Report on

Geotechnical Assessment

Prepared for: Dean Mahoney

Address: 12 Bubalo Street, Warriewood

Job No: 43014

Date: January 2020

idealgeotech
a division of idealcorp

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Our Ref: 43014
14 January 2020

Attention: Dean Mahoney

Geotechnical Assessment
12 Bubalo Street, Warriewood

1 INTRODUCTION

Ideal Geotech has prepared this report to discuss the results of the geotechnical investigation undertaken for the proposed pool at 12 Bubalo Street, Warriewood. Ideal Geotech was engaged to provide a geotechnical risk assessment.

The assessment was undertaken in order to demonstrate the following;

- The proposed development is justified in terms of geotechnical stability.
- To provide recommendations on footing design.

This report is based only on the information provided at the time of this report preparation and may not be valid if changes are made to the site or to the construction method.

2 PROPOSED DEVELOPMENT

With reference to the supplied architectural drawings prepared by Wincrest, job no 17295, it is understood that the proposed development will entail construction of a swimming pool. It is assumed that the site will undergo up to approximately 2m of cut to allow construction of the swimming pool.

3 SITE DETAILS

The following information, presented in Table 1, describes the site.

Table 1: Summary of Site Details

Site Address	12 Bubalo Street, Warriewood
Developer/Owner	Dean Mahoney
Council Area	Northern Beaches Council

4 GEOLOGY

The Sydney 1:100,000 scale Geological Series Map indicates that the subject site is underlain by Hawkesbury Sandstone comprising quartz sandstone and very minor shale and laminate lenses along with soils derived from the weathering of these rocks.

5 SITE DESCRIPTION

The site is rectangular in shape with a total area of approximately 314m^2. The site is bound by Bubalo Street to the south east and by vacant residential lots on all other sitdes. The site is currently vacant with a 1.5m high retaining wall running along the north western boundary. Vegetation consist of some grass cover and the site slopes downwards towards the south at approximately 2-3°.

Photograph 1: Looking at the site form Bubalo Street

6 GEOTECHNICAL INVESTIGATION

Fieldwork was undertaken on 13 January 2020. The geotechnical investigation included drilling two boreholes (BH1-BH2) using a 4wd mounted drilling rig equipped with continuous flight augers, at the location shown on Figure 1, attached in Appendix A. The Boreholes were supplemented with Pocket Penetrometer tests for the measurement of soil strength properties. The boreholes were terminated at 4.5m.

7 SOIL PROFILE

The soil profile consisted of silty gravelly sand fill overlying silty sandy clay fill up to a depth of 1.8m overlying sandy silty clay. Borehole logs are attached in Appendix B.

8 SLOPE STABILITY ASSESSMENT

During the course of the inspection, no slip scarps or tension cracks were documented nor was there any visible hummocking of the land. This leads to the assumption that no significant slope failures have occurred.

The stability of a site is generally governed by site factors such as slope angles, depth of in-situ soils, and strength of sub-surface material and concentrations of water. The Australian Geomechanics Society recommends that the landslide risk of a site is assessed on the basis of the likelihood of a landslide event and the consequences of that event.

A Risk Assessment related to shallow soil slips, near surface slumping and deep seated landslides, subject to adherence to our recommendations, has been provided in Table 2 below.

Table 2: Summary of Risk to Property and Life

HAZARD	SOIL CREEP	NEAR SURFACE SLUMPING	ACTIVE OR DEEP SEATED LAND SLIDE	ROCK FALL (ABOVE DWELLING LOCATION)
Likelihood	Unlikely	Unlikely	Rare	Not credible
Consequence to Property	Minor	Medium	Major	Major
Risk to Proposed Development	Low	Low	Low	Very low
Remarks	None observed	None observed	None observed	None observed

The site is currently in a stable condition, based on a **"Low"** Risk Level of instability relating to shallow soil slips and active or deep seated land slide. With reference to the supplied architectural drawings prepared by Wincrest, job no 17295, it is our assessment that the site is suitable for the proposed pool, provided all recommendations presented in this report are adhered to and that construction is carried out in accordance with good engineering and hill slope practices.

It should be noted that the surficial soils may be susceptible to localised erosion and instability could occur if the proposed development is not carried out with care, and if areas of the land disturbed by building activities are not subsequently suitably landscaped.

9 RECOMMENDATIONS

9.1 Batter Slopes

We assume that the site will be cut up to 2m to allow construction of the proposed pool. Resultant embankments will comprise of silty sandy clay fill which may stand unsupported for a short period of time. Where personnel are to enter excavations, options for short-term excavations include benching or battering back of excavations to 1H:1V.

Unretained excavations should not extend below the "zone of influence" of adjacent structures. That is, a line drawn 45^{o} down from the foundation level of adjacent structures or features, including temporary site sheds etc. If excavations are to extend below this line, or there is insufficient room for batter faces, proposed excavations are to be retained prior to excavation.

9.2 Footing Design

Based on the above principal geotechnical constraints, we would recommend the following allowable bearing pressures and notes during construction;

- 100kPa for footings founded in the very stiff natural sandy silty clay
- Piered footings should be socketed into underlying rock
- Penetrate through any fill
- Ensure all footings are on a similar material to minimise differential settlements

It is recommended that all footing excavations be inspected by a geotechnical engineer to confirm that founding conditions are consistent with design recommendations. The founding level may need to be adjusted if the required founding material is not encountered at the design founding level.

A combined storm water catch-drain/subsoil drainage system should be installed to intercept and divert surface flow and seepage away from the high side of the building area. The drains should preferably be installed prior to construction and ultimately connect to the development storm water system.

9.3 Retaining Walls

Retaining walls should be designed in consultation with a Geotechnical/Structural Engineer. Retaining wall footings should be founded in competent soils to the supervising engineer's direction and approval.

Excavations for retaining wall construction should remain stable as per comments in Section 9.1. Appropriate drainage systems and free draining backfill should be provided to prevent the build-up of hydrostatic pressures behind all retaining walls. To facilitate the site earthworks it would be prudent to install a temporary catch drain above the proposed excavation to divert surface run-off away from the building area during construction.

10 CONCLUSION

This site is suitable for the proposed pool and can achieve the acceptable risk management provided that all recommendations presented in this report are adhered to and that construction is carried out in accordance with good engineering and hill slope practices.

11 GENERAL

The scope and the period of Ideal Geotech services are described in the report and are subject to restrictions and limitations. Ideal Geotech did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Ideal Geotech in regards to it.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ideal Geotech for incomplete or inaccurate data supplied by others.

Any drawings or figures presented in this report should be considered only as pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions should not be used for accurate calculations or dimensioning.

11.0 REFERENCES

- AS3798-2007 "Guidelines on Earthworks for commercial and residential developments
- Geological Series Sheet 9130 (Edition 1) 1991, Map of the Sydney region, scale 1:100,000
- Landslide Risk Assessment (AGS 2007)

For and on behalf of

Ideal Geotech

Dane Dwyer
Senior Geotechnical Engineer

Miles Opacic
Geotechnical Engineer

Appendix A- *Test Site Location Plan*

Appendix B- *Borehole Logs*

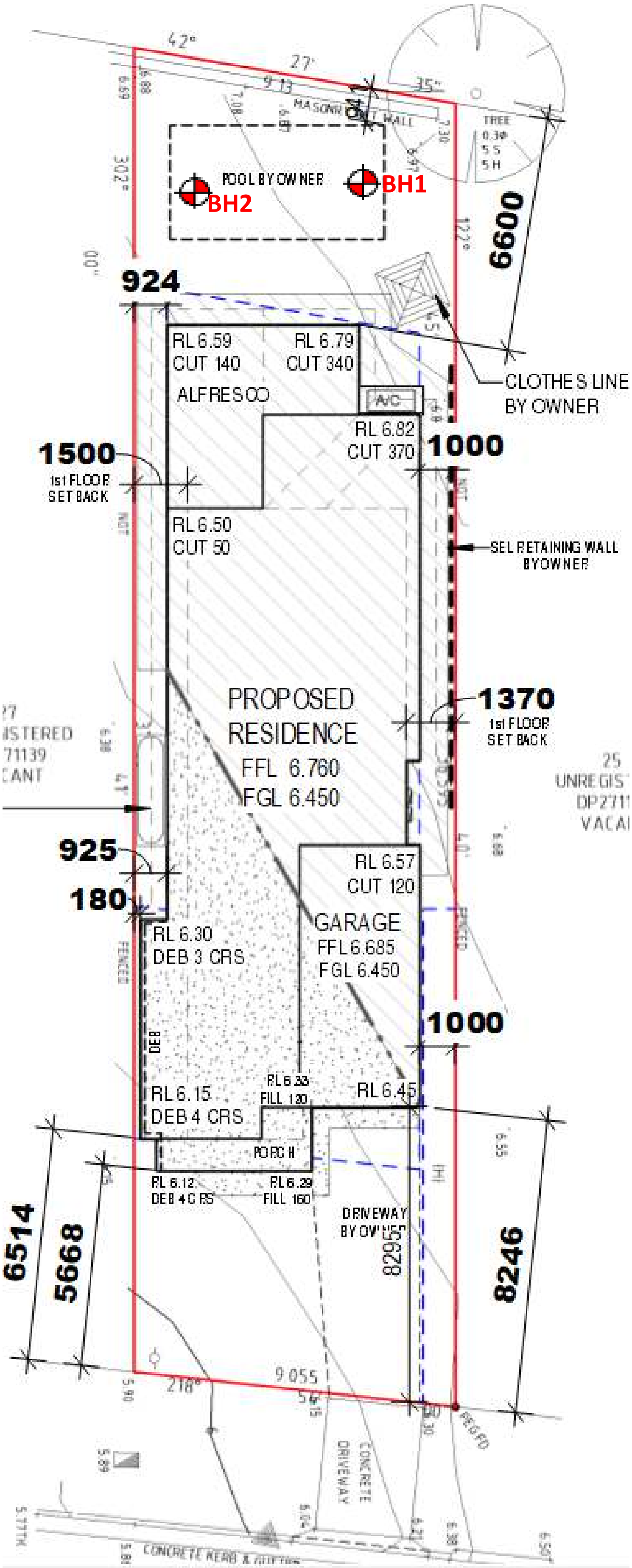
Appendix C- *Hillside Construction Practice*

APPENDIX A

Test Site Location Plan

Figure 1 – Borehole Location Plan

12 Bubalo Street, Warriewood



APPENDIX B

Borehole Logs

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5.1 FIELD LOG

Date: 14/01/2020
Customer Job: -
Ideal Job: 43014
Site Address: 41 Warriewood Road, WARRIEWOOD, NSW, 2102

Borehole: **BH1**
Surface RL:
Easting:
Northing:

Water	Depth (m)	DCP	PP	Sample	Classification Code	Material Description	Moisture	Density / Consistency	Fill
	0.1				SM	Silty Gravelly Sand	Moist	MD	
	0.2					Grey Brown			
	0.3								
	0.4								
	0.5								
	0.6		186 kPa		CI	Silty Sandy Clay	Moist	H	
	0.7					Brown Grey			
	0.8								
	0.9		>300 kPa						
	1.0								
	1.1								
	1.2		>300 kPa						
	1.3								
	1.4								
	1.5		>300 kPa						
	1.6								
	1.7								
	1.8		>300 kPa						
	1.9				CI	Sandy Silty Clay	Moist	VSt	
	2.0					Brown mottled Grey			
	2.1		240 kPa						
	2.2								
	2.3								
	2.4		250 kPa						
	2.5								
	2.6								
	2.7		206 kPa						
	2.8								
	2.9								
	3.0		152 kPa						
	3.1								
	3.2								
	3.3		147 kPa						
	3.4								
	3.5								
	3.6		103 kPa						
	3.7								
	3.8								
	3.9		108 kPa						
	4.0								
	4.1								
	4.2		132 kPa						
	4.3								
	4.4								
	4.5		123 kPa						
	4.6					End Bore 4.5m			
	4.7								
	4.8								
	4.9								
	5.0								
	5.1								
	5.2								
	5.3								
	5.4								
	5.5								
	5.6								
	5.7								
	5.8								
	5.9								
	6.0								

Water Table **UTP** - Unable to penetrate **DCP** - 9kg Dynamic Cone Penetrometer **PP** - Pocket Penetrometer

AND – Density Index vs Approx. Penetrometer results

DENSITY		Density Index	DCP Blow Count (blows/100mm)
VL	Very Loose	< 15 %	< 1
L	Loose	15 – 35 %	1 – 3
MD	Medium Dense	35 – 65 %	3 – 9
D	Dense	65 – 85 %	9 – 15
VD	Very Dense	> 85 %	> 15

SILTS & CLAY – Cu vs Approx. Penetrometer results

CONSISTENCY		Undrained Shear Strength (kPa)	DCP Blow Count (blows/100mm)	PP Dial Indicator
VS	Very Soft	0 – 12	< 1	0 – 0.2
S	Soft	12 – 25	1 – 2	0.2 – 0.5
F	Firm	25 – 50	2 – 3	0.5 – 1.0
St	Stiff	50 – 100	3 – 5	1.0 – 2.0
VSt	Very Stiff	100 – 200	5 – 8	3.0 – 4.0
H	Hard	> 200	> 8	> 4.0

MOISTURE	
D	Dry
M	Moist
W	Wet
W_P	Plastic Limit
W_L	Liquid Limit

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5.2 FIELD LOG

Date: 14/01/2020
Customer Job: -
Ideal Job: 43014
Site Address: 41 Warriewood Road, WARRIEWOOD, NSW, 2102

Borehole: BH2
Surface RL:
Easting:
Northing:

Water	Depth (m)	DCP	PP	Sample	Classification Code	Material Description	Moisture	Density / Consistency	Fill
	0.1				SM	Silty Gravelly Sand Grey Brown	Moist	MD	
	0.2								
	0.3								
	0.4								
	0.5								
	0.6								
	0.7								
	0.8				CI	Silty Sandy Clay Brown Grey	Moist	H	
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	1.0								
	1.1								
	1.2		>300 kPa						
	1.3								
	1.4								
	1.5		>300 kPa						
	1.6				CI	Sandy Silty Clay Brown mottled Grey	Moist	VSt	
	1.7								
	1.8		235 kPa						
	1.9								
	2.0								
	2.1		216 kPa						
	2.2								
	2.3								
	2.4		274 kPa						
	2.5								
	2.6								
	2.7		181 kPa						
	2.8								
	2.9								
	3.0		206 kPa						
	3.1								
	3.2								
	3.3		196 kPa						
	3.4								
	3.5								
	3.6		186 kPa						
	3.7								
	3.8								
	3.9		191 kPa						
	4.0								
	4.1								
	4.2		176 kPa						
	4.3								
	4.4								
	4.5		225 kPa						
	4.6					End Bore 4.5m			
	4.7								
	4.8								
	4.9								
	5.0								
	5.1								
	5.2								
	5.3								
	5.4								
	5.5								
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St	Stiff	50 – 100	3 – 5	1.0 – 2.0
VSt	Very Stiff	100 – 200	5 – 8	3.0 – 4.0
H	Hard	> 200	> 8	> 4.0

MOISTURE	
D	Dry
M	Moist
W	Wet
W_P	Plastic Limit
W_L	Liquid Limit

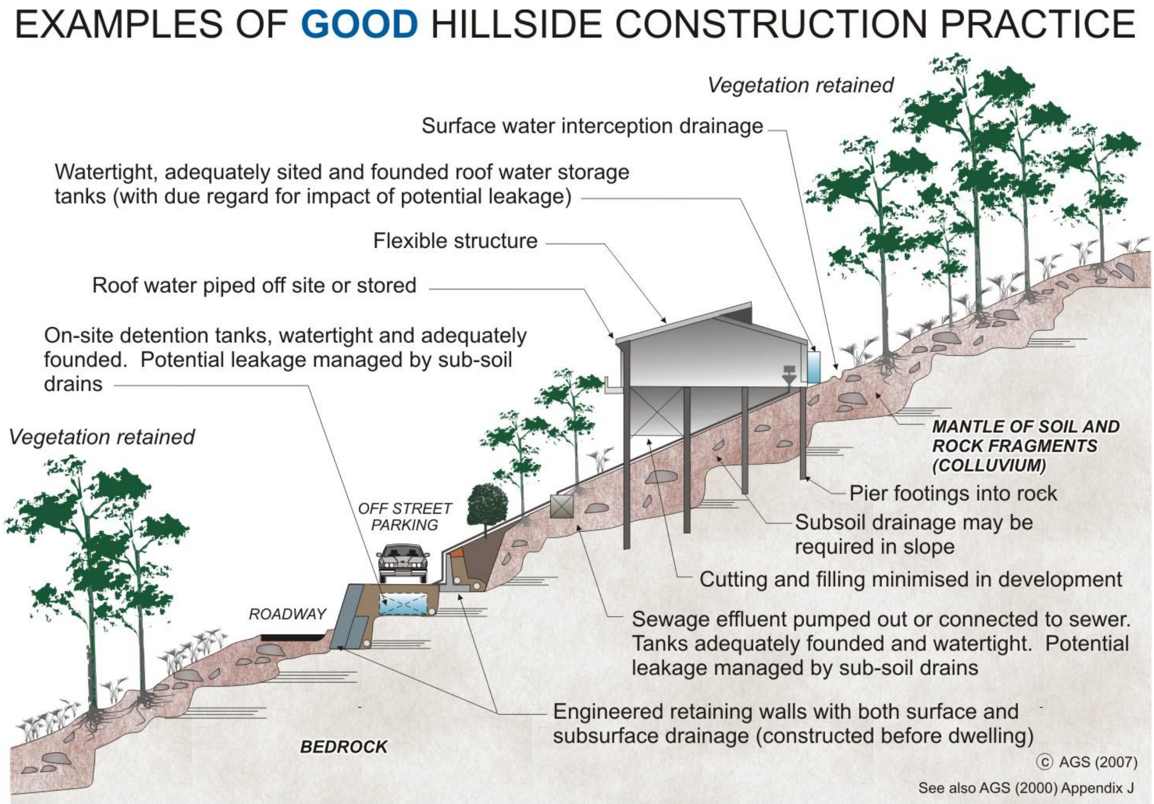
APPENDIX C

HILLSIDE CONSTRUCTION PRACTICE

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.

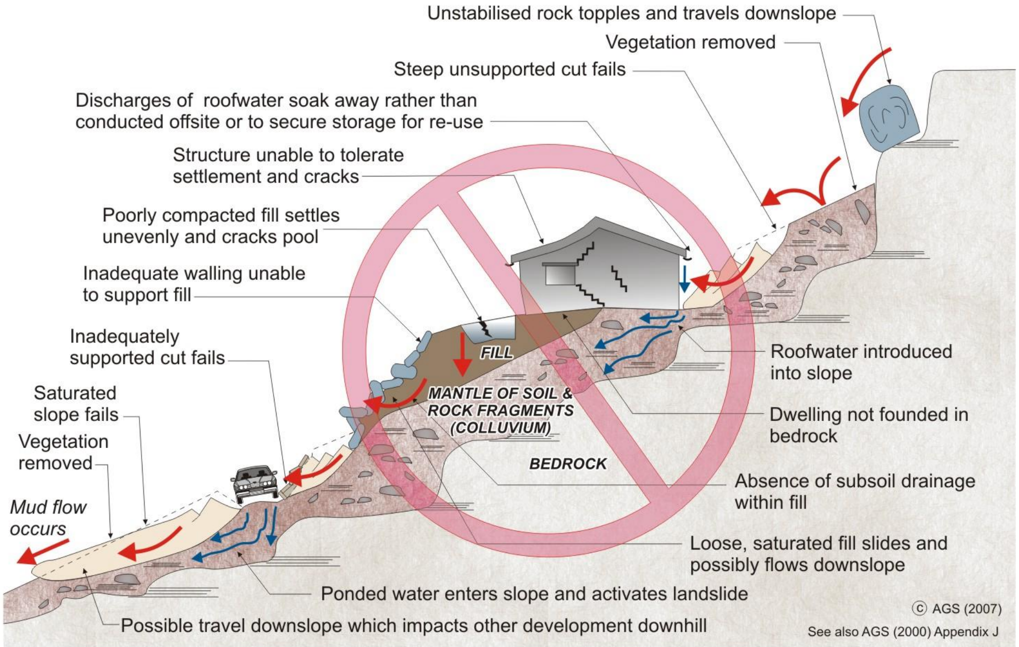
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing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