Jack Hodgson Consultants Pty Limited
CONSULTING CIVIL, GEOTECHNICAL AND STRUCTURAL ENGINEERS
ABN: 94 053 405 011



# RISK ANALYSIS & MANAGEMENT FOR PROPOSED ALTERATIONS, ADDITIONS AND DRIVEWAY AT 13 AMIENS ROAD, CLONTARF

## 1. INTRODUCTION.

**1.1** This Geotechnical Assessment Report has been prepared to accompany an application for Development Approval with Northern Beaches Council - Manly.

**1.2** The methods and definitions used in this Report are those described in *Landslide Risk Management March 2007*, published by the Australian Geo Mechanics Society.

**1.3** The experience of Jack Hodgson Consultants spans a time period over 40 years in the Northern Beaches Council area and Greater Sydney Region.

## 2. PROPOSED DEVELOPMENT.

**2.1** Demolish the existing residence, garage and driveway.

**2.2** Construct a new residence, entry staircase, associated landscaping, garage, driveway with under garage studio, storage and inclinator.

**2.3** Details of the proposed development are shown on architectural plans prepared by Case Ornsby Design Pty Ltd, Job ref: Faulkner, Drawing Nos DA_0 to DA_35, Revision A and dated 30/03/2019.

## 3. SITE DESCRIPTION.

**3.1** The site was inspected on the 25th March, 2019 for the purposes of this report.

**3.2** This property has a westerly aspect and is on the low side of the road. It is located towards the top of the steeper portion of the slope that rises from the waterfront to the Plateau above. The slope drops from the road at angles of some 20 to 25 degrees. The surface is controlled by the underlying sandstone that steps down the slope in a series of narrow benches.

**3.3** At the road frontage the short concrete driveway leads to the single garage at just below the road level, Photo 1. The driveway and the eastern front boundary and the edge of the Amiens Road are supported by several rock stacked retaining walls,

DIRECTOR: N. J. HODGSON
Unit 38D No 6 Jubilee Avenue, Warriewood NSW 2102
PO Box 389 Mona Vale NSW 1660
Telephone: 9979 6733 Facsimile: 9979 6926
www.jackhodgson.com.au

**3. SITE DESCRIPTION. (Continued)**

Photo 2. At the rear of the garage a gentle sloping lawn areas is accessed by a set stairs of the western side of the garage, Photo 3. This lawn area is created by use of retaining walls along the western and northern edges and the use of fill material placed over the existing bedrock. A storage area is under the existing garage. The sandstone walls of the storage room are also retaining walls. An elevated driveway runs adjacent the southern side boundary on the neighbouring property with low rock retaining wall supporting material along this boundary, Photo 4. A set stairs on the southern side of the property leads down a patio in front of the existing residence siting at the toe of the visible rock shelf, Photo 5. No access to the rear the property is possible on the southern side of the existing residence, Photo 6. A set stairs provides access to the rear of the property on the northern side of the existing residence, Photo 7. An elevated balcony and swimming pool is at the rear of the residence, Photo 8. On the northern underside of the elevated rear patio an old masonry retaining wall is observed to be out of vertical, Photo 9. This retaining wall maybe no longer required but we were unable to determine this at the time of our inspection and further investigation would be required. A set stairs on the southern side of the swimming pool provides access to the rear of the site. The landscaped stairs have been carved out of the exposed sandstone bedrock in some places, Photo 10. Some terraced rock stacked retaining walls provide support along the southern side boundary toward the south western rear corner. These retaining walls were observed stable at the time of inspection, Photo 11. A stable batter was observed underneath of the swimming pool where we also observed the piers that support the swimming pool, Photo 12.

**3.4** The existing multi single story brick house has been cut into the slope and terraced down the slope. The house is supported on brick and sandstone walls and piers. No significant movement attributed slope instability was observed in the existing buildings.

**4. GEOLOGY OF THE SITE.**

**4.1** Referencing the Sydney 1:100,000 Geological Series Sheet 9130 indicates the site is underlain by Hawkesbury Sandstone that outcrops across the property. These sandstones are of Middle Triassic age and were probably laid down in braided streams. The sand grains are mainly quartz with some sand grade claystone fragments. There are lenticular deposits of mudstones and laminites which are thought to have been deposited in abandoned channels of the main streams. The sandstones generally have widely spaced sub vertical joints with some current bedding. The joint directions are approximately north/south and east/west. The beds vary in thickness from 0.5 to in excess of 5 metres.

DIRECTOR: N. J. HODGSON
Unit 38D No 6 Jubilee Avenue, Warriewood NSW 2102
PO Box 389 Mona Vale NSW 1660
Telephone: 9979 6733 Facsimile: 9979 6926
www.jackhodgson.com.au

## 4. GEOLOGY OF THE SITE. (Continued)

**4.2** The soil materials are sandy loams over thin sandy clays with the sandy clays being absent at many locations. On this site the soil is up to 1.0 metres thick and the under lying bedrock are at depths expected to be in the range of 0.50 metres to 3.0 metres or deeper where filling has been undertaken.

**4.3** The surrounding area shows sandstone bedrock seen to be outcropping on the property above. The properties beside were at similar elevations and had similar geomorphology. Observation of these properties indicates that they do not present a risk of instability to the subject property.

## 5. SUBSURFACE INVESTIGATION AND SITE CLASSIFICATION.

**5.1** Four Dynamic Cone Penetrometer (DCP) tests were conducted in the locations shown on the site plan. The tests were conducted to the Australian Standard for ground testing: AS 1289.6.3.2 – 1997 (R2013). The results of these tests are as follows:

| NUMBER OF BLOWS - Conducted using a 9kg hammer, 510mm drop and conical tip - | | | | |
|---|---|---|---|---|
| **DEPTH (m)** | **DCP#1** | **DCP#2** | **DCP#3** | **DCP#4** |
| **0.0 to 0.3** | 3 | Refusal | 3 | 5 |
| **0.3 to 0.6** | 8 | | 4 | 7 |
| **0.6 to 0.9** | 12 | | 5 Drop 0.170 | 10 |
| **0.9 to 1.2** | **7/0.095** | | 3 | 18 |
| **1.2 to 1.5** | | | 12 | **16/0.027** |
| **1.5 to 1.8** | | | 10 | |
| **1.8 to 2.1** | | | 18 | |
| **2.1 to 2.4** | | | 19 | |
| **2.4 to 2.7** | | | 18 | |
| **2.7 to 3.0** | | | 17 | |
| **3.0 to 3.3** | | | 21 | |
| **3.3 to 3.6** | | | 20 | |
| **3.6 to 3.9** | | | 22 | |
| **3.9 to 4.2** | | | 28 | |
| **4.2 to 4.5** | | | 43 | |
| **4.5 to 4.8** | | | **50/0.200** | |
| **End of test** | **0.995** | **0.000** | **4.700** | **1.227** |
| **~DCP Surface RL AHD** | **24.88** | **27.88** | **33.50** | **34.80** |
| **~DCP End RL AHD** | **23.885** | **27.88** | **28.80** | **33.573** |

DIRECTOR: N. J. HODGSON
Unit 38D No 6 Jubilee Avenue, Warriewood NSW 2102
PO Box 389 Mona Vale NSW 1660
Telephone: 9979 6733 Facsimile: 9979 6926
www.jackhodgson.com.au

## 5. SUBSURFACE INVESTIGATION AND SITE CLASSIFICATION. (Continued)

**DCP TESTING NOTES:**

| | |
|---|---|
| **DCP#1** | 7 Blows for 0.095m then 8 blows for 0.015m. Strong Double Bounce. Refusal on rock.<br>Tip – Damp with some sandstone fragments. |
| **DCP#2** | Refusal possible concrete path. |
| **DCP#3** | 50 Blows for 0.200m then 8 blows for 0.012m. Slight Double Bounce. Refusal in weathered rock. Possible weathered joint as lower than visible rock.<br>Tip – Dry and clean. |
| **DCP#4** | 16 Blows for 0.027m then 8 blows for 0.010m. Double Bounce. Refusal on rock.<br>Tip – Dry and clean. |
| **Further Notes** | When ringing bouncing rock is not encountered, end of test occurs when there is less than 0.02m of penetration for 8 blows or danger of equipment damage is imminent.<br>No significant standing water table was identified in our testing. |

**5.2** The equipment chosen to undertake ground investigations provides the most cost effective method for understanding the subsurface conditions. Our interpretation of the subsurface conditions is limited to the results of testing undertaken and the known geology in the area. While every care is taken to accurately identify the subsurface conditions on-site, variation between the interpreted model presented herein, and the actual conditions onsite may occur. Should actual ground conditions vary from those anticipated, we would recommend the geotechnical engineer be informed as soon as possible to advise if modifications to our recommendations are required.

### 5.3 SITE CLASSIFICATION

The natural soil profile of the existing site is classified Class M, defined as 'Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes' as defined by AS 2870 - 2011. Where bedrock is encountered the site is classified as Class A.

## 6. DRAINAGE OF THE SITE.

### 6.1 ON THE SITE.

The site is naturally well drained with surface and subsurface runoff draining toward the rear wetstern boundary. No natural watercourses were observed on site.

### 6.2 SURROUNDING AREA.

Overland stormwater flow entering the site from the adjoining properties was not evident. Some stormwater run-off could enter the site from above during heavy or extended rainfall.

## 7. GEOTECHNICAL HAZARDS.

### 7.1 ABOVE THE SITE.

### 7.1 ABOVE THE SITE.

No geotechnical hazards likely to adversely affect the subject property were observed above the site as it is situated on the ridge of a hill.

### 7.2 ON THE SITE.

**7.2.1** The demolishing of the existing driveway, garage, storage and the construction of the new garage and studio will be a potential hazard risk to the road reserve and neighbouring property as the depth of works is some 3.5 metres below existing round levels. A failure of existing retaining walls and any required shoring during these works is considered to be a potential hazard **(HAZARD ONE)**.

### 7.3 BELOW THE SITE.

No geotechnical hazards likely to adversely affect the subject property were observed below the site.

### 7.4 BESIDE THE SITE.

The areas beside the site are also classed slip affected hazard areas. These blocks have similar elevation and geomorphology to the subject property. No geotechnical hazards likely to adversely affect the subject property were observed beside the site.

## 8. RISK ASSESSMENT.

### 8.1 ABOVE THE SITE.

As no geotechnical hazards likely to adversely impact upon the subject site were observed above the site, no risk analysis is required.

### 8.2 ON THE SITE.

#### 8.2.1 HAZARD ONE Qualitative Risk Assessment on Property

The demolishing of the existing driveway, garage, storage and the construction of the new garage and studio will be a potential hazard risk to the road reserve and neighbouring property as the depth of works is some 3.5 metres below existing round levels. It is a requirement of this report that an excavation

**8. RISK ASSESSMENT. (Continued)**

management plan is provided before bulk excavations occur. Provided a detailed excavation management plan is provided and the recommendations given in **Section 10** are undertaken the likelihood of the cut failing and impacting on the worksite is assessed as 'Unlikely' ($10^{-4}$). The consequences to property of such a failure are assessed as 'Minor' (5%). The risk to property is 'Low' ($5 \times 10^{-6}$).

### 8.2.2 HAZARD ONE Quantitative Risk Assessment on Life

For loss of life risk can be calculated as follows:
$\mathbf{R_{(LoI)} = P_{(H)} \times P_{(SH)} \times P_{(TS)} \times V_{(DT)}}$ (See Appendix for full explanation of terms)

**8.2.4.1 Annual Probability**
Provided recommendations in **Section 10** are followed and any soil portions of the cut are battered back and kept dry, batter failure is considered unlikely.
$\mathbf{P_{(H)}} = 0.0001$/annum

**8.2.4.2 Probability of Spatial Impact**
People will be working below the cut.
$\mathbf{P_{(SH)}} = 0.3$

**8.2.4.3 Possibility of the Location Being Occupied During Failure**
The average domestic worksite is taken to be occupied by 5 people. It is estimated that 1 person is below the cut for 10 hours a day, 6 days a week. It is estimated 4 people are below the cut 7 hours a day, 5 days a week.
For the person most at risk:

$$\frac{10}{24} x \frac{6}{7} = 0.36$$

$\mathbf{P_{(TS)}} = 0.36$

**8.2.4.4 Probability of Loss of Life on Impact of Failure**
Based on the volume of land failing and its likely velocity when it hits the work area, it is estimated that the vulnerability of a person to being killed below the cut when the batter fails is 0.3
$\mathbf{V_{(DT)}} = 0.3$

**8.2.4.5 Risk Estimation**
$\mathbf{R_{(LoI)}} = 0.0001 \times 0.3 \times 0.36 \times 0.3$
$= 0.00000108$
$\mathbf{R_{(LoI)}} = 3.24 \times 10^{-6}$/annum **NOTE:** This level of risk is **'ACCEPTABLE'** provided the recommendations given in **Section 10** are undertaken.

## 8. RISK ASSESSMENT. (Continued)

### 8.3 BELOW THE SITE.

As no geotechnical hazards likely to adversely impact upon the site were observed beside the property, no risk analysis is required.

### 8.4 BESIDE THE SITE.

As no geotechnical hazards likely to adversely impact upon the subject site were observed beside the site, no risk analysis is required.

## 9. SUITABILITY OF DEVELOPMENT FOR SITE.

### 9.1 GENERAL COMMENTS.

The proposed developments are suitable for the site.

### 9.2 GEOTECHNICAL COMMENTS.

No geotechnical hazards will be created by the completion of the proposed development in accordance with the requirements of this Report and good engineering and building practice.

### 9.3 CONCLUSIONS.

The site and the proposed development can achieve the Acceptable Risk Management criteria outlined in the *Landslide Risk Management March 2007*, published by the Australian Geo Mechanics Society provided the recommendations given in **Section 10** are undertaken.

## 10. RISK MANAGEMENT.

### 10.1. TYPE OF STRUCTURE.

The proposed structures are suitable for this site.

### 10.2. EXCAVATIONS.

**10.2.1** All excavation recommendations as outlined below should be read in conjunction with Safe Work Australia's *'Excavation Work – Code of Practice'*, published March, 2015.

**10. RISK MANAGEMENT. (Continued)**

**10.2.2** It is strongly recommended that detailed dilapidation reporting be undertaken on the adjacent structures before demolition or excavation work commences.

**10.2.3** Excavation cuts are expected to be through fill material, sandy topsoil and sandy clays before encountering the Hawkesbury Sandstones of the Wianamatta Group which are expected to be encountered approximately 0.5m to 3.0m below current surface levels.

**10.2.4** Temporary/permanent structural support and/or underpinning for the existing structures may be required during the excavation and construction phase of the project. This is to be designed, certified and supervised by the structural engineer.

**10.2.5** The cuts required for the construction of the new residence are to be approximate maximum depths of 2.0 metres. The bulk of the cut is expected to be through fill, sandy loam topsoil and thin sandy clays in some areas overlying or interbedded with the bedrock. Rock floaters and weathered sandstone is also expected in some areas.

**10.2.6** Excavations required will be through what is expected to be through low to medium strength sandstone in some locations. Given the proximity to neighbouring occupied residential buildings it would be considered prudent to monitor and limit vibration effects on the adjacent structures.

The Australian Standard AS2670.2-1990 "Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1-80 Hz)" suggests a day time limit of 8 mm/s component PPV for human comfort is acceptable.

We would suggest allowable vibration limits be set at 5mm/s PPV. It is expected that rock hammers with an approximate weight of 600-800kg will be adequate to operate within these tolerances.

**10.2.7** We recommend that any excavation through rock that cannot be readily achieved with a bucket excavator or ripper should be carried out initially using a rock saw to minimise the vibration impact and disturbance on the adjoining properties. Any rock breaking must be carried out only after the rock has been sawed and in short bursts (2-5 seconds) to prevent the vibration amplifying. The break in the rock from the saw must be between the rock to be broken and the closest adjoining structure.

## 10. RISK MANAGEMENT. (Continued)

**10.2.8** Any exposed cut batters are to be covered to prevent loss of moisture in dry weather and to prevent access of moisture in wet weather. Any potential runoff must be diverted from the cut faces by sandbag mounds or similar diversion works. Temporary support may be necessary depending upon the material encountered in the cuts, the likelihood of heavy rain and the length of period before permanent support is installed.

**10.2.9** Any unconsolidated portions of the cut batter that are unsupported such as sandy soils and soft clays are to be battered back from vertical a minimum of 45 degrees.

**10.2.10** All excavated material removed from the site is to be removed in accordance with current Office of Environment and Heritage (OEH) regulations.

### 10.3. FILLS.

**10.3.1** If filling is required all fills are to be placed in layers not more than 250 mm thick and compacted to not less than 95% of Standard Optimum Dry Density at plus or minus 2% of Standard Optimum Moisture Content.

**10.3.2** The fill batters are to be not steeper than 1 vertical to 1.7 horizontal or they are to be supported by properly designed and constructed retaining walls.

### 10.4. FOUNDATION MATERIALS AND FOOTINGS.

It is recommended that all footings be supported on and socketed into the underlying sandstone bedrock. The minimum design allowable bearing pressures are 800 kPa for spread footings or shallow piers. All footings are to be founded on material of equal consistency to prevent differential settlement.

### 10.5. STORM WATER DRAINAGE.

All storm water runoff from the development is to be connected to the existing storm water system for the block through any tanks or onsite detention systems that may be required by the regulating authorities. This drainage work is to comply with the relevant Australian standards (AS/NZS 3500 Plumbing and Drainage).

### 10.6. SUBSURFACE DRAINAGE.

**10.6.1** All retaining walls new and replaced are to have adequate back wall drainage.

**10. RISK MANAGEMENT. (Continued)**

**10.6.2** Retaining walls are to be back filled with non-cohesive free draining material to provide a drainage layer immediately behind the wall. The free draining material is to be separated from the materials by geotextile fabric ground.

**10.7. INSPECTIONS.**

**10.7.1** We would recommend the geotechnical engineer meet on site with the building contractor, structural engineer and the excavation contractor to discuss and approve construction methodology and equipment used before bulk excavations commence.

**10.7.2** It is recommended that the geotechnical engineer inspect the cut face at hold points of approximately 1.5m drops.

**10.7.3** It is essential that the foundation materials of all footing excavations be inspected and approved before concrete is placed. This includes retaining wall footings. Failure to advise the geotechnical engineer for these inspections could delay or stop the issuance of relevant certificates.

**11. GEOTECHNICAL CONDITIONS FOR ISSUE OF CONSTRUCTION CERTIFICATE.**

It is recommended that the following geotechnical conditions be applied to Development Approval:-

The work is to be carried out in accordance with the Risk Management Report MU 31713 dated 24th May, 2019.

The Geotechnical Engineer is to meet with the building contractor, structural engineer and the excavation contractor onsite before bulk excavations commence.

The Geotechnical Engineer is to inspect the cut face at regular 1.5m hold points.

The Geotechnical Engineer is to inspect and approve the foundation material of all footing excavations before concrete is placed.

## 12. GEOTECHNICAL CONDITIONS FOR ISSUE OF OCCUPATION CERTIFICATE.

The Geotechnical Engineer is to certify the following geotechnical aspects of the development:-

The work was carried out in accordance with the Risk Management Report MU 31713 dated 24th May, 2019.

The Geotechnical Engineer met with the building contractor, structural engineer and the excavation contractor onsite before bulk excavations commenced.

The Geotechnical Engineer inspected and approved the cut face at regular 1.5m hold points.

The Geotechnical Engineer inspected and approved the foundation material of all footing excavations before concrete was placed.

## 13. RISK ANALYSIS SUMMARY.

| HAZARDS | Hazard One |
|---|---|
| **TYPE** | The demolishing of the existing driveway, garage, storage and the construction of the new garage and studio will be a potential hazard risk to the road reserve and neighbouring property. A failure of existing retaining walls and any required shoring during these works is considered to be a potential hazard |
| **LIKELIHOOD** | 'Unlikely' ($10^{-4}$) |
| **CONSEQUENCES TO PROPERTY** | Minor (5%) |
| **RISK TO PROPERTY** | 'Low'($5 \times 10^{-6}$) |
| **RISK TO LIFE** | $3.24 \times 10^{-6}$/annum |
| **COMMENTS** | **'Acceptable'** level of risk. Provided the recommendations provided in **Section 10** are followed |

**JACK HODGSON CONSULTANTS PTY. LIMITED.**

Peter Thompson

**Peter Thompson MIE Aust CPEng**
**Member No. 146800**
**Civil/Geotechnical Engineer**


**Photo 1**


**Photo 2**


**Photo 3**


**Photo 4**


**Photo 5**


**Photo 6**

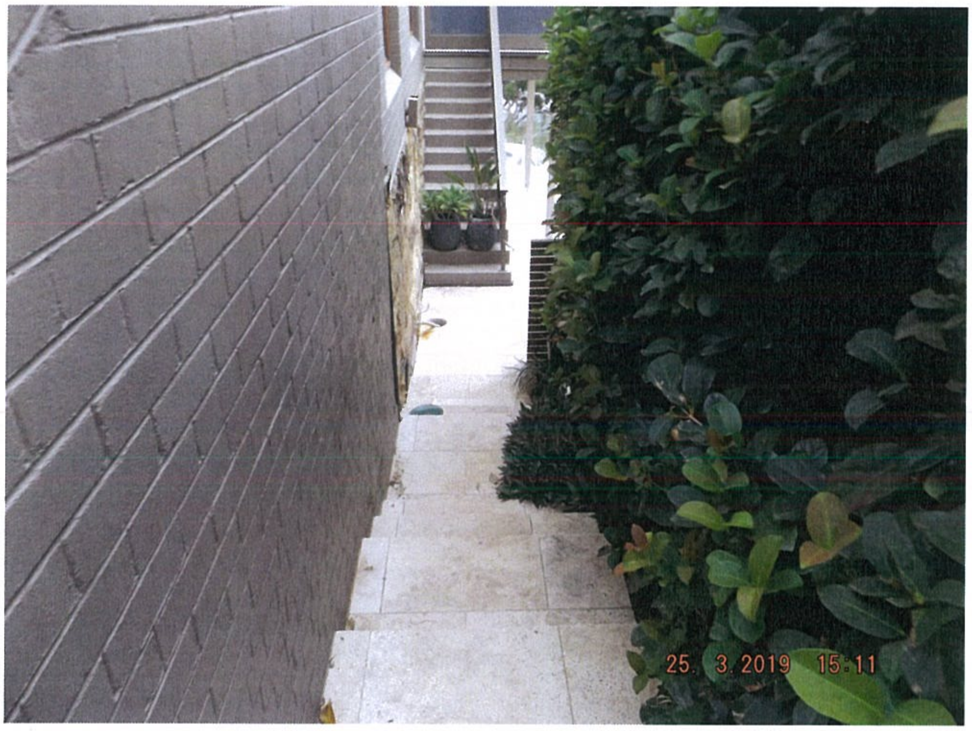



**Photo 7**


**Photo 8**


**Photo 9**


**Photo 10**

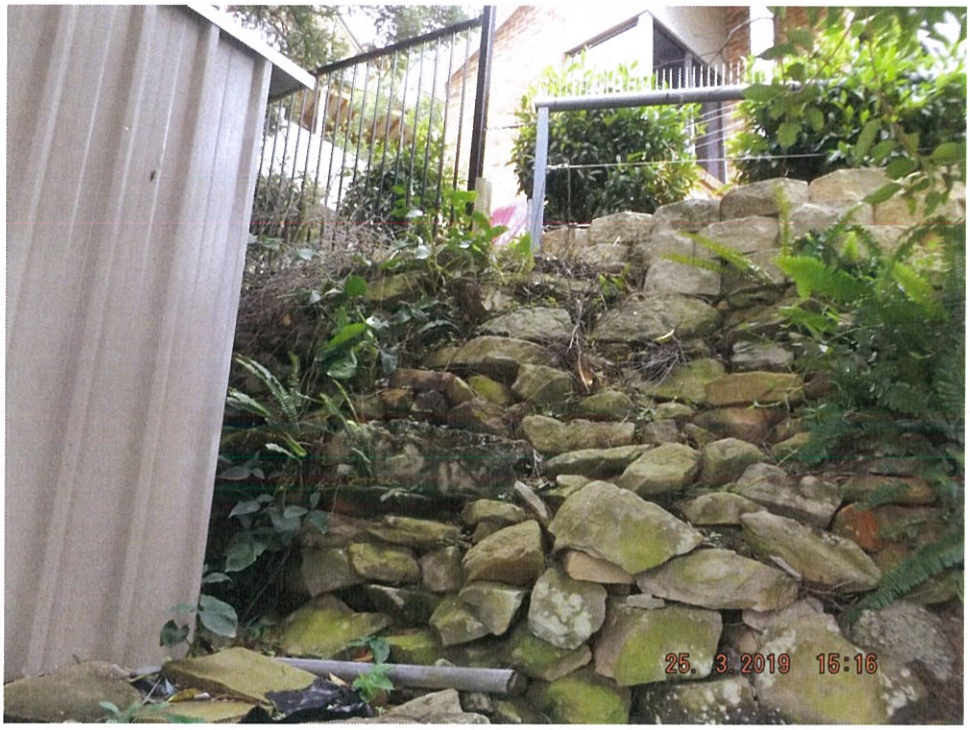



**Photo 11**


**Photo 12**

## 7. RISK ESTIMATION

### 7.1 QUANTITATIVE RISK ESTIMATION

Quantitative risk estimation involves integration of the frequency analysis and the consequences.
For property, the risk can be calculated from:
**R**(Prop) = **P**(H) x **P**(S:H) x **P**(T:S) x **V**(Prop:S) x **E (1)**

Where
**R**(Prop) is the risk (annual loss of property value).

**P**(H) is the annual probability of the landslide.

**P**(S:H) is the probability of spatial impact by the landslide on the property, taking into account the travel
distance and travel direction.

**P**(T:S) is the temporal spatial probability. For houses and other buildings **P**(T:S)= 1.0. For Vehicles and other
moving elements at risk1.0< **P**(T:S) >0.

**V**(Prop:S) is the vulnerability of the property to the spatial impact (proportion of property value lost).

**E** is the element at risk (e.g. the value or net present value of the property).
For loss of life, the individual risk can be calculated from:

**R**(LoL) = **P**(H) x **P**(S:H) x **P**(T:S) x **V**(D:T) **(2)**
Where

**R**(LoL) is the risk (annual probability of loss of life (death) of an individual).

**P**(H) is the annual probability of the landslide.

**P**(S:H) is the probability of spatial impact of the landslide impacting a building (location) taking into account
the travel distance and travel direction given the event.

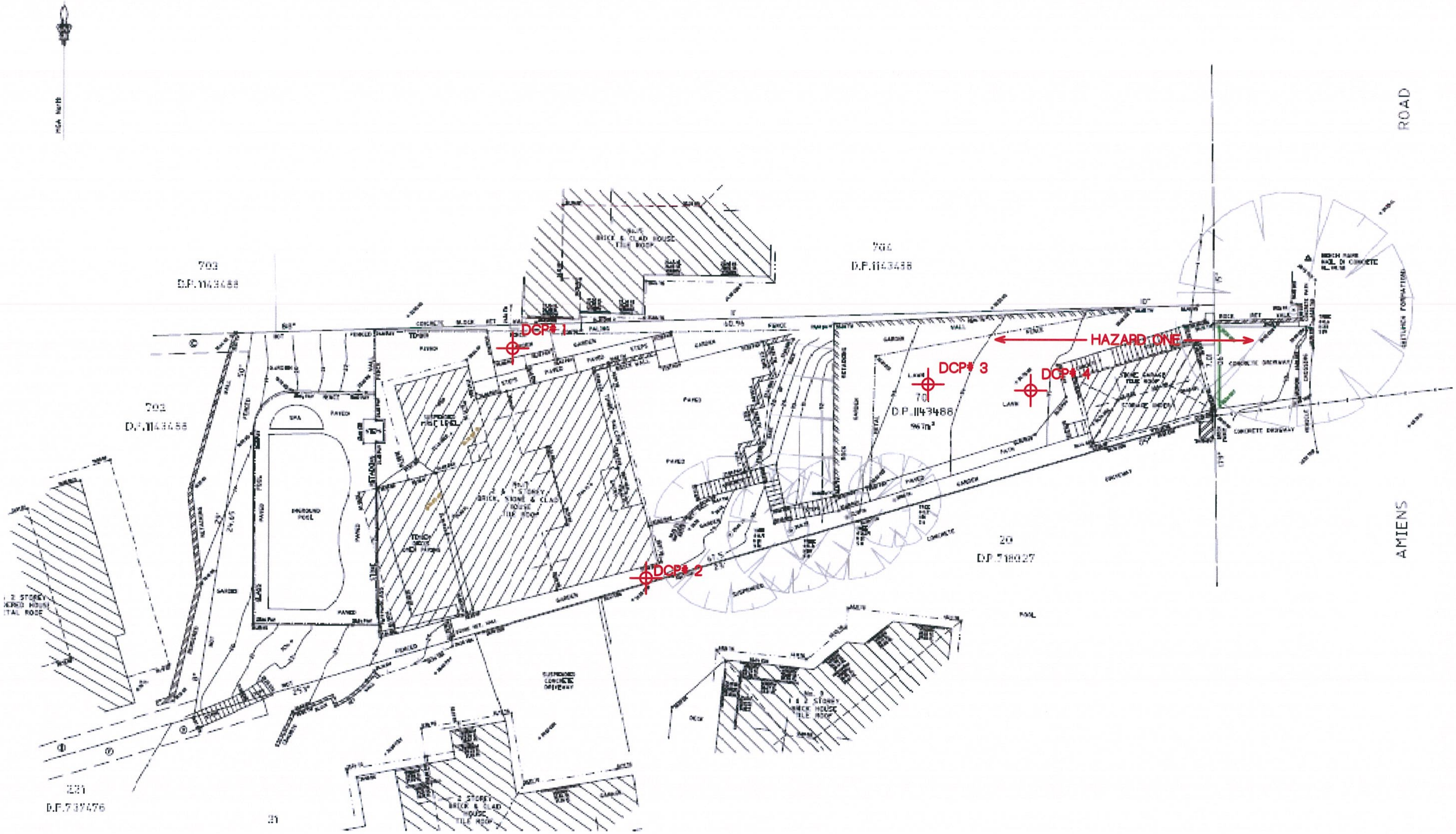
**P**(T:S) is the temporal spatial probability (e.g. of the building or location being occupied by the individual)
given the spatial impact and allowing for the possibility of evacuation given there is warning of the landslide occurrence.

**V**(D:T) is the vulnerability of the individual (probability of loss of life of the individual given the impact).
A full risk analysis involves consideration of all landslide hazards for the site (e.g. large, deep seated landsliding, smaller slides, boulder falls, debris flows) and all the elements at risk.

### PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

For comparison with tolerable risk criteria, the individual risk from all the landslide hazards affecting the person most at risk, or the property, should be summed.

The assessment must clearly state whether it pertains to 'as existing' conditions or following implementation of Recommended risk mitigation measures, thereby giving the 'residual risk'.

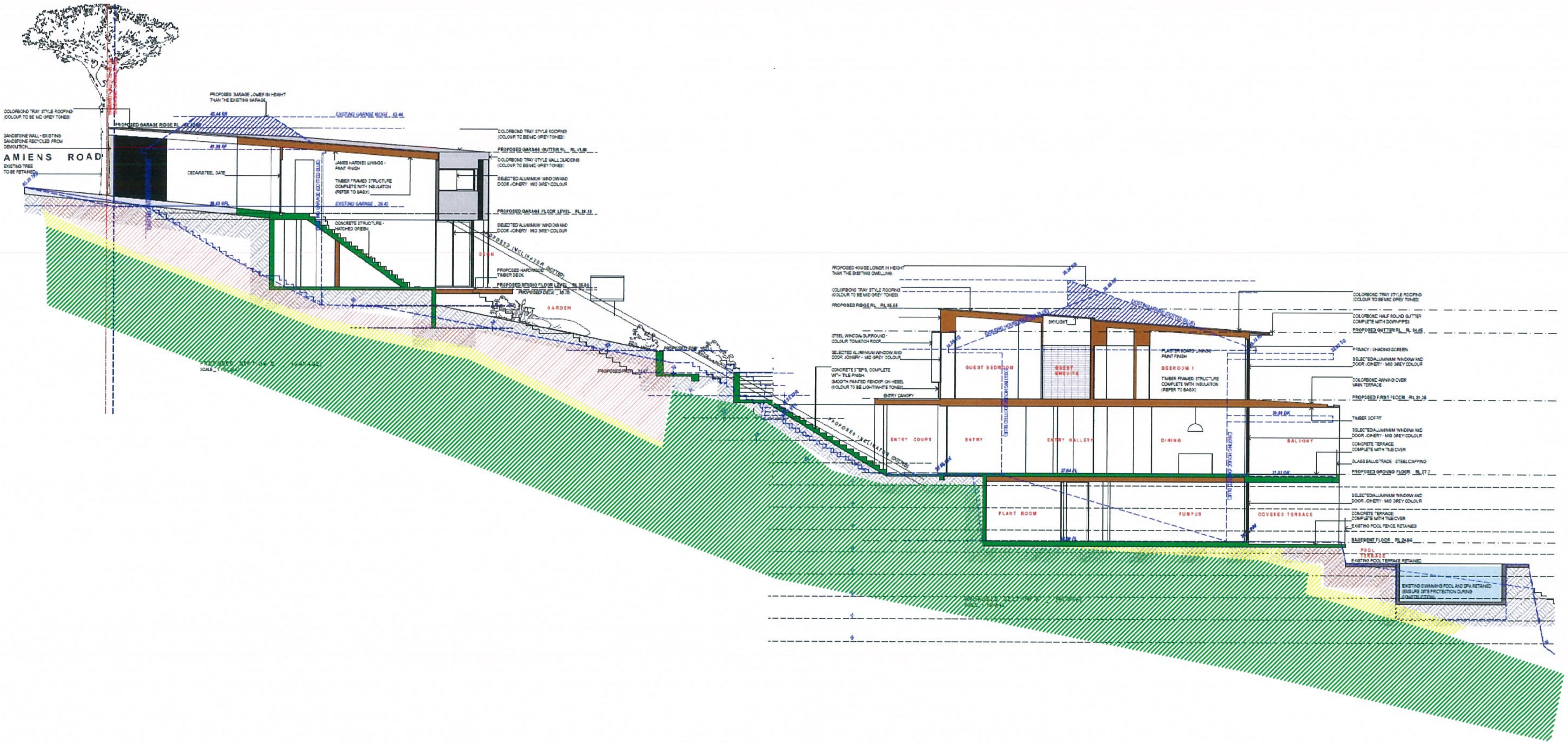



| SITE PLAN - DCP LOCATION & HAZARD | |
|---|---|
| Job No<br>MU 31713 | Address<br>13 AMIENS ROAD<br>CLONTARF<br>NSW |
| Scale<br>NTS | |

ABN: 94 053 405 011

Jack Hodgson Consultants Pty Limited

CONSULTING CIVIL, GEOTECHNICAL AND STRUCTURAL ENGINEERS




**NOTE**
**INTERPRETED SUB SURFACE SECTION ONLY.**
**ACTUAL GROUND CONDITIONS MAY VARY.**

ABN 94 053 405 011

Jack Hodgson Consultants Pty Limited

CONSULTING CIVIL, GEOTECHNICAL AND STRUCTURAL ENGINEERS

## TYPE SECTION

| Job No | Address |
|---|---|
| MU 31713 | 13 AMIENS ROAD |
| Scale | CLONTARF |
| NTS | NSW |

## STRATA PROFILE LEGEND

| | |
|---|---|
| Fill | Narrabeen Group Rocks |
| Sandy Topsoil | Hawkesbury Sandstone |
| Sandy Clay | |