JKGeotechnics

Date: 13 December 2019
Ref: 32859YFlet

Northern Beaches Council
125 Pittwater Road
DEE WHY NSW 2099

Attention: Anne-Marie Young
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GEOTECHNICAL PEER REVIEW
PROPOSED RESIDENTIAL DEVELOPMENT
3 BERITH STREET, WHEELER HEIGHTS, NSW

1 INTRODUCTION

We have been requested to carry out a peer review of a geotechnical report prepared by White Geotechnical Group, Ref: J2436, dated 17 October 2019 for the proposed residential development at 3 Berith Street, Wheeler Heights, NSW.

We have also been provided with the following documents to assist with our peer review:

- Architectural Drawings prepared by Barry Rush& Associates Pty Ltd, Job No. 1801, Dwg. A01 to A12, Version DA dated 7 November 2018.
- Survey Plan prepared by Donovan Associates, Job Ref: 1297/147760 dated 16 May 2017.

From the provided documents above, we understand that it is proposed to demolish the existing site structures and construct a two storey residential development over one basement level. The basement level has a proposed Finished Floor Level (FFL) of RL72.0m resulting in excavations of approximately 3.0m in the north-west corner and 6.2m in the south-east corner of the subject site, although some locally deeper excavations will occur, such as for the lift pit. This is based upon an estimated Bulk Excavation Level (BEL) of RL71.8m which allows for the assumed drainage blanket and basement slab. We note the Elevations drawing from the architectural drawings specify a basement FFL of RL72.65m however we have adopted the deeper level shown on the Basement Plan for the purposes of this review. The proposed basement will be setback from the common boundaries by approximately 3.3m, 7.9m, 3.0m and 16.3m from the northern, eastern, southern and western boundaries, respectively.

2 REPORT REVIEW

The following summaries our comments from our peer review of the geotechnical report prepared by White Geotechnical Group.

Section 1 – Proposed Development

1. The maximum excavation depth stated in the report is incorrect. The proposed maximum excavation depth is 6.2m, i.e. the stated depth is underestimated by approximately 1.5m.
2. No comment is made regarding the setback of the proposed basement from the common boundaries.

Section 4 – Subsurface Investigation

1. We consider the upper soil layer logged as 'Top Soil' encountered at 0m to 0.5m depth should be logged as 'Fill' given it has been placed by anthropogenic process (by man) as defined by the Australian Standard 1726:2017, *'Geotechnical Site Investigations'*.
2. The soils appear to have not been logged in accordance with the AS1726:2017 given the omission of the plasticity, moisture condition and strength of the Sandy Clay soil which was encountered at 0.5m to 1.0m depth.
3. We note that no borehole log was provided with the geotechnical report, only a summary within the report text.

Section 8 – Geotechnical Hazards and Risk Analysis

1. The geotechnical hazard assessment should consider the natural hillside above, on and below the site and carry out a risk assessment, this includes all existing retaining walls. Notwithstanding, based on our assessment we consider the likelihood of natural hillside instability to be 'Barely Credible' and therefore the level of risk would be considered 'Acceptable' to property and life which is perhaps why it was omitted from the report. In addition, due to the limited height of the retaining walls, the risk posed by these walls is similarly considered acceptable.
2. No details are provided on how the value for 'Risk to Life' was calculated, such as vulnerability, temporal spatial probability values, etc, and therefore it is difficult to review the provided value. Notwithstanding, we agree that the level of risk is 'Unacceptable' during the construction phase and therefore recommendations contained in the report must be executed.
3. Reference should be made to the attached Tables 1 and 2 for our risk analysis of the subject site.

Section 11 - Excavations

1. The recommendations provided are based upon an incorrect maximum excavation depth of 4.7m which should be 6.2m. However, despite this, we consider the comments generally acceptable.
2. The report states the bedrock will be 'Medium Strength' however provides no justification for this statement. Given the limited subsurface investigation carried out, there is no information supplied on the bedrock strength. We assume it is either based on past experience or local observations of sandstone exposures. Notwithstanding, based upon our site observations made as part of this review, sandstone bedrock of at least medium strength was observed at 44 Rose Avenue (about

150m north) and also 4 Ettalong Street (about 300m south-east), and therefore we consider this a reasonable assumption.

Section 12 - Vibrations

1. The report states ‘Excavation methods are to be used that limit peak particle velocity to 10mm/sec at the common boundaries’. Whilst we consider this a widely used general rule of thumb, the safe peak particle velocity is directly related to the frequency, and therefore a limit peak particle velocity as low as 5mm/sec may apply if frequencies are less than 10Hz. This is addressed further in Section 3 below.
2. We do not agree with the comment “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”. From our experience, saw cuts around the perimeter do very little to mitigating vibrations through the rock mass. Therefore, we recommend that vibration monitoring still be carried out.
3. Where hydraulic hammers will be used for excavation, consideration should be given to full-time vibration monitoring, if initial quantitative monitoring finds vibrations to be excessive.

Section 13 – Excavation Support Requirements

1. We do not agree with the comment “…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”. Whilst we agree that this is an option, we do not consider it compulsory given the sandstone bedrock is inferred to be self-supporting provided it is inspected by an experienced geotechnical engineer and where adverse defects are present they are identified and any potential instabilities stabilised.

Section 15 - Foundations

1. We do not understand the comment “This material [medium strength sandstone] is expected to be exposed across most of the base of the excavation”. From our assessment and reference to the ‘Type Section’ contained in their report, the bedrock should be uniformly exposed over the entire basement footprint, unless they are also referring to excavations outside the basement.

Section 16 - Inspections

1. The requirement for vibration monitoring should also be included in the list of inspection required during construction.

3 COMMENTS AND RECOMMENDATIONS

Section 3 above details our review of the geotechnical report prepared by White Geotechnical Group. Generally, we consider the report suitable for the proposed development at the subject site, although potentially too brief in parts. We provide further comments and recommendations below that should be considered as part of the development.

Given the expected basement excavation down to 6.2m depth and the proposed vertical excavation of the sandstone bedrock, we recommend undertaking additional investigations comprising of at least 2 cored boreholes. The reasoning for this recommendation is as follows:

- The cored boreholes will confirm the depth to bedrock and assess the suitability of the sandstone bedrock to be vertically excavated. Currently the depth to bedrock is based upon preliminary subsurface information which is inferred to have refused on the top of bedrock and the quality of the bedrock based upon past experience and local observations. If it is unsuitable for unsupported vertical excavations, a full height retention system will need to be installed prior to the commencement of excavation.
- The information will prove useful for the excavation contractor to ensure the most suitable equipment is utilised to limit the impact on neighbouring properties.

We recommend that initial quantitative vibration monitoring be carried out when using hydraulic rock hammers to determine if the transmitted vibrations are within an acceptable limit for the nearby structures and services. Reference should be made to the attached Vibration Emission Design goals sheet for acceptable limits of transmitted vibrations. We note full-time vibratory monitoring may be required if transmitted vibrations are found to be excessive. Furthermore, during construction, due to the expected 'hard rock' excavation techniques (hydraulic hammers, rock saws and grinders, etc.) consideration should be given to dust suppression.

Should you require any further information regarding the above, please do not hesitate to contact the undersigned.

Yours faithfully
For and on behalf of
JK GEOTECHNICS

Owen Fraser
Senior Geotechnical Engineer

Reviewed By:

Woodie Theunissen
Principal | Geotechnical Engineer

Encl: Table A: Summary of Risk Assessment to Property
Table B: Summary of Risk Assessment to Life
Vibration Emission Design Goals
Geotechnical Report prepared by White Geotechnical Group

TABLE A

SUMMARY OF RISK ASSESSMENT TO PROPERTY

POTENTIAL HAZARD	Instability of Existing Retaining Walls	Instability of Existing Natural Hillside			Instability of Basement Excavation
		Below Site	Within Site	Above Site	
Assessed Likelihood	Unlikely	Barely Credible	Barely Credible	Barely Credible	Barely Credible
Assessed Consequence	Minor	Major	Major	Major	Medium
Risk	Low	Very Low	Very Low	Very Low	Very Low
Comments	Relatively low height retaining wall so low debris volumes which are unlikely to impact neighbouring property	Given the gentle slope and no signs of instability, landslides, if they occur are expected to be relatively small and exhibit creep behaviour.	Given the gentle slope and no signs of instability, landslides, if they occur are expected to be relatively small and exhibit creep behaviour.	Given the gentle slope and no signs of instability, landslides, if they occur are expected to be relatively small and exhibit creep behaviour.	Assumes all geotechnical recommendations followed during construction.

TABLE B

SUMMARY OF RISK ASSESSMENT TO LIFE

POTENTIAL LANDSLIDE HAZARD	Instability of Existing Retaining Walls	Instability of Existing Natural Hillside			Instability of Basement Excavation
		Below Site	Within Site	Above Site	
Assessed Likelihood	Unlikely	Barely Credible	Barely Credible	Barely Credible	Barely Credible*
Indicative Annual Probability	$1x10^{-4}$	$1x10^{-6}$	$1x10^{-6}$	$1x10^{-6}$	$1x10^{-6}$
Duration of Use of area Affected (Temporal Probability)	5.95×10^{-3} (1 hour per week)	0.04 (1 hour per day)	0.5 (12 hours per day)	0.04 (1 hour per day)	0.167 (4 hours per day)
Probability of not Evacuating Area Affected	(i) Above Wall 1 No warning Likely (ii) Below Wall 0.1 Warning likely	0.1 Warning Likely	0.9 Little warning likely	0.3 Warning likely	0.5 Some warning likely
Spatial Probability	0.5	0.25	0.5	0.25	0.1
Vulnerability to Life if Failure Occurs Whilst Person Present	(i) Above Wall 0.01 Likely to ride failure down (ii) Below Wall 0.1 Unlikely to be buried	0.01 Unlikely to be buried	0.01 Unlikely to be buried	0.01 Unlikely to be buried	0.1 May be injured but unlikely to be killed
Risk for Person most at Risk	(i) 2.975×10^{-9} (ii) 2.975×10^{-9}	$1x10^{-11}$	$2.25x10^{-9}$	$1.2x10^{-10}$	$8.35x10^{-10}$
Total Risk for Person Most at Risk	9.165×10^{-9}				

* Assumes all geotechnical recommendations followed during construction

VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity in mm/s			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Note: For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.

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.

Ben White M.Sc. Geol.,
AusIMM., CP GEOL.
No. 222757
Engineering Geologist

Photo 1

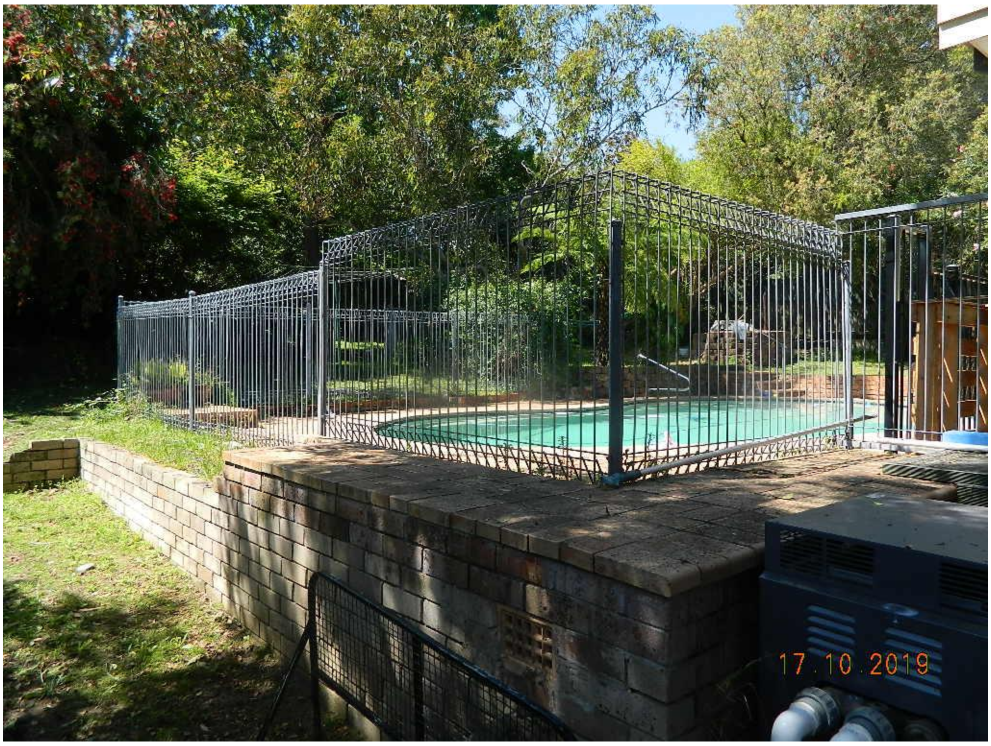


Photo 2

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.

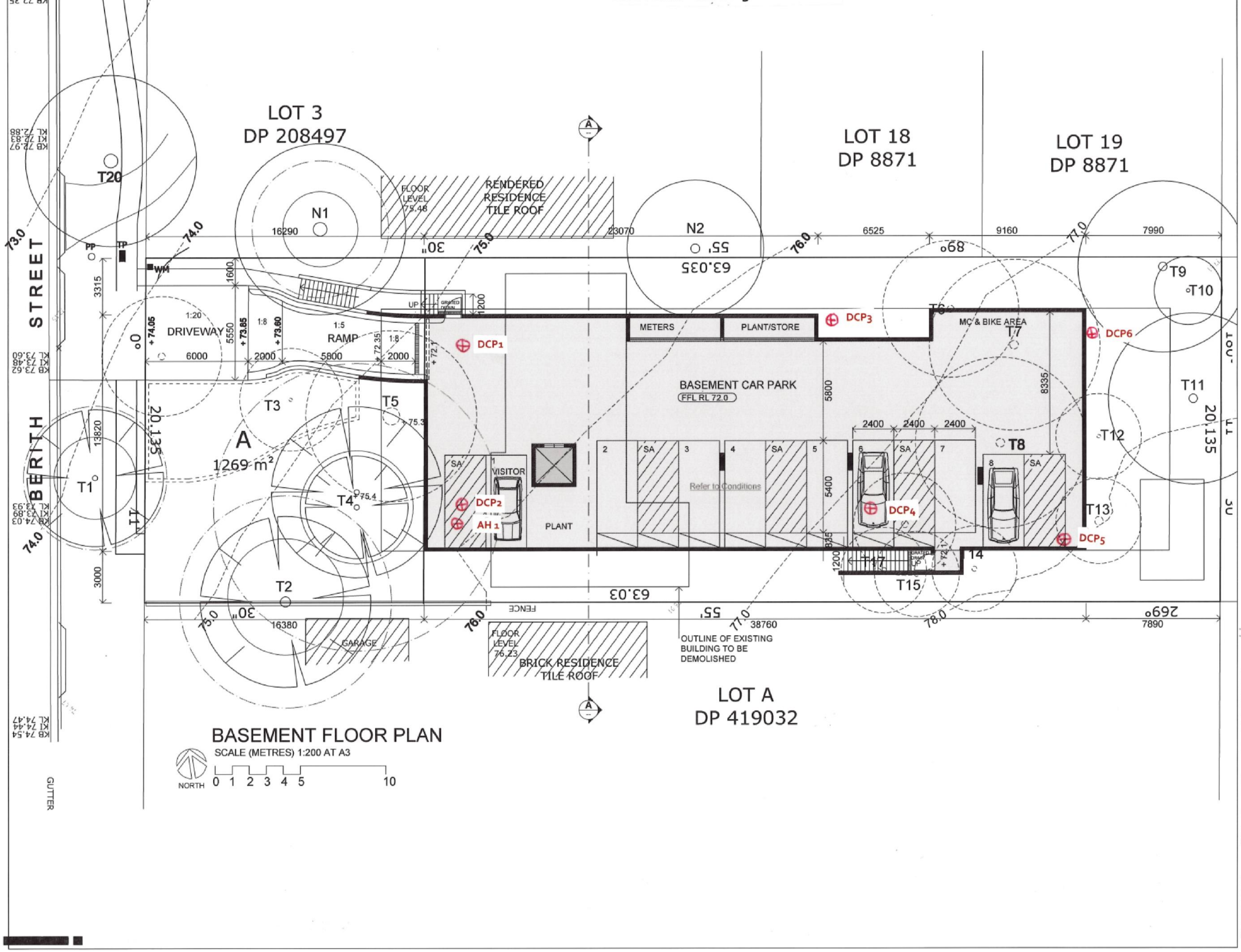
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



[redacted]

LEGEND

northern beaches council

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

DA2018/1828

ISSUE	DATE	AMENDMENTS

Barry Rush & Associates Pty Ltd
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Email: info@barryrush.com.au
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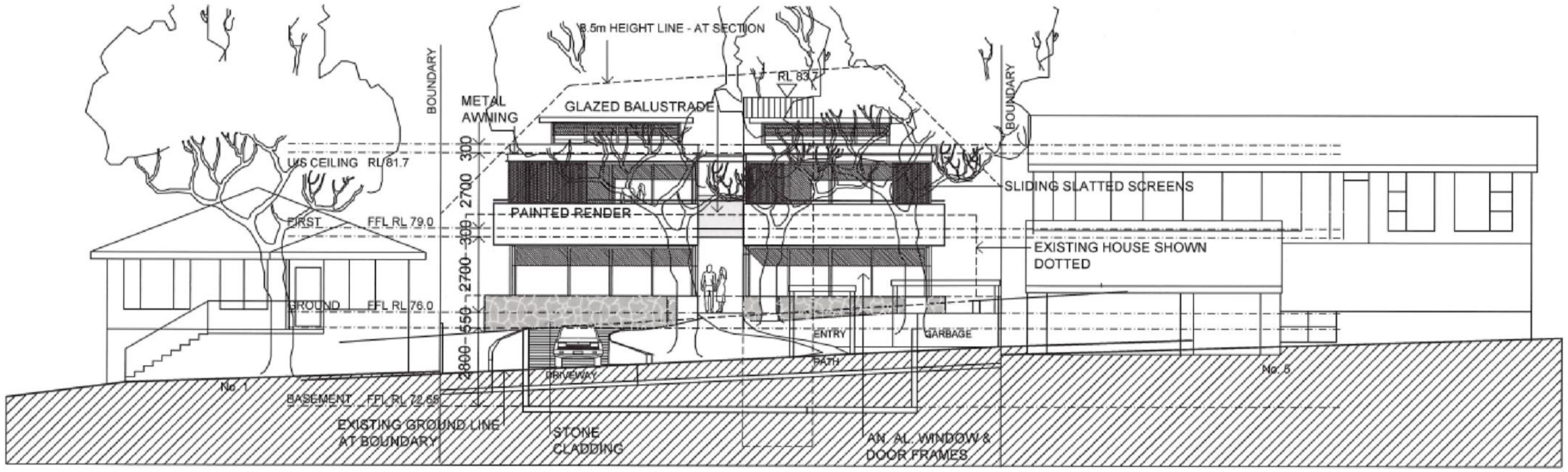
Client
ASTUTE INVEST Pty Ltd
ACN 629 772 765

Project
3 BERITH STREET WHEELER HEIGHTS
LOT A IN DP 411784

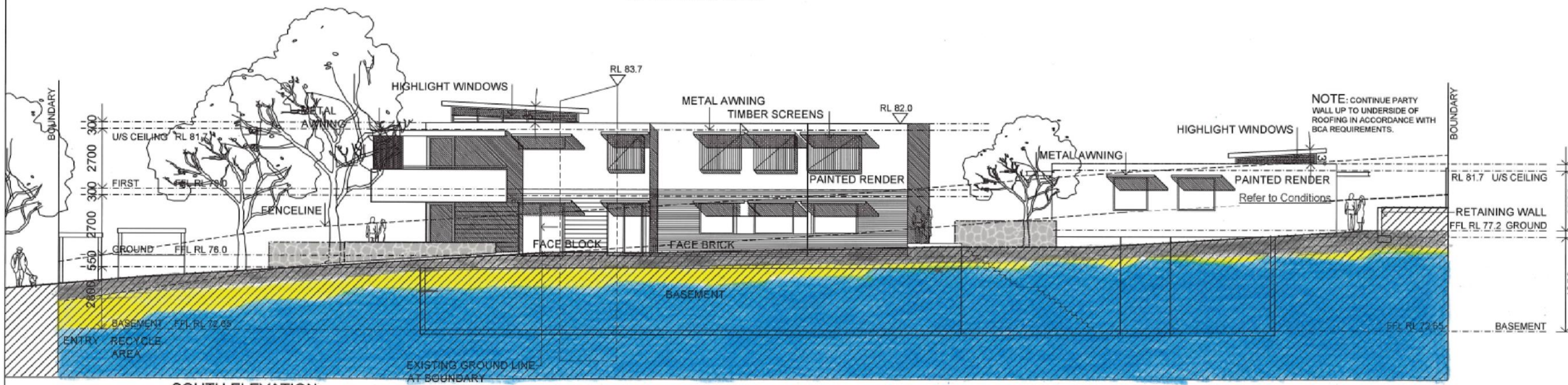
Drawing
BASEMENT PLAN

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

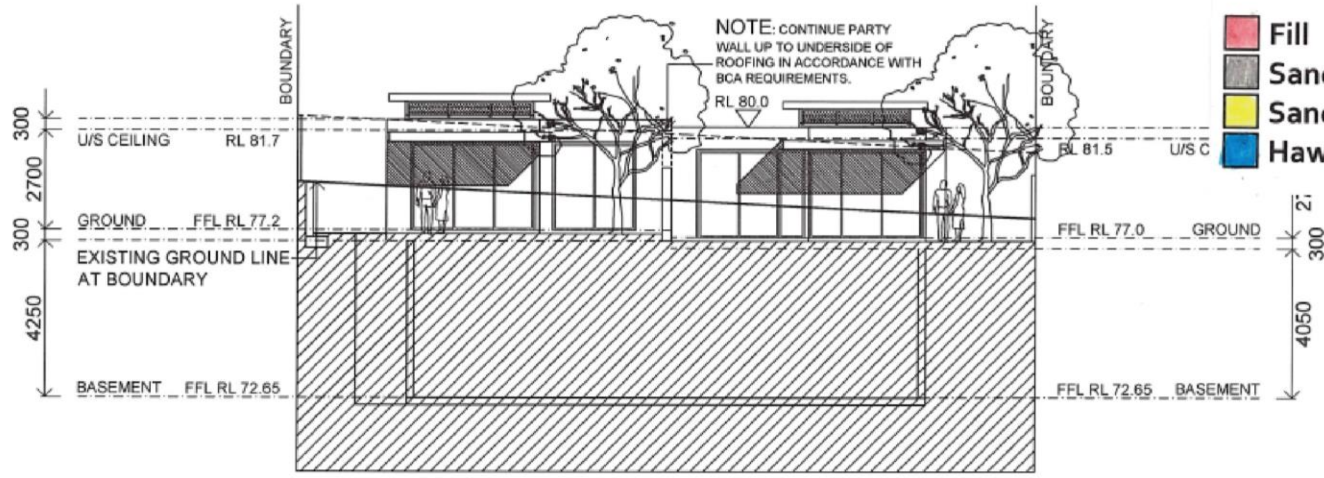
TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



WEST ELEVATION



SOUTH ELEVATION



EAST ELEVATION UNITS 5 & 6

- Fill
- Sandy Soil
- Sandy Clay
- Hawkesbury Sandstone – Medium Strength

LEGEND

northern beaches council

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

DA2018/1628

ISSUE	DATE	AMENDMENTS

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ACN 629 772 765

Project
3 BERITH STREET WHEELER HEIGHTS
LOT A IN DP 411784

Drawing
ELEVATIONS

Scale	1:100	Drawn	BR
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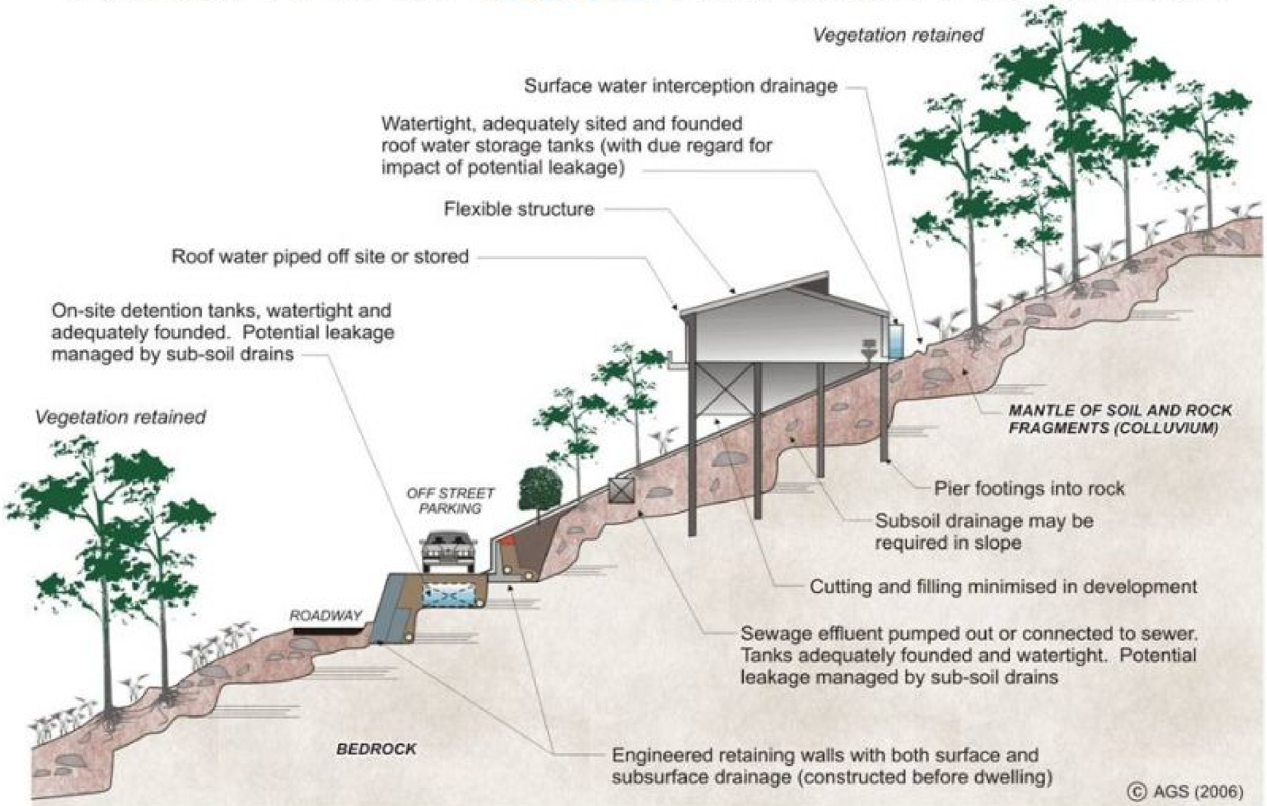
Plotted	7/11/2018 4:22 PM		
Job No	1801		
Version	DA	Drawing No:	A08

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE