GEOTECHNICAL INVESTIGATION:

New House at **45 Oxford Falls Road, Beacon Hill**

1. Proposed Development

1.1 Subdivide the block 25.5m W of Oxford Falls Rd.

1.2 Build a carport on the properties N downhill boarder by excavating ~2.5m.

1.3 Details of the proposed development are shown on 2 drawings prepared by Michal Korecky, Drawing number 18080 and are dated 13/6/19.

2. Site Description

2.1 The site was inspected on the 17th July, 2019.

2.2 This residential property has dual access. It is on the high side of Oxford Falls Road and on the low side of Dareen Street. The property has a N aspect. From the road frontage with Oxford Falls Road, the natural slope rises at steep angles of ~23° before encountering a rock face. The rock face reaches a maximum height of ~4.5m. From the top of the rock face to the upper boundary, the slope rises at an average angle of ~6°. A steep, densely-vegetated slope rises from the road frontage to Oxford Falls Road to the base of a rock face. No undercutting or other significant geological defects were observed in the rock face and it is considered stable.

2.3 A gently sloping lawn rises from the top of the rock face to the downhill side of the house. The lawn steps up below the house where the slope is filled. The fill is supported by a ~0.8m high stable concrete block retaining wall. The part two-storey brick and weatherboard clad house is supported on brick walls and brick piers. The external supporting brick walls of the house show no significant signs of cracking and the supporting brick piers stand vertical. A gently sloping lawn rises from the uphill side of the house to the upper boundary. The property is accessed by a concrete Right of Carriageway (ROW) off Dareen Street. The ROW runs to a concrete parking area and stable weatherboard clad garage on the uphill side of the property. The area surrounding the house is mostly paved or lawn covered.

2.4 No signs of movement associated with slope instability were observed on the grounds. The adjoining neighbouring properties were observed to be in good order as seen from the road and the subject property.

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 the soil materials. Two 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 (~RL26.75) **–** AH1 (Photo 5)

Depth (m)	Material Encountered
0.0 to 0.15	**TOPSOIL**, sandy soil, brown, medium grained with fine trace organic matter.
0.15 to 0.3	**SANDY SOIL**, light brown medium grained with clumps of white clay.

End of hole @ 0.3m grinding on rock surface. 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** (~RL26.75)	**DCP 2** (~RL27.5)
0.0 to 0.3	10	2
0.3 to 0.6	5	8
0.6 to 0.9	#	#
	Refusal on Rock @ 0.35m	Refusal on Rock @ 0.45m

#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 @ 0.35m, DCP bouncing off rock surface, white impact dust on dry tip
DCP2 – Refusal on rock @ 0.45m, DCP bouncing off rock surface, clean dry tip.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the outcropping and 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 that fill the bench step formation. In the test locations where it was not exposed, rock was encountered at depths of between 0.3 to 0.5m below the current surface. The neighbour's excavated carport is positioned 0.9m E of the proposed development (Photo 3) and exposed sandstone bedrock at 0.2m below the surface (Photo 4). The exposed rock across the site is estimated to be Medium Strength and 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 significant surface flows were observed on the property during the inspection. Normal sheet wash from the slope is expected to flow over the site. A proposed 0.9m stormwater easement will run between the E boundary of the site and the proposed car port.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The sandstone cliff face that rises just beyond the street frontage is a potential hazard (**Hazard One**). The vibrations from the proposed excavations are a potential hazard (**Hazard Two**). The proposed excavations are a potential hazard until retaining walls are in place (**Hazard Three**).

Risk Analysis Summary on the Next Page

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two	Hazard Three
TYPE	The sandstone cliff face above the carport failing and impacting on the proposed works (Photo 1).	The vibrations produced during the proposed excavations impacting on the cliff and supporting walls of the neighbouring carport.	The proposed excavations collapsing onto the work site before retaining walls are in place.
LIKELIHOOD	'Rare' (10^{-5})	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Major' (40%)	'Medium' (15%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (6×10^{-5})	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	9.96×10^{-6}/annum	5.3×10^{-7}/annum	8.9×10^{-6}/annum
COMMENTS	This level of risk is 'ACCEPTABLE'.	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 toward Oxford Falls Road. 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 ~2.5m is required to construct the proposed carport. This excavation is expected to be taken almost entirely through Medium Strength Sandstone.

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, 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 rock face immediately above and the neighbouring carport. The supporting walls of the neighbouring carport to the E will be as close as ~0.9m 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 fill and soil from the top of Medium Strength Sandstone towards the surrounding structures and boundaries.

Where shallow soil overlies the rock surface it is to be removed to 1.0m beyond the excavation footprint before excavation through rock commences. The excavation through medium strength sandstone or better will stand unsupported until retaining walls are in place.

It should be noted that clay seam some meter thick was observed in the existing cut for the neighbouring garage. If this seam is continuous we would expect it towards the base of the proposed cut. See type section. If the seam is present we do not expect it to be a major stability issue. To prevent the clay portion of the seam reeling back it may require support with drained sprayed concrete and mesh. The geotechnical consultant is to inspect the cut face as it is lowered in intervals of ~1.5m and can make the call on the stability of the clay seam when and if it is exposed.

All excavation spoil is to be removed from site.

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 on the Next Page

Table 1 – Likely Earth Pressures for Retaining Walls

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Fill, 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 carport. This material is expected to be exposed across the base of the excavation. A maximum allowable bearing pressure of 800kPa 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.

- The geotechnical consultant is to inspect the cut face as it is lowered to a depth of ~1.5m, while the machine/excavation equipment 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.
- 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

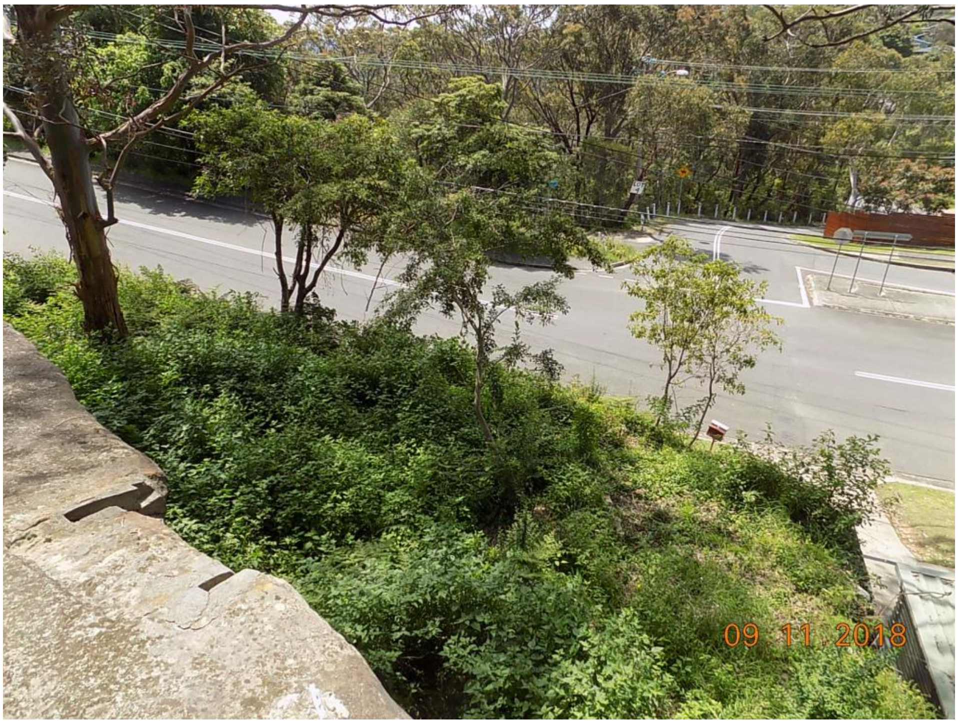


Photo 2

Photo 3

Photo 4

Photo 5–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.

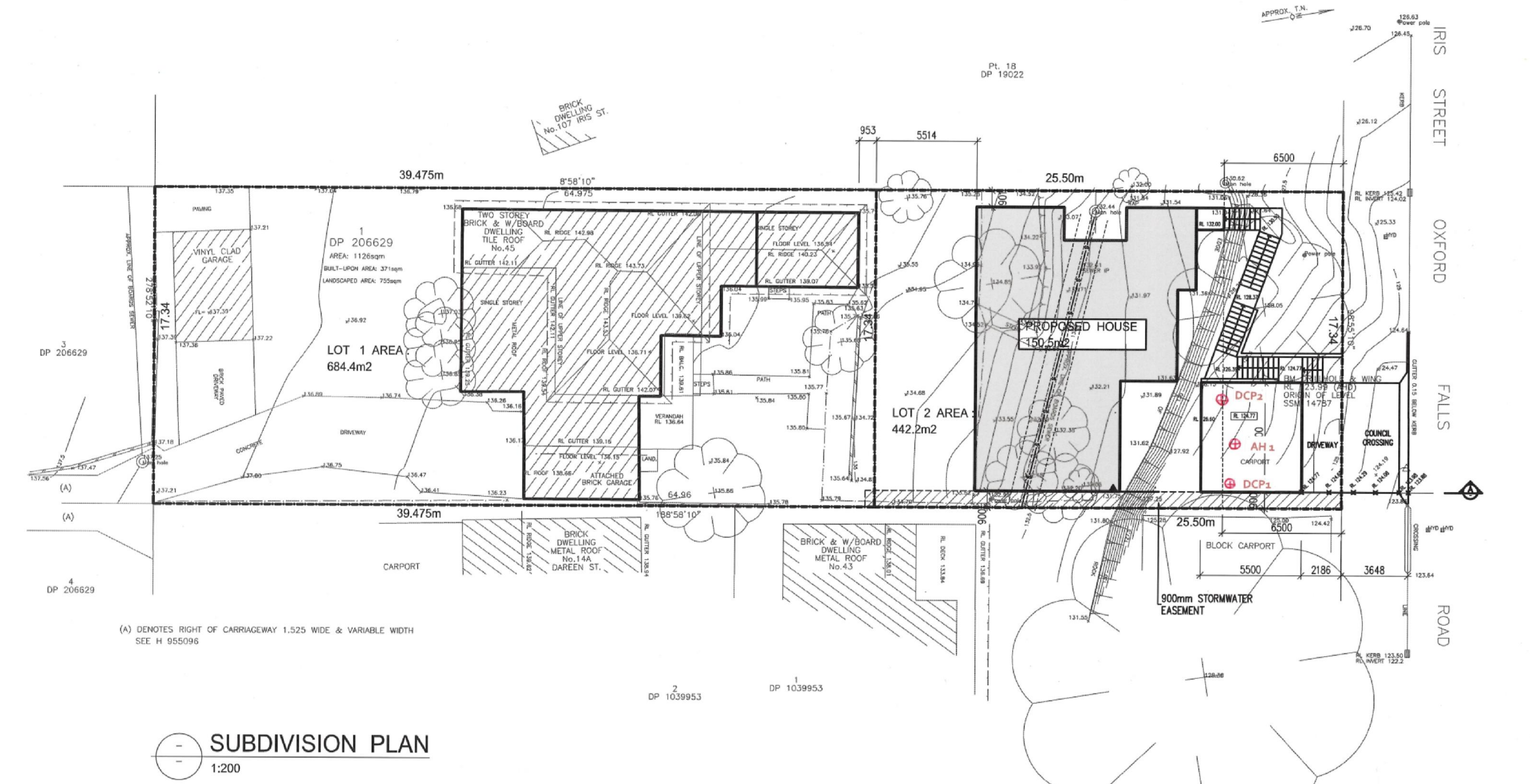
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



SUBDIVISION PLAN

1:200

GENERAL NOTES:

1 Builder to check and confirm all necessary dimensions on site prior to construction. Do not scale the drawing.
2 All dimensions that relate to site boundaries and easments are subject to verification by site survey.
3 All work to be in accordance with BUILDING CODE of AUSTRALIA & to the satisfaction of local council requirements & other authorities.
4 All timber construction to be in accordance with the "TIMBER FRAMING" code.
5 Any detailing in addition to what is supplied shall be resolved between the owner and the builder to the owner's approval, except for any structual details or design which is to be supplied by Structual Engineer.
6 Roof water & sub-soil drainage to be disposed of in the approved manner or as directed by local council inspectors.
7 All electrical power & light outlets to be determined by owner.
8 Make good and repair all existing finishes damaged by new work. Reuse existing material where possible.

No.	AMENDMENT	DATE
1	ISSUED FOR DA	13/06/19

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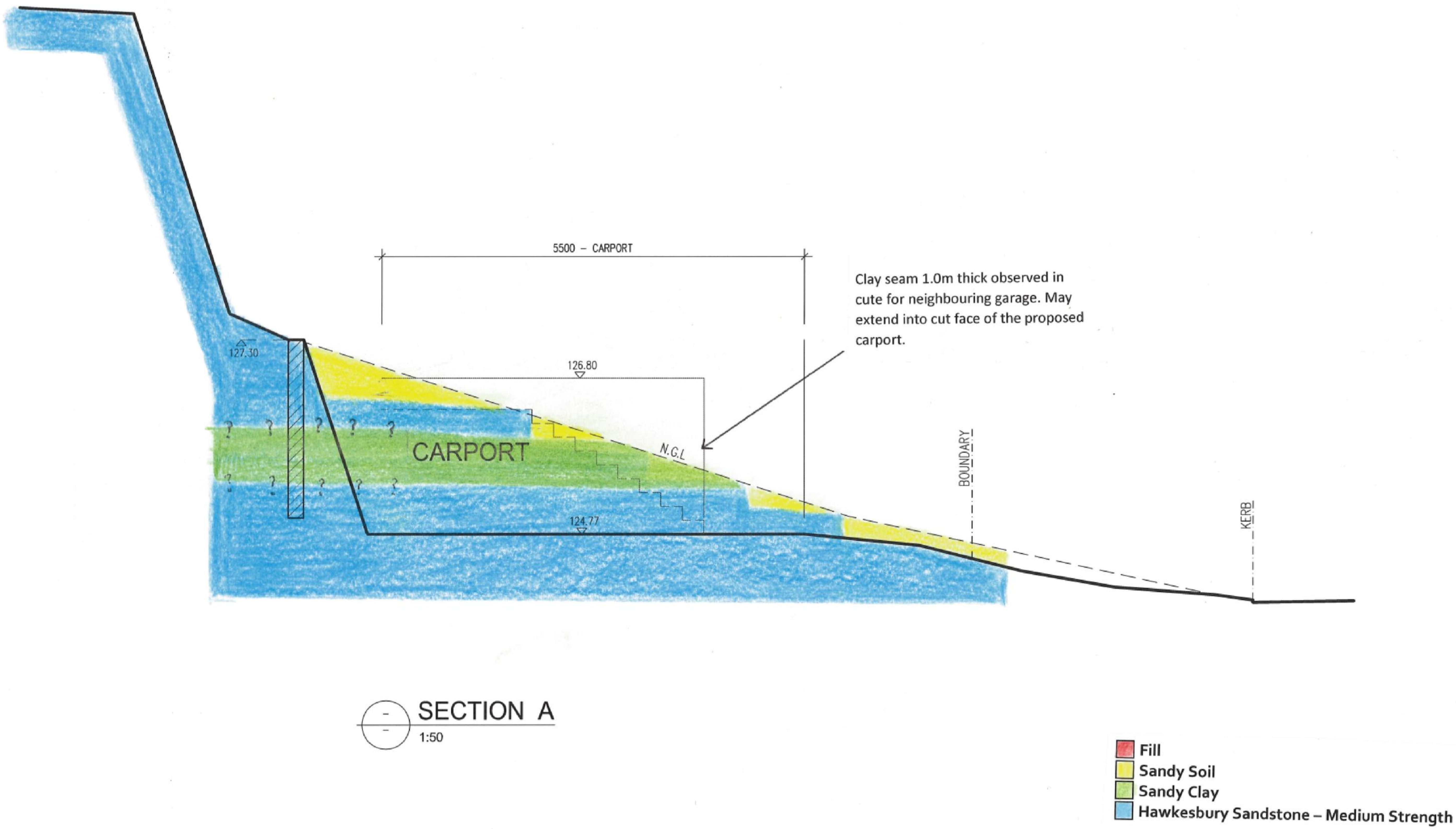
PROJECT:
SUBDIVISION
No 45 OXFORD FALLS ROAD
BEACON HILL
CLIENT:
JIRI AND MARCELA ALBRECHT

DATE: 13/06/19	SCALE: AS NOTED
DRAWN: MK	ISSUE: 1
DRAWING Nr : 18080	SHEET: 1

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



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No.	AMENDMENT	DATE
1	ISSUED FOR DA	13/06/19

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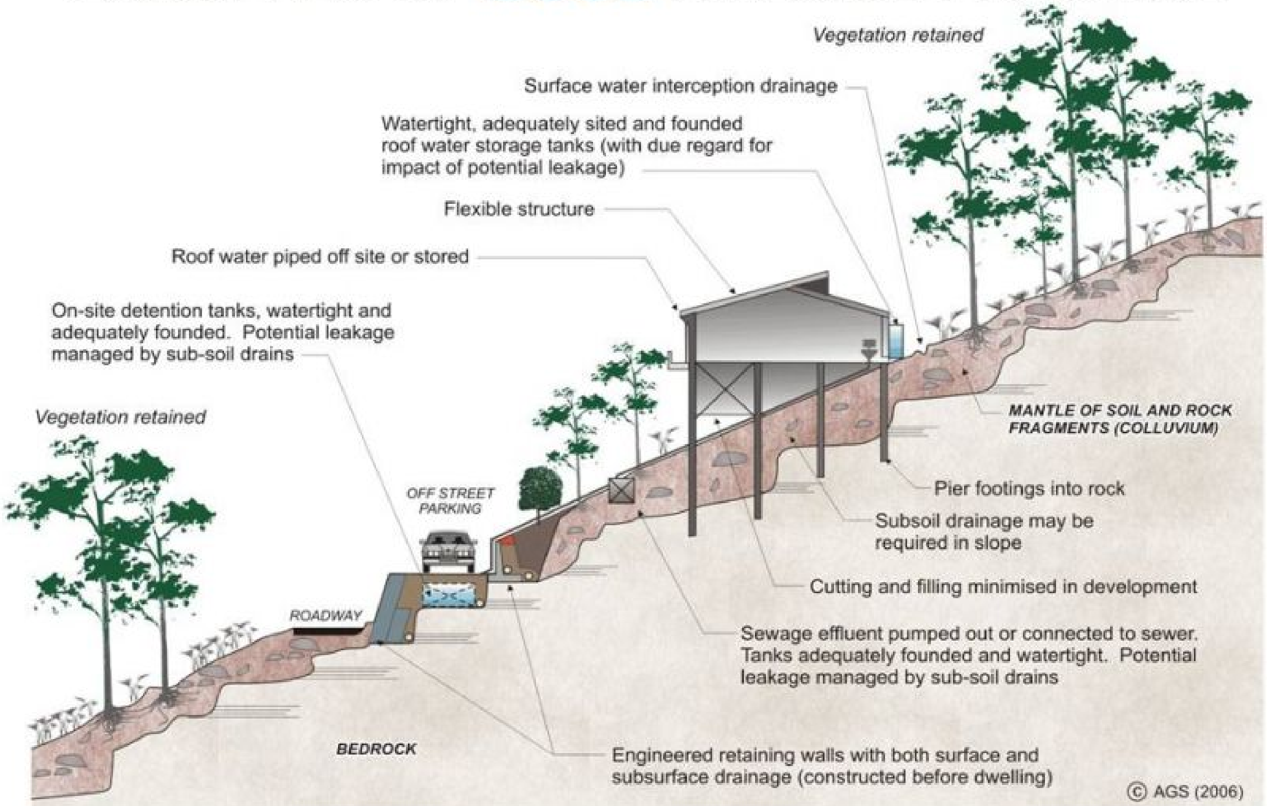
PROJECT:
SUBDIVISION
No 45 OXFORD FALLS ROAD
BEACON HILL
CLIENT:
JIRI AND MARCELA ALBRECHT

DATE: 13/06/19	SCALE: AS NOTED
DRAWN: MK	ISSUE: 1
DRAWING Nr : 18080	SHEET: 2

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE