GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **21 Heather Street, Wheeler Heights**

1. Proposed Development

1.1 Construct an extension to the downhill side of the house.

1.2 Construct a new driveway and turning area on the downhill side of the property.

1.3 Level the existing lower floor by excavating to a maximum depth of ~1.2m.

1.4 Other minor internal and external additions and alterations.

1.5 Details of the proposed development are shown on 6 drawings prepared by Network Design, Project number 05-21-HEA, drawings numbered 1-6, Issue DA, dated May 2021.

2. Site Description

2.1 The site was inspected on the 2nd November, 2021, and previously on the 9th February, 2021.

2.2 This residential property is on the low side of the street and has a S aspect. It is located on the gentle to moderately graded middle reaches of a hillslope. The slope falls across the property at an average angle of ~5° before falling at moderate angles to the natural bushland reserve below. The slope above the property continues at similar angles.

2.3 At the road frontage, a concrete driveway runs down the slope to a parking area on the W side of the house (Photo 1). Between the road frontage and the house is a level lawn area (Photo 2). The cut for the level lawn area is supported by a ~0.8m high stable brick retaining wall that lines the upper boundary and the fill is supported by a stable brick retaining wall reaching up to ~1.2m high on the W side of the lawn (Photos 3 & 4). The two-storey brick house is supported on brick walls and brick piers (Photo 5). The brick walls show no significant signs of movement. Access to the foundation space was not available at the time of this inspection. A gently sloping lawn area that extends off the downhill side of the house is supported by a low stable concrete block and brick retaining wall (Photo 6). Below the slope falls at moderate angles to the lower boundary and natural bushland reserve below (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

One hand Auger Hole (AH) was put down to identify the soil materials. Four 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:

GROUND TEST RESULTS ON THE NEXT PAGE

AUGER HOLE 1 (~RL60.8) **–** AH1 (Photo 8)

Depth (m)	**Material Encountered**
0.0 to 0.1	**TOPSOIL**, dark brown, medium grained, loose to medium dense, dry.
0.1 to 0.3	**SAND**, dark brown and grey, medium grained, loose to medium dense, damp.

Refusal @ 0.3m on rock. Auger grinding. No water table 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** (~RL62.0)	**DCP 2** (~RL60.8)	**DCP 3** (~RL61.0)	**DCP 4** (~RL63.1)
0.0 to 0.3	12	10	10	10
0.3 to 0.6	10	5	8	8
0.6 to 0.9	#	#	#	12
0.9 to 1.2				#
	Refusal on Rock @ 0.6m	Refusal on Rock @ 0.35m	Refusal on Rock @ 0.45m	Refusal on Rock @ 1.1m

#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 @ 0.6m, DCP bouncing off rock surface, white impact dust dry tip.

DCP2 – Refusal on rock @ 0.35m, DCP bouncing off rock surface, orange impact dust on dry tip.

DCP3 – Refusal on rock @ 0.45m, DCP bouncing off rock surface, orange impact dust on dry tip.

DCP4 – Refusal on rock @ 1.1m, 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 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. Filling has been placed around the site for minor levelling. The rock is overlain by a thin topsoil over sands that fill the bench step formation. In the test locations, the depth to rock ranged between 0.3 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 sandstone underlying the property is estimated to be medium strength or better as the DCP bounced at the end of every test. 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 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 Heather Street above.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The gentle to moderately graded slope that falls across the property and continues above and below is a potential hazard (**Hazard One**). The vibrations from the proposed excavation are a potential hazard (**Hazard Two**). The proposed excavation is a potential hazard until retaining walls are in place (**Hazard Three**). The proposed excavation undercutting the footings for the house is a potential hazard (**Hazard Four**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The gentle to moderate slope that falls across the property and continues above and below failing and impacting on the proposed works.	The vibrations produced during the proposed excavation 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	8.3×10^{-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	The excavation (up to a maximum depth of 1.2m) collapsing onto the work site before retaining structures are in place.	The proposed excavation undercutting the footings of the house causing failure.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (35%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	8.3×10^{-6}/annum	5.3×10^{-5}/annum
COMMENTS	This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 13 and 14** 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 away from the street. As a bushland reserve is immediately below the property, it is recommended stormwater runoff from the proposed works be piped to a spreader pipe clear of the downhill side of the house, through any tanks that may be required by the regulating authorities.

11. Excavations

An excavation up to a maximum depth of ~1.2m is required to level the lower floor of the existing house. The excavation is expected to be through sandy soils and sand with Medium Strength Rock expected at depths of between ~0.3m and ~0.6m below the current surface in the area of the proposed works.

It is envisaged that excavations through sandy soils and sand can be carried out with an excavator and bucket, and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavations through soil and sand will be below the threshold limit for building damage. It is expected that the majority of the excavation will be through Medium Strength Sandstone or better.

Excavations through rock should be carried out to minimise the potential to cause vibration damage to the subject house and neighbouring property to the E and W. Allowing ~0.5m for backwall drainage, the setbacks are as follows:

- Flush with the existing walls of the subject house.

- ~4.0m from the W neighbouring structure.
- ~7.0m from the E neighbouring structure.

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 8mm/sec at the subject walls. 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 excavation for the levelling of the lower floor will reach a maximum depth of ~1.2m. Allowing ~0.5m for backwall drainage, the setbacks are as follows:

- Near flush with the walls of the subject house.
- ~2.2m from the W common boundary.

As such, only the existing walls of the subject house will lie within the zone of influence of the proposed excavation. In this instance, the zone of influence is the area above a theoretical

30° line from the base of the excavation or top of Medium Strength Rock, whichever is encountered first, towards the surrounding structures and boundaries.

Given the shallow depth to rock, we think it is likely the supporting walls of the house are supported on rock. However, to be sure, where the walls of the house fall within the zone of influence of the excavation, exploration pits will need to be put down by the builder to determine the foundation depth and material. These are to be inspected by the geotechnical consultant.

If the foundations are found to be supported on rock or extend below the zone of influence of the proposed excavation, the excavation may commence. If they are not, the walls will need to be underpinned to rock or to below the zone of influence of the cut prior to the excavation commencing. See the site plan attached for the minimum extent of the required exploration pits/underpinning.

Underpinning is to follow the underpinning sequence 'hit one miss two'. Under no circumstances is the bulk excavation to be taken to the edges of the walls and then underpinned. Underpins are to be constructed from drives that should be proportioned according to footing type and size. Allowances are to be made for drainage through the underpinning to prevent a build-up of hydrostatic pressure. Underpins that are not designed as retaining walls are to be supported by retaining walls. The void between the retaining walls and the underpinning is to be filled with free-draining material such as gravel.

During the excavation process, the geotechnical consultant is to inspect the excavations as they approach no 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.

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.

Upon completion of the excavation, it is recommended all cut faces be supported with retaining walls to prevent any potential future movement of joint blocks in the cut face that can occur over time, when unfavourable jointing is obscured behind the excavation face. Additionally, retaining walls will help control seepage and to prevent minor erosion and sediment movement. Excavation spoil may be used for landscaping on site.

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/m^3)	'Active' K_a	'At Rest' K_0
Fill and Sandy Soil	20	0.40	0.55
Clays and Sands	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 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 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 walls, the likely hydrostatic pressures are to be accounted for in the structural design.

15. Foundations

The driveway and turning circle can be supported off the natural surface after any organic matter has been stripped. A maximum allowable bearing pressure of 100kPa can be assumed for soil of the natural surface. Where the foundation material changes between the garage and driveway, expansion joints are to be installed to separate the different foundation materials and to accommodate minor differential movement. Alternatively, the entire driveway and turning circle can be supported on rock.

The proposed extension to the downhill side of the house and levelled lower ground floor are expected to be partially seated in Medium Strength Sandstone. This is a suitable foundation material. This ground material is expected to be exposed across the uphill side of the excavation. Where it is not exposed, and where the footprint of the proposed works does not fall over the excavations, shallow piers taken to rock will be required to maintain a uniform bearing material across the structure. The piers for the downhill side of the house are expected to encounter Medium Strength Sandstone at depths from between 0.3 to 0.6m below the current surface.

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 owner or the regulating authorities if the following inspections have not been carried out during the construction process.

- The exploration pits to determine the foundation material along the supporting walls of the house are to be inspected by the geotechnical consultant to determine if underpinning is necessary. This is to occur before the bulk excavation for the lower floor commences.
- During the excavation process, the geotechnical consultant is to inspect the excavations as they approach no 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.
- 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.

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Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8 (Left to right)

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.

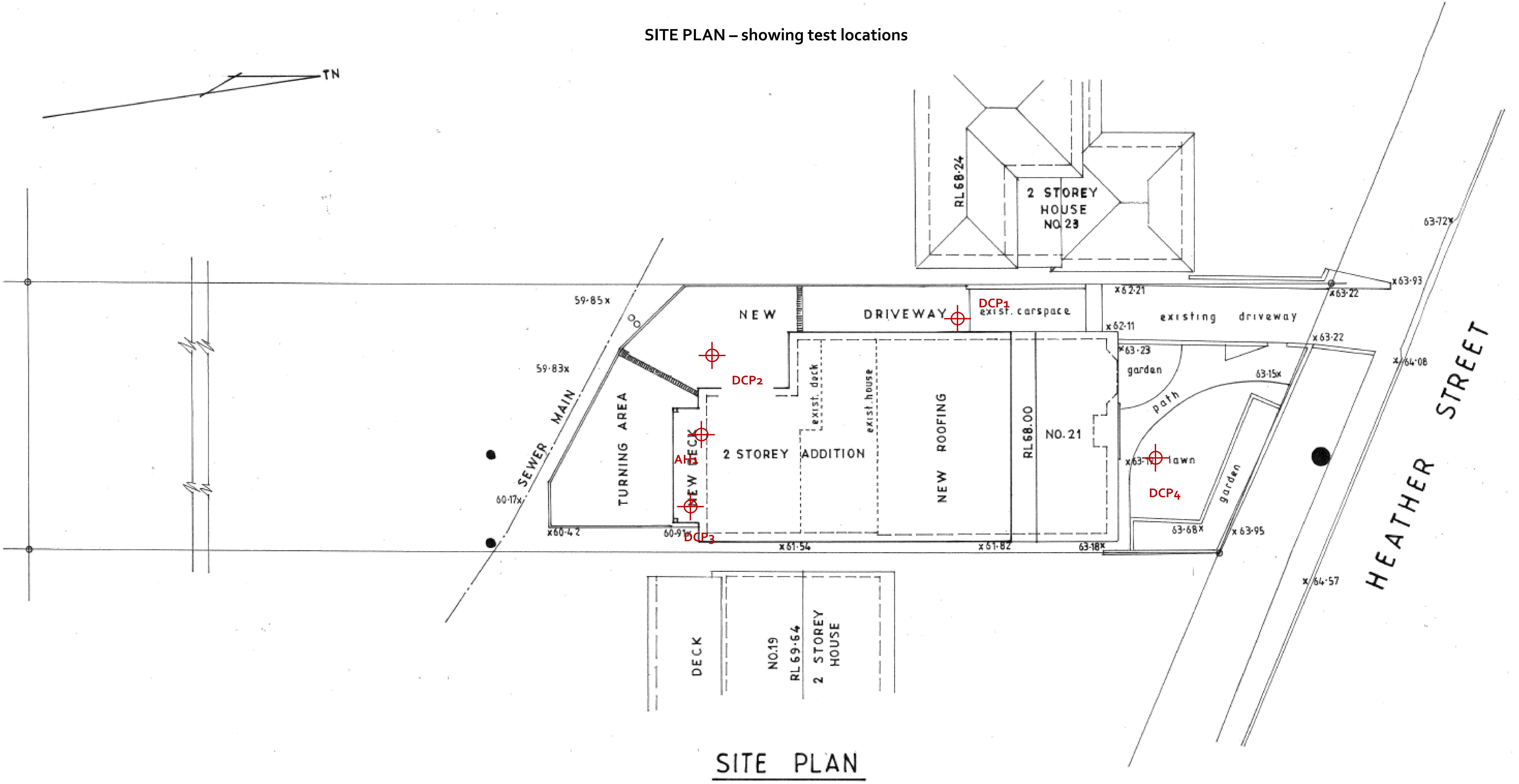
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



John Wright NETWORK DESIGN	ALTERATIONS AND ADDITIONS 21 HEATHER STREET WHEELER HEIGHTS LOT100 DP8871		
a.b.n.52 057 985 118	CLIENT RYAN AND DANI OLIVEY		
37 McKillop Road Beacon Hill 2100	SITE PLAN		
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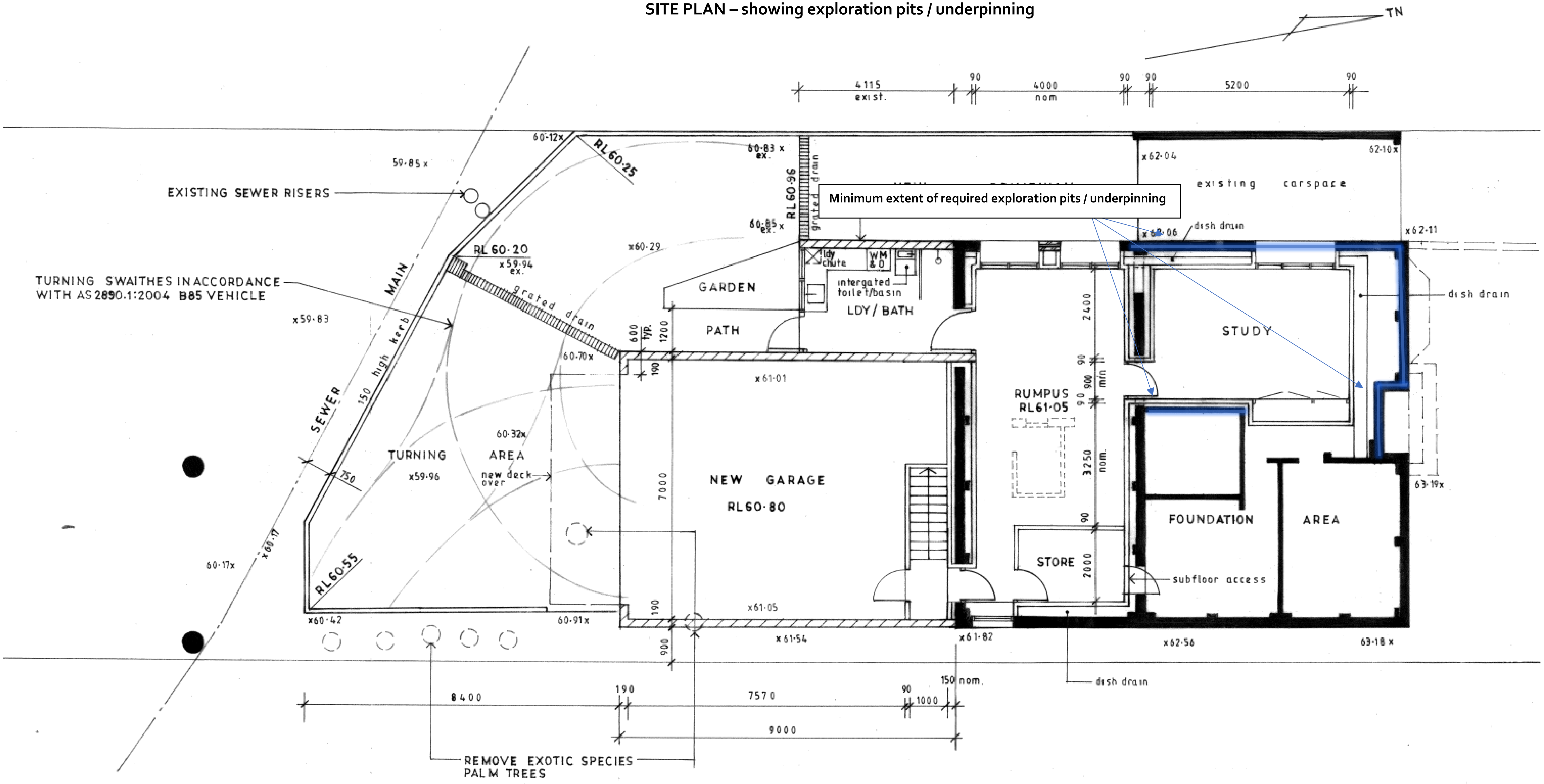
alwayswright@optusnet.com.au	SCALE 1:200	ISSUE: DA	SHEET NO. 6

SITE PLAN – showing exploration pits / underpinning



LOWER FLOOR PLAN

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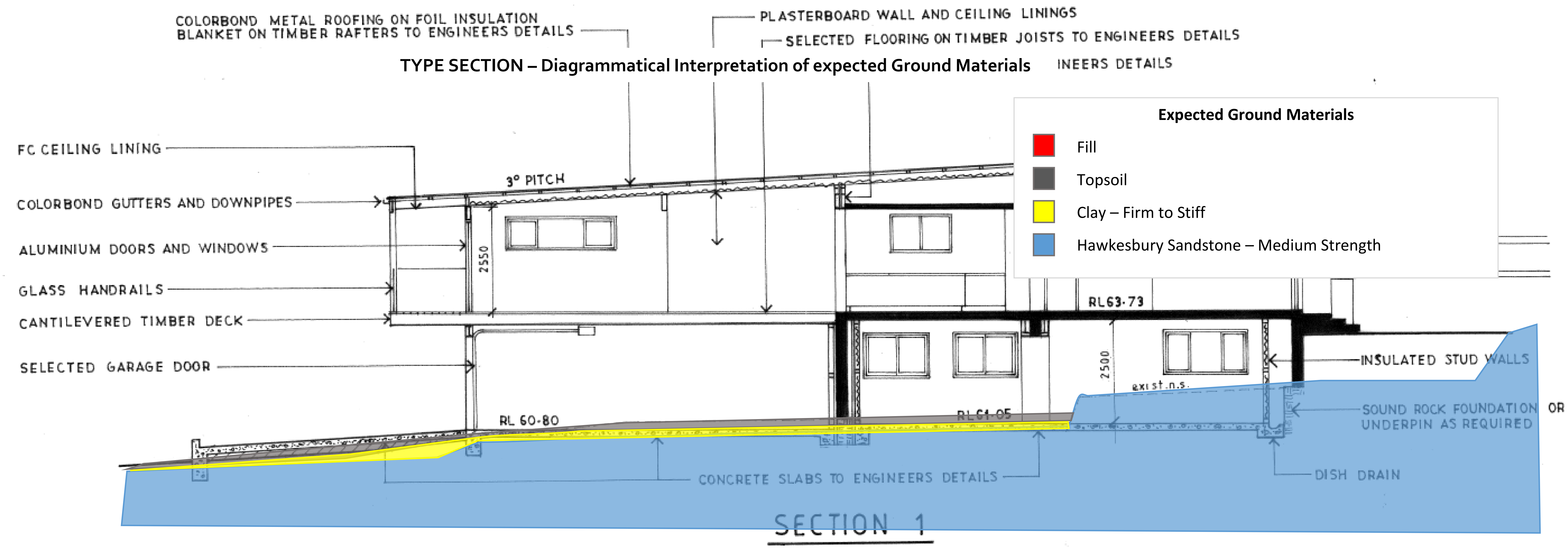
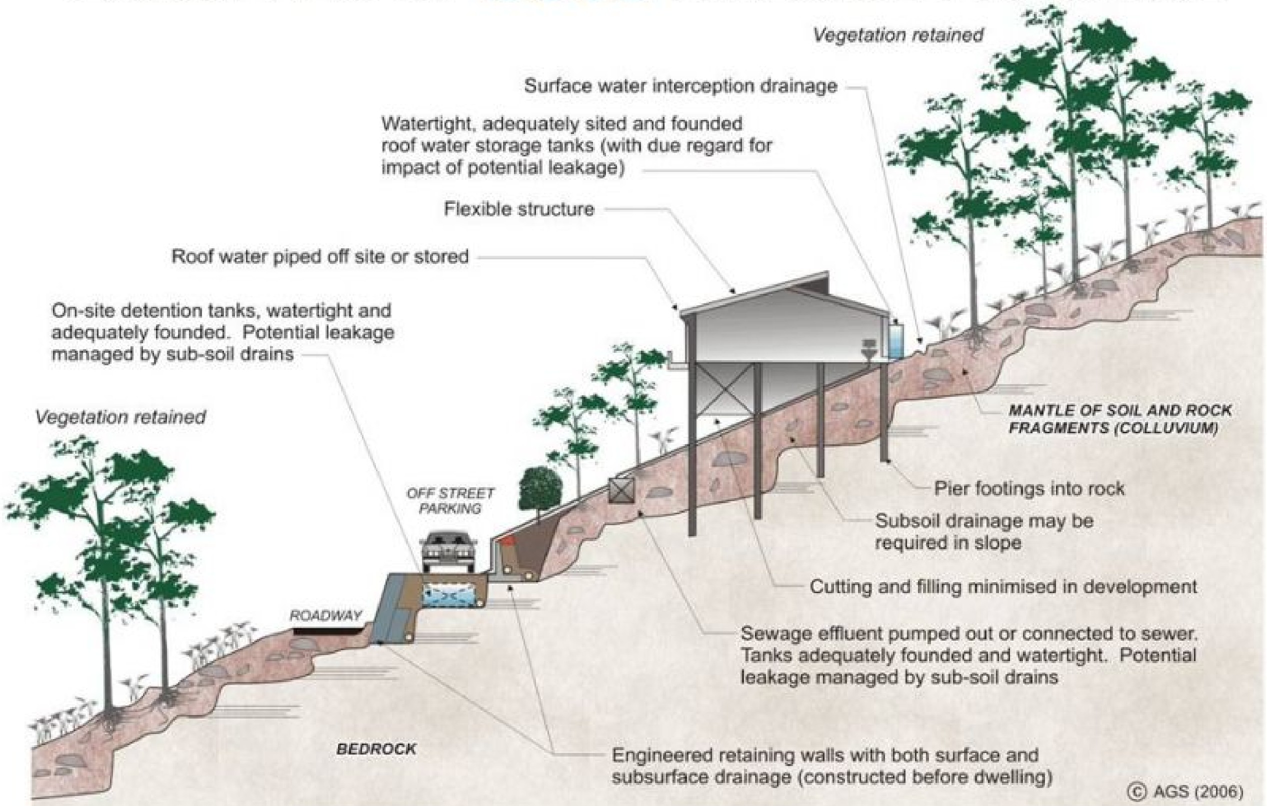
ALTERATIONS AND ADDITIONS 21 HEATHER STREET WHEELER HEIGHTS LOT100 DP8871		
CLIENT RYAN AND DANI OLIVEY		
LOWER FLOOR PLAN		
DATE MAY 2021	DRAWN J.WRIGHT	DRG. NO. 05-21-HEA
SCALE 1:100	ISSUE: DA	SHEET NO. 2

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



John Wright NETWORK DESIGN a.b.n.52 057 985 118 37 McKillop Road Beacon Hill 2100 M. 0417 459 596 alwayswright@optusnet.com.au	ALTERATIONS AND ADDITIONS 21 HEATHER STREET WHEELER HEIGHTS LOT100 DP8871		
	CLIENT RYAN AND DANI OLIVEY		
	SECTIONS		
	DATE MAY 2021	DRAWN J.WRIGHT	DRG. NO. 05-21-HEA
	SCALE 1:100	ISSUE: DA	SHEET NO. 5

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE