GEOTECHNICAL INVESTIGATION:

New House and Pool at **14 Bellevue Parade, Curl Curl**

1. Proposed Development

1.1 Demolish the existing house and garage and construct a new house by excavating to a maximum depth of ~4.0m and filling to a maximum height of ~1.5m.

1.2 Install a pool on the uphill side of the property by excavating to a maximum depth of ~3.0m.

1.3 Various other minor additions.

1.4 Details of the proposed development are shown on 22 drawings prepared by Watershed Architects, Project number 23004, drawings numbered DA01 to DA22, dated 25th July, 2024.

2. Site Description

2.1 The site was inspected on the 8th April, 2024.

2.2 This residential property is on the high side of the street and has a S aspect. It is located on the moderately graded middle reaches of a hillslope. The slope rises across the property at an average angle of ~12°. The slope above the property continues at similar angles and the slope below the property eases to gentle angles.

2.3 At the road frontage, a concrete driveway runs to a garage on the downhill side of the property (Photo 1). A ~2.5m high stable sandstone rock face steps up immediately behind the garage to the house (Photo 2). Between the road frontage and the house is a gentle to moderately sloping garden area (Photo 3). The single-storey clad house is supported on sandstone block piers (Photo 4). The house is to be demolished as part of the proposed works. The cut for the house and fill for the lawn

above is supported by a stable ~0.8m high mortared rock retaining wall (Photo 5). This wall was partially supported on outcropping Medium Strength Sandstone. The gently sloping lawn area extends upslope to a stable ~1.0m high timber retaining wall that supports the fill for a level paved area above (Photo 6). Moderately sloping garden extends above the paved area to a ~3.0m high Sandstone rock face that outcrops and steps up at the boundary (Photo 7 & 8). This rock face is undercut to ~0.8m but otherwise shows no significant defects and 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

One hand Auger Hole (AH) was put down to identify the soil materials. Six 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 (~RL30.0) **–** AH1 (Photo 8)

Depth (m)	Material Encountered
0.0 to 0.2	**TOPSOIL**, dark brown, clayey, medium grained, loose, dry.
0.2 to 0.6	**SAND**, dark grey, clayey, fine to medium grained, loose to medium dense, damp.
0.6 to 0.8	**SAND**, light grey, derived from Very Low Strength Sandstone, wet.

Refusal @ 0.8m 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 (~RL30.0)	DCP 2 (~RL29.0)	DCP 3 (~RL29.0)	DCP 4 (~RL25.5)	DCP 5 (~RL25.8)	DCP 6 (~RL23.0)
0.0 to 0.3	3	2	2	4	3	7
0.3 to 0.6	3	4	7	6	5	6
0.6 to 0.9	6	7	7	7	#	6
0.9 to 1.2	#	#	9	#		17
1.2 to 1.5			#			27
1.5 to 1.8						37
1.8 to 2.1						48
21. to 2.4						46
2.4 to 2.7						#
	Refusal on Rock @ 0.8m	Refusal on Rock @ 0.9m	Refusal on Rock @ 1.0m	Refusal on Rock @ 0.8m	Refusal on Rock @ 0.6m	Refusal on Rock @ 2.3m

#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 @ 0.8m, DCP bouncing off rock surface, white sand on wet tip.
DCP2 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, white sand on wet tip.
DCP3 – Refusal on rock @ 0.8m, DCP bouncing off rock surface, white sand on wet tip.
DCP4 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP5 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, white impact dust on dry tip.
DCP6 – Refusal on rock @ 2.3m, DCP bouncing off rock surface, white sand on wet tip.

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 and shallow soils over sands that fill the bench step formation. Filling has been placed above the house for landscaping. In the test locations, where the rock is not exposed, it was encountered at depths of between 0.6 to 2.3m 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. It is interpreted that a thin layer of Very Low Strength Sandstone overlies the buried rock in some locations as the DCP ended after a high blow count for some tests. The Very Low Strength Rock is expected to be encountered at a depth of ~1.2m below the current surface near the lower boundary. 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 moderately graded slope that rises across the property and continues above and below is a potential hazard (**Hazard One**). The undercut rock face (Photo 8) failing and toppling onto the slope below is a potential hazard (**Hazard Two**). The vibrations from the proposed excavations are a potential hazard (**Hazard Three**). The proposed excavations are a potential hazard until retaining structures are in place (**Hazard Four**). The proposed fill for the lawn area is a potential hazard until retaining walls are in place (**Hazard Five**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The moderate slope that rises across the property and continues above and below failing and impacting on the proposed works.	The undercut rock face (Photo 8) failing and causing damage to the property below.
LIKELIHOOD	'Unlikely' (10^{-4})	'Rare' (10^{-5})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Major' (60%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Low' (6×10^{-5})
RISK TO LIFE	8.3×10^{-7}/annum	8.3×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE'.	This level of risk is 'ACCEPTABLE'.

RISK ANALYSIS SUMMARY CONTINUES ON THE NEXT PAGE

HAZARDS	Hazard Three	Hazard Four	Hazard Five
TYPE	The vibrations produced during the proposed excavation impacting on the surrounding structures.	The excavations (up to a maximum depth of 4.0m) collapsing onto the work site before retaining structures are in place.	The proposed fill (up to a maximum height of 1.5m) failing and impacting the proposed works.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (15%)	'Medium' (15%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	8.3×10^{-6}/annum	6.0×10^{-5}/annum
COMMENTS	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 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 15** 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 Bellevue Parade. 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 ~4.0m is required to construct the proposed house and garage. A second excavation to a maximum depth of ~3.0m is required to install the proposed pool.

The excavations are expected to be through soils and sand with Medium Strength Rock expected at depths of between ~0.6m and ~2.3m 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 sands will be below the threshold limit for building damage. It is expected that the majority of the excavations 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 existing subject house and neighbouring structures to the E and W. Allowing for 0.5m of backwall drainage, the setbacks from the proposed excavation to the existing structures/boundaries are as follows:

- ~0.4m from the W common boundary.
- ~0.5m from the E common boundary.
- ~1.5m from W neighbouring house.
- ~2.0m from the E neighbouring house.

To reduce the likelihood of spurious claims, dilapidation reporting carried out on the E and W neighbouring properties is recommended prior to the excavation works commencing.

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 5 mm/sec at the property boundaries. 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, 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 neighbouring houses.

13. Excavation Support Requirements

The excavation for the house and garage will reach a maximum depth of ~4.0m. A second excavation for the proposed pool will reach a maximum depth of ~3.0m. Allowing ~0.5m for

backwall drainage, the setbacks from the proposed excavation to the existing structures/boundaries are as follows:

- ~0.4m from the W common boundary.
- ~0.5m from the E common boundary.
- ~1.5m from W neighbouring house.
- ~2.0m from the E neighbouring house.

As such, the W and E common boundaries will lie within the zone of influence of the proposed excavations. 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.

Bulk excavation for the house

Where room permits, the fill, soil, and sand portion of the house excavation is expected to stand temporarily at batter angles of 30° (1.0 Vertical to 1.7 Horizontal). Where there is not room for these batters, such as along the E and W sides of the excavation, the excavation through fill, soil, and sand will need to be temporarily or permanently supported prior to the commencement of the excavation through rock, or during the excavation process in a staged manner, so cut batters are not left unsupported. The support will need to be designed / approved by the structural engineer. See the site plan attached for the minimum extent of the required shoring. Medium Strength Sandstone or better is expected to stand at vertical angles unsupported subject to approval by the geotechnical consultant.

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.

Bulk excavation for the proposed pool

We recommend the soil and sand portions of the E and W sides of the pool excavation be temporarily supported with typical pool shoring such as braced sacrificial form ply, until the pool structure is in place. The remaining sides of the cut 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 sand remain unsupported for more than a day before pool construction commences, they are also to be supported with typical pool shoring until the pool structure is in place. The support will need to be designed by the structural engineer. See site plan attached for extent of minimum required shoring.

Advice applying to both excavations

During the excavation process, the geotechnical consultant is to inspect the cuts in 1.5m intervals as they are 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 through fill, soil, and sand 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 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. Fills

Filling will be placed in the middle of the property for landscaping. No fills are to be laid until retaining walls are in place. The fill will reach a maximum depth of ~1.5m. The surface is to be prepared before any fills are laid by removing any organic matter and topsoil. Fills are to be laid in a loose thickness not exceeding 0.3m before being moderately compacted. Tracking the machine over the loose fill in 1 to 2 passes should be sufficient. Immediately behind the retaining walls (say to 1.5m), the fills are to be compacted with light weight equipment such as a hand-held plate compactor so as not to damage the retaining walls. Where light weight equipment is used, fills are to be laid in a loose thickness not exceeding 0.15m before being compacted. No structures are to be supported on fill.

15. 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 and Sandy Soil	20	0.40	0.55
Sand	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.

16. Foundations

The proposed house and pool 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 sides of the excavations. 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 of between 0.6 to 2.3m 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.

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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REGISTERED PROFESSIONAL GEOSCIENTIST
AUSTRALIAN INSTITUTE OF GEOSCIENTISTS
NATHAN GARDNER
RPGeo No: 10307

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

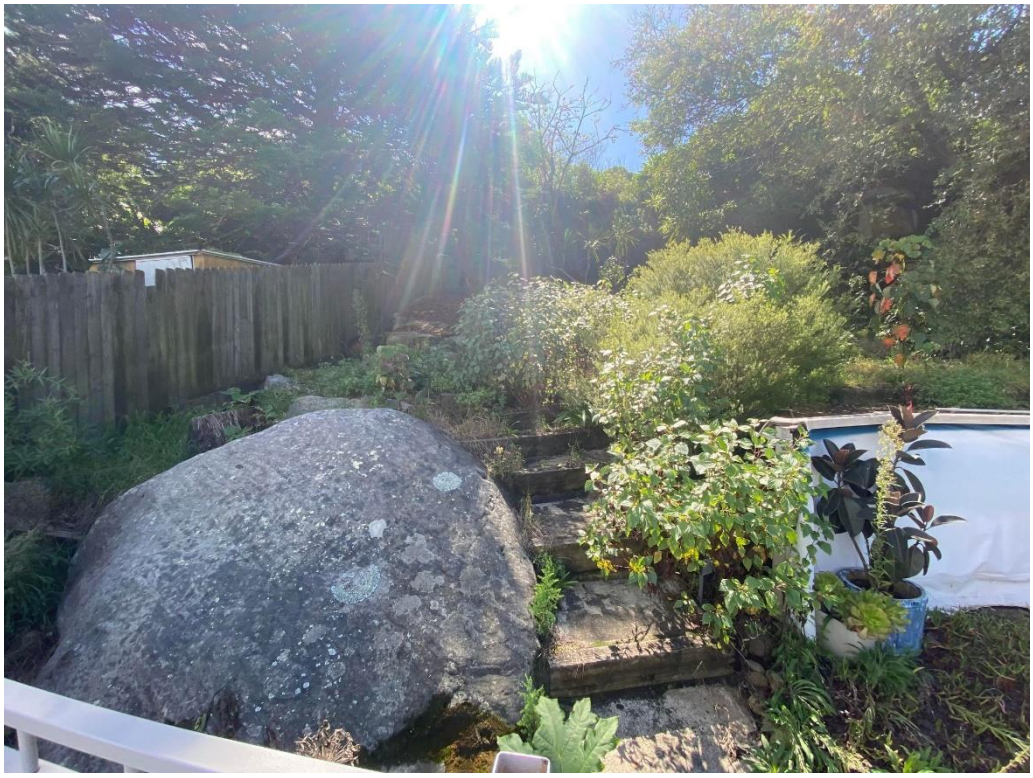


Photo 7

Photo 8

Photo 9 (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.

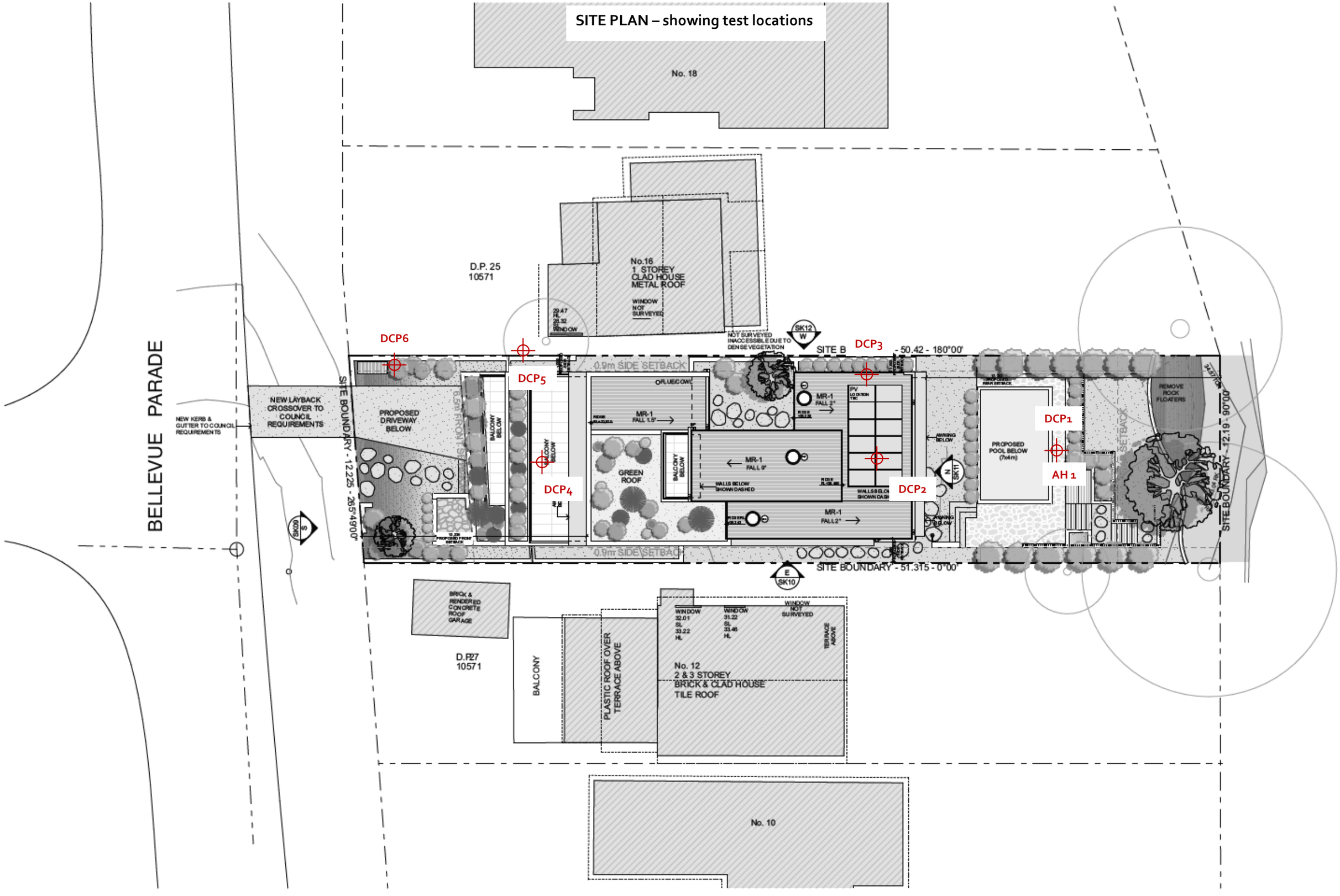
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



Watershed V \ Architects

Nominated Architect Mark Korgul No. 6221 **Studio** 9977 1076 **Address** Level 1, 167 Pittwater Road Manly NSW 2095

ISSUE	FOR	DATE
D	DA ISSUE	25/7/2024

JOB NO:	23004
ADDRESS:	14 Bellevue Parade, North Curl Curl
CLIENT:	Brett & Sarah Dickson
SCALE:	1:200 @ A3

SITE & ROOF PLAN

SHEET: DA03

ISSUE: D

SITE PLAN – showing minimum extent of required shoring / exploration pits / underpinning

Minimum extent of required shoring shown in blue

D.P. 25
10571

No. 16
1 STOREY
CLAD HOUSE
METAL ROOF

WINDOW NOT SURVEYED

SITE BOUNDARY - 51.315 - 0°00'

0.9m SIDE SE

1.000 SIDE SETBACK

BIN STORE

STORE

RL +22.233

PROPOSED DRIVEWAY

OSD UNDER DRIVEWAY REFER TO HYDRAULIC ENGINEER DRAWINGS

6.5m FRONT SETBACK

RL +22.246

RWT BELOW

ACCESS HATCH

RL +22.312

PV-1

NEW LANDSCAPING REFER LANDSCAPE PLANS

OUTDOOR SHOWER

ENTRY
RL+22.865

8,515
PROPOSED FRONT SETBACK

SEAT

GARAGE
CST

FALL

WORKSHOP/ STORAGE
RL +22.965

ROCK CUT LINES

ENTRY
FL+22.965

HALLWAY

VOID OVER

STAIR

TB-1

STORAGE

LIFT

LIFT SUMP

SITE BOUNDARY - 12.225 - 265°49'00"

SITE BOUNDARY - 50.42 - 180°00'

Y - 50.42 - 180°00'

MR-1
FALL 1.5°

SK11

SITE BOUNDARY - 12.19 - 90°00'

JNDARY - 51.315 - 0°00'

BRICK & RENDERED CONCRETE ROOF GARAGE

WINDOW
32.01
SL
33.22
HL

WINDOW
31.22
SL
33.46
HL

D.P. 27
10571

No. 12

Watershed\/\Architects

ISSUE FOR
D DA ISSUE

DATE
25/7/2024

Nominated Architect Mark Korgul No. 6221 **Studio** 9977 1076 **Address** Level 1, 167 Pittwater Road Manly NSW 2095

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials

Expected Ground Materials

- Fill
- Topsoil
- Clay – Firm to Stiff
- Hawkesbury Sandstone – Very Low to Low Strength
- Hawkesbury Sandstone – Medium Strength

WINTER 31°
SUMMER 65°
SUMMER 65°
AWNING
MR-1 2° FALL
MR-1 9° FALL
NO. 12 BE
SITE BOUNDARY
BEDROOM 02
BATH
ALFRESCO
COURTYARD
POOL
LIVING
EXISTING HOUSE TO BE DEMOLISHED SHOWN DASHED
NO. 12 BELLEVUE PARADE BEYOND
BALCONY
PLANTER
GAMES ROOM
BALCONY
PLANTER
GARAGE
DRIVEWAY
RIDGE RL+36,460
RL +34,710
RIDGE RL+32,970
L3 CL +32,720
L3 CL +31,865
L3 FL +28,965
L2 CL +28,565
L2 FL +25,965
L1 CL +25,565
L1 FL +22,965
RL +28,875
RL +28,111
1,750
2,445
400
1,750
1,740
250
855
2,900
400
2,600
400
2,600

Watershed\/\Architects

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ISSUE	FOR	DATE
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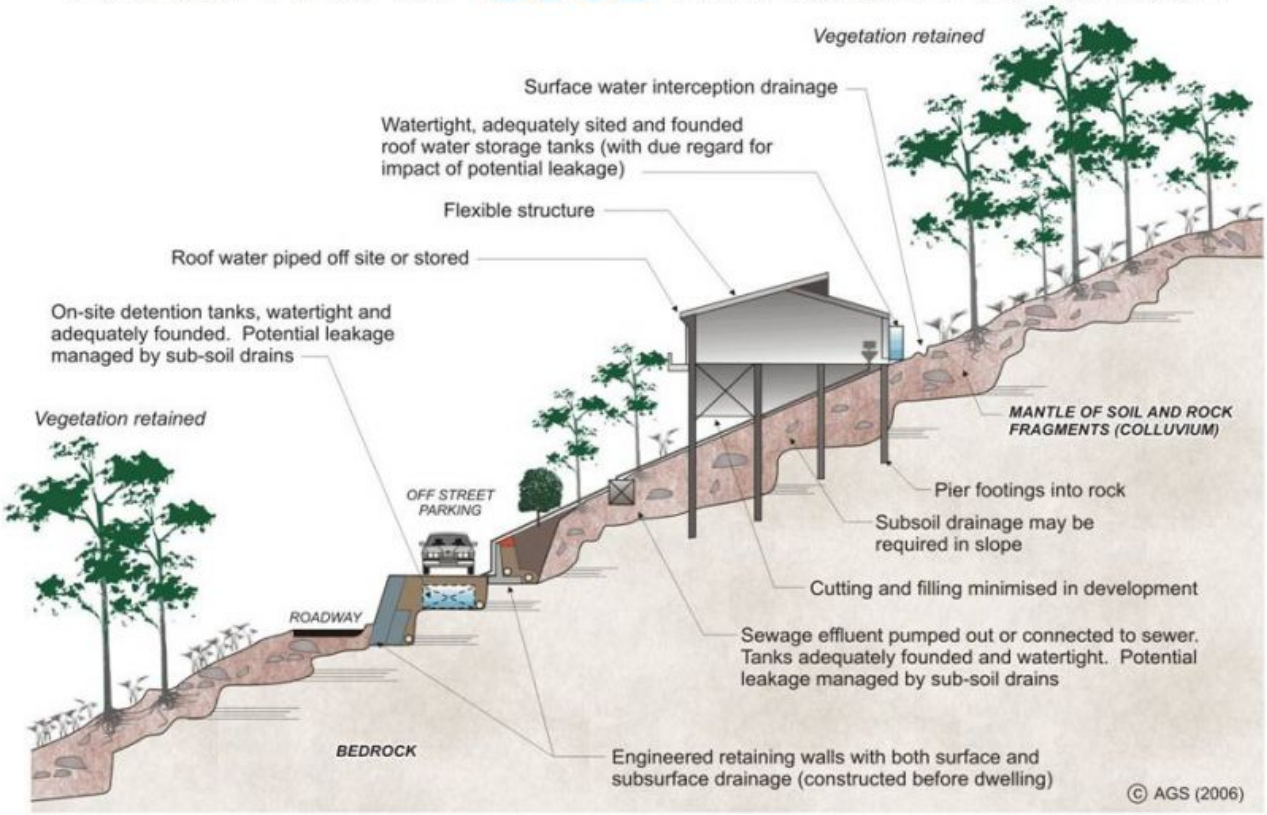
JOB NO: 23004
ADDRESS: 14 Bellevue Parade, North Curl Curl
CLIENT: Brett & Sarah Dickson
SCALE: 1:100 @ A3

SECTION AA
SHEET: DA08
ISSUE: D

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE