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REPORT ON GEOTECHNICAL ASSESSMENT

for

PROPOSED NEW APARTMENTS

at

30 DIGGINGS TERRACE, THREDBO
'BLACK BEAR INN'

Prepared For

Hidali Pty Ltd

Project No.: 2019-121
August, 2019

Document Revision Record

Issue No	Date	Details of Revisions
0	7th August 2019	Original issue

NSW GOVERNMENT | Planning & Environment

Geotechnical Policy
Kosciuszko Alpine Resorts

Form 1 – Declaration and certification made by geotechnical engineer or engineering geologist in a geotechnical report.

DA Number: ____________________

To be submitted with a development application

You can use Form 1 to verify that the author of a geotechnical report is a geotechnical engineer or engineering geologist as defined by the Department of Planning & Environment (DP&E) Geotechnical Policy. Alternatively, where a geotechnical report has been prepared by a professional person not recognised by DP&E Geotechnical Policy, then Form 1 may be used as technical verification of the geotechnical report if signed by a geotechnical engineer or engineering geologist as defined by the DP&E Geotechnical Policy.

Please contact the Alpine Resorts Team in Jindabyne for further information - phone 02 6456 1733.

To complete this form, please place a cross in the appropriate boxes ☐ and complete all sections.

1. Declaration made by geotechnical engineer or engineering geologist as part of a geotechnical report

I,

Mr ☑ Ms ☐ Mrs ☐ Dr ☐ Other ☐

First Name: TROY
Family Name: CROZIER

OF

Company/organisation: CROZIER GEOTECHNICAL CONSULTANTS

on this the 7th day of August 2019

certify that I am a geotechnical engineer or engineering geologist as defined by the "Policy" and I (tick appropriate box)

☑ prepared the geotechnical report referenced below in accordance with the AGS 2000 and DP&E Geotechnical Policy – Kosciuszko Alpine Resorts.

☐ am willing to technically verify that the Geotechnical Report referenced below has been prepared in accordance the AGS 2000 and DP&E Geotechnical Policy – Kosciuszko Alpine Resorts.

2. Geotechnical Report Details

Report Title: Geotechnical Assessment for Proposed New Apartments

Author: T. Crozier

Dated: 7th Aug 2019

DA Site Address: 30 Diggings Terrace, Thredbo "Black Bear Inn"

DA Applicant: Hidali Pty Ltd

I am aware that the Geotechnical Report I have either prepared or am technically verifying, (referenced above) is to be submitted in support of a development application for the proposed development site (referenced above), and it's findings will be relied upon by the Consent Authority in determining the development application.

3. Checklist of essential requirements to be contained in a geotechnical risk assessment report to be submitted with a development application

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Report. This checklist is to accompany the report.

Please tick appropriate box

- ☑ Risk assessment of all identifiable geotechnical hazards in accordance with AGS 2000, as per 6.1 (a) of the policy.
- ☑ Site plans with key hazards identified and other information as per 6.1 (b)
- ☑ Details of site investigation and inspections as per 6.1 (c)
- ☑ Photographs and/or drawings of the site as per 6.1 (d)
- ☑ Presentation of geotechnical model as per 6.1 (e)
- ☑ A specific conclusion as to whether the site is suitable for the development proposed on the above site, if applicable, subject to the following conditions;
  - ☑ Conditions to be provided to establish design parameters,
  - ☑ Conditions to be incorporated into the detailed design to be submitted for the construction certificate,
  - ☑ Conditions applying to the construction phase,
  - ☑ Conditions relating to ongoing management of the site/structure.

4. Signatures

Signature	Chartered professional status
T Gi	MAIG. RPGeo: N. 10197
Name	**Date**
Troy Crozier	7th Aug 2019

5. Contact details

Department of Planning & Environment
Alpine Resorts Team
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CROZIER
GEOTECHNICAL CONSULTANTS

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CROZIER GEOTECHNICAL CONSULTANTS

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Date: 7th August 2019
Project No: 2019-121

GEOTECHNICAL ASSESSMENT FOR PROPOSED NEW APARTMENTS
'BLACK BEAR' 30 DIGGINGS TERRACE, THREDBO, NSW

1. INTRODUCTION:

This report details the results of a geotechnical assessment carried out as part of a Development Application (DA) for a proposed new apartment building óBlack Bearô at 30 Diggings Terrace, Thredbo, NSW. The assessment was undertaken by Crozier Geotechnical Consultants (CGC) at the request of the client Hidali Pty Ltd.

It is understood that the existing óBlack Bear Innô structure will be demolished and new seven level apartment and restaurant structure built within a similar footprint.

The site is located within an area designated óGô within the Geotechnical Policy - Kosciuszko Alpine Resorts maps therefore a geotechnical report which meets the requirements of Section 4.0 of the Policy is required for submission with the DA. This report therefore includes a detailed description of the field work completed by others for a previous DA on the site, and by CGC in relation to this site and an adjacent development. It also includes a geotechnical assessment and landslide risk assessment and provides recommendations for construction to maintain an óAcceptableô risk level as defined by the Australian Geomechanics Society ï Guidelines for Landslide Risk Management. 2007.

The following plans, diagrams and documents were supplied for this work;

- Architectural Design Drawings by Popov Bass, Drawing No.: DA 000 to DA 020, Revision: 02, Dated: 19th August 2019.
- Site Survey Plan by Peter W Burns, Reference: 3576, Drawing No.: CD01, Revision: C, Dated: 24/09/2007.
- Geotechnical Report by Coffey Geotechnics, Reference No.: GEOTLCOV23158AA-AB, Revision: 1, Dated: 14th May 2007.

2. PROPOSED DEVELOPMENT:

It is understood that the new development involves demolition of the existing structure and construction of a new seven level apartment and restaurant building within a similar footprint. The lowest level (Level 00) is designed with a Finished Floor Level (FFL) at R.L. 1380.60 and therefore requires an excavation of up to 8.0m depth to achieve a Base Excavation Level (BEL) of approximately R.L. 1380 at the south-east corner. The natural ground surface fall to the south-west results in the excavation reducing to nil at the north-west corner of Level 00.

Both Level 00 and Level 1 have a similar footprint and are located approximately 2.70m from the western property boundary (No. 98 óSashasô), approximately 6.50m from the southern boundary to Diggings Terrace, >2.60m from the northern boundary and 7.50m from the eastern property boundary (No. 5 óCandlelight Lodgeô). However, Level 1 extends to the east for a gym, which is located 2.60m off the eastern boundary, with excavation up to 3.00m depth.

Level 2 occupies a larger footprint and includes a driveway access that extends along part of the western side boundary. The excavation for this level is up to 3.50m depth at the south-east corner, reducing to nil across the entire north-western two-thirds of the development due to the hill slope. The excavation is 4.73m to 6.50m from the Diggings Terrace boundary, 2.60m from the eastern boundary and 4.14m from the south-east corner boundary.

Level 3 requires an excavation of up to 1.5m depth at the south-east corner only with all other levels/areas located above ground surface levels and requiring no bulk excavation.

3. SITE FEATURES:

3.1. Description:

The site is a rectangular shaped block located on the low north side of Diggings Terrace within moderately north-west dipping topography close to the base of the Thredbo Village hill slope. It contains a four level lodge and restaurant of masonry and timber construction on the front southern half with open grassed land including several low retaining walls on the northern side. The southern side of the lower level appears partly excavated into the hill slope whilst the rear northern side is raised up to 1.50m above ground at the north-west corner. The lower level appears supported on fill soils retained by a mortared rock retaining wall that appears to form part of the buildings footing system.

The site falls from an approximate high of R.L. 1392.0 in the south-east corner to a low of approximately R.L. 1379.5 in the north-west corner. The site has a stepped front south boundary of 26.295m and side west boundary of 27.88m in length, as referenced from the provided survey plan.

An aerial photograph of the site and its surrounds is provided below, as sourced from NSW Government Six Map spatial data, as Photograph 1.

Photograph: 1 ï site and surrounding properties

4. FIELD WORK:

4.1. Methods:

A field investigation was undertaken by Coffey Geotechnics in June 2000 and comprised the drilling of two boreholes up to 4.40m depth at the front southern side of the existing lodge building. Another investigation was undertaken in June 2003 and comprised extension of the previous Borehole 1 to a total of 11.40m depth along with installation of a groundwater monitoring well/piezometer and measurement of water levels. A geological model/section showing identified geological conditions, as prepared by Coffey Geotechnics, with the proposed excavation outline is supplied in Appendix: 2.

A walk over inspection of the site and inspection of adjacent properties was undertaken by a Principal Engineering Geologist from Crozier Geotechnical Consultants on the 21st May 2019.

Inspections were also undertaken by the Principal Engineering Geologist during excavation and construction works in 2017 to 2019 for the nearby Mittabah Lodge, located approximately 50m to the south-east at No. 716 Bobuck Lane.

4.2. Field Observations:

The existing ôBlack Bear Innô building is at least 50 years of age and is formed of masonry and timber construction that appears supported off mortared rock footing walls at shallow depth around the perimeter. This footing wall increases to approximately 1.50m in height at the north-west corner of the building. An opening within the footing wall, created for previous service line repairs on the northern side, indicates that the sub-floor area of the building is in part underlain by fill soils placed to form a level pad for construction that is retained by the rock footing walls. The existing building shows deterioration due to age and some minor cracking at the front southern side due to what is understood to be infill/repair of a concrete tank, and the western side due to footing settlement, however there are no indications of significant slope movement.

The neighbouring property to the east No. 5 ôCandelight Lodgeô contains a three level masonry and timber development on the front half of the block located within approximately 1.0m off the eastern boundary of the site. A concrete driveway provides access to the south-west corner of this property at lower floor level, past the south-east corner of the site. This driveway is retained along the boundary by an approximately 1.5m high sloped rock retaining wall, see Photograph: 2. The building structure appears of similar age to the existing ôBlack Bear Innô building and appears formed above ground surface levels. There were no indications on external walls of any foundation/footing movement adjacent to the site.

The neighbouring property to the west (No. 98 ôSashasô) contains a three level masonry development located 1.5m to 2.0m from the western boundary of the site. The building structure appears of similar age to the existing ôBlack Bear Innô building and appears formed above ground surface levels. There were no indications on external walls of any foundation/footing movement adjacent to the site.

Diggings Terrace is a bitumen paved road with moderate west dip and no kerb or gutter formed adjacent to the site or adjacent properties. Inspection of the road pavement did not identify any signs of excess cracking or deformation to indicate slope movement.

The neighbouring property upslope (No. 12 Banjo Driveway) is retained above the road pavement of Diggings Terrace by a low (<1.0m) rock retaining wall with moderate sloping lawn areas extending up to a two storey timber lodge building supported on its northern side above ground surface by a mortared rock footing wall. There were no indications on external walls of any foundation/footing movement adjacent to the site.

Photograph: 2 – South-east corner of site showing neighbouring (No. 5) driveway and retention.

5. COMMENTS:

5.1. Geotechnical Assessment:

The site investigations and inspections identified no signs of recent landslip instability within the site or adjacent properties with no indications of excess surface stormwater flow or groundwater seepage identified.

The borehole drilled by Coffey Geotechnics, along with the inspection results from the Mittabah excavation, indicate that granular fill soils may extend up to 1.50m depth on this site, where previous development has occurred, and overlie silty sand with trace of gravel that grades to weathered granodiorite around 2.50m depth. The granodiorite will be encountered as medium to high strength boulders/core stones of variable sizes surrounded by extremely weathered material. The concentration of hard core stones is expected to increase with depth resulting in dominantly medium to high strength rock below approximately 5.0m however it may also be highly variable.

A standing groundwater table was interpreted by Coffey at 9.77m depth (R.L. 1380.3) based on the piezometer installed within BH 1 and other instruments they indicate were installed within the local area. A moderate (10L/min) level of groundwater seepage was encountered in the base of the excavation, below approximately 7.0m depth during the construction of the Mittabah Apartments. However, this seepage was isolated to one portion of the excavation only with all other areas above and to 8.50m depth encountering no seepage flow. The proposed excavation is therefore likely to encounter moderate levels of seepage in the lower portions however it should not intersect a standing groundwater table.

The proposed development involves an excavation of significant depth (8.0m) however a similar excavation was recently completed in an adjacent property without inducing landslip instability or creating detrimental impact to adjacent properties/structures. The proposed excavation will generally be located 6.50m from the Diggings Terrace boundary and pavement whilst the deepest portion of the excavation will also be located 8.50m from the neighbouring structure upslope to the east (No. 5).

The excavation for the Mittabah development was undertaken as a staged excavation and support (reinforced shotcrete and anchors) system without incident. This system involved 1.50 to 2.0m depth cut intervals supported by an anchored shotcrete wall prior to the next phase of excavation. It dealt with the seepage inflow via installation of sub-horizontal drainage pipes in the lower portion of the excavation and a similar system could be implemented during the site works from near the excavation base.

An alternative could involve construction of a bored pile support wall, however the high strength of core stones must be considered when selecting the piling equipment as these may prove difficult and costly to drill through to achieve the required embedment/foundation depths.

The proposed works are considered suitable for the site and may be completed with negligible impact to existing nearby structures within the site or neighbouring properties provided the recommendations of this report are implemented in the design and construction phases.

5.2. Slope Stability & Risk Assessment:

Based on the investigation/inspections we have identified the following credible geological/geotechnical landslip hazard which needs to be considered in relation to the proposed works. The hazard is:

A. Landslip (earth slide Ò5m^3) of soils/weathered rock from excavation for Level 2
B. Landslip (earth slide 10 - 15m^3) of soils/weathered rock from deeper excavation Level 00 to Level 2

A qualitative assessment of risk to life and property related to these hazards is presented in Table: A and B, Appendix: 3, and is based on methods outlined in Appendix: C of the Australian Geomechanics Society (AGS) Guidelines for Landslide Risk Management 2007. AGS terms and their descriptions are provided in Appendix: 4.

Hazard A was estimated to have a **Risk to Life** of up to **3.91 x 10^{-8} for persons,** while the **Risk to Property** was considered to be **'Very Low'**.

Hazard B was estimated to have a **Risk to Life** of up to **5.86 x 10^{-6} for persons,** while the **Risk to Property** was considered to be **'Low'**.

The hazards were assessed for instability during site works and were considered to be within the őTolerableô risk levels of the AGS 2007 guidelines. Provided permanent support systems, including engineered footings, are completed then the Likelihood of instability occurring over a design life of 50 years is further reduced and as such following completion of the development Risk to Life and Risk to Property values will continue to remain well within the őTolerableô criteria. Therefore, the project is considered suitable for the site provided the recommendations of this report are implemented.

5.3. Design & Construction Recommendations:

Design and the construction recommendations are tabulated below:

5.3.1. New Footings:	
Site Classification as per AS2870 ï 2011 for new footing design	Class ćAô for footings into weathered bedrock at base of excavation, non-reactive granular soils
Type of Footing	Shallow strip/pad at base of excavation potential requirement for piles or deep pad footing excavations to north-west due to ground surface fall and excavation reduction
Sub-grade material and Maximum Allowable Bearing Capacity	Weathered, Bedrock: 500kPa*
Site sub-soil classification as per *Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia*	B_e ï Rock Site
Remarks: *requires inspection/confirmation by geotechnical engineer/engineering geologist in each and every footing All new footings must be inspected by an experienced geotechnical professional before concrete or steel	

are placed to verify the bearing capacities and stability. This is mandatory to allow them to be ćertifiedô at the end of the project.

5.3.2. Excavation:	
Depth of Excavation	Level 2 excavation up to 3.50m depth Level 00 ï 1 ï 2 excavation up to 8.0m depth.
Type of Material to be Excavated	Granular Fill to Č1.50m depth
	Silty sand with gravel to Ò2.50m depth
	ELS bedrock with HS core stones to base of excavation

Guidelines for <u>un-surcharged</u> batter slopes for general information are tabulated below:

Material	Recommended Safe Batter Slope (H:V)	
	Short Term/Temporary	Long Term/Permanent
Fill and granular soils	1.5:1	2:1
ELS with HS*	0.5:1.0	1.5:1

Remarks:
*The ELS bedrock with HS core stones may be excavated at sub-vertical batter slopes with short term stability where by seepage is not encountered, however the stability for small scale (<2m³) failures in this situation cannot be guaranteed.

Seepage through the soils and weathered bedrock is expected, mainly in the lower portions of the excavation, and will reduce the stability of batter slopes. This may invoke the need to implement additional (temporary) support measures. Where the recommended safe batter slopes are not implemented the stability of any excavation cannot be guaranteed until the installation of permanent support measures. This should also be considered with respect to safe working conditions.

Geotechnical inspection of batters and excavation faces prior to support installation will be required at regular intervals to assess their stability and site conditions, especially for permanent batters.

Equipment for Excavation	Soils and ELS	Excavator with Bucket
	VLS bedrock	Bucket and ripper
	LS ï HS	Rock hammer

ELS ï extremely low strength, VLS ï very low strength, LS ï low strength, MS ï medium strength

Recommended Vibration Limits (Maximum Peak Particle Velocity (PPV))	5mm/s for all structures
Vibration Assessment Required	Only if large (>250kg) rock excavation equipment required within 5.0m lateral/vertical distance of any building footings

Full time vibration Monitoring Required	Unlikely
Geotechnical Inspection Requirement	Yes, as per Section 4.4
Dilapidation Surveys Requirement	Recommended on building structures or part thereof within 8m of excavation perimeter

Remarks:

Water ingress into exposed excavations can result in erosion and stability concerns in both soils and weathered bedrock. Drainage measures will need to be in place during excavation works to divert any surface flow away from the excavation crest and any batter slope, whilst any groundwater seepage must be controlled within the excavation and prevented from ponding or saturating slopes/batters.

5.3.3. Retaining Structures:

Required	New retaining structures are be required as part of the proposed development to support the excavation perimeters.
Types	Reinforced bored soldier pile support wall prior to bulk excavation or anchored shotcrete wall in stages <3.0m in height. Steel reinforced concrete/concrete block walls post excavation, where temporary batters can be maintained. All designed to Australian Standards AS4678-2002 Earth Retaining Structures.

Parameters for calculating pressures (unsurcharged) acting on retaining walls for the materials likely to be encountered:

Material	**Unit Weight (kN/m3)**	**Long Term (Drained)**	**Earth Pressure Coefficients**		**Passive Earth Pressure/ Coefficient**
			Active (Ka)	At Rest (K_0)	
Soils	18	$\phi' = 30°$	0.40	0.55	N/A
ELS bedrock with HS corestones	23	$\phi' = 38°$	0.25	0.30	200 kPa

Remarks:

In suggesting these parameters it is assumed that the retaining walls will be fully drained with suitable subsoil drains provided at the rear of the walls to release seepage. If this is not done, then the walls should be designed to support hydrostatic pressures in addition to pressures due to the soil/backfill. It is suggested that back fill for retaining walls be free-draining granular material (preferably not recycled concrete) which is only lightly compacted in order to minimize horizontal stresses. Weathered bedrock from the site is considered suitable.

Retaining structures near site boundaries or existing structures should be designed with the use of at rest (K_0) earth pressure coefficients to reduce the risk of movement in the excavation support and resulting surface movement in adjoining areas. Backfilled retaining walls within the site, away from site boundaries or existing structures, that may deflect can utilize active earth pressure coefficients (Ka).
It is considered that a triangular pressure distribution will exist for the excavation support however where negligible lateral deflection is maintained in the upper portions of a staged/anchored retention system then rectangular distribution (5H) is expected in at least the short term.
For anchors drilled into weathered bedrock to approximately 5.0m depth below surface a grout/rock bond stress of 100kPa is considered suitable, however below 5.0m depth the concentration of MS ï HS rock is expected to increase therefore a grout/rock bond stress of 200kPa is considered suitable in this material. However, anchors should be stress tested to the relevant standards and it is recommended that a minimum of 3 anchors be tested to failure within the full height of the excavation to allow assessment of grout/rock adhesion values.

5.3.4. Drainage and Hydrogeology		
Groundwater Table or Seepage identified in Investigation		No
Excavation likely to intersect	Water Table	No
	Seepage	Moderate in deeper levels (10L/min), within potential isolated
Site Location and Topography		Moderate sloping topography, low north side of road
Impact of development on local hydrogeology		Negligible
Onsite Stormwater Disposal		Not suitable.
Remarks: The excavation faces are expected to encounter some seepage especially at depth, therefore a system should be installed at the base of excavation cuts to below floor slab levels to reduce the risk of resulting dampness issues. Trenches, as well as all new building gutters, down pipes and stormwater intercept trenches should be connected to a stormwater system designed by a Hydraulic Engineer which discharges to the Councilôs stormwater system off site.		

5.4. Conditions Relating to Design and Construction Monitoring:

To allow certification as part of construction, building and post-construction activity for this project, it will be necessary for Crozier Geotechnical Consultants to:

1. Review and approve the structural design drawings, for compliance with the recommendations of this report with signing of Form 2 prior Construction Certificate.
2. Inspection of bored excavation soldier piles during installation - if this support method chosen
3. Inspection of initial excavation works and soil nail installation and testing results for upper row of nails, where anchored system is proposed
4. Inspection of benching and site/temporary batter stability where proposed across site
5. Inspect site conditions where any variability to the expected sub-surface conditions is identified during excavation
6. Inspection of lower levels of excavation and anchor installation and testing results
7. Inspection of completed excavation and support systems and seepage control measures
8. Inspect all footings to confirm compliance to design assumptions with respect to allowable bearing pressure and stability prior to the placement of steel or concrete.
9. Inspection of completed works including all retention and groundwater/stormwater control systems for provision of Form 3 for Occupation Certificate.

The client and builder should make themselves familiar with the requirements spelled out in this report for inspections during the construction phase. Crozier Geotechnical Consultants cannot provide certification (Form 3) for the Occupation Certificate if it has not been called to site to undertake the required reviews and inspections.

A maintenance program for the life of the development will need to be determined as part of the excavation support/detailed development design prior to the Construction Certificate application and will need to applied to ensure risk levels are as per the estimations of this report.

6. CONCLUSION:

The site inspection and investigations did not identify any signs of previous or impending landslip instability or significant geotechnical hazards within the site or adjacent properties. The proposed works involve an excavation of up to 8.0m depth that will be stepped in part and generally located a significant distance from property boundaries.

An assessment of the risk posed by the proposed excavation indicates that the works can be undertaken within óTolerableô risk levels and that through the implementation of the recommendations of this report and a suitable excavation support system the risk levels will further reduce. Therefor e the site is considered suitable for the proposed development works.

Form 1 of the NSW Government ï Planning and Development, Geotechnical Policy, Kosciusko Alpine Resorts is attached with this report.

Prepared By:

Troy Crozier
Principal
MAIG, RPGeo ï Geotechnical and Engineering
Registration No.: 10197

7. REFERENCES:

1. Australian Geomechanics Society 2007, ñLandslide Risk Assessment and Managementò, Australian Geomechanics Journal Vol. 42, No 1, March 2007.
2. C. W. Fetter 1995, ñApplied Hydrologyò by Prentice Hall. V. Gardiner & R. Dackombe 1983, ñGeomorphological Field Manualò by George Allen & Unwin
3. Australian Standard AS 2870 ï 2011, Residential Slabs and Footings ï Construction
4. Australian Standard AS1170.4 ï 2007, Part 4: Earthquake actions in Australia

Appendix 1

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination.
The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very soft	Less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT “N” Value (blows/300mm)	CPT Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling to allow information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150mm of say 4, 6 and 7
  as 4, 6, 7 then N = 13
- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm then as 15, 30/40mm.

The results of the test can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separte 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected buy electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: -

- Cone resistance – the actual end bearing force divided by the cross-sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

Q_c (MPa) = (0.4 to 0.6) N blows (blows per 300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

Q_c = (12 to 18) C_u

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Dynamic Penetrometers

Dynamic penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.3). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is generally carried out in accordance with Australian Standard 1289 “Methods of Testing Soil for Engineering Purposes”. Details of the test procedure used are given on the individual report forms.

Borehole Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than ‘straight line’ variations between the boreholes.

Details of the type and method of sampling are given in the report and the following sample codes are on the borehole logs where applicable:

D	Disturbed Sample	E	Environmental sample	DT	Diatube
B	Bulk Sample	PP	Pocket Penetrometer Test		
U50	50mm Undisturbed Tube Sample	SPT	Standard Penetration Test		
U63	63mm “ “ “ “ “	C	Core		

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made. More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. A three-storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty-storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

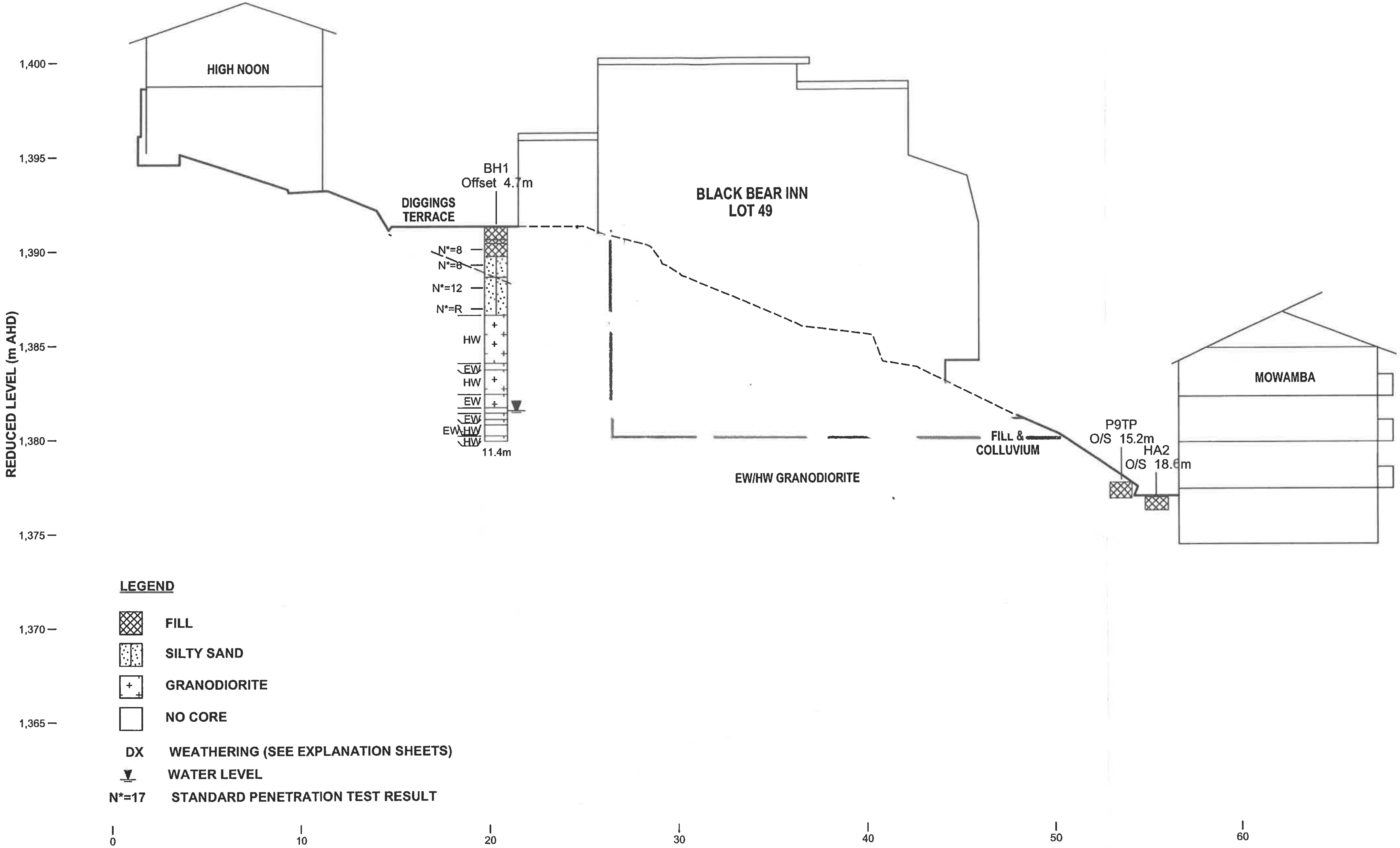
Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a special ally edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix 2



revision	description	drawn	approved	date

Horizontal Scale (metres): 2 0 10

Vertical Scale (metres): 2 0 10

drawn	PM/SW
approved	PM
date	14/5/07
scale	AS SHOWN
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	ALEX POPOV & ASSOCIATES
project:	BLACK BEAR INN LOT 49 - DIGGINGS TERRACE THREDBO ALPINE VILLAGE
title:	GEOTECHNICAL SECTION A-A'
project no:	GEOTLCOV23158AA
figure no:	

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 3

TABLE : A

Landslide risk assessment for Risk to life

HAZARD	Description	Impacting	Likelihood of Slide	Spatial Impact of Slide		Occupancy		Evacuation	Vulnerability	Risk to Life
A	Landslip (earth slide $<5m^3$) from soils from Level 2 excavation		No indications of excess creep movement, surface erosion or groundwater seepage in area at present. Soils and weathered rock expected for full height of excavation which is max. 3.50m depth, significant seepage unlikely	a) Bulk excavation located 6.50m from boundary, rare impact, may impact 20% of road at worst b) Building located 3.60m from ≤ 3.5m deep excavation, unlikely impact, impact <10% at worst c) Driveway located 4.1m from 3.50m deep excavation, unlikely impact, may impact 50% of driveway		a) Person on road, pedestrian 1hrs/day avge. b) Person in bedroom 10hr/day avge. c) Person in vehicle 0.5hrs/day avge.	a) 1 person b) 2 persons c) 2 persons	a) Unlikely to not evacuate b) Likely to not evacuate c) Likely to not evacuate	a) Person on road, not buried b) Person in building, damage only c) Person in vehicle, not buried	
			Unlikely	**Prob. of Impact**	**Impacted**					
		a) Diggings Terrace	0.0001	0.01	0.20	0.0417	1	0.25	0.20	**4.17E-10**
		b) Candelight Lodge building	0.0001	0.25	0.10	0.4167	2	0.75	0.05	**7.81E-08**
		c) Candlelight Lodge - driveway	0.0001	0.25	0.50	0.0208	2	0.75	0.10	**3.91E-08**
B	Landslip (earth/debris slide 10 - $15m^3$) within deep Level 00 - Level 1 - Level 2 excavation		No indications of excess creep movement. Soils and weathered rock expected for full height of excavation of up to 8.0m, groundwater seepage likely in lower portions, full height of excavation not unsupported at any time	a) Bulk excavation located 6.50m from boundary, possible impact, may impact 50% of road at worst b) Building located 8.50m from 8.0m deep excavation, unlikely impact, impact part of 1 bedroom c) Driveway located 6.0m from 8.0m deep excavation, possible impact, may impact 50% of driveway d) Building located 4.2m from 6.0m deep excavation, possible impact, impact most of 1 bedroom		a) Person on road, pedestrian 1hrs/day avge. b) Person in bedroom 10hr/day avge. c) Person in vehicle 0.5hrs/day avge. d) Person in bedroom 10hr/day avge	a) 1 person b) 2 persons c) 2 persons d) 2 persons	a) Unlikely to not evacuate b) Likely to not evacuate c) Likely to not evacuate d) Likely to not evacuate	a) Person on road, buried b) Person in building, damage only c) Person in vehicle, buried d) Person in building, damage, unlikely buried	
			Unlikely	**Prob. of Impact**	**Impacted**					
		a) Diggings Terrace	0.0001	0.50	0.50	0.0417	1	0.25	1.00	**2.60E-07**
		b) Candelight Lodge building	0.0001	0.25	0.10	0.4167	2	0.75	0.10	**1.56E-07**
		c) Candlelight Lodge - driveway	0.0001	0.50	0.50	0.0208	2	0.75	1.00	**7.81E-07**
		d) Sashas Building	0.0001	0.50	0.75	0.4167	2	0.75	0.25	**5.86E-06**

* hazards considered for excavation, prior to completion of staged support system (i.e. staged anchor and shotcrete). Soldier pile support prior to excavation reduces Likelihood further

* staged excavation and support system expected to involve excavations of up to 3.0m depth that are unsupported for up to 7 days at any one time

* assessment is for scale of landslip stated, smaller landslips may have higher Likelihood but will not impact adjacent boundaries or neighbouring structures

* Spatial Impact - Probaility of Impact refers to slide impacting structure/area expressed as a % (i.e. 1.00 = 100% probability of slide impacting area if slide occurs).
Impacted refers to expected % of area/structure damaged if slide impacts (i.e. small, slow earth slide will damage small portion of structure such as one bedroom (say 5%), where as large boulder roll may damage/destroy >50%)

* neighbouring buidlings considered for impact of slide to bedroom unless specified, due to high occupancy and lower potential for evacuation.

* considered for person most at risk, where multiple people occupy area then increased risk levels assessed against ALARP criteria

* for excavation induced landslip then considered for adjacent premises/buildings founded off shallow footings, unless indicated

* evacuation scale from Almost Certain to<u>not</u> evacuate (1.0), Likely (0.75), Possible (0.5), Unlikely (0.25), Rare to not evacuate (0.01). Based on likelihood of person knowing of landslide and completely evacuating area prior to landslide impact.

* vulnerability assessed using Appendix F - AGS Practice Note Guidelines for Landslide Risk Management 2007

TABLE : B

Landslide risk assessment for Risk to Property

HAZARD	Description	Impacting	Likelihood		Consequences		Risk to Property
A	Landslip (earth slide <5m³) from soils from Level 2 excavation	a) Diggings Terrace	Rare	The event is conceivable but only under exceptional circumstances over the design life.	Minor	Limited Damage to part of structure or site requires some stabilisation or INSIGNIFICANT damage to neighbouring properties.	Very Low
		b) Candelight Lodge building	Rare	The event is conceivable but only under exceptional circumstances over the design life.	Minor	Limited Damage to part of structure or site requires some stabilisation or INSIGNIFICANT damage to neighbouring properties.	Very Low
		c) Candlelight Lodge - driveway	Rare	The event is conceivable but only under exceptional circumstances over the design life.	Minor	Limited Damage to part of structure or site requires some stabilisation or INSIGNIFICANT damage to neighbouring properties.	Very Low
B	Landslip (earth/debris slide 10 - 15m³) within deep Level 00 - Level 1 - Level 2 excavation	a) Diggings Terrace	Unlikely	The event might occur under very adverse circumstances over the design life.	Minor	Limited Damage to part of structure or site requires some stabilisation or INSIGNIFICANT damage to neighbouring properties.	Low
		b) Candelight Lodge building	Unlikely	The event might occur under very adverse circumstances over the design life.	Minor	Limited Damage to part of structure or site requires some stabilisation or INSIGNIFICANT damage to neighbouring properties.	Low
		c) Candlelight Lodge - driveway	Unlikely	The event might occur under very adverse circumstances over the design life.	Minor	Limited Damage to part of structure or site requires some stabilisation or INSIGNIFICANT damage to neighbouring properties.	Low
		d) Sashas Building	Unlikely	The event might occur under very adverse circumstances over the design life.	Medium	Moderate damage to some of structure or significant part of site, requires large stabilising works or MINOR damage to neighbouring property.	Low

* hazards considered for unsupported excavation, prior to installation of support system (i.e. staged excavation and support system). Soldier pile support prior to excavation reduces Likelihood further

* qualitative expression of likelihood incorporates both frequency analysis estimate and spatial impact probability estimate as per AGS guidelines.

* qualitative measures of consequences to property assessed per Appendix C in AGS Guidelines for Landslide Risk Management.

* Indicative cost of damage expressed as cost of site development with respect to consequence values: Catastrophic : 200%, Major: 60%, Medium: 20%, Minor: 5%, Insignificant: 0.5%.

Appendix 4

APPENDIX A

DEFINITION OF TERMS

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES WORKING GROUP ON LANDSLIDES, COMMITTEE ON RISK ASSESSMENT

Risk – A measure of the probability and severity of an adverse effect to health, property or the environment. Risk is often estimated by the product of probability x consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form.

Hazard – A condition with the potential for causing an undesirable consequence (*the landslide*). The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material, and the likelihood of their occurrence within a given period of time.

Elements at Risk – Meaning the population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by landslides.

Probability – The likelihood of a specific outcome, measured by the ratio of specific outcomes to the total number of possible outcomes. Probability is expressed as a number between 0 and 1, with 0 indicating an impossible outcome, and 1 indicating that an outcome is certain.

Frequency – A measure of likelihood expressed as the number of occurrences of an event in a given time. See also Likelihood and Probability.

Likelihood – used as a qualitative description of probability or frequency.

Temporal Probability – The probability that the element at risk is in the area affected by the landsliding, at the time of the landslide.

Vulnerability – The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is affected by the landslide.

Consequence – The outcomes or potential outcomes arising from the occurrence of a landslide expressed qualitatively or quantitatively, in terms of loss, disadvantage or gain, damage, injury or loss of life.

Risk Analysis – The use of available information to estimate the risk to individuals or populations, property, or the environment, from hazards. Risk analyses generally contain the following steps: scope definition, hazard identification, and risk estimation.

Risk Estimation – The process used to produce a measure of the level of health, property, or environmental risks being analysed. Risk estimation contains the following steps: frequency analysis, consequence analysis, and their integration.

Risk Evaluation – The stage at which values and judgements enter the decision process, explicitly or implicitly, by including consideration of the importance of the estimated risks and the associated social, environmental, and economic consequences, in order to identify a range of alternatives for managing the risks.

Risk Assessment – The process of risk analysis and risk evaluation.

Risk Control or Risk Treatment – The process of decision making for managing risk, and the implementation, or enforcement of risk mitigation measures and the re-evaluation of its effectiveness from time to time, using the results of risk assessment as one input.

Risk Management – The complete process of risk assessment and risk control (*or risk treatment*).

Individual Risk – The risk of fatality or injury to any identifiable (named) individual who lives within the zone impacted by the landslide; or who follows a particular pattern of life that might subject him or her to the consequences of the landslide.

Societal Risk – The risk of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a landslide causing a number of deaths, injuries, financial, environmental, and other losses.

Acceptable Risk – A risk for which, for the purposes of life or work, we are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable.

Tolerable Risk – A risk that society is willing to live with so as to secure certain net benefits in the confidence that it is being properly controlled, kept under review and further reduced as and when possible.

In some situations risk may be tolerated because the individuals at risk cannot afford to reduce risk even though they recognise it is not properly controlled.

Landslide Intensity – A set of spatially distributed parameters related to the destructive power of a landslide. The parameters may be described quantitatively or qualitatively and may include maximum movement velocity, total displacement, differential displacement, depth of the moving mass, peak discharge per unit width, kinetic energy per unit area.

Note: Reference should also be made to Figure 1 which shows the inter-relationship of many of these terms and the relevant portion of Landslide Risk Management.

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	**Notional Boundary**					
10^{-1}	5×10^{-2}	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	5×10^{-3}	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	5×10^{-4}	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	5×10^{-5}	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	5×10^{-6}	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	**Notional Boundary**			
200%	100%	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%	40%	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%	10%	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%	1%	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 notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) 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.

(3) The Approximate Cost is to be 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 works required to render the site to tolerable risk level for the landslide 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 landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	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 RISK	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 RISK	May be tolerated in certain circumstances (subject 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.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.