RDA Consulting

GEOTECHNICAL • CIVIL • ENVIRONMENTAL

26 August 2022

Sravan Kumar Bade

Reflekt Design Limited

52746 REFLEKT BURNBY GEOTECH

SHALLOW SOILS INVESTIGATION AND ASSESSMENT FOR 78 BURNBY DRIVE, TE ANAU

Dear Sravan,

1. INTRODUCTION

RDA Consulting were commissioned by Reflekt Design Limited, in a signed Short Form Agreement dated the 15th of August 2022, to undertake a Shallow Soils Investigation and Assessment of the site at 78 Burnby Drive, Te Anau.

RDA Consulting's scope of work was to undertake a site assessment in accordance with Section 3 of the New Zealand Standards for Timber Framed Buildings (NZS 3604:2011) to determine if the soils meet the definition of "good ground". For soil to meet the definition of "good ground" it must have an Ultimate Bearing Pressure of 300 kilopascals (kPa). Evidence of good ground is where foundations on buildings show no signs of settlement, there is no evidence of landslides or buried services nearby, there is no potential for liquefaction or lateral spread, and there is no organic soil (topsoil), peat, soft clay or uncertified or uncontrolled fill.

Plans for the proposed dwelling were provided and these showed the structure to be a single story NZS3604 style house. The ground floor area of the building is 314.68 m^2, as described in the plans provided. Based on the recommendations in Sections 3.3.6 and 3.3.8 of NZS3604:2011, a minimum of six Scala Penetrometer tests and six hand auger boreholes would be required for a building of this size.

2. BEARING CAPACITY REQUIREMENTS

In addition to the definition provided above, "good ground" will have a bearing capacity of not less than 300 kPa when the number of blows per 100 mm depth of penetration at the test site exceeds:

- Five down to a depth equal to twice the width of widest footing below the underside of the proposed footing.
- Three at greater depths.

Providing the set blow count is relatively uniform, the number of blows per 100 mm may be obtained by averaging the number of blows for depths not exceeding 300 mm.

Furthermore, "good ground" must not have the following:

- Potentially compressible ground such as topsoil, soft soils such as clays which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids.
- Expansive soils being those that have a liquid limit of more than 50%, when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested from the liquid limit in accordance with NZS 4402 Test 2.6.
- Any ground which could foreseeably experience movement of 25 mm or greater for any reason including one, or a combination of land instability, ground creep, subsidence, liquefaction, lateral spread, seasonal swelling and shrinkage, frost heave, changing groundwater level, erosion, dissolution of soil in water and effects of tree roots.

3. DESKTOP REVIEW

A review of the Environment Southland natural hazard overlay on the website BEACON (https://maps.es.govt.nz) shows the site to have moderate risk of liquefaction and negligible natural hazards. Lateral spreading is not addressed by these maps and a site-specific assessment has been incorporated based on a visual assessment of the site and standard geotechnical assessment methods.

A copy of the BEACON hazard map for liquefaction is attached to this report. The results from the liquefaction and lateral spreading assessment are contained within the results section.

To assess the potential risk for liquefaction and/or lateral spreading, RDA use a combination of methods. These include, but a not limited to, a desktop assessment, previous geotechnical knowledge of the immediate area, and the on-site shallow soil investigation results.

There is a seismic risk for the region, which is typically mitigated by a prudent design, the MBIE guidelines and NZS3604.

No other natural hazards have been identified.

A review of the Environment Southland (ES) Selected Land Use Sites (SLUS) register on the BEACON website (https://maps.es.govt.nz) was completed. At the time of this review, the site was not identified on the Hazardous Activities and Industries List (HAIL), by ES. However, when the site is not on the SLUS register this does not mean that HAIL activity has not occurred there.

4. FIELDWORK

A site visit by an Engineering Geologist from RDA Consulting was completed on the 18th of August 2022. The investigation undertaken during the visit consisted of:

- Six Scala Penetrometer tests.
- Six hand auger boreholes.

The test results and borehole logs are attached.

The site was vacant with no apparent earthworks or filling. The boreholes undertaken did not encounter any evidence of filling.

Boreholes were attempted though refusal was encountered at shallow depths due to dense gravel soils. Due to the consistency of the soils at the site, six hand augers were completed to establish the depth of the topsoil across the building platform, and six Scala penetrometer tests were determined to be sufficient to confirm the site conditions. During development of the building site a subgrade inspection should be completed at the time of excavation.

5. RESULTS

A liquefaction risk assessment has been completed for the proposed dwelling. To assess the potential risk for liquefaction and/or lateral spreading, RDA use a combination of methods. A desktop assessment, previous geotechnical knowledge of the immediate area, and the on-site shallow soil investigation results. RDA conclude that the liquefaction risk potential is negligible beneath the building footprint, and lateral spreading is not considered a potential hazard.

The Scala results have shown that the soils in each test location have Geotechnical Ultimate Bearing Capacity strengths of greater than 300 kPa, as measured in accordance with NZS3604:2011. The remaining constraints in Section 2 above have also been satisfied and therefore the testing confirms that the area tested meets the definition of “good ground”, generally between 0.15 meters below ground level (mbgl) to 0.35 mbgl. The attached Test Location Plan shows the location where tests were undertaken onsite.

- Gravelly alluvial soils are~~was~~ the predominant soil encountered in the hand auger boreholes.
- Depth of topsoil varied between 0.20 mbgl and 0.40 mbgl in the boreholes.
- No groundwater was encountered in any of the boreholes.
- The Scala Penetrometer tests met refusal on dense gravel at all test locations between 0.25 mbgl and 0.45 mbgl.
- These results indicate the depth where the definition as per NZS3604 is met.

Table 1: Scala penetrometer test results table.

SCALA NUMBER	DEPTH TO 300 kPa (mbgl)	DEPTH TO 200 kPa (mbgl)	DEPTH TO TEST COMPLETION (mbgl)	DEPTH TO REFUSAL/ BOUNCING (mbgl)
1	0.25	>0.05	0.30	0.30
2	0.25	0.05	0.35	0.35
3	0.35	0.05	0.40	0.40
4	0.25	0.05	0.40	0.40

5	0.15	>0.05	0.25	0.25
6	0.35	0.05	0.45	0.45

Table 2: Hand auger borehole results table.

HAND AUGER NUMBER	DEPTH OF TOPSOIL/ UNSUITABLE MATERIALS (mbgl)	DEPTH OF FILL (mbgl)	SOIL TYPES ENCOUNTERED	DEPTH OF BOREHOLE (mbgl)	DEPTH TO GROUNDWATER (mbgl)
1	0.20	NE	Sandy Clayey SILT/ Gravelly Clayey SILT	0.40	NE
2	0.20	NE		0.30	NE
3	0.25	NE		0.40	NE
4	0.20	NE		0.30	NE
5	0.20	NE		0.30	NE
6	0.40	NE		0.50	NE

Notes: NE = Not encountered. Refer to borehole logs attached for full details.

6. RECOMMENDATIONS AND DISCUSSION

A liquefaction risk assessment has been completed for the proposed dwelling. RDA conclude that, due to the dense gravels encountered, the potential risk of liquefaction from a seismic event is negligible beneath the building footprint, and that lateral spreading is not considered a potential hazard.

The Scala results have shown that the soils in each test location have meet the Geotechnical Ultimate Bearing Capacity strength of 300 kPa required, in accordance with NZS3604:2011 at the depths as shown in Table 1.

All topsoil and organic matter beneath the proposed building footprint will need to be removed and replaced with compacted certified fill as per NZS4431 to achieve the foundation levels required. If excavations are undertaken and the removed soils are transported using a public roadway, ensure that a stabilised entrance way is constructed at the entrance and exit of the site to enable erosion and sediment control.

Any foundations on fill shall have the fill placed and compacted in accordance with NZS4431~~:2022~~, with certification by a suitably qualified engineer. It is reasonable to expect that fill foundation soils that are placed in accordance with NZS4431 will also achieve 300 kPa Geotechnical Ultimate bearing capacity stresses in accordance with NZS3604 Section 3 testing requirements.

Settlement is expected to be within limits set by NZS3604 for the above allowable bearing capacity stresses and development and design in accordance with NZS3604 building loads.

Where a cut and fill boundary is present with the foundation extents, consideration of differential settlement across the boundary shall be addressed by the structural engineer. Or RDA Consulting contacted for more specific advice.

The foundations suitable for the site are typical NZS3604 types with subgrade remediation for the topsoil encountered or the more thermally beneficial slabs such as waffle raft style slabs by suppliers such as MAXRaft, RibRaft, Allied Superslab or other proprietary foundation systems.

Seasonal shrink and swell effects from freeze thaw effects are relevant for the region and it is recommended where NZS3604:2011 foundations are proposed, all perimeter footings are embedded at least 0.4 m below finished ground levels with careful consideration given to final ground level clearances from exterior claddings.

At the time of construction all foundation excavation subgrades should be inspected, by a suitably qualified Geoprofessional, to ensure foundation conditions are as reported and the appropriate design assumptions for bearing capacity by the structural engineer are met.

Please note this report is not a detailed design report for consent purposes or construction, if design elements are requested RDA can provide this additional scope of works, and any safety in design elements to be considered.

7. HEALTH AND SAFETY

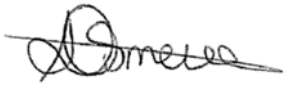
This report is not considered a detailed design report, it is a recommending report for others to determine design elements and construction. Any party utilising this information is responsible for ensuring the safety in design considerations and risk framework are undertaken as well as health and safety in the workplace of all subsequent practitioners and contractors that would be considered to be encapsulated under the Health and Safety Act.

8. APPLICABILITY

Findings presented as part of this letter are for the sole use of Reflekt Design Limited, in accordance with the specific scope and the purposes outlined above. While other parties may find this reporting useful, the findings are not intended for use by other parties and may not contain sufficient information for the purposes of other parties or other uses.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report.

Prepared by:



Stephanie Osmers
BSci (Geol)
Engineering Geologist

Reviewed by:

Mark Adam
BSci (Geol), PMEG
Engineering Geologist

52746 Reflekt Burnby Geotech - Shallow Soils Investigation Letter

☑ Issued, date sent 26/08/2022

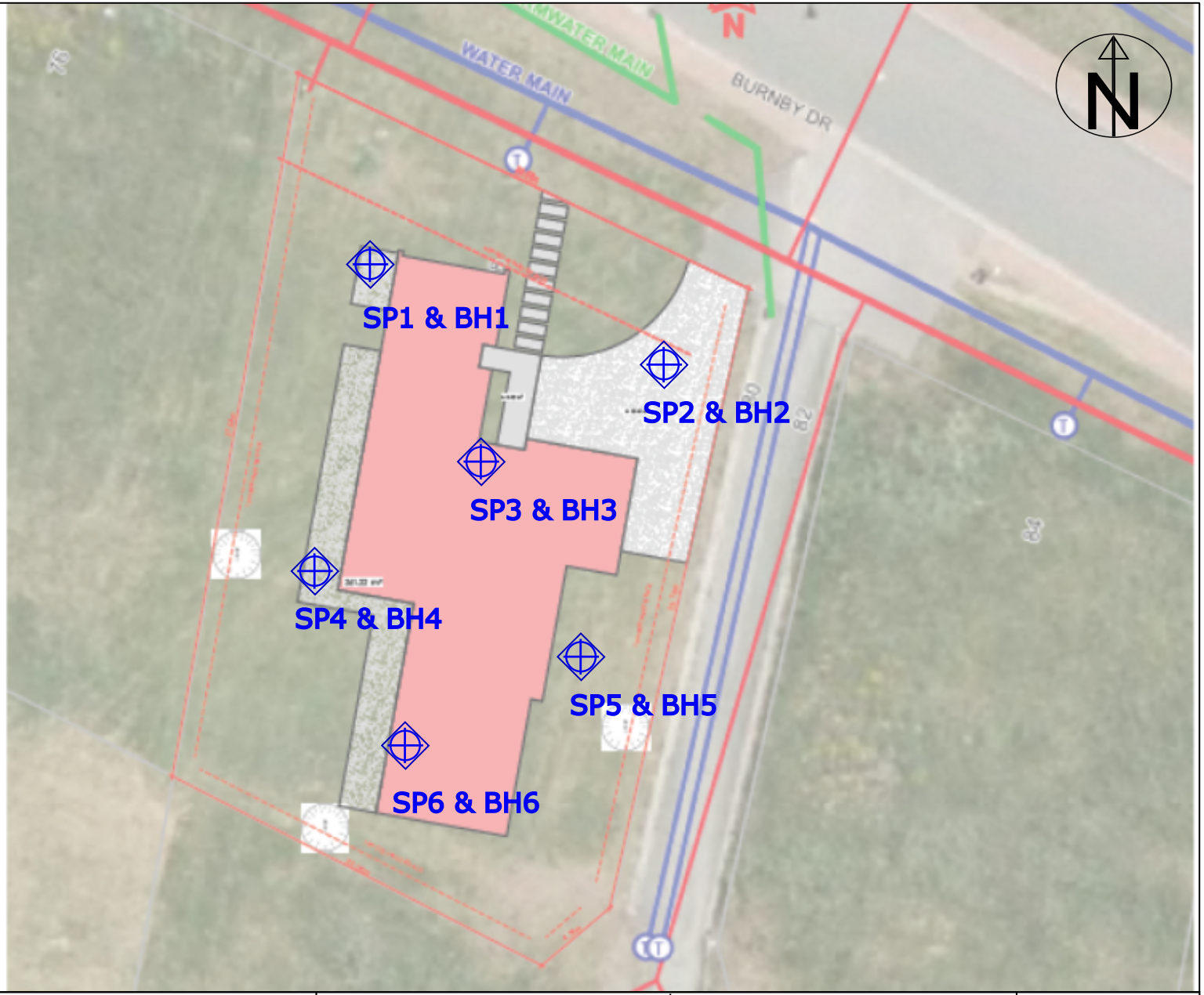
Attached: Test Location Plan, Natural Hazards Map, Scala Logs SP1-SP6, Borehole Log HA1-HA6

PHOTOS:

Photo 1: Overview of the site looking North.

Legend:

Location of Scala and Borehole test



Engineering firm: www.rda.co.nz RDA Consulting GEOTECHNICAL • CIVIL • ENVIRONMENTAL	Project: Reflekt Burnby Geotech 78 Burnby Drive, Te Anau	Client: Reflekt Design Limited	Drawing Title: Test Location Plan Job Number: 52746	Scale: NTS Date: 18/08/2022 Drawing No. 1

BEACON
Environment Southland Mapping Service

78 Burnby Drive, Te Anau - Natural Hazards Map

August 24, 2022

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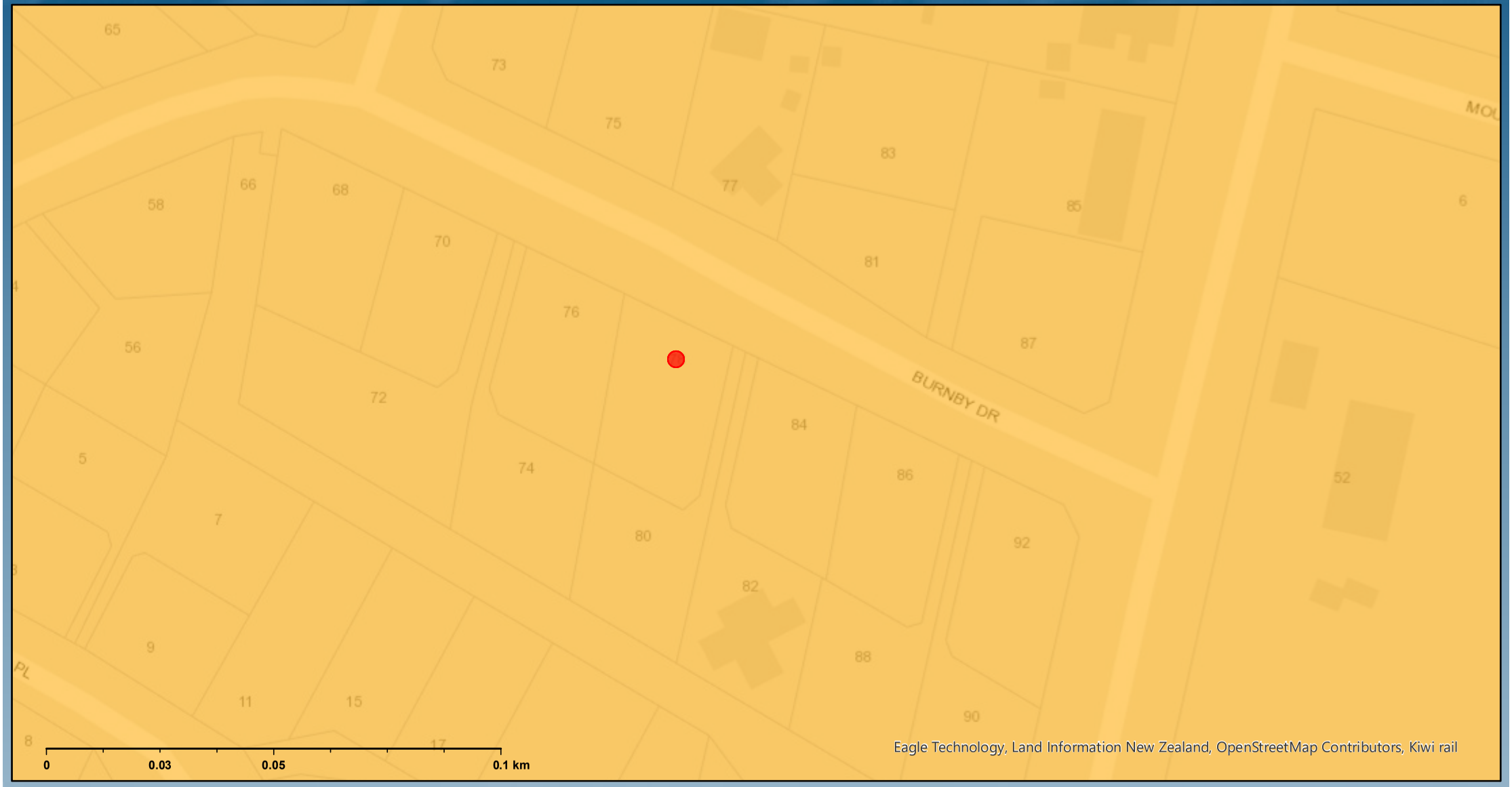

Liquefaction Risk

Medium

Environment Southland uses reasonable endeavours but does not warrant that this information is current, complete or accurate. Professional or specialist advice should be obtained before taking or refraining from taking any action on the basis of this information. To the extent permitted by law, Environment Southland will not be liable for any loss, liability or costs suffered or incurred as a result of any reliance placed on this information.

SCALA PENETROMETER RESULTS

JOB NUMBER:	52746	PROJECT:	Reflekt Burnby Geotech
		LOCATION:	78 Burnby Drive, Te Anau
CO-ORDINATES:	mE	DATE:	18-Aug-22
See attached plan	mN	OPERATOR:	SJO

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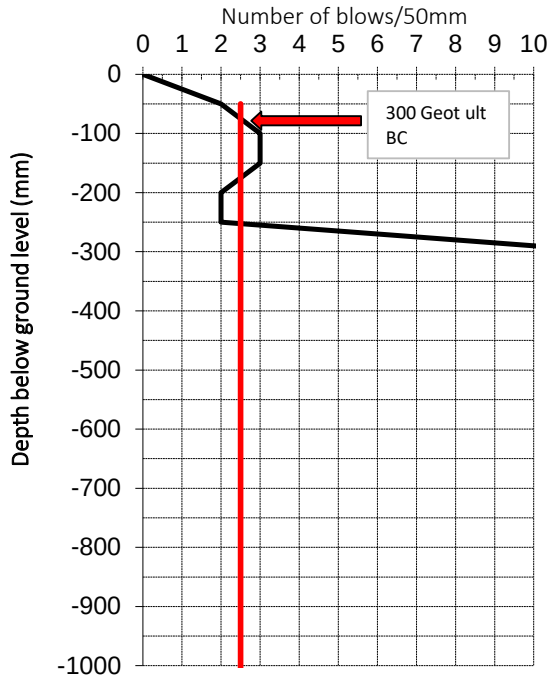
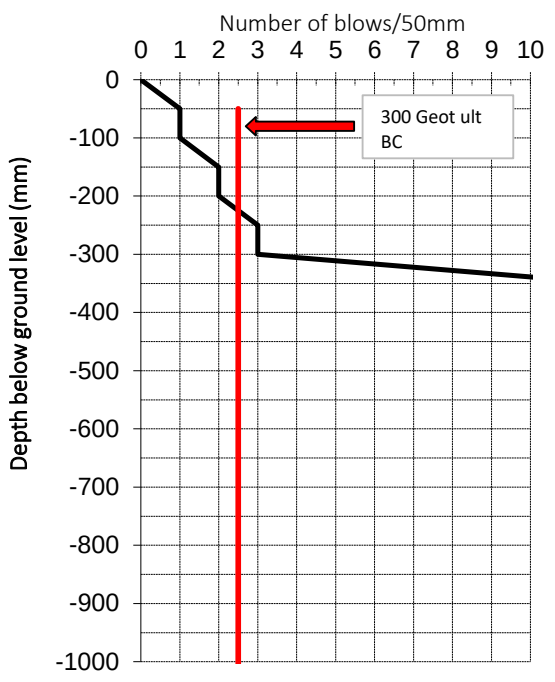
Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7

SP1



SP2



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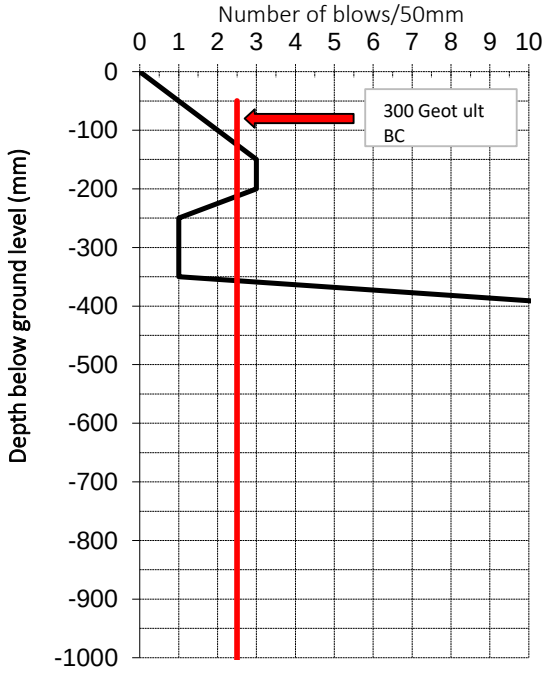
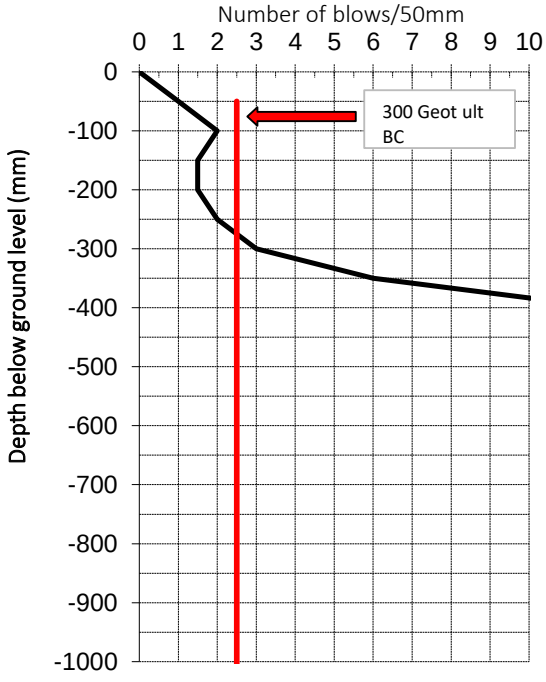


SP4



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SCALA PENETROMETER RESULTS

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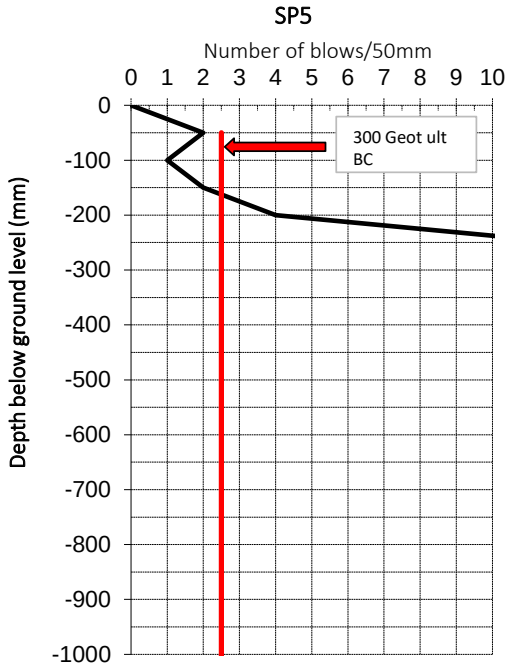
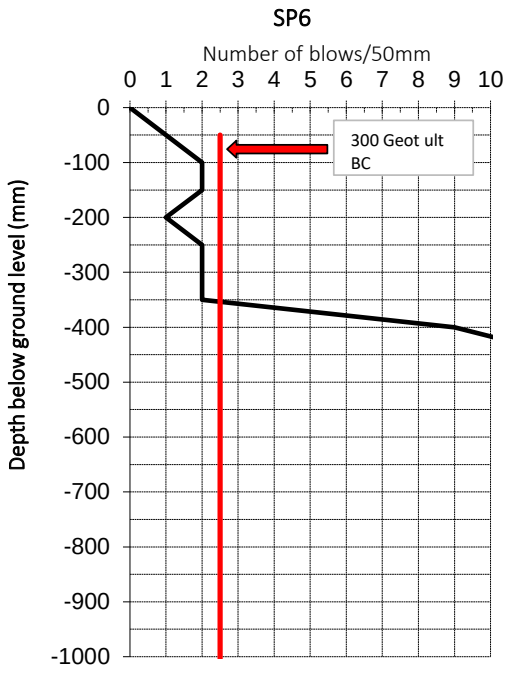
JOB NUMBER:	52746	PROJECT:	Reflekt Burnby Geotech
		LOCATION:	78 Burnby Drive, Te Anau
CO-ORDINATES:	mE	DATE:	18-Aug-22
See attached plan	mN	OPERATOR:	SJO

Note: No Friction correction has been applied to the field results. 5 Blows per 100mm is considered compliance with NZS3604 3.3.7





HA-1 Hand Auger Borehole Log

RDA Consulting
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Project:	Reflekt Burnby Geotech				
Site Location:	78 Burnby drive, Te Anau				
Job Number:	52746	Date:	18-Aug-22		
Operator:	SJO	Auger Diameter:	50 mm	Refer Site Plan For Location	
Auger Log		Calibration Constant	1.466		

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	Undrained Shear Strength (kPa) [shear/residual]	Sensitivity
0.1	ψψψψψ ψψψψψ ψψψψψ ψψψψψ	organic sandy clayey SILT with trace gravel; dark brown; dry; sand, fine; gravel, fine to coarse, subrounded to rounded; rootlets	Dry	TOPSOIL		
0.2						
0.3	oxxoxxoxx oxxoxxoxx oxxoxxoxx oxxoxxoxx	gravelly clayey SILT; yellow/brown; very stiff; moist; gravel, fine to coarse, sub rounded to rounded; sand, fine	Moist	ALLUVIAL	>206	
0.4						
0.5		Unable to penetrate further - gravel 				
0.6						
0.7						
0.8						
0.9						
1.0						
1.1						
1.2						
1.3						
1.4						
1.5						

Comments: No Groundwater encountered

Reviewed by:	SMA

HA-2 Hand Auger Borehole Log

RDA Consulting
GEOTECHNICAL • CIVIL • ENVIRONMENTAL

Project:	Reflekt Burnby Geotech				
Site Location:	78 Burnby drive, Te Anau				
Job Number:	52746	Date:	18-Aug-22		
Operator:	SJO	Auger Diameter:	50	mm	Refer Site Plan For Location
Auger Log		Calibration Constant	1.466		

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	Undrained Shear Strength (kPa) [shear/residual]	Sensitivity
0.1	ψψψψψ ψψψψψ ψψψψψ	organic sandy clayey SILT with trace gravel; dark brown; dry; sand, fine; gravel, fine to coarse, subrounded to rounded; rootlets	Dry	TOPSOIL		
0.2	ψψψψψ					
0.3	oxxoxxoxx oxxoxxoxx	gravelly clayey SILT; yellow/brown; very stiff; moist; gravel, fine to coarse; sub rounded to rounded; sand, fine	Moist	ALLUVIAL	147/28	
0.4		Unable to penetrate further - gravel				
0.5						
0.6						
0.7						
0.8						
0.9						
1.0						
1.1						
1.2						
1.3						
1.4						
1.5						

Comments: No Groundwater encountered

Reviewed by: SMA

HA-3	Hand Auger Borehole Log			RDA Consulting GEOTECHNICAL • CIVIL • ENVIRONMENTAL
Project:	Reflekt Burnby Geotech			
Site Location:	78 Burnby drive, Te Anau			
Job Number:	52746	Date:	18-Aug-22	
Operator:	SJO	Auger Diameter:	50 mm	Refer Site Plan For Location
Auger Log		Calibration Constant	1.466	

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	Undrained Shear Strength (kPa) [shear/residual]	Sensitivity
0.1	ψψψψψ ψψψψψ ψψψψψ ψψψψψ ψψψψψ	organic sandy clayey SILT with trace gravel; dark brown; dry; sand, fine; gravel, fine to coarse, subrounded to rounded; rootlets	Dry	TOPSOIL		
0.2						
0.3	oxxoxxoxx oxxoxxoxx oxxoxxoxx	gravelly clayey SILT; yellow/brown; very stiff; moist; gravel, fine to coarse, sub rounded to rounded; sand, fine	Moist	ALLUVIAL	105/28	3.7
0.4						
0.5		Unable to penetrate further - gravel 				
0.6						
0.7						
0.8						
0.9						
1.0						
1.1						
1.2						
1.3						
1.4						
1.5						

Comments: No Groundwater encountered

Reviewed by: SMA

HA-4	Hand Auger Borehole Log			RDA Consulting GEOTECHNICAL • CIVIL • ENVIRONMENTAL
Project:	Reflekt Burnby Geotech			
Site Location:	78 Burnby drive, Te Anau			
Job Number:	52746	Date:	18-Aug-22	
Operator:	SJO	Auger Diameter:	50 mm	Refer Site Plan For Location
Auger Log		Calibration Constant	1.466	

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	Undrained Shear Strength (kPa) [shear/residual]	Sensitivity
0.1 0.2	ψψψψψ ψψψψψ ψψψψψ ψψψψψ	organic sandy clayey SILT with trace gravel; dark brown; dry; sand, fine; gravel, fine to coarse, subrounded to rounded; rootlets	Moist	TOPSOIL		
0.3	oxxoxxoxx oxxoxxoxx	gravelly clayey SILT; yellow/brown; very stiff; moist; gravel, fine to coarse, sub rounded to rounded; sand, fine		ALLUVIAL		
0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5		Unable to penetrate further - gravel 				

Comments: No Groundwater encountered

Reviewed by: SMA

HA-5 Hand Auger Borehole Log

RDA Consulting
GEOTECHNICAL • CIVIL • ENVIRONMENTAL

Project:	Reflekt Burnby Geotech				
Site Location:	78 Burnby drive, Te Anau				
Job Number:	52746	Date:	18-Aug-22		
Operator:	SJO	Auger Diameter:	50 mm	Refer Site Plan For Location	
Auger Log		Calibration Constant	1.466		

DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	Undrained Shear Strength (kPa) [shear/residual]	Sensitivity
0.1	ψψψψψ ψψψψψ ψψψψψ	organic sandy clayey SILT with trace gravel; dark brown; dry; sand, fine; gravel, fine to coarse, subrounded to rounded; rootlets	Dry	TOPSOIL		
0.2						
0.3	oxxoxxoxx oxxoxxoxx	gravelly clayey SILT; yellow/brown; very stiff; moist; gravel, fine to coarse; sub rounded to rounded; sand, fine	Moist	ALLUVIAL	118/17	7.3
0.4		Unable to penetrate further - gravel				
0.5						
0.6						
0.7						
0.8						
0.9						
1.0						
1.1						
1.2						
1.3						
1.4						
1.5						

Comments: No Groundwater encountered

Reviewed by: SMA

HA-6	Hand Auger Borehole Log						
Project:	Reflekt Burnby Geotech						
Site Location:	78 Burnby drive, Te Anau						
Job Number:	52746	Date:	18-Aug-22				
Operator:	SJO	Auger Diameter:	50	mm	Refer Site Plan For Location		
Auger Log		Calibration Constant	1.466				

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DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PARTICLE SIZE CHARACTERISTICS,PLASTICITY, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SOIL / ROCK TYPE, ORIGIN, DEFECTS, STRUCTURE, FORMATION	Undrained Shear Strength (kPa) [shear/residual]	Sensitivity
0.1 0.2 0.3 0.4	ψψψψψ ψψψψψ ψψψψψ ψψψψψ ψψψψψ ψψψψψ ψψψψψ ψψψψψ	organic sandy clayey SILT with trace gravel; dark brown; dry; sand, fine; gravel, fine to coarse, subrounded to rounded; rootlets	Dry	TOPSOIL		
0.5	oxxoxxoxx oxxoxxoxx	gravelly clayey SILT; yellow/brown; very stiff; moist; gravel, fine to coarse, sub rounded to rounded; sand, fine	Moist	ALLUVIAL	91/22	4.1
0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5		Unable to penetrate further - gravel 				

Comments: No Groundwater encountered

Reviewed by: SMA