GEOTECHNICAL INVESTIGATION:

New Apartment Block and Basement Carpark at **3 Berith Street, Wheeler Heights**

1. Proposed Development

1.1 Demolish the existing house and construct a new two-storey apartment block and basement car park by excavating to a maximum depth of 4.7m.

1.2 Details of the proposed development are shown on 7 drawings prepared by Barry Rush and Associates, job number 1801, drawings numbered A03, A05, A06-9 and A011 all dated 7/11/18.

2. Site Description

2.1 The site was inspected on the 17th October, 2019.

2.2 This residential property is on the high side of the road and has an NW aspect. The block is located on the gently graded upper reaches of a hillslope. The slope falls across the site at an average angle of ~3°. The slope above and below the property continue at similar angles.

2.3 A concrete driveway and lawn run from the road frontage to the foot of the house (Photo 1). The part two storey brick house is supported on brick walls. The walls show no visible signs of movement and are considered stable. This house is to be demolished as part of the proposed works and a new two storey apartment block constructed. A concrete path runs along the N common boundary providing access to the rear of the house. A partially in ground pool is located upslope of the house with the fill used to level the area supported by a 0.8m high brick retaining wall in good condition (Photo 2). A gently sloping lawn extends upslope of the pool to the rear common boundary (Photo 3). A timber shed is located along this boundary (Photo 4).

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by Hawkesbury Sandstone. It is described as a medium to coarse grained quartz sandstone with very minor shale and laminite lenses.

4. Subsurface Investigation

One auger hole was put down to identify soil materials. Six Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to bedrock. The locations of the tests are shown on the site plan. It should be noted that a level of caution should be applied when interpreting DCP test results. The test will not pass through hard buried objects so in some instances it can be difficult to determine whether refusal has occurred on an obstruction in the profile or on the natural rock surface. This is not expected to be an issue for the testing on this site and the results are as follows:

AUGER HOLE 1 (~RL76.0) **–** AH1 (Photo 5)

Depth (m)	Material Encountered
0.0 to 0.5	**TOP SOIL**, sandy soil, dark brown medium grained with trace organic matter.
0.5 to 1.0	**SANDY CLAY**, brown, medium to coarse grained with rock fragments.

Refusal @ 1.0m in rock fragments. No watertable encountered.

DCP TEST RESULTS – Dynamic Cone Penetrometer						
Equipment: 9kg hammer, 510mm drop, conical tip.				Standard: AS1289.6.3.2 - 1997		
Depth(m) Blows/0.3m	**DCP 1** (~RL75.0)	**DCP 2** (~RL75.8)	**DCP 3** (~RL76.4)	**DCP 4** (~RL77.0)	**DCP 5** (~RL78.0)	**DCP 6** (~RL77.4)
0.0 to 0.3	8	7	10	2	10	6
0.3 to 0.6	7	11	10	7	30	8
0.6 to 0.9	7	8	9	10	5	#
0.9 to 1.2	31	21	14	#	#	
1.2 to 1.5	14	22	8			
1.5 to 1.8	#	#	#			
	Refusal on rock @ 1.4m	Refusal on rock @ 1.5m	Refusal on rock @ 1.5m	Refusal on rock @ 0.8m	Refusal on rock @ 0.6m	Refusal on rock @ 0.6m

#refusal/end of test. F = DCP fell after being struck showing little resistance through all or part of the interval.

DCP Notes:

DCP1 – Refusal on rock @ 1.4m, DCP bouncing off rock surface, maroon dust on wet tip
DCP2 - Refusal on rock @ 1.5m, DCP bouncing off rock surface, maroon dust on wet tip
DCP3 – Refusal on rock @ 1.5m, DCP bouncing off rock surface, white fragments on wet tip.
DCP4 – Refusal on rock @ 0.8m, DCP bouncing off rock surface, white dust on dry tip.
DCP5 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, muddy tip.
DCP6 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, muddy tip.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the underlying sandstone bedrock that steps down the property forming sub-horizontal benches between the steps. Where the grade is steeper, the steps are larger, and the benches narrower. Where the slope eases, the opposite is true. Where the rock is not exposed, it is overlain by natural sandy soils and firm to stiff sandy clays that fill the bench step formation. In the test locations rock was encountered at depths of between 0.6 to 1.5m below the current surface. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

Normal ground water seepage is expected to move over the buried surface of the rock and through the cracks.

Due to the slope and elevation of the block, the water table is expected to be many metres below the base of the proposed excavations.

7. Surface Water

No evidence of significant surface flows were observed on the property during the inspection. Normal sheet wash from the slope above is expected to flow over the site.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below or beside the property. The vibrations from the proposed excavations are a potential hazard (**Hazard One**). The proposed excavation is a potential hazard until retaining walls are in place (**Hazard Two**).

Risk Analysis Summary on the Next Page

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The vibrations produced during the proposed excavations impacting on the supporting walls of the neighbouring houses.	The proposed excavation collapsing onto the work site before retaining walls are in place.
LIKELIHOOD	‘Possible’ (10^{-3})	‘Possible’ (10^{-3})
CONSEQUENCES TO PROPERTY	‘Medium’ (15%)	‘Medium’ (15%)
RISK TO PROPERTY	‘Moderate’ (2×10^{-4})	‘Moderate’ (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	8.9×10^{-6}/annum
COMMENTS	This level of risk to property is ‘**UNACCEPTABLE**’. To move risk to ‘ACCEPTABLE’ levels the recommendations in **Section 12** are to be followed.	This level of risk to life and property is ‘**UNACCEPTABLE**’. To move the risk to ‘ACCEPTABLE’ levels the recommendations in **Section 13** are to be followed.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

9. Suitability of the Proposed Development for the Site

The proposed development is suitable for the site. No geotechnical hazards will be created by the completion of the proposed development provided it is carried out in accordance with the requirements of this report and good engineering and building practice.

10. Stormwater

The fall is to the street. Roof water from the proposed development is to be piped to the street drainage system through any tanks that may be required by the regulating authorities.

11. Excavations

An excavation to a maximum depth of ~4.7m is required to construct the basement level of the proposed apartment block. The excavation is expected to be through sandy soil and sandy clay over Medium Strength Sandstone. Sandstone is expected to be encountered on the downhill side of the block at 1.5m and on the uphill side at 0.6m below the existing ground level.

It is envisaged that excavations through sandy soil and sandy clays can be carried out with a bucket and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavations through sandy soil, and sandy clays will be below the threshold limit for building damage. The majority of the proposed excavations are expected to be through Medium Strength Sandstone.

Excavations through Medium Strength Sandstone or better should be carried out to minimise the potential to cause vibration damage to the neighbouring houses. The supporting walls of the neighbouring house to the N will be as close as ~4.0m and the supporting walls of the neighbouring house to the S will be as close as ~3.5m from the edges of the proposed excavations. Close controls by the contractor over rock excavation are recommended so excessive vibrations are not generated.

Excavation methods are to be used that limit peak particle velocity to 10mm/sec at the common boundaries. Vibration monitoring will be required to verify this is achieved.

If a milling head is used to grind the rock, vibration monitoring will not be required. Alternatively, if rock sawing is carried out around the perimeter of the excavation boundaries in not less than 1.0m lifts, a rock hammer up to 300kg could be used to break the rock without vibration monitoring. Peak particle velocity will be less than 10mm/sec at the common boundaries using this method provided the saw cuts are kept well below the rock to broken.

It is worth noting that vibrations that are below thresholds for building damage may be felt by the occupants of the neighbouring houses.

13. Excavation Support Requirements

No structures or boundaries will be within the zone of influence of any excavations. In this instance, the zone of influence is the area above a theoretical 30° line through soil, and a 45° line through clay from the top of Medium Strength Sandstone towards the surrounding structures and boundaries.

The proposed excavation reach a maximum depth of ~4.7m along the boundaries but will taper away slightly in height downslope. The excavation will be taken through a maximum of ~1.5m of soil and clay over Medium Strength Sandstone.

The excavation through soil and clay is to be scraped back from the excavation line at least 0.5m and battered at 1.0 Vertical to 1.7 Horizontal (30°) prior to the excavation through rock commencing. Alternatively, the soil and clay is to be temporarily or permanently supported before excavation through rock commences. The temporary or permanent support is to be designed by the structural engineer in consultation with the geotechnical consultant. Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. Unsupported cut batters through soil and clay are to be covered to prevent access of water in wet weather and loss of moisture in dry weather. The covers are to be tied down with metal pegs or other suitable fixtures so they can't blow off in a storm. The materials and labour to construct the retaining structures are to be organised so on completion of the excavations they can be constructed as soon as possible. The excavations are to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

During the excavation process, the geotechnical consultant is to inspect the cut faces in 1.5m intervals as they are lowered or after encountering softer sections of rock, while the machine is on site to ensure the ground materials are as expected and no wedges or other geological defects are present that could require additional support. Should any weak sections of rock be encountered, works are to stop until temporary or permanent support is installed. This is likely to be rock anchors, bolts, sprayed concrete, or similar support specified by the Geotechnical Consultant and designed by the structural engineer.

Upon completion of the excavations, it is recommended all cut faces be supported with retaining walls to prevent any potential future movement of joint blocks in the cut faces that can occur over time, when unfavourable jointing is obscured behind the excavation faces. Additionally, retaining walls will help control seepage and to prevent minor erosion and sediment movement.

Excavation spoil can be used as filing on site provided it is supported by retaining walls. Alternatively it is to be removed from the site following the NSW Environmental Protection Agency (EPA) Waste Classification Guidelines.

14. Retaining Walls

For cantilever or singly-propped retaining walls, it is suggested the design be based on a triangular pressure distribution of lateral pressures using the parameters shown in Table 1.

Table 1 – Likely Earth Pressures for Retaining Walls

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Sandy Soil, and Residual Clay	20	0.4	0.55
Medium Strength Sandstone	24	0.00	0.01

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region". Australian Geomechanics Journal 1978.

It is to be noted that the earth pressures in Table 1 assume a level surface above the wall, do not account for any surcharge loads, and assume retaining walls are fully drained. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

All retaining walls are to have sufficient back-wall drainage and be backfilled immediately behind the wall with free-draining material (such as gravel). This material is to be wrapped in a non-woven Geotextile fabric (i.e. Bidim A34 or similar), to prevent the drainage from becoming clogged with silt and clay. If no back-wall drainage is installed in retaining walls, the likely hydrostatic pressures are to be accounted for in the structural design.

15. Foundations

A concrete slab supported directly off Medium Strength Sandstone is a suitable footing for the proposed basement and apartment block. This material is expected to be exposed across most of the base of the excavation. Where it is not exposed, and where the footprint of the proposed apartment block does not fall over the excavation, piers will be required to maintain a uniform bearing material. A maximum allowable bearing pressure of 1000kPa can be assumed for footings on Medium Strength Sandstone.

Naturally occurring vertical cracks known as joints commonly occur in sandstone. These are generally filled with soil and are the natural seepage paths through the rock. They can extend to depths of several metres and are usually relatively narrow but can range between 0.1 to 0.8m wide. If a pad footing falls over a joint in the rock, the construction process is simplified if with the approval of the structural engineer the joint can be spanned or, alternatively, the footing can be repositioned so it does not fall over the joint.

NOTE: If the contractor is unsure of the footing material required, it is more cost effective to get the geotechnical consultant on site at the start of the footing excavation to advise on footing depth and material. This mostly prevents unnecessary over excavation in clay like shaly rock but can be valuable in all types of geology.

16. Inspections

The client and builder are to familiarise themselves with the following required inspections as well as council geotechnical policy. We cannot provide geotechnical certification for the owner or the regulating authorities if the following inspections have not been carried out during the construction process.

- During the excavation process, the geotechnical consultant is to inspect the cut faces as they are lowered in 1.5m intervals to ensure ground materials are as expected and that there are no wedges or other defects present in the rock that may require additional support.

- All footings are to be inspected and approved by the geotechnical consultant while the excavation equipment is still onsite and before steel reinforcing is placed or concrete is poured.

White Geotechnical Group Pty Ltd.

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No. 222757
Engineering Geologist

Photo 1

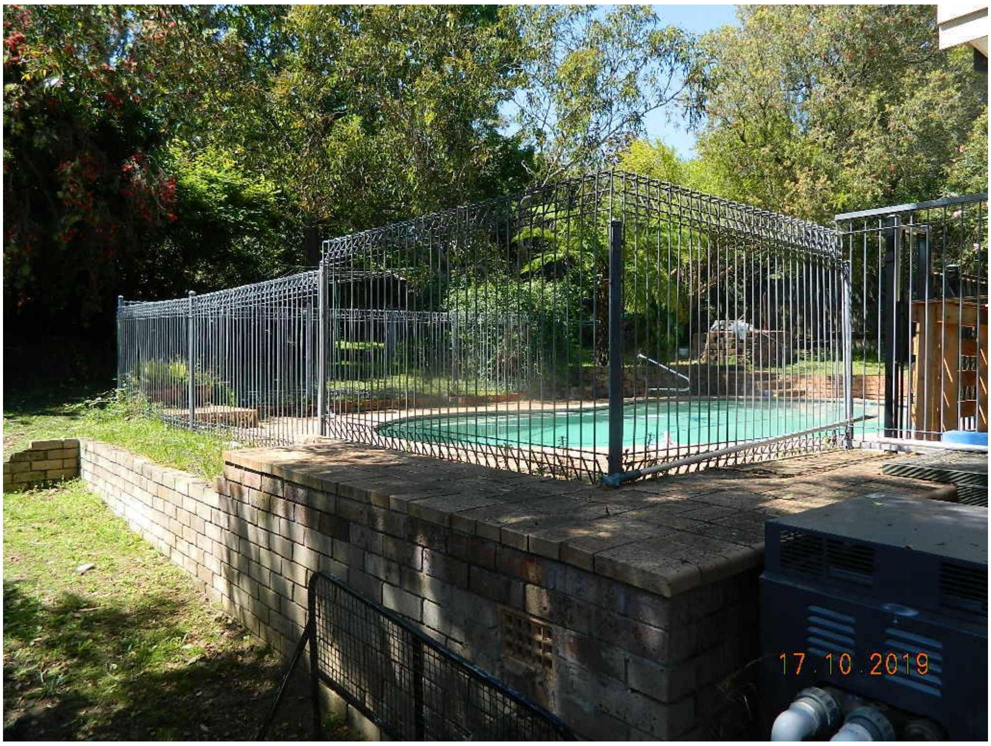


Photo 2

Photo 3

Photo 4

Photo 5 – AH1

Important Information about Your Report

It should be noted that Geotechnical Reports are documents that build a picture of the subsurface conditions from the observation of surface features and testing carried out at specific points on the site. The spacing and location of the test points can be limited by the location of existing structures on the site or by budget and time constraints of the client. Additionally, the test themselves, although chosen for their suitability for the particular project, have their own limiting factors. The testing gives accurate information at the location of the test, within the confines of the test's capability. A geological interpretation or model is developed by joining these test points using all available data and drawing on previous experience of the geotechnical consultant. Even the most experienced practitioners cannot determine every possible feature or change that may lie below the earth. All of the subsurface features can only be known when they are revealed by excavation. As such, a Geotechnical report can be considered an interpretive document. It is based on factual data but also on opinion and judgement that comes with a level of uncertainty. This information is provided to help explain the nature and limitations of your report.

With this in mind, the following points are to be noted:

- If upon the commencement of the works the subsurface ground or ground water conditions prove different from those described in this report, it is advisable to contact White Geotechnical Group immediately, as problems relating to the ground works phase of construction are far easier and less costly to overcome if they are addressed early.

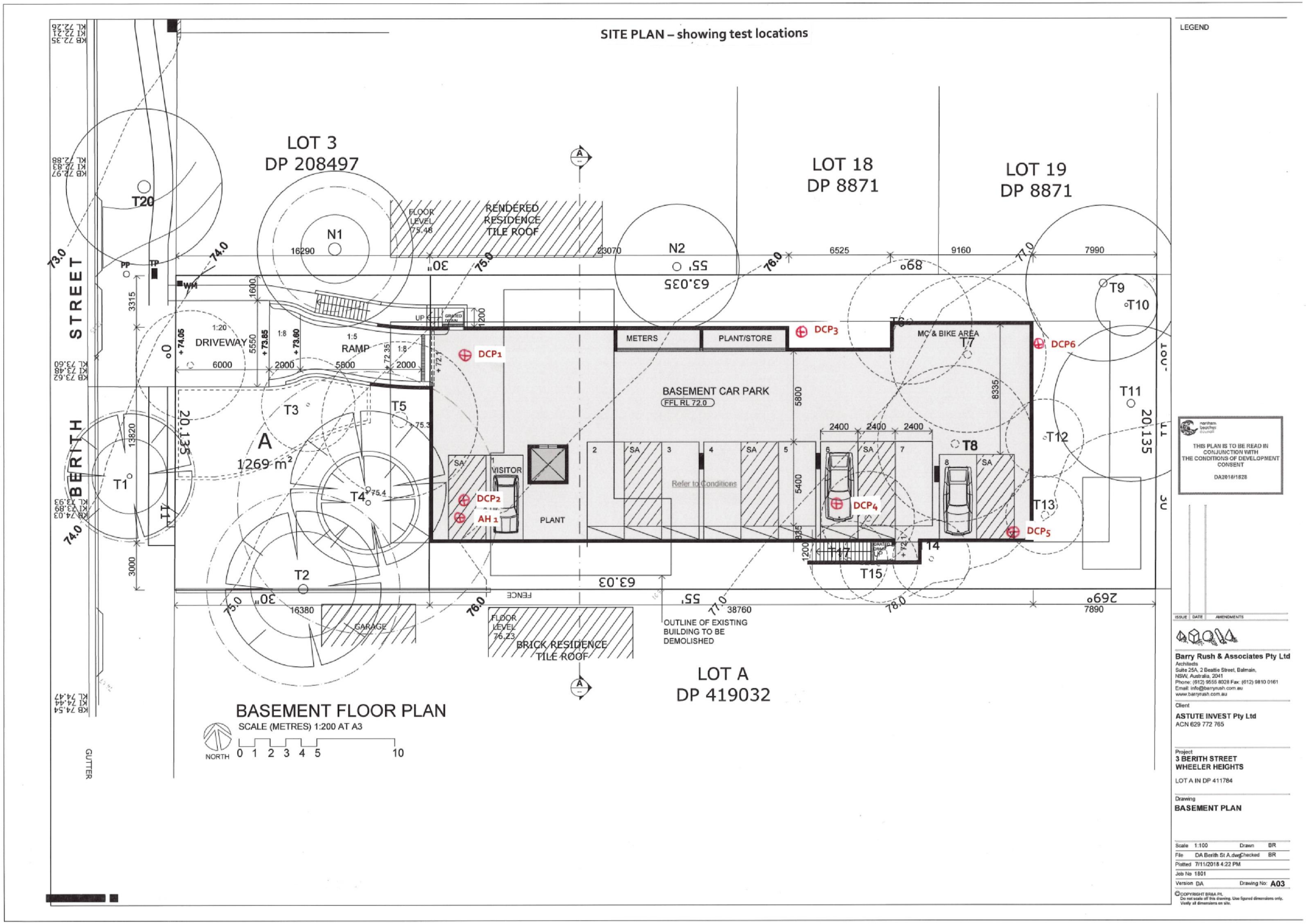
- If this report is used by other professionals during the design or construction process, any questions should be directed to White Geotechnical Group as only we understand the full methodology behind the report's conclusions.

- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- This report should not be applied to any other project other than that outlined in section 1.0.

- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar with a variety of techniques to reduce risk and can advise if your proposed methods are suitable for the site conditions.


SITE PLAN – showing test locations
LEGEND
LOT 3
DP 208497
LOT 18
DP 8871
LOT 19
DP 8871
LOT A
DP 419032
BERITH STREET
FLOOR LEVEL 75.48
RENDERED RESIDENCE TILE ROOF
FLOOR LEVEL 76.23
BRICK RESIDENCE TILE ROOF
GARAGE
FENCE
GUTTER
DRIVEWAY
1:20
1:8
1:5
RAMP
METERS
PLANT/STORE
MC & BIKE AREA
BASEMENT CAR PARK
FFL RL 72.0
VISITOR
PLANT
Refer to Conditions
A
1269 m²
OUTLINE OF EXISTING BUILDING TO BE DEMOLISHED
DCP1
DCP2
AH 1
DCP3
DCP4
DCP5
DCP6
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T17
T20
N1
N2
BASEMENT FLOOR PLAN
SCALE (METRES) 1:200 AT A3
NORTH
THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE CONDITIONS OF DEVELOPMENT CONSENT
DA2018/1828
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Client
ASTUTE INVEST Pty Ltd
ACN 629 772 765
Project
3 BERITH STREET
WHEELER HEIGHTS
LOT A IN DP 411784
Drawing
BASEMENT PLAN
Scale 1:100 Drawn BR
File DA Berith St A.dwg Checked BR
Plotted 7/11/2018 4:22 PM
Job No 1801
Version DA Drawing No: A03
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Do not scale off this drawing. Use figured dimensions only. Verify all dimensions on site.

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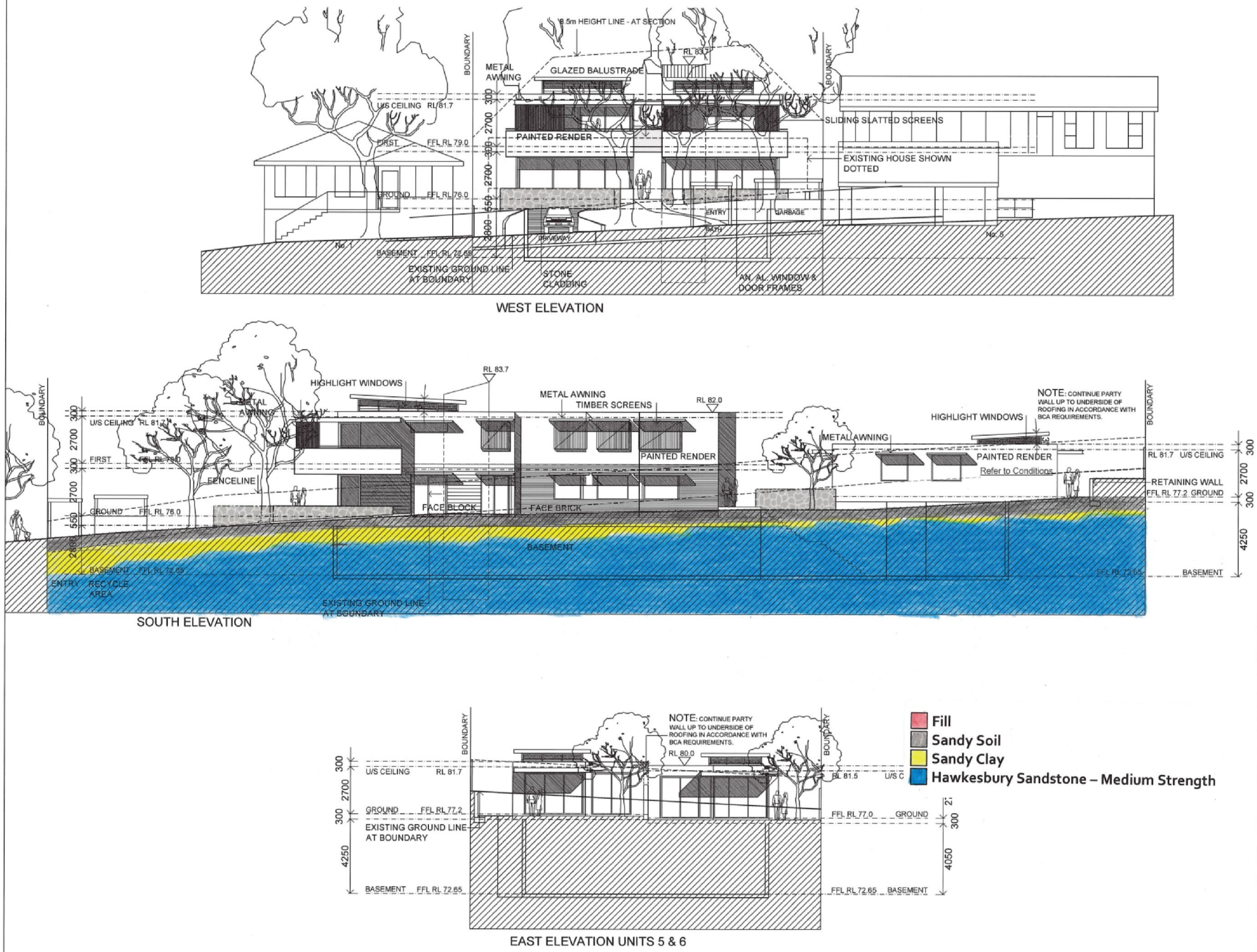
TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



LEGEND

northern beaches council

THIS PLAN IS TO BE READ IN CONJUNCTION WITH THE CONDITIONS OF DEVELOPMENT CONSENT

DA2018/1828

ISSUE	DATE	AMENDMENTS

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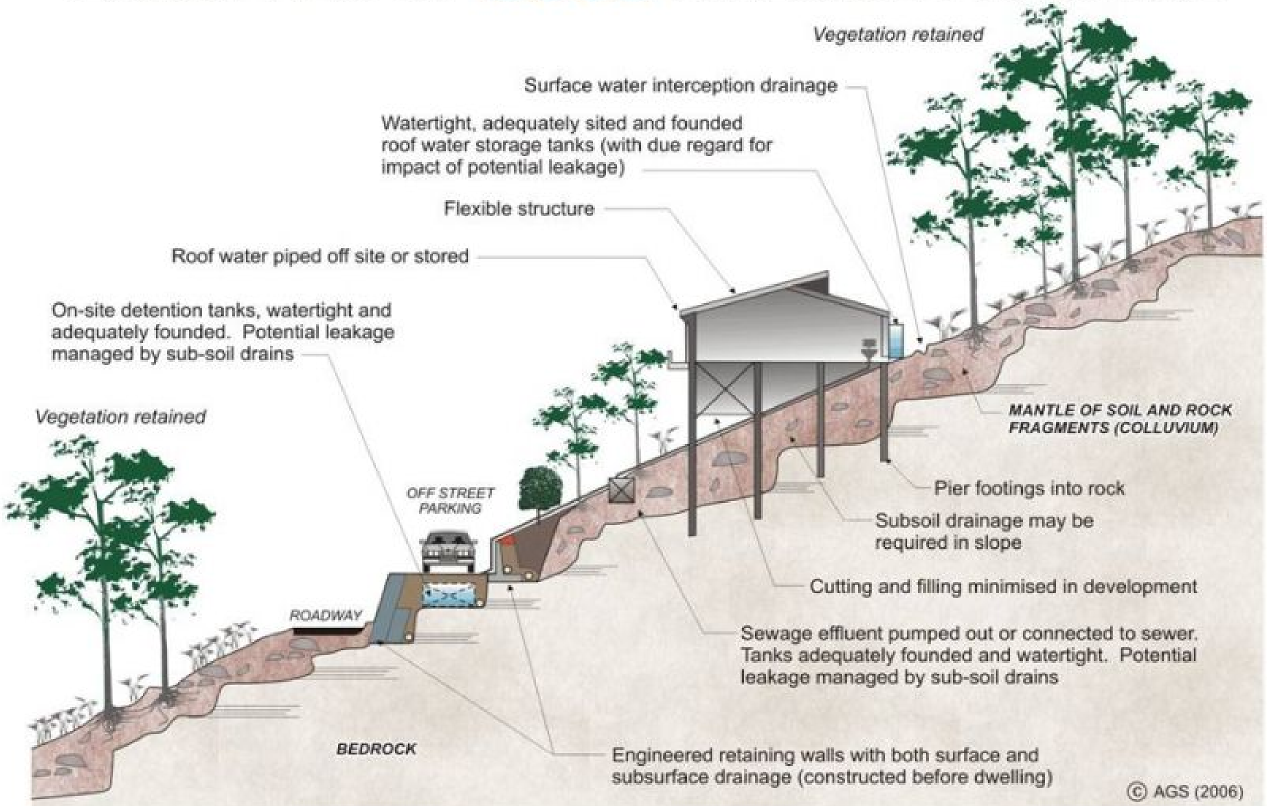
Project
3 BERITH STREET WHEELER HEIGHTS
LOT A IN DP 411784

Drawing
ELEVATIONS

Scale	1:100	Drawn	BR
File	DA Berith St A.dwg	Checked	BR
Plotted	7/11/2018 4:22 PM		
Job No	1801		
Version	DA	Drawing No:	A08

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE