GEOTECHNICAL INVESTIGATION:

Additions and Alterations at **56 Peronne Avenue, Clontarf**

1. Proposed Development

1.1 Construct a three-storey extension on the downhill side of the lower dwelling.

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

1.3 Various other external and internal additions and alterations.

1.4 Details of the proposed development are shown on 25 drawings, project 56 Peronne Ave, drawings numbered DA00-DA13, DA15, DA020-DA023, DA025, DA30-DA32, DA40, DA41, and DA50, dated 28th May, 2021.

2. Site Description

2.1 The site was inspected on the 28th June, 2021.

2.2 This residential property is on the high side of the road and has a SW aspect. The site is located on the steeply graded middle upper reaches of a hillslope. The slope rises across the property at angles averaging ~23°. The slope above and below the property continue at similar angles.

2.3 At the road frontage, a concrete driveway runs to a garage on the downhill side of the property. A stable, sandstone block retaining wall supports the cut for the driveway (Photo 1). The garage has been cut into the slope. The cut for the rendered brick garage has been taken entirely through Medium Strength Sandstone and appears stable (Photo 2). The garage is of brick construction and shows no signs of movement. A stable masonry retaining wall reaching up to ~3.0m high runs up the E common boundary and supports the E neighbouring pool area (Photo 3). A stable timber retaining wall supports the fill for a garden bed between the garage and the house

(Photo 4). A ~2.5m high, stable sandstone block retaining wall runs along the W common boundary and supports the neighbouring property (Photo 5). The part three-storey brick house on the downhill side of the property is supported on external brick walls and external steel columns. The brick walls show no significant signs of movement and the steel columns appear to stand vertical. Access to the foundation space of the dwelling on the downhill side of the property was unavailable at the time of inspection. Competent Medium Strength Sandstone outcrops immediately above the dwelling on the downhill side of the property (Photo 7). The outcrop was observed to be slightly undercut but is considered stable. A series of low timber retaining walls up to ~0.5m high form garden beds that terrace the slope between the upper and lower dwellings (Photo 8). A timber log retaining wall supports the fill for a decked path leading to the uphill dwelling. This retaining wall and deck are to be demolished as part of the proposed works. The part two-storey, steel and timber framed and clad house on the uphill side of the property is supported on brick walls and steel posts (Photo 9). Some of the supporting walls and posts were observed to be supported directly onto outcropping Medium Strength Sandstone. The brick walls show no significant signs of movement and the steel posts appear to stand vertical. Exposed sandstone benches continue to step up the slope to the upper common boundary (Photo 10). A rough stack rock wall on the upper common boundary supports the fill for the E neighbouring property (photo 11). The wall appears to be in the process of collapsing. See **Section 16** for advice regarding this wall.

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 (AH) was put down to identify the soil materials. Seven 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 attached. 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. However, excavation and foundation budgets should always allow for the possibility that the interpreted ground conditions in this report vary from those encountered during excavations. See the appended "Important information about your report" for a more comprehensive explanation. The results are as follows:

AUGER HOLE 1 (~RL52.5) **–** AH1 (Photo 12)

Depth (m)	**Material Encountered**
0.0 to 0.3	**FILL**, sandy soil, dark brown, loose, damp, orange and yellow sand intermixed, fine to coarse grained, fine trace of organic matter.
0.3 to 0.5	**FILL**, yellow, white, and orange sand, loose, damp, fine to coarse grained, traces of rock fragments.
0.5 to 0.7	**FILL**, orange and brown clayey sand, loose to medium dense, dry, medium grained.

Refusal @ 0.7m on rock. No watertable encountered.

GROUND 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** (~RL57.5)	**DCP 2** (~RL52.9)	**DCP 3** (~RL51.7)	**DCP 4** (~RL52.6)	**DCP 5** (~RL51.7)	**DCP 6** (~RL42.2)	**DCP 7** (~RL41.7)
0.0 to 0.3	2	5	Rock exposed at surface	2	Rock exposed at surface	2	Rock exposed at surface
0.3 to 0.6	#	8		2		#	
0.6 to 0.9		6	#	7	#		#
0.9 to 1.2		22		#			
1.2 to 1.5		#					
1.5 to 1.8							
1.8 to 2.1							
2.1 to 2.4							
2.4 to 2.7							
	Refusal on rock @ 0.15m	Refusal on rock @ 1.1m		Refusal on rock @ 0.9m		Refusal on rock @ 0.25m	

#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 @ 0.15m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP2 – Refusal on rock @ 1.1m, DCP bouncing off rock surface, orange impact dust on dry tip.

DCP3 – Rock exposed at surface.

DCP4 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, clean dry tip, orange and grey clayey sand in collar.

DCP5 – Rock exposed at surface.

DCP6 – Refusal on rock @ 0.25m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP7 – Rock exposed at surface.

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 fill, sandy soils and sandy clays that fill the bench step formation. Filling has been placed above and below the dwellings for landscaping. In the test locations, the depth to rock ranged between 0.15 to 1.1m below the current surface, being slightly deeper due to the presence of fill and the stepped nature of the underlying bedrock. The outcropping sandstone on the property is estimated to be medium strength or better and similar strength rock is expected to underlie 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. This type of seepage was observed at the rock exposure immediately behind the garage (Photo 6). 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. It is expected that normal sheet wash will move onto the site from above the property during heavy down pours. This will move down the slope at a relatively high velocity due to the steep slope.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The steeply graded slope that rises across the property and continues above and below is a potential hazard (**Hazard One**). The large sandstone face that steps ~2.0m up the slope is a potential hazard (photo 2) (**Hazard Two**). The vibrations from the proposed excavations are a potential hazard (**Hazard Three**). The proposed excavation is a potential hazard until retaining walls are in place (**Hazard Four**). The tilted and partially collapsed retaining wall on the uphill side of the property is a potential hazard (Photo 11) (**Hazard Five**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two	Hazard Three
TYPE	The steep slope that rises across the property and continues above and below failing and impacting on the proposed works.	The sandstone face that rises ~2.0m up the slope failing and impacting on the proposed works (Photo 2).	The vibrations produced during the proposed excavation impacting on the surrounding structures.
LIKELIHOOD	'Unlikely' (10^{-4})	'Unlikely' (10^{-4})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (25%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})
RISK TO LIFE	9.1×10^{-7}/annum	$2.9 \text{ X } 10^{-7}$/annum	5.3×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE', subject to the advice in **Section 16** being followed.	This level of risk is 'ACCEPTABLE'.	'UNACCEPTABLE' level of risk to life and property. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 12** are to be followed.

RISK ANALYSIS ON THE NEXT PAGE

HAZARDS	Hazard Four	Hazard Five
TYPE	The excavation (up to a maximum depth of 1.2m) collapsing onto the work site before retaining walls are in place.	Further movement of the stack rock retaining wall above the house that causes damage or failure (Photo 11).
LIKELIHOOD	'Possible' (10^{-3})	'Likely' (10^{-2})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Insignificant' (0.5%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Low' (5×10^{-5})
RISK TO LIFE	8.3×10^{-6}/annum	4×10^{-7}/annum
COMMENTS	'UNACCEPTABLE' level of risk to life and property. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 13** are to be followed.	This level of risk to life and property is 'ACCEPTABLE'. **Section 16** provides recommendations regarding this wall.

(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 Peronne Avenue. 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 ~1.2m is required to install the proposed pool. The excavation is expected to be through filling, sandy soils, and clayey sands with Medium Strength Sandstone either exposed or expected at depths between 0.9m and 1.1m below the surface.

It is envisaged that excavations through fill, 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 fill, soil and clay will be below the threshold limit for building damage. It is possible the base of the excavation may reach the underlying Sandstone bedrock.

Excavations through rock should be carried out to minimise the potential to cause vibration damage to the existing subject dwellings and neighbouring structures to the W. The setbacks are as follows:

- ~1.2m from the uphill subject dwelling.
- ~6.0m from the downhill subject dwelling.
- ~1.5m from the W common boundary wall.
- ~2.9m from the W neighbouring house.

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 property 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 property 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 properties.

13. Excavation Support Requirements

Following the demolition of the timber retaining walls in the location of the proposed works and deck immediately upslope, no structures or boundaries will be within the zone of influence of either excavation. In this instance, the zone of influence is the area above a theoretical 30° line from the top of Medium Strength Rock towards the surrounding structures and boundaries.

The fill, soil, and clay portions of the proposed pool excavation are expected to stand at near-vertical angles for short periods of time until the pool structure is installed, provided the cut batters are kept from becoming saturated. If the cut batters through soil and clay remain unsupported for more than a few days before pool construction commences, they are to be supported with typical pool shoring until the pool structure is in place. Excavations through Medium Strength Rock 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 fill and 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 pool structure/retaining walls are to be organised so on completion of the excavation they 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 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 – Likely Earth Pressures for Retaining Structures

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Fill & Sandy Soil	20	0.40	0.55
Residual Clays	20	0.30	0.40
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 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

Due to the presence of fill and steep grade of the slope below the location of the proposed pool, piers potted some 0.3m into Medium Strength Sandstone are suitable footings for the proposed pool structure. This material is expected at depths up to a maximum of ~1.1m below the current surface.

Any additional footings required for the proposed extension to the downhill side of the lower dwelling are to also be potted 0.3m into the Medium Strength Sandstone bedrock. This ground material is exposed or expected at shallow depths in the location of the proposed extension.

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 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. Site Maintenance

On steep slopes such as on this site, it is prudent for the owners to occasionally inspect the slope (say annually or after heavy rainfall events, whichever occurs first). Should any of the following be observed: movement or cracking in retaining walls (Photo 5), cracking in any structures, cracking or movement in the slope surface, tilting or movement in established trees, leaking pipes, or newly observed flowing water, or changes in the erosional process or drainage regime, then a geotechnical consultant should be engaged to assess the slope. We can carry out these inspections upon request. The risk assessment in **Section 8** is subject to this site maintenance being carried out.

17. Remedial Advice

The roughly stacked rock retaining wall on the uphill common boundary is in the process of collapsing (photo 11). Should it collapse, it will block the drain and damage the pipes. We recommend it be restacked or rebuilt to current engineering standards during the proposed works. Alternatively, the retaining wall can to be inspected by the owners on an annual basis or after heavy prolonged rainfall, whichever occurs first, keeping a photographic record of the inspections. We can carry out these inspections upon request. Should any new movement be observed, the retaining wall is to be remediated or rebuilt to current engineering standards.

18. Inspection

The client and builder are to familiarise themselves with the following required inspection as well as council geotechnical policy. We cannot provide geotechnical certification for the owners or the regulating authorities if the following inspection has 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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No. 222757
Engineering Geologist.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12 (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.

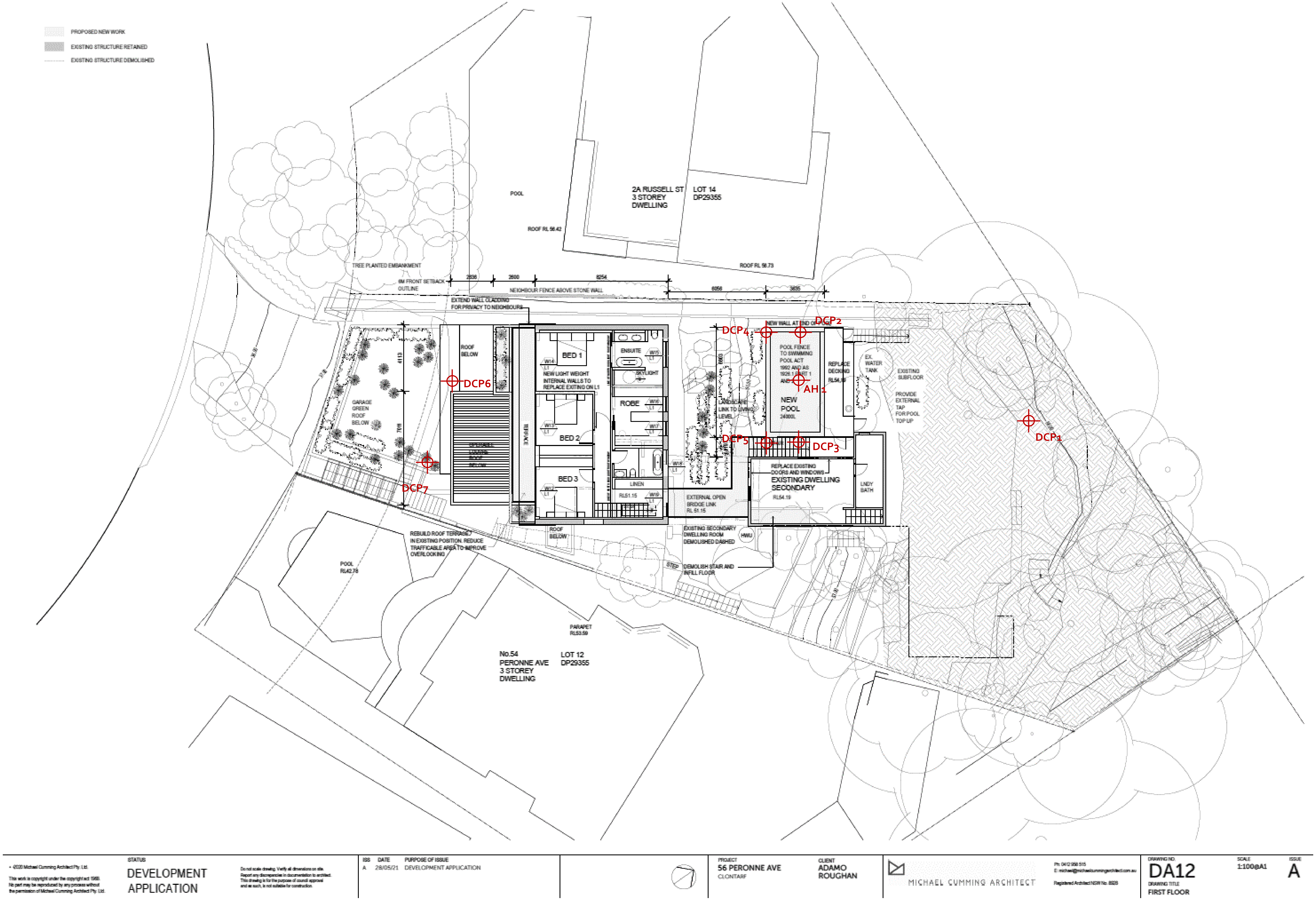
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

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

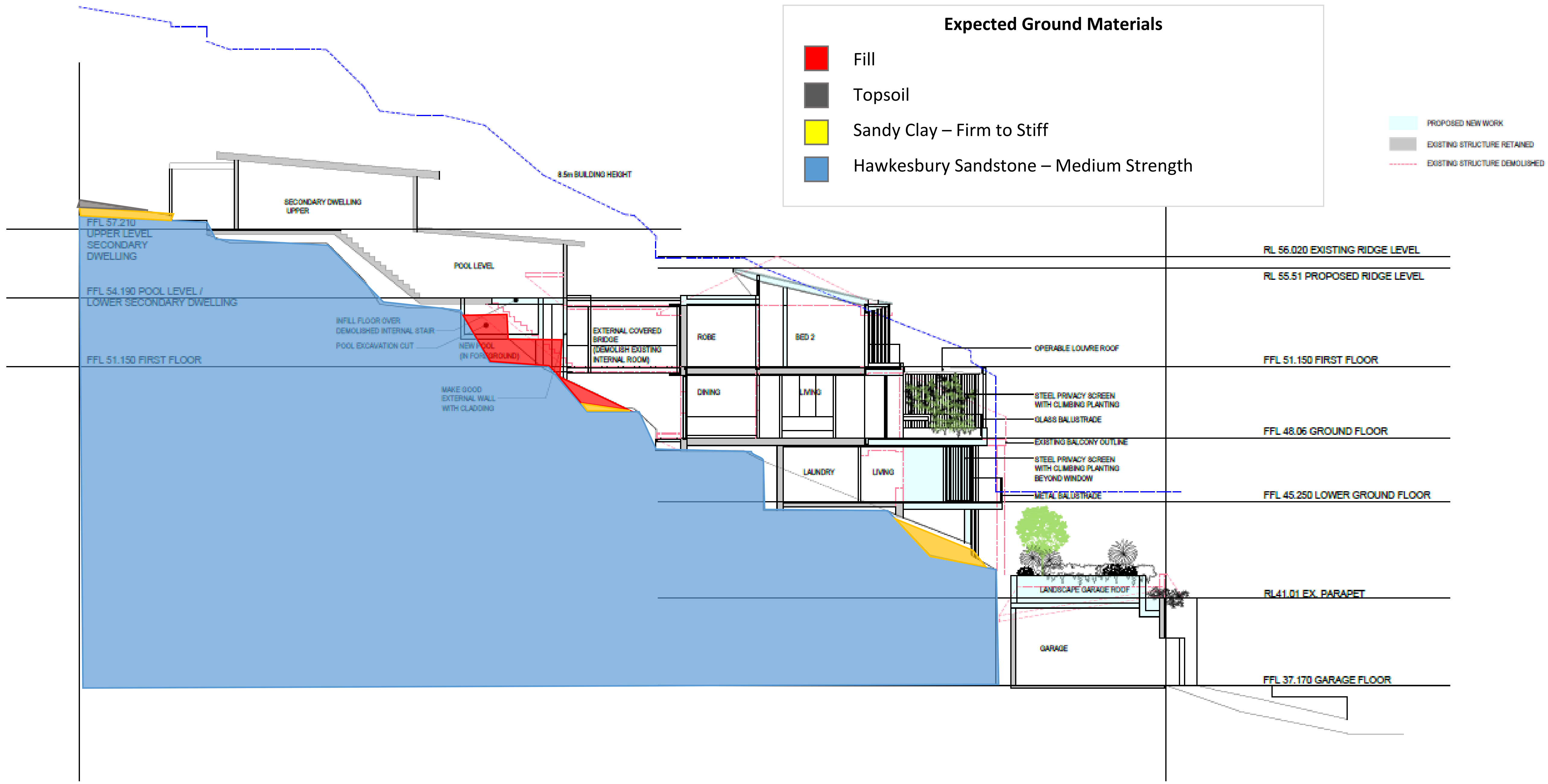
- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- 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



TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



STATUS
DEVELOPMENT APPLICATION

Do not scale drawing. Verify all dimensions on site. Report any discrepancies in documentation to architect. This drawing is for the purpose of council approval and as such, is not suitable for construction.

ISS	DATE	PURPOSE OF ISSUE
A		DEVELOPMENT APPLICATION

PROJECT
56 PERONNE AVE
CLONTARF

CLIENT
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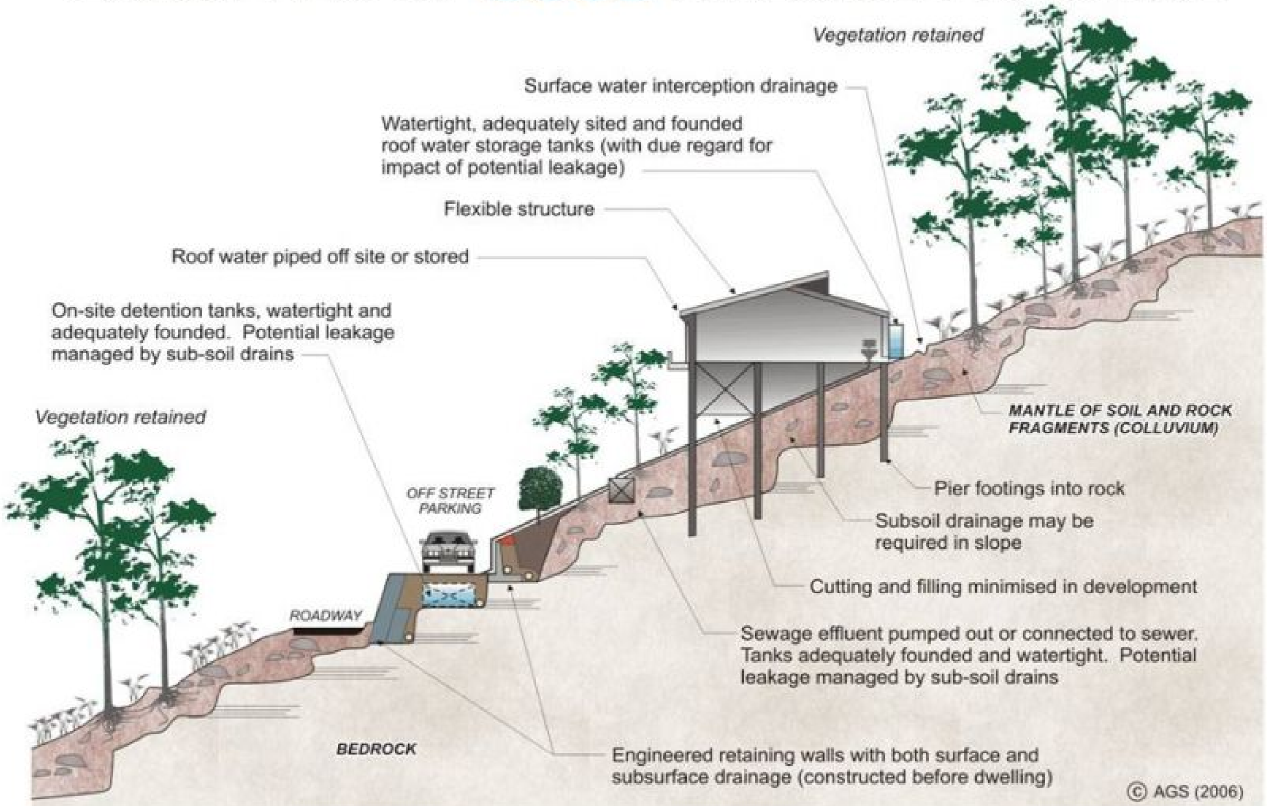
DRAWING NO. DA25
DRAWING TITLE SECTION A
SCALE 1:100@A1
ISSUE A

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE