# GEOTECHNICAL INVESTIGATION:

Alterations and Additions and New Pool at **57 Cutler Road, Clontarf**

## 1. Proposed Development

**1.1** Install a new pool in the SE corner of the property by excavating to a maximum depth of ~1.5m.

**1.2** Construct a new upper floor addition.

**1.3** Demolish the existing retaining walls on the S side of the property and construct new retaining walls in the same location.

**1.4** Extend the existing balcony on the N side of the house.

**1.5** Details of the proposed development are shown on 8 architectural drawings prepared by Gartner Trovato Architects, Project number 2212, drawings numbered A00-A07, Revision 1, dated 22/07/22.

## 2. Site Description

**2.1** The site was inspected on the 1st August, 2022.

**2.2** This residential property is on the low side of the road and has a SW aspect. The block is located on the gently to moderately graded middle reaches of a hillslope. The natural surface falls across the property at an average angle of ~7°. The slope above the property continues at similar angles.

**2.3** At the road frontage, a concrete driveway runs to a garage under the downhill side of the house (Photo 1). The fill for the driveway is supported by a concrete block retaining wall running along the W common boundary (Photo 2). The retaining wall was observed to be cracked and tilting downslope at an angle of ~5°. We recommend consideration be made to formulating a plan with the owner/s of the lower neighbouring property to rebuild this wall as part of the proposed works. A cut has been made in the slope for a gently sloping lawn surrounded by garden beds between the road frontage and the house. The cut is supported by a stable concrete block retaining wall ~1.0m high that lines the road frontage (Photo 3). The part two-storey rendered brick house is supported on brick walls and steel posts (Photo 4). The supporting walls displays no significant signs of movement. Some of the supporting walls and posts were observed to be supported directly off outcropping competent Medium Strength Sandstone within the foundation space of the house. An excavation has been made in the slope to create a level platform for the uphill side of the house. The cut is supported by a brick retaining wall ~0.6m high. The retaining wall displayed vertical cracking through the bricks but no signs of deflection (Photo 5). As such, the wall is considered currently stable. A cut and fill have been made in the SE corner of the property for a level lawn area. The cut is supported by a concrete block retaining wall ~1.8m high. The retaining wall was observed to be cracked and tilting downslope at an angle of ~4° and has been remediated with timber bracing (Photo 6). Additionally, the concrete block components of the wall were observed to not have been core-filled. The wall will be demolished and rebuilt as part of the proposed works. The fill is supported by a concrete block and sandstone block retaining wall which is ~2.0m high (Photo 7 & 8). The sandstone block section of the wall is cracked and displays signs of movement. This wall has also been remediated with timber bracing and will also be demolished and rebuilt as part of the proposed works. Fill has been placed below this wall for a level lawn area. The fill is supported by a concrete block retaining wall which was observed to be supported directly off outcropping competent Medium Strength Sandstone (Photo 9). Competent Medium Strength Sandstone outcrops immediately above the SE corner of the property (Photo 10). The outcrop was observed to be slightly undercut but 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. 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 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:

**AUGER HOLE 1** (~RL51.0) **–** AH1 (Photo 11)

| Depth (m) | Material Encountered |
|---|---|
| 0.0 to 0.3 | **FILL**, disturbed soil, dark brown, dry, medium to coarse grained, fine trace organic matter. |
| 0.3 to 0.4 | **FILL**, disturbed clayey sand, grey & dark grey, damp, fine to coarse grained. |

End of hole @ 0.4m at rock surface. 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** (~RL54.05) | **DCP 2** (~RL50.7) | **DCP 3** (~RL50.6) | **DCP 4** (~RL48.8) | **DCP 5** (~RL49.1) |
| 0.0 to 0.3 | Rock Exposed at Surface | 3 | 4 | 2F | 6 |
| 0.3 to 0.6 | | 12 | 8 | 11 | 6 |
| 0.6 to 0.9 | | 15 | 10 | 8 | 5 |
| 0.9 to 1.2 | | 24 | 13 | # | # |
| 1.2 to 1.5 | | # | 23 | | |
| 1.5 to 1.8 | | | # | | |
| | | Refusal on Rock @ 1.2m | Refusal on Rock @ 1.4m | Refusal on Rock @ 0.7m | Refusal on Rock @ 0.9m |

#refusal/end of test. F = DCP fell after being struck showing little resistance through all or part of the interval.

***DCP Notes:***

DCP1 – Medium Strength Sandstone exposed at surface

DCP2 – Refusal on rock @ 1.2m, DCP bouncing off rock surface, white & orange sandstone on dry tip.

DCP3 – Refusal on rock @ 1.4m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP4 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, brown sand on wet tip.

DCP5 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, brown silty sand on damp 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 typically overlain by sandy soils and sandy clays which fill the bench step formation. Filling has been placed across the property for landscaping. In the test locations, where the rock is not exposed, it was encountered at depths of between 0.7 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 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 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 excavation for the proposed pool is a potential hazard until the retaining structures are in place (**Hazard Three**).

**RISK ANALYSIS SUMMARY ON NEXT PAGE**

**Risk Analysis Summary**

| HAZARDS | Hazard One | Hazard Two | Hazard Three |
|---|---|---|---|
| **TYPE** | The gentle to moderate slope that falls across the site and continues above and below failing and impacting on the proposed works. | The vibrations produced during the proposed excavation impacting on the surrounding structures. | The excavation for the proposed pool collapsing onto the work site and impacting on the subject and neighbouring property 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' ($2 \times 10^{-5}$) | 'Moderate' ($2 \times 10^{-4}$) | 'Moderate' ($2 \times 10^{-4}$) |
| **RISK TO LIFE** | $5.5 \times 10^{-7}$/annum | $5.3 \times 10^{-7}$/annum | $8.3 \times 10^{-6}$/annum |
| **COMMENTS** | This level of risk is 'ACCEPTABLE'. | This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 12** are to be followed. | This level of risk to life and property is 'UNACCEPTABLE'. To move 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 Cutler Road. Roof water from the development is to be piped to the street drainage system through any tanks that may be required by the regulating authorities.

## 11. Excavations

An excavation to a maximum depth of ~1.5m is required to construct the proposed pool.

The excavation is expected to be through shallow fill with Medium Strength Sandstone expected at depths of between 0.7m and 1.4m below the current surface in the area of the proposed excavation.

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

## 12. Vibrations

Possible vibrations generated during excavations through fill will be below the threshold limit for building damage. The majority of the proposed excavation is expected to be taken through Medium Strength Sandstone.

Excavations through rock should be carried out to minimise the potential to cause vibration damage to the subject house and uphill and downhill neighbouring structures. The subject house will be located ~3.3m, the, the neighbouring house above will be as close as ~3.6m, and the neighbouring house below will be as close as ~8.6m from the edges of the excavation. Close controls by the contractor over rock excavation are recommended so excessive vibrations are not generated.

Dilapidation reporting carried out on the uphill and downhill neighbouring properties is recommended prior to the excavation works commencing to minimise the possibility of spurious building damage claims.

Excavation methods are to be used that limit peak particle velocity to 8mm/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.
- Use of rock grinders (milling head).

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 proposed excavation for the pool will be taken to a maximum depth of ~1.5m and will be set back ~0.5m from the S common boundary. No structures on the S neighbouring property will fall within the zone of influence of the excavation. As such, only the S common boundary will be within the zone of influence of the proposed excavation. To ensure the integrity of the S neighbouring property, we recommend the S side of the excavation be temporarily supported with typical pool shoring such as sacrificial form ply, until the pool structure is in place. See the site plan attached showing the minimum extent of the required shoring in blue.

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 fill remain unsupported for more than a few days, they are to be supported with typical pool shoring, such as sacrificial form ply, until the pool structure is in place. Excavations through Medium Strength Sandstone will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. Unsupported cut batters through fill 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 can't blow off in a storm. The materials and labour to construct the retaining structures 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 Structures

The existing concrete block retaining wall in the SE corner of the property (Photo 6) will be demolished and rebuilt as part of the proposed works. The wall is to be dismantled and rebuilt systematically in a "hit one, miss two" sequence so as not to impact on the uphill neighbouring property and to minimise the chance of instability during the wall construction. The replacement wall is to be designed by a structural engineer following the requirements below.

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, Sandy Soil, and Residual Clay | 20 | 0.4 | 0.55 |
| Medium Strength Sandstone | 24 | 0.00 | 0.01 |

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region". Australian Geomechanics Journal 1978.

It is to be noted that the earth pressures in Table 1 assume a level surface above the 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.

## 15. Foundations

The proposed pool is expected to be partially seated in Medium Strength Sandstone. Where sandstone is not exposed at the base of the excavation, the pool is to be supported on shallow piers taken to the underlying Medium Strength Sandstone.

The proposed retaining walls on the S side of the property are to be founded on Medium Strength Sandstone. This material is expected to be exposed across the base of the excavation or at a maximum depth of ~1.4m where any walls are not adjacent to the excavation.

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. Inspection

The client and builder are to familiarise themselves with the following required inspection as well as council geotechnical policy. We cannot provide geotechnical certification for the owner or the regulating authorities if the following inspection has not been carried out during the construction process.

- 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.

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*Photo 1*


*Photo 2*


*Photo 3*


*Photo 4*

*Photo 5*

*Photo 6*


*Photo 7*


*Photo 8*

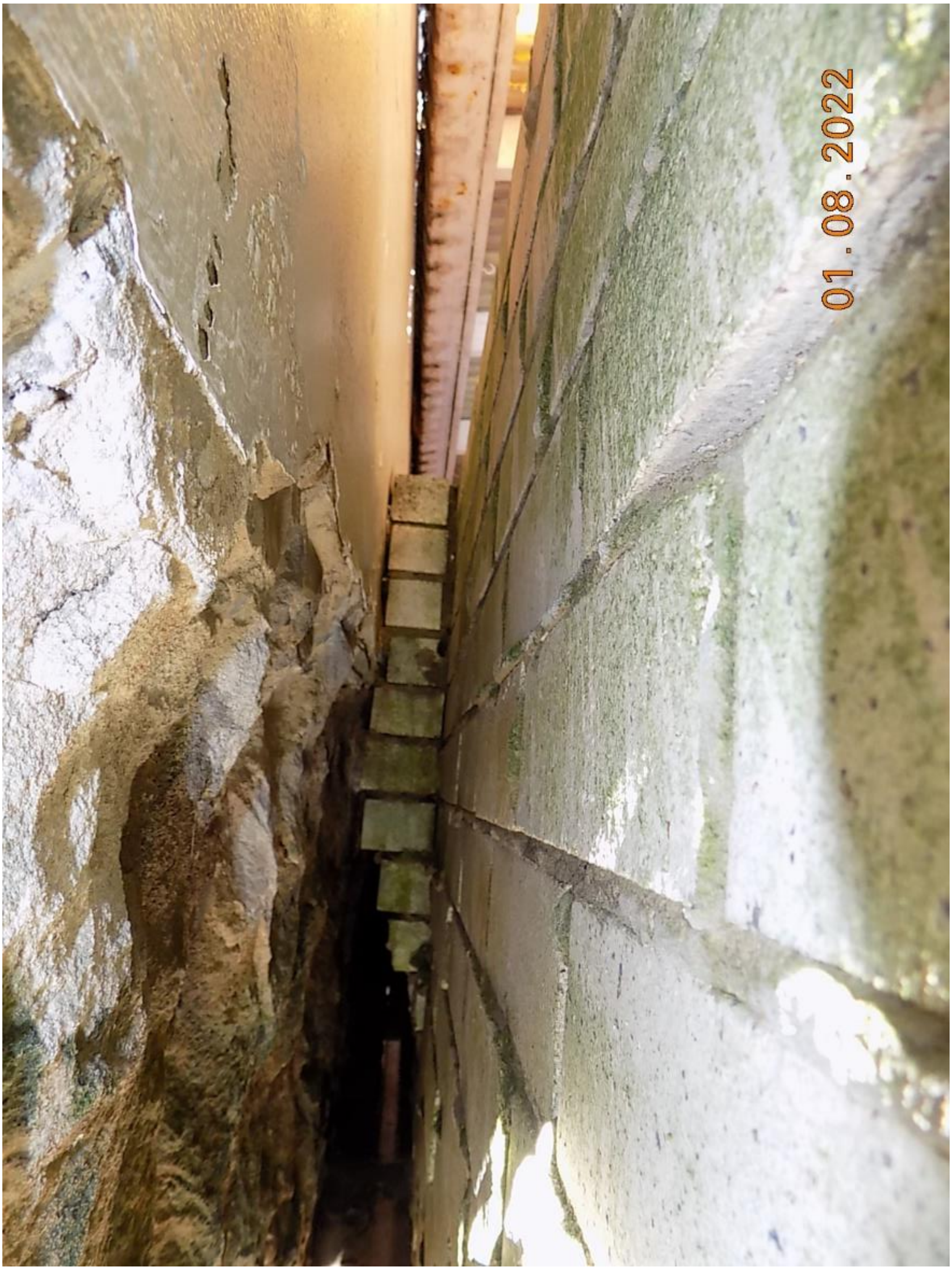



*Photo 9*

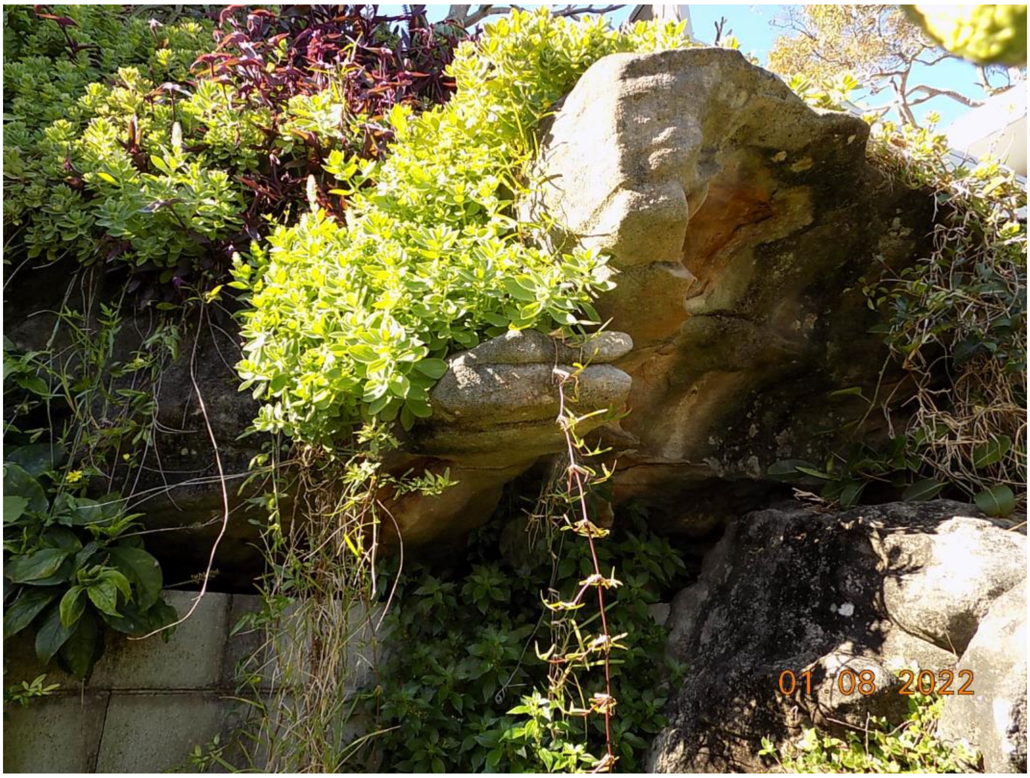



*Photo 10*


*Photo 11: AH1 – Downhole is from right to left*

## 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.

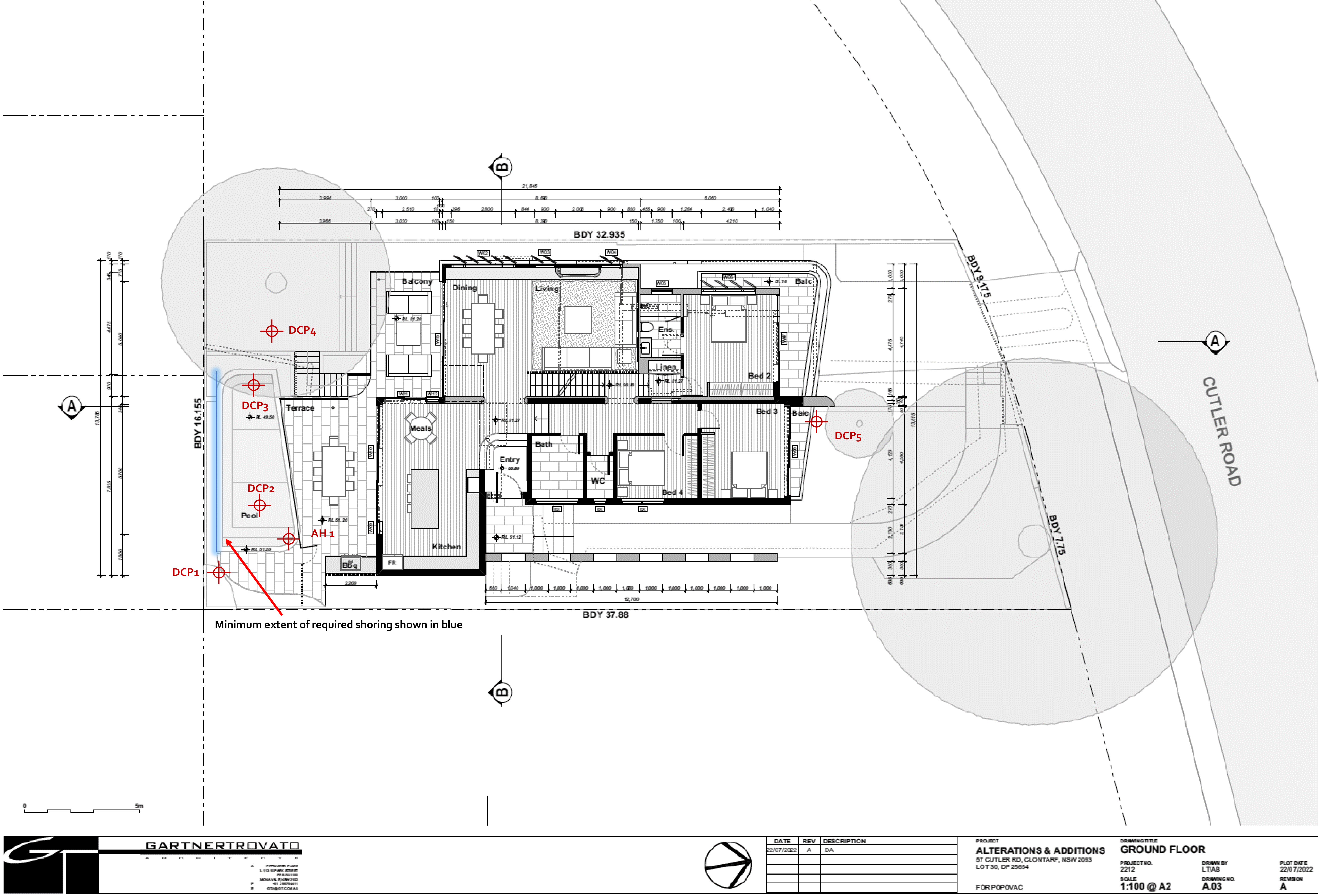
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

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

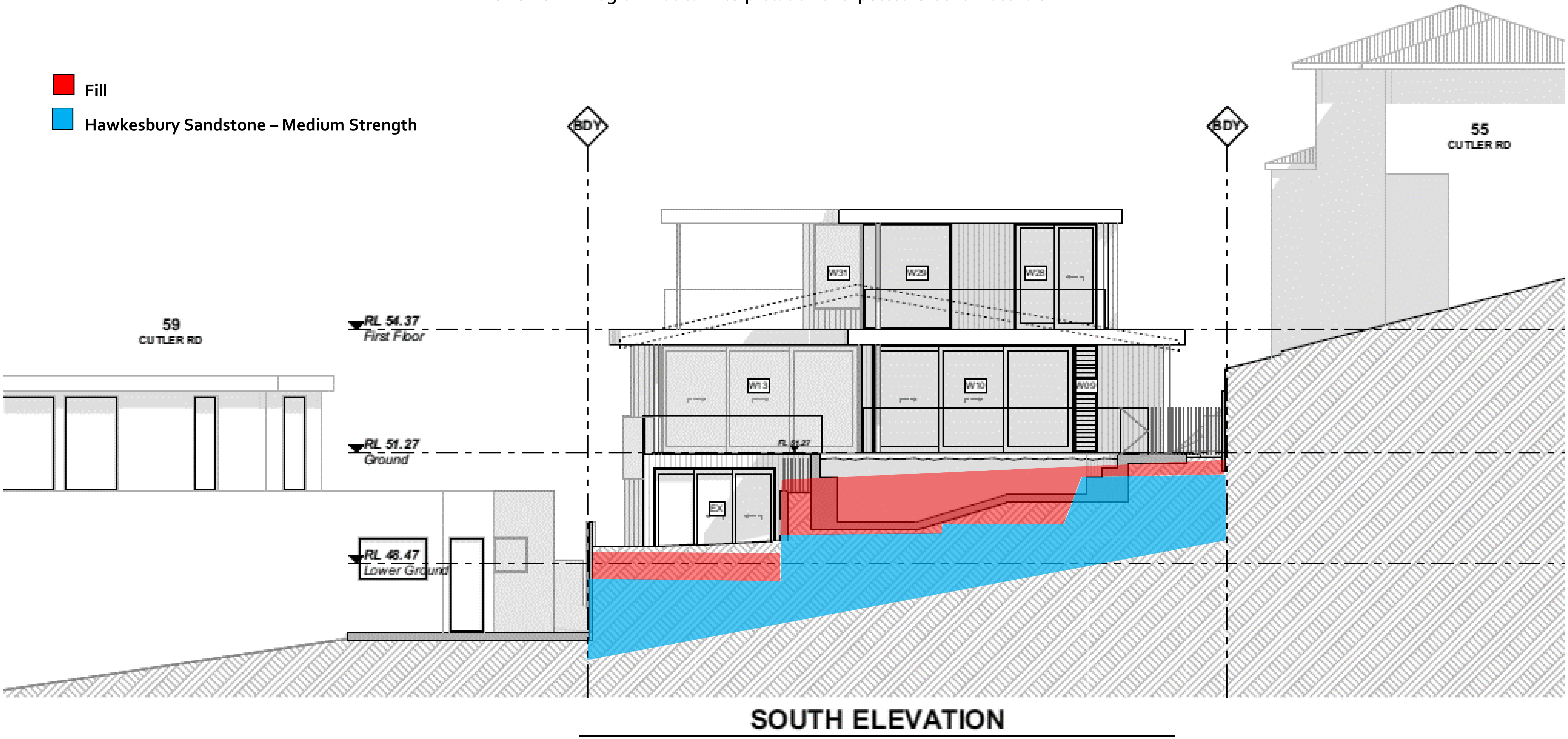
- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- 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.

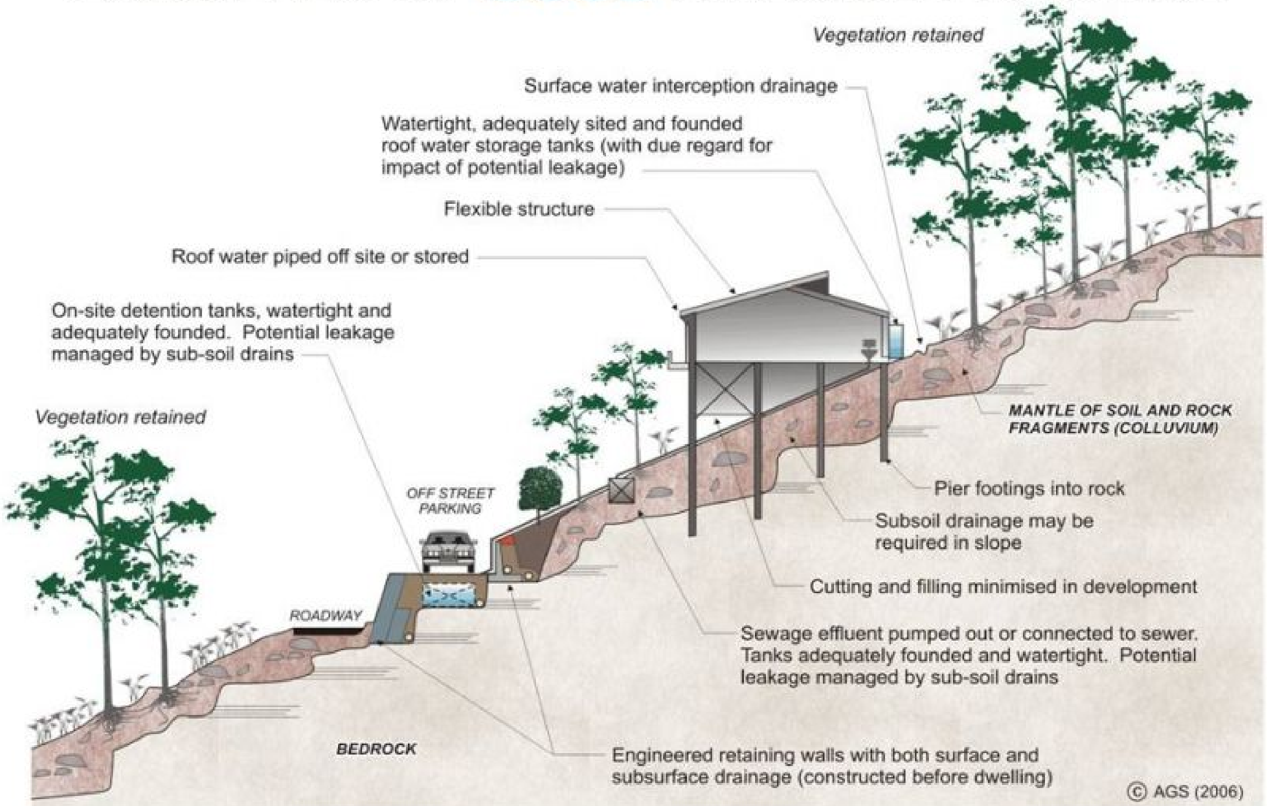
## SITE PLAN – showing test locations



**TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials**



# EXAMPLES OF GOOD HILLSIDE PRACTICE




# EXAMPLES OF POOR HILLSIDE PRACTICE