aurecon

Prestons Park Subdivision

GEOTECHNICAL REPORT FOR LOT 1092

CDL Land NZ Limited

16 September 2021

Revision: 1

Reference: 235361

Bringing ideas to life

Document control record

Document prepared by: Kieran Foote

Aurecon New Zealand Limited
Level 2, Iwikau Building
93 Cambridge Terrace
Christchurch 8013
New Zealand

T +64 3 366 0821
F +64 3 379 6955
E christchurch@aurecongroup.com
W aurecongroup.com

Document control						
Report title	GEOTECHNICAL REPORT FOR LOT 1092					
Document ID		**Project number**	235361			
File path	P:\235361\069 Stage 2 Building Consent\Geotech\Building Consent Reports\Development Lots\Lot 1092\235361 Building Consent Report Lot 1092.docx					
Client	CDL Land NZ Limited					
Client contact	Jason Adams	**Client reference**				
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
0	20 October 2014	Draft for Review	J Muirson	J Kupec	J Kupec	J Kupec
1	16 September 2021	Final for Issue	C Scott	J Muirson		J Kupec
Current revision	**1**					

Approval			
Author signature		Approver signature	
Name	Chris Scott	Name	Dr Jan Kupec
Title	Geotechnical Engineer	Title	Technical Director

Contents

1 Executive Summary 1
2 Introduction 2
3 Site Conditions 3
3.1 Site Description 3
3.2 Surface Water 3
3.3 Regional Geology 3
3.4 Site Earthworks 3
3.5 Technical Classification 4
4 Geotechnical Assessment 5
4.1 General 5
4.2 Previous Investigations 5
4.3 Hand Held Testing 5
4.4 Dynamic Cone Penetrometers 5
4.5 Groundwater Levels 5
4.6 Topsoil Depth 6
5 Foundation Recommendations 7
5.1 Foundation Types 7
5.2 Foundation Construction Recommendations 7
6 References 8
7 Explanatory Statement 9

Appendices

Appendix A

Figures

Appendix B

Test Results

1 Executive Summary

CDL Land NZ Ltd has commissioned Aurecon New Zealand Ltd to undertake site specific geotechnical investigations and assessments for individual residential lots for building consent purposes for the Prestons South Subdivision Stage 1. This report documents the results of the geotechnical assessment and presents geotechnical comments together with foundation recommendations for the residential house on Lot 1092 at the Prestons South Subdivision.

As part of the subdivision development extensive geotechnical testing, including cone penetration tests (CPT), were carried out to define the liquefaction potential at the overall subdivision and to monitor the site works that have occurred. **Based on our information the property is likely to perform to a level equivalent to Technical Category 1 (TC1 - Grey) set by the Ministry of Business, Innovation and Employment (MBIE) in their guidelines issued in December 2012.**

The site development has included extensive bulk earthworks. All earthworks and compliance testing have been undertaken in accordance with the earthworks specification. The engineering sign off and bulk earthworks are documented in the Geotechnical Completion Report. The earthfill at the subdivision construction stage was placed and signed off in accordance with NZS4431:1989. Based on review of the available geotechnical information, including bulk earthworks information and NZS4431 compliance records, we consider that a determination in accordance with NZS3604:2011 Section 3.1.3 is appropriate and the property meets the requirements for NZS3604 type foundations.

The geotechnical site specific assessment comprised a review of previous geotechnical investigations undertaken for the subdivision development and a site specific geotechnical investigation. A single hand auger borehole was undertaken to assess the upper soil profile and the groundwater level. Two DCPs were carried out on the lot, one of the DCPs was located immediately adjacent to the hand auger borehole with the second DCP located on the opposite half of the lot.

Based on our knowledge of the site setting and our past work we recommend that any residential structure that is to be developed on Lot 1092 be founded on standard NZS3604:2011 compliant foundations. These foundations require a minimum geotechnical ultimate bearing capacity of at least 300kPa, which for Lot 1092 is achieved at a minimum depth of 0.35m below ground level as this represents the current thickness of the topsoil and loose soil.

This report shall be read as a whole. Our limitations are presented in Section 7.

2 Introduction

CDL Land NZ Ltd is currently undertaking a large residential subdivision with associated commercial lots. Previously Aurecon New Zealand Ltd has undertaken detailed geotechnical investigations and assessments for the purpose of the plan change, subdivision resource consent application, liquefaction assessment, technical classification of the entire subdivision, and observation of bulk earthworks construction.

Aurecon New Zealand Ltd has since been commissioned to undertake site specific geotechnical investigations and assessment of individual lots for building consent application purposes. The site which this report is focused on comprises a single lot, designated Lot 1092 at the Prestons South Subdivision to the south of Prestons Road in Marshland, Christchurch. This report documents the results of the geotechnical assessment and presents geotechnical comments together with foundation recommendations for the proposed house on the lot. We note that at the time of writing this report the location and structural form of the dwelling were unknown but is expected to comprise a timber or steel framed building with lightweight cladding.

This report shall be read as a whole. Our limitations are presented in Section 7.

3 Site Conditions

3.1 Site Description

The Prestons Subdivision is located on the northern fringes of Christchurch City. The site is made up of a series of adjacent properties forming an irregular and elongated rectangle shape, orientated approximately north to south. The total area of the overall Prestons Subdivision site is approximately 190ha. The site can be separated into two distinct blocks, Prestons South which runs from the Lower Styx Road in the north through to Prestons Road in the south and Prestons South which continues from Prestons Road through to Mairehau Road to the south.

This building consent report is for Lot 1092 which is located in Stage 1 of the Prestons South Subdivision (refer Figure 1 in Appendix A). The lot is bordered by residential lots to the north, south and west, with an access road to the east.

3.2 Surface Water

There are no natural sources of surface water on the subdivision. There is a storm water channel to the south of Lot 1092.

3.3 Regional Geology

The geology of the site is described in the 1:250,000 scale geological map – '*Geology of the Christchurch Area*," published in 2008 by the Institute of Geological and Nuclear Sciences. Note this map has been referenced as it is at an appropriate scale and covers the entire site. The map indicates the underlying geology comprises *"Dominantly sand of fixed and semi-fixed dunes and beach deposits"* and '*drained peat swamp*'. The subdivision geotechnical investigation identified that this area was predominantly underlain by aeolian (dune) and beach sand deposits.

The GNS Active Fault System database (GNS, 2012a) indicates that the site is located approximately:

- 27km north east of the eastern end of the Greendale Fault System. Movement on the Greendale Fault System was responsible for the Magnitude 7.1 Darfield (Canterbury) Earthquake on 4 September 2010.
- 14km north of the epicentre of the Magnitude 6.2 Christchurch Earthquake on 22 February 2011.
- 12km north west of the Magnitude 6.0 earthquake on 13 June 2011 (GNS, 2012b).
- 8km north west of the Magnitude 5.9 earthquake on 23 December 2012.

3.4 Site Earthworks

Site earthworks have been undertaken to prepare the site for residential building purposes. Based on the earthworks plan provided, the lot levels have been cut to the required subgrade. The depth of cutting is up 1m across the lot. No engineered fill was placed on the lot, but topsoil has been placed. During bulk earthworks where shallow organic material was encountered, it was removed as part of the bulk earthworks.

All earthworks and compliance testing have been undertaken in accordance with the earthworks specification. Details of the site bulk earthworks are provided in the Aurecon report titled '*Prestons Subdivision – Geotechnical Completion Report Prestons South Stage M & N'*, Revision 0 dated 27 March 2015. The Geotechnical Completion Report has been completed as part of the requirements of NZS4404:2010 "*Land development and subdivision infrastructure"* and Christchurch City Council '*Infrastructure Design Standards - Part 4: Geotechnical Requirements"*. The compacted fill was placed and signed off in accordance with NZS4431:1989 "*Code of practice for earth fill for residential development*".

3.5 Technical Classification

The landcheck maps provided on the Canterbury Earthquake Recovery Authority (CERA) website indicate the site is classified as rural and unmapped. The technical categories were developed by the Ministry for Business, Innovation and Employment (MBIE) with the support from the Engineering Advisory Group (EAG) in mid-2011 and hence prior to the subdivision and bulk earthworks being underway.

As part of the subdivision consent geotechnical assessment, site specific liquefaction assessment was carried out over the wider subdivision area. This is detailed in the Aurecon reports titled *'Prestons Road Subdivision, Geotechnical Assessment Report for Resource Consent',* Revision 2 dated 5 March 2012, *'Prestons Road Subdivision, Detailed Geotechnical Design Report',* Revision 2 dated 12 July 2012 and *'Prestons South Subdivision Resource Consent Geotechnical Report'*, Revision 1 dated 6 June 2013.

Based on the results from our liquefaction assessment and bulk earthworks undertaken on the wider subdivision, Lot 1092 is likely to perform to a level equivalent to Technical Category 1 (TC1 - Grey) in the MBIE Guidelines issued in December 2012.

4 Geotechnical Assessment

4.1 General

The geotechnical assessment comprised a review of relevant previous geotechnical investigations and construction data and an in-situ geotechnical investigation. The geotechnical investigation comprised hand held testing on the individual lot and a review of the previous geotechnical investigations undertaken for the subdivision within the vicinity of the lot. A single hand auger borehole was undertaken to assess the upper soil profile and the groundwater level. Two dynamic cone penetrometers (DCPs) were carried out on the lot. The hand-held testing was undertaken on the lot following the site earthworks. The testing density is considered reasonable as the geotechnical project engineers were involved in the observation of the civil engineering works.

4.2 Previous Investigations

The previous geotechnical testing and investigations undertaken by Aurecon across the entire subdivision site comprised of a combination of cone penetrometer tests (CPT) and machine excavated test pits. Further details regarding these investigation locations are found in the Aurecon reports titled *'Prestons Road Subdivision, Geotechnical Assessment Report for Resource Consent',* Revision 2 dated 5 March 2012, *'Prestons Road Subdivision, Detailed Geotechnical Design Report',* Revision 2 dated 12 July 2012 and *'Prestons South Subdivision Resource Consent Geotechnical Report'*, Revision 1 dated 6 June 2013. In addition, testing carried out as part of the subdivision development is presented in the Aurecon Geotechnical Completion Report.

4.3 Hand Held Testing

One hand auger borehole was undertaken on the lot as part of the geotechnical investigation to assess the upper soil profile and the groundwater level. The test location and the borehole log have been uploaded to the New Zealand Geotechnical Database (NZGD). The borehole log is attached in Appendix B.

The hand auger borehole log indicates the upper soil profile consists of topsoil underlain by sand to the termination depth. The hand auger borehole was terminated when soils samples became saturated and the hole began to collapse.

The logging of the recovered hand auger samples was undertaken in accordance with the New Zealand Geotechnical Society's *"Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes: 2005".*

4.4 Dynamic Cone Penetrometers

Two DCPs were carried out with the locations and results uploaded to the NZGD. The DCP test results are attached in Appendix B. One of the DCPs was located adjacent to the hand auger borehole, with the second DCP located on the opposite half of the lot.

DCP logs indicate 5 blows per 100mm penetration, which is equivalent to an ultimate bearing capacity of 300kPa, was encountered from a shallow depth.

4.5 Groundwater Levels

Groundwater levels were measured within the hand auger borehole at the time of the investigation. Where holes collapsed due to saturated soil an indicative groundwater level was noted. Groundwater was encountered at 1.8m depth below ground level. It should be noted that groundwater levels may vary seasonally.

A review of the NZGD indicates that regional groundwater levels are likely to be in the order of 1m to 2m below ground level. These groundwater levels are reasonably consistent with those measured during the investigation, when taking into account the subdivision earthworks filling and cutting.

4.6 Topsoil Depth

The depth of topsoil has been determined from the single hand auger and two DCPs undertaken on site. We note that the topsoil depths may vary by +/- 100mm between the testing locations and hence it is recommended that at least a 100mm tolerance should be allowed for building foundation excavations.

If greater certainty of topsoil depths across the whole site is required for construction costing then further testing would be necessary across the footprint of the proposed structure (unknown at the time of writing this report). **The responsibility and liability for any additional testing shall be met by the section purchaser.**

5 Foundation Recommendations

The site is expected to perform in line with TC1 requirements in future earthquakes. Due to the residential land use of the development and the TC1 technical classification, future residential development will be able to adopt standard NZS3604 compliant foundations.

5.1 Foundation Types

It is recommended that residential structures that are built on Lot 1092 are founded on standard NZS3604:2011 compliant foundations. These foundations require a minimum geotechnical ultimate bearing capacity of at least 300kPa. The site investigation results indicate that approximately 300mm of topsoil was present, which will need to be removed and the clean subgrade exposed for foundation construction.

Based on our understanding of the site works and the investigation results, we recommend that NZS3604:2011 compliant foundations are embedded a minimum depth of 0.35m below current ground level.

5.2 Foundation Construction Recommendations

Topsoil should be removed from beneath the floor slab and compacted hardfill placed to bring the foundation to the required level. In addition, the following recommendations should be considered:

1. To ensure that excavated footings are adequately founded we recommend that excavations should be undertaken by a digger fitted with a smooth edge bucket. The base should be tidily trimmed by hand, lightly compacted with a plate compactor and immediately covered with a concrete tidy slab or 100mm of compacted granular hardfill. A suitable qualified engineer with foundation experience or territorial authority building inspector should be retained to verify the adequate founding has been achieved and all loose and soft or compressible material was removed.
2. If there are significant soft layers beneath a sub-excavation, the softer material will have to be excavated and backfilled with 10MPa concrete or compacted hardfill underneath all load bearing foundation elements. For the hardfill, the sub-excavation will have to have plan dimensions of B+2D where B is the footing width and D is the depth of undercut. For 10MPa concrete the sub-excavation can have the same dimensions as the footing.
3. Depending on the soil encountered, the time of year, and fluctuations of the groundwater level, it is possible that excavations may encounter groundwater. The building contractor is to take appropriate measures to deal with any groundwater ingress into the foundation excavations and keep the excavations and backfill free of groundwater intrusions until the footings are cast.
4. The footing excavations are likely to expose layers of granular soils, which can be adversely affected by rainfall or stormwater. Foundation excavations should not be left open for more than three days. In addition, rainfall and stormwater should not be allowed to pond within the footing excavations as this may affect the bearing capacity of the subsoils.

6 References

Forsyth, Barrell & Jongers, (compliers), 2008. *Geology of the Christchurch Area.* Institute of Geological and Nuclear Sciences, 1:250,000 Geological Map 16.

Canterbury Earthquake Recovery Authority (2014) *Canterbury Geotechnical Database.* Retrieved 4 October 2013 from https://canterburygeotechnicaldatabase.projectorbit.com/

Christchurch City Council, 2010. *Infrastructure Design Standards - Part 4: Geotechnical Requirements.*

Geonet, 2012. ftp://ftp.geonet.org.nz/strong/processed/Proc (23/10/12)

GNS, 2012a. http://maps.gns.cri.nz/website/af/viewer.htm (23/10/12)

GNS, 2012b. http://www.gns.cri.nz/Home/News-and-Events/Media-Releases/earthquake-part-of-aftershock-sequence (23/10/12)

Ministry of Business Innovation and Employment (MBIE), 2012 '*Repairing and rebuilding houses affected by the Canterbury earthquakes'.*

NZGS, 2005. *Guidelines for the Classification and Field Description of Soils and Rocks in Engineering.* NZ Geotechnical Society Inc, Wellington, New Zealand.

NZS 3604:2011. *Timber Framed Buildings.* Standards New Zealand, Wellington, New Zealand.

NZS 4404:2010 *Land development and subdivision infrastructure.* Standards New Zealand, Wellington, New Zealand.

NZS 4431:1989 *Code of practice for earth fill for residential development.* Standards New Zealand, Wellington, New Zealand.

7 Explanatory Statement

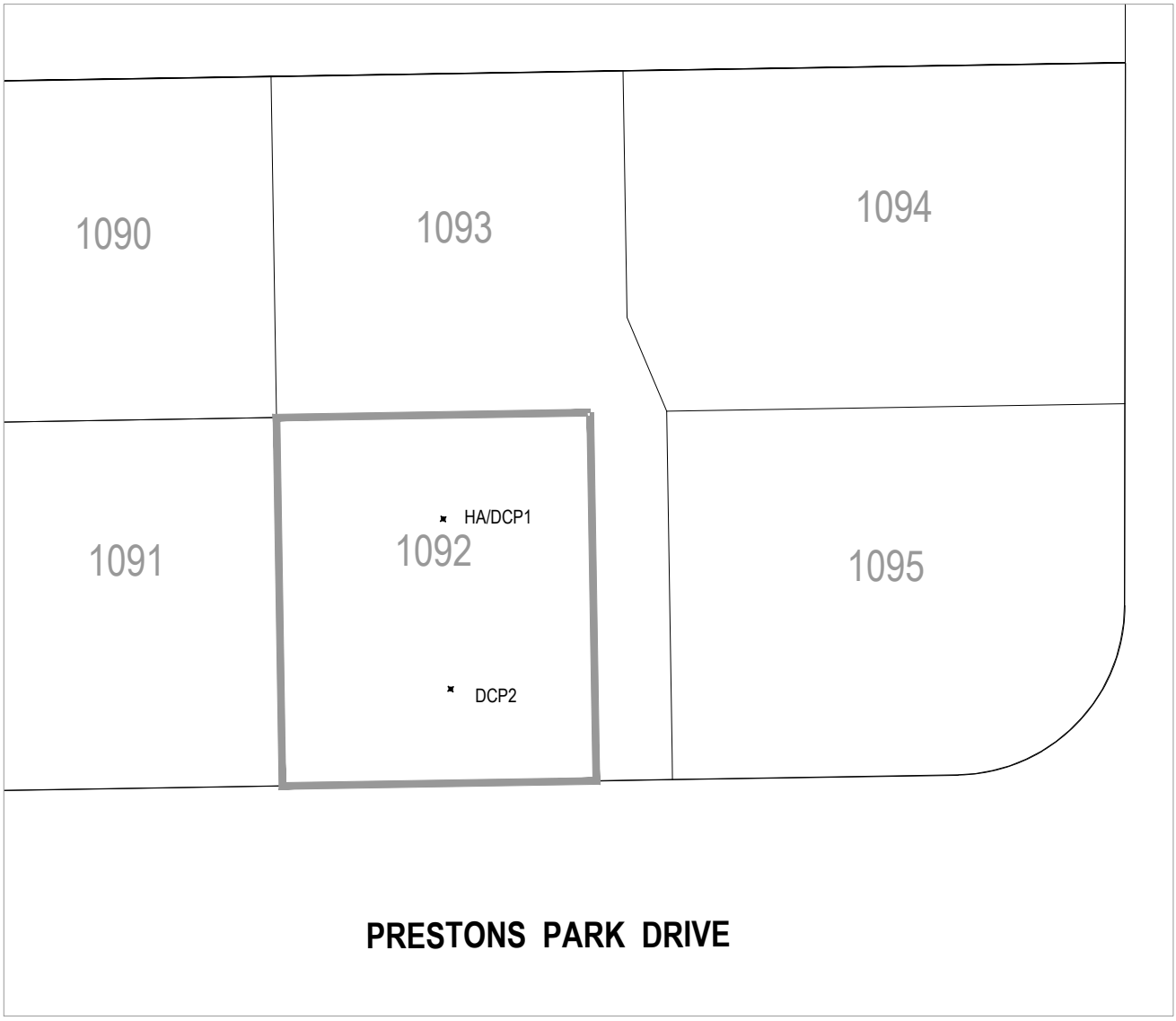
We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the Client for the purpose of building consent application only, and no responsibility or liability will be accepted to any other third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

The recommendations in this report are based on data collected at specific locations and by using suitable investigation techniques with limited site coverage. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground and groundwater between test locations has been inferred using experience and judgment and it must be appreciated that actual conditions could vary from the assumed model.

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.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

Appendix A
Figures



4 0 8 16m

SCALE 1:400

aurecon
www.aurecongroup.com

CLIENT

REV	DATE	REVISION DETAILS	APPROVED
A	25/02/21	ISSUE FOR INFORMATION	T BROWNE

DRAWN	DESIGNED
R DAWSON	K FOOTE

CHECKED
J MUIRSON

APPROVED
T BROWNE DATE 25/02/2021
T BROWNE

PROJECT
PRESTONS

TITLE
LOT 1092
SITE LOCATION PLAN
FIGURE 1

INFORMATION

PROJECT No.	
235361	
SCALE	SIZE
1:400	A4
DRAWING No.	REV
GO-PS-DC-IN-1092	A

Appendix B
Test Results

aurecon
www.aurecongroup.com

HAND AUGER RECORD

HOLE NO. **Lot 1092 - HA1**

PROJECT NO. **235361**

PROJECT **Prestons Park Subdivision**
Stage 1

CLIENT **CDL Land NZ Ltd**	CO-ORDINATES (NZTM) **E 1573219** **N 5186469**	SHEET **1** of **1**
METHOD **HA**		DATE from **15/03/2021** to **15/03/2021**
MACHINE & NO. **NA**	ORIENTATION **VERTICAL**	GROUND-LEVEL **+13.84** m RL

Water level	Tests	Samples (Type Ref Depth)	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		0.00		0.00		
			+13.54	0.30		Sandy SILT with trace rootlets; brown. Dry, non-plastic; sand, fine. (TOPSOIL)
		HA				Fine to medium SAND; grey. *Dense*, moist.
						1.50m Becomes dark grey.
						1.60m Becomes wet.
▼						1.80m Becomes saturated.
			+11.84	2.00		End of Hand Auger at 2.00m, on 15/03/2021 *Termination Reason:* Effective refusal, hole collapsing.

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR, STRUCTURE, STRENGTH, MOISTURE CONDITION GRADING, BEDDING, PLASTICITY, ETC....
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **C. SCOTT**
DATE **15/03/2021**
CHECKED **K. FOOTE**
DATE **19/03/2021**

REMARKS

Groundwater encountered at 1.8m.
Co-ordinates and elevation data from site survey.
Elevation based on Christchurch Drainage Datum.

Aurecon, , . Tel: Fax:

aurecon
www.aurecongroup.com

DYNAMIC CONE (SCALA) PENETROMETER TEST RECORD

SCALA PENETROMETER NO.
Lot 1092 - DCP1

PROJECT **Prestons Park Subdivision**
Stage 1

PROJECT NO. **235361**

CO-ORDINATES (NZTM)
E 1573219
N 5186469

GROUND LEVEL **+13.84** m RL

TESTED / SUPERVISED BY **C. SCOTT**
DATE **15/03/2021**

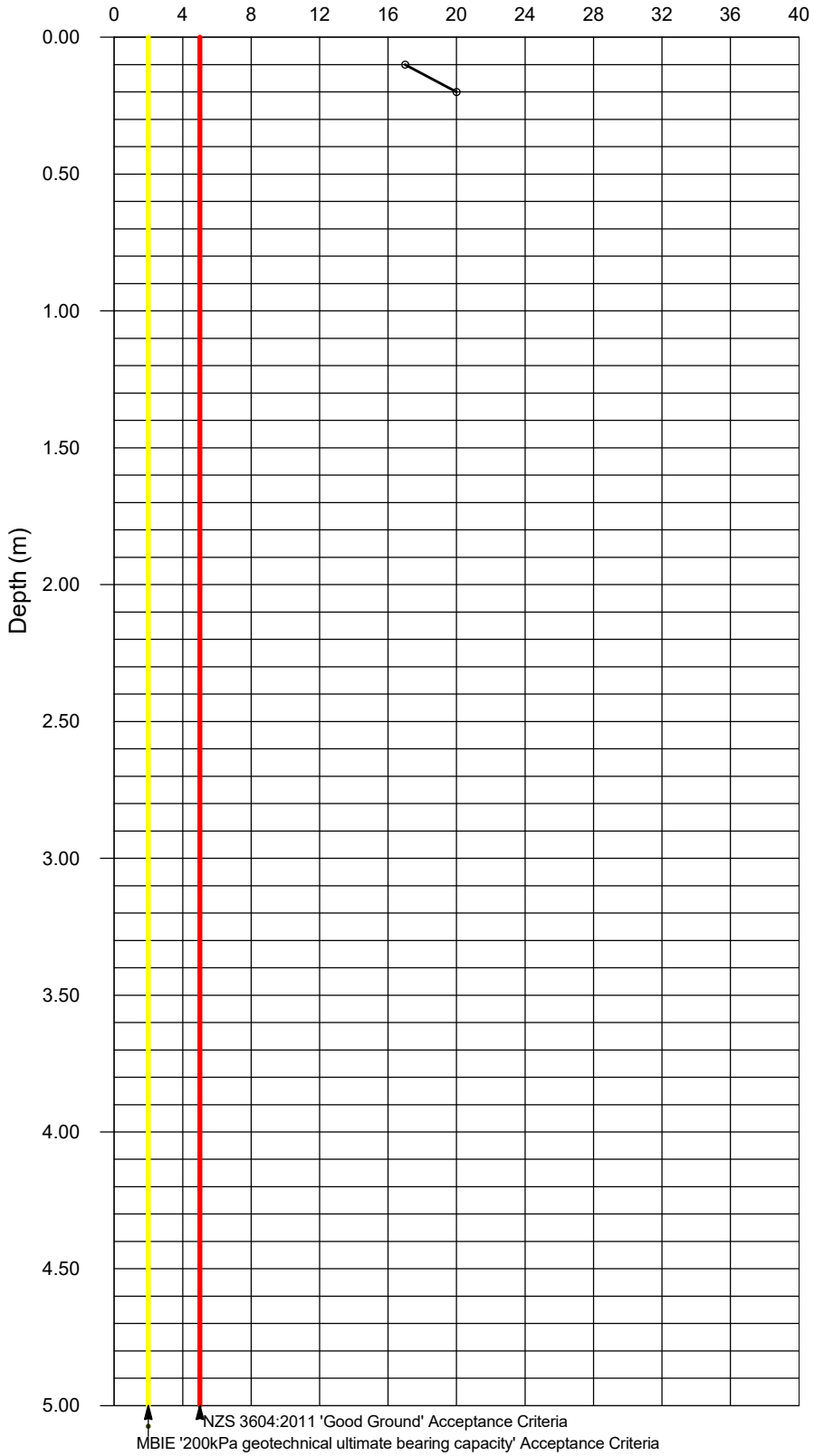
CHECKED BY **K. FOOTE**
DATE **19/03/2021**

Results

Depth (m)	Blows per 100 mm
0.0	17
	20
0.5	
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	

Depth (m)	Blows per 100 mm
3.5	
4.0	
4.5	
5.0	

Number of blows per 100mm



Remarks:

20 blows for 100mm in the last increment.
Co-ordinates and elevation data from site survey.
Elevation based on Christchurch Drainage Datum.
Effective refusal, 20+ blows per 100mm

Aurecon, , . Tel: Fax:

aurecon
www.aurecongroup.com

DYNAMIC CONE (SCALA) PENETROMETER TEST RECORD

SCALA PENETROMETER NO.
Lot 1092 - DCP2

PROJECT **Prestons Park Subdivision**
Stage 1

PROJECT NO. **235361**

CO-ORDINATES (NZTM)
E 1573229
N 5186470

GROUND LEVEL **+13.81** m RL

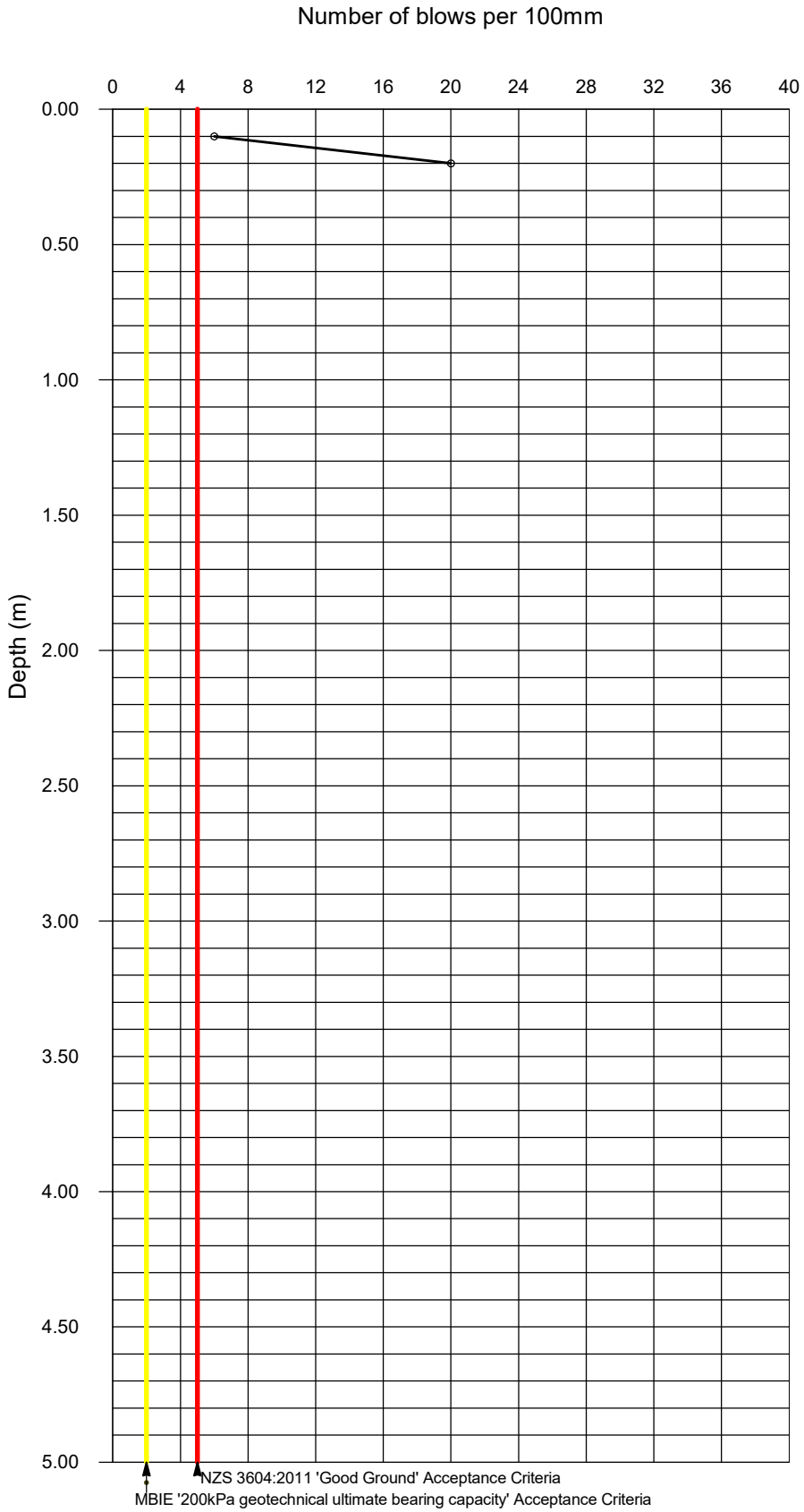
TESTED / SUPERVISED BY **C. SCOTT**
DATE **15/03/2021**

CHECKED BY **K. FOOTE**
DATE **19/03/2021**

Results

Depth (m)	Blows per 100 mm
0.0	6
	20
0.5	
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	

Depth (m)	Blows per 100 mm
3.5	
4.0	
4.5	
5.0	



Remarks:

20 blows for 100mm in the last increment.
Co-ordinates and elevation data from site survey.
Elevation based on Christchurch Drainage Datum.
Effective refusal, 20+ blows per 100mm

Aurecon, , . Tel: Fax:

aurecon

Bringing ideas to life

Aurecon New Zealand Limited
Level 2, Iwikau Building
93 Cambridge Terrace
Christchurch 8013
New Zealand

T +64 3 366 0821
F +64 3 379 6955
E christchurch@aurecongroup.com
W aurecongroup.com

Aurecon offices are located in:
Angola, Australia, Botswana, China,
Ghana, Hong Kong, Indonesia, Kenya,
Lesotho, Macau, Mozambique,
Namibia, New Zealand, Nigeria,
Philippines, Qatar, Singapore, South Africa,
Swaziland, Tanzania, Thailand, Uganda,
United Arab Emirates, Vietnam.