Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666

Hall & Hart Homes
Po Box 2005
NORTH PARRAMATTA NSW 1750

Project 207891.00
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DEM:pc

Attention: Ms Marrianne Read

Email mread@hallharthomes.com.au

Preliminary Geotechnical Assessment
Proposed New Residence
122 Clontarf Street, North Balgowlah

1. Introduction

This letter presents the results of a preliminary geotechnical assessment by Douglas Partners Pty Ltd (DP) of the site of a proposed new residence at 122 Clontarf Street, North Balgowlah. The assessment was carried out at the request of Ms Marrianne Read from Hall & Hart Homes.

It is understood that the site is located in an area identified on the Northern Beaches (Warringah) Council's Landslip Risk Map – sheet LSR 001_012 as Area B – Flanking Slopes 5^{o} to 25^{o}. In accordance with the Warringah Local Environment Plan 2011 and the Warringah Development Control Plan Clause E10, such areas require an assessment to determine whether a full geotechnical investigation and report is required.

The preliminary geotechnical assessment comprised a review of the drawings showing the proposed works and a visual inspection of the site by a senior engineering geologist on 13 August 2021. Reference has also been made to a previous geotechnical assessment as detailed in Report AWT 62465 (Rev A) dated 19 December 2020 by AW Geotechnics (AWG).

2. Site Description

The site comprises a battle-axe block located off the lower, eastern side of Clontarf Street. The main portion of the site measures approximately 27 m by 25 m in plan dimensions and is accessed from Clontarf Street via an access handle which is approximately 5 m wide and 35 m long.

The site is currently vacant and has a scattered cover of mature trees with shrubs, ferns and grass beneath. A grass covered drainage line crosses the lower, western portion of the site and the low point of the access handle. There was no evidence of recent stormwater flow within the drainage line.

The supplied drawings indicate that buried sewer and stormwater lines lie in the vicinity of the drainage line. Maximum slope angles across the site are typically 10^{o} to 15^{o}. towards the drainage line.

Developed residential lots lie to the west, east and south of the site. There is a sealed accessway and then developed residential lots to the north.

Published geological mapping indicates that the site is underlain by bedrock comprising Hawkesbury Sandstone of Triassic age. There is no bedrock outcrop on the site but sandstone bedrock outcropping to the south of the access handle and along Clontarf Street is consistent with the Hawkesbury Sandstone.

3. Proposed Development

The following design drawings for the works were reviewed:

- Architectural Drawings (Job No. H0451 Rev1 dated 25 June 2021) by Hall & Hart Homes;
- Stormwater Design Drawings (Job No. SW21210 Rev A dated 17 June 2021) by ALW Design.

The drawings indicate that the works will comprise the construction of a centrally located, two-storey brick veneer and weatherboard residence with a metal roof. Bulk excavation below the existing slope surface along the upslope, eastern side of the proposed residence is indicated to be less than 1.5 m.

Stormwater from the new development will be directed to the existing stormwater line via a below-ground detention tank.

4. Geotechnical Assessment

In accordance with the "Checklist for Council's Assessment of Site Conditions …" given in Clause E10 of the Warringah DCP the following information and observations are provided:

- based upon visual inspection of the site and external inspection of the adjacent sites, there is no observed evidence or known history of slope instability;
- excavation or filling to greater than 2 m is not proposed;
- the site is currently undeveloped and there are no cuts/excavations observed on the site that are greater than 2 m in height;
- there was no significant cracking visible within the brick walls of existing dwellings on the adjacent sites;

Probing with a DCP during the previous geotechnical investigation by AWG reportedly encountered test refusal at 2.6 m depth near the drainage line and 1.9 m depth near the north-eastern corner of the site. DP considers that the test refusal depth probably represents the depth of bedrock at these locations.

On the basis of the above observations, it is considered that a full geotechnical report to assess the Landslip Risk is not required.

It is considered that the proposed development can be successfully completed in a geotechnically stable condition, provided it is carried out in accordance with sound engineering practice (refer to attached Australian Geoguide 8).

5. General Geotechnical Advice

The following general geotechnical advice is provided for design and construction of the proposed works:

- Based on observations made on the site and the results of probing with a DCP, it is considered that sandstone bedrock of at least low strength probably underlies the proposed development footprint at depths ranging from around 1.5 m to 3 m;
- Following bulk excavation, the rear (eastern) edge of the proposed residence may lie close to bedrock. It is therefore recommended that all footings be taken to bedrock to avoid differential movements;
- Footings founded on sandstone bedrock of at least low strength can be proportioned for an allowable bearing capacity of 1000 kPa;
- Temporary lining of the pier excavations may be necessary to minimise the inward collapse of soils or water inflow.

6. Limitations

Douglas Partners (DP) has prepared this preliminary geotechnical assessment for this project at 122 Clontarf Street, North Balgowlah under DP's Conditions of Engagement. It is provided for the exclusive use of Hall & Hart Homes, and the owners of the property for the specific project and purpose as described in the report. It should not be used by or be relied upon for other projects or purposes on the same or any other site or by a third party. DP has necessarily relied upon information provided by the client and/or their agents.

This report must be read in conjunction with all the attached notes 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.

Douglas Partners Pty Ltd

David Murray
Senior Associate

Reviewed by

pp **John Braybrooke**
Principal

Encl. Notes about this report
Australian Geoguide LR8 (Hillside Construction Practice)

About this Inspection Report

Douglas Partners

Introduction

These notes are provided to amplify DP's inspection report in regard to the limitations of carrying out inspection work. Not all notes are necessarily relevant to this report.

Standards

This inspection report has been prepared by qualified personnel to current engineering standards of interpretation and analysis.

Copyright and Limits of Use

This inspection report is the property of DP and is provided for the exclusive use of the client for the specific project and purpose as described in the report. It should not be used by a third party for any purpose other than to confirm that the construction works addressed in the report have been inspected as described. Use of the inspection report is limited in accordance with the Conditions of Engagement for the commission.

DP does not undertake to guarantee the works of the contractors or relieve them of their responsibility to produce a completed product conforming to the design.

Reports

This inspection report may include advice or opinion that is based on engineering and/or geological interpretation, information provided by the client or the client's agent, and information gained from:

- an investigation report for the project (if available to DP);
- inspection of the work, exposed ground conditions, excavation spoil and performance of excavating equipment while DP was on site;
- investigation and testing that was carried out during the site inspection;
- anecdotal information provided by authoritative site personnel; and
- DP's experience and knowledge of local geology.

Such information may be limited by the frequency of any inspection or testing that was able to be practically carried out, including possible site or cost constraints imposed by the client/ contractor(s). For these reasons, the reliability of this inspection report is limited by the scope of information on which it relies.

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

- unexpected variations in subsurface conditions that are not evident from the inspection; and
- the actions of contractors responding to commercial pressures.

Should these issues occur, then additional advice should be sought from DP and, if required, amendments made.

This inspection report must be read in conjunction with any attached information. This inspection report should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions from review by others of this inspection report or test data, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this inspection report.

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

The Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive Strength MPa	Point Load Index * $Is_{(50)}$ MPa
Very low	VL	0.6 - 2	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Medium	M	6 - 20	0.3 - 1.0
High	H	20 - 60	1 - 3
Very high	VH	60 - 200	3 - 10
Extremely high	EH	>200	>10

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Residual Soil	RS	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered	XW	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately weathered	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposition or staining.
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.

Rock Descriptions

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

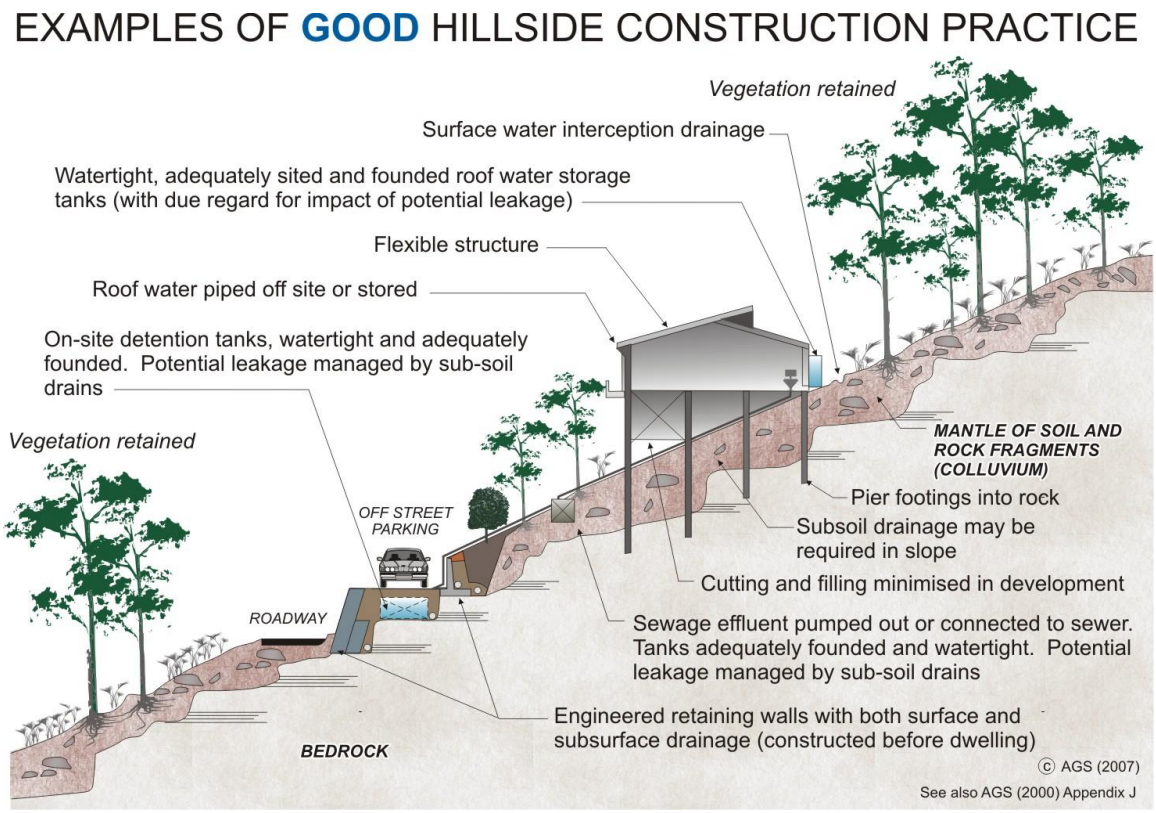
For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

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.

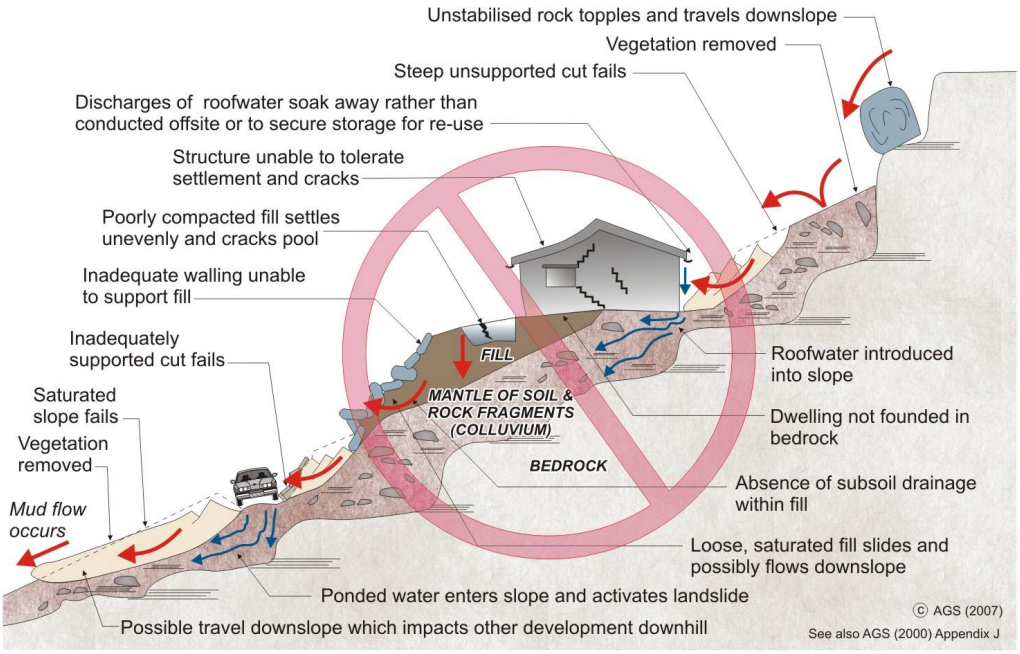
Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing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