Geotechnical Investigation

41-43 Brigham Creek Road

Whenuapai

Auckland

Submitted to:

41-43 Brigham Creek JV
41-43 Brigham Creek Road
Whenuapai
Auckland 0618

ENGEO Limited
8 Greydene Place, Takapuna, Auckland 0622
PO Box 33-1527, Takapuna, Auckland 0740
Tel +64 9 972 2205
www.engeo.co.nz

17.06.2021
18614.000.001_02

ACENZ

Contents

Tables

Appendices

ENGEO Document Control:

Report Title	Geotechnical Investigation - 41-43 Brigham Creek Road, Whenuapai			
Project No.	18614.000.001	Doc ID	01	
Client	41-43 Brigham Creek JV	Client Contact	Toby Mandeno	
Distribution (PDF)	Toby Mandeno			
Date	Revision Details/Status	Author	Reviewer	WP
17/06/2021	Issued to Client	BF	PF	VB

1 Introduction

ENGEO Ltd was requested by 41-43 Brigham Creek JV to undertake a geotechnical investigation of the property at 41-43 Brigham Creek Road, Whenuapai, Auckland (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 16 February 2021. This report has been prepared to support detailed design of the proposed development and it is understood that this report will be used to support an application for Resource Consent. This report is not intended to support applications for Building Consent.

Maven Associates Ltd have prepared a concept plan for the 41 – 43 Brigham Creek Development dated September 2020. This plan depicts a high-density subdivision made up of 218 approximately 130 m^2 to 260 m^2 residential lots accessed by a central road with various additional roads and JOALs. This concept plan is attached in Appendix 1. We have not been provided with plans detailing levels for the dwellings, a retaining wall layout plan or a cut and fill earthwork plan for this subdivision.

This report will need to be updated prior to submission for Resource Consent to include comment on the resource consent level civil plan set - once these plans are completed.

The scope of work for this report comprised reviewing published geological information, undertaking site investigations comprising 10 hand auger boreholes and five Scala penetrometer tests, laboratory testing of one shrink-swell index sample, and reporting.

2 Site Description

The site at 41-43 Brigham Creek Road is located on a 5.1921 HA farmland block in Whenuapai, Auckland, legally described as Lot 2 DP 538562. The site is bordered by other farmland properties to the west and south, Brigham Creek Road to the north and Mamari Road to the east.

The site is currently occupied by a single dwelling located in the western portion of the site. The overall site is mostly greenfield and includes mature vegetation, with general farm equipment stored in various areas. The site is generally level, with gentle slopes present in the western and south-eastern areas.

3 Area Wide Geotechnical Data

3.1 Regional Geology

The Institute of Geological and Nuclear Sciences (GNS) map the site as being predominantly underlain by alluvial deposits of the Puketoka Formation (Tauranga Group).

The Puketoka Formation generally consists of pumiceous mud, sand and gravel with muddy peat and lignite, rhyolite pumice, including non-welded ignimbrite, tephra and alluvial pumice deposits, as well as massive micaceous sand.

A nearby groundwater well (drilled in 1983), indicates a soil profile comprising clays to 34 m below ground level. However, strength testing was not completed. A thick layer of peat was identified extending from 34 m below ground level to 45 m below ground level. Sandstone was encountered at approximately 45 m below ground level. This is most likely East Coast Bays Formation Bedrock of the Waitemata Group.

Six CPTs located approximately 400 m to the northeast of the site have been used to represent ground conditions for liquefaction analysis undertaken as part of this report. These tests were completed at the same elevation as the Brigham Creek site were undertaken in the same geological unit and are considered to have encountered generally similar materials to those which underlies this site.

3.2 Seismicity

We have reviewed the GNS New Zealand Active Fault Database, which indicates there are no known active faults on-site. The nearest active fault is the Wairoa North Fault located approximately 36 km southeast of the site. The Wairoa North Fault dips at approximately 60 to 70 degrees to the west with a vertical slip rate of approximately 0.1 mm / year. GNS have not established a recurrence interval or date for the last event at the Wairoa North Fault.

3.3 Historical Aerial Photography

We have reviewed historical aerial photographs of the site from Auckland Council GeoMaps, Retrolens and Google Earth Pro dating back to 1940. The photographs were viewed under the context of identifying changes to the landform. Relevant visible features within the site and surrounding area are summarised in Table 1.

Table 1: Historical Aerial Photography Summary

Date	Site	Surrounding Area
1959	The site is a greenfield site. No development is visible from this photo.	The development at Ngahue Crescent is present.
1996	The site is being used for horticulture.	Minor rural development has occurred within the surrounding properties.
2000	Dwelling built at 41 Brigham Creek Road.	No significant change.
2015	Dwelling at 41 Brigham Creek extended with a pool and minor extensions.	Significant development occurring on the other side of Brigham Creek Road.

Review of historical aerial photographs of the site have not revealed any signs of large scale earthworks or geomorphological features which could affect the development of this site.

4 Site Investigation

4.1 Geotechnical Investigation

ENGEO attended site on 13 August 2020 to undertake an intrusive site investigation. This geotechnical investigation comprised ten hand auger boreholes, five Scala penetrometer tests, recovery of one soil sample for shrink swell testing, and installation of one groundwater measuring piezometer. Test locations are shown in Appendix 2.

While on-site ENGEO did not observe any superficial features of instability around the western and south-eastern areas.

Ten hand auger boreholes (HA01 to HA10), with associated soil strength testing (shear vane), were drilled to between 1.6 m depth and 5.0 m depth. Hand auger boreholes HA01, HA02, HA03, HA04 and HA10 encountered practical refusal. Full borehole records are presented in Appendix 3.

Logs have been prepared in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005).

Five Scala penetrometer tests were performed within the proposed carpark and driveway areas to gather data for indicative California Bearing Ratio values for pavement design. Testing was undertaken from the existing ground surface and extended to 0.9 m depth. The results of this testing can be seen in Appendix 4.

5 Summary of Subsurface Conditions

Ground conditions encountered on-site were generally in accordance with the mapped geology. Borehole findings are described as follows:

Topsoil

Topsoil was encountered within all hand auger boreholes to between 0.2 m and 0.4 m below ground level (bgl).

Puketoka Formation Alluvial Soils

Alluvial soils of the Puketoka Formation were encountered underlying topsoil at all test locations. This material generally consists of interbedded brown, grey and orange silts and clay soils with variable sand, gravel and organic content. The alluvial soils were generally found to be stiff to hard. Peat was encountered within HA06 from 3.7 m to 5.0 m bgl.

5.1 Laboratory Testing

One soil sample was selected for Shrink-Swell Index testing in accordance with AS1289: Test 7.1.1-2003, from the clayey silt material at the site. Full results are presented in Appendix 5, and the data is summarised in Table 2.

Table 2: Shrink Swell Testing Results

Sample ID	Sample Location	Sample Depth (m)	Initial Water Content (Swell Sample)	Shrink Swell index
SS01	HA09	1.0 – 1.4	85.4	16.4

ENGEO considers these testing results to be very high for the type of soil tested. Further testing within the detailed design stage of investigation should be undertake to further clarify the shrink swell index of the soils.

5.2 Groundwater Conditions

Standing groundwater levels were recorded by dipping each of the hand auger boreholes at the completion of drilling. ENGEO did not encounter groundwater within any of our hand augers at the time of our investigation.

6 Geohazards and Geotechnical Assessment

6.1 Soil Classification

Based on the findings of this subsurface investigation and the nearby NZGD groundwater well, the seismic site classification in line with NZS 1170.5:2004 is considered to be 'Class D – Deep / Soft Soil Sites' for the purpose of seismic design.

If required, this Seismic site classification can be further refined though deeper borehole and CPT testing.

6.2 Ground Shaking

As depicted in the conceptual plans, the proposed development is likely to contain Importance Level 2 buildings. According to NZS 1170.5:2004, Importance Level 2 buildings are required to be designed to resist earthquake shaking with an annual probability of exceedance of 1/500 (i.e. a 500 year return period). This is the ultimate limit state (ULS) design seismic loading. Structures are expected to retain their structural integrity during the ULS earthquake, and not collapse or endanger life.

Furthermore, Importance Level 2 buildings should sustain little or no structural damage under a serviceability limit state (SLS) design load case, which is based on earthquake shaking with a 25 year return period.

Peak horizontal ground accelerations (a_{max}) have been calculated in accordance with MBIE / NZGS Module 1 (2016) using the following formula:

a_{max} = $C_{0,1000}$ R f g / 1.3

$C_{0,1000}$ = 0.19 for Auckland (NZTA Bridge Manual (2016) Table 6A.1)

R = 1.0 for a 500 year return period event (NZS1170.5) (ULS)

= 0.25 for a 25 year return period event (NZS1170.5) (SLS)

f = 1.0 for Class D

Thus a_{max} = 0.19 x 1.0 x 1.0 g / 1.3 = 0.16 g for ULS

= 0.19 x 0.25 x 1.0 g / 1.3 = 0.04 g for SLS

The effective earthquake magnitude can be taken as 6.5.

6.3 Liquefaction and Lateral Spread

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are clean, loose, saturated, and uniformly graded, fine-grained, cohesionless materials. Empirical evidence indicates that loose to medium dense gravels, silty sands, low-plasticity silts, and some low-plasticity clays are also potentially liquefiable. These soils have been identified in hand auger boreholes, as well as nearby subsurface testing including inferred silt, sand and clay soils in six CPTs located approximately 400 m to the northeast of the site.

We have assessed the risk of soil liquefaction occurring at the site using the subsurface data from the nearby CPT tests and the methodology developed by Boulanger and Idriss (2014). Liquefaction induced settlements were calculated using the method put forward by Zhang et al (2002). We have modelled the groundwater at a depth of 2.0 m, based on standing water levels encountered in the on-site investigation locations and considering potential seasonal fluctuation of approximately 1.0 m.

Our analysis indicates that liquefaction is not triggered at SLS seismic accelerations. Based on the results of the liquefaction analysis, we do not expect surface expressions from liquefaction, or ground movements related to lateral spreading to occur in future SLS seismic events.

Under ULS seismic conditions, our analysis indicates that minor liquefaction may occur within the Puketoka Formation generally deeper than 4 m depth. Liquefaction is expected to result in a potential liquefaction induced settlement of less than 110 mm under a ULS seismic condition. Table 3 presents the resultant liquefaction induced settlements.

Table 3: Cliq Assessment Results

Test Id	Liquefaction Induced Settlement (mm)	
	SLS (1 / 25 yr. event)	ULS (1 / 500 yr. event)
CPT01	0	25
CPT02	0	10
CPT03	0	0
CPT04	0	45
CPT05	0	110
CPT06	0	65

We note a crust of non-liquefiable very stiff material overlies the liquefiable material, which is expected at depths of between 4 m and 12 m. NZGS geotechnical module 3 Table 5.1 general performance levels for liquefied deposits, show the results of a LSN number of 2.5 and LPI as 1.8 fits into the performance level L0 “insignificant - No significant excess pore water pressures (no liquefaction)”.

On this basis liquefaction induced settlement is considered unlikely to comprise a significant hazard for the proposed development, due to the results of this assessment and the presence of a stiff to very stiff crust of non-liquefiable material.

If the site specific potential liquefaction induced settlements are required during the detailed design phase, Site specific testing comprising CPT testing is undertaken to facilitate a more detailed liquefaction assessment for this development.

6.4 Expansive Soils

Expansive clay and silt soil are common in the Auckland area and they have a tendency to shrink and swell, particularly with seasonal fluctuations of soil and water content. This behavior has implications for foundation design and surface structures, and will need to be addressed during foundation design.

Based on laboratory testing of the soils encountered on-site, we consider that Expansive Site Class for this site is 'E – Extreme' in accordance with AS2870: Residential Slabs and Footings. From our experience with these types of soils, we consider this result to be unusually high and we recommend that further laboratory testing (both Atterberg Limits and linear shrinkage as well as shrink swell testing), should be undertaken as part of the preparation of the geotechnical completion report for this site.

6.5 Slope Stability

The slopes along the western edge and south-eastern corner of site have been assessed in regard to J1.4 of the Auckland Unitary Plan. We have used the Auckland Council Geomaps surface contours to assess the slope gradients of each of the steepest sections of site. The slope gradients for these sections are summarised in Table 4.

Table 4: Slope Gradients Summaries

Area of site	Calculated Gradient
Western edge	1:5
South-eastern Corner	1:5

Neither the site walkover nor the historical aerial photograph review identified any signs of slope instability on-site. Further to this site slopes are shallower than 1:4 horizon which is the threshold slope angle for detailed slope stability within this geological unit in accordance with the Auckland Unitary Plan.

6.6 Pre Existing Fill

Pre-existing fill was not identified within the subsurface investigations undertaken on-site. Even though pre-existing fill was not encountered, it is common in rural environments for site to contain buried rubbish pits and localised filling and the presence of these features should be expected.

6.7 Assessment against RMA Section 106

Based on our investigation and analysis, we do not consider this site to be subject to erosion, falling debris, slippage, flooding or inundation by soil or rock in accordance with the provision of Section 106 of the Resource Management Act 1991.

Furthermore, on the assumption that earthworks proposed as part of this development will be designed to ease steeper contours present on-site, we consider that future residential use of the land (as detailed in the plans provided to us) is unlikely to accelerate, worsen or result in material damage to the land provided that proper engineering practices are followed during any development, including those recommended in this report.

7 Geotechnical Recommendations

Based on the site investigations detailed herein, the site at 41 – 43 Brigham Creek Road is considered to be geotechnically suitable for the proposed development, subject to the following recommendations.

7.1 Shallow Foundations

At the time of preparing this report we have not been provided with plans showing finished levels or a preliminary cut / fill plan for this development. However, based on our discussions and understanding of the proposed development, it is intended to found the residential developments on shallow foundations roughly at grade.

At this preliminary stage is considered that a 300 kPa Ultimate Bearing Capacity (unfactored) will be appropriate for shallow strip and pad foundation design within this site. However, this bearing capacity will be confirmed through further investigations undertaken within each lot as part of the preparation of a geotechnical completion report for this development.

7.2 Strength Reduction Factor

As required by Section B1/VM4 of the New Zealand Code Handbook, a strength reduction factor of 0.5 must be applied to all recommended geotechnical ultimate soil capacities in conjunction with their use in factored limit state design load cases for static and earthquake conditions.

7.3 Preliminary Retaining Wall Parameters

The soil parameters presented in Table 5 may be utilised in the design of low height (less than 2 m high), retaining walls. Taller walls will necessitate specific investigation of wall locations.

Table 5: Retaining wall Design Parameters

Soil Type	Unit Weight kN/m^3	Friction Angle Φ°	Effective Cohesion c' kPa	Undrained Shear Strength (foundation Soils) Su kPa
Cohesive engineered fill	18	32	6	100
Native Puketoka Formation	18	28	3	60

The design of rigid retaining walls such as basement retaining walls, i.e. walls that are retained from movement at the top, should be based on an 'at rest' lateral earth pressure (Ko). Flexible walls that are free to deform or rotate at least 1% of the exposed wall height (H) may be designed utilising active soil coefficient (ka).

These values assume a level ground surface behind the wall, and that no surcharge is placed adjacent to the top of the wall. An allowance should be made in the design for the effects of surcharge from building loads and traffic loads.

Retaining walls should be back drained to prevent the build-up of hydrostatic water pressures. Where seismic design of retained structures is required, a wall displacement factor may be applied to reduce the peak ground acceleration in accordance with Section 5.3 of the MBIE / NZGS Earthquake Geotechnical Practice Module 6 – Earthquake Resistance Retaining Wall Design.

7.4 Pavement Design

Scala penetrometer (CBR equivalent) testing was carried out as part of our site investigations along the proposed access way and car parking areas.

Based on the testing completed, we recommend adopting a CBR of 3% for the proposed access way and car parking areas. This value should be confirmed by further testing following completion of fill and cut to finished levels within the car parking areas.

7.5 Earthworks Operation

- All engineered or structural hardfills should be placed in ≤ 200 mm lifts and be compacted to a minimum of 95% of maximum dry density, at no less than optimum moisture content. Maximum dry density for granular fill materials may be obtained from the source quarry, a geotechnical laboratory or from plateau testing undertaken on-site. Compaction should be achieved using standard plant and methodology suitable for the imported material. A water source should be maintained on-site for moisture control.

- Any filling on-site slopes should be suitably benched into slopes and include suitable underfill drainage in accordance with NZS4431.

- Exposed cohesive soils should be kept moist prior to pouring concrete. It is difficult to recharge clayey soils in excavations. If these soils dry out, undercutting and replacement with hardfill may be required.

- Our experience with the types of soils present on this site indicates that when they are exposed to the weather their strengths may be significantly reduced. We therefore recommend that trafficked areas and building platforms are only trimmed to final levels immediately prior to metaling and that at all times the site is shaped to avoid water ponding during rain, thereby limiting the need for additional undercutting and back filling. On no account should areas of trimmed subgrade be left exposed to allow the ingress of water, nor should subgrade areas be trafficked prior to drying out after rain.

- Wherever filling or soft native ground is present at foundation level it should be undercut and replaced with approved compacted hardfill. Its suitability or otherwise as a bearing material beneath the floor slab should be determined on-site by the Engineer.

- All foundation cuts or pile holes should be inspected by ENGEO (or a suitably qualified Geotechnical professional), prior to constructing foundation elements to verify founding conditions are as anticipated.

- All excavations should be in line with the WorkSafe Good Practice Guidelines for Excavation Safety (July 2016).

7.6 Cuts and Batters

- Where appropriate i.e. not in locations with surcharge loads or slopes; temporary unsupported cut slopes should not exceed a batter of 1 horizontal: 1 vertical (45° from horizontal) to a maximum batter height of 2.0 m, and should not be left unsupported at this batter angle for longer than four weeks.
- Cut batters must not be exposed to adverse weather conditions and should be covered to minimise environmental effects (i.e. with polythene plastic).
- Suitable drainage channels must be put in place to divert surface water from unsupported cut faces. Subsurface drains should also be considered for the toe of long-term slopes.
- If any permanent cuts are to be higher than 1.5 m, they should be supported with a specifically designed retaining wall and will need to be approved by a Chartered Professional Engineer practising in Geotechnical Engineering.
- Where vertical and sub-vertical cut faces higher than 0.5 m are required for the construction of retaining walls, in addition to the above recommendations, we recommend that this is done in shortened sections (< 5 m) and the faces are left unsupported for a minimal time period (i.e. 1 week) or temporarily shored, particularly in close proximity to site boundaries and structures.
- All temporary cuts and batters proximate to boundaries should take into account the potential surcharge and risk of undermining neighbouring property.
- All cuts and batters should be in line with the WorkSafe Good Practice Guidelines for Excavation Safety (July 2016).

7.7 Sediment and Erosion Control

During construction, measures should be undertaken to control and treat stormwater runoff, with silt and erosion controls complying with Auckland Council Guidance for Erosion & Sediment Control (GD05).

Surface cut-off drains or appropriate stormwater flow paths should be maintained upslope of the proposed development area both during and following construction. These drains and impervious surfaces will divert water away from any buildings, and minimise possible movement in expansive soils during and post construction.

Stormwater from paved areas shall be taken in a piped system and disposed of into an approved stormwater system. Uncontrolled discharge onto land should be avoided. All service trenches should be capped with low permeability materials, so that excavations do not become points of entry for surface run-off.

7.8 Site Preparation

Topsoil and pre-existing fill should be stripped from all cut and fill areas with stripping operations being planned to extend well beyond cut and fill lines to avoid peripheral fill contamination. Stockpiles of topsoil and unsuitable materials should be sited well clear of the works on suitable areas of natural ground, such that these stockpiles will not adversely affect existing slopes and structures.

Exposed cohesive soils within the foundation footprint should be kept covered prior to pouring concrete. It is difficult to recharge clayey soils in excavations. If these soils dry out, undercutting and replacement with hard-fill may be required.

If temporary platforms are required to facilitate construction and mobilisation of heavy machinery, the Geotechnical Engineer and earthworks contractor should coordinate formation of stable platforms that are suitable for use.

8 Future Work

- As this report has been prepared in advance of completion of earthworks and civil design plans a Geotechnical Design Report (or a revision of this report) will be required to support bulk earthworks approval. The requirement for any further geotechnical investigation and analysis / design will be determined once we have been supplied with copies of the civil and earthworks plans for this development. It is important that we are given an opportunity to review these plans prior to submission for Resource Consent. We reserve the right to revisit and add to our recommendations when these plans are made available.
- ENGEO (or a suitably qualified Geotechnical Engineer familiar with the content of the geotechnical reports for this site) must be engaged to observe and test any earthworks undertaken on-site and then to prepare a geotechnical completion report for the site which will provide foundation design parameters for future housing to be constructed onsite.

9 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, 41-43 Brigham Creek JV, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. This report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by

Ben Fleetwood

Engineering Geologist

Report reviewed by

Paul Fletcher, CMEngNZ (CPEng)

Associate Geotechnical Engineer

10 References

Auckland Council GIS Viewer < http://maps.aucklandcouncil.govt.nz/aucklandcouncilviewer/>.

Auckland Regional Council. (2001). Background Concentration of Inorganic Elements in Soils from the Auckland Region, Auckland Regional Council, Technical Publication No. 153.

Auckland Regional Council. (2012). Auckland Council Regional Plan: Air, Land and Water (ALW Plan).

Australian National Environmental Protection Council. (2013). National Environmental Protection (Assessment of Site Contamination) Measure 1999, Schedule B(1): Guideline on the Investigation Levels for Soil and Groundwater.

Institute of Geological and Nuclear Sciences Ltd. 2001. 1:250,000 Geological Map 3, Auckland.

Ministry for the Environment. (1997). Guidelines for assessing and managing contaminated gasworks sites in New Zealand.

Ministry for the Environment. (2006). Identifying, investigating and managing risks associated with former sheep-dip sites: A guide for local authorities.

Ministry for the Environment. (2011). Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand.

Ministry for the Environment. (2011). Contaminated Land Management Guidelines No.2: Hierarchy and Application in New Zealand of environmental guideline values.

Ministry for the Environment. (2011). Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils

Ministry for the Environment. (2011). Guidelines for assessing and managing pertroleum hydrocarbon contaminated sites in New Zealand.

Ministry for the Environment. (2011). Hazardous Activities and Industries List (HAIL).

Ministry for the Environment. (2011). Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health.

Ministry for the Environment. (2012). Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations (2011).

Waste Management Institute New Zealand. (2016). Technical Guidelines for Disposal to Land.

APPENDIX 1:

Maven Associates Concept Plans

Notes

1. All works to be in accordance with Auckland council standards.
2. Boundaries are subject to final survey.

Legend

- EX BDY
- EX EASEMENT
- PR MAJOR CONTOUR
- PR MINOR CONTOUR
- PR SANITARY SEWER
- PR STORMWATER
- PR WATER MAIN
- PR GAS
- PR POWER
- PR TELECOM
- PR SITE CLEARANCE
- PR BUILDING

Rev	Description	By	Date
A	CONCEPT PLAN	AP	SEP 2020

	By	Date
Survey	-	-
Design	AP	SEP 2020
Drawn	-	-
Checked	WM	SEP 2020

Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
12-14 Walls Road, Penrose

Project

41-43 BRIGHAM CREEK RESIDENTIAL DEVELOPMENT FOR AI LING

Title

PROPOSED CONCEPT PLAN

Project no.	PROMO		
Scale	1:1000 @ A3		
Cad file	41-43 BRIGHAM CREEK (OPTION C).DWG		
Drawing no.	C100	Rev	A

DATE: 9/17/20

APPENDIX 2:

Investigation Location Plan

Legend

- Site Boundary
- Hand Auger
- Shrink-swell Sample
- Scala Penetrometer

Contours (0.5 m)

- Contours

10m 0 10 20 30 40 50m

© Nearmaps

ENGEO

Produced by **Evalu8.earth**

Title: Investigation Location Plan		
Client: 41-43 Brigham Creeks JV		Figure No: 1.0
Project: 41 - 43 Brigham Creek Road	Drawn: JT	Size: A4
Date: 24-05-2021	Checked: BF	
Proj No: 18614	Scale: 1:1807	Version: 1.0

APPENDIX 3:

Hand Auger borehole logs

LOG OF AUGER HA01

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 3.6 m
Hole Diameter : 50 mm

Shear Vane No : 2093
Logged By : JT
Reviewed By : JC
Latitude : -36.79439
Longitude : 174.60906

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
	TOPSOIL	OL	TOPSOIL.				D	H	200+	
0.5	PUKETOKA FORMATION	ML	Clayey SILT with trace sand; brownish grey with orange streaks. Low plasticity. Becomes light grey with orange streaks at 0.5 m depth.						200+	
1.0					24			VSt-H	200+	
1.5		ML	Clayey SILT with some fine sand; grey with orange mottles. Low plasticity.					VSt	171/28	
2.0		CH	Silty CLAY; light grey with occasional orange mottles. High plasticity.		23		M	VSt-H	147/28	
2.5		ML	Fine to medium sandy SILT; orange with light grey streaks. Low plasticity. Becomes light grey with trace orange streaks at 2.45 m depth.					H	200+	
3.0		ML	Clayey SILT with minor fine to medium sand; light grey with orange mottles. Low plasticity.					H	200+	
		CH	Silty CLAY; purple brown with black carbonaceous inclusions. High plasticity. Becomes light greyish brown at 3.1 m depth.		22			VSt-H	120/36	
3.5		ML	Fine to medium sandy SILT; light greyish brown. Low plasticity.					H	200+	
			End of Hole Depth: 3.6 m Termination Condition: Practical refusal						UTP	>>
4.0										
4.5										
5.0										

Hand auger met practical refusal at 3.6 m depth on hard material.
Scala Pentrometer met practical refusal at 3.7 m depth.
Standing groundwater was not encountered.
UTP = Unable to Penetrate.

Elevation data obtained from Auckland Council GeoMaps.

GEOTECH HAND AUGER 41-34 BRIGHAM CREEK ROAD HA'S.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF AUGER HA02

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 4.3 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : ML
Reviewed By : JC
Latitude : -36.79491
Longitude : 174.60897

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Elevation (mRL)	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	OL	TOPSOIL.		D	St	90/16
0.5	PUKETOKA FORMATION	ML	Clayey SILT with trace sand; light brown with occasional orange mottles. Low plasticity.	23	M	VSt	187/47
1.0		SM	Silty fine SAND; light yellowish brown. Poorly graded.			MD-D	189/19 UTP
1.5		CH	Silty CLAY; black. High plasticity.	22		St-H	UTP 171/23
2.0							83/20
2.5			Encountered dark orange sandy SILT between 2.3 m and 2.5 m depth.	21			94/39
3.0			Becomes greenish grey from 2.6 m depth.				62/31 75/28
3.5				20			147/47 178/41
4.0		ML	Clayey SILT with trace sand; bluish grey. Low plasticity.			H	200+
4.5			Becomes dark greenish blue from 4.2 m depth.				UTP
5.0			End of Hole Depth: 4.3 m Termination Condition: Practical refusal				

Scala Penetrometer
Blows per 100mm
2 4 6 8 10 12
>>

Hand auger met practical refusal at 4.3 m depth on hard material.
Scala Penetrometer met practical refusal at 4.3 m depth.
Standing groundwater was not encountered.
UTP = Unable to Penetrate.

Elevation data obtained from Auckland Council GeoMaps.

GEOTECH HAND AUGER 41-34 BRIGHAM CREEK ROAD HA'S.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF AUGER HA03

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 1.6 m
Hole Diameter : 50 mm

Shear Vane No : 1546
Logged By : TN
Reviewed By : JC
Latitude : -36.7951
Longitude : 174.60909

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
0.0	TS	OL	TOPSOIL					N/A		
0.5	PUKETOKA FORMATION	ML	Clayey SILT; light grey. Low plasticity.		24		D	H	200+ 200+ 200+	
1.0		ML	Clayey SILT with trace fine sand; light grey. Low plasticity.						200+	
1.5		ML	Fine sandy pumiceous SILT; whitish light grey. Low plasticity.		23				200+	>>
			End of Hole Depth: 1.6 m Termination Condition: Practical refusal							

Hand auger met practical refusal at 1.6 m depth on hard material.
Scala Penetrometer met practical refusal at 1.6 m depth.
Standing groundwater was not encountered.
TS = Topsoil; N/A = Not Applicable.

Elevation data obtained from Auckland Council GeoMaps.

LOG OF AUGER HA04

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 2 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : ML
Reviewed By : JC
Latitude : -36.79522
Longitude : 174.6098

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
0.0	TS	OL	TOPSOIL.					N/A		
0.5	PUKETOKA FORMATION	CH	Silty CLAY with trace sand; light grey with occasional orange mottles and grey streaks. High plasticity.		25			H	200+ 200+ 200+	
1.0		ML	Clayey SILT with trace sand; light grey with occasional orange and grey mottles. Low plasticity.				M	VSt-H	164/16 200+	
1.5		ML	Fine to medium sandy pumiceous SILT; white. Low plasticity.		24			H	UTP	
2.0			End of Hole Depth: 2 m Termination Condition: Practical refusal							>>
2.5										
3.0										
3.5										
4.0										
4.5										
5.0										

Hand auger met practical refusal at 2 m depth on hard material.
Scala Penetrometer met practical refusal at 2.0 m depth.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil; UTP = Unable to Penetrate.

Elevation data obtained from Auckland Council GeoMaps.

LOG OF AUGER HA05

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : ML
Reviewed By : JC
Latitude : -36.79526
Longitude : 174.6117

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Elevation (mRL)	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TS	OL	TOPSOIL.		D	N/A	
0.5	PUKETOKA FORMATION	CH	Silty CLAY with trace sand; light grey with occasional orange, dark grey and white mottles. High plasticity.	22		St-VSt	128/31
		SM	Silty fine SAND; light grey with occasional light brown mottles. Poorly graded.			MD	62/23
1.0							187/31
		ML	Clayey SILT; black. Low plasticity.				122/27
1.5			Becomes reddish brown with trace wood fragments from 1.3 m depth.	21		F-VSt	59/28
			Becomes black from 1.65 m depth.				47/33
2.0		SM	Silty fine SAND; light brown with grey mottles. Poorly graded.		M	MD	65/28
		CH	Silty CLAY; dark grey. High plasticity.	20		St-H	62/31
2.5							59/37
3.0							117/59
		ML	Fine to medium sandy SILT; light grey with dark grey mottles. Low plasticity.			H	UTP
3.5		CH	Silty CLAY; dark grey. High plasticity.	19		St-VSt	122/62
			Becomes wet from 3.9 m depth.		W		86/25
4.0							75/34
4.5				18			78/37
							94/62
5.0			End of Hole Depth: 5 m Termination Condition: Target depth				

Scala Penetrometer
Blows per 100mm
2 4 6 8 10 12

Hand auger met target depth at 5 m.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil; UTP = Unable to Penetrate.
Elevation data obtained from Auckland Council GeoMaps.

GEOTECH HAND AUGER 41-34 BRIGHAM CREEK ROAD HA'S.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF AUGER HA06

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1546
Logged By : TN
Reviewed By : JC
Latitude : -36.79545
Longitude : 174.61125

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Elevation (mRL)	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
0.0	TS	TS	TOPSOIL			N/A		
	PUKETOKA FORMATION	ML	Clayey SILT; greyish brown. Low plasticity.			H	200+	
0.5			SILT with some clay and minor fine sand; light grey. Low plasticity.		D		200+	
							94/60	
1.0			Becomes moist at 2.0 m depth.	25			60/45	
1.5							78/33	
		ML	Becomes light grey mottled orange brown at 1.7 m depth.			St-H	106/30	
2.0				24			94/30	
2.5							200+	
							200+	
3.0			Fine sandy SILT with trace clay; light grey. Low plasticity.	23	M		200+	
		ML				St-H	UTP	
3.5							91/60	
		PT	Amorphous PEAT with some clay; blackish brown. Low plasticity.			St-VSt	121/48	
4.0				22			60/36	
							106/45	
4.5							118/69	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth	21				

Hand auger met target depth at 5 m.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil; UTP = Unable to Penetrate.
Elevation data obtained from Auckland Council GeoMaps.

GEOTECH HAND AUGER 41-34 BRIGHAM CREEK ROAD HA'S.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF AUGER HA07

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1546
Logged By : TN
Reviewed By : JC
Latitude : -36.79385
Longitude : 174.60948

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Elevation (mRL)	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TS	TS	TOPSOIL		D	N/A	151/63
0.5	PUKETOKA FORMATION	ML	Clayey SILT; greyish brown. Low plasticity.	27		VSt	157/72
1.0		CH	Silty CLAY with trace fine sand; light grey. High plasticity.			VSt-H	200+
1.5				26			200+
2.0							200+
2.5				25	M		166/97
3.0			Silty CLAY with minor fine sand; light grey. High plasticity.				151/121
3.5			Becomes light grey mottled orange brown at 3.5 m depth.	24			136/88
4.0			Becomes orange brown mottled light grey at 4.1 m depth.			VSt	142/72
4.5				23			175/72
5.0			End of Hole Depth: 5 m Termination Condition: Target depth				178/60
							166/45
							121/88
							109/60
							133/88

Scala Penetrometer
Blows per 100mm
2 4 6 8 10 12

Hand auger met target depth at 5 m.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil.
Elevation data obtained from Auckland Council GeoMaps.

LOG OF AUGER HA08

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 2093
Logged By : JT
Reviewed By : JC
Latitude : -36.79462
Longitude : 174.61008

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
	TS	OL	TOPSOIL.				D	N/A		
0.5	PUKETOKA FORMATION	ML	Clayey SILT with trace sand; orange brown with trace light brown and brown streaks. Low plasticity.		27			St-VSt	156/29 99/23	
1.0		CH	Silty CLAY with trace sand; light grey. High plasticity.						94/11 168/72	
1.5					26			VSt-H	200+	
2.0		ML	Clayey SILT with trace fine sand; light grey. Low plasticity.				M		200+ 200+	
2.5			Becomes light grey with occasional red streaks and occasional orange mottles at 2.6 m depth.		25			VSt-H	182/70	
3.0		CH	Silty CLAY; light grey with orange brown mottles. High plasticity.						109/62 101/59	
3.5			Encountered light purple mottles at 3.5 m to 3.7 m depth.		24			St-VSt	72/42	
4.0		ML	Clayey SILT with minor fine sand; light grey. Low plasticity. Becomes saturated at 4.0 m depth. Poor recovery from 4.1 m depth.						109/42 200+	
4.5					23		S	VSt-H	UTP	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						UTP	

Hand auger met target depth at 5 m.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil; UTP = Unable to Penetrate.
Elevation data obtained from Auckland Council GeoMaps.

GEOTECH HAND AUGER 41-34 BRIGHAM CREEK ROAD HA'S.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF AUGER HA09

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1546
Logged By : TN
Reviewed By : JC
Latitude : -36.79442
Longitude : 174.61078

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Elevation (mRL)	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
	TS	TS	TOPSOIL			N/A	166/57	
0.5		ML	SILT with minor clay and trace fine sand; orange brown. Low plasticity. Becomes yellowish brown at 0.5 m depth.			VSt	166/30	
1.0	PUKETOKA FORMATION	CL	Silty CLAY with trace sand; light grey. High plasticity.	27			178/27	
							163/48	
1.5			Becomes light grey mottled orange brown at 1.4 m depth.		D		124/42	
							200+	
2.0			Becomes grey mottled orange brown at 1.9 m depth.	26			151/78	
			Becomes light grey at 2.2 m depth.					
2.5						VSt-H	184/91	
							181/57	
3.0			Becomes light grey mottled orange brown at 3.05 m depth. Becomes moist at 3.2 m depth.	25			136/54	
							121/45	
3.5			Becomes orange brown mottled light grey at 3.5 m depth.				109/88	
4.0		CH	CLAY with minor silt; orange brown. High plasticity.	24	M		118/91	
							109/94	
4.5			Becomes dark grey at 4.3 m depth.			St-VSt	94/72	
							101/75	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth	23				

Hand auger met target depth at 5 m.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil.
Elevation data obtained from Auckland Council GeoMaps.

LOG OF AUGER HA10

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 27/04/2021
Hole Depth : 3.4 m
Hole Diameter : 50 mm

Shear Vane No : 2093
Logged By : JT
Reviewed By : JC
Latitude : -36.79478
Longitude : 174.61165

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
	TS	OL	TOPSOIL.				D	N/A		
0.5	PUKETOKA FORMATION	CH	Silty CLAY; greyish brown with orange streaks. High plasticity.					VSt	130/47 179/73	
		CH	Silty CLAY with trace sand; grey with orange streaks and white inclusions. High plasticity.					VSt	163/73	
1.0		ML	Clayey SILT with some fine to medium sand; greyish white with orange streaks. Low plasticity.		26		M	VSt	192/59	
1.5		CH	Silty CLAY; white with orange streaks. High plasticity.					St-VSt	148/33 98/28	
2.0			Becomes wet and with occasional orange streaks at 2.0 m depth.		25		W		68/21	
			Becomes white at 2.2 m depth.						65/29	
2.5			Becomes saturated at 2.6 m depth.				S		50/41	
3.0					24				132/50	
		SM	Silty fine to medium SAND; greyish white. Well graded.				W	D	UTP	
3.5			End of Hole Depth: 3.4 m Termination Condition: Practical refusal							>>
4.0										
4.5										
5.0										

Hand auger met practical refusal at 3.4 m depth on hard material.
Scala Penetrometer met practical refusal at 3.5 m depth.
Standing groundwater was not encountered.
N/A = Not Assessed; TS = Topsoil; UTP = Unable to Penetrate.

Elevation data obtained from Auckland Council GeoMaps.

GEOTECH HAND AUGER 41-34 BRIGHAM CREEK ROAD HA'S.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

APPENDIX 4:

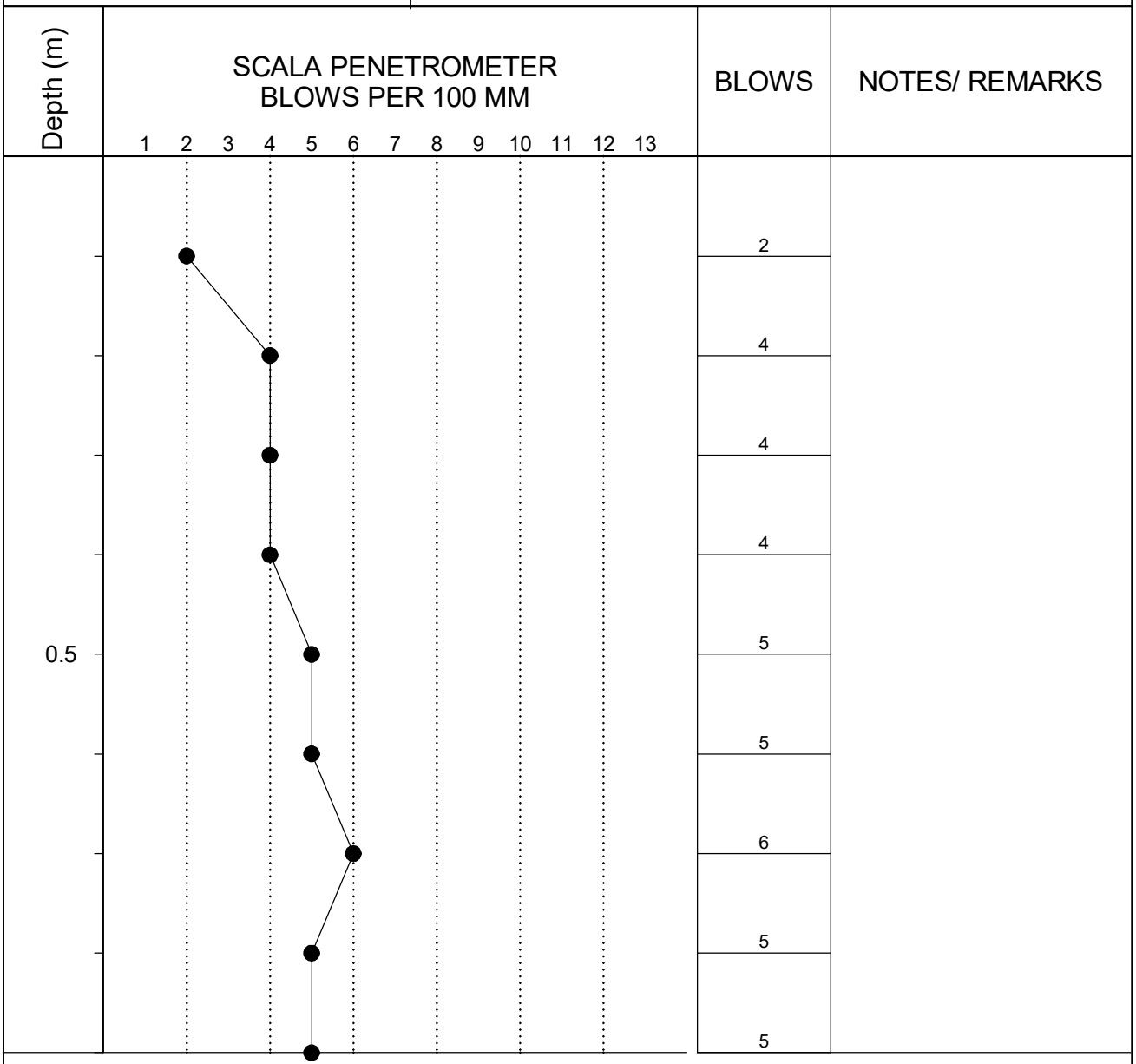
Scala Results

LOG OF SCALA SP01

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 22/04/2021
Scala Depth : 0.9 m

Logged By : ML
Reviewed By : JC
Latitude : -36.79406
Longitude : 174.60919



BLOWS	NOTES/ REMARKS
2	
4	
4	
4	
5	
5	
6	
5	
5	

Scala Penetrometer met target depth at 0.9 m depth.

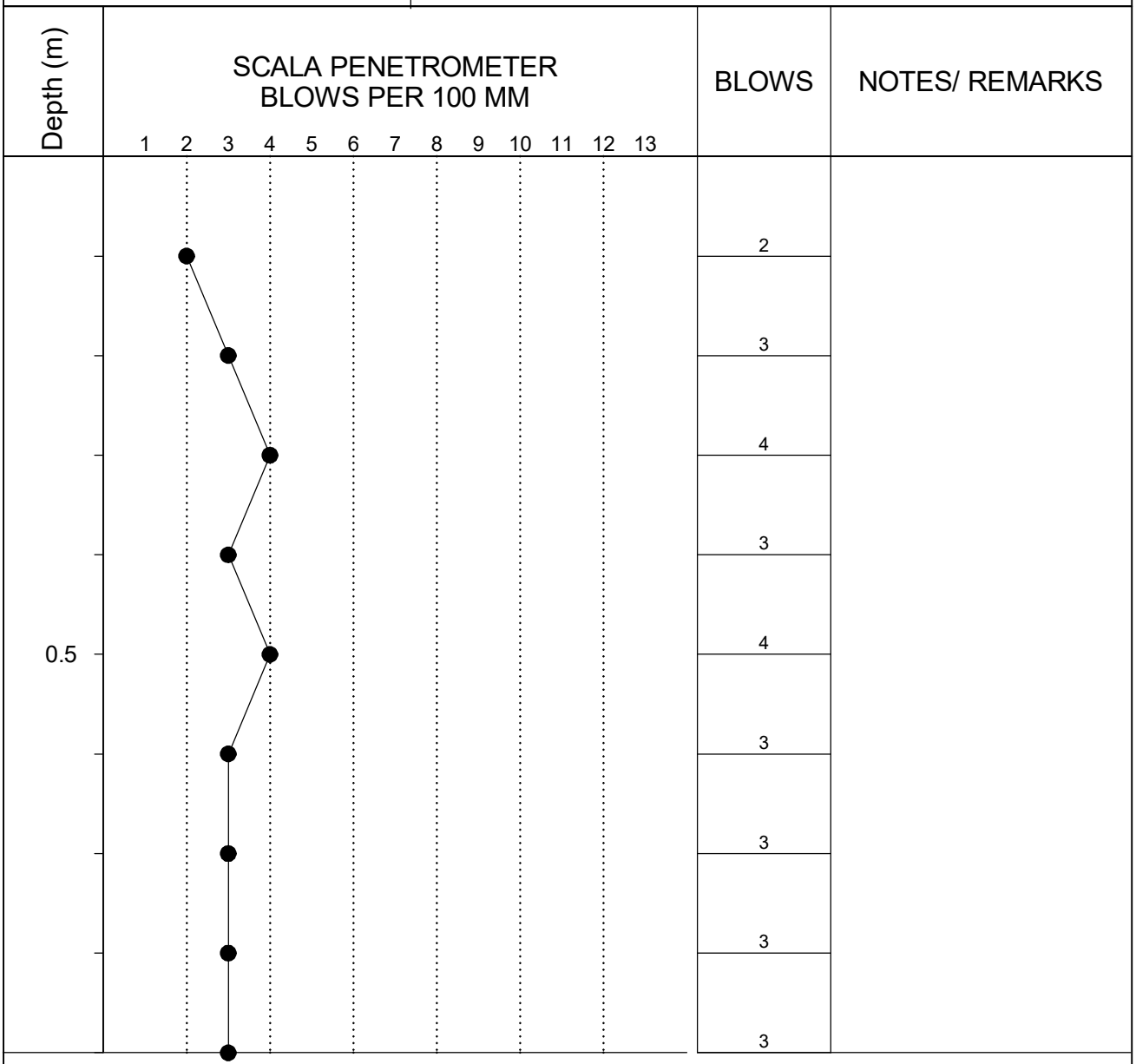
GEOTECH SCALA 41-43 BRIGHAM CREEK SP01-05.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF SCALA SP02

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 22/04/2021
Scala Depth : 0.9 m

Logged By : ML
Reviewed By : JC
Latitude : -36.79503
Longitude : 174.60926



BLOWS	NOTES/ REMARKS
2	
3	
4	
3	
4	
3	
3	
3	
3	

Scala Penetrometer met target depth at 0.9 m depth.

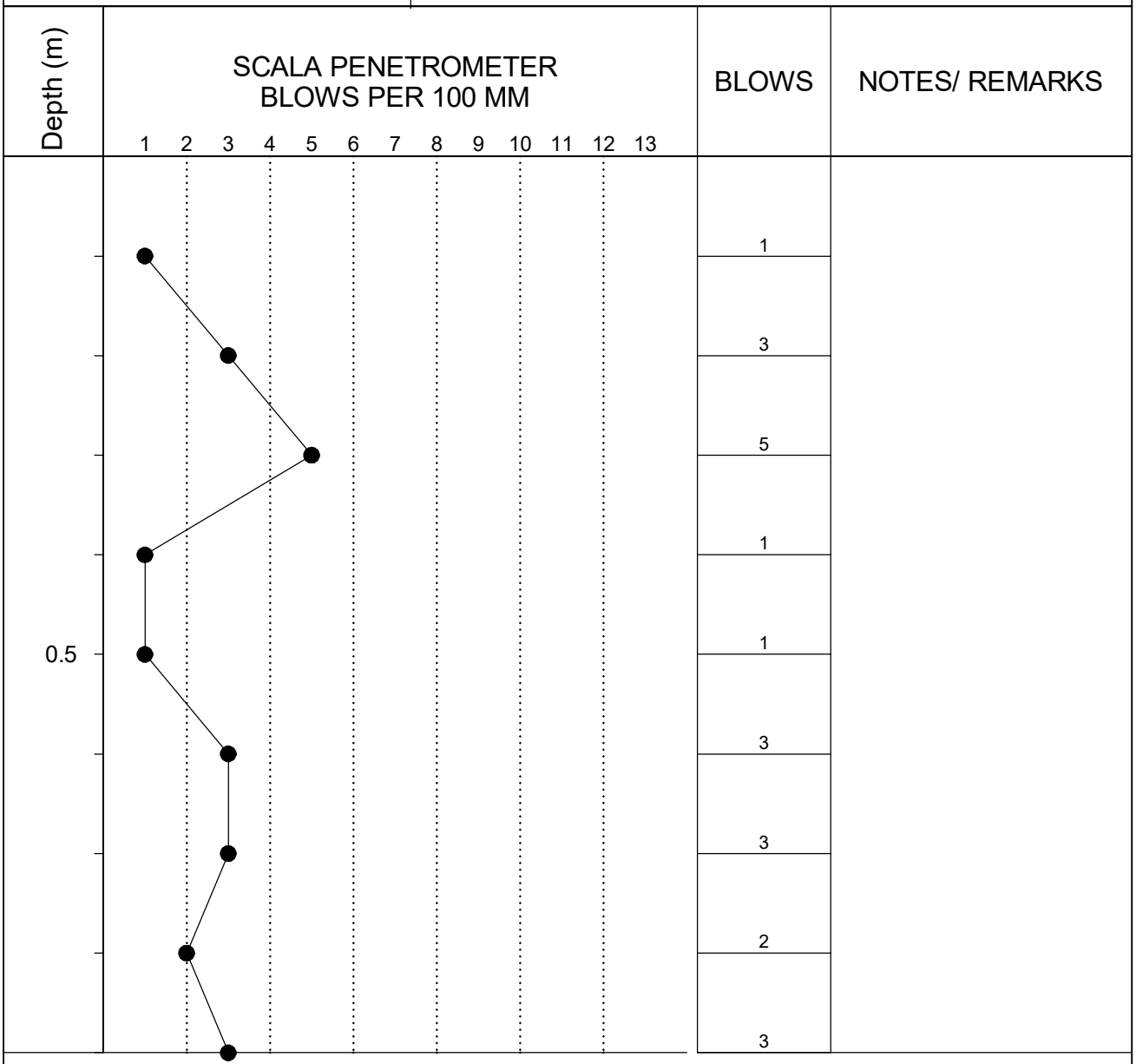
GEOTECH SCALA 41-43 BRIGHAM CREEK SP01-05.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF SCALA SP03

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 22/04/2021
Scala Depth : 0.9 m

Logged By : ML
Reviewed By : JC
Latitude : -36.79507
Longitude : 174.61071



BLOWS	NOTES/ REMARKS
1	
3	
5	
1	
1	
3	
3	
2	
3	

Scala Penetrometer met target depth at 0.9 m depth.

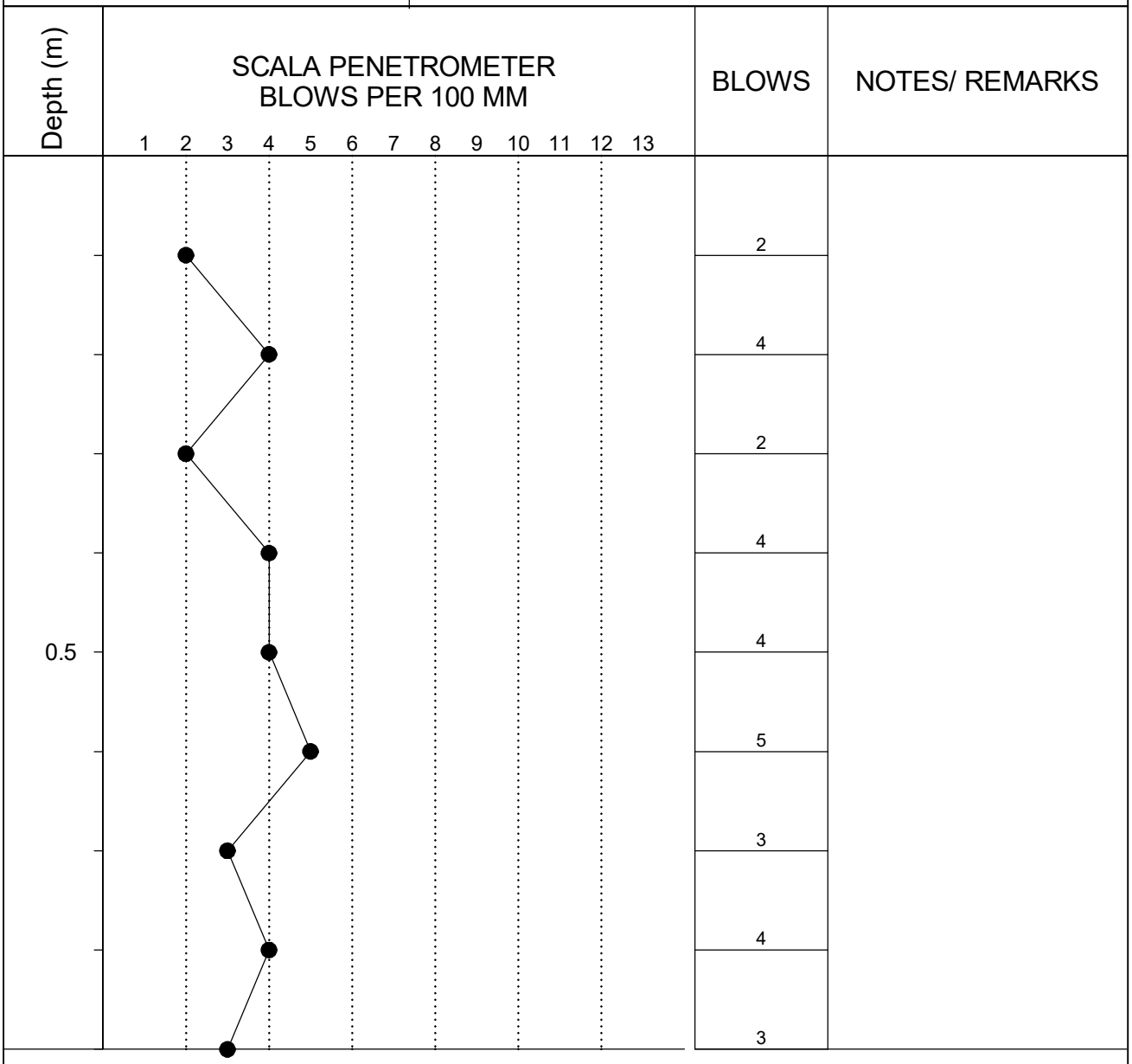
GEOTECH SCALA 41-43 BRIGHAM CREEK SP01-05.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF SCALA SP04

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 22/04/2021
Scala Depth : 0.9 m

Logged By : ML
Reviewed By : JC
Latitude : -36.79453
Longitude : 174.61169



BLOWS	NOTES/ REMARKS
2	
4	
2	
4	
4	
5	
3	
4	
3	

Scala Penetrometer met target depth at 0.9 m depth.

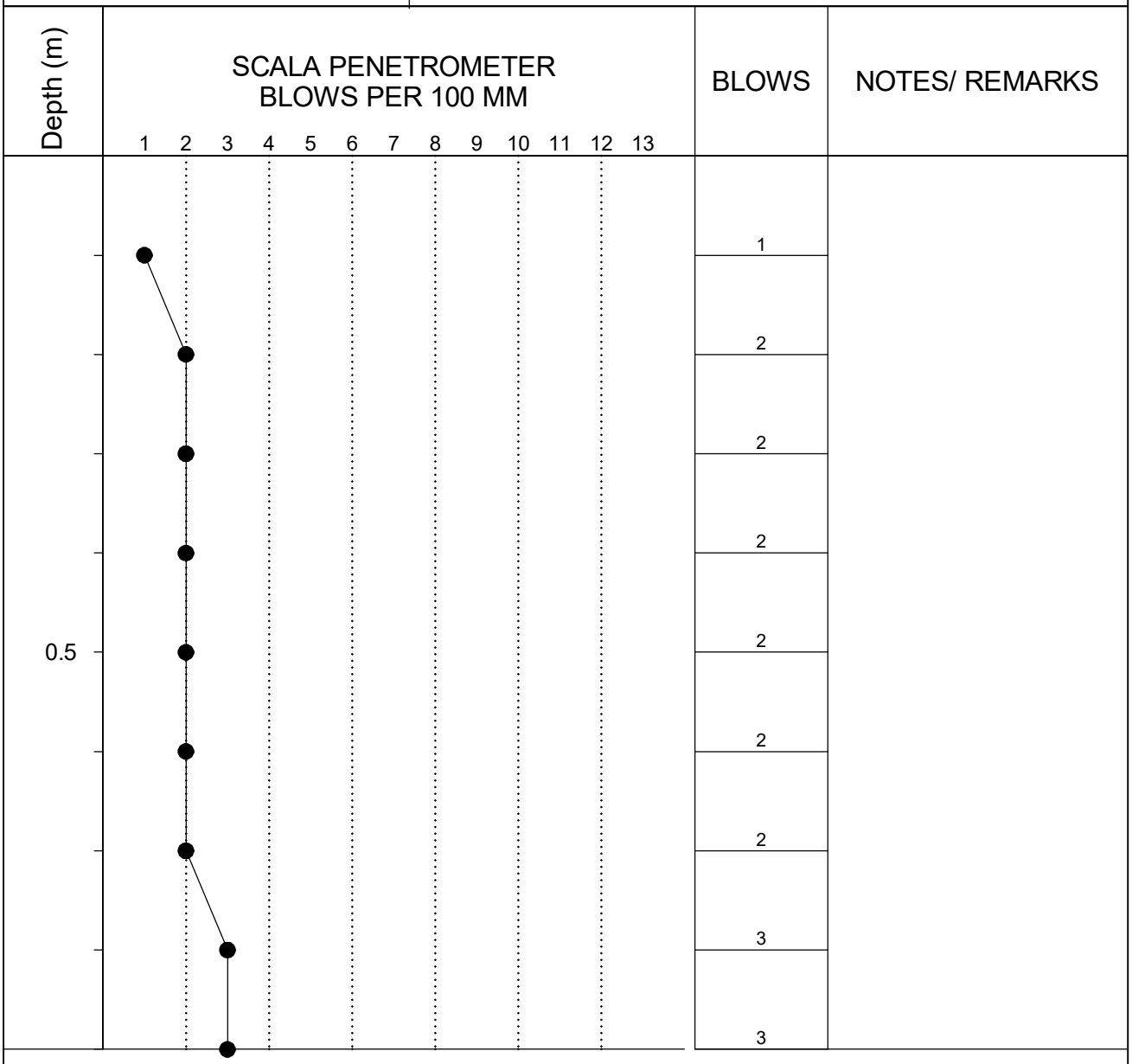
GEOTECH SCALA 41-43 BRIGHAM CREEK SP01-05.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

LOG OF SCALA SP05

Geotechnical Investigation
41-43 Brigham Creek Road
Whenuapai, Auckland

Client : 41-43 Brigham Creeks JV
Client Ref. : 18614.000.001
Date : 22/04/2021
Scala Depth : 0.9 m

Logged By : ML
Reviewed By : JC
Latitude : -36.79545
Longitude : 174.61195



BLOWS	NOTES/ REMARKS
1	
2	
2	
2	
2	
2	
2	
2	
3	
3	

Scala Penetrometer met target depth at 0.9 m depth.

GEOTECH SCALA 41-43 BRIGHAM CREEK SP01-05.GPJ NZ DATA TEMPLATE 2.GDT 13/5/21

APPENDIX 5:

Shrink Swell Results

Shrink – Swell Index Testing Results

Project Name	41-43 Brigham Creek Road, Whenuapai		
ENGEO Reference	18614.000.001		
Testing Conducted by	LA		
Date Samples Received	22/05/2021	**Date Test Started**	22/05/2021
Tests and Standards used	Water Content Sampling *in situ* Density Shrink - Swell Index	NZS4402:1986:Test 2.1 NZS4402:1986:Test 5.1.3 AS1289:Test 7.1.1 - 2003	
Sample ID	SS01		
Sample Depth (m)	1.0-1.4		
Soil Description*	Clayey SILT		
Initial Water Content (Swell Sample)	85.4%		
Initial Water Content (Shrink Sample)	108.6%		
Estimated Percentage of inert inclusions	<5%		
Extent of Crumbling	Minor		
Extent of Shrinkage Cracking	Moderate		
Swelling Strain	0.0		
Shrinkage Strain	29.6		
Shrink-Swell Index	**16.4**		

*Logged in accordance with NZGS Field Description of Soil and Rock, 2005.
For full log description, refer to relevant report appendix.

All testing was carried out in general accordance with stated New Zealand and Australian Standards. ENGEO currently holds ISO9001 accreditation for Quality Assurance, however, ENGEO does not currently hold ISO Accreditation specifically for lab testing.