Prestons Park Subdivision

Stage E2 Geotechnical Completion Report

CDL Land New Zealand Ltd

Reference: 235361

Revision: 0

2022-07-29

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Document control record

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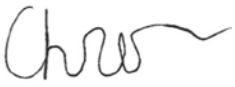
Author signature		Approver signature	
Name	Chris Scott	Name	Dr Jan Kupec
Title	Geotechnical Engineer	Title	Principal – Ground Engineering

Contents

Executive Summary

CDL Land New Zealand Limited is developing Stage E2 of the Prestons Park Subdivision, located on Prestons Road, Christchurch. As part of the work, a geotechnical completion report is required to confirm that the site works have been carried out to the required standard and provide recommendations for building developments. This report describes the earthworks and ground improvement involved with Stage E2 of the Prestons Park Subdivision.

The Client's brief on previous stages of the Prestons Park project was to develop the land to Technical Category 1 (TC1) equivalent performance. Based on our geotechnical assessment, Stage E2 was predominantly TC1, with one lot classified as TC2 equivalent prior to earthworks commencing. Thus, ground improvement was deemed to be necessary.

Aurecon's role was to monitor the earthworks, fill compaction testing and complete post earthworks quality assurance testing which comprised Cone Penetration Testing (CPT).

Extensive earthworks predominantly comprising filling have occurred on the site. The quality assurance testing of the engineered earthfill indicates that the earthfill placed within the Stage E2 area has achieved the required compaction levels as per NZS4431:1989.

Following completion of the earthworks and topsoil placement throughout the subdivision, a series of CPTs was carried out to confirm the ground conditions. The purpose of the CPTs was to allow an assessment of the future land performance during large earthquakes and to determine the equivalent Technical Category of the land. Assessments of these results confirms that all the lots within Stage E2 are classified as TC1.

From the monitoring and testing undertaken as part of the development of Stage E2 the following is concluded:

Certificate of Compliance

The standard of bulk earthworks generally meets the earthworks specification and the applicable codes, including NZS4431:1989.

Building Considerations

General

This report shall not be used for building consent application for buildings on individual lots. Site specific geotechnical investigations, in-line with NZS3604:2011, shall be undertaken at building consent application stage.

TC1 Foundations

For lots identified as TC1, NZS 3604:2011 type foundations are considered suitable. At the time of writing this report, the location and structural form of the future dwelling on the lots are unknown and this recommendation relates to NZS3604:2011 type lightweight timber or steel framed residential buildings only.

Explanatory Statement

This report shall be read as a whole. Our explanatory statement is presented in Section 7.

1 Introduction

1.1 Geotechnical Completion

CDL Land New Zealand Limited are developing Stage E2 of the Prestons Park Subdivision, located on Prestons Road, Christchurch. Stage E2 is a sub-stage within Stage Five of Prestons Park Subdivision. The site works in Stage E2 included bulk earthworks for the lot development. As part of this work, a geotechnical completion report is required to certify the site works have been carried out to the required standard and provide recommendations for building developments.

This report has been prepared for CDL Land New Zealand Limited and issued to Christchurch City Council (CCC). It describes earthworks involved with Stage E2 of the Prestons Park Subdivision (see Figure 1 in Appendix A).

The purpose of this geotechnical completion report is to present the following:

- Summarise information from previous investigations carried out as part of the subdivision consent and detailed design;
- Summarise the ground conditions and liquefaction risk;
- Extent of earthworks on the lots and compliance testing of bulk earthworks;
- Quality assurance testing of land for the purposes of technical category assessment;
- Summary of the findings, land technical category and recommendations for building development.

This report has been prepared based on geotechnical data from observations and compaction testing during and after earthworks construction and ground improvements. All references to cut-fill depths are based on subgrade levels.

This report shall be read as a whole. Our explanatory statement is presented in Section 7.

1.2 Site Description

The Prestons Road 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 North runs from the Lower Styx Road in the north through to Prestons Road in the south. Prestons Park continues from Prestons Road, through to Mairehau Road to the south.

The focus of the geotechnical completion report is on Stage E2 of the Prestons Park Subdivision. Stage E2 incorporates a block in the south eastern area of the Prestons Park subdivision (see Figure 1 in Appendix A).

2 Pre-Development Geotechnical Work

2.1 Geotechnical Testing

The subdivision consent and detailed geotechnical design for the subdivision included an extensive series of geotechnical investigations. These comprised Cone Penetration Tests (CPT), test pits, groundwater measurements and laboratory testing.

The details of these investigations are presented in the following Aurecon reports:

- *Caldwell Block Subdivision Resource Consent Geotechnical Report,* Revision 0 dated 11 July 2018.
- *Prestons Park Stage Five Gravel Embankment Design*, Revision 0 dated 9 October 2019.

The investigation tests carried out within Stage E2 of the Prestons Park area are presented in Figure 2 in Appendix A.

2.2 Ground Conditions

From the extensive geotechnical investigations, the ground conditions within the Prestons Park Subdivision were defined into various geological areas. The typical ground conditions in the area are presented in Table 1.

Table 1: Typical ground conditions within Stage E2.

Depth to Top of Unit (m)	Depth to Base of Unit (m)	Soil Unit
0	0.3 to 0.4	TOPSOIL.
0.3 to 0.4	3	SAND with up to minor silt, loose to medium dense, a 50mm peat layer was found in Test Pit TP05.
3	12	SAND with up to minor silt, medium dense to dense.
12	Not determined	SAND, dense to very dense.

Groundwater levels ranged from 1m to 2.5m below ground level. During the site earthworks the above soil profile and groundwater levels were typically encountered within the area of interest.

2.3 Liquefaction Potential

As part of the geotechnical assessment and detailed design, a liquefaction assessment was carried out. The details of the liquefaction assessments are presented in the above reports. The land categorisation was based on the criteria of Ministry of Business, Innovation and Development (MBIE), Technical Category deformation performance limits are set out in Table 2.

Table 2: Technical category definitions and foundation implications (MBIE, 2012).

Technical Category	Liquefaction Deformation Limits				Likely Implications for House Foundations (Subject to individual assessment)
	Vertical		Lateral Spread		
	SLS	ULS	SLS	ULS	
TC1	15mm	25mm	nil	nil	Standard 3604-like foundation with tied slabs
TC2	50mm	100mm	50mm	100mm	MBIE Enhanced Foundation Solutions
TC3	>50mm	>100mm	>50mm	>100mm	Site Specific Measures – Piles or Ground Improvement

The results from the liquefaction assessment, detailed in the geotechnical report dated 11 July 2018, indicated that the Prestons Park Subdivision can be classified as Technical Category 1 (TC1) and Technical Category 2 (TC2).

3 Subdivision Earthworks

3.1 General

Bulk earthworks for Stage E2 of Prestons were carried out in accordance with the requirements of NZS 4404:2010, "*Code of Practice for Urban Subdivision*" and NZS4431:1989 "*Code of Practice for Earthfill for Residential Development*" (since superseded by the NZS 4431:2022 "*Engineered fill construction for lightweight structures"*). The earthworks typically comprised stripping the site of topsoil, filling using imported pit run gravel or site-won sand, and then replacing topsoil. No excavation to remove in-situ organic material was undertaken as organics were infrequent, typically thin seams if encountered and at depths of greater than 2m.

3.2 Areas of Cut and Fill

Site earthworks within Stage E2 has included filling in comparison to the original site levels. The fill material comprises site-won sand and pit run gravel overlying a natural sand subgrade. A layer of topsoil overlies the fill material. The extent of filling is shown in Figure 3 in Appendix A.

3.3 Compaction Quality Control Testing

Independent testing of earthfill compaction completed using traditional earthworks techniques was carried out using a Nuclear Densometer (NDM). The acceptance criterion was based on the Prestons Subdivision earthworks specification as follows:

- Compaction of fill is to be in accordance with NZS 4431: 1989.
- Compaction standard is 95% Maximum Dry Density (MDD) for all areas of bulk filling, per NZS4402 Test 4.1.3.

Fill materials comprised of site-won sand and imported pit run gravel. Compaction curves for each of the fill materials are presented in Appendix B.

The MDD from the compaction curves were used to determine the level of compaction required for the fill material. A summary of these NDM results is presented in Appendix C and the NDM testing locations are presented in Figure 4 in Appendix A.

On those occasions where quality control testing did not meet the specification, the Contractor was required to rework the fill to achieve the required compaction.

3.4 Compaction Results

The results presented in Appendix C indicate that 95% MDD or greater compaction has been consistently achieved in the areas of bulk fill. Where NDM results indicated the required compaction had not been achieved, the Contractor completed additional compaction effort and conforming NDM results were achieved. From these results and our site observations, we confirm that all the earthfill placed within Stage E2 has achieved the required compaction.

4 Post Earthworks CPT

4.1 Introduction

Following completion of the earthworks and topsoil placement throughout Stage E2, a series of CPT tests has been carried out to confirm the ground conditions. Areas of Stage E2 which were identified as TC1 in Aurecon's previous assessment have not been retested, as the earthworks undertaken would only improve the technical categorisation. As such, post earthworks CPT have been undertaken in the TC2 areas to confirm if the technical category has improved as a result of the subdivision earthworks. The post earthworks CPTs are presented in Appendix D and the locations are shown in Figure 5 in Appendix A.

4.2 Liquefaction Assessment

To allow an assessment of the land technical category, a liquefaction assessment has been carried out on the post earthworks CPTs. The liquefaction assessment methodology has been discussed below.

Introduction

As technical categories are derived by liquefaction induced deformation limits, a liquefaction assessment on the post compaction CPTs has been carried out to determine the extent of liquefaction and the induced settlements. To allow CPT testing to be undertaken on the natural sand subgrade, predrilling has been undertaken through the granular pit run fill material. The pit run fill is non-liquefiable by inspection due its density and being located above the groundwater table.

Earthquake Cases

Earthquake induced ground acceleration and sustained shaking, leading to sufficient load cycles, is a requirement and a potential trigger of liquefaction. For this assessment we have reviewed three levels of seismic shaking.

1. Serviceability Limit State (SLS) design level earthquake, as defined by MBIE.
2. Intermediate design level earthquake, as defined by the subdivision consent conditions.
3. Ultimate Limit State (ULS) design level earthquake, as defined by MBIE.

Each of these earthquake cases is discussed in detail below:

Serviceability Limit State (SLS) Earthquake

From the NZGS/MBIE Guidelines (2021), a Peak Ground Acceleration (PGA) of 0.13g has been derived for a SLS event with a Magnitude 7.5 earthquake.

Intermediate Level (Int) Earthquake

Subdivision consent conditions indicate that liquefaction mitigation measures for the subdivision infrastructure shall be designed for a 1 in 150-year return period under the serviceability limit state (SLS) and as defined by NZS1170.5:2004.

Based on NZS1170.5:2004 for an Importance Level 2 (IL2) structure, with an increased Z hazard factor of 0.3, a PGA of 0.2g has been derived for a 1 in 150-year period of return. A Magnitude 7.5 has been used.

Ultimate Limit State (ULS) Earthquake

The NZGS/MBIE Guidelines (2021) recommend a PGA of 0.35g for residential buildings in Christchurch. This PGA value with a magnitude 7.5 earthquake has been adopted for the ULS assessment.

Liquefaction Methodology

In assessing the liquefaction potential, the method of Boulanger and Idriss (2014) has been utilised to assess the potential settlement for each design level event, as per the MBIE Guidelines (2012) for residential properties. The assessment was carried out using an excel spreadsheet developed by Aurecon. The method of Robertson and Wride (1998) with the modified fines content was used to assess the liquefaction potential from the CPT results. The method of Zhang et al (2002) was used for estimating the liquefaction induced settlements from CPT results.

The CPT analysis has been performed to a depth of 10m, as this is the required depth in the MBIE Guidelines for technical category assessment.

In addition to determining the liquefaction induced reconsolidation settlement, we have assessed the potential for liquefaction induced ground damage based on the Liquefaction Severity Number (LSN), as defined by Tonkin and Taylor (2013). Other ground damage potential methods (such as Ishihara, 1985) were assessed but LSN was considered the more appropriate method. Tonkin & Taylor (T&T) developed the Liquefaction Severity Number (LSN) based on investigation data and observations made following major earthquake events in Christchurch. The LSN number is an index number which qualitatively assesses the effects of liquefaction on a site and on a shallow founded building. The LSN number is calculated by the equation below.

$$LSN = 1000 \int \frac{\varepsilon_v}{z} . dz$$

Where: $\varepsilon_v = \text{volumetric reconsolidation strain}$

$z = \text{depth of liquefaction below ground level}$

The LSN number is likely to be a better index of surface damage than reconsolidation settlement because the LSN number is weighted more heavily by shallow liquefaction and less by liquefaction at depth, which is less likely to affect the ground surface or shallow founded buildings. Reconsolidation settlement places the same weighting on deep liquefaction as shallow liquefaction, even though settlement will have less impact at the ground surface with increasing depth. LSN numbers have been correlated to observed liquefaction effects during recent earthquakes in Christchurch as shown in Table 3 below.

Table 3: LSN Ranges and Observed Effects (Tonkin and Taylor, 2013).

LSN Range	Predominant Performance
0-10	Little to no expression of liquefaction, minor effects
10-20	Minor expression of liquefaction, some sand boils
20-30	Moderate expression of liquefaction, with sand boils and some structural damage
30-40	Moderate to severe expression of liquefaction, settlement can cause structural damage
40-50	Major expression of liquefaction, undulations and damage to ground surface, severe total and differential settlement of structures
>50	Severe damage, extensive evidence of liquefaction at surface, severe total and differential settlements affecting structures, damage to services

When compared to the broad descriptions of expected land performance in TC1, TC2 and TC3, as outlined in Section 2.3, the LSN number can be approximately correlated to technical categories as follows:

- TC1 = $LSN_{(ULS)} < 10$
- TC2 = $LSN_{(SLS)} < 20$ and $LSN_{(ULS)} < 30$
- TC3 = $LSN_{(SLS)} > 20$ or $LSN_{(ULS)} > 30$

A groundwater depth of 2.0m below finished earthworks level has been used for the purposes of this liquefaction assessment. Testing information throughout Stage Five indicates the groundwater level is typically greater than 2.0m depth (more likely to be at depths of 2.5m or greater) therefore a conservative groundwater level of 2.0m below ground level has been used for the assessment.

Liquefaction Assessment Results

The results of the liquefaction induced reconsolidation settlement analysis are presented in Table 4. The results for the liquefaction induced ground damage potential (based on LSN numbers) are presented in Table 5.

Table 4: Liquefaction induced settlements for post earthworks CPTs to 10m depth.

Earthquake Magnitude 7.5, Water Depth 2m, 10m Analysis			
CPT	**SLS Design Event (0.13g)**	**Intermediate Design Event (0.20g)**	**ULS Design Event (0.35g)**
	Settlement (mm)	Settlement (mm)	Settlement (mm)
CPTu301	<5	<5	15
CPTu302	<5	<5	10
CPTu303	<5	<5	30

Table 5: LSN for post earthworks CPTs to 10m depth.

Earthquake Magnitude 7.5, Water Depth 2m, 10m Analysis			
CPTs	**SLS Design Event (0.13g)**	**Intermediate Design Event (0.20g)**	**ULS Design Event (0.35g)**
	LSN	*LSN*	*LSN*
CPTu301	0	0	2
CPTu302	0	0	1
CPTu303	0	0	4

5 Building Development

5.1 Technical Category

Geotechnical testing has been carried out as part of the subdivision development. The testing indicates the lots within Stage E2 are likely to perform to TC1 equivalent. The technical category classification of the lots is given in Figure 6 in Appendix A.

5.2 Earthworks on Building Lots

The extent of earthfill on the lots in Stage E2 is shown on Figure 3 in Appendix A.

The fill areas have been constructed using materials and processes that have been randomly measured by independent testing. The testing shows that the placement of filling is generally in accordance with the specification and relevant standards.

5.3 Soil Suitability Criteria

Section 3 of New Zealand Standard NZS 3604:2011 "*Timber Framed Buildings not requiring specific Engineering Design*" provides several criteria for defining foundation soil suitability for lightweight timber or steel framed residential buildings.

Clauses 3.1.3 and 3.3 of NZS 3604:2011 provide criteria for determining strength and suitability of founding soils. Clauses 3.4.1 and 3.4.2 of NZS 3604:2011 discuss depths to competent founding. For purposes of this report, we have interpreted these clauses as meaning that for sound bearing at depths of 200mm to 600mm, standard shallow type foundations can be utilised. For depths greater than this, specific foundation designs could be used or alternatively excavations can be backfilled to the required level with 10MPa site concrete or compacted hardfill. In line with the Client's brief, Aurecon will be undertaking site specific investigations on each residential lot. We will prepare site specific geotechnical reports addressing the foundation requirements on individual building lots. The testing data for the lot specific investigations will be uploaded to the New Zealand Geotechnical Database. For building consent purposes reports prepared for individual lots shall be used.

5.4 Building Considerations

The recommendations in this report shall not be used for individual building consent applications. Site specific investigations in accordance with NZS 3604:2011 are required.

TC1 Foundations

For lots identified as TC1 we consider NZS 3604:2011 type foundations are suitable. We note that at the time of writing this report, the location and structural form of the future dwelling on the lots are unknown and our recommendations relate to NZS3604:2011 type lightweight timber or steel framed residential buildings only.

5.5 Future Earthworks

We do not anticipate that future earthworks will be required on the majority of the lots, however should such work be required the following should be noted.

- All earthworks should be carried out in accordance with the Health and Safety at Work Act 2015 and the Worksafe New Zealand Excavation Safety Good Practice Guidelines, 2016.
- Cuts that exceed 0.6m high around any of the house sites must be retained by a suitable retaining wall designed by a Chartered Professional Engineer.
- We recommend that no more than 450mm of fill is placed on the allotment without detailed engineering design.
- Earthworks (cut and fill) should not be undertaken adjacent to any timber retaining wall, if present.
- Any development where excavations greater than 1.2m in depth are proposed, must be subject to specific investigation and design to confirm these works will have no adverse effect on land stability, infrastructure and/or structures on adjacent lots. Excavations near sensitive structures or near boundaries may require geotechnical engineering input even if shallower than 1.2m.

5.6 Construction Observations

The suitability of foundation conditions must be verified at the time of construction. Foundation inspections by a Building Inspector or a Chartered Professional Engineer who are familiar with this report must be carried out to ensure the adequacy of the foundation subgrade prior to the placement of granular hardfill or the construction of foundations.

6 References

Boulanger R.W. and Idriss, I.M., 2014. *CPT and SPT based Liquefaction Triggering Procedures.* Center for Geotechnical Modelling Report No. UCD/CGM-14/01, Department of civil and Environmental Engineering, College of Engineering, University of California at Davis.

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NZS1170.0:2002. *Australia/New Zealand Standard, Structural Design Actions, Part 0: General Principals.* Standards New Zealand, Wellington, New Zealand.

NZS1170.5:2002. *Australia/New Zealand Standard, Structural Design Actions, Part 5: Earthquake Actions – New Zealand.* Standards New Zealand, 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.

Robertson and Wride, 1998. *Evaluating cyclic liquefaction potential using the cone penetration test*. Canadian Geotechnical Journal, Vol. 35, pp. 442 – 459.

Tonkin and Taylor (2013) *Liquefaction Vulnerability Study*, Tonkin and Taylor Report 52020.0200/v1.0. February 2013. 52 pages and 14 appendices.

Zhang, Robertson, and Brachman, 2002. *Estimating liquefaction-induced ground settlements from CPT for level ground.* Canadian Geotechnical Journal, Vol. 39, pp.1168 – 1180.

7 Explanatory Statement

This report has been prepared for CDL Land New Zealand Limited. It may be made available to others but only in full. As noted above, it shall not be used by any person as a substitute for specific field observations and testing once house sites are confirmed.

This report has been prepared as part of the development of the Prestons Park Stage E2 Subdivision. It has been prepared to provide the following information:

- To report on the management of the earthworks during construction, including compaction standards of fills.
- To report on the extent of ground improvement and the resulting land technical category.

This report does not remove the responsibility of the Owner / Builder / Building Certifier to satisfy themselves of foundation depth and suitability at the finally selected house location.

Subsurface conditions relevant to construction works should be assessed by experienced Contractors and designers 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 or in wet weather.

It is strongly recommended that any plans and specifications prepared by others and relating to the content of this report, or amendments to the original plans and specifications, are reviewed by Aurecon to verify that the intent of our recommendations is properly reflected in the design. During construction we request the opportunity to review our interpretations if the exposed site conditions are significantly different from those inferred in this report.

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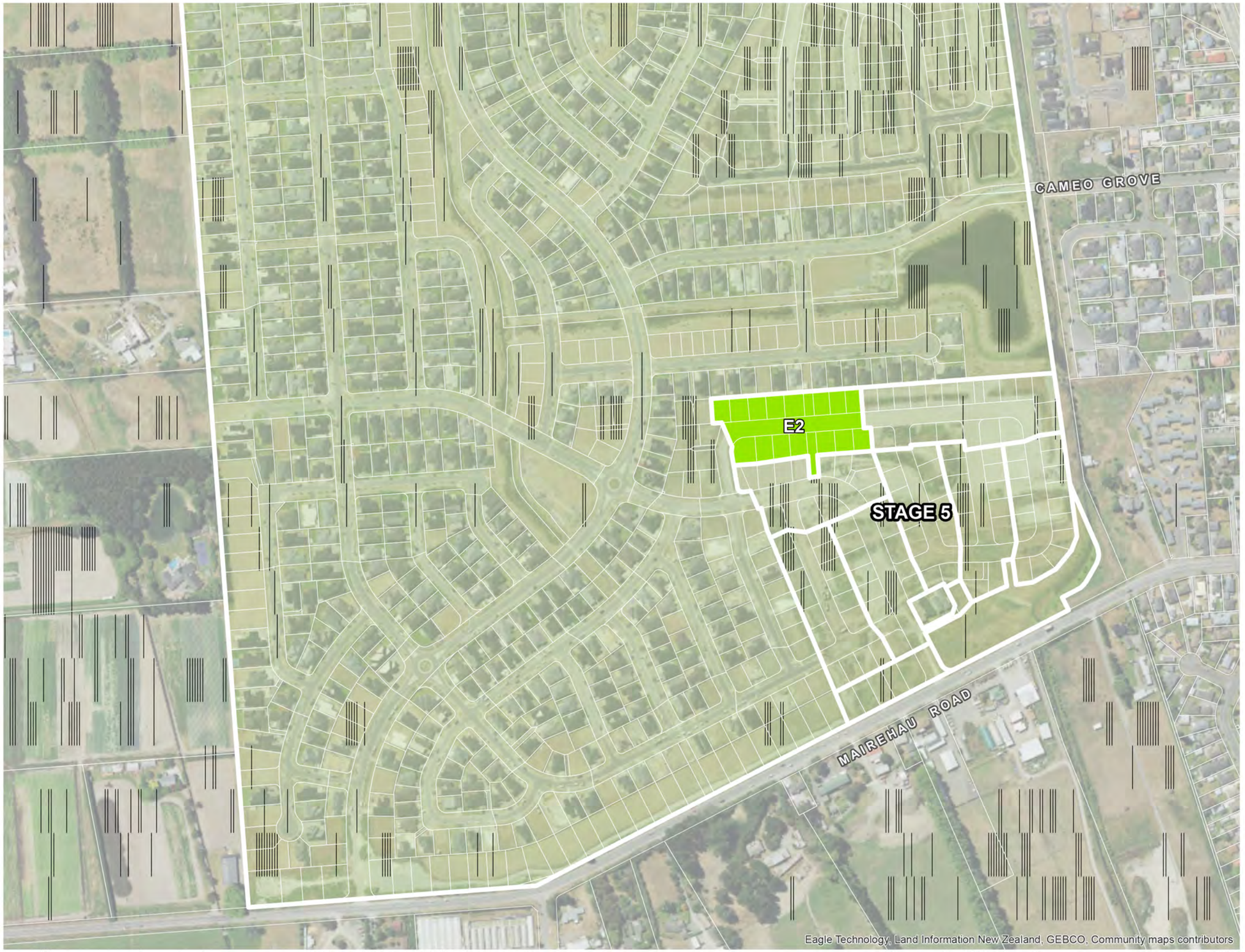
Appendix A
Figures



Meters
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NOTES - PROPERTY DATA FROM LINZ
- DEPTH BANDING DATA EXISTING TO FINISHED SURFACE

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A	22/07/22	ISSUE FOR INFORMATION	J. Kupec

DRAWN	DESIGNED
R.Dawson	K. Foote
CHECKED	
J. Muirson	
APPROVED	DATE
J. Kupec	22/07/22

PROJECT
PRESTONS SOUTH SUB-STAGE E2

TITLE
SITE PLAN

PROJECT No.
235361
SCALE
AS SHOWN
SIZE
A3
DRAWING NO.
FIG 1
REV
A

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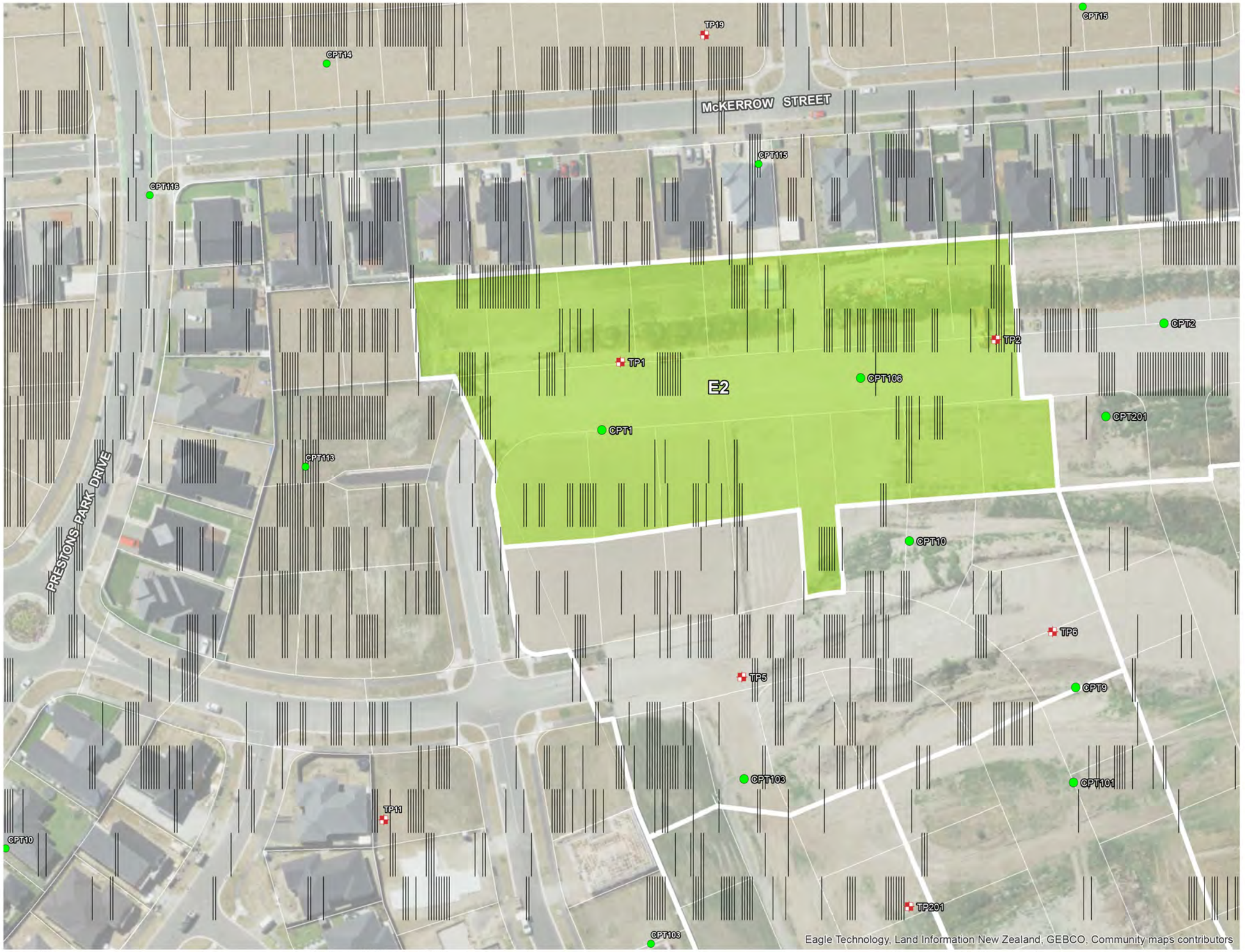

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PROJECT
PRESTONS SOUTH SUB-STAGE E2

TITLE
PREVIOUS INVESTIGATIONS

PROJECT No. 235361
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REV A

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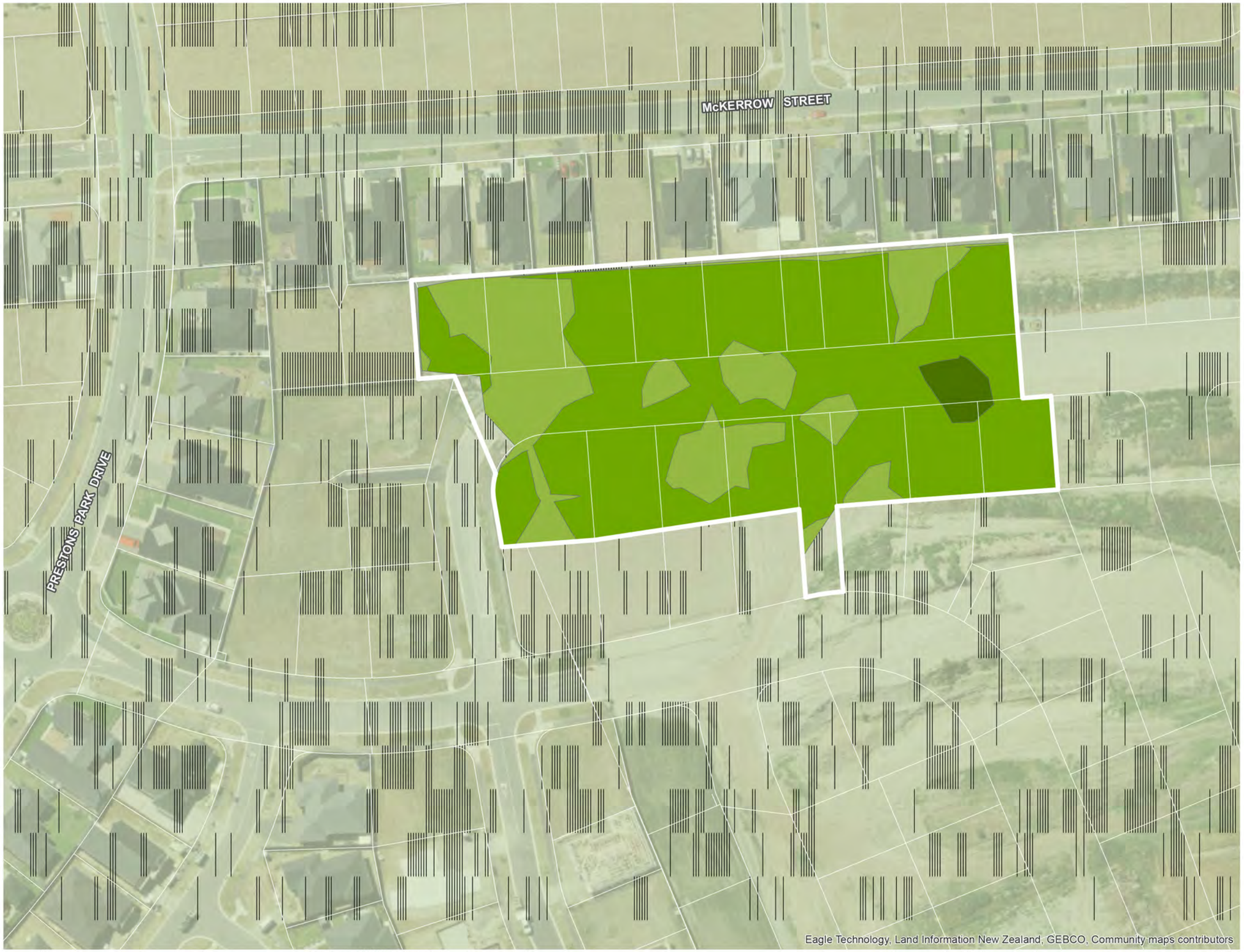

FILL
- 0.8 - 1.0m
- 1.0 - 1.2m
- 1.2 - 1.4m

0 10 20 30 40 Meters

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PROJECT
PRESTONS SOUTH SUB-STAGE E2

TITLE
CUT FILL BANDING

PROJECT No. 235361
SCALE AS SHOWN | SIZE A3
DRAWING NO. FIG 3 | REV A

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LEGEND

NDM TEST LOCATION

Meters
0 10 20 30 40

NOTE:
A selection of NDM test points only has been shown due to NDM testing density. Full details of all NDM test results are provided in 235361 - Prestons Park Stage Four Geotechnical Completion Report.

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PROJECT
PRESTONS PARK SUB-STAGE E2

TITLE
NDM LOCATIONS

PROJECT No.
235361

SCALE @ SIZE
AS SHOWN A3

DRAWING NO. REV
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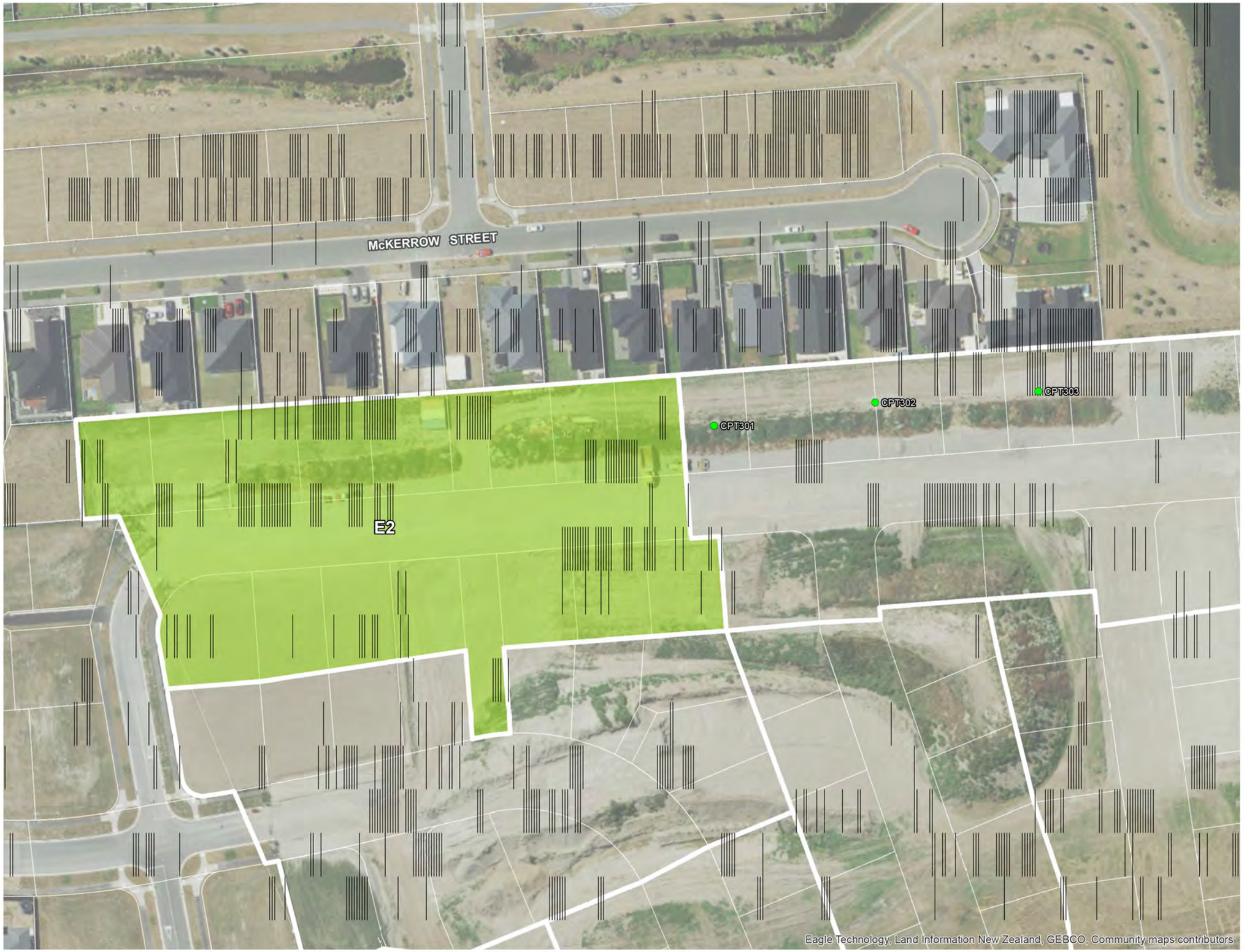

Meters
0 10 20 30 40

LEGEND

- POST EARTHWORKS CPT

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PROJECT: PRESTONS SOUTH SUB-STAGE E2

TITLE: POST EARTHWORKS CPTS

PROJECT No.: 235361
SCALE: AS SHOWN
SIZE: A3
DRAWING NO.: FIG 5
REV: A

Path: C:\Users\Ros.Dawson\Desktop\prestons\GIS\SOUTH STAGE 5\E2\FIG 5 POST EARTHWORKS CPTS.mxd

NOTE

TECHNICAL CATEGORY CLASSIFICATION HAS BEEN ASSESSED IN ACCORDANCE WITH SECTION 3 OF THE MBIE GUIDELINES (2012)

LEGEND

TC1 EQUIVALENT BEHAVIOUR

Meters
0 10 20 30 40

NOTES - PROPERTY DATA FROM LINZ

aurecon
www.aurecongroup.com

CLIENT
CDL LAND NEW ZEALAND LIMITED

REV	DATE	REVISION DETAILS	APPROVED
A	22/07/22	ISSUE	J. Kupec

DRAWN	DESIGNED
R.Dawson	T Tremain
CHECKED	
J. Muirson	
APPROVED	
DATE	
J. Kupec	22/07/22

PROJECT
PRESTONS PARK - SUB-STAGE E2

TITLE
TECHNICAL CATEGORY PLAN

PROJECT No.
235361

SCALE
AS SHOWN

SIZE
A3

DRAWING NO.
FIG 6

REV
A

Path: C:\Users\Ros.Dawson\Desktop\prestons\GIS\SOUTH STAGE 5\E2\FIG 6 TECHNICAL CATEGORY PLAN.mxd

Appendix B
Compaction Curves

Canterbury Laboratory

24 Miners Road, Templeton, Christchurch
PO Box 16-064, Christchurch 8441
Telephone: +64 3 349 9142
Facsimile: +64 3 349 9143
www.fultonhogan.com
0800 LABORATORY

Report No: MDD:CAN20S-01176
Issue No: 1

Maximum Dry Density Report

Client: Toni O'Regan
City Care Limited
PO Box 7669
Sydenham

Christchurch 8240
NZ

Project: QA Testing - City Care Ltd

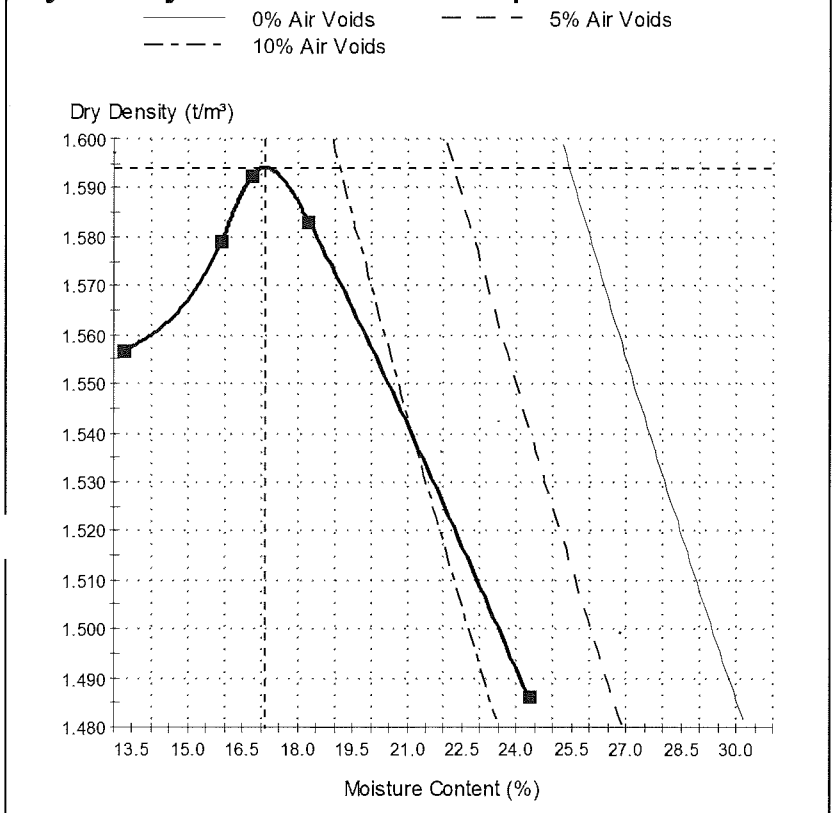
IANZ ACCREDITED LABORATORY

Approved Signatory: Max Burford (Supervisor)
IANZ Accreditation No:200
Date of Issue: 22/01/2020

Sample Details

Sample ID:	CAN20S-01176	**Client Sample ID:**	0055/20 Sample 3
Material:	Sand	**Sample Source:**	Miscellaneous Material Source
Site/Sampled From:	CDL Prestons Road	**Date Sampled:**	20/01/2020
Specification:	Vibrating Hammer Compaction Test	**Sampled By:**	Advised - See Comments
Sampling Method:	Not Advised	**Date Tested:**	21/01/2020
Technician:	Atu Rova	**Sampling Endorsed?:**	No

Dry Density - Moisture Relationship



Test Results

NZS 4402:1986 Test 4.1.3

Maximum Dry Density (t/m³):	**1.60**
Optimum Moisture (%):	**17**
Solid Density (t/m³):	2.68 assumed
Fraction Tested Passes (mm):	37.5
Material Removed (%):	0
Sample History:	Natural
Tested By:	Atu Rova
Date Tested:	21/01/2020

Comments

* Sample 3
* Material sampled by Clive Gould.

Canterbury Laboratory

24 Miners Road, Templeton, Christchurch
PO Box 16-064, Christchurch 8441
Telephone: +64 3 349 9142
Facsimile: +64 3 349 9143
www.fultonhogan.com
0800 LABORATORY

Maximum Dry Density Report

Report No: MDD:CAN20S-01175
Issue No: 1

Client: Toni O'Regan
City Care Limited
PO Box 7669
Sydenham

Christchurch 8240
NZ

Project: QA Testing - City Care Ltd

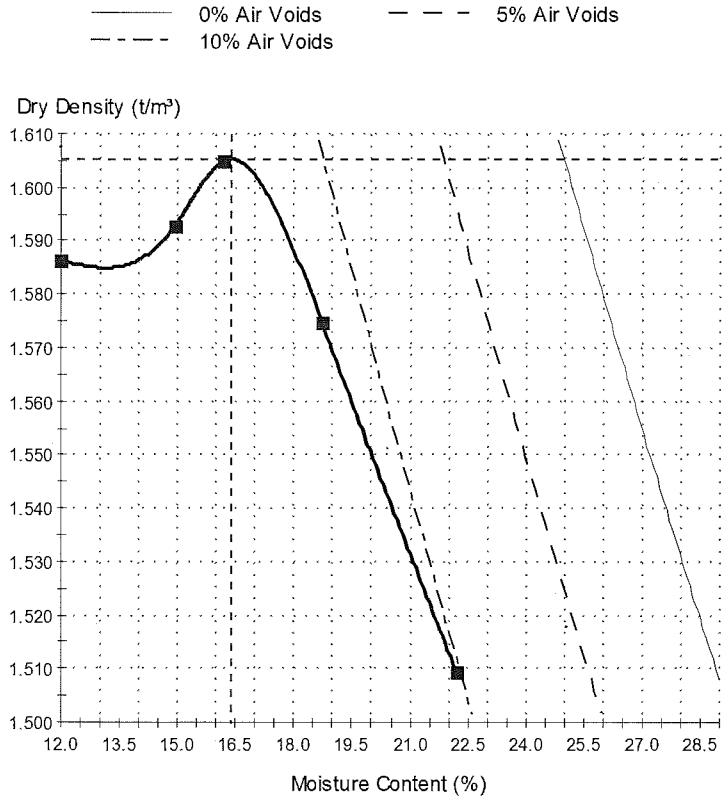
IANZ ACCREDITED LABORATORY

Approved Signatory: Max Burford
(Supervisor)
IANZ Accreditation No:200
Date of Issue: 22/01/2020

Sample Details

Sample ID:	CAN20S-01175	**Client Sample ID:**	0054/20 Sample 2
Material:	Sand	**Sample Source:**	Miscellaneous Material Source
Site/Sampled From:	CDL Prestons Road	**Date Sampled:**	20/01/2020
Specification:	Vibrating Hammer Compaction Test	**Sampled By:**	Advised - See Comments
Sampling Method:	Not Advised	**Date Tested:**	21/01/2020
Technician:	Atu Rova	**Sampling Endorsed?:**	No

Dry Density - Moisture Relationship



Test Results

NZS 4402:1986 Test 4.1.3

Maximum Dry Density (t/m³):	**1.60**
Optimum Moisture (%):	**16**
Solid Density (t/m³):	2.68 assumed
Fraction Tested Passes (mm):	37.5
Material Removed (%):	0
Sample History:	Natural
Tested By:	Atu Rova
Date Tested:	21/01/2020

Comments

* Sample 2
* Material sampled by Clive Gould.

Canterbury Laboratory

24 Miners Road, Templeton, Christchurch
PO Box 16-064, Christchurch 8441
Telephone: +64 3 349 9142
Facsimile: +64 3 349 9143
www.fultonhogan.com
0800 LABORATORY

Maximum Dry Density Report

Report No: MDD:CAN20S-17343
Issue No: 1

Client: Toni O'Regan
City Care Limited
PO Box 7669
Sydenham

Christchurch 8240
NZ

Project: QA Testing - City Care Ltd

ACCREDITED IANZ TESTING LABORATORY

The tests reported herein (unless otherwise indicated) have been performed in accordance with the laboratory's scope of accreditation. Samples are tested as received, in natural condition, unless stated otherwise in the comments. This report may only be reproduced in full.

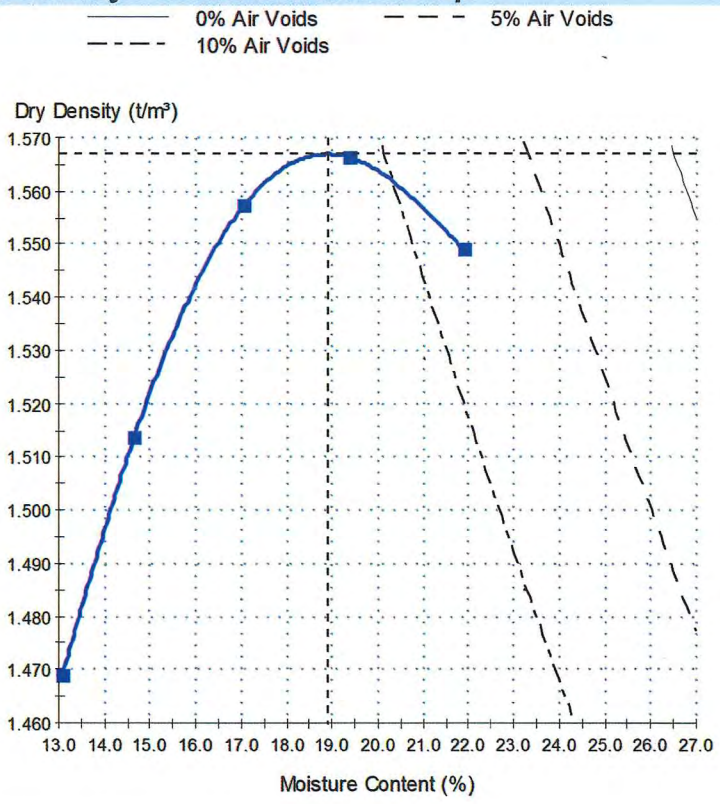
The results in this report relate only to the items / samples that were tested

Approved Signatory: Rebecca Royfee (Laboratory Technician)
IANZ Accreditation No:200
Date of Issue: 23/10/2020

Sample Details

Sample ID:	CAN20S-17343	**Client Sample ID:**	1691/20
Material:	Sand	**Sample Source:**	Miscellaneous Material Source
Site/Sampled From:	CD2 Prestons - Stage 5 East side of S/P	**Date Sampled:**	20/10/2020
Specification:	Vibrating Hammer Compaction Test	**Sampled By:**	Advised - See Comments
Sampling Method:	Stated to be NZS 4407:2015 2.4.6.5	**Date Tested:**	22/10/2020
Technician:	Laura Cranston	**Sampling Endorsed?:**	No

Dry Density - Moisture Relationship



Test Results

NZS 4402:1986 Test 4.1.3 - 1986

Maximum Dry Density (t/m³):	**1.56**
Optimum Moisture (%):	**19**
Solid Density (t/m³):	2.68 assumed
Fraction Tested Passes (mm):	37.5
Material Removed (%):	0
Sample History:	Natural
Tested By:	Laura Cranston
Date Tested:	22/10/2020

Comments

Sampled by A Hadlee

Canterbury Laboratory

24 Miners Road, Templeton, Christchurch
PO Box 16-064, Christchurch 8441
Telephone: +64 3 349 9142
Facsimile: +64 3 349 9143
www.fultonhogan.com
0800 LABORATORY

Report No: MDD:CAN21S-00814
Issue No: 1

Maximum Dry Density Report

Client:
City Care Limited
PO Box 7669
Sydenham

Christchurch 8240
NZ

Project: City Care

The tests reported herein (unless otherwise indicated) have been performed in accordance with the laboratory's scope of accreditation. Samples are tested as received, in natural condition, unless stated otherwise in the comments. This report may only be reproduced in full.

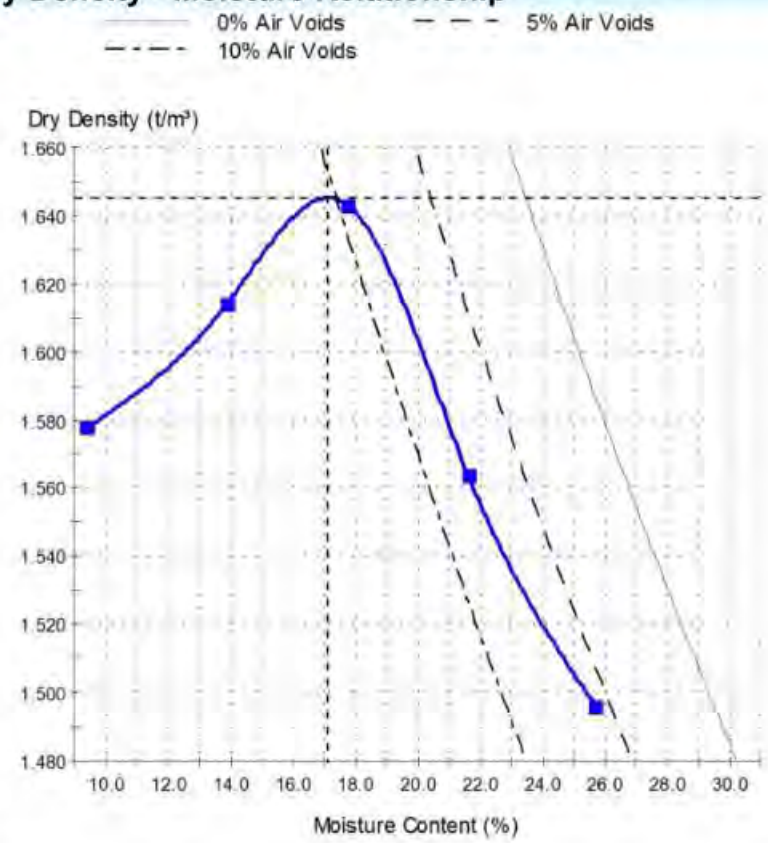
The results in this report relate only to the items / samples that were tested

Approved Signatory: Liam Brennan
(Laboratory Technician)
IANZ Accreditation No:200
Date of Issue: 29/01/2021

Sample Details

Sample ID:	CAN21S-00814	**Client Sample ID:**	Lab Ref: 0095/21
Material:	Silty Sand	**Sample Source:**	Miscellaneous Material Source
Site/Sampled From:	Ex Oakbridge, Eastern BDY Reserve	**Date Sampled:**	27/01/2021
Specification:	Vibrating Hammer Compaction Test	**Sampled By:**	Advised - See Comments
Sampling Method:	As Received - Not Accredited	**Date Tested:**	28/01/2021
Technician:	Maciej Gaworecki	**Sampling Endorsed?:**	No

Dry Density - Moisture Relationship



Test Results

NZS 4402:1986 Test 4.1.3 - 1986

Maximum Dry Density (t/m³):	**1.64**
Optimum Moisture (%):	**17**
Solid Density (t/m³):	2.68 assumed
Fraction Tested Passes (mm):	37.5
Material Removed (%):	0
Sample History:	Natural
Tested By:	Maciej Gaworecki
Date Tested:	28/01/2021

Comments

Compaction for test points @ 21.6% & 25.7% ceased prior to 3 minutes due to oversaturation causing ejection of fines from sample.
Material sampled by Clive Gould

Road Science
Leading Transport Technology

CHRISTCHURCH LABORATORY

397 Mcleans Island Road, Harewood
P O Box 11-326, Sockburn, Christchurch 8443
Phone: (03) 359-0757

Test Report

Client:	K.B. Contracting & Quarries Limited	**Sample Date:**	08/12/2017	08:00
Address:	PO Box 19746, Woolston, Christchurch 8241	**Sampled By:**	Pete Haward	
Client Ref:	Not advised	**Laboratory No:**	C17/3810	
Job Location:	McLeans Island	**Report No:**	257833	**Final**
Material:	Pit Run	**Report Date:**	15/12/2017	Page 1 of 2
Material Source:	McLeans Island			

Test Methods:

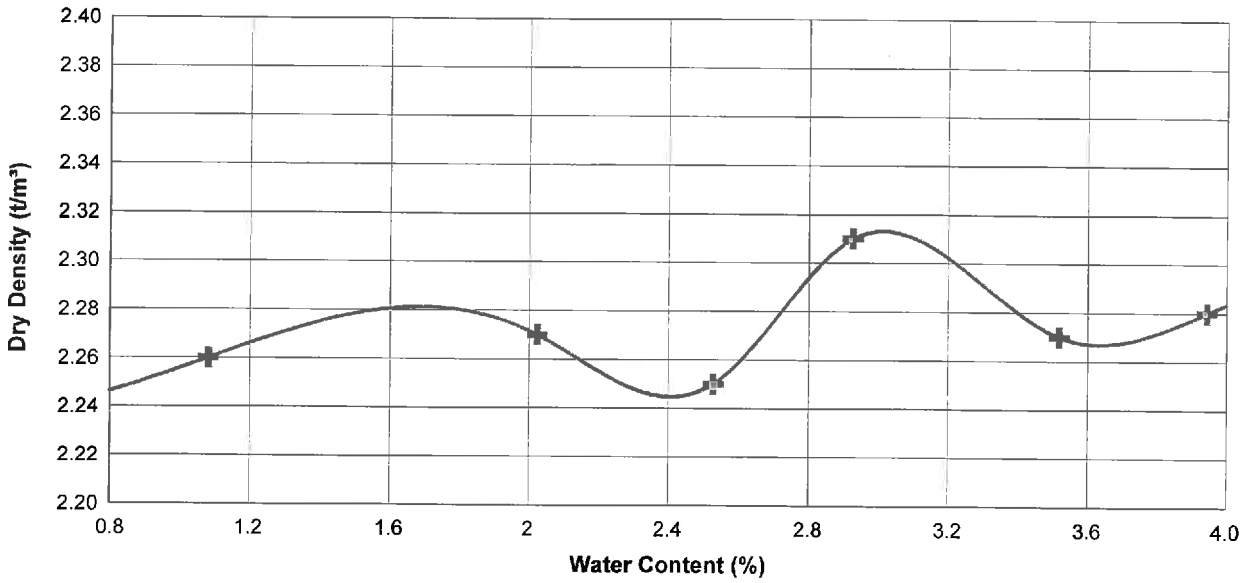
1#	Sampling from stockpiles of well graded aggregate - machine method	NZS4407:2015 2.4.6.3.2
2	Determination of the Dry Density/Water Content Relationship - New Zealand Vibrating Hammer Compaction Test	NZS4402:1986 Test 4.1.3

Test methods marked with a hash are not accredited.

Results

Water Content (%)	1.08	2.02	2.53	2.93	3.52	3.94
Dry Density (t/m³)	2.26	2.27	2.25	2.31	2.27	2.28

Dry Density/Water Content Relationship



Maximum Dry Density (t/m³)	2.32
Optimum Water Content (%)	3.0
History of Sample	Result obtained from oven-dried sample.
Test Fraction	Passing 37.5mm sieve
Test Date:	13/12/2017

Notes

Date of sample receipt: 08/12/2017

Vicky Henderson
Approved Signatory
Laboratory Manager
IANZ Accreditation No: 439
Date of Issue: 10/04/92

IANZ ACCREDITED LABORATORY

Road Science
Leading Transport Technology

CHRISTCHURCH LABORATORY
PO Box 11326, Sockburn, Christchurch, 8443
Phone: 03 359 0757

Test Report

Client:	K.B. Contracting & Quarries Limited	**Sample Date:**	14/10/2021	10:00
Address:	PO Box 19746, Woolston, Christchurch 8241	**Sampled By:**	Pete Haward	
Job Location:	Mcleans Island	**Laboratory No:**	C21/1895	
Material:	Pitrun	**Client Ref:**	Not Advised	
Material Source:	Mcleans Island	**Report No:**	52897	**Final**
		Report Date:	20/10/2021	

Test Methods

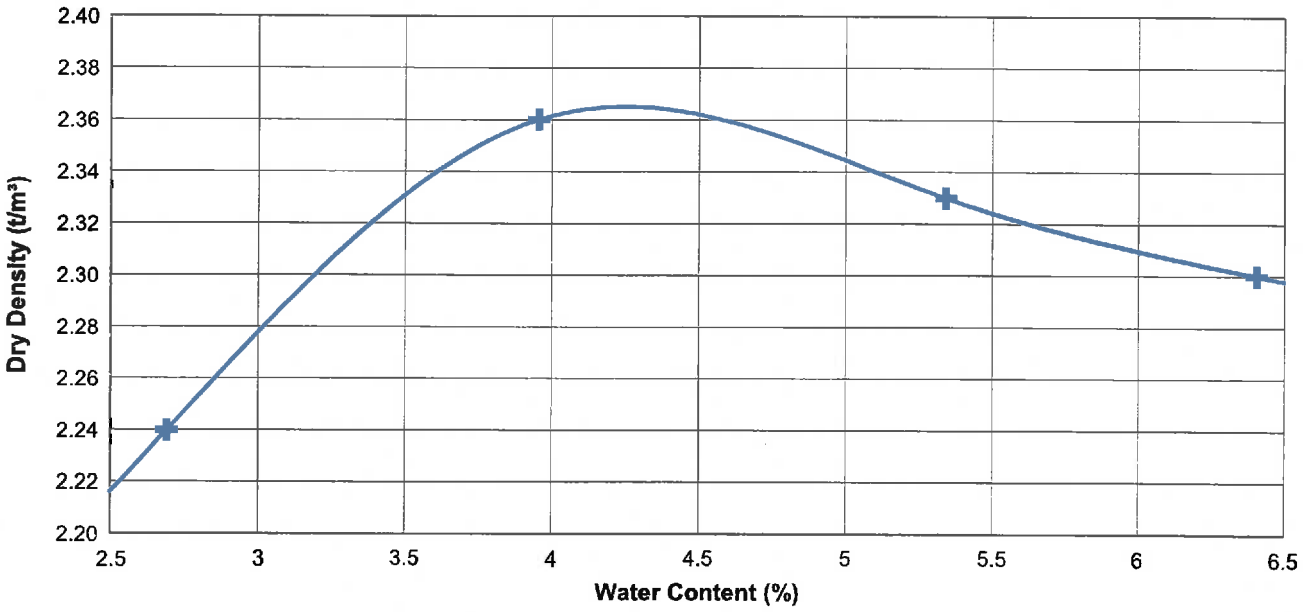
1	Determination of the dry density/water content relationship - New Zealand vibrating hammer compaction test	NZS4402:1986 Test 4.1.3
2	Sampling from stockpiles of well graded aggregate - machine method	NZS4407:2015 Test 2.4.6.3.2

Determination of the Dry Density/Water Content Relationship - New Zealand Vibrating Hammer Compaction Test

Results

Dry Density (t/m³)	2.24	2.36	2.33	2.30
Water Content (%)	2.7	4.0	5.3	6.4

Dry Density/Water Content Relationship



	Results
Natural moisture content (%)	3.5
Maximum Dry Density (t/m³)	2.36
Optimum Water Content (%)	4.2
Test Fraction	Passing 37.5mm sieve
Test Date:	19-10-2021

Road Science
Leading Transport Technology

CHRISTCHURCH LABORATORY
PO Box 11326, Sockburn, Christchurch, 8443
Phone: 03 359 0757

Laboratory No: C21/1895
Report No: 52897 **Final**
Report Date: 20/10/2021

Sample Notes

Sample received in a damp condition.

Test results apply to sample as received.

Date of sample receipt: 14/10/2021

Vicky Henderson
Laboratory Manager

Appendix C
NDM Earthfill Testing Results

Project Prestons South Subdivision
Project No. 235361
Date 29-July-22

Title Summary of Compaction

Date	Test ID#	Test #	Unique ID#	mE	mN	Stage	MDD	Type	Lift #	Lot ID	Compaction (%)	Retest	Pass (Yes/No)
19/09/2019	2334/19	3	9	395784.023	812126.79	Stage 5	2320	Pitrun	Lift 1	Lot 1041	101		YES
19/09/2019	2334/19	4	10	395793.347	812147.391	Stage 5	2320	Pitrun	Lift 1	Lot 1041	100		YES
25/09/2019	2391/19	7	53	395793.76	812128.401	Stage 5	2320	Pitrun	Lift 2	Lot 1041	98		YES
25/09/2019	2391/19	8	54	395783.843	812145.921	Stage 5	2320	Pitrun	Lift 2	Lot 1041	100		YES
1/10/2019	2421_19 (2454/19)	3	664	395782.525	812130.058	Stage 5	2320	Pitrun	lift 3	Lot 1041	99		YES
1/10/2019	2421_19 (2454/19)	4	665	395793.478	812144.317	Stage 5	2320	Pitrun	lift 3	Lot 1041	96		YES
3/10/2019	2454/19	1	107	395783.843	812145.921	Stage 5	2320	Pitrun	Final Lift	Lot 1041	99		YES
3/10/2019	2454/19	2	108	395793.76	812128.401	Stage 5	2320	Pitrun	Final Lift	Lot 1041	97		YES
19/09/2019	2334/19	1	7	395765.438	812145.06	Stage 5	2320	Pitrun	Lift 1	Lot 1042	101		YES
19/09/2019	2334/19	2	8	395777.66	812125.971	Stage 5	2320	Pitrun	Lift 1	Lot 1042	99		YES
25/09/2019	2391/19	9	55	395775.8	812146.031	Stage 5	2320	Pitrun	Lift 2	Lot 1042	97		YES
25/09/2019	2391/19	10	56	395767.536	812126.087	Stage 5	2320	Pitrun	Lift 2	Lot 1042	98		YES
1/10/2019	2421_19 (2454/19)	1	662	395765.434	812142.523	Stage 5	2320	Pitrun	lift 3	Lot 1042	98		YES
1/10/2019	2421_19 (2454/19)	2	663	395775.537	812129.492	Stage 5	2320	Pitrun	lift 3	Lot 1042	97		YES
10/09/2019	2243/19	11	45	395749.431	812125.248	Stage 5	2320	Pitrun	Lift 1	Lot 1043	98		YES
10/09/2019	2243/19	12	46	395757.161	812142.861	Stage 5	2320	Pitrun	Lift 1	Lot 1043	98		YES
13/09/2019	2281/19	1	57	395755.069	812125.497	Stage 5	2320	Pitrun	Lift 2	Lot 1043	101		YES
13/09/2019	2281/19	2	58	395754.111	812143.223	Stage 5	2320	Pitrun	Lift 2	Lot 1043	101		YES
17/09/2019	2306/19	11	33	395749.431	812125.248	Stage 5	2320	Pitrun	Lift 3	Lot 1043	100		YES
17/09/2019	2306/19	12	34	395757.161	812142.861	Stage 5	2320	Pitrun	Lift 3	Lot 1043	98		YES
18/09/2019	2316/19	5	5	395749.432	812143.287	Stage 5	2320	Pitrun	Final Lift	Lot 1043	98		YES
18/09/2019	2316/19	6	6	395760.796	812125.877	Stage 5	2320	Pitrun	Final Lift	Lot 1043	98		YES
10/09/2019	2243/19	9	43	395719.527	812140.327	Stage 5	2320	Pitrun	Lift 1	Lot 1044	97		YES
10/09/2019	2243/19	10	44	395731.311	812124.614	Stage 5	2320	Pitrun	Lift 1	Lot 1044	99		YES
13/09/2019	2281/19	3	59	395725.75	812140.827	Stage 5	2320	Pitrun	Lift 2	Lot 1044	100		YES
13/09/2019	2281/19	4	60	395727.091	812123.485	Stage 5	2320	Pitrun	Lift 2	Lot 1044	101		YES
17/09/2019	2306/19	9	31	395719.527	812140.327	Stage 5	2320	Pitrun	Lift 3	Lot 1044	97		YES
17/09/2019	2306/19	10	32	395731.311	812124.614	Stage 5	2320	Pitrun	Lift 3	Lot 1044	98		YES
18/09/2019	2316/19	3	3	395721.112	812123.01	Stage 5	2320	Pitrun	Final Lift	Lot 1044	98		YES
18/09/2019	2316/19	4	4	395730.664	812141.108	Stage 5	2320	Pitrun	Final Lift	Lot 1044	98		YES
10/09/2019	2243/19	7	41	395700.936	812120.035	Stage 5	2320	Pitrun	Lift 1	Lot 1045	99		YES
10/09/2019	2243/19	8	42	395709.861	812140.089	Stage 5	2320	Pitrun	Lift 1	Lot 1045	101		YES
13/09/2019	2281/19	5	61	395707.449	812121.281	Stage 5	2320	Pitrun	Lift 2	Lot 1045	99		YES
13/09/2019	2281/19	6	62	395706.395	812139.39	Stage 5	2320	Pitrun	Lift 2	Lot 1045	100		YES
17/09/2019	2306/19	7	29	395700.936	812120.035	Stage 5	2320	Pitrun	Lift 3	Lot 1045	98		YES
17/09/2019	2306/19	8	30	395709.861	812140.089	Stage 5	2320	Pitrun	Lift 3	Lot 1045	98		YES
18/09/2019	2316/19	1	1	395700.667	812139.097	Stage 5	2320	Pitrun	Final Lift	Lot 1045	99		YES
18/09/2019	2316/19	2	2	395712.565	812122.004	Stage 5	2320	Pitrun	Final Lift	Lot 1045	96		YES
10/09/2019	2243/19	5	39	395679.78	812138.546	Stage 5	2320	Pitrun	Lift 1	Lot 1046	99		YES
10/09/2019	2243/19	6	40	395694.104	812119.594	Stage 5	2320	Pitrun	Lift 1	Lot 1046	97		YES
13/09/2019	2281/19	7	63	395686.274	812138.24	Stage 5	2320	Pitrun	Lift 2	Lot 1046	101		YES
13/09/2019	2281/19	8	64	395687.424	812119.652	Stage 5	2320	Pitrun	Lift 2	Lot 1046	99		YES
17/09/2019	2306/19	5	27	395679.78	812138.546	Stage 5	2320	Pitrun	Lift 3	Lot 1046	97		YES
17/09/2019	2306/19	6	28	395694.104	812119.594	Stage 5	2320	Pitrun	Lift 3	Lot 1046	97		YES
10/09/2019	2243/19	3	37	395662.04	812117.832	Stage 5	2320	Pitrun	Lift 1	Lot 1047	98		YES
10/09/2019	2243/19	4	38	395672.728	812137.885	Stage 5	2320	Pitrun	Lift 1	Lot 1047	102		YES

Project Prestons South Subdivision
Project No. 235361
Date 29-July-22

Title Summary of Compaction

Date	Test ID#	Test #	Unique ID#	mE	mN	Stage	MDD	Type	Lift #	Lot ID	Compaction (%)	Retest	Pass (Yes/No)
13/09/2019	2281/19	9	65	395667.399	812117.928	Stage 5	2320	Pitrun	Lift 2	Lot 1047	98		YES
13/09/2019	2281/19	10	66	395666.537	812136.707	Stage 5	2320	Pitrun	Lift 2	Lot 1047	101		YES
17/09/2019	2306/19	3	25	395662.04	812117.832	Stage 5	2320	Pitrun	Lift 3	Lot 1047	95		YES
17/09/2019	2306/19	4	26	395672.728	812137.885	Stage 5	2320	Pitrun	Lift 3	Lot 1047	98		YES
10/09/2019	2243/19	1	35	395642.348	812134.513	Stage 5	2320	Pitrun	Lift 1	Lot 1048	97		YES
10/09/2019	2243/19	2	36	395654.657	812117.391	Stage 5	2320	Pitrun	Lift 1	Lot 1048	98		YES
13/09/2019	2281/19	11	67	395648.106	812134.364	Stage 5	2320	Pitrun	Lift 2	Lot 1048	99		YES
13/09/2019	2281/19	12	68	395649.5	812117.131	Stage 5	2320	Pitrun	Lift 2	Lot 1048	96		YES
17/09/2019	2306/19	1	23	395642.348	812134.513	Stage 5	2320	Pitrun	Lift 3	Lot 1048	97		YES
17/09/2019	2306/19	2	24	395654.657	812117.391	Stage 5	2320	Pitrun	Lift 3	Lot 1048	98		YES
7/07/2020	KB20/0209	3	149	395668.679	812074.672	Stage 5	2320	Pitrun	Lift 3	Lot 975	101		YES
7/07/2020	KB20/0209	4	150	395667.321	812090.745	Stage 5	2320	Pitrun	Lift 3	Lot 975	100		YES
28/10/2020	1774-20	1	203	395670.081	812090.712	Stage 5	1600	Sand	Lift 2	Lot 975	101		YES
28/10/2020	1774-20	2	204	395672.694	812074.597	Stage 5	1600	Sand	Lift 2	Lot 975	98		YES
3/11/2020	1838-20	9	163	395672.948	812091.485	Stage 5	1600	Sand	Lift 3	Lot 975	102		YES
3/11/2020	1838-20	10	164	395672.038	812077.299	Stage 5	1600	Sand	Lift 3	Lot 975	102		YES
3/07/2022	KB20/0203	2	762	395663.905	812074.851	Stage 5	2320	Pit run	Lift 1	Lot 975	98		YES
3/07/2022	KB20/0203	3	763	395663.244	812086.748	Stage 5	2320	Pit run	Lift 1	Lot 975	100		YES
14/10/2020	1651-20	1	191	395686.98	812095.704	Stage 5	1600	Sand	Lift 1	Lot 976	101		YES
14/10/2020	1651-20	2	192	395699.142	812075.892	Stage 5	1600	Sand	Lift 1	Lot 976	102		YES
20/10/2020	1693-20	3	189	395694.778	812079.84	Stage 5	1660	Sand	Lift 2	Lot 976	90	Yes (1738-20, 3)	NO
20/10/2020	1693-20	4	190	395693.097	812092.157	Stage 5	1660	Sand	Lift 2	Lot 976	91	Yes (1738-20, 4)	NO
22/10/2020	1738-20	3	217	395694.909	812075.995	Stage 5	1600	Sand	Lift 2	Lot 976	99		YES
22/10/2020	1738-20	4	218	395693.615	812093.922	Stage 5	1600	Sand	Lift 2	Lot 976	100		YES
28/10/2020	1774-20	3	205	395694.615	812075.323	Stage 5	1600	Sand	Lift 3	Lot 976	97		YES
28/10/2020	1774-20	4	206	395692.365	812094.341	Stage 5	1600	Sand	Lift 3	Lot 976	96		YES
3/11/2020	1838-20	7	161	395696.25	812078.045	Stage 5	1600	Sand	Lift 3	Lot 976	102		YES
3/11/2020	1838-20	8	162	395695.386	812093.407	Stage 5	1600	Sand	Lift 3	Lot 976	97		YES
14/10/2020	1651-20	3	193	395707.695	812077.371	Stage 5	1600	Sand	Lift 1	Lot 977	105		YES
14/10/2020	1651-20	4	194	395715.635	812096.607	Stage 5	1600	Sand	Lift 1	Lot 977	98		YES
20/10/2020	1693-20	1	187	395711.373	812094.617	Stage 5	1660	Sand	Lift 2	Lot 977	99		YES
20/10/2020	1693-20	2	188	395712.46	812081.953	Stage 5	1660	Sand	Lift 2	Lot 977	90	Yes (1738-20, 2)	NO
22/10/2020	1738-20	1	215	395712.18	812095.095	Stage 5	1600	Sand	Lift 2	Lot 977	99		YES
22/10/2020	1738-20	2	216	395713.102	812080.203	Stage 5	1600	Sand	Lift 2	Lot 977	100		YES
28/10/2020	1774-20	5	207	395711.528	812096.083	Stage 5	1600	Sand	Lift 3	Lot 977	96		YES
28/10/2020	1774-20	6	208	395713.851	812079.388	Stage 5	1600	Sand	Lift 3	Lot 977	98		YES
3/11/2020	1838-20	1	155	395712.718	812093.733	Stage 5	1600	Sand	Lift 3	Lot 977	101		YES
3/11/2020	1838-20	2	156	395715.241	812081.481	Stage 5	1600	Sand	Lift 3	Lot 977	101		YES
14/10/2020	1651-20	5	195	395723.465	812097.762	Stage 5	1600	Sand	Lift 1	Lot 978	101		YES
14/10/2020	1651-20	6	196	395736.616	812080.963	Stage 5	1600	Sand	Lift 1	Lot 978	99		YES
3/02/2022	KB22/0047	7	394	395731.535	812095.241	Stage 5	2360	Pitrun	Lift 1	Lot 978	100		YES
3/02/2022	KB22/0047	8	395	395732.713	812084.802	Stage 5	2360	Pitrun	Lift 1	Lot 978	103		YES
4/02/2022	KB22/0051	7	428	395731.535	812095.241	Stage 5	2360	Pitrun	Lift 2	Lot 978	98		YES
4/02/2022	KB22/0051	8	429	395732.713	812084.802	Stage 5	2360	Pitrun	Lift 2	Lot 978	101		YES
8/02/2022	KB22/0052	7	440	395731.535	812095.241	Stage 5	2360	Pitrun	Lift 3	Lot 978	100		YES
8/02/2022	KB22/0052	8	441	395732.713	812084.802	Stage 5	2360	Pitrun	Lift 3	Lot 978	103		YES

Project Prestons South Subdivision
Project No. 235361
Date 29-July-22

Title Summary of Compaction

Date	Test ID#	Test #	Unique ID#	mE	mN	Stage	MDD	Type	Lift #	Lot ID	Compaction (%)	Retest	Pass (Yes/No)
9/02/2022	KB22/0054	7	420	395731.535	812095.241	Stage 5	2360	Pitrun	Lift 4	Lot 978	103		YES
9/02/2022	KB22/0054	8	421	395732.713	812084.802	Stage 5	2360	Pitrun	Lift 4	Lot 978	102		YES
3/02/2022	KB22/0047	5	392	395762.576	812101.386	Stage 5	2360	Pitrun	Lift 1	Lot 979	101		YES
3/02/2022	KB22/0047	6	393	395752.333	812100.607	Stage 5	2360	Pitrun	Lift 1	Lot 979	102		YES
4/02/2022	KB22/0051	5	426	395762.576	812101.386	Stage 5	2360	Pitrun	Lift 2	Lot 979	98		YES
4/02/2022	KB22/0051	6	427	395752.333	812100.607	Stage 5	2360	Pitrun	Lift 2	Lot 979	98		YES
8/02/2022	KB22/0052	5	438	395762.576	812101.386	Stage 5	2360	Pitrun	Lift 3	Lot 979	95		YES
8/02/2022	KB22/0052	6	439	395752.333	812100.607	Stage 5	2360	Pitrun	Lift 3	Lot 979	99		YES
9/02/2022	KB22/0054	5	418	395762.576	812101.386	Stage 5	2360	Pitrun	Lift 4	Lot 979	100		YES
9/02/2022	KB22/0054	6	419	395752.333	812100.607	Stage 5	2360	Pitrun	Lift 4	Lot 979	99		YES
30/05/2022	0907_001 (0909/22)	1	557	395754.107	812084.283	Stage 5	1560	Sand	Lift 1	Lot 979	107		YES
30/05/2022	0907_001 (0909/22)	2	558	395762.576	812101.386	Stage 5	1560	Sand	Lift 1	Lot 979	105		YES
2/06/2022	1022_001 (0939/22)	1	565	395754.107	812084.283	Stage 5	1640	Sand	Lift 2	Lot 979	97		YES
2/06/2022	1022_001 (0939/22)	2	566	395762.576	812101.386	Stage 5	1640	Sand	Lift 2	Lot 979	100		YES
14/06/2022	1204_001 (1001/22)	1	618	395754.107	812084.283	Stage 5	1640	Sand	Lift 3	Lot 979	96		YES
14/06/2022	1204_001 (1001/22)	2	619	395762.576	812101.386	Stage 5	1640	Sand	Lift 3	Lot 979	102		YES
17/06/2022	1541_001 (1033/22)	1	626	395754.107	812084.283	Stage 5	1640	Sand	Lift 4	Lot 979	102		YES
17/06/2022	1541_001 (1033/22)	2	627	395762.576	812101.386	Stage 5	1640	Sand	Lift 4	Lot 979	102		YES
3/02/2022	KB22/0047	3	390	395783.396	812103.279	Stage 5	2360	Pitrun	Lift 1	Lot 980	96		YES
3/02/2022	KB22/0047	4	391	395770.481	812102.277	Stage 5	2360	Pitrun	Lift 1	Lot 980	102		YES
4/02/2022	KB22/0051	3	424	395783.396	812103.279	Stage 5	2360	Pitrun	Lift 2	Lot 980	100		YES
4/02/2022	KB22/0051	4	425	395770.481	812102.277	Stage 5	2360	Pitrun	Lift 2	Lot 980	102		YES
8/02/2022	KB22/0052	3	436	395783.396	812103.279	Stage 5	2360	Pitrun	Lift 3	Lot 980	95		YES
8/02/2022	KB22/0052	4	437	395770.481	812102.277	Stage 5	2360	Pitrun	Lift 3	Lot 980	97		YES
9/02/2022	KB22/0054	3	416	395783.396	812103.279	Stage 5	2360	Pitrun	Lift 4	Lot 980	101		YES
9/02/2022	KB22/0054	4	417	395770.481	812102.277	Stage 5	2360	Pitrun	Lift 4	Lot 980	102		YES
30/05/2022	0907_001 (0909/22)	3	559	395770.481	812102.277	Stage 5	1560	Sand	Lift 1	Lot 980	103		YES
30/05/2022	0907_001 (0909/22)	4	560	395784.8	812085.604	Stage 5	1560	Sand	Lift 1	Lot 980	101		YES
2/06/2022	1022_001 (0939/22)	3	567	395770.481	812102.277	Stage 5	1640	Sand	Lift 2	Lot 980	101		YES
2/06/2022	1022_001 (0939/22)	4	568	395784.8	812085.604	Stage 5	1640	Sand	Lift 2	Lot 980	101		YES
14/06/2022	1204_001 (1001/22)	3	620	395770.481	812102.277	Stage 5	1640	Sand	Lift 3	Lot 980	104		YES
14/06/2022	1204_001 (1001/22)	4	621	395784.8	812085.604	Stage 5	1640	Sand	Lift 3	Lot 980	100		YES
17/06/2022	1541_001 (1033/22)	3	628	395770.481	812102.277	Stage 5	1640	Sand	Lift 4	Lot 980	102		YES
17/06/2022	1541_001 (1033/22)	4	629	395784.8	812085.604	Stage 5	1640	Sand	Lift 4	Lot 980	99		YES
3/02/2022	KB22/0047	1	388	395803.437	812104.504	Stage 5	2360	Pitrun	Lift 1	Lot 981	100		YES
3/02/2022	KB22/0047	2	389	395791.19	812103.613	Stage 5	2360	Pitrun	Lift 1	Lot 981	101		YES
4/02/2022	KB22/0051	1	422	395803.437	812104.504	Stage 5	2360	Pitrun	Lift 2	Lot 981	97		YES
4/02/2022	KB22/0051	2	423	395791.19	812103.613	Stage 5	2360	Pitrun	Lift 2	Lot 981	101		YES
8/02/2022	KB22/0052	1	434	395803.437	812104.504	Stage 5	2360	Pitrun	Lift 3	Lot 981	102		YES
8/02/2022	KB22/0052	2	435	395791.19	812103.613	Stage 5	2360	Pitrun	Lift 3	Lot 981	99		YES
9/02/2022	KB22/0054	1	414	395803.437	812104.504	Stage 5	2360	Pitrun	Lift 4	Lot 981	98		YES
9/02/2022	KB22/0054	2	415	395791.19	812103.613	Stage 5	2360	Pitrun	Lift 4	Lot 981	102		YES
17/02/2022	1541_001 (1033/22)	5	630	395793.947	812086.823	Stage 5	1640	Sand	Lift 4	Lot 981	97		YES
17/02/2022	1541_001 (1033/22)	6	631	395803.437	812104.504	Stage 5	1640	Sand	Lift 4	Lot 981	99		YES
30/05/2022	0907_001 (0909/22)	5	561	395793.947	812086.823	Stage 5	1560	Sand	Lift 1	Lot 981	103		YES
30/05/2022	0907_001 (0909/22)	6	562	395803.437	812104.504	Stage 5	1560	Sand	Lift 1	Lot 981	96		YES

Project Prestons South Subdivision
Project No. 235361
Date 29-July-22

Title Summary of Compaction

Date	Test ID#	Test #	Unique ID#	mE	mN	Stage	MDD	Type	Lift #	Lot ID	Compaction (%)	Retest	Pass (Yes/No)
2/06/2022	1022_001 (0939/22)	5	569	395793.947	812086.823	Stage 5	1640	Sand	Lift 2	Lot 981	98		YES
2/06/2022	1022_001 (0939/22)	6	570	395803.437	812104.504	Stage 5	1640	Sand	Lift 2	Lot 981	100		YES
14/06/2022	1204_001 (1001/22)	5	622	395793.947	812086.823	Stage 5	1640	Sand	Lift 3	Lot 981	97		YES
14/06/2022	1204_001 (1001/22)	6	623	395803.437	812104.504	Stage 5	1640	Sand	Lift 3	Lot 981	97		YES

Appendix D
Post Earthworks CPT Testing

CONE PENETRATION TEST (CPT) REPORT

Client: Aurecon NZ Ltd

Location: Prestons Park, Christchurch

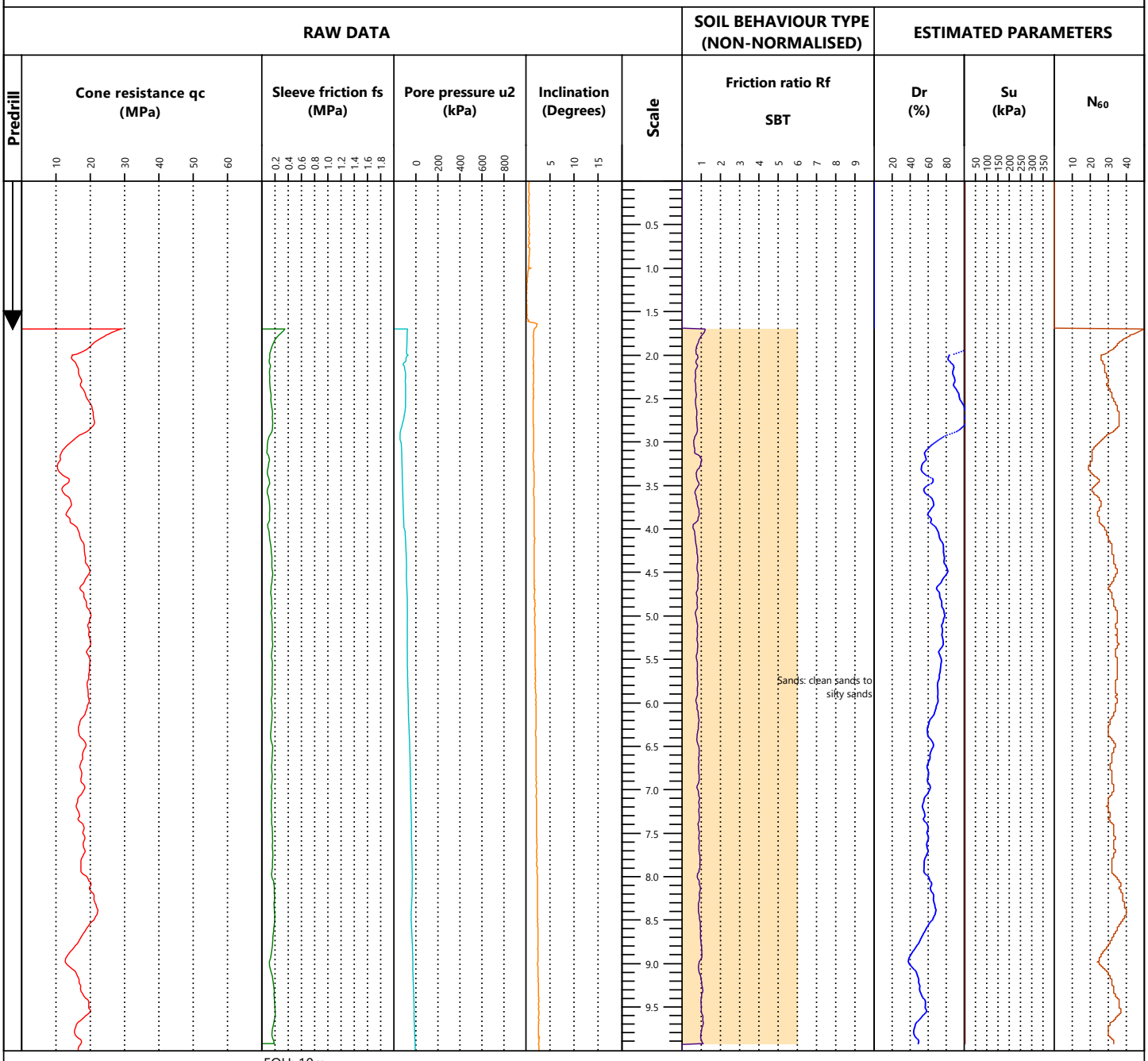
Printed: 09/05/2022

McMILLAN Drilling	Client: Aurecon NZ Ltd	Bore No.: CPTu301
	Project: Prestons Park, Christchurch	Job No.: 20882

Site Location: Prestons Park, Christchurch **Date:** 6/5/2022

Grid Reference: 1573724.73m E, 5185683.38m N (NZTM) - Map or aerial photograph **Rig Operator:** B. Wilson

Elevation: 0.00m **Datum:** Ground **Equipment:** Geomil Panther 100



Cone Type: I-CFXYP20-10 - Compression
Cone Reference: 100992
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: 1.70m
Water Level: -
Collapse: 2.2m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	0.9252	0.8986
Local Friction	0.0266	0.0265
Pore Pressure	0.0146	0.0130

Termination

Target Depth ✓

Effective Refusal

Tip
Gauge
Inclinometer
Other

Soil Behaviour Type (SBT) - Robertson et al. 1986

0 Undefined
1 Sensitive fine-grained
2 Clay - organic soil
3 Clays: clay to silty clay
4 Silt mixtures: clayey silt & silty clay
5 Sand mixtures: silty sand to sandy silt
6 Sands: clean sands to silty sands
7 Dense sand to gravelly sand
8 Stiff sand to clayey sand
9 Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal, Guide to Cone Penetration Testing for Geotechnical Engineering. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

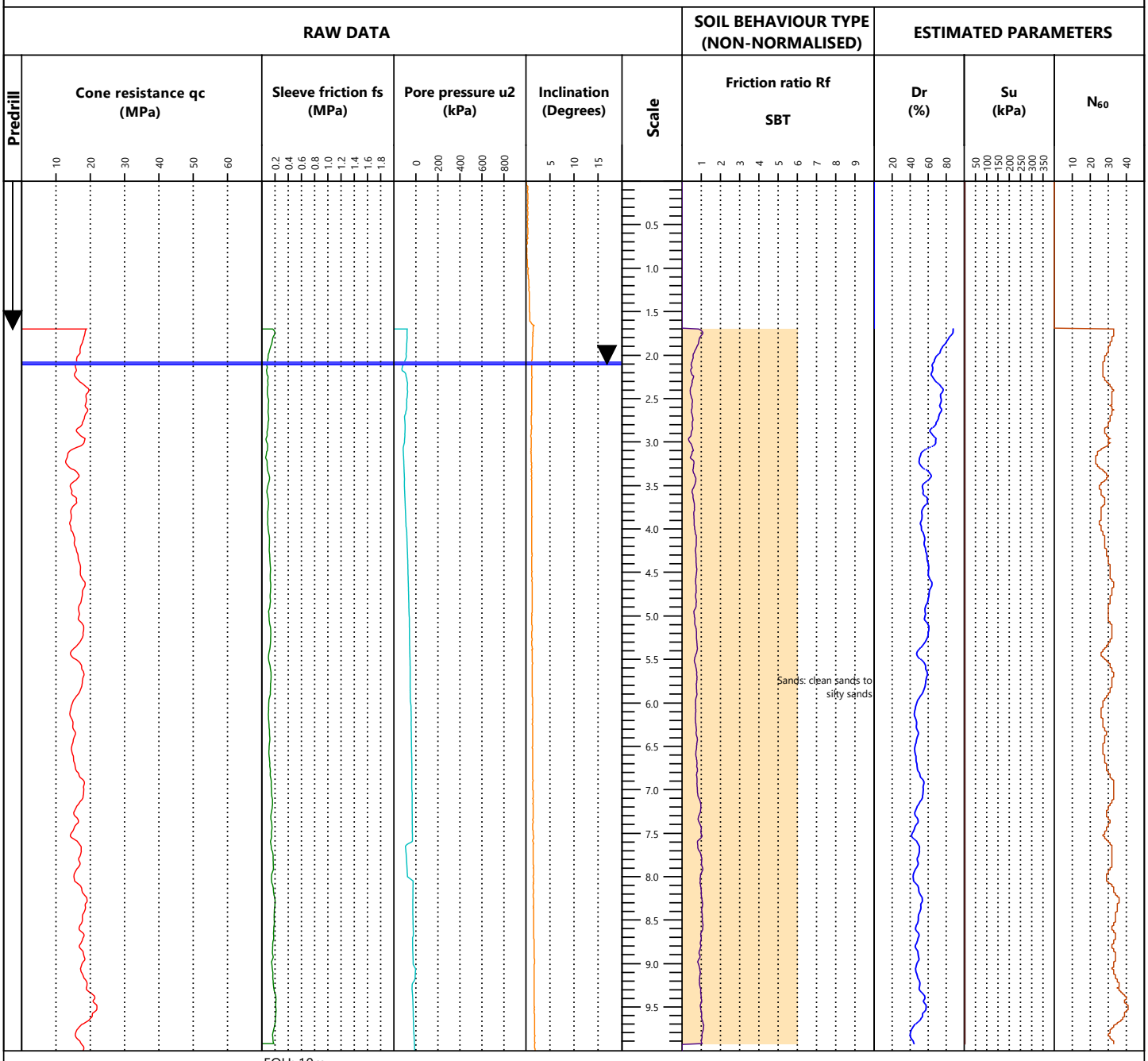
Remarks

McMILLAN Drilling	Client: Aurecon NZ Ltd	Bore No.: CPTu302
	Project: Prestons Park, Christchurch	Job No.: 20882

Site Location: Prestons Park, Christchurch **Date:** 6/5/2022

Grid Reference: 1573767m E, 5185686.4m N (NZTM) - Map or aerial photograph **Rig Operator:** B. Wilson

Elevation: 0.00m **Datum:** Ground **Equipment:** Geomil Panther 100



Cone Type: I-CFXYP20-10 - Compression
Cone Reference: 100992
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: 1.70m
Water Level: 2.10m
Collapse: 2.2m

Termination

Target Depth ✓

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Zero load outputs (MPa)	Before test	After test
Tip Resistance	0.9258	0.9206
Local Friction	0.0286	0.0272
Pore Pressure	0.0180	0.0157

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal, Guide to Cone Penetration Testing for Geotechnical Engineering. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

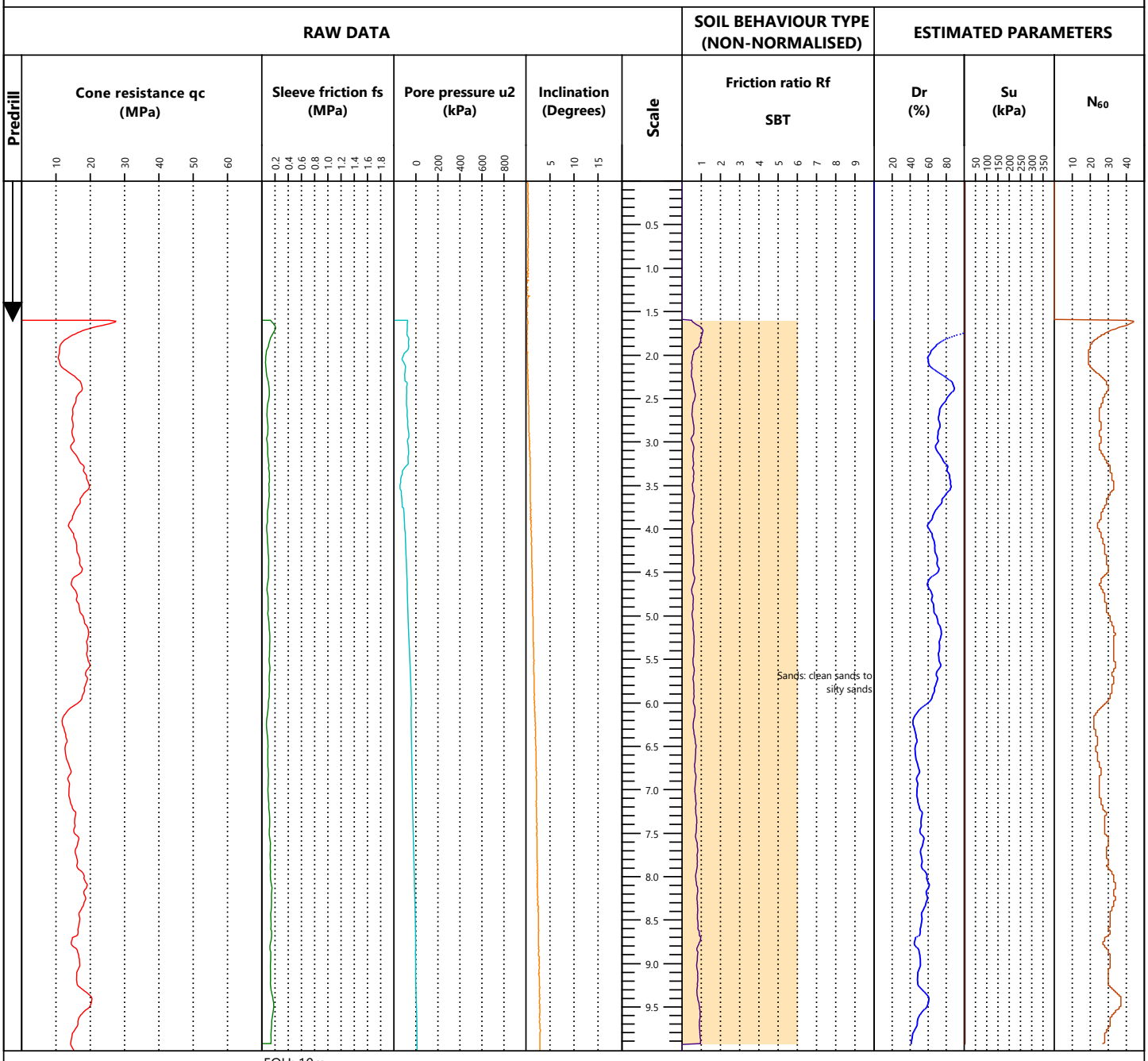
Remarks

McMILLAN Drilling	Client: Aurecon NZ Ltd	Bore No.: CPTu303
	Project: Prestons Park, Christchurch	Job No.: 20882

Site Location: Prestons Park, Christchurch **Date:** 6/5/2022

Grid Reference: 1573806.15m E, 5185696.46m N (NZTM) - Map or aerial photograph **Rig Operator:** B. Wilson

Elevation: 0.00m **Datum:** Ground **Equipment:** Geomil Panther 100



Cone Type: I-CFXYP20-10 - Compression
Cone Reference: 111007
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: 1.60m
Water Level: -
Collapse: 2.05m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	0.1578	0.1308
Local Friction	0.0047	0.0049
Pore Pressure	-0.0074	-0.0116

Termination

Target Depth ✓

Effective Refusal

Tip
Gauge
Inclinometer
Other

Soil Behaviour Type (SBT) - Robertson et al. 1986

0 Undefined
1 Sensitive fine-grained
2 Clay - organic soil
3 Clays: clay to silty clay
4 Silt mixtures: clayey silt & silty clay
5 Sand mixtures: silty sand to sandy silt
6 Sands: clean sands to silty sands
7 Dense sand to gravelly sand
8 Stiff sand to clayey sand
9 Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal, Guide to Cone Penetration Testing for Geotechnical Engineering. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

TEST DETAIL

PointID: CPTu301
Sounding: 1

Operator: B. Wilson
Cone Type: I-CFXYP20-10 - Compression
Cone Reference: 100992
Cone Area Ratio: 0.75

Date: 6/5/2022
Predrill: 1.70m
Water Level: -
Collapse: 2.2m

Termination

Target Depth ☑

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Zero load outputs (MPa)	Before test	After test
Tip Resistance	0.9252	0.8986
Local Friction	0.0266	0.0265
Pore Pressure	0.0146	0.0130

PointID: CPTu302
Sounding: 2

Operator: B. Wilson
Cone Type: I-CFXYP20-10 - Compression
Cone Reference: 100992
Cone Area Ratio: 0.75

Date: 6/5/2022
Predrill: 1.70m
Water Level: 2.10m
Collapse: 2.2m

Termination

Target Depth ☑

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Zero load outputs (MPa)	Before test	After test
Tip Resistance	0.9258	0.9206
Local Friction	0.0286	0.0272
Pore Pressure	0.0180	0.0157

PointID: CPTu303
Sounding: 3

Operator: B. Wilson
Cone Type: I-CFXYP20-10 - Compression
Cone Reference: 111007
Cone Area Ratio: 0.75

Date: 6/5/2022
Predrill: 1.60m
Water Level: -
Collapse: 2.05m

Termination

Target Depth ☑

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other ☐

Zero load outputs (MPa)	Before test	After test
Tip Resistance	0.1578	0.1308
Local Friction	0.0047	0.0049
Pore Pressure	-0.0074	-0.0116

CPT CALIBRATION AND TECHNICAL NOTES

These notes describe the technical specifications and associated calibration references pertaining to the following cone types:

- I-CFXY-10 measuring cone resistance, sleeve friction and inclination (standard cone, 10cm²);
- I-CFXY-15 measuring cone resistance, sleeve friction and inclination (standard cone, 15cm²);
- I-CFXYP20-10 measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm²);
- I-CFXYP100-10 measuring cone resistance, sleeve friction, inclination and high range pore pressure (piezocone, 10cm²);
- I-C2xFXYP100-10 measuring cone resistance, high range sleeve friction, inclination and high range pore pressure (piezocone, 10cm²);
- I-C5F0p15XYP20-10 measuring sensitive cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm²).
- I-CFXYP20-15 measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 15cm²);

Dimensions

Dimensional specifications for all cone types are detailed below. All tolerances are routinely checked prior to testing and measurements taken are electronically recorded. All records are kept on file and available on request.

A.P. van den Berg Machinefabriek

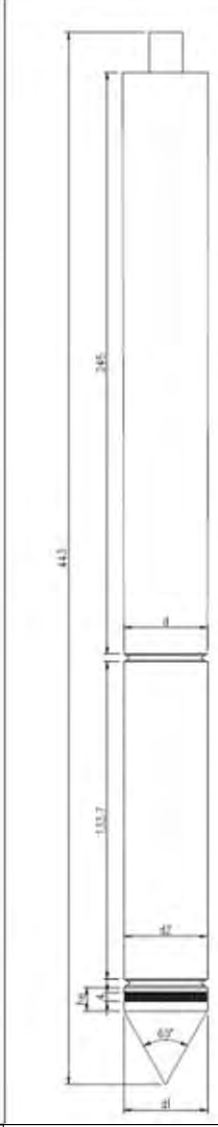
tel.: +31 (0)513-631355
info@apvandenberg.com

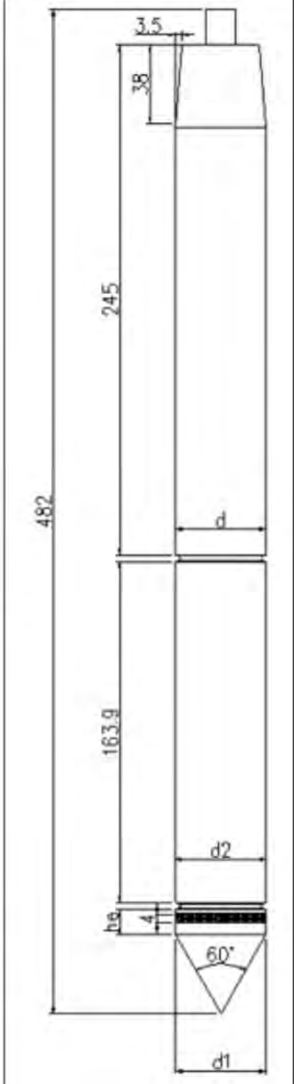
DEVIATION of Straightness + MINIMUM Dimensions tip, friction jacket, cone adapter

Standards:

EN ISO 22476-1
APB-standard

Type of cone:	Icone 10 cm²	Icone 15 cm²
ALLOWABLE SIZE VARIATION		
Diameter of tip:	35,3 ≤ d1 ≤ 36,0	43,2 ≤ d_1 ≤ 44,1
Diameter of centering ring CFP	35,3 ≤ d1 ≤ 36,0	43,2 ≤ d_1 ≤ 44,1
Diameter of friction jacket:	$d_1 \le d_2 < d_1 + 0{,}35$	$d_1 \le d_2 < d_1 + 0{,}43$
Height dimension of tip edge:	$7 \le h_e \le 10$	$9 \le h_e \le 12$
PRODUCTION DIMENSIONS		
Tip:	$d_1 = 35{,}7\ ^{+0,2}_{0}$	$d_1 = 43{,}8\ ^{+0,2}_{0}$
Jacket (C-cone):	$d_2 = 35{,}7\ ^{+0,2}_{0}$	$d_2 = 43{,}7\ ^{+0,2}_{0}$
Friction jacket (CF-cone):	$d_2 = 35{,}9\ ^{+0,1}_{0}$	$d_2 = 44{,}0\ ^{+0,1}_{0}$
Tip for used cone:	$d_1 = 35{,}5\ ^{+0,1}_{0}$	$d_1 = 43{,}5\ ^{+0,1}_{0}$
MINIMUM DIMENSIONS		
Minimum diameter jacket (C-cone):	d_2 = 35,2 (APB standard)	d_2 = 43,0 (APB standard)
Minimum diameter friction jacket (CF-cone):	d_2 = 35,3	d_2 = 43,2
Use "used cone"-tip when friction jacket diameter:	$d_2 \le 35{,}65$	$d_2 \le 43{,}7$
Minimum diameter of cone adaptor:	d = 35,3	d = 43,8
Maximum deviation of straightness:	1 mm on a length of 1000 mm (max. oscillation 1,0 mm.)	1 mm on a length of 1000 mm (max. oscillation: 2.0 mm)

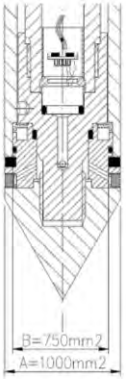




Tip and Local Friction sensor displacement

The different distances of the sensors are compensated depending on the cone types:

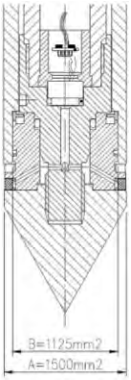
- 10cm² cones: 80mm
- 15cm² cones: 100mm



Cone area ratio

α = B / A = 0.75

β = 1 - B / A = 0.25



McMILLAN Drilling

CPT CALIBRATION AND TECHNICAL NOTES

Calibration

Each cone has a unique identification number that is electronically recorded and reported for each CPT test. The identification number enables the operator to compare 'zero-load offsets' to manufacturer calibrated zero-load offsets.

The recommended maximum zero-load offset for each sensor is determined as ± 5% of the nominal measuring range.

In addition to maximum zero-load offsets, the difference in zero load offset before and after the test is limited as ± 2% of the maximum measuring range. See table below:

	Tip (MPa)		Friction (MPa)			Pore Pressure (MPa)	
Maximum Measuring Range:	150	15 *	1.50	0.3 *	3 **	3	15 ***
Nominal Measuring Range:	75	7.5 *	1.00	0.15 *	1 **	2	10 ***
Max. 'zero-load offset':	7.5	0.75 *	0.10	0.015 *	0.1 **	0.2	1 ***
Max 'before and after test':	3	0.3 *	0.03	0.006 *	0.06 **	0.06	0.3 ***

***** I-C5F0p15XYP20-10 ("sensitive")
** I-C2xFXYP100-10 (high range friction and pore water pressure sensors)
******* I-CFXYP100-10 (high range pore water pressure sensor)

Note: The zero offsets are electronically recorded and reported for each test in the same units as that of each sensor.

Calibration Certificate

CALIBRATION RvA K 176

a.p. van den berg

1.1 General

Probe number:	100992
Probe type:	I-CFXYP20-10
Description:	Tip 75 MPa Sleeve 1.00 MPa Inclinometer 20° Pore 2MPa
Part number:	0100277B
Certificate number:	100992-2
Manufacturer:	A.P. van den Berg, Heerenveen (NL)
Calibration lab.:	A.P. van den Berg Ingenieursburo, IJzerweg 4, 8445 PK, Heerenveen (NL) RvA accredited laboratory according to ISO/IEC 17025:2017
Location of calibration:	Heerenveen (NL)
Client:	McMillan Drilling Ltd 120 High Street SOUTHBRIDGE, CANTERBURY New Zealand

1.2 Calibration equipment

Reference measuring equipment:

DAQ MX238B 0177FD	March 2021 (HBM: 92591)
DAQ MX440B 0182F3	March 2021 (HBM: 92778)
Loadcell 100kN H54435	August 2020 (HBM: 86959 2020-07)
Loadcell 20kN D16200	July 2020 (HBM: 86871 2020-07)
Sensor 20 Bar 240310140	Sept 2020 (ZMK: 02-1194 2020-09)
ACS-080-SC00-HE2-PM 12/17 2321909	April 2021 (Trescal: 2103-24007)
Temperature logger: 620-2326 SN:170800101	March 2021 (AVANTOR 219001540)

1.3 Laboratory conditions:

Ambient temperature: 23.8 ± 2 °C

1.4 Measurement uncertainty

The expanded combined uncertainty (k=2) of the sensor at laboratory conditions was analysed according to ISO/IEC Guide 98-3:2008 and is based on the standard uncertainty of the measurement multiplied by a coverage factor k, such that the coverage probability corresponds to approximately 95%. The results of the measurement uncertainty analysis of the different parameters are as listed below:

Cone resistance	5,6 + 0,165%	(kPa)
Sleeve friction	0,17 + 0,105%	(kPa)
Pore Pressure 2 MPa sensor	4,16 + 0,037%	(kPa)
Inclination	0,42	(degrees)

1.5 Standard and method of calibration

EN ISO 22476-1 2012 Class 2

1.6 Results

The probe complies with the requirements of the above-mentioned standard and indicated calibration class. The calibrated sensors compiy if the measured deviations over the nominal measuring range are within the accuracy limits of the standard (decision rule). The deviations and standard limits are shown in graphs in the Calibration Report.

Calibrated by:	D.Bisschops
Calibration Date:	23 November 2021
Signature:	
QA Manager:	N.R.E. de Jong
Date:	23 November 2021
Signature:	
Expiration date according to EN ISO 22476-1:	24 May 2022

1.7 Remarks

The calibration results only relate to the probe identified in this certificate. This new calibration certificate replaces all previously issued certificates for this probe. The calibration certificate documents the traceability to national and international standards, which realize the units of measurement according to the International System of Units (SI). This calibration certificate may not be reproduced other than in full and except with permission of the issuing laboratory. Calibration certificates without signature are not valid.

McMILLAN Drilling

Calibration Certificate

CALIBRATION RvA K 176

a.p. van den berg

1.1 General

Probe number:	111007
Probe type:	I-CFXYP20-10
Description:	Tip 75 MPa Sleeve 1.00 MPa Inclinometer 20° Pore 2MPa
Part number:	0100277B
Certificate number:	111007-5
Manufacturer:	A.P. van den Berg, Heerenveen (NL)
Calibration lab.:	A.P. van den Berg Ingenieursburo, IJzerweg 4, 8445 PK, Heerenveen (NL) RvA accredited laboratory according to ISO/IEC 17025:2017
Location of calibration:	Heerenveen (NL)
Client:	McMillan Drilling Ltd 120 High Street SOUTHBRIDGE, CANTERBURY New Zealand

1.2 Calibration equipment

Reference measuring equipment:

DAQ MX238B 00E80F	Aug 2021 (HBM: 96998 2021-08)
DAQ MX440B 00FCAB	Aug 2021 (HBM: 97005 2021-08)
Loadcell 100kN 201330120	August 2021 (HBM: 96532 2021-08)
Loadcell 20kN 210230193	Aug 2021 (HBM: 96418 2021-08)
Sensor 20 Bar 240310135	Sept 2020 (ZKM: 02-1193 2020-09)
ACS-080-SC00-HP2-PM 02/18 2610439	April 2021 (Trescal: 2103-24005)
Temperature logger: 620-2326 SN: 170800285	June 2021 (AVANTOR: 219003177)

1.3 Laboratory conditions:

Ambient temperature: 22.5 ± 2 °C

1.4 Measurement uncertainty

The expanded combined uncertainty (k=2) of the sensor at laboratory conditions was analysed according to ISO/IEC Guide 98-3:2008 and is based on the standard uncertainty of the measurement multiplied by a coverage factor k, such that the coverage probability corresponds to approximately 95%. The results of the measurement uncertainty analysis of the different parameters are as listed below:

Cone resistance	5,6 + 0,165%	(kPa)
Sleeve friction	0,17 + 0,105%	(kPa)
Pore Pressure 2 MPa sensor	4,16 + 0,037%	(kPa)
Inclination	0,42	(degrees)

1.5 Standard and method of calibration

EN ISO 22476-1 2012 Class 2

1.6 Results

The probe complies with the requirements of the above-mentioned standard and indicated calibration class. The calibrated sensors comply if the measured deviations over the nominal measuring range are within the accuracy limits of the standard (decision rule). The deviations and standard limits are shown in graphs in the Calibration Report.

Calibrated by:	D. Bisschops
Calibration Date:	22 February 2022
Signature:	
QA Manager:	N.R.E. de Jong
Date:	22 February 2022
Signature:	
Expiration date according to EN ISO 22476-1:	23 August 2022

1.7 Remarks

The calibration results only relate to the probe identified in this certificate. This new calibration certificate replaces all previously issued certificates for this probe. The calibration certificate documents the traceability to national and international standards, which realize the units of measurement according to the International System of Units (SI). This calibration certificate may not be reproduced other than in full and except with permission of the issuing laboratory. Calibration certificates without signature are not valid.

McMILLAN Drilling

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Bringing ideas to life

Aurecon offices are located in:
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