Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Assessment

Proposed Balcony
48 Beacon Avenue, Beacon Hill

Prepared for
Mr Richard Wulff

Project 86822.00
July 2019

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
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Reviewer		4/7/19

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Geotechnics / Environment / Groundwater

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Report on Geotechnical Assessment
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1. Introduction

This report presents the results of a geotechnical assessment undertaken by Douglas Partners Pty Ltd (DP) for a proposed balcony at 48 Beacon Avenue, Beacon Hill. The assessment was commissioned by Mr Richard Wulff, the property owner, and was undertaken in accordance with DP's proposal SYD190619.P.001.Rev0, dated 18 June 2019.

It is understood that the proposed development will include the construction of a balcony at the first floor level along the eastern side of the existing two-storey building, with stairs along the northern side of the building. A geotechnical report is required for planning and design purposes.

It is understood that this report will be submitted as part of a Development Application (DA) to Northern Beaches Council.

This assessment included an inspection of site features by an experienced geotechnical engineer and a slope risk assessment. Details of the assessment are given in the report, together with comments on footings. This report should be read in conjunction with the notes About This Report provided in Appendix A.

2. Site Description

The residential site occupies an area of 561 m^2 and is located on an east-facing hillside. At the time of the assessment, most of the site was occupied by a two-storey building, surrounded by concrete paths, grassed lawns and garden beds. Residential properties are located to the north, east and south.

Based on the survey drawing (Ref: Drawing No. 191252-A, dated 11 June 2019, by Total Surveying Solutions Pty Ltd), the ground surface where the balcony is proposed is relatively flat with surface level at approximately RL 111 m relative to Australia Height Datum (AHD) and a difference over the area of less than 0.2 m over 15 m. The remainder of the site slopes down towards the Beacon Avenue frontage at less than 10°

3. Geology

Reference to the Sydney 1:100 000 Series Geological Sheet indicates that the site is underlain by Hawkesbury Sandstone, which typically comprises medium to coarse grained quartz sandstone with some shale bands or lenses.

Reference to the Warringah Landslide Risk Map indicates that the site is located in Area B, which is defined as areas with flanking slopes from 5° to 25°.

Reference to the Acid Sulfate Soil Risk Map indicates that the site is in an area of no known occurrence of ASS.

4. Results of Site Walkover

A walkover was carried out by an experienced geotechnical engineer, who mapped rock outcrops and site features on the site and nearby properties, where accessible. The location and direction of view of site photographs are shown on Drawing 1 in Appendix B. Site photographs showing the current site features are provided in Appendix C.

The results of the site walkover are summarised below:

- Medium to high strength Hawkesbury Sandstone was exposed along the eastern site boundary. The cutting was about 2 m high, with an approximate 1 m high retaining wall bearing on the bedrock (refer to Photo 1). Sandstone outcrops were also observed in cuttings along Beacon Hill Road, in proximity to the site;
- The ground surface levels either side of the northern and southern site boundaries are similar. The ground surface in the subject site lies about 1 m above the property to the east, and is supported by a masonry retaining wall;
- The external walls of the existing two-storey brick building show no signs of cracking or ground movement.

5. Geotechnical Model

Based on the results of the site walkover, published mapping and DP's experience in the area, the subsurface profile at the site is anticipated to include fill and stiff to hard residual sandy clay to depths of about 1 m, underlain by Hawkesbury Sandstone. The bedrock is likely to be predominantly medium to high strength, possibly with some low strength rock bands and 'hard' ironstone bands.

The regional groundwater table is expected to be below the site surface levels. Some water seepage is expected to occur at the soil and rock interface and within joints and weathered bands in the bedrock. The water seepage is likely to be sourced from rainfall events.

6. Comments

6.1 Proposed Development

It is understood that the proposed development will include the construction of a balcony at the first floor level along the eastern side of the existing two-storey building, with stairs along the northern side

of the building. The approximate footprint of the development is shown on Drawing 1 in Appendix B, together with sketches of the proposed balcony.

6.2 Slope Risk Assessment

There was no obvious evidence of slope instability on the site during the site walkover.

The stability of the site has been assessed in accordance with the methods of the Australian Geomechanics Society (Landslide Risk Management AGS Subcommittee, March 2007) for risk to property and to human life. Both assessments assume that the development will be carried out in accordance with the recommendations provided in this report.

Identified hazards within the site and at adjacent property boundaries are summarised in Table 1, together with a qualitative assessment of likelihood (after construction), consequence and risk to property.

Table 1: Risk to Property Assessment for Proposed Development

Hazard	Likelihood	Consequence	Risk
A. Localised collapse of existing 1 m high retaining wall along eastern boundary.	Unlikely	Insignificant	Very Low
B. Deep-seated slide beneath the site.	Barely Credible	Medium	Very Low
C. Failure of new balcony footings.	Rare	Minor	Very Low

The AGS (2007) also provides a framework for landslide risk management, guidance on risk analysis methods and information on acceptable or tolerable risks for loss of life.

Risk to life analysis can be broken up into four components, namely:

- Hazard identification;
- Frequency analysis;
- Consequence analysis; and
- Risk estimation.

For the loss of life, the individual risk can be calculated using:

$$R_{LOL} = P_H \times P_{S:H} \times P_{T:S} \times V_{D:T}$$

where R_{LOL} is the risk, or annual probability of death of an individual;
P_H is the annual probability of the hazardous event;
$P_{S:H}$ is the probability of spatial impact by the hazard given the event;
$P_{T:S}$ is the temporal probability given the spatial impact; and

$V_{D:T}$ is the vulnerability of the individual.

Table 2 below presents the results of the assessment undertaken in relation to risk to life for the hazards identified at this site.

Table 2: Risk to Life Assessment – Proposed Development

Hazard	$P_{(H)}$	$P_{(S:H)}$	$P_{(T:S)}$	$V_{(D:T)}$	Risk $R_{(LOL)}$
A. Localised collapse of existing 1 m high retaining wall along eastern boundary.	1×10^{-4}	0.2	0.004	0.1	6.9×10^{-9}
B. Deep-seated slide beneath the site.	1×10^{-6}	0.5	0.4	0.1	2.0×10^{-8}
C. Failure of new balcony footings.	1×10^{-5}	0.05	0.02	0.1	1×10^{-9}

Australian Geoguides for Slope Management and Maintenance (AGS, March 2007) provides various guidelines for hillside construction. Geoguide LR8 – Construction Practice from AGS (March 2007) is included in Appendix D and provides examples of good and poor hillside construction practice.

There are no established individual or societal risk acceptance criteria for the loss of life due to a hazardous event such as a landslide or rock fall. Geoguide LR7 – Landslide Risk from AGS (March 2007) is also provided in Appendix D. This guide discusses “acceptable” and “tolerable” levels of risk which have been proposed by several authorities.

When compared to the risk levels of the AGS (2007), it is considered that the risk levels associated with the proposed development will be acceptable in regards to both property and to life. Therefore the site is considered to be suitable for the proposed development. Further geotechnical inspections during construction, as described in the following sections, will be required to maintain risks within acceptable levels.

6.3 Disposal of Excavated Material

The scope of this geotechnical assessment did not include sampling and testing for Waste Classification or Contamination Assessment purposes. All material requiring off-site disposal should be classified in accordance with NSW EPA Guidelines - 2014. This includes filling and natural materials, such as may be removed from this site. The type and extent of testing undertaken will depend on the final use or destination of the spoil, and requirements of the receiving site.

6.4 Foundations

Provided all new footings are founded on sandstone bedrock, a ‘Class A’ site classification in accordance with the Australian Standard AS 2870 Residential Slabs and Footings – 2011 would be appropriate.

All structures should be uniformly founded on sandstone bedrock. Strip and pad footings bearing on at least very low strength bedrock are likely to be suitable to support the balcony and stair loads.

Footings founded on at least very low strength sandstone may be designed for an allowable bearing pressure of 1000 kPa.

Foundations proportioned on the basis of the allowable bearing pressure provided above would be expected to experience total settlements of less than 1% of the minimum footing width under the applied working load.

All footings should be founded below an imaginary line extending upwards at an angle of 45° from the base of any adjacent excavation or retaining wall. Where this is not the case, the allowable bearing pressure provided above should be reduced by 50%, with inspection by a geotechnical engineer of the adjacent excavation face for any adverse joints.

All footings should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters.

6.5 Hydrogeology

Water seepage should be expected along the top of the rock surface and through joints and clay bands in the bedrock, particularly following periods of extended wet weather.

Due to the absence of proposed basement or similar, it is anticipated that the proposed development will have no significant influence on the existing surface and regional groundwater flow system, both in the site and the surrounding area.

6.6 Acid Sulfate Soils

Acid sulfate soils (ASS) are typically found in low-lying, water-logged, alluvium soil deposits below RL 4 m AHD. Given the site topography, the near-surface rock and absence of a water table, ASS are considered to be absent on the site.

7. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 48 Beacon Avenue, Beacon Hill in accordance with DP's proposal SYD190619.P.001.Rev0 dated 18 June 2019 and acceptance received from Mr Richard Wulff dated 18 June 2019. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Mr Richard Wulff for this project only and for the purposes as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or another site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's site walkover has been completed.

DP's advice is based upon the conditions encountered during this assessment. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

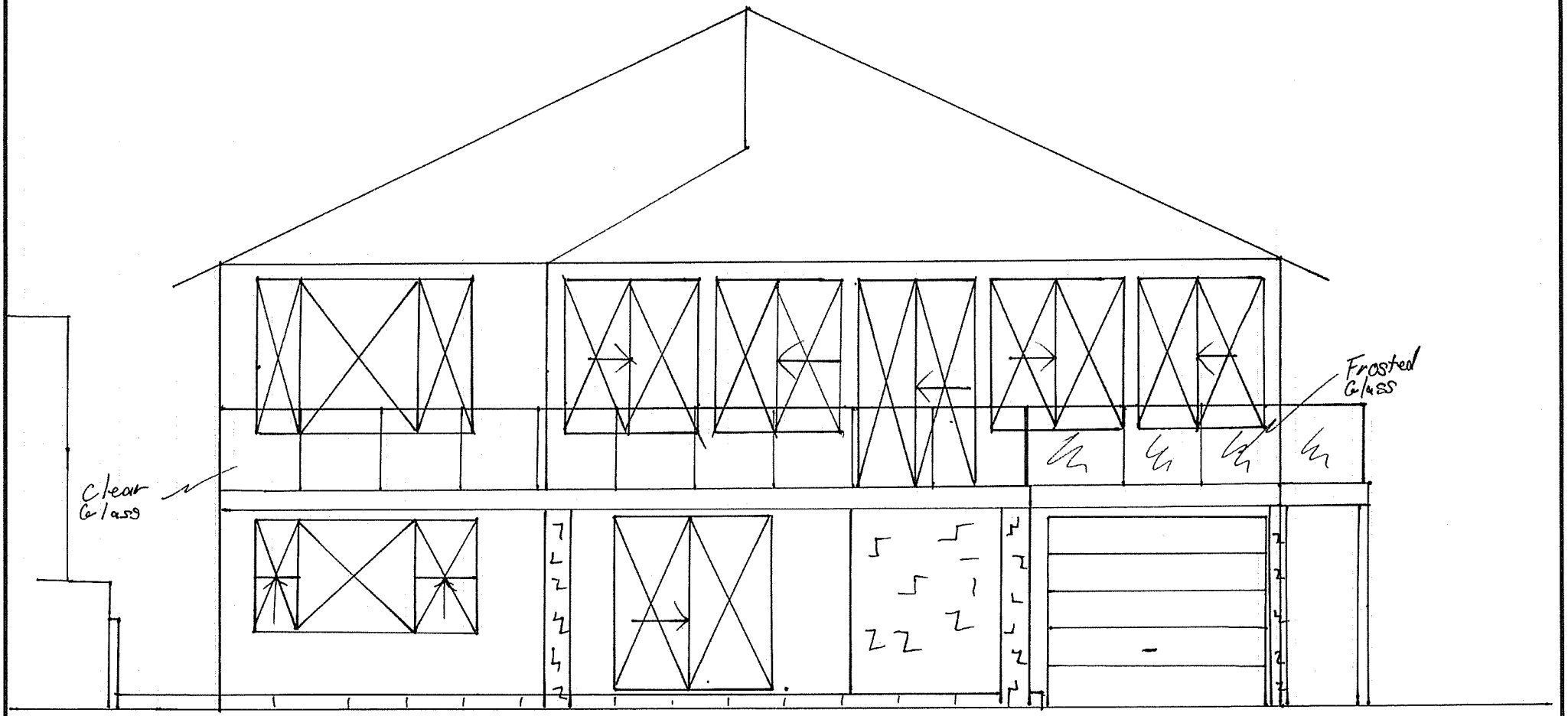
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

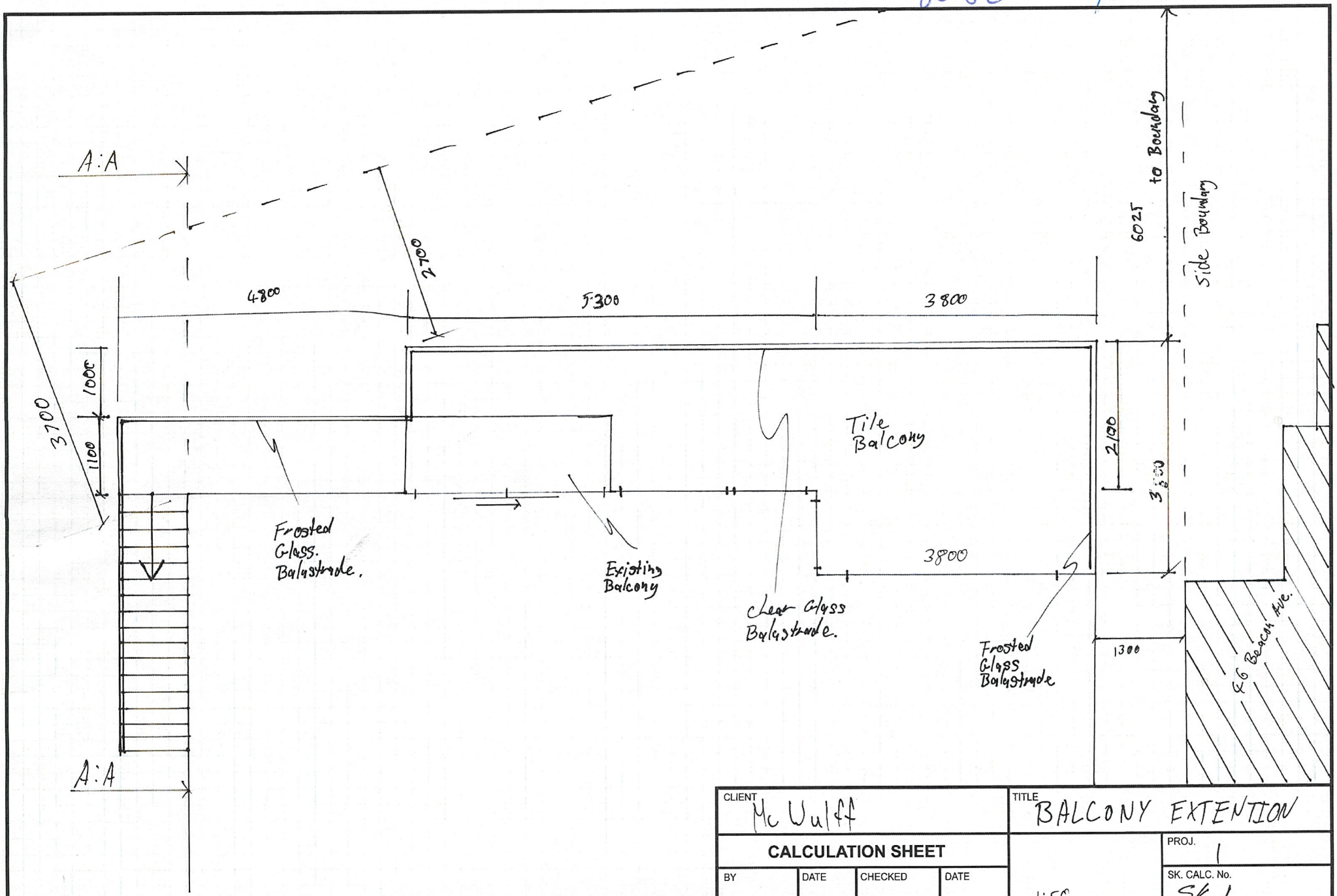
Appendix B

Drawings

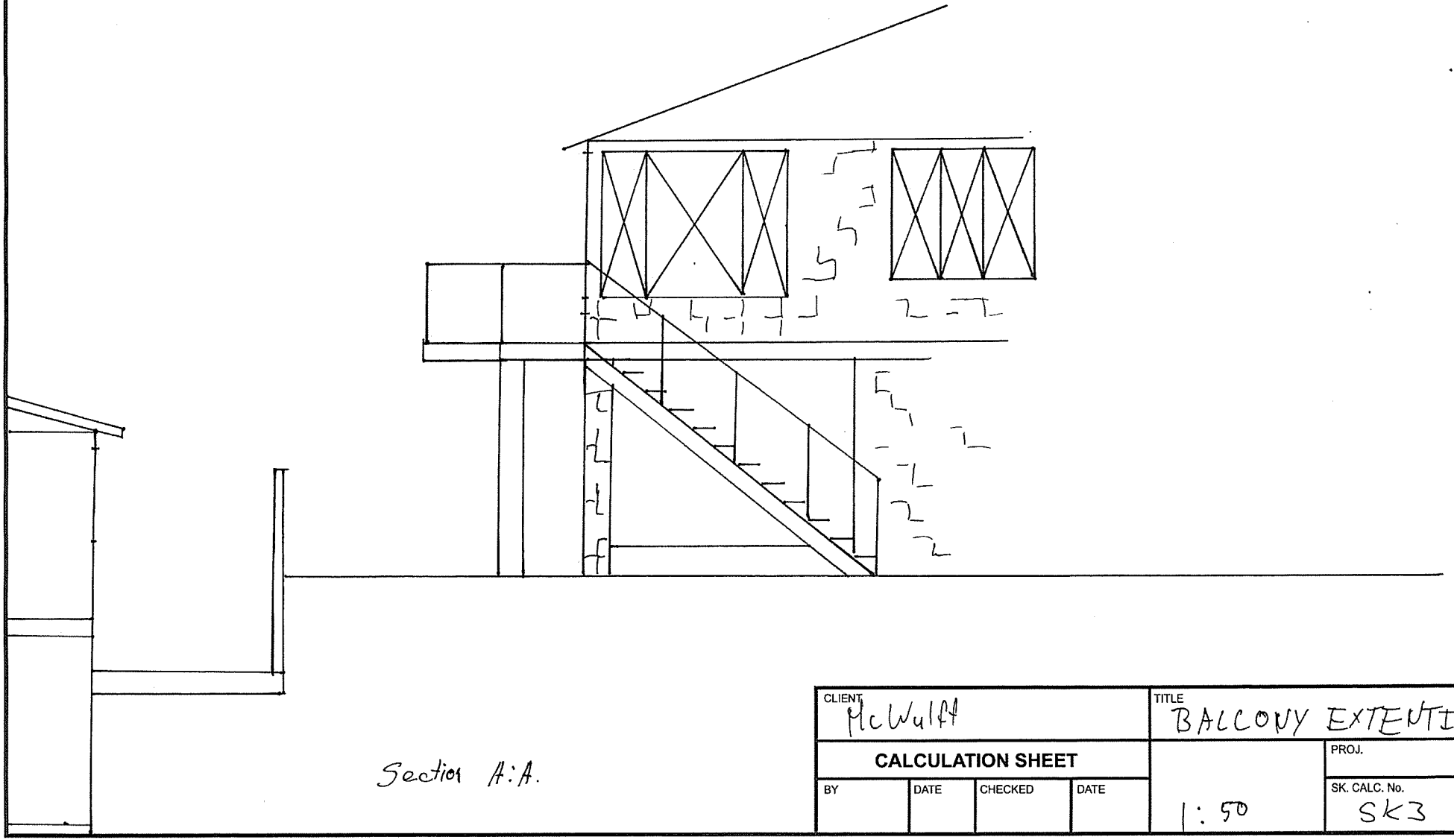


CLIENT				TITLE	
MC Wulff				BALCONY EXTENTION	
CALCULATION SHEET					PROJ.
BY	DATE	CHECKED	DATE		SK. CALC. No. SK 03

86823 /22 BHM



CLIENT	Mc Wulff	TITLE	BALCONY EXTENTION
CALCULATION SHEET			PROJ. 1
BY	DATE / CHECKED / DATE	1:50	SK. CALC. No. SK 1



Section A:A.

CLIENT McWulff				TITLE BALCONY EXTENTION	
CALCULATION SHEET					PROJ.
BY	DATE	CHECKED	DATE	1:50	SK. CALC. No. SK3

NO. 61 BEACON HILL ROAD

TWO STOREY
BRICK RESIDENCE
TILE ROOF
NO. 48

TWO STOREY
RENDERED RESIDENCE
FLAT METAL ROOF
NO. 46

GARAGE

BEACON AVENUE

APPROXIMATE 1m HIGH RETAINING WALL ALONG BOUNDARY

4
DP 31216

6
DP 31216

7
DP 31216

PROPOSED BALCONY

MEDIUM TO HIGH STRENGTH SANDSTONE.
VERTICAL CUT APPROXIMATELY 2m HIGH

Locality Plan

SITE

NOTE:
2: Base drawing from TSS Total Surveying Solutions Pty Ltd (Plan 191252_A, dated 11.6.2019)
2: Test locations are approximate only and are shown with reference to existing features.

LEGEND

1 Photo number with direction of view

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Mr Richard Wulff		TITLE: **Geotechnical Assessment**
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Balcony**
SCALE: 1:125 @ A3	DATE: 28.6.2019	**48 Beacon Avenue, BEACON HILL**

PROJECT No: 86822.00
DRAWING No: 1
REVISION: 0

Appendix C

Site Photographs

Photo 1 – Medium to high strength sandstone exposed along eastern boundary. Top of rock approximately 1m below surface level in rear garden of 48 Beacon Avenue.

Photo 2 – Approximate area of proposed balcony footings (view south)

Douglas Partners Geotechnics / Environment / Groundwater	**Proposed Balcony** **48 Beacon Avenue,** **Beacon Hill**	PROJECT: 86822.00 PLATE No: 1 REV: 0
	CLIENT: Mr Richard Wulff	DATE: 28-Jun-19

Appendix D

Geoguide LR7 and LR8 – Landslide Risk from AGS

LANDSLIDE RISK

Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as *"a measure of the probability and severity of an adverse effect to health, property, or the environment."* This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is often covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, go first for information to your local council.

Landslide risk assessment must be undertaken by a geotechnical practitioner. It may involve visual inspection, geological mapping, geotechnical investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site)
- the likelihood that they will occur
- the damage that could result
- the cost of disruption and repairs and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction tends to lack precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. "Likelihood" is the chance of it happening in any one year, as indicated in Table 2. "Consequences" are related to the cost of repairs and temporary loss of use if a landslide occurs. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

TABLE 2: LIKELIHOOD

Likelihood	Annual Probability
Almost Certain	1:10
Likely	1:100
Possible	1:1,000
Unlikely	1:10,000
Rare	1:100,000
Barely credible	1:1,000,000

The terms "unacceptable", "may be tolerated", etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others.

Some local councils and planning authorities stipulate a maximum tolerable level of risk to property for developments within their jurisdictions. In these situations the risk must be assessed by a geotechnical practitioner. If stabilisation works are needed to meet the stipulated requirements these will normally have to be carried out as part of the development, or consent will be withheld.

TABLE 1: RISK TO PROPERTY

Qualitative Risk		Significance - Geotechnical engineering requirements
Very high	VH	**Unacceptable** without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low. May be too expensive and not practical. Work likely to cost more than the value of the property.
High	H	**Unacceptable** without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property.
Moderate	M	**May be tolerated** in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as possible.
Low	L	**Usually acceptable** to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required.
Very Low	VL	**Acceptable**. Manage by normal slope maintenance procedures.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

Risk to Life

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in water-related activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. Importantly, the data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us any day. If this were not so, no one would ever be struck by lightning.

Most local councils and planning authorities that stipulate a tolerable risk to property also stipulate a tolerable risk to life. The AGS Practice Note Guideline recommends that 1:100,000 is tolerable in newly developed areas, where works can be carried out as part of the development to limit risk. The tolerable level is raised to 1:10,000 in established areas, where specific landslide hazards may have existed for many years. The distinction is deliberate and intended to prevent the concept of landslide risk management, for its own sake, becoming an unreasonable financial burden on existing communities. Acceptable risk is usually taken to be one tenth of the tolerable risk (1:1,000,000 for new developments and 1:100,000 for established areas) and efforts should be made to attain these where it is practicable and financially realistic to do so.

TABLE 3: RISK TO LIFE

Risk (deaths per participant per year)	**Activity/Event Leading to Death** (NSW data unless noted)
1:1,000	Deep sea fishing (UK)
1:1,000 to 1:10,000	Motor cycling, horse riding , ultra-light flying (Canada)
1:23,000	Motor vehicle use
1:30,000	Fall
1:70,000	Drowning
1:180,000	Fire/burn
1:660,000	Choking on food
1:1,000,000	Scheduled airlines (Canada)
1:2,300,000	Train travel
1:32,000,000	Lightning strike

More information relevant to your particular situation may be found in other AUSTRALIAN GEOGUIDES:

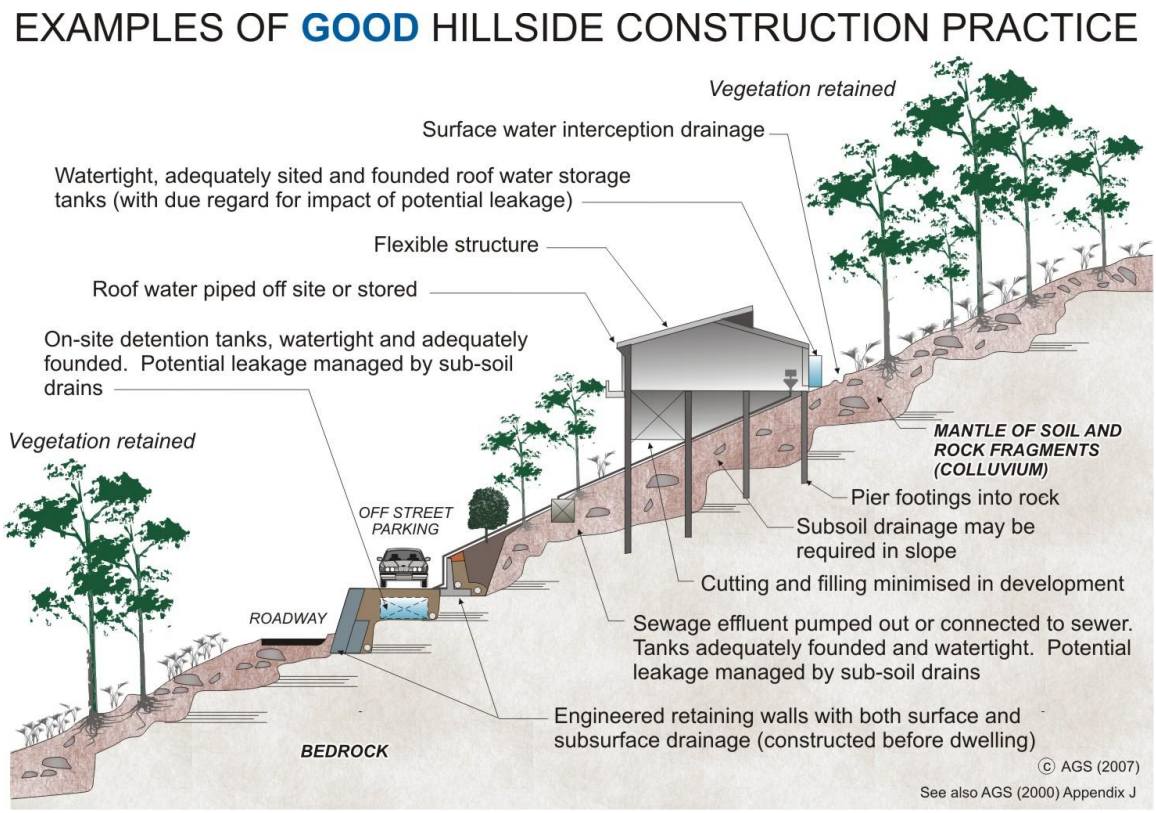
- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.



WHY ARE THESE PRACTICES GOOD?

Roadways and parking areas - are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

Cuttings - are supported by retaining walls (GeoGuide LR6).

Retaining walls - are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that in level ground. Retaining walls must be designed taking these forces into account.

Sewage - whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

Surface water - from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfil the same purpose (GeoGuide LR5).

Surface loads - are minimised. No fill embankments have been built. The house is a lightweight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

Flexible structures - have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

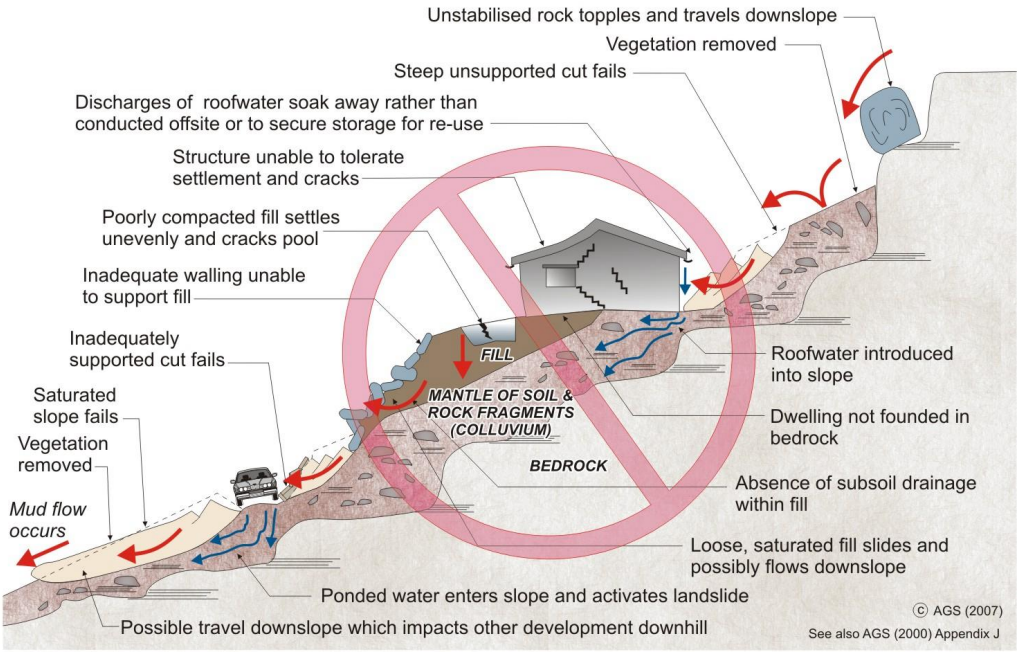
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

ADOPT GOOD PRACTICE ON HILLSIDE SITES

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

EXAMPLES OF **POOR** HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES POOR?

Roadways and parking areas - are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soak into the ground.

Cut and fill - has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

Retaining walls - have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

A heavy, rigid, house - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

Soak-away drainage - has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herring bone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

Rock debris - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flow paths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

Vegetation - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

Appendix E

Form 1 and Form 1(a)

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1 – To be submitted with Development Application

Development Application for MR RICHARD WULFF
Name of Applicant

Address of site 48 BEACON AVENUE, BEACON HILL

Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report

I, PETER VALENTI *on behalf of* DOUGLAS PARTNERS P/L
(Insert Name) (Trading or Company Name)

on this the 3 JULY 2019 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $10million.

I: PETER VALENTI

Please mark appropriate box

- ✓ have prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.
- ☐ have examined the site and the proposed development/alteration in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.
- ☐ have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.
- ☐ have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: REPORT ON GEOTECHNICAL ASSESSMENT
Report Date: JULY 2019
Author: PETER VALENTI
Author's Company/Organisation: DOUGLAS PARTNERS

Documentation which relate to or are relied upon in report preparation:

SURVEY DRAWING – # 191252_A, 11.6.19, BY TSS
PROPOSED BALCONY – SK1, SK3, SK

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature .....
Name GEOFF YOUNG
Chartered Professional Status BE, MEng Sc, FIEAust, CPEng NER
Membership No. 98650
Company DOUGLAS PARTNERS P/L

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1(a) - Checklist of Requirements For Geotechnical Risk Management Report for Development Application

Development Application for MR RICHARD WULFF
Name of Applicant
Address of site 48 BEACON AVENUE, BEACON HILL

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Geotechnical Report. This checklist is to accompany the Geotechnical Report and its certification (Form No. 1).

Geotechnical Report Details:

Report Title: REPORT ON GEOTECHNICAL ASSESSMENT
Report Date: JULY 2019
Author: PETER VALENTI
Author's Company/Organisation: DOUGLAS PARTNERS P/L

Please mark appropriate box

- ✓ Comprehensive site mapping conducted 8.6.19 (date)
- ✓ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)
- ○ Subsurface investigation required
  - ✓ No Justification NUMEROUS ROCK OUTCROPS IN AREA OF DEVELOPMENT
  - ○ Yes Date conducted .....
- ✓ Geotechnical model developed and reported as an inferred subsurface type-section
- ✓ Geotechnical hazards identified
  - ✓ Above the site
  - ✓ On the site
  - ✓ Below the site
  - ✓ Beside the site
- ✓ Geotechnical hazards described and reported
- ✓ Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
  - ✓ Consequence analysis
  - ✓ Frequency analysis
- ✓ Risk calculation
- ✓ Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.
- ○ Design Life Adopted:
  - ✓ 100 years
  - ○ Other ..... (specify)
- ✓ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified
- ✓ Additional action to remove risk where reasonable and practical have been identified and included in the report.
- ○ Risk assessment within Bushfire Asset Protection Zone.

I am aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ensuring that the geotechnical risk management aspects of the proposal have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated, and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature .....
Name GEOFF YOUNG
Chartered Professional Status BE, MEngSc, FIEAust, CPEng, NER
Membership No. 98650
Company DOUGLAS PARTNERS P/L