



LandTech
CONSULTING

GEOTECHNICAL INVESTIGATION REPORT

FOR PROPOSED LAND USE CHANGE

69 Inland Kaikoura Road, Kaikoura

Client: Kaikoura Business Park 2021 Limited

Project Reference: LTC22138

Revision: B

Date: 29 June 2022

Documentation Control:

LandTech Consulting Ltd

Postal Address:

PO Box 119
Christchurch 8013



Christchurch Office:


11B Carlyle Street
Sydenham
Christchurch 8023
P: 03 390 1371

Auckland Office:

9B Collard Place
Henderson
Auckland 0610
P: 09 930 9334

E. info@landtech.nz

W. www.landtech.nz

Document Title:	Geotechnical Report for Proposed Land Use Change	
Address:	69 Inland Kaikoura Road, Kaikoura	
Revision:	B	
Client:	Kaikoura Business Park 2021 Limited	
Project Reference:	LTC22138	
Author:		Callum Nicholas, Engineering Geologist BSc (Geology), MEngNZ
Authorised:		Dwayne Wilson, Director CMEngNZ, CPEng, IntPE(NZ)

REPORT DISTRIBUTION:		
Recipient	Release Date	Document Type
Kaikoura Business Park 2021 Limited	29 June 2022	PDF

COPYRIGHT:

The information presented in this geotechnical report/document is the property of LandTech Consulting Limited. Use or copying of this document in whole or in part without the previous permission of LandTech Consulting Limited implies a breach of copyright.

Table of Contents:

1.0	Introduction & Scope of Work	1
2.0	Site & Dwelling Description	2
3.0	Previous Reporting.....	3
4.0	Area Geology	3
5.0	Faults.....	4
6.0	Area Seismicity.....	5
7.0	Geological Data Review	6
7.1	NZGD Geotechnical Investigation Data	8
8.0	Field Investigation	9
9.0	Subsurface Conditions	10
9.1	Topsoil and Fill	10
9.2	River Deposits	10
9.3	Scala Penetrometer Tests and Shear Vane Tests.....	10
9.4	DPSH Tests.....	11
9.5	Groundwater.....	11
9.6	Site Seismicity	11
9.7	Qualitative Liquefaction Analysis	12
10.0	Geotechnical Hazard Evaluation.....	13
10.1	Erosion	13
10.2	Falling Debris	13
10.3	Subsidence.....	13
10.4	Slippage	13
10.5	Inundation.....	13
10.6	Contamination	14
11.0	Geotechnical Recommendations	14
11.1	Preliminary Foundation Recommendations	14
11.2	Preliminary Earthwork Recommendations	14
11.3	Future Geotechnical Involvement	15
12.0	Limitations	15

Appendices:

APPENDIX A: LandTech Drawings

APPENDIX B: LandTech Field Logs

APPENDIX C: Deep Test Results

1.0 Introduction & Scope of Work

LandTech Consulting Limited (LandTech) were engaged by Kaikoura Business Park 2021 Limited (the Client) to carry out a geotechnical investigation at 69 Inland Kaikoura Road, Kaikoura. The geotechnical investigation is in relation to the proposed land use change for the subdivision into an industrial zone.

This geotechnical report summarises the findings of our investigation and analysis as per the brief given to us by our Client. It includes evaluation of ground conditions, assessment of potential geohazards, and provision of preliminary foundation recommendations. This report may be relied upon by our Clients appointed consultants for preliminary design purposes only and by the Kaikoura District Council (KDC) for plan change consent applications.

Our scope of works for the geotechnical investigation and reporting for the site included the following:

- Desktop study;
- Field investigation (i.e. site walkover, shallow and deep geotechnical investigations);
- Geohazard assessment; and
- Provision of this geotechnical report.

2.0 Site & Dwelling Description

The site is located at 69 Inland Kaikoura Road, Kaikoura and is legally described as Lot 2 Deposited Plan 501321 and part of lot 2 Deposited Plan 527436 with a combined area of approximately 21.5ha according to LINZ¹. The site is shown on the LandTech *Test Location Plan*, Drawing No. LTC22138 / 1 (attached in Appendix A) and Figure 1 (below).

The site is located on the corner of State Highway 1 (SH1) and the Inland Kaikoura Road. To the east of the site is the Kowhai River, to the south past SH1 is the coast, to the west is a small stream (Stoney Creek). To the north is farmland and the main trunk line (train tracks) which runs in a southwest to northeast direction.

The land is relatively flat with historic terraces throughout with associated changes in elevations and undulations typical of these landforms. There are several farm tracks across the property some are well formed with gravel and are located in similar locations to the proposed roads and right of ways. The only structure within the proposed industrial zone is a farm shed with multiple pieces of machinery stored outside. There are no watercourses or free faces located within the proposed industrial zone area.

Figure 1: Aerial photograph of investigation site



(Source: Canterbury Maps image captured 16 June 2022)

¹<https://data.linz.govt.nz/>, accessed 16 June 2022

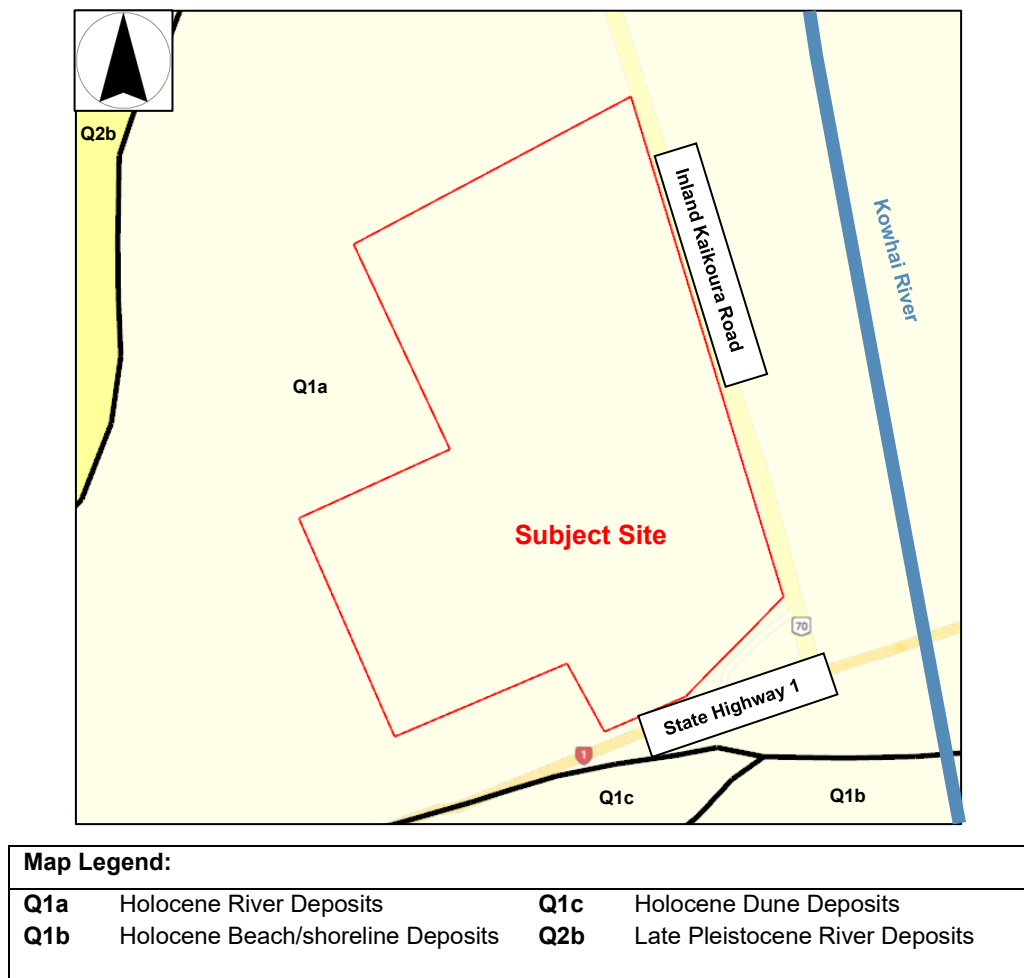
3.0 Previous Reporting

LandTech has previously investigated the areas north and west of the subject site. The report was titled: *Geotechnical Investigation Report for Proposed Residential Subdivision 69 Inland Kaikoura Road, Kaikoura*, dated 16 September 2021 Ref. LTC21305. The report summarised that the is suitable for residential development and that the natural hazard risk is low.

4.0 Area Geology

Reference has been made to the *New Zealand Geology Web Map*, GNS Science, <http://data.gns.cri.nz/geology/>, website accessed 16 June 2022. The reviewed sources indicate that the site is underlain by Holocene Aged River Deposits, with Late Pleistocene River Deposits to the northwest. The delineation between the two geologic units a river terrace located to the northwest of the property. These materials generally comprise rounded to subrounded gravel and cobble sized particles within a matrix of silt and sand, deposited via the lateral and vertical migration of the past and present river systems, draining from the nearby ranges out toward the east coast. Due to the depositional environment, the geotechnical characteristics of this material can be variable.

Figure 2: Area Geology



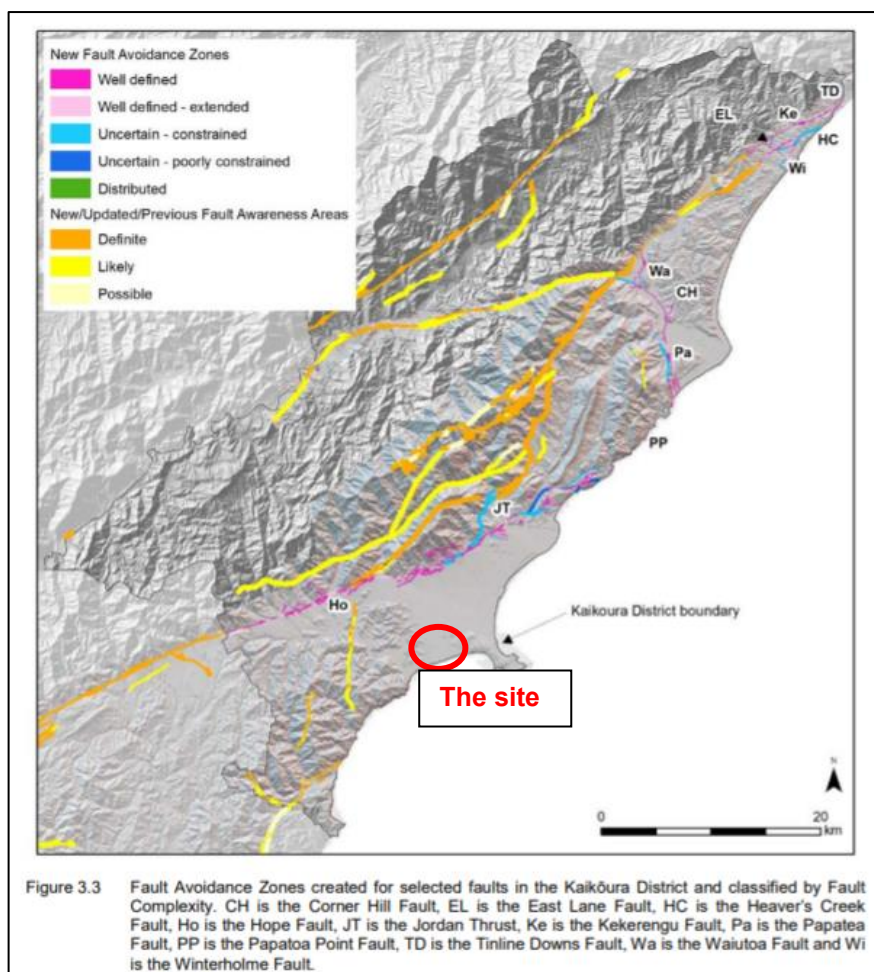
(Source: <http://data.gns.cri.nz/geology/>, accessed 16 June 2022)

The characteristics of the River Deposits can vary widely over small distances. These variances include vertical and horizontal differences in both soil particle size distribution and consolidation. It is discussed above that these materials generally comprise gravel and cobbles; however, interbedded horizons of fine to coarse grained sand, silt and clay can also exist. They can also be capped by loessal soils or finer grained silts and sands

5.0 Faults

The GNS *New Zealand Geology Web Map* Indicates the nearest faults is the Hope fault located to the north / northwest of the site (circa 7.8km north). This source also shows the Fyffe and Kowhai Faults a further of the Hope fault and around 9.5km to 13.0km north of the site.

Figure 3: shows excerpt from figure 3.3 of the referenced GNS report.



(Source: GNS, Updated Assessment of Active Faults in the Kaikoura District Sept 2019)

Further reference has been made to the Canterbury Fault Awareness Areas 2019 map and Kaikoura District Fault Avoidance Zones. Both these maps (viewed from within Canterbury Maps web viewer) show the faults mapped by GNS in the same general location. Additionally, these awareness maps show the Whites Fault ≈8.5km west of the site, which we understand has only been mapped since the Kaikoura Earthquakes Sequence 2016 (KES).

The report that covers the Active Faults in the Kaikoura District and covers the fault awareness zones viewed through the Canterbury Maps Web viewer shows in the GNS updated Assessment of Active Faults in the Kaikoura District, dated September 2019. A review of this report shows the nearby faults Hope, Kowhai and Fyffe have a Return interval of as low as <2,000 years. While the Whites fault is inferred to have a return interval of between 10,000 and 20,000 years.

A review of the New Zealand Active Fault Database (GNS) also shows the faults with fault traces mapped following the KES, occurring along discrete parts of each fault identified above.

6.0 Area Seismicity

The Kaikoura Earthquake Sequence was initiated at 12:02am 14 November 2016 by a magnitude Mw 7.8 event. The epicentre of the earthquake was approximately 15km northeast of Culverden (approximately 60km southwest of Kaikoura), 15km below the surface. At this time a number of other earthquake events were spontaneously triggered and their associated aftershocks. The earthquakes propagated in a north-western direction from the Humps Fault Zone (close to Waiau) to the Needles Fault (off the coast of Cape Campbell, northwest of Ward).

Due to the nature of the earthquake sequence (i.e. multiple spontaneous events), the initial epicentre does not represent the strongest ground motion. The area of greatest Peak Ground Acceleration (PGA) was located in close proximity to Ward; at this location PGAs of 1.2g were recorded.

To ascertain the PGAs for the investigation site during the Kaikoura Earthquake Sequence, information has been sourced from the United States Geologic Survey. Table 1 represents the recorded PGAs and other associated data with relation to nearby SGM stations. The closest station to the site is situated on Kaikoura Peninsula on the seaward (southern) corner of Moa and Kaka Roads; approximately 10km north east of the investigation site.

Table 1: Strong ground motion data

Station ID	Location	Distance / Direction from Site	PGA (g)	Site Soil Class (at Station)
KIKS	Kaikoura Peninsula	~10km / Northeast	0.25	B

A USGS report: *Overview of the geologic Effects of the November 14, 2016 M_w 7.8 Kaikoura, New Zealand Earthquake* was carried out in 2017. The report has a shake map showing PGA's associated with the KES. The site is located in an area that likely experienced PGA's of between 22% and 40% of gravity or between 0.22g and 0.40g.

7.0 Geological Data Review

Reference has been made to sources including the New Zealand Geotechnical Database (NZGD): <http://www.nzgd.org.nz/> and Environment Canterbury (ECan): <http://canterburymaps.govt.nz/> (accessed 15 February 2021), and various supplied geotechnical reports prepared for properties in the vicinity of the development. The following text summaries the findings of our data review:

- A review of historical photograph of the site from between 1960 and 2014 has been carried out on Canterbury Maps. Imagery from 2010-2014 (shown below in Figure 4), shows evidence of braided historic river channels through the site. Some historic infilling of these river channels could have taken place as part of farming activities. However, our investigation found limited evidence of filling having taken place across the general site.

Figure 4: Aerial photograph of the site from the 1990–1994 image set.



(source: <https://mapviewer.canterburymaps.govt.nz/>, accessed 16 June 2022)

Overall, the review of the historic images showed little obvious change in the landscape, with farmland and river occupying the same areas throughout this time period.

Further review of historic images has taken place through Google Earth. When looking at images following the KES there is no noticeable land damage to the site.

- According to the Environment Canterbury Soil Type map, the site is mapped as comprising a moderately deep silt on the western side of the site and the eastern side is mapped as having a stony loam. Both the soil types are described as having moderate over rapid permeability.
- According to the Canterbury Maps, Kaikoura Liquefaction Susceptibility (2019) map and the KDC natural hazards maps the site has a liquefaction Vulnerability categorization of "Liquefaction Damage is Possible". The explanation of this zone mentions a detailed liquefaction assessment including deep geotechnical testing is required. An assessment should meet a MBIE Level C or D assessment depending on the projects scope.
- The KDC hazards map features the site within a Tsunami orange zone indicating that there is a less than 1 in 20 chance of the lots being affected in someone's lifetime (or a 0.04% chance of it occurring in any one year).
- The KDC hazards map features the site within flood zone. The perimeter of the site is shown to be affected by a 1 in 500-year event with water depths of less than 0.2m.
- The KDC hazards map features do not show any Fault Rupture and Debris Inundation features within the site.
- According to Canterbury Maps there are a series of ECan wells within the site and one long term monitoring well located within the northeastern corner. The associated bore logs for the following ECan wells have been reviewed, and a copy of them along with a location plan are attached within Appendix B:
 - O31/0083, drilled to 12.9m and located to the south of the site. The borelog for the well shows gravels to the termination depth of 29.0m.
 - O31/0155, drilled to 18.6m and located in the center of the site. The borelog for the well shows gravels to 9.1m with interbedded layers of clay and gravel to the termination depth of 29.0m. The groundwater level (gwl) reading ranges from 4.0m to 10.0m below ground level (bgl) from between 1985 and 1995. Recent recordings where at 6.0m bgl in 2015.

7.1 NZGD Geotechnical Investigation Data

The *NZGD Geotechnical Investigation Data* map shows that there have been several geotechnical tests undertaken at the site and within close proximity to the site. The positions of the tests referred to below are marked on the LandTech *Test Location Plan*, Drawing No. LTC22138 / 1 (attached in Appendix A), and the details of a sample of these test are as follows:

- Machine borehole (BH_108017), drilled by PDP on 18 July 2017, located in the south eastern corner of the site;
- Machine borehole (BH_108021), drilled by McNeil Drilling on 21 July 2017, located in the south eastern corner of the site;
- Machine borehole (BH_108027), drilled by McNeil Drilling on 21 July 2017, located in the south eastern corner of the site;
- Cone Penetration Test (CPT_130236), drilled by Geotechnics on 13 September 2017, located south east of the site along State Highway 1.
- Cone Penetration Test (CPT_130234), drilled by Geotechnics on 13 September 2017, located south west of the site along State Highway 1.

The borehole results indicated that material encountered generally comprised silty and sandy gravel. SPT tests weren't undertaken within these boreholes, a copy of the logs are included within Appendix C.

Results of the CPT tests correlate with the boreholes discussed above. The results show that cone resistance, Q_c values were generally less than 5MPa within the first 0.8m to 1.0m indicative of weak silt and sand layers. Below this Q_c increased to generally between 20MPa and 50MPa indicating dense gravel material to a depth of 2.0m. Below this Q_c values decrease to between 10MPa and 20MPa, indicating a less dense gravel or dense sand then increase to over 50MPa below 3.0m. The CPTs terminated at a depth of 3.3 and 1.9m. Groundwater was not recorded during testing. The CPT logs are attached in Appendix C.

8.0 Field Investigation

The field investigation for the site took place on 31 May 2022 and comprised the following components:

- Detailed site inspection;
- Drilling of six hand auger holes with associated in-situ soil testing; and
- Four Dynamic Probe Super Heavy (DPSH) tests.

The approximate test positions² are indicated on the LandTech *Test Location Plan*, Drawing No. LTC22138 / 1, (attached in Appendix A).

The soil conditions encountered within the hand auger holes were logged by LandTech technical staff³. The hand auger hole logs are attached in Appendix B, together with the results of the various tests undertaken, including the groundwater conditions determined during the site investigation.

Dynamic Cone (Scala) Penetrometer testing was carried out through the hand auger hole locations, to determine a density profile with depth⁴. The undrained shear strength of the fine-grained soils was recorded where applicable using a Geovane handheld shear vane⁵. The peak and remoulded vane shear strength values have been factored in terms of BS1377.

DPSH testing was carried out by LandTech. The tests (DPSH01 – DPSH04) across the site except for the southeast corner where many deep tests are available on the NZGD. The DPSH results are attached in Appendix C and are discussed in Section 9.4, below.

Groundwater measurements were made on the day of drilling upon completion of the fieldwork, as indicated on the attached logs (where encountered). The auger holes were subsequently backfilled and no long-term groundwater monitoring has taken place as part of our investigation.

² Field tests and sections were located using a hand-held GPS unit and a measuring tape without survey control and are therefore approximate only.

³ Soil was logged in accordance with New Zealand Geotechnical Society *Guideline for the Description of Soil and Rock for Engineering Purposes* (2005).

⁴ In accordance with NZS 4402:1988, Test 6.5.2, *Dynamic Cone Penetrometer*.

⁵ In accordance with the New Zealand Geotechnical Society *Guideline for Hand Held Shear Vane Test*, (2001).

9.0 Subsurface Conditions

The subsurface conditions encountered during our field investigation generally comprised a surface layer of topsoil and fill, overlying River Deposits, consistent with the mapped geology. A summary of the subsurface conditions is given in Table 1 and a general description of the main soil units follow. Detailed descriptions are given in the hand auger logs attached in Appendix B.

Table 1: Subsurface Summary

Augerhole ID	Drill Depth	Depth of Topsoil	Groundwater Level	Scala Depth
HA01	0.3	0.2	NE	0.3
HA02	1.2	0.3	NE	1.3
HA03	0.4	0.2	NE	0.4
HA04	0.3	0.1	NE	0.3
HA05	0.2	0.1	NE	0.2
HA06	0.2	0.2	NE	0.2

Table Notes: Measurements are in metres (m) below present ground level (bpgl)
NE = Not Encountered

9.1 Topsoil and Fill

Topsoil and fill were encountered from the existing ground surface to depths between 0.1m and 0.3m. Due to the nature of the fill and organic content of the topsoil, these materials are not considered suitable for permanent support of foundations due to the potential for differential settlement.

Our hand augers were drilled across the site, in point locations that were accessible for our hand auger equipment. Therefore, ground conditions could vary away from the test. This bears the potential for greater depths of unsuitable topsoil and fill than those encountered within our hand auger holes, which should be taken into account during earthworks and foundation excavations.

9.2 River Deposits

River soils were encountered from below the topsoil and fill to the termination of the auger holes at 0.2m to 1.2m where they refused on dense gravel. The River Deposits generally comprised sandy gravels, although HA02 recorded sandy silt to 1.2m depths.

9.3 Scala Penetrometer Tests and Shear Vane Tests

Scala Penetrometer testing through the hand auger locations returned results ranging between 1 and 40+ blows per 100mm. Relative density generally increased significantly at or below hand auger refusal, indicating dense material (i.e. inferred gravel). Shear vane testing within the fine-grained material ranged between 108kPa and 130kPa for undrained shear strength within HA02 comprising 'very stiff' consistency for the fine grained soil.

9.4 DPSH Tests

The DPSH mostly indicated dense gravels from 0.5m depth or shallower. DPSH01 recorded a softer layer with blows less than 8 per 100mm between 1.0m and 2.0m. DPSH03 recorded blows less than 8 between 5.0m and 6.0m.

All the tests terminated early due to refusal on very dense gravel at depths between 1.5m and 7.4m. CPT_130234 and CPT_130236 recorded a similar profile to the DPSH data.

9.5 Groundwater

Groundwater was not encountered on the day of drilling (31 May 2022). Groundwater level was measured within the NZGD boreholes in the southeast, between 3.3m and 4.2m within BH_108017 and BH_108027 accessed through the NZGD.

Additionally, it is expected likely that levels rise following periods of prolonged and heavy rainfall. In contrast, there is potential for these levels to lower during drier times. Due to the proximity to the coast, groundwater may also be tidally influenced.

9.6 Site Seismicity

For the purpose of applying the requirements of NZS 1170.5:2004 the site subsoil is considered Class D - Deep or Soft Soil Sites. This classification is based on the depth of soils estimated to exceed those given in table 3.2 of the standard.

9.7 Qualitative Liquefaction Analysis

For the purpose of our geotechnical analysis, and deriving Serviceability Limit State (SLS) and Ultimate Limit State (ULS) earthquake parameters for the site, we have referred to the NZGS *Earthquake Geotechnical Engineering Module 1 – Overview of the Guidelines* (2021). The Ultimate Limit State (ULS) and the Serviceability Limit State (SLS) Peak Ground Acceleration (PGA) and corresponding Effective Magnitudes (M_{eff}) are given below:

ULS = PGA = 0.14 and M_{eff} = 6.1

SLS = PGS = 0.56 and M_{eff} = 6.7

The MBIE & New Zealand Geotechnical Society Inc. report titled *Earthquake geotechnical engineering practice, Module 3: Identification, assessment and mitigation of liquefaction hazards* (2016) explains that the evaluation of the geologic susceptibility of liquefaction is a key aspect in the evaluation of liquefaction potential at a given site.

Based on our desktop study and field investigation, we have established that the site is generally underlain by Holocene Age horizons of tightly packed gravel (i.e. River Deposits) capped with a relatively thin layer of loose alluvial soil in the northwest. Nearby monitoring of groundwater levels indicates a water table as shallow as 3.0m. In addition to this the site is mapped as “Liquefaction Possible” by the Kaikoura District Council in 2019.

Further investigation into site groundwater levels and soil depths would be required to determine the liquefaction potential of each lot within the site. However, based on the expected depth and thickness of gravel and depths to groundwater, we consider the liquefaction potential of the site is likely to be low (i.e. equivalent TC1 MBIE Canterbury Rebuild Guidelines, December 2012; <15mm of settlement at SLS, and <25mm settlement at ULS).

10.0 Geotechnical Hazard Evaluation

Section 106 of the Resource Management Act 1991 outlines hazards that must be assessed when a territorial authority considers a Subdivision Consent application. This section outlines our evaluation of possible geotechnical hazards associated with the site. Based on the results of our investigation and assessment, we consider this site suitable for land use change to residential zoning from a geotechnical perspective.

10.1 Erosion

The site is not considered to be subject to active erosion, and is unlikely to accelerate, worsen, or result in erosion due to the proposed land use change.

10.2 Falling Debris

No elevated land exists in close proximity to the site; therefore, the risk of falling debris from upslope rock fall or land slippage is considered negligible. This assessment excludes avulsion of the two nearby waterways or landform changes as a result of a large earthquake.

10.3 Subsidence

As a result of our shallow testing liquefaction induced settlements are considered to be low or very low, when considering a maximum alluvial soil thickness of 2.0m with no or limited groundwater influence. Regardless further site-specific testing would be required to accurately assess the static and seismic settlement of each lot.

10.4 Slippage

Due to the site being near level to gently undulating, it's removed location from any major waterways, and inferred non-liquefiable nature of the underlying subsoils, slippage via liquefaction-induced lateral spreading is not considered to affect the subdivision site. No other geotechnical mechanism of slippage was noted during out field investigation or from our assessment.

10.5 Inundation

According to KDC hazard mapping, parts of the site are located within a 1 in 500 year flooding zone. Based on the hazard mapping inundation should be considered for those particular sites and their proposed building locations.

10.6 Contamination

Whilst not a requirement of Section 106 of the Resource Management Act 1991, soil contamination is a potential geotechnical hazard that should be considered when making Consent applications to territorial authorities where ground disturbance works are proposed (i.e. foundation excavations etc).

We have made reference to the ECan Listed Land Use Register (LLUR), that indicates no HAIL activities are recorded to have taken place at the site, according to the register. This does not confirm the site has no soil contamination, but only indicates the regional council does not have records of potentially hazardous activities taking place at the site that could lead to soil contamination

11.0 Geotechnical Recommendations

It is stated in the previous sections that the site has been classified as TC1; based on our desktop study, the underlying geology and qualitative liquefaction assessment. Following our assessment, we consider the site suitable land use change to industrial zoning from a geotechnical perspective. Our recommendations with regard to site development and preliminary foundation design follow subsequently.

11.1 Preliminary Foundation Recommendations

Due to the low risk of liquefaction at the subdivision we have classified the investigation site as TC1 and conclude the River Deposits beneath any surficial soils meet the criteria for “good ground” as defined by the New Zealand Building Code. Some areas of weak upper surficial soils may require foundations to be subject to specific engineering design due to low bearing capacities. Alternatively, earthworks during subdivision may compact any weak upper layers so standard foundations can be utilised without engineering design input. The extent of any weak upper soils can be determined with further shallow soil testing as part of the subdivision design/consenting stage.

11.2 Preliminary Earthwork Recommendations

All proposed earthworks will need to be carried out to the requirements of NZS 4431:2022, ‘Engineered fill construction for lightweight structures’. All unsuitable materials (vegetation, organic or detritus material, and organic rich topsoil etc.) should be stripped from any areas of earthworks and stockpiled well clear of operations or carted from the site.

11.3 Future Geotechnical Involvement

Should the land use change be approved and a subdivision plan be made, a more detailed geotechnical investigation will be required to identify areas of deep alluvial soils and provided further geotechnical recommendations for the subdivision development more accurately.

Dependent on the extent of earthworks during the subdivision stage and involvement from a geotechnical professional to observe areas of stripped ground and fill compaction, additional lot specific shallow soil testing may be required. The results of which may supersede our preliminary foundation recommendations if the test results differ to our area wide investigation. However, the risk of differing ground conditions is considered to be low, due to the relatively uniform presence of dense river gravels throughout the general area. Potential variations could be from deeper areas of surficial alluvial soils or localised uncontrolled filling in the past.

12.0 Limitations

This geotechnical report has been prepared for our Client, Kaikoura Business Park 2021 Limited, for the purposes of supporting their land use change application. This report shall not be extrapolated for other nearby sites or used for any other purposes without the express approval of LandTech and their Client.

This report has been based on the results of tests at point locations; therefore, subsurface conditions could vary away from the assumed geotechnical model. Should exposed soil conditions vary from those described herein we request to be informed to determine the continued applicability of our recommendations. We have attempted to conduct a thorough investigation of soil types across the site, within the agreed scope of works. However, variations still may exist as soils can vary naturally and due to previous human activities, which LandTech have no control over and should not be held accountable for.

The geotechnical investigation was confined to geotechnical aspects of the site only and did not involve the assessment for environmental contaminants. In addition, our investigation and analyses have also not considered possible fault rupture that may cause deformations and displacements of the ground directly below the site. This type of assessment is outside of the scope of our geotechnical engagement.

END OF REPORT

APPENDIX A

LandTech Drawings





- KEY:**
- HA01 LandTech Consulting Ltd. augerhole locations, drilled 31 May 2022
 - DPSH01 LandTech Consulting Ltd. DPSH test locations, tested 31 May 2022
 - BH01 PDP machine borehole location, drilled July 2017
 - CPT01 Geotechnics CPT test locations, tested 10 September 2017
 - Existing boundary

NOTES:

Locations of features approximate only

Original sheet size A3

Boundary information on this *Test Location Plan* adapted from LINZ website: www.data.linz.govt.nz (23 May 2022)

AMENDMENTS		
DATE	REV	DESCRIPTION
13/06/2022	A	Report Issue

Check all dimensions and levels on site before commencing construction.

This drawing and design remains the property of LandTech Consulting Ltd. and may not be reproduced without approval and permission from LandTech Consulting Ltd.

Test Location Plan

69 Inland Kaikoura Road
PEKETA



Christchurch Office:
11B Carlyle Street, Sydenham, Christchurch 8023

Auckland Office:
9B Collard Place, Henderson, Auckland 0610

Postal Address:
PO Box 119, Christchurch 8013

Website: www.landtech.nz Email: info@landtech.nz

Drawing No: LTC22138/ 1	Drawn by: K Pearcy	Date: 13/06/2022
Scale: 1: 5,000 (A3)	Checked by: CN	Revision: A
Filename: LTC22138 - Drawings.dwg		

APPENDIX B

LandTech Field Logs





Client: Kaikoura Business Park 2021 Limited
Project: Land Use Change
Address: 69 Inland Kaikoura Road, Kaikoura

Augerhole No.: HA01

Sheet No.: 1 of 1

Project No.: LTC22138 **Coordinates:** NZTM2000: E1651530.40, N5303757.95 **Logged By:** CN
Drill Type: 50mm Hand Auger & Shovel **Reduced Level:** 8.50m (NZVD2016) **Shear Vane No.:**
Date Started: 31-May-22 **Ground Conditions:** Near Level, Grass **Calibration Factor:**
Date Finished: 31-May-22 **Groundwater Level (m):** Not Encountered **Calibration Date:**

Stratigraphy	Depth (m)	Graphic Log	Description <i>Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005</i>	Groundwater Level (m)	Depth (m)	In-situ Field Testing												
						Shear Strength (kPa)				Dynamic Cone (Scala) Penetrometer								
						<ul style="list-style-type: none"> ● Peak ● Remoulded 				Depth (m) Blow Count Scala Blow Count / 100mm								
						50	100	150	200									
FILL			SILT, some fine to coarse sand, trace fine subangular gravel, dark brown, firm, moist, [FILL].									-0.1	2					
Alluvial Deposits			Fine to coarse subangular to rounded GRAVEL, some silt and fine to coarse sand, very dense, moist, [ALLUVIAL DEPOSITS].									-0.2	6					
			End of Augerhole: 0.3m [Too Dense to Auger]									-0.3	40+					

Too dense to auger due to inferred gravel

In-situ testing in accordance with the following standards:
 Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
 Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

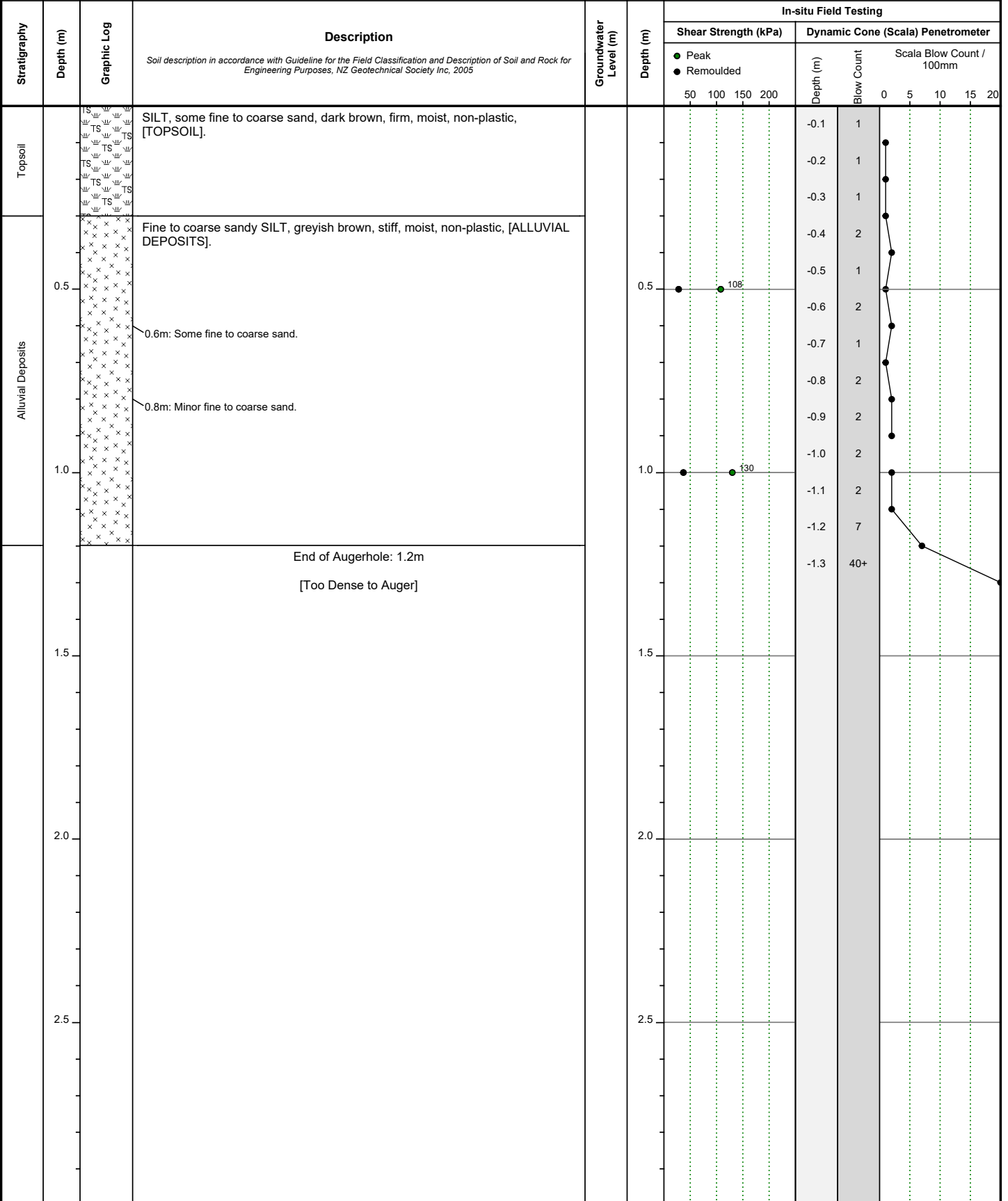


Client: Kaikoura Business Park 2021 Limited
Project: Land Use Change
Address: 69 Inland Kaikoura Road, Kaikoura

Augerhole No.: HA02

Sheet No.: 1 of 1

Project No.: LTC22138 **Coordinates:** NZTM2000: E1651435.78, N5303878.75 **Logged By:** CN
Drill Type: 50mm Hand Auger **Reduced Level:** 10.20m (NZVD2016) **Shear Vane No.:** 1999
Date Started: 31-May-22 **Ground Conditions:** Near Level, Grass **Calibration Factor:** 1.447
Date Finished: 31-May-22 **Groundwater Level (m):** Not Encountered **Calibration Date:** 20-Apr-22



Too dense to auger due to inferred gravel

In-situ testing in accordance with the following standards:
 Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
 Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001



Client: Kaikoura Business Park 2021 Limited
Project: Land Use Change
Address: 69 Inland Kaikoura Road, Kaikoura

Augerhole No.: HA03

Sheet No.: 1 of 1

Project No.: LTC22138 **Coordinates:** NZTM2000: E1651464.41, N5304125.60 **Logged By:** CN
Drill Type: 50mm Hand Auger & Shovel **Reduced Level:** 16.00m (NZVD2016) **Shear Vane No.:**
Date Started: 31-May-22 **Ground Conditions:** Near Level, Grass **Calibration Factor:**
Date Finished: 31-May-22 **Groundwater Level (m):** Not Encountered **Calibration Date:**

Stratigraphy	Depth (m)	Graphic Log	Description <i>Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005</i>	Groundwater Level (m)	Depth (m)	In-situ Field Testing									
						Shear Strength (kPa)		Dynamic Cone (Scala) Penetrometer							
						● Peak	● Remoulded	Depth (m)	Scala Blow Count / 100mm						
						50	100	150	200	0	5	10	15	20	
Topsoil			SILT, minor fine to coarse sand, trace subangular to rounded gravel, dark brown, firm, moist, non-plastic, [TOPSOIL].							-0.1	1				
Alluvial Deposits			Fine to coarse subangular to rounded GRAVEL, some silt and fine to coarse sand, dark brown, very dense, moist, [ALLUVIAL DEPOSITS].							-0.2	5				
										-0.3	15				
										-0.4	40+				
	0.5		End of Augerhole: 0.4m [Too Dense to Auger]		0.5										
	1.0				1.0										
	1.5				1.5										
	2.0				2.0										
	2.5				2.5										

Too dense to auger due to inferred gravel

In-situ testing in accordance with the following standards:
 Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
 Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001



Client: Kaikoura Business Park 2021 Limited
Project: Land Use Change
Address: 69 Inland Kaikoura Road, Kaikoura

Augerhole No.: HA04

Sheet No.: 1 of 1

Project No.: LTC22138 **Coordinates:** NZTM2000: E1651521.98, N5303970.07 **Logged By:** CN
Drill Type: 50mm Hand Auger & Shovel **Reduced Level:** 13.00m (NZVD2016) **Shear Vane No.:**
Date Started: 31-May-22 **Ground Conditions:** Near Level, Grass **Calibration Factor:**
Date Finished: 31-May-22 **Groundwater Level (m):** Not Encountered **Calibration Date:**

Stratigraphy	Depth (m)	Graphic Log	Description <i>Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005</i>	Groundwater Level (m)	Depth (m)	In-situ Field Testing										
						Shear Strength (kPa)				Dynamic Cone (Scala) Penetrometer						
						<ul style="list-style-type: none"> ● Peak ● Remoulded 				Depth (m) Blow Count Scala Blow Count / 100mm						
						50	100	150	200							
Topsoil	0.0 - 0.1		SILT, some fine to coarse sand, trace fine subangular gravel, dark brown, firm, moist, non-plastic, [TOPSOIL].									-0.1	5			
FILL	0.1 - 0.3		Silty fine to coarse subangular to rounded GRAVEL, some fine to coarse sand, dark brown, very dense, moist, [FILL].									-0.2	21			
	0.3 - 0.5		End of Augerhole: 0.3m [Too Dense to Auger]									-0.3	40+			
	0.5 - 2.5															

Too dense to auger due to inferred gravel

In-situ testing in accordance with the following standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001



Client: Kaikoura Business Park 2021 Limited
Project: Land Use Change
Address: 69 Inland Kaikoura Road, Kaikoura

Augerhole No.: HA05

Sheet No.: 1 of 1

Project No.: LTC22138 **Coordinates:** NZTM2000: E1651641.80, N5304230.44 **Logged By:** CN
Drill Type: 50mm Hand Auger & Shovel **Reduced Level:** 15.00m (NZVD2016) **Shear Vane No.:**
Date Started: 31-May-22 **Ground Conditions:** Near Level, Grass **Calibration Factor:**
Date Finished: 31-May-22 **Groundwater Level (m):** Not Encountered **Calibration Date:**

Stratigraphy	Depth (m)	Graphic Log	Description <i>Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005</i>	Groundwater Level (m)	Depth (m)	In-situ Field Testing							
						Shear Strength (kPa)				Dynamic Cone (Scala) Penetrometer			
						<ul style="list-style-type: none"> ● Peak ● Remoulded 				Depth (m) Blow Count Scala Blow Count / 100mm			
				50	100	150	200	0	5	10	15	20	
Topsoil	0.0 - 0.1		SILT, some fine to coarse sand, trace fine subangular gravel, dark brown, firm, moist, non-plastic, [TOPSOIL].						-0.1	14			
Alluvial Deposits	0.1 - 0.2		Fine to coarse subangular to rounded GRAVEL, some fine to coarse sand, brown, very dense, moist, [ALLUVIAL DEPOSITS].						-0.2	40+			
	0.2 - 0.25		End of Augerhole: 0.2m [Too Dense to Auger]										

Too dense to auger due to inferred gravel

In-situ testing in accordance with the following standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001



Client: Kaikoura Business Park 2021 Limited
Project: Land Use Change
Address: 69 Inland Kaikoura Road, Kaikoura

Augerhole No.: HA06

Sheet No.: 1 of 1

Project No.: LTC22138 **Coordinates:** NZTM2000: E1651718.92, N5304049.93 **Logged By:** CN
Drill Type: 50mm Hand Auger & Shovel **Reduced Level:** 12.20m (NZVD2016) **Shear Vane No.:**
Date Started: 31-May-22 **Ground Conditions:** Near Level, Grass **Calibration Factor:**
Date Finished: 31-May-22 **Groundwater Level (m):** Not Encountered **Calibration Date:**

Stratigraphy	Depth (m)	Graphic Log	Description <i>Soil description in accordance with Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes, NZ Geotechnical Society Inc, 2005</i>	Groundwater Level (m)	Depth (m)	In-situ Field Testing									
						Shear Strength (kPa)		Dynamic Cone (Scala) Penetrometer							
						● Peak	● Remoulded	Depth (m)	Scala Blow Count / 100mm						
						50	100	150	200	0	5	10	15	20	
Topsoil	0.0 - 0.1		SILT, some fine to coarse sand, trace fine subangular gravel, dark brown, firm, moist, non-plastic, [TOPSOIL].							-0.1	13				
FILL	0.1 - 0.2		Fine to coarse subangular to rounded GRAVEL, some fine to coarse sand, dark brown, very dense, moist, [ALLUVIAL DEPOSITS].							-0.2	40+				
	0.2 - 2.5		End of Augerhole: 0.2m [Too Dense to Auger]												

Too dense to auger due to inferred gravel

In-situ testing in accordance with the following standards:
 Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer
 Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

APPENDIX C

Deep Test Results

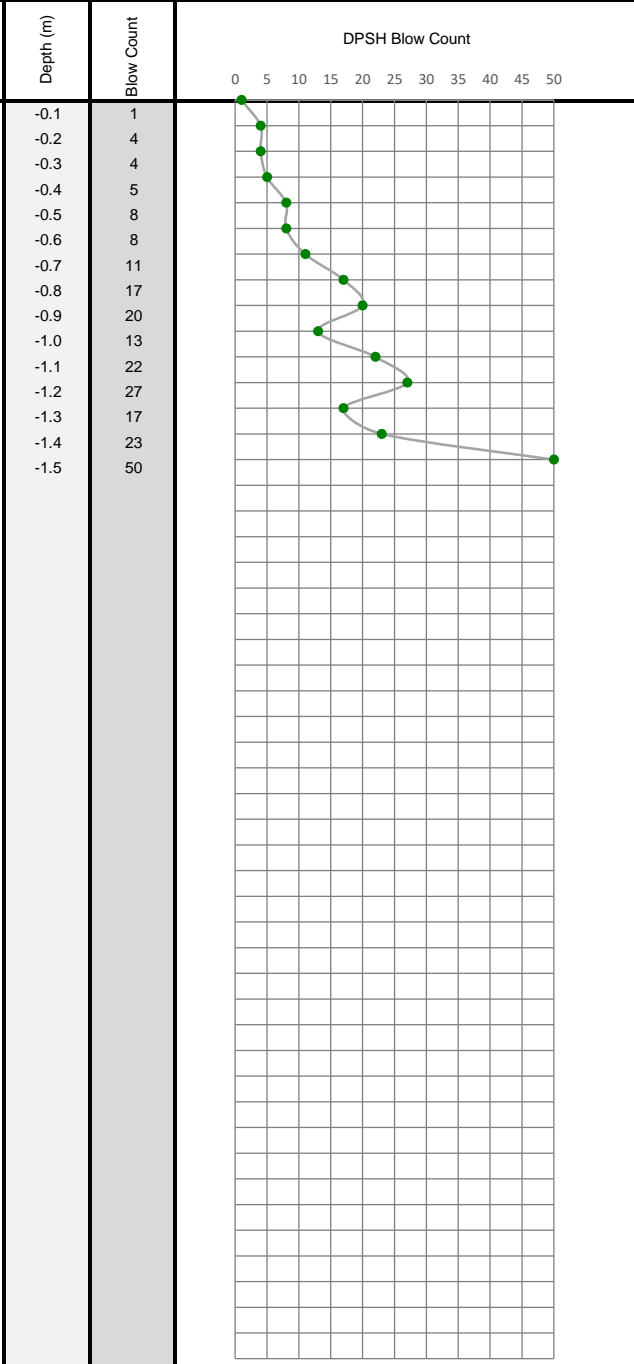
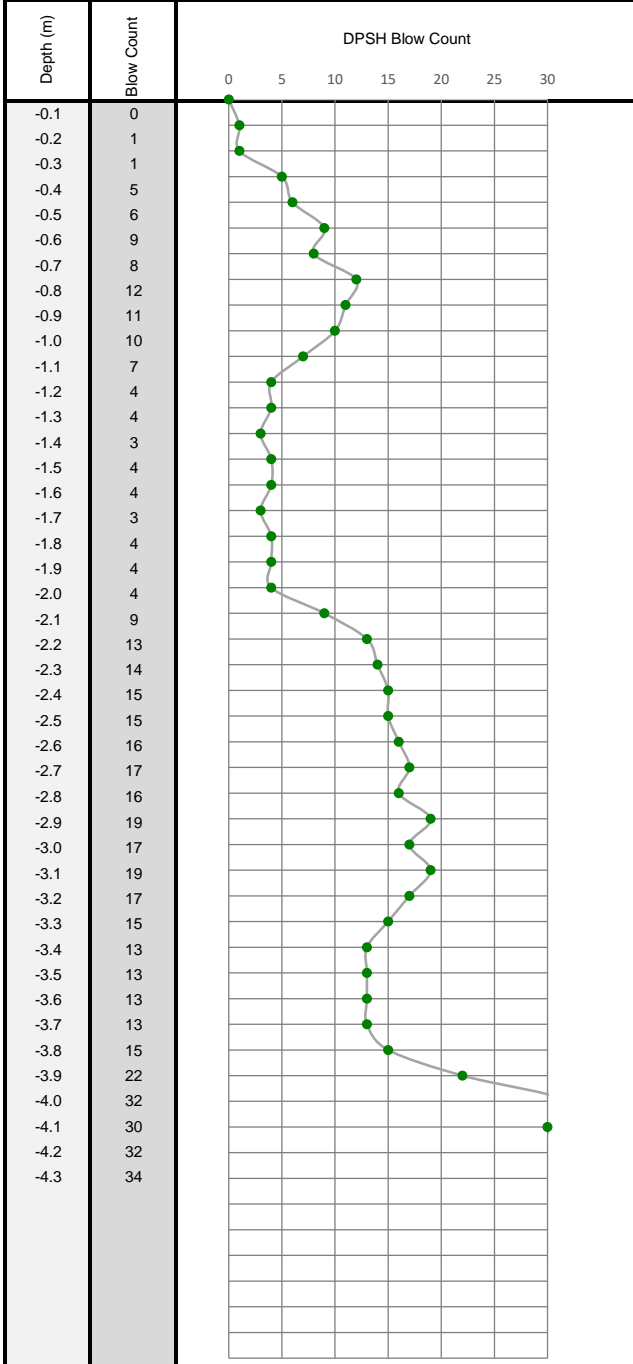




Client: Kaikoura Business Park
 Project: Geotechnical Investigation and Report
 Address: 69 Inland Kaikoura Road, Kaikoura

Test Type: Dynamic Probe Super Heavy Project No: LTC22138
 Tested By: CW & JM Test Date:

Test ID: DPSH01 Test ID: DPSH02
 Surface Condition: Near Level, Grass Surface Condition: Near Level, Grass





Client: Kaikoura Business Park
 Project: Geotechnical Investigation & Report
 Address: 69 Inland Kaikoura Road, Kaikoura

Test Type: Dynamic Probe Super Heavy
 Tested By: CW & JM

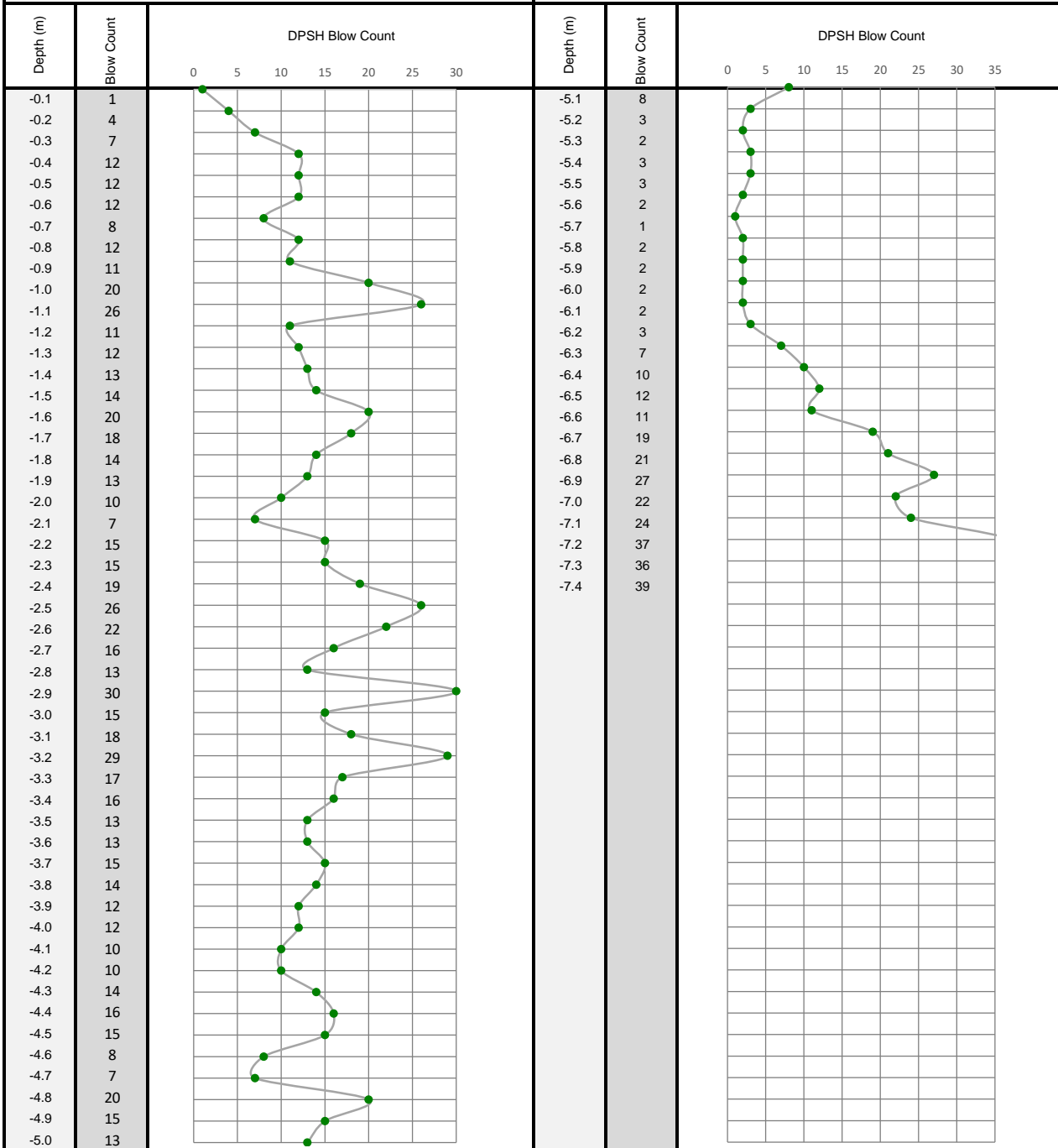
Project No: LTC22138
 Test Date:

Test ID: DPSH03

Test ID: DPSH03

Surface Condition: Near Level, Grass

Surface Condition: Near Level, Grass





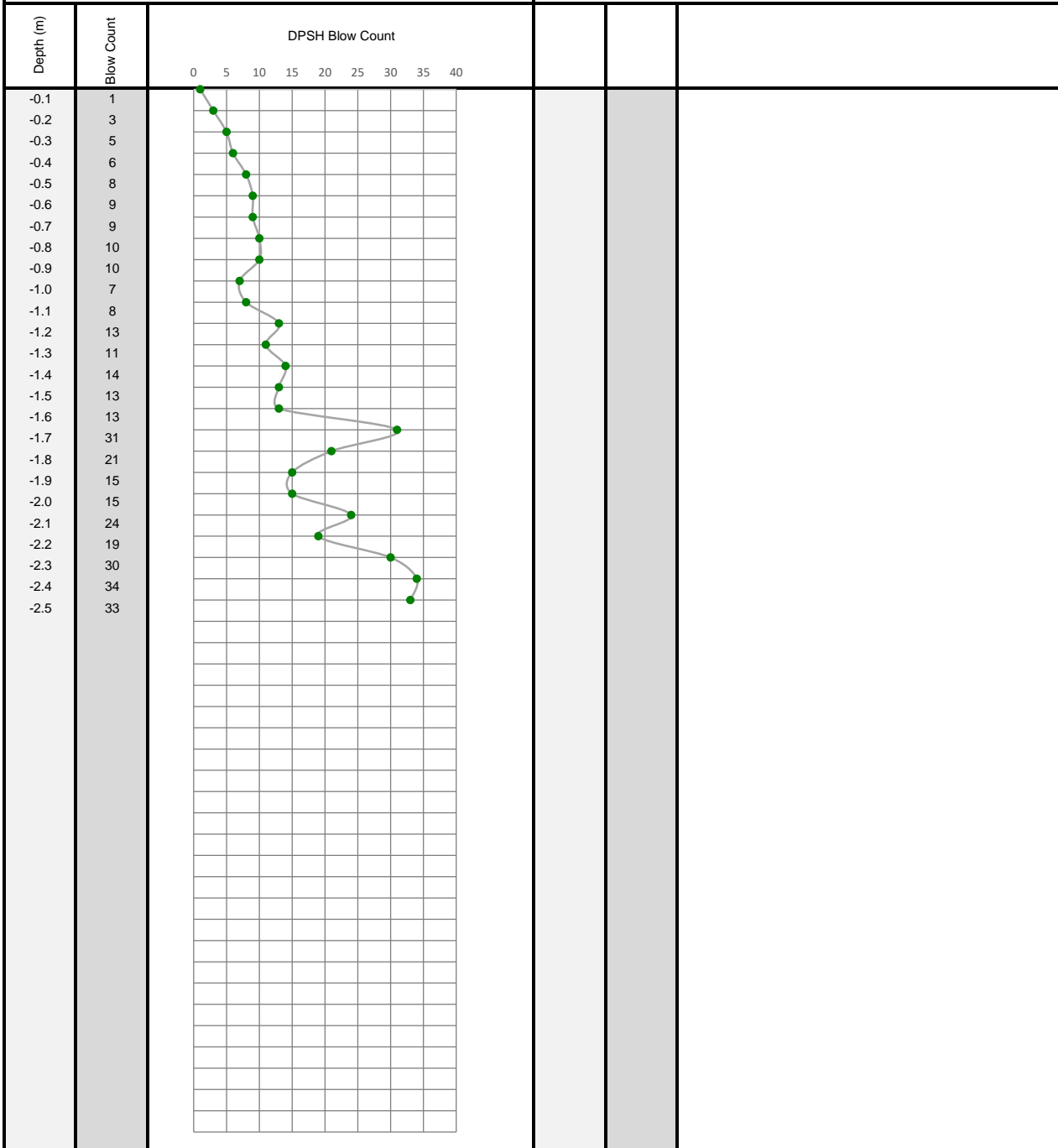
Client: Kaikoura Business Park
 Project: Geotechnical Investigation and Report
 Address: 69 Inland Kaikoura Road, Kaikoura


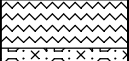
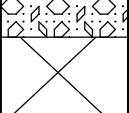
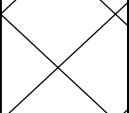
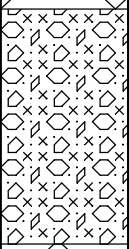
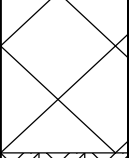
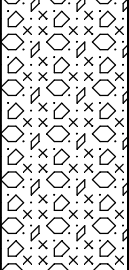
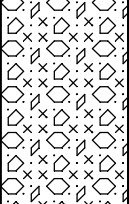
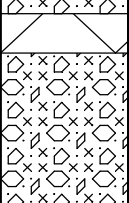
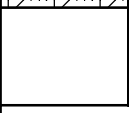
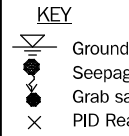





Test Type: Dynamic Probe Super Heavy
 Tested By: CW & JM

Project No: LTC21002
 Test Date: 3-Jun-22




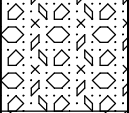
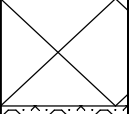
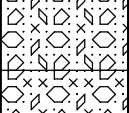
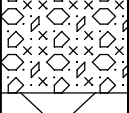
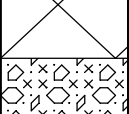
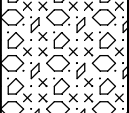
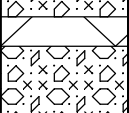





Test ID: DPSH04

Surface Condition: Near Level, Grass



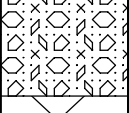

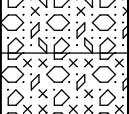
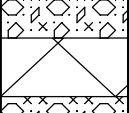

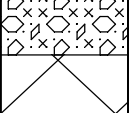

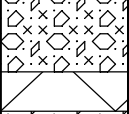

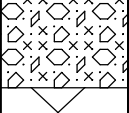

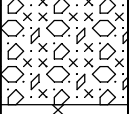

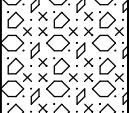






 <p>GEOTECHNICAL BOREHOLE GASOLINE ALLEY - KAIKOURA</p>		HOLE NO. BH001 JOB NO: C03682700			
CLIENT: PETROTEC		LOCATION: 69 INLAND KAIKOURA ROAD			
START DATE: 18/07/2017 END DATE: 18/07/2017	TOTAL DEPTH: 7m	LOGGED BY: RN	SHEET 1 OF 1		
DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILT. Dark brown, firm, some organics and rootlets, moderately plastic (TOPSOIL)		0.0			
Sandy GRAVEL with minor silt; greyish brown. Loosely packed, well graded, dry; gravel, fine to coarse, subangular to angular, moderately weathered, greywacke; sand, medium to coarse		0.5			
CORELOSS (0.5 - 1.5m)		1.0			
Silty GRAVEL with sand; dark grey. Tightly packed, well graded, moist; gravel, fine to medium, subrounded to subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		1.5			
CORELOSS (2.7 - 3.5m)		2.0			
Silty GRAVEL with sand; brownish grey, bedded. Tightly packed, well graded, saturated; gravel, fine to medium, subrounded to subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		2.5			
CORELOSS (6.0 - 6.2m)		3.0			
Lense of coarse sand and fine gravel (rounded), poorly graded, approx. 100 mm thick @ 5.0 m.		3.5			
CORELOSS (6.0 - 6.2m)		4.0			
Silty GRAVEL with sand; brownish grey, bedded. Tightly packed, well graded, saturated; gravel, fine to medium, subrounded to subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse. Lense of coarse sand with some medium sand, poorly graded, approx. 100 mm thick @ 6.2 m.		4.5			
END OF BOREHOLE @ 7.0 m		5.0			
		5.5			
		6.0			
		6.5			
		7.0			
		7.5			
Notes:	KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)	Method: Direct Push AMS VTR9700D Diameter: 50mm Datum: - Coordinates: 1651777 / 5303969 NZTM Filename: C03682700_BH1			 4.2m

Logs based on NZ Geotechnical Society Field Description Guidelines (2005)

  PATTLE DELAMORE PARTNERS LTD		GEOTECHNICAL BOREHOLE GASOLINE ALLEY - KAIKOURA			HOLE NO. BH005 JOB NO: C03682700	
CLIENT: PETROTEC			LOCATION: 69 INLAND KAIKOURA ROAD			
START DATE: 21/07/2017		TOTAL DEPTH: 4.0m		LOGGED BY: RN		SHEET 1 OF 1
END DATE: 21/07/2017						
DESCRIPTION OF SOIL		GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILT. Dark brown, soft, moist, rootlets, moderately plastic. Some fine to medium gravel near base of silt. (TOPSOIL)			0.0			
Sandy GRAVEL with minor boulders; dark greyish brown. Loosely packed, well graded, dry; gravel, fine to coarse, subangular to angular, moderately weathered, greywacke; sand, fine to coarse.			0.5			
CORELOSS (0.8 - 1.2m)			1.0			
Sandy GRAVEL with minor boulders; dark greyish brown. Loosely packed, well graded, dry; gravel, fine to coarse, subangular to angular, moderately weathered, greywacke; sand, fine to coarse.			1.5			
Silty GRAVEL with sand; brownish grey. Tightly packed, well graded, dry; gravel, fine to medium, subangular to angular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse. Becoming moist around 1.95 m.			2.0			
CORELOSS (2.0 - 2.3m)			2.5			
Silty GRAVEL with sand; brownish grey. Tightly packed, well graded, moist; gravel, fine to medium, subangular to angular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse. Increasing silt content.			3.0			
CORELOSS (3.0 - 3.1m)			3.5			
Silty GRAVEL with sand; brownish grey. Tightly packed, well graded, wet; gravel, fine to medium, subangular to angular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.			4.0			
END OF BOREHOLE @ 4.0 m			4.5			
			5.0			
Notes: Saturated zone not encountered		KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Direct Push AMS VTR9700D Diameter: 50mm Datum: - Coordinates: 1651658 / 5303939 NZTM Filename: C03682700_BH5		

Logs based on NZ Geotechnical Society Field Description Guidelines (2005)

 <p>GEOTECHNICAL BOREHOLE GASOLINE ALLEY - KAIKOURA</p>		HOLE NO. BH011 JOB NO: C03682700			
CLIENT: PETROTEC		LOCATION: 69 INLAND KAIKOURA ROAD			
START DATE: 21/07/2017 END DATE: 21/07/2017	TOTAL DEPTH: 7.0m	LOGGED BY: RN	SHEET 1 OF 1		
DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILT. Dark brown, soft, wet, some rootlets, moderately plastic. (TOPSOIL)		0.0			
Sandy GRAVEL; dark greyish brown. Loosely packed, well graded, moist; gravel, fine to coarse, subrounded to subangular, moderately weathered, greywacke; sand, fine to medium.		0.5			
CORELOSS (0.6 - 1.2m)		1.0			
Sandy GRAVEL; dark greyish brown. Loosely packed, well graded, moist; gravel, fine to coarse, subrounded to subangular, moderately weathered, greywacke; sand, fine to medium.		1.5			
Silty GRAVEL with some sand; brownish grey. Tightly packed, well graded, moist; gravel, fine to coarse, subangular to angular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		2.0			
CORELOSS (2.0 - 2.3m)		2.5			
Silty GRAVEL with some sand; brownish grey. Tightly packed, well graded, wet; gravel, fine to coarse, subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		3.0			
CORELOSS (3.0 - 3.3m)		3.5			
Silty GRAVEL with some sand; brownish grey. Tightly packed, well graded, saturated; gravel, fine to coarse, subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		4.0			
CORELOSS (4.0 - 4.2m)		4.5			
Silty GRAVEL with some sand; brownish grey. Tightly packed, well graded, saturated; gravel, fine to coarse, subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		5.0			
CORELOSS (5.0 - 5.4m)		5.5			
Silty GRAVEL with some sand; brownish grey. Tightly packed, bedded, well graded, saturated; gravel, fine to coarse, subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse. Interbedded lenses of loosely packed, poorly graded coarse sand and fine gravel up to 200mm thick at 5.4m.		6.0			
CORELOSS (6.0 - 6.3m)		6.5			
Silty GRAVEL with some sand; brownish grey. Tightly packed, bedded, well graded, saturated; gravel, fine to coarse, subangular, slightly weathered greywacke; silt, firm, moderately plastic; sand, medium to coarse.		7.0			
END OF BOREHOLE @ 7.0 m		7.5			
Notes:	KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Direct Push AMS VTR9700D Diameter: 50mm Datum: - Coordinates: 1651770 / 5303844 NZTM Filename: C03682700_BH11		


3.3m

Logs based on NZ Geotechnical Society Field Description Guidelines (2005)

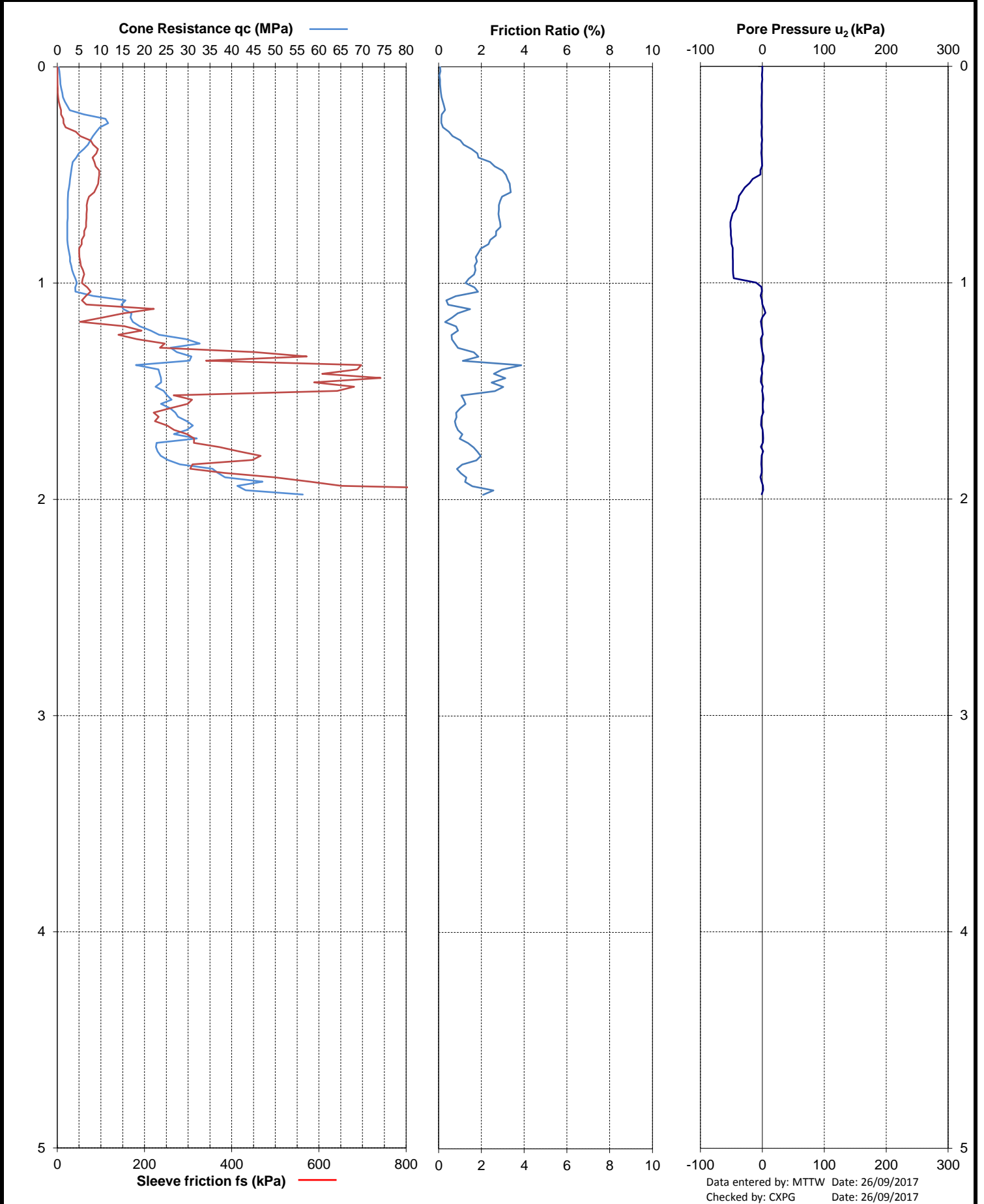
CPT010 Peketa - Kaikoura SH1 - 14 September, 2017

Pre-Drill: 0m **NZMG** 2561445mE 5865301mN 7m(amsl)
 Assumed GWL: Not encountered **Other Tests:** None
 Operator: MTTW **Comments:** Test refusal at 1.98m > 56Mpa
 Located By: Hand GPS/GE (el)

45a Parkhouse Rd, Christchurch
 e. christchurch@geotechnics.co.nz
 p.+64 (0)3 361 0300



Geotechnics Ref: 1002464.0.5009.0



CPT012 Peketa - Kaikoura SH1 - 14 September, 2017

Pre-Drill: 0.2m **NZMG** 2561905mE 5865467mN 8m(amsl)
 Assumed GWL: Not encountered **Other Tests: None**
 Operator: MTTW **Comments:** Test refusal at 3.37m > 66Mpa
 Located By: Hand GPS/GE (el)

45a Parkhouse Rd, Christchurch
 e. christchurch@geotechnics.co.nz
 p.+64 (0)3 361 0300



GEOTECHNICS

Geotechnics Ref: 1002464.0.5009.0

