REPORT

Tonkin+Taylor

Geotechnical Engineering Assessment of Environmental Effects

Ryman Village, Park Terrace, Christchurch

Prepared for
Ryman Healthcare Limited
Prepared by
Tonkin & Taylor Ltd
Date
March 2020
Job Number
30315.v1

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Document Control

Title: Geotechnical Engineering Assessment of Environmental Effects					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
February 2020	1	Initial issue	Kirsti Murahidy		
March 2020	2	Issue	Kirsti Murahidy	Pierre Malan	
March 2020	3	Final	Kirsti Murahidy	Pierre Malan	Pierre Malan

Distribution:

Ryman Healthcare Limited	1 electronic copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

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1 Introduction

Ryman Healthcare Limited ("Ryman") engaged Tonkin & Taylor Ltd (T+T) to undertake a geotechnical investigation and assessment for a proposed comprehensive care retirement village ("Proposed Village") on two parcels of land at 100 - 104 Park Terrace, 24 Dorset Street and 19 Salisbury Street (Bishopspark site) and 78 - 80 Park Terrace (Peterborough site) in Central Christchurch (collectively "the Site").

This report addresses the potential seismic and liquefaction and subsistence/settlement and stability environmental effects from construction of the Proposed Village.

The geotechnical engineering, groundwater, contaminated land and civil engineering aspects of design are integrated. This report is intended to be read together with the Ground Contamination Report[1] and the Civil Earthworks Report[2].

In geotechnical terms, we consider the Site to be suitable for the Proposed Village provided the recommendations presented in this report are reflected in the detailed design.

1.1 Proposed Village

A full description of the Proposed Village is included in the Assessment of Environmental Effects. The Bishopspark site will contain the Village Centre, care rooms, assisted living suites, and apartments. The Peterborough site will contain apartment buildings. Basements, extending across the building footprints, are proposed for both the Bishopspark and Peterborough sites. The Proposed Village site layout is shown in Appendix A.

1.2 Site description

The Site is shown in Figure 1.1 below and is described in detail in the Assessment of Environmental Effects. In brief, the Bishopspark site covers an area of approximately 1.2 hectares and generally slopes gently to the west. The Peterborough site is typically flat and covers an area of approximately 5,078 m^2 (refer Figure 1.1). The Bishopspark site includes Lot 1 DP 46369, Lot 1, DP 46511 and Part Section 23 TN RES Christchurch and the Peterborough site includes Lot 1 DP 77997.

[1] Tonkin & Taylor Ltd (13/03/2020) Report prepared for Ryman Healthcare titled *Ground Contamination Assessment of Environmental Effects – 78 and 100 Park Terrace and 20 Dorset Street*, T+T Ref 30315.
[2] Beca Limited (March 2020) Report prepared for Ryman Healthcare titled *Proposed Comprehensive Care Retirement Village Park Terrace*, Beca Ref NZI-11471268-61 0.61.

Figure 1.1: Proposed Village Site showing approximate boundaries in red. (Source: Google Earth Pro).

The Bishopspark site is currently occupied by a number of disused single and two storey buildings which are being demolished. The majority of the buildings currently on the Bishopspark site were constructed in the 1980s as the former Bishopspark aged care facility. A small chapel, located in the southern part of the Bishopspark site, was constructed in the 1920s and is currently listed as a heritage building. A number of buildings on the Bishopspark site were damaged during the February 2011 earthquake event and subsequently demolished in 2015.

The Peterborough site is currently covered in gravel and used for parking vehicles. The Terrace on the Park Apartment building that formerly occupied the Peterborough site was removed following the February 2011 earthquake, however approximately 330 precast concrete piles remain in the ground. The approximate location of the former foundation of building and pile locations are shown on Figure 1.2.

The nearest waterway is the Avon River, located approximately 30 to 50 m west of the Site.

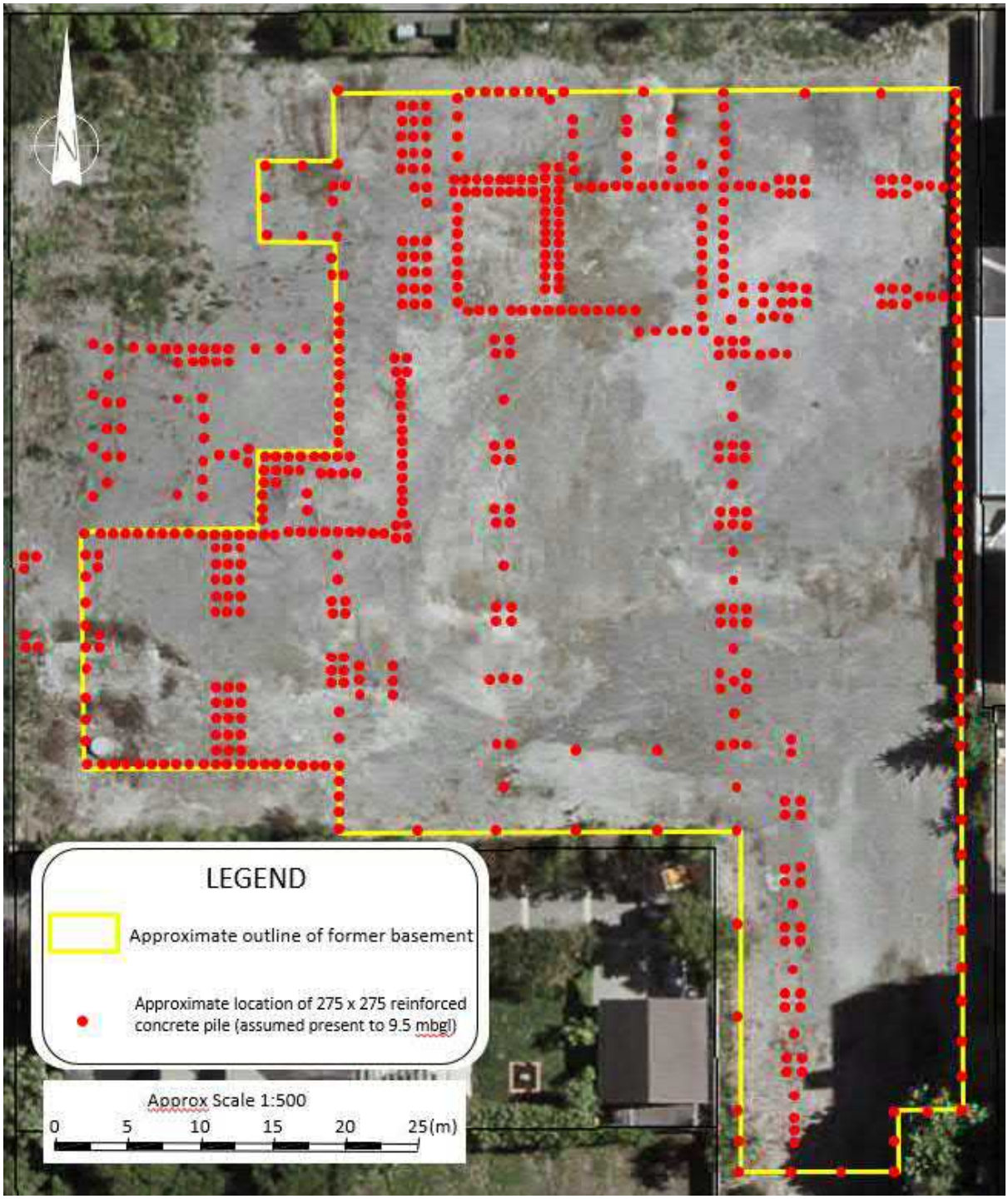


Figure 1.2: Approximate location of the precast concrete piles at the Peterborough site.

2 Existing Environment – Subsurface Conditions

2.1 Geological conditions

Published geological information for the Christchurch area[3,4] shows that the Site is underlain by alluvial sand and silt overbank deposits, underlain by greywacke gravels of the Springston Formation.

Geotechnical investigations were undertaken across the Bishopspark site in November 2018. The investigations comprised ten cone penetration tests (CPTs), two seismic cone penetration tests (SCPTs), six machine-drilled boreholes and four hand augered boreholes and seven Scala penetrometer tests. The locations of these investigations are shown on (refer Appendix A) drawing 30315-Bishopspark-01 in Appendix A and copies of the investigation results are included in Appendix B.

At the Peterborough site, geotechnical investigations were undertaken in December 2013[5]. The investigations comprised seven machine-drilled boreholes and 12 cone penetration tests. The locations of these investigations are shown on drawing 30315-Peterborough-01 in Appendix A and copies of the investigation results are included in Appendix B.

The natural geological conditions at the Site comprise fill and silty topsoil, interbedded sands, silts and peat deposits to approximately 20 m depth below the existing ground surface. These materials overlie a layer of organic silt, generally up to 1.5 m thick, beneath which are dense to very dense sandy gravel deposits (Riccarton Formation).

The generalised subsurface profile inferred from the geotechnical investigations is provided in Table 2.1 and Table 2.2 for the Bishopspark and Peterborough sites respectively and shown graphically on drawings 30315-Bishopspark-02 through 303015-Bishopspark-06 and drawings 30315-Peterborough-02 and 303015-Peterborough-03.

The nature and continuity of subsurface conditions away from investigation locations is inferred, and it must be appreciated that the actual conditions may vary from the assumed model.

Table 2.1: Generalised geotechnical profile beneath the Bishopspark site

Layer No.	Geological Unit	Typical lithology	Depth to top of layer (m)	Layer thickness (m)
0	Fill/Topsoil	Sandy GRAVEL with trace silt and cobbles. Silty TOPSOIL with trace rootlets	0.0	0.3 – 0.5
1	Yaldhurst Member of Springston Formation	Interbedded firm Sandy SILT and loose SAND/Silty SAND	0.5	2.7 – 3.5
2		Fibrous PEAT and PEAT within very soft SILT matrix	3.2 – 4.0	4.3 – 4.0
3		Loose Silty SAND/firm Sandy SILT	7.5 – 8.0	1.0 – 1.75
3a		Medium dense to dense sandy GRAVEL. Isolated 2.5 m thick area at location BH3; thins out towards the west (i.e. location of BH1).	8.5 – 9.75	0.7 – 1.2

[3] Brown L.J. & Weeber J.H (1992). Geology of the Christchurch Urban Area. Institute of Geological and Nuclear Sciences Limited, geological map 1.
[4] Brown L.J. et al. (1995). Geology of Christchurch, New Zealand. Environmental and Engineering Geoscience 1 p.427-488.
[5] These investigations, while 7 years old, provide relevant and reliable factual data for the site. We do not consider that the changes to investigation techniques in the intervening time would alter our assessment of the environmental effects at this site.

4	Christchurch Formation	Medium dense to dense SAND	8.5 – 10.95	10.5 – 11.75
5		Stiff SILT/Sandy SILT	20.25	1.5
6	Riccarton Gravels	Medium dense to very dense Sandy GRAVEL	21.75	>4.0 (confirmed)

Table 2.2: Generalised geotechnical profile beneath the Peterborough site

Layer No.	Geological Unit	Typical lithology	Depth to top of layer (m)	Layer thickness (m)
0	Fill/Topsoil	Sandy GRAVEL with trace silt, cobbles and building waste comprising concrete, plastic, electrical wiring etc.).	0.0	0.3 – 6.0
1	Yaldhurst Member of Springston Formation	Interbedded firm Sandy SILT and loose SAND/Silty SAND	0.3 – 0.5	0 – 3.0
2		Fibrous PEAT and PEAT within very soft SILT matrix	2.6 - 5.5	1 – 3.7
3		Loose Silty SAND/firm Sandy SILT	5.0 – 6.4	2.4 – 3.4
3a		Medium dense to dense sandy GRAVEL and gravelly SAND	8 - 9.4	2 – 9.3
3b[1]		Organic SILT / PEAT within SILT / SAND/ GRAVEL matrix	11.4 – 14.6	0 – 2.6
4	Christchurch Formation	Medium dense to dense SAND	10.9 – 17.3	2 – 8.4
5		Stiff SILT / Sandy SILT	18.9 – 20.0	0 – 1.6
5a		Organic SILT / fibrous PEAT within a firm SILT matrix	20 – 21.3	0.5 - 1.2
6	Riccarton Gravels	Medium dense to very dense Sandy GRAVEL	21 – 21.8	>0.3 to 0.8 (confirmed)

1 – Layer 3b is localised in nature and was encountered in BH04 and BH05 only.

2.2 Groundwater

Groundwater is encountered in the upper layers of silt and sand at depths of approximately 1.5 m below ground level (bgl) at both sites. This shallow groundwater forms a water table (unconfined aquifer) in the shallow geology ie within 10 m of the surface. Deeper groundwater (confined aquifer) exists in the Riccarton gravels at depths greater than 20 m bgl beneath a layer of stiff silt and sandy silt. The Riccarton aquifer has artesian water pressures, meaning the groundwater in this aquifer is pressurised, but is being confined by the overlying layers.

Groundwater flow in the shallow water table aquifer at the sites is assumed to be toward the Avon River. Groundwater movement through the shallow deposits (through flow) will be variable across the sites, with preferential flow through the shallow sand and deeper gravel. Provided that there is no leakage from the Riccarton aquifer, flows into the proposed excavations are expected to be from the shallow water table aquifer via the base of the excavation.

However, the installation of piles (or removal of existing piles) has the potential to create conduits for groundwater at depth to well up into the excavation, particularly if springs exist in these locations. These will be managed during construction and blocked if they occur.

A design depth to groundwater of 1.5 m bgl across the Site is adopted for our geotechnical analysis purposes, including the liquefaction analysis presented in Section 5 to account for variations across

the sites. As this level may temporarily rise under rainfall/storm events, the effects of temporarily elevated groundwater associated with floods or storms must be considered in longer-term static design (including structures).

3 Planning Context

The planning context for the Proposed Village is addressed in the Assessment of Environmental Effects. In a geotechnical context, we understand that the relevant effects to be considered are:

- Natural hazards that may affect the Proposed Village, specifically subsidence, earthquake shaking and liquefaction/lateral spreading;
- The potential for construction works to affect the groundwater regime at the Site and consequently adjacent land; and
- The potential for construction works to affect the stability and settlement of the Site and adjacent land.

In assessing the effects, we have considered the objectives and policies which are set out in the Assessment of Environmental Effects and summarised below:

- *Land and Water Regional Plan (LWRP) Objective 3.13, and Policies 4.13 and 4.15:* The discharge of construction-phase and operational stormwater to ground will be managed such that the groundwater quality in the Riccarton Aquifer and the surface water quality in the Avon River will not be adversely affected. This will include the use of a treatment system to filter any potential contaminants from hardstand areas;
- *LWRP Policy 4.17*: Stormwater run-off from the Proposed Village will not cause or exacerbate flooding to downstream properties;
- *LWRP Policy 4.19*: Earthworks will be managed to minimise sediment run-off from the site. In particular, the Erosion and Sediment Control Plan will detail the sediment and erosion controls for earthworks at the site in accordance with the relevant sections of the Canterbury Regional Council's Erosion and Sediment Control Toolbox for Canterbury. Tonkin & Taylor have also confirmed that the disturbance of contaminated materials on the site will not contaminate groundwater – Policy 4.19;
- *LWRP Policy 4.77*: The establishment of a bore will not result in the contamination of groundwater; and
- *District Plan Natural hazards Objective 5.2.1.1 and Policies 5.2.2.2.1 and 5.2.2.3.1:* Management of natural hazards relating to flooding and liquefaction risk.

4 Assessment Methodology

In order to assess the geotechnical effects of the Proposed Village, the following methodology was adopted.

A geological and geotechnical model for the Site was developed in stages. An initial model was prepared on a review of aerial photographs, geological maps, our internal geotechnical database, and previous investigations available for the Site. Based on this, and considering the proposed land use, a geotechnical investigation was then carried out. This included boreholes, cone penetrometer tests and groundwater monitoring work. The current subsurface model was then finalised and is summarised in Section 2 of this report.

Following the subsurface model development, the Proposed Village has been considered in the context of the subsurface conditions. In carrying out this work, we liaised with other experts (including Structural Engineers, Mitchell Vranjes) and Ryman to understand the likely foundation and

geotechnical requirements for the Proposed Village. The peat, silt, sand and gravel materials that underlie the Site are suitable for building foundations with appropriate design.

The effects of the Proposed Village have then been assessed based on our experience with similar foundation systems and construction, in the context of the subsurface model and proposed geometry and structural form. The performance of the land during the Canterbury Earthquake Sequence was considered in our geotechnical assessment.

The results of that assessment are set out below.

5 Assessment of Effects

5.1 General

The key geotechnical effects to be considered at both sites comprise liquefaction effects (including lateral spreading and settlement) and consolidation settlements (subsidence). These effects will be mitigated through the use of appropriate retention and foundation design.

The techniques proposed will be designed so that there will be no adverse effects from these activities.

5.2 Seismic and liquefaction assessment

The Site seismic subsoil class has been assessed in accordance with NZS 1170.5[6] to be Class D (deep or soft soil). This is due to the presence of loose/soft soil (with an equivalent SPT blowcount of less than 6) within the upper soil profile. This assessment is consistent with published geological information[7] that indicates the depth to bedrock is greater than 100 m beneath the Site.

The seismic performance of the Site (including liquefaction effects) has been evaluated in terms of the seismic shaking hazard assessed for the Site and the requirements of the New Zealand Building Code.

The design earthquake scenarios derived from "NZS 1170 – Structural Design Actions" representing the following design performance requirements have been considered for structures at the Site:

- Serviceability limit state 1 (SLS1) – the building should suffer little or no structural damage, and remain accessible and safe to occupy. There may be minor damage to building fabric that is readily repairable; and
- Ultimate limit state (ULS) – the building can suffer moderate to significant structural damage, but not collapse.

The design earthquake scenarios are described in terms of an event moment magnitude (M_w) and peak horizontal ground acceleration (PGA_H) and were derived assuming a building design life of 50 years and an Importance Level (IL) of IL2 and IL3, as set out in NZS 1170.

For liquefaction analysis, two SLS1 scenarios (SLS1a and SLS1b) are presented. The SLS1b scenario represents an alternative SLS1 scenario that is also considered when using the Boulanger and Idriss (2014)[8] liquefaction triggering analysis in the Christchurch area, in accordance with guidance

[6] Standards New Zealand (2004) – *NZS 1170.5:2004 – Structural Design Actions Part 5: Earthquake Actions – New Zealand.*
[7] Brown, L. J. and Weeber, J. H. (1992), *Geology of the Christchurch Urban Area.* Institute of Geological & Nuclear Sciences Limited Geological Map 1. Scale 1:25,000.
[8] Boulanger, R. W. and Idriss, I. M. (2014). *CPT and SPT Based Liquefaction Triggering Procedures.* Center for Geotechnical Modeling, Dept. of Civil and Environmental Engineering, University of California at Davis.

updates released recently by MBIE[9] (MBIE Guidance). The earthquake scenarios adopted for analysis are presented in Table 5.1 (below).

Table 5.1: Design earthquake scenarios

	Design earthquake scenario			
	SLS1a	**SLS1b**	**ULS IL2**	**ULS IL3**
Return period (years)	25	25	500	1,000
Moment magnitude (M_w)	7.5	6.0	7.5	7.5
Peak horizontal ground acceleration (PGA_H)	0.13 g	0.19 g	0.35 g	0.44 g

The results of the liquefaction triggering and settlement analyses show that:

- Minor to moderate land damage is assessed to occur in a SLS1 level event (settlement in the order of 140 to 200 mm). Differential settlement may also occur across individual buildings and this may be in the order of 100 mm over a 6 m distance (unless specifically mitigated in design); and
- Liquefaction-related settlement resulting from ULS level shaking is estimated to be in the order of 200 – 300 mm. The expected liquefaction-related land damage during such an event could be moderate to severe. Such settlement could occur following 200 to 300 year-equivalent, and greater, return period events. Differential settlements at the ground surface may be in the order of 150 mm over a 6 m distance.

Ground cracks mapped following the Canterbury Earthquake Sequence (CES) indicate that lateral ground movement of up to 50 mm occurred in the vicinity of the Site. The pattern of cracks indicates that this movement is related to spreading towards the Avon River. The liquefaction triggering analyses along with observations from the CES indicate lateral spreading may occur in the order of 10 to 25 mm and 50 to 100 mm in future SLS and ULS seismic events, respectively.

The potential effects of lateral spreading and liquefaction induced settlement can be adequately addressed through foundation design for buildings on the Site. The Proposed Village buildings will be founded on deep foundation systems comprising either CFA piles, or ground improvement (rigid inclusions or CFA columns) extending to the sandy gravel deposits at approximately 13 m depth.

5.3 Subsidence (settlement) and stability

The near surface soils (variable silt and peat deposits) to depths of approximately 8 m below the existing ground level at each Site are prone to both primary and secondary consolidation settlement under applied static loads.

Static consolidation settlements under typical four to seven storey buildings (40 by 80 m in plan dimension) loads on ground that has not been loaded before are assessed to be between 250 and 400 mm over a 50 year time period. Our analyses indicate that around half of this settlement is likely to occur within two years of construction. These settlements are expected to vary across the Site with different subsurface conditions, and possibly across the footprint of larger buildings.

Consolidation of the soft silts and peat deposits may also result in long term secondary “creep” settlements. This has the potential to affect in ground services (such as storm water services), pavement and landscaping features over the design life.

[9] Ministry of Business, Innovation & Employment (2014). Clarifications and updates to the guidance. *Repairing and rebuilding houses affected by the Canterbury earthquakes,* Issue 7, October 2014.

The anticipated settlements will be accommodated in design through engineered solutions such as the use of piling or ground improvement beneath the buildings.

The proposed earthworks will comprise excavation of Site materials (that will then be removed from Site) to allow for the construction of basements. Hard fill will be imported and placed as a bedding layer beneath the foundation basement slabs. The retention system is likely to comprise a modified steel sheet pile (clutch tube) system or other retention system with similar performance. The Proposed Village buildings will be setback from the property boundaries and the construction sequence will be designed to limit lateral and vertical movement at the property boundary.

The Proposed Village is therefore not assessed as being at risk of consequential subsidence or potential instability.

We therefore assess the risk of subsidence affecting adjacent sites due to the construction of the Proposed Village as negligible.

5.4 Groundwater

5.4.1 General

In the permanent case, the building will be waterproofed and will therefore not cause any consequential drawdown of groundwater.

During construction of the basements, excavation of soils up to 4.8 m depth is required with the top of the basement floor slab proposed at RL 13.1m. The natural groundwater levels are relatively shallow at a depth of approximately 1.5 m bgl at both sites. This means that excavation at the Bishopspark and Peterborough sites will encounter groundwater ingress below this level. In order to work in reasonably dry conditions, groundwater will need to be removed via dewatering (pumping) during the basement excavation and basement construction works.

Ingress of groundwater into deep excavations will be restricted by the placement of piles around the excavation which are also essential for stability of the excavation. The current proposed piling preference around the perimeter of the excavations is to install welded steel clutch tubes which will limit any horizontal groundwater seepages entering through the wall system. Clutch tubes provide a continuous barrier to groundwater ingress that will be welded above excavation level. Because of this retention system, groundwater flows at the Bishopspark and Peterborough sites will occur upwards through the base of the excavation, rather than laterally (through the retention system).

5.4.2 Groundwater users

There are a number of groundwater (bore) users in the local area. The depressurisation of the aquifer could therefore have an effect on the water levels in any shallow groundwater bores in the local area. Our dewatering assessment models the potential changes to groundwater levels based on the surrounding external influences. This means that different results can be presented on each side of the Bishopspark and Peterborough sites. Each of the bores nearby is addressed below.

A review of the local bores in the area shows that the closest bore with an active take is shown to be bore M35/2325 located at 447A Montreal Street approximately 230 northeast of (the centre of) Bishopspark site. This bore is owned by Christchurch City Council (CCC) and is reported to be 31.7 m deep with a groundwater take for community supply (likely to be from the Riccarton aquifer). This bore is considerably deeper than the proposed depth for dewatering and we therefore assess that, based on the setback and depth of Bore M35/2325, the proposed excavation will not have consequential effects.

The nearest, most shallow depth bore, reported to have an active take is bore M35/18558, located at Hagley Park approximately 530 m southwest of (the centre of) Park Terrace site. This bore is

reported to be 23 m deep and has a groundwater take for domestic supply. The use of this water is questionable since there are no domestic properties in the area and the bore is located beside a recreational boating pond. A secondary use of groundwater monitoring is noted for this bore. Two other bores located around the periphery of the pond and drilled at the same time as bore M35/18558 also have a secondary use of groundwater monitoring. We assess that, based on the setback of Bore M35/18558, the proposed excavation will not have consequential effects on that bore.

5.4.3 Stream depletion

The Avon River is located at around the same elevation as the proposed basement excavation. Based on our modelling, as the duration of dewatering continues, the proportion of groundwater inflows that comprise water loss from the Avon River increases. However, any dewatering that occurs will discharge directly into the stormwater network, after treatment to address any elevated total suspended solids (TSS). The stormwater network discharges directly into the Avon River. Hence, while the Avon River is potentially affected by the dewatering through loss of flow, any stream depletion effects are mitigated by the effects of the direct discharge (returning the treated discharge to the Avon via the stormwater network).

5.4.4 Drawdown settlement

The thickness of peat around the Site means that this layer could be subject to the effects of consolidation if it is dewatered. The proposed perimeter wall around the excavations limits any horizontal groundwater flow, which then restricts the amount of dewatering in the adjacent in-situ strata. The underlying sand layer (through which water flows into the excavation) has strong recharge from the surrounding area. Combined with the retention system, the potential to cause consolidation (settlement) adjacent to the Bishopspark and Peterborough sites through dewatering is minimal, and we do not assess any consequential settlement risks.

5.4.5 Conclusion

On this basis, we consider that there is no credible risk of the Proposed Village causing consequential adverse effects on the groundwater, either to existing groundwater users, to the Avon, or through settlement of adjacent land. Further details supporting this assessment are provided in Appendix C.

6 Recommendations

The following recommendations address the potential adverse effects for the Bishopspark and Peterborough Sites as outlined in this report:

Foundation design must be undertaken by a suitably qualified and experienced Geotechnical Engineer. The structural foundation design, drawings and specification should be reviewed by an appropriately qualified and experienced Geotechnical Chartered Professional Engineer.

7 Conclusions

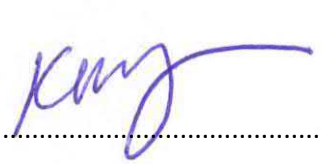
Provided the detailed design reflects the recommendations in this report, we assess:

- Natural hazards at the site either meet acceptable thresholds of risk, or the Village detailed design can mitigate the effects to an acceptable level;
- No consequential effect on groundwater is assessed and therefore no subsidence effects on neighbouring properties are predicted; and
- The Site is suitable for the Proposed Village from a geotechnical engineering perspective.

8 Applicability

This report has been prepared for the exclusive use of our client Ryman Healthcare Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement. We understand and agree that Ryman will submit this report in support of an application for resource consents, and that Christchurch City Council and Environment Canterbury as the consenting authorities will rely on this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
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Appendix A: Drawings

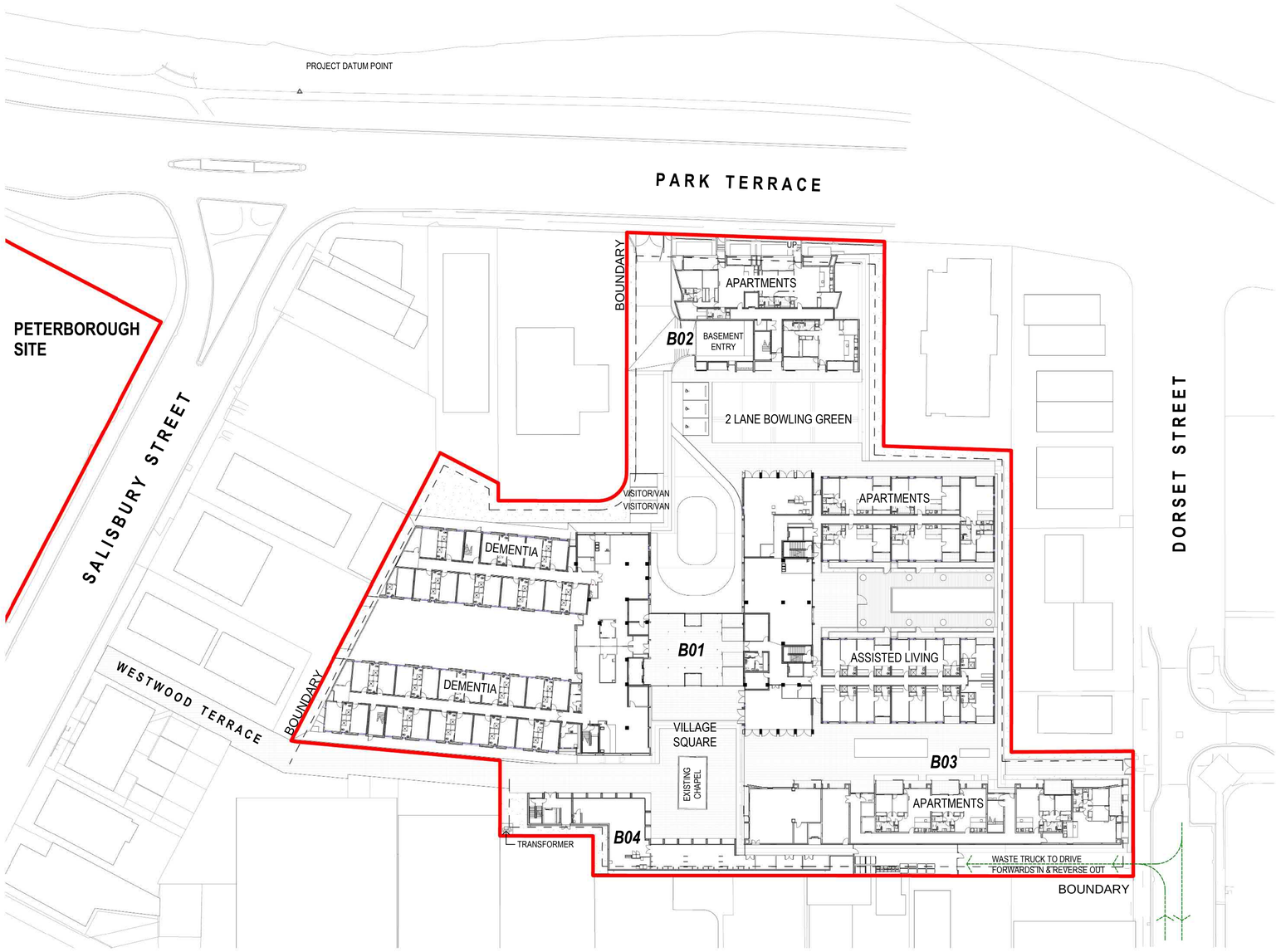
Warren & Mahoney Drawings

Bishopspark

Drawing name	Revision	Title
• 30315-BISHOPSPARK-01	A	Site Investigation Plan
• 30315-BISHOPSPARK-02	A	Geological Cross Section 1
• 30315-BISHOPSPARK-03	A	Geological Cross Section 2
• 30315-BISHOPSPARK-04	A	Geological Cross Section 3
• 30315-BISHOPSPARK-05	A	Geological Cross Section 4
• 30315-BISHOPSPARK-06	A	Geological Cross Section 5

Peterborough

Reference Drawing	Revision	Title
• 30315-PETERBOROUGH-01	A	Site Investigation Plan
• 30315-PETERBOROUGH-02	A	Geological Cross Section 1
• 30315-PETERBOROUGH-03	A	Geological Cross Section 2



SITE INFORMATION

SITE ADDRESS: 100 PARK TERRACE, CHRISTCHURCH
SITE AREA: 12290m2

WASTE MANAGMENT STRATEGY

- All village centre waste is transferred to the waste room by the staff.
- Residents in Apartments can dispose of rubbish in the bin rooms located in each apartment building. All apartments have a nurse call facility for assistance if required. The bins are transferred to the waste room by staff.
- Assisted Living Suites and Care room are fully serviced by staff who will transfer waste to the waste room.

CCC waste management truck route

1. AREA FOOTPRINTS

Name	Count	Total Area
B01 FOOTPRINT	1	3952.27 m²
B02 FOOTPRINT	1	684.12 m²
B03 FOOTPRINT	1	858.69 m²
B04 FOOTPRINT	1	440.06 m²
Grand total: 4		5935.14 m²

3. CAR PARKS

Comments	Count
90 DEGREE	135
ACCESSIBLE	3
ON GRADE VAN	3
PARALLEL	3
Grand total: 144	

4. APARTMENT MIX

Building	Apartment Type	Count
BUILDING B01	APT - 1 BED	7
BUILDING B01	APT - 2 BED	35
BUILDING B01	APT - 3 BED	2
BUILDING B01: 44		
BUILDING B02	APT - 1 BED	1
BUILDING B02	APT - 2 BED	5
BUILDING B02	APT - 3 BED	13
BUILDING B02: 19		
BUILDING B03	APT - 1 BED	2
BUILDING B03	APT - 2 BED	20
BUILDING B03: 22		
Grand total: 85		

5. CARE UNIT MIX

Building	Care Unit Type	Count
BUILDING B01	ALS	54
BUILDING B01	DEM	6
BUILDING B01	DEMENTIA	29
BUILDING B01	HOSPITAL CARE	20
BUILDING B01	REST HOME CARE	15
BUILDING B01: 124		

Revisions

A 25/10/19 RESOURCE CONSENT DRAFT
B 13/12/19 RESOURCE CONSENT
C 09/03/20 FOR INFORMATION

Notes

N
TRUE NORTH

Client

Ryman Healthcare Ltd

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Christchurch 8011
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Phone + 64 3 961 5926

Registered Architects and Designers
www.warrenandmahoney.com

Project Title

PARK TERRACE
SITE ONE
BISHOPSPARK

Drawing Title

SITE .S01
PROPOSED SITE PLAN - GROUND

Drawing Issue

RESOURCE CONSENT

Drawing Details

Scale	As indicated @ A1
Date	09/03/20
Job No	8917
Drawn	WM Team
Checked	TDH

Drawing No .S01 .A0-030

Revision C

WARREN AND MAHONEY

Revisions

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A 25/10/19 RESOURCE CONSENT DRAFT
B 13/12/19 RESOURCE CONSENT
C 09/03/20 FOR INFORMATION

Notes

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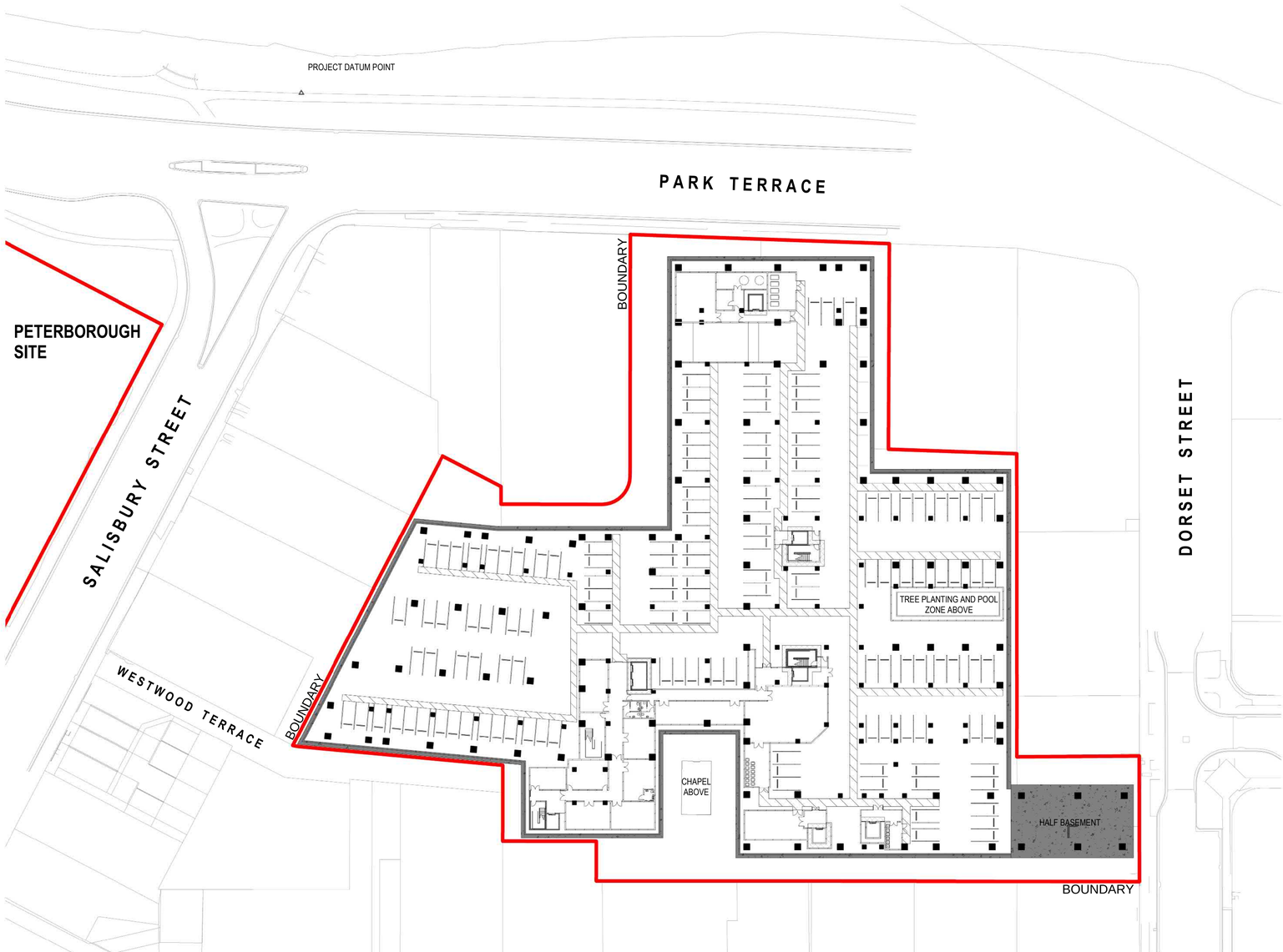

N
TRUE NORTH

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Project Title

—

PARK TERRACE
SITE ONE
BISHOPSPARK

Drawing Title

—

SITE .S01
PROPOSED SITE PLAN
- BASEMENT

Drawing Issue

RESOURCE CONSENT

Drawing Details

—

Scale	1 : 500 @ A1
Date	09/03/20
Job No	8917
Drawn	WM Team
Checked	TDH

Drawing No **Revision**

—

.S01 .A0-040 C

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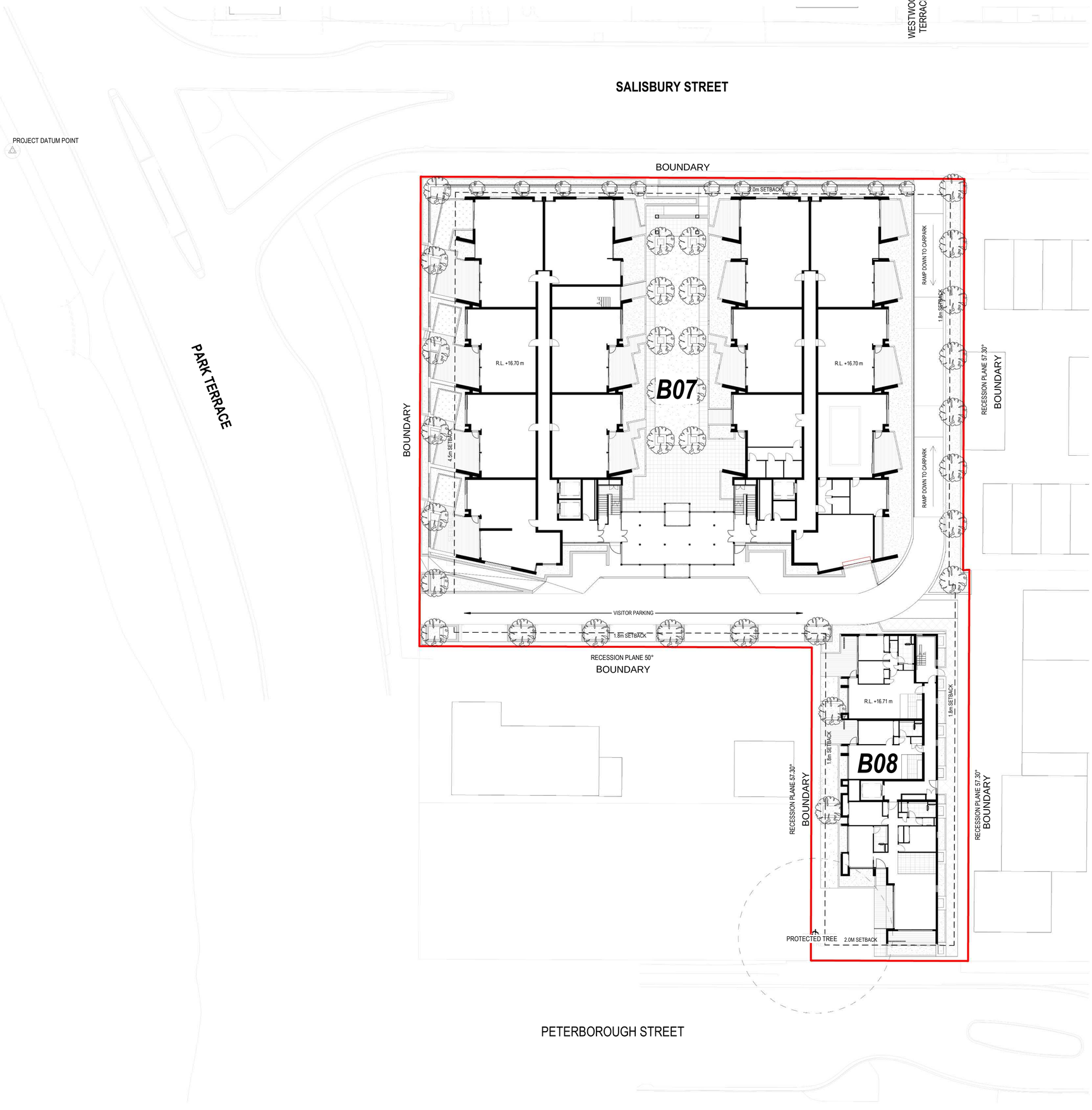

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Revisions

A	22/11/19	COORDINATION SET
B	18/12/19	DRAFT RESOURCE CONSENT
C	09/03/20	FOR INFORMATION

Notes

1. AREA FOOTPRINTS

Name	Count	Total Area
B07 FOOTPRINT	1	2047.44 m²
B08 FOOTPRINT	1	448.15 m²
Grand total: 2		2495.59 m²

3. CAR PARKS

Comments	Count
LEVEL 0	
90DEG PARKS	67
ACCESSIBLE PARKS	2
DOUBLE BANKED PARKS	8
PARALLEL PARKS	3
LEVEL 1	
PARALLEL PARKS	5
Grand total: 85	

4. APARTMENT MIX

Name	Count
APT - 1 BED	4
APT - 2 BED	53
APT - 3 BED	23
Grand total: 80	

N
TRUE NORTH

Client

RYMAN HEALTHCARE

Warren and Mahoney Architects New Zealand Ltd
254 Montreal Street
PO Box 25086
Christchurch 8011
New Zealand
Phone + 64 3 961 5926

Registered Architects and Designers
www.warrenandmahoney.com

Project Title

PARK TERRACE
SITE TWO
PETERBOROUGH

Drawing Title

SITE .S02
PROPOSED SITE PLAN
- GROUND

Drawing Issue

RESOURCE CONSENT

Drawing Details

Scale	1 : 250 @ A1
Date	09/03/20
Job No	8899
Drawn	WM Team
Checked	TDH

Drawing No .S02 .A0-030

Revision C

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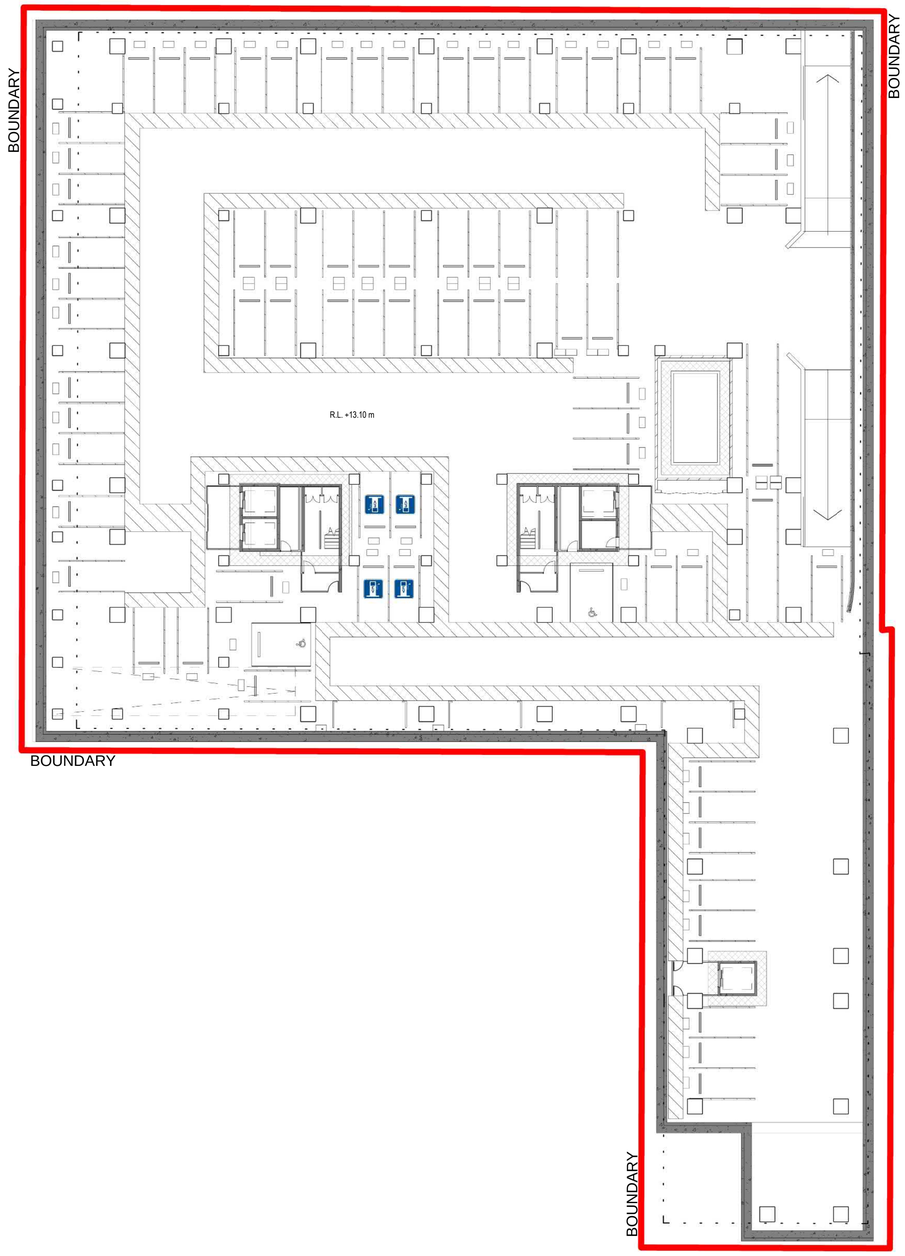
Revisions

A	22/11/19	COORDINATION SET
B	18/12/19	DRAFT RESOURCE CONSENT
C	09/03/20	FOR INFORMATION

Notes



1 A0-060 **PROPOSED SITE PLAN - BASEMENT**

A1 sheet scale = 1 : 250
A3 sheet scale is twice scale shown above

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Project Title

PARK TERRACE
SITE TWO
PETERBOROUGH

Drawing Title

SITE .S02
PROPOSED SITE PLAN
- BASEMENT

Drawing Issue

RESOURCE CONSENT

Drawing Details

Scale	1 : 250 @ A1
Date	09/03/20
Job No	8899
Drawn	WM Team
Checked	TDH

Drawing No .S02 .A0-040

Revision C

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A3 SCALE 1:1000

0 5 10 15 20 30 40 50 (m)

ORIGINAL IN COLOUR

LEGEND

- PROPERTY BOUNDARY
- BH3 — TONKIN + TAYLOR BOREHOLE LOCATION (NOV 2018)
- HA/SC2 — TONKIN + TAYLOR HAND AUGER LOCATION (NOV 2018)
- CPT3 — TONKIN + TAYLOR CONE PENETRATION TEST LOCATION (NOV 2018)
- SC1 — TONKIN + TAYLOR SCALA LOCATION (NOV 2018)
- SCPT1 — TONKIN + TAYLOR SEISMIC CONE PENETRATION TEST LOCATION (NOV 2018)

TTGD/NZGD PREVIOUS INVESTIGATIONS:

- BOREHOLE LOCATION
- HAND AUGER LOCATION
- CONE PENETRATION TEST LOCATION

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REV	DESCRIPTION	CAD	CHK	DATE
A	RESOURCE CONSENT	JC		

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PROJECT **GEOTECHNICAL INVESTIGATION**

TITLE BISHOPSPARK, CHRISTCHURCH
SITE INVESTIGATION PLAN

SCALE (A3) 1:1000 DWG No. 30315-BISHOPSPARK-01 REV A

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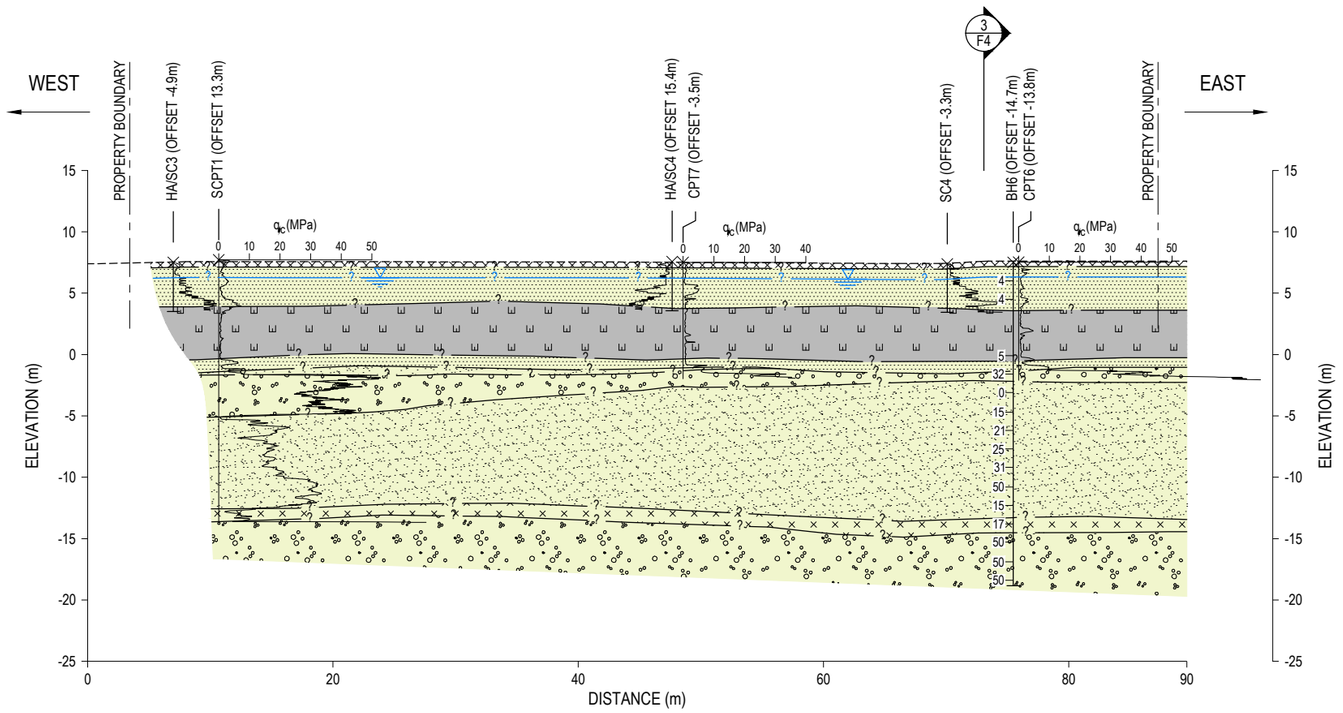

SECTION 1/01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- PEAT AND PEAT WITHIN SILT MATRIX
- SAND
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:500
0 5 10 15 20 25 (m)
ORIGINAL IN COLOUR

NOTE:
1. ALL DIMENSION ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) LYTTELTON VERTICAL DATUM 1937
3. EXISTING GROUND PROFILE BASED ON RL OF INVESTIGATIONS.

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
A	RESOURCE CONSENT	JC				

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TITLE BISHOPSPARK, CHRISTCHURCH
GEOLOGICAL CROSS SECTION 1
SCALE (A3) 1:500 DWG No. 30315-BISHOPSPARK-02 REV A

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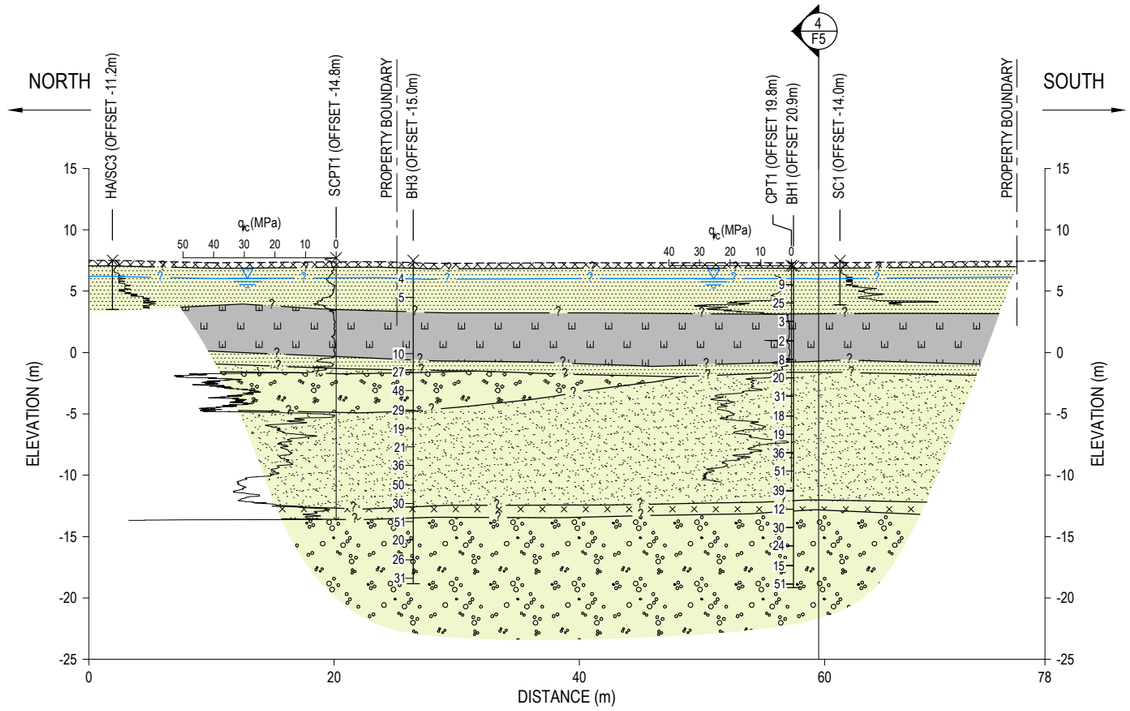

SECTION 2 / 01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- PEAT AND PEAT WITHIN SILT MATRIX
- SAND
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:500
0 5 10 15 20 25 (m)
ORIGINAL IN COLOUR

NOTE:
1. ALL DIMENSION ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) LYTTELTON VERTICAL DATUM 1937
3. EXISTING GROUND PROFILE BASED ON RL OF INVESTIGATIONS.

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REV	DESCRIPTION	CAD	CHK	DATE
A	RESOURCE CONSENT	JC		

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TITLE BISHOPSPARK, CHRISTCHURCH
GEOLOGICAL CROSS SECTION 2
SCALE (A3) 1:500 DWG No. 30315-BISHOPSPARK-03 REV A

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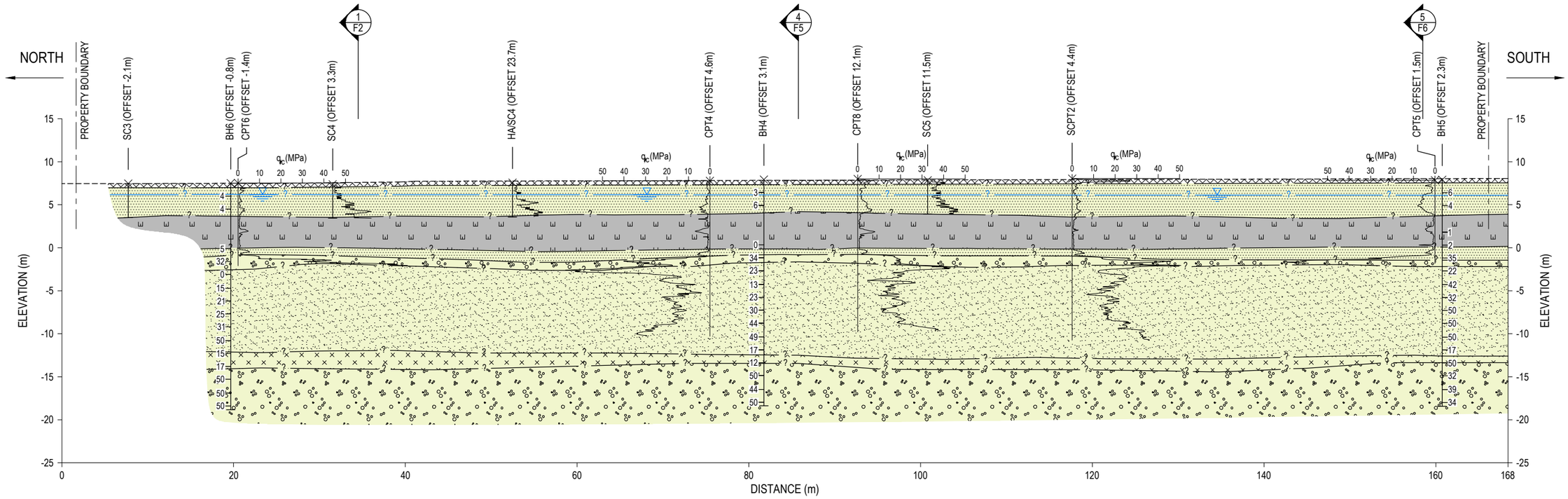

SECTION 3-01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- PEAT AND PEAT WITHIN SILT MATRIX
- SAND
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:500
0 5 10 15 20 25 (m)
ORIGINAL IN COLOUR

NOTE:
1. ALL DIMENSION ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) LYTTELTON VERTICAL DATUM 1937
3. EXISTING GROUND PROFILE BASED ON RL OF INVESTIGATIONS.

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
A	RESOURCE CONSENT	JC				

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PROJECT: GEOTECHNICAL INVESTIGATION
TITLE: BISHOPSPARK, CHRISTCHURCH
GEOLOGICAL CROSS SECTION 3
SCALE (A3): 1:500 DWG No. 30315-BISHOPSPARK-04 REV A

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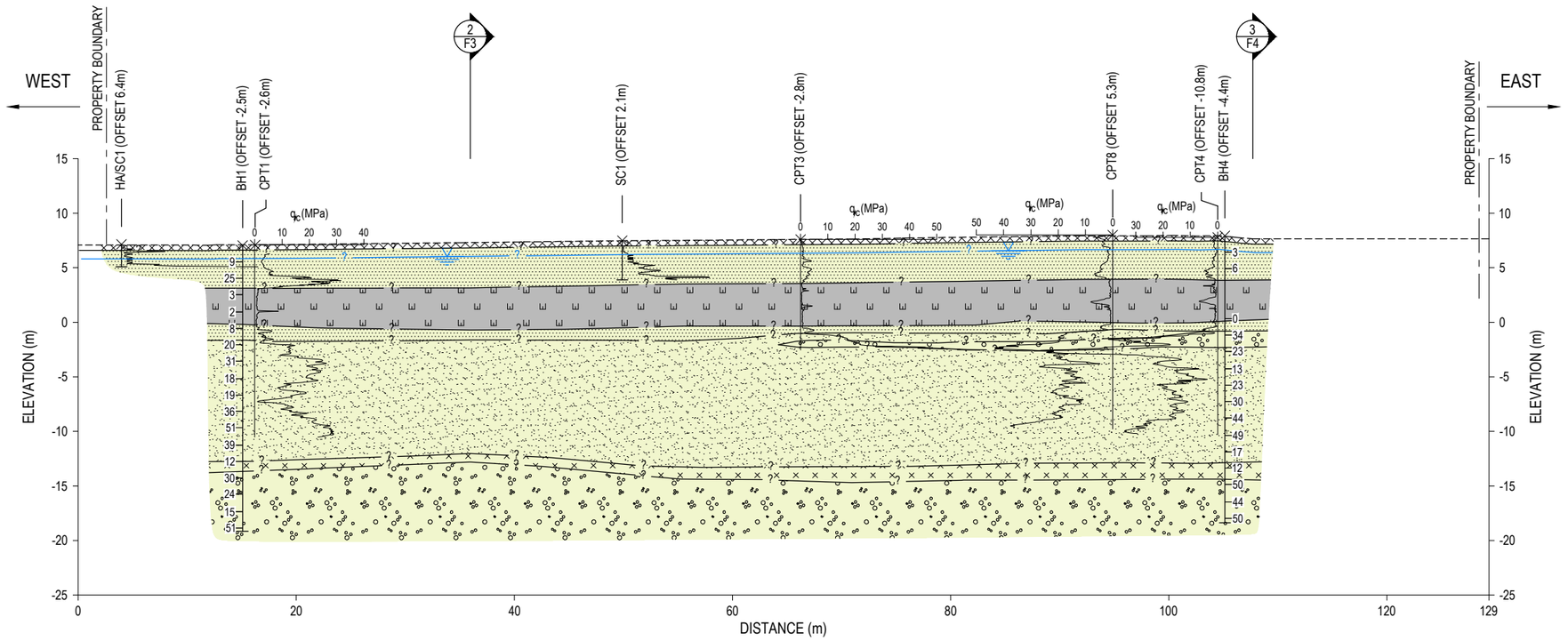

SECTION 4-01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- PEAT AND PEAT WITHIN SILT MATRIX
- SAND
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

NOTE:
1. ALL DIMENSION ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) LYTTELTON VERTICAL DATUM 1937
3. EXISTING GROUND PROFILE BASED ON RL OF INVESTIGATIONS.

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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE
A	RESOURCE CONSENT	JC				

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TITLE BISHOPSPARK, CHRISTCHURCH
GEOLOGICAL CROSS SECTION 4

SCALE (A3) 1:500 DWG No. 30315-BISHOPSPARK-05 REV A

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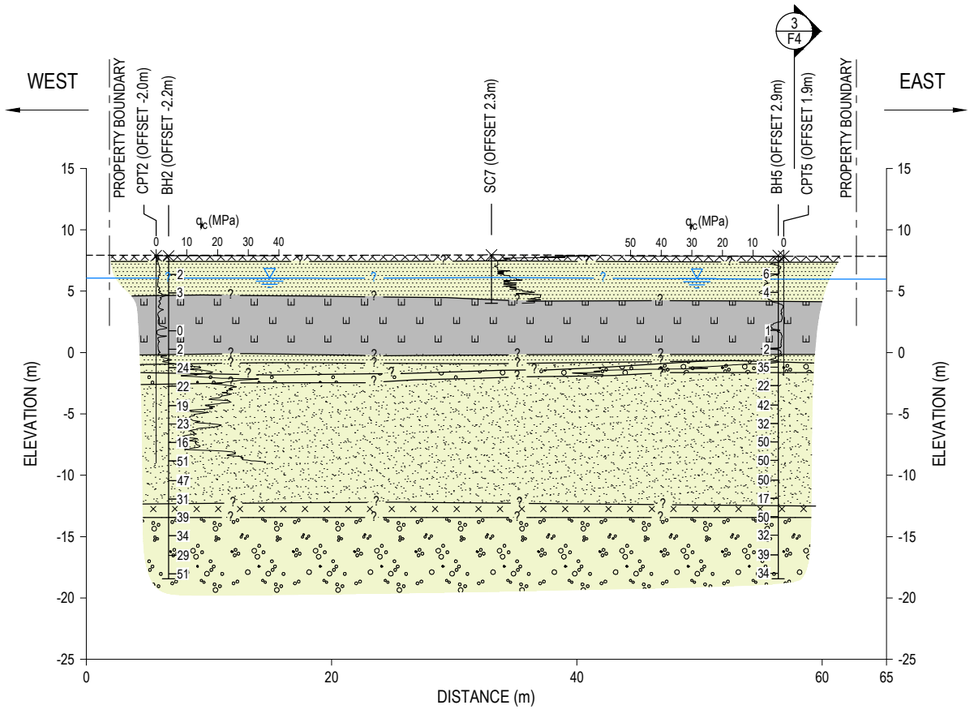

SECTION 5/01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- PEAT AND PEAT WITHIN SILT MATRIX
- SAND
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:500
0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

NOTE:
1. ALL DIMENSION ARE IN METRES UNLESS NOTED OTHERWISE.
2. LEVEL DATUM: LINZ (MSL) LYTTELTON VERTICAL DATUM 1937
3. EXISTING GROUND PROFILE BASED ON RL OF INVESTIGATIONS.

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A	RESOURCE CONSENT	JC				

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PROJECT **GEOTECHNICAL INVESTIGATION**
TITLE BISHOPSPARK, CHRISTCHURCH
GEOLOGICAL CROSS SECTION 5
SCALE (A3) 1:500 DWG No. 30315-BISHOPSPARK-06 REV A

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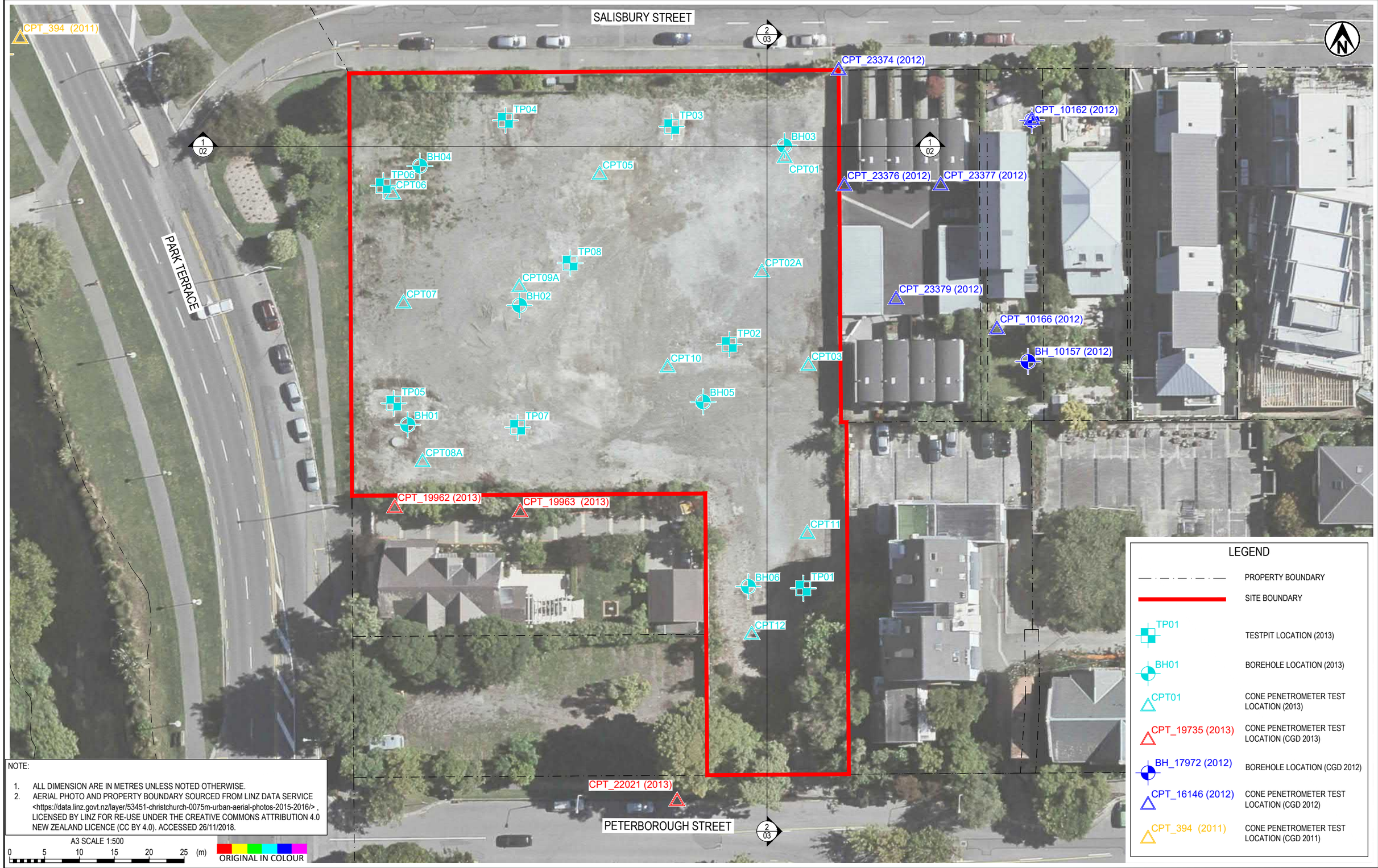

NOTE:

1. ALL DIMENSION ARE IN METRES UNLESS NOTED OTHERWISE.
2. AERIAL PHOTO AND PROPERTY BOUNDARY SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/layer/53451-christchurch-0075m-urban-aerial-photos-2015-2016/> , LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/11/2018.

A3 SCALE 1:500

0 5 10 15 20 25 (m)

ORIGINAL IN COLOUR

LEGEND

	PROPERTY BOUNDARY
	SITE BOUNDARY
TP01	TESTPIT LOCATION (2013)
BH01	BOREHOLE LOCATION (2013)
CPT01	CONE PENETROMETER TEST LOCATION (2013)
CPT_19735 (2013)	CONE PENETROMETER TEST LOCATION (CGD 2013)
BH_17972 (2012)	BOREHOLE LOCATION (CGD 2012)
CPT_16146 (2012)	CONE PENETROMETER TEST LOCATION (CGD 2012)
CPT_394 (2011)	CONE PENETROMETER TEST LOCATION (CGD 2011)

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A	RESOURCE CONSENT	JC		

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TITLE PETERBOROUGH, CHRISTCHURCH
SITE INVESTIGATION PLAN

SCALE (A3) 1:500 DWG No. 30315-PETERBOROUGH-01 REV A

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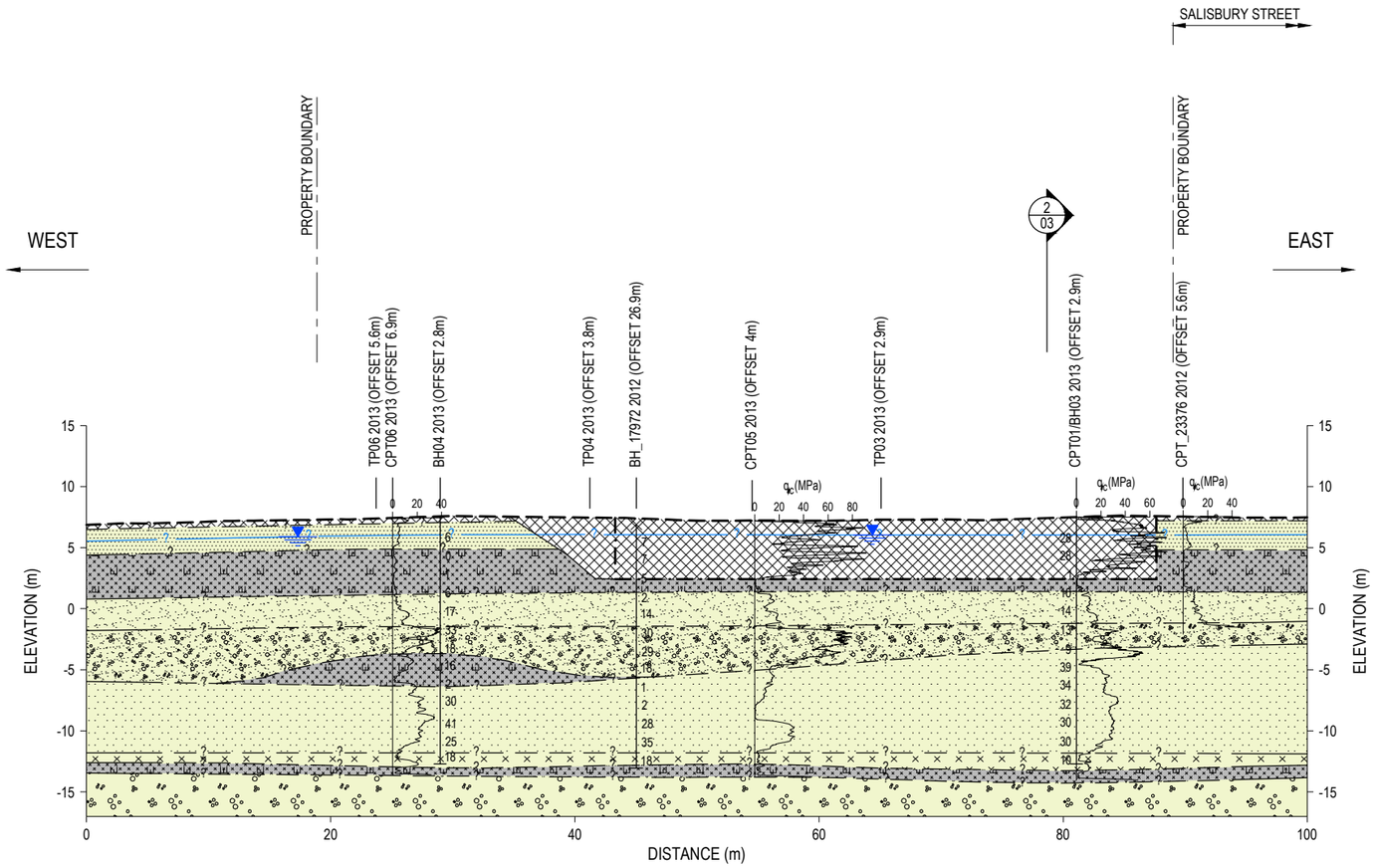

SECTION 1 01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- APPROXIMATE EXTENT OF FORMER BASEMENT
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- SILT/SANDY SILT WITH LENSES OF PEAT/ ORGANIC SILT
- SAND
- SAND WITH VARIABLE GRAVEL COMPONENT
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:1500
0 20 40 60 80 100 (m)
ORIGINAL IN COLOUR

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A	RESOURCE CONSENT	JC				

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TITLE PETERBOROUGH, CHRISTCHURCH
GEOLOGICAL CROSS SECTION 1
SCALE (A3) 1:500 DWG No. 30315-PETERBOROUGH-02 REV A

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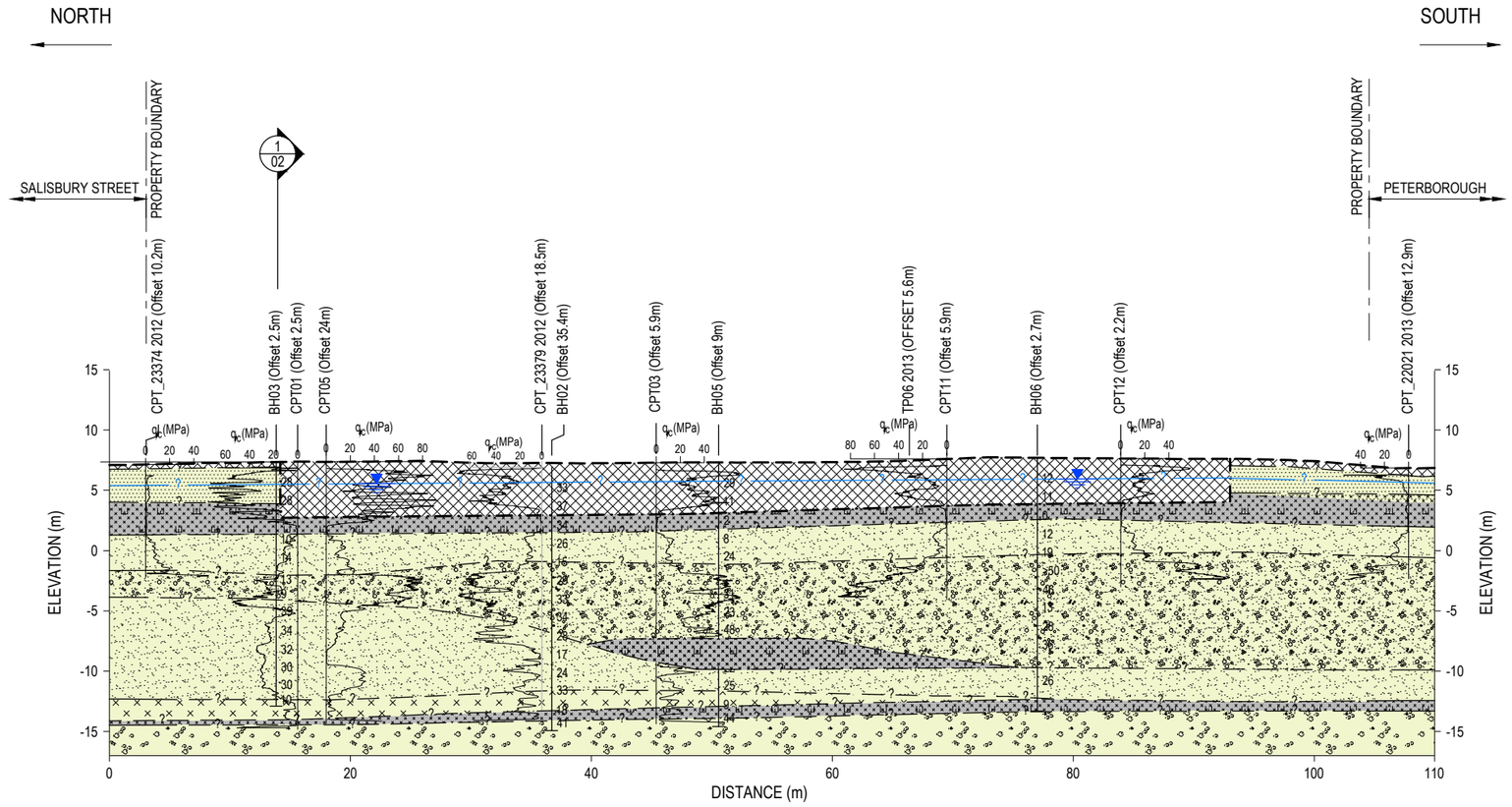

SECTION 2/01
SCALE 1: 500

LEGEND

- EXISTING GROUND PROFILE
- INFERRED GEOLOGICAL BOUNDARY
- INFERRED GROUNDWATER LEVEL
- APPROXIMATE EXTENT OF FORMER BASEMENT
- FILL OR TOP SOIL
- SILTY SAND/SANDY SILT
- SILT/SANDY SILT WITH LENSES OF PEAT/ ORGANIC SILT
- SAND
- SAND WITH VARIABLE GRAVEL COMPONENT
- SILT/SANDY SILT
- SANDY GRAVEL

A3 SCALE 1:1500
0 20 40 60 80 100 (m)
ORIGINAL IN COLOUR

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REV	DESCRIPTION	CAD	CHK	DATE
A	RESOURCE CONSENT	JC		

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PROJECT GEOTECHNICAL INVESTIGATION
TITLE PETERBOROUGH, CHRISTCHURCH GEOLOGICAL CROSS SECTION 1
SCALE (A3) 1:500 DWG No. 30315-PETERBOROUGH-02 REV A

Appendix B: Geotechnical Investigations

B1 Bishopspark: T+T 2018 Site-specific geotechnical investigations

B1.1 Overview

Site-specific geotechnical investigations were carried out between 8 November and 21 November 2018 under the supervision of T+T to assess the subsurface conditions beneath the Bishopspark site. The site investigation works comprised the following:

- Six sonic machine-drilled boreholes advanced to depths between 26.1 m bgl and 26.35 m bgl;
- 10 CPTs advanced to depths between 9.45 m bgl and 18.07 m bgl;
- Two seismic cone penetration tests (SCPTs) advanced to depths of 18.81 m bgl and 21.4 m bgl;
- Four hand auger boreholes with adjacent Scala penetrometer tests advanced to depths between 2.05 mbgl and 4.0 mbgl;
- Seven Scala penetrometer tests advanced to depths between 1.45 m bgl and 3.95 m bgl; and
- Surveying to record the locations and levels of the T+T 2018 site-specific geotechnical investigations.

The locations of these locations are shown in Dwg 30315-Bishopspark-01, Appendix A, and the investigation logs are provided within Appendix B

B1.2 Machine-drilled boreholes

Machine-drilled boreholes were carried out by Prodrill Ltd between 8 November and 20 November 2018. All boreholes were drilled using a high frequency (120 Hz) sonic drill rig, and advanced to at depths between 26.1 m bgl and 26.35 m bgl. Standard Penetration Tests (SPTs) were carried out within the boreholes at 1.5 m intervals.

In-situ testing and sampling of the subsurface materials encountered in the boreholes was undertaken using a Standard Penetration Test - SPT (35mm I.D.) split-spoon sampler. The sampler was driven into the soil a distance of 450 mm using a 63 kg hammer dropped from a height of 760 mm. The number of blows required for each 75 mm increment of sampler drive was recorded. The cumulative blow count for the last 300 mm of drive, or fraction thereof, that is presented on the borehole log represents the number of SPT blows required to drive the sampler.

During drilling a T+T geotechnical engineer logged the subsurface materials encountered in general accordance with the New Zealand Geotechnical Society Guidelines[10]. Open standpipe piezometers were installed in two boreholes. Table B1.1 presents a summary of the boreholes.

[10] FIELD DESCRIPTION OF SOIL AND ROCK, Guideline for the field classification and description of soil and rock for engineering purposes, NZ Geotechnical Society Inc, December 2005.

Table B1.1: Machine-drilled borehole summary

Borehole ID	Penetration depth (mbgl)	Instrumentation
BH1	26.20	-
BH2	26.30	-
BH3	26.35	-
BH4	26.30	-
BH5	26.35	Open standpipe piezometer
BH6	26.35	Open standpipe piezometer

B1.3 Cone penetration tests

Eight CPTs were undertaken by Geotechnics Ltd (Geotechnics) on 12 and 13 November 2018, and two CPTs were carried out by Ground Investigations Ltd (G-I) on 15 November 2018. The CPTs were terminated at depths between 9.45 m bgl and 18.7 m bgl, where they generally refused on dense sand or gravel material.

Geotechnics used a 16 tonne truck mounted rig and G-I used a Pagani TG63-150 rig to complete the CPTs. The CPTs were undertaken in general accordance with ISO 22467-1: 2012(E). Table B1.2 presents a summary of the CPTs.

Table B1.2: Cone penetration test summary

CPT ID	Penetration depth (mbgl)	Reason for termination
CPT01	17.63	Test refusal at 17.63 m >20 MPa, truck lifting
CPT02	16.98	Test refusal at 16.89 m >35 MPa, truck lifting
CPT03	10.14	Test refusal at 10.14 m >65 MPa, truck lifing
CPT04	18.07	Test refusal at 18.07 m >30 MPa, truck lifting
CPT05	9.67	Test refusal at 9.67 m >60 MPa, truck lifting
CPT06	9.58	Test refusal at 9.58 m >75 MPa, truck lifting
CPT07	9.45	Test refusal at 9.45 m >35 MPa, anchor failure
CPT08	17.7	Test refusal at 17.7 m >35 MPa, truck lifting
SCPT1	21.4	High cone end resistance
SCPT2	18.8	Limit of reaction force

B1.4 Seismic Cone Penetration Tests

Two SCPTs were carried out by G-I on 15 November 2018 with a Pagani TG63-150 rig. The SCPTs were performed adjacent to CPTs (undertaken by G-I) and terminated at depths of 18.8 m bgl and 21.4 m bgl on dense materials. A summary of the SCPTs is provided in Table B1.3.

Table B1.3: Seismic cone penetration summary

SCPT ID	Penetration depth (m)	Reason for termination
SCPT1	21.4	High cone end resistance
SCPT2	18.8	Limit of reaction force

B1.5 Hand auger boreholes and Scala penetrometer tests

Hand auger boreholes and Scala penetrometer tests were carried out by Geotechnics on 12 and 13 November 2018. The hand auger boreholes were terminated at depths between 1.5 m bgl and 4.0 m bgl due to refusal on gravel material. The Scala penetrometer tests were terminated at 3.95 m bgl or refused on dense sand at depths shallower than 3.95 m bgl. These were undertaken adjacent to a number of hand auger boreholes. The Scala penetrometer tests were performed in general accordance with NZS 4402 (1998) Test 6.5.2. The soil was logged in general accordance with the New Zealand Geotechnical Society Guidelines[4]. Table B1.4 presents a summary of the Scala penetrometer tests and hand auger boreholes.

Table B1.4: Hand auger borehole and Scala penetrometer test summary

Test ID	Hand auger borehole investigation depth (mbgl)	Scala penetrometer refusal depth (mbgl)
HASC01	1.5	2.05
HASC02	2.4	2.4
HASC03	4.0	3.95
HASC04	4.0	3.95
SC01	-	3.6
SC02	-	3.95
SC03	-	3.95
SC04	-	3.95
SC05	-	3.95
SC06	-	1.45
SC07	-	3.95

B1.6 Groundwater monitoring

Two open standpipe piezometers were installed in BH5 and BH6 to monitor the groundwater level at the site.

B1.7 Laboratory testing

A geotechnical laboratory testing programme was undertaken by Geotechnics on representative samples of the materials recovered from the machine-drilled boreholes. Details of the testing schedule are summarised in Table B1.5 and the results for fines content and Atterberg Limit are summarised in Table B1.6. Results from the one dimensional consolidation testing will be provided once available. The full laboratory testing results are provided in Appendix D.

Table B1.5: Laboratory testing schedule

Sample source	Sample depth (m)	Laboratory test type
BH2	4.5	One dimensional consolidation (NZS4402 Test 7.1)
BH3	0.9 3.0 8.05	Atterberg Limits (ASTM D4318) Fines content (GEO190-13)
	4.5 6.0	One dimensional consolidation (NZS4402 Test 7.1)
BH4	8.5	Atterberg Limits (ASTM D4318) Fines content (GEO190-13)
	4.5 6.0	One dimensional consolidation (NZS4402 Test 7.1)
BH5	1.5 3.0	Atterberg Limits (ASTM D4318) Fines content (GEO190-13)
	4.5	One dimensional consolidation (NZS4402 Test 7.1)
BH6	1.2 8.05	Atterberg Limits (ASTM D4318) Fines content (GEO190-13)
	4.5 6.0	One dimensional consolidation (NZS4402 Test 7.1)

Table B1.6: Laboratory test results – Atterberg Limits and fines content

Sample source	Sample depth (m)	Laboratory classification	Fines content passing 75µm sieve (%)	Plasticity index
BH3	0.9	Sandy SILT, greyish brown. Wet.	73.8	Non Plastic
	3.0	Sandy SILT, greyish brown. Moist to wet.	63.8	Non Plastic (Liquid Limit 24)
	8.05	Sandy SILT, greyish brown, mottled yellow. Wet.	64.5	Non Plastic
BH4	8.5	SILT with some sand, grey. Moist to wet.	86.7	Non Plastic
BH5	1.5	SILT with minor sand, grey. Moist to wet.	94.8	Non Plastic
	3.0	SILT with some sand, grey. Moist to wet.	86.6	Non Plastic
BH6	1.2	SILT with some sand, grey. Moist to wet. Low plasticity.	84.4	7
	8.05	Sandy SILT, grey. Moist to wet.	62.9	Non Plastic (Liquid Limit 20)

B2 Peterborough: T+T 2013 Site-specific geotechnical investigations

B2.1 Overview

Site-specific geotechnical investigations were carried out between 16 and 19 December 2013 under the supervision of T+T to assess the subsurface conditions beneath the Peterborough site. The site investigation works comprised the following:

- Seven sonic machine-drilled boreholes advanced to depths between 3.0 m bgl and 21.9 m bgl;
- 12 CPTs advanced to depths between 9.5 m bgl and 21.8 m bgl; and
- Eight test pits terminated at depths between 1.5 and 4.3 mbgl.

The locations of these investigations are shown in Drawing 30315-Peterboough-01, Appendix A, and the investigation logs are provided within Appendix B.

B2.2 Machine-drilled boreholes

Machine-drilled boreholes were carried out by Prodrill Ltd between 16 December and 19 December 2013. All boreholes were drilled using a Mobil Sonic MS1000 drill rig, and advanced to at depths between 3.0 m bgl and 21.9 m bgl. Standard Penetration Tests (SPTs) were carried out within the boreholes at 1.5 m intervals.

In-situ testing and sampling of the subsurface materials encountered in the boreholes was undertaken using a Standard Penetration Test - SPT (35mm I.D.) split-spoon sampler. The sampler was driven into the soil a distance of 450 mm using a 63 kg hammer dropped from a height of 760 mm. The number of blows required for each 150 mm increment of sampler drive was recorded. The cumulative blow count for the last 300 mm of drive, or fraction thereof, that is presented on the borehole log represents the number of SPT blows required to drive the sampler.

During drilling a T+T engineering geologist logged the subsurface materials encountered in general accordance with the New Zealand Geotechnical Society Guidelines[11]. Two single and two nested open standpipe piezometers were installed. Table B2.1 presents a summary of the boreholes.

Table B2.1: Machine-drilled borehole summary

Borehole ID	Penetration depth (mbgl)	Instrumentation
BH01	21.9	-
BH02	21.9	-
BH03	20.3	Nested standpipe piezometer
BH04	20.3	Nested standpipe piezometer
BH05	21.9	-
BH06	21.0	Standpipe piezometer
BH07	3.0	Standpipe piezometer

[11] FIELD DESCRIPTION OF SOIL AND ROCK, Guideline for the field classification and description of soil and rock for engineering purposes, NZ Geotechnical Society Inc, December 2005.

B2.3 Cone penetration tests

Twelve CPTs were undertaken by Lankelma Ltd (Lankelma) on 16 and 17 December 2013. The CPTs were terminated at depths between 9.4 m bgl and 21.8 m bgl, where they generally refused on dense sand or gravel material.

Lankelma used a 20 tonne truck mounted rig to complete the CPTs. The CPTs were undertaken in general accordance with ISO 22467-1: 2012(E). Table B2.2 presents a summary of the CPTs.

Table B2.2: Cone penetration test summary

CPT ID	Penetration depth (mbgl)	Reason for termination
CPT01	21.5	Tip load
CPT02A	21.8	Tip load
CPT03	21.0	Tip load
CPT04	20.9	Tip load
CPT05	20.9	Tip load
CPT06	21.0	Tip load
CPT07	20.9	Tip load
CPT08A	10.0	Inclination
CPT09A	21.0	Tip load
CPT10	21.9	Tip load
CPT11	10.9	Tip load
CPT12	9.5	Tip load

B2.4 Groundwater monitoring

Two single standpipe piezometers were installed in BH03 and BH04 and two nested open standpipe piezometers were installed in BH06 and BH07 to monitor the groundwater level at the site.

BOREHOLE LOG

BOREHOLE No.: **BH1**

Hole Location: Park Terrace Accessway

SHEET: 1 OF 3

PROJECT: 100 Park Terrace (Geotechnical) | LOCATION: Christchurch | JOB No.: 30315.0000

CO-ORDINATES: (NZTM2000) 5180964.89 mN, 1569908.77 mE

R.L.:

DATUM:

DRILL TYPE: Mobile Sonic 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 08/11/2018

HOLE FINISHED: 09/11/2018

DRILLED BY: ProDrill

LOGGED BY: OP CHECKED: KCC

GEOLOGICAL															ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Fill			73	SNC				6	1		D-M	MD				ASPHALT, 10mm.
																Sandy, fine to coarse GRAVEL, with trace silt; greyish brown. Medium dense, dry to moist; sand, fine to medium.
											M-W	L				Silty, fine to coarse SAND, with trace gravel; brownish grey with orange mottling. Loose, moist to wet.
																0.60m: no gravel
																0.7m: fine sand only; greyish brown
			100	SPT		1/1 2/2 2/3 **N=9**		5	2		W					1.1-1.5m: CORE LOSS.
																[CONT] Silty, fine to coarse SAND; brownish grey with orange mottling. Loose, moist to wet, no dilatancy.
			100	SNC												*1.50m:* becomes wet (SPT sample wet). *1.95m:* sand, fine to medium.
											M-W	F				2.6m: trace gravel; coarse, sub-rounded.
			33	SPT		4/6 7/6 6/6 **N=25**		4	3		M	MD				Sandy SILT, with some gravel; grey. Firm, moist to wet, low plasticity, no dilatancy; sand, fine to coarse; gravel, medium to coarse, sub-rounded to sub-angular.
			100	SNC				3	4							Sandy, fine to coarse GRAVEL, with minor silt; grey. Medium dense, moist; gravel, sub-angular to sub-rounded; sand, fine to coarse.
												VS				3.75-3.85m: cobble within fibrous peat.
																Fibrous PEAT; dark brown. Very soft, moist. Organic smell.
			100	SPT		0/1 0/1 1/1 **N=3**		2	5							SILT and PEAT; brownish grey. Very soft, moist, moderate plasticity; peat, fibrous, mixed in with silt.
Yaldhurst Member			100	SNC								S				*5.30 - 5.50m:* SILT lense; grey. Soft, moist, moderate plasticity. *5.50m:* large fibrous material throughout, eg, 2-10mm dia. tree roots.
			71	SPT		0/0 0/0 1/1 **N=2**		1	6							
			100	SNC				0	7							SILT, with trace fibrous peat; grey and brown peat. Soft, moist, moderate plasticity.
												F				Sandy SILT; grey. Firm, moist, low plasticity; sand, fine.
			100	SPT		1/1 1/1 3/3 **N=8**		-1	8							
			100	SNC								MD				Fine to coarse SAND, with trace silt; grey. Medium dense, moist.
			100	SPT		2/3 4/5 5/6 **N=20**		-2	9							*9.55 - 9.75m:* some silt present; grey, non-plastic.
			100	SNC												

Box 1, 0.0-3.5m

Box 2, 3.5-6.6m

Box 3, 6.6-9.6m

COMMENTS:

Hole Depth 26.2m

Scale 1:50

Rev.: A

BoreLog - 13/03/2020 4:36:24 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH1**

Hole Location: Park Terrace Accessway

SHEET: 2 OF 3

PROJECT: 100 Park Terrace (Geotechnical) | LOCATION: Christchurch | JOB No.: 30315.0000

CO-ORDINATES: (NZTM2000) 5180964.89 mN, 1569908.77 mE

R.L.:

DATUM:

DRILL TYPE: Mobile Sonic 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 08/11/2018

HOLE FINISHED: 09/11/2018

DRILLED BY: ProDrill

LOGGED BY: OP CHECKED: KCC

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Christchurch Formation			100	SNC				-			M	MD				[CONT] Fine to coarse SAND, with trace silt; grey. Medium dense, moist. *10.15m:* grades to greyish brown.
			100	SPT		3/5 7/7 8/9 **N=31**		-4	11							
			91	SNC				-5	12							12.1-12.2m: CORE LOSS.
Box 4, 9.6-12.7m			100	SPT		2/3 4/5 6/3 **N=18**					W					Fine to coarse SAND, with minor silt; greyish brown. Medium dense, wet.
											W-S					Silty, fine to medium SAND, with trace fibrous organics; grey. Medium dense, wet to saturated.
			100	SNC				-6	13		W					Fine to coarse SAND, with trace silt; brownish grey. Medium dense, wet. *13.65 - 13.75m:* minor silt.
			100	SPT		2/3 3/4 4/8 **N=19**		-7	14							
			100	SNC								D				Silty, fine to coarse SAND, with trace fibrous organics; grey. Dense, wet.
Box 5, 12.7-15.7m			100	SPT		4/6 8/7 10/11 **N=36**		-8	15							*15.20 - 15.65m:* greyish brown. *15.35m:* minor silt.
			100	SNC				-9	16			MD-D				Fine to coarse SAND, with trace silt; light brown. Medium to very dense, wet. *16.50m:* some silt.
			100	SPT		3/7 12/13 14/11 for 45mm **N>=50**		-10	17							*17.15m:* trace silt.
			91	SNC				-11	18							18.2-18.3m: CORE LOSS.
Box 6, 15.7-18.8m			100	SPT		2/4 7/10 10/12 **N=39**						D				18.3m: becomes dense. 18.8-19.1m: minor shell present. *18.85m:* grades to grey.
			100	SNC				-12	19			MD				Silty, fine to coarse SAND; grey. Medium dense, wet.
			100	SPT												Coarse SAND, with trace silt; grey. Medium dense, wet.

COMMENTS:

Hole Depth 26.2m

Scale 1:50

Rev.: A

BoreLog - 13/03/2020 4:36:25 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH1**

Hole Location: Park Terrace Accessway

SHEET: 3 OF 3

PROJECT: 100 Park Terrace (Geotechnical) | LOCATION: Christchurch | JOB No.: 30315.0000

CO-ORDINATES: (NZTM2000) 5180964.89 mN 1569908.77 mE

R.L.:

DATUM:

DRILL TYPE: Mobile Sonic 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 08/11/2018

HOLE FINISHED: 09/11/2018

DRILLED BY: ProDrill

LOGGED BY: OP CHECKED: KCC

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Christchurch Formation			100	SPT		1/1 2/1 4/5 **N=12**					W	St				Sandy SILT; grey. Stiff, wet, moderate plasticity; sand, fine.
											M					SILT, with trace sand; grey. Stiff, moist, moderate plasticity; sand, fine.
			100	SNC							W	MD				Sandy, fine to coarse GRAVEL, with some silt; greyish brown. Medium dense, wet; gravel, sub-angular to sub-rounded; sand, fine to coarse. *21.20m:* becomes silty.
Box 7, 18.8-21.8m			66	SPT		12/10 7/10 8/5 **N=30**		-14	21			L-MD				
			100	SNC				-15	22			MD				Fine to coarse SAND, with some silt; brownish grey. Loose to medium dense, wet, slow dilatancy. Sandy, fine to coarse GRAVEL, with some silt; brownish grey. Medium dense, wet; gravel, sub-rounded; sand, fine to coarse.
			100	SPT		4/6 7/5 6/6 **N=24**		-16	23							Fine to coarse SAND, with trace gravel; greyish brown. Medium dense, wet, non-dilatant; gravel, fine to medium, sub-rounded.
Riccarton Gravels			100	SNC				-17	24							Sandy, fine to coarse GRAVEL; brown. Medium dense, wet; gravel, sub-rounded; sand, fine to coarse. *24.40m:* Low N value due to artesian pressure effects
Box 8, 21.8-24.9m			100	SPT		5/4 3/2 4/6 **N=15**		-18	25							
			100	SNC												
Box 9, 24.9-26.2m			100	SNC		14/16 18/32 for 75mm **N>=50**		-19	26			VD				*25.90m:* very dense.
								-20	27							26.2m: Target depth
								-21	28							
								-22	29							

COMMENTS:

Hole Depth 26.2m

Scale 1:50

Rev.: A

BoreLog - 13/03/2020 4:36:25 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH2**

SHEET: 1 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5180939.93 mN (NZTM2000) 1569966.19 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 12/11/2018
	DRILL METHOD: SNC	HOLE FINISHED: 12/11/2018
R.L.:		DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
Fill			46	SNC				7	1		M	MD				Asphalt
																Sandy GRAVEL; greyish brown. Medium dense, moist; gravel, fine to coarse, subangular; sand, fine to coarse.
												VL				SAND, minor silt; greyish brown. Medium dense, moist; sand, fine to medium.
																Silty SAND; greyish brown. Very loose, moist, low plasticity; sand, fine to medium.
																CORE LOSS: 0.7 - 1.5m
			100	SPT		0/0 0/0 1/1 **N=2**		6	2			VS				SILT, trace sand; light brown. Very soft, moist, high plasticity; sand, fine.
			100	SNC				5	3		M-W					Sandy SILT; grey. Very soft, moist to wet; silt, moderate plasticity, no dilatancy; sand, fine. *2.50m:* orange mottling present
Box 1, 0.0-3.5m			100	SPT		1/1 0/1 1/1 **N=3**										
			100	SNC				4	4		M	F				SILT and fibrous PEAT; grey with brown mottling. Firm, moist, moderate plasticity.
												VS				Fibrous PEAT; dark brown. Very soft/loose; moist.
												St				Sandy SILT; grey. Stiff, moist, low plasticity; sand, fine. *4.30 - 4.50m:* Peat and silt lense
			100	DPT		BH2-PT1 @ 4.5m		3	5			VS				Silty fibrous PEAT with some sand; brown. Very soft, moist, low plasticity.
Yaldhurst Member			100	SNC				2	6							*5.35 - 5.65m:* Fibrous peat lense
Box 2, 3.5-6.7m			44	SPT		0/0 0/0 0/0 **N=0**		1	7							*6.90 - 6.95m:* Silt with trace fibrous peat
			100	SNC				0	8							SILT, some peat (fibrous), trace sand; grey and brown mottling. Sand, fine.
			100	SNC		0/0 0/0 1/1 **N=2**										*8.30m:* grades to silt with some sand, trace fibrous peat
												L				Silty SAND; grey. Loose, moist; sand, fine to medium.
Box 3, 6.7-9.1m								-1	9			MD				SAND, minor to trace silt; grey. Medium dense, moist; sand, fine to coarse.
			100	SPT		2/2 5/6 7/6 **N=24**										*9.95 - 10.25m:* Sand with some gravel, trace silt lense. Gravel, fine to coarse, subangluar to subrounded.
								-2								

COMMENTS:

Hole Depth 26.3m

Scale 1:50

Rev.: A

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BOREHOLE LOG

BOREHOLE No.: **BH2**

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5180939.93 mN (NZTM2000) 1569966.19 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 12/11/2018
		HOLE FINISHED: 12/11/2018
R.L.:	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
			100	SNC							M	MD				[CONT] SAND, minor to trace silt; grey. Medium dense, moist; sand, fine to coarse.
			81	SPT		2/3 6/6 5/5 **N=22**		-3	11							
			100	SNC				-4	12							*12.00m:* coarse sand
Box 4, 9.1-12.2m			100	SPT		1/2 4/6 5/4 **N=19**										
			100	SNC				-5	13							*13.40 - 13.90m:* fine to coarse sand, trace silt; colour grades to brownish grey
			100	SPT		2/3 4/5 5/9 **N=23**		-6	14							
Box 5, 12.2-15.2m			100	SNC				-7	15							
Christchurch Formation			100	SPT		3/3 1/3 4/8 **N=16**										
			100	SNC				-8	16							
			100	SPT		2/4 7/13 14/16 for 70mm **N>=50**		-9	17							
Box 6, 15.2-18.3m			100	SNC				-10	18							*18.30m:* becomes dense. Sand, predominantly fine to medium.
			100	SPT		2/4 8/11 15/13 **N=47**										
			100	SNC				-11	19							
			100	SPT				-12								

COMMENTS:

Hole Depth 26.3m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH2**

SHEET: 3 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: (NZTM2000) 5180939.93 mN 1569966.19 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 12/11/2018
	DRILL METHOD: SNC	HOLE FINISHED: 12/11/2018
R.L.:		DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																	ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Christchurch Formation Box 7, 18.3-21.3m			100	SPT		3/4 5/6 10/10 **N=31**		-13	21		M	MD				[CONT] SAND, minor silt; grey. Medium dense, moist; sand, fine to coarse.
											W	L-MD				Fine to coarse SAND, with some shells, minor silt; grey and white speckling. Loose to medium dense, wet.
			100	SNC							M-W	St				Sandy SILT; grey. Stiff, moist to wet, low plasticity; sand, fine to medium.
																21.0-21.3m: trace fibrous peat.
			100	SPT		7/11 7/9 12/11 **N=39**					W					SILT, with trace sand; greyish brown. Stiff, wet, low plasticity.
								-14	22			D				Sandy, fine to coarse GRAVEL, with trace silt; brown. Dense, wet; gravel, sub-angular to sub-rounded; sand, fine to coarse.
			100	SNC												22.0m: trace cobbles.
			66	SPT		10/10 9/10 7/8 **N=34**		-15	23							22.8m: grades to GRAVEL, with some sand.
Riccarton Gravels			78	SNC				-16	24							
																24.15-24.4m: CORE LOSS.
Box 8, 21.3-25.1m			77	SPT		7/7 6/7 9/7 **N=29**		-17	25							*24.40m:* becomes medium dense.
												F				24.85m: becomes silty.
			100	SNC							S	MD				Sandy SILT; light brown. Firm, wet, low plasticity; sand, fine to coarse.
Box 9, 25.1-26.3m																Silty, sandy, fine to coarse GRAVEL; brown. Medium dense, saturated; gravel, sub-angular to sub-rounded; sand, fine to coarse.
			100	SPT		16/13 12/15 17/6 for 35mm **N>=50**		-18	26							25.45m: grades to sandy GRAVEL, with minor silt.
								-19	27							26.3m: Target depth
								-20	28							
								-21	29							
								-22								

COMMENTS:

Hole Depth 26.3m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH3**

Hole Location: Northern Carport

SHEET: 1 OF 3

PROJECT: 100 Park Terrace (Geotechnical) | LOCATION: Christchurch | JOB No.: 30315.0000

CO-ORDINATES: (NZTM2000) 5181008.75 mN, 1569926.96 mE

R.L.:

DATUM:

DRILL TYPE: Mobile Sonic 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 10/11/2018

HOLE FINISHED: 10/11/2018

DRILLED BY: ProDrill

LOGGED BY: OP CHECKED: KCC

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Fill			100	SNC		BH3-S1 @ 0.9m		7	1							ASPHALT, 10mm.
																Sandy, fine to coarse GRAVEL; greyish brown. Medium dense, moist; gravel, sub-angular to sub-rounded; sand, fine to coarse.
																0.25-0.3m: becomes silty.
			44	SPT		1/1 1/1 1/1 **N=4**		6	2							SILT, with trace sand and rootlets; grey with orange mottling. Stiff, moist, non-plastic; sand, fine.
																0.45m: trace fine gravel, becomes moist to wet.
			76	SNC				5	3							Sandy SILT; greyish brown. Firm, moist to wet, low plasticity; sand, fine.
																Silty, fine to medium SAND; greyish brown. Loose, moist to wet.
			100	SPT		BH3-S2 @ 3.0m 1/1 0/1 2/2 **N=5**		4	3							Sandy SILT, with trace fibrous peat; grey. Firm to stiff, moist, moderate plasticity; sand, fine.
																3.00m: grades to low plasticity.
			100	SNC				3	4							Fibrous PEAT; dark brown. Very soft/loose, moist.
			0	PT		BH3-PT1 @ 4.5m		2	5							
Yaldhurst Member			100	SNC				1	6							Fibrous PEAT and SILT; brown. Soft to firm, moist, low plasticity. Peat and silt mixed, homogeneous.
			0	PT		BH3-PT2 @ 6.1m		0	7							
			100	SNC				-1	8							SILT, with some fibrous peat and trace sand; grey with brown speckling/mottled. Firm to stiff, moist, moderate plasticity; sand, fine.
			100	SPT		0/1 3/2 3/2 **N=10**		-2	9							Sandy SILT, with trace fibrous organics; grey with brown speckling. Firm, moist, low plasticity; sand, fine to medium.
						BH3-S3 @ 8.1m										8.05m: no peat; becomes grey.
			100	SNC												Silty, fine to medium SAND; grey. Medium dense, moist to wet.
			66	SPT		6/8 7/6 7/7 **N=27**										*8.90m:* sand, fine to coarse; some silt.
																9.2m: fine to medium gravel present.
			100	SNC												Gravelly, fine to coarse SAND; brownish grey. Dense, wet; gravel, fine to coarse, sub-angular to sub-rounded.

Box 1, 0.0-3.0m

Box 2, 3.0-6.1m

Box 3, 6.1-9.6m

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BoreLog - 13/03/2020 4:36:29 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH3**

Hole Location: Northern Carport

SHEET: 2 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5181008.75 mN (NZTM2000) 1569926.96 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 10/11/2018
		HOLE FINISHED: 10/11/2018
R.L.:	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
Yaldhurst Member				100	SNC				-3	11							[CONT] Gravelly, fine to coarse SAND; brownish grey. Dense, wet; gravel, fine to coarse, sub-angular to sub-rounded.
				66	SPT		5/12 11/13 12/12 **N=48**										*10.80 - 10.90m:* fibrous peat present.
				91	SNC				-4	12							
	Box 4, 9.6-12.7m			88	SPT		1/3 5/7 8/9 **N=29**		-5								12.1-12.2m: CORE LOSS.
				100	SNC					13							Fine to coarse SAND, with minor silt; greyish brown. Medium dense, wet.
									-6								*12.75 - 12.85m:* Sandy SILT lense, stiff, non-plastic.
				100	SPT		1/2 3/4 5/7 **N=19**			14							*13.60m:* trace silt.
									-7								
	Box 5, 12.7-15.7m			100	SNC					15							
Christchurch Formation				100	SPT		2/3 4/5 6/6 **N=21**		-8								*15.65 - 16.05m:* saturated
										16							
				100	SNC				-9								
				100	SPT		1/3 5/8 11/12 **N=36**			17			D				*16.70m:* becomes dense.
				86	SNC				-10								*17.25m:* grades to fine to medium sand.
	Box 6, 15.7-18.7m			100	SPT		2/4 9/11 15/15 for 70mm **N>=50**		-11	18							
				100	SNC												*18.70m:* fine to coarse sand. *18.85 - 19.20m:* Fine to medium SAND lense. *19.00m:* grades to grey.
										19							
				100	SPT				-12								*19.80m:* becomes medium dense.

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BoreLog - 13/03/2020 4:36:30 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH3**

Hole Location: Northern Carport

SHEET: 3 OF 3

PROJECT: 100 Park Terrace (Geotechnical) | LOCATION: Christchurch | JOB No.: 30315.0000

CO-ORDINATES: (NZTM2000) 5181008.75 mN, 1569926.96 mE

R.L.:

DATUM:

DRILL TYPE: Mobile Sonic 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 10/11/2018

HOLE FINISHED: 10/11/2018

DRILLED BY: ProDrill

LOGGED BY: OP CHECKED: KCC

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Christchurch Formation Box 7, 18.7-21.7m			100	SPT		2/5 6/6 6/12 **N=30**		-13	21							[CONT] Fine to coarse SAND, with minor silt; greyish brown. Medium dense, wet. Sandy SILT, with trace organics; grey. Stiff, moist, moderate plasticity; sand, fine to medium; organics, fibrous.
			100	SNC												
			100	SPT		9/12 13/13 12/12 for 50mm **N>=50**		-14								Fine to coarse SAND, with trace silt; light brown. Dense, moist. 21.5m: minor gravel, fine to coarse, sub-angular to sub-rounded. Very dense.
			100	SNC				-15	22							Gravelly, fine to coarse SAND; greyish brown. Wet; gravel, fine to coarse, sub-angular to sub-rounded. Sandy, fine to coarse GRAVEL; greyish brown. Wet; gravel, sub-angular to sub-rounded; sand, coarse. *22.40m:* grades to some sand. *22.80m:* sandy GRAVEL, as above.
			33	SPT		6/8 7/6 5/2 **N=20**		-16	23							
Riccarton Gravels			78	SNC					24							23.7m: minor silt.
Box 8, 21.7-25.1m			77	SPT		6/6 5/4 7/10 **N=26**		-17								
			85	SNC				-18	25							
Box 9, 25.1-26.4m			66	SPT		7/9 8/7 6/10 **N=31**			26							
								-19								26.35m: Target depth
									27							
								-20								
									28							
								-21								
									29							
								-22								

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BoreLog - 13/03/2020 4:36:30 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH4**

SHEET: 1 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5181008.78 mN (NZTM2000) 1569987.44 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 19/11/2018
	DRILL METHOD: SNC	HOLE FINISHED: 19/11/2018
R.L.:		DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Topsoil			100	SNC				7	1	TS	D-M	St				TOPSOIL - Sandy SILT with trace rootlets; dark brown. Stiff, dry to moist.
											M	F-St				Sandy SILT; greyish brown. Firm to stiff, moist, low plasticity; sand, fine.
											W	VL				Silty SAND; greyish brown with orange mottling. Very loose, wet; sand, fine to coarse.
			100	SPT		0/0 1/1 0/1 **N=3**		6	2		M	F-St				Sandy SILT; greyish brown with orange mottling. Firm to stiff, moist; silt, low to moderate plasticity; sand, fine. *2.35m:* Colour change to grey
			100	SNC				5	3							
			88	SPT		1/1 1/2 1/2 **N=6**						St				Sandy SILT, minor peat (fibrous); grey and dark brown. Stiff, moist, low plasticity; sand, fine.
			100	SNC				4	4			F				PEAT (FIBROUS); dark brown. Firm, moist.
Yaldhurst Member			100	PT		BH4-PT1 @ 4.5m		3	5			S				SILT and fibrous PEAT; grey and dark brown mottling. Soft, moist, moderate plasticity.
			100	SNC							W	L				Silty SAND, trace peat (fibrous); grey with brown speckling. Loose, wet; sand, fine to medium, moderate dilatancy.
			100	PT		BH4-PT2 @ 6.1m		2	6		M	S				SILT and fibrous PEAT; grey and dark brown. Soft, moist, low plasticity.
			100	SNC				1	7			S-F				SILT, some sand, minor peat (fibrous); grey and dark brown mottling. Firm to soft, moist; sand, fine. *7.60m:* grades to sandy SILT; grey, no plasticity
			33	SPT		0/0 0/0 0/0 **N=0**		0	8							
			100	SNC		BH4-S1 @ 8.5m		-1	9			D				SAND, trace silt; grey. Dense, moist; sand, fine to coarse.
			77	SPT		0/2 7/9 10/8 **N=34**		-2								SAND, some gravel; grey. Dense, moist; sand, fine to coarse; gravel, medium, subrounded to subangular.

COMMENTS:

Hole Depth 26.3m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH4**

SHEET: 2 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5181008.78 mN (NZTM2000) 1569987.44 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 19/11/2018
		HOLE FINISHED: 19/11/2018
R.L.:	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																	ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Yaldhurst Member			100	SNC							W	D				Sandy GRAVEL; grey. Dense, wet; gravel, fine to coarse, subrounded to subangular; sand, fine to coarse.
												MD				SAND, trace silt; grey. Medium dense, wet; sand, fine to coarse.
			66	SPT		2/3 4/5 6/8 **N=23**		-3	11							*10.75 - 10.85m:* sandy gravel lense
			91	SNC												*11.20 - 11.30m:* silty sand lense
								-4	12							*12.00 - 12.10m:* silty fine sand lense
			100	SPT		2/2 3/3 4/3 **N=13**										12.1-12.2m: CORE LOSS
			100	SNC				-5	13							SAND, trace silt; grey. Medium dense, wet; sand, fine to coarse.
			100	SPT		1/3 3/5 7/8 **N=23**		-6	14							
Christchurch Formation			100	SNC												*14.55m:* sand becomes fine to medium
			100	SPT		2/2 4/6 10/10 **N=30**		-7	15							
			100	SNC												*15.65m:* sand becomes fine to coarse
			100	SPT		2/5 6/11 12/15 **N=44**		-8	16							
			91	SNC				-9	17			D				*16.70m:* becomes dense
			88	SPT		3/3 8/9 16/16 **N=49**		-10	18							
			100	SNC				-11	19							
								-12								*19.80 - 19.90m:* trace crushed shells

COMMENTS:

Hole Depth 26.3m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH4**

SHEET: 3 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5181008.78 mN (NZTM2000) 1569987.44 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 19/11/2018
	DRILL METHOD: SNC	HOLE FINISHED: 19/11/2018
R.L.:		DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Christchurch Formation			100	SPT		3/3 4/5 4/4 **N=17**		-13	21		W	D				[CONT] SAND, trace silt; grey. Dense, wet; sand, fine to coarse.
			100	SNC							M	St				Sandy SILT; grey. Stiff, moist, low plasticity; sand, fine. *20.60m:* trace fibrous organics
			100	SPT		3/2 3/3 3/3 **N=12**					W	MD				Silty SAND; grey. Medium dense, wet; sand, fine to coarse.
Riccarton Gravels			100	SNC				-14	22		S					Silty GRAVEL, some sand; grey and greyish brown. Medium dense, saturated; gravel, fine to coarse, subrounded to subangular; sand, fine to coarse.
											W	VD				22.0m: grades to sandy GRAVEL with minor silt. Sandy GRAVEL; brown. Very dense, wet; gravel, fine to coarse, subrounded to subangular; sand, fine to coarse.
			33	SPT		9/16 17/20 13 for 75mm **N>=50**		-15	23							
			91	SNC				-16	24							*24.10m:* trace cobbles
			77	SPT		7/8 8/11 11/13 **N=44**		-17	25			D				*24.40m:* becomes dense
			100	SNC												
			75	SPT		19/16 18/18 12/2 for 15mm **N>=50**		-18	26			VD				*25.90m:* becomes very dense.
								-19	27							26.3m: Target depth
								-20	28							
								-21	29							
								-22								

COMMENTS:

Hole Depth 26.3m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH5**

SHEET: 1 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5180935.11 mN (NZTM2000) 1570015.94 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 13/11/2018
	DRILL METHOD: SNC	HOLE FINISHED: 13/11/2018
R.L.:		DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Fill			50	SNC				7	1		M					Asphalt Sandy GRAVEL; greyish brown. Moist; gravel, fine to coarse, subangular to subrounded; sand, fine to coarse.
												St				Sandy SILT; greyish brown. Stiff, moist, low plasticity; sand, fine. CORE LOSS: 0.75 - 1.5m
			77	SPT		BH5-S1 @ 1.5m 1/2 1/2 2/1 **N=6**		6	2							Sandy SILT; brownish grey with orange mottling. Stiff, moist, low plasticity; sand, fine.
			100	SNC								L				Silty SAND; grey with orange mottling. Loose, moist; sand, fine to medium. *2.20m:* colour grades to grey
			100	SPT		BH5-S2 @ 3.0m 1/1 1/1 1/1 **N=4**		5	3			St				Sandy SILT; grey. Stiff, moist, high plasticity; sand, fine.
			100	SNC				4	4			S				Silty PEAT (FIBROUS); dark greyish brown. Soft, moist, low plasticity. *4.30 - 4.40m:* Fibrous PEAT lense
			100	PT		BH5-PT1 @ 4.5m					W					Sandy SILT, trace peat (fibrous); brownish grey with dark brown mottling. Soft, wet; silt, moderate plasticity; sand, fine to medium.
Yaldhurst Member			100	SNC				3	5							*5.95m:* some fibrous peat
			100	SPT		0/0 0/0 0/1 **N=1**		2	6							*6.20 - 6.35m:* Silty fibrous PEAT lense
			100	SNC				1	7							*6.65m:* Trace to minor fresh organics (roots, fibrous material) *7.40 - 7.60m:* Fine to coarse sand lense with minor silt
			88	SPT		0/1 0/1 0/1 **N=2**		0	8			L				Silty SAND; grey. Loose, wet; sand, fine to medium, non-dilatant.
			100	SNC				-1	9							SAND, minor silt; grey. Loose, wet; sand, fine to coarse.
			66	SPT		2/4 8/9 9/9 **N=35**		-2				MD				Gravelly SAND, trace silt; grey. Medium dense, wet; sand, fine to coarse; gravel, fine to coarse, subangular to subrounded.

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH5**

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5180935.11 mN (NZTM2000) 1570015.94 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 13/11/2018
		HOLE FINISHED: 13/11/2018
R.L.:	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																	ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
Yaldhurst Member			100	SNC							W	MD				[CONT] Gravelly SAND, trace silt; grey. Medium dense, wet; sand, fine to coarse; gravel, fine to coarse, subangular to subrounded.
			77	SPT		2/3 4/5 6/7 **N=22**		-3	11							SAND, trace silt; grey. Medium dense, wet; sand, fine to coarse.
			100	SNC				-4	12							
			100	SPT		3/6 7/9 11/15 **N=42**						D				*12.20m:* becomes dense
			100	SNC				-5	13							
			100	SPT		2/3 6/8 9/9 **N=32**		-6	14							*13.95 - 14.15m:* sand is fine to medium; minor silt
Christchurch Formation			100	SNC				-7	15							
			100	SPT		3/7 12/11 12/15 **N>=50**						VD				*15.20m:* becomes very dense
			100	SNC				-8	16							
			100	SPT		4/10 12/14 19/5 for 15mm **N>=50**		-9	17							
			91	SNC				-10	18							CORE LOSS: 18.2 - 18.3m
			100	SPT		3/6 9/14 17/10 for 30mm **N>=50**						MD-D				SAND, trace silt; grey. Very dense to medium dense, wet; sand, fine to coarse. *18.75m:* brown mottling and white speckling (crushed up shells)
			100	SNC				-11	19							
						2/3		-12								

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH5**

SHEET: 3 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5180935.11 mN (NZTM2000) 1570015.94 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 13/11/2018
		HOLE FINISHED: 13/11/2018
R.L.:	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Christchurch Formation			100	SPT		4/4 5/4 **N=17**		-13	21		M	F				[CONT] SAND, trace silt; grey. Very dense to medium dense, wet; sand, fine to coarse.
			100	SNC												Silty SAND; grey. Very dense to medium dense, wet; sand, fine to coarse.
			100	SPT		4/7 10/14 14/12 for 45mm **N>=50**		-14	22			VSt				Sandy SILT, trace peat (fibrous); grey. Firm, moist, high plasticity; sand, fine. *21.20 - 21.30m:* silty sand lense
			85	SNC							S	VD				21.6m: colour grades to greyish brown SILT; grey. Very stiff, moist, low plasticity. Silty sandy GRAVEL; greyish brown. Very dense, saturated; gravel, fine to coarse, subangular to subrounded; sand, fine to coarse. *21.75m:* trace silt *22.40m:* trace cobbles
			66	SPT		10/11 9/8 7/8 **N=32**		-15	23		W	D				CORE LOSS: 22.65-22.8m Sandy GRAVEL, trace silt; greyish brown. Dense, wet; gravel, fine to coarse, subrounded to subangular; sand, fine to coarse.
Riccarton Gravels			100	SNC				-16	24							
			0	SPT		8/9 7/10 12/10 **N=39**		-17	25							
			85	SNC												
			66	SPT		5/4 6/8 8/12 **N=34**		-18	26							CORE LOSS: 25.75-25.9m Sandy GRAVEL, as above.
								-19	27							26.35m: Target depth
								-20	28							
								-21	29							
								-22								

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH6**

SHEET: 1 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5181068.29 mN (NZTM2000) 1569969.33 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 20/11/2018
	DRILL METHOD: SNC	HOLE FINISHED: 20/11/2018
R.L.:		DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	TESTS	RL (m)	DEPTH (m)	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
						ENGINEERING DESCRIPTION
				D	MD	Asphalt
Fill		7				Sandy GRAVEL, trace cobbles; brownish grey. Medium dense, dry; gravel, fine to coarse, subrounded to subangular; sand, fine to coarse.
			1	W	S	Sandy SILT; greyish brown. Soft, wet, low plasticity; sand, fine to medium.
	BH6-S1 @ 1.2m	6				*0.85 - 1.25m:* silty sand lense; loose.
	0/1 0/1 1/2 **N=4**		2			*1.25m:* grey with orange mottling
		5		M	St	*2.00 - 2.15m:* silty sand lense; loose.
	1/0 1/1 1/1 **N=4**		3			Sandy SILT; grey. Stiff, moist, high plasticity; sand, fine; minor fibrous material (bark) and rootlets.
		4			S	PEAT (FIBROUS); dark brown. Soft, moist.
	BH6-PT1 @ 4.5m	3	4			SILT and fibrous PEAT; grey and dark brown. Soft, moist, low plasticity.
Yaldhurst Member			5			5.2-5.4m: Silty SAND, with trace fibrous peat; grey, loose.
		2				*5.80 - 6.10m:* fresh organic material (bark, 2-5mm dia. roots).
	BH6-PT2 @ 6.1m		6			
		1			F	SILT, with trace sand, minor fibrous peat; grey with brown mottling. Firm, moist, moderate plasticity; sand, fine.
			7			
	1/1 2/1 1/1 **N=5**	0				7.6m: grades to sandy SILT.
	BH6-S2 @ 8.1m		8			
		-1		W	L-MD	Fine to coarse SAND, with minor silt; grey. Loose to medium dense, wet.
			9		D	Sandy, fine to coarse GRAVEL, trace cobbles; grey. Dense, wet; gravel, sub-angular to sub-rounded; sand, fine to coarse.
	4/8 9/7 8/8 **N=32**	-2				*9.95m:* grades to fine to medium gravel.

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH6**

PROJECT: 100 Park Terrace (Geotechnical) | LOCATION: Christchurch | JOB No.: 30315.0000

CO-ORDINATES: (NZTM2000) 5181068.29 mN, 1569969.33 mE

R.L.:

DATUM:

DRILL TYPE: Mobile Sonic 1000

DRILL METHOD: SNC

DRILL FLUID: WATER

HOLE STARTED: 20/11/2018

HOLE FINISHED: 20/11/2018

DRILLED BY: ProDrill

LOGGED BY: OP CHECKED: KCC

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Yaldhurst Member			100	SNC				-3	11		W	D				[CONT] Sandy, fine to coarse GRAVEL, trace cobbles; grey. Dense, wet; gravel, sub-angular to sub-rounded; sand, fine to coarse.
			22	SPT		0/0 0/0 0/0 **N=0**						MD				
												S				Fine to coarse SAND; grey. Medium dense, wet. 10.3-10.4m: some fine to coarse gravel, sub-angular to sub-rounded.
			86	SNC				-4	12			St				SILT, with minor sand; grey. Soft, wet, moderate plasticity; sand, fine to coarse. 11.05m: trace sand.
																Sandy SILT; grey. Stiff, wet, low plasticity, no dilatancy; sand, fine to coarse.
			100	SPT		2/1 2/3 4/6 **N=15**		-5	13			MD				Fine to coarse SAND; grey. Medium dense, wet.
			100	SNC				-6	14							12.05-12.2m: CORE LOSS.
			100	SPT		5/3 5/4 6/6 **N=21**		-7	15							Fine to coarse SAND; grey. Medium dense, wet.
Christchurch Formation			100	SNC				-8	16							
			100	SPT		2/3 4/5 8/8 **N=25**		-9	17							
			100	SNC				-10	18							*16.70m:* becomes dense.
			91	SNC				-11	19							18.2-18.3m: CORE LOSS.
			100	SPT		2/4 6/6 9/10 **N=31**										[CONT] Fine to coarse SAND; grey. Dense, wet.
			100	SNC		4/7 10/15 12/13 for 35mm **N>=50**		-12								*18.90 - 19.10m:* minor crushed shells.

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH6**

SHEET: 3 OF 3

PROJECT: 100 Park Terrace (Geotechnical)	LOCATION: Christchurch	JOB No.: 30315.0000
CO-ORDINATES: 5181068.29 mN (NZTM2000) 1569969.33 mE	DRILL TYPE: Mobile Sonic 1000	HOLE STARTED: 20/11/2018
		HOLE FINISHED: 20/11/2018
R.L.:	DRILL METHOD: SNC	DRILLED BY: ProDrill
DATUM:	DRILL FLUID: WATER	LOGGED BY: OP CHECKED: KCC

GEOLOGICAL															ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
Christchurch Formation			100	SPT		4/3 4/3 3/5 **N=15**		-13	21		W	D				[CONT] Fine to coarse SAND; grey. Dense, wet.
												St				Sandy SILT, with trace fibrous peat; grey with light brown speckling. Stiff, wet, moderate plasticity; sand, fine.
			100	SNC								MD				Silty, fine to medium SAND, with trace fresh organic material (bark, roots); grey. Medium dense, wet.
			100	SPT		0/3 4/5 5/3 **N=17**		-14								
Riccarton Gravels			100	SNC				-15	22			D-VD				Sandy, fine to coarse GRAVEL, with some silt; greyish brown. Medium to very dense, wet; sand, fine to coarse. 22.5m: no silt.
			66	SPT		9/11 10/13 15/12 for 65mm **N>=50**		-16	23							
			86	SNC					24							
			66	SPT		14/17 17/16 17 for 75mm **N>=50**		-17								
			90	SNC				-18	25							
			66	SPT		7/9 11/14 14/11 **N>=50**			26							
								-19								26.35m: Target depth
									27							
								-20								
									28							
								-21								
									29							
								-22								

COMMENTS:

Hole Depth 26.35m

Scale 1:50

Rev.: A

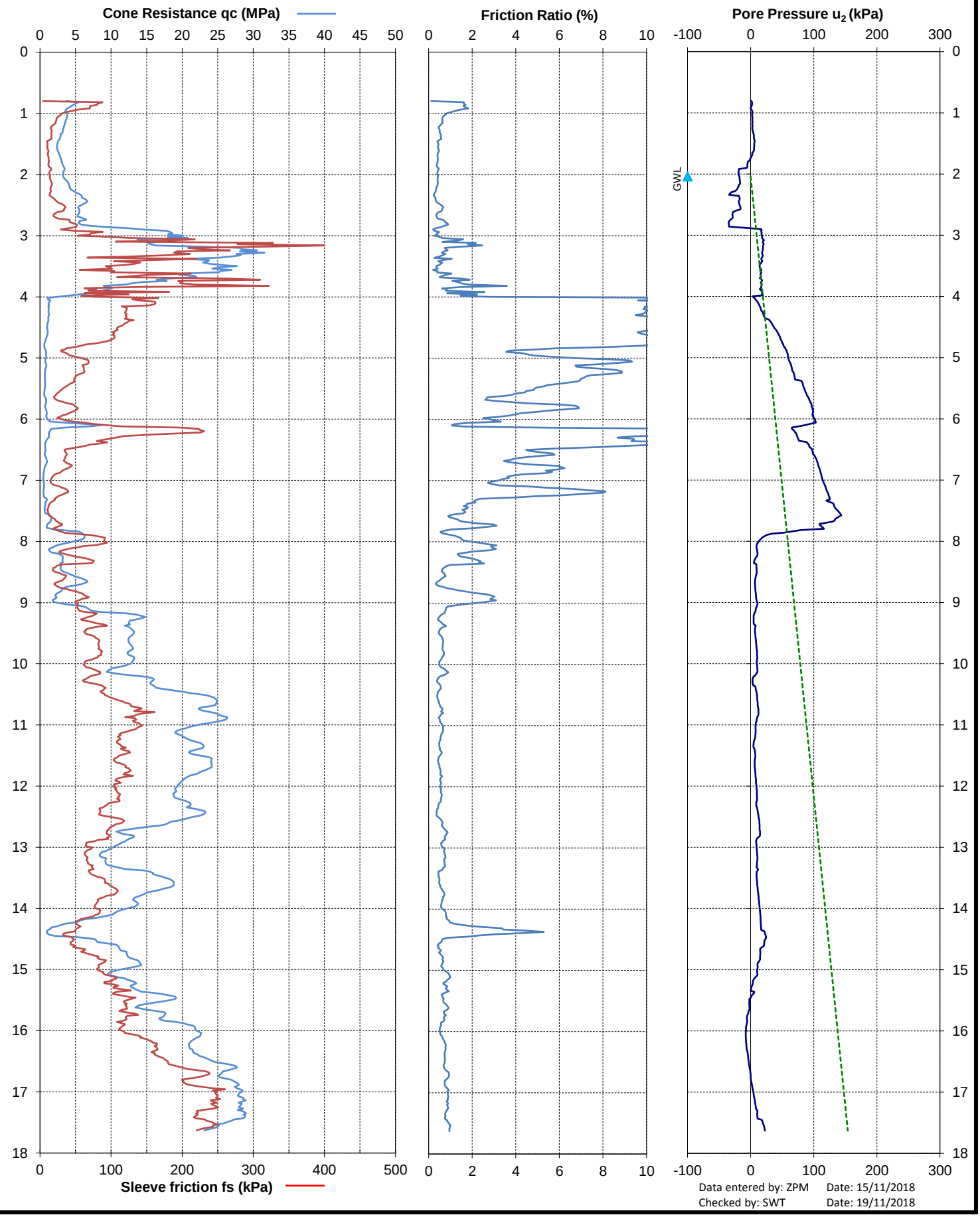
CPT01 100 - 104 Park Terrace, Christchurch Central - 12 November, 2018

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

GEOTECHNICS

Pre-Drill:	0.8m	**NZMG**	2479908mE 5742582mN 13m(amsl)
Measured GWL:	2.04m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 17.63m > 20MPa, truck lifting
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



Data entered by: ZPM Date: 15/11/2018
Checked by: SWT Date: 19/11/2018

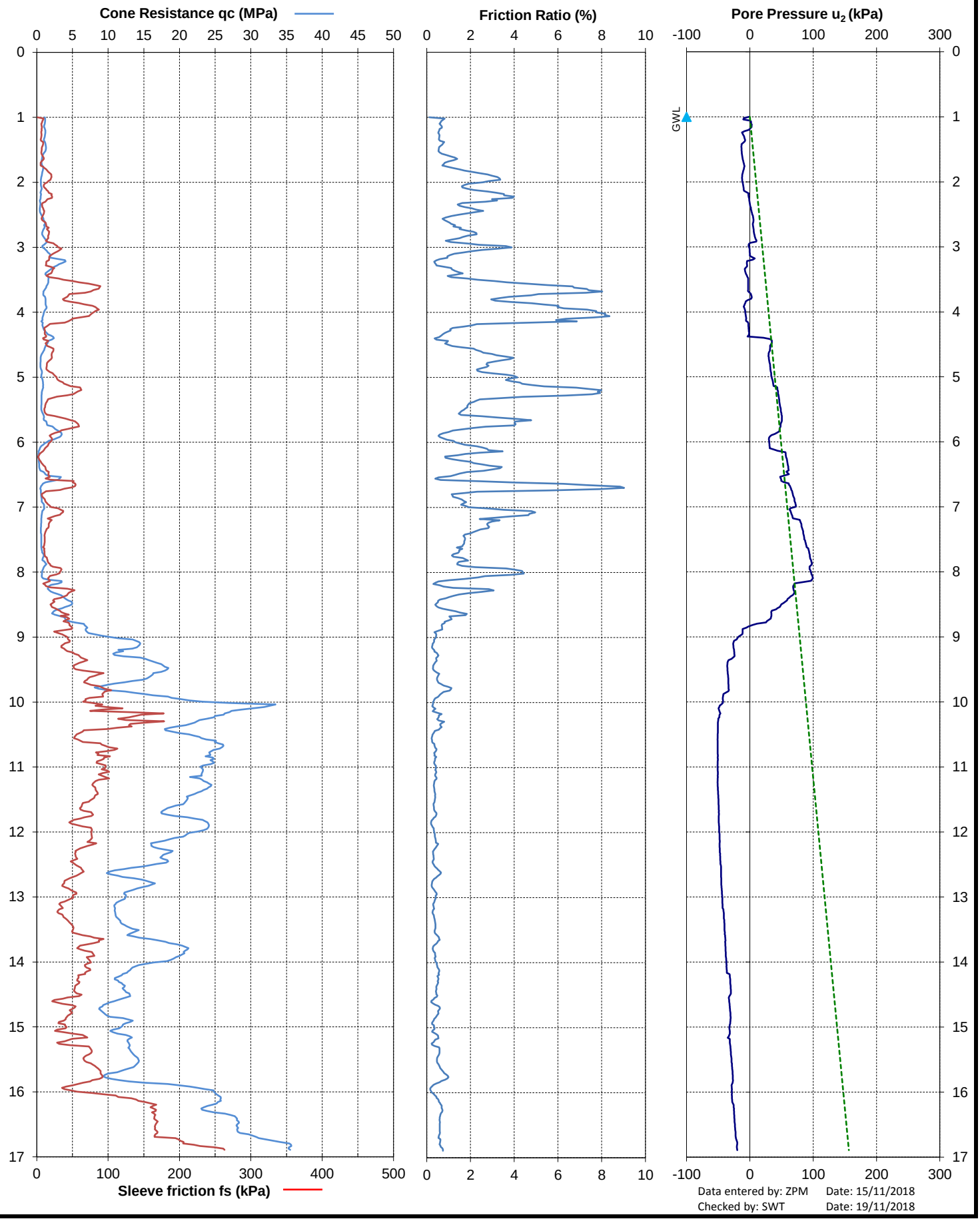
CPT02 100 - 104 Park Terrace, Christchurch Central - 13 November, 2018

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

GEOTECHNICS

Pre-Drill:	1m	**NZMG**	2479963mE 5742554mN 13m(amsl)
Assumed GWL:	1m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 16.89m > 35MPa, truck lifting
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



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Checked by: SWT Date: 19/11/2018

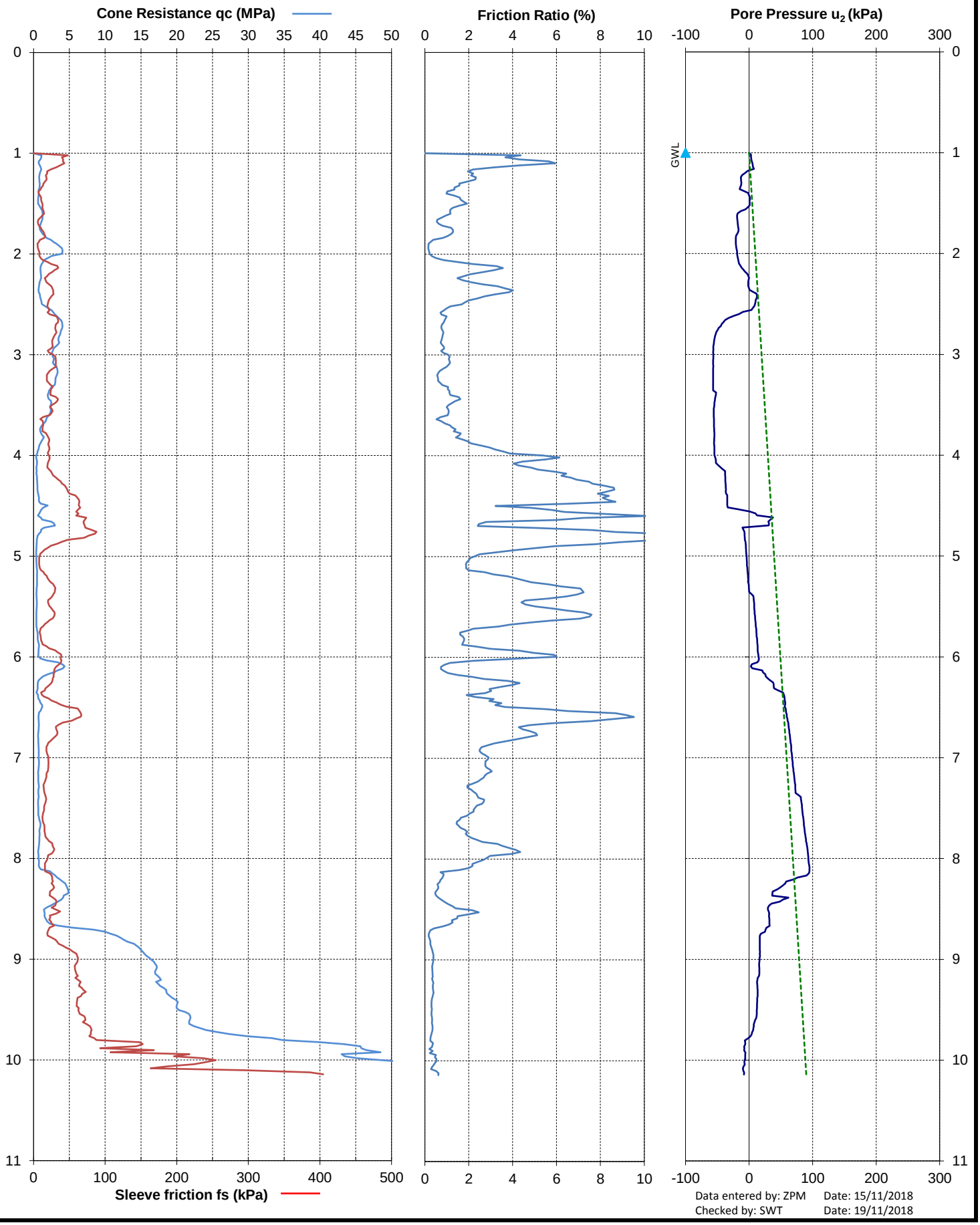
CPT03 100 - 104 Park Terrace, Christchurch Central - 12 November, 2018

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

GEOTECHNICS

Pre-Drill:	1m	**NZMG**	2479955mE 5742604mN 13m(amsl)
Assumed GWL:	1m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 10.14m > 65MPa, truck lifting
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



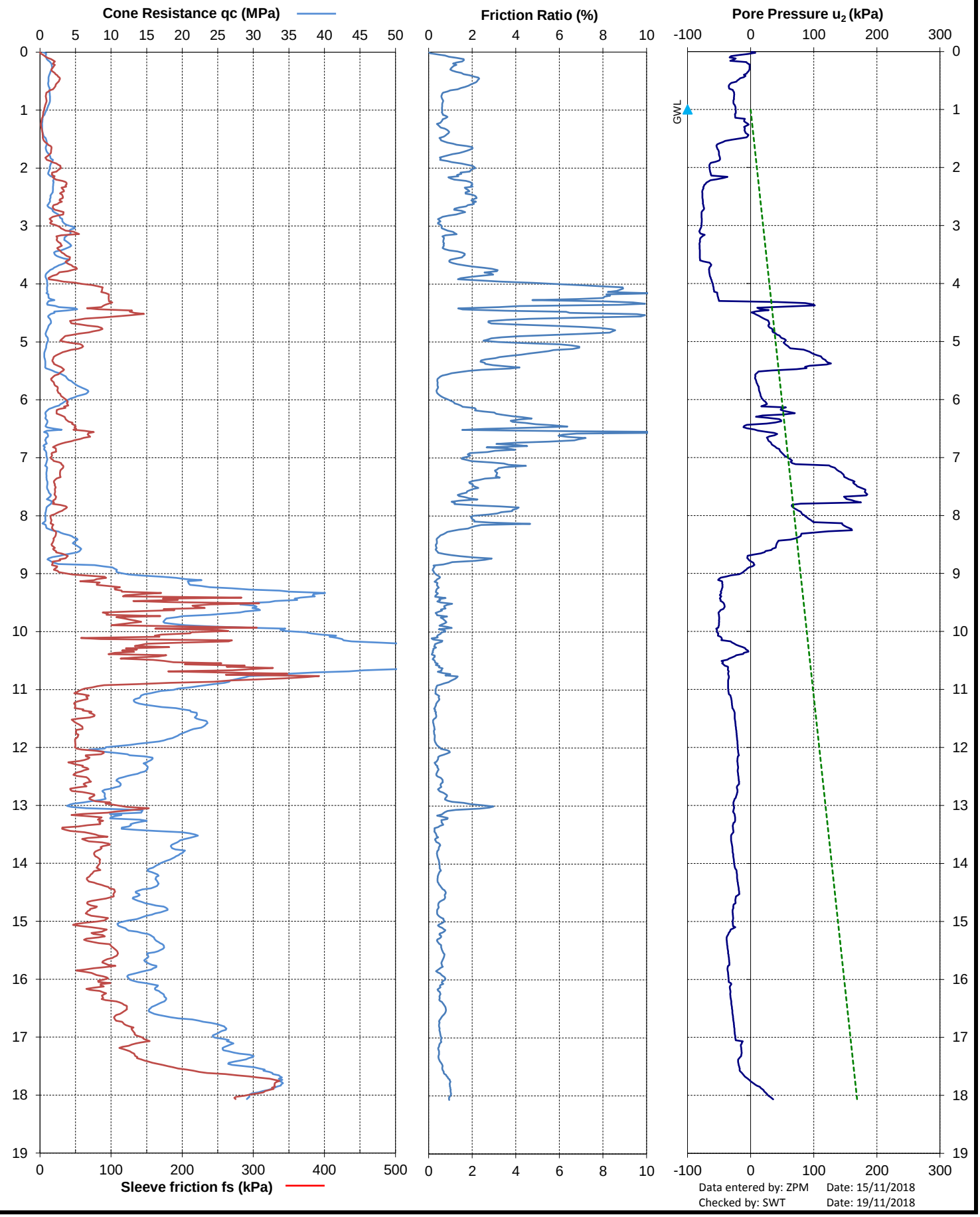
CPT04 100 - 104 Park Terrace, Christchurch Central - 13 November, 2018

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

GEOTECHNICS

Pre-Drill:	0m	**NZMG**	2479991mE 5742625mN 13m(amsl)
Assumed GWL:	1m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 18.07m > 30MPa, truck lifting
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



Data entered by: ZPM Date: 15/11/2018
Checked by: SWT Date: 19/11/2018

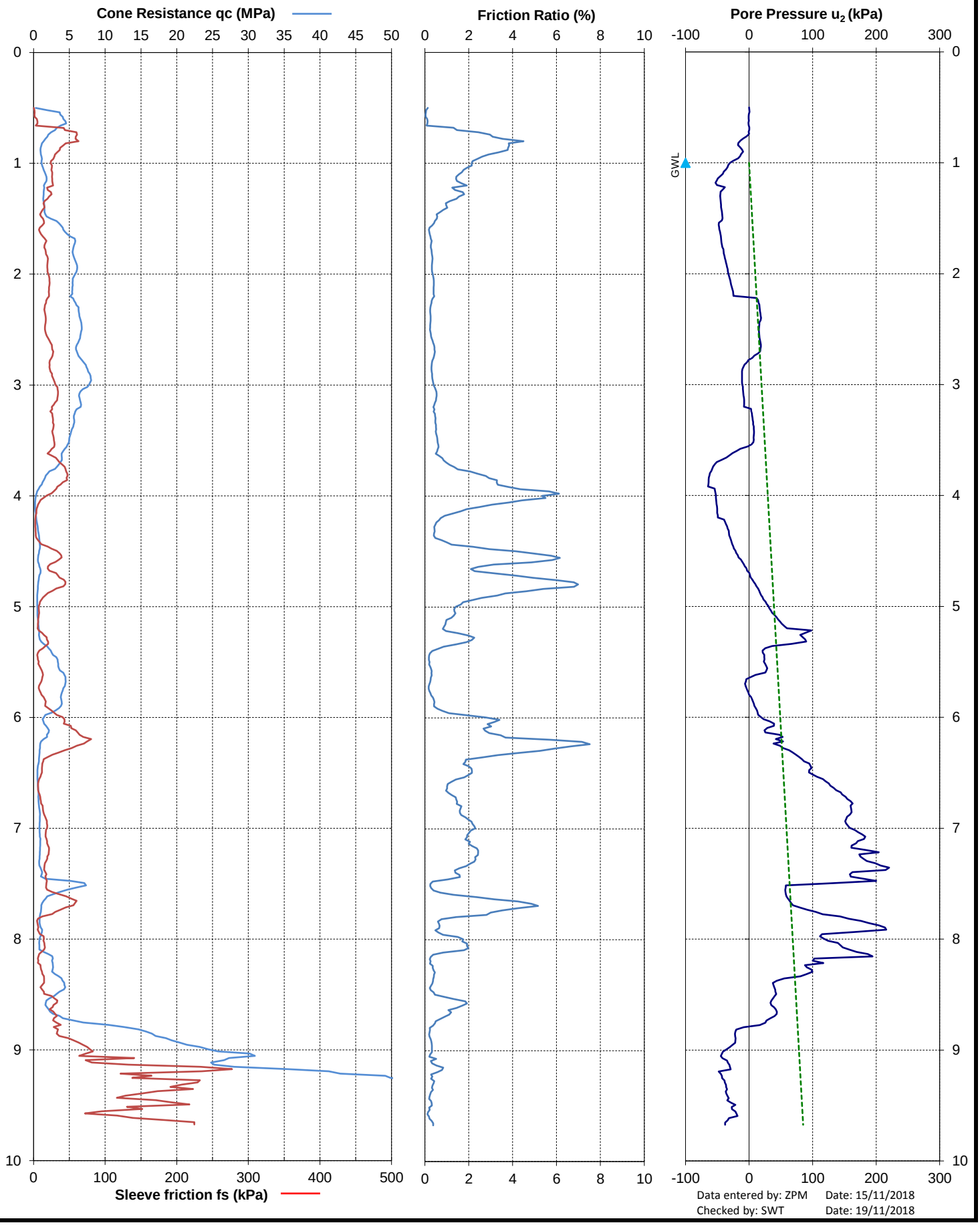
CPT05 100 - 104 Park Terrace, Christchurch Central - 12 November, 2018

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

GEOTECHNICS

Pre-Drill:	0.5m	**NZMG**	2480013mE 5742560mN 13m(amsl)
Assumed GWL:	1m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 9.67m > 60MPa, truck lifting
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



Data entered by: ZPM Date: 15/11/2018
Checked by: SWT Date: 19/11/2018

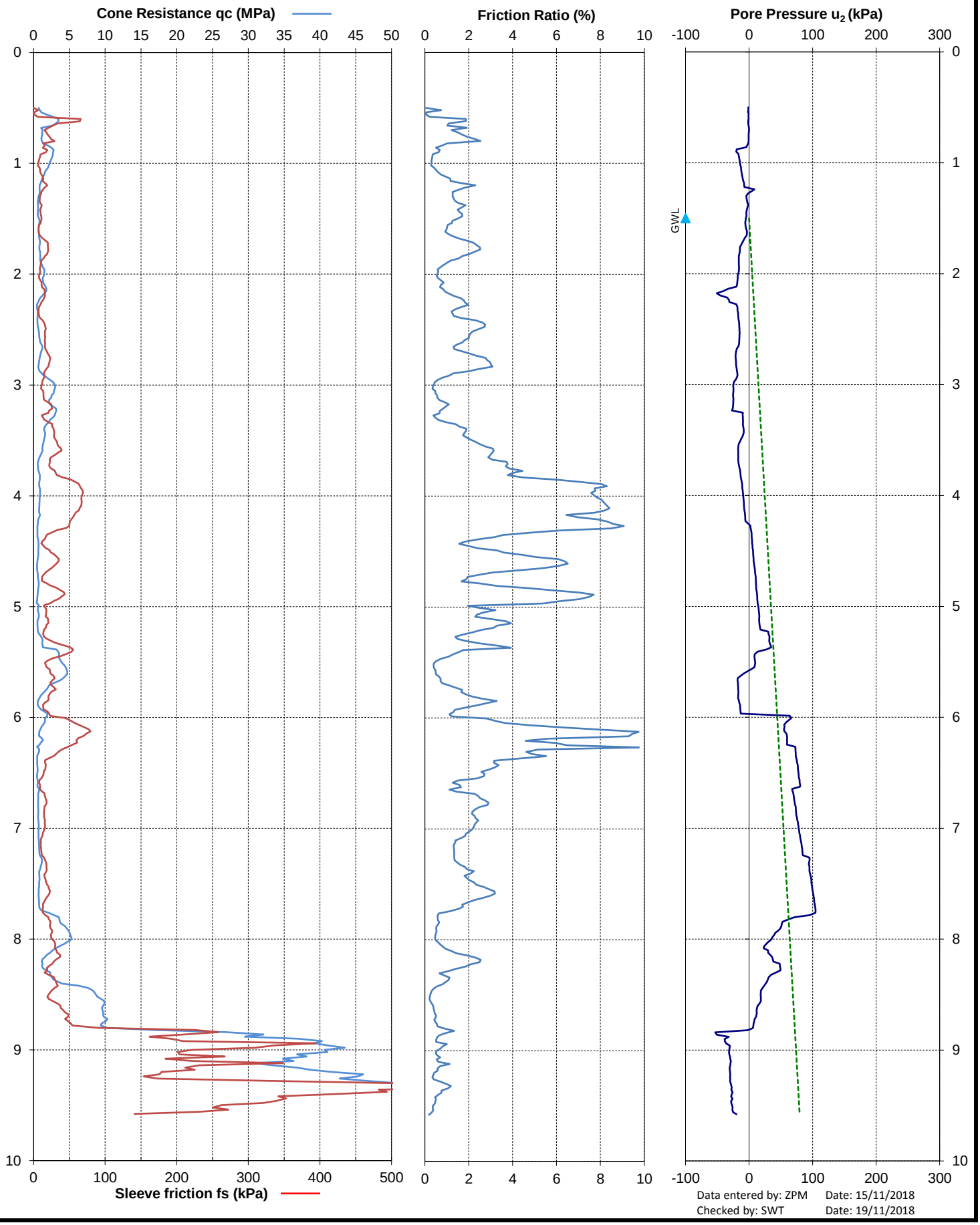
CPT06 100 - 104 Park Terrace, Christchurch Central - 13 November, 2018

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

GEOTECHNICS

Pre-Drill:	0.5m	**NZMG**	5742682mE 2479972mN 13m(amsl)
Assumed GWL:	1.5m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 9.58m > 75MPa, truck lifting
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



Data entered by: ZPM Date: 15/11/2018
Checked by: SWT Date: 19/11/2018

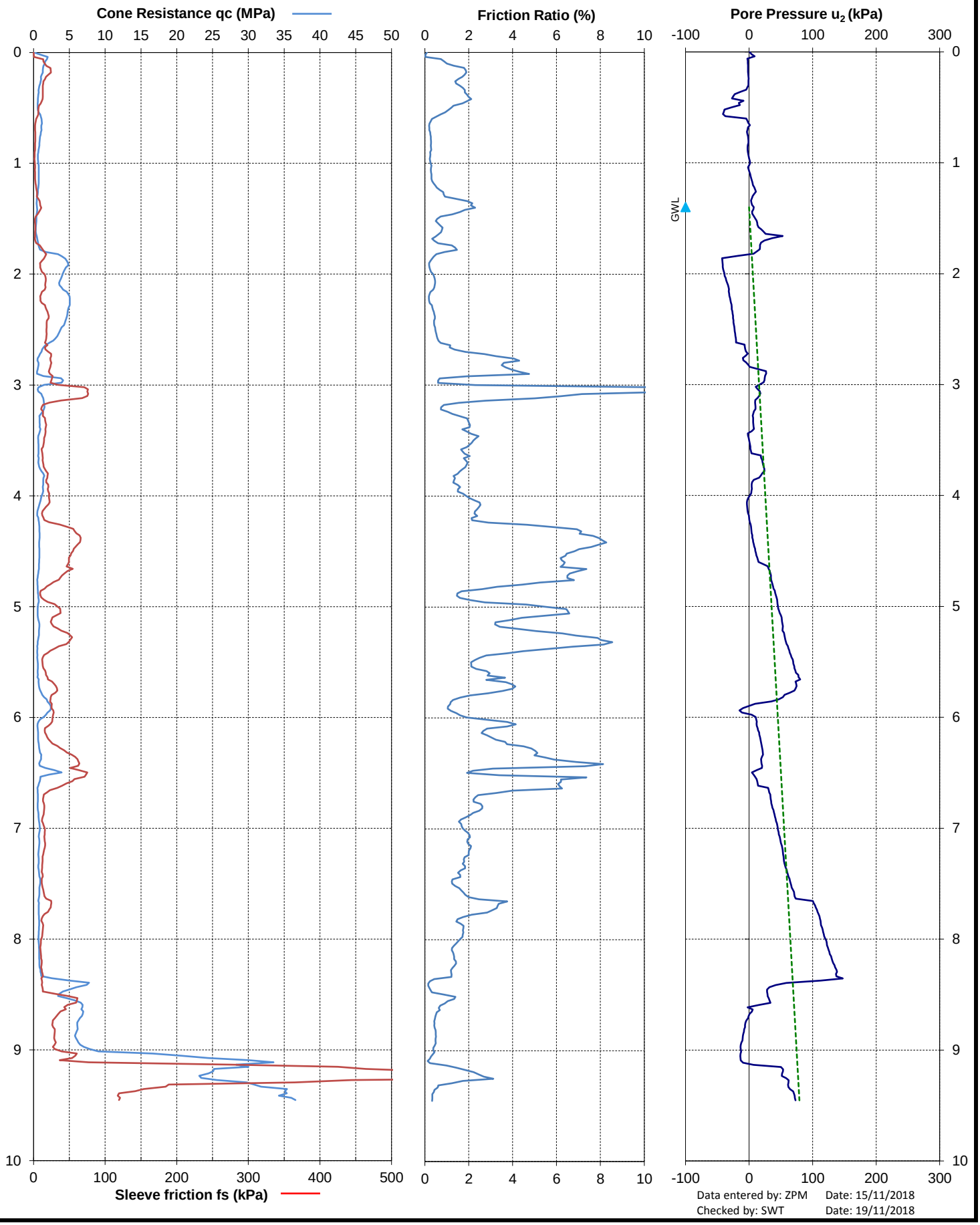
CPT07 100 - 104 Park Terrace, Christchurch Central - 13 November, 2018

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

GEOTECHNICS

Pre-Drill:	0m	**NZMG**	2479948mE 5742662mN 13m(amsl)
Measured GWL:	1.4m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 9.45m > 35MPa, anchor failure
Located By:	Hand GPS/GE (el)		

Geotechnics Ref: 1008830.0.0.0



Data entered by: ZPM Date: 15/11/2018
Checked by: SWT Date: 19/11/2018

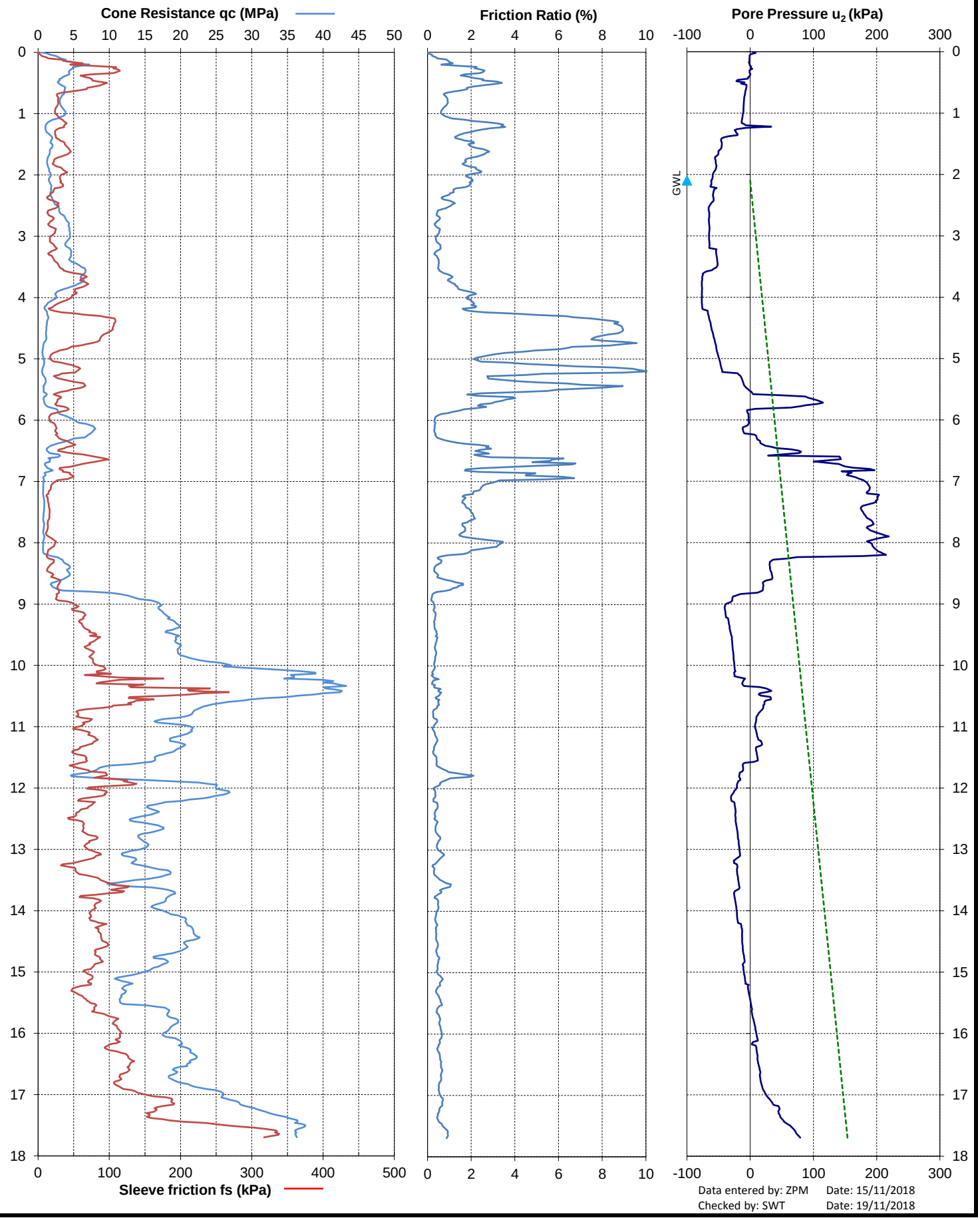
CPT08 100 - 104 Park Terrace, Christchurch Central - 13 November, 2018

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

GEOTECHNICS

Pre-Drill:	0m	**NZMG**	2479982mE 5742609mN 13m(amsl)
Measured GWL:	2.1m (BGL)	**Other Tests:**	None
Operator:	ZPM	**Comments:**	Test refusal at 17.7m > 35MPa, truck lifting
Located By:	Hand GPS/GE (el)		

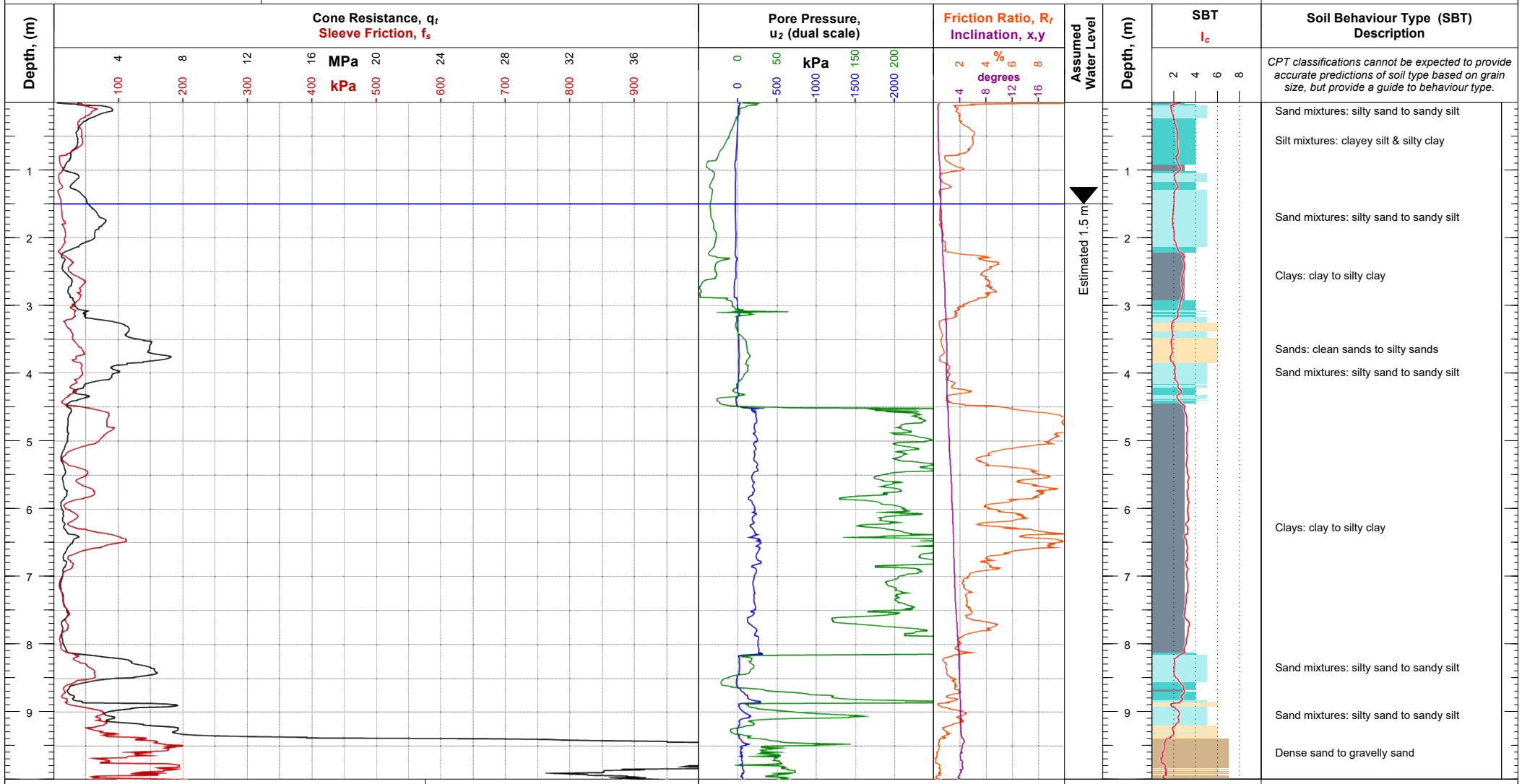
Geotechnics Ref: 1008830.0.0.0



CONE PENETRATION TEST (CPT) LOG

Tonkin+Taylor

GROUND INVESTIGATION



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ311
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5181014.39, 1569923.61
WGS84, (deg): 43.523204, 172.627829
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 21.40
Pre-Drill (m): N/A

Client Job Ref:

CPT Number: SCPT-01

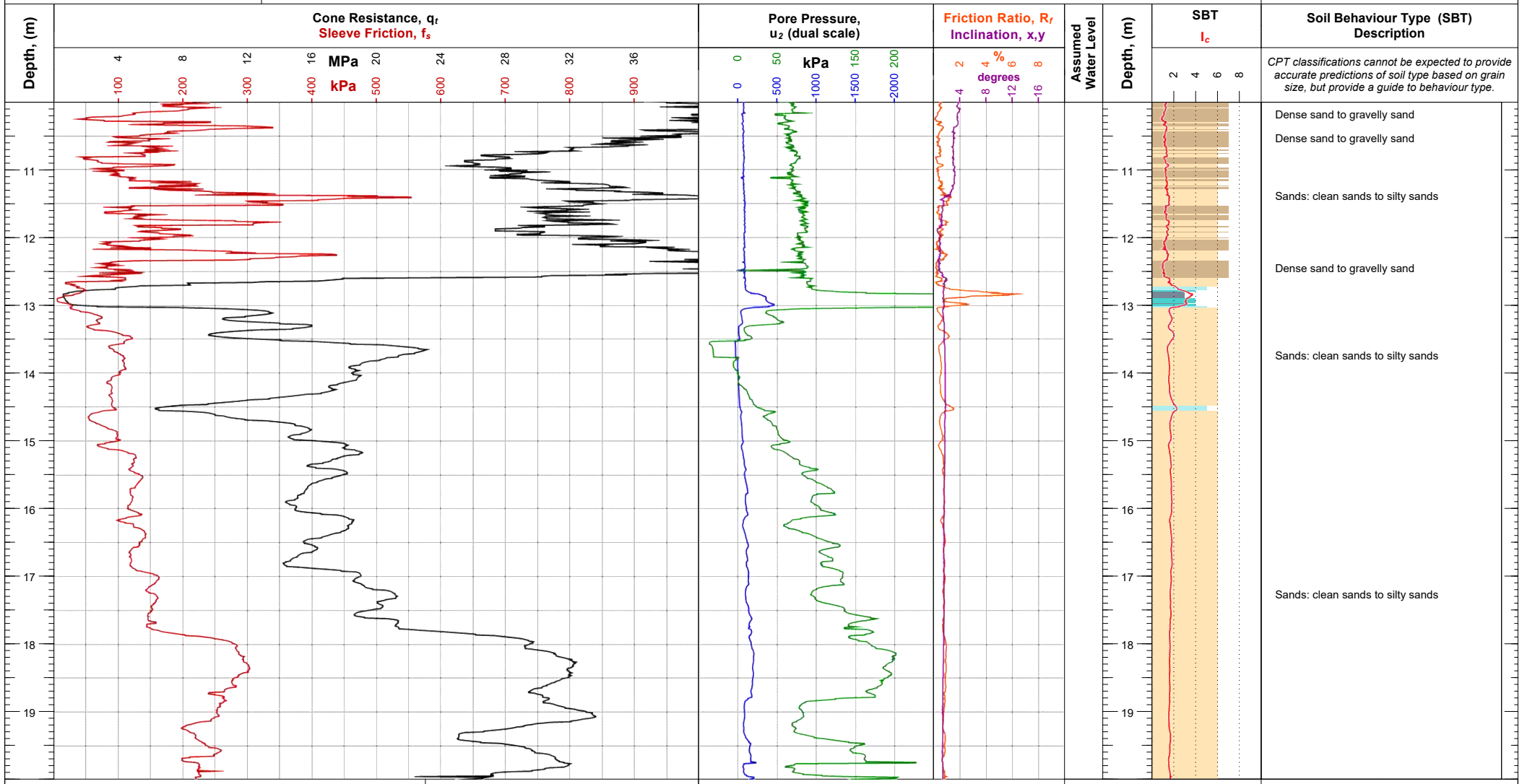
G.I. Job Ref: 18-711

Remarks:

CONE PENETRATION TEST (CPT) LOG

Tonkin+Taylor

GROUND INVESTIGATION



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ311
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5181014.39, 1569923.61
WGS84, (deg): 43.523204, 172.627829
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 21.40
Pre-Drill (m): N/A

Client Job Ref:

CPT Number: SCPT-01

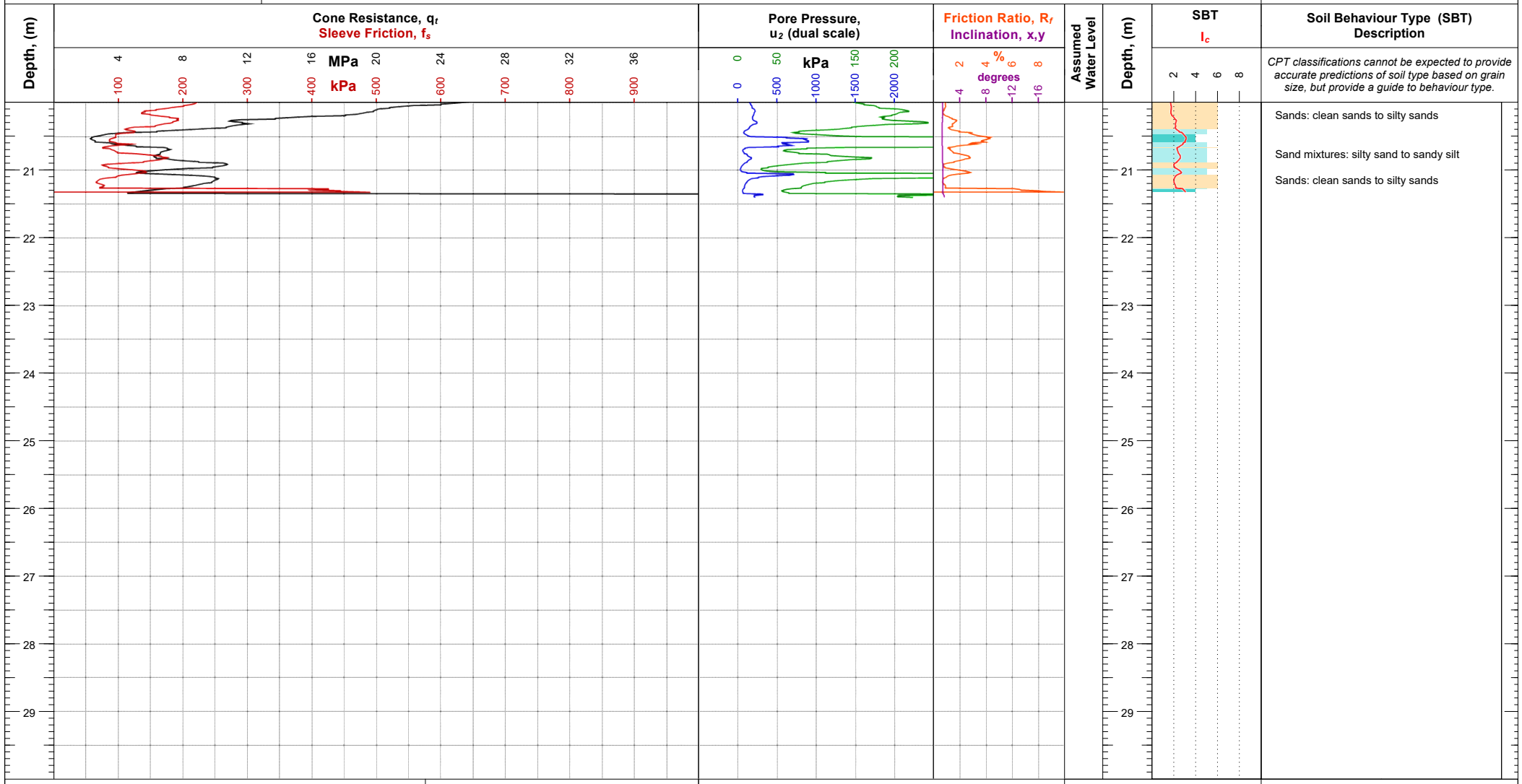
G.I. Job Ref: 18-711

Remarks:

CONE PENETRATION TEST (CPT) LOG

Tonkin+Taylor

GROUND INVESTIGATION



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ311
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5181014.39, 1569923.61
WGS84, (deg): 43.523204, 172.627829
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 21.40
Pre-Drill (m): N/A

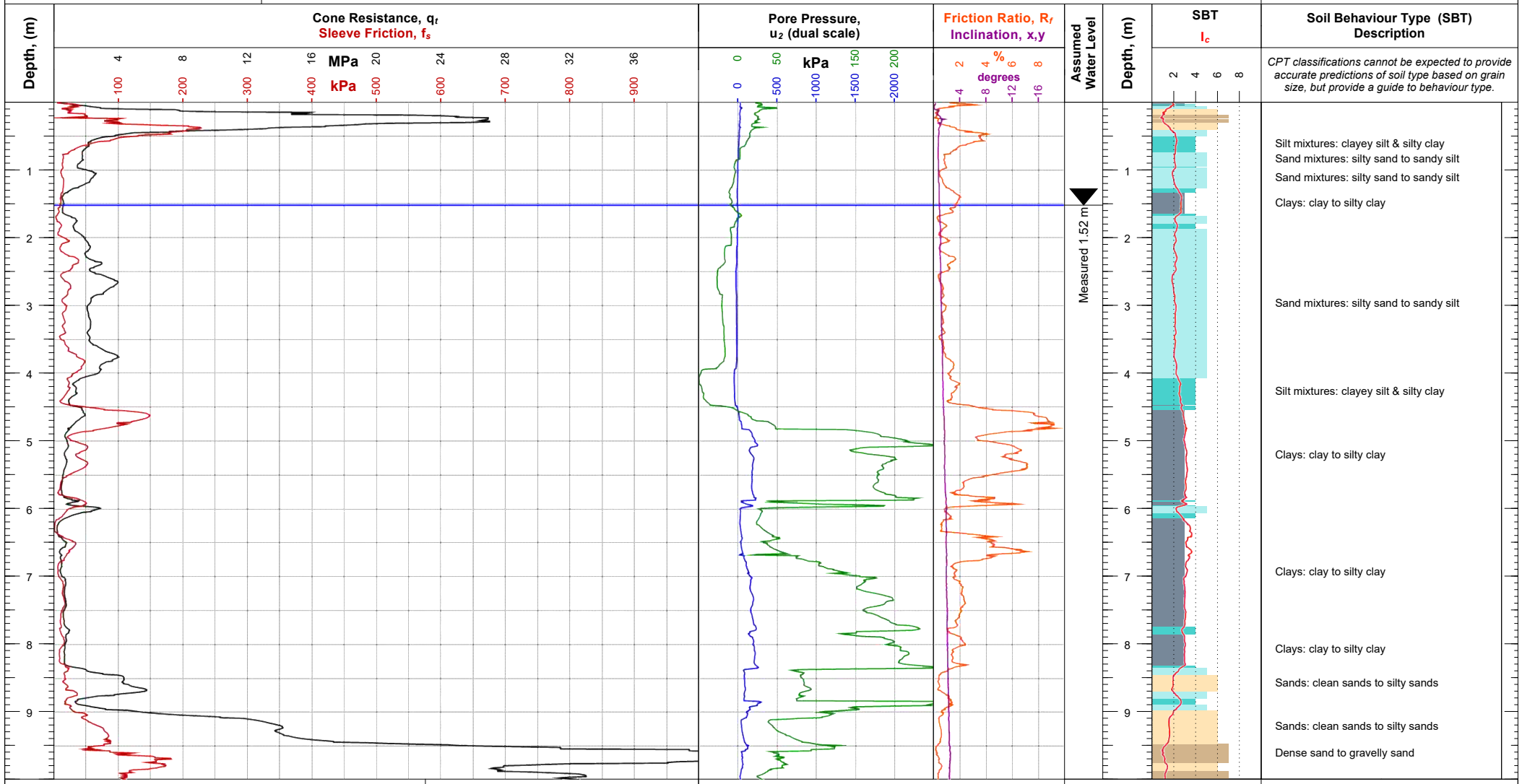
Client Job Ref:

CPT Number: SCPT-01

G.I. Job Ref: 18-711

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ311
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5180974.86, 1569998.33
WGS84, (deg): 43.523563, 172.628752
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 18.81
Pre-Drill (m): N/A

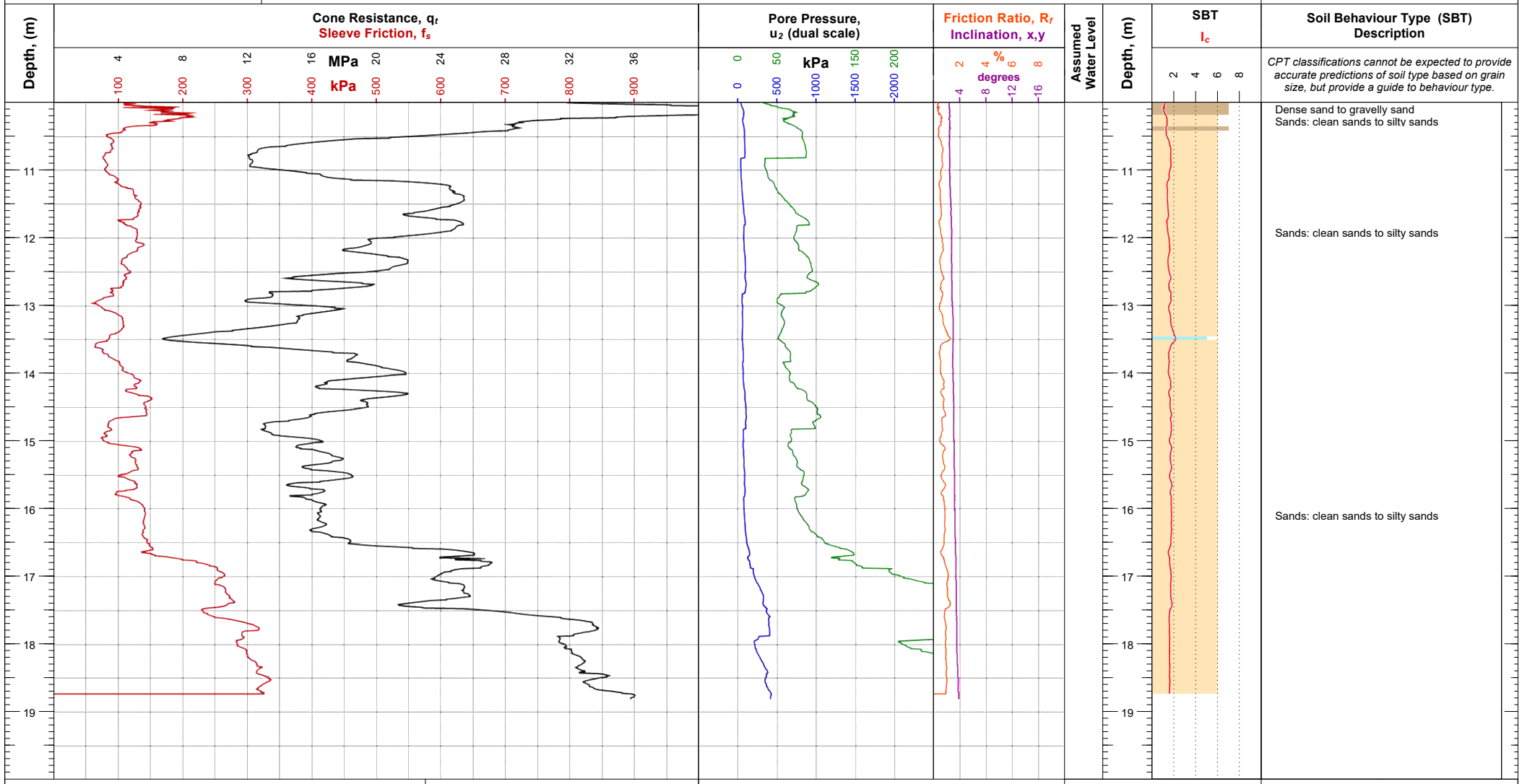
Client Job Ref:

CPT Number: SCPT-02

G.I. Job Ref: 18-711

Remarks:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Brendon Lemm
Cone Ref: MKJ311
Cone Type: 10 cm² Compression
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5180974.86, 1569998.33
WGS84, (deg): 43.523563, 172.628752
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 18.81
Pre-Drill (m): N/A

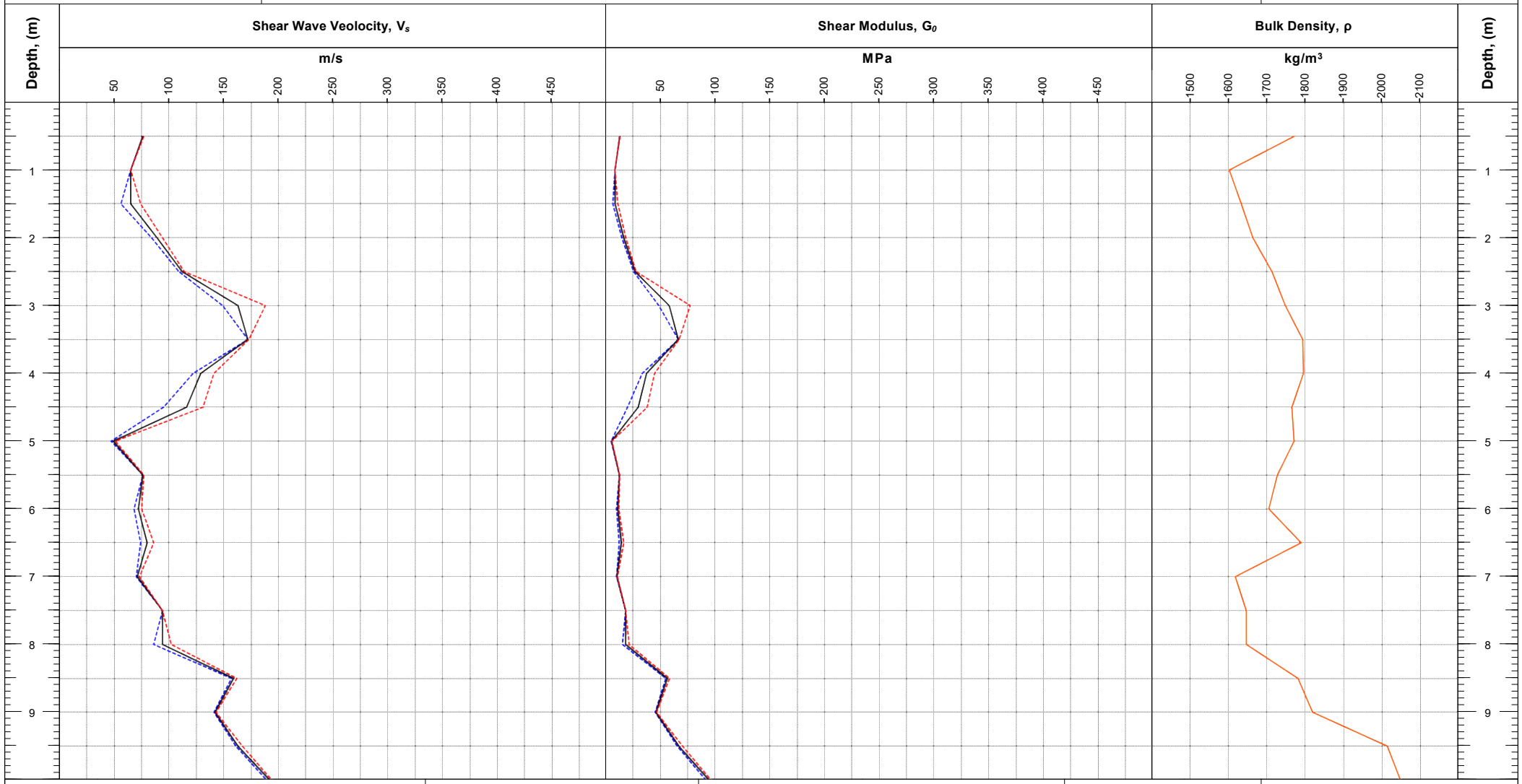
Client Job Ref:

CPT Number: SCPT-02

G.I. Job Ref: 18-711

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

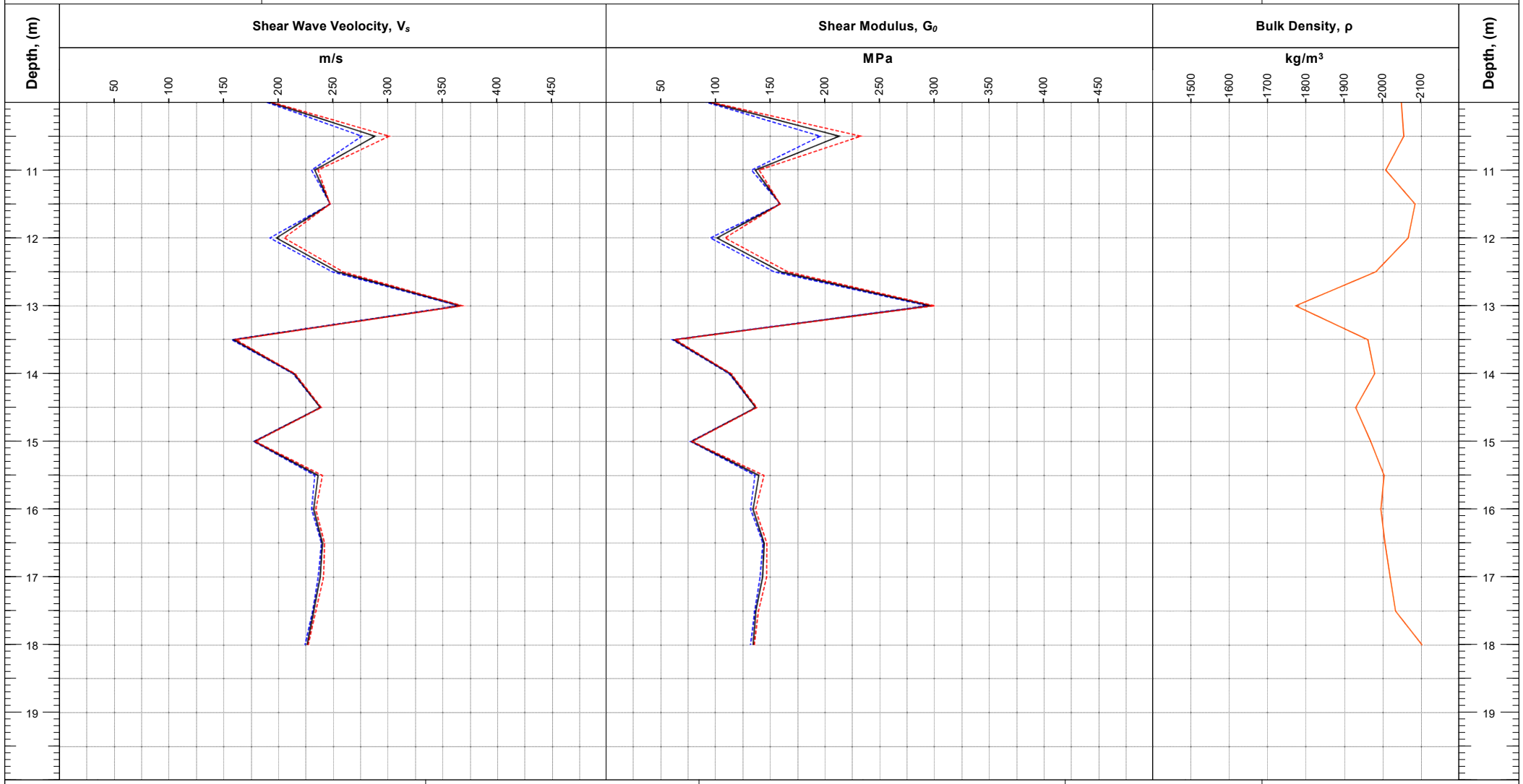
NZTM2000 N,E (m): 5181014.39, 1569923.61
WGS84, (deg): 172.627829, 43.523204
Location Method: Handheld GPS
Source Type:
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 21.40
Offset (m): 0.30

Test Number: SCPT-01
Client Job Ref:
G.I. Job Ref: 18-711

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

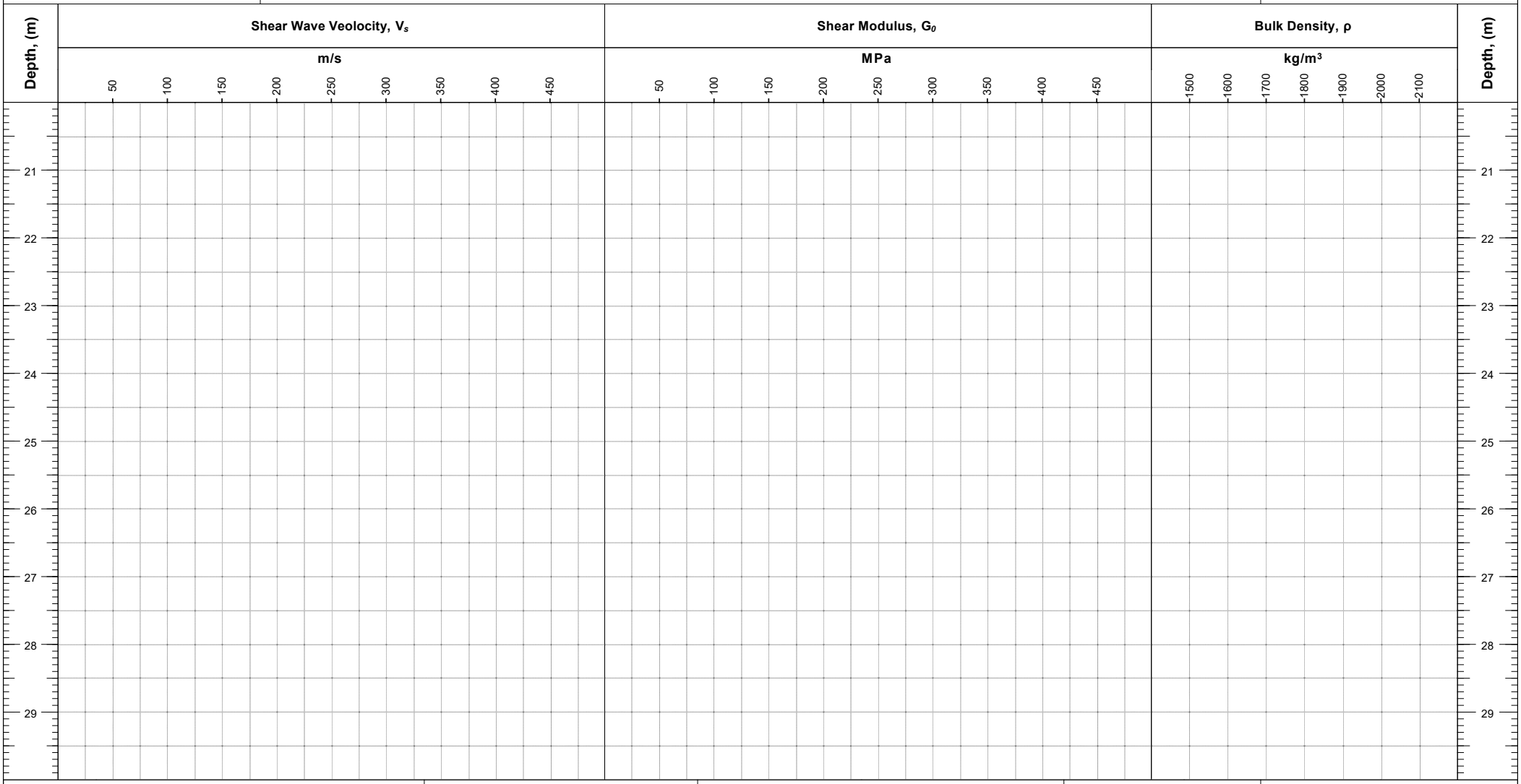
NZTM2000 N,E (m): 5181014.39, 1569923.61
WGS84, (deg): 172.627829, 43.523204
Location Method: Handheld GPS
Source Type:
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 21.40
Offset (m): 0.30

Test Number: SCPT-01
Client Job Ref:
G.I. Job Ref: 18-711

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

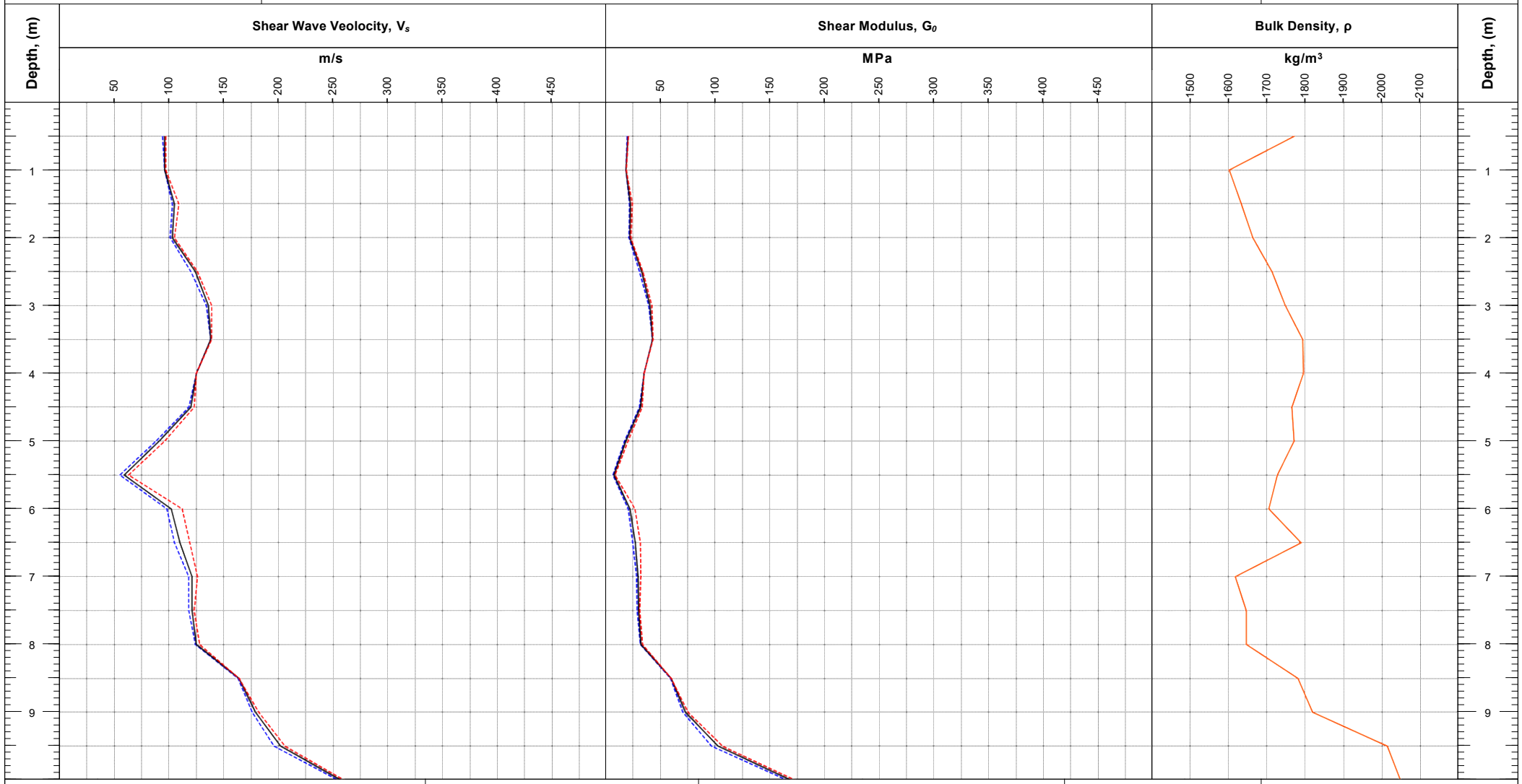
NZTM2000 N,E (m): 5181014.39, 1569923.61
WGS84, (deg): 172.627829, 43.523204
Location Method: Handheld GPS
Source Type:
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 21.40
Offset (m): 0.30

Test Number: SCPT-01
Client Job Ref:
G.I. Job Ref: 18-711

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

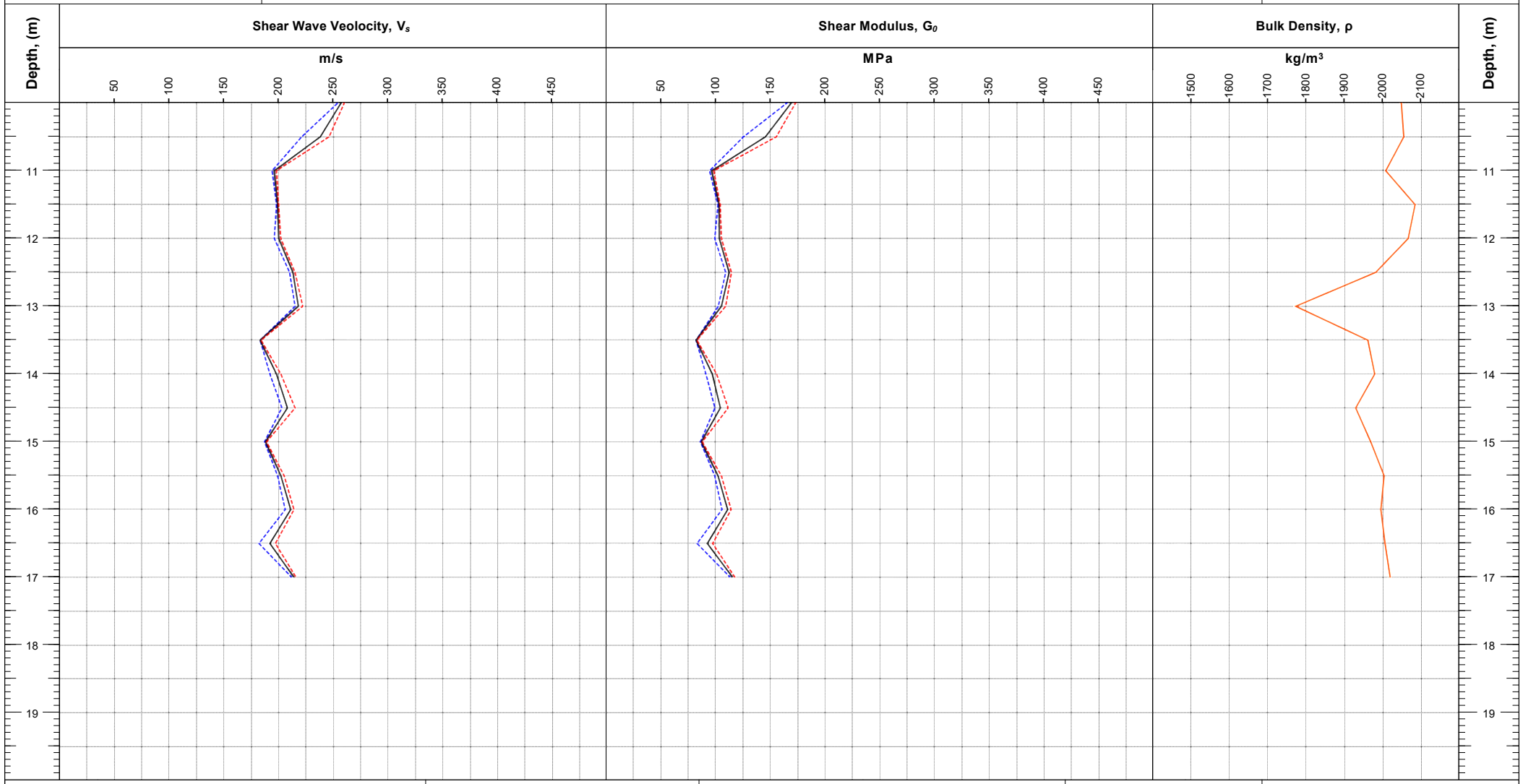
NZTM2000 N,E (m): 5180974.86, 1569998.33
WGS84, (deg): 172.628752, 43.523563
Location Method: Handheld GPS
Source Type:
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 18.81
Offset (m): 0.30

Test Number: SCPT-02
Client Job Ref:
G.I. Job Ref: 18-711

Remarks:

DOWNHOLE SEISMIC TEST LOG



Client: Tonkin + Taylor
Project: 100 Park Terrace
Location: Central Christchurch
Engineer: Omm Prahankhet
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Key:
- Measured Lower Bound
- Measured Average Value
- Measured Upper Bound
- ρ from G_0 Calculation

NZTM2000 N,E (m): 5180974.86, 1569998.33
WGS84, (deg): 172.628752, 43.523563
Location Method: Handheld GPS
Source Type:
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 15/11/2018
Depth (m): 18.81
Offset (m): 0.30

Test Number: SCPT-02
Client Job Ref:
G.I. Job Ref: 18-711

Remarks:

HOLE Id: **HASC01**

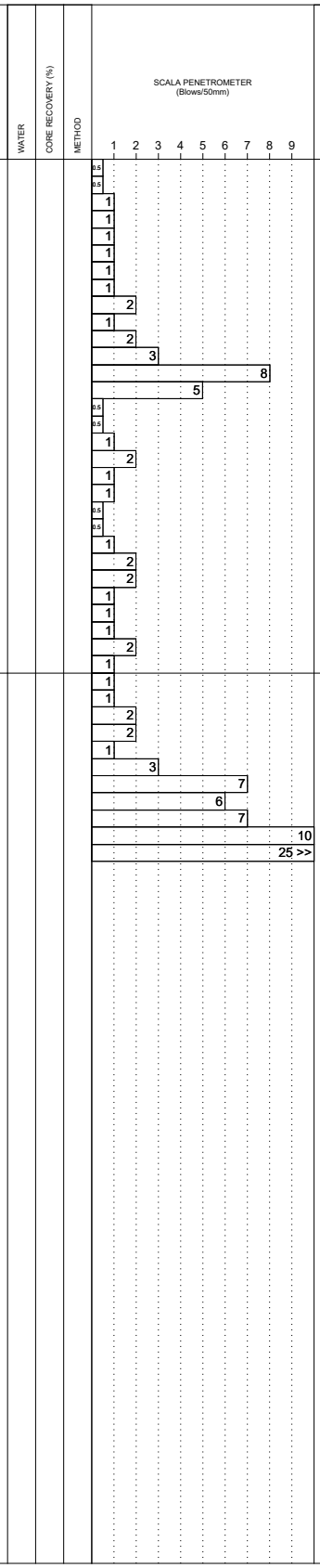
SHEET: 1 OF 1

GEOTECHNICS

HAND AUGER LOG

PROJECT: G CH Park Terrace Markout, CPT, HA/SC		LOCATION: Park Terr100-104 Park Terrace, City C	JOB No.: 1008830.0000
CO-ORDINATES: WGS84	172.627566 -43.523756	DRILL TYPE: Hand Auger/Scala	HOLE STARTED: 12/11/2018
		DRILL METHOD: HA+DCP	HOLE FINISHED: 12/11/2018
R.L.:	8.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: SWT CHECKED: HEWI

GEOLOGICAL | ENGINEERING DESCRIPTION



Organic SILT, minor sand, trace gravel; dark brown. Very soft, moist, non-plastic; silt, non-dilatant; Organic, amorphous; gravel, fine, subrounded to subangular; trace rootlets.

0.1m: trace brick fragments; gravel, fine to medium, brown.

0.3-0.9m: no recovery (core loss).

Gravelly SAND, some brick fragments; brown. Loose, moist, well graded; sand, fine to coarse; gravel, angular to rounded.

1.0m: trace charcoal.

1.2-1.3m: no recovery (core loss).

1.3m: trace concrete.

End of hole at 1.50mbgl - refusal.

COMMENTS: No standing groundwater encountered on completion.

Hole Depth 1.5m

Scale 1:21

Rev.: A

HOLE Id: **HASC02**

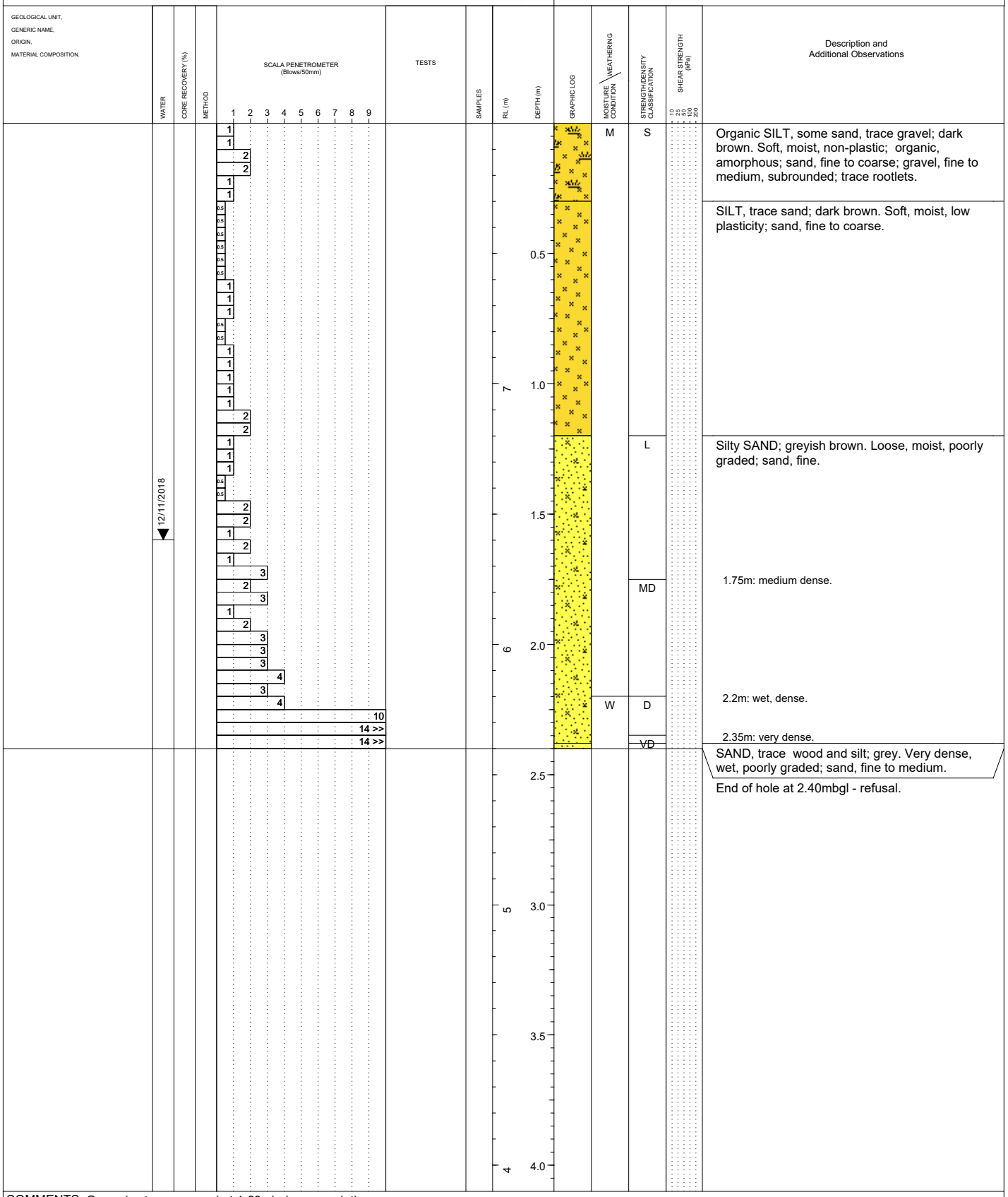
SHEET: 1 OF 1

GEOTECHNICS

HAND AUGER LOG

PROJECT: G CH Park Terrace Markout, CPT, HA/SC		LOCATION: Park Terr100-104 Park Terrace, City C	JOB No.: 1008830.0000
CO-ORDINATES: WGS84	172.627415 -43.523451	DRILL TYPE: Hand Auger/Scala	HOLE STARTED: 12/11/2018
		DRILL METHOD: HA+DCP	HOLE FINISHED: 12/11/2018
R.L.:	8.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: SWT CHECKED: HEWI

GEOLOGICAL | ENGINEERING DESCRIPTION



COMMENTS: Groundwater measured at 1.60mbgl on completion.

Hole Depth 2.4m

Scale 1:21

Rev.: A

HOLE Id: **HASC03**

SHEET: 1 OF 1

GEOTECHNICS

HAND AUGER LOG

PROJECT: G CH Park Terrace Markout, CPT, HA/SC		LOCATION: Park Terr100-104 Park Terrace, City C	JOB No.: 1008830.0000
CO-ORDINATES: WGS84	172.627687 -43.523070	DRILL TYPE: Hand Auger/Scala	HOLE STARTED: 12/11/2018
		DRILL METHOD: HA+DCP	HOLE FINISHED: 12/11/2018
R.L.:	8.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: SWT CHECKED: HEWI

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
	12/11/2018			0.5 0.5 1 1 1 1 1 1 0.5 0.5 0.5 0.5 1 1 1 1 1 2 1 1 1 2 1 1 1 2 1 1 1 2 2 2 3 2 2 2 2 2 3 1 2 1 2 2 3 2 4 3 4 3 5 5 5 6 5 6 6 5 7 7 5 6 7 6 6 5 5 6 5 6 6			7 6 5 4	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0		D M W	S VL MD F	10 25 50 100 200	Organic SILT, some sand; dark brown. Soft, dry, non-plastic; trace rootlets. 0.1m: trace gravel, trace brick fragments; gravel, fine, rounded. 0.25m: gravel and brick absent. SILT, trace sand; grey. Soft, moist, low plasticity; trace rootlets. 0.5m: rootlets absent. 0.7m: minor sand. Silty SAND; grey. Very loose, moist, poorly graded; sand, fine. SAND, some silt; grey. Very loose, moist, poorly graded; sand, fine. 1.9m: minor silt, greenish grey, medium dense. 2.4m: wet. SILT, trace organics and sand; grey. Firm, moist, low plasticity; organics, amorphous; trace rootlets. 3.2m: minor sand. 3.4m: some sand. 3.6-4.0m: no recovery (core loss). End of hole at 4.00mbgl - target depth.

COMMENTS: Groundwater measured at 1.39mbgl on completion.

Hole Depth 4m

Scale 1:21

Rev.: A

HOLE Id: **HASC04**

SHEET: 1 OF 1

GEOTECHNICS

HAND AUGER LOG

PROJECT: G CH Park Terrace Markout, CPT, HA/SC		LOCATION: Park Terr100-104 Park Terrace, City C	JOB No.: 1008830.0000
CO-ORDINATES: WGS84	172.628246 -43.523069	DRILL TYPE: Hand Auger/Scala	HOLE STARTED: 12/11/2018
		DRILL METHOD: HA+DCP	HOLE FINISHED: 12/11/2018
R.L.:	8.00m		DRILLED BY: GEOTECHNICS
DATUM:	NZVD2016		LOGGED BY: SWT CHECKED: HEWI

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
							7	0.5		D	S		Organic SILT, some sand; brown. Soft, dry, non-plastic; organic, amorphous; sand, fine to medium; trace rootlets.
										M			0.1m: moist. 0.2m: trace gravel, rootlets absent; gravel, fine, roundd. 0.35 - 0.4m: trace rootlets.
													SILT, minor sand; brownish grey. Soft, moist, non-plastic; sand, fine.
								1.0			VL		SAND, trace silt; grey. Very loose, moist, poorly graded; sand, fine.
											L		1.25m: minor silt, loose.
							6	1.5		W	S		Sandy SILT; grey. Soft, wet, low plasticity; sand, fine.
								2.0					SILT, minor sand; grey. Soft, wet, low plasticity; sand, fine. 2.0m: trace sand.
								2.5		M	D		SAND, some silt; greenish grey. Dense, moist, poorly graded; sand, fine.
										W	MD		2.7m: wet, medium dense.
							5	3.0			F		SILT, trace sand; dark grey. Firm, wet, low plasticity; sand, fine. 3.4m: minor sand, grey. 3.7m: trace sand.
							4	4.0					End of hole at 4.00mbgl - target depth.

COMMENTS: No standing groundwater measured (hole collapse).

Hole Depth 4m

Scale 1:21

Rev.: A

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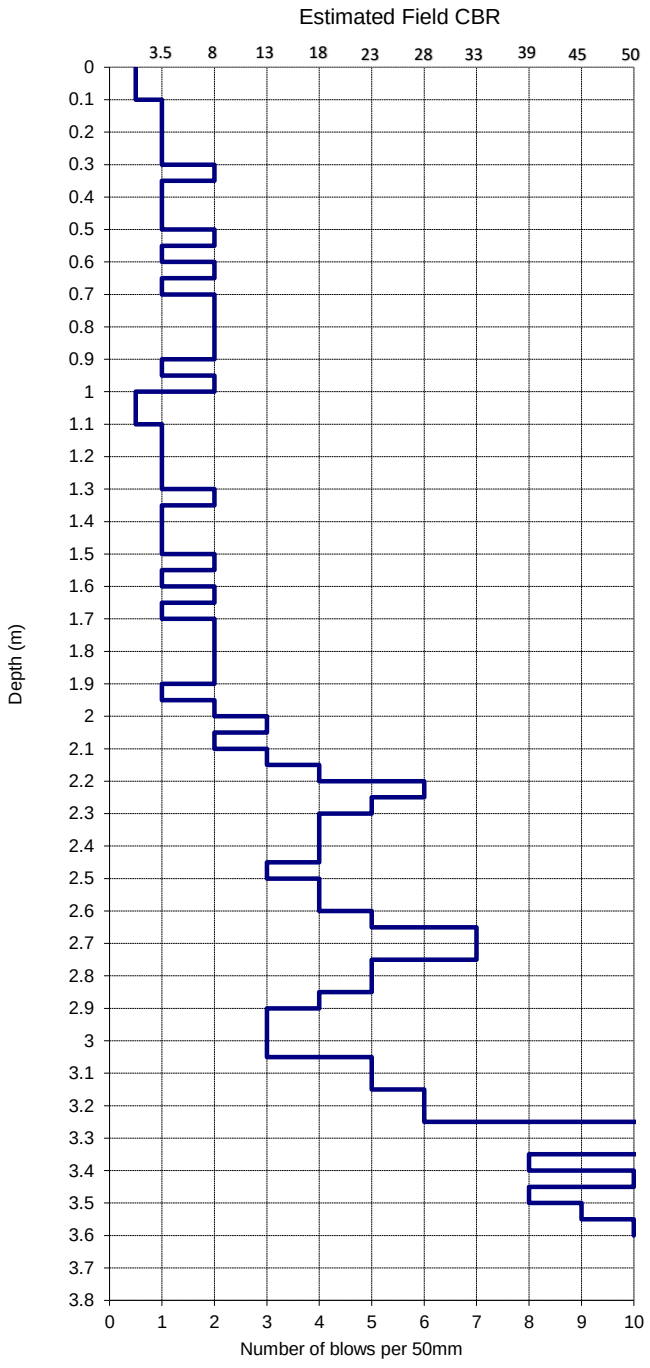
NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0	Test Number	SC01

Easting (NZMG)	Northing	Level
2479940	5742590	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	50	0.5	1750	1750	2	3450	3450	10
100	100	0.5	1800	1800	2	3500	3500	8
150	150	1	1850	1850	2	3550	3550	9
200	200	1	1900	1900	2	3600	3600	10
250	250	1	1950	1950	1	3650	3650	
300	300	1	2000	2000	2	3700	3700	
350	350	1	2050	2050	3	3750	3750	
400	400	1	2100	2100	2	3800	3800	
450	450	0.33	2150	2150	3	3850	3850	
500	500	0.33	2200	2200	4	3900	3900	
550	550	0.33	2250	2250	6	3950	3950	
600	600	0.25	2300	2300	5	4000	4000	
650	650	0.25	2350	2350	4	4050	4050	
700	700	0.25	2400	2400	4	4100	4100	
750	750	0.25	2450	2450	4	4150	4150	
800	800	0.2	2500	2500	3	4200	4200	
850	850	0.2	2550	2550	4	4250	4250	
900	900	0.2	2600	2600	4	4300	4300	
950	950	0.2	2650	2650	5	4350	4350	
1000	1000	0.2	2700	2700	7	4400	4400	
1050	1050	0.5	2750	2750	7	4450	4450	
1100	1100	0.5	2800	2800	5	4500	4500	
1150	1150	1	2850	2850	5	4550	4550	
1200	1200	1	2900	2900	4	4600	4600	
1250	1250	1	2950	2950	3	4650	4650	
1300	1300	1	3000	3000	3	4700	4700	
1350	1350	2	3050	3050	3	4750	4750	
1400	1400	1	3100	3100	5	4800	4800	
1450	1450	1	3150	3150	5	4850	4850	
1500	1500	1	3200	3200	6	4900	4900	
1550	1550	2	3250	3250	6	4950	4950	
1600	1600	1	3300	3300	15	5000	5000	
1650	1650	2	3350	3350	16	5050	5050	
1700	1700	1	3400	3400	8	5100	5100	



Test Remarks

Please note Estimated Field CBR cannot be calculated over 10 blows.

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

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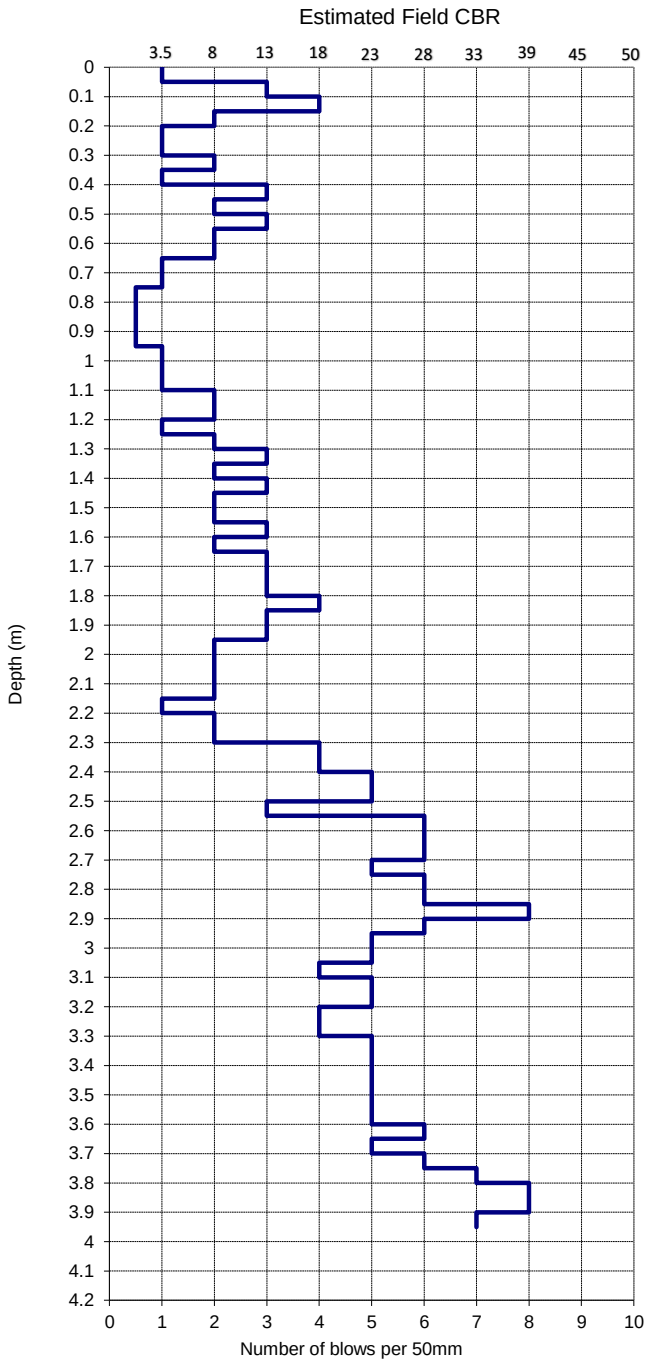
NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0	Test Number	SC02

Easting (NZMG)	Northing	Level
2479959	5742623	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	50	1	1750	1750	3	3450	3450	5
100	100	3	1800	1800	3	3500	3500	5
150	150	4	1850	1850	4	3550	3550	5
200	200	2	1900	1900	3	3600	3600	5
250	250	1	1950	1950	3	3650	3650	6
300	300	1	2000	2000	2	3700	3700	5
350	350	2	2050	2050	2	3750	3750	6
400	400	1	2100	2100	2	3800	3800	7
450	450	3	2150	2150	2	3850	3850	8
500	500	2	2200	2200	1	3900	3900	8
550	550	3	2250	2250	2	3950	3950	7
600	600	2	2300	2300	2	4000	4000	
650	650	2	2350	2350	4	4050	4050	
700	700	1	2400	2400	4	4100	4100	
750	750	1	2450	2450	5	4150	4150	
800	800	0.5	2500	2500	5	4200	4200	
850	850	0.5	2550	2550	3	4250	4250	
900	900	0.5	2600	2600	6	4300	4300	
950	950	0.5	2650	2650	6	4350	4350	
1000	1000	1	2700	2700	6	4400	4400	
1050	1050	1	2750	2750	5	4450	4450	
1100	1100	1	2800	2800	6	4500	4500	
1150	1150	2	2850	2850	6	4550	4550	
1200	1200	2	2900	2900	8	4600	4600	
1250	1250	1	2950	2950	6	4650	4650	
1300	1300	2	3000	3000	5	4700	4700	
1350	1350	3	3050	3050	5	4750	4750	
1400	1400	2	3100	3100	4	4800	4800	
1450	1450	3	3150	3150	5	4850	4850	
1500	1500	2	3200	3200	5	4900	4900	
1550	1550	2	3250	3250	4	4950	4950	
1600	1600	3	3300	3300	4	5000	5000	
1650	1650	2	3350	3350	5	5050	5050	
1700	1700	3	3400	3400	5	5100	5100	



Test Remarks

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

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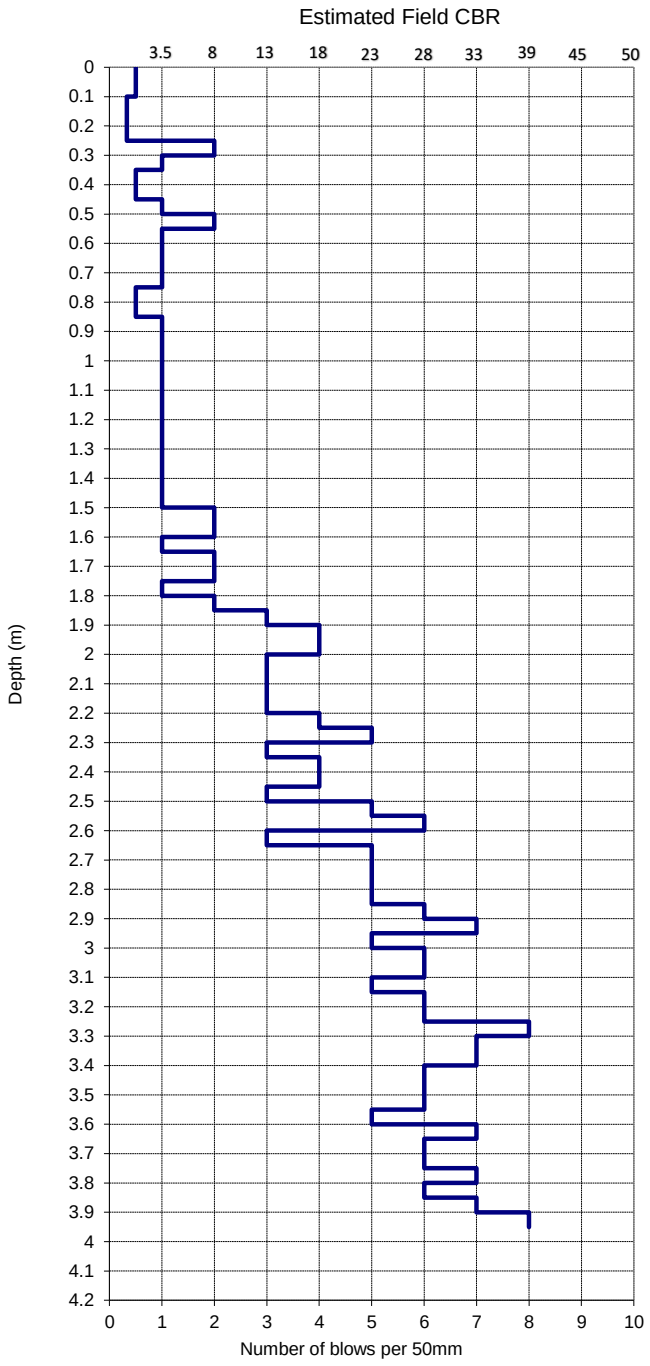
NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0	Test Number	SC03

Easting (NZMG)	Northing	Level
2479966	5742694	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	50	0.5	1750	1750	2	3450	3450	6
100	100	0.5	1800	1800	1	3500	3500	6
150	150	0.33	1850	1850	2	3550	3550	6
200	200	0.33	1900	1900	3	3600	3600	5
250	250	0.33	1950	1950	4	3650	3650	7
300	300	2	2000	2000	4	3700	3700	6
350	350	1	2050	2050	3	3750	3750	6
400	400	0.5	2100	2100	3	3800	3800	7
450	450	0.5	2150	2150	3	3850	3850	6
500	500	1	2200	2200	3	3900	3900	7
550	550	2	2250	2250	4	3950	3950	8
600	600	1	2300	2300	5	4000	4000	
650	650	1	2350	2350	3	4050	4050	
700	700	1	2400	2400	4	4100	4100	
750	750	1	2450	2450	4	4150	4150	
800	800	0.5	2500	2500	3	4200	4200	
850	850	0.5	2550	2550	5	4250	4250	
900	900	1	2600	2600	6	4300	4300	
950	950	1	2650	2650	3	4350	4350	
1000	1000	1	2700	2700	5	4400	4400	
1050	1050	1	2750	2750	5	4450	4450	
1100	1100	1	2800	2800	5	4500	4500	
1150	1150	1	2850	2850	5	4550	4550	
1200	1200	1	2900	2900	6	4600	4600	
1250	1250	1	2950	2950	7	4650	4650	
1300	1300	1	3000	3000	5	4700	4700	
1350	1350	1	3050	3050	6	4750	4750	
1400	1400	1	3100	3100	6	4800	4800	
1450	1450	1	3150	3150	5	4850	4850	
1500	1500	1	3200	3200	6	4900	4900	
1550	1550	2	3250	3250	6	4950	4950	
1600	1600	2	3300	3300	8	5000	5000	
1650	1650	1	3350	3350	7	5050	5050	
1700	1700	2	3400	3400	7	5100	5100	



Test Remarks

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

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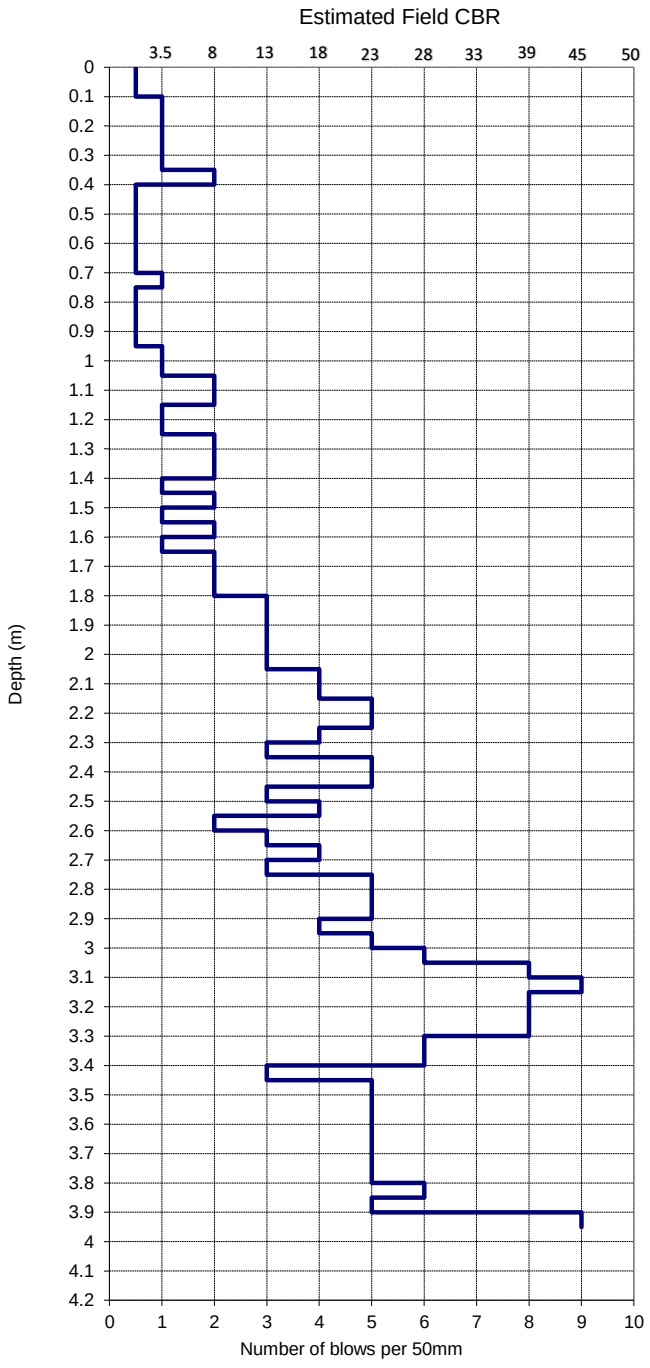
NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0	Test Number	SC04

Easting (NZMG)	Northing	Level
2479970	5742669	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	50	0.5	1750	1750	2	3450	3450	3
100	100	0.5	1800	1800	2	3500	3500	5
150	150	1	1850	1850	3	3550	3550	5
200	200	1	1900	1900	3	3600	3600	5
250	250	1	1950	1950	3	3650	3650	5
300	300	1	2000	2000	3	3700	3700	5
350	350	1	2050	2050	3	3750	3750	5
400	400	2	2100	2100	4	3800	3800	5
450	450	0.5	2150	2150	4	3850	3850	6
500	500	0.5	2200	2200	5	3900	3900	5
550	550	0.5	2250	2250	5	3950	3950	9
600	600	0.5	2300	2300	4	4000	4000	
650	650	0.5	2350	2350	3	4050	4050	
700	700	0.5	2400	2400	5	4100	4100	
750	750	1	2450	2450	5	4150	4150	
800	800	0.5	2500	2500	3	4200	4200	
850	850	0.5	2550	2550	4	4250	4250	
900	900	0.5	2600	2600	2	4300	4300	
950	950	0.5	2650	2650	3	4350	4350	
1000	1000	1	2700	2700	4	4400	4400	
1050	1050	1	2750	2750	3	4450	4450	
1100	1100	2	2800	2800	5	4500	4500	
1150	1150	2	2850	2850	5	4550	4550	
1200	1200	1	2900	2900	5	4600	4600	
1250	1250	1	2950	2950	4	4650	4650	
1300	1300	2	3000	3000	5	4700	4700	
1350	1350	2	3050	3050	6	4750	4750	
1400	1400	1	3100	3100	8	4800	4800	
1450	1450	1	3150	3150	9	4850	4850	
1500	1500	2	3200	3200	8	4900	4900	
1550	1550	1	3250	3250	8	4950	4950	
1600	1600	2	3300	3300	8	5000	5000	
1650	1650	1	3350	3350	6	5050	5050	
1700	1700	2	3400	3400	6	5100	5100	



Test Remarks

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

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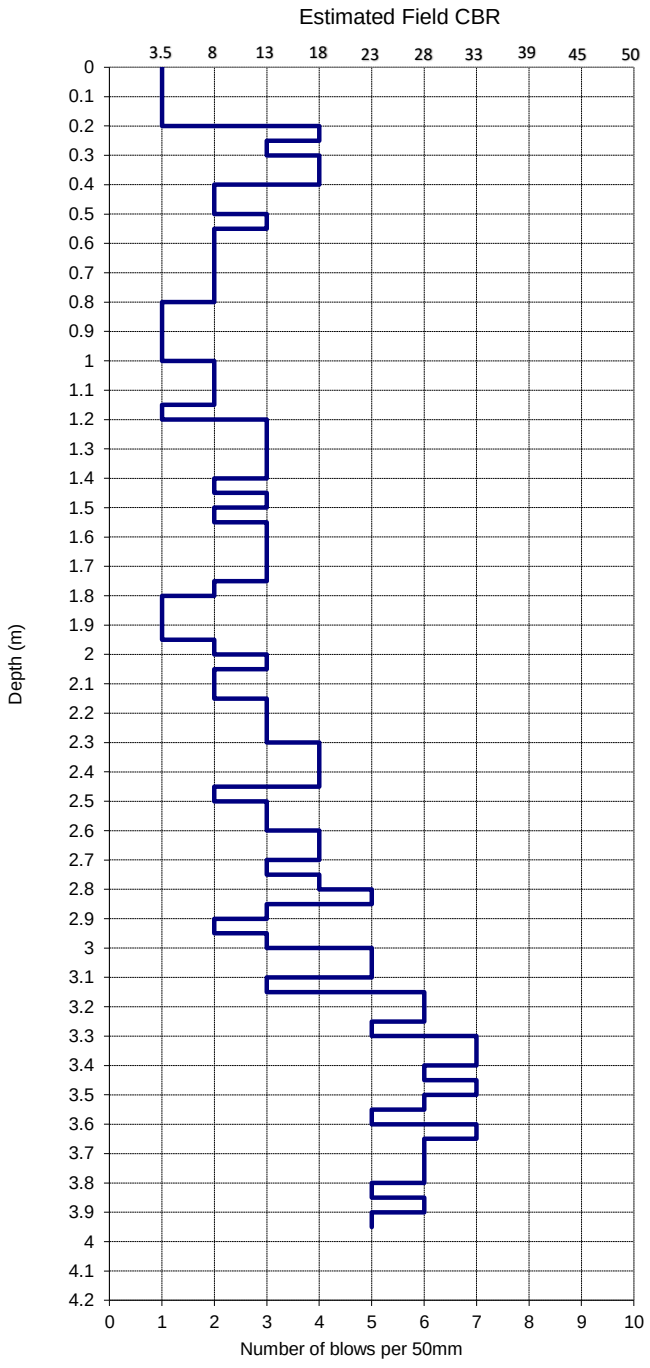
Lab Ref/URN
167/18

NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0	Test Number	SC05

Easting (NZMG)	Northing	Level
2479987	5742600	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	50	1	1750	1750	3	3450	3450	6
100	100	1	1800	1800	2	3500	3500	7
150	150	1	1850	1850	1	3550	3550	6
200	200	1	1900	1900	1	3600	3600	5
250	250	4	1950	1950	1	3650	3650	7
300	300	3	2000	2000	2	3700	3700	6
350	350	4	2050	2050	3	3750	3750	6
400	400	4	2100	2100	2	3800	3800	6
450	450	2	2150	2150	2	3850	3850	5
500	500	2	2200	2200	3	3900	3900	6
550	550	3	2250	2250	3	3950	3950	5
600	600	2	2300	2300	3	4000	4000	
650	650	2	2350	2350	4	4050	4050	
700	700	2	2400	2400	4	4100	4100	
750	750	2	2450	2450	4	4150	4150	
800	800	2	2500	2500	2	4200	4200	
850	850	1	2550	2550	3	4250	4250	
900	900	1	2600	2600	3	4300	4300	
950	950	1	2650	2650	4	4350	4350	
1000	1000	1	2700	2700	4	4400	4400	
1050	1050	2	2750	2750	3	4450	4450	
1100	1100	2	2800	2800	4	4500	4500	
1150	1150	2	2850	2850	5	4550	4550	
1200	1200	1	2900	2900	3	4600	4600	
1250	1250	3	2950	2950	2	4650	4650	
1300	1300	3	3000	3000	3	4700	4700	
1350	1350	3	3050	3050	5	4750	4750	
1400	1400	3	3100	3100	5	4800	4800	
1450	1450	2	3150	3150	3	4850	4850	
1500	1500	3	3200	3200	6	4900	4900	
1550	1550	2	3250	3250	6	4950	4950	
1600	1600	3	3300	3300	5	5000	5000	
1650	1650	3	3350	3350	7	5050	5050	
1700	1700	3	3400	3400	7	5100	5100	



Test Remarks

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

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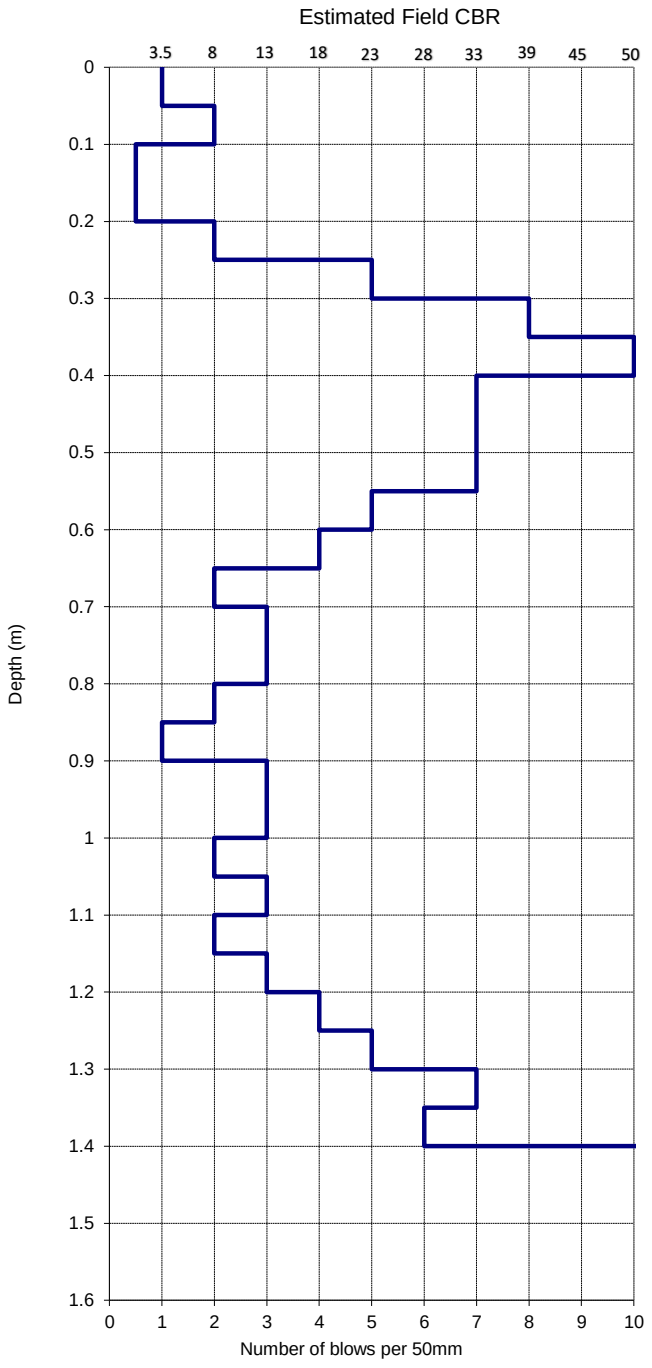
NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0	Test Number	SC06

Easting (NZMG)	Northing	Level
2479979	5742578	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	50	1	1750	1750		3450	3450	
100	100	2	1800	1800		3500	3500	
150	150	0.5	1850	1850		3550	3550	
200	200	0.5	1900	1900		3600	3600	
250	250	2	1950	1950		3650	3650	
300	300	5	2000	2000		3700	3700	
350	350	8	2050	2050		3750	3750	
400	400	10	2100	2100		3800	3800	
450	450	7	2150	2150		3850	3850	
500	500	7	2200	2200		3900	3900	
550	550	7	2250	2250		3950	3950	
600	600	5	2300	2300		4000	4000	
650	650	4	2350	2350		4050	4050	
700	700	2	2400	2400		4100	4100	
750	750	3	2450	2450		4150	4150	
800	800	3	2500	2500		4200	4200	
850	850	2	2550	2550		4250	4250	
900	900	1	2600	2600		4300	4300	
950	950	3	2650	2650		4350	4350	
1000	1000	3	2700	2700		4400	4400	
1050	1050	2	2750	2750		4450	4450	
1100	1100	3	2800	2800		4500	4500	
1150	1150	2	2850	2850		4550	4550	
1200	1200	3	2900	2900		4600	4600	
1250	1250	4	2950	2950		4650	4650	
1300	1300	5	3000	3000		4700	4700	
1350	1350	7	3050	3050		4750	4750	
1400	1400	6	3100	3100		4800	4800	
1450	1450	30	3150	3150		4850	4850	
1500	1500		3200	3200		4900	4900	
1550	1550		3250	3250		4950	4950	
1600	1600		3300	3300		5000	5000	
1650	1650		3350	3350		5050	5050	
1700	1700		3400	3400		5100	5100	



Test Remarks

Please note Estimated Field CBR cannot be calculated over 10 blows.

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

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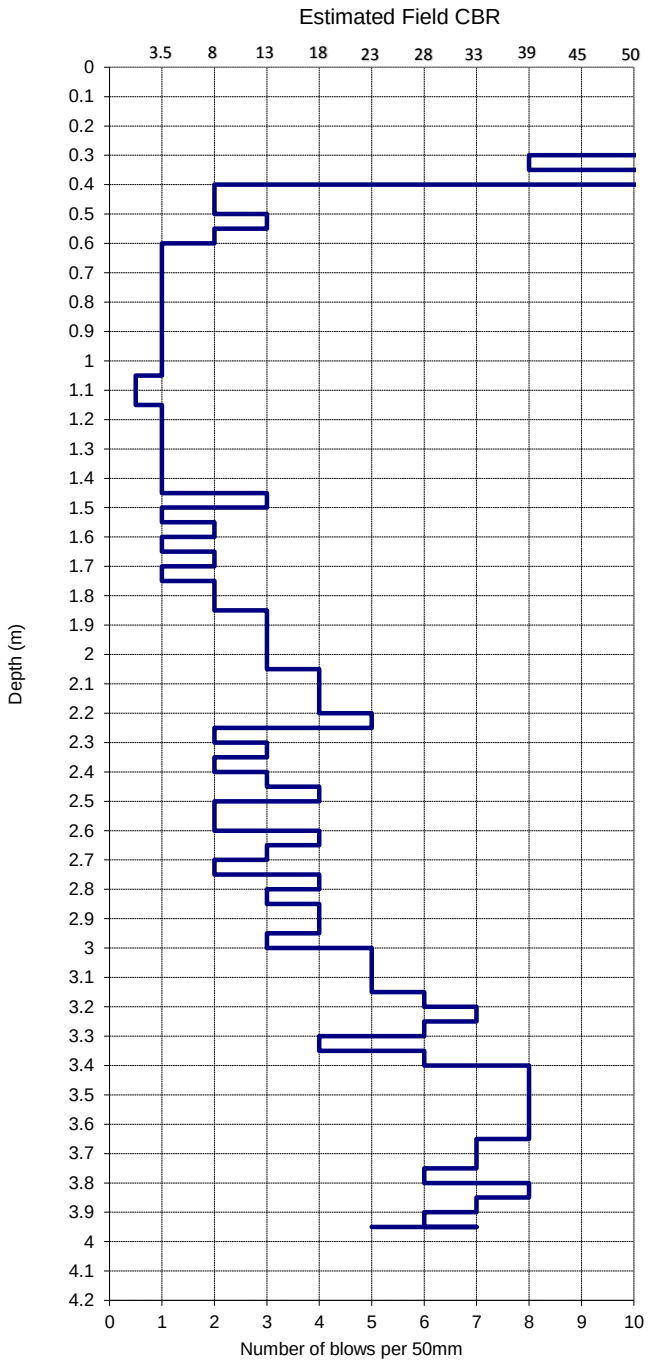
NZS 4402: 1998 Test 6.5.2 Dynamic Cone Penetrometer - Scala

Project Name	G CH Park Terrace Investigations	Project ID	1008830.0000
Customer Project ID	30315	Equipment ID	CH068
Site Location	100-104 Park Terrace, City Centre, Christchurch	Material Source	NA
Material Description	NA	Test Series	parktce/131818/hasc+cpt
Depth from ground surface to commencement of penetration (m)	0.2	Test Number	SC07

Easting (NZMG)	Northing	Level
2479992	5742549	8.0m

Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows	Vertical distance driven (mm)	Depth (mm)	Number of blows
50	250	2	1750	1950	4	3450	3650	8
100	300	2	1800	2000	4	3500	3700	7
150	350	3	1850	2050	5	3550	3750	6
200	400	2	1900	2100	2	3600	3800	7
250	450	1	1950	2150	3	3650	3850	7
300	500	1	2000	2200	2	3700	3900	7
350	550	1	2050	2250	3	3750	3950	5
400	600	1	2100	2300	4	3800	4000	
450	650	1	2150	2350	2	3850	4050	
500	700	1	2200	2400	2	3900	4100	
550	750	1	2250	2450	4	3950	4150	
600	800	1	2300	2500	3	4000	4200	
650	850	1	2350	2550	2	4050	4250	
700	900	0.5	2400	2600	4	4100	4300	
750	950	0.5	2450	2650	3	4150	4350	
800	1000	1	2500	2700	4	4200	4400	
850	1050	1	2550	2750	4	4250	4450	
900	1100	1	2600	2800	3	4300	4500	
950	1150	1	2650	2850	5	4350	4550	
1000	1200	1	2700	2900	5	4400	4600	
1050	1250	1	2750	2950	5	4450	4650	
1100	1300	3	2800	3000	6	4500	4700	
1150	1350	1	2850	3050	7	4550	4750	
1200	1400	2	2900	3100	6	4600	4800	
1250	1450	1	2950	3150	4	4650	4850	
1300	1500	2	3000	3200	6	4700	4900	
1350	1550	1	3050	3250	8	4750	4950	
1400	1600	2	3100	3300	8	4800	5000	
1450	1650	2	3150	3350	8	4850	5050	
1500	1700	3	3200	3400	8	4900	5100	
1550	1750	3	3250	3450	8	4950	5150	
1600	1800	3	3300	3500	7	5000	5200	
1650	1850	3	3350	3550	7	5050	5250	
1700	1900	4	3400	3600	6	5100	5300	



Test Remarks

Tested By	MASC	Date	12/11/2018
Data Entry By	SWT	Date	13/11/2018
Checked by	HEWI	Date	20/11/2018

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH01
Hole Location:

SHEET 1 OF 3

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180819.36 mN 1569972.51 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 16/12/13 HOLE FINISHED: 16/12/13
R.L.:	6.83 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
FILL		From core @ 9:15AM	100	RotoSonic				6	1			D	MD				Sandy, fine to coarse GRAVEL, with minor silt, light grey, homogeneous. Tightly packed, dry grades to wet, well graded. Gravel, sub-rounded to angular, slightly weathered, greywacke; Sand, fine to coarse, well graded; various building waste throughout (concrete, plastic, electrical wiring etc).
			100	SPT		16 19 14 N=33		5	2			M					
			100	RotoSonic								W					
			100	SPT		12 16 13 N=29		4	3								
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic				3	4				VL				Silty SAND, grey. Medium dense, moist, low plasticity. Sand, very fine, poorly graded. Many decomposing tubular rootlets throughout.
			100	SPT		1 0 1 N=1		2	5								grades into SILT, with some organics, dark grey brown. Firm, moist, low plasticity.
			100	RotoSonic				1	6								grades into soft SILT, many rootlets
			100	SPT		1 1 3 N=4		0	7								grades into an organic very fine sandy SILT, organic odour, slow dilatancy
			100	RotoSonic													Silty SAND, dark grey. Medium dense, wet, non-plastic, quick dilatancy
			100	SPT		0 2 5 N=7		-1	8				L				grades into fine SAND, with some silt. Quick dilatancy
			100	RotoSonic				-2	9				VL				SAND, with trace silt, grey. Loose, slow dilatancy
			100	SPT		1 1 2 N=3		-3	10								Gravelly SAND, grey. Loose, wet. Gravel, fine to coarse, sub-rounded to rounded, well graded, greywacke;sand, medium to coarse, sub-rounded to rounded
																	Wood
																	SAND, with trace silt, yellow grey, homogeneous. Loose, wet. Sand, medium, poorly graded

T+T DATATEMPLATE.GDT amm

Log Scale 1:50

BORELOG 29759_CRG.GPJ 17-Jan-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH01
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180819.36 mN 1569972.51 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 16/12/13 HOLE FINISHED: 16/12/13
R.L.:	6.83 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	ENGINEERING DESCRIPTION
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic								W	MD				SAND, with trace silt, yellow grey, homogeneous. Loose, wet. Sand, medium, poorly graded
			100	SPT		9 11 14 N=25		-4	11								
			100	RotoSonic				-5	12								11 Sandy GRAVEL, dark blue grey. Tightly packed. Gravel, fine to coarse, well graded; sand, medium, poorly graded.
			100	SPT		15 20 22 N=42							D				SAND, with trace silt, yellow grey, homogeneous. Medium dense, wet. Sand, medium, poorly graded. 12 Sandy GRAVEL, brown grey. Loosly packed
			100	RotoSonic				-6	13								13
			100	SPT		22 25 14 N=39		-7	14								14
			100	RotoSonic				-8	15								15
			100	SPT		14 20 20 N=40		-9	16								16
			100	RotoSonic									MD				
			100	SPT		17 15 17 N=32		-10	17								with trace lensoidal clay, gey, moderate to high plasticity 17
			100	RotoSonic				-11	18								SAND, with trace silt, yellow brown. Medium dense, fine 18
			100	SPT		9 10 6 N=16		-12	19								
CHRISTCHURCH FORMATION			1.15	RotoSonic									L				SAND, with trace silt, grey. Medium dense, quick dilatancy, very fine 19
								-13	20								

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH01
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180819.36 mN 1569972.51 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 16/12/13 HOLE FINISHED: 16/12/13
R.L.:	6.83 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL															ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
CHRISTCHURCH FORMATION			100	SPT		2 2 5 N=7						W					SILT, grey. Firm, wet, moderate plasticity
									7								SAND, brown. Dense
			100	RotoSonic				-14									SILT, with minor organic fragments, grey. Stiff, wet, moderate to low plasticity
Riccarton Gravels									21				MD				Silty fine to coarse GRAVEL, grading to Sandy fine to coarse GRAVEL, orange grey. Tightly packed, wet.
			100	SPT		12 16 21 N=37		-15									
									22								**EoH @ Target Depth - 21.85 m.**
								-16	23								
								-17	24								
								-18	25								
								-19	26								
								-20	27								
								-21	28								
								-22	29								
								-23	30								

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH02
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180836.48 mN 1569988.55 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 16/12/13 HOLE FINISHED: 16/12/13
R.L.:	7.10 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	ENGINEERING DESCRIPTION
FILL		From core @ 2PM	100	RotoSonic				7				D	D				Sandy, fine to coarse GRAVEL, with minor silt, light grey, homogeneous. Tightly packed, dry grades to wet, well graded. Gravel, sub-rounded to angular, slightly weathered, greywacke; Sand, fine to coarse, well graded; various building waste throughout (concrete, plastic, electrical wiring etc).
			100	SPT		10 18 15 N=33		6	1			D-M					
			100	RotoSonic				5	2			W					
			100	SPT		16 17 20 N=37		4	3								
			100	RotoSonic				3	4								
			100	SPT		8 15 19 N=34		2	5								
			100	RotoSonic				1	6								
Yaldhurst Member of SPRINGSTON FORMATION			100	SPT		8 12 14 N=26		0	7				MD				SAND, with trace silt, grey, homogeneous. Medium dense, wet, poorly graded. Sand, fine to medium.
			100	RotoSonic				-1	8								grades into very fine SAND grades into fine SAND, with lensoidal silt grades into fine to medium SAND, with organic fragments
			100	SPT		5 6 9 N=15		-2	9								grades into fine SAND, with lensoidal silt, and trace organic fragments grades into fine SAND, brown. Medium dense, wet, poorly graded. grades into fine SAND, grey, with lensoidal silt, and trace organic fragments
			100	RotoSonic													
			100	SPT		8 12 17 N=29			10				D				SAND, with minor gravel, grey. Sand, fine; gravel, fine to coarse. SAND, with trace silt, grey, homogeneous. Dense, wet, poorly graded.

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH02
Hole Location:

SHEET 2 OF 3

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180836.48 mN 1569988.55 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 16/12/13 HOLE FINISHED: 16/12/13
R.L.:	7.10 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic				-3	11			W					grades organic rootlets
			100	SPT		10 16 17 N=33		-4									SAND, with trace silt, yellow brown, homogeneous. Dense, wet, poorly graded. Sand, fine. 11
			100	RotoSonic				-5	12								12
			100	SPT		7 14 20 N=34											SAND, with minor gravel (medium).
			100	RotoSonic				-6	13								SAND, with trace silt, yellow brown, homogeneous. Dense, wet, poorly graded. Sand, fine. Gradational colour change to brown grey. 13
			100	SPT		5 12 16 N=28		-7	14				MD				14
			100	RotoSonic				-8	15								15
			100	SPT		3 7 10 N=17											slow dilatency 16
			100	RotoSonic				-9	16								sharp colour change to blue grey
CHRISTCHURCH FORMATION			100	SPT		4 8 16 N=24		-10	17								Organic SILT, brown. Sandy GRAVEL, yellow grey Clayey SILT, purple grey, moderate to high plasticity. 17
			100	RotoSonic				-11	18				D				SAND, yellow grey, homogeneous. Medium dense, wet, poorly graded. Sand, fine to medium; wood fragments. grades into very fine to fine SAND, blue gray, homogeneous, slow dilatancy. Shell fragments 18
			100	SPT		10 15 18 N=33											grades into fine SAND, yellow grey.
			100	RotoSonic				-12	19				MD				SILT, with trace clay, minor lensoidal sand, blue grey, homogeneous. Firm, wet, poorly graded, quick dilatancy. Trace organics. 19
									20								

T+T DATATEMPLATE.GDT amm

Log Scale 1:50

BORELOG 29759_CRG.GPJ 17-Jan-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH02
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180836.48 mN 1569988.55 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 16/12/13 HOLE FINISHED: 16/12/13
R.L.:	7.10 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION / ROCK DESCRIPTION
CHRISTCHURCH FORMATION			100	SPT		1 7 11 N=18		-13	21			W					SAND, with trace silt, blue grey. Medium dense, wet, poorly graded.
			100	RotoSonic				-14									Silty PEAT (fibrous), brown. Firm, wet, organic odour, woody (spongy?) texture
																	Organic SILT, with minor clay, blue grey. Firm, wet, moderate plasticity, many oorganic (woody) spars/rootlets
Riccarton Gravels			100	SPT		14 18 23 N=41		-15	22			S	D				Silty fine to coarse GRAVEL, grading to Sandy fine to coarse GRAVEL, orange grey. Tightly packed, wet.
								-16	23								**EoH @ Target Depth - 21.85 m.**
								-17	24								
								-18	25								
								-19	26								
								-20	27								
								-21	28								
								-22	29								
									30								

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

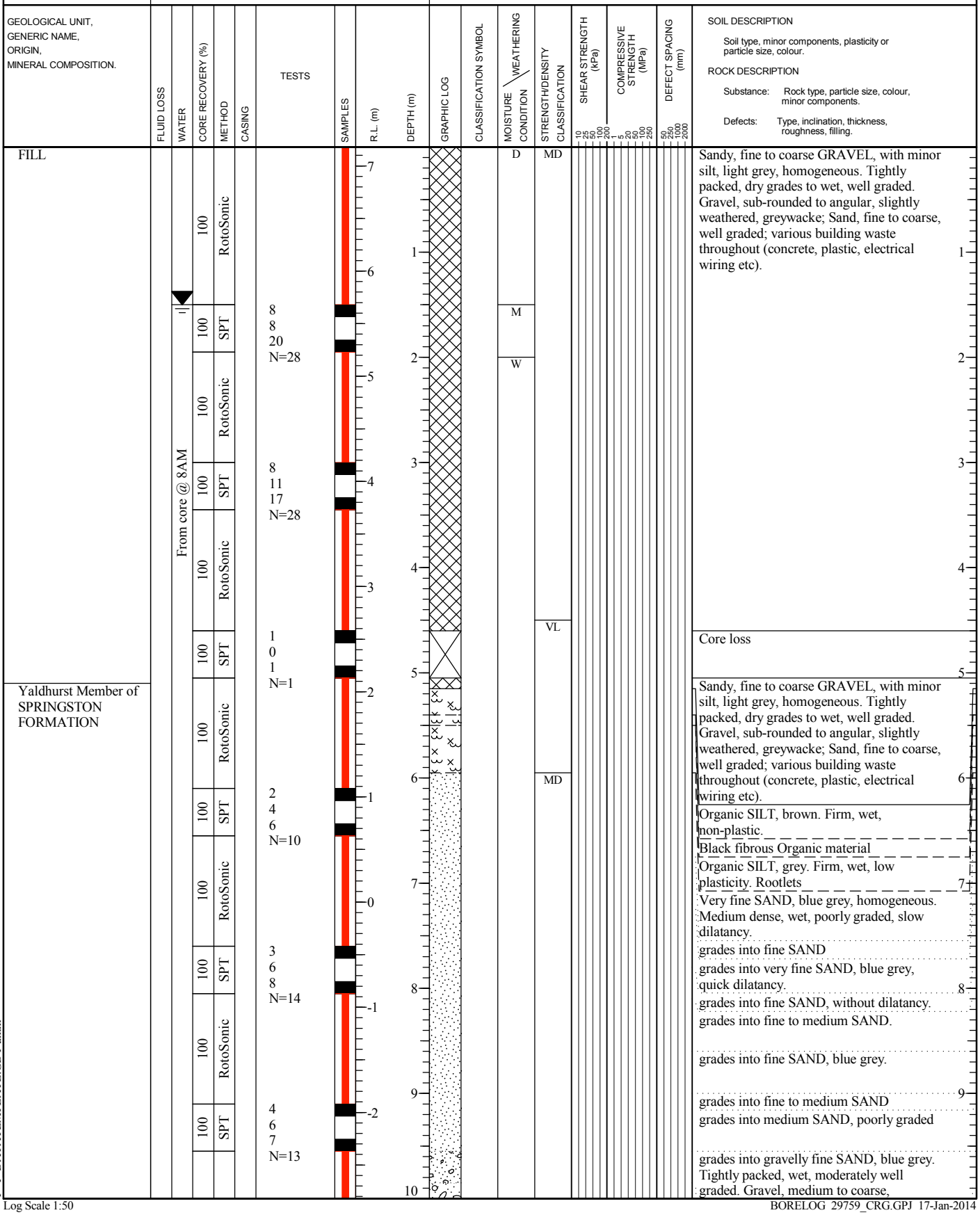
BOREHOLE LOG

BOREHOLE No:BH03
Hole Location:

SHEET 1 OF 3

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180859.36 mN 1570026.54 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 17/12/13 HOLE FINISHED: 17/12/13
R.L.:	7.18 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION



T+T DATATEMPLATE.GDT amm

Log Scale 1:50

BORELOG 29759_CRG.GPJ 17-Jan-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH03
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180859.36 mN 1570026.54 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 17/12/13 HOLE FINISHED: 17/12/13
R.L.:	7.18 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	ENGINEERING DESCRIPTION
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic				-3									sub-rounded to rounded, slightly weathered, greywacke.
			100	SPT		3 3 6 N=9			11								grades into sandy fine to coarse GRAVEL, blue grey. Tightly packed, wet, well graded.Sand, fine to medium.
CHRISTCHURCH FORMATION			100	RotoSonic				-4									grades into gravelly SILT, with minor sand & clay, trace organics, brown grey. Firm, wet, low plasticity. Gravel, medium to coarse, sub-rounded to rounded, slightly weathered, greywacke. 11
																	Fine to medium SAND, blue grey, homogeneous. Medium dense, wet, poorly graded.
									12								12
								-5									grades into medium SAND
			100	SPT		8 17 22 N=39											grades into fine to medium SAND
			100	RotoSonic				-6	13								13
			100	SPT		9 15 19 N=34											grades into fine SAND
			100	RotoSonic				-7	14								14
																	grades into very fine SAND
								-8	15								with slow dilatency without dilatency 15
			100	SPT		6 14 20 N=32											with minor lensoidal silt
			100	RotoSonic				-9	16								very fine SAND, blue grey, homogeneous. Medium dense, wet, poorly graded.
																	16
			100	SPT		8 13 17 N=30		-10	17								with quick dilatency with slow dilatency 17
			100	RotoSonic				-11	18								grades to fine SAND, blue grey, homogeneous. Medium dense, wet, poorly graded, non-dilatent. with shell fragments, dark blue grey 18
			100	SPT		9 12 18 N=30											grades into medium SAND, without shell fragments
			1.15	RotoSonic				-12	19								19 grades into SILT, with minor clay, grey, bedded. Firm, wet, moderate to high plasticity.
									20								with minor shell fragments

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH03
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180859.36 mN 1570026.54 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 17/12/13 HOLE FINISHED: 17/12/13
R.L.:	7.18 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
			100	SPT		4 4 6 N=10		-13									grades into fine SAND, with some shell fragments & trace silt. **EoH @ Target Depth - 20.25 m.**
									21								
								-14									
									22								
								-15									
									23								
								-16									
									24								
								-17									
									25								
								-18									
									26								
								-19									
									27								
								-20									
									28								
								-21									
									29								
								-22									
									30								

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH04
Hole Location:

SHEET 1 OF 3

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180856.45 mN 1569974.26 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 17/12/13 HOLE FINISHED: 17/12/13
R.L.:	7.27 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) | COMPRESSIVE STRENGTH (MPa) | DEFECT SPACING (mm)

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

No Recovery		20	RotoSonic				7	1								Core Loss
Yaldhurst Member of SPRINGSTON FORMATION	From core @ 2PM	100	SPT		1 3 3 N=6		6	2			M	L				Sandy SILT, with trace organic fragments, grey brown. Stiff, moist to wet, low plasticity.
		100	RotoSonic				5									grades into fint to medium SAND, green grey, Fe stain.
											W	VL				PEAT (fibrous), brownish black, organic odour.
		100	SPT		1 0 0 N=0		4	3								Organic SILT, grey. Firm, wet, low to moderate plasticity. Large rootlets.
		100	RotoSonic				3									Sandy SILT, brownish grey. Soft, wet, low plasticity. Sand, very fine to fine, poorly graded.
								4								grades into grey SILT, with minor sand. Firm, wet, low plasticity. Sand, very fine, poorly graded; rootlets.
		100	SPT		0 0 1 N=1		2	5								PEAT (fibrous),brown, with minor lensoidal grey silt.
		100	RotoSonic				1									SILT, with minor sand, grey. Firm, wet, low plasticity. Sand, very fine, poorly graded; rootlets.
																PEAT (fibrous) brown. Firm.
																SILT, with minor lensoidal sand, grey. Firm, wet, low plasticity. Sand, fine, poorly graded; rootlets.
		100	SPT		1 3 3 N=6		0	6				L				grades, no rootlets
		100	RotoSonic				-1	7								grades into fine SAND, with trace silt & organics, blue grey, homogeneous. Loose, wet, poorly graded, quick dilatency.
																with lensoidal silt, medium dense
																without lensoidal silt
		100	SPT		5 7 10 N=17		-2	8				MD				grades into fine to medium SAND
		100	RotoSonic					9								Gravely fine to medium SAND, blue grey, homogenous. Dense, wet, well graded. Sand; sub-rounded; gravel, medium to coarse, slightly weathered, greywacke, sub-rounded to rounded.
		100	SPT		10 18 15 N=33			10								

T+T DATATEMPLATE.GDT amm

Log Scale 1:50

BORELOG 29759_CRG.GPJ 17-Jan-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH04
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180856.45 mN 1569974.26 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 17/12/13 HOLE FINISHED: 17/12/13
R.L.:	7.27 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic				-3									grades in to sandy fine to coarse GRAVEL, blue grey, homogeneous. Tightly packed, wet, well graded. Gravel, sub-rounded to rounded, slightly weathered, greywacke; sand, fine to medium,poorly graded.
			100	SPT		5 7 11 N=18			11								Medium SAND, grey blue. Medium dense, wet, poorly graded. 11
			100	RotoSonic				-4									grades into silty medium to coarse GRAVEL, with trace sand, blue grey. Tightly packed, wet, well graded. Gravel, sub-rounded to rounded, slightly weathered, greywacke; sand, fine.
									12								PEAT (spongy), with trace gravel & silt, brown. Soft, wet, non-plastic. Gravel, medium, rounded. 12
			100	SPT		6 8 8 N=16		-5									Sandy medium to coarse GRAVEL, with trace silt & wood fragments. Tightly packed, wet, poorly graded.
																	Wood
			100	RotoSonic				-6	13				VL				Fine to medium SAND, with trace silt & wood fragments/lensoidal peat, grey. Firm, wet, low plasticity, quick dilatancy. 13
																	Wood
CHRISTCHURCH FORMATION			100	SPT		0 1 1 N=2			14				MD				Organic SILT, with minor lensoidal sand, grey brown. Firm, wet, low plasticity. Sand, medium. 14
								-7									PEAT (fibrous), brown. Firm, wet.
			100	RotoSonic													Medium SAND, with trace gravel, blue grey. Medium dense, wet, poorly graded.
																	grades into fine SAND, with trace silt.
									15								without silt 15
			100	SPT		7 11 19 N=30		-8									
																	grades into fine to medium SAND.
									16								16
			100	RotoSonic				-9									grades into SAND, with some shell fragments, dark blueish grey.
													D				grades into fine SAND, blue grey. Dense, wet, poorly graded.
			100	SPT		6 20 21 N=41		-10	17								grades into fine SAND, with trace silt. 17
																	grades into fine to medium SAND, with some shell fragments, dark blueish grey.
			100	RotoSonic				-11	18								18
			100	SPT		6 12 13 N=25							MD				without shell fragments
									19								19
			1.15	RotoSonic				-12									grades into fine SAND, with minor lensoidal silt, blue grey. Medium dense, wet, quick dilatancy.
									20								grades into SILT, with some fine lensoidal sand & trace organic fragments blue grey,

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH04
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180856.45 mN 1569974.26 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 17/12/13 HOLE FINISHED: 17/12/13
R.L.:	7.27 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

FLUID LOSS | WATER | CORE RECOVERY (%) | METHOD | CASING | TESTS | SAMPLES | R.L. (m) | DEPTH (m) | GRAPHIC LOG | CLASSIFICATION SYMBOL | MOISTURE CONDITION / WEATHERING | STRENGTH/DENSITY CLASSIFICATION | SHEAR STRENGTH (kPa) 10 25 50 100 200 | COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250 | DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

		100	SPT		5 8 10 N=18		-13	21								bedded. grades into fine SAND, with minor silt, blueish grey. **EoH @ Target Depth - 20.25 m.**
							-14	22								
							-15	23								
							-16	24								
							-17	25								
							-18	26								
							-19	27								
							-20	28								
							-21	29								
							-22	30								

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH05
Hole Location:

SHEET 1 OF 3

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180822.63 mN 1570014.87 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 19/12/13 HOLE FINISHED: 19/12/13
R.L.:	7.00 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	ENGINEERING DESCRIPTION
FILL		From core @ 8AM	100	RotoSonic				6	1			D	MD				Sandy, fine to coarse GRAVEL, with minor silt, light grey, homogeneous. Tightly packed, dry grades to wet, well graded. Gravel, sub-rounded to angular, slightly weathered, greywacke; Sand, fine to coarse, well graded; various building waste throughout (concrete, plastic, electrical wiring etc).
			100	SPT		13 13 16 N=29		5	2			W					
			100	RotoSonic													
			100	SPT		12 7 4 N=11		4	3								
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic				3	4				F				Sandy SILT, with some organics, dark grey. Firm, wet, low plasticity. Sand, very fine, poorly graded. Organic odour.
																	grades into fine sandy SILT, with minor organics, dark greenish grey. Low plasticity
			100	SPT		0 1 1 N=2		2	5								grades into very fine sandy SILT, with wood fragments, dark brownish grey, organic odour
			100	RotoSonic									L				grades into fine grey SAND, with minor silt, homogeneous. Medium dense, slow dilatancy
			100	SPT		0 1 7 N=8		1	6								SAND, with trace silt, yellow grey, homogeneous. Loose, wet, slow dilatancy. Sand, fine, poorly graded
			100	RotoSonic				0	7								grades into fine to medium SAND, brown grey, homogeneous. Medium dense, non-dilatent
			100	SPT		7 10 14 N=24		-1	8				MD				Sandy GRAVEL, yellowish brown grey. Tightly packed, wet. Sand, fine to coarse, well graded, rounded to sub-rounded; gravel, fine to coarse, well graded, rounded to sub-rounded.
			100	RotoSonic				-2	9				VD				
			100	SPT		23 31 19 For 40mm N>50			10								

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH05
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180822.63 mN 1570014.87 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 19/12/13 HOLE FINISHED: 19/12/13
R.L.:	7.00 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	ENGINEERING DESCRIPTION
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic								W	D				Sandy GRAVEL, yellowish brown grey. Tightly packed, wet. Sand, fine to coarse, well graded, rounded to sub-rounded; gravel, fine to coarse, well graded, rounded to sub-rounded.
			100	SPT		9 18 13 N=31		-4	11								11
			100	RotoSonic									MD				SAND, yellowish brown grey, homogeneous. Medium dense, wet. Fine to medium, poorly graded
			100	SPT		3 9 14 N=23		-5	12								12
			100	RotoSonic									D				Gravelly SAND, yellow brown, homogeneous. Dense, wet. Sand, fine to medium, rounded to sub-rounded, poorly graded; gravel, fine to medium, rounded to sub-rounded.
			100	SPT		13 24 24 N=48		-6	13								13
			100	RotoSonic				-7	14								14
													MD				fine to medium SAND
								-8	15								Gravelly SAND, blue grey Wood 15
			100	SPT		2 3 5 N=8											SAND, yellow brown, homogeneous. Fine
				RotoSonic				-9	16								SAND, blue grey, homogeneous. Fine Wood SAND, blue grey. Medium 16
			100	SPT		10 11 11 N=22		-10	17								Sandy GRAVEL, blue grey Organic SILT, with wood fragments, grey Silty GRAVEL, yellow grey. Tightly packed, wet, sub rounded Gravelly SAND, yellow grey. Medium dense, wet 17
			100	RotoSonic				-11	18								Silty GRAVEL, yellow grey. Tightly packed, wet, sub rounded SAND, yellow grey, homogeneous. Medium dense, wet. Sand, fine to medium Organic SAND, blue Organic SILT, dark brown. Firm, odour 18
CHRISTCHURCH FORMATION			100	SPT		13 14 11 N=25		-12	19				F				Interbedded lenses of blue & yellow brown SAND, with some organic fragments Fibrous PEAT, brown SAND, with trace organics & lensoidal silt, blue grey. Medium dense, wet, poorly graded. Fine to medium, sub-rounded 19 SILT, with minor lensoidal fine sand, blue grey. Firm, wet with shell fragments grades into very fint to fine SAND, with minor silt, blue grey. Slow dilatancy
			100	RotoSonic					20								

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH05
Hole Location:

PROJECT: Ryman Geotech Investigation	LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES: 5180822.63 mN 1570014.87 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 19/12/13
	DRILL METHOD: RotoSonic	HOLE FINISHED: 19/12/13
R.L.: 7.00 m		DRILLED BY: Pro-Drill
DATUM: LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL	ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION / ROCK DESCRIPTION
CHRISTCHURCH FORMATION			100	SPT		5 5 4 N=9						W					with shell fragments SILT, with minor organic rootlets & lensoidal fine sand, blue grey. Organic odour
			100	RotoSonic				-14	21								
Riccarton Gravels			100	SPT		15 15 29 N=44							D				Silty fine to coarse GRAVEL, grading to Sandy fine to coarse GRAVEL, orange grey. Tightly packed, wet.
								-15	22								**EoH @ Target Depth - 21.85 m.**
								-16	23								
								-17	24								
								-18	25								
								-19	26								
								-20	27								
								-21	28								
								-22	29								
									30								

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.

ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH06
Hole Location:

SHEET 1 OF 3

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180796.17 mN 1570021.35 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 18/12/13
		DRILL METHOD: RotoSonic	HOLE FINISHED: 18/12/13
R.L.:	6.97 m		DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	ENGINEERING DESCRIPTION
FILL		From core @ 9AM	100	RotoSonic				6	1			D	MD				Sandy, fine to coarse GRAVEL, with minor silt, light grey, homogeneous. Tightly packed, dry grades to wet, well graded. Gravel, sub-rounded to angular, slightly weathered, greywacke; Sand, fine to coarse, well graded; various building waste throughout (concrete, plastic, electrical wiring etc). 1
			100	SPT		6 6 6 N=12		5	2			W					2
			100	RotoSonic				4	3								3
			100	SPT		7 7 4 N=11											
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic				3	4								SILT, with trace organics, grey. Firm, wet, low plasticity. 4 Silty very fine SAND, grey, homogeneous. Medium dense, wet, poorly graded.
			100	SPT		0 0 0 N=0		2	5				VL				SILT, grey. Firm, wet, low plasticity. Fibrous black organics 5 Organic SILT, brown. Firm, wet, non-plastic. Organic odour, rootlets.
			100	RotoSonic				1	6				MD				grades into SILT, with minor clay & organic fragments, grey. Firm, wet, low plasticity. Wood and rootlets. Very fine SAND, with trace silt, grey. Medium dense, wet, poorly graded.
			100	SPT		1 5 7 N=12		0	7								with slow dilatancy 6 grades into fine SAND, without dilatancy with minor lensoidal silt
			100	RotoSonic				-1	8								Fine SAND, grey, homogeneous. Medium dense, wet, poorly graded 7 Fine to medium SAND, with trace silt, yellow grey, homogeneous. Medium dense, wet, poorly graded.
			100	SPT		5 10 9 N=19		-2	9				VD				8 Sandy fine to coarse GRAVEL, with trace fine red gravel(?), yellow grey, homogeneous. Tightly packed, wet, well graded. Gravel, sub-rounded to rounded, slightly weathered, greywacke; sand, medium. 9 without red gravel
			100	RotoSonic													
			100	SPT		15 27 23 For 120mm N=50			10								

SOIL DESCRIPTION
Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION
Substance: Rock type, particle size, colour, minor components.
Defects: Type, inclination, thickness, roughness, filling.

T+T DATATEMPLATE.GDT anm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH06
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180796.17 mN 1570021.35 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 18/12/13 HOLE FINISHED: 18/12/13
R.L.:	6.97 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
Yaldhurst Member of SPRINGSTON FORMATION			100	RotoSonic									D				sandy bed
			100	SPT		15 26 20N=46		-4	11								Sandy fine to coarse GRAVEL, yellow grey, homogeneous. Tightly packed, wet, well graded. Gravel, sub-rounded to rounded, slightly weathered, greywacke; sand, medium. 11
			100	RotoSonic									MD				Fine to medium SAND, with trace medium gravel, yellow grey.
								-5	12								Sandy fine to coarse GRAVEL, yellow grey, homogeneous. Tightly packed, wet, well graded. Gravel, sub-rounded to rounded, slightly weathered, greywacke; sand, medium. 12
			100	SPT		4 7 6 N=13											Fine to medium SAND, with trace medium gravel, yellow grey. With Fe stain.
			100	RotoSonic				-6	13								Fine SAND, with some wood fragments, blue. 13
																	Fine to medium SAND, with trace medium gravel, yellow grey. With Fe stain.
			100	SPT		11 14 14 N=28		-7	14								Fine SAND, with some wood fragments, blue.
																	Wood 14
			100	RotoSonic				-8	15								Fine to medium SAND, blue grey, homogenous. Medium dense, wet, poorly graded.
			100	SPT		8 18 18 N=36											Gravelly medium SAND, blue grey. Medium dense, wet, poorly graded. Gravel, fine to coarse, sub-rounded, slightly weathered greywacke. 15
								-9	16								Fine SAND, blueish grey. Medium dense, wet, poorly graded.
																	Gravelly medium SAND, blue grey. Medium dense, wet, poorly graded. Gravel, fine to coarse, sub-rounded, slightly weathered greywacke. 16
			100	RotoSonic				-10	17								grades into sandy fine to coarse GRAVEL, orange grey, homogeneous. Tightly packed, wet, well graded. Gravel, sub-rounded to rounded, slightly weathered, greywacke; sand, fine.
																	grades into brown grey 17
								-11	18								SAND bed
																	Fine SAND, blue grey. Medium dense, wet, poorly graded.
																	Sandy medium to coarse SAND, blue grey. Tightly packed. [no fines, see note]
CHRISTCHURCH FORMATION																	Gravelly SAND, blue grey. [no fines, see note] 18
			100	SPT		5 12 14 N=26											grades into fine SAND, with minor silt, blue grey. Medium dense, wet, poorly graded.
								-12	19								with trace gravel
																	without gravel
			100	RotoSonic													grades into silty very fine SAND, grey. Medium dense, wet, poorly graded, slow dilatancy. 19
																	with some shell fragments
																	without shell fragements
																	with trace shell fragments
									20								with some shell fragments

T+T DATATEMPLATE.GDT amm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH06
Hole Location:

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180796.17 mN 1570021.35 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 18/12/13 HOLE FINISHED: 18/12/13
R.L.:	6.97 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION / ROCK DESCRIPTION
CHRISTCHURCH FORMATION								-14	21								SILT, with trace organic fragments & clay, grey. Stiff, wet, moderate plasticity. Rootlets & wood.
																	grades into very fine SAND, with some silt, grey. Medium dense, wet, poorly graded. 21.7
																	SILT, with minor very fine SAND
																	EoH @ 21 m. - Target Depth End of hole touched Riccarton Gravels. Shoe malfunction @ 15.8 - drill string pulled, and new shoe & core barrel installed. Casing advance stopped at 18.1 but misalinged head, SPT unavailable. 2nd shoe lost downhole during piezo install.
								-15	22								
								-16	23								
								-17	24								
								-18	25								
								-19	26								
								-20	27								
								-21	28								
								-22	29								
									30								

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH07
Hole Location:

SHEET 1 OF 1

PROJECT: Ryman Geotech Investigation		LOCATION: 78 Park Terrace	JOB No: 29759
CO-ORDINATES:	5180816.36 mN 1570004.87 mE	DRILL TYPE: Mobile Sonic MS1000	HOLE STARTED: 19/12/13 HOLE FINISHED: 19/12/13
R.L.:	7.00 m	DRILL METHOD: RotoSonic	DRILLED BY: Pro-Drill
DATUM:	LYTTHT1937 (15/12/2013 - PostEQ)	DRILL FLUID: Water (Casing only)	LOGGED BY: CRG CHECKED: JKK

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
FILL		1.375 @ 19/12/2013 | 1.305 @ 13/01/2014						6.5 0.5 6.0 1.0 5.5 1.5 5.0 2.0 4.5 2.5 4.0 3.0 3.5 3.5 3.0 4.0 2.5 4.5 5								Sandy, fine to coarse GRAVEL, with minor silt, light grey, homogeneous. Tightly packed, dry grades to wet, well graded. Gravel, sub-rounded to angular, slightly weathered, greywacke; Sand, fine to coarse, well graded; various building waste throughout (concrete, plastic, electrical wiring etc). 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 **EoH @ Target Depth - 3.0 m.**

T+T DATATEMPLATE.GDT amm

Log Scale 1:25

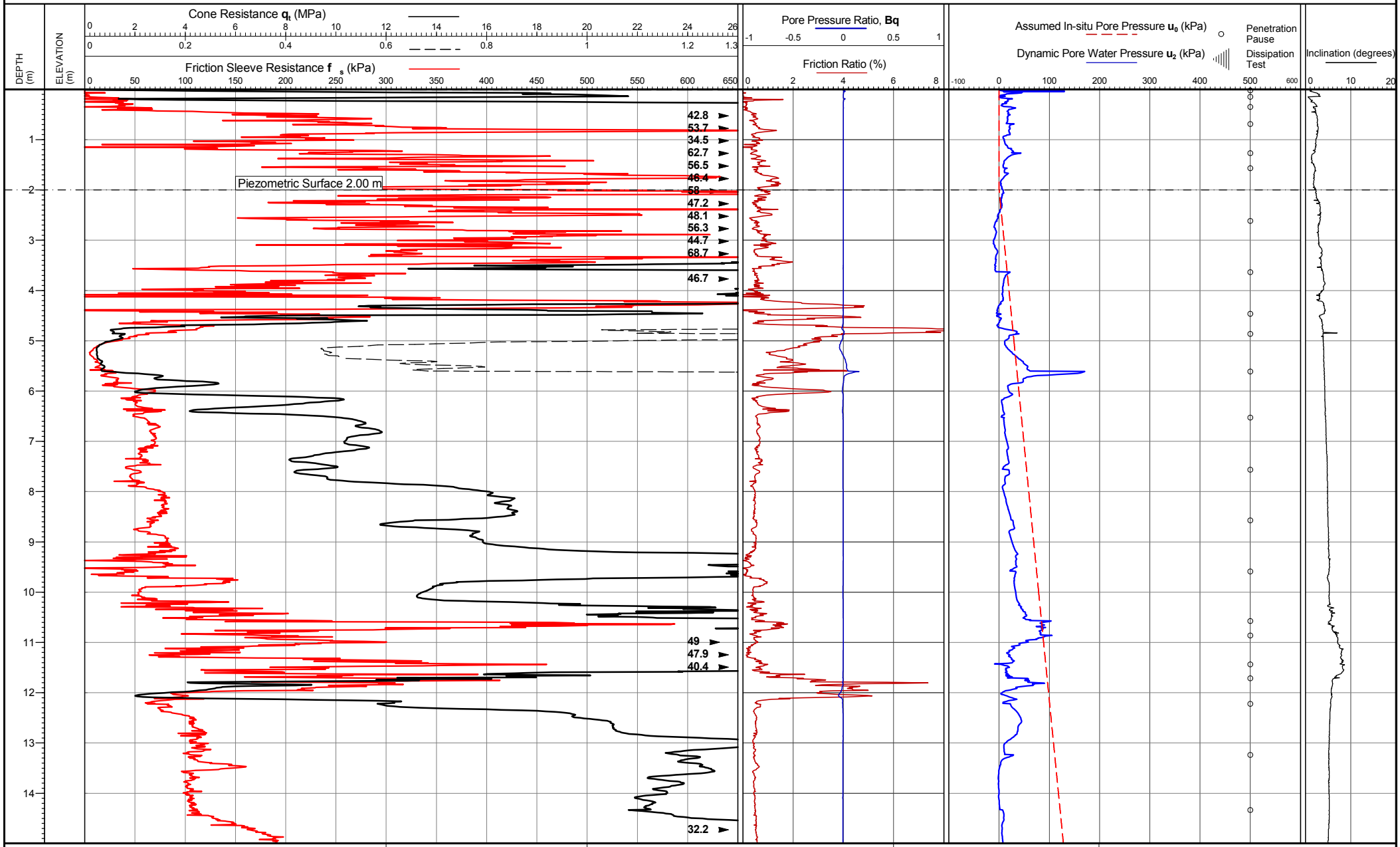
BORELOG 29759_CRG.GPJ 17-Jan-2014

CPT Data

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



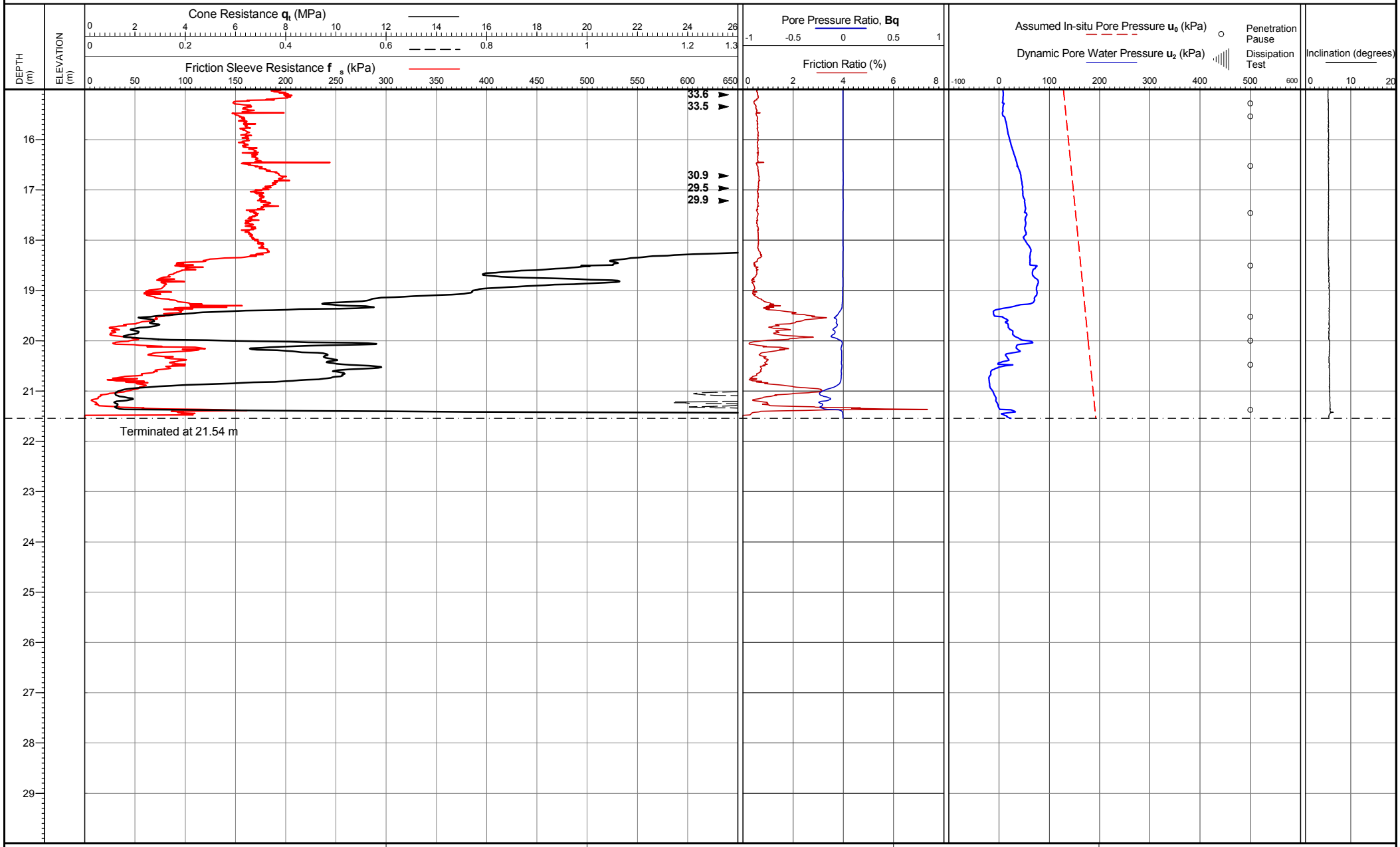
Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 16/12/2013 22:12:18	Coordinate system:	Termination Remark: Tip load		

TEST ID: CPT01

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

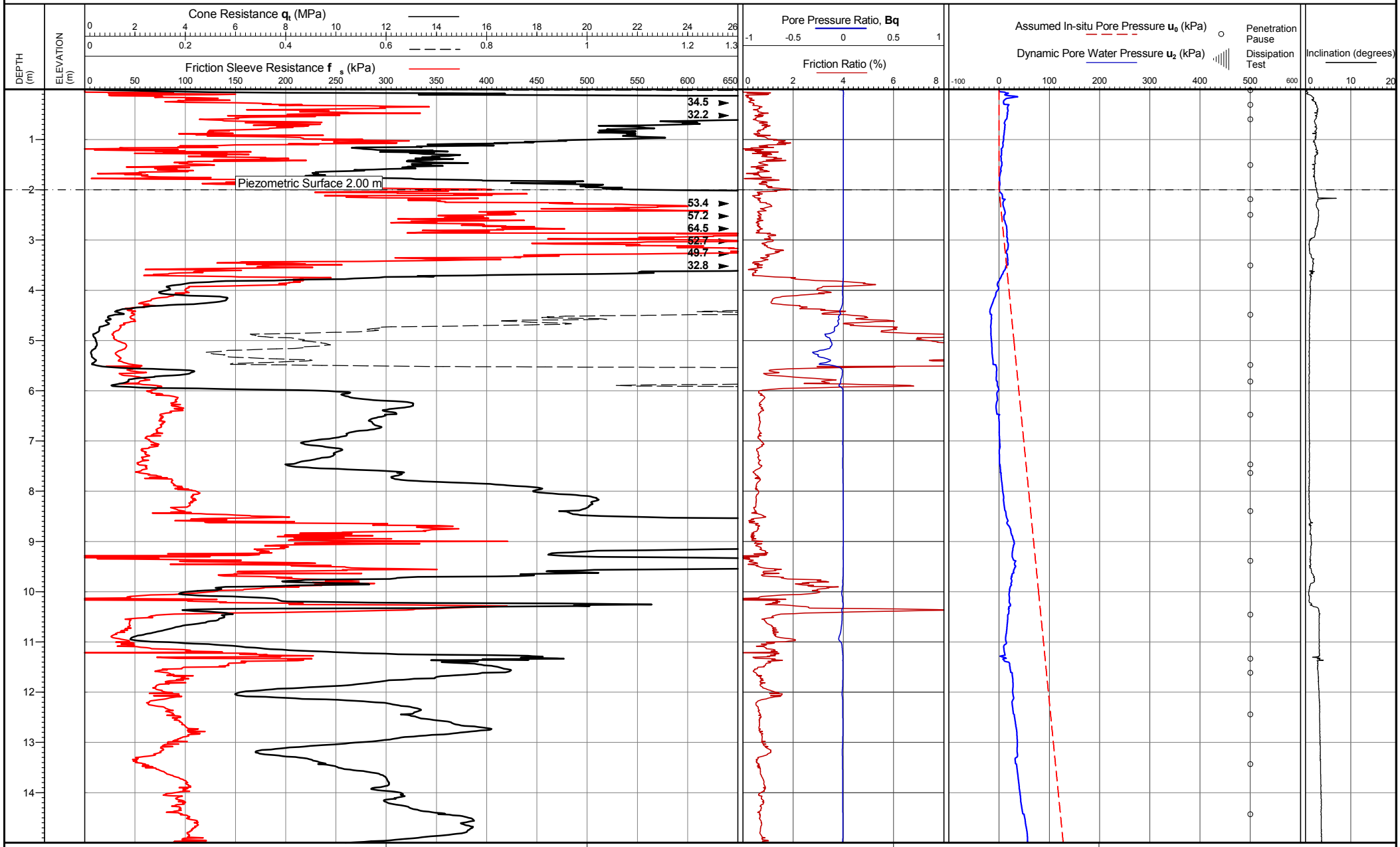


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT01**
Date of test: 16/12/2013 22:12:18	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



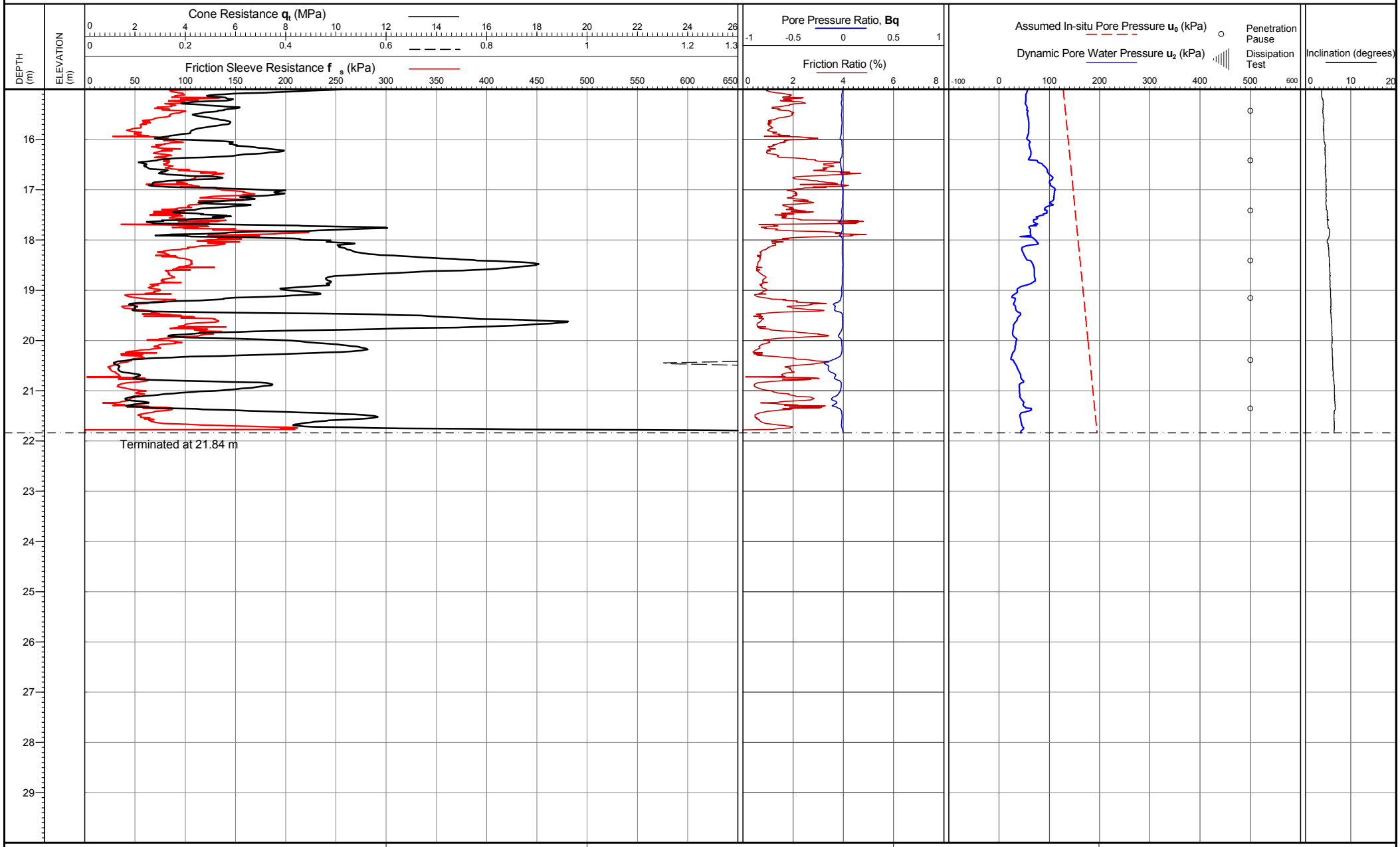
Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 17/12/2013 00:26:24	Coordinate system:	Termination Remark: Tip load		

TEST ID: CPT02A

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

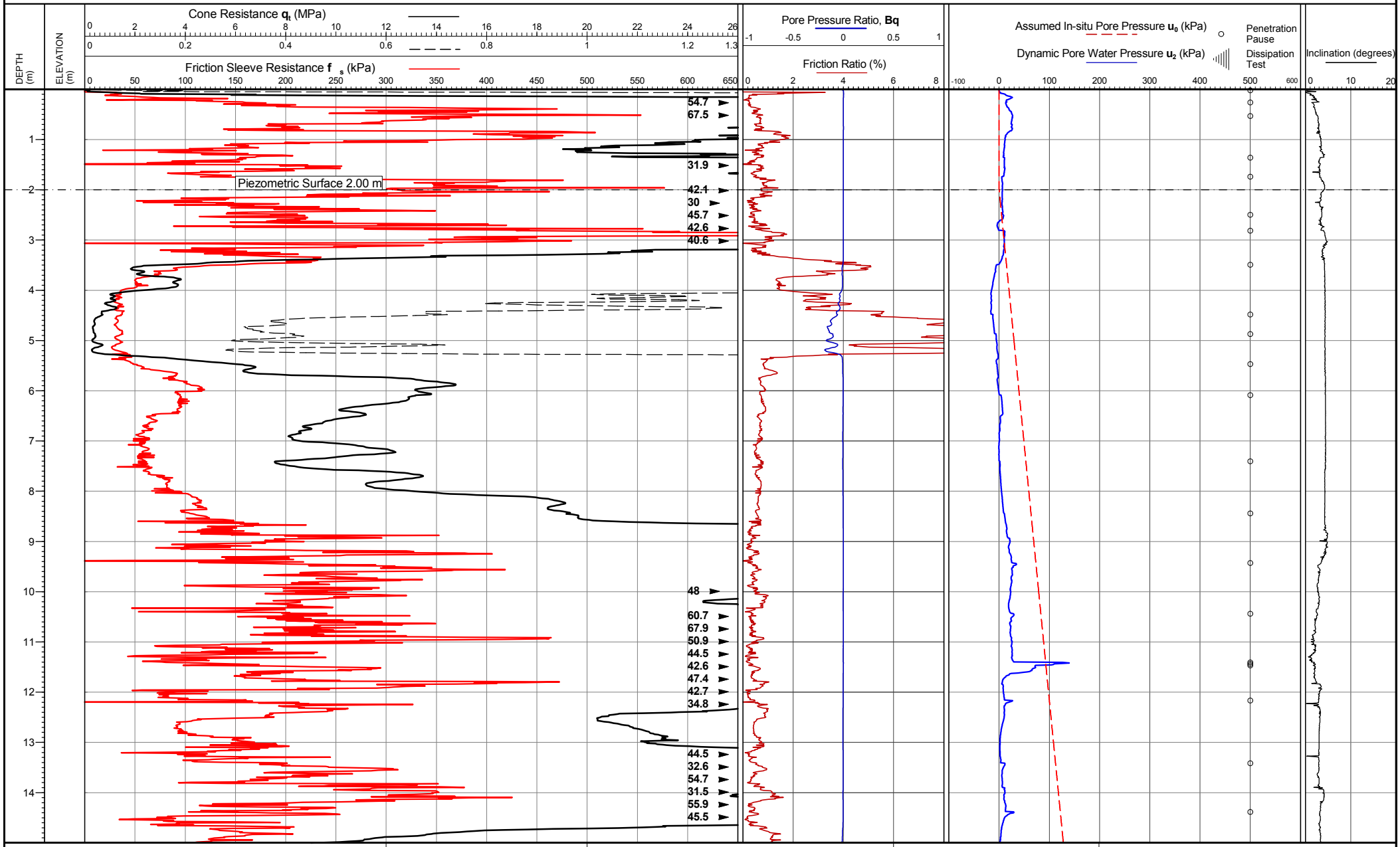


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			**TEST ID: CPT02A**
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 17/12/2013 00:26:24	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

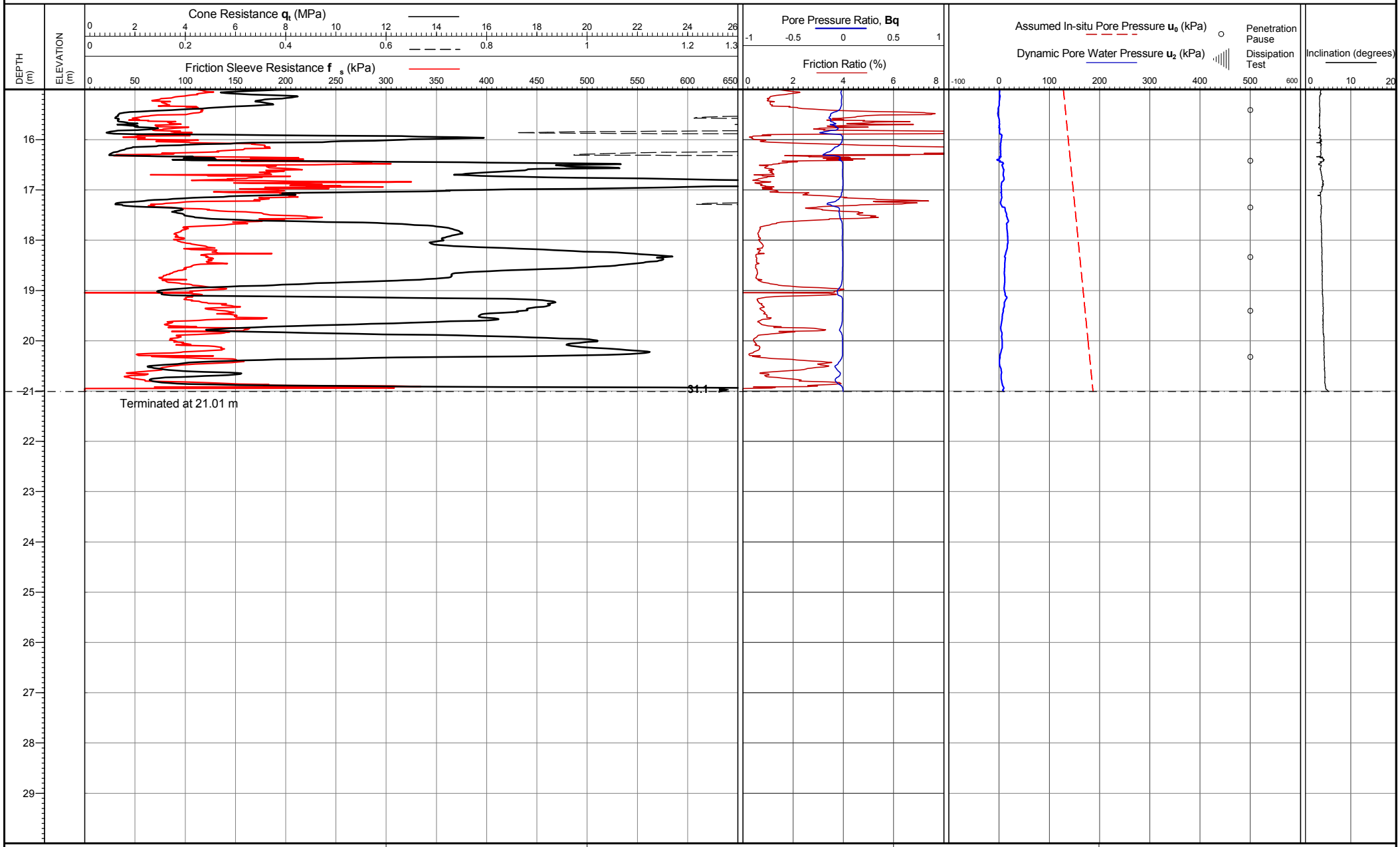


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT03**
Date of test: 17/12/2013 01:34:43	Coordinate system:	Termination Remark: Tip load		Page 1 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

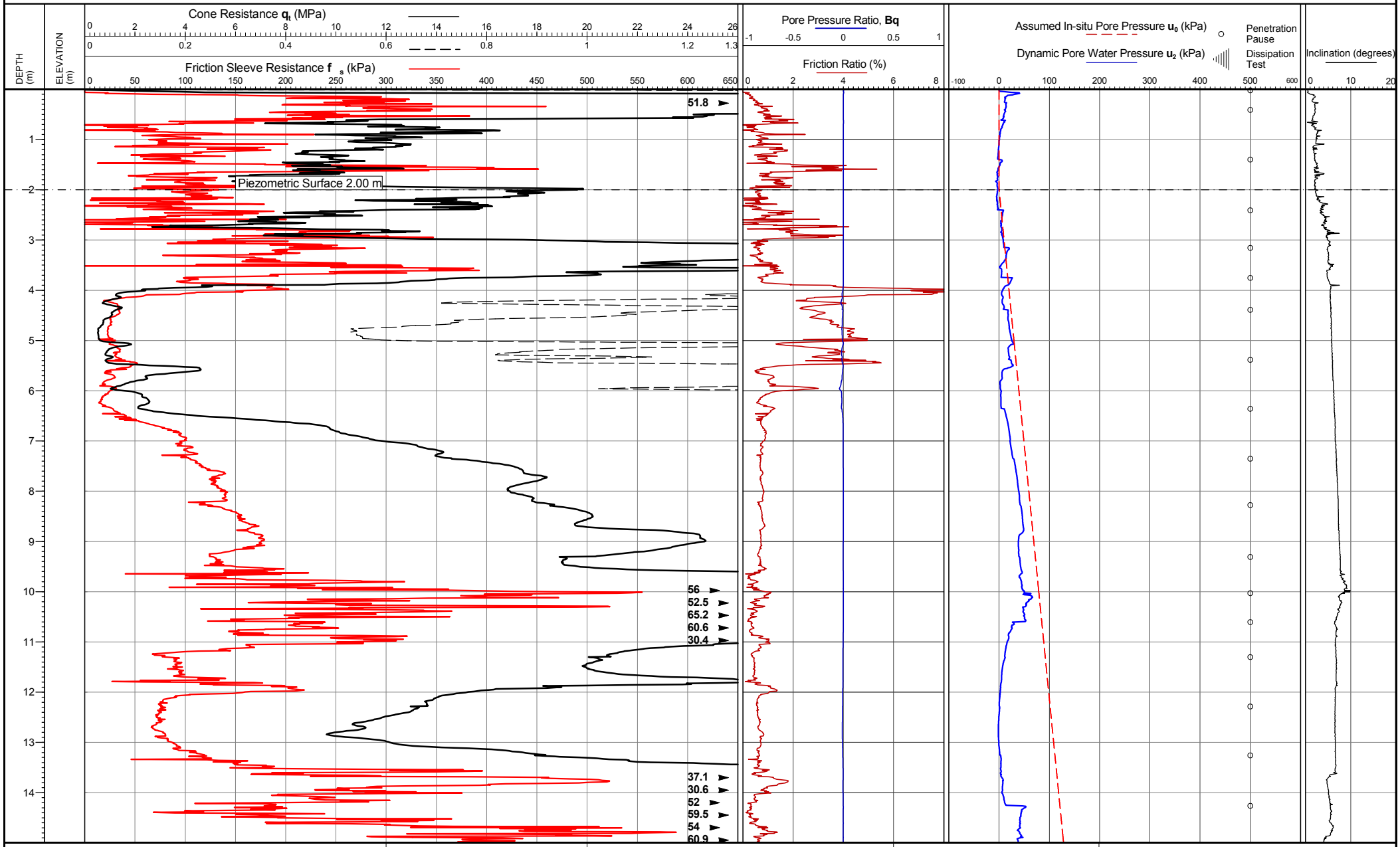


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			**TEST ID: CPT03**
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 17/12/2013 01:34:43	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



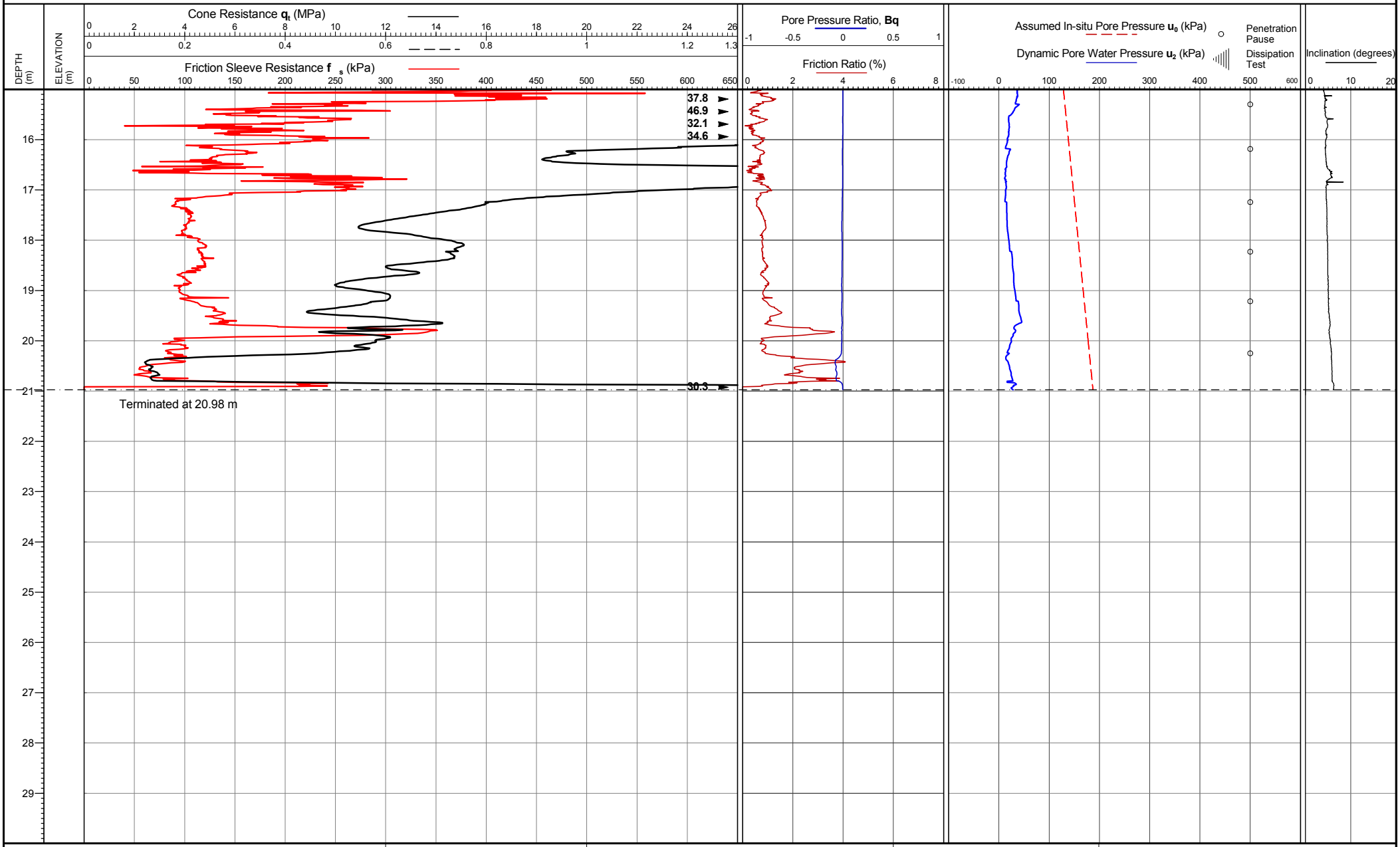
Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 17/12/2013 03:14:02	Coordinate system:	Termination Remark: Tip load		

TEST ID: CPT04

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

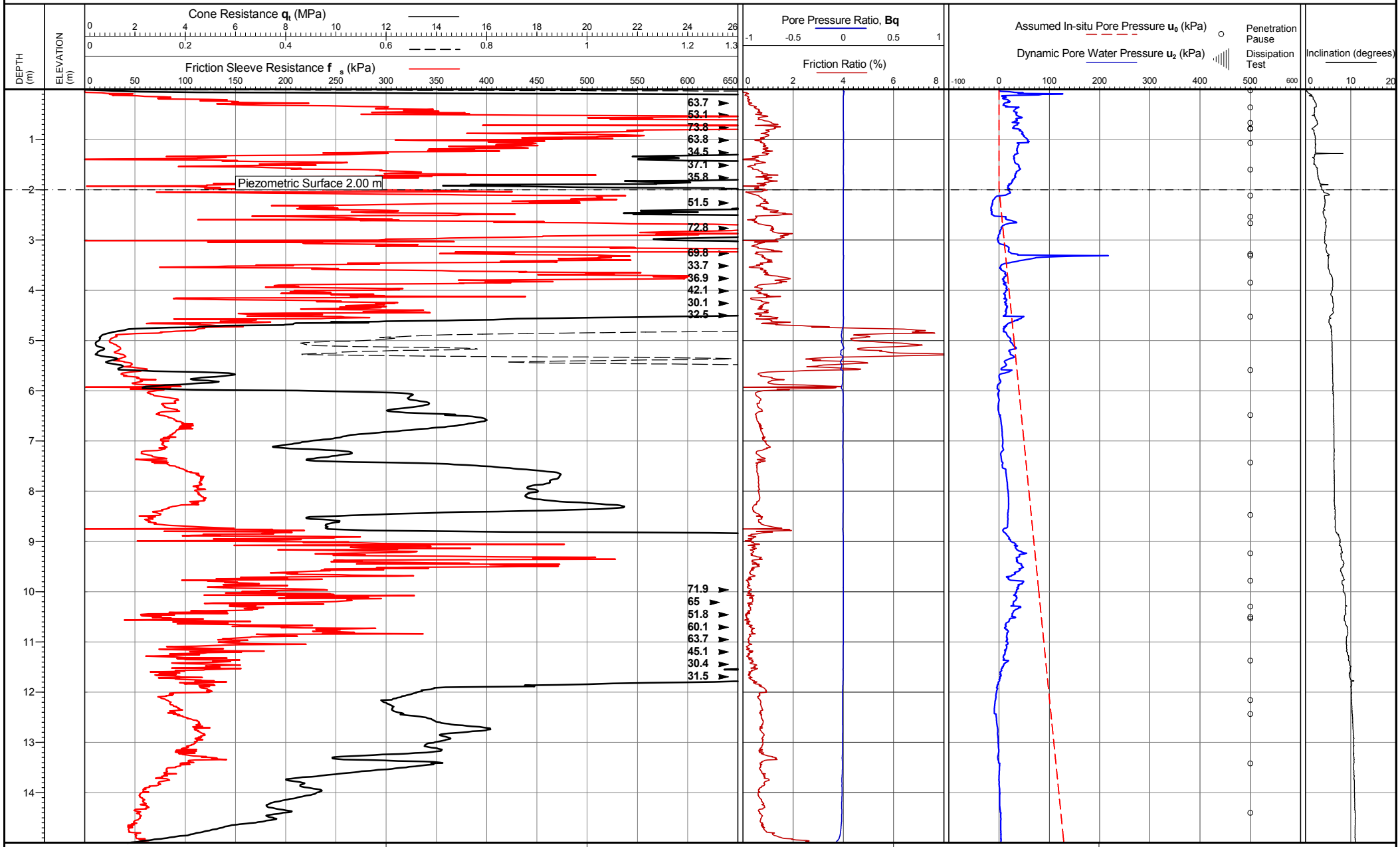


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 16-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT04**
Date of test: 17/12/2013 03:14:02	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

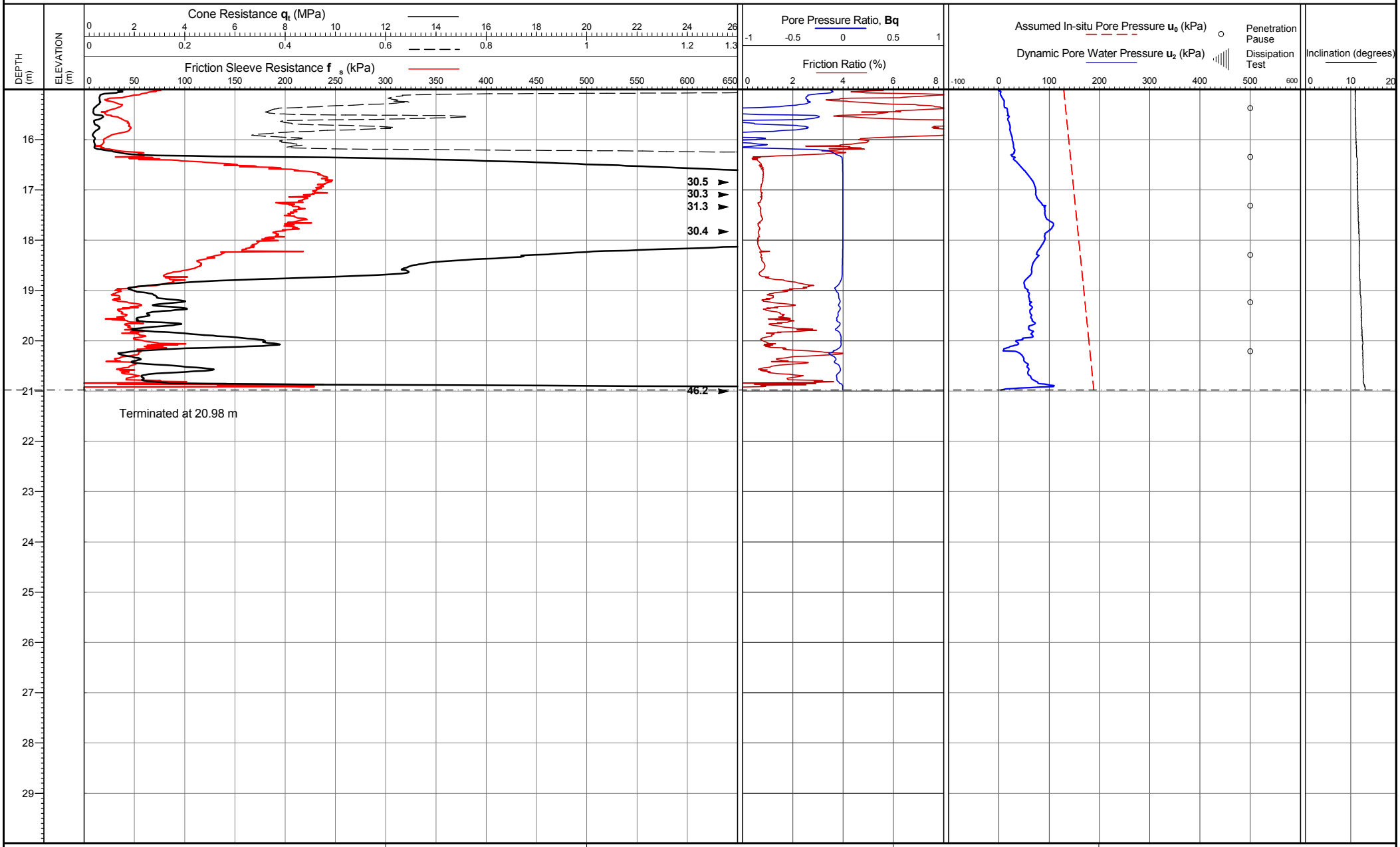


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT05**
Date of test: 17/12/2013 19:58:14	Coordinate system:	Termination Remark: Tip load		Page 1 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

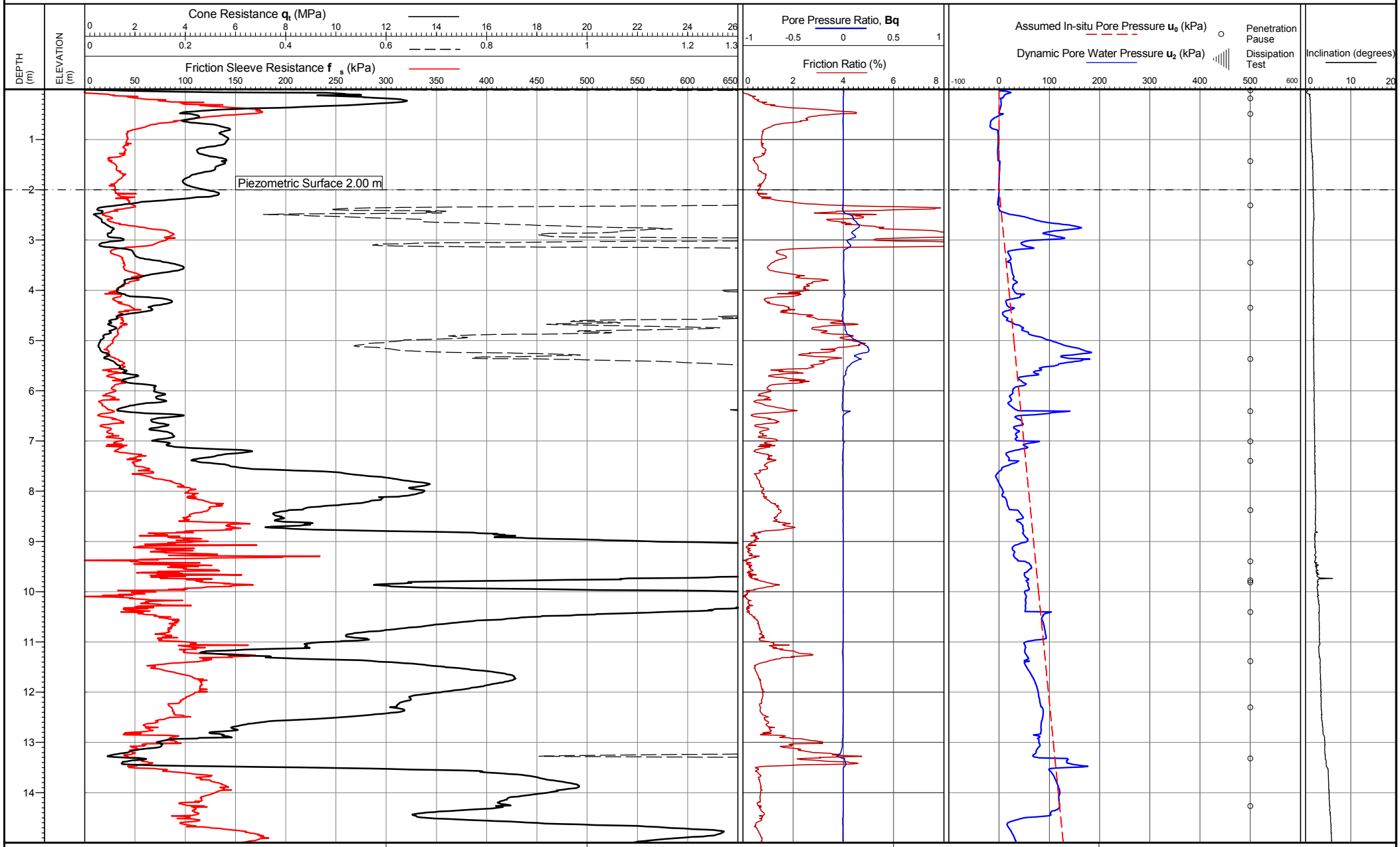


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT05**
Date of test: 17/12/2013 19:58:14	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

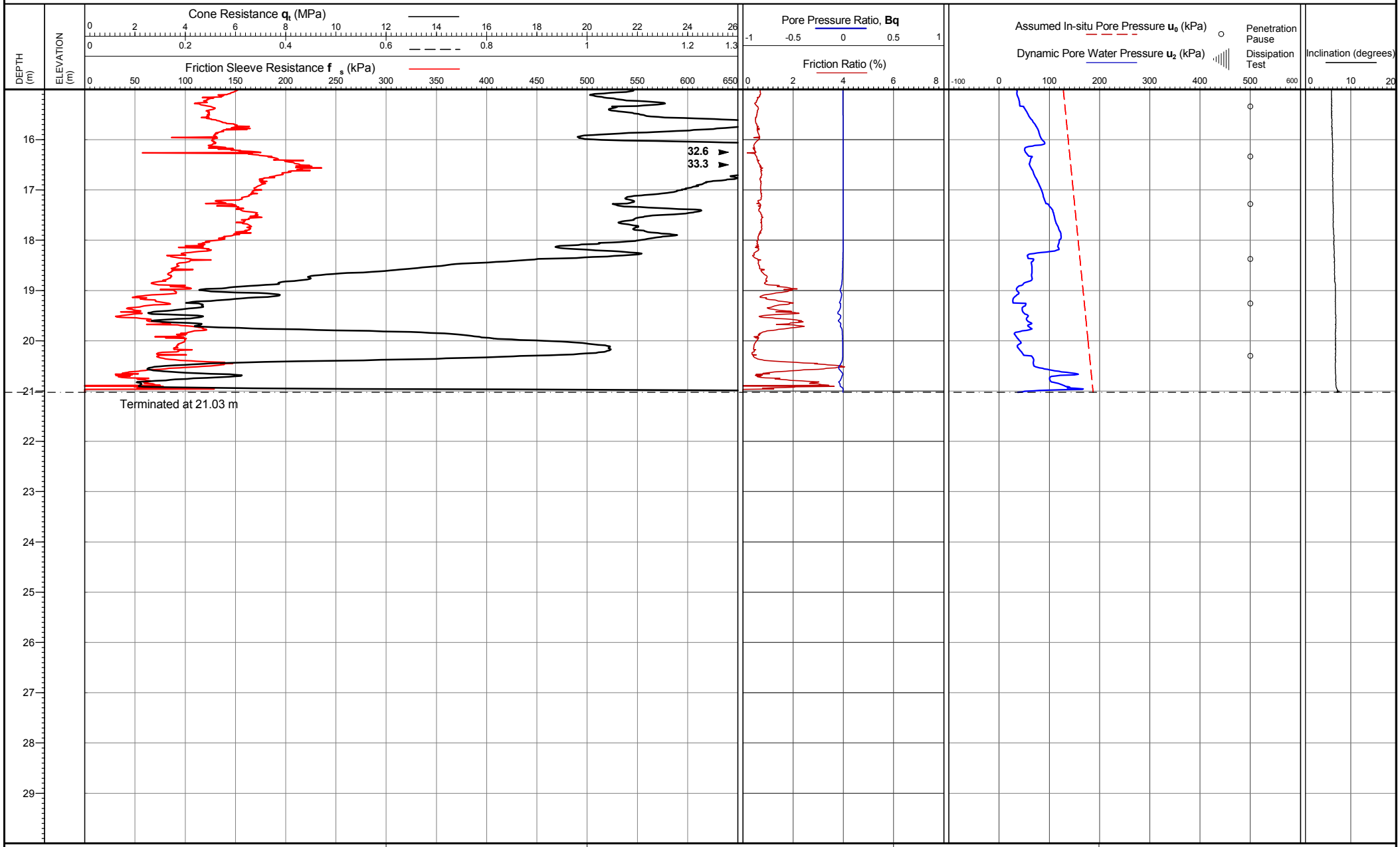


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT06**
Date of test: 17/12/2013 21:22:22	Coordinate system:	Termination Remark: Tip load		Page 1 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

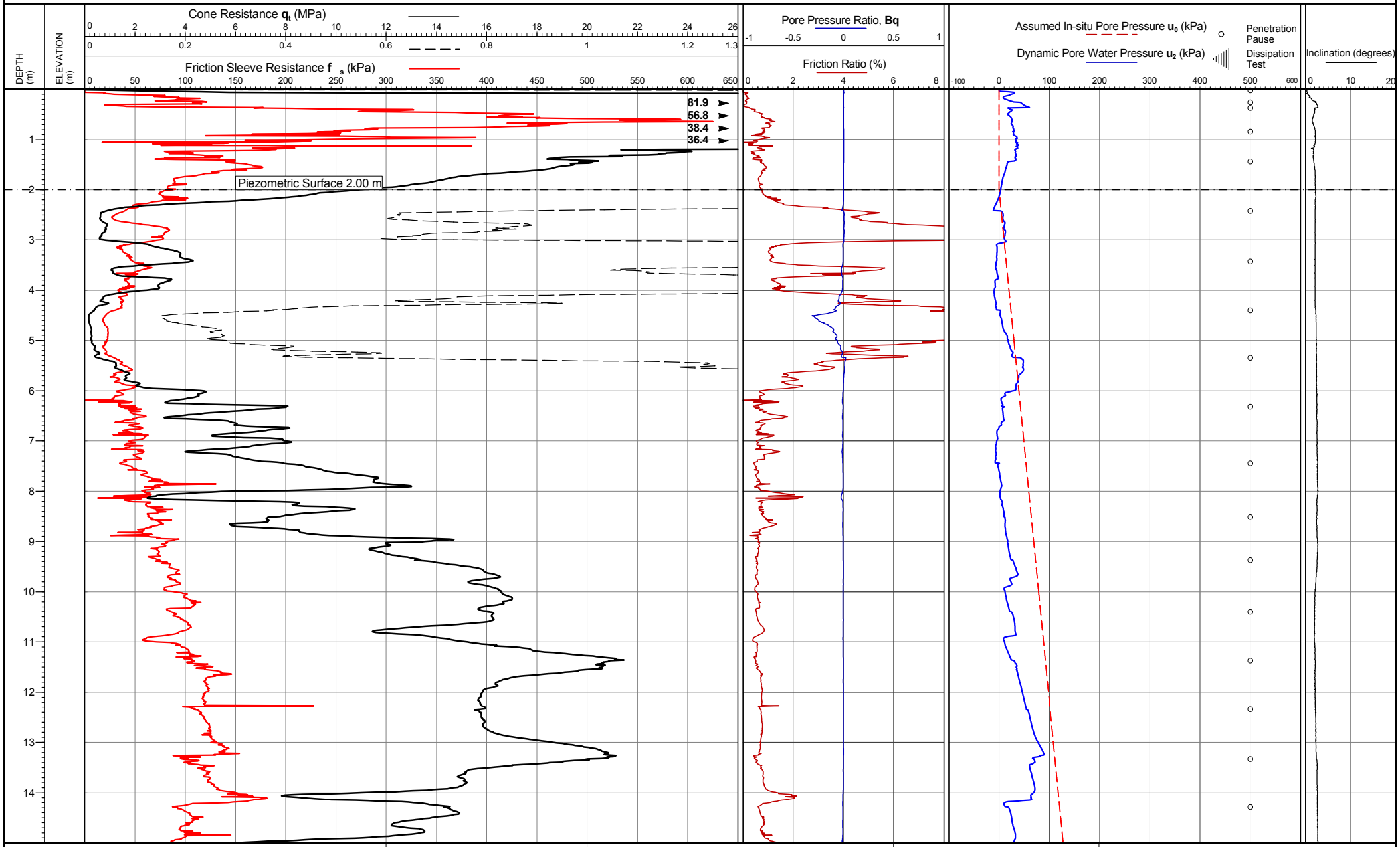


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT06**
Date of test: 17/12/2013 21:22:22	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



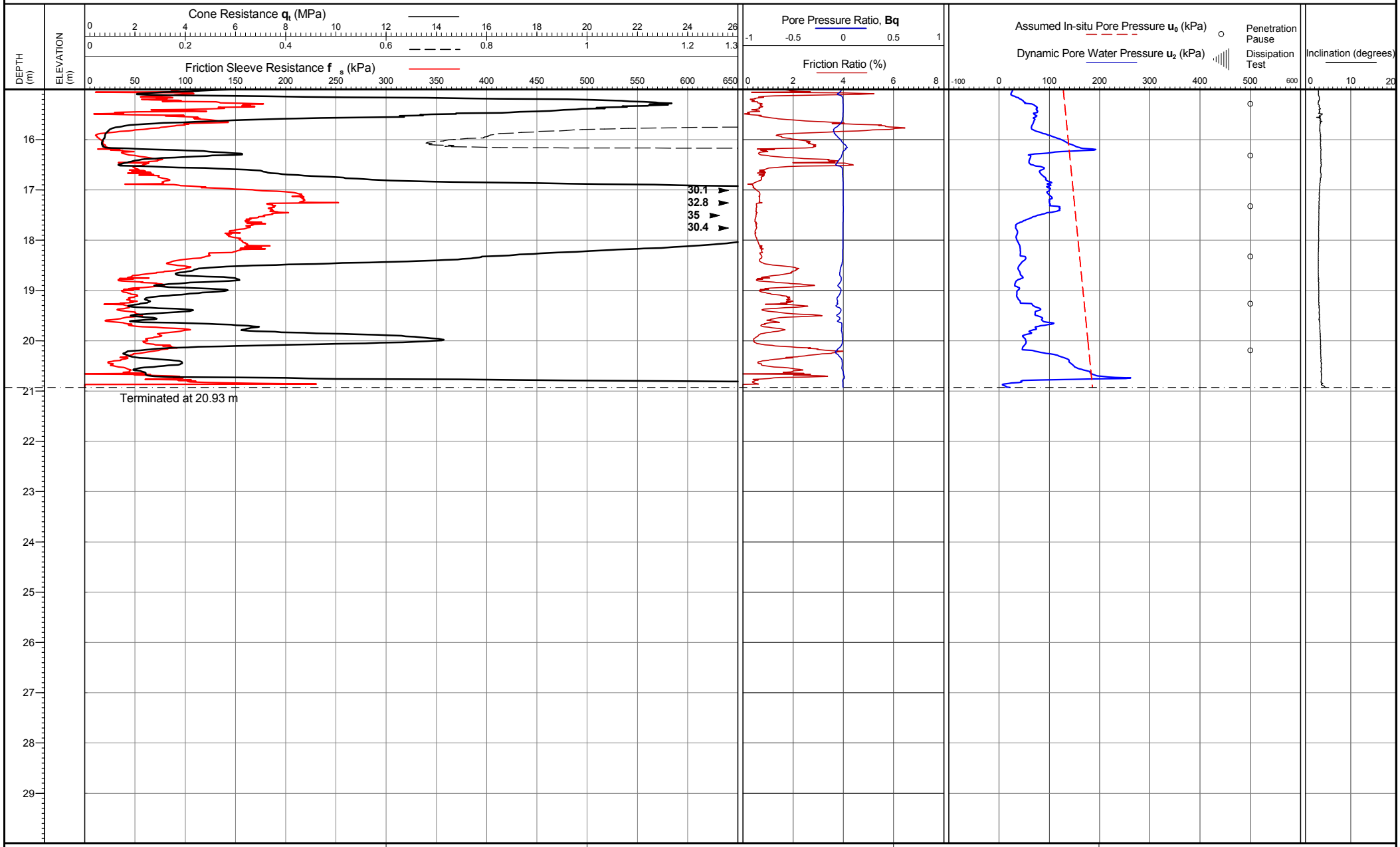
Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 17/12/2013 22:51:37	Coordinate system:	Termination Remark: Tip load		

TEST ID: CPT07

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

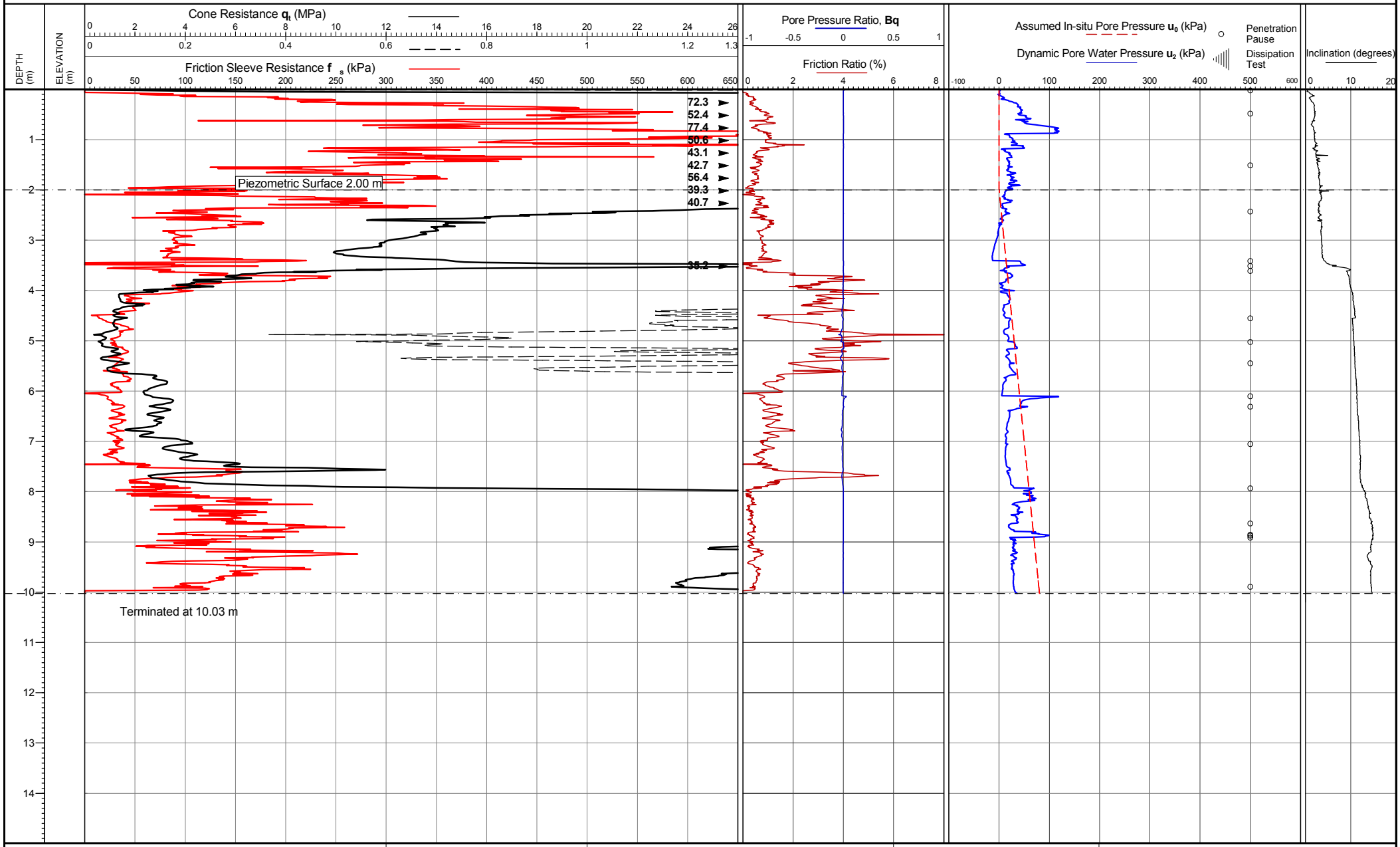


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT07**
Date of test: 17/12/2013 22:51:37	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

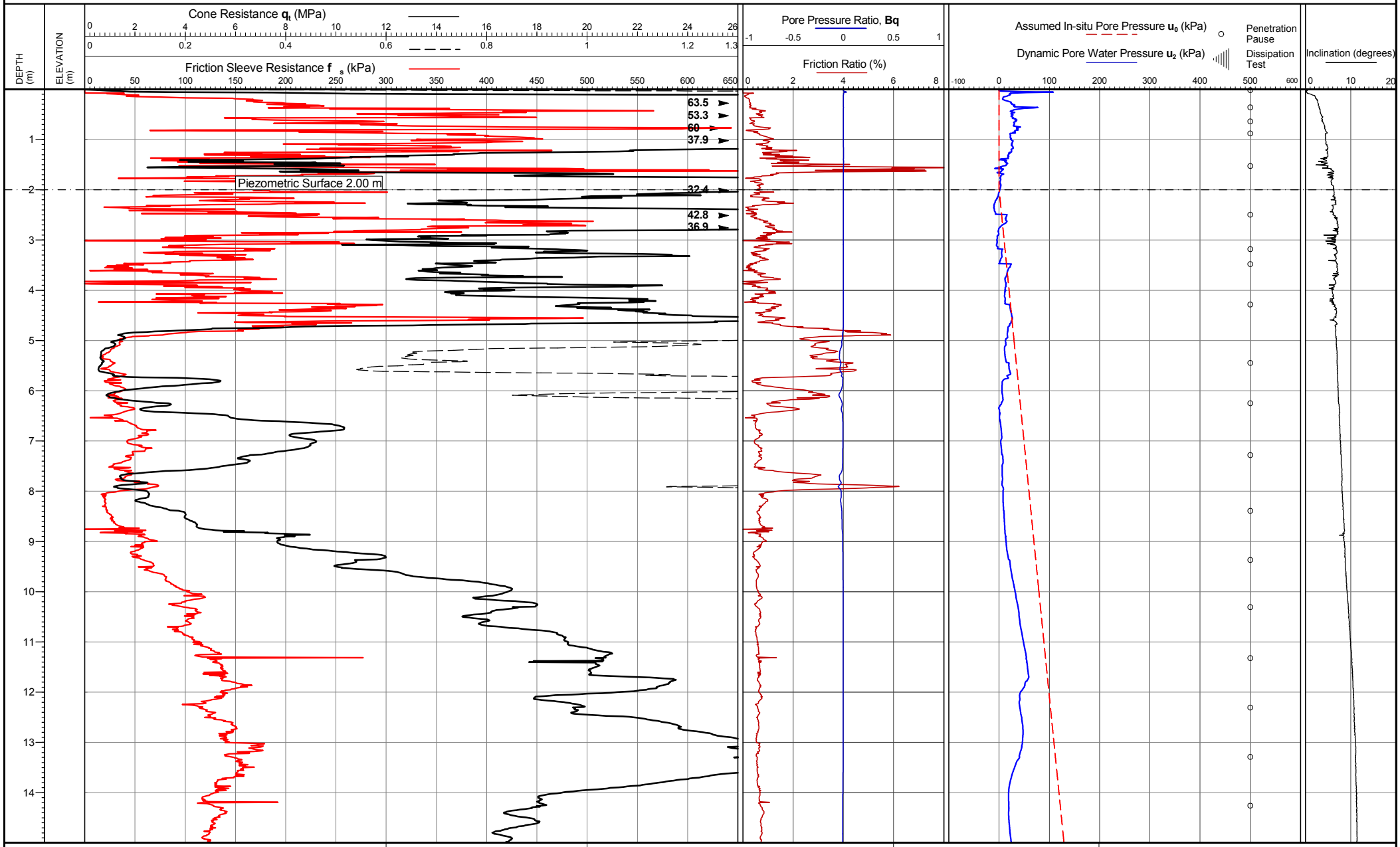


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT08A**
Date of test: 17/12/2013 23:46:36	Coordinate system:	Termination Remark: Inclination		Page 1 of 1

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



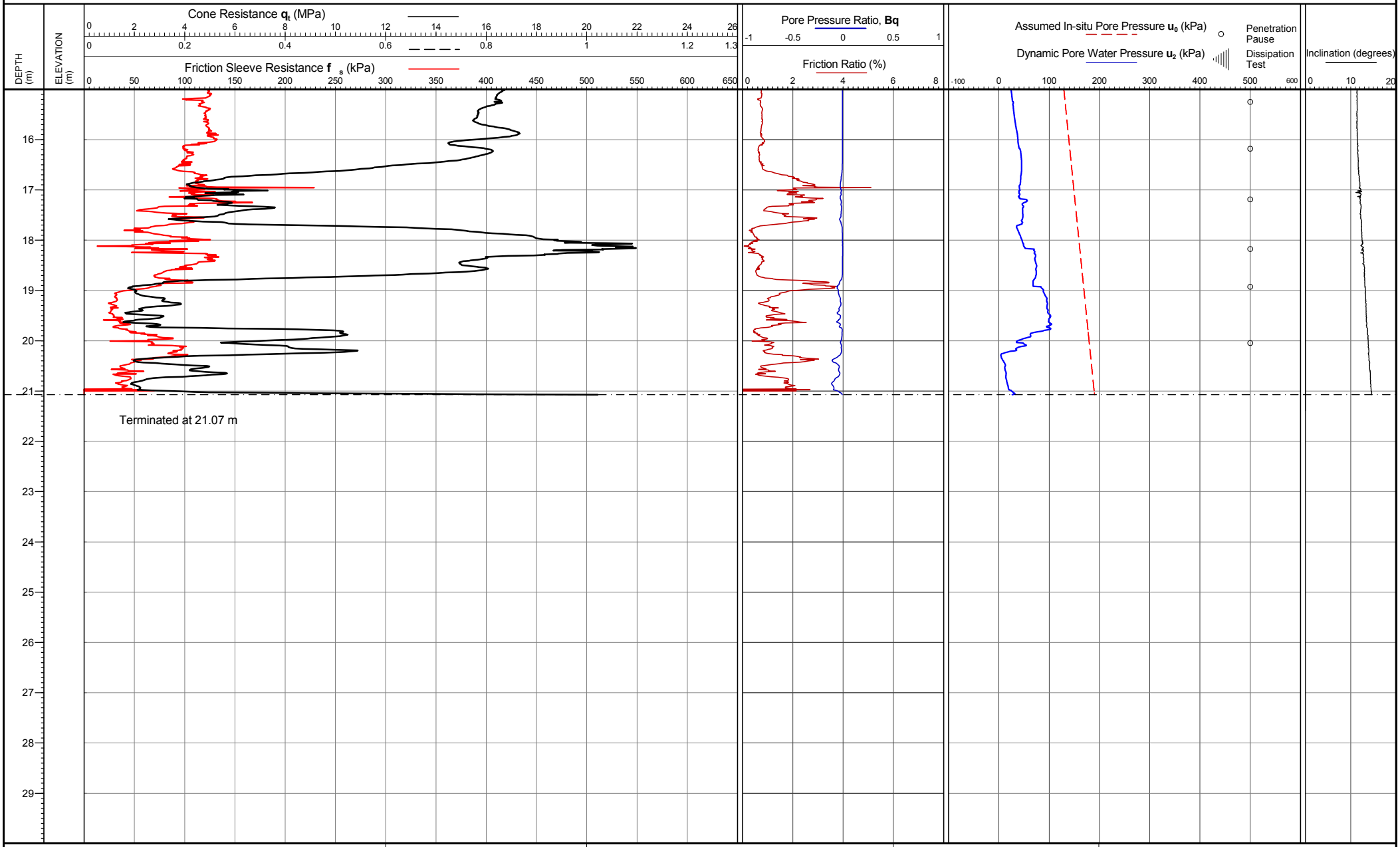
Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	
Date of test: 18/12/2013 02:01:06	Coordinate system:	Termination Remark: Tip load		

TEST ID: CPT09A

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA

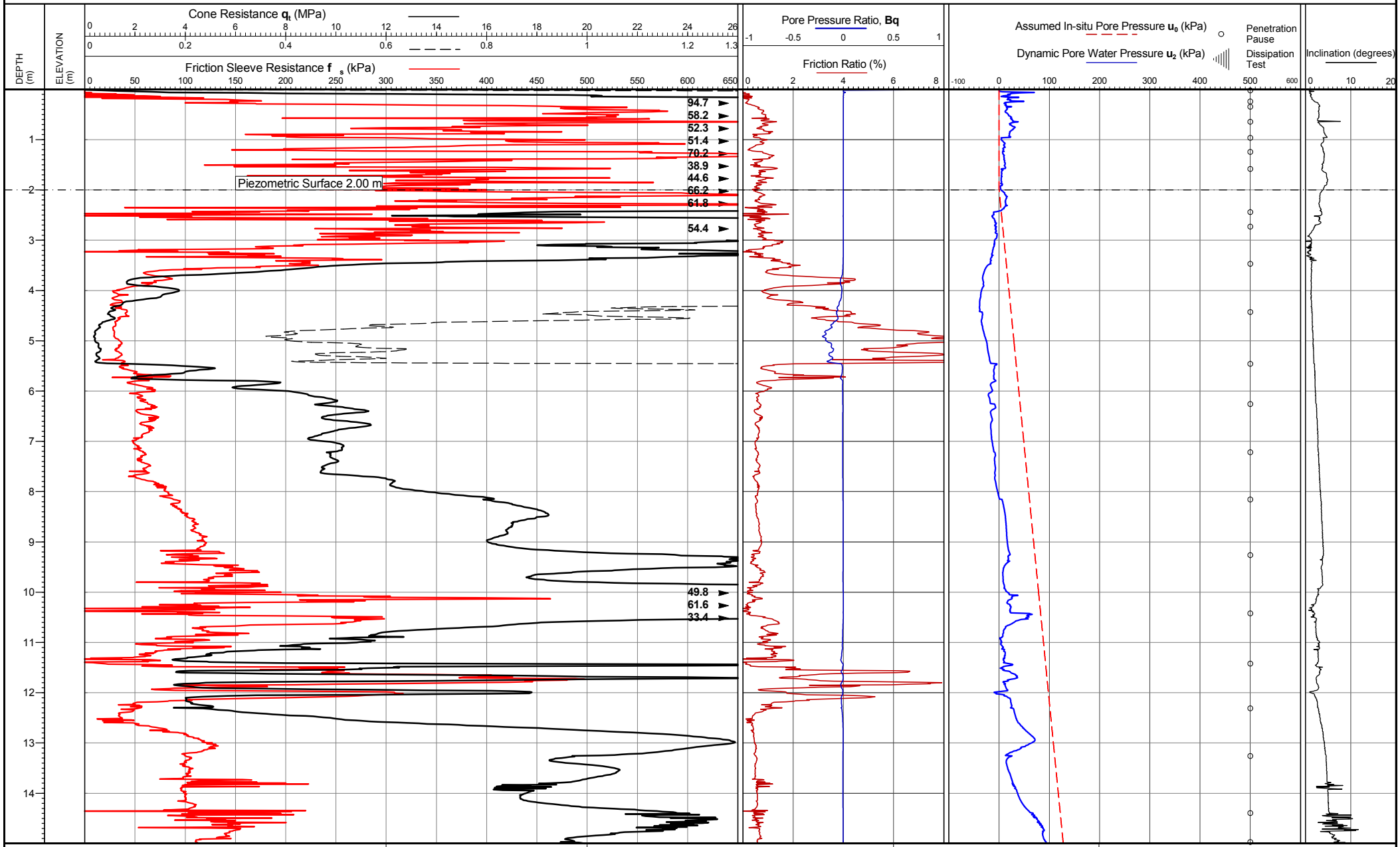


Cone area (mm2):1500	Location: Christchurch	Remarks:	Date of plot: 19-12-13	Lankelma Project Ref: PNZ2258
Cone ID: S15CFIIP.835	Coordinates: ,			
Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT09A**
Date of test: 18/12/2013 02:01:06	Coordinate system:	Termination Remark: Tip load		Page 2 of 2

Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



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Operator: Javan Cassidy	Elevation:		Checked by: Emma Stickland	**TEST ID: CPT10**
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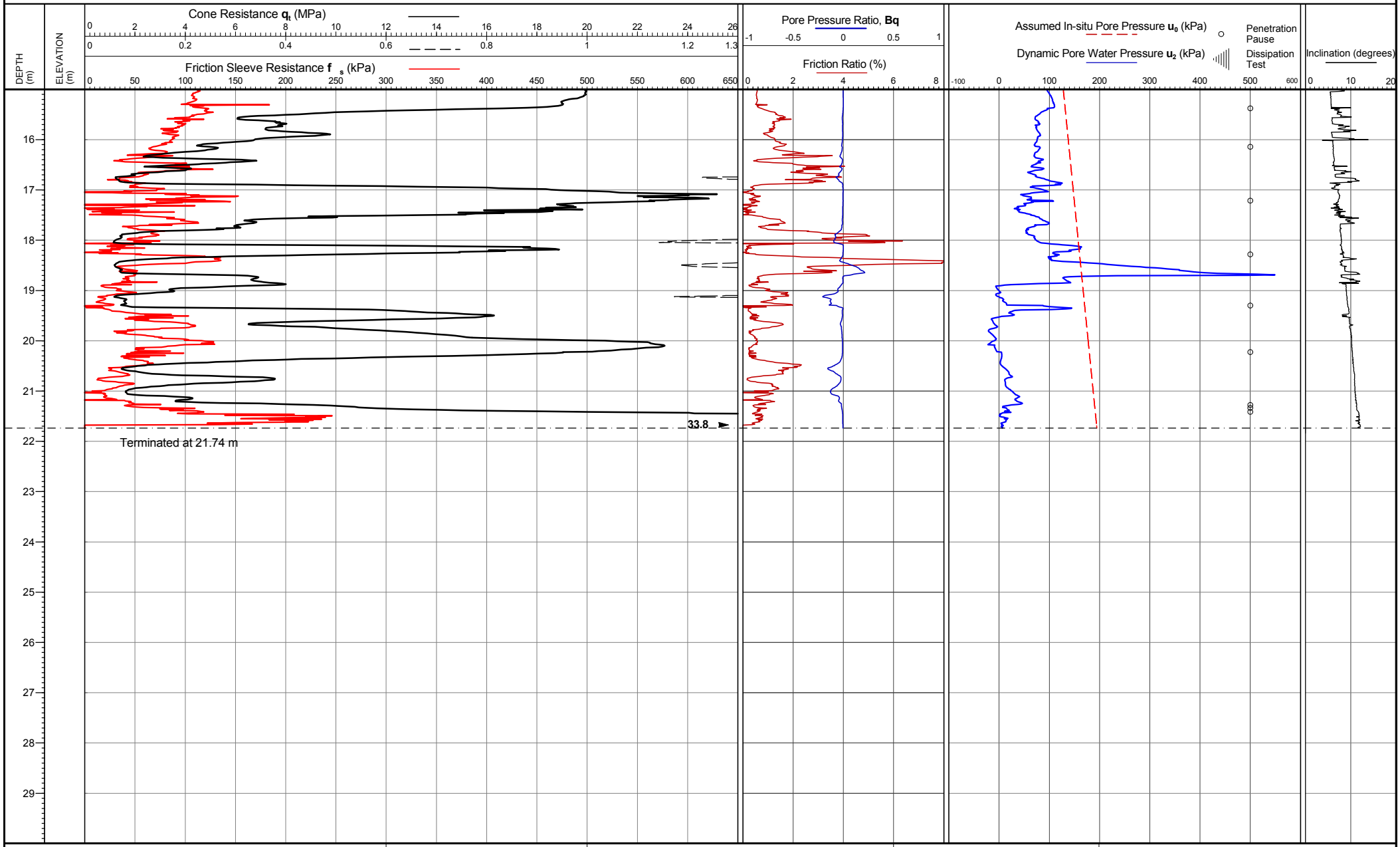
Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



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TEST ID: CPT10

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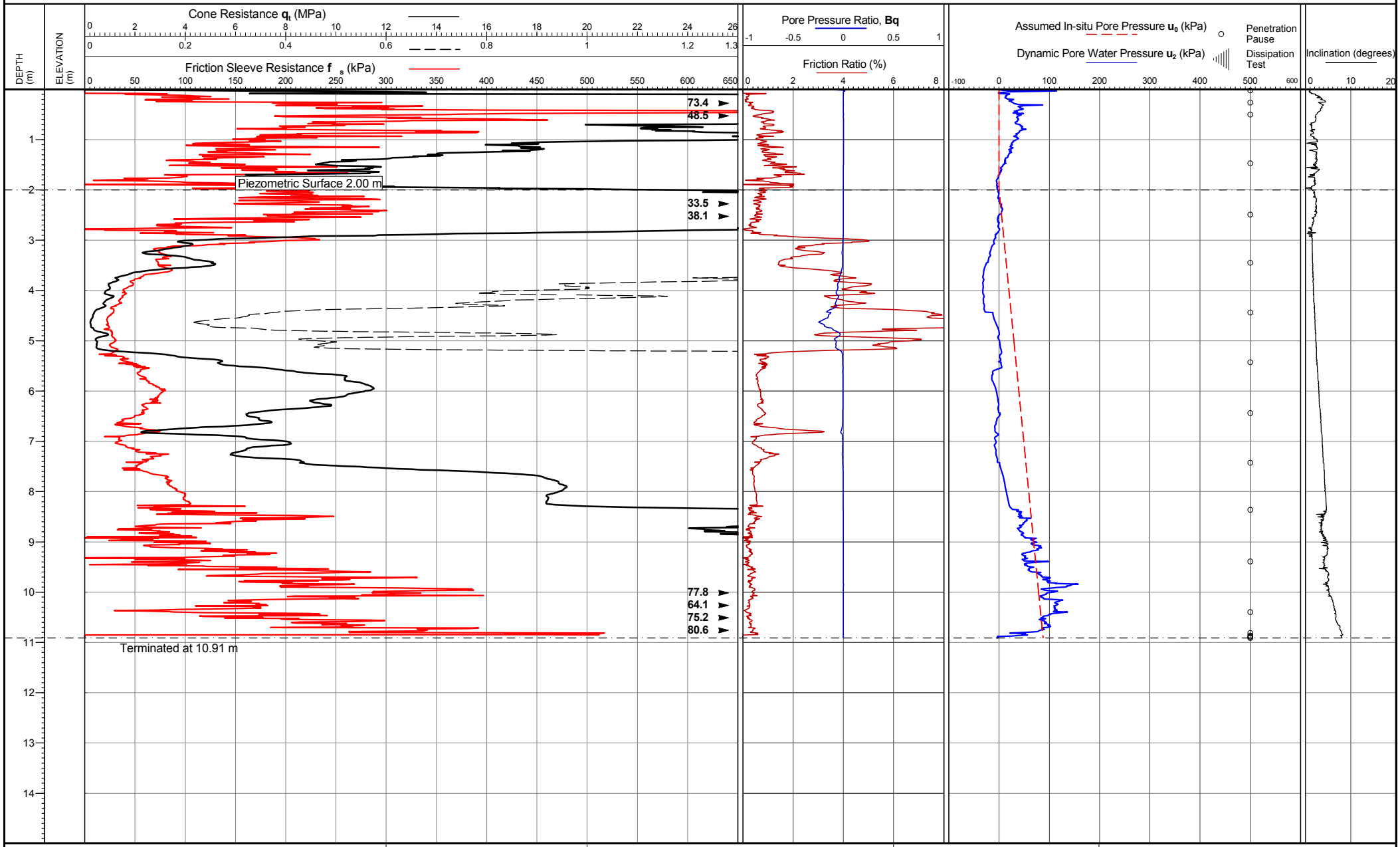

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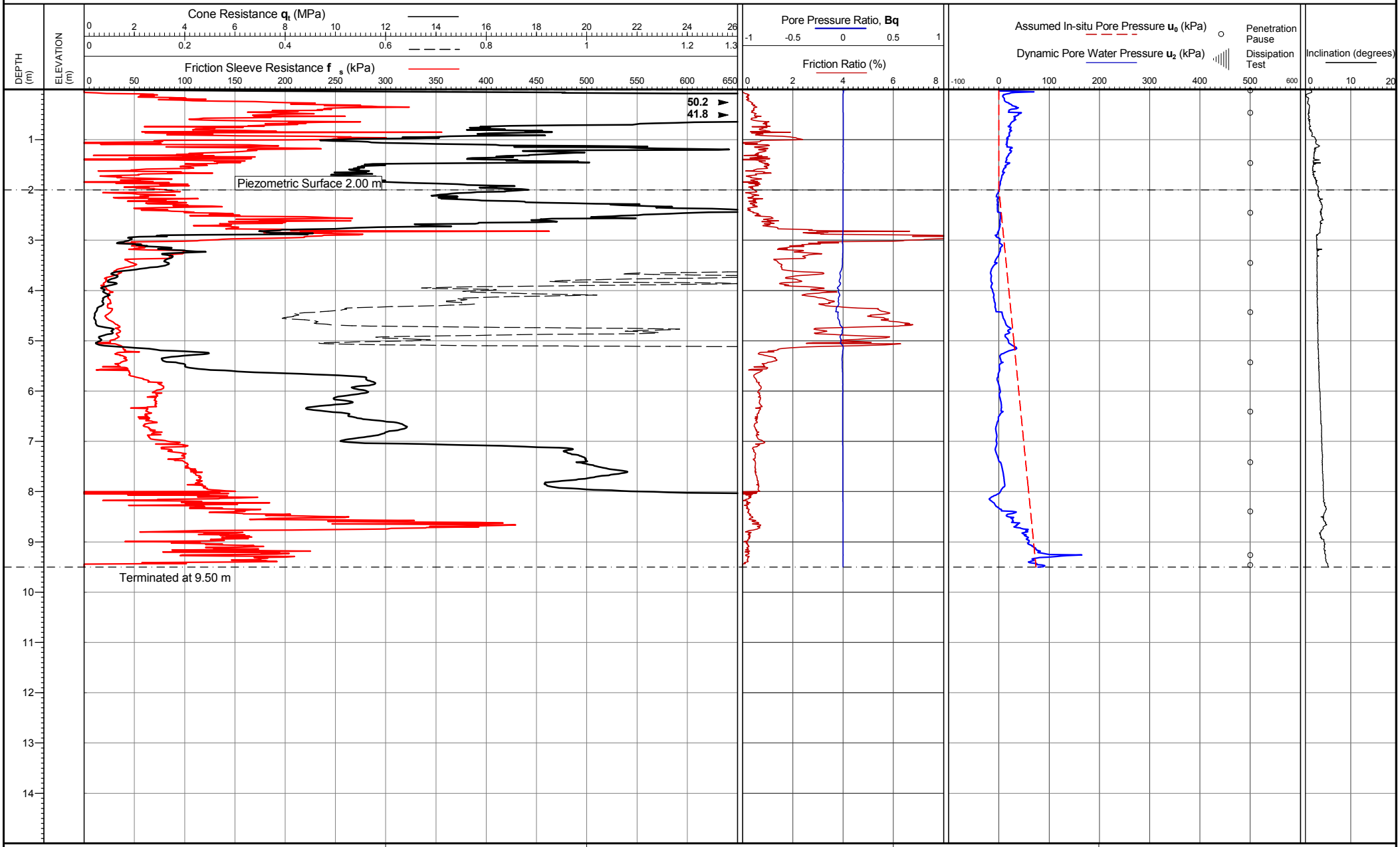
Client: TONKIN & TAYLOR

Project: 78 PARK TERRACE

LANKELMA



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Appendix C: Summary of Dewatering Assessment

C1 Introduction

T+T has undertaken a dewatering assessment for the Proposed Village development at the Bishopspark and Peterborough sites, Because the proposed basements will be constructed below the water table at both sites, construction of these basements requires mechanical support of the excavation and dewatering to allow work in the dry.

This summary sets out our dewatering assessment for resource consenting purposes.

C2 Our understanding of the proposed works

The Proposed Village works comprise extensive basements at the two sites which cover approximately 85% of the site area at both the Park Terrace and Bishopspark sites.

To allow construction of these basements, excavation of soils up to 4.8 m depth is required with the basement floor to approximately 3.5 m depth. A summary of the excavation areas are shown in Table C.1. The natural groundwater levels are shallow at a depth of approximately 1.5 m below ground level (bgl) at both sites. This means that excavation at the sites are expected to encounter groundwater ingress below this level. In order to work in reasonably dry conditions, groundwater will need to be removed via dewatering (pumping) during the basement excavation and basement construction works.

Table C.1: Summary of proposed excavations and volumes

Village	Site area	Basement area	Estimated groundwater level	Estimated volume of material below natural groundwater level
Peterborough	5,078 m^2	4,300 m^2	1.5 m bgl	12,500 m^3
Bishopspark	10,929 m^2	9,300 m^2	1.5 m bgl	37,900 m^3

Ingress of groundwater into deep excavations will be restricted by the placement of piles around the excavation which are also essential for stability of the excavation. The proposed retention system around the perimeter of the excavations is welded steel clutch tubes which will limit any horizontal groundwater seepages entering through the wall system. Groundwater flows will occur through the base of the excavation.

At the Park Terrace site, concrete piles exist at the site (the old building foundations) and extend to a depth of approximately 9 m bgl. As part of the site enabling works, some of these piles may be removed and depending on the method of removal some groundwater seepages and/or additional inflows may occur into the excavation which will need to be managed during the construction period. The piling may also cause hydraulic connections, and this risk will be managed during construction by blocking flows if they occur.

Given the site locations and the close proximity to the Avon River (as shown in Figure A.1), there will be a relationship between the river, and the aquifer affected by the excavation. .

Figure C.1: Site outline of two sites; Bishopspark and Peterborough, and the close proximity of the Avon River.

C3 Geology and hydrogeology

The shallow site-specific geology (ie within 10 m of the surface) for both the Bishopspark and Peterborough sites comprise alluvial deposits of sand, silt, gravel and peat. There is some variation in the thickness of each layer across the sites, as summarised below. However, these layers are generally laterally extensive and typical of the geology in the wider area beyond the sites.

These shallow alluvial deposits for the Bishopspark site are described as predominantly:

- Interbedded firm, sandy silt and loose sand/silty sand (of the Springston Formation) to a depth of up to 3.5 m;
- Up to 4.3 m thickness of peat within a very soft silt matrix to a depth of up to 8 m; and
- Up to 3 m thickness of loose silty sand, firm sandy silt and medium dense to dense sandy gravel to a depth of up to 10.95 m.

The shallow alluvial deposits for the Park Terrace site are described as predominantly:

- Interbedded firm, sandy silt and loose sand/silty sand (of the Springston Formation) to a depth of up to 3.0 m overlying up to 6 m of fill and/or topsoil;
- Up to 2.6 m thickness of peat within a very soft silt matrix to a depth of up to 5.5 m; and
- Up to 2 m thickness of loose silty sand, firm sandy silt and medium dense to dense sandy gravel to a depth of up to 13.7 m.

Groundwater is encountered in the upper layers of silt and sand at depths of approximately 1.5 m bgl at both sites. This shallow groundwater forms a water table (unconfined aquifer) in the shallow geology ie within 10 m of the surface. Deeper groundwater (confined aquifer) exists in the Riccarton gravels at depths greater than 20 m bgl beneath a layer of stiff silt and sandy silt. The Riccarton aquifer has artesian water pressures, meaning the groundwater in this aquifer is pressurised, but is being confined by the overlying layers.

Groundwater flow in the shallow water table aquifer at the sites is assumed to be toward the Avon River. Groundwater movement through the shallow deposits (through flow) will be variable across the sites, with preferential flow through the shallow sand and deeper gravel. Provided that there is no leakage from the Riccarton aquifer, flows into the proposed excavations are expected to be from the shallow water table aquifer via the base of the excavation.

C4 Surrounding environment

C4.1 Avon River

The Avon River is located adjacent to Park Terrace and approximately 30 m west of the sites at the closest point. During normal dry conditions, water level of the Avon River is approximately 4 m below the ground level at the Bishopspark and Peterborough sites and is estimated to be at a similar level to the base of the proposed excavations.

The groundwater in the water table aquifer at the sites is assumed to be hydraulically connected to the Avon River. This means that the Avon River is likely to be receiving some groundwater flow from the shallow groundwater at the sites. It is also possible that the Avon River is supporting groundwater flows in the water table aquifer by leakage through the river bed.

Therefore, the Avon River is a sensitive receptor and could potentially be affected by the proposed dewatering activities at the sites by the lowering of the groundwater levels in the local area and having a stream depletion effect on the river. This effect is mitigated by the discharge of water from the excavation back into the Avon (via the stormwater network), and is discussed in more detail in Section C8.

C4.2 Groundwater users

There are a number of groundwater (bore) users in the local area. The depressurisation of the aquifer could therefore have an effect on the water levels in any shallow groundwater bores in the local area. Our dewatering assessment models the potential changes to groundwater levels based on the surrounding external influences. This means that different results can be presented on each side of the sites. Each of the bores nearby is addressed below.

A review of the local bores in the area shows that the closest bore with an active take is shown to be bore M35/2325 located at 447A Montreal Street approximately 230 northeast of (the centre of) Bishopspark site. This bore is owned by Christchurch City Council (CCC) and is reported to be 31.7 m deep with a groundwater take for community supply (likely to be from the Riccarton aquifer). This bore is considerably deeper than the proposed depth for dewatering and we therefore assess that, based on the setback and depth of Bore M35/2325, the proposed excavation will not have consequential effects.

The nearest, most shallow depth bore, reported to have an active take is bore M35/18558, located at Hagley Park approximately 530 m southwest of (the centre of) Park Terrace site. This bore is reported to be 23 m deep and has a groundwater take for domestic supply. The use of this water is questionable since there are no domestic properties in the area and the bore is located beside a recreational boating pond. A secondary use of groundwater monitoring is noted for this bore. Two other bores located around the periphery of the pond and drilled at the same time as bore M35/18558 also have a secondary use of groundwater monitoring. We assess that, based on the setback of Bore M35/18558, the proposed excavation will not have consequential effects on that bore.

C5 Groundwater Modelling

Our assessment is based on understanding the potential inflows of groundwater into the proposed excavation from the surrounding area and from the Avon River. This is to allow us to determine the volume of dewatering at the Bishopspark and Peterborough sites and the possible effect around the village.

We have developed a multi-layer 3D transient groundwater model, using groundwater modelling software known as AnAqSim[12] to assess the anticipated groundwater inflows into the excavations and to assess the potential stream depletion effect of the Avon River. The transient groundwater model means multiple assessments can be made through time and over the course of the dewatering activity. This is because changes occur to the amount of drawdown over time as groundwater table is lowered and maintained at a lower level during the course of the dewatering activity.

To allow the set-up of the model, we have made a number of assumptions where actual data are not immediately available, as described below. This means that the current model is conservative and can be refined once site specific data have been obtained. We have adopted the hydraulic conductivities presented in Table C.2 for the dewatering assessment, and have varied the hydraulic conductivity as part of our sensitivity study. These values are based on site specific investigations, and are generally consistent with parameters adopted around Christchurch.

Table C.2: Adopted input parameters

Depth (m bgl)	Lithology	Adopted hydraulic conductivity (m/s)	Notes
0 – 3.5	Sand	5×10^{-5}	
3.5 – 7.5	Peat	5×10^{-7}	Varied from 5×10^{-6} to 5×10^{-8} to obtain range of flows
7.5 – 12	Sand	5×10^{-5}	
12 – 20	Coarse sand	5×10^{-4}	
River Avon	Sandy silt	7×10^{-6}	River bed conductance estimated as 7×10^{-6} m/s, based on river width = 15 m and a bed thickness = 1 m.

C6 Assumptions

The multi-layer 3D transient groundwater model is based on the following assumptions to make a conservative assessment:

- Entire footprint of both the Bishopspark and Peterborough sites is used to represent the basement excavation extent;
- Ground conditions were adopted from the investigations contained within this report;
- Proposed excavation is supported by sheet piles to 12 m bgl;
- Static groundwater level is 1.5 m bgl and the groundwater flow is horizontal across the sites;
- Aquifer input parameters for permeability (hydraulic conductivity) is based on a secondary source for the aquifer in the Springston Formation[13];

[12] AnAqSim – **An**alytical **Aq**uifer **Sim**ulator is a highly versatile Analytic Element Method (AEM) groundwater modelling software developed by Charlie Fitts www.fitssgeosolutions.com.

[13] https://nzgeothermal.org.nz/app/uploads/2016/11/12June2015_1-2_AQUALINC-Rutter.pdf.

- Aquifer input parameters for porosity and storativity are based on published values[14] and using our hydrogeological judgement;
- Values of stream bed conductance (leakage) are based on adopted values using our hydrogeological judgement;
- The duration of the dewatering is estimated to be around 18 months; and
- For this assessment has been based on the geological and hydrogeological conditions for Bishopspark.

C7 Limitations

The limitations of our groundwater model is the absence of site specific data. Our estimates of the aquifer input parameters (hydraulic conductivity and storativity) are based on reporting by others rather than site specific values. All of these input parameters can vary significantly and the model results are sensitive to these hydraulic input parameters. Therefore, the results provide a range of the anticipated groundwater inflow rates and stream depletion effects on the Avon River, and a conservative approach has been adopted. The parameters will be confirmed by geotechnical testing to obtain site specific data.

C8 Results

The model assesses how much dewatering is required to maintain a dry excavation, with an initial depth selected to 4.4 m, by the amount of groundwater inflow to the excavation. The results are a function of the input aquifer parameters and Avon River bed permeability values. We have included a range of hydraulic input parameters with sensitivity analysis for our model, which has resulted in the range of groundwater inflow and stream deletion rates.

The results of our groundwater modelling show groundwater inflows into the basement excavation are calculated to be in the order of:

- 12 to 50 Litres/second (L/s) or 43 to 180 m^3/hr after two weeks of the dewatering (1,000 – 4,300 m^3/d); and
- 3 to 17 L/s or 11 to 60 m^3/hr after approximately 100 days of dewatering (250 – 1,500 m^3/d).

Based on these reported results, the pumped volumes will require management and control during the dewatering on the Bishopspark and Peterborough sites. This assessment assumes that both these excavations will be completed concurrently, whereas in reality the work may be sequential. These groundwater inflows are based on flows from the shallow water table aquifer.

Groundwater inflow rates, and thus dewatering volumes are expected to be greatest during the early stages of dewatering to remove water from storage i.e. lowering of the water table within the excavation. As the groundwater levels are lowered, a cone of depression expands out from the dewatering point and the rates of inflow approach steady state of the throughput by the aquifer.

Our groundwater modelling shows that the stream depletion effects will be up to 80% of these groundwater inflow rates, with the range provided below:

- 10 to 40 L/s or 36 to 145 m^3/hr after two weeks of the dewatering (865 – 3,500 m^3/d); and
- 2 to 14 L/s or 7 to 50 m^3/hr after approximately 100 days of dewatering (170 – 1,200 m^3/d).

The Avon River is located at around the same elevation as the proposed basement excavation. Based on our modelling, as the duration of dewatering continues, the proportion of groundwater

[14] Morris, D.A. and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, U.S. Geological Survey Water-Supply Paper 1839-D, 42p.

inflows that comprise water loss from the Avon River increases. However, any dewatering that occurs will discharge directly into the stormwater network, after treatment to address any elevated total suspended solids (TSS). The stormwater network discharges directly into the Avon River. Hence, while the Avon River is potentially affected by the dewatering through loss of flow, any stream depletion effects are mitigated by the effects of the direct discharge (returning the treated discharge to the Avon via the stormwater network).

The thickness of peat around the Site means that this layer could be subject to the effects of consolidation if it is dewatered. The proposed perimeter wall around the excavations limits any horizontal groundwater flow, which then restricts the amount of dewatering in the adjacent in-situ strata. The underlying sand layer (through which water flows into the excavation) has strong recharge from the surrounding area. Combined with the retention system, the potential to cause consolidation (settlement) adjacent to the sites through dewatering is minimal, and we do not assess any consequential settlement risks.

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