ACT Geotechnical Engineers Pty Ltd
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08 February 2024
Our ref: MA/14112

Alan Taylor
Via email: alan@2t4l.com

Attention: Alan Taylor

Dear Sir

PROPOSED MODIFIED LOWER LEVEL ROOM – MUDDLES LODGE
LOT 1, DP1175667, 129 PERISHER CREEK ROAD, PERISHER VALLEY, NSW

GEOTECHNICAL INVESTIGATION REPORT

We are pleased to present our geotechnical investigation report for the proposed modified lower level room at the Muddles ski lodge at 129 Perisher Creek Road, in Perisher Valley, NSW.

The report outlines the methods and results of exploration, describes site subsurface conditions and provides recommendations for building footing design, excavation conditions, stability of cut and fill batters, and provides site drainage advice.

Should you require any further information regarding this report, please do not hesitate to contact our office.

Yours faithfully
ACT Geotechnical Engineers Pty Ltd

Jeremy Murray
Director - Senior Geotechnical Engineer
FIEAust CPEng EngExec NER RPEQ APEC Engineer IntPE (Aust)
NSW Professional Engineer Registration #PRE0001487 (for Class 2 Buildings)

ALAN TAYLOR

PROPOSED MODIFIED LOWER LEVEL ROOM – MUDDLES LODGE
LOT 1, DP1175667, 129 PERISHER CREEK ROAD, PERISHER VALLEY, NSW

GEOTECHNICAL INVESTIGATION REPORT

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ALAN TAYLOR

PROPOSED MODIFIED LOWER LEVEL ROOM – MUDDLES LODGE
LOT 1, DP1175667, 129 PERISHER CREEK ROAD, PERISHER VALLEY, NSW

GEOTECHNICAL INVESTIGATION REPORT

1 Introduction

At the request of Alan Taylor, ACT Geotechnical Engineers Pty. Ltd. carried out a site classification to AS2870 - 2011 *Residential Slabs & Footings*, of the ski lodge located at 129 Perisher Creek Road, in Perisher Valley, NSW. It is understood that the project involves the modifications to the lower level room, which includes a new window in the north elevation, lowering the floor level in the lower level room, installing sub-floor drainage, and a new door access to lower level room. The plans of the proposed works are attached to the end of the report.

It is understood the site is within "Zone G" of the Kosciusko National Parks Alpine Resorts, so under the NSW Department of Planning Geotechnical Policy, a geotechnical investigation and slope instability risk assessment is required. However, as per Section 10.4 of The Policy, where only minor construction works are proposed, that present minimal or no geotechnical impact on the site or related land, then a "Form 4 - Minimal Impact Certification" can be provided instead. However, the submission of a Form 4 still requires a qualified geotechnical engineer to conduct a site inspection and complete a site classification report in accordance with AS2870.

The site is legally described as Lot 1, DP1175667, 129 Perisher Creek Road, in Perisher Valley, NSW. The ~3,995m^2 block is currently occupied by the existing Muddles Lodge in the centre of the lot, and the proposed additions will be to the North and West of the existing lodge. The site slopes moderately at 10° eastwards. The existing lodge is on shallow cut-to-fill and the extension will be on the upslope, western side, which appears to be in shallow cut. The surface is mostly grass-covered, with some small to very large granite outcroppings.

To establish the subsurface conditions, a 50mm diameter pushtube was used to drill four (4) boreholes on the block, designated BH1 to BH4, on 24 March 2023. Figure 1 is an aerial photograph that shows the location of the investigation boreholes, while Figures 2 (1-6) are photos of the site taken at the time of investigation.

The subsurface profile was logged in general accordance with AS1726 – 2017 "*Geotechnical Site Investigations*" by an experienced geotechnical engineer, and the borehole log is attached to this report.

2 Investigation Results

2.1 Geology

The NSW Seamless Geology Map indicates the site is underlain by Mowambah Granodiorite (Sbum). Granodiorite is a medium to coarse grained intrusive igneous rock, similar to granite, containing quartz and plagioclase feldspar as its primary constituents. This was formed as a large batholith that cooled deep in the Earth's crust. Processes active in the earth caused this to be forced to the surface, with the overlying rock being subsequently eroded away. During this process, major faults and fractures developed in the granitic rock which became areas of weakness that were more easily eroded than the stronger unaltered rock. The faulted zones have in many cases become drainage pathways, of which the Thredbo River course is one. The elevated topography in the area, combined with high water flows during the snow melt has caused the Perisher Creek to cut its way down into the valley, with consequent steep slopes on either side in the vicinity of the creek.

The bedrock is mainly a granodiorite but is locally referred to simply as "granite" or "decomposed granite" if more weathered. As is typical for this formation, there are numerous less-weathered corestones or "floaters" and surface boulders which are surrounded by decomposed granite. These boulders have often become more concentrated in watercourses where soil and finer gravel has been washed away. The massive bedrock often has joints which can contain water, resulting in localised deep weathering, and springs on the slopes.

The upper subsurface profile typically comprises loose black topsoil, ~0.1m to 0.5m thick, often containing granitic cobbles and boulders, then medium dense to dense colluvial soil, and then medium dense to dense residual soils typically to between 0.5m to 1.5m depth. Extremely weak, extremely weathered (EW) massive granite underlies the soil and may contain corestones of less-weathered rock to large boulder size. Wet zones can be present in the colluvium in particular, and there are often aquifers or seepage zones associated with rock jointing or sheet flows over less-weathered bedrock, especially after rain.

2.2 Subsurface Conditions and Groundwater

The subsurface profile found in boreholes BH1 to BH4 is summarized in Table 1.

Table 1 – Summary of Subsurface Profile

Geological Profile	Depth Interval	Description
TOPSOIL	0.0m to 0.4m/0.7m	Clayey Silty SAND; fine to coarse sand, low plasticity, dark brown, grass roots, moist, loose.
COLLUVIAL SOIL	0.4m/0.7m to 0.7m/1.1m	Gravelly Clayey SAND; fine to coarse sand, low plasticity, angular granite gravel to 50 mm, grey-brown, moist
RESIDUAL SOIL	0.7m/1.1m to 1.1m/1.4m	Clayey SAND; fine to coarse sand, low plasticity, grey-brown, yellow-brown, spotted white, moist
XW/HW/MW GRANITE BEDROCK	1.1m/1.4m to below 1.2m/1.6m	EW GRANITE; coarse grained, pale grey, spotted black, dry, extremely low strength. The boreholes terminated at refusal in medium strong to strong, highly weathered (HW) and moderately weathered (MW) granite bedrock. It is expected that the bedrock profile comprises a matrix of EW rock, with small to very large core-stones of medium strong to very strong rock.

Groundwater was not encountered and the soils were mostly dry or moist. However, temporary, perched seepages could be present within the more pervious colluvial soils following rainfall. The depth of unsuitable material, depth to the bedrock at each borehole and the depth to refusal are shown in Table 2 below.

Table 2 – Depth of Unsuitable Material, Depth to Bedrock and Depth to Refusal

Borehole No.	Depth of Unsuitable Material (Topsoil & Fill)	Depth to EW Bedrock (m)	Depth to Refusal (m)
BH1	0.6m	1.2m	1.2m
BH2	0.7m	1.1m	1.2m
BH3	0.6m	1.4m	1.6m
BH4	0.4m	1.2m	1.6m

*all refusals were on EW GRANITE or HW or MW core-stones within the EW GRANITE.

The shear strength properties of the various soil/rock layers are summarized in Table 3.

Table 3 – Soil & Rock Properties

Soil/Rock Property	Bulk Density, γb (kN/m^3)	c (kPa)	Φ' (degrees)	Elastic Modulus (MPa)	Active K_a	At Rest K_o	Passive K_p
Fill	17	0	25	8	0.41	0.58	2.46
Colluvial & Residual Soil	20	5	25	25	0.41	0.58	2.46
EW Granite Bedrock	22	10	30	50	0.5	0.5	3.0

γ – Bulk Unit Weight, Cu – Undrained Shear Strength, Φ – Internal Friction Angle, c – Cohesion.

3 DISCUSSIONS AND RECOMMENDATIONS

3.1 Site Classification

The colluvial soils at the site within the depth of suction change are reactive in terms of potential shrink-swell movements that may occur due to soil moisture changes. Due to the presence of uncontrolled fill materials exceeding 0.4m depth, the site is designated as a Class "P" (problem) site in accordance with AS2870. If the fill is removed, or if footings are founded in the colluvial/residual soil or extremely weathered material below the fill, a Class "M" (moderately reactive) category can be used in design of new footings. The characteristic ground surface movement "ys", as defined by AS2870 for the range of normal soil moisture conditions is estimated to be between 20mm to 30mm for the encountered subsurface profile described in Section 2.

Normal moisture conditions are those caused by seasonal and regular climatic effects.

Should earthworks (cut or fill) be undertaken on the site, or other activities which may cause abnormal moisture conditions to impact the soils within or near the building envelope beyond those addressed herein, the site classification shall be reassessed.

3.2 Building Footings & Slabs

AS2870 provides "deemed-to-comply" footing/slab designs, which for a Class "M" site includes stiffened rafts, stiffened footing slabs, waffle rafts, and strip and/or pad footings with above ground floors. Footings and slabs should be designed in accordance with the principles of AS2870.

Footings including thickened sections of slabs must be founded below any topsoil, loose material and uncontrolled fill, into the colluvial/residual soils. However, it is strongly recommended that all footings are founded in the weathered granite bedrock. Footings should be inspected by a geotechnical engineer to confirm the ground conditions. Table 4 below gives recommended allowable end bearing pressures for design purposes.

Table 4 - Recommended Foundation Design Parameters

Foundation Material Type	Depth Below existing surface level	Allowable End-Bearing Pressure		
		Strips/Beams	Pads	Bored Piers[1]
Newly Placed Controlled Fill (Section 5.6)	-	100 kPa	125 kPa	-
Colluvial/Residual Soils (medium dense or better)	Below 0.4m/0.7m	100 kPa	125 kPa	200 kPa
EW Granite Bedrock	Below 1.1m/1.4m	400 kPa	500 kPa	600 kPa

[1]Assumes a minimum embedment depth of 4 pile diameters

Consideration should be given to the design of footings where interaction with slopes, retaining walls, service trenches and existing foundations will occur, and specific geotechnical advice sought.

Ground slabs can be constructed on the natural soils or newly placed controlled fill, following the removal of any topsoil and uncontrolled fill material. Following excavation to required level, slab areas on soil should be proof-rolled by a pad foot roller to check for any weak, wet or deforming soils that may require replacement. Suitable replacement fill should be compacted in not thicker than 150mm layers to not less than 95%ModMDD.

If required for design of ground slabs, a modulus of subgrade reaction of 50kPa/mm can be assumed for a natural soil or controlled fill foundation, and 100kPa/mm for a weathered bedrock foundation.

3.3 Excavation Conditions & Use of Excavated Material

The depth of proposed excavations is generally expected to be less than 1m, but could be up to 2.5m depth. Such excavations would be through topsoil and colluvial soils, which are readily diggable by backhoe and medium sized excavator; however, floaters or boulders of granite bedrock could be encountered below ~1m/1.5m. Excavation of very strong granite boulders would require rock hammering or rock sawing.

The low and medium plasticity colluvial/residual soils and weathered granite bedrock can be used in controlled fill construction of building platforms, although rock particles should be broken down to <75mm size. Topsoil and the existing uncontrolled fill material should not be used in controlled fill construction, but could be used in non-structural applications such as landscaping.

If imported fill is required, a suitable select fill material would include a low or medium plasticity soil such as clayey sand or gravelly clayey sand, containing between 25% and 50% fines less than 0.075mm size (silt and clay), and no particles greater than 75mm size.

3.4 Stable Excavation Batters

Temporary site excavations to 1.5m depth can be formed near vertical, although loose topsoil and fill should be cut back at 1(H):1(V). If required and space allows, deeper temporary cuts can be formed at 1(H):1(V) or benched at 1.5m intervals in soils. A geotechnical engineer should inspect all cut batters during construction to confirm stability. Exposed temporary batters should be protected from the weather by black plastic pinned to the face with link-wire mesh, or similar.

Permanent cut & fill batter slopes should be formed at no steeper than 2(H):1(V) in soil. Permanent cuts in HW and less weathered bedrock could be formed at 1(H):1(V). All soil cut and fill surfaces should be protected against erosion by topsoiling and grassing, or other suitable means. Steeper permanent cuts should be supported by structural retaining walls.

3.5 Low Retaining Walls

Retaining walls constructed in open excavation, with the gap between the excavation face and the wall backfilled later, can be designed for an earth pressure distribution given by:

$$\sigma h = (K\gamma' h) + Kq$$

where,

σh is the horizontal earth pressure acting on the back of the wall, in kPa

K is the dimensionless coefficient of earth pressure; this can be assumed to be 0.4 when the top of the wall is unrestrained horizontally, and 0.6 when the top of the wall is restrained (i.e. by building slabs etc.)

γ' is the effective unit weight of the backfill, and can be assumed to be $20kN/m^3$ for a lightly compacted soil backfill

h is the height of the backfill, in metres

q is any uniform distributed vertical surcharge acting on the top of the backfill, in kPa

Apart from structural restraints such as floor slabs, resistance to overturning and sliding of retaining walls is provided by frictional and adhesive resistance on the base, and by passive resistance at the toe of the wall. For a natural soil or controlled fill foundation, an ultimate base friction factor ($\tan\delta$) of 0.4, base adhesion (c) of 5kPa, and allowable passive earth pressure coefficient Kp=2.5 can be used for calculation of sliding resistance. For a weathered granite bedrock foundation, an ultimate base friction factor ($\tan\delta$) of 0.4, base adhesion (c) of 10kPa, and allowable passive earth pressure coefficient Kp=3 can be used for calculation of sliding resistance.

Free-draining granular backfill or synthetic fabric drains should be installed behind all walls. These should connect to weep holes and/or a collector drain, and ultimately to the stormwater system. Granular backfill should be wrapped in a suitable filter fabric to minimise infiltration of silt/clay fines.

3.6 Controlled Fill Construction

For construction of any new fill foundation platforms and driveway subgrades, it is recommended that:

- Areas be fully stripped of all topsoil and uncontrolled fill material. A stripping depth of ~0.7m may be required. Stripped foundations should be proof-rolled by a vibratory pad-foot roller of not less than 9 tonne static mass to check for any weak or wet areas that would require replacement. No fill should be placed until a geotechnical engineer has confirmed the suitability of the foundation.

- Controlled fill comprising suitable site excavated or imported materials of not greater than 75mm maximum particle size, be compacted in not greater than 150mm layers to not less than 95%ModMDD at about OMC.

- Fill placement and control testing be overviewed and certified by a geotechnical engineer at Level 1 involvement of AS3798 – 1996 "Guidelines on Earthworks for Commercial & Residential Developments".

3.7 Design CBR Values

On-grade driveway subgrades should be stripped of all topsoil and fill, and soil subgrades then proof-rolled by a pad-foot roller to check for any wet or otherwise weak spots which may require additional removal. Suitable replacement fill can be compacted in not thicker than 150mm layers, to not less than 95%ModMDD.

On-grade carpark pavements are expected to comprise colluvial/resdiual soil or newly placed controlled fill of similar material. An indicative design CBR value of 5% can be used for colluvial/residual soils and controlled fill subgrades, while a CBR value of 10% can be used for cut, in-situ weathered granite subgrades. A geotechnical engineer should inspect prepared subgrades to confirm design values, and preferably view a proof-roll to identify any soft spots or other weaknesses.

3.8 Earthquake Site Factor

Table 2.3 of AS1170.4 "Minimum Design Loads on Structures - Part 4: Earthquake Loads" (Reference 4) lists the earthquake acceleration coefficients for major centres to be considered in structural design. The Perisher area has an acceleration coefficient of 0.08.

Section 4.2 of AS1170.4 "Minimum Design Loads on Structures – Part 4: Earthquake Loads" lists the site sub-soil classes to be considered in structural design. The site is classified as a "Class Ce – Shallow Soil Site".

3.9 Drainage and Foundation Maintenance

The effective drainage of the site is a prerequisite for satisfactory performance of building footings. Existing subsoil drainage should be augmented with new subfloor drainage (under proposed new concrete slab) adjacent to the existing external footings. Drainage should be directed away from foundations and collected by a suitably designed stormwater system to maintain normal soil moisture conditions.

Furthermore surface water run-off should be directed away from the new door entrance threshold with the installation a grated drainage channel and discharge to the existing stormwater system.

Trees, gardens, landscaping and ponds can also induce abnormal soil moisture conditions. Caution should be exercised when planting, or constructing these items near the perimeter of the structure.

4 Form 4 – Minimal Impact Certification

It is understood the site is within "Zone G" of the Kosciusko National Parks Alpine Resorts, so under the NSW Department of Planning Geotechnical Policy, a geotechnical investigation and slope instability risk assessment is required. However, as per Section 10.4 of The Policy, where only minor construction works are proposed, that present minimal or no geotechnical impact on the site or related land, then a "Form 4 - Minimal Impact Certification" can be provided instead. The signed Form 4 is attached.

A site inspection was carried out by Jeremy Murray, an experienced, Chartered, senior geotechnical engineer, and a site classification to AS2870 was conducted. Based on this, and a review of the architectural drawings, the following conclusions have been drawn:

- the current load-bearing capacity of the existing building will not be exceeded or adversely impacted by the proposed development, and
- the proposed works are of such 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 AS2870 "Residential slabs & footings", the site is classified as a Class "M" (moderately reactive) site.

5 Closure

Should you require any further information regarding this report, please do not hesitate to contact our office.

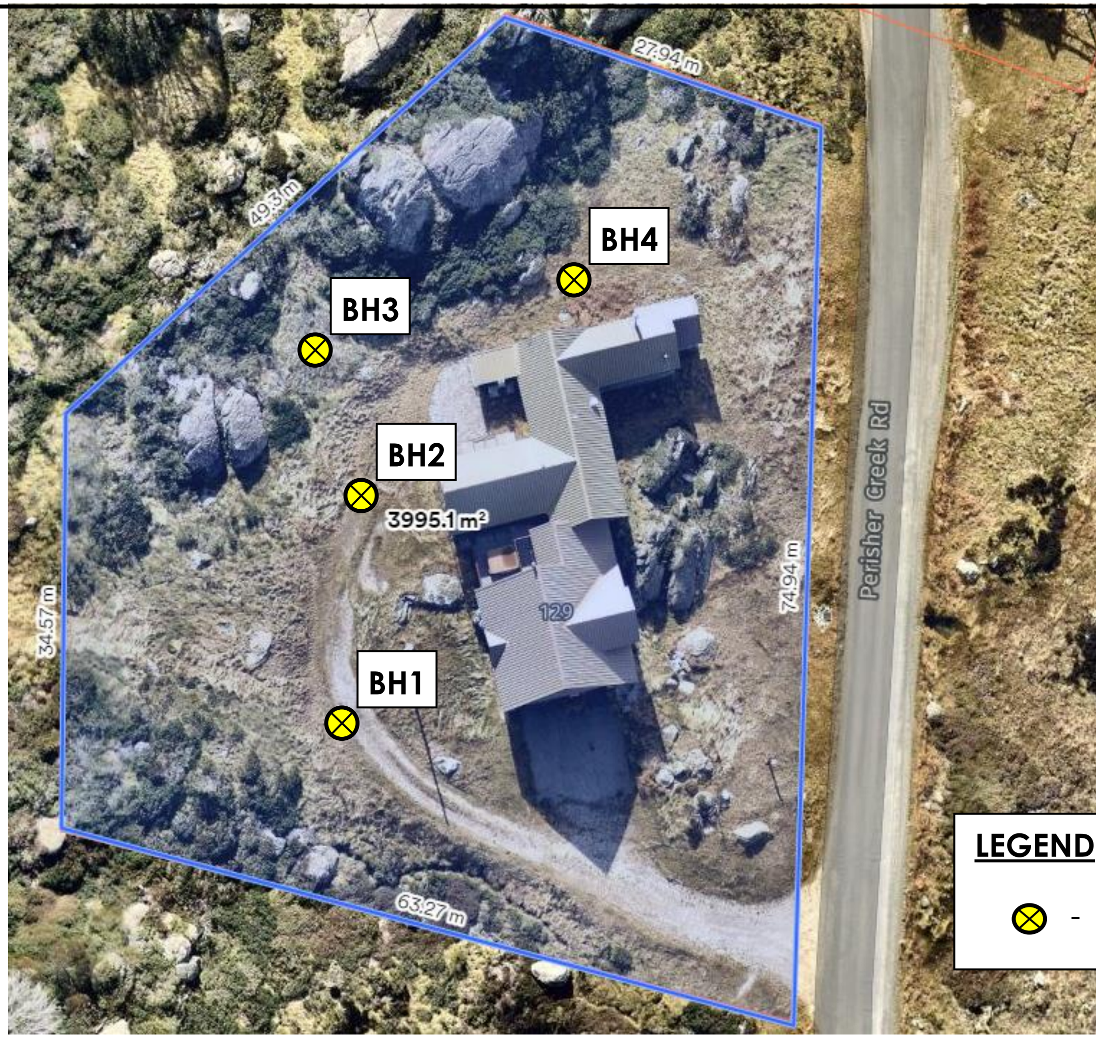
Yours faithfully,

ACT Geotechnical Engineers Pty Ltd

Jeremy Murray
Senior Geotechnical Engineer | Director
FIEAust CPEng Eng Exec NER RPEQ APEC Engineer IntPE(Aust)
Registered Professional Engineer of Queensland (RPEQ) #19719
NSW Professional Engineer Registration #PRE0001487

Attachments:

- Site Plan
- Borehole Logs
- Form 4
- Limitation of Geotechnical Reports



LEGEND

⊗ - Location of Test Holes

ALAN TAYLOR
PROPOSED ADDITIONS – MUDDLES LODGE – LOT 1, DP1175667, PERISHER CREEK ROAD, PERISHER VALLEY, NSW
SITE PLAN & LOCATION OF BOREHOLE

ACT Geotechnical Engineers Pty Ltd	**C14112**	**FIGURE 1**

Figure 2 – Site Photo 1

ACT Geotechnical Engineers Pty Ltd **C14112**

Figure 2 – Site Photo 2

ACT Geotechnical Engineers Pty Ltd **C14112**

Figure 2 – Site Photo 3

ACT Geotechnical Engineers Pty Ltd **C14112**

Figure 2 – Site Photo 4

ACT Geotechnical Engineers Pty Ltd **C14112**

Figure 2 – Site Photo 5

ACT Geotechnical Engineers Pty Ltd **C14112**

Figure 2 – Site Photo 6

Borehole Log

Borehole No.	BH1
Sheet	1 of 1
Job No.	C14112

CLIENT: Alan Taylor

PROJECT Geotechnical Investigation Report
Lot 1, DP1175667, Perisher Creek Road, Perisher Valley, NSW

Location : See Report
Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Push-tube
Hole Diameter : 50mm

Samples		Casing	Depth Metres	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Consistency or Relative Density	Field Test Results	Geological Profile
			0.6		SC	Clayey Silty SAND; fine to coarse sand, low plasticity, dark brown, grass roots, moist	LOOSE		TOPSOIL
			0.9		SC	Gravelly Clayey SAND; fine to coarse sand, low plasticity, angular granite gravel to 50 mm, grey-brown, moist	MEDIUM DENSE		COLLUVIAL SOIL
	Slow Seepage		1.0 1.2		SC	Clayey SAND; fine to coarse sand, low plasticity, grey-brown, spotted white, moist	MEDIUM DENSE		RESIDUAL SOIL
			1.8			BOREHOLE TERMINATED AT 1.2m Refusal on bedrock			

Logged By : MA	Date : 27/3/23	Checked By : JM	Date : 27/3/23

BOREHOLE/EXCAVATION LOG C14112-LOGS.GPJ ACT GEO.GDT 27/3/23

ACT Geotechnical Engineers

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Borehole Log

Borehole No.	BH2
Sheet	1 of 1
Job No.	C14112

CLIENT: Alan Taylor

PROJECT: Geotechnical Investigation Report
Lot 1, DP1175667, Perisher Creek Road, Perisher Valley, NSW

Location : See Report
Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Push-tube
Hole Diameter : 50mm

Samples		Casing	Depth Metres	Graphic Log	U.S.C.S.	Material Description, Structure (Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure)	Consistency or Relative Density	Field Test Results	Geological Profile
			0.1		SC	Clayey Silty SAND; fine to coarse sand, low plasticity, dark brown, grass roots, moist	LOOSE		TOPSOIL
			0.5		SC	Gravelly Clayey SAND; fine to coarse sand, low plasticity, angular granite gravel and cobbles to 80 mm size, trace brick pieces, grey-brown, moist	MEDIUM DENSE		FILL
			0.7		SC	Buried TOPSOIL; Clayey Silty SAND; fine to coarse sand, low plasticity, dark brown, grass roots, moist	MEDIUM DENSE		TOPSOIL
			1.0 1.1		SC	Gravelly Clayey SAND; fine to coarse sand, low plasticity, angular granite gravel to 20 mm size, red-grey, grey-brown, dry-moist	DENSE		COLLUVIAL/RESIDUAL SOIL
			1.2			HW/MW GRANITE; coarse grained, pale grey, spotted black, dry, medium strength			BEDROCK
			1.8			BOREHOLE TERMINATED AT 1.2m Refusal on bedrock			

Logged By : MA	Date : 27/3/23	Checked By : JM	Date : 27/3/23

Borehole Log

Borehole No.	BH3
Sheet	1 of 1
Job No.	C14112

CLIENT: Alan Taylor

PROJECT: Geotechnical Investigation Report
Lot 1, DP1175667, Perisher Creek Road, Perisher Valley, NSW

Location : See Report
Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Push-tube
Hole Diameter : 50mm

Samples	Casing	Depth Metres	Graphic Log	U.S.C.S.	Material Description, Structure (Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure)	Consistency or Relative Density	Field Test Results	Geological Profile
				SC	Clayey Silty SAND; fine to coarse sand, low plasticity, dark brown, grass roots, moist	LOOSE		TOPSOIL
		0.6		SC	Gravelly Clayey SAND; fine to coarse sand, low plasticity, angular granite gravel to 50 mm, grey-brown, moist	MEDIUM DENSE		COLLUVIAL SOIL
		1.0						
		1.1		SC	Clayey SAND; fine to coarse sand, low plasticity, yellow-brown, spotted white, moist	MEDIUM DENSE		RESIDUAL SOIL
		1.4			XW GRANITE; coarse grained, pale grey, spotted black, dry, medium strength			BEDROCK
		1.6			BOREHOLE TERMINATED AT 1.6m Refusal on bedrock			
		1.8						

Logged By : MA	Date : 27/3/23	Checked By : JM	Date : 27/3/23

BOREHOLE/EXCAVATION LOG C14112-LOGS.GPJ ACT GEO.GDT 27/3/23

ACT Geotechnical Engineers

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Borehole Log

Borehole No.	BH4
Sheet	1 of 1
Job No.	C14112

CLIENT: Alan Taylor

PROJECT: Geotechnical Investigation Report
Lot 1, DP1175667, Perisher Creek Road, Perisher Valley, NSW

Location : See Report
Collar Level : Not Known
Angle From Vertical : 0°
Bearing : N.A.

Equipment Type : Push-tube
Hole Diameter : 50mm

Samples		Casing	Depth Metres	Graphic Log	U.S.C.S.	Material Description, Structure (Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure)	Consistency or Relative Density	Field Test Results	Geological Profile
					SC	Clayey Silty SAND; fine to coarse sand, low plasticity, dark brown, grass roots, moist	LOOSE		TOPSOIL
			0.4		SC	Gravelly Clayey SAND; fine to coarse sand, low plasticity, angular granite gravel to 50 mm, grey-brown, moist	MEDIUM DENSE		COLLUVIAL SOIL
			0.7		SC	Clayey SAND; fine to coarse sand, low plasticity, yellow-brown, spotted white, moist	MEDIUM DENSE		RESIDUAL SOIL
			1.0						
			1.2			XW GRANITE; coarse grained, pale grey, spotted black, dry, medium strength			BEDROCK
			1.6			BOREHOLE TERMINATED AT 1.6m Refusal on bedrock			
			1.8						

Logged By : MA	Date : 27/3/23	Checked By : JM	Date : 27/3/23

BOREHOLE/EXCAVATION LOG C14112-LOGS.GPJ ACT GEO.GDT 27/3/23

Planning & Environment

Geotechnical Policy
Kosciuszko Alpine Resorts

Form 4 – Minimal Impact Certification

DA Number: ________________________

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 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 in relation to a nil or minimal geotechnical impact assessment and site classification

I,

Mr ☒ Ms ☐ Mrs ☐ Dr ☐ Other [ ]

First Name	Family Name
Jeremy	Murray

OF

Company/organisation

ACT Geotechnical Engineers

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

Proposed Basement Alterations @ 129 Perisher Creek Road, Perisher Valley

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

(List of documentation reviewed)

Architectural Plans Issue E - Jude Little 08/12/2023
Structural Engineering 21090 Rev C - Camstruct Consulting 11/12/2023
Structural Design Certificate 21090 Cert C - Camstruct Consulting 11/12/2023
Geotech Report C14112 - ACT Geotechnical Engineers – 30/1/2024

I have determined that;

☑ the current load-bearing capacity of the existing building 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)

"M"

☑ 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.

2. Signatures

Signature	Chartered professional status
[signature]	CP Eng # 2122247
Name	**Date**
Jeremy Murray	30/1/24

3. Contact details

Alpine Resorts Team
Shop 5A, 19 Snowy River Avenue
P O Box 36, JINDABYNE NSW 2627
Telephone: 02 6456 1733
Facsimile: 02 6456 1736
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DESCRIPTION AND CLASSIFICATION OF SOILS

The methods of description and classification of soils used in this report are based on the Australian Standard 1726 – 1993, Geotechnical site investigations. In general, descriptions cover the following properties – soil type, colour, secondary grain size, structure, inclusions, strength or density and geological description.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (e.g. sandy clay) on the following basis:

Classification	**Particle Size**
Clay	Less than 0.002mm
Silt	0.002mm to 0.06mm
Sand	0.06mm to 2.00mm
Gravel	2.00mm to 60.00mm
Cobbles	60mm (63mm) to 200mm
Boulders	>200mm

Soils are also classified according to the Unified Soil Classifications System which is included in this Appendix. Rock types are classified by their geological names.

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

Consistency	**Shear Strength su(kPa) (Representative Undrained Shear)**	
Very soft	< 12	<2 (~SPT "N")
Soft	12 - 25	2-4
Firm	25 - 50	4-8
Stiff	50 – 100	8-15
Very Stiff	100 – 200	15-30
Hard	> 200	>30

Non-cohesive soils are classified on the basis of relative density, generally from the results of in-situ standard penetration tests as below:

Term	**Relative Density (%)**	**SPT Blows/300mm 'N'**
Very loose	< 15	<4
Loose	15-35	4-10
Medium dense	35-65	10-30
Dense	65-85	30-50
Very Dense	>85	>50

SAMPLING

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

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

Undisturbed samples are generally taken by one of two methods:

1. Driving or pushing a thin walled sample tube into the soil and withdrawing with a sample of soil in a relatively undisturbed state.

2. Core drilling using a retractable inner tube (R.I.T.) core barrel.

Such samples yield information on structure and strength in additions to that obtained from disturbed samples and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

PENETRATION TESTING

The relative density of non-cohesive soils is generally assessed by in-situ penetration tests, the most common of which is the standard penetration test. The test procedure is described in Australian Standard 1289 “Testing Soils for Engineering Purposes” Testing Soils for Engineering Purposes” – Test No. F3.1.

The standard penetration test is carried out by driving a 50mm diameter split tube penetrometer of standard dimensions under the impact of a 63 kg hammer having a free fall of 750mm.

The “N” value is determined as the number of blows to achieve 300mm of penetration (generally after disregarding the first 150mm penetration through possibly disturbed material). The results of these tests can be related empirically to the engineering properties of the soil.

The test is also used to provide useful information in cohesive soils under certain conditions, a good quality disturbed sample being recovered with each test. Other forms of in situ testing are used under certain conditions and where this occurs, details are given in the report.

DEFINITIONS OF ROCK, SOIL, AND DEGREES OF CHEMICAL WEATHERING

GENERAL DEFINITIONS – ROCK AND SOIL

ROCK In engineering usage, rock is a natural aggregate of minerals connected by strong and permanent cohesive forces.

Note: Since "strong" and "permanent" are subject to different interpretations, the boundary between rock and soil is necessarily an arbitrary one.

SOIL In engineering usage, soil is a natural aggregate of mineral grains which can be separated by such gentle mechanical means as agitation in water, can be remoulded and can be classified according to the Unified Soil Classification System. Three principal classes of soil recognized are:

Residual soils: soils which have been formed in-situ by the chemical weathering of parent rock. Residual soil may retain evidence of the original rock texture or fabric or, when mature, the original rock texture may be destroyed.

Transported soils: soils which have been moved from their places of origin and deposited elsewhere. The principal agents of erosion, transport and deposition are water, wind and gravity. Two important types of transported soil in engineering geology and materials investigations are:

Colluvium – a soil, often including angular rock fragments and boulders, which has been transported downslope predominantly under the action of gravity assisted by water. The principle forming process is that of soil creep in which the soil moves after it has been weakened by saturation. It may be water borne for short distances.

Alluvium – a soil which has been transported and deposited by running water. The larger particles (sand and gravel size) are water worn.

Lateritic soils: soils which have formed in situ under the effects of tropical weathering include all reddish residual and non residual soils which genetically form a chain of material ranging from decomposed rock through clay to sesqui-oxide rich crusts. The term does not necessarily imply any compositional, textural or morphological definition; all distinctions useful for engineering purposes are based on the differences in geotechnical characteristics.

ROCK WEATHERING DEFINITIONS

Extremely Weathered (EW)	Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered (HW)	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of the chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered (MW)	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered (SW)	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance, usually by limonite, has taken place. The colour and texture of the fresh rock is recognisable.
Fresh (Fr)	Rock substance unaffected by weathering.

The degrees of rock weathering may be gradational. Intermediate stages are described by dual symbols with the prominent degree of weathering first (e.g. EW-HW).

The various degrees of weathering do not necessarily define strength parameters as some rocks are weak, even when fresh, to the extent that they can be broken by hand across the fabric, and some rocks may increase in strength during the weathering process.

Fresh drill cores of some rock types, such as basalt and shale may disintegrate after exposure to the atmosphere due to slaking, desiccation, expansion or contraction, stress relief or a combination of any of these factors.

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS

This classification system provides a standardised terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable. Where other rock types are encountered, such as in dykes, standard geological descriptions are used for rock types and the same descriptions as below are used for strength, fracturing and weathering.

Under this system rocks are classified by Rock Type, Strength, Stratification Spacing, Degree of Fracturing and Degree of Weathering. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc) where these are relevant.

ROCK TYPE DEFINITIONS

ROCK TYPE	DEFINITION
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2mm) fragments.
Sandstone:	More than 50% of the rock consists of sand sized (0.06 to 2mm) grains.
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of silt or clay sized particles and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g. clayey sandstone, sandy shale.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly Laminated	< 6mm
Laminated	6mm to 20mm
Very thinly bedded	20mm to 60mm
Thinly bedded	60mm to 0.2m
Medium bedded	0.2m to 0.6m
Thickly bedded	0.6m to 2m
Very thickly bedded	> 2m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks.

Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20mm, and mostly of width less than the core diameter
Highly Fractured:	Core lengths are generally less than 20mm – 40mm with occasional fragments.
Fractured:	Core lengths are mainly 30mm – 100mm with occasional shorter and longer section.
Slightly Fractured:	Core lengths are generally 300mm – 1000mm with occasional longer sections and occasional sections of 100mm – 300mm.
Unbroken:	The core does not contain any fracture.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics.

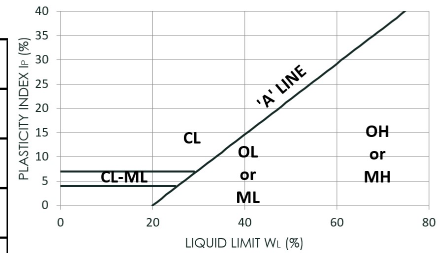
Term	Point Load Index Is(50) MPa	Field Guide	Approx qu MPa*
Extremely Weak:	0.03	Easily remoulded by hand to a material with soil properties.	0.7
Very Weak:	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.	2.4
Weak:	0.3	A piece of core 150mm long x 50mm dia. May be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium Strong:	1	A piece of core 150mm long x 50mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
Strong: (SW)	3	A piece of core 150mm long x 50mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very Strong (SW)	10	A piece of core 150mm long x 50mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely Strong (Fr)	>10	A piece of core 150mm long x 50mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	>240

The approximate unconfined compressive strength (qu) shown in the table is based on an assumed ration to the point load index of 24:1. This ratio may vary widely.

Unified Soil Classification System (Metricated)
Data for Description Indentification and Classification of Soils

MAJOR DIVISIONS				DESCRIPTION: Group Symbol	Graphic Symbol	TYPICAL NAME	DESCRIPTIVE DATA	FIELD IDENTIFICATION		GRAVELS AND SANDS: GRADATIONS		NATURE OF FINES	DRY STRENGTH	Group Symbol	LABORATORY CLASSIFICATION	% [2] < 0.06mm	PLASTICITY OF FINE FRACTION			NOTES
COARSE GRAINED SOILS	More than 50% by dry mass, less than 60mm is greater than 0.06mm.	GRAVELS	More than 50% of coarse grains are greater than 2.0mm	GW		Well graded gravels and gravel-sand mixtures, little or no fines	Give typical name, indicate approximate percentages of sand and gravel, maximum size, angularity, surface condition and hardness of the coarse grains, local or geological name and other perfinent descriptive information, symbols in parenthesis. For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics. EXAMPLE: Silty Sand, gravelly, about 20% hard, angular gravel particles, 10mm maximum size, rounded and sub angular sand grains coarse to fine, about 15% non-plastic fines with low dry strength, well compacted and moist in place, light brown alluvial sand, (SM)	Determine approximate percentages of material over 60mm size, maximum size, shape, surface texture, hardness of material, geological description. Identify on estimated percentage mass of the various fractions.	COARSE GRAINED SOILS More than half of the material less than 60mm is larger than 0.06mm	GOOD	Wide range in grain size	"Clean" materials (not enough fines to band coarse grains)	None	GW	Use the gradation curve of material passing 60mm for classification of fractions according to criteria given under "Major Division".	0-5	-	>4	Between 1 and 3	1. Identify Fines by the method given for fine grained soils. 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.06mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols eg SP-SM GW-GC
				GP		Poorly graded gravels and gravel-sand mixtures, little or no fines				POOR	Predominantly one size or range of sizes			GP		0-5	-	Fails to comply with above		
		GRAVELLY SOILS		GM		Silty gravels, gravel-sand-silt mixtures				GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are non-plastic (1)	None to medium	GM		12-50	Below 'A' line and Ip >7	-	-	
				GC		Clayey gravels gravel-sand-clay mixtures						Fines are plastic (1)		GC		12-50	Above 'A' line and Ip > 7	-	-	
		SANDS	More than 50% of coarse grains are greater than 2.0mm	SW		Well graded sands and gravelly sands, little or no fines				GOOD	Wide range in grain size	"Clean" materials (not enough fines to band coarse grains)	None	SW		0-5	-	>6	between 1 and 3	
				SP		Poorly graded sands and gravelly sands, little or no fines				POOR	Predominantly one size or range of sizes			SP		0-5	-	Fails to comply with above		
		SANDY SOILS		SM		Silty sand, sand-silt mixtures				GOOD TO FAIR	"Dirty" materials (Excess of fines)	Fines are non-plastic (1)	None to medium	SM		12-50	Below 'A' line or Ip < 4	-	-	
				SC		Clayey sands, sand-clay mixtures						Fines are plastic (1)		SC		12-50	Above 'A' line and Ip > 7	-	-	

MAJOR DIVISIONS			Group Symbol	Graphic Symbol	TYPICAL NAME	DESCRIPTIVE DATA	FIELD IDENTIFICATION		SILT AND CLAY FRACTION — Fraction smaller than 0 20mm AS sieve size: DRY STRENGTH	DILATANCY	TOUGHNESS	Group Symbol	LABORATORY CLASSIFICATION		PLASTICITY OF FINE FRACTION
FINE GRAINED SOILS	More than 50% by dry mass, less than 6mm is less than 0.06mm	Liquid Limit less than 50%	ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.	Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains, colour in wet condition, odour if any, local or geological name and r pertinent descriptive information, symbols in parenthesis. For undisturbed soil add information on structure, stratification, consistancy in undisturbed and remoulded states, moisture and drainage conditions. EXAMPLE Clayey Silt, brown, low plasticity, small percentage of fine sand, numerous vertical root-holes, firm and dry in place, fill, (ML).	FINE GRAINED SOILS More than half of the material less than 50mm is less than 0.06mm	0.05mm is about the smallest particle visible to the naked eye	None to low	Quick to slow	None	ML		More than 50% passing 0.06mm	Below 'A' line
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.				Medium to high	None to very slow	Medium	CL			Above 'A' line
			OL		Organic silts and organic silty clays of low plasticity				Low to medium	Slow	Low	OL			Below 'A' line
		Liquid Limit more than 50%	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.				Low to medium	Slow to none	Low to medium	MH			Below 'A' line
			CH		Inorganic clays of high plasticity, fat clays.				High to very high	None	High	CH			Above 'A' line
			OH		Organic clays of medium to high plasticity.				Medium to high	None to very slow	Low to medium	OH			Below 'A' line
			Pt		Peat muck and other highly organic soils.		Readily identified by colour, odour, spongy feel and generally by fibrous texture					Pt*	*Effervescence with H2O2		



PLASTICITY CHART
FOR CLASSIFICATION
OF FINE GRAINED SOILS

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Limitations in the Use and Interpretation of this Geotechnical Report

Our Professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject development and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive borehole and test pit logs, cross- sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory bore holes, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory bore holes and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between conducting this investigation and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and the recommendations considering the changed conditions and time lapse.

The summary bore hole and test pit logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the test holes progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The bore hole and test pit logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Soil conditions at the other locations may differ from conditions occurring at these bore hole and test pit locations. Also, the passage of time may result in a change in the soil conditions at these test locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, bore holes or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report: nor can our company be responsible for any construction activity on sites other than the specific site referred to in this report.