construction, and minor structures:

Cohesive soils

- Strip existing fill and topsoil. Remove unsuitable materials from the Site (e.g. material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate residual clayey soils and rock, stockpiling for re-use as engineered fill or remove to spoil. Rock could be stockpiled separately from clayey soils, for select use beneath pavements.
- Where rock is exposed in bulk excavation level beneath pavements, rip a further 150mm.
- Where rock is exposed at footing invert level, it should be free of loose, "drummy" and softened material before concrete is poured.
- Where soil is exposed at bulk excavation level, compact the upper 150mm depth to a dry density ratio (AS1289.5.4.1–2007) not less than 100% Standard.
- Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill compacted to a dry density ratio not less than 100%.

Non-cohesive soils

- Strip existing fill and topsoil. Remove unsuitable materials from the Site (e.g. material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate natural soils and rock, stockpiling for re-use as engineered fill or remove to spoil. Rock could be stockpiled separately from clayey soils, for select use beneath pavements.
- Where rock is exposed in bulk excavation level beneath pavements, rip a further 150mm.
- Where rock is exposed at footing invert level, it should be free of loose, "drummy" and softened material before concrete is poured.
- Where soil is exposed in bulk excavation level, compact the upper 150mm depth to a density index (AS1289.5.6.1–1998) not less than 80%. Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill compacted to a density index not less than 80%.

Further advice should be sought where filling is required to support major structures.

Any waste soils being removed from the Site must be classified in accordance with current regulatory authority requirements to enable appropriate disposal to an appropriately licensed landfill facility. Asset can provide further advice on this matter if required.

5.4.4 Filling

Where filing is required, place in horizontal layers over prepared subgrade and compact as per Table 5.

Table 5 – Compaction Specifications

Parameter	Cohesive Fill	Non Cohesive Fill
Fill layer thickness (loose measurement): • Within 1.5m of the rear of retaining walls • Elsewhere	 0.2m 0.3m	 0.2m 0.3m
Density: • Beneath Pavements • Beneath Structures • Upper 150mm of subgrade	 ≥ 95% Std ≥ 98% Std ≥ 100% Std	 ≥ 70% ID ≥ 80% ID ≥ 80% ID
Moisture content during compaction	± 2% of optimum	Moist but not wet

Filling within 1.5m of the rear of any retaining walls should be compacted using lightweight equipment (e.g. hand-operated plate compactor or ride-on compactor not more than 3 tonnes static weight) to limit compaction-induced lateral pressures.

Any soils to be imported onto the Site for backfilling and reinstatement of excavated areas should be free of contamination and deleterious material and should include appropriate validation documentation in accordance with current regulatory authority requirements which confirms its suitability for the proposed land use. Asset can provide further advice on this matter if required.

5.4.5 Batter Slopes

Permanent batter slopes are not proposed for the development. Temporary batter slopes are not suitable for the deep alluvial soils but could be adopted for the shallow residual soils and for the weathered bedrock. We note that temporary batters are required to assist in installation of capping beams during construction.

Recommended maximum slopes for temporary batters are presented in Table 6.

Table 6 – Recommended Maximum Dry Temporary Batter Slopes

Unit	Maximum Temporary Batter Slope (H : V)
Medium Dense Sand (or denser)	1.5 : 1
Residual Clay	1.5 : 1
Class 5 Sandstone	1 : 1
Class 4 Sandstone	0.5 : 1*
Class 3 (or better) Sandstone	vertical *

* subject to inspection by a Geotechnical Engineer and carrying out remedial works as recommended (e.g. shotcrete, rock bolting).

5.5 Footings

Suitable footings might comprise a slab on ground for the basement area where bedrock is exposed at bulk excavation level, and piles to rock elsewhere. Footings may be designed for the parameters in Table 7.

Table 7 – Footing Design Parameters

Founding Stratum	Maximum Allowable (Serviceability) Values (kPa)			Ultimate Strength Limit State Values (kPa)			
	End Bearing	Shaft Friction – Compression #	Shaft Friction – Tension	End Bearing	Shaft Friction – Compression #	Shaft Friction – Tension*	Typical E_{field} MPa
Class 4 Sandstone	1,000	100	50	3,000	300	150	200
Class 3 Sandstone	3,500	350	175	10,500	1,000	500	350

Note:

* Uplift capacity of piles in tension loading should also be checked for inverted cone pull out mechanism.

clean socket of roughness category R2 or better is assumed

In accordance with AS2159-2009 "Piling–Design and Installation", for limit state design, the ultimate geotechnical pile capacity shall be multiplied by a geotechnical reduction factor (Φg). This factor is derived from an Average Risk Rating (ARR) which considers geotechnical uncertainties, redundancy of the foundation system, construction supervision, and the quantity and type of pile testing (if any). Where testing is undertaken, or more comprehensive ground investigation is carried out, it may be possible to adopt a larger Φg value that results in a more economical pile design. Further geotechnical advice will be required in consultation with the pile designer and piling contractor, to develop an appropriate Φg value.

Settlements for footings on rock are anticipated to be about 1% of the minimum footing dimension, based on serviceability parameters as per Table 7.

Options for piles include:

Bored Piles. It assessed that the bored piles would not be suitable due to the sandy soils and presence of groundwater.

Continuous Flight Auger (CFA) Piles. CFA piles are constructed by drilling a hollow-stemmed continuous flight auger to the required founding depth. Concrete is then injected under pressure through the auger stem as the auger is extracted from the soil. The reinforcing cage is then inserted upon completion of the concreting process. Pile diameters vary from 300mm to 1200mm. Drilled spoil is produced during CFA piling and must subsequently be removed from the Site. CFA piles are considered non-displacement piles as defined in AS2159. Examples of CFA piles are Frankipile "Atlas" type piles or Vibropile "Omega" type piles.

An experienced Geotechnical Engineer should review footing designs to check that the recommendations of the geotechnical report have been included and should assess footing excavations to confirm the design assumptions.

5.6 Groundwater Control

The development will require groundwater control during construction and for a permanently drained basement if applicable. Refer to groundwater assessment and dewatering management plan prepared by Reditus Consulting.

5.7 Basement Slabs

Subgrade preparation should be carried out such that a minimum 0.5 metre cover of granular material is provided as a working platform. This could be provided by imported granular material (e.g. ripped / crushed sandstone). A subgrade Californian Bearing Ratio (CBR) of 3% may be adopted for the preliminary design of the basement slab.

Where basement slabs are constructed below groundwater depths as indicated in this report and the basement is designed as a tanked structure, uplift pressures should also be considered.

5.8 Excavation Support

Excavation of soil and rock results in stress changes in the remaining material and some ground movement is inevitable. The magnitude and extent of lateral and vertical ground movements will depend on the design and construction of the excavation support system. Experience and published data suggest that lateral movements of an adequately designed and installed retention system in soil and weathered rock will typically be in the range of 0.2% to 0.5% of the retained height. The extent of the horizontal movement behind the excavation face typically varies from 1.5 to 3 times the excavated height.

5.8.1 Excavation Support Construction Methodology

Design of retaining walls will need to consider both long-term (i.e. permanent) and short-term (i.e. during construction) loading conditions, as well as the possible impact on adjoining developments.

In the long term, the ground floor slab will provide bracing at the top of the wall and the basement floor slab will provide bracing at the bottom of the wall. Therefore, basement retaining walls should be designed as braced walls for the long-term loading condition.

5.8.2 Excavation Support Design Parameters

Excavation support design can be relatively complex as it involves soil-structure interaction. Also, the pressures acting on the support will depend on a range of factors including the stiffness of the support, the construction sequence, external forces (e.g. surcharge loading), and varying groundwater conditions.

For relatively simple support systems (e.g. cantilever walls or anchored/propped walls with only one row of anchors/props, the design may be based on an Earth Pressure Approach and using closed-form solutions or simple analytical programs such as WALLAP.

For more complex support systems (e.g. multiple anchors/props), or where it is desired to optimise the design, more advanced numerical analysis tools are recommended (e.g. 2D Finite Element Method), which include more complex soil models that allow for stress re-adjustment to occur with wall

movements. The use of 3D FEM software may also be appropriate depending on the excavation geometry and potential cost-savings by optimising the support design.

Earth Pressure Approach

Support systems designed using the Earth Pressure Approach may be based on the parameters given in Table 8.

Cantilever walls or walls within only a single row of anchors/props may be designed for a triangular earth pressure distribution with the lateral pressure being determined as follows:

$\sigma_z = K_{o,a,p} \; z \; \gamma$ where σ_z = lateral earth pressure (kPa) at depth z
$K_{o,a,p}$ = earth pressure coefficient
o = 'at rest', a = 'active', p = 'passive'
z = depth (m)
γ = unit weight of soil / rock (kN/m^3)

Table 8 – Excavation Support Design Parameters (Earth Pressure Approach)

Material	Moist Unit Weight (γ_m) kN/m^3	'Active' Lateral Earth Pressure Coefficient [1] (K_a)	'At Rest' Coefficient [1] (K_o)	'Passive' Coefficient [2] (K_p)
Alluvial SAND	19.0	0.3	0.5	N/A
Residual CLAY	19.0	0.3	0.5	N/A
Class 5 Sandstone [3]	21.0	0.2	0.4	6
Class 4/3 Sandstone [3]	22.0	0.1	0.3	15

Notes to table:

1. These values assume that some wall movement and relaxation of horizontal stress will occur due to the excavation. Actual in-situ K_0 values may be higher, particularly in the rock units.
2. Includes a reduction factor to the ultimate value of K_p to consider strain incompatibility between active and passive pressure conditions. Parameters assume horizontal backfill and no back of wall friction.
3. The values for rock assume no adversely dipping joints or other defects are present in the bedrock. All excavation rock faces should be inspected regularly by an experienced Geotechnical Engineer / Engineering Geologist as excavation proceeds.

The parameters for the 'at rest' condition (K_o) should be used for the design of lateral earth pressures where adjacent footings/structures are located within the 'zone of influence' of the wall. The 'zone of influence' may be taken as a line extending upwards and outwards at 45° above horizontal from the base of the wall. Piles for cantilever walls should be socketed below bulk excavation level by a depth at least equal to the retained height. For assessment of passive restraint embedded below excavation level, we recommend a triangular pressure distribution.

Walls supported by multiple rows of anchors/props may be designed for a uniform lateral earth pressure of 0.65 γ H K_a where γ = unit weight of the retained material, H = height of the wall, and K_a = earth pressure coefficient (Table 8). Piles for braced walls should be socketed at least 0.75m below basement subgrade level to provide toe "kick-in" resistance until the slab can be poured.

Numerical Modelling Approach

More complex excavation support may also be designed using strength and stiffness parameters for soil and rock stratum, with 2D numerical analysis software such as RS^2 or PLAXIS, or WALLAP (for preliminary design).

The values in Table 9 provide typical parameters that can be adopted for design. Review and refinement of these parameters may be necessary as part of carrying out more advanced numerical modelling (e.g. consideration of advanced soil models, use of elasto-plastic parameters).

Table 9 – Excavation Support Design Parameters (Numerical Modelling Approach)

Material	Moist Unit Weight (γ_m) kN/m^3	'At Rest' Coefficient [1] (K_o)	Effective Cohesion (c') kPa	Effective Friction Angle (ϕ') deg	Elastic Modulus (E) MPa
Alluvial SAND	19.0	0.5	0	32	40
Residual CLAY	19.0	0.5	0	32	40
Class 5 Sandstone [2]	21.0	0.4	5	28	100
Class 4/3 Sandstone [2]	24.0	0.3	100	35	400

Notes to table:

1. Actual in-situ K_0 values may be higher, particularly in the rock units. Consideration should be given to the locked-in horizontal stress which may be present within the rock units.
2. The values for rock assume no adversely dipping joints or other defects are present in the bedrock. All excavation rock faces should be inspected regularly by an experienced Geotechnical Engineer / Engineering Geologist as excavation proceeds.

5.8.3 Surcharge

Allowance must also be made for surcharge loadings and footing loads from adjacent structures.

5.8.4 Hydrostatic Pressure

Where an adequate subsoil drainage system designed by an appropriately qualified and experienced Hydraulic / Stormwater Engineer is provided behind non-tanked retaining walls, no allowance for hydrostatic pressure would be necessary.

Where tanked retaining walls are to be adopted, they should be designed for a hydrostatic pressure based on an appropriate design groundwater level (refer to Section 5.6).

5.8.5 Ground Anchors

Prestressed anchoring of shoring / retaining walls can be adopted for the development, subject to obtaining permission from adjacent property owners/authorities where anchors extend outside the Site boundaries.

Anchors could be inclined up to a maximum of 30° below horizontal if required to intercept bedrock / higher strength bedrock. Design of excavation support must be carried out by a suitably experienced and qualified structural/civil engineer. Requirements for rock support must be nominated or approved by the Geotechnical Engineer during excavation. Rock bolts may be designed for the parameters in Table 10.

Table 10 – Rock Bolting Design Parameters

Layer	Ultimate Bond Stress (without Factor of Safety)

Class 4 Sandstone	600 kPa
Class 3 Sandstone	1,500 kPa

The following should be noted during anchor design and construction:

- The contractor should adopt design values including an appropriate factor of safety relevant to the installation methodology and anchor type adopted.
- Anchor holes must be cleaned prior to grouting.
- Anchors should be check stressed to 125% of the nominal working load and then locked off at 60% to 80% of the working load.

5.9 Site Classification – Earthquake Actions

In accordance with the earthquake loading standard, AS1170.4 (2007), this site is assessed to be sub-soil Class Ce – Shallow soil site.

A Hazard Factor, z, of 0.08 for Sydney region is recommended.

6. Limitations

In addition to the limitations inherent in site investigations (refer to the attached Information Sheets), it must be pointed out that the recommendations in this report are based on assessed subsurface conditions from limited investigations. To confirm the assessed soil and rock properties in this report, further investigation would be required such as coring and strength testing of rock and should be carried out if the scale of the development warrants, or if any of the properties are critical to the design, construction, or performance of the development.

It is recommended that a qualified and experienced Geotechnical Engineer be engaged to provide further input and review during the design development; including site visits during construction to verify the Site conditions and provide advice where conditions vary from those assumed in this report. Development of an appropriate inspection and testing plan should be carried out in consultation with the Geotechnical Engineer.

This report may have included geotechnical recommendations for design and construction of temporary works (e.g. temporary batter slopes or temporary shoring of excavations). Such temporary works are expected to perform adequately for a relatively short period only, which could range from a few days (for temporary batter slopes) up to six months (for temporary shoring). This period depends on a range of factors including but not limited to: site geology; groundwater conditions; weather conditions; design criteria; and level of care taken during construction. If there are factors which prevent temporary works from being completed and/or which require temporary works to function for periods longer than originally designed, further advice must be sought from the Geotechnical Engineer and Structural Engineer.

This report and details for the proposed development should be submitted to relevant regulatory authorities that have an interest in the property (e.g., Council) or are responsible for services that may be within or adjacent to the Site (e.g. Sydney Water, Transport for NSW), for their review.

Asset accepts no liability where our recommendations are not followed or are only partially followed. The document “Important Information about your Geotechnical Report” in Appendix A provides additional information about the uses and limitations of this report.

Figures

0 1:2,500 A4 100m

issue	date	description
A	25.9.21	Initial issue

Source: SixMAPS.
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Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Site Locality

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:2,500 A4

job no.: 6561
fig: 1
issue: A

1 D.P. 710661, LOT 1 D.P. 220220
) THE LAND IN S.P. 32071 & S.P. 32072

AREA 11,061.3m² BY TITLE DIMENSIONS

CES HAVE NOT BEEN INVESTIGATED.

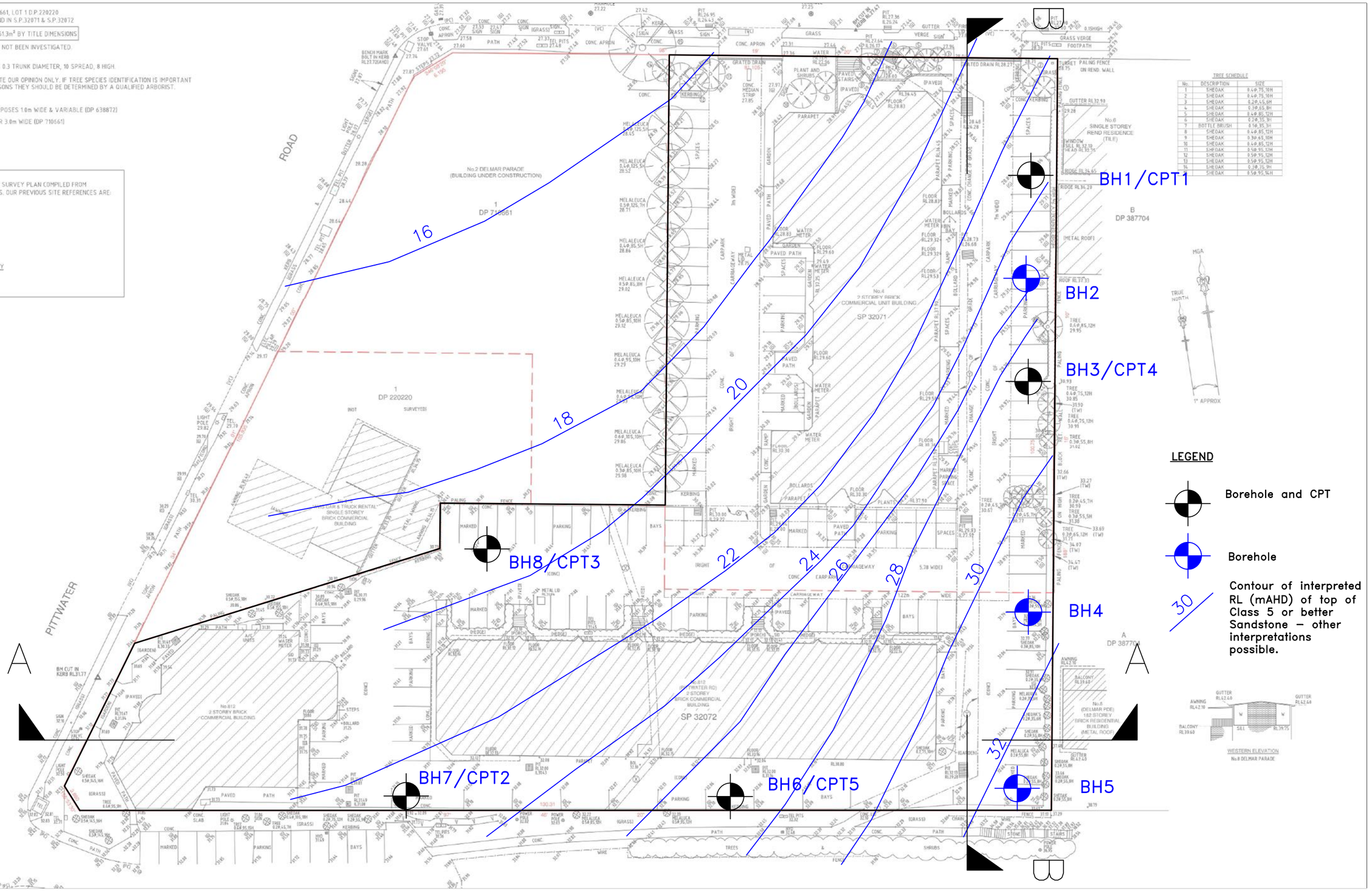
LEVEL.
TREE SIZE 0.3 TRUNK DIAMETER, 10 SPREAD, 8 HIGH.

CONSTITUTE OUR OPINION ONLY. IF TREE SPECIES IDENTIFICATION IS IMPORTANT
AGE REASONS THEY SHOULD BE DETERMINED BY A QUALIFIED ARBORIST.

ICITY PURPOSES 1.0m WIDE & VARIABLE (DP 638872)

AIN WATER 3.0m WIDE (DP 710661)

OLIDATED SURVEY PLAN COMPILED FROM
EYS BY US. OUR PREVIOUS SITE REFERENCES ARE:
EE WHY
20
EE WHY
20
. DEE WHY
20



TREE SCHEDULE

No.	DESCRIPTION	SIZE
1	SHEOAK	0.4Ø.75, 16H
2	SHEOAK	0.4Ø.75, 16H
3	SHEOAK	0.2Ø.55, 8H
4	SHEOAK	0.3Ø.65, 8H
5	SHEOAK	0.4Ø.85, 12H
6	SHEOAK	0.2Ø.35, 9H
7	BOTTLE BRUSH	0.1Ø.35, 3H
8	SHEOAK	0.4Ø.85, 12H
9	SHEOAK	0.3Ø.65, 10H
10	SHEOAK	0.4Ø.85, 12H
11	SHEOAK	0.5Ø.95, 12H
12	SHEOAK	0.5Ø.95, 12H
13	SHEOAK	0.5Ø.95, 12H
14	SHEOAK	0.3Ø.75, 9H
15	SHEOAK	0.5Ø.95, 14H

Approximate only – subject to detail survey.

Source: Norton Survey Partners, Ref: 53046, date 11/3/21.

This drawing is used to illustrate test locations only and must not be used for any other purpose. Copyright of source drawing remains with North Survey Partners.

0 1:500 A3 25m

issue	date	description
A	25.9.21	Initial issue

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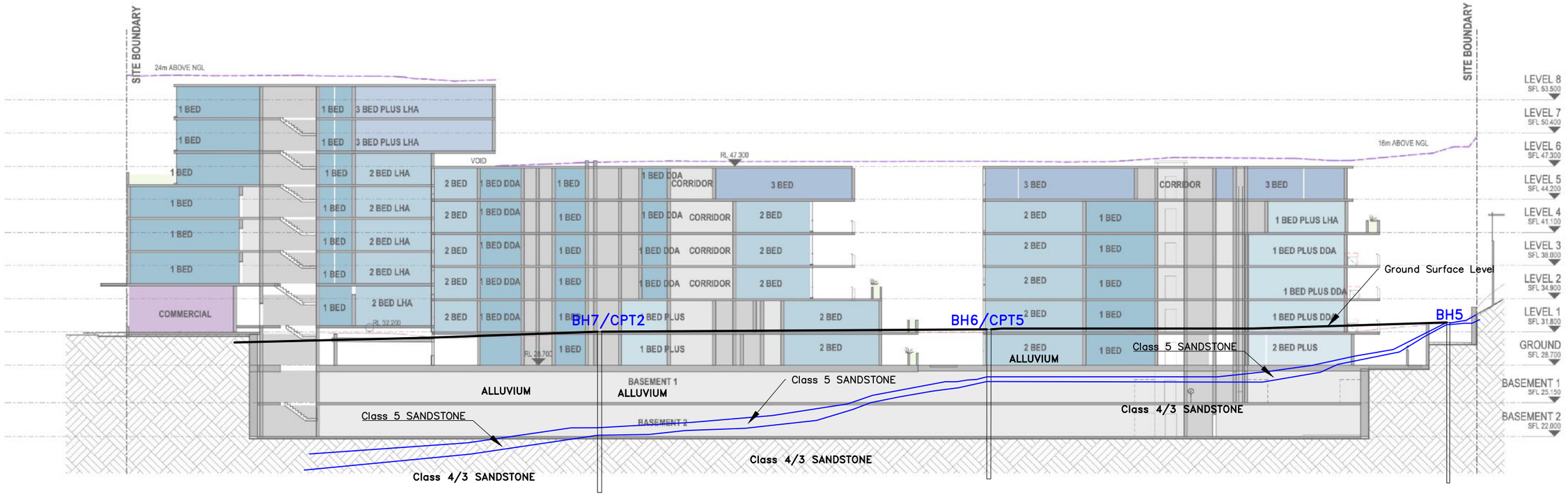
Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Test Locations

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:500 A3

job no.: 6561
fig: 2
issue: A



SECTION 4

PRELIMINARY

Revisions			
P3	06.08.2021	FOR INFORMATION	JC
P4	06.09.2021	SECTIONS	JC
P5	14.09.2021	FOR INFORMATION	JC
P6	17.09.2021	FOR INFORMATION	JC
P7	29.10.2021	DRAFT DA	JC

Project: **4 Delmar Pde & 812 Pittwater Rd, Dee Why**
4 Delmar Pde & 812 Pittwater Rd, Dee Why

Drawing: **SECTIONS** | Project No: **221054** | Date: **29.10.2021** | Author: **BR** | Scale: @ A1: **1 : 250** | Drawing No

Approximate only – subject to detail survey.

Source: "Architectural Sections plan, prepared by rothelowman, ref: 221054, dwg no: TP03.01 P7, dated 29 October 2021"

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issue	date	description
A	15.11.21	Initial issue

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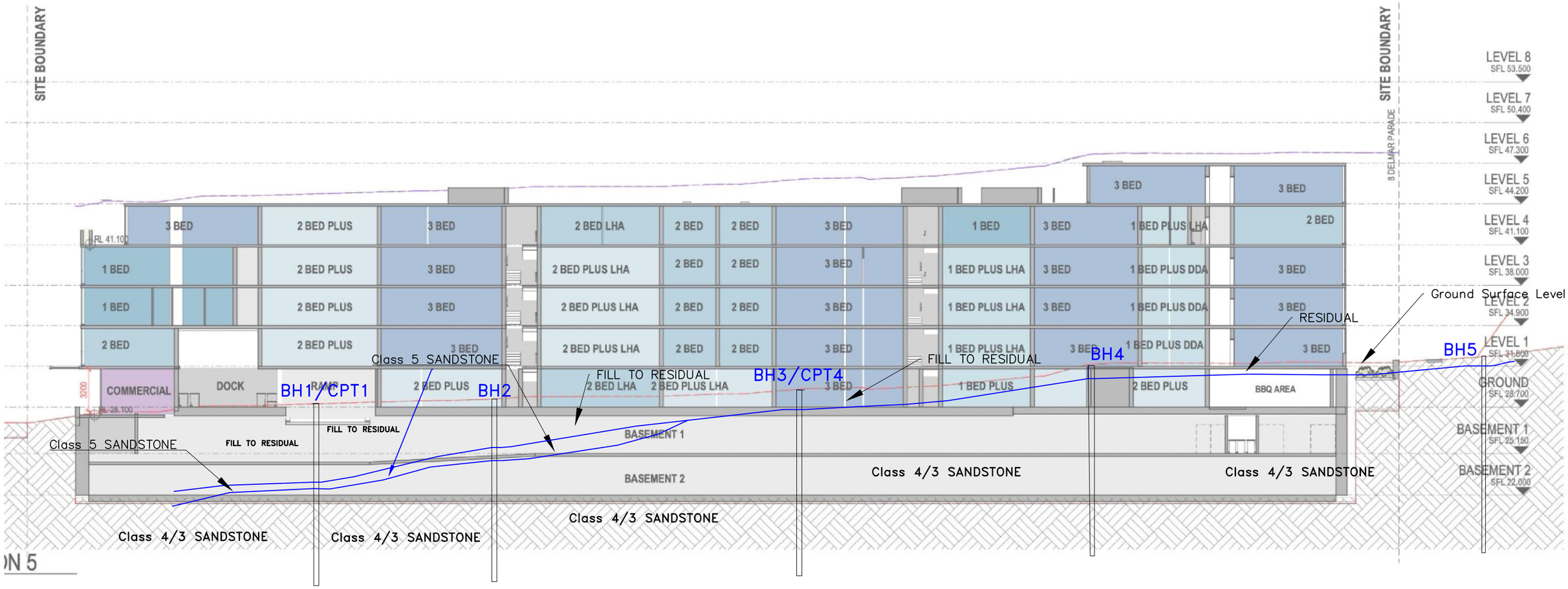
PROPOSED MIXED–USE DEVELOPMENT
4 DELMAR PARADE
DEE WHY NSW
for
LANDMARK GROUP

CROSS SECTION A

drawn: AT
date: 15.11.2021
checked: MAB
scale: 1:400 A3

job no.: 6561
fig: 3
issue: A



Approximate only – subject to detail survey.

Source: "Architectural Sections plan, prepared by rothelowman, ref: 221054, dwg no: TP03.02 P7, dated 29 October 2021"

issue	date	description
A	15.11.21	Initial issue

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PROPOSED MIXED–USE DEVELOPMENT
4 DELMAR PARADE
DEE WHY NSW
for
LANDMARK GROUP

CROSS SECTION B

drawn: AT
date: 15.11.2021
checked: MAB
scale: 1:400 A3

job no.: 6561
fig: 4
issue: A

Appendix A

Important Information about your Geotechnical Report
Important Information about your Slope Instability Risk Assessment

Important Information about your Geotechnical Report

Scope of Services

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client and Asset Geotechnical Engineering Pty Ltd ("Asset"), for the specific site investigated. The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

The report should not be used if there have been changes to the project, without first consulting with Asset to assess if the report's recommendations are still valid. Asset does not accept responsibility for problems that occur due to project changes if they are not consulted.

Reliance on Data

Asset has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. Asset has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, Asset will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Asset.

Geotechnical Engineering

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

Limitations of Site Investigation

The investigation program undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behavior with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

Therefore, the recommendations in the report can only be regarded as preliminary. Asset should be retained during the project implementation to assess if the report's recommendations are valid and whether or not changes should be considered as the project proceeds.

Subsurface Conditions are Time Dependent

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Asset should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

Verification of Site Conditions

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 Asset be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

Reproduction of Reports

This report is the subject of copyright and shall not be reproduced either totally or in part without the express permission of this Company. Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. Asset assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Asset or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

Data Must Not Be Separated from The Report

The report as a whole presents the site assessment, and must not be copied in part or altered in any way.

Logs, figures, drawings, test results etc. included in our reports are developed by professionals based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Partial Use of Report

Where the recommendations of the report are only partially followed, there may be significant implications for the project and could lead to problems. Consult Asset if you are not intending to follow all of the report recommendations, to assess what the implications could be. Asset does not accept responsibility for problems that develop where the report recommendations have only been partially followed if they have not been consulted.

Other Limitations

Asset will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.

Important Information about your Landslide Risk Assessment

Basis of The Assessment

Our assessment of landslide risk is presented in the framework of Landslide Risk Management (Australian Geomechanics Society, Vol 42, No 1, March 2007). The attached GeoGuides provide further information on landslide risk management and maintenance.

This assessment is based on a visual inspection of the property and the immediate adjoining land. Limited subsurface investigation may also have been undertaken as part of this appraisal. Slope monitoring has not been carried out within or adjacent to the property for the purpose of this appraisal. The opinions expressed in this report also consider our relevant local experience.

The property is within an area where landslip and/or subsidence have occurred, or where there is a risk of landslide. Important factors relating to slope conditions and the impact of development which commonly influence the landslide risks are discussed herein.

An owner's decision to acquire, develop or build on land within an area such as this involves the understanding and acceptance of a level of risk. It is important to recognise that soil and rock movements are an ongoing geological process, which may be affected by development and land management within the site or on ad- joining land. Soil and rock movements may cause visible damage to structures even where the risk of slope failure is considered low. This report is intended only to assess the landslide risk apparent at the time of inspection.

Our opinion is provided on the present landslide risk for the land specifically referenced in the title to this report. Foundations suitable for future building development are discussed in relation to slope stability considerations. Limited foundation advice may be provided. If so, advice is intended to guide the footing design for the proposed development. However, this report is not intended as, is not suitable for, and must not be used in lieu of a detailed foundation investigation for final design and costing of foundations, retaining walls or associated structures.

Limitations of The Assessment Procedure

The assessment procedures carried out for this appraisal are in accordance with the recommendations in Landslide Risk Management (Australian Geomechanics Society, Vol 42, No 1, March 2007), and with accepted local practice.

The following limitations must be acknowledged:

- the assessment of the stability of natural slopes requires a great degree of judgment and personal experience, even for experienced practitioners with good local knowledge;
- the assessment must be based on development of a sound geological model; slope processes and process rates influencing land sliding or landslide potential will vary according to geomorphologic influences;
- the likelihood that land sliding may occur on a given slope is generally hard to predict and is associated with significant uncertainties;
- different practitioners may produce different assessments of risk;
- actual risk of land sliding cannot be determined; risk changes with time;
- consequences of land sliding need to be considered in a rational framework of risk acceptance;
- acceptable risk in relation to damage to property from landslide activity is subjective; it remains the responsibility of the owner and/or local authority to decide whether the risk is acceptable; the geotechnical practitioner can assist with this judgment;
- the extent and methods of investigation for assessment of landslide risk will be governed by experience, by the perceived risk level, and by the degree to which the risk or consequences of land sliding are accepted for a specific project;
- the assessment may be required at several stages of the project or development; frequently (due to time or budget constraints imposed by the client) there will be no opportunity for long-term monitoring of the slope behaviour or groundwater conditions, or for on-going opportunity for the slope processes and performance of structures to be reviewed during and after development; such limitations should be recognised as relevant to the assessment.

Development on Slopes

Some landslide risk is always attached to the development of land on slopes.

Guidelines for hillside construction and examples of good practices for hillside developments are described in the attached GeoGuides.

Appendix B

Soil & Rock Explanation Sheets
CPT Logs
Core Logs
Core Photographs

Soil and Rock Explanation Sheets (1 of 2)

Log Abbreviations & Notes

METHOD

borehole logs

AS	auger screw *
AD	auger drill *
RR	roller / tricone
W	washbore
CT	cable tool
HA	hand auger
D	diatube
B	blade / blank bit
V	V-bit
T	TC-bit

* bit shown by suffix e.g. ADV

excavation logs

NE	natural excavation
HE	hand excavation
BH	backhoe bucket
EX	excavator bucket
DZ	dozer blade
R	ripper tooth

coring

NMLC, NQ, PQ, HQ

SUPPORT

borehole logs	
N	nil
M	mud
C	casing
NQ	NQ rods

excavation logs	
N	nil
S	shoring
B	benched

CORE—LIFT

casing installed

barrel withdrawn

NOTES, SAMPLES, TESTS

D	disturbed
B	bulk disturbed
U50	thin-walled sample, 50mm diameter
HP	hand penetrometer (kPa)
SV	shear vane test (kPa)
DCP	dynamic cone penetrometer (blows per 100mm penetration)
SPT	standard penetration test
N*	SPT value (blows per 300mm) * denotes sample taken
Nc	SPT with solid cone
R	refusal of DCP or SPT

USCS SYMBOLS

GW	Gravel and gravel-sand mixtures, little or no fines.
GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels
GM	Gravel-silt mixtures and gravel-sand-silt mixtures.
GC	Gravel-clay mixtures and gravel-sand-clay mixtures.
SW	Sand and gravel-sand mixtures, little or no fines.
SP	Sand and gravel sand mixtures, little or no fines.
SM	Sand-silt mixtures.
SC	Sand-clay mixtures.
ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays.
OL	Organic silts
MH	Inorganic silts
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity, organic silt
PT	Peat, highly organic soils.

MOISTURE CONDITION

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

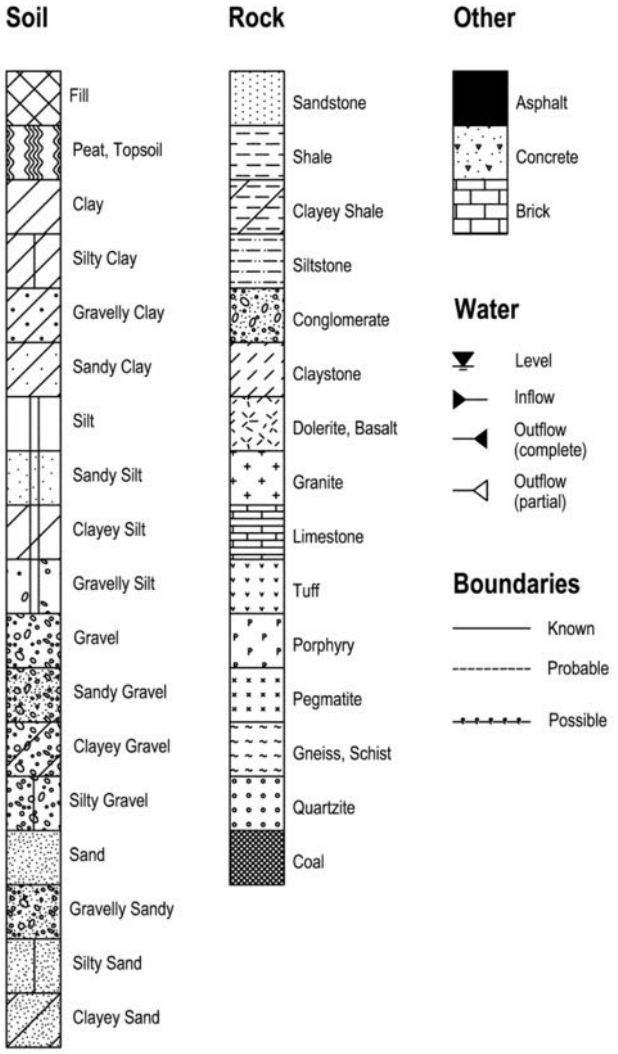
CONSISTENCY

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable

DENSITY INDEX

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Graphic Log



WEATHERING

XW	extremely weathered
HW	highly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

STRENGTH

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

RQD (%)

= sum of intact core pieces > 2 x diameter x 100
total length of core run drilled

DEFECTS:

type	
JT	joint
PT	parting
SZ	shear zone
SM	seam

coating	
cl	clean
st	stained
ve	veneer
co	coating

shape	
pl	planar
cu	curved
un	undulating
st	stepped
ir	irregular

roughness	
po	polished
sl	slickensided
sm	smooth
ro	rough
vr	very rough

inclination

measured above axis and perpendicular to core

Soil and Rock Explanation Sheets (2 of 2)

AS1726-2017

Soils and rock are described in the following terms, which are broadly in accordance with AS1726-2017.

Soil

MOISTURE CONDITION

Term	Description
Dry	Looks and feels dry. Fine grained and cemented soils are hard, friable or powdery. Uncemented coarse grained soils run freely through hand.
Moist	Soil feels cool and darkened in colour. Fine grained soils can be moulded. Coarse soils tend to cohere.
Wet	As for moist, but with free water forming on hand.

Moisture content of cohesive soils may also be described in relation to plastic limit (W_P) or liquid limit (W_L) [>> much greater than, > greater than, < less than, << much less than].

CONSISTENCY OF FINE-GRAINED SOILS

Term	Su (kPa)	Term	Su (kPa)
Very soft	< 12	Very Stiff	>100 – ≤200
Soft	>12 – ≤25	Hard	> 200
Firm	>25 – ≤50	Friable	–
Stiff	>50 – ≤100		

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Term	Density Index (%)	Term	Density Index (%)
Very Loose	< 15	Dense	65 – 85
Loose	15 – 35	Very Dense	>85
Medium Dense	35 – 65		

PARTICLE SIZE

Name	Subdivision	Size (mm)
Boulders		> 200
Cobbles		63 – 200
Gravel	coarse	19 – 63
	medium	6.7 – 19
	fine	2.36 – 6.7
Sand	coarse	0.6 – 2.36
	medium	0.21 – 0.6
	fine	0.075 – 0.21
Silt & Clay		< 0.075

MINOR COMPONENTS

Term	Proportion by Mass:	
	coarse grained	*fine grained*
Trace	≤ 15%	≤ 5%
With	>15% – ≤30%	>5% – ≤12%

SOIL ZONING

Layers	Continuous across exposures or sample.
Lenses	Discontinuous, lenticular shaped zones.
Pockets	Irregular shape zones of different material.

SOIL CEMENTING

Weakly	Easily broken up by hand pressure in water or air.
Moderately	Effort is required to break up by hand in water or in air.

USCS SYMBOLS

Symbol	Description
GW	Gravel and gravel-sand mixtures, little or no fines.
GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels.
GM	Gravel-silt mixtures and gravel-sand-silt mixtures.
GC	Gravel-clay mixtures and gravel-sand-clay mixtures.
SW	Sand and gravel-sand mixtures, little or no fines.
SP	Sand and gravel sand mixtures, little or no fines.
SM	Sand-silt mixtures.
SC	Sand-clay mixtures.
ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays.
OL	Organic silts
MH	Inorganic silts
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity, organic silt
PT	Peat, highly organic soils.

Rock

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition (more than 50% of rock consists of …..)
Conglomerate	... gravel sized (>2mm) fragments.
Sandstone	... sand sized (0.06 to 2mm) grains.
Siltstone	... silt sized (<0.06mm) particles, rock is not laminated.
Claystone	... clay, rock is not laminated.
Shale	... silt or clay sized particles, rock is laminated.

LAYERING

Term	Description
Massive	No layering apparent.
Poorly Developed	Layering just visible. Little effect on properties.
Well Developed	Layering distinct. Rock breaks more easily parallel to layering.

STRUCTURE

Term	Spacing (mm)	Term	Spacing
Thinly laminated	<6	Medium bedded	200 – 600
Laminated	6 – 20	Thickly bedded	600 – 2,000
Very thinly bedded	20 – 60	Very thickly bedded	> 2,000
Thinly bedded	60 – 200		

STRENGTH (NOTE: Is50 = Point Load Strength Index)

Term	Is50 (MPa)	Term	Is50 (MPa)
Extremely Low	<0.03	High	1.0 – 3.0
Very low	0.03 – 0.1	Very High	3.0 – 10.0
Low	0.1 – 0.3	Extremely High	>10.0
Medium	0.3 – 1.0		

WEATHERING

Term	Description
Residual Soil	Material is weathered to an extent that it has soil properties. Rock structures are no longer visible, but the soil has not been significantly transported.
Extremely …..	Material is weathered to the extent that it has soil properties. Mass structures, material texture & fabric of original rock is still visible.
Highly …..	Rock strength is significantly changed by weathering; rock is discolored, usually by iron staining or bleaching. Some primary minerals have weathered to clay minerals.
Moderately …..	Rock strength shows little or no change of strength from fresh rock; rock may be discolored.
Slightly …..	Rock is partially discolored but shows little or no change of strength from fresh rock.
Fresh	Rock shows no signs of decomposition or staining.

DEFECT DESCRIPTION

Type	
Joint	A surface or crack across which the rock has little or no tensile strength. May be open or closed.
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/bedding. May be open or closed.
Sheared Zone	Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects.
Seam	Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed).
Shape	
Planar	Consistent orientation.
Curved	Gradual change in orientation.
Undulating	Wavy surface.
Stepped	One or more well defined steps.
Irregular	Many sharp changes in orientation.
Roughness	
Polished	Shiny smooth surface.
Slickensided	Grooved or striated surface, usually polished.
Smooth	Smooth to touch. Few or no surface irregularities.
Rough	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper.
Very Rough	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper.
Coating	
Clean	No visible coating or discolouring.
Stained	No visible coating but surfaces are discolored.
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	Visible coating =1mm thick. Thicker soil material described as seam.

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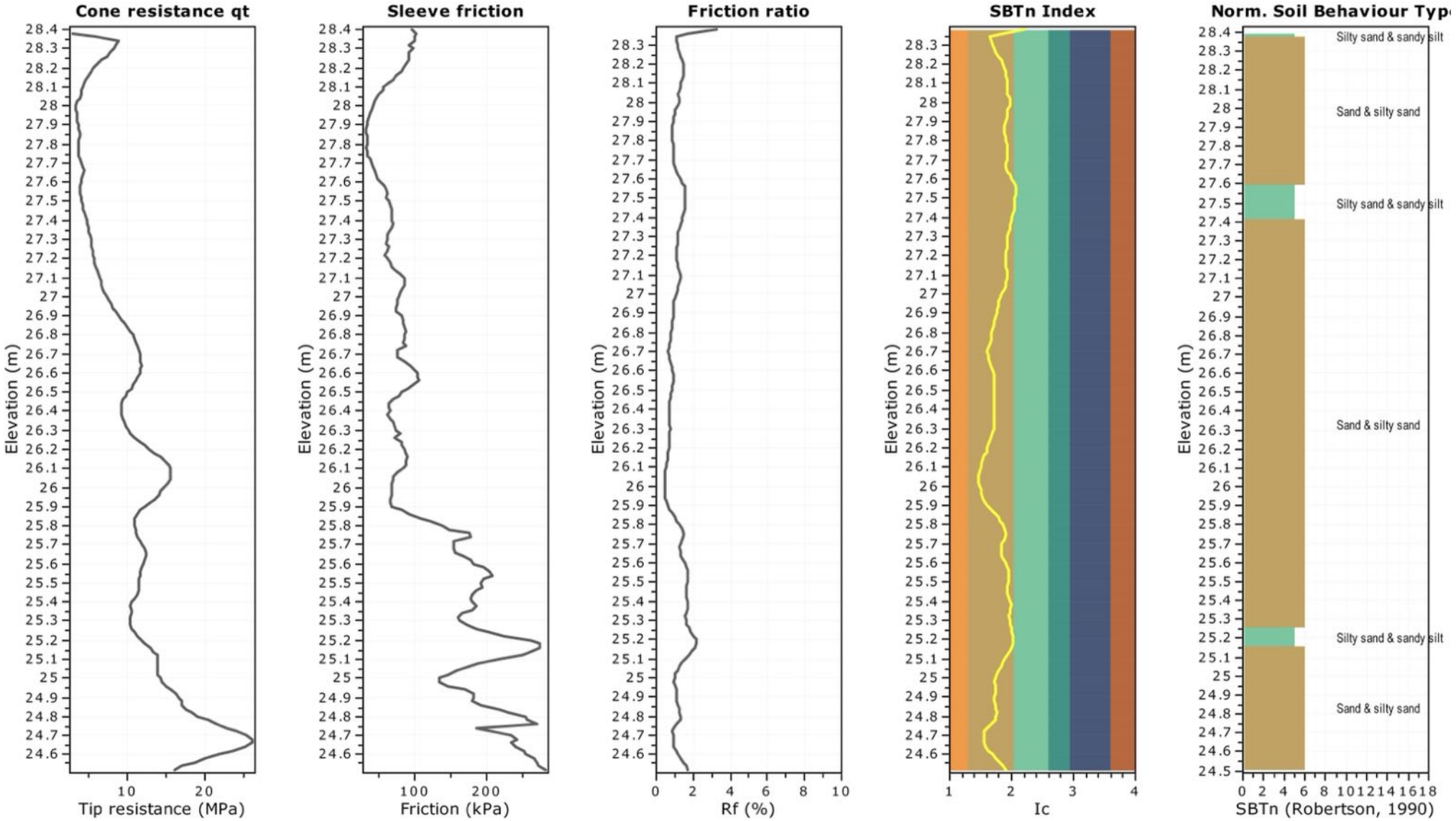
Project: 6561
Location: 4 Delmar Parade, Dee Why

CPT 1
Total depth: 4.48 m, Date: 8/09/2021
Surface Elevation: 29.00 m
Coords: X:0.00, Y:0.00
Cone Type: Serial No 5552
Cone Operator: Terratest



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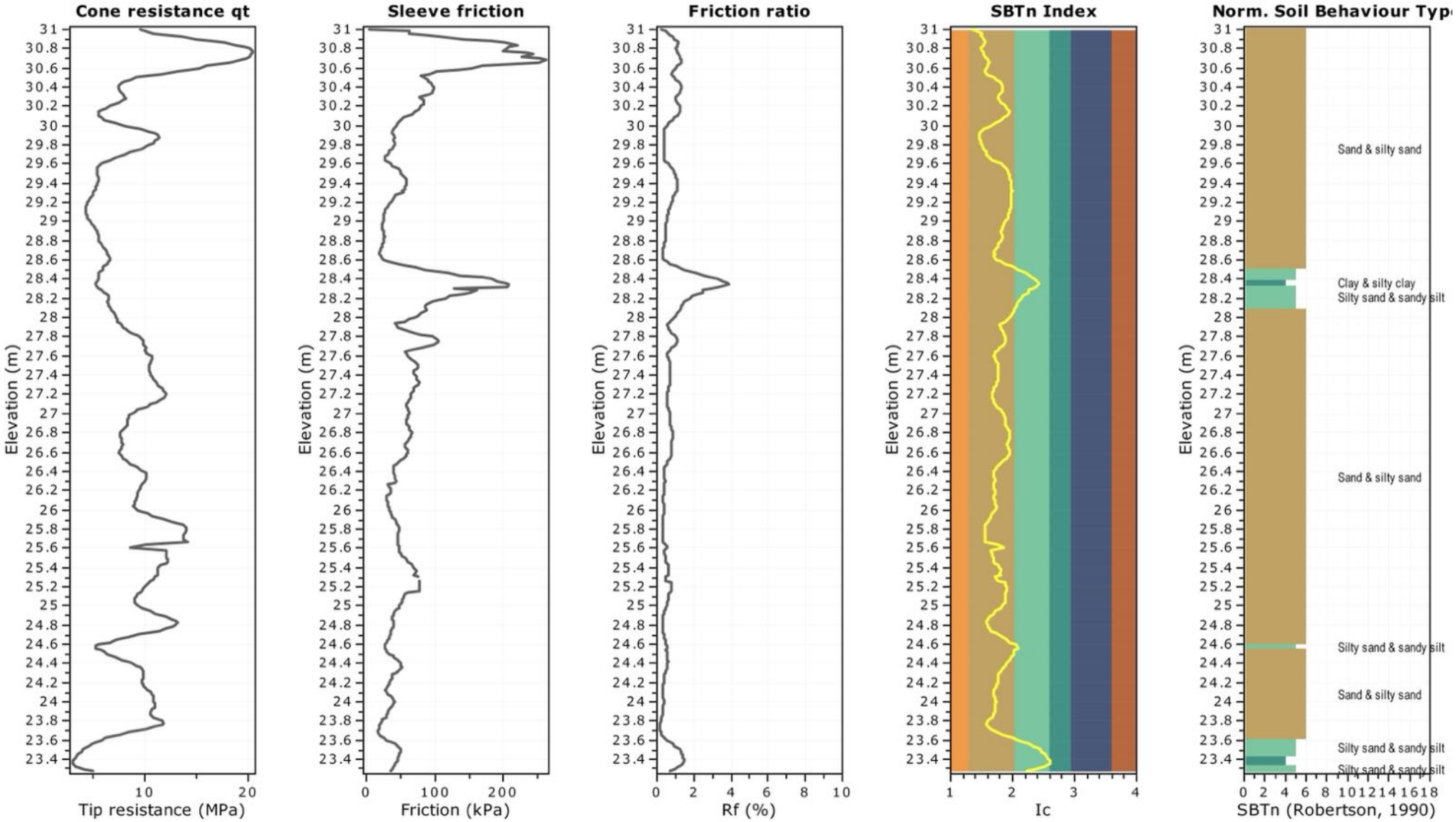
CPT 2
Total depth: 8.52 m, Date: 8/09/2021
Surface Elevation: 31.80 m
Coords: X:0.00, Y:0.00
Cone Type: Serial No 5552
Cone Operator: Terratest

Project: 6561
Location: 4 Delmar Parade, Dee Why



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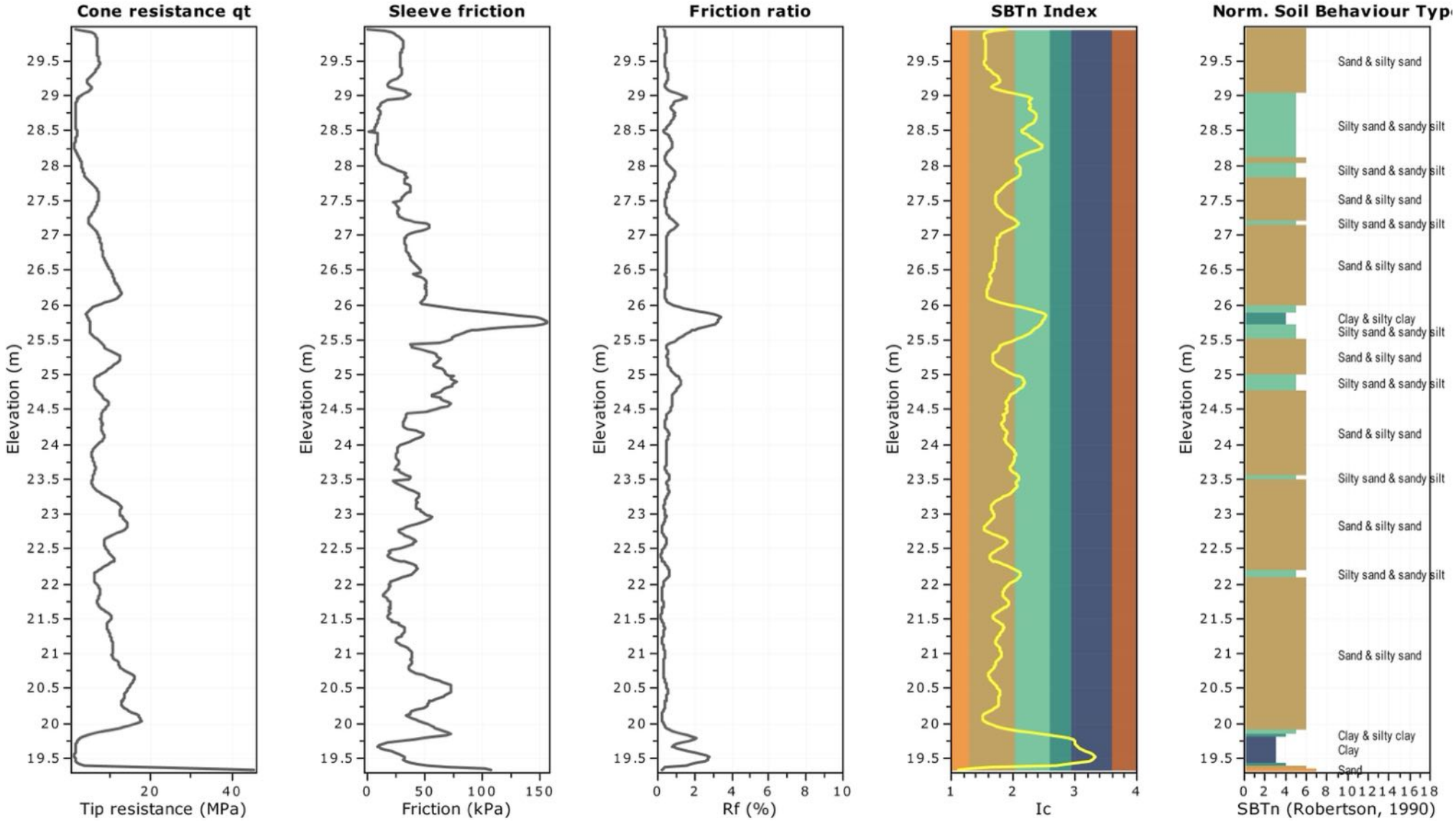
CPT 3
Total depth: 11.22 m, Date: 8/09/2021
Surface Elevation: 30.55 m
Coords: X:0.00, Y:0.00
Cone Type: Serial No 5552
Cone Operator: Terratest

Project: 6561
Location: 4 Delmar Parade, Dee Why



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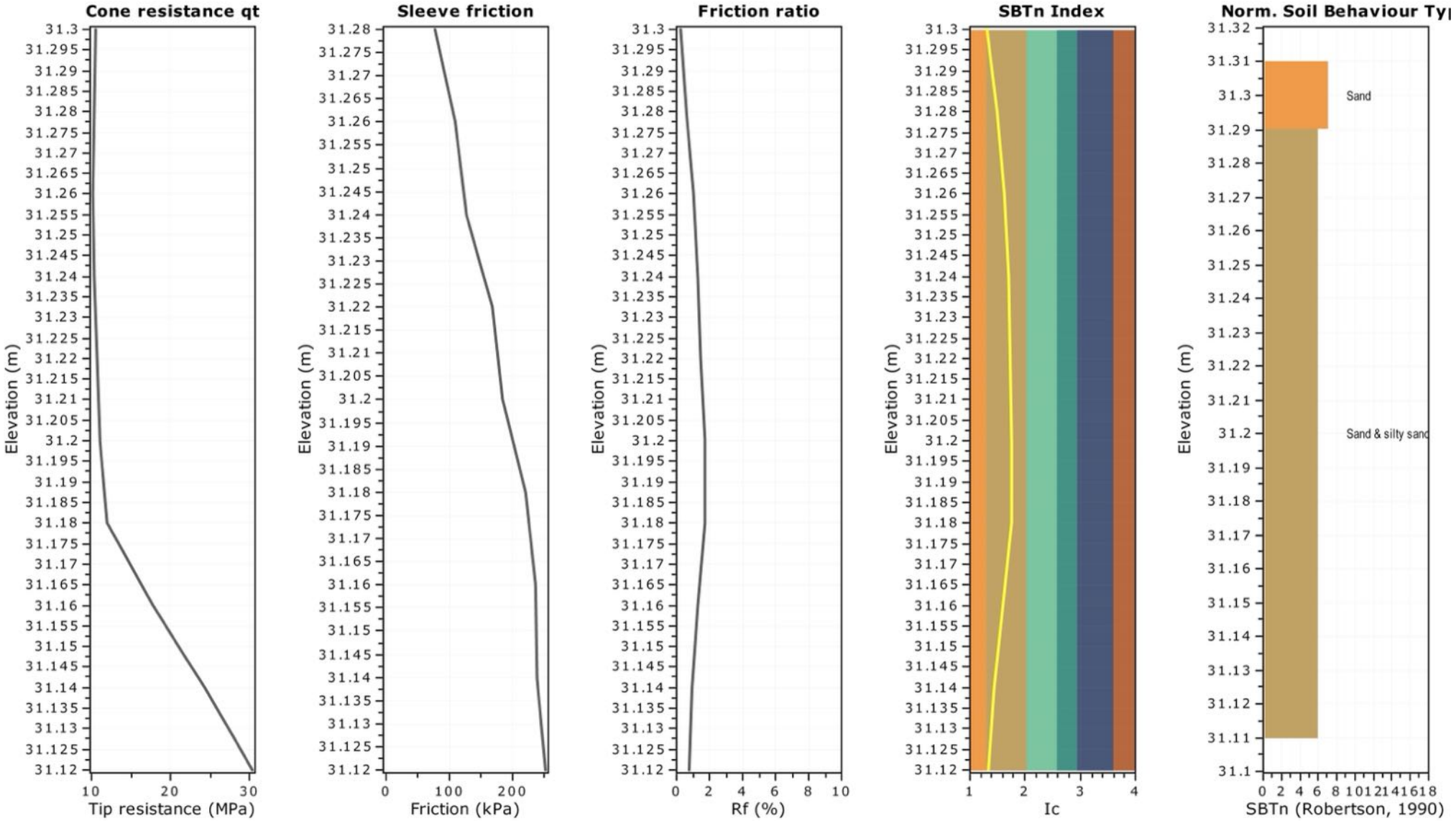
CPT 5
Total depth: 0.96 m, Date: 8/09/2021
Surface Elevation: 32.08 m
Coords: X:0.00, Y:0.00
Cone Type: Serial No 5552
Cone Operator: Terratest

Project: 6561
Location: 4 Delmar Parade, Dee Why



Borehole Log

BH no:	**BH1**
sheet:	1 of 4
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	28.90 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
ATD	N	None Observed					PAVERS	CONCRETE Pavement				PAVEMENT
					0.2		FILL	Silty SAND, fine to medium grained, dark brown, trace of gravel and brick fragments	D-M	L		FILL
				28.5	0.5							
					0.5		FILL	Silty SAND, fine grained, grey to dark grey, trace of gravels		MD		
				28.0	1.0							
					1		CL	Sandy CLAY, medium plasticity, brown	M	F-St		ALLUVIUM
				27.5	1.5							
				27.0	2.0							
				26.5	2.5							
					2.5		SC	Clayey SAND, fine to medium grained, brown to red	M-<Wp	D-VD		
				26.0	3.0							
				25.5	3.5							RESIDUAL
				25.0	4.0							
				24.5	4.5							
					4.8		SM	Silty SAND, fine grained, pale brown, trace of extremely weathered sandstone fragments		VD		
				24.0	5.0							

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Hard/Practical Refusal

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Borehole Log

BH no:	**BH1**
sheet:	2 of 4
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	28.90 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ATD	N	None Observed	D	23.5	5.5		SM	Silty SAND, fine grained, pale brown, trace of extremely weathered sandstone fragments *(continued)*	M-<Wp	VD		
				23.0	6.0							
					6			SANDSTONE, fine to medium grained, pale grey and pale brown				
				22.5	6.5							
								Borehole No: BH1 continued as cored hole from 6.5m				
				22.0	7.0							
				21.5	7.5							
				21.0	8.0							
				20.5	8.5							
				20.0	9.0							
				19.5	9.5							
				19.0	10.0							

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Cored Borehole Log

BH no:	**BH1**
sheet:	3 of 4
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	28.90 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
		None Observed	22.5	6.5		Continued from non-cored borehole from 6.5m						
NMLC				6.5		SANDSTONE, fine to medium grained, pale grey to grey, massive to poorly developed layering at 0°, thckly to medium bedded	HW - MW		D=0.25 A=0.32			PT, pl, 10-15°, cl
			22.0	7.0								
			21.5	7.5					D=0.24 A=0.33			
			21.0	8.0								FZ, 5°, ro, fill
			20.5	8.5			MW		D=0.06 A=0.24			
			20.0	8.87		Sandy CLAY, medium plasticity, pale grey				98		
				9.0 8.93		SANDSTONE, fine to medium grained, grey, poorly to well developed layering at 0°, medium to thinly bedded	SW - FR					PT, pl, 3°, sm, cl
			19.5	9.5								PT, un, 0-3°, ro , cl
									D=0.2 A=0.28			
			19.0	10.0								PT, pl, 20°, ro, fill
												PT, un, 0-5°, ro, fill
												JT, un, 60-70°, ro, cl
												PT, pl, 0-3°, ro, cl
			18.5	10.5								PT, pl, 0°, sm , cl
									D=0.31 A=0.27			
												PT, pl, 0-3°, sm, cl
		None Observed	18.0	11.0								PT, fill,10mm
												PT, un, 10-15°, ro, cl

6561 BH LOGS.GPJ 7/10/21

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Cored Borehole Log

BH no:	**BH1**
sheet:	4 of 4
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	28.90 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log / core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (MPa: 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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			17.5	11.5		SANDSTONE, fine to medium grained, grey, poorly to well developed layering at 0°, medium to thinly bedded *(continued)*	SW - FR		D=0.32 A=0.37			PT, un, 5-45°, sm, cl
			17.0	12.0								PT, pl, 2°, ro, cl
												PT, pl, 2°, ro, cl
												PT, un, 0-5°, sm, fill
			16.5	12.5					D=0.27 A=1	98		
			16.0	13.0								PT, un, 0-5°, ro, fill
												PT, pl, 3°, ro, cl
			15.5	13.5					D=0.73 A=0.85			PT, un, 0-10°, ro, cl
			15.0	13.9								PT, pl, 10°, sm, cl
				14.0		NMLC terminated @ 13.9m. BH1 terminated at 13.9m						
			14.5	14.5								
			14.0	15.0								
			13.5	15.5								
			13.0	16.0								

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issue	date	description
A	25.9.21	Initial issue

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Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH1

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A

Borehole Log

BH no:	**BH2**
sheet:	1 of 3
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	29.25 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ATD	N	None Observed		29.0	0.2			CONCRETE PAVEMENT				PAVEMENT
							SM	Silty SAND, fine to medium grained, black	D-M	L		FILL
					0.5		SM	Silty SAND, fine to medium grained, brown to dark brown with red mottle		L-MD		
				28.5	1.0							
				28.0	1.5							
					1.6		SM	Silty SAND, fine grained, grey	Wp	D		RESIDUAL
				27.5	2.0							
				27.0	2.5							
				26.5	3.0							
			D	26.0	3.5							
				25.5	3.7			SANDSTONE, extremely weathered, fine to medium grained, pale grey, very low strength				
				25.0	4.0							
					4.5							
				24.5				Borehole No: BH2 continued as cored hole from 4.6m				Hard Practical Refusal
					5.0							

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Borehole Log - Revision 10

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Cored Borehole Log

BH no:	**BH2**
sheet:	2 of 3
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	29.25 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
		None Observed	25.0	4.5		Continued from non-cored borehole from 4.6m						
NMLC			24.5	4.6		SANDSTONE, fine to medium grained, pale grey and pale brown, poorly developed layering at 0°, thinly to medium bedded	HW - MW					PT, un, 5°, sm, fill PT, un, 10-15°, ro, fill
			24.0	5.0								FZ, ro, fill PT, pl, 0°, ro, fill
				5.5					D=0.2 A=0.19			FZ, 5-25°, ro, fill PT. un, 0-5°, ro, cl
			23.5	5.63		SHALE, fine grained, with clay coating, dark grey, massive	HW					
				5.72		CORE LOSS						
			23.0	6.0								
				6.4		SHALE, fine grained, with clay coating, dark grey, massive	HW - MW					FZ, ro, fill
				6.5								
			22.5	6.6		SANDSTONE, fine to medium grained, pale grey to grey, massive to poorly developed layering at 0°, thickly to medium bedded	MW		D=0.13 A=0.28	85		
				7.0								PT, pl, 0°, sm, cl
			22.0									FZ, XW, SM, 50mm
				7.5					D=0.09 A=0.26			
			21.5									
				8.0								
			21.0									
				8.5					D=0.28 A=0.65			FZ, X, SM, 20mm
			20.5	8.7		SANDSTONE, fine to medium grained, pale grey to grey, poorly developed layering at 10°, medium to thinly bedded	SW - FR					PT, un, 0-5°, sm, cl
		None Observed		9.0								PT, st, 0-3°, ro,cl

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Cored Borehole Log

BH no:	**BH2**
sheet:	3 of 3
job no.:	6561

client:	Landmark Group	**started:**	14.9.2021
principal:		**finished:**	14.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	29.25 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			20.0	9.5		SANDSTONE, fine to medium grained, pale grey to grey, poorly developed layering at 10°, medium to thinly bedded *(continued)*	SW - FR		D=0.63 A=1.15			
			19.5	10.0								PT, un, 10° ro, cl PT, pl, 10°, sm, fill
			19.0	10.5					D=0.2 A=0.39			PT, un, 0-5°, ro, fill PT, pl, 10°, ro, fill
			18.5	11.0								PT, st, 5-10°, ro, fill
			18.0	11.5					D=0.22 A=0.79	85		
			17.5	12.0								
				11.96		SANDSTONE, fine to coarse grained, grey with purple layers, and white gravels. massive	MW - SW					
			17.0	12.18		SANDSTONE, fine to medium grained, pale grey to grey, poorly to well developed layering at 0°, thinly to very thinly bedded.	SW - FR					FZ, XW, ro, 350mm
			16.5	12.5					D=0.72 A=0.9			PT, st, 5-10°, ro, cl
			16.0	13.0					D=0.36 A=0.36			HT, pl, 70-75°, ro,cl PT, st, 5°, ro, cl
			15.5	13.5								JT, un, 70-80°, ro, cl PT, st, 5°, ro, cl
				13.95		NMLC terminated @ 13.95m BH2 terminated at 13.95m						

6561 BH LOGS.GPJ 7/10/21

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

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A	25.9.21	Initial issue
issue	date	description

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North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH2

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A

Borehole Log

BH no:	**BH3**
sheet:	1 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.0 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetrometer kPa 100 200 300 400	structure and additional observations
ATD	N	None Observed						CONCRETE PAVEMENT				PAVEMENT
					0.2		SM	Silty SAND, fine grained, brown, trace of gravels	D	L-MD		FILL
				29.5	0.5							
					0.5			SAMDSTONE, wihte to pale brown, extremely weathered, very low strength				RESIDUAL
				29.0	1.0							
				28.5	1.5			Borehole No: BH3 continued as cored hole from 1.5m				Hard Practical Refusal
				28.0	2.0							
				27.5	2.5							
				27.0	3.0							
				26.5	3.5							
				26.0	4.0							
				25.5	4.5							
				25.0	5.0							

6561 BH LOGS.GPJ 7/10/21

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Cored Borehole Log

BH no:	**BH3**
sheet:	2 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.0 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
		None Observed	28.5	1.5		Continued from non-cored borehole from 1.5m						
NMLC				1.53		SANDSTONE, fine to medium grained, pale grey ,with some red iron stains, massive to poorly developed layering at 0°, thickly bedded	HW - MW		D=0.09 A=0.18			PT, pl, 2°, sm, cl FZ, XW, SM, 30mm PT,un, 0-3°, ro,cl
			28.0	2.0								
												PT, un, 10-15°, sm, cl PT, un, 5-10°, sm ,cl
			27.5	2.5					D=0.09 A=0.53			
			27.0	3.0								PT, un, 10°, ro, cl
			26.5	3.5					D=0.43 A=0.35			
			26.0	4.0						88		
												PT, pl, 0-5°, ro, cl FZ, XW, SM, 60mm
			25.5	4.5		SANDSTONE, fine grained, grey, poorly to well developed layering at 5°, thinly to very thinly bedded.	MW		A=0.28 D=0.18			
				4.48								FZ, XW, SM, 30mm
			25.0	5.0								
			24.5	5.5					D=0.24 A=0.22			FZ, XW, SM, 70mm
												PT, pl, 5°, ro, cl PT, un, 10°, ro, cl
		None Observed	24.0	6.0								FZ, XW, SM, 70mm

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Cored Borehole Log - Revision 9

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Cored Borehole Log

BH no:	**BH3**
sheet:	3 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.0 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			23.5	6.5		SANDSTONE, fine grained, grey, poorly to well developed layering at 5°, thinly to very thinly bedded. *(continued)*	MW		D=0.32 A=0.5			
				6.27		SANDSTONE, find grained, grey to dark grey, massive to poorly developed layering at 5°, thickly bedded	HW - MW					
				6.36		CORE LOSS						
			23.0	7.0								
				7.09		SANDSTONE, fine grained, grey to dark grey, clay interbedded, poorly developed layering at 5°, medium bedded.	MW - SW		D=0.09 A=0.07			
			22.5	7.5								
				7.7		SANDSTONE, fine grained, poorly to well developed layering at 2°, thinly to very thinly bedded,	SW - FR					
			22.0	8.0								
			21.5	8.5					D=0.3 A=0.78	88		FZ, XW, SM, 40mm
			21.0	9.0								PT, pl, 4°, ro, cl
												PT, un, 3°, cl, ro
			20.5	9.5					D=0.59 A=0.49			
			20.0	10.0								
			19.5	10.5					D=0.52 A=1.15			
		None Observed	19.0	11.0								FZ, XW, SM, 90mm
												PT, un, 5°, sm, fill

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Cored Borehole Log

BH no:	**BH3**
sheet:	4 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.0 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			18.5	11.5		SANDSTONE, fine grained, poorly to well developed layering at 2°, thinly to very thinly bedded, *(continued)*	SW - FR		D=0.21 A=0.6			PT, un, 0-10°, ro, cl
			18.0	12.0								PT, pl, 2°, ro, cl
			17.5	12.5					D=0.61 A=0.55	88		FZ, XW, SM , 40mm
			17.0	13.0								PT, un, 5°, ro, cl
			16.5	13.5					D=0.42 A=1.12			
			16.0	14.0								
				14.2		NMLC terminated @ 14.2m BH3 terminated at 14.2m						
			15.5	14.5								
			15.0	15.0								
			14.5	15.5								
			14.0	16.0								

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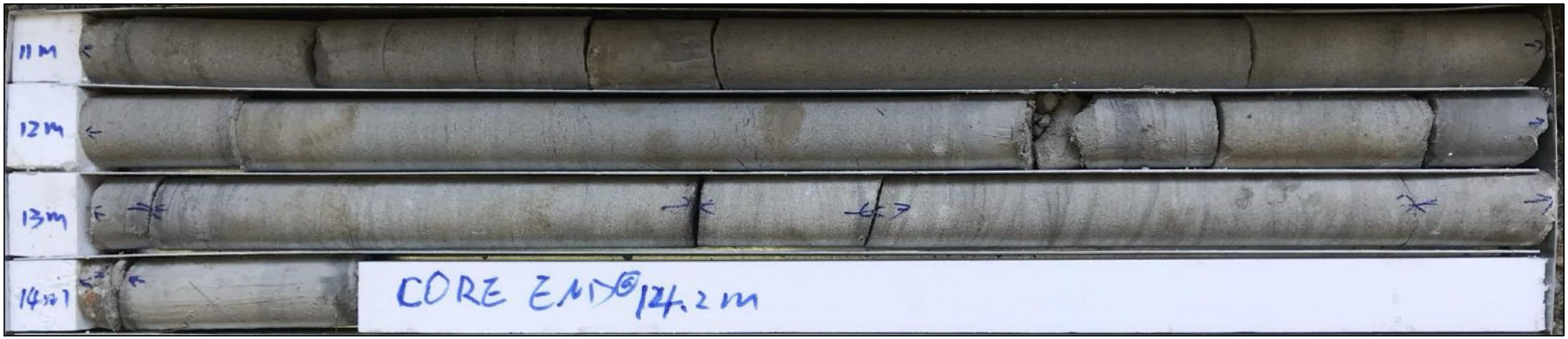

issue	date	description
A	25.9.21	Initial issue

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North Ryde NSW 2113
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Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH3

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A

Borehole Log

BH no:	**BH4**
sheet:	1 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.92 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ATD	N	None Observed						CONCRETE PAVEMENT				PAVEMENT
				31.5	0.2		SM	Silty SAND, fine grained, brown	D	L		FILL
					0.5							
			D		0.5			SANDSTONE, fine grained, white and pale brown, extremely weathered, very low strength				RESIDUAL
				31.0	1.0			Borehole No: BH4 continued as cored hole from 1m				Hard Practical Refusal
				30.5	1.5							
				30.0	2.0							
				29.5	2.5							
				29.0	3.0							
				28.5	3.5							
				28.0	4.0							
				27.5	4.5							
				27.0	5.0							

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Cored Borehole Log

BH no:	**BH4**
sheet:	2 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.92 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa D=diametral × A=axial o	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
		None Observed	31.0	1.0		Continued from non-cored borehole from 1m						
NMLC				1		SANDSTONE, fine to medium grained, pale grey to white, massive	HW - MW		D=0.21 A=0.81			PT, un, 5-10° , ro, cl
			30.5	1.5								XW, SM, 10mm
			30.0	2.0								
			29.5	2.5					D=0.47 A=0.46			PT, pl, 3°, ro, cl
			29.0	3.0								
				3.18		SANDSTONE, fine grained, pale grey to white, massive to poorly developed layering at 0°, thinly bedded	MW			92		
			28.5	3.5					D=0.16 A=0.18			XW, SM, 20mm
			28.0	4.0								
			27.5	4.5					D=0.48 A=0.83			PT, un, 0-2°, ro, cl
			27.0	5.0								
		None Observed	26.5	5.5					D=0.32 A=0.96			XW, SM, 20mm
												FZ, XW, SM, 70mm

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Cored Borehole Log

BH no:	**BH4**
sheet:	3 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.92 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC		None Observed	26.0	6.0		SANDSTONE, fine grained, pale grey to white, massive to poorly developed layering at 0°, thinly bedded *(continued)*	MW					
				6		SANDSTONE, fine to medium grained, grey to pale grey, poorly to well developed layering at 10°, thinly to very thinly bedded	MW - SW					PT, un, 0-10°, ro, cl
			25.5	6.5					D=0.34 A=0.84			
			25.0	7.0					D=0.56 A=1.53			XW, SM, 20mm
			24.5	7.5								XW, SM, 30mm
				7.46		SILTSTONE, fine grained, grey, massive with sandy clay	HW - XW					
				7.6		CORE LOSS						
			24.0	8.0						92		
				8.16		SILTSTONE, fine grained, dark grey, massive with clay coating	HW - XW					
			23.5	8.5					D=0.06 A=0.15			PT, pl, 3°, sm , cl
				8.56		SHALE, fine grained, dark grey, well developed layering at 0°	HW					FZ, XW, SM, 100mm
			23.0	9.0								XW, SM, 20mm
				9.12		SANDSTONE, fine grained, poorly to well developed layering at 5°, thinly to very thinly bedded	SW					PT, pl, 5°, ro, cl
			22.5	9.5					D=0.19 A=0.36			
			22.0	10.0								
			21.5	10.5								

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Cored Borehole Log

BH no:	**BH4**
sheet:	4 of 4
job no.:	6561

client:	Landmark Group	**started:**	15.9.2021
principal:		**finished:**	15.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.92 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			21.0	11.0		SANDSTONE, fine grained, poorly to well developed layering at 5°, thinly to very thinly bedded *(continued)*	SW		D=0.23 A=1.03			PT, pl, 2°, ro, cl
			20.5	11.5					D=0.53 A=1.02			PT, un, 0-5°, sm, cl
			20.0	12.0								
			19.5	12.5					D=0.24 A=0.85	92		PT, pl, 10°, sm, cl PT, un, 5°, ro, fill
			19.0	13.0								FZ, XW, SM, 60mm
			18.5	13.5					D=0.6 A=0.75			
			18.0	14.0								PT, lp, 3°, ro, cl
			17.5	14.1		SANDSTONE, fine to coarse grained, grey, white mottled, poorly to well developed layering at 0°, thinly to very thinly bedded	SW - FR		D=0.74 A=0.65			
				14.5								
			17.0	14.55		NMLC terminated @ 14.55m BH4 terminated at 14.55m						
			16.5	15.0								
				15.5								

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issue	date	description
A	25.9.21	Initial issue

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North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH4

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A

Borehole Log

BH no:	**BH5**
sheet:	1 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.66 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ATD	N	None Observed		32.5				CONCRETE PAVEMENT				PAVEMENT
					0.2			SANDSTONE, fine grained, extremely weathered, very low strength, white				RESIDUAL
				32.0	0.5							
								Borehole No: BH5 continued as cored hole from 0.75m				Hard Practical Refusal
				31.5	1.0							
					1.5							
				31.0								
					2.0							
				30.5								
					2.5							
				30.0								
					3.0							
				29.5								
					3.5							
				29.0								
					4.0							
				28.5								
					4.5							
				28.0								
					5.0							

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Cored Borehole Log

BH no:	**BH5**
sheet:	2 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.66 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating (specific / general)
		None Observed	32.0	0.5		Continued from non-cored borehole from 0.75m						
NMLC			31.5	0.75		SANDSTONE, fine grained, massive to poorly developed layering at 10°, medium to thickly bedded, pale brown	HW - MW		D=0.35 A=0.5			PT, pl, 5°, ro, cl
				1.0								PT, un, 5-15°, ro, fill
			31.0	1.5					D=0.41 A=0.42			PT, un, 10-20°, ro, fill
			30.5	2.0								
				2.31		SANDSTONE, fine to medium grained, pale grey to grey, poorly to well developed layering at 10°, thinly to vey thinly bedded.	MW - SW		D=0.26 A=0.96			PT, XW, pl, 10°, ro, cl
			30.0	2.5								PT, XW, un, 10°, ro, cl
			29.5	3.0						99		FZ, XW, SM, 50mm
			29.0	3.5					D=0.48 A=1.07			
			28.5	4.0								
			28.0	4.5					D=0.95 A=0.65			
		None Observed	27.5	5.0								

6561 BH LOGS.GPJ 7/10/21

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Cored Borehole Log

BH no:	**BH5**
sheet:	3 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.66 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH MPa)	$Is_{(50)}$ MPa (D=diametral ×, A=axial ○)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			27.0	5.5		SANDSTONE, fine to medium grained, pale grey to grey, poorly to well developed layering at 10°, thinly to vey thinly bedded. *(continued)*	MW - SW		D=0.57 A=20.2			FZ, XW, CL, 30mm
				6.0								PT, un, 3°, ro, cl
			26.5	6.5								PT, XW-HW, pl, 5°, ro, fill
				6.51		SANDSTONE, fine to medium grained, pale brown with white mottles, red ironstone interbedded, poorly developed layering at 10°, medium bedded	SW		D=0.64 A=1.5			
			26.0	7.0								
			25.5	7.5					D=0.26 A=1.09			
			25.0	8.0								
			24.5	8.5					D=0.15 A=0.73	99		
			24.0	8.61		SHALE, fine grained, dark grey, well developed layering	MW - SW					PT, XW, st, 10°, ro, cl
				9.0								
			23.5	9.5								PT, XW< un, 0°, ro, cl
			23.0	9.81		SANDSTONE, fine grained, grey, poorly to well developed at 5°, thinly to very thinly bedded	SW - FR		D=0.04 A=0.91			PT, XW, un, 5°, ro, cl
		None Observed		10.0								
			22.5									

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Cored Borehole Log - Revision 9

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Cored Borehole Log

BH no:	**BH5**
sheet:	4 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.66 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC			22.0	10.5		SANDSTONE, fine grained, grey, poorly to well developed at 5°, thinly to very thinly bedded *(continued)*	SW - FR		D=0.51 A=1.57			
			21.5	11.0								
			21.0	11.5					D=0.51 A=1.21			
			20.5	12.0								
			20.0	12.5					D=0.57 A=0.71	99		
			19.5	13.0								
			19.0	13.5					D=0.4 A=0.93			PT, XW-HW, un, 0-10°, ro, cl
			18.5	14.0								PT, XW, un, 10°, ro, cl
			18.0	14.5					D=1.54 A=0.9			
			17.5	15.0								
				15		NMLC terminated @ 15m BH5 terminated at 15m						

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Cored Borehole Log - Revision 9

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

issue	date	description
A	25.9.21	Initial issue

assetgeoenviro
2.06/56 Delhi Rd
North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH5

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A

Borehole Log

BH no:	**BH6**
sheet:	1 of 3
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.08 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ADT	N	None Observed		32.0				CONCRETE PAVEMENT				PAVEMENT
					0.2		CL	Sandy CLAY, medium plasticity, brown	M	F-St		ALLUVIUM
				31.5	0.5							
				31.0	1.0							
				30.5	1.5							
			D	30.0	2.0							
				29.5	2.5							
				29.0	3.0							
					3.2			SANSTONE, fine grained, yellow to pale brown, extremely to highly weathered, very low strength				RESIDUAL
				28.5	3.5							
				28.0	4.0							
					4.5							
				27.5				Borehole No: BH6 continued as cored hole from 4.5m				Hard Practical Refusal
					5.0							

6561 BH LOGS.GPJ 7/10/21

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Cored Borehole Log

BH no:	**BH6**
sheet:	2 of 3
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.08 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa (D=diametral ×, A=axial o)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating (specific / general)
		None Observed		4.5		Continued from non-cored borehole from 4.5m						
NMLC			27.5	4.5		SANDSTONE, fine grained, dark brown to brown, massive bedding	XW - HW		D=0.04 A=0.04			PT, XW, un, 20°, ro, fill
			27.0	5.0								PT, XW, un, 2°, ro, cl
			26.5	5.5					D=0.04 A=0.11			PT, XW, un, 0-5°, ro, fill
												PT, un, 0-10°, ro, cl
			26.0	6.0		SANDSTONE, fine grained, pale grey, massive bedding	HW - MW		D=0.12 A=0.24			
			25.5	6.5								
			25.0	7.0								
			24.5	7.5					D=0.45 A=0.92	92		
			24.0	8.0								FZ, XW, SM, black coating, 60mm
			23.5	8.5		SANDSTONE, fine grained, purple, poorly developed layering at 5°, thinly to very thinly bedded	MW - SW		D=0.99 A=0.68			PT, pl, 20°, ro, cl
		None Observed	23.0	9.0					D=0.12 A=0.29			XW, CL, 30mm

5.89 8.48

6561 BH LOGS.GPJ 7/10/21

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Cored Borehole Log - Revision 9

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Cored Borehole Log

BH no:	**BH6**
sheet:	3 of 3
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	16.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	32.08 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
NMLC				9.15		SHALE, fine grained, dark grey, massive bedding	MW - HW					
				9.2		CORE LOSS						
			22.5	9.5								
				10.0								
			22.0	10.1		SANSTONE, fine to mdium grained, dark grey, well developed layering at 0°, thinly bedded	HW - MW					
				10.5					D=0.12 A=0.28			
			21.5									PT, XW, un, 5°, ro, fill
				11.0								
			21.0	11.06		SANDSTONE, fine grained, grey, poorly to well developed layering at 3°, very thinly bedded	MW - SW					
				11.5					D=0.61 A=1.22	92		
			20.5									PT, XW, un, 0°, ro, fill
				12.0								
			20.0									
				12.5					D=0.53 A=1.19			
			19.5									PT, pl, 10°, ro, cl
				13.0								
			19.0									
				13.5					D=2 A=2.81			
			18.5									
				14.0								
			18.0	14		NMLC terminated @ 14.0m						

BH6 terminated at 14m

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

issue	date	description
A	25.9.21	Initial issue

assetgeoenviro
2.06/56 Delhi Rd
North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

Proposed Mixed–use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH6

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A

Borehole Log

BH no:	**BH7**
sheet:	1 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.80 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ADT	N							CONCRETE PAVEMENT				PAVEMENT
				31.5	0.25		CL-ML	SANDY CLAY, medium plasticity, brown to black	D-M	F-St		FILL
				31.0	0.5							
					0.9		SM	Silty SAND, fine grained, dark grey	D	VL-L		ALLUVIUM
				30.5	1.0							
					1.5							
				30.0	1.8		CL	Sandy CLAY, medium to high plasticity, dark grey	M	St		
				29.5	2.0							
					2.5							
				29.0	2.9		CL	Sandy CLAY, meidum plasticity, brown to dark brown	M-<Wp	St-VSt		RESIDUAL
				28.5	3.0							
					3.5							
				28.0	4.0							
				27.5	4.5							
				27.0	5.0							

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Hard/Practical Refusal

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Borehole Log

BH no:	**BH7**
sheet:	2 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.80 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa (100 200 300 400)	structure and additional observations
ADT	N		D	26.5	5.5		CL	Sandy CLAY, meidum plasticity, brown to dark brown *(continued)*	M-<Wp	St-VSt		
		►		26.0	6.0							
				25.5	6.5							
					6.5		SM	Silty SAND, fine to medium grained, brown with grey and red stains	Wp-Wl	MD-D		
				25.0	7.0							
				24.5	7.5							
				24.0	8.0							
			D	23.5	8.5							
				23.0	9.0							
								Borehole No: BH7 continued as cored hole from 9m				
				22.5	9.5							
				22.0	10.0							

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Cored Borehole Log

BH no:	**BH7**
sheet:	3 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.80 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa D=diametral × A=axial o	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
			23.0	9.0		Continued from non-cored borehole from 9m						
NMLC				9		SANDSTONE, fine grained, pale brown to brown, red ironstone interbedded, massive,	XW - HW					
			22.5	9.5								PT, XW, pl, 45°, ro, cl
				9.58								FZ, XW, clay coating, 20mm
			22.0			SANDSTONE, fine to medium grained, pale brown, massive to poorly developed layering at 0°	MW		D=0.18 A=0.36			
				10.0								
			21.5									
				10.5								PT, un, 15°, ro, cl
												PT, pl, 25°, ro, cl
			21.0						D=0.33 A=0.19			
				11.0								
			20.5							71		
				11.5								
			20.0						D=0.2 A=0.7			XW, CL, 30mm
				12.0								FZ, XW. 340mm
			19.5									
				12.5								
			19.0						D=0.17 A=0.35			
				12.78		SHALE, fine grained, dark grey, massive						
				12.9		CORE LOSS						
			18.5	13.0								
				13.5								

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Cored Borehole Log - Revision 9

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Cored Borehole Log

BH no:	**BH7**
sheet:	4 of 4
job no.:	6561

client:	Landmark Group	**started:**	16.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	31.80 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength (MPa: 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 (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating (specific / general)
NMLC			18.0	13.8		CORE LOSS *(continued)*						
				14.0		SILTSTONE, fine grained, dark grey, massive	MW - HW		D=0.02 A=0.05			
			17.5									FZ, XW, SM, 30mm
				14.32		CORE LOSS				71		
				14.5								
				14.47		SILTSTONE, fine grained, dar k grey, poorly to well developed layering	MW - SW					PT, XM, un, 5°, ro, cl 5mm
			17.0						D=0.03 A=0.06			FZ, XW, 20mm
				15.0					D=0.03 A=0.04			
				15.06		NMLC terminated at 15.06m BH7 terminated at 15m						
			16.5	15.5								
			16.0	16.0								
			15.5	16.5								
			15.0	17.0								
			14.5	17.5								
			14.0	18.0								
			13.5	18.5								

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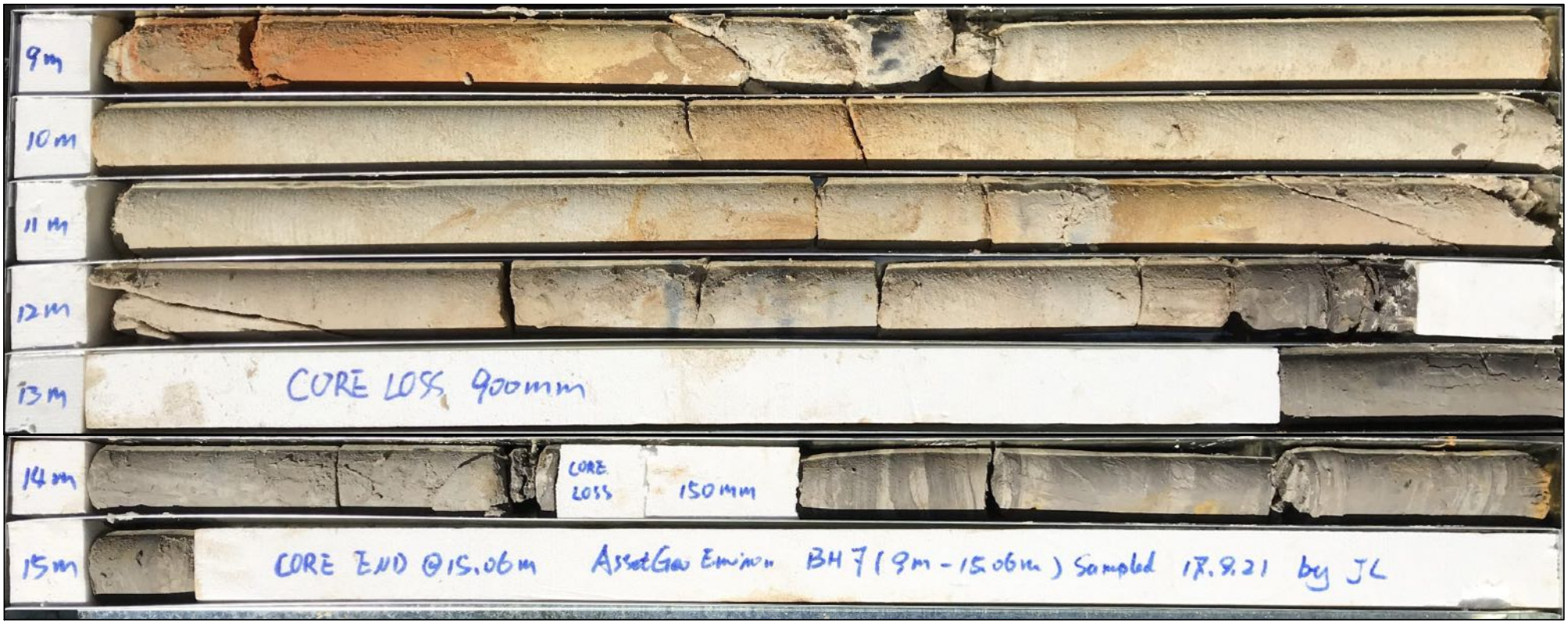

issue	date	description
A	25.9.21	Initial issue

assetgeoenviro
2.06/56 Delhi Rd
North Ryde NSW 2113
t: 02 9878 6005
e: info@assetgeoenviro.com.au

Proposed Mixed-use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH7

drawn: MAB	job no.: 6561
date: 25.6.2021	
checked: MAB	fig: —
scale: 1:4 A4	issue: A

Borehole Log

BH no:	**BH8**
sheet:	1 of 4
job no.:	6561

client:	Landmark Group	**started:**	17.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.51 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ADT	N							CONCRETE PAVEMENT				PAVEMENT
					0.2		SM	Silty SAND, fine to medium grained, dark grey to grey	M-<Wp	L-MD		FILL
				30.0	0.5							
										MD-D		
				29.5	1.0							
				29.0	1.5							
				28.5	2.0							
					2.3		SM	Silty SAND, fine to medium grained, brown to dark brown				ALLUVIUM
				28.0	2.5							
			D									
				27.5	3.0							
				27.0	3.5							
				26.5	4.0							
				26.0	4.5							
					5.0							

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Borehole Log

BH no:	**BH8**
sheet:	2 of 4
job no.:	6561

client:	Landmark Group	**started:**	17.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.51 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ADT	N	▼					SM	Silty SAND, fine to medium grained, brown to dark brown *(continued)*	M-<Wp	MD-D		
					5.2		SM	Silty SAND, fine grained, grey and brown	Wp-Wl	D		RESIDUAL
				25.0	5.5							
				24.5	6.0							
				24.0	6.5							
				23.5	7.0							
				23.0	7.5							
				22.5	8.0							
				22.0	8.5							
				21.5	9.0							
					9.3		SM	Silty SAND, fine grained, brown and purple				
				21.0	9.5							
					10.0							

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

Hard/Practical Refusal

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au

Borehole Log

BH no:	**BH8**
sheet:	3 of 4
job no.:	6561

client:	Landmark Group	**started:**	17.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.51 m approx.
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information**

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material description soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetro-meter kPa 100 200 300 400	structure and additional observations
ADT	N						SM	Silty SAND, fine grained, brown and purple *(continued)*	Wp-Wl	D		
				20.0	10.5							
				19.5	11.0							
				19.0	11.5							
				18.5	12.0							
				18.0	12.5							
				17.5	13.0							
				17.0	13.5							
				16.5	14.0							
				16.0	14.5							
					15.0							

Borehole No. BH8 continued as cored hole from 15m

Cored Borehole Log

BH no:	**BH8**
sheet:	4 of 4
job no.:	6561

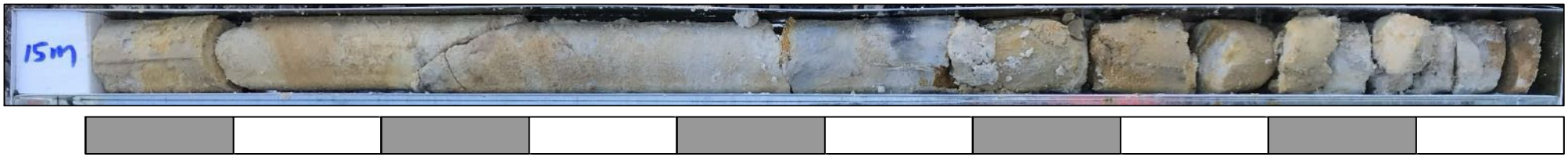
client:	Landmark Group	**started:**	17.9.2021
principal:		**finished:**	17.9.2021
project:	Proposed Mixed-use Development	**logged:**	JL
location:	4 Delmar Parade & 812 Pittwater Road, Dee Why NSW	**checked:**	MAB
equipment:	Truck-Mounted Drilling Rig	**RL surface:**	30.51 m
diameter:	110mm **inclination:** -90° **bearing:** --- **E:** **N:**	**datum:**	AHD

drilling information | **material information** | **rock mass defects**

method	support & core-lift	water	RL	depth metres	graphic log core recovery	rock substance description: rock type; grain characteristics, colour, structure, minor components	weathering	estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	$Is_{(50)}$ MPa D=diametral × A=axial o	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
			15.5	15.0		Continued from non-cored borehole from 15m						
NMLC			15.0	15 15.5		SANSTONE, fine grained, massive	HW - MW	× o	D=0.09 A=0.25	93		PT, XW, un, 45°, ro, cl, 70mm PT, XW, SM, 5mm
			14.5	16.0								
				16		NMLC terminated @ 16.m BH8 terminated at 16m						
			14.0	16.5								
			13.5	17.0								
			13.0	17.5								
			12.5	18.0								
			12.0	18.5								
			11.5	19.0								
			11.0	19.5								

6561 BH LOGS.GPJ 7/10/21

A: 2.06 / 56 Delhi Road, North Ryde NSW 2113 P: 02 9878 6005 W: assetgeoenviro.com.au



issue	date	description
A	25.9.21	Initial issue

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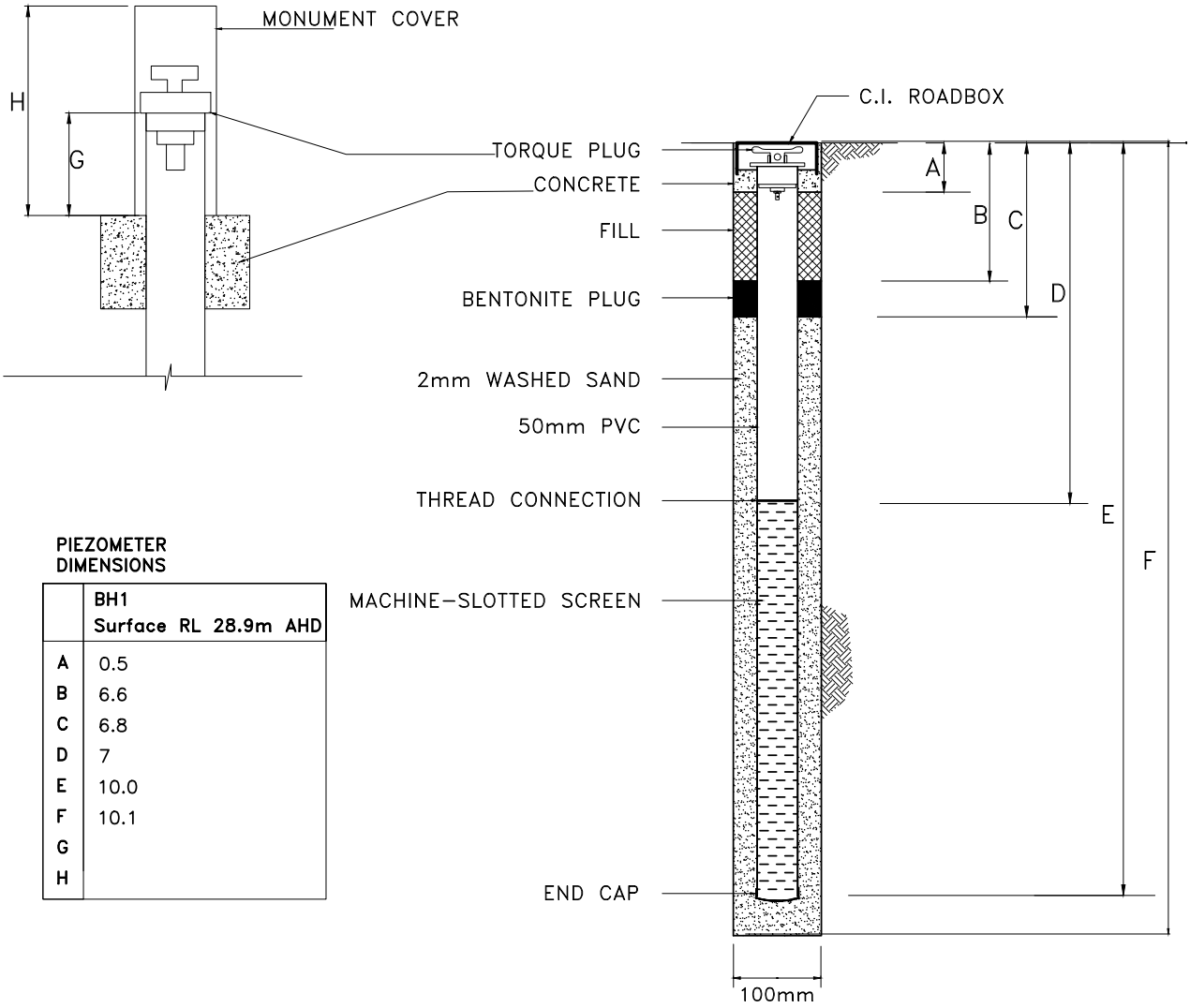
Proposed Mixed–use Development
4 Delmar Parade, Dee Why NSW
for
Landmark Group Australia Pty Ltd

Core Photos – BH8

drawn: MAB
date: 25.6.2021
checked: MAB
scale: 1:4 A4

job no.: 6561
fig: —
issue: A



PIEZOMETER DIMENSIONS

	BH1 Surface RL 28.9m AHD
A	0.5
B	6.6
C	6.8
D	7
E	10.0
F	10.1
G	
H	

GROUNDWATER READINGS

DATE:	BOREHOLE	DEPTH (m)	REDUCED LEVEL	COMMENTS
17.9.2021	BH1	–	–	Bailed out drilling water on completion.

issue	date	description
A	22.9.21	INITIAL ISSUE

assetgeoenviro

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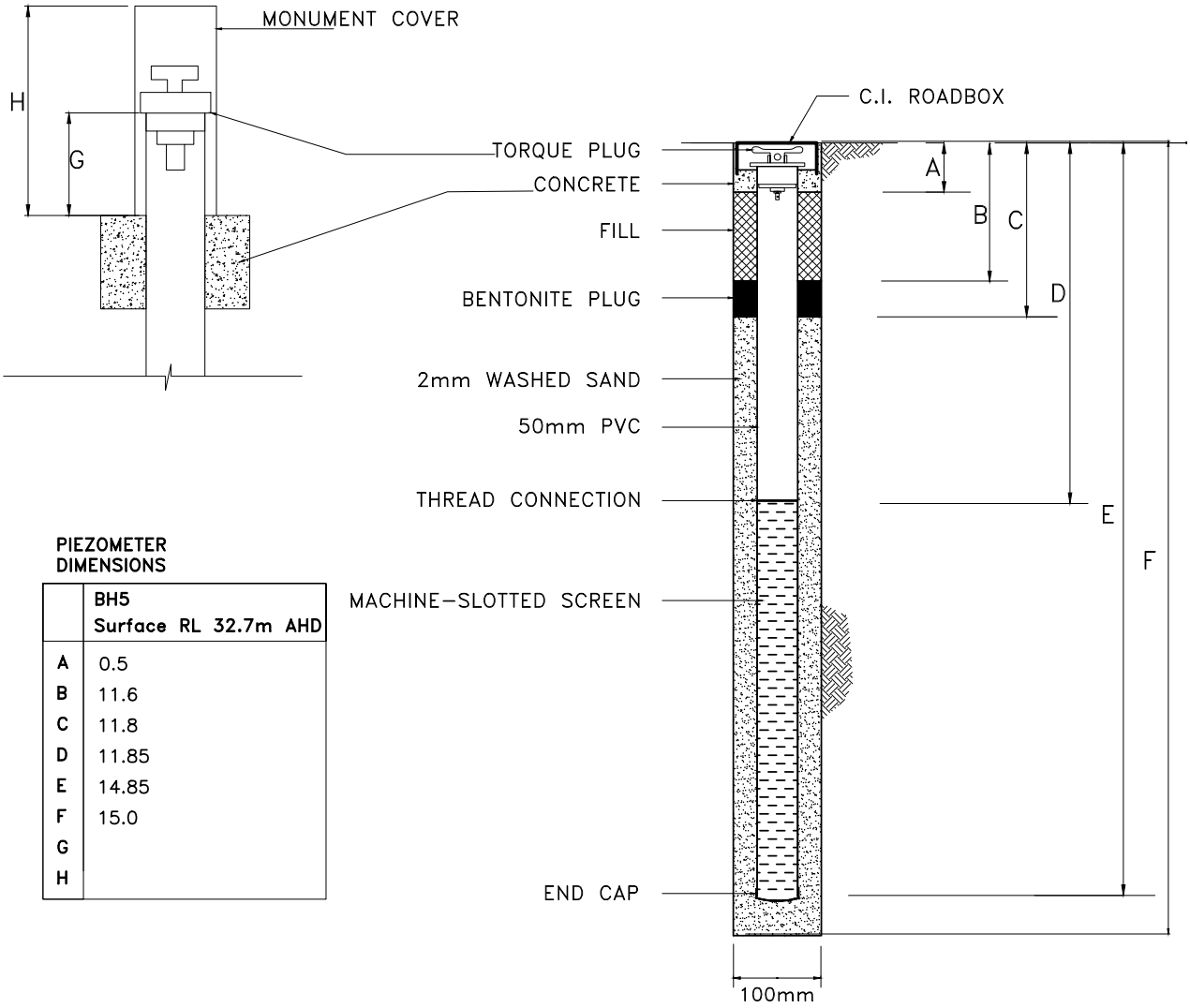
PROPOSED MIXED–USE DEVELOPMENT
4 DELMAR PARADE & 812 PITTWATER ROAD, DEE WHY NSW
for
LANDMARK GROUP

PIEZOMETER DETAILS – BH1

drawn: JL	job no.: 6561
date: 22.9.21	
checked: MAB	fig: —
scale: NTS	issue: A



PIEZOMETER DIMENSIONS

	BH5 Surface RL 32.7m AHD
A	0.5
B	11.6
C	11.8
D	11.85
E	14.85
F	15.0
G	
H	

GROUNDWATER READINGS

DATE:	BOREHOLE	DEPTH (m)	REDUCED LEVEL	COMMENTS
17.9.2021	BH5	–	–	Bailed out drilling water on completion.

issue	date	description
A	22.9.21	INITIAL ISSUE

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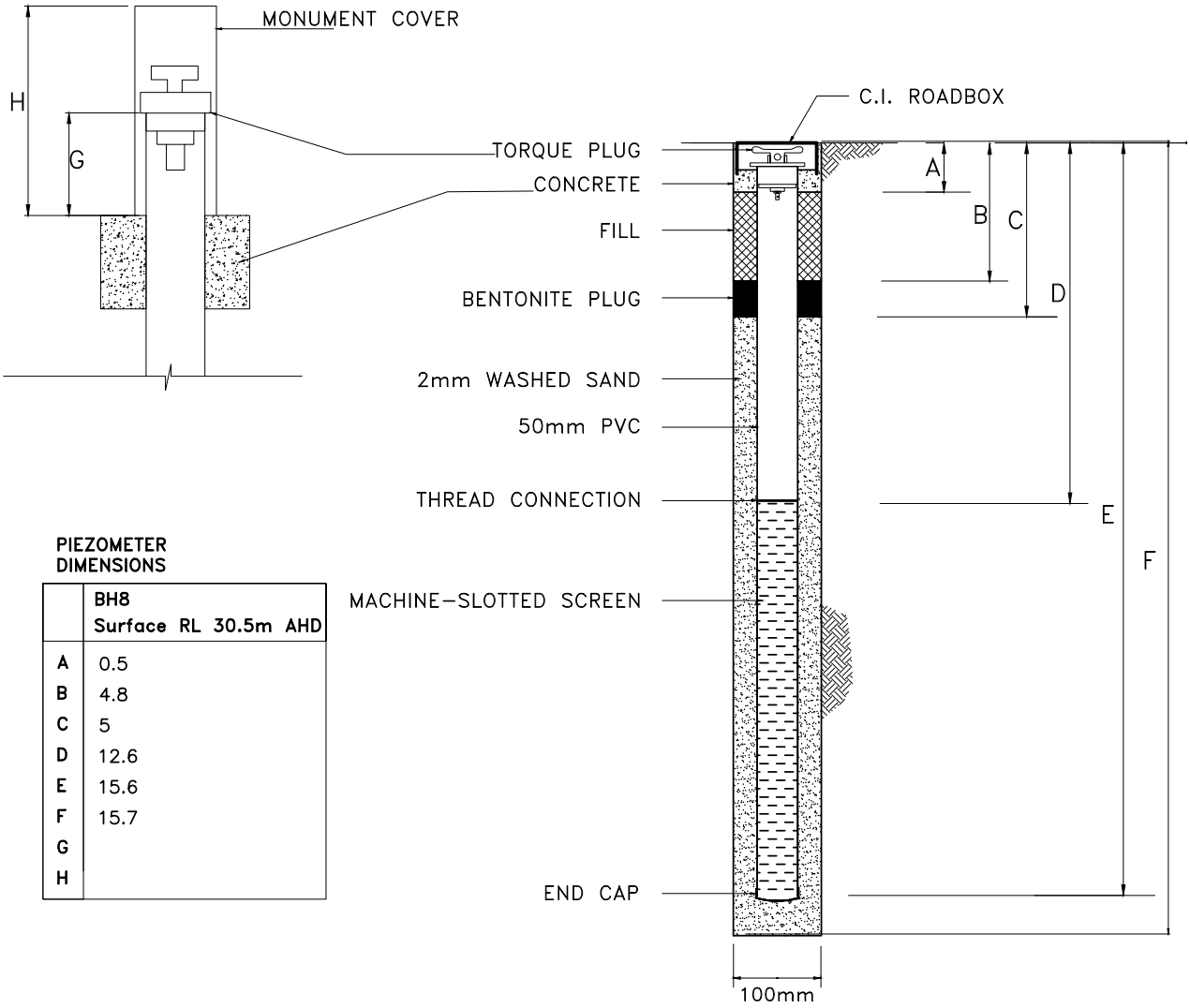
PROPOSED MIXED–USE DEVELOPMENT
4 DELMAR PARADE & 812 PITTWATER ROAD, DEE WHY NSW
for
LANDMARK GROUP

PIEZOMETER DETAILS – BH5

drawn: JL
date: 22.9.21
checked: MAB
scale: NTS

job no.: 6561
fig: —
issue: A



PIEZOMETER DIMENSIONS

	BH8 Surface RL 30.5m AHD
A	0.5
B	4.8
C	5
D	12.6
E	15.6
F	15.7
G	
H	

GROUNDWATER READINGS

DATE:	BOREHOLE	DEPTH (m)	REDUCED LEVEL	COMMENTS
17.9.2021	BH8	–	–	Bailed out drilling water on completion.

issue	date	description
A	22.9.21	INITIAL ISSUE

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4 DELMAR PARADE & 812 PITTWATER ROAD, DEE WHY NSW
for
LANDMARK GROUP

PIEZOMETER DETAILS – BH8

drawn: JL	job no.: 6561
date: 22.9.21	
checked: MAB	fig: —
scale: NTS	issue: A

Appendix C

Laboratory Test Results

Asset Geotechnical Engineering Pty Ltd
Suite 2.06 / 56 Delhi Road
North Ryde
NSW 2113

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Jeff Lu**

Report **826235-S**
Project name PROPOSED DEVELOPMENT
Project ID 6561
Received Date Sep 20, 2021

Client Sample ID			**BH1-5.8M**	**BH2-3M**	**BH4-(0.7-0.8M)**	**BH6-2.3M**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S21-Se42717**	**S21-Se42718**	**S21-Se42719**	**S21-Se42720**
Date Sampled			**Sep 14, 2021**	**Sep 14, 2021**	**Sep 15, 2021**	**Sep 16, 2021**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	11	< 10	70	< 10
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	28	21	180	13
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.1	7.2	8.0	5.5
Resistivity*	0.5	ohm.m	360	480	57	790
Sulphate (as SO4)	10	mg/kg	< 10	< 10	46	< 10
% Moisture	1	%	13	15	1.9	6.6

Client Sample ID			**BH7-5.3M**	**BH7-8.3M**	**BH8-2.8M**	**BH8-15M**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S21-Se42721**	**S21-Se42722**	**S21-Se42723**	**S21-Se42724**
Date Sampled			**Sep 17, 2021**	**Sep 17, 2021**	**Sep 17, 2021**	**Sep 17, 2021**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	16	13	< 10	13
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	37	33	28	30
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.0	4.7	5.8	5.3
Resistivity*	0.5	ohm.m	270	310	350	330
Sulphate (as SO4)	10	mg/kg	15	13	14	< 10
% Moisture	1	%	14	22	10	27

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	Sep 24, 2021	28 Days
- Method: In-house method LTM-INO-4270 Anions by Ion Chromatography			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Sep 24, 2021	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Sep 24, 2021	7 Days
- Method: LTM-GEN-7090 pH by ISE			
Sulphate (as SO4)	Sydney	Sep 24, 2021	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
% Moisture	Sydney	Sep 21, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

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web: www.eurofins.com.au
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NATA # 1261 Site # 18217

Brisbane
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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

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IANZ # 1327

Christchurch
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Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name: Asset Geotechnical Engineering Pty Ltd
Address: Suite 2.06 / 56 Delhi Road
North Ryde
NSW 2113

Project Name: PROPOSED DEVELOPMENT
Project ID: 6561

Order No.: 3303
Report #: 826235
Phone: 02 9878 6005
Fax:

Received: Sep 20, 2021 4:54 PM
Due: Sep 27, 2021
Priority: 5 Day
Contact Name: Jeff Lu

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254							
Sydney Laboratory - NATA # 1261 Site # 18217						X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							
Mayfield Laboratory - NATA # 1261 Site # 25079							
Perth Laboratory - NATA # 2377 Site # 2370							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1-5.8M	Sep 14, 2021		Soil	S21-Se42717	X	X
2	BH2-3M	Sep 14, 2021		Soil	S21-Se42718	X	X
3	BH4-(0.7-0.8M)	Sep 15, 2021		Soil	S21-Se42719	X	X
4	BH6-2.3M	Sep 16, 2021		Soil	S21-Se42720	X	X
5	BH7-5.3M	Sep 17, 2021		Soil	S21-Se42721	X	X
6	BH7-8.3M	Sep 17, 2021		Soil	S21-Se42722	X	X
7	BH8-2.8M	Sep 17, 2021		Soil	S21-Se42723	X	X
8	BH8-15M	Sep 17, 2021		Soil	S21-Se42724	X	X

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Phone : 0800 856 450
IANZ # 1290

Company Name: Asset Geotechnical Engineering Pty Ltd
Address: Suite 2.06 / 56 Delhi Road
North Ryde
NSW 2113

Project Name: PROPOSED DEVELOPMENT
Project ID: 6561

Order No.: 3303
Report #: 826235
Phone: 02 9878 6005
Fax:

Received: Sep 20, 2021 4:54 PM
Due: Sep 27, 2021
Priority: 5 Day
Contact Name: Jeff Lu

Eurofins Analytical Services Manager : Asim Khan

Sample Detail	Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254		
Sydney Laboratory - NATA # 1261 Site # 18217	X	X
Brisbane Laboratory - NATA # 1261 Site # 20794		
Mayfield Laboratory - NATA # 1261 Site # 25079		
Perth Laboratory - NATA # 2377 Site # 2370		
External Laboratory		
Test Counts	8	8

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	uS/cm	< 10			10	Pass	
Sulphate (as SO4)	mg/kg	< 10			10	Pass	
LCS - % Recovery							
Chloride	%	94			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	%	102			70-130	Pass	
Resistivity*	%	102			70-130	Pass	
Sulphate (as SO4)	%	92			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Chloride	S21-Se42724	CP	%	91			70-130	Pass	
Sulphate (as SO4)	S21-Se42724	CP	%	91			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1	Result 2	RPD	Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
pH (1:5 Aqueous extract at 25°C as rec.)	S21-Se42589	NCP	pH Units	5.4	5.4	<1	30%	Pass	
Duplicate									
Conductivity (1:5 aqueous extract at 25°C as rec.)	S21-Se42719	CP	uS/cm	180	190	7.5	30%	Pass	
Resistivity*	S21-Se42719	CP	ohm.m	57	53	7.5	30%	Pass	
Duplicate									
% Moisture	S21-Se42723	CP	%	10	9.4	7.0	30%	Pass	
Duplicate									
Chloride	S21-Se42724	CP	mg/kg	13	13	1.0	30%	Pass	
Sulphate (as SO4)	S21-Se42724	CP	mg/kg	< 10	< 10	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
Sample correctly preserved	No
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Asim Khan	Analytical Services Manager
Charl Du Preez	Senior Analyst-Inorganic (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70865-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70865	BH1 6.70-6.80m	Sandstone	Diametral	-	48.0	0.58	0.25	0.25	1
			Axial	50.7	40.0	0.83	0.32	0.32	1
S70866	BH1 7.44-7.54m	Sandstone	Diametral	-	49.0	0.57	0.24	0.24	1
			Axial	51.7	39.0	0.83	0.32	0.33	1
S70867	BH1 8.43-8.51m	Sandstone	Diametral	-	49.0	0.16	0.06	0.06	1
			Axial	51.5	39.0	0.61	0.24	0.24	1
S70868	BH1 9.72-9.82m	Sandstone	Diametral	-	49.0	0.48	0.20	0.20	1
			Axial	51.7	42.0	0.75	0.27	0.28	1
S70869	BH1 10.45-10.54m	Sandstone	Diametral	-	49.0	0.74	0.31	0.31	1
			Axial	51.8	45.0	0.79	0.26	0.27	1
S70870	BH1 11.51-11.60m	Sandstone	Diametral	-	49.0	0.78	0.32	0.32	3
			Axial	51.9	33.0	0.84	0.39	0.37	1
S70871	BH1 12.44-12.54m	Sandstone	Diametral	-	49.0	0.66	0.27	0.27	1
			Axial	51.8	36.0	2.41	1.02	1.00	1
S70872	BH1 13.31-13.41m	Sandstone	Diametral	-	48.0	1.72	0.74	0.73	1
			Axial	51.8	45.0	2.42	0.81	0.85	1
S70873	BH2 4.77-4.85m	Sandstone	Diametral	-	48.0	0.38	0.16	0.16	1
			Axial	51.8	37.0	0.33	0.14	0.13	1
S70874	BH2 5.27-5.37m	Sandstone	Diametral	-	49.0	0.49	0.20	0.20	1
			Axial	52.5	34.0	0.45	0.20	0.19	4

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

27/09/2021

Date

MACQUARIE GEOTECH

Macquarie Geotec
U7/8 10 Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70875-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70875	BH2 6.70-6.80m	Sandstone	Diametral	-	49.0	0.31	0.13	0.13	1
			Axial	51.8	36.0	0.67	0.28	0.28	1
S70876	BH2 7.46-7.56m	Sandstone	Diametral	-	49.0	0.23	0.09	0.09	1
			Axial	52.0	43.0	0.72	0.25	0.26	1
S70877	BH2 8.34-8.44m	Sandstone	Diametral	-	49.0	0.68	0.28	0.28	1
			Axial	52.1	41.0	1.74	0.64	0.65	1
S70878	BH2 9.35-9.44m	Sandstone	Diametral	-	49.0	1.52	0.63	0.63	1
			Axial	51.9	41.0	3.06	1.13	1.15	1
S70879	BH2 10.33-10.43m	Sandstone	Diametral	-	49.0	0.48	0.20	0.20	1
			Axial	52.0	40.0	1.03	0.39	0.39	1
S70880	BH2 11.40-11.50m	Sandstone	Diametral	-	48.0	0.52	0.22	0.22	1
			Axial	51.9	41.0	2.12	0.78	0.79	1
S70881	BH2 12.5-12.59m	Sandstone	Diametral	-	50.0	1.81	0.72	0.72	1
			Axial	52.0	42.0	2.44	0.88	0.90	1
S70882	BH2 13.15-13.25m	Sandstone	Diametral	-	48.0	0.85	0.37	0.36	1
			Axial	51.9	44.0	1.57	0.54	0.56	1
S70883	BH3 1.72-1.8m	Sandstone	Diametral	-	49.0	0.23	0.10	0.09	1
			Axial	51.1	41.0	0.47	0.17	0.18	1
S70884	BH3 2.51-2.62m	Sandstone	Diametral	-	49.0	0.23	0.09	0.09	1
			Axial	51.4	41.0	1.41	0.52	0.53	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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U7/8 10 Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70885-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70885	BH3 3.52-3.62m	Sandstone	Diametral	-	48.0	1.01	0.44	0.43	1
			Axial	51.5	44.0	0.98	0.34	0.35	1
S70886	BH3 4.55-4.65m	Sandstone	Diametral	-	49.0	0.45	0.19	0.18	1
			Axial	51.6	43.0	0.78	0.28	0.28	1
S70887	BH3 5.4-5.5m	Sandstone	Diametral	-	49.0	0.59	0.25	0.24	1
			Axial	51.7	45.0	0.64	0.22	0.22	1
S70888	BH3 6.1-6.19m	Sandstone	Diametral	-	49.0	0.79	0.33	0.32	1
			Axial	52.1	44.0	1.40	0.48	0.50	1
S70889	BH3 7.24-7.34m	Claystone/Siltstone	Diametral	-	43.0	0.19	0.10	0.09	1
			Axial	52.5	34.0	0.17	0.07	0.07	1
S70890	BH3 8.55-8.66m	Sandstone	Diametral	-	48.0	0.71	0.31	0.30	1
			Axial	51.7	38.0	1.96	0.78	0.78	1
S70891	BH3 9.45-9.55m	Sandstone	Diametral	-	48.0	1.40	0.61	0.59	1
			Axial	51.7	36.0	1.19	0.50	0.49	1
S70892	BH3 10.4-10.5m	Sandstone	Diametral	-	49.0	1.25	0.52	0.52	1
			Axial	51.7	40.0	2.99	1.14	1.15	1
S70893	BH3 11.44-11.53m	Sandstone	Diametral	-	49.0	0.51	0.21	0.21	1
			Axial	51.6	41.0	1.60	0.59	0.60	1
S70894	BH3 12.43-12.53m	Sandstone	Diametral	-	49.0	1.49	0.62	0.61	1
			Axial	51.7	40.0	1.43	0.54	0.55	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

Notes

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70895-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70895	BH3 13.44-13.55m	Sandstone	Diametral	-	49.0	1.02	0.42	0.42	1
			Axial	51.8	37.0	2.75	1.12	1.12	1
S70896	BH3 14.1-14.2m	Sandstone	Diametral	-	49.0	0.53	0.22	0.22	1
			Axial	52.1	39.0	1.68	0.65	0.65	1
S70897	BH4 1.24-1.33m	Sandstone	Diametral	-	50.0	0.52	0.21	0.21	1
			Axial	52.2	41.0	2.16	0.79	0.81	1
S70898	BH4 2.51-2.61m	Sandstone	Diametral	-	49.0	1.14	0.47	0.47	1
			Axial	51.9	45.0	1.31	0.44	0.46	1
S70899	BH4 3.56-3.67m	Sandstone	Diametral	-	49.0	0.39	0.16	0.16	1
			Axial	52.1	37.0	0.44	0.18	0.18	1
S70900	BH4 4.41-4.51m	Sandstone	Diametral	-	49.0	1.16	0.48	0.48	1
			Axial	52.1	45.0	2.39	0.80	0.83	1
S70901	BH4 5.36-5.48m	Sandstone	Diametral	-	50.0	0.79	0.32	0.32	1
			Axial	52.0	43.0	2.66	0.93	0.96	1
S70902	BH4 6.46-6.56m	Sandstone	Diametral	-	49.0	0.82	0.34	0.34	1
			Axial	51.5	44.0	2.35	0.81	0.84	1
S70903	BH4 7.19-7.28m	Sandstone	Diametral	-	48.0	1.32	0.57	0.56	1
			Axial	52.0	39.0	3.93	1.52	1.53	1
S70904	BH4 8.4-8.48m	Sandstone/Siltstone	Diametral	-	45.0	0.13	0.06	0.06	1
			Axial	54.2	27.0	0.29	0.16	0.15	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70905-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70905	BH4 9.31-9.41m	Sandstone	Diametral	-	48.0	0.45	0.19	0.19	1
			Axial	51.3	43.0	0.98	0.35	0.36	1
S70906	BH4 10.6-10.7m	Sandstone	Diametral	-	48.0	0.55	0.24	0.23	1
			Axial	51.7	36.0	2.48	1.04	1.03	1
S70907	BH4 11.5-11.6m	Sandstone	Diametral	-	49.0	1.29	0.54	0.53	1
			Axial	51.5	40.0	2.65	1.01	1.02	1
S70908	BH4 12.44-12.56m	Sandstone	Diametral	-	49.0	0.59	0.25	0.24	1
			Axial	51.7	41.0	2.26	0.84	0.85	1
S70909	BH4 13.5-13.61m	Sandstone	Diametral	-	49.0	1.45	0.60	0.60	1
			Axial	51.9	42.0	2.04	0.73	0.75	1
S70910	BH4 14.11-14.21m	Sandstone	Diametral	-	50.0	1.85	0.74	0.74	1
			Axial	51.9	45.0	1.86	0.63	0.65	1
S70911	BH5 0.76-0.85m	Sandstone	Diametral	-	49.0	0.85	0.35	0.35	1
			Axial	51.5	43.0	1.37	0.49	0.50	1
S70912	BH5 1.46-1.55m	Sandstone	Diametral	-	49.0	1.00	0.42	0.41	1
			Axial	51.6	44.0	1.19	0.41	0.42	1
S70913	BH5 2.43-2.56m	Sandstone	Diametral	-	49.0	0.64	0.26	0.26	1
			Axial	51.9	45.0	1.99	0.67	0.69	1
S70914	BH5 3.46-3.57m	Sandstone	Diametral	-	49.0	1.15	0.48	0.47	1
			Axial	51.7	40.0	2.78	1.06	1.07	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70915-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70915	BH5 4.46-4.55m	Sandstone	Diametral	-	48.0	2.24	0.97	0.95	1
			Axial	51.6	44.0	1.81	0.63	0.65	1
S70916	BH5 5.58-5.66m	Sandstone	Diametral	-	49.0	1.39	0.58	0.57	1
			Axial	51.7	42.0	5.47	1.98	2.02	1
S70917	BH5 6.61-6.7m	Sandstone	Diametral	-	49.0	1.56	0.65	0.64	1
			Axial	51.8	43.0	4.14	1.46	1.50	1
S70918	BH5 7.29-7.39m	Sandstone	Diametral	-	50.0	0.74	0.29	0.29	1
			Axial	52.1	44.0	3.07	1.05	1.09	1
S70919	BH5 8.29-8.38m	Sandstone	Diametral	-	49.0	0.37	0.15	0.15	1
			Axial	52.1	40.0	1.92	0.72	0.73	1
S70920	BH5 9.8-9.9m	Siltstone	Diametral	-	49.0	0.10	0.04	0.04	2
			Axial	51.8	35.0	2.13	0.92	0.91	1
S70921	BH5 10.48-10.58m	Sandstone	Diametral	-	49.0	1.24	0.52	0.51	1
			Axial	51.7	38.0	3.92	1.57	1.57	1
S70922	BH5 11.48-11.58m	Sandstone	Diametral	-	49.0	1.24	0.52	0.51	1
			Axial	51.8	38.0	3.02	1.20	1.21	1
S70923	BH5 12.5-12.59m	Sandstone	Diametral	-	49.0	1.38	0.57	0.57	1
			Axial	51.9	41.0	1.90	0.70	0.71	1
S70924	BH5 13.42-13.51m	Sandstone	Diametral	-	49.0	0.97	0.40	0.40	1
			Axial	51.7	41.0	2.46	0.91	0.93	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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U7/8 10 Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70925-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70925	BH5 14.49-14.58m	Sandstone	Diametral	-	48.0	3.62	1.57	1.54	1
			Axial	52.2	44.0	2.53	0.87	0.90	1
S70926	BH6 4.79-4.88m	Sandstone	Diametral	-	49.0	0.09	0.04	0.04	1
			Axial	52.0	44.0	0.13	0.04	0.04	1
S70927	BH6 5.56-5.66m	Sandstone	Diametral	-	49.0	0.10	0.04	0.04	1
			Axial	51.6	45.0	0.31	0.10	0.11	1
S70928	BH6 6.31-6.42m	Sandstone	Diametral	-	48.0	0.27	0.12	0.12	1
			Axial	51.7	44.0	0.67	0.23	0.24	1
S70929	BH6 7.31-7.43m	Sandstone	Diametral	-	49.0	1.08	0.45	0.45	1
			Axial	52.0	38.0	2.30	0.91	0.92	1
S70930	BH6 8.58-8.68m	Sandstone	Diametral	-	49.0	2.41	1.00	0.99	1
			Axial	51.8	38.0	1.71	0.68	0.68	1
S70931	BH6 9-9.09m	Sandstone	Diametral	-	49.0	0.29	0.12	0.12	1
			Axial	51.9	34.0	0.66	0.29	0.29	1
S70932	BH6 10.48-10.59m	Siltstone	Diametral	-	49.0	0.30	0.12	0.12	2
			Axial	51.4	32.0	0.60	0.29	0.28	1
S70933	BH6 11.4-11.51m	Sandstone	Diametral	-	48.0	1.44	0.62	0.61	1
			Axial	51.7	40.0	3.18	1.21	1.22	1
S70934	BH6 12.41-12.51m	Sandstone	Diametral	-	49.0	1.30	0.54	0.53	1
			Axial	51.6	41.0	3.16	1.17	1.19	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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POINT LOAD STRENGTH INDEX REPORT

Client	AssetGeoEnviro	**Moisture Content Condition**	As received
Address	Suite 2.06, 56 Delhi Road, North Ryde, NSW 2113	**Storage History**	Core boxes
Project	Proposed Development (6561)	**Report #**	S70935-PL
Job #	S21352-1	**Test Date**	23/09/2021

Test Procedure ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Failure Mode
S70935	BH6 13.41-13.51m	Sandstone	Diametral	-	49.0	4.84	2.02	2.00	1
			Axial	51.7	42.0	7.59	2.74	2.81	1
S70936	BH7 9.69-9.77m	Sandstone	Diametral	-	49.0	0.45	0.19	0.18	1
			Axial	51.7	40.0	0.94	0.36	0.36	1
S70937	BH7 10.66-10.76m	Sandstone	Diametral	-	49.0	0.81	0.34	0.33	1
			Axial	51.7	44.0	0.54	0.19	0.19	1
S70938	BH7 11.7-11.8m	Sandstone	Diametral	-	49.0	0.48	0.20	0.20	1
			Axial	52.1	41.0	1.87	0.69	0.70	1
S70939	BH7 12.63-12.72m	Sandstone	Diametral	-	49.0	0.42	0.17	0.17	1
			Axial	51.8	39.0	0.89	0.35	0.35	1
S70940	BH7 13.8-13.9m	Claystone/Siltstone	Diametral	-	48.0	0.04	0.02	0.02	1
			Axial	53.1	37.0	0.13	0.05	0.05	1
S70941	BH7 14.7-14.8m	Siltstone	Diametral	-	49.0	0.08	0.03	0.03	1
			Axial	51.0	37.0	0.15	0.06	0.06	1
S70942	BH7 15-15.06m	Siltstone	Diametral	-	46.0	0.06	0.03	0.03	1
			Axial	50.9	33.0	0.08	0.04	0.04	1
S70943	BH8 15.1-15.2m	Sandstone	Diametral	-	49.0	0.22	0.09	0.09	1
			Axial	51.3	42.0	0.69	0.25	0.25	1

Failure Modes

1 - Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.

2 - Fracture along bedding.

3 - Fracture influenced by pre-existing plane, microfracture, vein or chemical alteration.

4 - Chip or partial fracture.

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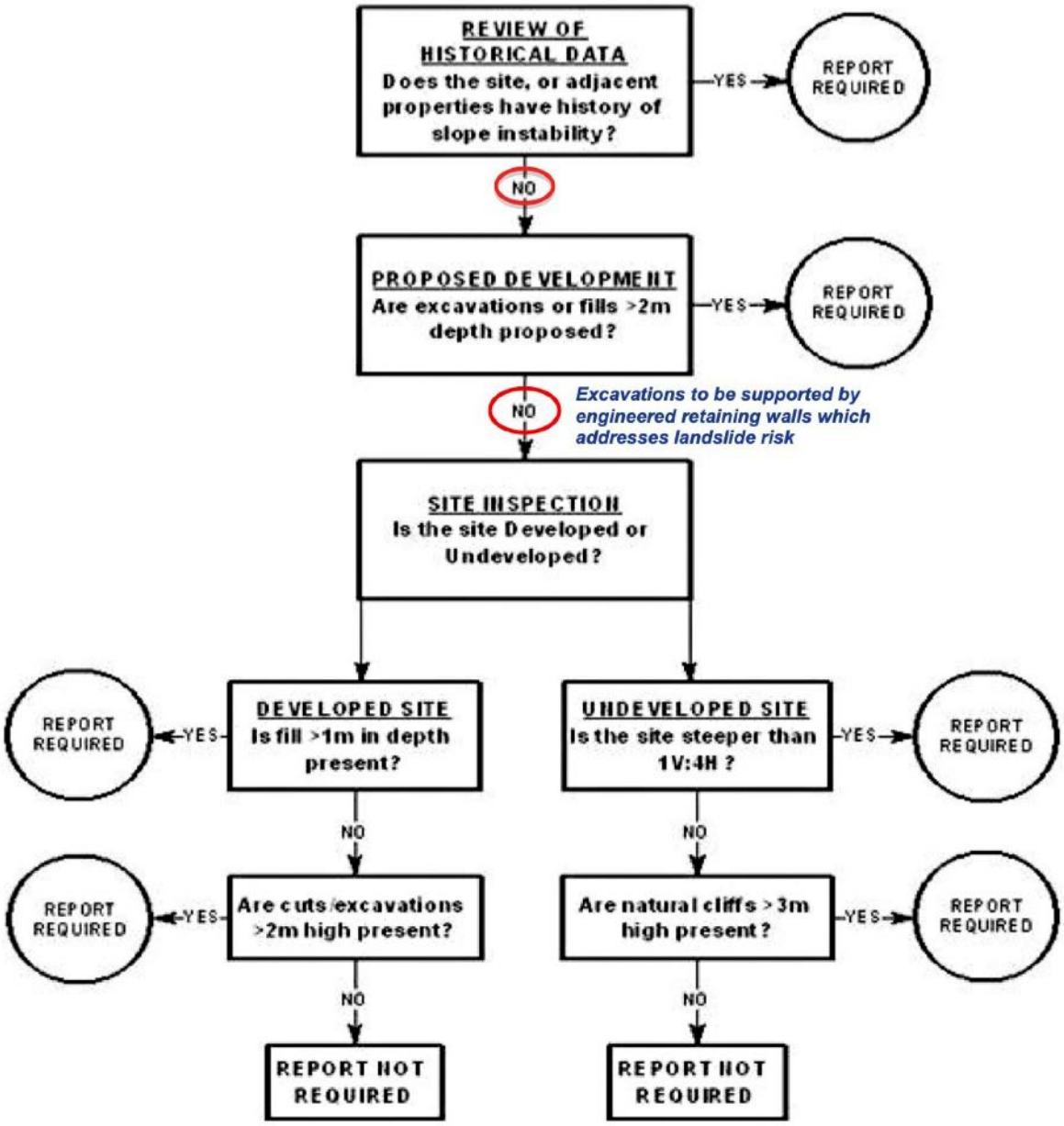
Appendix D

E10 Checklist and Flowchart

CHECKLIST FOR COUNCIL'S ASSESSMENT OF SITE CONDITIONS AND NEED FOR GEOTECHNICAL REPORT IN GEOTECHNICAL CLASS B AND D



SUGGESTED CHECKLIST FOR COUNCIL'S ASSESSMENT OF SITE CONDITIONS

1.0	***LANDSLIP RISK CLASS** (circle Landslip Risk Class in which site is located)*
	A Geotechnical report not normally required.
	B Council officers to decide if geotechnical report required.
	C Geotechnical report required.
	D Council officers to decide if geotechnical report required.
	E Geotechnical report required.

2.0 SITE LOCATION

Street no.& Name, Position in street (above or below), Site dimensions (block shape & size);

Refer report 6561-G1

3.0 PROPOSED DEVELOPMENT:

General description, including maximum excavation depths, maximum fill depths, and proximity to existing structures;

Refer report 6561-G1

4.0 EXISTING SITE DESCRIPTION:

eg. Topography, slope angles (in degrees), exposures of rock and soil, existing site development, evidence of possible slope instability.

Refer report 6561-G1

5.0 RECOMMENDATIONS

Based on the above items, and the attached flowchart (sheet 2 of 2) that indicates the principal factor(s) considered in the assessment, it is recommended that:

~~*Geotechnical assessment is required*~~.

Geotechnical assessment is not required.

Other comments:

6.0 DATE OF ASSESSMENT; ***25.11.2021*** *7.0 ASSESSMENT BY;* ***Mark Bartel***

Appendix E

Site Photos

Photo 1

View of eastern part of site looking south.

Photo 2

View of rock outcrop in south-eastern part of site, looking east.

Photo 3

View of southern part of site looking east.

Photo 4

View of western part of site adjacent to development at 2 Delmar Parade looking north

Photo 5

View of western part of site south of adjacent development at 2 Delmar Parade looking west