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

Development Application for ROBERT BISHOP
Name of Applicant

Address of site 115A PACIFIC ROAD, PALM BEACH NSW

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

I, PAUL STUBBS (Insert Name) *on behalf of* JK GEOTECHNICS (Trading or Company Name)

on this the _____ 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:
Please mark appropriate box

X 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

X 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.

X 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.

X 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.

X have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: STABILITY ASSESSMENT

Report Date: 31 JULY 2019

Author: WOODIE THEUNISSEN

Author's Company/Organisation: JK GEOTECHNICS

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

ARCHITECTURAL DRAWINGS BY MICHEAL FOUNTAIN ARCHITECTS Pty Ltd (JOB NO. 1901, DRAWING NOS: SK-01 to SK-03, dated 23 FEBRUARY 2019, REVISION C)

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 .....

Chartered Professional Status.....

Membership No. .....

Company.....

The Institution of Engineers, Australia

Paul Stubbs
MIEAust CPEng
Chartered Professional Engineer
Membership No. 130775

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

Development Application for ROBERT BISHOP
Name of Applicant

Address of site 115A PACIFIC ROAD, PALM BEACH, NSW

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: STABILITY ASSESSMENT
Report Date: 31 JULY 2019
Author: WOODIE THEUNISSEN
Author's Company/Organisation: JK GEOTECHNICS

Please mark appropriate box

✓ Comprehensive site mapping conducted 8 JULY 2003, ADDITIONAL OBSERVATIONS MADE ON 20 JUNE 2019 (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 ..... SANDSTONE EXPOSED AT SURFACE/SHALLOW DEPTH
- ○ 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.

X 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 .....
Chartered Professional Status.....
Membership No. .....
Company.....

The Institution of Engineers, Australia

Paul Stubbs
MIEAust CPEng
Chartered Professional Engineer
Membership No. 130775

Date: 31 July 2019
Ref: 15991SY Let

Robert Bishop
115A Pacific Road
Palm Beach NSW 2108

Attention: Mr Robert Bishop
Email: rrbishop@hotmail.com

STABILITY ASSESSMENT
PROPOSED GARAGE
115A PACIFIC ROAD, PALM BEACH, NSW

1 INTRODUCTION

This report presents the results of our geotechnical assessment of the site at 115a Pacific Road, Palm Beach, NSW. The assessment was commissioned by Mr Robert Bishop and was completed in accordance with our proposal (Ref P49671S, dated 7 June 2019. The site was inspected by our Principal Associate, Mr Woodie Theunissen on 20 June 2019, in order to assess whether the stability assessment and recommendations contained in our earlier report (Ref: 15991VT2rpt, dated 29 August 2019) were still valid and to assess the potential impact of the proposed development on the stability of the site.

The proposed works comprise the construction of a new garage and are presented in the architectural drawings prepared by Micheal Fountain Architects Pty Ltd (Job No: 1901, Drawing No's: SK-01 to SK-03, dated 26 February 2019, Revision C). Reference to these drawings indicates that the proposed development comprises the construction of a new garage in the north-western corner of the site. This garage will be cut into the existing hillside and once completed will be covered with a thin soil cover and vegetated.

This report has been prepared in accordance with the requirements of the Geotechnical Risk Management Policy for Pittwater (2009) as discussed in Section 6 below. It is understood that the report will be submitted to Council as part of the DA documentation. Our report is preceded by the completed Council Forms 1 and 1a.

2 ASSESSMENT METHODOLOGY

- **Walkover Survey**

This review of our original stability assessment is based on a detailed inspection of the topographic, surface drainage and geological conditions of the site and its immediate environs. These features were compared to

those of other similar lots in neighbouring locations to provide a comparative basis for assessing the risk of instability affecting the proposed development.

Our specific recommendations regarding the proposed development are discussed below.

3 SUMMARY OF OBSERVATIONS

Following the preparation of our earlier report a number of changes have been made. These are as follows:

- The driveway has now been concrete paved with river gravel positioned between the two wheel paths.
- The flat section of the front yard has been extended further to the south which has resulted in excavation to maximum depths of about 1.5m and the bank battered at up to about 45^{o} and grassed.
- The cut batter that was faced with sandstone pitching adjacent to the front of the house has now been replaced by sandstone block retaining walls that appear in good condition and vary in height up to about 0.7m.
- The existing house on site is no longer a single storey cement rendered/timber structure but is now a two to three storey masonry house and appears in good condition.
- The area to the south of the house now contains a timber deck that has been cut into the hill.
- The house in the adjacent property to the west is now two storeys and appeared in good condition when viewed from the site.

4 GEOTECHNICAL ASSESSMENT

As part of the development of the site, JK Geotechnics have been involved in inspection of the geotechnical aspects of the development such as the construction of footings. In this capacity, JK Geotechnics have also provided a Form 3 for the site following the completion of the development indicating that the works have been completed in accordance with the intent of our earlier report.

Based on our site inspection the site, the geotechnical hazards posed by the site are largely unchanged. The proposed development will result in excavation and the construction of retaining walls to support the excavation batters. On the assumption that our comments and recommendations provided below will be followed and that these walls will be designed and constructed by competent professionals, the likelihood of failure of these walls is barely credible. Consequently, the risk to both life and property will remain unchanged from our earlier report which, in both cases was considered to be acceptable in accordance with Northern Beaches Council's Geotechnical Risk Management Policy for Pittwater.

5 COMMENTS AND RECOMMENDATIONS

We consider that the proposed development may proceed provided the following specific design, construction and maintenance recommendations are adopted to maintain and reduce the present risk of instability of the site and to control future risks. These recommendations address geotechnical issues only and other conditions may be required to address other aspects.

5.1 Conditions Recommended to Establish the Design Parameters

5.1.1 The existing props present below the overhang immediately to the east of the southern end of the house must be replaced with permanent underpins.

5.1.2 All proposed footings must be founded in bedrock. The footings should be designed for an allowable bearing pressure of 600kPa, subject to inspection by a geotechnical engineer prior to pouring.

5.1.3 Continuous vibration monitoring must be carried out during percussive rock excavations (ie rock hammers). The ground vibration measured as peak particle velocity must not exceed 5mm/sec at the southern and western site boundaries and at the nearest wall of the house on site. In this regard we recommend that where percussive excavation techniques are proposed that dilapidation reports be completed on the properties to the south and west of the site. The purpose of these reports is to provide a baseline condition report of these adjoining structures such that if claims are made that construction activities have caused damage to the adjoining structures there is a record of their existing condition. In this way the builder is protected from spurious claims of construction related damage. The owners of these adjoining structures should be asked to confirm, in writing that the dilapidation reports present a true and accurate record of the existing building condition. Consideration should also be given to completing a dilapidation report on the house on site.

5.1.4 Subject to inspection by a geotechnical engineer temporary batters for the proposed excavation should be no steeper than 1 Vertical (V) in 1 Horizontal (H) within the soil profile and extremely weathered rock and vertical in competent rock. All surcharge and footing loads must be kept well clear of the excavation perimeter. Temporary batters are anticipated to be able to be accommodated within the site. If this is not the case we recommend that further advice be sought from this office.

5.1.5 The surface water discharging from the new roof and paved areas must be diverted to outlets for controlled discharge to the existing stormwater system where present.

5.1.6 The proposed new retaining walls should be designed using the following parameters:

- For cantilever walls, adopt a triangular lateral earth pressure distribution and an 'active' earth pressure coefficient, K_a, of 0.3, for the retained height, assuming a horizontal backfill surface.
- For walls braced by roof slabs etc. adopt an earth pressure at rest coefficient, k, of 0.5.
- A bulk unit weight of 20kN/m^3 should be adopted for the soil profile.
- Any surcharge affecting the walls (eg. traffic loading, live loading, compaction stresses, etc) should be allowed in the design.
- The retaining walls should be provided with complete and permanent drainage of the ground behind the walls. The subsoil drains should incorporate a non-woven geotextile fabric (eg. Bidim A34), to act as a filter against subsoil erosion.
- Toe resistance of the wall may be achieved by keying the footing into bedrock. An allowable lateral stress of 200kPa may be adopted for design.

5.1.7 The Guidelines for Hillside Construction given below should also be adopted.

5.2 Conditions Recommended to the Detailed Design to be Undertaken for the Construction Certificate

5.2.1 All structural design drawings must be reviewed by the geotechnical engineer who should endorse that the recommendations contained in this report have been adopted in principle.

5.2.2 All hydraulic design drawings must be reviewed by the geotechnical engineer who should endorse that the recommendations contained in this report have been adopted in principle.

5.2.3 All landscape design drawings must be reviewed by the geotechnical engineer who should endorse that the recommendations contained in this report have been adopted in principle.

5.2.4 Dilapidation surveys should be carried out on the neighbouring buildings and structures to the south and west and consideration should be given to completing a dilapidation report on the house on site where percussive excavation techniques are proposed. A copy of the dilapidation report must be provided to the neighbours and Council or the Principle Certifying Authority where completed.

5.2.5 An excavation/retention methodology must be prepared prior to bulk excavation commencing. The methodology must include but not be limited to proposed excavation techniques, the proposed excavation equipment, excavation sequencing, geotechnical inspection intervals or hold points, vibration monitoring procedures, monitor locations, monitor types, contingency plans in case of exceedances.

5.2.6 The excavation/retention methodology must be reviewed and approved by the geotechnical engineer.

5.3 Conditions Recommended During the Construction Period

5.3.1 Construction of permanent underpins to support the overhang present immediately to the east at the southern end of the house must be witnessed by the geotechnical engineer.

5.3.2 The geotechnical engineer must inspect all footing excavations prior to placing reinforcement or pouring the concrete.

5.3.3 The approved excavation/retention methodology must be followed.

5.3.4 Bulk excavations must be progressively inspected by the geotechnical engineer as excavation proceeds. We recommend inspections at 1.5m vertical depth intervals and on completion.

5.3.5 Proposed material to be used for backfilling behind retaining walls must be approved by the geotechnical engineer prior to placement.

5.3.6 Compaction density of the backfill material must be checked by a NATA registered laboratory to at least Level 2 in accordance with, and to the frequency outlined in, AS3798, and the results submitted to the geotechnical engineer.

5.3.7 Prior to the placement of pavements or fill (where the fill will support pavements or structural elements), where a soil subgrade is present it must be proof rolled with a smooth drum vibratory

roller with a minimum static weight of 3 tonnes. The purpose of proof rolling is to improve the near surface density of the soils and to identify any loose or unstable zones. All proof rolling should be completed in the presence of an experienced geotechnician or geotechnical engineer. Should loose or unstable zones be identified advice on remediation of these areas will be provided by this office.

5.3.8 The geotechnical engineer must inspect all subsurface drains prior to backfilling.

5.3.9 An 'as-built' drawing of all buried services at the site must be prepared (including all pipe diameters, pipe depths, pipe types, inlet pits, inspection pits, etc).

5.3.10 The geotechnical engineer must confirm that the proposed alterations and additions have been completed in accordance with the geotechnical reports.

We note that all above Conditions must be complied with. Where this has not been done, it may not be possible for Form 3, which is required for the Occupation Certificate, to be signed.

5.4 Conditions Recommended for Ongoing Management of the Site/Structure(s)

The following recommendations have been included so that the current and future owners of the subject property are aware of their responsibilities:

5.4.1 All existing and proposed surface (including roof) and subsurface drains must be subject to ongoing and regular maintenance by the property owners.

5.4.2 No cut or fill in excess of 0.5m (eg. for landscaping, buried pipes, retaining walls, etc), is to be carried out on site without prior consent from Pittwater Council.

5.4.5 Where the structural engineer has indicated a design life of less than 100 years then the structure and/or structural elements must be inspected by a structural engineer at the end of their design life; including a written report confirming scope of work completed and identifying the required remedial measures to extend the design life over the remaining 100 year period.

6 OVERVIEW

We consider that the proposed development of the above site poses an acceptable risk to both life and property provide the above recommendations are followed.

It is possible that the subsurface soil, rock or groundwater conditions encountered during construction may be found to be different (or may be interpreted to be different) from those inferred from our surface observations in preparing this report. Also, we have not had the opportunity to observe surface run-off patterns during heavy rainfall and cannot comment directly on this aspect. If conditions appear to be at variance or cause concern for any reason, then we recommend that you immediately contact this office.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally

exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

Should you require any further information regarding the above, please do not hesitate to contact the undersigned.

Yours faithfully
For and on behalf of
JK GEOTECHNICS

Woodie Theunissen
Principal Associate | Geotechnical Engineer

Appendix A: Guidelines for Hillside Construction

Reference 1: Australian Geomechanics Society (2007c) *'Practice Note Guidelines for Landslide Risk Management'*, Australian Geomechanics, Vol 42, No 1, March 2007, pp63-114.

Reference 2: MacGregor, P, Walker, B, Fell, R, and Leventhal, A (2007) *'Assessment of Landslide Likelihood in the Pittwater Local Government Area'*, Australian Geomechanics, Vol 42, No 1, March 2007, pp183-196.

APPENDIX A

APPENDIX B – SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements.
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance (including onto properties below). Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc. in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on bedrock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within bedrock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide generous falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge of roof run-off into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use of absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by a geotechnical consultant.	
SITE VISITS	Site visits by consultant may be appropriate during construction.	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident seek advice. If seepage observed, determine cause or seek advice on consequences.	

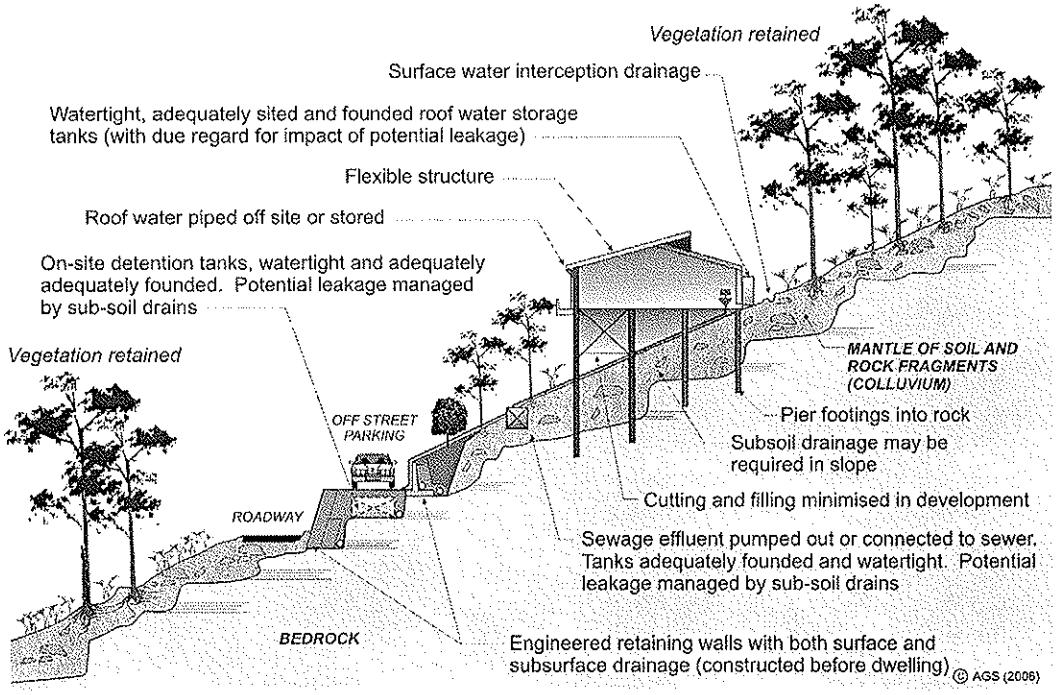
This table is an extract from PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT as presented in *Australian Geomechanics*, Vol 42, No 1, March 2007 which discusses the matter more fully.

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.

EXAMPLES FOR **GOOD** HILLSIDE CONSTRUCTION PRACTICE



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 due to 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 fulfill 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.

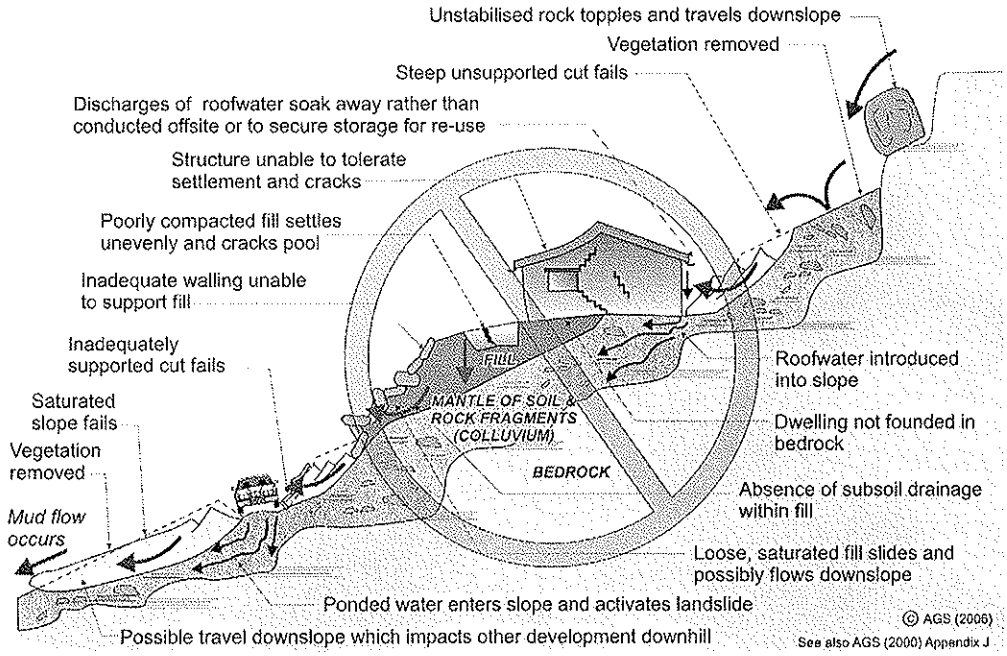
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing 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

Extract from Geoguide LR8 – Hillside Construction Practice

EXAMPLES FOR **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 soaks 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 herringbone, 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.

Extract from Geoguide LR8 – Hillside Construction Practice.