GEOTECHNICAL INVESTIGATION:

Alterations and Additions and New Pool at **5 Lae Place, Allambie Heights**

1. Proposed Development

1.1 Extend the existing garage upslope by excavating to a maximum depth of ~1.3m.

1.2 Install a new pool on the uphill side of the property by excavating to a maximum depth of ~4.4m.

1.3 Construct a new deck over the garage.

1.4 Various other minor alterations.

1.5 Details of the proposed development are shown on 28 drawings prepared by Envirotecture, Project number H83, drawings numbered A3 10.01, A3 11.01, A3 20.01 to A3 20.04, A3 21.01 to A3 21.04, A3 22.01, A3 22.02, A3 30.01, A3 30.02, A3 40.01, A3 60.01 to A3 60.03, A3 61.01, A3 63.01, A3 65.01, A3 70.01, A3 71.01, A3 91.01, A3 91.02, A3 92.01, A3 100.01, and A3 100.02, Revision 1, dated 17/11/21.

2. Site Description

2.1 The site was inspected on the 5th November, 2021, and previously on the 15th December, 2020, and 23rd September, 2014.

2.2 This residential property is on the high side of the road and has an E aspect. The block is located on the steeply graded lower middle reaches of a hillslope. The slope rises across the site at an average angle of ~23°. The slopes above and below the property continues at easing angles.

2.3 At the road frontage, a concrete driveway runs to a garage attached to the N side of the house (Photo 1). The slope between the road frontage and the house is

terraced with a stable timber retaining wall and with a stable rendered masonry retaining wall (Photo 2). The part two-storey brick house is supported on brick walls (Photo 3). No significant signs of movement were observed in the supporting brick walls of the house. Competent Medium Strength Sandstone outcrops and steps up the slope immediately above the house (Photos 4 & 5). The majority of the rock displays no significant geological defects. However, the rock was observed to be undercut to ~1.0m near the top of the outcrop (Photo 6). The undercut rock has a relatively thick cantilever arm in relation to its overhang length, displays no signs of cracking as viewed from above or below, and was observed to continue back up the slope a significant distance. As such, the outcropping rock is considered stable. A shallow fill has been placed on the N side of the outcrop for a level lawn area. The fill is supported by a stable concrete block retaining wall that was observed to be supported directly onto the rock (Photo 7).

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

As Medium Strength Sandstone was observed to be outcropping across the location of the proposed works, no subsurface investigation was necessary (Photos 4 & 5). See the site plan attached showing locations where rock was observed to be outcropping.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the outcropping and underlying sandstone bedrock that steps up 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 very stiff sandy clays that fill the bench step formation. Rock of at least Medium Strength was observed to be outcropping across the location of the proposed works. A similar strength rock is expected to underly the entire site. 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 surface flows were observed on the property during the inspection. It is expected that normal sheet wash will move onto the site from above the property during heavy down pours.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The steeply graded slope that falls across the property is a potential hazard (**Hazard One**). The large sandstone face that rises above the house is a potential hazard (**Hazard Two**). The vibrations from the proposed excavations are a potential hazard (**Hazard Three**). A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process is a potential hazard (**Hazard Three**).

SEE THE RISK ANALYSIS SUMMARY OVER THE PAGE

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The steep slope that falls across the property failing and impacting on the property.	The sandstone face that rises above the house failing and impacting on the proposed development (Photos 4 & 5).
LIKELIHOOD	'Unlikely' (10^{-4})	'Unlikely' (10^{-4})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Medium' (25%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Low' (2×10^{-5})
RISK TO LIFE	9.1×10^{-7}/annum	2.9×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE'.	This level of risk is 'ACCEPTABLE'.

HAZARDS	Hazard Three	Hazard Four
TYPE	The vibrations produced during the proposed excavations impacting on the supporting walls of the subject and neighbouring houses.	A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (20%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	4.5×10^{-4}/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 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 Lae Place. 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 ~4.4m is required to construct the proposed pool. Another excavation to a maximum depth of ~1.3m is required to construct the proposed garage extension. The excavations are expected to be taken entirely through Medium Strength Sandstone.

It is envisaged that excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

Excavations through Medium Strength Rock or better should be carried out to minimise the potential to cause vibration damage to the subject house and neighbouring house to the N. The excavation will be taken close to flush with the supporting walls of the subject house and will be set back ~5.8m from the N neighbouring house.

Dilapidation reporting carried out on the N neighbouring property is recommended prior to the excavation works commencing.

Excavation methods are to be used that limit peak particle velocity to 8mm/sec at the supporting walls of the subject house and property boundaries. Vibration monitoring will be required to verify this is achieved. The vibration monitoring equipment must include a light/alarm so the operator knows if vibration limits have been exceeded. It also must log and record vibrations throughout the excavation works.

In Medium Strength Rock or better, techniques to minimise vibration transmission will be required. These include:

- Rock sawing the excavation perimeter to at least 1.0m deep prior to any rock breaking with hammers, keeping the saw cuts below the rock to be broken throughout the excavation process.
- Limiting rock hammer size.
- Rock hammering in short bursts so vibrations do not amplify.
- Rock breaking with the hammer angled away from the nearby sensitive structures.
- Creating additional saw breaks in the rock where vibration limits are exceeded.

13. Excavation Support Requirements

The excavations will reach a maximum depth of ~4.4m. They will be taken close to flush with the supporting walls of the subject house, low concrete block retaining wall above, and N common boundary. However, Medium Strength Sandstone was observed to be outcropping across the entire footprint of both excavations. As such, no structures or boundaries will be within the zone of influence of the excavations.

Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

It is proposed to bring the excavation back to the existing low retaining wall (Photo 7). The rock is at least Medium Strength and no jointing was observed in the vicinity of the low wall. This is important because jointing immediately up slope can result in an excavation failure along the joint plane. At the S end of the proposed excavation, the downhill edge of an existing joint block will be trimmed to accommodate the excavation (Photo 5). The balance point of this rock is well upslope and removing the downhill edge will not cause instability. Another small block of rock is immediately beside this joint block to the S (Photo 5). This smaller rock can be broken down/removed from the face.

The materials and labour to construct the retaining walls 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 excavations as they approach to not less than 1.0m horizontally from the supporting walls of the house to confirm the stability of the cut to go flush with the footings.

Additionally, during the excavation process, the geotechnical consultant is to inspect the excavations as they are lowered in 1.5m intervals to ensure the ground materials are as expected and no wedges or other geological defects are present that could require additional support. Should additional ground support be required, this will likely involve the use of mesh, sprayed concrete, and rock bolts.

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.

All excavation spoil is to be removed from site following the current Environmental Protection Agency (EPA) waste classification guidelines.

14. Retaining Structures

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

TABLE 1 IS ON THE NEXT PAGE

Table 1 – Likely Earth Pressures for Retaining Structures

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Medium Strength Sandstone	24	0.00	0.10

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 structure, do not account for any surcharge loads, and assume retaining structures are fully drained. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

All retaining structures are to have sufficient back-wall drainage and be backfilled immediately behind the structure 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 structures, 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 garage extension. This material is expected to be exposed across the base of the excavation.

The proposed pool is expected to be seated on the Medium Strength Sandstone. This is a suitable foundation 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 excavations as they approach to not less than 1.0m horizontally from the supporting walls of the house to confirm the stability of the cut to go flush with the footings.

- 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 and contractors are 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

Photo 6

Photo 7

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.

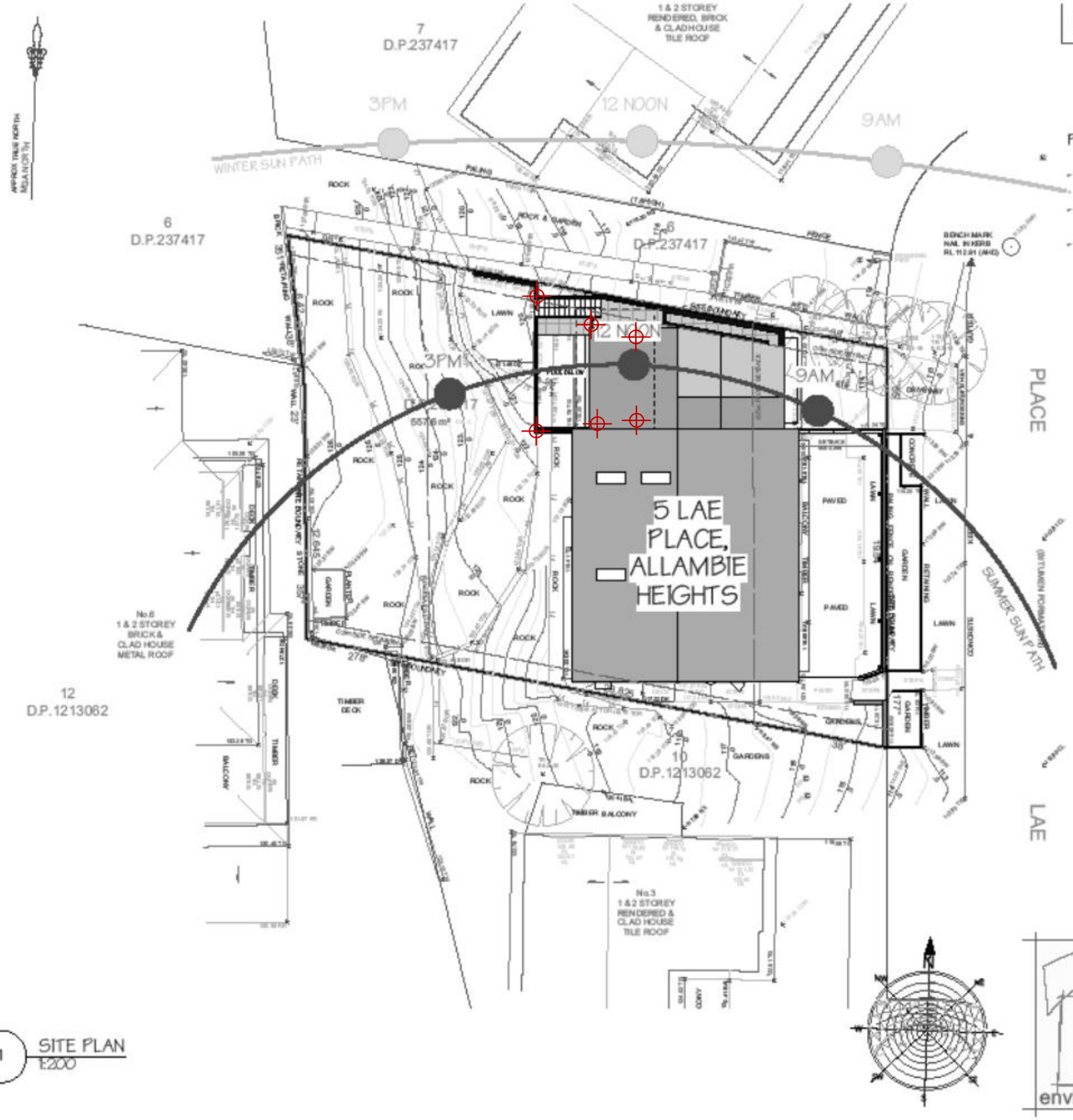
- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar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

SITE PLAN – showing relevant locations where rock was observed to be outcropping

NOT FOR CONSTRUCTION

PROPOSED WORKS:

- PROPOSED NEW DECK AND ASSOCIATED ROOF
- NEW INSULATION TO EXISTING BUILDING ENVELOPE
- INSTALLATION OF NEW HIGH PERFORMANCE WINDOWS & SHADING DEVICES



1 SITE PLAN
1:200

envirotecture

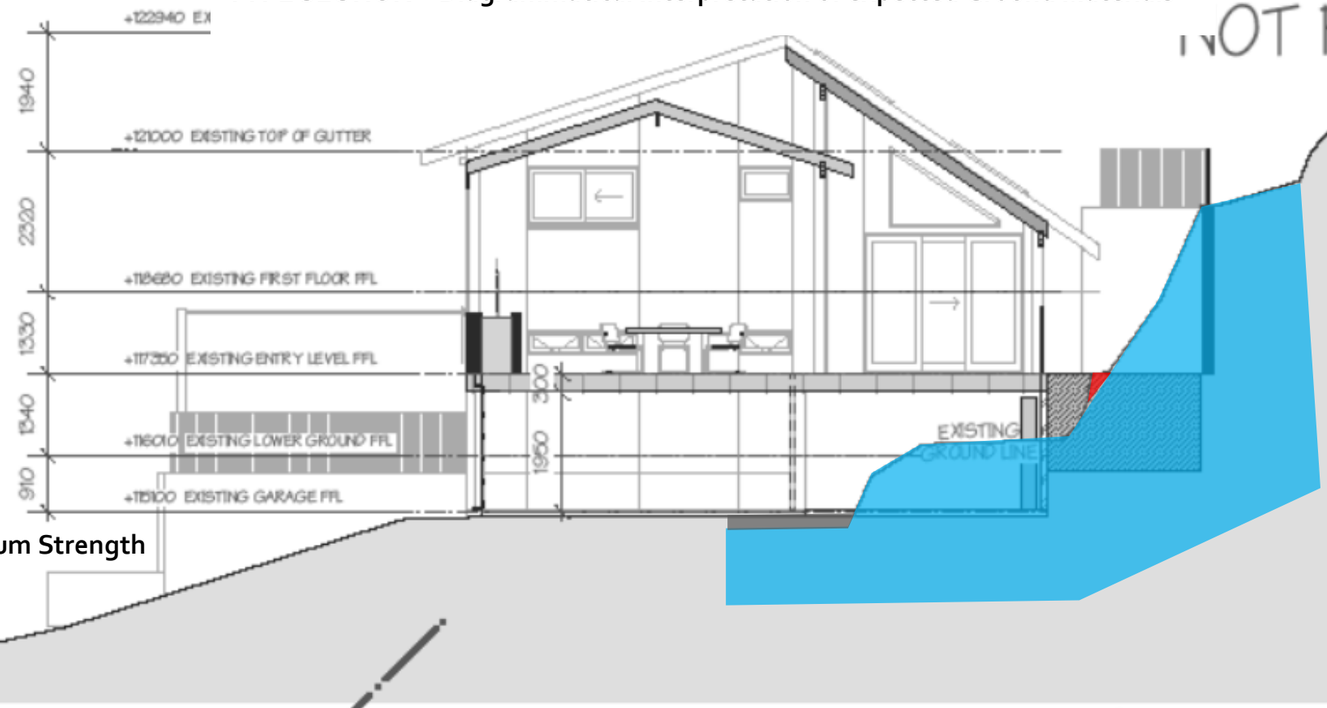
REV # 1	BY JD	DATE 01/12/21	DA SUBMISSION
PROJECT	ALTERATIONS & ADDITIONS		PROJECT # H83
ADDRESS	5 LAE PLACE ALLAMBIE HEIGHTS, NSW 2100		PROJECT STATUS DA
CLIENT	CHRIS HOLLOWAY & TESSA CAMPBELL	DATE # 20/12/2021	DRG # A3 11.01
		SCALE AS SHOWN @ A3	
DWG	SITE & SITE ANALYSIS PLAN	DRAWN JD	REVISION # 1
		CHKD DC	

48 KALANG ROAD ELANORA HTS NSW 2101
OFFICE 02 9913 3997
www.envirotecture.com.au
envirotecture projects pty ltd ABN 49 078 853 577
ACCREDITED BUILDING DESIGNER DICK CLARKE #6638
NOMINATED ARCHITECT: ANDY MARLOW NSW #6667 TAS #1090

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials

NOT FOR CONSTRUCTION

1 SECTION 1
1:100



Fill
Topsoil
Hawkesbury Sandstone – Medium Strength

2 SECTION 2
1:100

LEGEND

- EXISTING TIMBER FRAMED FLOORS: INSULATE WITH MINIMUM R2.0 BATTS AS SPECIFIED AND ENCLOSE WITH AIR-CELL PERMIFLOOR OR EQUIV.
- EXISTING EXTERNAL WALLS: INSULATE WITH ICYNENE OR SUPAFIL AS SPECIFIED (TBC).
- EXISTING ROOF: EXISTING INSULATION TO REMAIN (TBC)
- NEW FLOOR: NEW CONCRETE SLAB AS PER ENG SPEC.
- NEW EXTERNAL FLOOR: STRUCTURE TBC
- NEW EXTERNAL TIMBER FRAMED WALLS: 90mm TIMBER STUD WALLS TO AS1684, R2.5 BATT INSULATION
- NEW INTERNAL TIMBER FRAMED WALLS: 90mm TIMBER STUD WALLS TO AS1684, R2.0 ACOUSTIC BATT INSULATION
- NEW BRICK WALLS: 110 BRICK
- NEW RETAINING WALLS: AS PER ENG SPEC TBC
- NEW UNINSULATED COLORBOND ROOF: AS PER ENG SPEC.
- NEW POLYCARBONATE ROOF: POLY CARBONATE & STRUCTURE AS PER ENG. SPEC.

REV # 1	BY JD	DATE 11/11/21	DA SUBMISSION
PROJECT	ALTERATIONS & ADDITIONS		PROJECT # H83
ADDRESS	5 LAE PLACE ALLAMBIE HEIGHTS, NSW 2100		PROJECT STATUS DA
CLIENT	CHRIS HOLLOWAY & TESSA CAMPBELL	DATE # 20210527	DRG # A3 40.01
		SCALE AS SHOWN @ A3	
DWG	SECTIONS	DRAWN JD	REVISION # 1
		CHKD DC	

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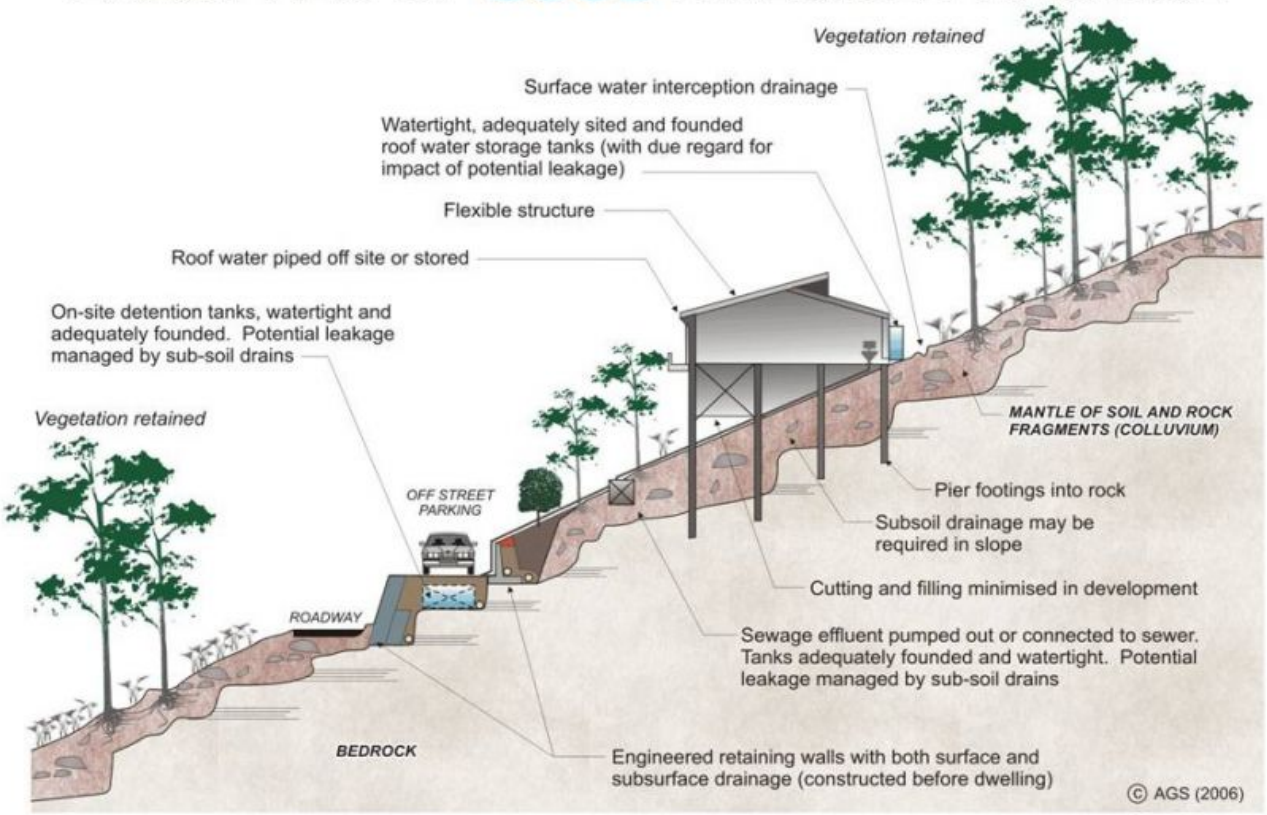
envirotecture projects pty ltd ABN 49 078 853 577
ACCREDITED BUILDING DESIGNER: DICK CLARKE #6029
NOMINATED ARCHITECT: ANDY MARLOW NSW #6367 TAS #1260

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE