GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **13 Carolyn Avenue, Beacon Hill**

1. Proposed Development

1.1 Construct a new lower floor extension by excavating to a maximum depth of ~2.2m into the slope.

1.2 Extend the existing balcony on the downhill side of the house.

1.3 Extend the existing upper floor of the house.

1.4 Various other internal and external alterations.

1.5 Details of the proposed development are shown on 6 drawings prepared by Network Design, drawing number 02-21-CAR, sheets numbered 1 to 6, dated February, 2021.

2. Site Description

2.1 The site was inspected on the 29th April, 2021.

2.2 This residential property is on the high side of the road and has a N aspect. The block is located on the gentle to moderately graded upper middle reaches of a hillslope. The natural surface rises across the property at an average angle of ~11°. The slope above and below the property continues at similar angles.

2.3 At the road frontage, a concrete driveway runs up the slope to a garage on the lower ground floor of the house (Photo 1). Between the road frontage and the house is a gently sloping lawn-covered fill (Photo 2). The fill is supported by a stable stack rock retaining wall reaching ~1.0m high (Photo 3). This wall was observed to be supported directly onto outcropping Medium Strength Sandstone at the road frontage. The part three-storey rendered brick house is supported on brick walls and brick piers (Photo 4). The supporting walls display no significant signs of movement and the supporting piers stand vertical. Many of the walls and piers were observed to be supported directly off competent Medium Strength Sandstone bedrock within the foundation space of the house (Photo 5). A gently sloping lawn extends off the uphill side of the house to the base of a terraced slope (Photo 6). The slope is terraced with a series of stable brick retaining walls reaching ~1.0m high (Photo 7). Many of these walls were observed to be supported directly onto outcropping sandstone bedrock. An outcrop in the SW corner of the property was observed to be undercut to ~1.0m (Photo 8). The undercut joint block has a relatively thick cantilever arm compared to its overhang length and displays no signs of cracking as viewed from below. The undercut is considered stable.

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

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 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:

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** (~RL124.1)	**DCP 2** (~RL124.1)	**DCP 3** (~RL122.2)	**DCP 4** (~RL121.6)	**DCP 5** (~RL121.8)
0.0 to 0.3	4	Rock Exposed at Surface	6	12	Rock Exposed at Surface
0.3 to 0.6	2		9	6	
0.6 to 0.9	#		#	3	
0.9 to 1.2				10	
1.2 to 1.5				#	
	Refusal on Rock @ 0.4m		Refusal on Rock @ 0.6m	Refusal on Rock @ 1.0m	

#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 @ 0.4m, DCP bouncing off rock surface, orange sandstone fragments on dry tip.

DCP2 – Rock exposed at surface.

DCP3 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, white impact dust and brown sand on damp tip.

DCP4 – Refusal on rock @ 1.0m, DCP bouncing off rock surface, light brown clay on dry tip.

DCP5 – 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 sandy soils over sandy clays that fill the bench step formation. Filling has been placed above and below the house for landscaping. In the test locations where rock was not exposed, the depth to rock ranged between 0.4 to 1.0m below the current surface, being slightly deeper due to 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. 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.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The gentle to moderately graded slope that rises across the property and continues above and below 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**). The proposed excavations undercutting the footings for the house is a potential hazard (**Hazard Four**).

RISK ANALYSIS SUMMARY IS ON THE NEXT PAGE

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The gentle to moderate slope that rises across the site and continues above and below failing and impacting on the proposed works.	The vibrations produced during the proposed excavations impacting on the surrounding structures.
LIKELIHOOD	'Unlikely' (10^{-4})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.5×10^{-7}/annum	5.3×10^{-7}/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.

HAZARDS	Hazard Three	Hazard Four
TYPE	A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process.	The proposed excavations undercutting the footings of the house causing failure (Photo 5).
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (20%)	'Medium' (35%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.4×10^{-5}/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 Carolyn 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

Excavations to a maximum depth of ~2.2m are required to extend the lower floor. The excavations are expected to be through a shallow soil over Medium Strength Sandstone.

It is envisaged that excavations through soil 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 soil will be below the threshold limit for building damage.

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 properties to the E and W. The excavation will be taken immediately beside the supporting walls of the subject house and will be set back ~2.1m from the W neighbouring house and ~7.9m from the E neighbouring house.

Dilapidation reporting carried out on the E and W neighbouring properties is recommended prior to the excavation works commencing.

Excavation methods are to be used that limit peak particle velocity to 5mm/sec at the property boundaries. Vibration monitoring will be required to verify this is achieved. Vibration monitoring must include a light/alarm so the operator knows if vibration limits have been exceeded the equipment is to 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, 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 and creating more saw breaks in the rock where vibration limits are exceeded.

13. Excavation Support Requirements

The excavations will come close to flush with the supporting brick walls of the subject house (Photo 5). However, apart from a thin layer of soil over the rock, the excavations will be taken almost entirely through Medium Strength Sandstone and any nearby structures are already supported on the rock so no structures or boundaries will be within the zone of influence of the excavations.

The shallow soil portions of the cuts will stand at near-vertical angles for short periods of time until the retaining walls are installed, provided the cut batters are kept from becoming saturated. Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

If any supporting walls and/or piers are required to be removed, the house is to be propped and supported with beams prior to the excavation through rock commencing.

During the excavation process, the geotechnical consultant is to inspect the excavations as they approach to within a horizontal distance of not less than 0.7m from the supporting posts and piers 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.

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.

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/m³)	**'Active' K_a**	**'At Rest' K_0**
Soil	20	0.40	0.55
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 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 and shallow piers supported directly off Medium Strength Sandstone are suitable footings for the proposed lower floor extensions. This ground material is expected to be exposed across the majority of the base of the excavations. Where sandstone is not exposed, it is expected at shallow depths.

The proposed balcony extension off the downhill side of the house is to be supported off piers taken to Medium Strength Sandstone. This material is expected at shallow depths of ~1.0m or less below the current surface on the downhill side of the house.

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. 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 owners 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 within a horizontal distance of not less than 0.7m from the supporting posts and piers 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 is still onsite and before steel reinforcing is placed or concrete is poured.

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Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

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.

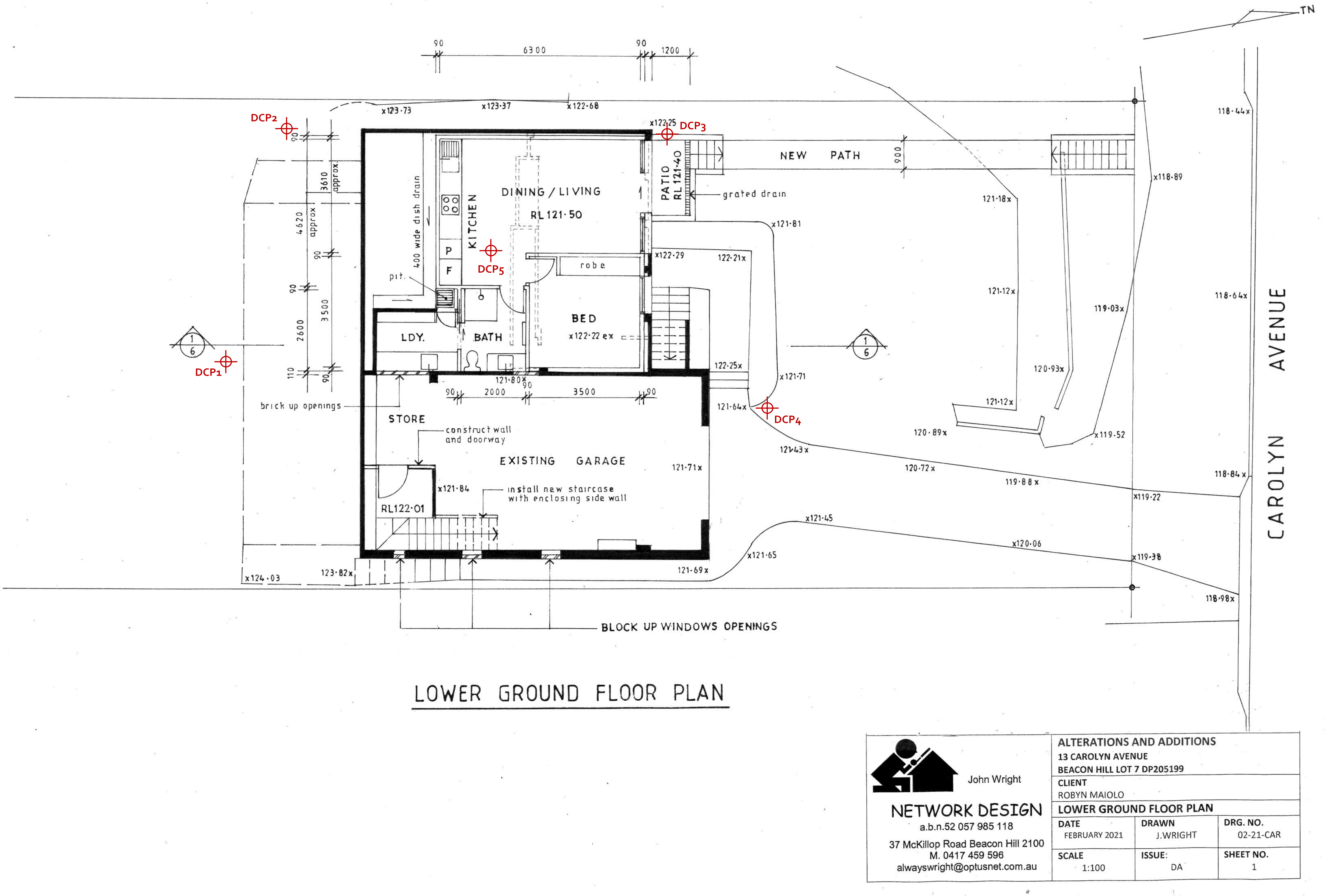
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

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

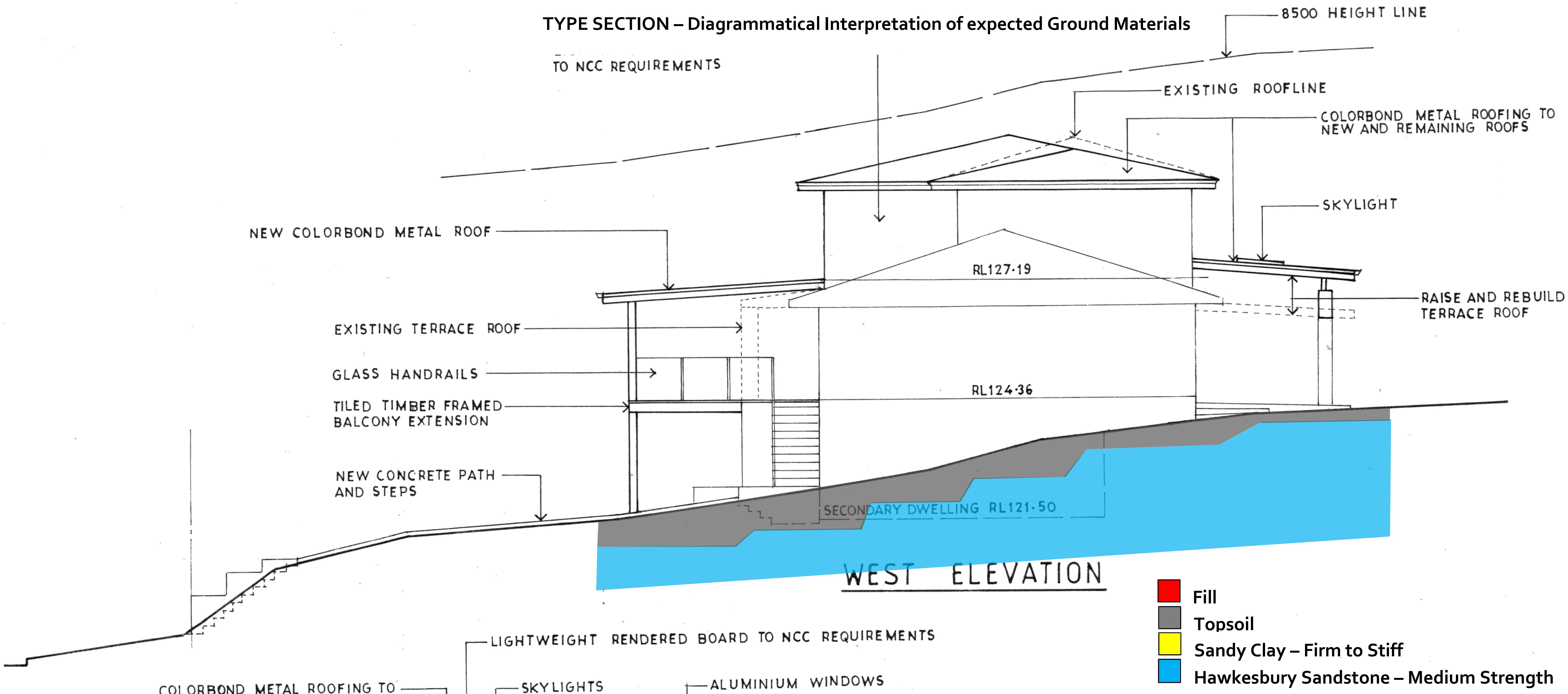
- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

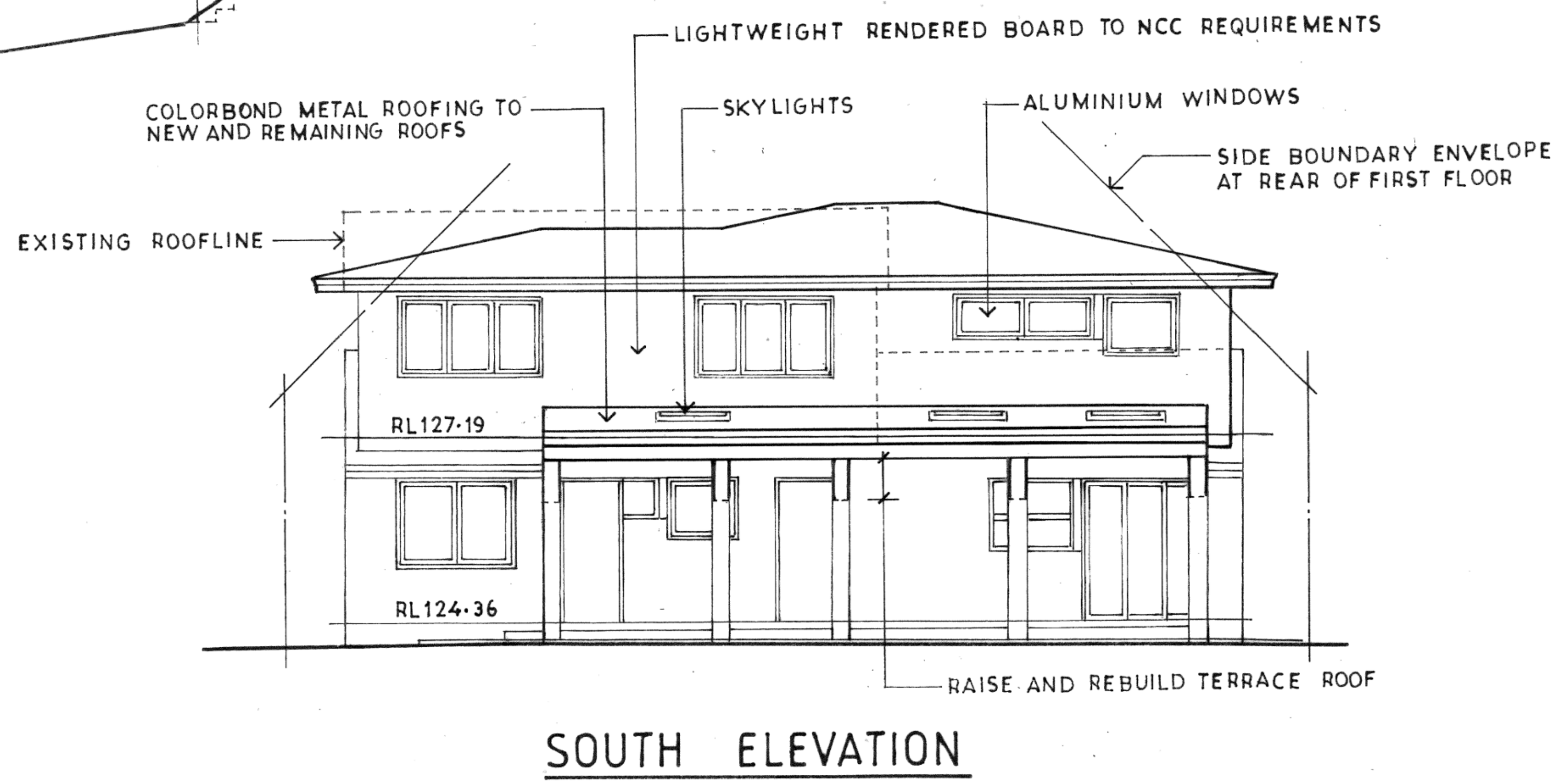
- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar 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





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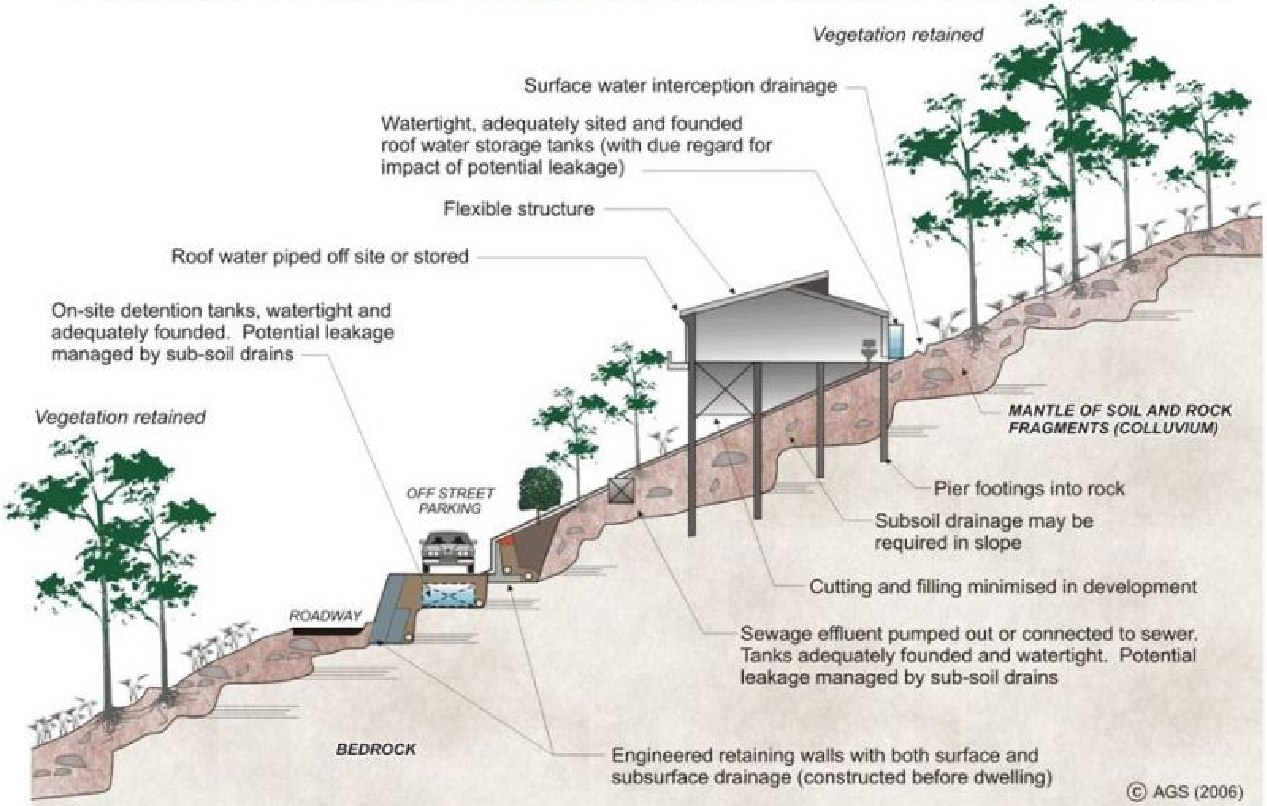
ALTERATIONS AND ADDITIONS 13 CAROLYN AVENUE BEACON HILL LOT 7 DP205199		
CLIENT ROBYN MAIOLO		
WEST AND SOUTH ELEVATION		
DATE FEBRUARY 2021	DRAWN J.WRIGHT	DRG. NO. 02-21-CAR
SCALE 1:100	ISSUE: DA	SHEET NO. 5

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE