29 August 2018 Our Ref: 419748

Ngāi Tahu Property Limited
PO Box 13-0060
Christchurch
New Zealand

Attention: Dean Christie

Geotechnical and Foundation Report: Lot 9, Manakura Neighbourhood, Karamū Subdivision, Riccarton, Christchurch

1 Introduction

This report provides the geotechnical appraisal and foundation recommendations for Lot 9 (DP 518068), Manakura Neighbourhood, Karamū Subdivision, Riccarton, Christchurch.

We anticipate the building will comprise a residential dwelling that is designed and constructed within the scope of NZS 3604:2011. Buildings outside the scope of NZS 3604:2011 require specific engineering design.

This report is intended to be used as technical supporting documentation for foundation design and Building Consent application purposes.

2 Ground Model

Our knowledge of the ground model is based on information from a number of sources, including:

Subdivision investigation[1] including shallow and deep testing. The subdivision report concluded *"Based on our liquefaction assessment, we consider the site to behave similarly to MBIE Technical Category 1 (TC1)"*. The surface geology is Springston Formation alluvium, comprising mixtures of silt, sand and gravel. Groundwater is at approximately 10m depth.

Subdivision earthworks engineering undertaken with Eliot Sinclair as designer and Engineer to Contract, and works constructed by Blakely Construction Limited. All controlled fill placed across the subdivision area was supervised by an Engineer from Eliot Sinclair & Partners, and has been certified to NZS4431 as reported in the Inspecting Engineer's Report[2]. The existing topsoil layer and any unsuitable material was removed down to clean insitu alluvium, followed by placement of controlled fill and finished with topsoil.

Site specific testing - see details below.

[1] Aurecon (2016): *"Champions Mile – Geotechnical Investigation Report – Ngai Tahu Property Limited"*, dated 23 September 2016; Revision: 1; Reference: 238331.
[2] Eliot Sinclair (2018) *"Inspecting Engineer's Report (NZS4431) – Karamu Subdivision Stage 1A, Riccarton, Christchurch – Prepared for Ngāi Tahu Property Ltd – 419748"* and dated 2 August 2018.

3 Site Specific Testing

Following the completion of the earthworks, we undertook site specific geotechnical testing across all residential lots within the subdivision. Testing within Lot 9 comprised 1 shallow spade hole and 3 hydraulic penetrometers[3].

Table 1 presents the inferred ground profile in Lot 9. The site investigation factual records and test location plans are attached.

Table 1: Inferred ground profile in Lot 9.

Depth (Below Ground Level)	**Soil Description**	**Information Source**
0m to 0.4-0.45m	Silty TOPSOIL FILL.	Spade hole following the earthworks.
0.4-0.45m to 0.45-0.9m	Controlled Fill: sandy SILT or silty SAND with minor to some gravel.	Observations made during the earthworks.
0.45-0.9m to ~1.6m	Insitu silts and sands.	Refusal depth from a nearby CPT.
~1.6m to >10m	Insitu sandy gravels.	Site wide subdivision testing.

4 Foundation Recommendations

The TC1 foundation design provisions of the MBIE residential guidelines[4] apply to the site – refer to MBIE Section 5, Figure 5.1.

Typically, below the topsoil layer the penetrometer test results generally indicate a geotechnical ultimate bearing capacity >300 kPa. Standard foundations for dwellings within the scope of NZS 3604:2011 are suitable. Refer to MBIE Section 5.2 *Overview of new foundations options*.

For a more resilient design the TC2 raft foundations Options 2 – 4 are suitable for the site.

Foundations for dwellings outside the scope of NZS 3604:2011 require specific engineering design.

General foundation design and construction advice is as follows:

1 Foundations should be excavated through the topsoil layer and bear onto competent subgrade material.

2 All turf and topsoil shall be removed to at least 100mm bgl, along with any deeper areas of soft or organic rich topsoil, from beneath the lightly loaded floor slab area. The depth of the topsoil strip shall be confirmed at the time of inspection (as described in Section 5 below) to confirm a satisfactory surface is achieved. The subgrade will then need to be proof-rolled or compacted to achieve a firm uniform surface. The area can then be backfilled by placing and compacting AP40 sandy gravels in maximum 200mm thick loose layers to achieve a minimum dry density of 2150kg/m^3 up to the underside of the floor slab.

3 Internal floor slab thickenings and any other pads that are supporting concentrations of weight from roof trusses or columns shall be supported on, or be replaced with, mass concrete filled pads of the same area that are excavated through the topsoil and bear onto competent subgrade material.

4 Reinforcing in floor slabs shall be a minimum of 2.27kg/m^2 welded reinforcing mesh sheets and the reinforcing is to be Ductility Class E in accordance with NZS 4671.

[3] Hydraulic penetrometer testing was undertaken by Canterbury Geotest Ltd.
[4] Ministry of Business, Innovation & Employment "*Guidance: Repairing and Rebuilding houses affected by the Canterbury earthquakes*".

5 Inspection Requirements

A suitably competent and experienced inspector should validate that the ground conditions exposed in the foundation excavations are consistent with the findings of this report and the foundation design assumptions. Loose material should be removed from excavations. Foundations should bear onto competent subgrade material.

The inspection can be undertaken by Council personnel or a consultant's engineering personnel.

Please contact us with **48 hours' notice** if you require Eliot Sinclair & Partners to undertake the inspection work. Following a satisfactory inspection, we will provide a *'Producer Statement - Construction Review'* to validate the exposed ground conditions.

6 Disclaimer

Comments made in this report are based on reporting by others, our earthworks reporting, our soil investigations, and the Ministry of Business Innovation & Employment Guidelines.

Whilst every care was taken during our investigation and interpretation of subsurface conditions, there may well be subsoil strata and features that were not detected. Additionally, on-going seismicity in the general area may lead to deterioration or additional ground movement that could not have been anticipated at time of writing of this report.

The exposure of such conditions, or occurrence of additional strong seismicity, or any future update of MBIE's guidelines or the NZBC, may require a review of our recommendations. Eliot Sinclair & Partners should be contacted to confirm the validity of this report should this occur.

This report has been prepared for the benefit of Ngāi Tahu Property Ltd (or purchasers of the site from Ngāi Tahu Property Ltd), and the Christchurch City Council. No liability is accepted by this company or any employee of this company with respect to the use of this report by any other party.

Yours sincerely
ELIOT SINCLAIR & PARTNERS LTD

Prepared By:

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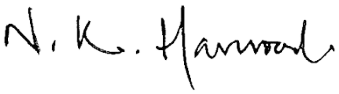
Reviewed & Approved for Release By:



Nick Harwood
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Principal
Senior Geotechnical Engineer

Encl.

- Site Investigation Records – 1 page
- Eliot Sinclair & Partners drawings: *"Geotechnical Test Locations and Controlled/Engineered Fill Thickness Contour Plan"*, Project No. 419748, Set No. G7, Sheet No. 2, Rev. A – 1 page.

Eliot Sinclair
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Job Number **419748**
Date Tested **11-Jun-2018**
Set Page No. **1 of 1**
Log Sheet No. **1 of 1**

SITE INVESTIGATION RECORD

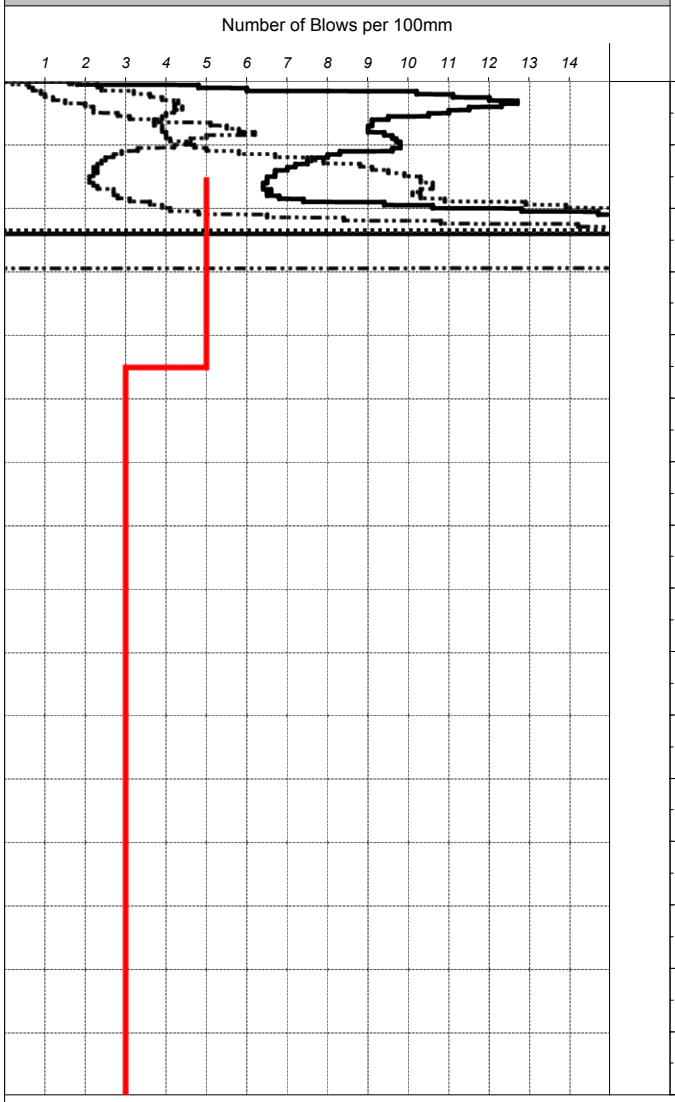
Lot **9**
D.P. **518068**

Client **Ngāi Tahu Property Ltd**

Site **Stage 1, Manakura Neighbourhood, Karamū Subdivision, Riccarton Park**

Technical Category **TC1 Equivalent**

SCALA PENETROMETER TEST RESULTS



Lot 9 P01 — Lot 9 P02 - - - Lot 9 P03 · · · · Lot 9 P03

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for "Good Ground" as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

SOIL PROFILE

Test Location - Lot 9, A

Water

Groundwater Not Encountered

FILL: silty TOPSOIL, with trace gravel; dark brown. Damp; gravel, fine to coarse, subround to round; trace rootlets.

FILL: silty gravelly SAND; greyish brown. Moist; gravel, fine to coarse, subround to round.

EOH: 0.5m - Target depth.
0.70m: Indicative controlled fill depth at P03.
0.80m: Indicative controlled fill depth at P01, P02 and A.

COMMENTS

Scala penetrometers undertaken by Canterbury Geotest Ltd using a Hydraulic penetrometer rig.

SITE PLAN (Not to Scale)

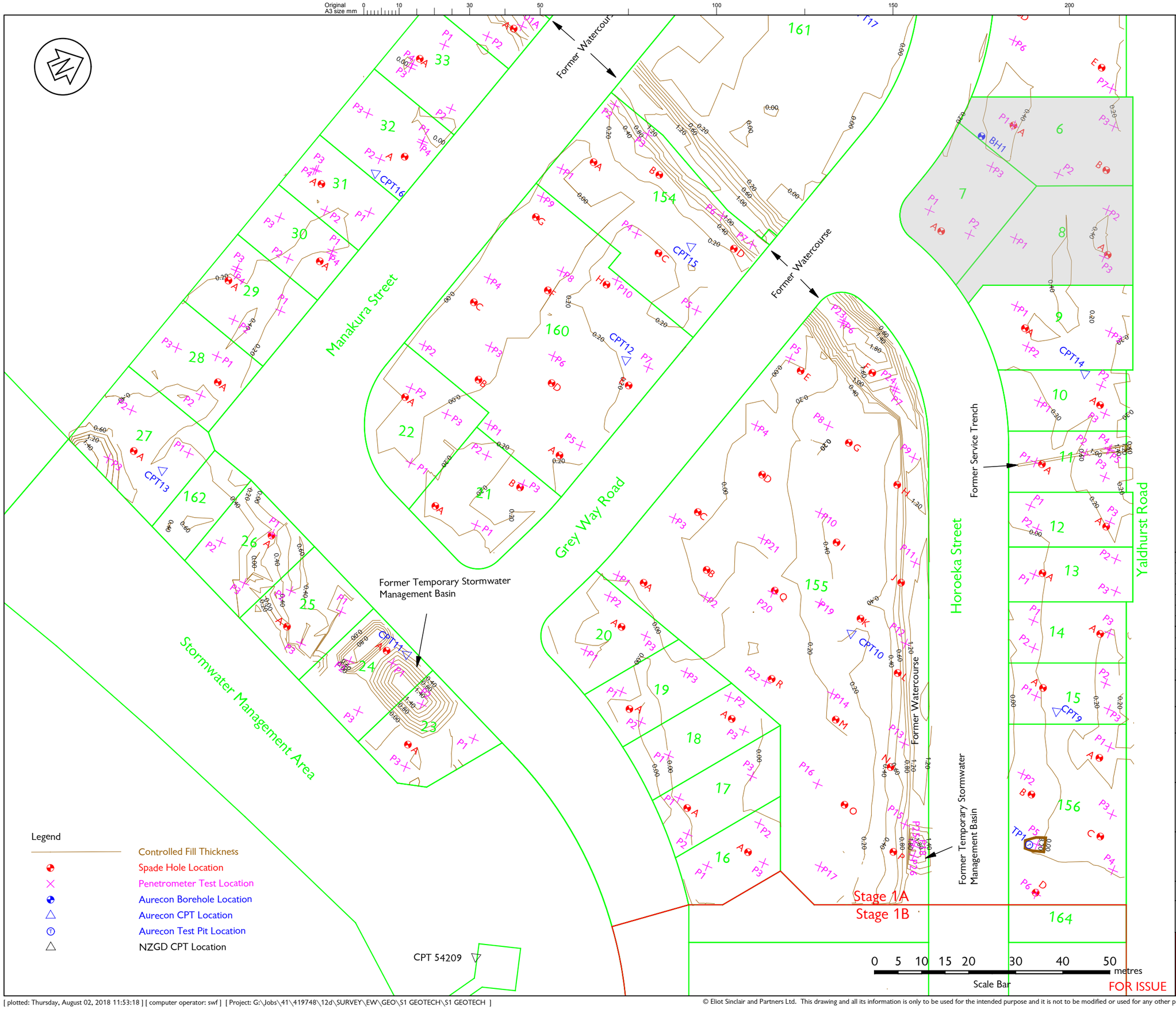
For test locations, refer to Eliot Sinclair & Partners drawing: "Geotechnical Test Locations and Controlled/Engineered Fill Thickness Contour Plan"; Project No. 419748; Set No. G7; Sht No. 1 or 2; Rev. A.

Field Staff:	*Prepared By:*	*Investigation Type*
PLN	QJF/JSF	☐ Hand Auger
Job Manager:	*Approved By:*	☑ Spade Hole
MAA	NKH	☐ Test Pit

Produced with CORE-GS

Printed: 29/08/2018 12:06:33 p.m.

Original A3 size mm 0 10 30 50 100 150 200 300



Notes:

1) The Aurecon test locations shown have been sourced from Aurecon New Zealand Limited - Champions Mile Geotechnical Investigation Report. Dated 23 September 2016. The coordinates of test locations have not been confirmed or verified by Eliot Sinclair.

2) Lots 6, and 8 have been amalgamated into one lot - Lot 6 under consent variation RMA/2017/2099/A

Rev.	Description	Drawn	Date
A	For Issue	SWF	23.07.2018

	Name	Date
Designed		
Drawn	S Forrest	02.08.2018
Drg. Chk	L Jagvik N Harwood	02.08.2018
Proj. Mgr	J Schutte	
Design Review		Date
Approved		Date

Surveyed: Various
Survey Date: 12/2017 - 07/2018
Coord System: NZGD2000 Mt Pleasant
Calibration: City CDD
Origin of Levels: EHCH Masonry Nail and Washer in Kerb 148 Yaldhurst Road R.L. 31.287
Datum: CDD

Client: NGĀI TAHU Property

Project Title: KARAMŪ - Riccarton Park
Stage 1A

Drawing Title: Geotechnical Test Locations and Controlled/ Engineered Fill Thickness Contour Plan

Scales: 1:750 [A3]

Project No.	Set No.	Sht No.	Rev.
419748	G7	2	A

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