GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **24 Penrith Avenue, Wheeler Heights**

1. Proposed Development

1.1 Extend the downhill side of the house by excavating to a maximum depth of ~3.2m.

1.2 Extend the W side of the house.

1.3 Various other internal and external modifications.

1.4 Details of the proposed development are shown on 14 drawings prepared by Sammy Fedele, Job number 18/18, drawings numbered DA01 to 14, dated 20/11/19.

2. Site Description

2.1 The site was inspected on the 10th December, 2019.

2.2 This residential property is on the high side of the road and has a SE aspect. It is located on the gentle to moderately graded lower reaches of a hillslope. The slope above the property continue at increasing angles. The slope below the property continues at gentle angles.

2.3 At the road frontage, a concrete driveway runs up the slope to a garage attached to the NE side of the house (Photos 1 & 2). The garage will be demolished as part of the proposed works. The driveway is cut into the slope. The cut is supported on both sides by sandstone flagging walls that will be demolished as part of the proposed works. Between the road frontage and the house is a gentle to moderately sloping lawn and garden area (Photo 3). The two-storey brick and timber framed and clad house is supported on brick walls and brick piers (Photo 4). Some cracking was observed in the supporting brick wall on the downhill side of the existing patio area

but this wall will be demolished as part of the proposed works (Photo 5). The external supporting house walls display no other significant signs of cracking and the supporting piers stand vertical. A pool has been cut into the slope on the uphill side of the property (Photo 6). The water level of the pool indicates no ground movement has occurred in the shell of the pool since its construction.

3. Geology

The Sydney 1:100 000 Geological sheet indicates the contact of the Hawkesbury Sandstone and the Newport Formation of the Narrabeen Group is on the slope immediately below the property. On a household scale, the map boundaries can be considered approximate and the geology will only be known for certain when it is exposed by the excavation.

4. Subsurface Investigation

One auger hole was put down to identify the soil materials. Five Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to weathered rock. 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 (~RL21.5) **–** AH1 (Photo 7)

Depth (m)	**Material Encountered**
0.0 to 0.2	**TOPSOIL**, sandy soil, brown, medium dense to dense, dry, coarse grained with fine trace organic matter.
0.2 to 1.0	**CLAYEY SAND**, orange brown, medium dense to dense, dry, fine to medium grained.

End of test @ 1.0m in clayey sand. 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** (~RL22.3)	**DCP 2** (~RL21.5)	**DCP 3** (~RL21.4)	**DCP 4** (~RL21.4)	**DCP 5** (~RL19.5)
0.0 to 0.3	9	24	34	7	1F
0.3 to 0.6	18	9	38	11	1F
0.6 to 0.9	29	5	15	9	3
0.9 to 1.2	11	17	18	18	23
1.2 to 1.5	17	23	26	30	23
1.5 to 1.8	24	30	35	#	19
1.8 to 2.1	27	#	#		20
2.1 to 2.4	30				30
2.4 to 2.7	#				#
	End of Test @ 2.4m	End of Test @ 1.8m	End of Test @ 1.8m	End of Test @ 1.5m	End of Test @ 2.4m

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

DCP Notes:

DCP1 – End of test @ 2.4m, DCP still very slowly going down, brown shale fragments on dry tip.
DCP2 – End of test @ 1.8m, DCP still very slowly going down, brown shale fragments on dry tip.
DCP3 – End of test @ 1.8m, DCP still very slowly going down, brown shale fragments on dry tip.
DCP4 – End of test @ 1.5m, DCP still very slowly going down, brown shale fragments on dry tip.
DCP5 – End of test @ 2.4m, DCP still very slowly going down, brown shale fragments on dry tip.

5. Geological Observations/Interpretation

The slope materials are colluvial at the near surface and residual at depth. In the test locations, the ground materials consist of a sandy soil over firm to stiff sandy clays. The sandy

clays merge into the underlying weathered rock at depths between 1.2 to 2.1m below the current surface. The weathered zone is interpreted to be Extremely Low to Very Low Strength Rock that becomes progressively stronger with depth. 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 excavation.

7. Surface Water

No evidence of surface flows were observed on the property during the inspection. Normal sheet wash is expected to move onto the site from the slope above during heavy down pours.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The proposed excavation is a potential hazard until retaining walls are installed (**Hazard One**). The proposed excavation undercutting the footings for the house is a potential hazard (**Hazard Two**).

SEE THE RISK ANAYSIS SUMMARY OVER THE PAGE

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The proposed excavation (up to a depth of ~3.2m) collapsing onto the work site before retaining walls are in place.	The proposed excavation undercutting the footings of the house causing failure (Photo 4).
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (30%)	'Medium' (35%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	2.9×10^{-4}/annum	5.3×10^{-5}/annum
COMMENTS	This level of risk to life and property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 13** are to be followed.	This level of risk to life and property is 'UNACCEPTABLE'. To move 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 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 ~3.2m is required to construct the proposed extension to the downhill side of the house. The excavation is expected to be through a shallow soil over

sandy clays with Extremely Low to Very Low Strength Shale expected at an average depth of ~1.5m below the current surface. Excavations through soil, clay, and Extremely Low to Very Low Strength Shale can be carried out with an excavator and bucket.

12. Vibrations

It is expected the proposed excavations will be carried out with an excavator and bucket and the vibrations produced will be below the threshold limit for building damage.

13. Excavation Support Requirements

The excavation will reach a maximum depth of ~3.2m and will be taken close to flush with the downhill supporting wall of the subject house (Photo 4). Thus, the subject house will be within the zone of influence of the excavation. In this instance, the zone of influence is the area above a theoretical 30° line through soil and a 45° line through clay/shale from the base of the excavation towards the surrounding boundaries or structures.

To ensure the integrity of the subject house, ground support will need to be installed along the uphill side of the excavation with the support installed before the excavation commences. See the site plan attached for the minimum required extent of the shoring shown in blue. For ease of design and construction piling the entire perimeter of the excavation may be preferred. A spaced pile retaining wall is a suitable method of support. Pier spacing for spaced piers is typically ~2.0m but can vary between 1.6 to 2.4m depending on the design. All piers can be supported by embedment and/or bracing installed as the excavation is lowered. To drill the pier holes for the wall, a powerful excavator or small pilling rig that can excavate through medium strength rock will be required. If a machine of this type is not available, we recommend carrying out core drilling before the construction commences to confirm the strength of the rock and to ensure the excavation equipment is capable of reaching the required depths. As the excavation is lowered in 1.5m lifts, infill sprayed concrete panels or similar are added between the piers to form the spaced wall. Drainage is installed behind the

panels. The walls are to be tied into the concrete floor and ceiling slabs after which any temporary bracing support can be released.

The geotechnical consultant is to inspect the drilling process of the entire first pile and the ground materials at the base of all pier holes/excavations for ground support purposes.

Alternatively, the downhill supporting wall of the subject house may be underpinned to below the base of the proposed excavation prior to the excavation commencing. As the excavation is up to 3.2m deep, this may require a staged construction of underpinning then lowering the excavation and repeating the process until the base of the proposed bulk excavation is exceeded by the underpinning.

Where shoring/underpinning is not required, the portions of the excavation that will be taken through soil are to be battered at 1.0 Vertical to 1.7 Horizontal (30^{o}). Excavations through clay and weathered rock will stand unsupported at near-vertical angles for short periods of time until retaining walls are installed provided they are kept from becoming saturated.

During the excavation process, the geotechnical consultant is to inspect the cut in 1.5m intervals as it is lowered, while the machine/excavation equipment is on site, to ensure the ground materials are as expected and no additional temporary support is required.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. Unsupported cut batters through soil 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 walls are to be organised so on completion of the excavation it can be constructed as soon as possible. The excavation is to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

All excavation spoil is to be removed from site following the current 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	Passive
Soil and Residual Clays	20	0.40	0.55	N/A
Extremely Low Strength Rock	22	0.25	0.35	Kp 2.5 ultimate
Rock Up to Low Strength Rock	24	0.25	0.35	Kp 2.5 ultimate

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. It should be noted that passive pressure is an ultimate value and should have an appropriate safety factor applied. No passive resistance should be assumed for the top 0.4m to account for any disturbance from the excavation. 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

Spread footings and piers supported on the underlying Extremely Low to Very Low Strength Rock are suitable footings for the proposed extension to the downhill side of the house. This ground material is expected to be exposed across the majority of the base of the proposed excavation. A maximum allowable pressure of 600kPa can be assumed for Extremely Low to Very Low Strength Rock.

Ideally, footings should be founded on the same footing material across the old and new structures. Where the footing material changes across the structure, construction joints or similar are to be installed to prevent differential settlement, where the structure cannot tolerate such movement.

As the bearing capacity of clay and shale reduces when it is wet, we recommend the footings be dug, inspected, and poured in quick succession (ideally the same day if possible). If the footings get wet, they will have to be drained and the soft layer of wet clay or shale on the footing surface will have to be removed before concrete is poured.

If a rapid turnaround from footing excavation to the concrete pour is not possible, a sealing layer of concrete may be added to the footing surface after it has been cleaned.

The proposed extension to the W side of the house can be supported on a raft slab embedded 0.5m from the current surface into the underlying medium dense clayey sands of the natural profile. The footing walls are to be shored with timber to prevent collapse. A maximum allowable bearing pressure of 100kPa can be assumed for footings supported on the medium dense clayey sands of the natural profile.

The base of the footing excavations in sand should be compacted as the excavation will loosen the upper sands. This can be carried out with a hand-held plate compactor. Water may be used to assist in compaction in sand but footing materials should be kept damp but not saturated. As a guide to the level of compaction required a density index of >85% is to be achieved.

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 certification for the regulating authorities or the owner if the following inspections have not been carried out during the construction process.

- The geotechnical professional is to inspect the drilling process of the entire first pile of the retaining wall and the ground materials at the base of all the piers before any concrete is placed.

- During the excavation process, the geotechnical consultant is to inspect the cut in 1.5m intervals as it is lowered, while the machine/excavation equipment is on site, to ensure the ground materials are as expected and no temporary support is required.

- All footings are to be inspected and approved by the geotechnical professional 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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Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7 – AH1: Downhole is from top to bottom.

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.

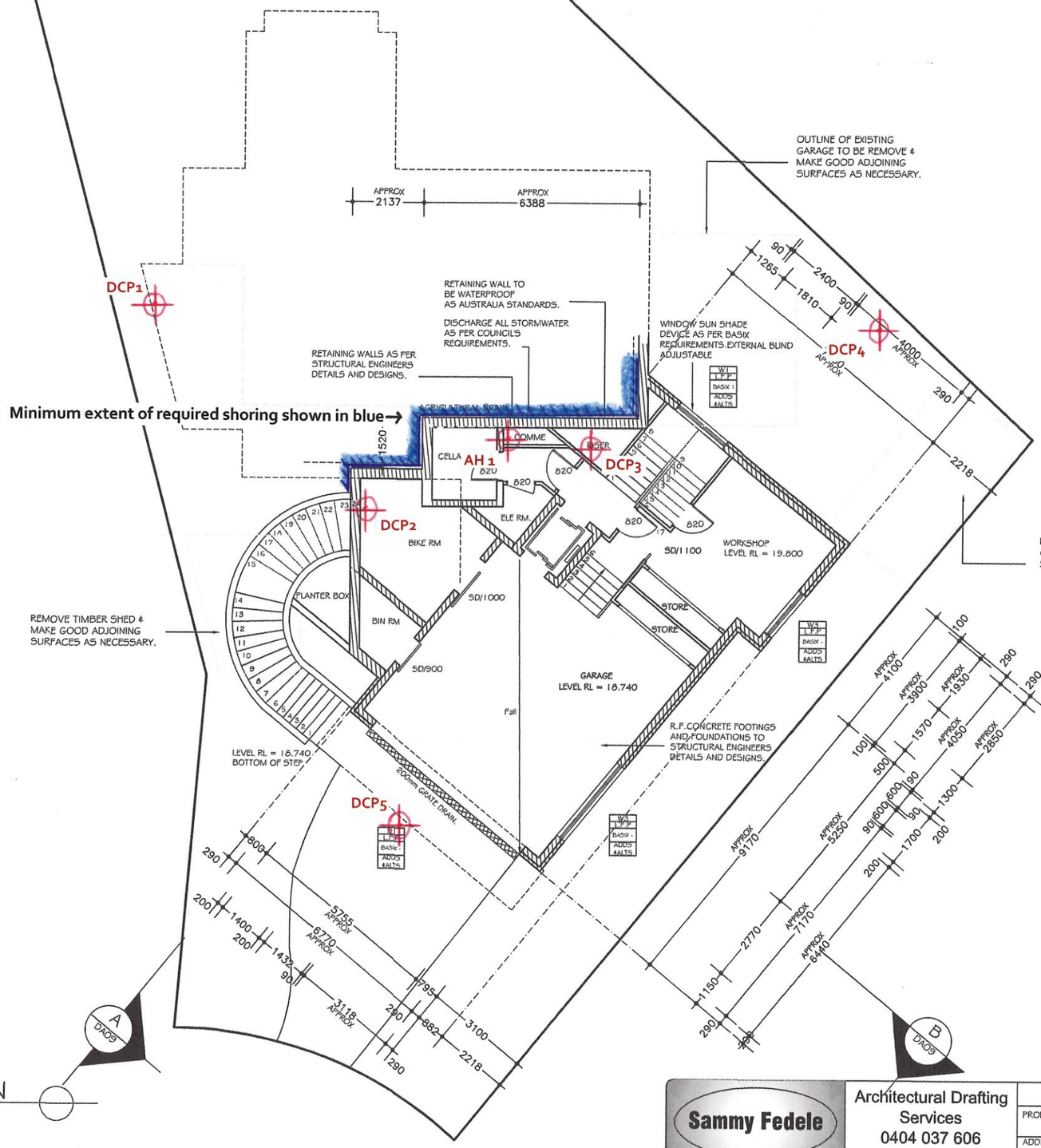
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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:

(S)	SMOKE ALARM
(F)	FAN MECHANICAL
DP.	DOWN PIPE
tap	EXTERNAL TAP
	METER BOX
	GAS METER
	RIANNI
AC	AIR-CONDITION UNIT
	SKYLIGHT
fw	FLOOR WASTE
	EXISTING WALLS
	DEMOLITION WALLS
	NEW WALLS

NOTES

1. Do not scale off drawings. ***(If in doubt- ask.)***
2. All measurements to be checked on site prior to commencement of construction.
3. Check all levels, roof pitch, location of services and boundary lines, site and building conditions before commencing work or ordering materials.
4. Supply & install selected smoke alarm system to comply with AS3786.
5. All storm water to be connected to street gutters as per council requirements
6. The work shown on this and associated drawings shall be carried in a tradesmanlike manner and shall be in accordance with the standards, codes, ordinances,regulations, of the Standards Association of Australia, the Building Code of Australia and any statutory authority having jurisdiction over the works.
7. Setting out dimensions shown on the drawings shall be verified by the builder
8. During construction the structure shall be maintained in a stable condition, and no part shall be overstressed.
9. Flashings and damproof course to be placed in accordance with good building principles whether shown on the details or not.
10. Supply and install lift off hinges to all wet area doors .

PROPOSED
LOWER FLOOR PLAN
SCALE 1:100

Sammy Fedele
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Architectural Drafting Services
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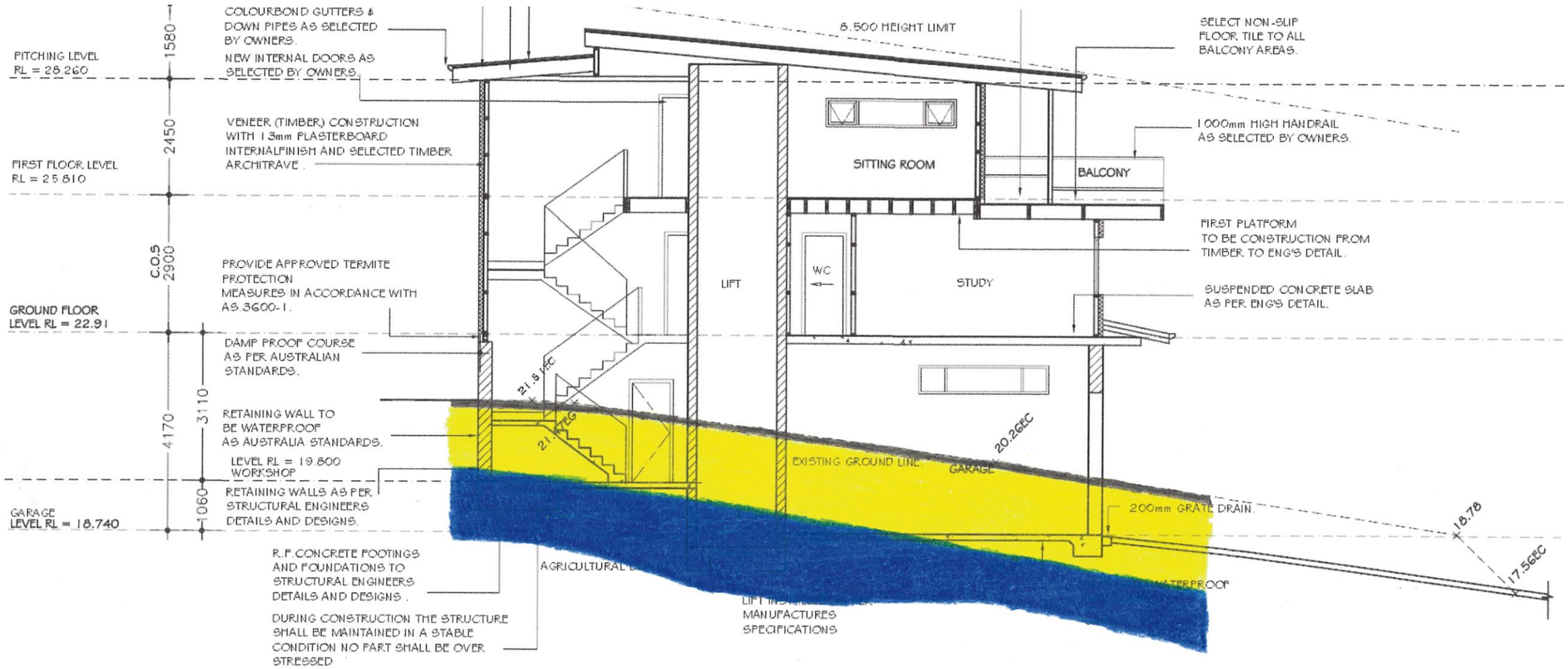
email:sammyfedele@iprimus.com.au

V AND J TURNER		PLAN	
PROPOSED : ALTERATIONS AND ADDITIONS (NEW RESIDENCE) TO EXISTING RESIDENCE		SCALE: 1:100	SHEET No : DA03
ADDRESS : 24 PENRITH AVE WHEELER HEIGHTS NSW 2097	DP 512855 LOT 2	DATE: 20.11.2019	A2
		REV: JOB: 18/18	

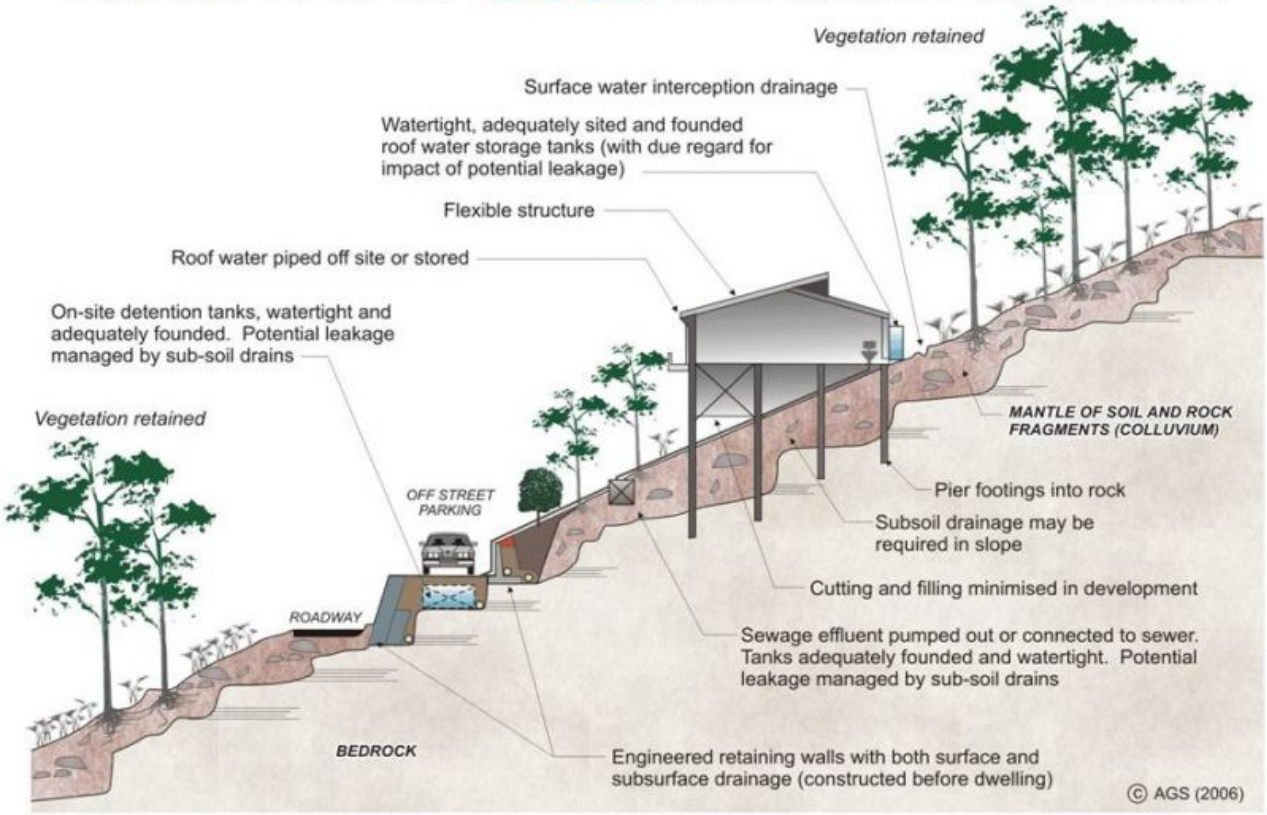
TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



PROPOSED
SECTION A
SCALE 1:100

- **Fill**
- **Topsoil**
- **Clayey Sand & Sandy Clay**
- **Extremely Low to Very Low Strength Rock - after being cut up by excavation equipment can resemble a stiff to hard clay.**

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE