

20 September 2019

Our Ref: 419750

Ngāi Tahu Property
PO Box 13-0060
Christchurch
New Zealand

Attention: Dean Christie

Geotechnical and Foundation Report: Lot 239 Miromiro Street, **Kākāpō** Neighbourhood - Karamū Subdivision, Riccarton, Christchurch

1 Introduction

This report provides the geotechnical appraisal and foundation recommendations for Lot 239 (LT 530544), Kākāpō Neighbourhood - Karamū Subdivision, Riccarton, Christchurch.

We anticipate the building will comprise a residential dwelling that is designed and constructed within the scope of NZS3604:2011. Buildings outside the scope of NZS3604:2011 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 investigation¹ 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 Report². 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 – Ngāi Tahu Property Limited", dated 23 September 2016; Revision: 1; Reference: 238331.

2 Eliot Sinclair (2019) "Inspecting Engineer's Report (NZS 4431:1989) – Kākāpō - Stage 2, Karamū Subdivision, Riccarton, Christchurch – Prepared for Ngāi Tahu Property Ltd – 419750" and dated 29 August 2019.

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 239 comprised 1 hand auger, 1 spade hole and 2 hydraulic penetrometers³.

The typical ground profile at the site is topsoil overlying sand/silt soil with sandy gravel at depth. The sand/silt soil may be the natural insitu subgrade, or controlled fill, or a combination of these across the lot area.

Some lots in the subdivision have no fill, but simply have topsoil placed over insitu subgrade. Where controlled fill is present it was largely sourced from other areas of the site (cut from the subgrade) so the fill has very similar appearance to the insitu soil; essentially being the same material. Some lots may have granular fill.

For foundation engineering purposes it may be assumed that the insitu sand/silt and the sand/silt fill are a single soil unit, so the actual thickness of fill is not relevant. The geotechnical properties (notably penetrometer resistance and, hence, bearing capacity) are the important characteristic to determine, which comes from the investigation logs.

Please refer to the attached site-specific investigation factual records and the test location plans that also include information on the depth of controlled fill placed on the lot.

4 Foundation Recommendations

The TC1 foundation design provisions of the MBIE residential guidelines⁴ 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 MBIE TC2 foundation options 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 Beneath the lightly loaded floor slab area, all turf and topsoil shall be removed to at least 100mm bgl, along with any deeper areas of soft or organic rich topsoil. 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 gravel in maximum 200mm thick loose layers to achieve a minimum dry density of 2150kg/m³ 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.

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".

- 4 Reinforcing in floor slabs shall be a minimum of 2.27kg/m² welded reinforcing mesh sheets (1.14kg/m² in each direction) and the reinforcing is to be Ductility Class E in accordance with NZS 4671.

5 Inspection Requirements

A suitably competent and experienced inspector should validate that the ground conditions exposed in the 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 (or purchasers of the site from Ngāi Tahu Property), 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:



Jeffrey Fleming
NZDipEng (Civil)
Geotechnical Engineering Technician

Reviewed & Approved for Release By:



Nick Harwood
BE(Hons) MSc DIC IntPE(NZ) CMEngNZ CPEng (1007273)
Principal
Senior Geotechnical Engineer

Encl.

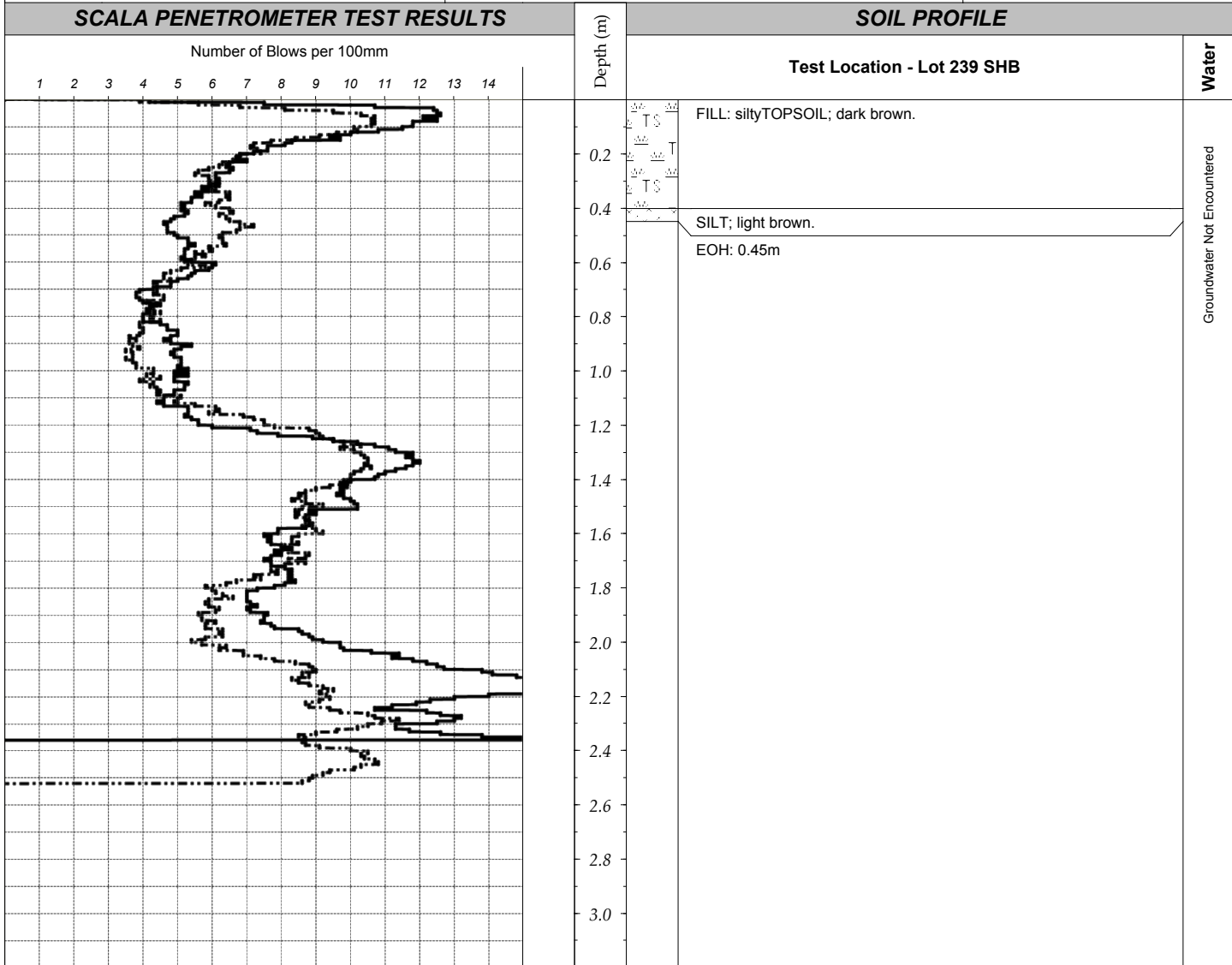
- Site Investigation Records – 2 pages.
- Eliot Sinclair & Partners drawings: "Karamū Stage 2 Kākāpō - Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil", Project No. 419750, Set No. G4, Sheet No. 1 & 2; Rev. A.

SITE INVESTIGATION RECORD

Client **Ngāi Tahu Property**

Site **Stage 2 (Kākāpō), Karamū Subdivision, Riccarton, Christchurch**

Technical Category
TC1 Equivalent



— Lot 239 P01 - - - Lot 239 P02

SITE PLAN (Not to Scale)

Eliot Sinclair & Partners drawings: "Karamu Stage 2 Kakapo - Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil", Project No. 419750, Set No. G4, Sheet No. 1 & 2; Rev. A.

COMMENTS
 Penetrometers undertaken by Canterbury Geotest Ltd using their Hydraulic penetrometer rig.

| | | |
|-------------------------------|----------------------------|---|
| Field Staff: PN/JSF | Prepared By: JSF | Investigation Type <input type="checkbox"/> Hand Auger <input checked="" type="checkbox"/> Spade Hole <input type="checkbox"/> Test Pit |
| Job Manager: MAA | Approved By: NKH | |

SITE INVESTIGATION RECORD

Client **Ngāi Tahu Property**

Site **Stage 2 (Kākāpō), Karamū Subdivision, Riccarton, Christchurch**

Technical Category
TC1 Equivalent

SCALA PENETROMETER TEST RESULTS

SOIL PROFILE

| Number of Blows per 100mm | | | | | | | | | | | | | | Depth (m) | Test Location - Lot 239 A | Water |
|---------------------------|---|---|---|---|---|---|---|---|----|----|----|----|----|-----------|---|-----------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | | | |
| | | | | | | | | | | | | | | 0.2 | Silty TOPSOIL; dark brown. Non-plastic; moist; trace rootlets present. | Groundwater Not Encountered |
| | | | | | | | | | | | | | | 0.4 | Sandy SILT; brown. Non-plastic; moist; trace rootlets present. | |
| | | | | | | | | | | | | | | 0.6 | 0.60m: Greyish brown. Trace iron staining present. | |
| | | | | | | | | | | | | | | 0.8 | 0.80m: No iron staining present. | |
| | | | | | | | | | | | | | | 1.2 | SILT; greyish brown. Non-plastic; moist; trace iron staining present. | |
| | | | | | | | | | | | | | | 1.6 | Fine to medium SAND; greyish brown. Moist; trace iron staining present. | |
| | | | | | | | | | | | | | | 1.8 | Sandy SILT; greyish brown. Moist; trace iron staining present. | |
| | | | | | | | | | | | | | | 2.0 | EOH: 2m - Target Depth Reached. | |
| | | | | | | | | | | | | | | 2.2 | | |
| | | | | | | | | | | | | | | 2.4 | | |
| | | | | | | | | | | | | | | 2.6 | | |
| | | | | | | | | | | | | | | 2.8 | | |
| | | | | | | | | | | | | | | 3.0 | | |

COMMENTS

Auger test Lot 238 A carried out prior to final topsoil reshaping.

SITE PLAN (Not to Scale)

Eliot Sinclair & Partners drawings: "Karamu Stage 2 Kakapo - Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil", Project No. 419750, Set No. G4, Sheet No. 1 & 2; Rev. A.

Field Staff:

LBW/JSF/SH

Prepared By:

LBW

Investigation Type

Hand Auger

Spade Hole

Test Pit

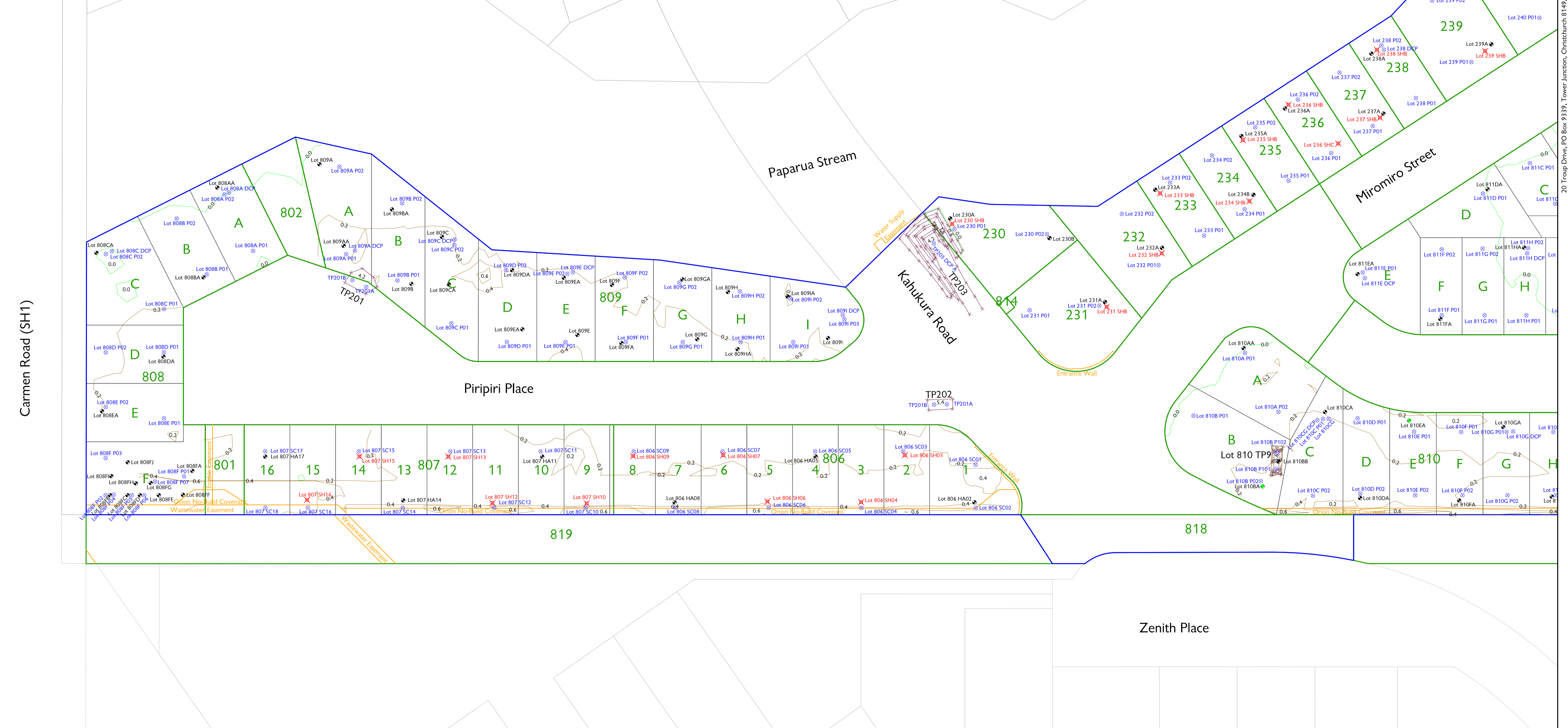
Job Manager:

MAA

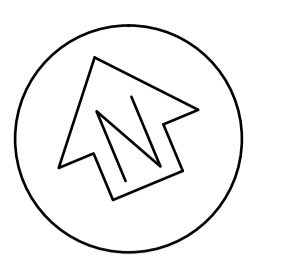
Approved By:

NKH

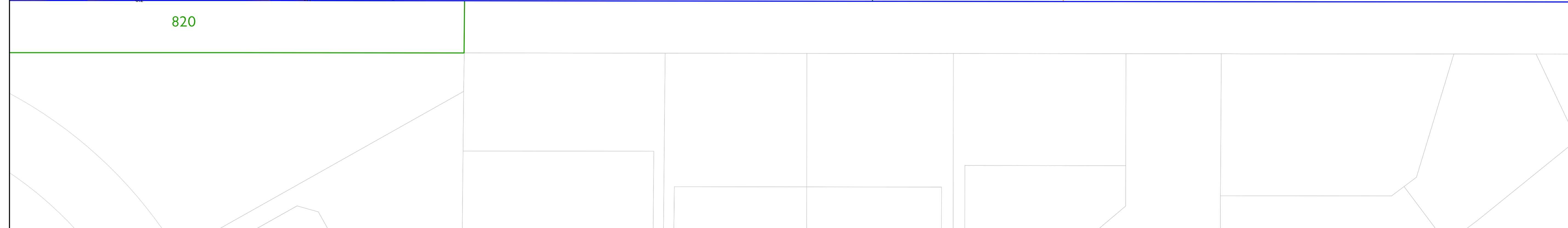
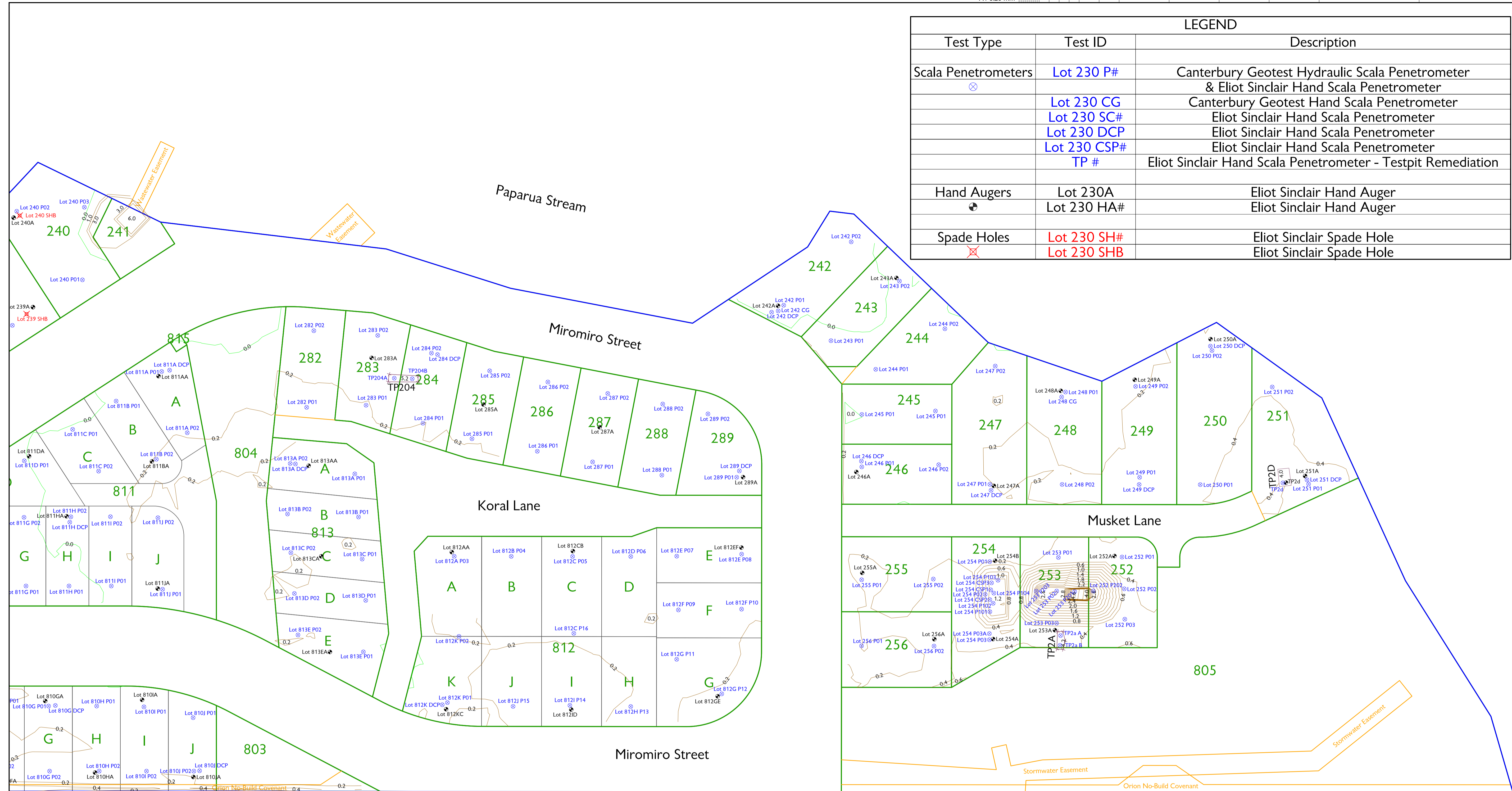
| LEGEND | | |
|---------------------|--------------|--|
| Test Type | Test ID | Description |
| Scala Penetrometers | Lot 230 P# | Canterbury Geotest Hydraulic Scala Penetrometer & Eliot Sinclair Hand Scala Penetrometer |
| | Lot 230 CG | Canterbury Geotest Hand Scala Penetrometer |
| | Lot 230 SC# | Eliot Sinclair Hand Scala Penetrometer |
| | Lot 230 DCP | Eliot Sinclair Hand Scala Penetrometer |
| | Lot 230 CSP# | Eliot Sinclair Hand Scala Penetrometer |
| | TP # | Eliot Sinclair Hand Scala Penetrometer - Testpit Remediation |
| Hand Augers | Lot 230A | Eliot Sinclair Hand Auger |
| | Lot 230 HA# | Eliot Sinclair Hand Auger |
| Spade Holes | Lot 230 SH# | Eliot Sinclair Spade Hole |
| | Lot 230 SHB | Eliot Sinclair Spade Hole |



| | | | | | | | | | | | | | | |
|--------|-------------|-----------|-----------------|---|---------------------------|-----------|-----------|--------|-----------------------|---|--------------------------------------|---------|------|--|
| Rev. A | Description | Drawn WFP | Date 26.08.2019 | Surveyed: R Paulsen | Survey Date: to July 2019 | Name | Date | Client | Project Title | Project No. | Set No. | Sht No. | Rev. | |
| | | | | Coord System: NZGD 2000 Mt Pleasant | | Designed | - | | Karamū Stage 2 Kākāpō | 419750 | G4 | 1 | A | |
| | | | | Calibration: CDD City 2014 | | Drawn | W Paulsen | | 26.08.2019 | Drawing Title | surveyors engineers planners | | | |
| | | | | Origin of Levels: EHCH | Datum: CDD 2014 | Dr. Chk | J Fleming | | 26.08.2019 | Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil | | | | |
| | | | | Masonry nail & washer in kerb 148 Yaldhurst Road R.L. 31.287m | | Proj. Mgr | M A Allan | | - | Scales | | | | |
| | | | | Design Review | | Approved | - | | - | | | | | |



| LEGEND | | |
|-------------------------|--------------|--|
| Test Type | Test ID | Description |
| Scala Penetrometers | Lot 230 P# | Canterbury Geotest Hydraulic Scala Penetrometer & Eliot Sinclair Hand Scala Penetrometer |
| | Lot 230 CG | Canterbury Geotest Hand Scala Penetrometer |
| | Lot 230 SC# | Eliot Sinclair Hand Scala Penetrometer |
| | Lot 230 DCP | Eliot Sinclair Hand Scala Penetrometer |
| | Lot 230 CSP# | Eliot Sinclair Hand Scala Penetrometer |
| | TP # | Eliot Sinclair Hand Scala Penetrometer - Testpit Remediation |
| Hand Augers | Lot 230A | Eliot Sinclair Hand Auger |
| | Lot 230 HA# | Eliot Sinclair Hand Auger |
| Spade Holes | Lot 230 SH# | Eliot Sinclair Spade Hole |
| | Lot 230 SHB | Eliot Sinclair Spade Hole |



| | | | | | | | | | | | | | | | |
|--------|-------------|-----------|-----------------|---|---------------------------|---------------------|------------|--------|--|---|-----------------------|---------|------|--|--|
| Rev. A | Description | Drawn WFP | Date 26.08.2019 | Surveyed: R Paulsen | Survey Date: to July 2019 | Name | Date | Client | Project Title | Project No. | Set No. | Sht No. | Rev. | | |
| | | | | Coord System: NZGD 2000 Mt Pleasant | | Designed - | - | | Karamū Stage 2 Kākāpō | 419750 | G4 | 2 | A | | |
| | | | | Calibration: CDD City 2014 | | Drawn W Paulsen | 26.08.2019 | | Drawing Title | Eliot Sinclair surveyors engineers planners | | | | | |
| | | | | Origin of Levels: EHCH | Datum: CDD 2014 | Dr. Chk J Fleming | 26.08.2019 | | Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil | | | | | | |
| | | | | Masonry nail & washer in kerb 148 Yaldhurst Road R.L. 31.287m | | Proj. Mgr M A Allan | - | | Scales | | 1:400 [A1] 1:800 [A3] | | | | |
| | | | | | | Design Review - | - | | | | | | | | |
| | | | | | | Approved - | - | | | | | | | | |