Geotechnical Investigation Report

Project

Proposed Temporary Mountain Bike Storage Unit
Kosciuszko Chairlift Base, Thredbo NSW

Department of Planning
and Environment

Issued under the Environmental Planning and Assessment Act 1979

Approved Application No DA 22/11263

Granted on the 17 February 2023

Signed M Brown

Sheet No 4 of 15

Prepared for

Kosciusko Thredbo Pty Ltd

Date

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Report No

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APPENDICES

1 Introduction

This report presents the findings of a geotechnical investigation carried out by Alliance Geotechnical Pty Ltd (Alliance) for the proposed temporary mountain bike storage unit at the Kosciuszko Chairlift Base, Thredbo NSW (the site). The investigation was commissioned by Kosciuszko Thredbo Pty Ltd (the client) and was undertaken in accordance with Alliance's Estimate No. 6819, dated 23 May 2022.

The objective of this geotechnical investigation was to assess the surface and subsurface conditions of the site and provide comments and recommendations relating to:

- The site geotechnical and groundwater conditions,
- Geotechnical parameters such as allowable bearing pressure,
- Recommended foundation layer,
- Foundation and footing options,
- Earthworks Preparation, and
- Geotechnical constraints, if encountered.

The investigation comprised drilling two boreholes, followed by reporting. Details of the field results are presented in this report, together with comments and recommendations relating to the suitability of the site to the proposed development. In accordance with DP&E Geotechnical Policy – Kosciuszko Alpine Resorts, we also include Form 1.

2 Proposed Development

Alliance received a request for fee proposal from Andrew Harrigan of Kosciuszko Thredbo Pty Ltd on 20 May 2022 which includes a brief description of the proposed development. Based on the request, it is understood that the development would comprise the installation of a demountable shed to be used as a temporary mountain bike storage unit.

Alliance understands that the structure would be founded on a combination of an existing concrete slab and an extension of the slab adjacent to the barbecue area at the Kosciuszko Chairlift base.

3 Site Description and Regional Geology

The site is located at the Kosciuszko Chairlift ski resort in Thredbo Resort Centre within Thredbo Village, Thredbo NSW 2625. The proposed project location is bound by the Thredbo Ski Racing Club assembly building to the southwest, a commercial building to the southeast, and a barbecue area to the northeast. The site location relative to the surrounding features is shown in Figure 1 below.

During the site walkover, it was noted that a retaining wall is present on the south-eastern side, adjacent to the location of the proposed storage unit.

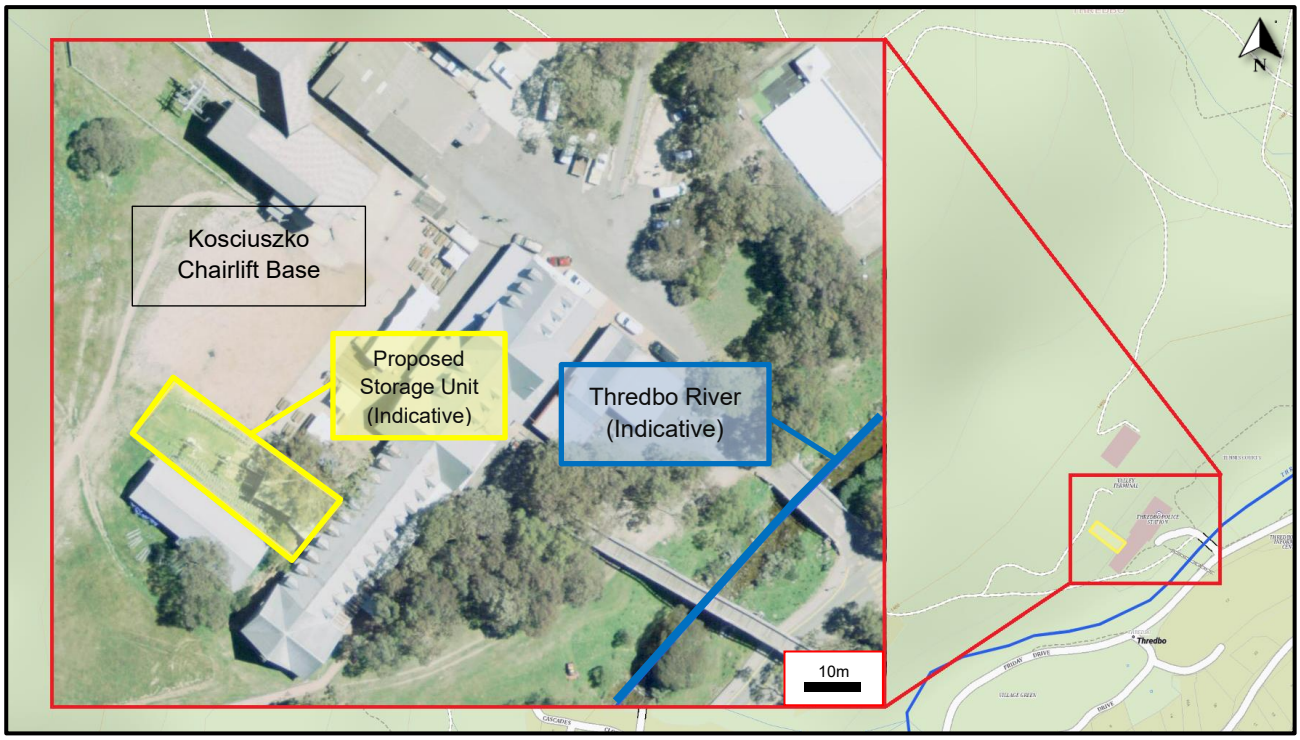

Figure 1 - The Site Location

At the time of preparing this report, the site detailed survey plan has not been provided. Based on the regional topography, the site lies on a valley side slope with slightly steep gradients of less than 30° towards the northwest and southeast direction.

The New South Wales Seamless Geology dataset, version 2.1 [Digital Dataset] published by the Geological Survey of New South Wales, indicates that the site is underlain by Silurian aged Mowambah Granodiorite which may contain *medium-grained mafic biotite-rich granodiorite, strong foliation defined by quartz and biotite crystals plus aligned xenoliths, muscovite flakes accentuate foliation, and metasedimentary xenoliths include banded cordierite gneiss*. The geology map identifies a fault trend, Crackenback Fault, along the site southeast boundary following the line of Thredbo River.

The site overlaying NSW Seamless Geology map with 10m contours are presented in Figure 2 below.

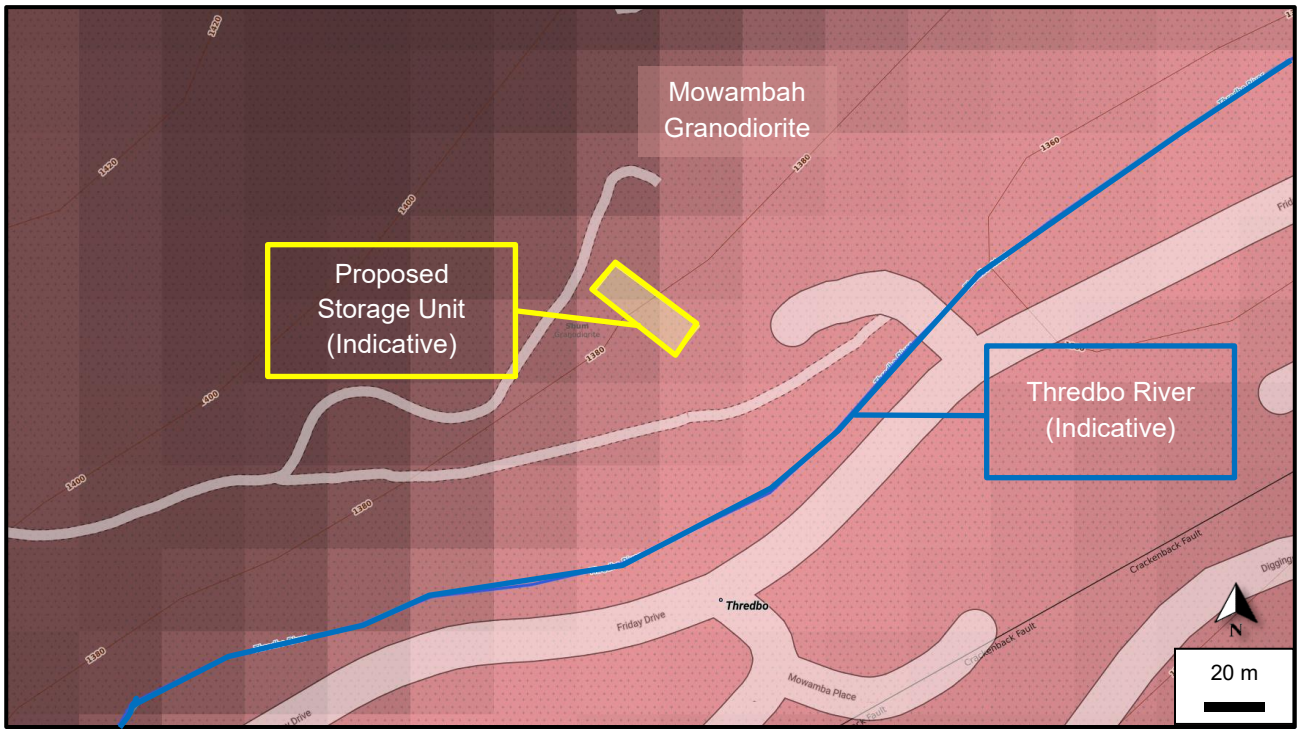

Figure 2 - The Site Location with NSW Seamless Geology and 10m Contours

4 Fieldwork

4.1 Methods

The geotechnical site investigation was carried out on 3 June 2022 and commenced with a site walkover and inspection by an Alliance geotechnical engineer. During the walkover, geological and topographical features of the site were documented.

Selected photographs taken during the fieldwork are presented in Appendix A and the approximate borehole locations are shown on the Geotechnical Investigation Plan (Drawing 15282-GR-1-A) presented in Appendix B.

Two boreholes were drilled to a target depth of 3.0m bgl or prior hand auger refusal. The borehole locations were checked against dial before you dig (DBYD) plans before drilling commencement.

Dynamic Cone Penetrometer (DCP) tests were conducted on each borehole location to assess the near surface soil consistency. The DCP tests commenced at the existing surface level and terminated at target depths between 3.0m and 3.45m bgl.

The encountered soil profile was logged by a geotechnical engineer from Alliance in accordance with AS1726 - 2017 Geotechnical Site Investigation.

At completion, the boreholes were backfilled with drilling spoils and made flush with the surrounding surface.

4.2 Results

The borehole logs and the DCP test results are attached in Appendix C. These log sheets should be read in conjunction with the attached Explanatory Notes, which explain the terms, abbreviations and symbols used, together with the interpretation and limitation of the logging procedure.

Table 1 below summarises the termination depths of all investigations that were carried out and the summary of the encountered subsurface profile and interpreted geotechnical units are provided in Table 1.

Table 1 - Summary of Subsurface Profile Encountered

Ground Profile	Consistency/ Strength	Depth to top of unit	Depth to top of unit	Thickness*
Unit	-	m bgl	m AHD	m
Fill Silty SAND/ Clayey SAND/ SAND/ Sandy CLAY	Moderately to well compacted	0.0	1372.0	0.85 – 2.9
Colluvium Silty SAND	Dense	2.9	1369.1	>0.2
Colluvium Sandy CLAY	Very Stiff	3.1	1368.9	>0.1

*Inferred based on terminated depth at some units

The site subsurface profile comprised moderately to well compacted fill (up to 2.9m bgl at borehole HA01) underlain by colluvium of dense silty sand followed by very stiff sandy clay. No bedrock was encountered within the depth of investigation.

4.3 Groundwater

Groundwater was not observed during the fieldwork and long-term groundwater monitoring was not carried out. It should be noted that groundwater seepage condition is subject to the soil permeability, seasonal and climatic conditions and it may vary across the site. It is expected the groundwater seepage occurs through the interface between soil and rock boulders.

5 Recommendations

5.1 Geotechnical Constraints

The following geotechnical constraints were identified during the geotechnical investigation:

- Necessary checks should be given to the adjacent structures. Loading within the zone of influence of the existing retaining wall may cause potential failure if soil pressure imposed by the load is not considered.
- Consideration must be given to the properties of the fill material, given the varying soil type across the encountered soil profile if it is to be used as the foundation layer.
- Presence of high plasticity clay layer which is sensitive to moisture changes should be noted during excavation and construction.

The site is relatively flat at this location, so no immediate slope instability risks are considered beyond the village-wide background risks.

5.2 Footings

The existing fill is not an ideal foundation material, and the proposed structure should be founded on the natural stratum in preference. For lightly loaded, settlement insensitive structures, it may be feasible to design shallow footings founded uniformly in natural colluvium or residual soil. Parameters for shallow footing design are presented in Table 2. If lightly loaded footings are planned to be founded on the Fill, the formation should be proof rolled or re-compacted on the surface to tighten up the formation and check for any localised soft or loose spots.

It should be noted that the provided bearing pressures do not apply to raft footing designs. If a raft footing is proposed, an assessment of settlements needs to be made using the applied loads and geometry. Alliance can assist in the geotechnical aspects of this design if required.

Table 2 - Preliminary Geotechnical Parameters for Shallow Foundations

Description	Minimum Embedment depth (m bgl)	Allowable Bearing Pressure (kPa)
Fill Moderate to well-compacted	0.5	50
Colluvium Silty SAND, dense	2.9	700
Colluvium Sandy CLAY, very stiff	3.1	400

Allowable bearing pressure is not a soil property, but also a function of the size of the footing, embedment depth, and load eccentricity. Larger and deeper footings have larger bearing capacities, and eccentric loads reduce the bearing capacity. It is recommended that the footings are founded on the same strata to minimise the risk of differential settlement.

Additional geotechnical investigations may be required should highly loaded and settlement sensitive structures be proposed.

All footing excavations are required to be cleaned of any frozen, loose or disturbed material and any water immediately prior to placing the concrete.

Geotechnical inspection should be undertaken during shallow footing excavation. An experienced geotechnical engineer or engineering geologist should be on site to confirm the design embedment depth and the assumptions made in this report regarding the subsoil conditions. The base of footing should be free of soft, loose, wet, frozen or disturbed soils.

The effect of temporary excavation and loading on adjacent structures, in this case the assembly building on the southwest and the retaining wall on the southeast of the project location, should be noted. A dilapidation survey of any nearby structures (within the zone of influence of the proposed structure) and infrastructure is recommended to be undertaken by a structural engineer prior to the commencement of any site excavations. The report should include precise measurements of the existing defects and cracks presented with relevant photos.

5.3 Earthworks

5.3.1 Subgrade Preparation

The following recommendations are provided for subgrade preparation for earthworks, pavements and slab-on-ground construction:

- Strip existing fill and topsoil. Remove unsuitable materials from the site (e.g., material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.

- If natural soils need to be excavated, stockpile for re-use as fill or remove as spoil.

- Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill. The replaced select fill layers (following moisture conditioning, if required) shall be compacted with a roller until a minimum standard dry density ratio of 95% SMDD is achieved, and the in-situ moisture content of the layer is within ± 2% of standard optimum at the time of carrying out the field density testing.

Any waste soils being removed from the site must be classified in accordance with current regulatory authority requirements to enable appropriate disposal to an appropriately licensed landfill facility.

5.3.2 Fill Placement and Compaction

Any minor fill (up to 1.0m) which is to support pavements or lightly loaded ground slabs should be placed in a controlled manner as outlined below, and in general accordance with the relevant Australian Standard (AS 3798 – Earthworks for residential and commercial developments). If any major filling is required (greater than 1m), then it is subject to a site-specific earthwork specification.

Any off-site disposal of excavated materials will require an assessment for re-use or classification of the soils in accordance with EPA guidelines. This includes fill soils and natural soils removed from site. Environmental assessments will need to be undertaken on excavated soils to classify spoil prior to removal from site.

Fill material should be placed and compacted to achieve the density ratio and moisture content as specified in Table 3.

Table 3 - Fill Compaction Criteria

Application	Maximum Loose Layer Thickness	Minimum density ratio (Cohesive soils)	Minimum density index (Granular soils)	Moisture Content when compacted
General Filling to support pavements and lightly loaded ground slabs	300mm	95%	70	±2% OMC

It is recommended that all compaction control testing in areas that will support slabs and pavements be undertaken under the supervision of a suitable geotechnical testing authority (GTA).

6 Limitations

Alliance Geotechnical Pty Ltd (Alliance) has prepared this report for Kosciuszko Chairlift Base, Thredbo NSW (the Site), in accordance with Alliance's fee proposal and Terms of Engagement. This geotechnical report has been prepared for Kosciusko Thredbo Pty Ltd (the Client) for this project and for the purposes outlined in this report. This report cannot be relied on for other projects, other parties on this site or any other site.

The comments and recommendations provided in this report are provided based on limited investigation. The borehole investigation and testing results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths drilled at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from Alliance.

APPENDIX A – Selected Site Photographs

Photo 1 – Borehole HA01 location, looking northwest

Photo 2 – Site location shown relative to the adjacent retaining wall, looking southeast.

APPENDIX B – Geotechnical Investigation Plan

Legend

- Indicative Borehole and DCP Location

Geotechnical Investigation Plan

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Client Name:	Kosciuszko Thredbo Pty Ltd	Figure / Drawing Number:	15282-GR-1-A
Project Name:	Proposed Storage Building	Figure / Drawing Date:	06 June 2022
Project Location:	Kosciuszko Express Ski Lift, Thredbo	Report Number:	15282

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APPENDIX C – Explanatory Notes, Borehole Logs, and Dynamic Cone Penetrometer Test Report

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Explanatory Notes
Drill & Excavation Logs

General

Information obtained from site investigations is recorded on log sheets. Soils and very low strength rock are commonly drilled using a combination of solid-flight augers with a Tungsten-Carbide (TC) bit. Descriptions of these materials presented on the “Borehole Log” are based on a combination of regular sampling and in-situ testing. Rock coring techniques commences once material is encountered that cannot be penetrated using a combination of solid-flight augers and Tungsten-carbide bit. The "Cored Borehole Log" presents data from drilling where a core barrel has been used to recover material - commonly rock.

The "Excavation – Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits or trenches.

The heading of the log sheets contains information on Project Identification, Hole or Test Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The scale is presented in the depth column as metres below ground level.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is included in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures, and geological unit. Material description and classifications are based on Australian Standard Geotechnical Site Investigations: AS 1726 - 2017 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

Drilling

Drilling, Casing and Excavating

Drilling methods deployed are abbreviated as follows

Abbreviation	Method
AS	Auger Screwing
ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
BH	Backhoe
E	Excavator
HA	Hand Auger
HQ	HQ core barrel (~63.5 mm diameter core) *
HMLC	HMLC core barrel (~63.5 mm diameter core) *
NMLC	NMLC core barrel (~51.9 mm diameter core) *
NQ	NQ core barrel (~47.6 mm diameter core) *
RR	Rock Roller
WB	Wash-bore drilling

* Core diameters are approximate and vary due to the strength of material being drilled.

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage. It is introduced to assist with the drill process, in particular, when core drilling. The introduction of drill fluid/water does not allow for accurate identification of water seepages.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

Abbreviation	Description
VE	Very Easy
E	Easy
F	Firm
H	Hard
VH	Very Hard

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

Groundwater inflow water level

Samples/Tests

Samples collected and testing undertaken are abbreviated as follows

Abbreviation	Test
ES	Environmental Sample
DS	Disturbed Sample
BS	Bulk Sample
U50	Undisturbed (50 mm diameter)
C	Core Sample
SPT	Standard Penetration Test
N	Result of SPT (*sample taken)
VS	Vane Shear Test
IMP	Borehole Impression Device
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test
HB	Hammer Bouncing

Excavation Logs

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added. Photos are recommended.

Material Description – Soil

Material Description - In accordance with AS 1726-2017

Classification Symbol - In accordance with the Unified Classification System (AS 1726-2017).

Abbreviation	Typical Name
GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands, gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sands, sand-clay mixtures.
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL	Organic silts and organic silty clays of low plasticity. *
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, clastic silts.
CH	Inorganic clays of high plasticity, fat clays.
OH	Organic clays of medium to high plasticity, organic silts. *
Pt	Peat and other highly organic soils. *

* Additional details may be provided in accordance with the Von Post classification system (1922).

Organic Soils – Identification using laboratory testing:

Material	Organic Content - % of dry mass
Inorganic	<2
Organic Soil	<2 ≤ 25
Peat	> 25

Organic Soils – Descriptive terms for the degree of decomposition of peat:

Term	Decomposition	Remains	Squeeze
Fibrous	Little or none	Clearly recognizable	Only water No solid
Pseudo-fibrous	Moderate	Mixture of fibrous and amorphous	Turbid water < 50% solids
Amorphous	Full	Not recognizable	Paste > 50% solids

Particle Characteristics – Definitions are as follows:

Fraction	Component (& subdivision)		Size (mm)
Oversize	Boulders		> 200
	Cobbles		> 63 ≤ 200
Coarse grained soils	Gravel	Coarse	> 19 ≤ 63
		Medium	> 6.7 ≤ 19
		Fine	> 2.36 ≤ 6.7
	Sand	Coarse	> 0.6 ≤ 2.36
		Medium	> 0.2 ≤ 0.6
		Fine	> 0.075 ≤ 0.21
Fine grained soils	Silt		0.002 ≤ 0.075
	Clay		< 0.002

Secondary and minor soil components

In coarse grained soils – The proportions of secondary and minor components are generally estimated from a visual and tactile assessment of the soils. Descriptions for secondary and minor soil components in coarse grained soils are as follows.

Designation of components	Percentage fines	Terminology (as applicable)	Percentage accessory coarse fraction	Terminology (as applicable)
Minor	≤ 5	Trace clay / silt	≤ 5	Trace sand / gravel
	> 5 ≤12	With clay / silt	> 5 ≤12	With sand / gravel
Secondary	> 12	Silty or clayey	> 30	Sandy or gravelly

Descriptions for secondary and minor soil components in fine grained soils are as follows.

Designation of components	Percentage coarse grained soils	Terminology (as applicable)
Minor	≤ 5	Trace sand / gravel / silt / clay
	> 5 ≤12	With sand / gravel / silt / clay
Secondary	> 30	Sandy / gravelly / silty / clayey

Plasticity Terms - Definitions for fine grained soils are as follows:

Descriptive Term	Range of Liquid Limit for silt	Range of Liquid Limit for clay
Low Plasticity	≤ 50	≤ 35
Medium Plasticity	N/A	> 35 ≤50
High Plasticity	> 50	> 50

Particle Characteristics

Particle shape and angularity are estimated from a visual assessment of coarse-grained soil particle characteristics. Terminology used includes the following:

Particle shape – spherical, platy, elongated,

Particle angularity – angular, sub-angular, sub-rounded, rounded.

Moisture Condition – Abbreviations are as follows:

D	Dry, looks and feels dry.
M	Moist, No free water on remoulding.
W	Wet, free water on remoulding.

Moisture content of fine-grained soils is based on judgement of the soils moisture content relative to the plastic and liquid limit as follows:

MC < PL	Moist, dry of plastic limit.
MC ≈ PL	Moist, near plastic limit.
MC > PL	Moist, wet of plastic limit.
MC ≈ LL	Wet, near liquid limit.
MC > LL	Wet of liquid limit.

Consistency - of cohesive soils in accordance with AS 1726-2017, Table 11 are abbreviated as follows:

Consistency Term	Abbreviation	Indicative Undrained Shear Strength Range (kPa)
Very Soft	**VS**	< 12
Soft	**S**	12 ≤ 25
Firm	**F**	25 ≤ 50
Stiff	**St**	50 ≤ 100
Very Stiff	**VSt**	100 ≤ 200
Hard	**H**	≥ 200
Friable	**Fr**	-

Density Index (%) of granular soils is estimated or is based on SPT results. Abbreviations are as follows:

Description	Abbreviation	Relative Density	SPT N
Very Loose	**VL**	< 15%	0 - 4
Loose	**L**	15 - 35%	4 - 10
Medium Dense	**MD**	35 - 65%	10 - 30
Dense	**D**	65 - 85%	30 - 50
Very Dense	**VD**	> 85%	> 50

Structures – Fissuring and other defects are described in accordance with AS 1726-2017 using the terminology for rock defects

Origin – Where practicable an assessment is provided of the probable origin of the soil, e.g. fill, topsoil, alluvium, colluvium, residual soil.

MATERIAL DESCRIPTION - ROCK

Material Description – In accordance with AS 1726-2017

Rock Naming – Where possible conventional geological names are used within the logs. Engineering properties cannot be inferred directly from the rock names in the table, but the use of a particular name provides an indicative range of characteristics to the reader. Lithological identification of rock is provided to appreciate the geology of an area, to correlate geological profiles seen in boreholes or to distinguish boulders from bedrock.

Grain Size – Grain size is done in accordance with AS1726-2017 as follows:

For sedimentary rock:

Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mmto 0.6mm
Fine grained	Mainly 0.06mm to 0.2mm

For igneous and metamorphic rock:

Coarse grained	Mainly greater than 2 mm
Medium grained	Mainly 0.6mm to 2mm
Fine grained	Mainly less than 2mm

Colour - Rock colour is described in the moist condition.

Texture and Fabric

Frequently used terms:

Sedimentary Rock	Metamorphic Rock	Igneous
Bedded	Banded	Amorphous
Cross-bedded	Cleaved	Crystalline
Folded	Folded	Flow banded
Graded	Foliated	Folded
Interbedded	Gneissose	Lineated
Laminated	Lineated	Massive
Massive	Schistose	Porphyritic

Bedding and fabric:

Description	Spacing
Very Thickly Bedded	> 2m
Thickly Bedded	0.6m to 2m
Medium Bedded	0.2m to 0.6m
Thinly Bedded	60mm to 200mm
Very Thinly Bedded	20mm to 60mm
Thickly Laminated	6mm to 20mm
Thinly Laminated	< 6mm

Degree of development:

Massive	No layering or fabric. Rock is homogeneous.
Indistinct	Layering or fabric just visible, There is little effect on strength properties.
Distinct	Layering or fabric obvious. The rock may break more easily parallel to the fabric.

Features, inclusions, and minor components - Features, inclusions and minor components within the rock material shall be described where those features could be significant such as gas bubbles, mineral veins, carbonaceous material, salts, swelling minerals, mineral inclusions, ironstone or carbonate bands, cross-stratification, or minerals the readily oxidise upon atmospheric exposure.

Moisture content - Where possible descriptions are made by the feel and appearance of the rock using one according to following terms:

Dry	Looks and feels dry.
Moist	Feels cool, darkened in colour, but no water is visible on the surface.
Wet	Feels cool, darkened in colour, water film or droplets visible on the surface.

The moisture content of rock cored with water may not be representative of its in-situ condition.

Durability – Descriptions of the materials durability such as tendency to develop cracks, break into smaller pieces or disintegrate upon exposure to air or in contact with water are provided where observed.

Rock Material Strength – The strength of the rock material is based on uniaxial compressive strength (UCS). The following terms are used:

Term / Abbreviation		Description	UCS (MPa)	Point Load Strength Index (MPa)
Very Low	**VL**	Crumbles under firm blow with sharp end of pick, can be peeled with a knife; too hard to cut a triaxial by hand; 30mm pieces can be broken by hand.	0.6 – 2	0.03 – 0.1
Low	**L**	Easily scored with a knifed; indentations 1-3mm show with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	2 – 6	0.1 – 0.3
Medium	**M**	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.	6 – 20	0.3 – 1
High	**H**	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	20 – 60	1 – 3
Very High	**VH**	Hand specimen breaks with pick after more than one blow; rock rings under hammer.	60 – 200	3 – 10
Extremely High	**EH**	Specimen requires many blows with geological pick to break into intact materials; rock rings under hammer.	> 200	> 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical logs as follows:

D	Diametral Point Load Test
A	Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown. Point Load Strength Index test results are presented as $I_{s\,(50)}$ values in MPa.

Weathering – Weathering classification assists in identification but does not imply engineering properties. Descriptions are as follows:

Term / Abbreviation		Description
Residual Soil	**RS**	Material has soil properties. Mass structure and material texture and fabric of original rock not visible, but the soil has not been significantly transported.
Extremely Weathered	**EW**	Material has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Highly Weathered	**HW**	Material is completely discoloured, significant decrease in strength from fresh rock.
Moderately Weathered	**MW**	Material is `completely discoloured, little or no change of strength from fresh rock.
Slightly Weathered	**SW**	Partly stained or discoloured, little or no change to strength from fresh rock.
Fresh	**FR**	No signs of mineral decomposition or colour change.

Alteration – Physical and chemical changes of the rock material due to geological processes by fluids at depth at pressures and temperatures above atmospheric conditions. Unlike weathering, alteration shows no relationship to topography and may occur at any depth. When altered materials are recognized, the following terms are used:

Term / Abbreviation				Description
Extremely Altered		**XA**		Material has soil properties. Structure, texture, and fabric of original rock are still visible. The rock name is replaced with the name of the parent material, e.g., Extremely Altered basalt. Soil descriptive terms are used.
Highly Altered	**Distinctly altered**	**HA**	**DA**	The whole of the rock material is discoloured. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be higher or lower due to loss of minerals or precipitation of secondary minerals in pores.
Moderately Altered	**Distinctly altered**	**MA**	**DA**	The whole of the rock material is discoloured. Little or no change of strength from fresh rock. The term 'Distinctly Altered' is used where it is not practicable to distinguish between 'Highly Altered' and 'Moderately Altered'. Distinctly Altered is defined as follows: - The rock may be highly discoloured; - Porosity may be higher due to mineral loss; or may be lower due to precipitation of secondary minerals in pores; and - Some change of rock strength.
Slightly Altered		**S**		Rock is slightly discoloured. Little or no change of strength from fresh rock.

Alteration is only described in the context of the project where it has relevance to the civil and structural design.

Defect Descriptions

General and Detailed Descriptions – Defect descriptions are provided to suit project requirements. Generalized descriptions are used for some projects where it is unnecessary to describe each individual defect in a rock mass, or where multiple similar defects are present which are too numerous to log individually. The part of the rock mass to which this applies is delineated.

Detailed descriptions are given of defects judged to be particularly significant in the context of the project. For example, crushed seams in an apparently unstable slope. As a minimum, general descriptions outlining the number of defect sets within the rock mass and their broad characteristics are provided where it is possible to do so.

Defect Type – Defect abbreviations are as follows:

BP	Bedding parting	**SSM**	Sheared seam	**DB**	Drilling break
JT	Joint	**CS**	Crushed seam	**HB**	Handling break
SS	Shear surface	**SM**	Infilled seam		
SZ	Sheared zone	**EWS**	Extremely weathered seam		

Sheared surfaces, sheared zones, sheared seams, and crushed seams are generally faults in geological terms.

Defect Orientation

For oriented core: The dip and dip direction are recorded as a two-digit and three-digit number separated by a slash, are collected e.g., 50°/240° and there is not core loss that could obscure core orientation. If alternative measurements are made, such as dip and strike or dip direction relative to magnetic north this shall be documented.

For non-oriented core: The dip is recorded as a two-digit number, e.g., 10°. In vertical boreholes the dip is generally measured relative to the horizontal plan. If the borehole is inclined the dip is generally measured from the core axis.

Surface Roughness – Defect surface roughness is described as follows:

VR	**Very rough**	Many large surface irregularities with amplitude generally more than 1 mm.
RO	**Rough**	Many small surface irregularities with amplitude generally less than 1 mm.
SO	**Smooth**	Smooth to touch. Few or no surface irregularities.
PO	**Polished**	Shiny smooth surface
SK	**Slickensided**	Grooved or striated surface, usually polished.

Surface Shape – Defect surface roughness is described as follows:

PL	**Planar**	The defect does not vary in orientation.
CU	**Curved**	The defect has a gradual change in orientation
UN	**Undulating**	The defect has a wavy surface.
ST	**Stepped**	The defect has one or more well defined steps
IR	**Irregular**	The defect has many sharp changes of orientation

Defect Infilling – Common abbreviation as follows:

Ca	Calcite	**Fe**	Iron Oxide	**Qz**	Quartz
Cy	Clay	**MS**	Secondary mineral	**X**	Carbonaceous

Defect Coatings and Seam Composition - Coatings are described using the following terms:

CN	**Clean**	No visible coating.
SN	**Stained**	No visible coating but surfaces are discoloured.
VN	**Veneered**	A visible coating of soil or mineral, too thin to measure; may ne patchy.
CO	**Coating**	A visible coating up to 1 mm thick. Soil in-fill greater than 1 mm shall be described using defect terms (e.g., infilled seam). Defects greater than 1 mm aperture containing rock material great described as a vein.

Defect Spacing, Length, Openness and Thickness – Described directly in millimetres and metres. In general descriptions, half order of magnitude categories is used, e.g. joint spacing typically 100 mm to 300 mm, sheared zones 1m to 3m thick.

Depending on project requirements and the scale of observation, spacing may be described as the mean spacing within a set of defects, or as the spacing between all defects within the rock mass. Where spacing is measured within a specific set of defects, measurements shall be made perpendicular to the defect set.

Where significant, the nature of the defect end condition is recorded in the context of the scale of the exposure.

Block Shape – Where it is considered significant, block shape should be described using terms given in Table 23, AS 1725:2017.

Stratigraphic Unit – Geological maps related to the project are used for the designation of lithological formation name and, where possible geological unit name, e.g., Bringelly Shale, Potts Hill Sandstone Member.

Core Loss – Core loss occurs when material is lost during the drilling process It is shown at the bottom of the run unless otherwise indicated where core loss is known.

Total Core Recovery – The percentage of rock recovered excluding core loss per core run.

Defect Spacing – The spacing of successive defects or the mean spacing for relatively broken core.

Fracture Index – Which is the number defects per metre of core.

Rock Quality Designation (RQD) – The percentage of sound core pieces of 100mm or greater per core run and is calculated using Deere et al. (1989) method.

Rock Classification System – For design purpose, Sydney Rock Mass Classification System (Pells et al. 1998, 2019) is adopted.

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BH No: HA01
Sheet: 1 of 1
Job No: 15282

Borehole Log

Client: Koscuiuszko Thredbo Pty Ltd
Project: Proposed Storage Unit
Location: Kosciuszko Express Ski Lift, off Friday Drive, Thredbo

Started: 3/06/2022
Finished: 3/06/2022
Borehole Size 50 mm

Rig Type: HA
Hole Location: Refer to drawing 15282-GR-1-A
Driller: SY
Logged: SY
RL Surface: 1372m
Contractor: Alliance
Bearing: ---
Checked: MAG

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
HA	None Encountered During Augering	1371.5	0.5		--	FILL: Silty SAND, low plasticity, dark brown, fine to medium grained sand, trace fine to medium grained angular crushed granite gravel, trace rootlets. Appears moderately compacted.		D		FILL
		1371.0	1.0		--	FILL: Clayey SAND, fine to coarse grained, brown, low to medium plasticity, trace fine to coarse angular crushed granite gravel. Appears well compacted.				
		1370.5	1.5		--	FILL: SAND, fine to coarse grained, pale grey mottled orange with clay lenses, trace coarse angular crushed granite gravels. Appears well compacted.		M		
					--	FILL: Clayey SAND, fine to coarse grained, grey, medium to high plasticity. Appears well compacted.				
		1370.0	2.0		--	FILL: Sandy CLAY, low to medium plasticity, brown-grey, trace fine to coarse angular gravel. Appears well compacted.		MC ~ PL		
		1369.5	2.5		--	FILL: Sandy CLAY, medium plasticity, brown-grey, trace fine to coarse angular gravel. Appears well compacted.				
		1369.0	3.0		SP	Silty SAND, fine to coarse grained, brown.		W		COLLUVIUM
					CI	Sandy CLAY, medium to high plasticity, grey, fine to coarse grained sand.		MC > PL		
		1368.5	3.5			Target Depth. Borehole HA01 terminated at 3.2m				

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BH No: HA02
Sheet: 1 of 1
Job No: 15282

Borehole Log

Client: Koscuiuszko Thredbo Pty Ltd
Project: Proposed Storage Unit
Location: Kosciuszko Express Ski Lift, off Friday Drive, Thredbo

Started: 3/06/2022
Finished: 3/06/2022
Borehole Size 50 mm

Rig Type: HA
Hole Location: Refer to drawing 15282-GR-1-A
Driller: SY
Logged: SY
RL Surface: 1372m
Contractor: Alliance
Bearing: ---
Checked: MAG

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
HA	None Encountered During Augering				--	FILL: Silty SAND, fine to coarse grained, dark brown, trace fine coarse grained sub-rounded to angular gravel, trace rootlets. Appears well compacted.		D		FILL
						At 0.4m: Appears very poorly compacted.				
		1371.5	0.5		--	FILL: Silty SAND, brown with yellow speckles, with medium rounded gravels. Appears well compacted.				
						Hand Auger Refusal (possible granite boulder). Borehole HA02 terminated at 0.85m				
		1371.0	1.0							
		1370.5	1.5							
		1370.0	2.0							

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Dynamic Cone Penetrometer (DCP) Test Report

Client	Koscuiuszko Thredbo Pty Ltd	**Report Number**	15282-GR-1-1
Project Name	Proposed Storage Unit	**Project Number**	15282
Project Location	Kosciuszko Express Ski Lift, off Friday Drive, Thredbo	**Date Tested**	03/06/2022
Test Method	AS 1289.6.3.2		

Test Number	**DCP01 (HA01)**	**DCP02 (HA02)**
Test Locations	Refer to drawing 15282-GR-1-A	
Surface Material	FILL: Silty SAND	FILL: Silty SAND
Surface Conditions	D	M
RL (m AHD)	1372	1372
0.00 – 0.15	5	7
0.15 – 0.30	5	7
0.30 – 0.45	14	10
0.45 – 0.60	14	1
0.60 – 0.75	13	6
0.75 – 0.90	14	16
0.90 – 1.05	9	9
1.05 – 1.20	8	8
1.20 – 1.35	10	8
1.35 – 1.50	9	6
1.50 – 1.65	15	12
1.65 – 1.80	15	7
1.80 – 1.95	16	8
1.95 – 2.10	8	8
2.10 – 2.25	11	3
2.25 – 2.40	15	9
2.40 – 2.55	11	12
2.55 – 2.70	15	19
2.70 – 2.85	11	20
2.85 – 3.00	7	18
3.00 – 3.15	8	Target Depth

3.15 - 3.30	7	
3.30 – 3.45	13	
	Target Depth	

Notes: This test report is intended to be read in conjunction with the geotechnical report by Alliance Geotechnical (ref: 15282-GR-1-1).

HB indicates hammer bounce.

APPENDIX D – KT Geotechnical Form 1

Department of Planning and Environment

Issued under the Environmental Planning and Assessment Act 1979

Approved Application No DA 22/11263

Granted on the 17 February 2023

Signed M Brown

Sheet No 5 of 15

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 [x] and complete all sections.

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

I,

Mr [x] Ms [ ] Mrs [ ] Dr [ ] Other [ ]

First Name: Mark Green

Family Name:

OF

Company/organisation: Alliance Geotechnical Pty Ltd

on this the 30 day of June 20 22

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 Investigation Report

Author: Roni Marquez / Mark Green

Dated: 30/6/2022

DA Site Address: Proposed Temporary Mountain Bike Storage Unit
Kosciuszko Chairlift Base, Thredbo NSW

DA Applicant: Kosciuszko Thredo PL

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

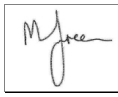
The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Report. This checklist is to accompany the report.

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

BSc(Hons) CPEng MIEAus NER RPEQ
APEC IntPE(Aus) CGeol FGS JP
NSW Reg PE (civil/geo) / DP (geo)

Name

Mark Green

Date

30/6/2022

5. Contact details

Department of Planning & Environment
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