Our ref: 4428-L1 Rev 1
19 July 2017

Operations Director
Mr Michael Fearnside
Perisher Ski Resort
c/o Dabyne Planning Pty Ltd
PO Box 179
Jindabyne NSW 2627

Attention: Mr Ivan Pasalich

Dear Sir,

PROPOSED MODIFICATION TO SMIGGINS STAGE 1 SNOWMAKING, PERISHER SKI RESORT GEOTECHNICAL ASSESSMENT

1. INTRODUCTION

As requested, we have carried out a geotechnical assessment for the above project. Documentssupplied to us for this assessment comprised:

- DA Plans by Steve Gibb (Plan 672017-1 dated 6 July 2017, 2 pages)
- Site Photos from Dabyne Planning Pty Ltd
- Details of Snow Factory Structure by Technoalpin (AU0006-17-03A dated 13 June 2017)

Based on the supplied information, we understand that the project involves construction of an elevated platform 14.5m x 4.6m plan area to accommodate a pre-fabricated 'snow factory', to be built immediately adjacent to the Kaaten Triple Chair top station.

The objective is to carry out a geotechnical assessment and provide a completed Form 4 with geotechnical recommendations for the development in accordance with DIPNR Geotechnical Policy – Kosciuszko Alpine Resorts.

This report must be read in conjunction with the attached "Important Information about your Geotechnical Report". Particular attention is drawn to the limitations inherent in site investigations and the importance of verifying the subsurface conditions inferred herein.

2. SCOPE OF WORK

In order to achieve the project objectives, the following scope of work:

- Review of existing regional maps and reports relevant to the site, held within our files.
- Examination of supplied site photographs, and previous site photographs taken by the undersigned.
- Engineering assessment and reporting.

3. SITE GEOLOGY & REGIONAL INSTABILITY

The 1:250,000 Tallangatta Geological Map indicates the site is underlain by Silurian aged intrusive granite.

All of the proposed development sites lie within the G line as defined in DIPNR's *"Geotechnical Policy – Kosciuszko Alpine Resorts"*, November 2003.

4. SITE DESCRIPTION

The Kaaten Triple Chair top station is situated on a relatively steep slope of about 10 to 15º, within the ski slopes to the north-west of the main car park.

The proposed 'snow factory' station is located immediately adjacent to the station (north-eastern side), as indicated in Plate 1 (from Steve Gibb).

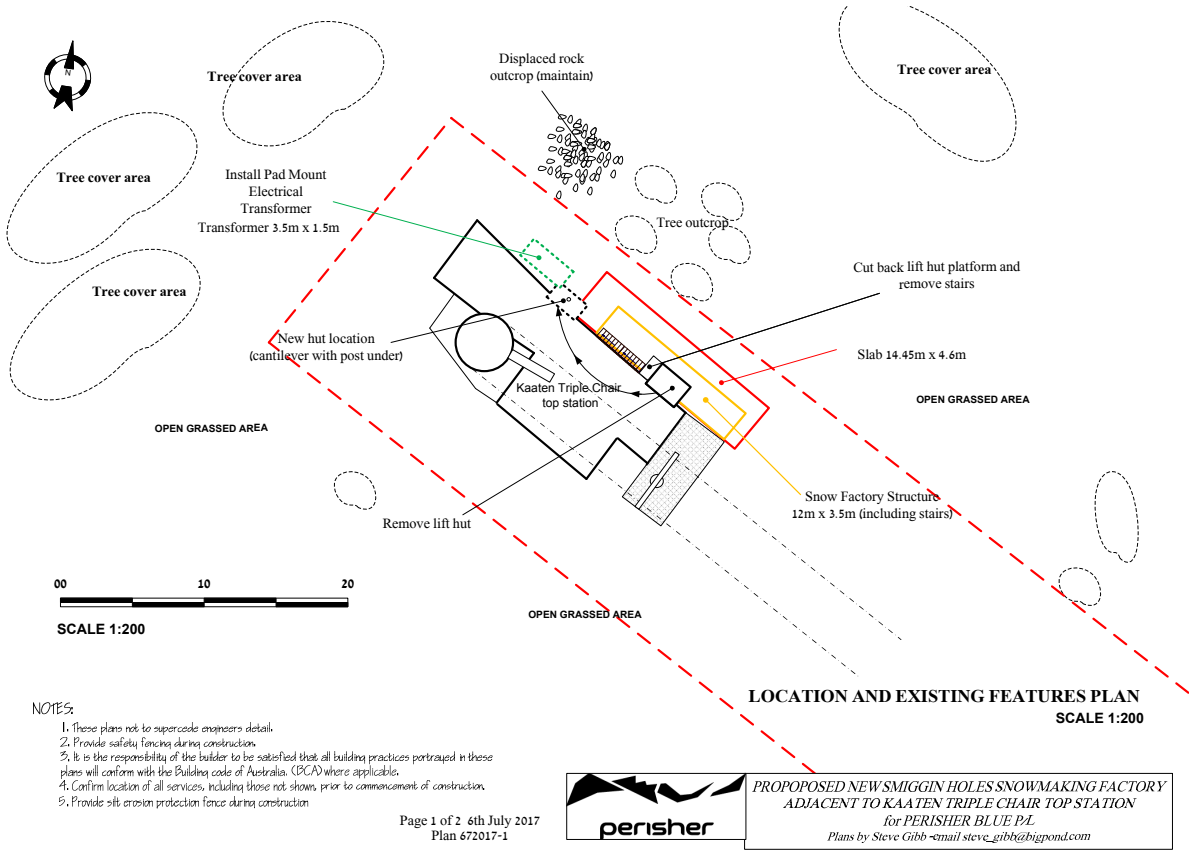

Plate 1 – Proposed Snow Factory Location Plan

Vegetation comprises thin grasses and some scattered bushes and small trees.

The ground surface slopes down to the southeast, dropping about 1.5m to 2m in level over the 15m long proposed concrete slab. Surface drainage is via overland flow, and there do not appear to be any areas of localised ponding of surface water concentration affecting the immediate site vicinity.

A view of the site from Woodrun, looking west, is shown in Plate 2.

Plate 2 – View of the site from Woodrun, looking west (courtesy Daybne Planning)

Granite outcrop and boulders are scattered across the development areas, including less weathered and intact granite boulders sitting proud of the terrain, to bedrock outcropping at the ground surface. The granite bedrock is variably weathered, from completely weathered granite with soil properties (i.e. clayey sand) ranging up to about 1.2m depth in some areas, to moderately weathered, high strength rock at the surface in other areas.

A topsoil covering of up to about 0.2m thickness supporting the grasses and undergrowth blankets the ground surface between the outcrop and protruding boulders.

There were no obvious signs of slope instability in the area of the proposed development, from our previous observations and by examination of the supplied site photos. It is expected that there could be shallow, surficial creep of the topsoils in some of the steeper areas, and in some of the open depressions where surface water and subsurface seepage concentrates. However, the depth of creeping soils is likely to be relatively shallow (less than about 0.3m to 0.5m depth), and the lateral extent is likely to be relatively limited.

5. DISCUSSIONS & RECOMMENDATIONS

It is understood that the 'snow making' facility comprises a 'snow factory' about 12.2m long by 3.5m wide by 8.5m high weighing 33,000kg, to be sited on a concrete slab 14.5m long by 4.6m wide. No cutting is proposed to the ground level, other than for excavation of footings. The slab will therefore be up to about 2.2m above the existing ground level. Options for slab construction include:

Option 1 – suspended slab on internal columns and perimeter walls

Option 2 – perimeter retaining walls with engineered fill to provide formwork for the slab

We consider that Option 1 is preferred over Option 2 from a geotechnical perspective, as Option 2 will impart substantial additional vertical loading on the ground, and will also require importing and compaction of a sizeable volume of fill. Compaction control would be required for the filling to ensure that it is suitable to support the slab as formwork. The level of compaction and material quality selection / control that would be required to ensure an engineered fill suitable to support the slab without experiencing excessive settlement is considered to be impractical.

Highly weathered or less weathered granite is considered to be a suitable founding stratum for the concrete slab. In view of the moderate slopes and anticipated subsurface profile, the site classification for footings onto the highly or less weathered granite is assessed to be Class S in accordance with AS2870-2011 "Residential Slabs and Footings".

Columns and strip footings should be founded not less than 0.75m below the existing ground surface level, onto the highly or less weathered granite, and may be designed for a maximum allowable bearing pressure of 300 kPa.

If filling is used beneath the slab (e.g. to dispose of surplus material from footing excavation, or to ensure there are no open spaces beneath the slab), we recommend that it could be adopted as formwork for the concrete slab but should not be relied upon as permanent slab support. However, it should still be placed in accordance with the recommendations for "controlled" fill contained in AS2870-2011 "Residential Slabs and Footings" and AS3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments", adopting a minimum dry density ratio not less than 95% standard. A method specification could also be used, subject to the proposed material grading (e.g. if larger granite particles are to be included). Perimeter walls would also need to be designed as retaining walls in this event.

Surface drainage should be provided particularly around the uphill side of the slab to direct surface water around the perimeter walls.

The above classification and footing recommendations are provided on the basis that the performance expectations set out in Appendix B of AS2870–2011 are acceptable and that future site maintenance is in accordance with CSIRO BTF 18.

An experienced geotechnical engineer should review footing designs to check that the recommendations of the geotechnical report have been included. Inspection of footing excavations should be carried out by experienced and appropriately qualified personnel to confirm the subsurface profile and design assumptions.

6. LIMITATIONS

In addition to the limitations inherent in site investigations (refer to the attached Information Sheets), it must be pointed out that the recommendations in this report are based on assessed subsurface conditions from limited investigations. In order to confirm the assessed soil and rock properties in this report, further investigation would be required such as subsurface investigation, and should be carried out if the scale of the development warrants, or if any of the properties are critical to the design, construction or performance of the development.

❖ ❖ ❖ ❖ ❖

Please do not hesitate to contact the undersigned if you have any questions regarding this report or if you require further assistance.

For and on behalf of
Asset Geotechnical Engineering Pty Ltd

Mark Bartel
BE MEngSc GMQ RPEQ MIEAust CPEng NER (Civil)
Managing Director / Senior Principal Geotechnical Engineer

Encl: *Form 4*
Important Information about your Geotechnical Report
Explanation Sheets

DOCUMENT CONTROL

Distribution Register

Copy	Media	Recipient	Location
1	Secure PDF	Ivan Pasalich	Dabyne Planning Pty Ltd
2	Secure PDF	Michael Fearnside	Perisher Blue
3	Secure PDF	Mark Bartel	Asset Geotechnical Engineering

Document Status

Rev	Revision Details	Author	Reviewer		Approved for Issue		
			Name	Initials	Name	Initials	Date
0	Initial issue	M. Bartel	M. Bartel	MAB	M. Bartel	MAB	18 July 2017
1	Updated with current plans and review comments	M. Bartel	M. Bartel		M. Bartel		19 July 2017

Department of
Infrastructure, Planning and Natural Resources

Geotechnical Policy – Kosciuszko Alpine Resorts
Form 4 – Minimal Impact Certification

Date received: ____/____/____ DA no: _____

This form may be used where minor construction works which present minimal or no geotechnical impact on the site or related land are proposed to be erected within the "G" line area of the geotechnical maps. A geotechnical engineer or engineering geologist must inspect the site and/or review the proposed development documentation to determine if the proposed development requires a geotechnical report to be prepared to accompany the development application. Where the geotechnical engineer determines that such a report is not required then they must complete this form and attach design recommendations where required. A copy of form 4 with design recommendation, if required, must be submitted with the development application.

Please contact the Alpine Resorts Assessments Team in Jindabyne for further information. Phone 02 6456 1733.

To complete this form, please place a cross in the boxes ☐ and fill out the white sections.

1. Declaration made by geotechnical engineer or engineering geologist in relation to a nil or minimal geotechnical impact assessment and site classification

I,

Mr ☐ Ms ☐ Mrs ☐ Dr ☐ Other

First name

Family name

OF

Company/organisation

certify that I am a geotechnical engineer /engineering geologist as defined by the "Policy" and I have inspected the site and reviewed the proposed development known as

As a result of my site inspection and review of the following documentation

(List of documentation reviewed)

I have determined that;

☐ the current load-bearing capacity of the existing ~~building~~ ground will not be exceeded or adversely impacted by the proposed development, and

☐ the proposed works are of such a minor nature that the requirement for geotechnical advice in the form of a geotechnical report, prepared in accordance with the "Policy", is considered unnecessary for the adequate and safe design of the structural elements to be incorporated into the new works, and

☐ in accordance with AS 2870.1 Residential Slabs and Footings, the site is to be classified as a type

(insert classification type)

☐ I have attached design recommendations to be incorporated in the structural design in accordance with this site classification.

I am aware that this declaration shall be used by the Department as an essential component in granting development consent for a structure to be erected within the "G" line area (as identified on the geotechnical maps) of Kosciuszko Alpine Resorts without requiring the submission of a geotechnical report in support of the development application.

4. Signatures

Signature

Mark Bartel

Name

Chartered professional status

Date

5. Contact details

Alpine Resorts Assessments team
Snowy River Avenue
PO Box 36 JINDABYNE 2627
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Important Information about your Geotechnical Report

SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client and Asset Geotechnical Engineering Pty Ltd ("Asset"), for the specific site investigated. The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

The report should not be used if there have been changes to the project, without first consulting with Asset to assess if the report's recommendations are still valid. Asset does not accept responsibility for problems that occur due to project changes if they are not consulted.

RELIANCE ON DATA

Asset has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. Asset has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, Asset will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Asset.

GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

LIMITATIONS OF SITE INVESTIGATION

The investigation program undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation program and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behavior with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

Therefore, the recommendations in the report can only be regarded as preliminary. Asset should be retained during the project implementation to assess if the report's recommendations are valid and whether or not changes should be considered as the project proceeds.

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Asset should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Asset be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

REPRODUCTION OF REPORTS

This report is the subject of copyright and shall not be reproduced either totally or in part without the express permission of this Company. Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. Asset assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Asset or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

DATA MUST NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the site assessment, and must not be copied in part or altered in any way.

Logs, figures, drawings, test results etc. included in our reports are developed by professionals based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

PARTIAL USE OF REPORT

Where the recommendations of the report are only partially followed, there may be significant implications for the project and could lead to problems. Consult Asset if you are not intending to follow all of the report recommendations, to assess what the implications could be. Asset does not accept responsibility for problems that develop where the report recommendations have only been partially followed if they have not been consulted.

OTHER LIMITATIONS

Asset will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.

Soil and Rock Explanation Sheets (1 of 2)

LOG ABBREVIATIONS AND NOTES

METHOD

borehole logs		excavation logs	
AS	auger screw *	NE	natural excavation
AD	auger drill *	HE	hand excavation
RR	roller / tricone	BH	backhoe bucket
W	washbore	EX	excavator bucket
CT	cable tool	DZ	dozer blade
HA	hand auger	R	ripper tooth
D	diatube		
B	blade / blank bit		
V	V-bit		
T	TC-bit		

* bit shown by suffix e.g. ADV

coring
NMLC, NQ, PQ, HQ

SUPPORT

borehole logs		*excavation logs*	
N	nil	N	nil
M	mud	S	shoring
C	casing	B	benched
NQ	NQ rods		

CORE—LIFT

	casing installed
	barrel withdrawn

NOTES, SAMPLES, TESTS

D	disturbed
B	bulk disturbed
U50	thin-walled sample, 50mm diameter
HP	hand penetrometer (kPa)
SV	shear vane test (kPa)
DCP	dynamic cone penetrometer (blows per 100mm penetration)
SPT	standard penetration test
N*	SPT value (blows per 300mm) * denotes sample taken
Nc	SPT with solid cone
R	refusal of DCP or SPT

USCS SYMBOLS

GW	Well graded gravels and gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands and gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands, little or no fines.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sand, sand-clay mixtures.
ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands.
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
OL	Organic silts and organic silty clays of low plasticity.
MH	Inorganic silts of high plasticity.
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity.
PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

D	dry
M	moist
W	wet
Wp	plastic limit
Wl	liquid limit

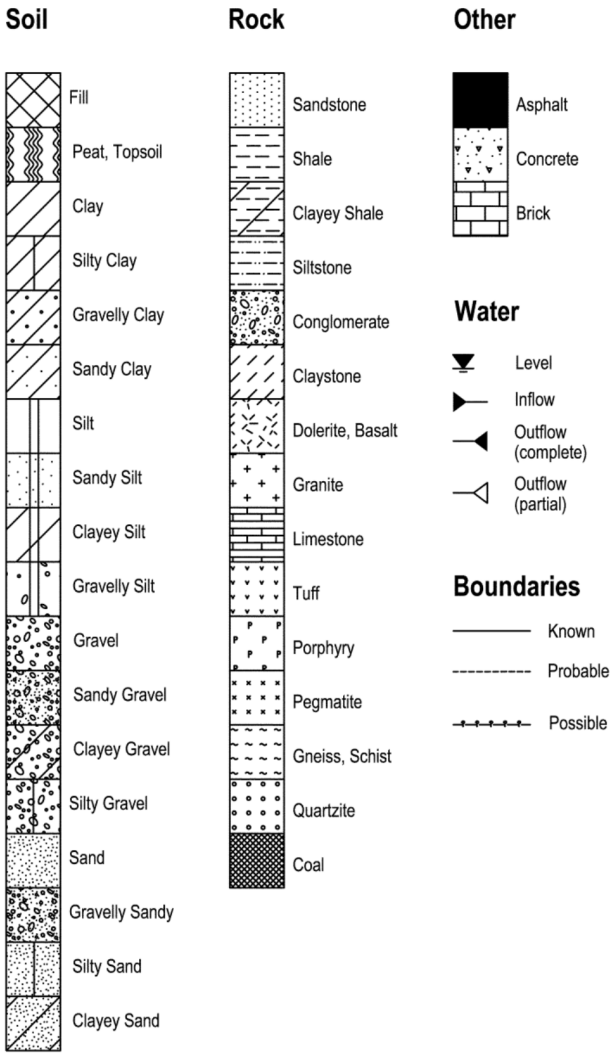
CONSISTENCY

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable

DENSITY INDEX

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

GRAPHIC LOG



WEATHERING

XW	extremely weathered
HW	highly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

STRENGTH

EL	extremely low
VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

RQD (%)

= sum of intact core pieces > 2 x diameter / total length of section being evaluated x 100

DEFECTS:

type		*coating*	
JT	joint	cl	clean
PT	parting	st	stained
SZ	shear zone	ve	veneer
SM	seam	co	coating

shape		*roughness*	
pl	planar	po	polished
cu	curved	sl	slickensided
un	undulating	sm	smooth
st	stepped	ro	rough
ir	irregular	vr	very rough

inclination
measured above axis and perpendicular to core

Soil and Rock Explanation Sheets (2 of 2)

AS1726-1993

Soils and rock are described in the following terms, which are broadly in accordance with AS1726-1993.

SOIL

MOISTURE CONDITION

Term	Description
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Un-cemented granular soils run freely through the hand.
Moist	Feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist, but with free water forming on hands when handled.

Moisture content of cohesive soils may also be described in relation to plastic limit (W_P) or liquid limit (W_L) [>> much greater than, > greater than, < less than, << much less than].

CONSISTENCY OF COHESIVE SOILS

Term	Su (kPa)	Term	Su (kPa)
Very soft	< 12	Very Stiff	100 – 200
Soft	12 – 25	Hard	> 200
Firm	25 – 50	Friable	–
Stiff	50 – 100		

DENSITY OF GRANULAR SOILS

Term	Density Index (%)	Term	Density Index (%)
Very Loose	< 15	Dense	65 – 85
Loose	15 – 35	Very Dense	>85
Medium Dense	35 – 65		

PARTICLE SIZE

Name	Subdivision	Size (mm)
Boulders		> 200
Cobbles		63 – 200
Gravel	coarse	20 – 63
	medium	6 – 20
	fine	2.36 – 6
Sand	coarse	0.6 – 2.36
	medium	0.2 – 0.6
	fine	0.075 – 0.2
Silt & Clay		< 0.075

MINOR COMPONENTS

Term	Proportion by Mass:	
	coarse grained	*fine grained*
Trace	= 5%	= 15%
Some	5 – 2%	15 – 30%

SOIL ZONING

Layers	Continuous exposures.
Lenses	Discontinuous layers of lenticular shape.
Pockets	Irregular inclusions of different material.

SOIL CEMENTING

Weakly	Easily broken up by hand.
Moderately	Effort is required to break up the soil by hand.

USCS SYMBOLS

Symbol	Description
GW	Well graded gravels and gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
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CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity.
PT	Peat muck and other highly organic soils.

ROCK

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition (more than 50% of rock consists of .....)
Conglomerate	... gravel sized (>2mm) fragments.
Sandstone	... sand sized (0.06 to 2mm) grains.
Siltstone	... silt sized (<0.06mm) particles, rock is not laminated.
Claystone	... clay, rock is not laminated.
Shale	... silt or clay sized particles, rock is laminated.

LAYERING

Term	Description
Massive	No layering apparent.
Poorly Developed	Layering just visible. Little effect on properties.
Well Developed	Layering distinct. Rock breaks more easily parallel to layering.

STRUCTURE

Term	Spacing (mm)	Term	Spacing
Thinly laminated	<6	Medium bedded	200 – 600
Laminated	6 – 20	Thickly bedded	600 – 2,000
Very thinly bedded	20 – 60	Very thickly bedded	> 2,000
Thinly bedded	60 – 200		

STRENGTH (NOTE: Is50 = Point Load Strength Index)

Term	Is50 (MPa)	Term	Is50 (MPa)
Extremely Low	<0.03	High	1.0 – 3.0
Very low	0.03 – 0.1	Very High	3.0 – 10.0
Low	0.1 – 0.3	Extremely High	>10.0
Medium	0.3 – 1.0		

WEATHERING

Term	Description
Residual Soil	Soil derived from weathering of rock; the mass structure and substance fabric are no longer evident.
Extremely	Rock is weathered to the extent that it has soil properties (either disintegrates or can be remoulded). Fabric of original rock is still visible.
Highly	Rock strength usually highly changed by weathering; rock may be highly discoloured.
Moderately	Rock strength usually moderately changed by weathering; rock may be moderately discoloured.
Slightly	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	Rock shows no signs of decomposition or staining.

DEFECT DESCRIPTION

Type	
Joint	A surface or crack across which the rock has little or no tensile strength. May be open or closed.
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/bedding. May be open or closed.
Sheared Zone	Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects.
Seam	Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed).
Shape	
Planar	Consistent orientation.
Curved	Gradual change in orientation.
Undulating	Wavy surface.
Stepped	One or more well defined steps.
Irregular	Many sharp changes in orientation.
Roughness	
Polished	Shiny smooth surface.
Slickensided	Grooved or striated surface, usually polished.
Smooth	Smooth to touch. Few or no surface irregularities.
Rough	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper.
Very Rough	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper.
Coating	
Clean	No visible coating or discolouring.
Stained	No visible coating but surfaces are discolored.
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	Visible coating =1mm thick. Thicker soil material described as seam.