LANDSLIDE RISK ASSESSMENT REPORT

PROJECT: 30-32 Telfer Road, Castle Hill, NSW 2154

CLIENT: Mark Mina

DATE: 26 September 2019

REPORT NO: NE568

GEOTESTA

GEOTESTA PTY LTD | ABN 91851620815| Unit 20, 1 Talavera Rd, Macquarie Park
Phone: 1300 852216 | Fax: 03 9562 9098 | email: info@geotesta.com.au

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1. INTRODUCTION

This report presents our result of risk assessment for a proposed new dwelling development at 30-32 Telfer Road Castle Hill NSW 2154. The purpose of the investigation was to assess the existing slope conditions, consider the implications of the construction of proposed structures and advise appropriate measures to minimise potential instability and erosion at the site.

Our scope of works included undertaking a site inspection, assessing the site conditions and preparing this report. The report presents the results of the landslip risk assessment and recommendations for risk mitigation strategies relevant to the proposed dwelling development. The site inspection was carried out on 25 September 2019.

Please note that this report is not intended as a replacement to engineering design. The results of this investigation should not be used for any other purpose than that for which it is specifically intended. We recommend that our advice be sought prior to any third party using or relying on the field data or the interpreted results. There may be significant variations from the conditions presented in this report that could affect the total project cost or its construction.

2. SITE CONDITIONS

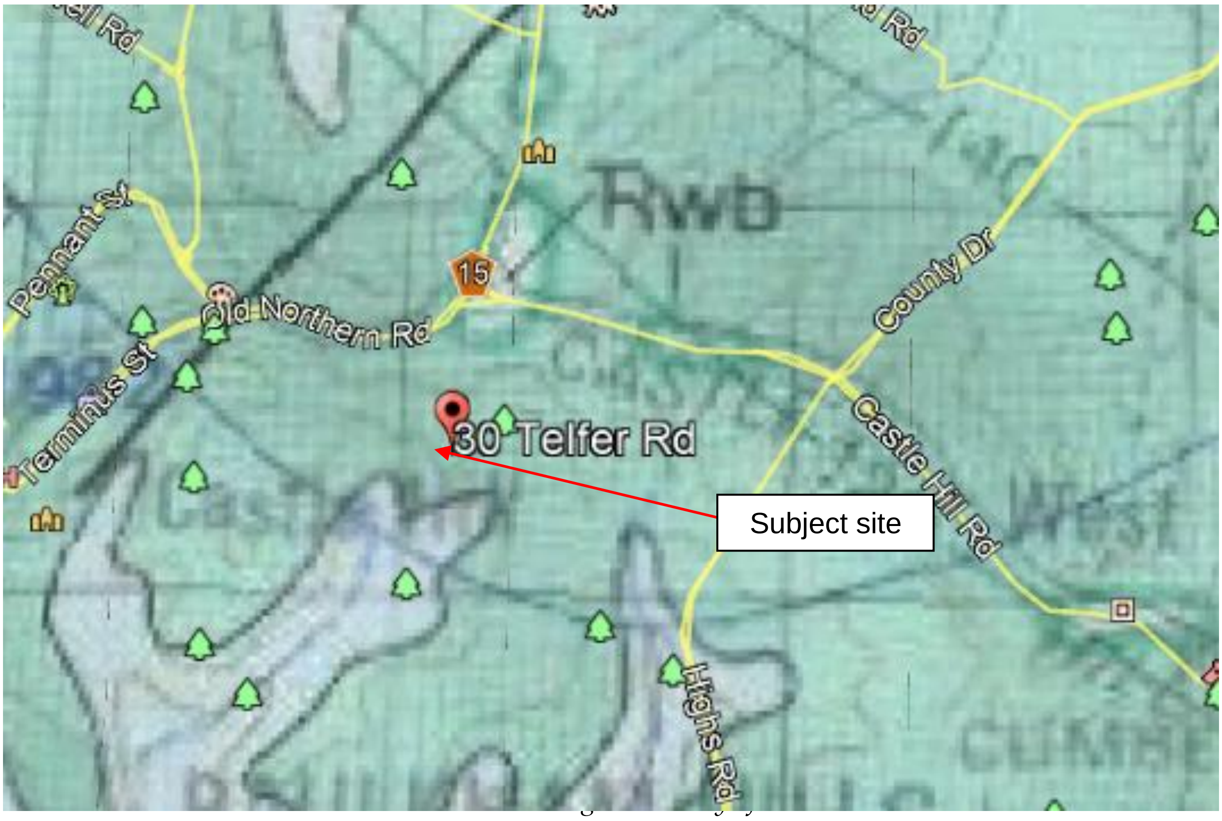
2.1 Site details and location

The site under investigation is situated in 30-32 Telfer Road Castle Hill, NSW 2154 (DP 358163) on the eastern side of Telfer Road and, approximately 30 km (by road) northwest of Sydney CBD. The site location and features are shown in Figure 1. The proposed site being a residential property is occupied by a two/three-story residential building, a swimming pool and garage located on the western side of the site. The site is roughly rectangular shape with an area of approximately 4293m2. The property has a width of 41.35m along Telfer Road and a length of 104.5m. The area is covered with short grass and a few scatter trees exist around the boundaries and in the middle of site. Steel fencing runs along the border of the site.
The site is actually backyard of an existing property that is proposed to be subdivided in two or three lots.

Figure 1. Site location and features

2.2 Site Geology

The geological origin of the soil profile was identified from our geotechnical experience, and reference to geological maps of the area. The geological map of the area indicates that the site is underlain by shale, carbonaceous, claystone, claystone laminate, fine to medium grained lithic sandstone, rare coal and tuff of the Wianamatta Group (1:100,000 Geological Sheet, 9035). The geology map of the site is presented in Figure 2.



to

Figure 2. Geology map of the site and surrounding area

2.3 Surface Conditions and Topography

The property is located on the side of an undulating to moderately steep hill on the south-eastern side of Telfer Road. The natural slope angle of the site is about 10°, generally dipping to the south east. The elevation contour map of the site is presented in Figure 3. The site lies at an elevation of approximately 141m-150m above sea level (ASL) referenced to Australian Height Datum (AHD) (http://en-au.topographic-map.com). The site is within the Hills Shire City Council.

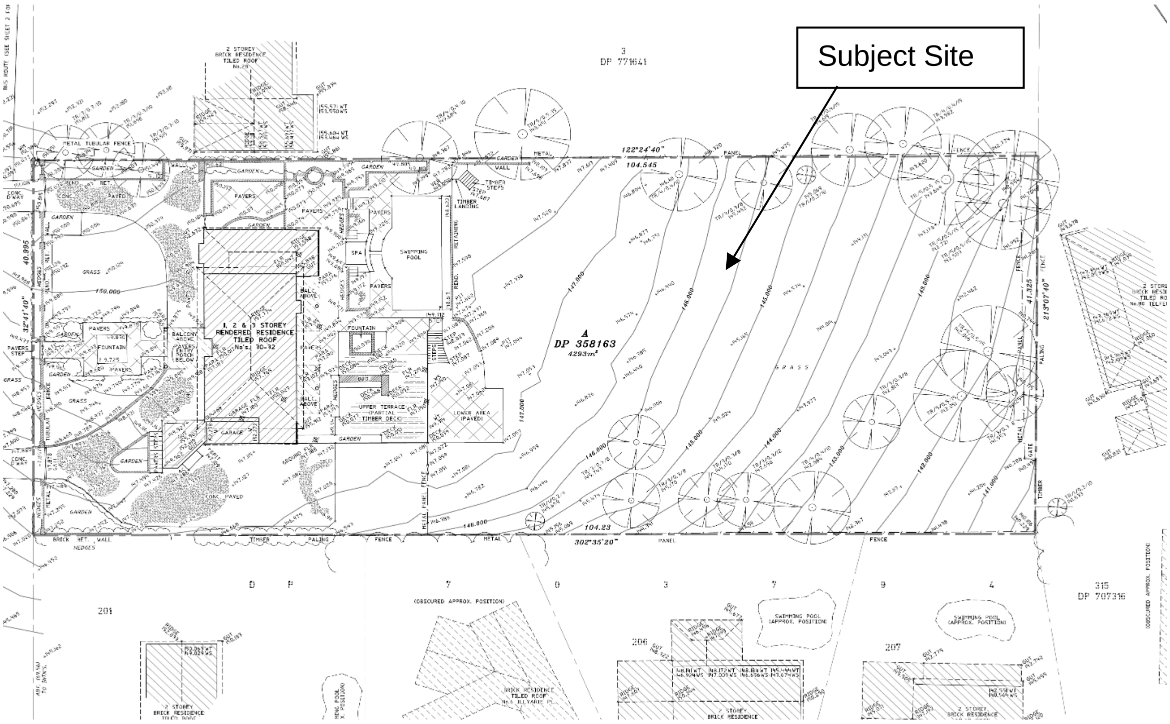


Figure 3. Contour Map of the Site

3. PREVIOUS GEOTECHNICAL SITE INVESTIGATION

A preliminary Geotechnical Site Investigation (soil testing) was undertaken on 21 January 2010 by Geotechnique Pty Ltd involved drilling of four test pits (TP1, TP2, TP3 and TP4) using a small tracked excavator.

The investigation revealed that the soil profile at test pits comprised 0.35m thick topsoil overlying medium to high plasticity residual Clay with some ironstone gravels and Shale fragments to 1.5-2.9m depth underlain by very low to high strength bedrock Shale.

Fill material was encountered within TP3 to a depth of 0.6m overlain by topsoil to 300mm depth. The result of DCP tests indicated clayey soil to have a consistency of stiff to very stiff and hard at depth.

Ground water was not encountered in the test pits for the short time they remained open. It should be noted that fluctuations in the levels of groundwater might occur due to variations in rainfall and/or other factors. Based on the swell-shrink index results carried out in the investigation undertaken by Geotechnique Pty Ltd, the site may be classified as Class H (Highly reactive clay sites, which may experience high ground movement from moisture changes) in accordance with AS2870-1996 "Residential Slabs and Footings. Potential free surface movement was calculated to be in the range of 40-60mm.

Based on the observations, the stability of the site was classified LOW risk according to Walker et al, 1985 for the Australian Geomechanics Society. Good engineering practice suitable for hillside construction required and risk after development is usually acceptable.

The site was recommended to be suitable for the proposed residential development, provided the recommendations given below:

- Foundation loads may be supported on ground bearing slabs, pads or bored piers. Bored piers, if constructed, should be socketed a minimum of 300 millimetres (mm) into the shale bedrock and may be designed for an allowable end bearing pressure of 600kPa. It should be noted that some high strength ironstone bands and gravels are present which may hinder pier drilling.
- Foundation loadings should be supported on the same bearing stratum to minimise the effect of differential settlements.

4. POTENTIAL MODES OF INSTABILITY

4.1 Proposed Site Development

It is proposed to construct new dwellings on this site by sub-dividing the property into four (4) lots. According to Subdivision plan (See Figure 4), Lot 1 will include the exiting dwelling with a lot size of 1561.16m^2, Lots 2 and 3 each will include 703.48m^2 and Lot 4 locating in the eastern side of the site will have a size of 819.98m^2. The cross section of the proposed subdivision plan is shown in Figure 5.

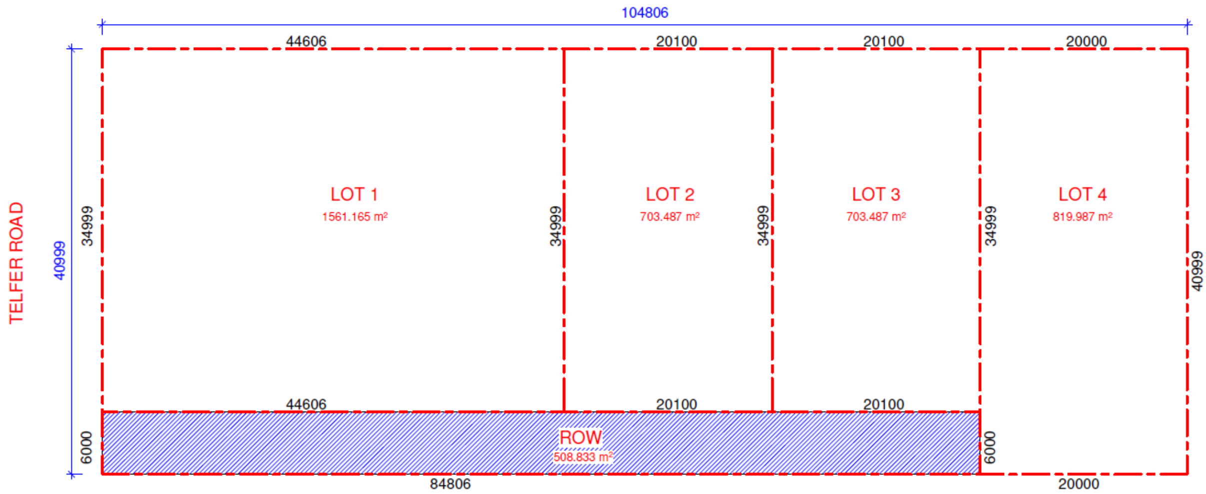


Figure 4. Proposed Subdivision Plan

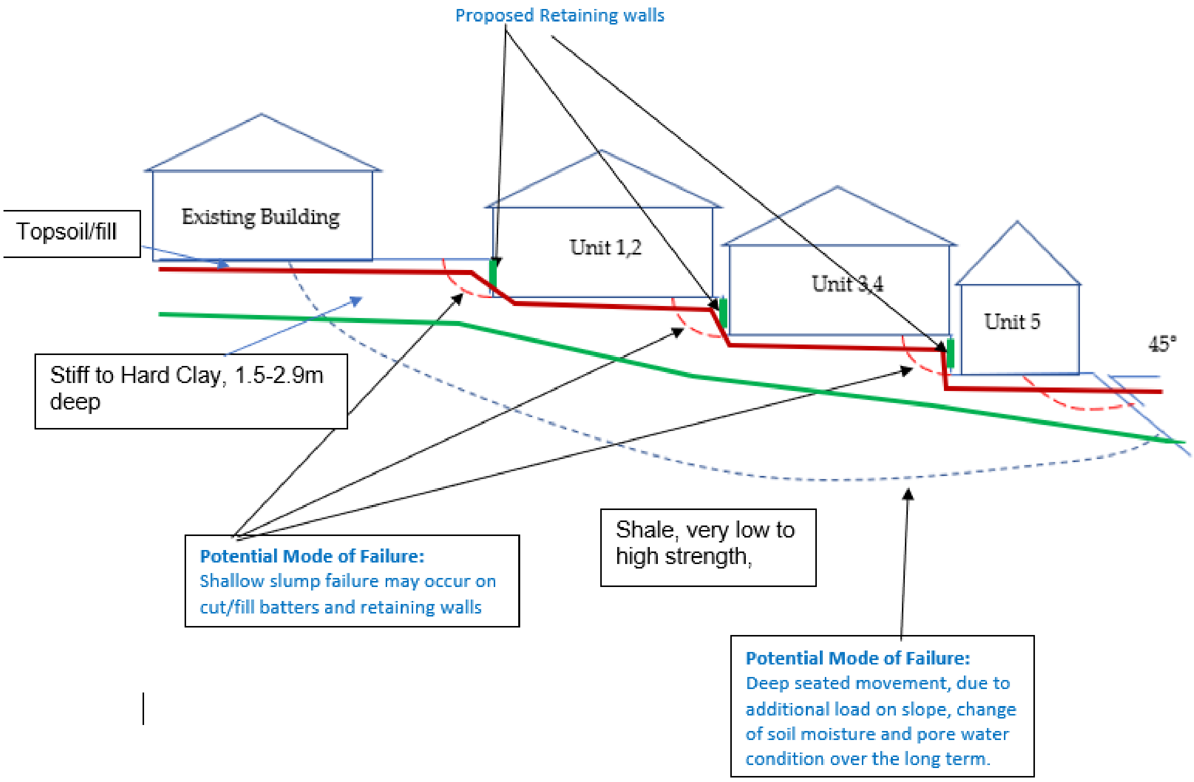


Figure 5. Cross Sections of the proposed subdivision plan and Potential Mode of Failure (not to scale)

Based on the proposed work, some of the construction activities related to the slope conditions are:

- Construction of the proposed dwelling and effect of live loading from machinery and materials during construction activities;
- Modifying the surface and subsurface drainage.
- Construction of retaining walls for associated cut/fill.

4.2 Potential Modes of Instability

There are two main classes of failure hazards differentiated on the basis of material type and scale of failure due to the proposed works:

Mode 1: A shallow slump (earth slide or earth flow) involving the natural slope, cuts and man-made fill. This mode of failure may occur in the area surcharged with uncontrolled fill or subject to additional loading from the new constructions or steep cut batters;

Mode 2: Deep seated failure (rotational or translational landslip) that involves the underlying fill, natural soil and rock in steep slope. The area subject to this failure could be identified from the presence of steep slopes combined with additional load on the slope.

The sketch of the slope cross section illustrating the potential modes of instability is shown in Figure 5.

5. GEOTECHNICAL RISK ASSESSMENT FOR PROPERTY LOSS

5.1 Risk Assessment Methodology

The risk assessment process is a qualitative process designed to enable ranking of the sites identified as hazardous. This ranking is important to allow prioritisation of sites for either nomination to a hazard monitoring program or for hazard treatment. In this qualitative process, risk has been assessed as the product of likelihood and consequence criteria, determined by a matrix method in line with accepted risk management principles. The likelihood rating is applied to the table *'Qualitative Measures of Likelihood'* to derive a likelihood level, A to F. Qualitative Measures of Likelihood is presented in Table 1.

Table 1. Qualitative Measures of Likelihood-Property Loss

Indicative Value	Implied Indicative Landslip Recurrence	Descriptor	Definition	Level
10^{-1}	10 years	ALMOST CERTAIN	The event is expected to occur over the design life	A
10^{-2}	100 years	LIKELY	The event will probably occur under adverse conditions over the design life	B
10^{-3}	1000 years	POSSIBLE	The event could occur under adverse conditions over the design life	C
10^{-4}	10,000 years	UNLIKELY	The event might occur under very adverse circumstances over the design life	D
10^{-5}	100,000 years	RARE	The event is conceivable but only under exceptional circumstances over the design life	E
10^{-6}	1,000,000 years	BARELY CREDIBLE	The event is inconceivable or fanciful over the design life	F

The consequence rating is applied to the table 'Qualitative Measures of Vulnerability and Consequence' to derive a consequence level, 1 to 5. Qualitative Measures of Consequence is detailed in Table 2.

Table 2. **Qualitative Measures of Consequence to Property**

Approx. Cost of damage Indicative Value	Definition	Descriptor	Level
200%	Structure(s) completely destroyed and/or large-scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage	CATASTROPHIC	1
60%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage	MAJOR	2
20%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage	MEDIUM	3
5%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works	MINOR	4
0.5%	Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a national boundary of 0.1%. See risk Matrix)	INSIGNIFICANT	5

The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures. It is an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation work required to render the site to tolerable risk level for the landslip which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslips which may affect the property.

A qualitative risk rating is derived by using both the likelihood level (Table 1) and the consequence level (Table 2) in a standard form of risk analysis matrix. Table 3 outlines the *Qualitative Risk Analysis matrix*. This matrix assigns a four-fold risk level ranging from VH (very high), H (high), M (moderate) to L (low).

Table 3. Qualitative Risk Analysis Matrix – Level of Risk to Property

Likelihood	Indicative value of Approximate Annual Probability	Consequences to Property				
		1. Catastrophic 200%	2. Major 60%	3. Medium 20%	4. Minor 5%	5. Insignificant 0.5%
Almost Certain (A)	10^{-1}	VH	VH	VH	H	M or L
Likely (B)	10^{-2}	VH	VH	H	M	L
Possible (C)	10^{-3}	VH	H	M	M	VL
Unlikely (D)	10^{-4}	H	M	L	L	VL
Rare (E)	10^{-5}	M	L	L	VL	VL
Barely Credible (F)	10^{-6}	L	VL	VL	VL	VL

A table of *'Risk Level Implications'* is shown in Table 4 below. These implications are only given as a general guide as the implications for a particular site are often very site specific.

Table 4. Risk Level Implications

Risk Level	**Implications**
VH - Very High	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 value of the property
H – High	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M – Moderate	May be tolerated in certain circumstances (subjected 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 practicable

Risk Level	Implications
L – Low	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required
VL – Very Low	Acceptable. Manage by normal slope maintenance procedures

We have undertaken the risk assessment of the site with reference to the guidelines set out by the Australian Geomechanics Society (AGS) in "Landslide Risk Management Concepts and Guidelines" as published in the Australian Geomechanics Journal, Vol. 42 No. 1, March 2007c.

5.2 Likelihood of Failure Event

The estimation of the probability that a slope failure event will occur has been based on inspection of the site and any indications of current or past events.

The following observations were important in estimating the indicative annual probability of a slope instability event:

- The soil properties;
- Review of geotechnical data;
- The site topography;
- The surface run-off and groundwater conditions;

These observations can enable an estimation of indicative annual probability for both small volume shallow slumps and deep-seated failure.

5.2.1 Shallow Slump Failure Mode

Likelihood

The major factors which govern the likelihood of a shallow slump are the presence of:

- Unretained and over steepened man-made fill or cut;
- Alteration of soil moisture condition due to removal of vegetation cover and installation of new surface and subsurface drainage;
- Additional pressure on the slope from the proposed dwelling and construction machinery.

The likelihood of a shallow failure is considered "Possible" on any proposed cut or fill batters and retaining walls.

A design that incorporated a good surface and subsurface drainage system, limited the number and extent of fill, incorporated placement of engineered fill and engineer designed earth retaining structures would reduce the likelihood of a shallow slump failure occurring to "Unlikely".

Although it is acknowledged that the client cannot control development beyond the boundaries of their site, good maintenance of the drain in the adjacent properties will also be important to prevent over saturation of the slope.

If drainage of the site is not managed well, it could lead to saturation of the soil profile and reducing the soil shear strength. The likelihood of a shallow slump failure would therefore increase if the above factors eventuate. They can, of course, be offset by ensuring good drainage and placement of engineered fill. Some mitigation options against the slope instability are presented in section 8 of this report.

Consequences

The element at risk on this site is the proposed dwellings. A small slump failure may cause “Minor” damage to the structures.

5.2.2 Deep Seated Failure Mode

Likelihood

A deeper failure involving deeper soil profile is heavily dependent on the overall slope angle and in the engineering properties of the soil mass. The common triggers that initiate deep seated slope failure are excessive cutting or erosion and change in groundwater conditions including saturation in the uppermost soil profile due to poor surface drainage condition. A kinematic analysis and review of the geomorphology of this region indicates that the likelihood of failure through the soil mass occurring at the site is “Rare”.

If the engineering recommendations suggested in this report are adopted and the works do not involve excavation of any substantial cuttings or significant fill, as proposed, it is considered that the impact of the proposed development with regards to this mode of failure will be to further reduce its likelihood of occurring.

Consequences

The deep-seated failure occurring at the site may result in “Major” damage to the proposed dwelling. A construction strategy that improves the surface and subsurface drainage conditions and minimises or prohibits deep excavation that undercut the slope should be adopted.

5.3 Results of Risk Level Estimation

The estimated risk levels are shown below in the following Table 5. This table also presents the implications of the estimated risk levels.

Table 5. Risk Levels after Risk Mitigation

Mode of Failure	Element at Risk	Likelihood of Occurrence	Consequence	Risk
Mode 1: Shallow Slump failure	New dwellings	Unlikely	Minor	L
Mode 2: Deep Seated failure	New dwellings	Rare	Major	L

Adopting an Important Level of Structure of 2 (Low rise structures) (NCC Volume 1, 2015), the suggested acceptable qualitative risk to property criteria is "Low (L)". It should be noted that the above risk level has been estimated based on the assumption that all the risk mitigation recommendations given in this report are adopted.

6. GEOTECHNICAL RISK ASSESSMENT – QUANTITATIVE RISK TO LIFE

6.1 Method of Assessment

The risk of loss of life has been estimated using the methodology outlined by the AGS, 2007, Section 7.

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

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

Where:

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

P(H) is the annual probability of the landslip;

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

The shallow slump failure may occur at any cut/fill and retaining walls that would be required for the proposed dwelling. This failure is estimated to hit a part of the proposed structures. P(S:H) for shallow slump failure is estimated as 0.2. The deep-seated failure may also impact a part of the proposed dwelling. Hence, the P(S:H) for deep-seated failure is estimated as 0.5.

P(T:S) is the temporal spatial probability (e.g. of the building or location being occupied by the individual) given the spatial impact and allowing for the possibility of evacuation given there is warning of the landslip occurrence; in this case it is assumed that the proposed dwelling will be occupied by 2 persons on average 10 hours/day, 365 days per year, so P(T:S)=0.83.

V(D:T) is the vulnerability of the individual (probability of loss of life of the individual given the impact). Vulnerability value due to shallow slump failure occurring upslope/downslope of the proposed dwelling is 0.1. Vulnerability value due to deep seated failure is 0.5.

Vulnerability is generally based on the guidelines contained in Appendix F of AGS, 2007 and refers to the probability of survival given the type of failure and its spatial impact on the element at risk. Low value of vulnerability has been assigned to events that are unlikely to cause any significant effect on the structures due to spatial distance and /or low impact energy, such as a shallow slump.

6.2 Risk to Life

Based on the stated tolerable risks for loss of life of the AGS (2007) guidelines, a risk of 10^{-5} per annum for persons most at risk on new development is considered tolerable provided that risk treatment options will be employed to maintain or reduce the level of risk. Acceptable risks are usually considered to be one order of magnitude smaller than tolerable risks (10^{-6} per annum).

Risk estimate (Loss of life) calculation including individual risk is presented in Table 6. An evaluation of the estimated risk levels against the adopted criteria indicates the assessed risks for shallow slump failure and deep-seated failure are “Acceptable”.

Table 6. Risk Estimate – Loss of Life

Mode of Failure	Likelihood of Occurrence	Indicative Annual Probability	Probability of Spatial Impact	Temporal Factor	Vulnerability	Individual Risk
Mode 1: Shallow slump failure	Unlikely	10^{-4}	0.2	0.83	0.1	$1.66*10^{-6}$
Mode 2: Deep seated	Rare	10^{-5}	0.5	0.83	0.5	$2.08*10^{-6}$

7. LANDSLIP RISK MANAGEMENT

7.1 Risk Mitigation

Based on the landslip risk assessment detailed in the preceding sections, the following site-specific risk mitigation options have been considered in the preparation of this document.

7.2 Risk Treatments

Based on the qualitative and quantitative risk assessment, the following recommendations are made to reduce the risk to both property and individuals at this site.

7.2.1 Stabilisation of Slope

Additional control measures should be adopted to reduce the risk to an acceptable level. The work may involve the following scope of work (see Figure 6):

- Installation of engineer designed retaining walls for any cut or fill batter higher than 1m or create a minimum batter of 2H:1V in unretained cut or engineered fill. Review of existing surface stormwater drain. The surface runoff should be regulated to prevent flow onto the slopes.

7.2.2 Drainage

- It is important that drainage of the slope in the vicinity of the proposed dwellings/buildings is well managed. This may include ensuring that the surface stormwater drain is regularly maintained and diverted away from the slope. If stormwater is collected into a water storage tank, care must be taken to ensure the overflow is discharged into a legal outlet point via a sealed pipe. No excess water should discharge directly onto the slope.
- Surface water should be prevented from ponding anywhere on site. The collected water from the roof of the proposed dwelling should be discharged to an appropriate collection point specified by the Council.
- Any retaining wall structures should have adequate surface and subsurface drainage installed behind the crest and at the toe of the wall to collect water and direct it to an appropriate outlet point specified by Council. The subsurface drain aimed to prevent surface soil saturation in the area behind the wall.

7.2.3 Footing Designs

Based on site observations, subsurface investigations, the size and type of proposed development it is considered that the site be assigned a Class P classification (slope stability), in accordance with AS 2870-2011. The recommended Site Classification can be updated/reviewed after the final subdivision plans and cross sections.

A new geotechnical site investigation to be carried out to advice on the site classification, footing types, founding depths, bearing capacity of footings/piers and lateral earth pressure for design of retaining walls.

It is recommended that bored piers be used to support the proposed dwelling. At a minimum, the pier footings should be founded in the natural very stiff silty clay and penetrate through any fill material. The founding depth should be 2.0-2.5m or to a hard layer, whichever is shallower.

A suitably qualified geotechnical engineer should be engaged to confirm the appropriate founding depth during footing excavation stage. The founding depth may be deepened subject to the findings during the excavation.

7.2.4 Cut and Fill

The following guidelines should be adopted for any earthwork that may be required at the site:

- Any unrestrained fill on this site or during construction should be minimised to not greater than 1.0m in height above the original ground surface level. Fill should be placed in layers not exceeding 150mm loose thickness and compacted to achieve 95% standard compaction dry density as per AS 3798 - 2007 “Guidelines on earthworks for commercial and residential developments”. It is recommended that the backfill be tested to ensure it meets the required minimum compaction criteria.
- The existing material derived in-situ is considered suitable for fill material, except for materials greater than 75mm, such as large cobbles or boulders.
- Key the fill into the natural slope. The vegetation and topsoil should be removed before placing fill.
- The unretained cut and fill slope should not be steeper than 2H:1V.
- Any retaining walls should be constructed with appropriate drainage that is incorporated into the overall site storm water management plan. Where possible, batters above retained cut batters should be revegetated.
- Any retaining structures higher than 1m should be designed by a qualified Engineer and should adopt the guidelines as recommended in AS4678-2002 (Earth Retaining Structures).

7.2.5 Site Revegetation

Emerson class testing to be carried out in the geotechnical investigation, to provide the erosion potential characteristics of the soil profile. Revegetation of bare patches resulting from any construction works is essential on steep slopes for limiting the effects of erosion. Revegetating is integral to maintain surface stability and the balance of water in the soils.

7.2.6 Erosion and Sediment Control

Erosion and Sediment control plan should be implemented before commencing any earthworks for the proposed development. Below are some general guidelines to be taken into considerations:

- Establish a single entry/exit point when construction work starts
- Minimize area to be cleared and provide as much as vegetation as possible
- Install sediment fences along the low side of the site before work begins
- Ensure the imported fill material/top soil within the sediment controlled plan
- Fill in and compact all trenches immediately after services have been laid
- Divert water around the work site and stabilized channels
- A silt trap to be installed around the site perimeter during construction.
- Provide temporary earth drain around the proposed site if possible, to prevent water logging within the site
- Stabilize exposed earth banks/embankment

7.2.7 Construction Supervision and Site Maintenance

- It is recommended that the detailed drainage and structural designs be reviewed by a Geotechnical Engineer.
- It is recommended that a suitably qualified engineer be engaged to design and oversee construction of retaining walls for the cutting and filling.
- The house owner should engage a Geotechnical Engineer that will provide a site inspection in the first year after the earthwork is completed. The inspection should include visual observation of the slope condition in the vicinity of the proposed development.

This assessment has been determined based on the assumption that recommendations contained in this report are adopted in their entirety for the final design and that the construction phase of the project is supervised by an appropriately qualified geotechnical engineer.

To ensure that the risk does not increase to unsatisfactory levels, it is strongly recommended that ongoing site maintenance be undertaken. Maintaining site drainage and monitoring the site for evidence of deterioration in slope stability are key components of any ongoing maintenance program for this site. Some guidelines for hillside construction published by AGS (Australian Geomechanics Society) are attached.

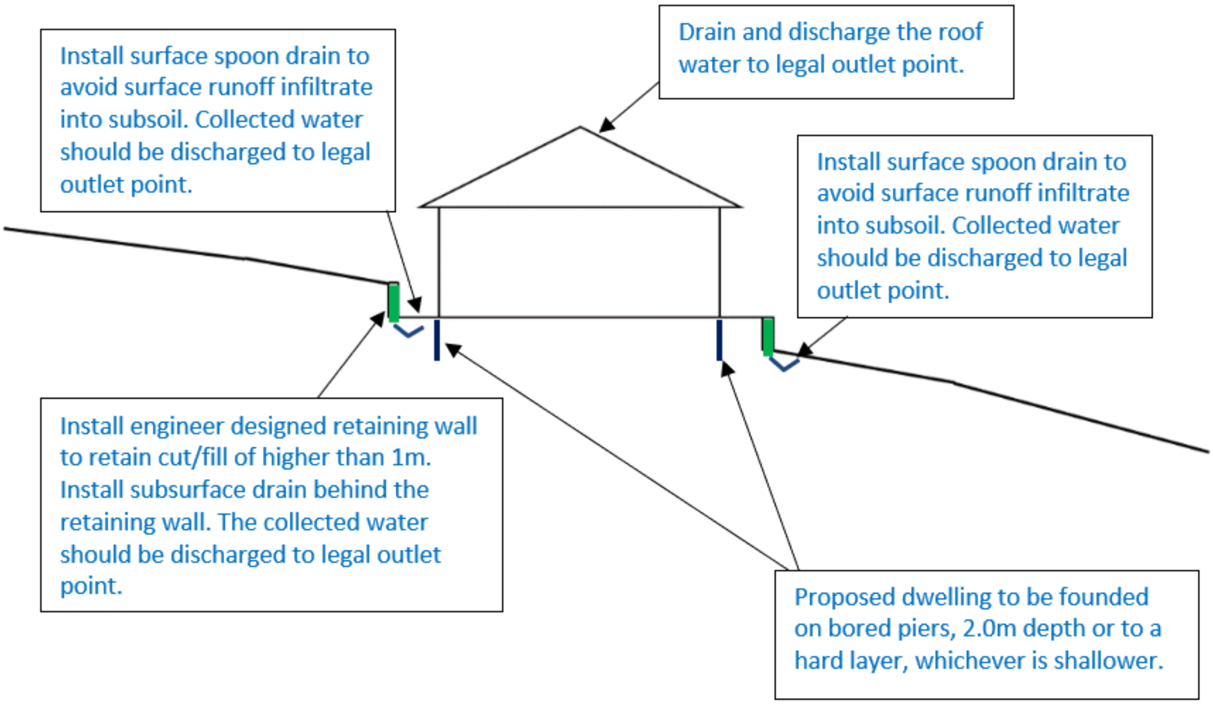


Figure 6. Proposed Engineering Measures

8. GENERAL RECOMMENDATIONS

- Good drainage is an important part of any footing design. The Builder should follow all of the drainage requirements in AS 2870 to prevent water accumulation near the building footings (even during construction). It is recommended that sufficient ground clearance be created to accommodate paving which slopes a minimum of 1:20 away from the building. This slope should be achieved by excavation and not by building-up loose fill around the footings.
- Any proposed footings which are close to an easement and/or other excavations, (including those in adjoining properties) should be founded below a line projected up at 30° to the horizontal (for Sand) and 40° to the horizontal (for firm/stiff Clay) and measured from the nearest base of the easement excavations.
- Avoid excavations close to footings since those founded on sandy soils can experience settlements while those founded in clayey soils can also move due to the shrinking and swelling of the clay. Plumbers and drainers should follow all the recommendations made in AS 2870 and other appropriate codes with respect to drainage works.
- It is also recommended that the Owners follow the requirements of AS 2870 and the C.S.I.R.O. BTF18 (www.csiro.au), which requires Owners to carry out regular maintenance of drainage and care for the soil moisture conditions.
- A new geotechnical site investigation to be carried out to advice on the site classification, footing types, founding depths, bearing capacity of footings/piers and lateral earth pressure for design of retaining walls.

9. CONDITIONS OF THE RECOMMENDATIONS

- This report is a geotechnical report only and the classification stated shall not be regarded as an engineering design nor shall it replace a design by engineering principles although it may contribute information for such designs. It shall be read in conjunction with AS 2870 and must be reproduced only in total.
- The advice given in this report is based on the assumption that the test results are representative of the overall subsurface conditions. However, it should be noted that actual conditions in some parts of the building site may differ from those found in our test holes. If excavations reveal soil conditions significantly different from those shown in our attached Borehole Log(s), Geotesta must be consulted and excavations stopped immediately.
- Any sketches in this report should be considered as only an approximate pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions or slope information should not be used for any building cost calculations and/or positioning of the building.
- Whilst Geotesta has accepted the commission for the work reported herein, the ownership of the report and any liabilities associated with it, remain with Geotesta until all relevant accounts have been paid.

For and on behalf of
GEOTESTA PTY LTD

Dr. Mohammad Hossein Bazyar
B.Eng M.Eng Ph.D CPEng NER MIEAust
Senior Geotechnical Engineer

Appendix A
SITE PHOTOGRAPHS

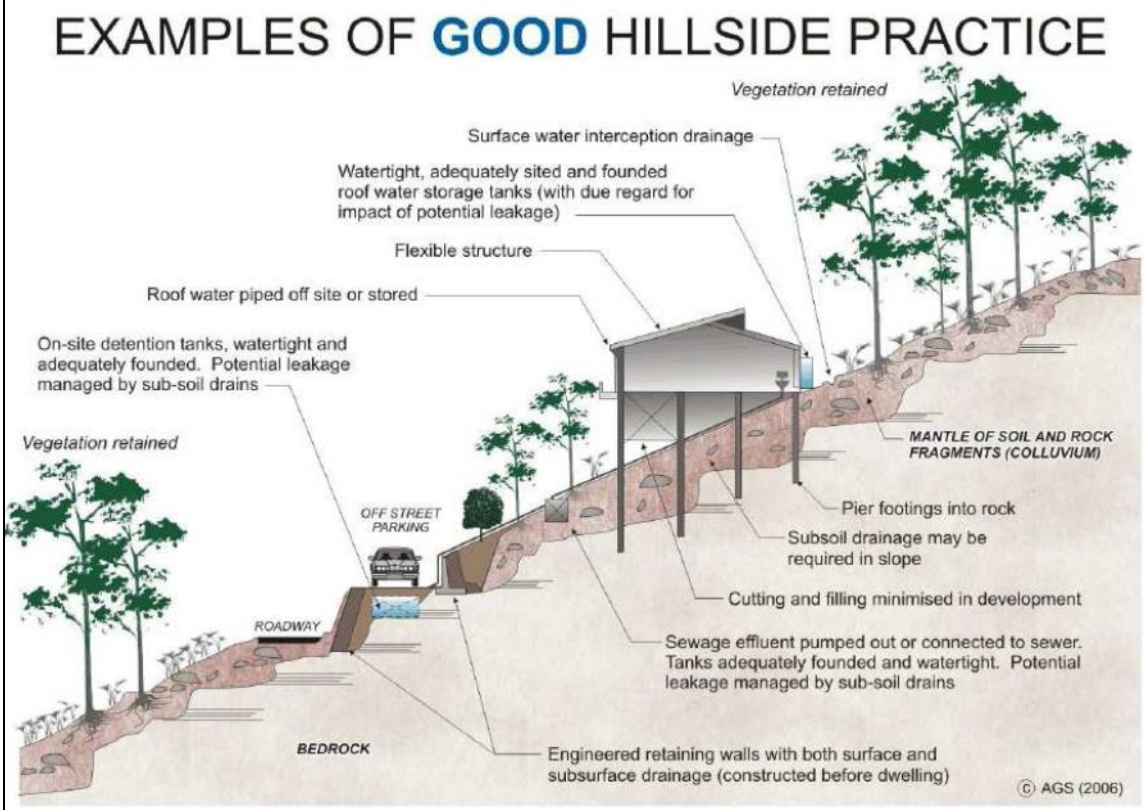
View of the dwelling, looking west

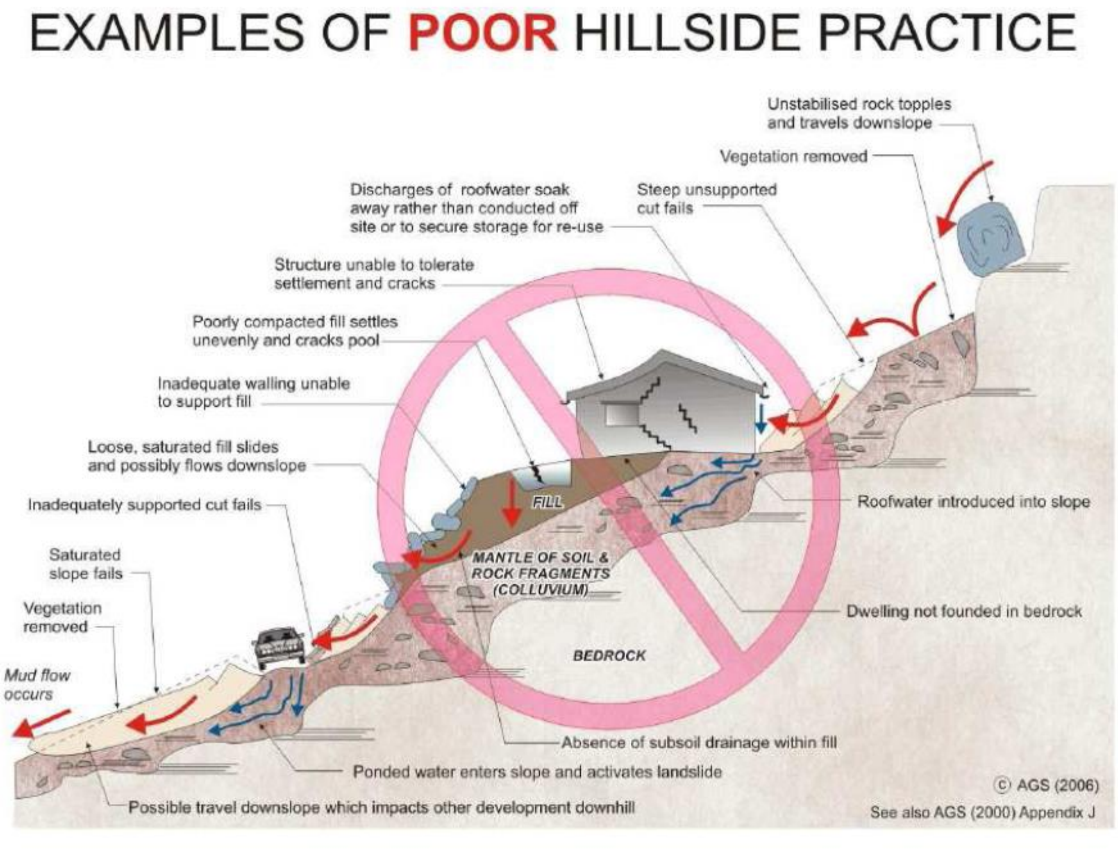
View of the site, looking south-east

View of the dwelling, looking east

Appendix B

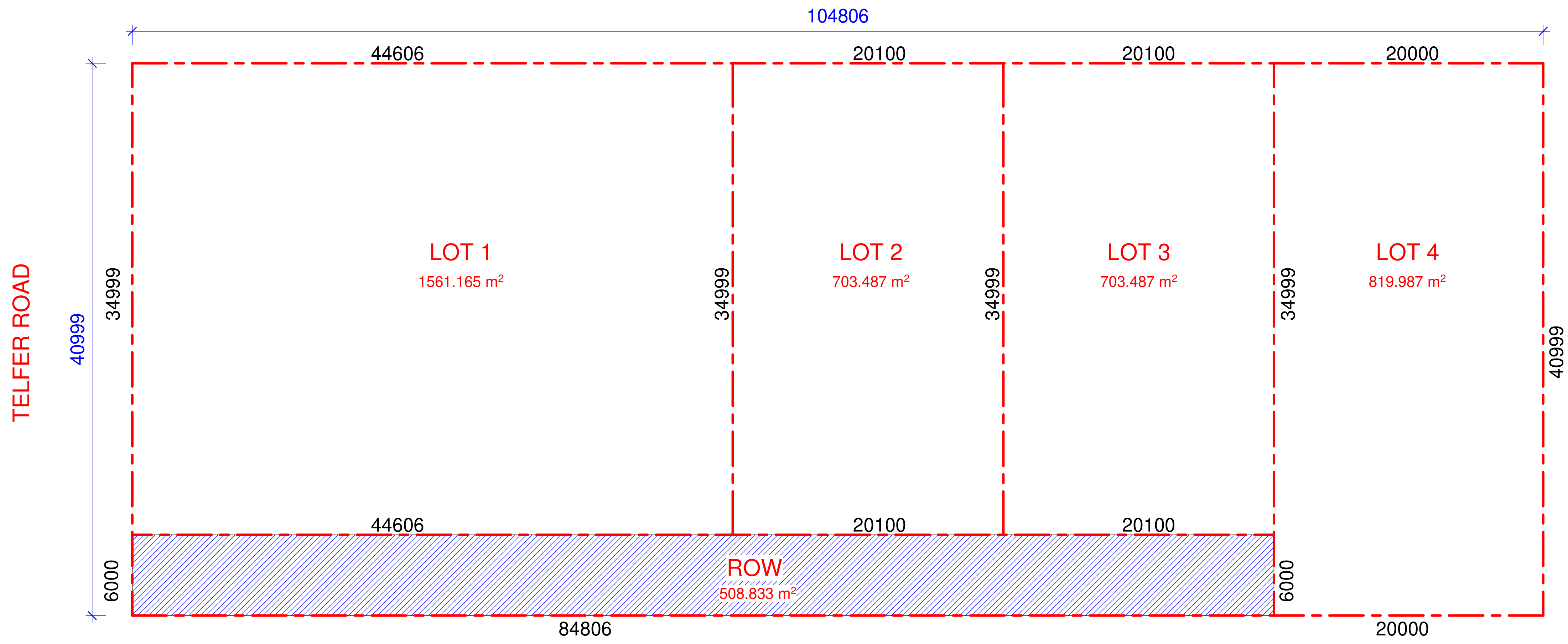
EXAMPLES OF GOOD HILLSIDE PRACTICE





Australian Geomechanics Vol 42 No 1 March 2007

Appendix C
PROPOSED SUBDIVISION PLAN



1 SUBDIVISION PLAN
1 : 200

0m 4m 8m 12m 16m 20m
VISUAL SCALE 1:200 @ A1

REVISION SCHEDULE

ISSUE	DESCRIPTION	ISSUED BY	DATE
A	AREA OF LOT 2 AND LOT 3 REVISED	SO	25-10-2019

Member Australian Institute of Architects

CONSULTANTS

PM

NORTH POINT

THIS DRAWING ISSUE HAS BEEN REVIEWED BY
DIRECTOR - SO

CLIENT
MARK MINA

DRAWING TITLE
SUBDIVISION PLAN

DATE 25-10-2019
SCALE @ A1 1 : 200

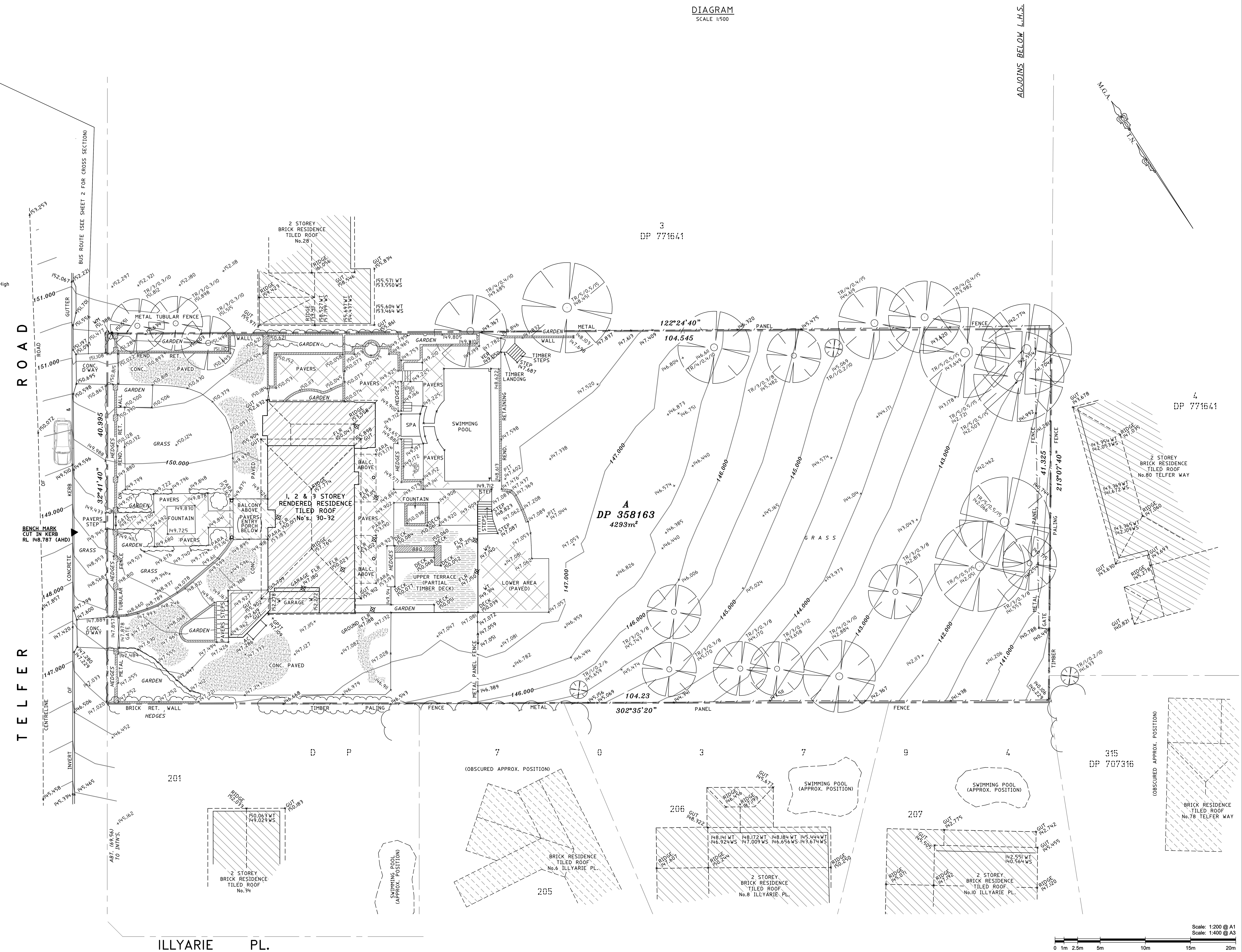
PROJECT NUMBER 037 / 17-18
DRAWING No. A101
ISSUE A

PROJECT
PROPOSED SENIORS LIVING DEVELOPMENT
30-32 TELFER ROAD, CASTLE HILL

JS Architects Pty Ltd
Suite 4.04, Level 4, No: 5 Celebration Drive
BELLA VISTA ~ NSW 2153 Australia
T :61 2 8814-6991 FAX: 61 2 8814-6992
M :61 412 06 06 04
E :info @ jsarchitects.com.au
W :www.jsarchitects.com.au
ABN 70 119 946 575
Nominated Architect: Szymon Ochudzawa (RAIA 6865)

Appendix D

EXISTING DRAWINGS AND PREVIOUS PRELIMINARY GEOTECH REPORT



LEGEND:

TR/5/0.5/15 = TREE 5m Radius Spread / 0.5m Dia Trunk / 15m High
WT= WINDOW TOP
WS= WINDOW SILL
RL= REDUCED LEVEL
FLR= FLOOR LEVEL
AWN= AWNING
LP= LAMP POLE
PP= POWER POLE
SV= STOP VALVE
WM= WATER METER
ELP= ELECTRICITY LIGHT POLE
GAS= GAS METER
GASV= GAS VALVE
GUT= TOP OF GUTTER
PARA= PARAPET
HYD= HYDRANT
SLH= SEWER LAMP HOLE
SMH= SEWER MANHOLE
GPIT= GRATED PIT
TPIT= TELECOMMUNICATION PIT
SVENT= SERVICE VENT
BRET= BOTTOM OF RETAINING WALL
TRET= TOP OF RETAINING WALL

APPROXIMATE BOUNDARY POSITION ONLY.

NOTES:

× THIS PLAN HAS BEEN PREPARED FOR MARK MINA FROM A COMBINATION OF FIELD SURVEY AND EXISTING RECORDS FOR THE PURPOSE OF SHOWING THE PHYSICAL FEATURES OF THE LAND TO ASSIST IN DESIGNING FUTURE DEVELOPMENT, AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.
× THE TITLE BOUNDARIES SHOWN HEREON WERE NOT VERIFIED OR MARKED AT THE TIME OF SURVEY BUT WERE DETERMINED BY EXISTING TITLE DIMENSIONS AND OCCUPATION (WHERE AVAILABLE), NOT BY FIELD MEASUREMENT. AS SUCH, THESE DIMENSIONS COULD BE OUT OF DATE AND INCORRECT BY MODERN STANDARDS. THIS PLAN SHOULD NOT BE USED FOR BUILDING TO BOUNDARY, OR TO PRESCRIBED SET-BACKS WITHOUT FURTHER BOUNDARY SURVEY.
× LOT AREA SHOWN AS PER TITLE DIAGRAM UNLESS OTHERWISE STATED. CALCULATED AREA FROM BEARINGS AND DISTANCES SHOWN MAY DIFFER.
× CURRENT TITLE SEARCH SHOULD BE PERFORMED PRIOR TO ANY PLANNING OR WORKS BEING UNDERTAKEN TO CONFIRM EXISTENCE OR OTHERWISE OF EASEMENTS, RESTRICTIONS, COVENANTS OR ANY OTHER NOTIFICATIONS ON THE TITLE.
× DO NOT SCALE OFF THIS PLAN - RELATIONSHIP OF IMPROVEMENTS AND DETAIL TO BOUNDARIES IS DIAGRAMMATIC AND IF CRITICAL SHOULD BE CONFIRMED BY A FURTHER BOUNDARY SURVEY.
× CONTOURS IF SHOWN ARE AN INDICATION OF THE TOPOGRAPHY AND SHOULD ONLY BE USED FOR PLANNING PURPOSES. IF DETAILED DESIGN IS TO BE UNDERTAKEN, SPOT LEVELS SHOULD BE USED.
× NO SERVICE SEARCH HAS BEEN UNDERTAKEN. SERVICES SHOWN ARE BASED ON SURFACE INDICATORS EVIDENT AT THE DATE OF SURVEY DURING FIELD SURVEY & CHARTED AS A GUIDE TO THE POSITION & NATURE OF THE SERVICE.
× BEFORE STARTING ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT PERSON SHOULD MAKE AN INDEPENDENT AND UPDATED ENQUIRY OF 'DIAL BEFORE YOU DIG' (Ph.1100) AND ANY RELEVANT SERVICE PROVIDERS TO ASCERTAIN THE EXISTANCE OF FURTHER SERVICES (IF ANY) AND THE ACCURATE LOCATION OF THOSE NOT ABLE TO HAVE BEEN SURVEYED AT THE TIME OF PREPARING THIS PLAN (OR DATA).
× NO RESPONSIBILITY CAN BE ACCEPTED BY SUMMIT GEOMATIC PTY LTD FOR ANY DAMAGE CAUSED TO ANY UNDERGROUND SERVICE OR ANY LOSS OR INJURY SO SUFFERED IF ENQUIRY AND VERIFICATION HAVE NOT BEEN COMPLETED IN ACCORDANCE WITH THIS NOTE.
× ONLY VISIBLE SERVICES AND FEATURES EVIDENT AT THE DATE OF SURVEY HAVE BEEN OBSERVED.
× FLOOR LEVEL HAS BEEN TAKEN AT ACCESSIBLE POINT INDICATED. (eg. THRESHOLD) INTERNAL FLOOR LEVELS MAY DIFFER FROM INDICATED LEVEL AND SHOULD BE CONFIRMED IF CRITICAL.
× RIDGE, EAVE AND GUTTER HEIGHTS HAVE BEEN OBTAINED BY AN INDIRECT METHOD AND ARE ACCURATE FOR PLANNING PURPOSES ONLY.
× ADJOINING BUILDINGS AND DWELLINGS HAVE BEEN PLOTTED FOR DIAGRAMMATIC PURPOSES ONLY.
× THE SPREAD AND HEIGHT OF EACH TREE IS INDICATIVE ONLY.
× ORIENTATION IS ON MAP GRID OF AUSTRALIA (M.G.A.)
× AUSTRALIAN HEIGHT DATUM (AHD) HAS BEEN OBTAINED FROM GPS OBSERVATIONS UTILISING CORSNET-NSW. IF AHD HEIGHT IS CRITICAL ADDITIONAL SURVEY CONNECTION TO LOCAL CO-ORDINATED MARKS SHOULD BE MADE.
× THIS NOTE IS AN INTEGRAL PART OF THIS PLAN/DATA. REPRODUCTION OF THIS PLAN OR ANY PART OF IT WITHOUT THIS NOTE BEING INCLUDED IN FULL WILL RENDER THE INFORMATION SHOWN ON SUCH REPRODUCTION INVALID AND NOT SUITABLE FOR USE.

CLIENT:

Mark Mina
85 Grose Street
Parramatta NSW 2150

Revisions:

ISSUE	DATE	AMENDMENT	BY
A	01/12/2011	Preliminary Drawing Issued	P.N.
B	07/12/2011	Revised Drawing Issued	P.N.
C			
D			

LOT A	SECTION: -
DP 358163	
TITLE: A/358163	
L.G.A.: THE HILLS SHIRE	
PARISH: FIELD OF MARS	
COUNTY: CUMBERLAND	

SURVEYOR:	DRWN BY:	CHKD BY:
P.N.	S.S.	P.N.
DATE OF SURVEY: 29/11/2011		
LEVEL DATUM: AHD	ORIGIN: -	
ORIGIN RL: -	SOURCE: SCIMS -	
CONTOUR INTERVAL: 0.5m		

PLAN OF DETAIL AND LEVELS
Lot A in DP 358163
No's. 30 - 32 Telfer Road, Castle Hill, NSW 2154

ORIENTATION: M.G.A. (see note) SCALE: 1: 200 @A1 SCALE: 1: 400 @A3

summit GEOMATIC
REGISTERED CONSULTING SURVEYORS

SUMMIT GEOMATIC PTY LTD
ABN: 71 092 947 601
PO BOX 7809, BAULKHAM HILLS B.C. NSW 2153
SUITE 101, 33 LEXINGTON DRIVE
BELLA VISTA, N.S.W. 2153
Ph. (02) 9836 3155 Fax (02) 9836 3177
Email: survey@summitgeo.com.au
http://www.summitgeo.com.au

JOB REF: 3655
REV No: B
SHEET 1 OF 2 A1

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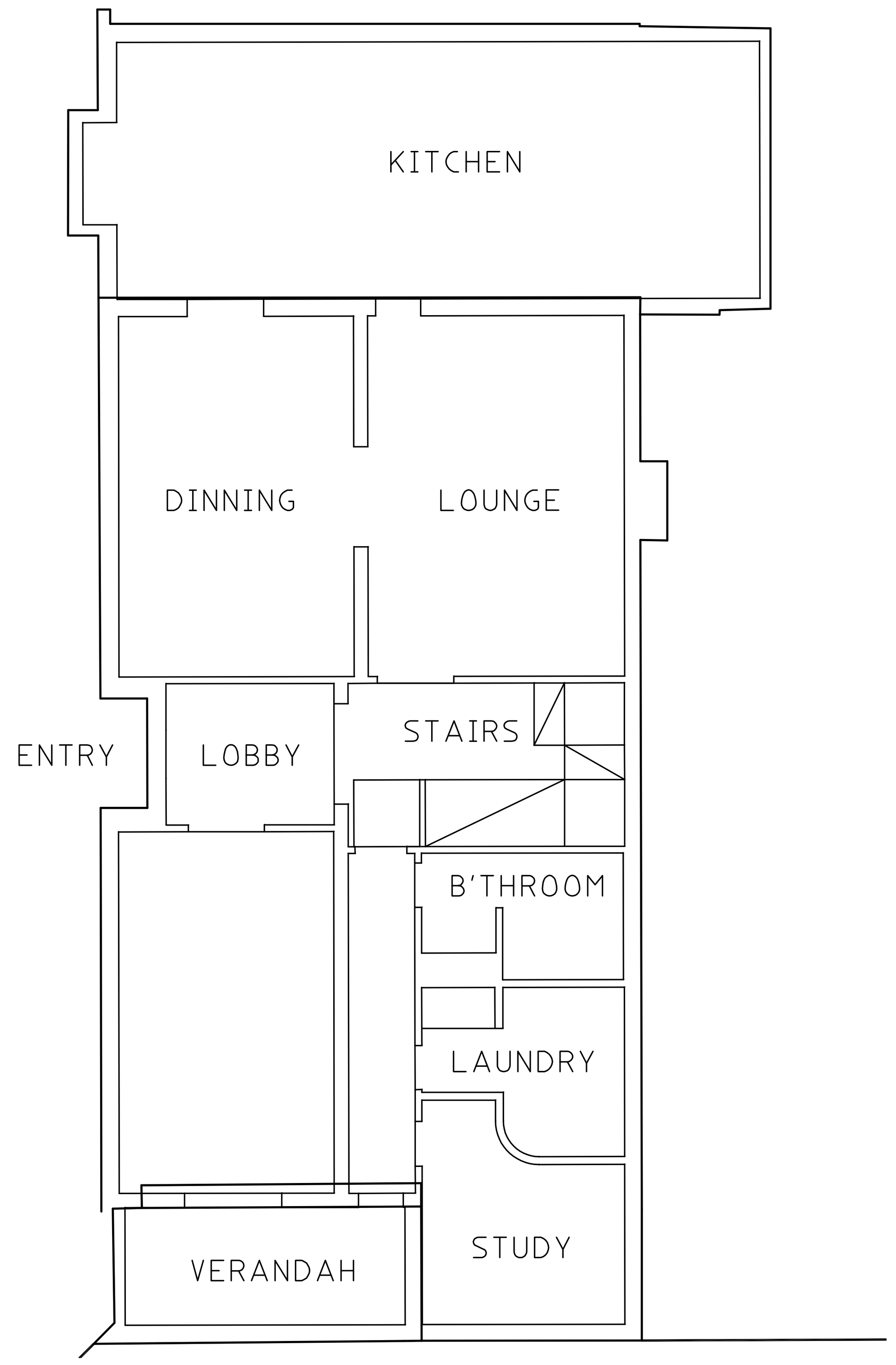
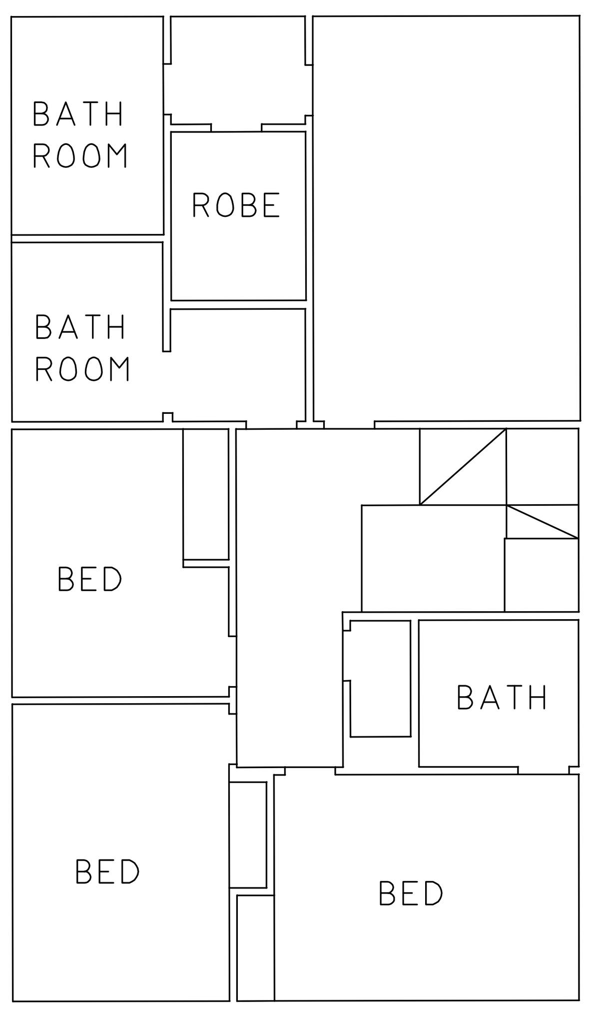
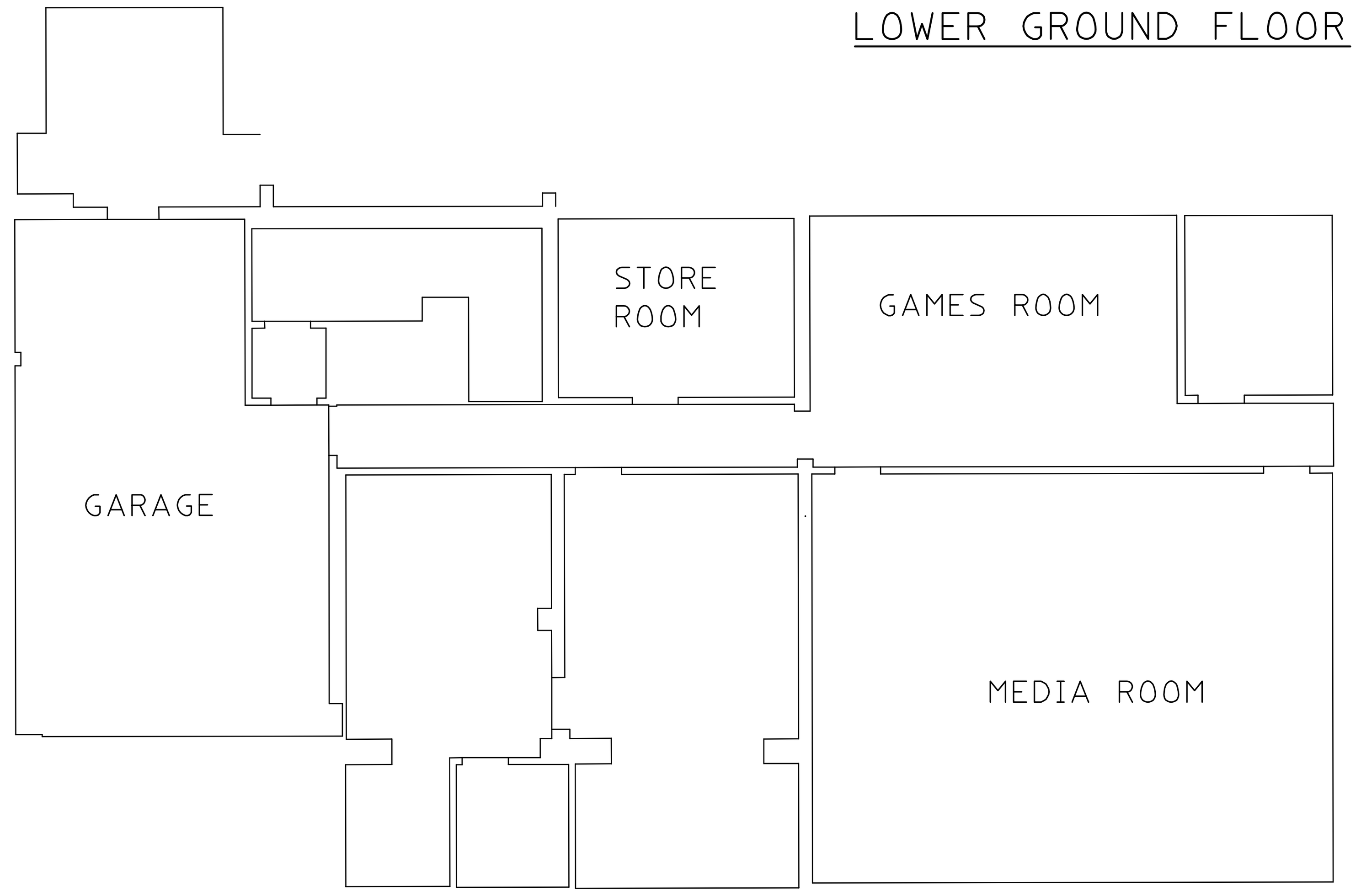
GROUND FLOOR

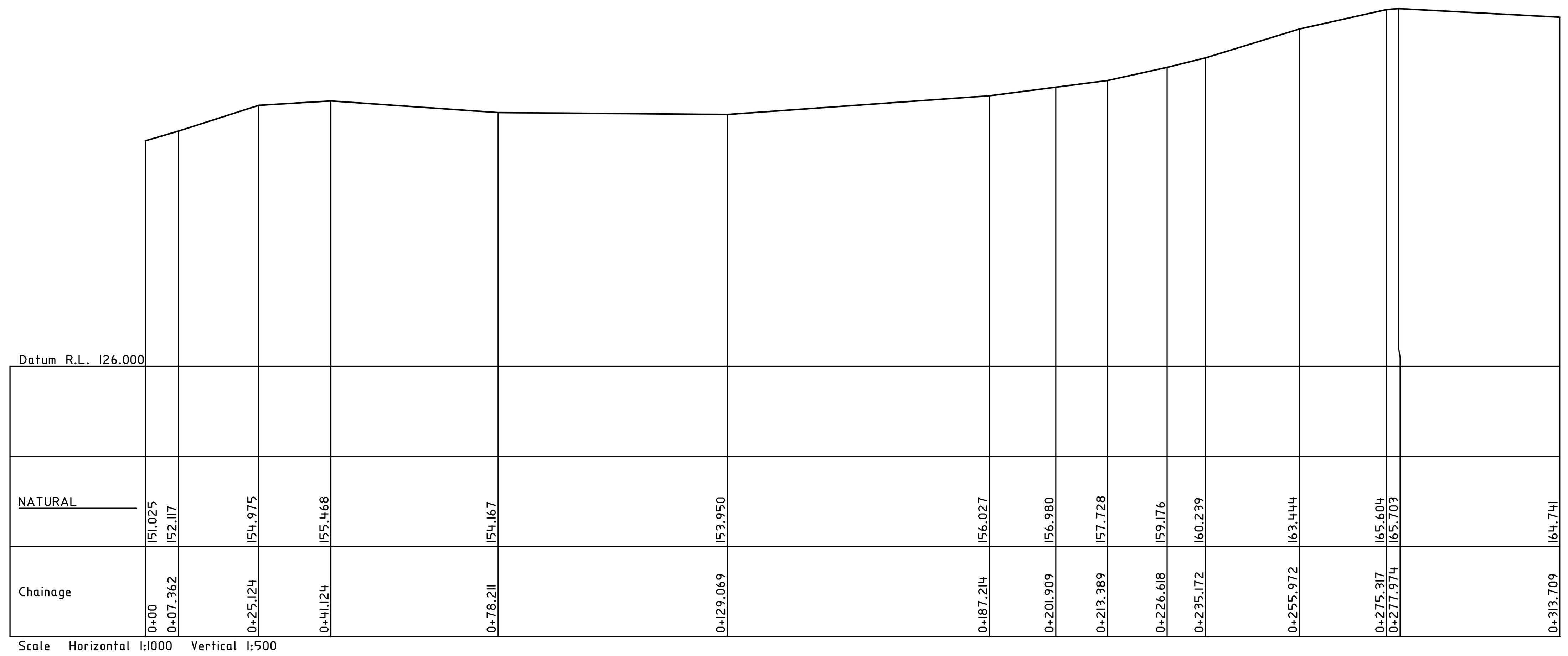


FIRST FLOOR

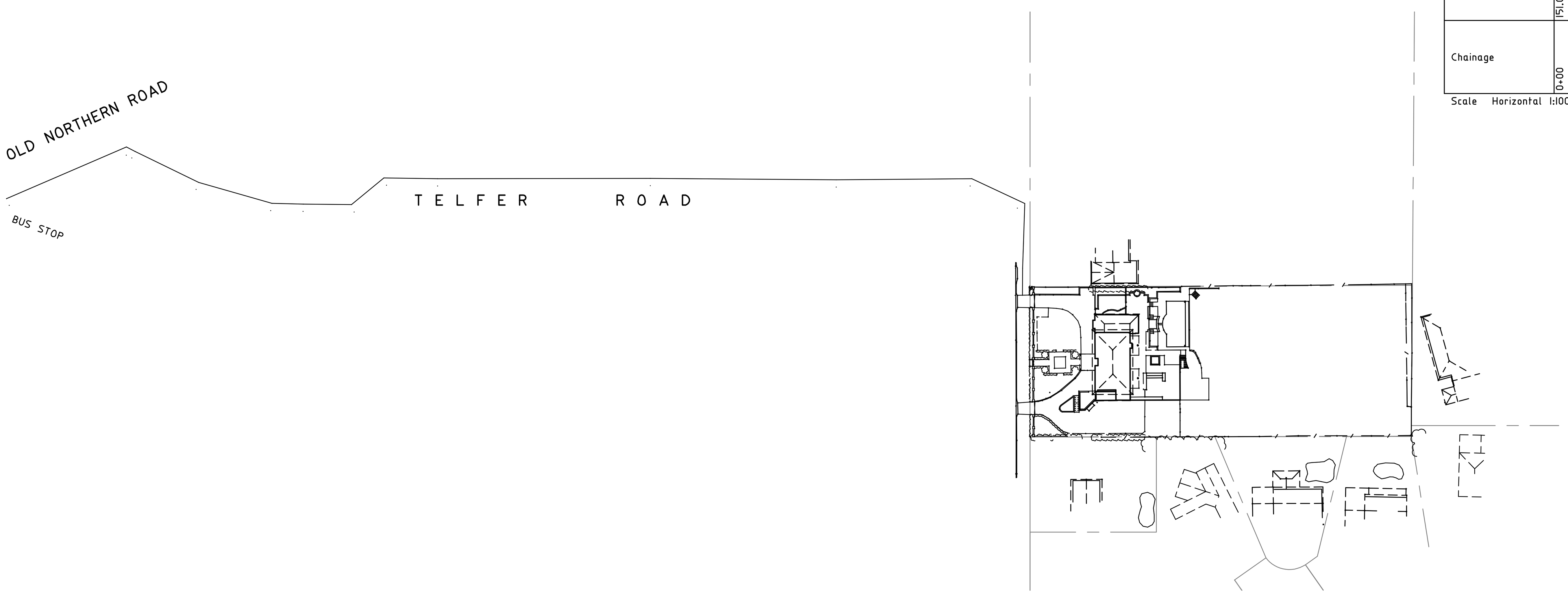


LOWER GROUND FLOOR





CROSS SECTION - ACCESS TO BUS STOP



CLIENT:	Revisions:				LOT A SECTION: -	SURVEYOR:	DRWN BY:	CHKD BY:	PLAN SHOWING FLOOR LAYOUT & BUS ACCESS
	ISSUE	DATE	AMENDMENT	BY	DP 358163	P.N.	S.S.	P.N.	Lot A in DP 358163
Mark Mina	A	01/12/2011	Preliminary Drawing Issued	P.N.	TITLE: A/358163	DATE OF SURVEY: 29/11/2011			No's. 30 - 32 Telfer Road, Castle Hill, NSW 2154
85 Grose Street	B	07/12/2011	Revised Drawing Issued	P.N.	L.G.A.: THE HILLS SHIRE	LEVEL DATUM: AHD ORIGIN:			
Parramatta NSW 2150	C				PARISH: FIELD OF MARS	ORIGIN RL: SOURCE: SCIMS			
	D				COUNTY: CUMBERLAND	CONTOUR INTERVAL: 0.5m			ORIENTATION: M.G.A. (see note) SCALE: 1: 200 @A1 SCALE: 1: 400 @A3

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JOB REF:	3655
REV No:	B
SHEET 2 OF 2	A1

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GEOTECHNIQUE
PTY LTD

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Land Consultants Association Inc

Quality
ISO 9001
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ABN 64 002 841 063

Email: geotech@pnc.com.au

Job No: 3034/1
Our Ref: 3034/1-AA

21 January 2010

Mr P Della Vedova
30 Telfer Road
CASTLE HILL NSW 2154

Dear Sir

re: **Proposed Development**
30 Telfer Road, Castle Hill
Geotechnical Investigation

This report presents the results of a geotechnical investigation carried out for the proposed redevelopment of the rear of the above site. It is understood that the proposed development will be of a residential nature, possibly of brick veneer construction. The investigation was commissioned by Mr P Della Vevoda, the owner of the above property.

The purpose of the investigation was:

- To provide information on surface and sub-surface conditions for site classification and the design and construction of floor slabs and footings.
- To assess the stability of existing slopes.

SITE DESCRIPTION

At the time of conducting the investigation, the site contained an existing rendered brick residence and swimming pool.

The property is located on the side of an undulating to moderately steep hill on the south-eastern side of Telfer Road and is rectangular in shape, measuring approximately 41 metres (m) by 104m. The area of investigation is immediately to the rear of the existing residence and covers an area approximately 60m by 35m. Slopes in this area fall approximately 7 to 8 degrees toward the south.

The area of investigation was well grassed, with juvenile trees planted throughout and scattered mature trees. Trees were noted to be predominantly vertical.

A 1.0m high timber retaining wall was present along the rear boundary of the site. The retaining wall was in poor condition. This retaining wall was inclined downslope and supported in places by props.

Ground surfaces in places were wet. This wetness was apparently due to recent rains and the presence of a rainwater soak-away trench on the up slope neighbouring property.

REGIONAL GEOLOGY

Reference to the Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1) 1983 indicates that the site is underlain by Ashfield Shale of Triassic Age. This rock unit is described as comprising black to dark grey shale and laminite.

INVESTIGATION PROCEDURE

Field work for the investigation was carried out on 19th August 1999 and comprised the excavation of four (4) test pits (TP1 to TP4) at the locations indicated on the attached Drawing No 3034/1-1. The test pits were excavated using a small tracked excavator, to depths ranging from 1.6m to 2.9m below existing ground levels. Insitu testing utilising the Dynamic Cone Penetrometer (DCP) test was carried out adjacent to each test pit.

One undisturbed sample was recovered from TP3 for laboratory testing to provide shrink swell information for foundation design.

A member of our Engineering Staff, who was responsible for sampling and testing of the sub-surface materials and preparation of the engineering logs, supervised the field work.

SUB-SURFACE CONDITIONS

Details of the conditions encountered in the test pits are provided on the attached Engineering Excavation Logs, together with notes defining the descriptive terms used in the report. The sub-surface profile encountered is summarised below:

Topsoil	Silty clay, low to medium plasticity, dark brown, to depths of 0.3m to 0.35m, underlain by
Residual	Clays, medium to high plasticity, orange-grey and grey, with some ironstone gravel and shaley in parts, to depths of 1.5m to 2.9m, underlain by
Bedrock	Shale, very low to high strength, extremely to distinctly weathered, grey and brown with iron cementation in places.

Fill material was encountered within TP3 to a depth of 0.6m overlain by topsoil to 300mm depth.

The results of the DCP tests indicate clays to be stiff to very stiff and hard at depth.

Groundwater was not encountered in the test pits for the short time they remained open. It should be noted that fluctuations in the levels of groundwater might occur due to variations in rainfall and/or other factors.

LABORATORY RESULTS

During the course of the investigation an undisturbed (U_{50}) sample of the naturally occurring clays was recovered for laboratory testing, aimed at determining the reactivity of the soils to seasonal moisture variations. The test conducted was Shrink/Swell Index Determination (I_{ss}), in accordance with Australian Standard AS1289 7.1.1-1992, and from the results obtained the potential free surface movement was calculated to be in the range of 40-50 millimetres (mm).

The laboratory test results certificates are attached.

COMMENTS AND RECOMMENDATIONS

Stability

The stability of a property is generally governed by site factors such as slope angles, depth of insitu soils, strength of sub-surface materials and concentrations of water. A property may generally be classified under five categories in terms of stability, as indicated by *Walker et al, 1985*, for the Australian Geomechanics Society.

Class	Implication
Very Low	Good engineering practice should be followed.
Low	Good engineering practices suitable for hillside construction required. Risk after development usually acceptable.
Medium	Development restrictions may be required. Engineering practices suitable to hillside construction necessary. Geotechnical investigation may be needed. Risk after development generally no higher than usually accepted.
High	Development restrictions and/or geotechnical works required. Geotechnical investigation necessary. Risk after development may be higher than usually accepted.
Very High	Unsuitable for development unless major geotechnical work can satisfactorily improve the stability. Extensive geotechnical investigation necessary. Risk after development may be higher than usually accepted.

Based on the foregoing observations, the stability of the site may be classified as **LOW** risk. The log retaining wall along the rear boundary of the site should be reconstructed, following re-design in accordance with good engineering practice.

Site Classification

It is considered that the site may be classified as **Class "H"** (Highly Reactive) in accordance with AS2870-1996 "Residential Slabs and Footings".

General

It is considered that the site is suitable for the proposed residential development, provided the recommendations given below are followed.

- Foundation loads may be supported on ground bearing slabs, pads or bored piers. Bored piers, if constructed, should be socketed a minimum of 300 millimetres (mm) into the shale bedrock and may be designed for an allowable end bearing pressure of 600kPa. It should be noted that some high strength ironstone bands and gravels are present which may hinder pier drilling.

- Foundation loadings should be supported on the same bearing stratum to minimise the effect of differential settlements.

- If filling is required for ground bearing slabs, site works should be as follows:

  - Strip existing topsoil and vegetation to an average depth of about 300mm.

  - Excavate any fill material to natural clay subgrade levels.

  - Place fill material in 200mm maximum loose thickness layers and compact to a Dry Density Ratio of at least 98% Standard, at a moisture content within 2% of Optimum Moisture Content (OMC). The final layer should be compacted to a minimum Dry Density Ratio of at least 100%. Fill materials should preferably be of low plasticity clays, sandy clays and clayey sands, with a maximum particle size of 150mm.

  - Filled slopes or batters should be overfilled and cut to the required shape or batter to ensure compaction of the fill material.

  - Ground bearing slabs should not be constructed within two metres of the top of any filled batter slope.

- Slopes not steeper than 2.5 Horizontal : 1 Vertical, for filled slopes and insitu soils, are considered stable. All slope modification should be grassed, or suitably maintained, to reduce erosion. Steeper slopes may be used provided they are retained by engineer-designed retaining walls.

- Retaining walls, if required, may be designed using the following parameters:

Unit weight of residual soils and compacted fill	18kN/m^3
Unit weight of extremely weathered shale	20kN/m^3
Coefficient of active pressure (Ka) in residual soils	0.3
Coefficient of active pressure (Ka) in weathered shale	0.2
Coefficient of passive pressure (Kp) in weathered shale	3.0
Coefficient of "at rest" pressure in residual soils and/or compacted fill	0.45

- For the case of fully suspended slabs, filling may be required for temporary support of concrete slabs in the first few weeks after casting. Fill material should be placed in layers not exceeding 300mm loose thickness and lightly compacted. Maximum particle size should not exceed 200mm.

- All roof catchment should be collected or piped away from the development.

- All surface run-off should be diverted away from slopes and batters.

- Development should generally be in accordance with the attached "Some Guidelines for Hillside Construction".

Should you have any questions relating to this report, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

Reviewed by:

MATTHEW CUPITT
Engineering Geologist

EMGED RIZKALLA
Senior Geotechnical Engineer

Encl: Engineering Excavation Logs
Drawing No 3034/1-1 - Test Pit and Borehole Location Plan
Some guidelines for hill-side construction