GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **24A Hay Street, Collaroy Plateau**

1. Proposed Development

1.1 Construct a new crossing, driveway and raised garage off Bedford Crescent.

1.2 Construct a lift on the uphill side of the house excavating ~1.0m into the slope

1.3 Construct a new rumpus area downhill of the existing garage.

1.4 Construct a loft above the existing house.

1.5 Details of the proposed development are shown on 19 DA drawings prepared by Michael Airey, drawings numbered 1-19 revision A and dated 31/5/2019.

2. Site Description

2.1 The site was inspected on the 19th July, 2019.

2.2 This residential property has a NE aspect. The triangular block is located on the steep middle reaches of the hillslope. The slope across the property rises at angles of ~20°. The grade below the property reduces downslope to the base of the hill with the grade also reducing to gentler angles above the property.

2.3 A moderately sloped driveway extends uphill from Hay St to the existing garage (Photo 1). The proposed rumpus area will extend downhill of the existing garage and will require minor levelling of the slope. The Three-storey rendered brick house is supported on brick walls and piers (Photo 2). No significant signs of movement were observed in the supporting brick walls. Beside the house a series of stacked sandstone rock retaining walls have been used to terrace the slope (Photo 3). The walls appear stable and continue uphill of the house to the boundary with Bedford Crescent (Photo 4). The fill laid to create Bedford Crescent merges into the natural slope. The vertical crest of fill is supported with a sand stone block retaining wall up to ~1.2m

high. The walls line approximates the upper boundary (Photo 5). The proposed elevated garage and drive way will extend from Bedford Crescent to the uphill side of the house. Additionally uphill of the house, next to the porch, a lift is proposed.

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by the Newport Formation of the Narrabeen Group. It is described as interbedded laminite, shale and quartz to lithic quartz sandstone.

4. Subsurface Investigation

One auger hole was put down to identify the soil materials. Five DCP (Dynamic Cone Penetrometer) tests were carried out 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 (~RL39.9) **–** AH1 (Photo 7)

Depth (m)	Material Encountered
0.0 to 0.4	**TOPSOIL**, clayey sand, dark brown and grey, loose, medium grained with fine trace organic matter.
0.4 to 0.9	**CLAY**, brown, soft to firm.
0.9 to 1.2	**CLAY**, orange to brown, stiff to firm.
1.2 to 1.5	**SANDY CLAY**, yellow to white, dry, medium grained.

Refusal @ 1.5m grinding on rock, white dust on tip. No watertable encountered.

DCP TEST RESULTS ON THE NEXT PAGE

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** (RL41.4)	**DCP 2** (RL42.7)	**DCP 3** (RL40.6)	**DCP 4** (RL38.0)	**DCP 5** (RL35.75)
0.0 to 0.3	2	7	1	2	2
0.3 to 0.6	19	11	7F	8	12
0.6 to 0.9	19	12	4	26	15
0.9 to 1.2	28	35	14	17	#
1.2 to 1.5	#	27	60	10	
1.5 to 1.8		26	#	7	
1.8 to 2.1		8		#	
2.1 to 2.4		#			
	Refusal on Rock @ 1.2 m	Refusal on Rock @ 1.85m	End of test @ 1.5m	Refusal on Rock @ 1.55m	Refusal on Rock @ 0.9m

#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 @ 1.2m, DCP bouncing off rock surface, white impact dust on dry tip.
DCP2 – Refusal on rock @ 1.85m, DCP bouncing off rock surface, maroon to orange impact dust on dry tip.
DCP3 – End of test @ 1.5m, DCP very slowly moving, white impact dust on dry tip.
DCP4 – Refusal on rock @ 1.55m, DCP bouncing off rock surface, maroon impact dust on dry tip.
DCP5 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, white impact dust on dry tip.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the 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. The rock is overlain by sandy soils and firm to stiff sandy clays that fill the bench-step formation. In the test locations, the depth to Medium Strength Sandstone ranged from between 0.9 to 1.85m below the current surface, being deeper where filling is present

and due to the stepped nature of the underlying rock. 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 will be intercepted by the street drainage system for Bedford Crescent, and by the drainage system for the pedestrian pathway above.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The Warringah Council landslip risk map identifies the block in Area E of slopes greater than 15°. The steeply graded slope that falls across the property and continues above and below is a potential hazard (**Hazard One**). The proposed excavation for the lift is a potential hazard until retaining walls are in place (**Hazard Two**).

RISK ANALYSIS SUMMARY ON NEXT PAGE

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The moderate to steep slope that falls across the property and continues above and below failing and impacting on the property.	The proposed excavation collapsing onto the work site before the retaining structure is in place.
LIKELIHOOD	'Unlikely' (10^{-4})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (20%)	'Medium' (11%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})
RISK TO LIFE	8.3×10^{-7}/annum	3.3×10^{-7}/annum
COMMENTS	'ACCEPTABLE' level of risk to life & property.	This level of risk to property is 'TOLERABLE'. 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

There is fall to Hay St below. 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

The proposed lift will require an excavation to a maximum height of ~1.2m through a retaining wall uphill of the house (Photo 6). This excavation is expected to be through clayey sand. It is envisaged that excavations through soil and clay be carried out with a bucket. Excavations for footings and minor levelling for the downhill rumpus area will also be required.

12. Vibrations

Possible vibrations generated during excavations through fill, sandy soils, and sandy clays will be below the threshold limit for building damage.

13. Excavation support requirements

No structures or boundaries will be within the zone of influence of the proposed excavation for the lift. The relatively small excavations through clay are expected to stand at near vertical angles for short periods of time until retaining walls are in place provided it is prevented from becoming saturated.

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. Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. 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.

The plans show the surface level for the proposed Rumpus addition will be ~ 0.5m lower than the existing adjoining floor level and will require a low excavation. The builder is to ensure the existing house foundations extend below this depth with the use of exploration pits dug prior to the excavation commencing. If the foundations do not extend below the proposed excavation the house footings will need to be underpinned to at least 0.3m below the base of the excavation.

Excavation spoil is to be removed from site following the current NSW Environment Protection Authority (EPA) Waste Classification Guidelines.

14. Retaining Walls

Retaining walls supporting soil and clay can be designed for a lateral earth pressure coefficient K_o of 0.50 and assume a bulk density of 20kN/m^3. It should be noted that this lateral earth pressure coefficient assumes the surface above the wall is near level, so slope surcharges need to be added. Earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

Any surcharge loads that may act on the retaining walls are to be accounted for in the design.

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, likely hydrostatic pressures are to be accounted for in the retaining wall design.

15. Foundations

It is recommended the proposed additions are supported on piered foundations taken to the underlying Medium Strength sandstone.

This material is expected at depths of between ~0.9 to 1.5m below the current ground level in the location of the rumpus area extension, 0.6m below the surface in the location of the lift and between ~1.2 to 1.9m below the current surface for the suspended garage. The piered foundations for the garage are to be socketed at least 0.3m into the Medium Strength Rock.

A maximum allowable bearing pressure of 800kPa can be assumed for footings supported on Medium Strength Sandstone.

It is recommended construction joints be installed between the proposed and existing parts of the structure to allow for some differential foundation movement between the existing and newer parts of the structure.

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 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.

13. 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.

- 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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Photo 1

Photo 2

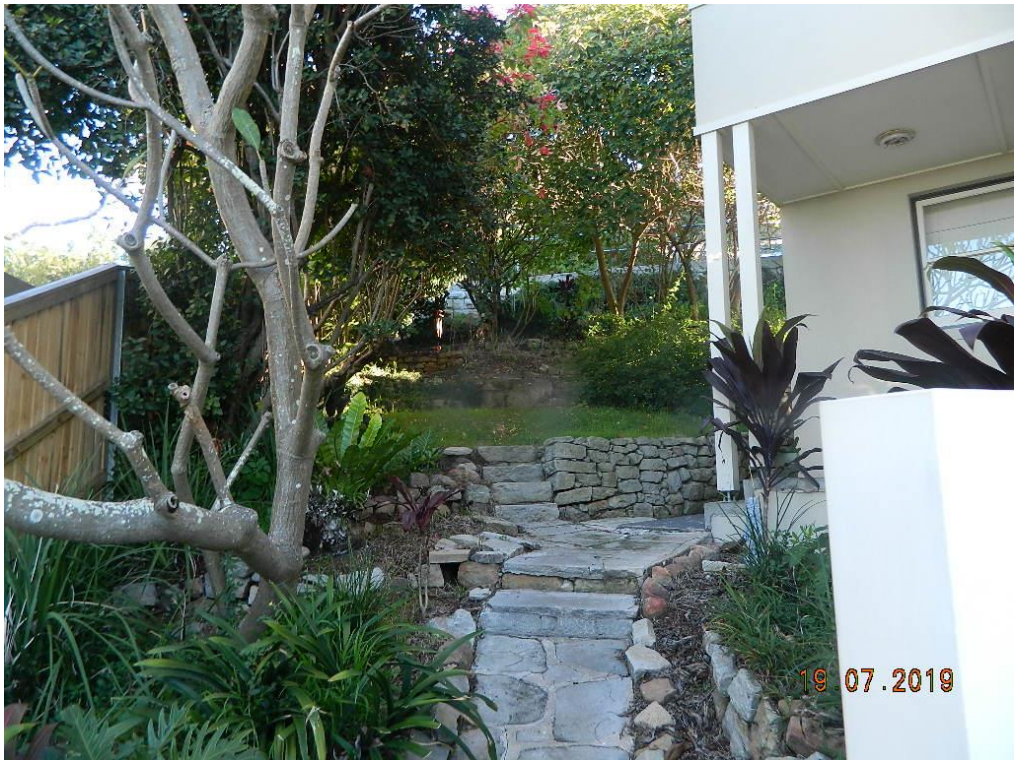

Photo 3

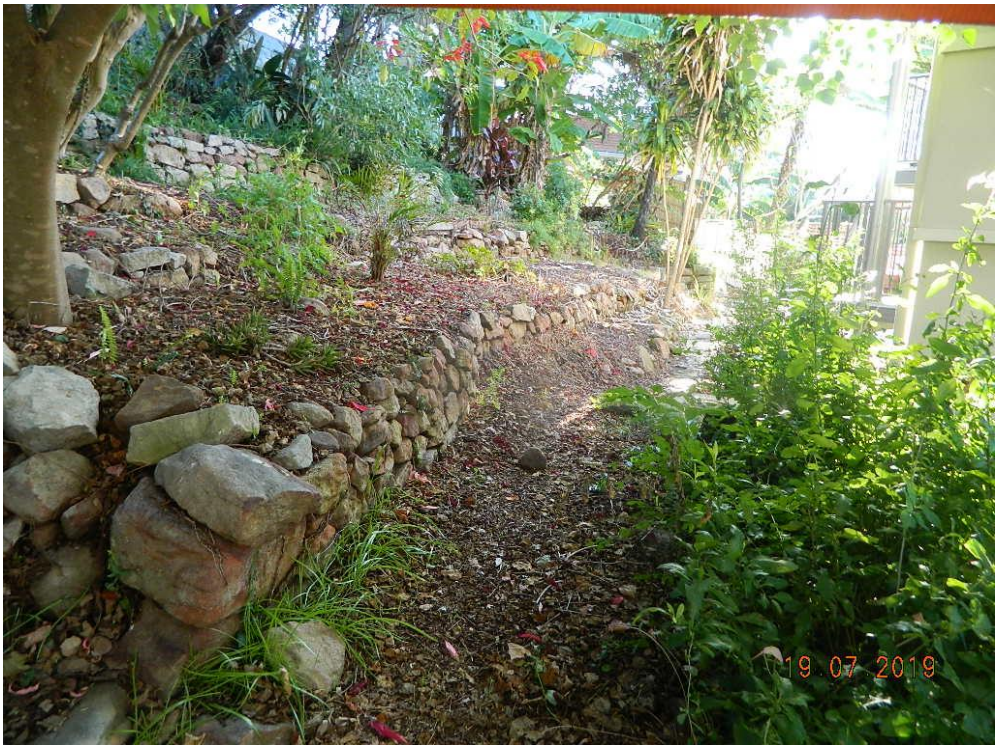

Photo 4

Photo 5

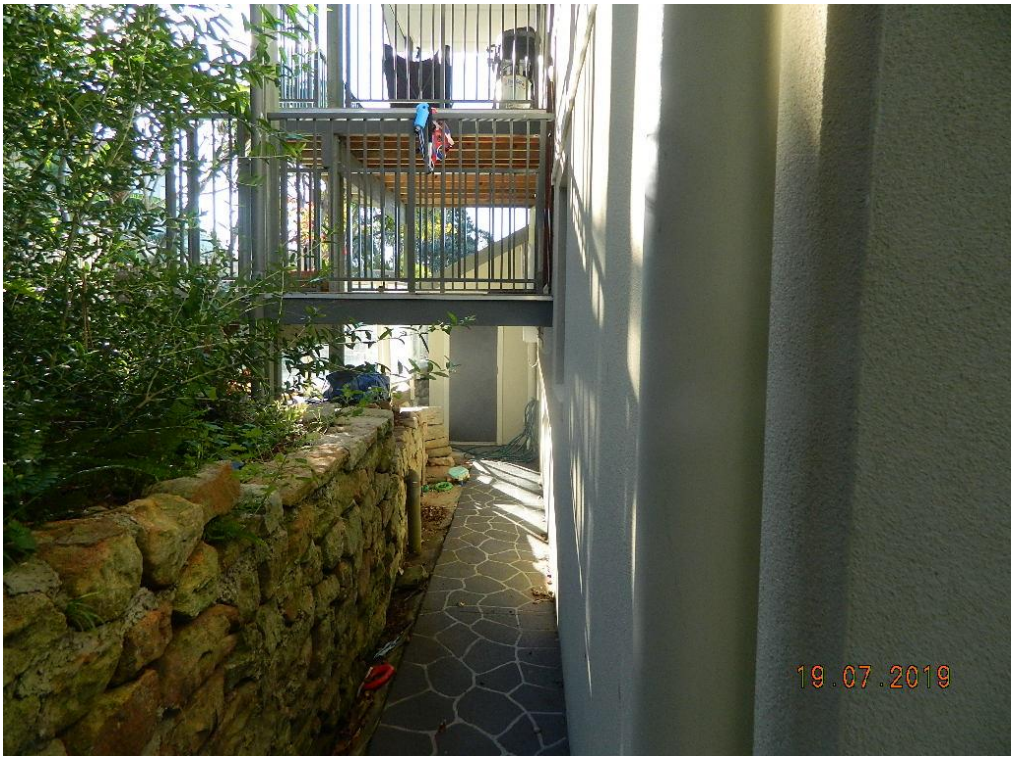

Photo 6

Photo 7: 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

SITE PLAN / SITE ANALYSIS PLAN

1:200

DRAFT 31-05-2019

No.24A HAY STREET, COLLAROY
PROPOSED ALTERATIONS & ADDITIONS
APPLICANT: MR & MRS DONALDSON
SITE PLAN / SITE ANALYSIS PLAN

SCALE 1:200
DATE MAY 2019

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DRAWING NO. 1 REV. A

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials

0 1 2 3 4 5 10M

SCALE 1:100

PROPOSED SOUTH ELEVATION
1:100

Fill
Topsoil
Firm to Stiff Clay
Sandstone – Medium Strength

DRAFT 31-05-2019

No.24A HAY STREET, COLLAROY
PROPOSED ALTERATIONS & ADDITIONS
APPLICANT: MR & MRS DONALDSON
PROPOSED SOUTH ELEVATION

SCALE 1:100
DATE MAY 2019

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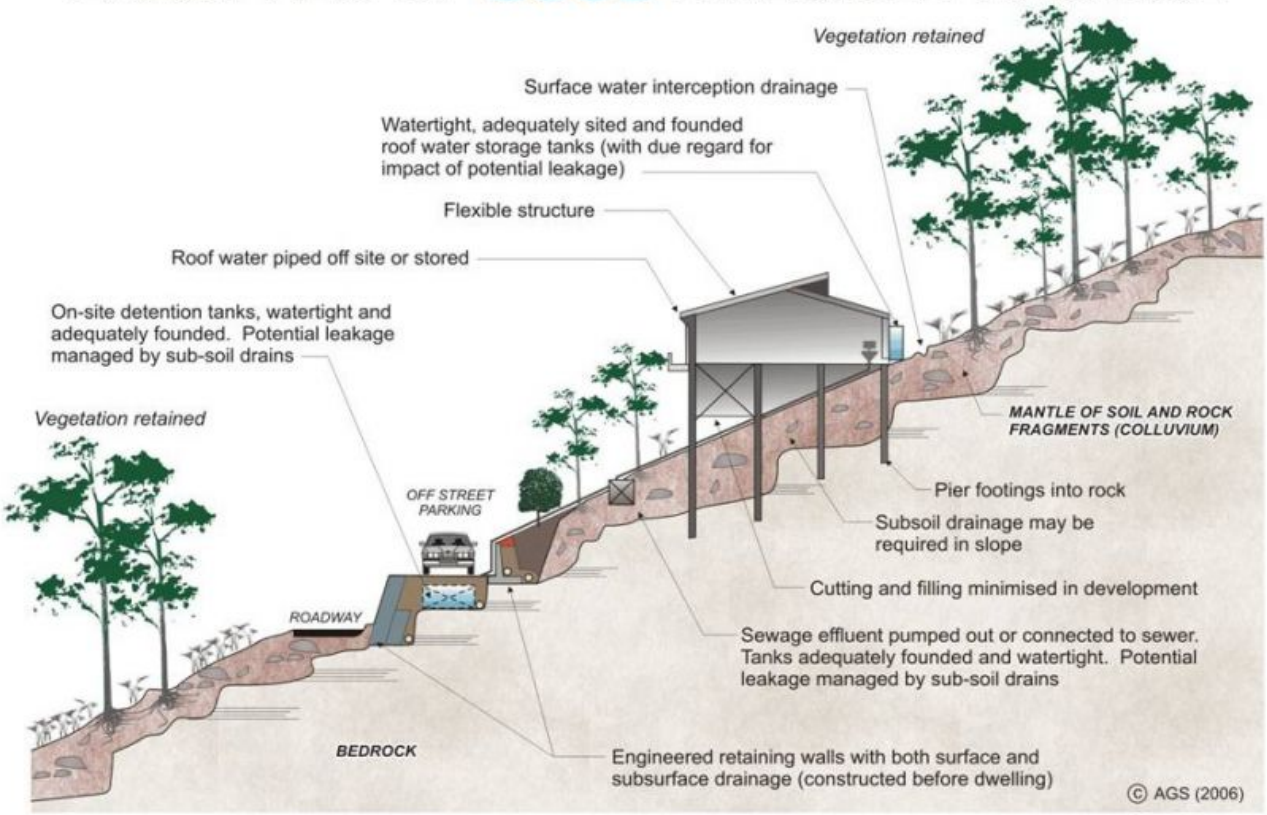
DRAWING NO. **14** REV. **A**

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE