GEOTECHNICAL INVESTIGATION:

New Garage and Pool at **88 Quirk Street, Dee Why**

1. Proposed Development

1.1 Construct a garage with pool above on the downhill side of the property by excavating to a maximum depth of ~1.7m

1.2 Other minor external additions and alterations.

1.3 Details of the proposed development are shown on 17 drawings prepared by LKS Design and Drafting, project reference 2401, drawings numbered DA01 to DA17. All revision A. All dated 16th December 2024.

2. Site Description

2.1 The site was inspected on the 29th November, 2024. And previously in May 2021.

2.2 This residential property has dual access. It is on the downhill side of Quirk Street and on the uphill side of Bushey Place. The property has a N aspect. It encompasses the gently graded crest and moderately graded N flank of a W to E-trending ridgeline. The natural slope falls across the upper half of the property at angles of <5° before increasing to moderate angles of ~16°. The slope above the property eases to near-level angles at the crest of the ridge. The slope below the property gradually increases in grade.

2.3 At the Quirk Street frontage, a concrete driveway runs to a garage on the ground floor of the house. Between the road frontage and the house is near level garden bedding (Photo 1). The part three-story rendered brick house is supported on brick walls. No significant signs of movement were observed in the visible supporting walls of the house. Fill for a level lawn and garden below the house (Photo 2) has been

laid over exposed competent Medium Strength Sandstone which steps down the property below the house. Where the fill is deeper towards the W common boundary, it has been supported by a loose stack stone retaining wall (Photo 3). This wall will be demolished as part of the proposed works. The outcrop steps ~2.0m down the slope below the fill (Photo 4). A portion of the outcropping rock to the E is undercut up to ~1.0m (Photo 5). However, the undercut portion has a relatively thick cantilever arm in relation to its overhang length, and displays no horizontal cracking when viewed from above or below. No other significant geological defects we observed in the rock face. As such, it is considered stable. A detached joint block immediately below this outcrop is resting in a stable position (Photo 6). The remainder of the outcropping rock across the property was observed to be free from significant geological defects that could affect its stability. A low cut has been made at the Bushey Place frontage for a parking space (Photo 7). The cut is supported by a low concrete block retaining wall which will be demolished as part of the proposed works.

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. Five 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 have been an issue for this site. But due to the possibility that the actual ground conditions vary from our interpretation there should be allowances in

the excavation and foundation budget to account for this. We refer to the appended "Important Information about Your Report" to further clarify. The results are as follows:

AUGER HOLE 1 (~RL57.6) **–** AH1 (Photo 8)

Depth (m)	**Material Encountered**
0.0 to 0.3	**TOPSOIL**, sandy soil, brown, Medium Dense, dry, Fine to Medium grained.
0.3 to 0.7	**RESIDUAL CLAY**, sandy clay, derived from weathered sandstone, mottled orange, grey, and maroon, Soft to Stiff, dry, Fine to Medium grained.

End of Hole @ 0.7m in Residual Clay. 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** (~RL61.3)	**DCP 2** (~RL59.0)	**DCP 3** (~RL58.0)	**DCP 4** (~RL57.6)	**DCP 5** (~RL56.6)
0.0 to 0.3	5	Rock Exposed at Surface	Rock Exposed at Surface	5	25
0.3 to 0.6	2			4	#
0.6 to 0.9	2			14	
0.9 to 1.2	11			#	
1.2 to 1.5	9				
1.5 to 1.8	#				
	Refusal on Rock @ 1.4m			Refusal on Rock @ 0.8m	Refusal on Rock @ 0.2m

#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 @ 1.4m, DCP bouncing off rock surface, white impact dust on dry tip.
DCP2 – Medium Strength Sandstone exposed at surface.
DCP3 – Medium Strength Sandstone exposed at surface.
DCP4 – Refusal on Rock @ 0.8m, DCP bouncing off rock surface, white impact dust on dry tip, grey sandy clay in collar above.

DCP5 – Refusal on Rock @ 0.2m, DCP bouncing off rock surface, maroon impact dust on 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 shallow soils over clays that fill the bench step formation. Filling has been placed below the house for landscaping. In the test locations, where the rock is not exposed, it was encountered at depths of between 0.2 to 1.4m 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 as all the DCP tests bounced at refusal. 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 Quirk Street above.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The moderately graded slope that falls across the property and continues 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 the retaining structures are in place (**Hazard Three**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two	Hazard Three
TYPE	The moderate slope that falls across the property and continues below failing and impacting on the proposed works.	The vibrations produced during the proposed excavation impacting on the surrounding structures.	The excavation collapsing onto the work site before retaining structures are in place.
LIKELIHOOD	'Unlikely' (10^{-4})	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Medium' (15%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	8.3×10^{-7}/annum	5.3×10^{-7}/annum	5.9×10^{-5}/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 risk to 'ACCEPTABLE' levels, the recommendations in **Section 13 and 14** 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 Bushey Place. 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 up to a maximum depth of ~1.7m is required to construct the proposed garage.

The excavation is expected to be through fill, soil, and clay with Medium Strength Sandstone, where it is not already exposed, expected at depths of between 0.2m and 1.4m below the surface in the area of the proposed excavation.

It is envisaged that excavations through fill, soil, and clay 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 fill, soil, and clay will be below the threshold limit for building damage utilising a domestic-sized excavator up to 16 tonnes. It is expected that the majority of the excavation will be through Medium Strength Sandstone or better.

Excavations through Medium Strength Rock or better should be carried out to minimise the potential to cause vibration damage to the W neighbouring property and a sewer main that runs along Bushey Place near the lower boundary. Allowing ~0.5m for backwall drainage where necessary, the setbacks from the proposed excavation to the existing structures are as follows:

- ~2.6m from the W neighbouring granny flat.
- ~3.0m from the sewer main.

Dilapidation reporting carried out on the W neighbouring property is recommended prior to the excavation works commencing to minimise the potential for spurious building damage claims.

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 5mm/sec at the W neighbouring granny flat walls and sewer main. 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, 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, as well as reducing hammer size as necessary.
- Use of rock grinders (milling head).

Should excavation induced vibrations exceed vibration limits after the recommendations above have been implemented, excavation works are to cease immediately and our office is to be contacted.

It is worth noting that vibrations that are below thresholds for building damage may be felt by the occupants of the subject and neighbouring houses.

13. Excavation Support Requirements

The excavation for the proposed garage will reach a maximum depth of ~1.7m. Allowing 0.5m for back wall drainage, the setbacks are as follows:

- ~Flush with the loose stack stone retaining wall near the W common boundary (Photo 3).
- ~Flush with a detached joint block below the ~2.0m outcrop (Photo 6)

As such, the loose stack stone retaining wall and detached joint block will lie within the zone of influence of the proposed excavation. In this instance, the zone of influence is the area above a theoretical 45° line (from horizontal) from the base of the excavation or top of Medium Strength Rock, whichever is encountered first, towards the surrounding structures and boundaries. This line reduces to 30° through the fill and soil.

The W common boundary fence is to be braced before the works commence.

The excavation requires the removal of the loose stack stone retaining wall which supports fill on the W side of the ~2.0m outcrop. The wall is to be demolished from the top down in an orderly manner prior to the excavation commencing. The fill, soil, and clay behind the walls, and at the location of any new excavation is to be battered temporarily at 1.0 Vertical to 1.7 Horizontal (30°) until retaining structures are in place.

Prior to the excavation through rock, the detached joint block above the cut for the proposed garage (Photo 6) is to be sawn up and removed from the slope immediately above the cut.

Once the boulder is removed and the fill, soil, and clay portions are appropriately battered, the excavation through bedrock may commence. Medium Strength Sandstone or better is expected to stand at vertical angles unsupported subject to approval by the geotechnical consultant.

During the excavation process, the geotechnical consultant is to inspect the cut in 1.5m intervals as it is lowered 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.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. All unsupported cut batters 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 cannot 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.

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.

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 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 and Topsoil	20	0.40	0.55
Residual Clays	20	0.35	0.45
Medium Strength Rock	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 full hydrostatic pressures are to be accounted for in the retaining structure design.

15. Site Classification

The site classification is Class S in accordance with AS2870-2011. Assume no ground movement from moisture changes for footings supported on Medium Strength Sandstone.

16. Foundations

The proposed garage is expected to be partially seated in Medium Strength Sandstone. This is a suitable foundation material. It is expected to be exposed across the base of the excavation. Where the footprint of the pool and spa above does not fall over the garage structure, piers to this material may be required. Where it is not already exposed Medium Strength Sandstone is expected to be encountered at depths of between ~0.2m to ~1.4m below the current surface in the location of the proposed works.

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.

17. 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.

- 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 and contractors are still onsite and before steel reinforcing is placed or concrete is poured.

White Geotechnical Group Pty Ltd.

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Engineering Geologist.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8 – downhole is 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.

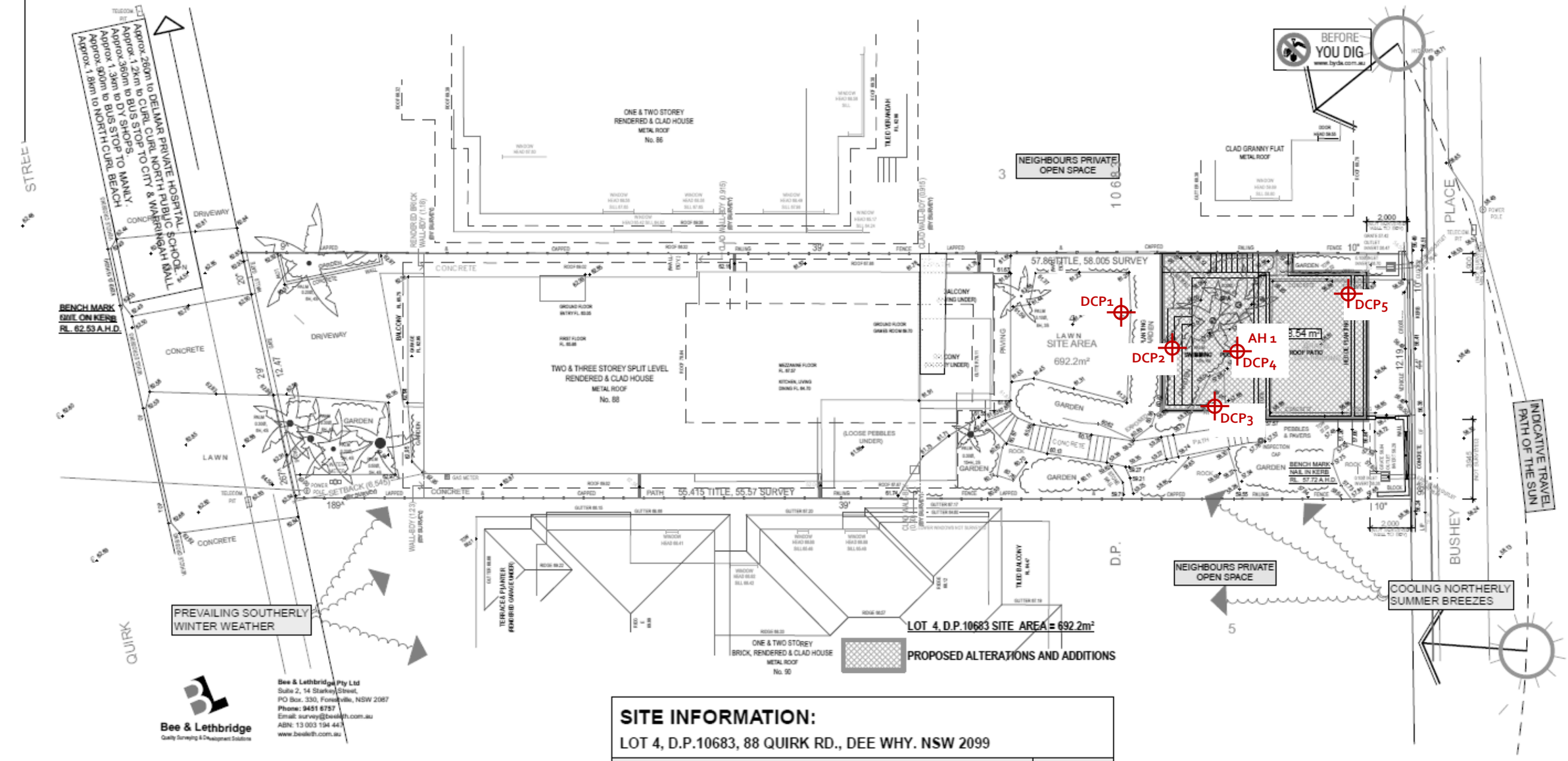
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



SITE SURVEY & SITE EVALUATION PLAN
1:200

Bee & Lethbridge Pty Ltd
Suite 2, 14 Starkey Street,
PO Box. 330, Forestville, NSW 2087
Phone: 9451 6757
Email: survey@beelath.com.au
ABN: 13 003 194 447
www.beelath.com.au

SITE INFORMATION:
LOT 4, D.P.10683, 88 QUIRK RD., DEE WHY. NSW 2099

TOTAL SITE AREA:		**692.2m²**
EXISTING DWELLING FLOOR AREA		441.7m²
ADDITIONAL DWELLING FOOTPRINT		0.0m²
TOTAL DWELLING FLOOR AREA		**441.7m²**
PROPOSED GARAGE/WORKSHOP/STORE FLOOR AREA		**52.04m²**
EXISTING LANDSCAPE AREA	38.09% of site	263.71m²
LANDSCAPE AREA TO BE REMOVED		40.19m²
PROPOSED SURFACE AREA OF POOL & SPA WATER		30.31m²
TOTAL PROPOSED LANDSCAPE AREA	36.67% of site	253.83m²

BUILDING DESIGNERS ASSOCIATION OF AUSTRALIA
CHARTERED ACCREDITED MEMBER
ACCREDITATION No.6120

DATE	REV.	AMENDMENT
16-12-2024	A	DEVELOPMENT APPLICATION ISSUE

LKS DESIGN & DRAFTING
ABN 62343830361
ACCREDITED BUILDING DESIGNER No.6120
P.O. Box 4101, North Curl Curl, N.S.W. 2099
Mobile: 0418 662 771
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PROJECT:
PROPOSED ALTERATIONS & ADDITIONS TO EXISTING DWELLING
88 QUIRK STREET,
DEE WHY. N.S.W. 2099
LOT. 4. DP.10683

CLIENT:
Mr.& Mrs.J.& T.Lowry
DRAWING TITLE:
SITE SURVEY AND SITE EVALUATION PLAN & SITE INFORMATION

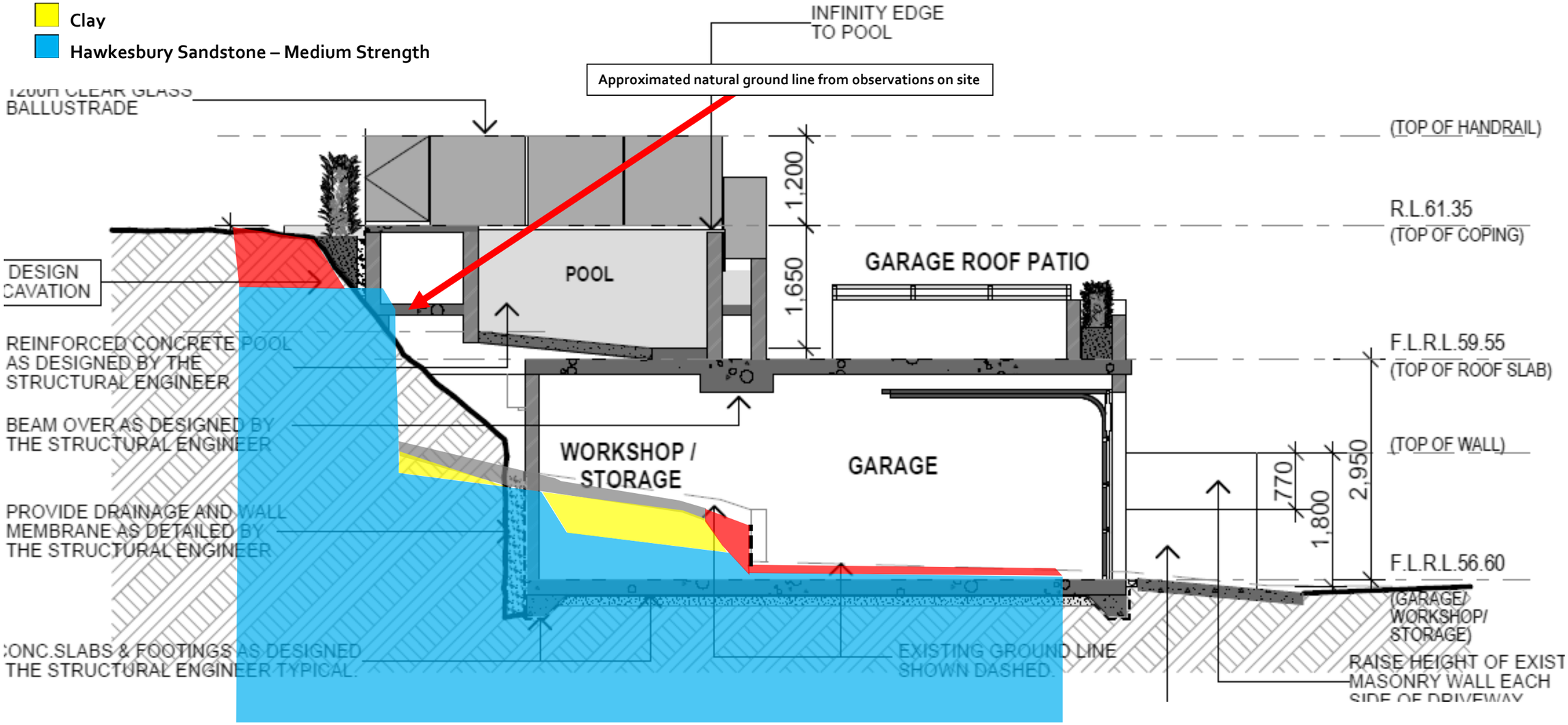
DEVELOPMENT APPLICATION ISSUE

DATE: 16th December, 2024
SCALE: As Shown
DRAWN: L.K.S.
PROJECT REF: 2401 **DA02** **Rev. A**

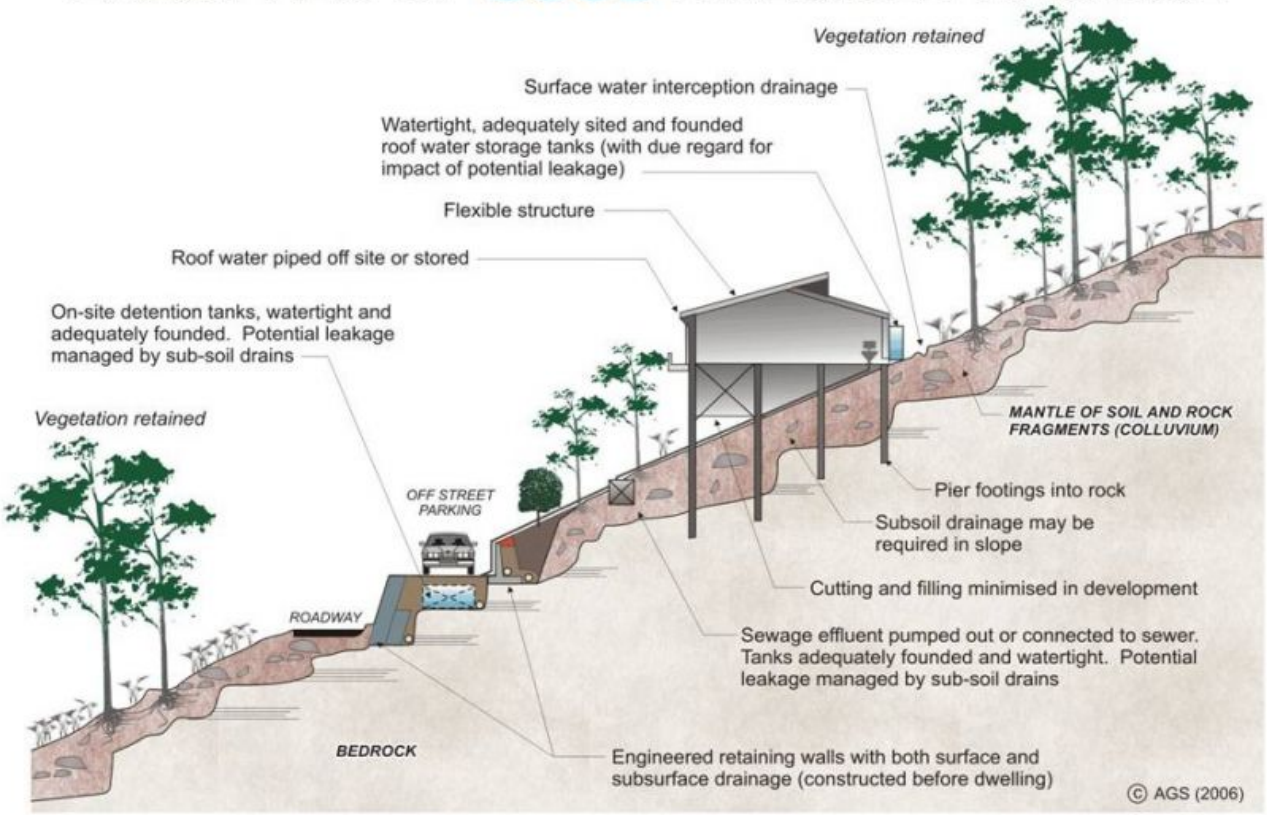
Expected Ground Materials

- Fill
- Topsoil
- Clay
- Hawkesbury Sandstone – Medium Strength

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE