

## **GEOTECHNICAL INVESTIGATION:**

Alterations and Additions and New Pool at **1/6 College Street, Manly**

### **1. Proposed Development**

- 1.1** Extend the garage level of the unit by excavating to a maximum depth of ~2.4m.
- 1.2** Install a new pool in the N corner of the property by excavating to a maximum depth of ~1.8m.
- 1.3** Details of the proposed development are shown on 10 drawings prepared by EDAA, Project number 201806, drawings numbered DA.00 to 04, and 06 to 08, with two drawings numbered DA.09, all drawings Revision A, dated 10/12/18.

### **2. Site Description**

- 2.1** The site was inspected on the 13<sup>th</sup> November, 2018.
- 2.2** This residential property is level with the road and has a NE aspect. It is located on the gently graded middle reaches of a hillslope. The slope rises across the site at an average angle of ~7°. The slope above and below the property continues at gentle angles.
- 2.3** The block is on the corner of College Street and a Right of Carriageway (ROW) off College Street (Photo 1). A tile-paved driveway runs to a garage under the unit that has been cut into the slope (Photo 2). The cut for the garage has been taken entirely through competent Medium Strength Sandstone bedrock (Photos 3 & 4). Between the road frontage to College Street and the unit is a gently sloping lawn-covered fill (Photo 5). The fill is supported by a stable rendered masonry retaining wall reaching ~1.8m high (Photo 6). The two-storey rendered concrete block unit is supported on concrete block walls (Photo 7). No significant signs of movement were observed in the supporting walls which were observed to be supported directly off Medium Strength

Sandstone. A low cut has been made in the slope for a tile-paved patio that extends off the uphill side of the unit (Photo 8). The cut for the patio area is supported by a stable sandstone block retaining wall ~0.6m high.

### 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

Three 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. 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 and the results are as follows:

| DCP TEST RESULTS – Dynamic Cone Penetrometer    |                        |                               |                        |
|-------------------------------------------------|------------------------|-------------------------------|------------------------|
| Equipment: 9kg hammer, 510mm drop, conical tip. |                        | Standard: AS1289.6.3.2 - 1997 |                        |
| Depth(m)<br>Blows/0.3m                          | DCP 1<br>(~RL33.0)     | DCP 2<br>(~RL33.0)            | DCP 3<br>(~RL33.0)     |
| 0.0 to 0.3                                      | 5                      | 5                             | 9                      |
| 0.3 to 0.6                                      | 15                     | #                             | 4                      |
| 0.6 to 0.9                                      | 6                      |                               | #                      |
| 0.9 to 1.2                                      | 9                      |                               |                        |
| 1.2 to 1.5                                      | 4                      |                               |                        |
| 1.5 to 1.8                                      | #                      |                               |                        |
|                                                 | Refusal on Rock @ 1.3m | Refusal on Rock @ 0.3m        | Refusal on Rock @ 0.5m |

#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 @ 1.3m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP2 – Refusal on rock @ 0.3m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP3 – Refusal on rock @ 0.5m, 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 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. The rock is overlain by manmade fill over natural sandy soils and firm to stiff sandy clays that fill the bench-step formation. In the test locations, the depth to Medium Strength Sandstone ranged between 0.3 to 1.3m below the current surface, being deeper where filling is present and due to the stepped nature of the underlying rock. See Type Section attached for a diagrammatical representation of the expected ground materials.

## **6. Acid Sulfate Soils**

The subsurface profile of the site is derived from the Hawkesbury Sandstone. This formation is Middle Triassic in age and is much older than the Holocene sediments from which acid sulphates are generally derived from on the east coast. Additionally, Hawkesbury Sandstone does not contain high concentrations of sulphides which can provide the required iron concentrations for acid generation in older bedrock. These ground materials do not generate acid sulfate conditions and so a preliminary acid sulfate assessment is not required.

## **7. 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 excavations.

## 8. 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.

## 9. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The vibrations from the proposed excavation are a potential hazard (**Hazard One**). A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process is a potential hazard (**Hazard Two**).

### Risk Analysis Summary

| HAZARDS                  | Hazard One                                                                                                                                         | Hazard Two                                                                                                                                                  |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TYPE                     | The vibrations produced during the proposed excavation impacting on the surrounding structures.                                                    | A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process.                                             |
| LIKELIHOOD               | 'Possible' ( $10^{-3}$ )                                                                                                                           | 'Possible' ( $10^{-3}$ )                                                                                                                                    |
| CONSEQUENCES TO PROPERTY | 'Medium' (15%)                                                                                                                                     | 'Medium' (20%)                                                                                                                                              |
| RISK TO PROPERTY         | 'Moderate' ( $2 \times 10^{-4}$ )                                                                                                                  | 'Moderate' ( $2 \times 10^{-4}$ )                                                                                                                           |
| RISK TO LIFE             | $5.3 \times 10^{-7}$ /annum                                                                                                                        | $4.3 \times 10^{-5}$ /annum                                                                                                                                 |
| COMMENTS                 | This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels the recommendations in <b>Section 13</b> are to be followed. | This level of risk to life and property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels the recommendations in <b>Section 14</b> are to be followed. |

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

## **10. 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.

## **11. Stormwater**

No significant stormwater runoff will be created by the proposed development.

## **12. Excavations**

An excavation to a maximum depth of ~2.4m is required to extend the garage level. The excavation is expected to be made entirely through Medium Strength Sandstone.

Another excavation to a maximum depth of ~1.8m is required to install the proposed pool. This excavation is expected to be through a manmade fill over a thin sandy soil and firm to stiff sandy clay with Medium Strength Sandstone expected at depths of between 0.3 to 1.3m below the current surface.

It is envisaged that excavations through fill, sandy soil, and sandy clays can be carried out with a bucket and excavations through rock will require grinding or rock sawing and breaking.

## **13. Vibrations**

Possible vibrations generated during excavations through fill, sandy soil, and sandy clays will be below the threshold limit for building damage. The majority of the proposed excavations are expected to be taken through Medium Strength Sandstone.

Excavations through Medium Strength Rock should be carried out to minimise the potential to cause vibration damage to the subject unit and SE neighbouring unit. The supporting walls of the subject unit and SE neighbouring unit (party wall) will be immediately beside the proposed excavation. 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 common boundaries and supporting walls of the subject and neighbouring units. Vibration monitoring will be required to verify this is achieved.

If a milling head is used to grind the rock, vibration monitoring will not be required. Alternatively, if rock sawing is carried out around the perimeter of the excavation boundaries in not less than 1.0m lifts, a rock hammer up to 300kg could be used to break the rock without vibration monitoring. Peak particle velocity will be less than 5mm/sec at the common boundaries using this method provided the saw cuts are kept well below the rock to broken.

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

## **14. Excavation Support Requirements**

### **Bulk Excavation for Garage Level Extension**

No structures or boundaries will be within the zone of influence of the excavation. The neighbouring side of the party wall was inspected and found to be bedrock on the opposite side of the proposed excavation. Thus, eliminating the risk of a “rock column” forming between the two units as a result of the proposed works. However, we recommend the boundaries of the excavation be carried out with a rock saw so as to not fracture the rock towards the existing foundations. The excavation is not come to within 0.5m of the supporting walls of the subject unit block and party wall to the SE neighbouring unit block to reduce the risk of destabilising the rock outcrop onto which the units are supported.

If it is desired to take the excavation closer to the supporting walls than recommended, it should be noted this significantly increases risk. When the excavation has been taken to the recommended setbacks, the geotechnical consultant can inspect the rock to determine if the excavation can be taken closer. This is dependent on the rock strength remaining uniform and being free from geological defects.

During the excavation process for the garage level, the geotechnical consultant is to inspect the cut faces 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.

Upon completion of the excavation for the garage level, 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.

### **Bulk Excavation for Pool**

No structures or boundaries will be within the zone of influence of the excavation. In this instance, the zone of influence is the area above a theoretical 30° line through fill and soil, and a 45° line through clay from the top of Medium Strength Rock towards the surrounding structures and boundaries.

The fill, soil, and clay portions of the cut for the pool will stand at near-vertical angles for short periods of time until the pool structure is installed, provided the cut batters are kept dry. Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

Unsupported cut batters through soil and clay 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. Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. The materials and labour to construct the pool structure are to be organised so on completion of the excavation it 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.

All excavation spoil is to be removed from site.

## 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 Walls**

| Unit                      | Earth Pressure Coefficients      |                         |                          |
|---------------------------|----------------------------------|-------------------------|--------------------------|
|                           | Unit weight (kN/m <sup>3</sup> ) | 'Active' K <sub>a</sub> | 'At Rest' K <sub>0</sub> |
| Fill and Sandy Soil       | 20                               | 0.40                    | 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.



## 16. Foundations

A concrete slab supported directly off Medium Strength Sandstone is a suitable footing for the proposed garage level extension. This ground material is expected to be exposed across the entire base of the excavation.

The proposed pool is expected to be seated on the Medium Strength Sandstone. This is a suitable foundation material.

A maximum allowable bearing pressure of 600kPa 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.

**REQUIRED INSPECTIONS ARE ON THE NEXT PAGE**

## 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 for the garage level extension, the geotechnical consultant is to inspect the cut face in 1.5m intervals as it is lowered to ensure ground materials are as expected and that there are no wedges or other defects present in the rock that may require additional support.
- All footings are to be inspected and approved by the geotechnical consultant while the excavation equipment is still onsite and before steel reinforcing is placed or concrete is poured.

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

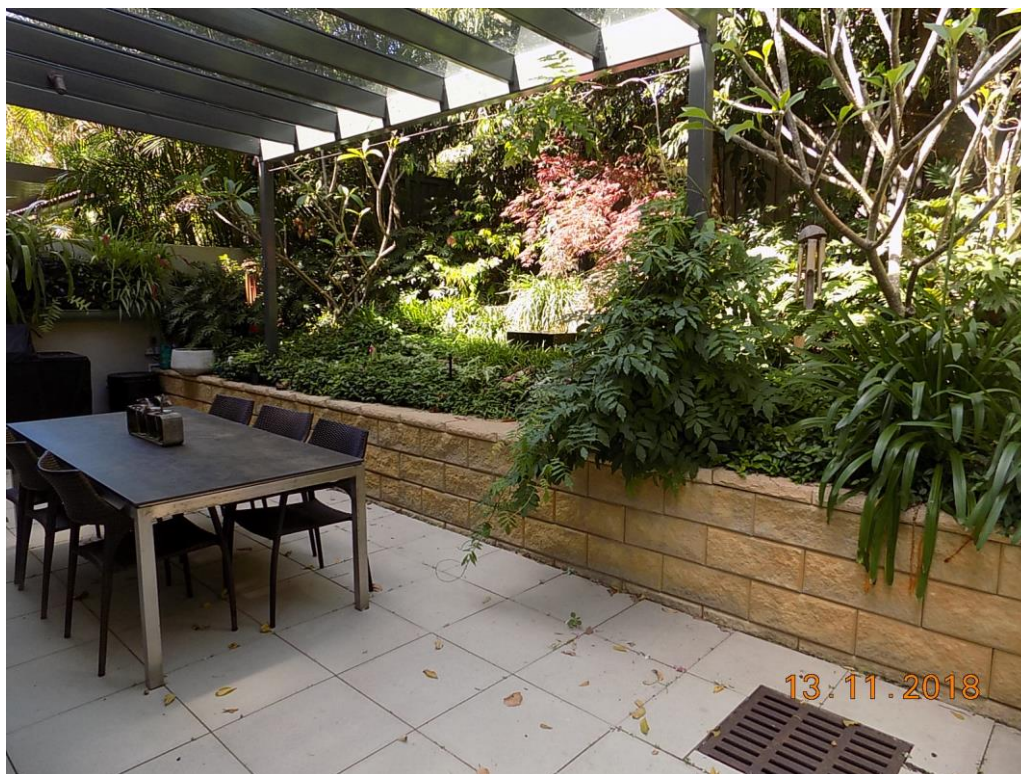


Photo 8

## 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.

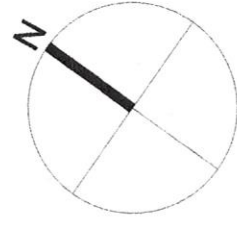
With this in mind, the following points are to be noted:

- 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

S.P. 67855



92  
D. P. 998494

A  
D. P.

B  
301333

101  
D. P.

102  
998494

New in ground swimming pool.  
Pool coping to match existing terrace RL.  
Existing Viburnum hedge to be retained  
around boundary line.

DCP1

DCP2

DCP3

PROPOSED  
POOL  
2.3m x 6.6m  
Depth 1m to 1.8m  
2260 litres

Pool coping  
RL 33.08

GLASS POOL FENCE

No.1

No.2

EXIST.  
TERRACE  
Existing RL 33.08

UNIT 2  
EXISTING DWELLING  
NO CHANGE

UNIT 1  
EXISTING DWELLING  
NO CHANGE  
SITE AREA 509.9sqm

EXIST.  
GARDEN

EXIST.  
TERRACE

| GENERAL LEGEND |                             |                      |                 |
|----------------|-----------------------------|----------------------|-----------------|
| WALL TYPES     |                             | MATERIALS / FINISHES |                 |
|                | EXISTING                    | PNT                  | PAINT           |
|                | NEW BRICKWORK               | POLY                 | POLYURETHANE    |
|                | NEW TIMBER STUD             | GLS                  | GLASS           |
|                | DEMOLISHED                  | MIR                  | MIRROR          |
|                |                             | TIM                  | TIMBER          |
|                |                             | CPT                  | CARPET          |
|                |                             | TLE 1                | TILE 1          |
|                |                             | STN 1                | STONE 1         |
|                |                             | REN                  | RENDER          |
|                |                             | PWD                  | POWDER COAT     |
|                |                             | VEN                  | VENEER          |
|                |                             | LAM                  | LAMINATE        |
|                |                             | VJ                   | "V" JOIN BOARDS |
|                |                             | PB                   | PLASTERBOARD    |
|                |                             | CON                  | CONCRETE        |
|                |                             | TR                   | TILED ROOF      |
|                |                             | MR                   | METAL ROOFING   |
|                |                             | WB                   | WEATHERBOARD    |
|                |                             | MF                   | METAL FINISH    |
|                |                             | ALM                  | ALUMINIUM       |
|                |                             | STST                 | STAINLESS STEEL |
| SYMBOLS        |                             |                      |                 |
|                | ELEVATION/SECTION REFERENCE |                      |                 |
|                | WINDOW REFERENCE            |                      |                 |
|                | SKYLIGHT                    |                      |                 |

A: Development Application 10.12.18

AMENDMENTS

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PROJECT **PLATT RESIDENCE**  
**Unit 1, 6 College Street Manly**  
**Lot 1, SP67855**

PROJECT NO. 201805

DRAWING **SITE/ ROOF PLAN**

DATE 15.11.18 DRAWN SE 1.100 CHECKED DA.02

DO NOT SCALE OFF THIS DRAWING. Use figured dimensions only. Verify all dimensions on site. Any discrepancies shall be brought to the attention of the author.

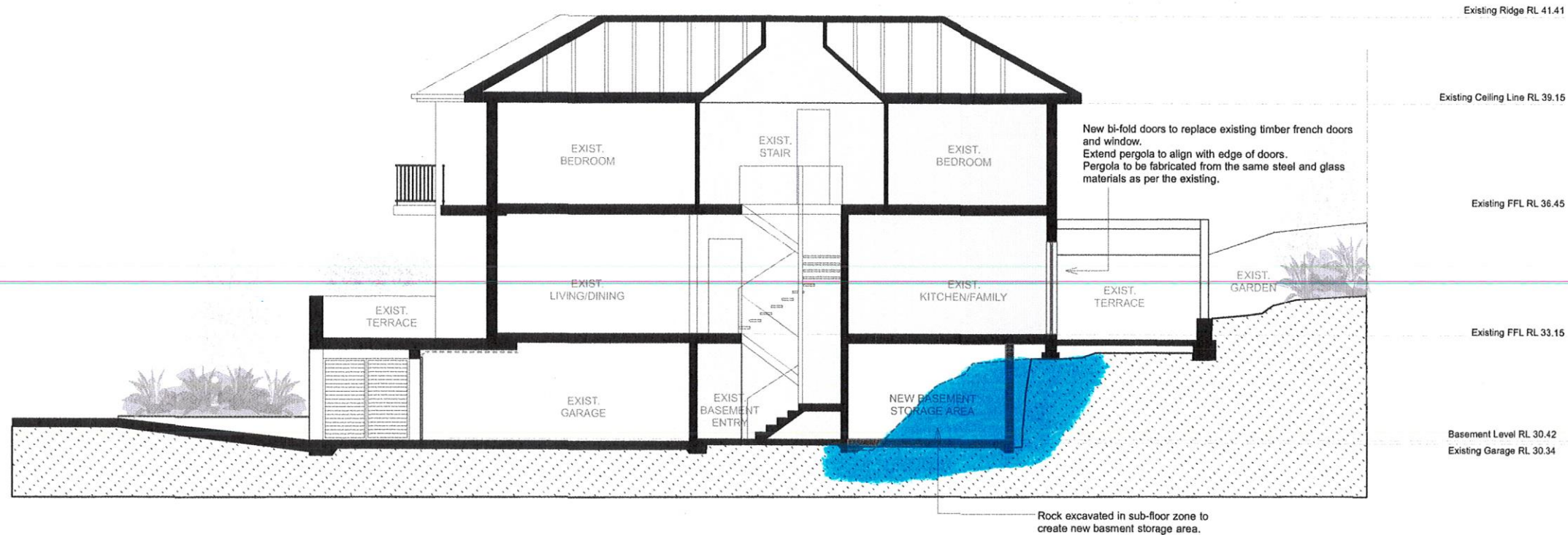


# TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



01 NORTH WEST ELEVATION - View from College Street

- Fill
- Sandy Soil
- Sandy Clay – Firm to Stiff
- Hawkesbury Sandstone – Medium Strength



02 LONG SECTION

A: Development Application 10.12.18

AMENDMENTS

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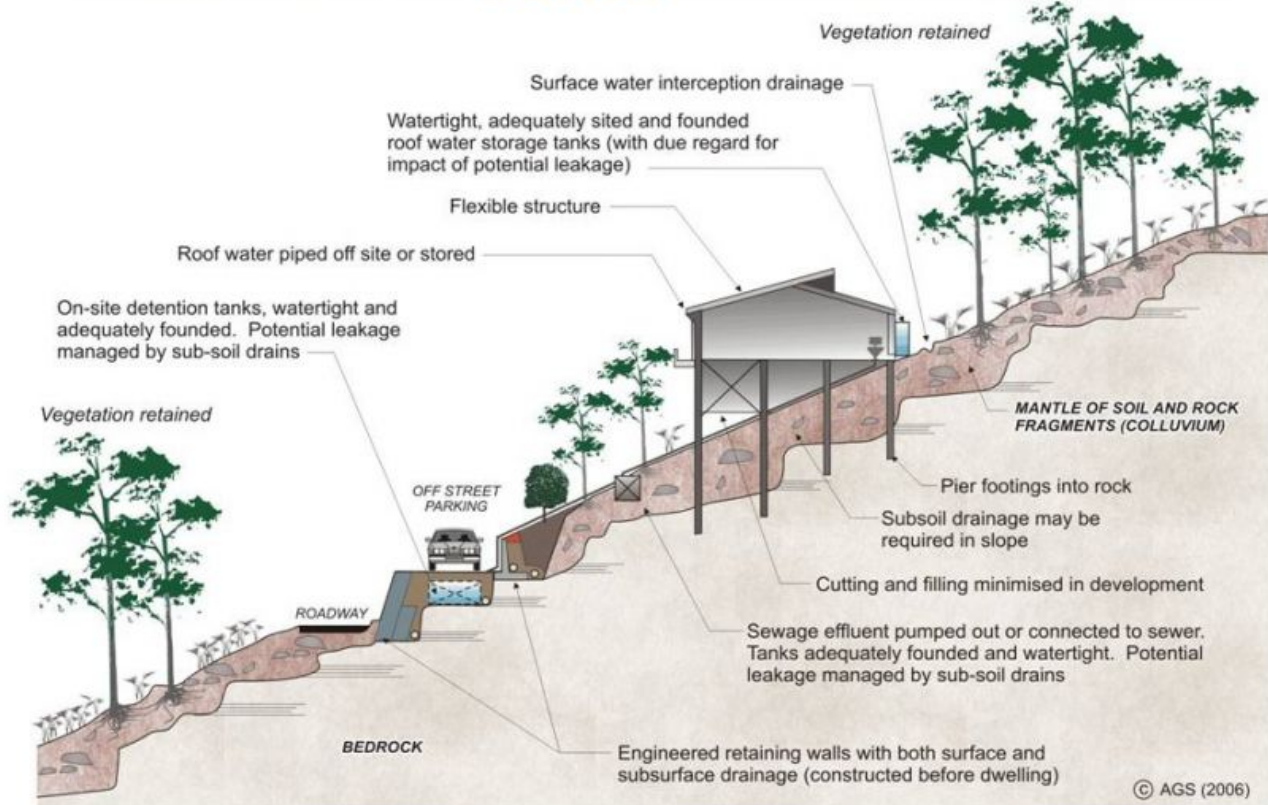
PROJECT NO. 201805  
DRAWING **ELEVATION NORTH**  
**LONG SECTION**

DATE 15.11.18 DRAWN SE SCALE 1:100 DESIGNED **DA.07**

DO NOT SCALE OFF THIS DRAWING. Use figured dimensions only. Verify all dimensions on site. Any discrepancies shall be brought to the attention of the author.



# EXAMPLES OF **GOOD** HILLSIDE PRACTICE



# EXAMPLES OF **POOR** HILLSIDE PRACTICE

