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

Development Application for_____
Name of Applicant

Address of site __40 Sunrise Road, Palm Beach_____

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

I, _____Woodie Theunissen_____ on behalf of JK Geotechnics Pty Ltd
(Insert Name) (Trading or Company Name)

on this the ____2 February 2022____ 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 $2million.
we/I have:

Please mark appropriate box

☒ 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

☐ ~~I~~ *Are*/am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. *We*/I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.

☐ Have examined the site and the proposed development/alteration in detail and *are*/am of the opinion that the Development Application only involves Minor Development/Alterations that do not require a Detailed Geotechnical Risk Assessment and hence my/*our* report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements for Minor Development/Alterations.

☐ Provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: Geotechnical Assessment

Report Date: 2 February 2022 Report Ref No: 33855Yrptrev
:
Author: Woodie Theunissen

Author's Company/Organisation: JK Geotechnics Pty Ltd

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

Drawings prepared by Susan Rothwell Architects Pty Ltd, (Project SRSP, Drawing No's: DA100 to DA110, Issue D, E, E, E, D, E, E, D, E, D and D respectively, Dated 28 February 2023)

~~I am~~ *We are* 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~~ *confirming* 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, *as discussed in the Report*.

Signature …… …|……..……..

Name ……Woodie Theunissen……..

Chartered Professional Status……CPEng…….

Membership No. ……889807……

Company: JK Geotechnics Pty Ltd.

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

Development Application for_____

Name of Applicant

Address of site __40 Sunrise Road, Palm beach, Palm Beach_____

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: Geotechnical Assessment

Report Date: 2 February 2022 Report Ref No: 33855BYrpt

Author: Woodie Theunissen

Author's Company/Organisation: JK Geotechnics Pty Ltd

Please mark appropriate box

☒ Comprehensive site mapping conducted ____11 February 2021_____
(date)

☒ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:250 (as appropriate)

☒ Subsurface investigation required

- ☒ No Justification …Bedrock exposed across site and adjoining properties
- ☐ 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~~ *recommendations presented in the Report are adopted.*

☒ Design Life Adopted:

- ☒ 100 years
- ☐ Other ……..
  specify

☒ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified

☒ Additional action to remove risk where reasonable and practical have been identified and included in the report.

☐ Risk assessment within Bushfire Asset Protection Zone.

~~I am~~ *We are* aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ~~ensuring~~ *confirming* 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 *as discussed in the Report*.

Signature …  …

Name …Woodie Theunissen……..……..

Chartered Professional Status……CPEng……

Membership No. ……889807……..

Company JK Geotechnics Pty Ltd.

REPORT TO

SUSAN ROTHWELL ARCHITECTS PTY LTD

ON

GEOTECHNICAL ASSESSMENT
(In Accordance with Pittwater Council Risk Management Policy)

FOR

PROPOSED HOUSE

AT

40 SUNRISE ROAD, PALM BEACH, NSW

Date: 13 March 2023
Ref: 33855BYrptrev1

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Report prepared by:

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For and on behalf of
JK GEOTECHNICS
PO BOX 976
NORTH RYDE BC NSW 1670

DOCUMENT REVISION RECORD

Report Reference	Report Status	Report Date
33855BYrpt	Final Report	18 February 2020
33855BYrptrev	Revised Report	2 February 2022
33855BYrptrev1	Revised Report	13 March 2023

Table of Contents

1 INTRODUCTION

This report presents the results of our geotechnical assessment of the site at 40 Sunrise Road, Palm Beach, NSW. The location of the site is shown in Figure 1. The assessment was commissioned by Mr Alan Kempster on behalf of Susan Rothwell Architects Pty Ltd and was completed in accordance with our proposal (Ref P53212Y) dated 7 December 2020. The site was inspected by our Principal Associate, Mr Woodie Theunissen on 11 February 2021, in order to assess the existing stability of the site and the effect on stability of the proposed development.

Reference to the drawings prepared by Susan Rothwell Architects Pty Ltd (Project SRSP, Drawing No's: DA100 to DA110, Issue D, E, E, E, D, E, E, D, E, D and D respectively, Dated 13 March 2023) indicate that the proposed residence will comprise a three-storey house, pool and spa. The house will be cut into the hillside at the southern end and will result in cuts to maximum depths of about 3m. The pool, spa and a grassed terrace area will adjoin the rear of the house and will be raised above existing ground levels. Consequently, only minor excavation will be necessary for construction of the pool and spa. Placement of fill will be required at the front of the house to achieve the required levels for the driveway, terrace and front yard, although this is anticipated to be limited to no more than of about 1m.

We have also been supplied with the hydraulic drawings prepared by ACOR Consultants (Project No: NSW202638, Drawing No: C1.01, C1.02, C1.05, C1.06, C1.07, C3.01, C3.10 and C5.01, dated 7 June 2021). These drawings indicate that collected stormwater will be piped downslope and off site at Barrenjoey Road.

This report has been prepared in accordance with the requirements of the Geotechnical Risk Management Policy for Pittwater (2009) as discussed in Section 5 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

2.1 Walkover Survey

This stability assessment is based upon 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. The attached Appendix A defines the terminology adopted for the risk assessment together with a flowchart illustrating the Risk Management Process based on the guidelines given in AGS 2007c (Reference 1).

A summary of our observations is presented in Section 3 below. Our specific recommendations regarding the proposed development are discussed in Section 6 following our geotechnical assessment.

The attached Figure 2 presents a geotechnical sketch plan showing the principal geotechnical features present at the site. Figure 2 is based on the survey plan prepared by Higgins Surveyors (Ref 42136, dated 30 May 2016). Additional features on Figure 2 have been measured by hand held inclinometer and tape measure techniques and hence are only approximate. Should any of the features be critical to the proposed development, we recommend they be located more accurately using instrument survey techniques. Figures 3 and 4 present typical cross-sections through the site based on the survey data augmented by our mapping observations. Figure 4 defines the mapping symbols used.

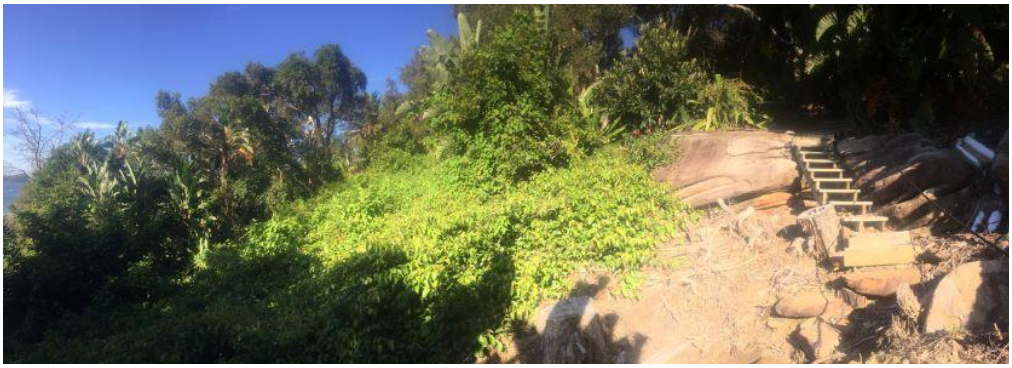
3 SUMMARY OF OBSERVATIONS

We recommend that the summary of observations which follows be read in conjunction with the attached Figure 2.

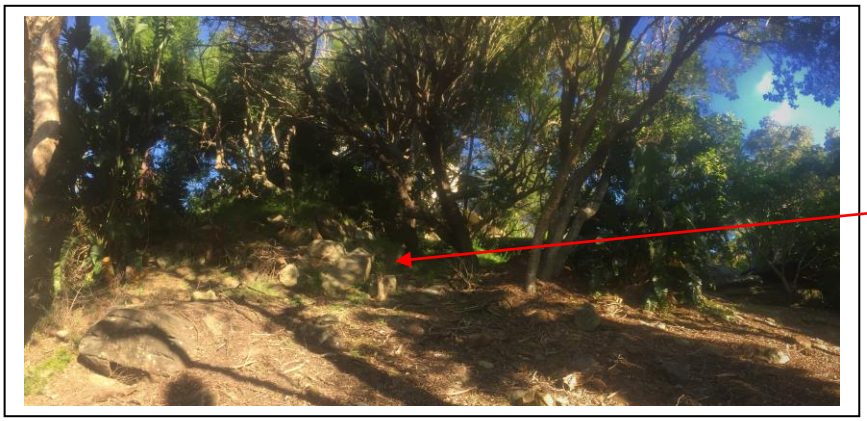
The site is located at the most northern end of the ridgeline that defines the Palm Beach peninsula and was formed as a result of the downcutting of the sandstone plateau during the formation of Pittwater. The site is located on the upper reaches of a north-western slope that drops down at an average of about 20^{o} through a series of low height sandstone cliff lines and sloping ground. Site slopes vary from about 15^{o} to 25^{o}.

The site is currently unoccupied with the exception of demolition rubble comprising sandstone blocks that have been left in the south-western corner of the site. With the exception of approximately the rear third of the site, which was heavily overgrown and in accessible, the remainder of the site has been cleared of undergrowth. Mature trees are scattered throughout the site and vary in height up to about 10m to 12m. These trees display no signs of basal curvature of the trunk.

Where present sandstone outcrops are a maximum of about 2.7m in height and were assessed to be of at least medium to high strength. There appears to be two low height sandstone cliff lines that run diagonally across the site and are located approximately one-third of the way in from either ends of the site. While the upper cliff line could easily be observed and was undercut in places, the lower cliff line was heavily overgrown, inaccessible and could not be viewed, as can be seen in the photo below. Where undercut in the upper cliff line, the overhanging bedrock cantilevered by up to about 1.8m.



Approximately one third of the way down the eastern site boundary is what appears to be a rough sandstone boulder wall that appears to have been constructed to provide a level area to the rear of the house on the adjoining property to the east, 38 Sunset Road. This wall has a maximum height of about 2.5m and is raked back at about 45° to 50°. This wall extends into the site and does not appear to show signs of distress. This is shown in the photo below.



The site is bound by a two-storey masonry house to the east and a four-storey masonry house to the west. Both adjoining houses appeared to be in good condition when viewed from the site. The adjoining eastern and western properties had similar landforms to that of the subject site. To the south is Sunrise Road while to the north the land is overgrown and continues to slope down to the property to the north.

4 SUBSURFACE CONDITIONS

Reference to the 1:100,00 Geology Sheet of Sydney indicates that the site is underlain by sandstone bedrock. Sandstone bedrock can be seen outcropping throughout the site and, where visible, was assessed to be of at least medium to high strength. Where soil cover is present, we anticipate that it will be fairly shallow (i.e. no greater than about 1.5m) and will predominantly comprise sandy clay or clayey sand.

5 GEOTECHNICAL ASSESSMENT

5.1 Potential Landslide Hazards

We consider that the potential landslide hazards associated with the site to be the following:

A Stability of hillside slope:

i. Upslope of the proposed house,

ii. Beneath the proposed house,

iii. Downslope of the proposed house,

B Stability of the existing low height cliff lines beneath the proposed house,

C Stability of the existing boulder retaining wall located approximately one third of the way down the eastern site boundary, and

D Stability of proposed retaining walls:

i. Supporting the excavation for the main house,

ii. Landscaped walls supporting proposed driveway and front yard.

These potential hazards are indicated in schematic form on the attached Figures 2 and 3.

5.2 Risk Analysis

The attached Table A summarises our qualitative assessment of each potential landslide hazard and of the consequences to property should the landslide hazard occur. Use has been made of data in MacGregor *et al* (2007) to assist with our assessment of the likelihood of a potential hazard occurring. Based on the above, the qualitative risks to property have been determined. The terminology adopted for this qualitative assessment is in accordance with Table A1 given in Appendix A. Table A indicates that the assessed risk to property be "Very Low", which would be considered 'acceptable' in accordance with the criteria given in Reference 1 and the Pittwater Council Risk Management Policy.

We have also used the indicative probabilities associated with the assessed likelihood of instability to calculate the risk to life for the person most at risk. The temporal and vulnerability factors that have been adopted are given in the attached Table B together with the resulting risk calculation. Our assessed risk to life for the person most at risk is about 8×10^{-7}. This would be considered to be 'acceptable' in relation to the criteria given in Reference 1 and the Pittwater Council Risk Management Policy.

5.3 Risk Assessment

The Pittwater Risk Management Policy requires suitable measures 'to remove risk'. It is recognised that, due to the many complex factors that can affect a site, the subjective nature of a risk analysis, and the imprecise nature of the science of geotechnical engineering, the risk of instability for a site and/or development cannot be completely removed. It is, however, essential that risk be reduced to at least that which could be reasonably anticipated by the community in everyday life and that landowners are made aware of reasonable and practical measures available to reduce risk as far as possible. Hence, where the policy requires that 'reasonable and practical measures have been identified to remove risk', it means that there has been an active process of reducing risk, but it does not require the geotechnical engineer to warrant that risk has been completely removed, only reduced, as removing risk is not currently scientifically achievable.

Similarly, the Pittwater Risk Management Policy requires that the design project life be taken as 100 years unless otherwise justified by the applicant. This requirement provides the context within which the geotechnical risk assessment should be made. The required 100 years baseline broadly reflects the expectations of the community for the anticipated life of a residential structure and hence the timeframe to be considered when undertaking the geotechnical risk assessment and making recommendations as to the appropriateness of a development, and its design and remedial measures that should be taken to control

risk. It is recognised that in a 100 year period external factors that cannot reasonably be foreseen may affect the geotechnical risks associated with a site. Hence, the Policy does not seek the geotechnical engineer to warrant the development for a 100 year period, rather to provide a professional opinion that foreseeable geotechnical risks to which the development may be subjected in that timeframe have been reasonably considered.

Our assessment of the probability of failure of existing structural elements such as retaining walls (where applicable) is based upon a visual appraisal of their type and condition at the time of our inspection. Where existing structural elements such as retaining walls will not be replaced as part of the proposed development, where appropriate we identify the time period at which reassessment of their longevity seems warranted.
In preparing our recommendations given below we have adopted the above interpretations of the Risk Management Policy requirements. We have also assumed that no activities on surrounding land which may affect the risk on the subject site would be carried out. We have further assumed that all Council's buried services are, and will be regularly maintained to remain, in good condition.

We consider that our risk analysis has shown that the site and existing and proposed development can achieve the 'Acceptable Risk Management' criteria in the Pittwater Risk Management Policy provided that the recommendations given in Section 6 below are adopted. These recommendations form an integral part of the Landslide Risk Management Process.

6 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.

6.1 Conditions Recommended to Establish the Design Parameters

6.1.1 All proposed footings must be founded in sandstone bedrock. The footings should be designed for an allowable bearing pressure of 600kPa, subject to inspection by a geotechnical engineer prior to pouring. Care must be taken that footings are not founded on undercut sections of the existing cliff beneath the house. Removal of the overhanging rock or underpinning would be required where this occurs.

6.1.2 Continuous vibration monitoring must be carried out during rock excavations. The ground vibration measured as peak particle velocity must not exceed 5mm/sec at the eastern and western site boundaries.

6.1.3 Subject to inspection by a geotechnical engineer, temporary batters for the proposed excavation should be no steeper than 1 Vertical (V) in 1.5 Horizontal (H) within the soil profile and extremely weathered rock and vertical in competent rock, provided it is free from adverse defects. An allowance should be made for remedial measures should adverse defects be present. These

measures will likely comprise shotcrete, mesh and bolts. All surcharge and footing loads must be kept well clear of the excavation perimeter.

6.1.4 Whilst it appears that temporary batters can be accommodated within much of the site due to the apparent presence of shallow good quality bedrock, it appears that where the pool is to be sited it will be cut into the upper portion of the sandstone boulder retaining wall located roughly one third of the way down the eastern site boundary. Care will be required to ensure that excavation for the pool does not result in the destabilising of the existing wall. In addition, the presence of the boulder wall and fill behind it may make the installation of piles to bedrock difficult.

6.1.5 Where the required batters cannot be accommodated within the site geometry, or where not preferred, a retention system would be required and should be installed prior to excavation commencing. We anticipate that the retention system may comprise a cantilevered soldier pile wall with reinforced shotcrete infill panels, although where the soils are sandy a contiguous pile wall will be required. While not expected to be the case, in the initial stages of construction the soil conditions across the site must be determined so that the most appropriate retention system may be adopted. The infill panels must be progressively installed as excavation proceeds (ie. at maximum 1.8m depth intervals). Design parameters for cantilevered walls are provided in Section 6.1.7 below.

6.1.6 The surface water discharging from the new roof and paved areas must be diverted to outlets for controlled discharge to Council's stormwater system.

6.1.7 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.
- A bulk unit weight of 20kN/m^3 should be adopted for the soil profile.
- Any surcharge affecting the walls (e.g. 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 (e.g. 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. The upper 0.5m of any key formed in the bedrock must be ignored when calculating the required key depth.

6.1.8 It is difficult to successfully place engineered fill on a small scale and consequently, we recommend that all slabs be designed as fully suspended. Where it is decided not to suspend all slabs prior to the placement of engineered fill or slabs on grade we recommend that all topsoil and root affected soils be first stripped from site. The exposed subgrade should then be proof rolled with a minimum of six passes of five tonne (static weight) smooth drum roller. The final pass should be completed in the presence of an experienced geotechnical engineer or geotechnician. Where engineered fill is to be placed it should be free from organic or otherwise deleterious materials, should have a maximum particle size of no greater than 70mm and should ideally comprise a ripped sandstone or similar. Engineered fill should generally be placed in loose layers not exceeding 150mm thickness,

although layer thickness may be varied provided the full layer thickness is compacted to within the required specification. Where engineered fill will be used to support structures it must be compacted to between 98% and 102% of Standard Maximum Dry Density (SMDD). Where it is used in areas of soft landscaping this specification may be relaxed to 95% to 102% of SMDD. In both instances it should be placed within 2% of Standard Optimum Moisture Content (SOMC).

6.1.9 The guidelines for Hillside Construction given in Appendix B should also be adopted.

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

6.2.1 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.

6.2.2 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.

6.2.3 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.

6.2.4 Dilapidation surveys must be carried out on the neighbouring buildings and structures to the east and west. A copy of the dilapidation report must be provided to the neighbours and Council or the Principle Certifying Authority.

6.2.5 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.

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

6.3 Conditions Recommended During the Construction Period

6.3.1 The geotechnical engineer must be on site during the initial stages of construction during the excavation of test pits across the site to confirm the depth to bedrock and whether retaining walls must be installed prior to the commencement of excavation or whether temporary batters may be adopted.

6.3.2 The geotechnical engineer must inspect all footing excavations prior to placing reinforcement or pouring the concrete. Careful inspection of footings located close to the existing cliff must be carried out and removal of overhanging portions of the cliff or underpinning may be required at some locations.

6.3.3 The approved excavation/retention methodology must be followed.

6.3.4 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. Similarly, where existing sandstone cliffs are to remain these must be inspected by a geotechnical engineer during construction and any support required installed.

6.3.5 Construction of the stormwater system for discharge at Barrenjoey Road will require excavation through neighbouring properties to the west of the site. This will result in the excavation of a trench, installation of pipes and pits and backfilling. Excavation of the trench must be in accordance with the recommendations provided above in Section 6.1.3. Where temporary batters cannot be accommodated, trench boxes or temporary shoring will be necessary to allow the safe installation of the stormwater system. Backfilling of the trench should be completed in accordance with Sections 6.1.8 and 6.3.6.

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

6.3.7 Compaction density of the backfill material that will support structures must be checked by a NATA registered laboratory to least Level 1. Where the fill will support soft landscaped areas the level of control may be reduced to Level 2. All testing must be completed in accordance with, and to the frequency outlined in, AS3798, and the results submitted to the geotechnical engineer for review.

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

6.3.9 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).

6.3.10 The geotechnical engineer must confirm that the house has been constructed 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.

6.4 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:

6.4.1 All proposed surface (including roof) and subsurface drains must be subject to ongoing and regular maintenance by the property owners. In addition, such maintenance must also be carried out by a plumber at no more than ten yearly intervals; including provision of a written report confirming scope of work completed (with reference to the 'as-built' drawing) and identifying any required remedial measures.

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

6.4.3 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.

7 OVERVIEW

Provided the comments and recommendations above are followed, we consider that the site poses an acceptable risk to both life and property for the proposed house.

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.

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.