Geotechnical Investigation and Assessment Report for Subdivision

511 Halswell Road, Halswell, Christchurch

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Executive Summary

Miyamoto International NZ Ltd (MINZ) has been engaged by Yoursection Ltd to undertake a geotechnical land suitability assessment for the proposed residential subdivision at 511 Halswell Road, Halswell, Christchurch. The key findings of our evaluation and assessment are outlined below.

GROUND CONDITIONS	**Ground profile**	The sub-surface conditions comprise mainly topsoil over sand-silt mixtures underlain by soft clayey silts and shallow gravels. The ground conditions are highly variable in horizontal and vertical spread.	
	Soil classification as per NZS 1170.5:2004	Residential Subdivision Area: Class 'D' (deep or soft soil site)	
	Depth to water table	Perched water tables and shallow saturated soils were encountered within the top 1.0 to 2.0m bgl. Permanent ground water is anticipated below the soft silts within the underlying sands and gravels.	
SEISMIC ASSESSMENT	**Design Earthquake Event**	**SLS/SLS2**	**ULS**
	Estimated "free-field" Index post-liquefaction volumetric settlements	5 – 40mm / 10 – 50mm	20 – 85mm
	Liquefaction Severity Number (LSN) Value	<5 – 15 Little to minor expression of liquefaction	10 – 30 Minor to moderate expression of liquefaction
	MBIE Technical Categorization (TC)	**Mapped MBIE**	80% - Rural & Unmapped 20% - TC3
		Site Specific Foundation TC	TC2
GEOTECHNICAL CONSIDERATIONS	Our assessment of the site under RMA Section 106 found that there are no further significant hazards present that pose undue risk to development on the site, other than those highlighted (presence of the upper soft soil layers and liquefaction induced subsidence) within this report. As the site is located within an FMA set out by CCC, the majority of the site will require filling to raise the ground level to a suitable level for the proposed development. Filling of the site may cause static consolidation settlements in the soft compressible soils underlying the site, therefore, a suitable period of preloading should be undertaken to accelerate any potential settlements prior to development of the site.		

1. Introduction

Miyamoto International NZ Ltd (MINZ) has been engaged by Yoursection Ltd to undertake a geotechnical evaluation and assessment as part of a land suitability assessment for the proposed residential subdivision located at 511 Halswell Road, Halswell, Christchurch.

At the time of writing, the subdivision plans (layout etc.) had not yet been fully developed, as such we have based our work on the following preliminary information (also refer to Figure 1):

- The northern section of the site is to be subdivided for residential development;
- The southern section of the site is to be utilised for stormwater management (treatment and detention);
- The intersection of Hallswell and Candys Road will be modified to accommodate a new road into the subdivision.

The scope of this geotechnical engineering assessment was to evaluate the geotechnical conditions at the site and to provide preliminary recommendations for development of the sections. This assessment comprised the following:

- Research of the available information from the New Zealand Geotechnical Database (NZGD), Christchurch City Council (CCC) and Environment Canterbury (ECan);
- Site walkover inspection of the land;
- Shallow field investigation comprising hand-augered boreholes (HA) with associated dynamic cone penetrometer (DCP) and shear vane (SV) tests;
- Multichannel Analysis of Surface Waves (MASW) geophysical survey;
- Electrical Resistivity Tomography (ERT) geophysical survey;
- Liquefaction analyses using CPT-based liquefaction triggering procedures.

The geotechnical investigation and assessment were carried out considering the Ministry of Business, Innovation & Employment (MBIE) Guidance documents “Planning and engineering guidance for potentially liquefaction-prone land” - Version 1, dated September 2017, “Repairing and rebuilding houses affected by the Canterbury earthquakes” - Version 3, dated December 2012, and “Earthquake geotechnical engineering practice - Modules 2 & 3”. This report presents our findings and conclusions which are provided to facilitate the development of an initial subdivision plan for the site.

2. Site Description

The site, legally described as Part RS 1593 and RS 772, is located in Halswell, Christchurch and is approximately 16.0 hectares (ha) in area. There is an approximate elevation change of 3.0m over a distance of 600m at an average gradient of 0.5%. The site generally slopes from north to south, with the low point at the toe of the hill present at the southern boundary. The property is bound by Halswell Road (State Highway 75) along the northwest and west boundaries and is bound by rural properties on the south and east boundaries.

Green’s Stream runs through the section, with approximately two-thirds of the total section situated north of the waterway. It is understood that the land to the north of the waterway will form the area to be subdivided for residential development and the land to the south of the waterway is to be utilised for stormwater management (Figure 1).

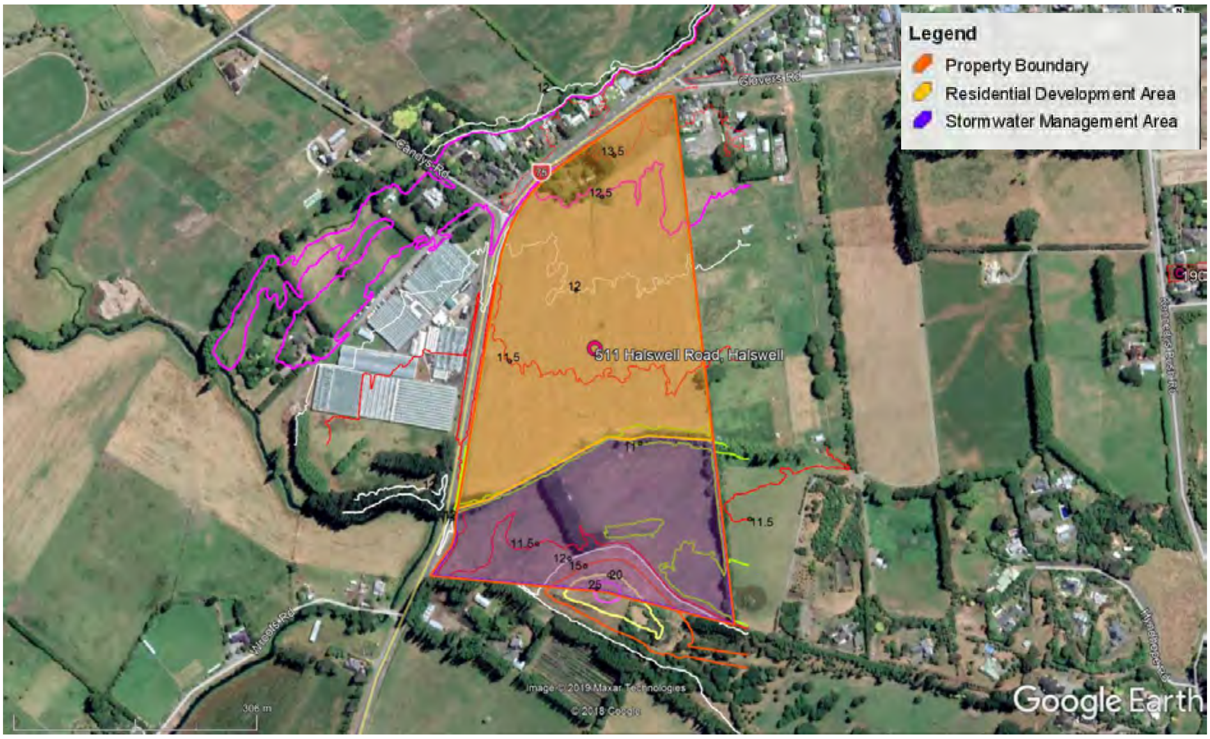

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Figure 1: Proposed Site Layout (Scale as Shown)

The majority of the property is located within the "Rural and Unmapped" category listed under the MBIE Technical Categories Map. Approximately 20% of the site in the southwest corner is mapped as MBIE Technical Category (TC) 3, indicating "moderate to significant land damage from liquefaction is possible in future large earthquakes". The site location with reference to the MBIE Technical Categories is shown in Figure 2.

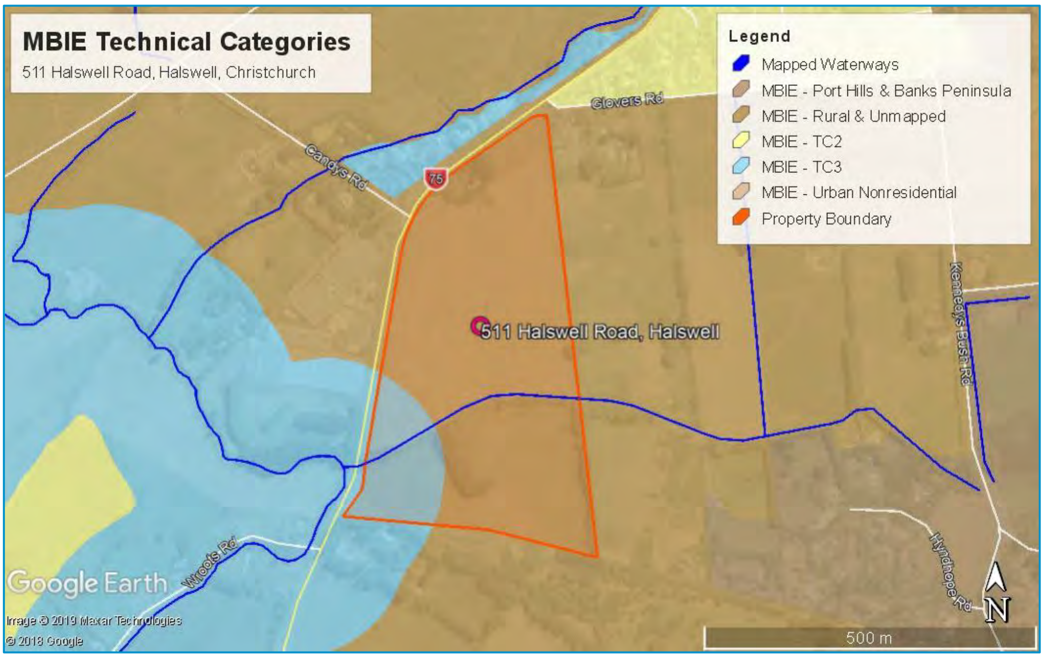

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Figure 2: Site Location Plan Showing MBIE Technical Categories and Mapped Waterways (Scale as Shown)

3. Desk Study

The following sources of third-party information were considered and are referenced in this report:

- New Zealand Geotechnical Database (NZGD);
- Environment Canterbury (ECan);
- Christchurch City Council (CCC).

3.1 New Zealand Geotechnical Database

The NZGD website was reviewed to identify any additional information related to the extent of land damage after the CES on the site and in the immediate surrounding areas. The results of this review indicate that no significant land damage was observed across the site. Table 1 provides a summary of the information obtained from our review of the NZGD.

Table 1: Desk Study Information Summary (NZGD)

	September 2010 (M_w 7.1)	**February 2011 (M_w 6.2)**	**June 2011 (M_w 6.0)**	**December 2011 (M_w 5.9)**
Aerial Photography Review	Outside of photographed area	Small areas of potential ejecta identified in the central and the northernmost boundary section	Outside of photographed area	Outside of photographed area
Land damage observations	Minor ground cracking but no observed ejected liquefied material was recorded along Halswell Road during the June 2011 event of the CES.			
Observed ground cracking	10mm – 200mm ground cracks mapped ~30m northwest of the northernmost boundary of the site within the residential area on the opposite side of Halswell Road			
PGA (g) ± SD	0.297 ± 0.390	0.350 ± 0.435	0.143 ± 0.465	0.135 ± 0.300
Scaled $PGA_{7.5}$ $PGA_{16\%ile}$ to $PGA_{84\%ile}$(I) (g)	0.181 to 0.395	0.161 to 0.384	0.061 to 0.154	0.066 to 0.120

(I) Scaled to M7.5 using Idriss and Boulanger recommendations (2008); 68% confidence $PGA_{7.5}$ range

3.2 Contaminated Land Considerations

The ECan Listed Land Use Register (LLUR) was reviewed and holds no previous records of land contamination for the site.

3.3 Flood Hazard

Christchurch is a low-lying city and there have always been areas that are prone to flooding during heavy rainfall. The CES has worsened flood risk in many areas of the city through damage to waterways and land. Flood Management Areas (FMAs) have been identified by CCC in the District Plan and take into consideration the impacts of the CES.

At the time of writing this report the site is located within a FMA as indicated by the CCC District Plan.

It is understood that a Finished Floor Level (FFL) of 21.25m above Christchurch Drainage Datum (CDD) is a requirement for development of the site.

3.4 Ground Motion

Using the MBIE and Bradley & Hughes (2012) procedures, we have found that the site was "sufficiently tested" to the Serviceability Limit State (SLS) level of earthquake demand during the September 2010 and February 2011 events of the CES. This indicates that land and building damage in a future SLS event is likely to be similar to these individual events.

Additionally, based on the SLS2 level of shaking (M_w 6.0 and PGA of 0.19g) which was introduced by MBIE following the updated liquefaction triggering CPT-based procedure by Boulanger & Idriss (2014), it is our opinion the site was "sufficiently tested" to the SLS2 level of earthquake demand during the September 2010 and February 2011 events of the CES.

Utilising a derivation of the Bradley and Hughes method, we can suggest that the site was not tested to Ultimate Limit State (ULS) level of shaking during the CES. Based on the probabilistic analysis of the PGAs experienced at the site, the nature of land and building damage is likely to be more severe during a future ULS event than that already experienced during the individual CES events.

4. Subsurface Conditions

4.1 Geological Setting

The geological map of the area (GNS 1:250,000 QMap) indicates that most of the site has surface geology consisting of "modern (Quaternary) river floodplain andlow-level degradation terraces (<2° slopes) comprised of unweatherd, variably sorted gravel/sand/silt/clay". The southeast corner of the section abruptly changes to "basaltic to trachytic lava flows interbedded with tuff and breccia (including lahars), many with dykes and minor lava domes" of the Mt. Herbert Volcanic Group. This contact correlates to the change in topography of the Port Hills.

4.2 Field Investigations

The NZGD website was reviewed to identify relevant geotechnical investigations completed within the site vicinity. Twenty-one (21) Piezocone Penetration Tests (CPT), six (6) Dynamic Probe Super Heavy (DPSH) tests, and a machine borehole (BH) have previously been completed on the site and the data is referenced in this assessment.

To supplement the existing ground investigation data, the following site-specific ground investigations and testing were undertaken:

- Seven (7) hand-augered boreholes (referenced HA1 to HA7) with in-situ shear vane testing;
- Seven (7) Dynamic Cone Penetrometer (DCP) tests (referenced DCP1 to DCP7);
- Laboratory testing including fines content (FC) and Atterberg Limits;
- Multichannel Analysis of Surface Waves (MASW) geophysical survey;
- Electrical Resistivity Tomography (ERT) geophysical survey.

The locations of the tests are shown in Figure 3, Figure 4 and Figure 5, general details of the ground investigations are summarised in Table 2, and the HA/DCP logs, BH log, CPT and DPSH plots are presented in Appendix A.

Table 2: Summary of Ground Investigations

Test Ref.	Source	Source Ref.	Test Type	Depth (m bgl)
HA1/DCP1 to HA7/DCP7	MINZ	190666	Hand Auger/ DCP	1.7 to 2.9
CPT_97674 & CPT_97675	LandTest	17277	CPT	8.6 to 10.3
CPT_121612 to CPT_121643	McMillan Drilling	01 to 15		2.5 to 15.0
CPT_128289 to CPT_128296	ProDrill	CPT17 to CPT20		4.6 to 9.2
Other_121645 to Other_121655	ProDrill	02, 08, 09, 13, 14a, 14b	DPSH	1.4 to 15.0
BH_110263	Beca	3205665	Machine Borehole	15.5
MASW 1 to MASW 5	Southern Geophysical Ltd	1875	MASW	Up to 75.0
ERT 1 & ERT 2			ERT	Up to 25.0

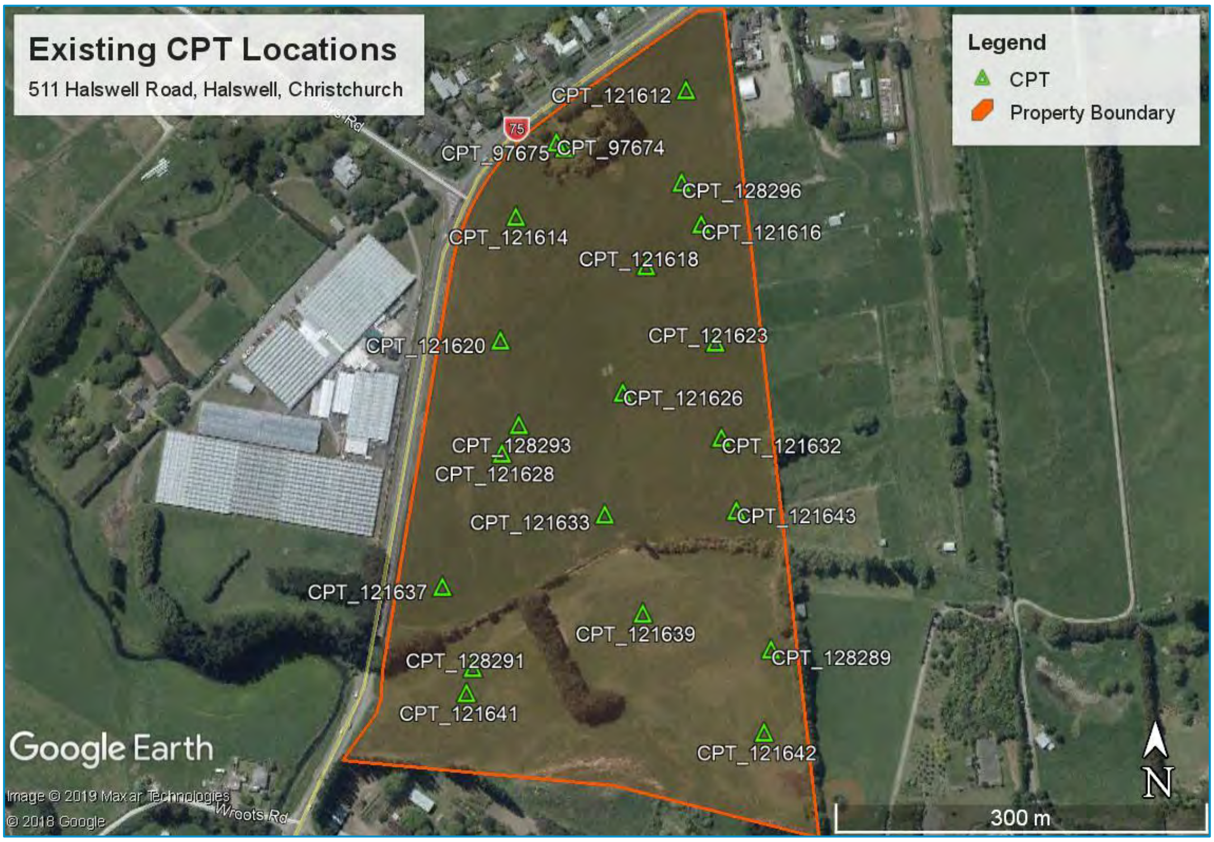

Figure 3: CPT Investigation Location Plan (Scale as Shown)

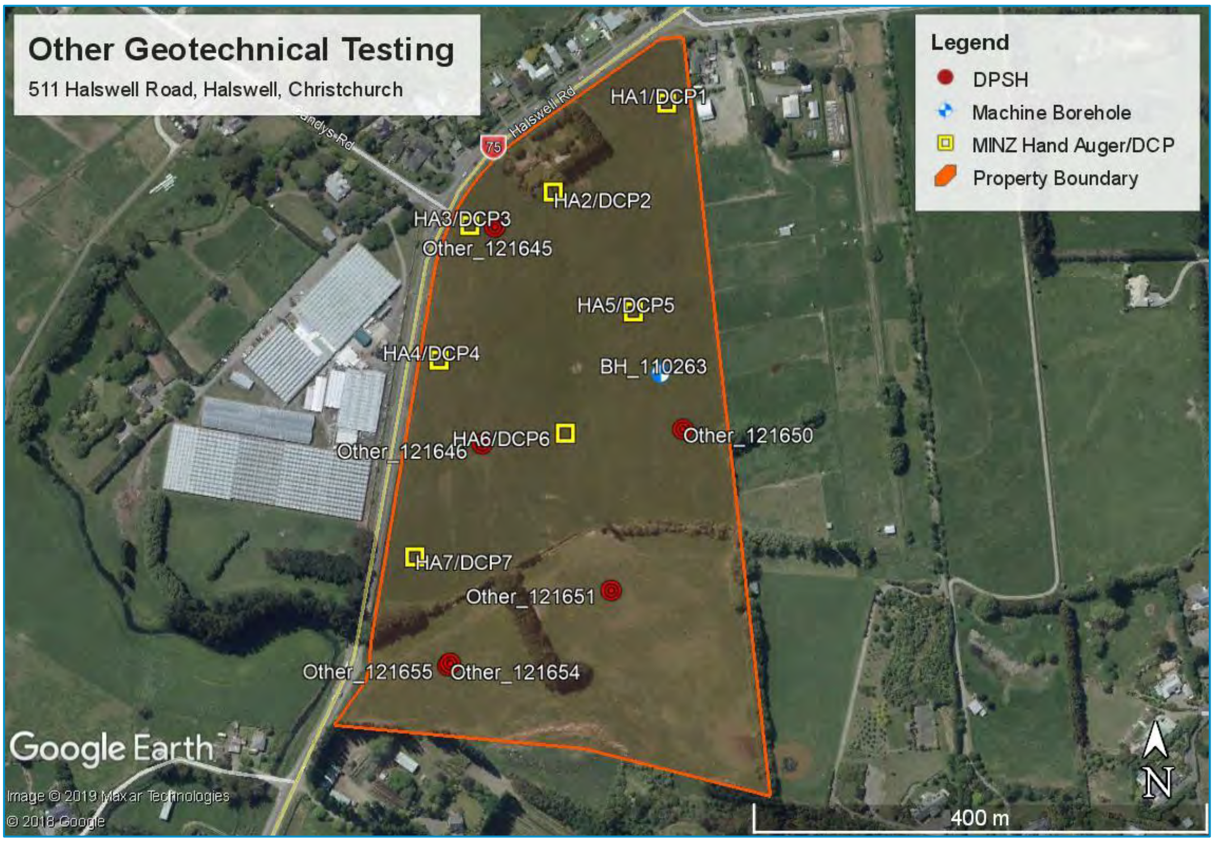

Figure 4: Other Geotechnical Investigation Location Plan (Scale as Shown)

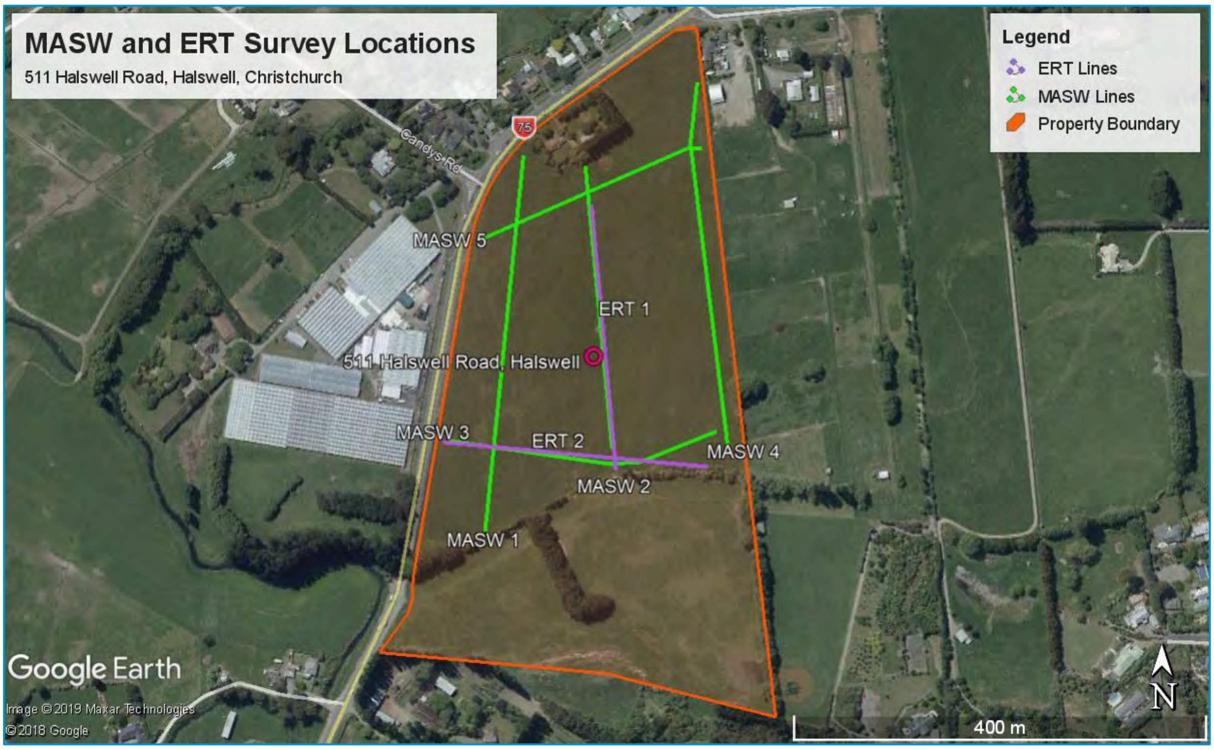

Figure 5: MASW and ERT Survey Locations (Scale as Shown)

4.3 Laboratory Test Results

Laboratory testing was undertaken on samples obtained from our shallow ground investigation to assess the soil characteristics across the site. The testing undertaken includes wet sieving to determine the fines content, and Atterberg limits tests to determine the plastic and liquid limits. A summary of the test results is presented in Table 3, with the full results presented in Appendix B.

Table 3: Laboratory Test Results

Sample Ref.	Depth of sample (m)	Soil Description	Plasticity Index	% Passing		
				0.3mm	0.15 mm	0.063 mm
C19-536	HA1 1.0m – 1.7m	SAND, some silt, brown, no plasticity	-	95	40	13
C19-537	HA2 2.5m – 2.9m	Silty CLAY, brown-grey, low plasticity	17	-	-	-
C19-538	HA6 2.2m – 2.9m	Sandy SILT, brown grey, no plasticity	NP	100	100	54
C19-539	HA7 0.8m – 1.2m	Silty CLAY, minor sand, brown grey, low plasticity	10	100	99	88

4.4 Ground Conditions

The ground conditions interpreted from the available data are presented graphically in the geotechnical cross sections included in Appendix D and the basic soil descriptions are outlined in Table 4.

Table 4: Ground Conditions Summary

Layer	Soil Name
a	Silty SAND and Sandy SILT, loose to firm
b	Clayey SILT, soft to firm, medium plasticity
c	Silty SAND, medium dense to dense with increasing depth
GS	Gravelly SAND to Sandy GRAVEL, dense
d	Clayey SILT to silty CLAY, firm
e	Medium dense SAND with silt and gravels
f	Clayey SILT, firm to stiff
S	Very dense gravelly SAND

4.5 MASW & ERT Geophysical Survey

The shear wave velocity measurement was assessed with MASW survey. The results of the survey were used to refine the boundaries and extents between the shallow, softer soils and denser sandy/gravelly layers.

The ERT survey was undertaken to assess the resistivity of the soil layers. The primary objective of this survey was to identify contrasts between high resistivity (unsaturated) and low resistivity (saturated) soils to aid in the liquefaction assessment. There are several limitations of this method when dealing with cohesive, low permeability soils like those described above, however, this survey, when used in conjunction with our other geophysical tests, has allowed us to better define parameters for the liquefaction assessment.

The results generally show a consistent contrast in resistivity at around 4.0m depth which broadly correlates with the change in soil type around this depth from predominantly silty soils to more sandy/gravelly soils. Low resistivity soils at the near surface, which are underlain by high resistivity soils, could be indicative of perched water tables, while the “true” ground water table is deeper. However, due to the change in soil type around this depth, there is no clear detection of the water table based on the resistivity data.

4.6 Groundwater

Our site-specific investigation encountered groundwater levels between 0.3m and 1.0m bgl, however, it should be noted that standing surface water was present at the time of our investigation due to recent heavy rainfall. The CPT data shows variable piezometric conditions due to the differing depth of cohesive soils in the upper soil profile. The observations of standing groundwater were mainly across the south and central part of the test area indicating potential perched water tables likely as a result of the low permeability soils encountered and the proximity to Green’s Stream.

Based on the above, a groundwater depth range of between 0.5m to 1.2m bgl was adopted for the liquefaction triggering and free-field settlement assessment, depending on the location of the test across the site.

4.7 Site Subsoil Class

Based on the site-specific investigation, geological maps and other available information, the majority of the site is classified as a Class D (deep or soft soil) site in accordance with NZS 1170.5:2004. The southern part of the property which meets the Port Hills volcanics is classified as a Class C (shallow soil) near the base of the hill, and Class B (rock) on the hill itself, although it is noted that this area is planned for stormwater management and not development.

4.8 Shallow Soils

The geotechnical investigations indicate the existence of softer, compressible silts within the top 4.0 to 6.0m. Those layers are with lower strength and have the potential for long-term consolidation settlements from loads such as residential dwellings. Additionally, the likely requirement to fill the site would cause further settlement issues. This is further discussed later in this report.

5. Liquefaction Assessment

5.1 Methodology

An assessment of the earthquake-induced free-field post-liquefaction volumetric settlement at the site has been carried out in accordance with the MBIE Guidance and using proprietary liquefaction assessment software, for SLS and ULS earthquake scenarios.

The seismic design requirements adopted for use in the analyses are defined in MBIE/NZGS Earthquake Geotechnical Engineering Practice Module 3 (May 2016), and Part C of the MBIE Guidelines “Repairing and rebuilding houses affected by the Canterbury earthquakes” and its subsequent updates - clarifications. These are:

- Buildings of normal use (Importance Level 2);
- Deep or soft soil sites (Class D) as specified previously;
- Boulanger and Idriss (2014) methodology for liquefaction triggering, as per the MBIE Guidance subsequent updates (Issue 7, October 2014);
- Zhang et al. (2002) post-liquefaction volumetric strain calculation for estimating the free-field settlements;

Calculations were performed for the full depth of the CPTs and the upper 10m of the soil profile (as per the MBIE Guidance “index value” estimations). It should be noted that the settlement estimates only account for the free-field component of the expected settlement. Actual total settlements under SLS or ULS earthquake loading may be greater or less.

The Liquefaction Severity Number (LSN[1]) has been calculated and used in our assessment as it tends to better reflect the more damaging effects of shallow liquefaction, which is more critical for shallow founded structures. The level of ground damage associated with LSN is summarised in Table 5.

Table 5: Liquefaction Severity Number Ranges and Related Effects

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

5.2 Liquefaction Assessment Results

Due to the rapid changes at the interface between fine and coarse-grained soils, a layer correction was applied. The cone tip penetration, and subsequently, the ability to resist liquefaction of a sandy material, is reduced by the surrounding silty layers, while the I_c[2] of the silt layers is reduced due to the presence of the surrounding sandy layers and hence the susceptibility of the fine layers is overestimated. For our analysis, an I_c change of >0.05 per 10mm has been adopted, which eliminates the liquefaction potential for the layer.

The results of our liquefaction triggering analyses utilising the CPT data are presented in Appendix E and summarised in Table 6. The majority of the CPTs used in this analysis terminated between 5m and 8m bgl within the dense sand/gravel layers, which are anticipated to extend to >10.0m bgl. Two of the available CPTs penetrate the sand/gravel layers and in order to capture the worst-case conditions, the liquefaction assessment has been weighted towards these CPTs.

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[1] **LSN = Liquefaction Severity Number**. LSN (van Ballegooy et al., 2014) is a vulnerability indicator (damage index) quantifying liquefaction-induced damage developed to reflect more damaging effects of shallow liquefaction on residential land and foundations following the Canterbury Earthquakes (2010-11). LSN considers depth weighted calculated volumetric densification strain within soil layers as a proxy for the severity of liquefaction land damage likely at the ground surface.

[2] **I_c = Soil Behaviour Classification Index -** Robertston & Wride 1998.

Table 6: Estimated “Free-Field” Post-Liquefaction Volumetric Ground Surface Settlements

Earthquake scenario	**Moment magnitude (M_w) / PGA (g)**	**MBIE “Index Value” (mm)**	**MBIE Technical Category**	**LSN Values**
GWD = varying (in-situ) and 0.5m to 1.2m (earthquake); Layer transition applied				
SLS1 SLS2	7.5/0.13 6.0/0.19	5 – 40 10 – 50	TC2 TC2	2 – 15 5 – 22
ULS	7.5/0.35	20 – 85	TC2	10 – 30

In accordance with the MBIE Guidance, the analysis indicates that under SLS and ULS loading conditions the predicted index value settlements fall within the expected future land performance values for a TC2 category site.

Based on the LSN estimated for the design events, ‘no to minor’ expression of liquefaction may be expected for a future SLS design event, and ‘minor to moderate’ expression of liquefaction may be expected for a future ULS design event. The values of LSN at the upper end of the ranges estimated are generally located in the southeast portion of the residential development area (where ejecta has been observed following the CES events) and in the proposed stormwater management area.

5.3 Lateral Spreading

Given the generally flat topography of the site, and the assumption that the site will be levelled further during the development of the subdivision, there is unlikely to be significant height differences, with the exception of the area immediately adjacent to Green’s Stream. As the area needs to be developed with the FMA in mind, and land levels lifted, there is the potential for a more pronounced ‘free-face’ that could create a risk of lateral spreading. Options to address this are discussed later in the report.

6. Site Designation Assessment

Based on the findings of our desk study, our site-specific ground investigation and observations, and assessment of the performance of the land, we consider the MBIE TC2 category generally appropriate for the site. Despite the deformation characteristics of TC2, the land does not meet the definition of ‘Good Ground’ as per the New Zealand Standards without modification to standard foundation systems and specific engineering design to account for this.

7. Geotechnical Considerations for Subdivision

7.1 Geotechnical Hazards

The most significant geotechnical hazards at the site comprise the potential for earthquake-induced soil liquefaction and potential static subsidence of the soft compressible soils. These hazards can be partly mitigated by providing strengthened foundations, which reduce the potential for differential settlement of the buildings and are designed to be re-levellable.

However, as part of the land development it is understood that, in order to meet the CCC FFL requirements, the site grade will need to be raised by filling. Area wide (bulk) filling will induce additional loading of the underlying soft compressible deposits and potentially lead to consolidation settlement of the fill and / or construction above.

Until the subdivision plan is further developed, specific detailed recommendations cannot be provided, however, the following sections outline general considerations for future development.

7.2 Development Considerations

As discussed above, the majority of the site will require filling to meet the CCC FFL requirements (FFL = 12.25mCDD), particularly if the preferred foundation options comprise concrete slab foundations.

The approximate extent of filling that would be required to reach the required levels is shown in Figure 6.

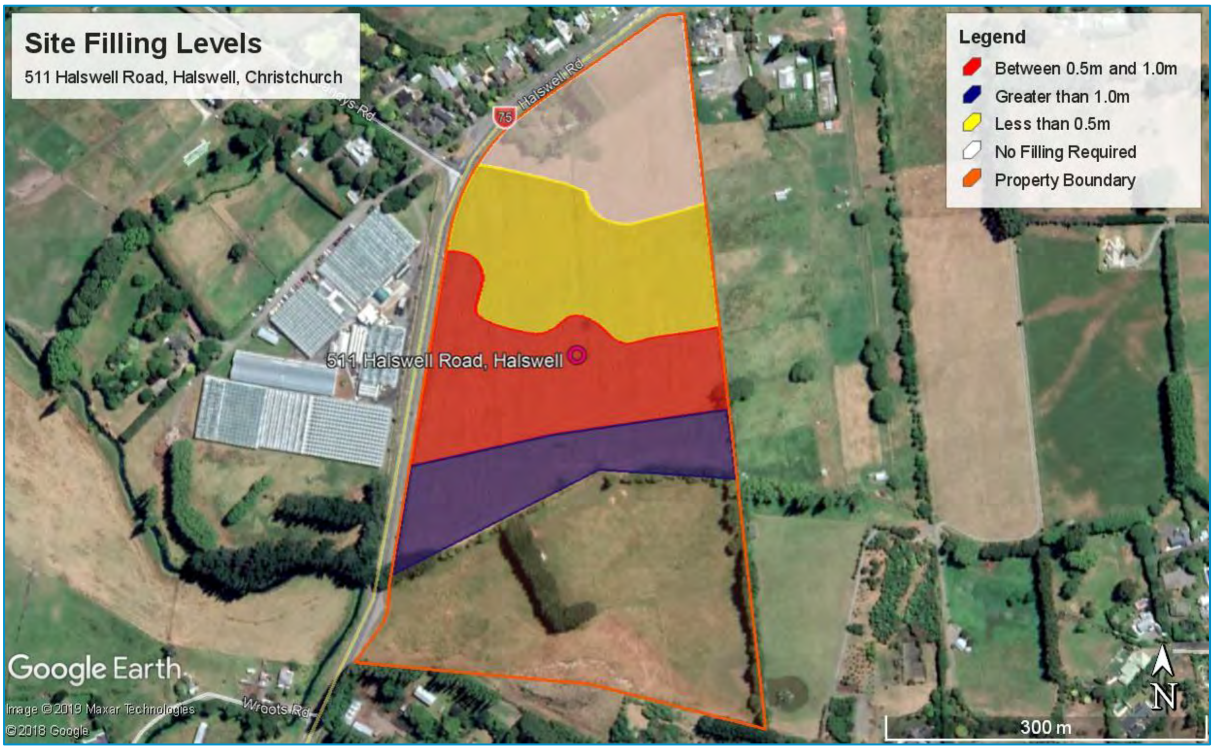

Figure 6: Approximate extents of Site Filling

In order to mitigate the effects of settlement of the underlying soft soils, filling including pre-loading the land with a stockpile of material until the majority of the settlement has occurred is geotechnically feasible. It is unlikely that the entire site would require pre-loading (potentially limited to where greater than 0.5m to 1.0m filling is required over shallow soft soils) and this option could be undertaken through a staged approach whereby material utilised in the stockpile for the pre-loading phase could be utilised as engineered fill for other areas of the site.

This option would require further consideration and detailed design with the likely implementation of a monitoring programme, however, at a high level may comprise the following steps:

- Preparation of the site for filling (removal of topsoil and unsuitable material, subgrade preparation etc.);
- Placement of fill to required levels including additional height of fill (likely <1.5m) for pre-loading;
- Installation of settlement monitoring instrumentation (e.g. settlement plates, extensometers);
- Monitor surface deformations until adequate settlement has occurred (likely <6 months);
- Remove material above required levels and use as engineered fill elsewhere.

A significant benefit of the above option is that all required areas of the site would be treated including areas of proposed infrastructure and services and the risk of future differential settlement is low.

The southern extent of the filling (in proximity of Green’s Stream) will be the maximum height of fill (and pre-load) required and will require detailed design to ensure stability. Depending on the proposed proximity of the development to the stream a number of options are considered feasible, including but not limited to:

- Construction of an unreinforced shallow slope from the filled area to the original ground level (minimum area for development);
- Construction of a steeper reinforced slope from the filled area to the original ground level;
- Construction of a retaining structure (maximum area for development).

All options will require a nominal set-back from Green’s Stream.

Subsequent to completion of the above works the following foundation solutions would be considered suitable for the construction of NZS3604 compliant structures:

- MBIE TC2 (Options 1 to 4) enhanced foundation slab;
- Specifically designed, enhanced NZS 3604 perimeter foundation wall and shallow piles.

Other options that may be suitable to mitigate the effects of consolidation settlement of the underlying soils comprise:

- Piled foundations installed to below the soft compressible material:
  - Piled foundations would separate the building from the effects of consolidation settlement and shallow liquefaction. However, careful consideration would need to be given to adjoining infrastructure and services. The pile depths would also need to be specifically designed considering the underlying liquefiable soil layers and variability of such.
- Specifically designed re-levellable foundation systems with the understanding that they would require re-levelling at some point in the future due to static settlement:

- The re-levellable nature of the foundation system would facilitate level correction at some point in the future due to static (or seismic) settlement. The building owner (and future owners) would be required to buy in to this option. As for piled foundations, careful consideration would need to be given to adjoining infrastructure and services.

These options are localised solutions to mitigate the hazards and are only considered suitable / more cost effective for less densely populated subdivisions.

7.3 Stormwater Management

Stormwater management is outside the scope of our works. However, it is understood the southern section of the site (area south of Green's Stream) will be utilised for stormwater detention and treatment with up 1.0 m deep shallow basins excavated through the area. Based on the available geotechnical information for the area, the majority of the excavated material is likely to comprise topsoil over soft to firm Clay / Silt mixtures and is unlikely to be suitable for the filling works required for the residential subdivision. However, the material would be suitable for use in the pre-loading works (if opted for).

7.4 Services

Buried services at the site are potentially vulnerable to seismically induced liquefaction where located in or in proximity of shallow liquefiable soils. The services may also be affected by the presence of soft, compressible soils at shallow depths across the site. All services should be designed by a suitably qualified person to accommodate both seismically induced settlements and static settlement of the soft soils. As discussed in Section 7.2, implementation of area wide filling and pre-loading will significantly reduce the risk of differential settlement of services.

7.5 Pavement/Roading Infrastructure

As for the services at the site, pavements will require detailed design by a suitably experienced person to accommodate both seismically induced settlements (only likely an issue under larger events) and static settlement of the soft soils.

It is currently understood that the Halswell Road - Candys Road intersection will be modified to accommodate a new road into the subdivision, and it is assumed that filling in this area will be required to raise the grade. The underlying soils in this area are generally typical for the site with the upper 1.0m comprising topsoil over soft silt (loosely corresponding to a CBR of ~2 to 3 below the topsoil). If area wide filling is implemented for development of the residential subdivision, similar methods for construction of the intersection should be considered.

8. Assessment Against RMA Section 106

As per the requirements of Section 106 of the Resource Management Act (RMA) (2017), we have undertaken a high-level assessment of the significant geotechnical hazards that may affect the site. These hazards include, but are not limited to:

- Erosion;
- Falling debris;
- Slippage;
- Subsidence;
- Inundation.

At the time of our site visit, there was no evidence of erosion. Likewise, no evidence was observed to suggest that lateral movement is an issue on the site, given the site is generally flat.

Rock Fall or slope movement could be considered a risk at the site, given the rock outcrops in the southernmost portion of the section. However, given that no development is planned to occur near the source, (less the stormwater management area), we consider that there is no immediate risk to the residential development.

As the site is identified as being within a Flood Management Area (FMA) as defined by the CCC, inundation is likely to be a risk, as the site currently stands. If the site is built up to ensure the FFLs set by the CCC are met and suitable stormwater drainage is in place, then inundation is not considered an imminent risk to the development.

Based on our assessment, we consider that the "significant" geotechnical hazards may be mitigated to an acceptable standard, provided that the geotechnical recommendations given in this report are followed, and the appropriate engineering measures implemented, we consider that the development is unlikely to be affected nor worsen, accelerate or result in material damage.

9. Limitations

This report is subject to the following limitations:

- This report has been prepared by Miyamoto for the Client for the purpose/s agreed with the Client (Purpose). Miyamoto accepts no responsibility for the validity, appropriateness, sufficiency or consequences of the Client using the report for purposes other than for the Purpose.
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- This report is provided based on the various assumptions contained in the report.
- Miyamoto's professional services are performed using a degree of care and skill reasonably exercised by reputable consultants providing the same or similar services as at the date of this report.
- The Client is responsible for ensuring that the design of any foundations ensures the functionality of the building under SLS level loads.
- The sub surface information has been obtained from investigation carried out at discrete locations, which by their nature only provide information about a relatively small volume of subsoils. While Miyamoto has taken reasonable skill and care in carrying out the investigation to determine the subsoil condition, the subsoil condition

could differ substantially from the results of any sampling investigation. Miyamoto is not responsible for and does not accept any liability in respect of any difference between the actual subsoil conditions and the results of our investigation.

- Any susceptibility analysis carried out in respect of liquefaction is based on Miyamoto's current understanding as an experienced professional engineering consultant of the data, methods etc. Future seismic events may change our understanding of liquefaction and its affects, which may affect the content of this report. Miyamoto is not responsible for and does not accept any liability where the content of this report is changed due to a change in industry knowledge of matters relating to liquefaction.
- This report specifically excludes assessment or advice relating to hazardous materials, such as asbestos.
- Where the Client provides information to Miyamoto, including design calculations and drawings of the as-built structure, or where the report indicates that we have obtained and/or relied upon information provided from a third party, Miyamoto has not made any independent verification of this information except as expressly stated in the report. Miyamoto assumes no responsibility for any inaccuracies in, or omissions to, that information.
- A change in circumstances, facts, information after the report has been provided may affect the adequacy or accuracy of the report. Miyamoto is not responsible for the adequacy or accuracy of the report as a result of any such changes.
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If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact Miyamoto International (NZ) Ltd.

10. References

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Appendices

A. Desktop Study Data & Existing Geotechnical Information

Test Ref.	Source	Source Ref.	Test Type	Depth (m bgl)
CPT_97674	LandTest	17277	CPT	10.3
CPT_97675	LandTest	17277	CPT	8.6
CPT_121612	McMillan Drilling	01	CPT	15.0
CPT_121614	McMillan Drilling	02	CPT	6.8
CPT_121616	McMillan Drilling	03	CPT	15.0
CPT_121618	McMillan Drilling	04	CPT	6.6
CPT_121620	McMillan Drilling	05	CPT	7.2
CPT_121623	McMillan Drilling	06	CPT	7.0
CPT_121626	McMillan Drilling	07	CPT	5.9
CPT_121628	McMillan Drilling	08	CPT	5.0
CPT_121632	McMillan Drilling	09	CPT	7.6
CPT_121633	McMillan Drilling	10	CPT	5.6
CPT_121637	McMillan Drilling	11	CPT	5.4
CPT_121639	McMillan Drilling	13	CPT	2.5
CPT_121641	McMillan Drilling	14	CPT	7.7
CPT_121642	McMillan Drilling	15	CPT	12.2
CPT_121643	McMillan Drilling	12	CPT	7.0
CPT_128289	ProDrill	CPT20	CPT	6.9
CPT_128291	ProDrill	CPT19	CPT	4.6
CPT_128293	ProDrill	CPT18	CPT	5.1
CPT_128296	ProDrill	CPT17	CPT	9.2
Other_121645	McMillan Drilling	02	DPSH	14.5
Other_121646	McMillan Drilling	08	DPSH	7.2
Other_121650	McMillan Drilling	09	DPSH	15.0
Other_121651	McMillan Drilling	13	DPSH	15.0
Other_121654	McMillan Drilling	14a	DPSH	1.4
Other_121655	McMillan Drilling	14b	DPSH	12.0

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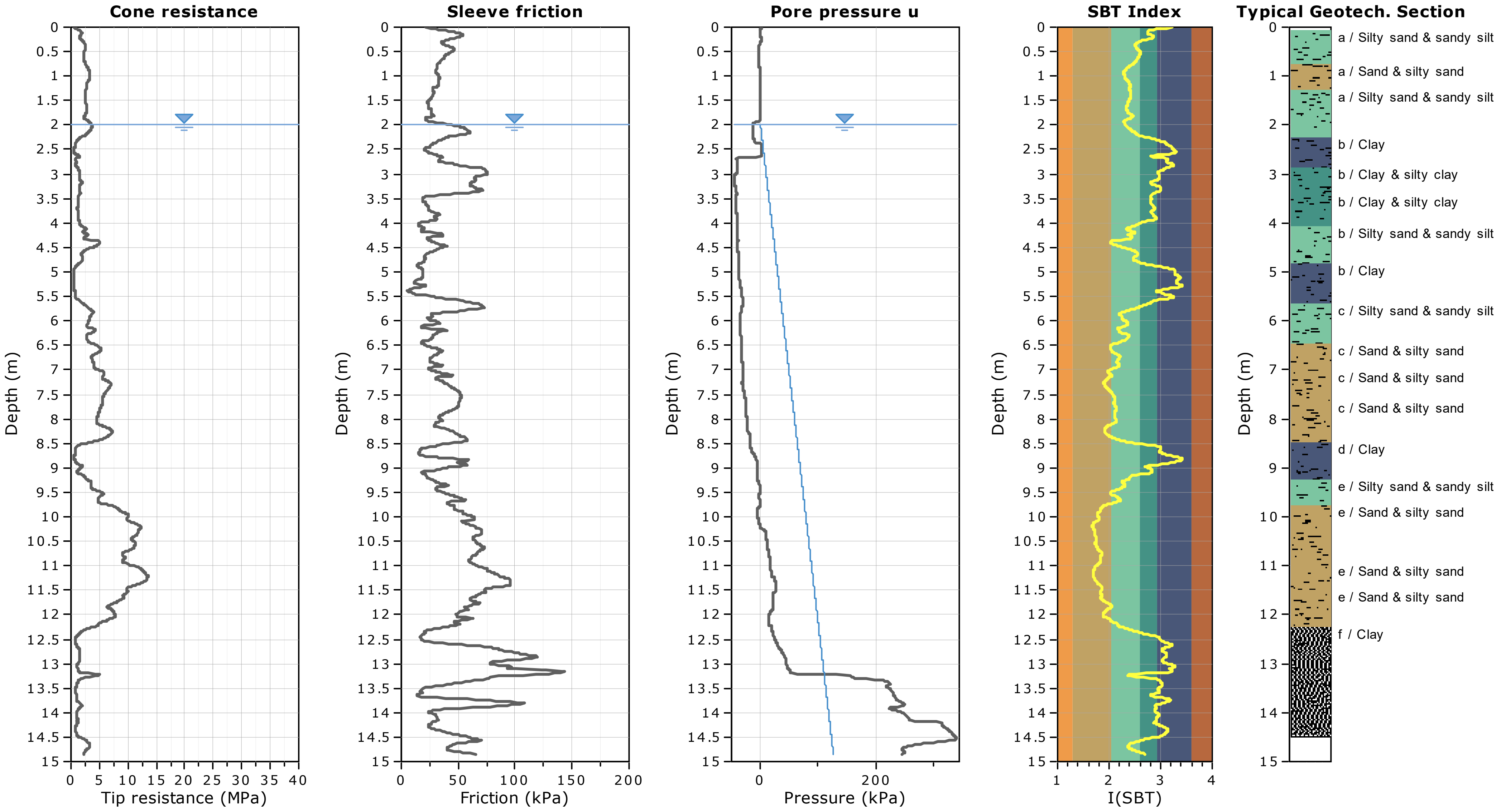
CPT: CPT_121612
Total depth: 14.84 m, Date: 29/08/2019
Surface Elevation: 13.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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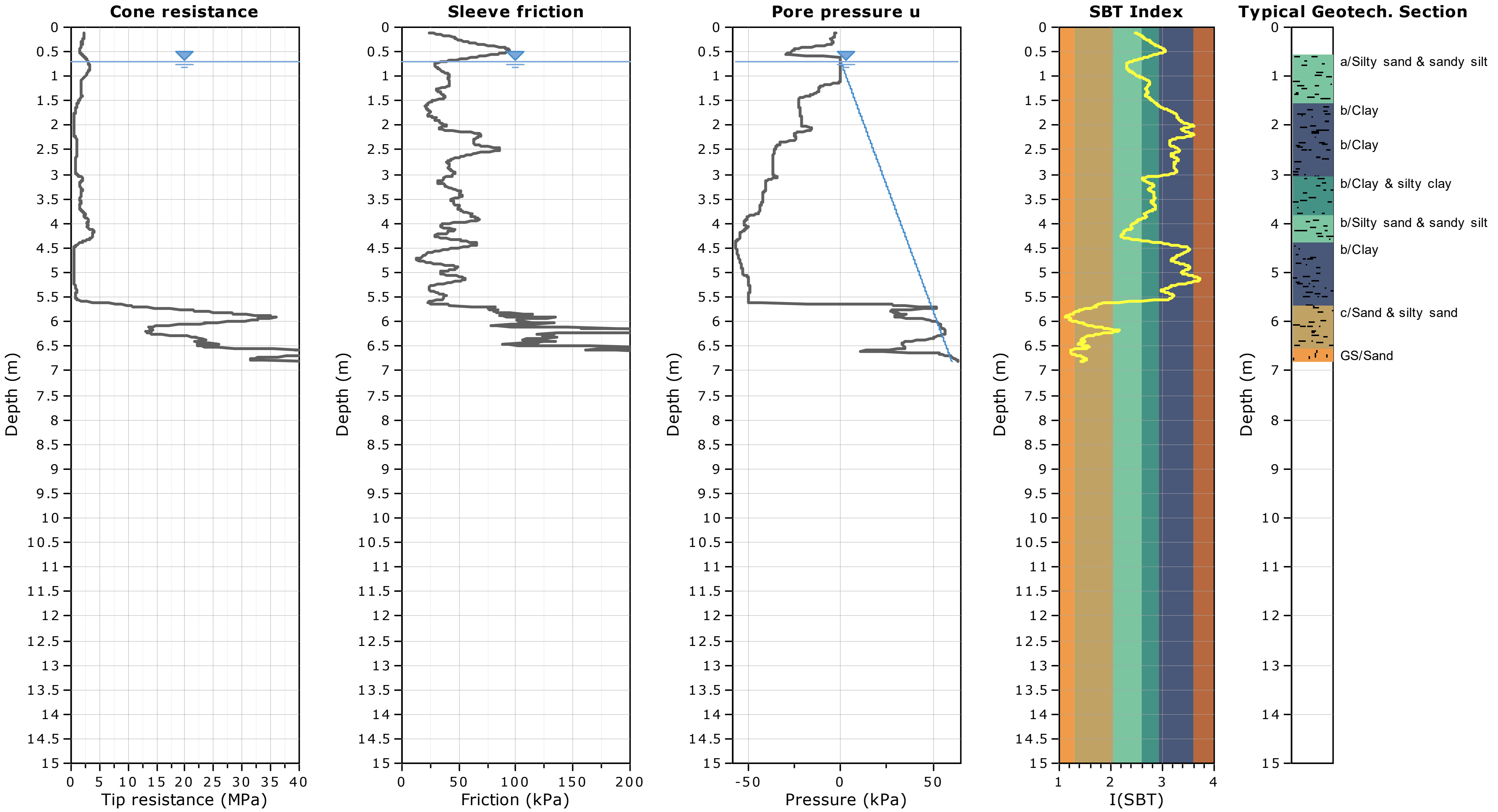
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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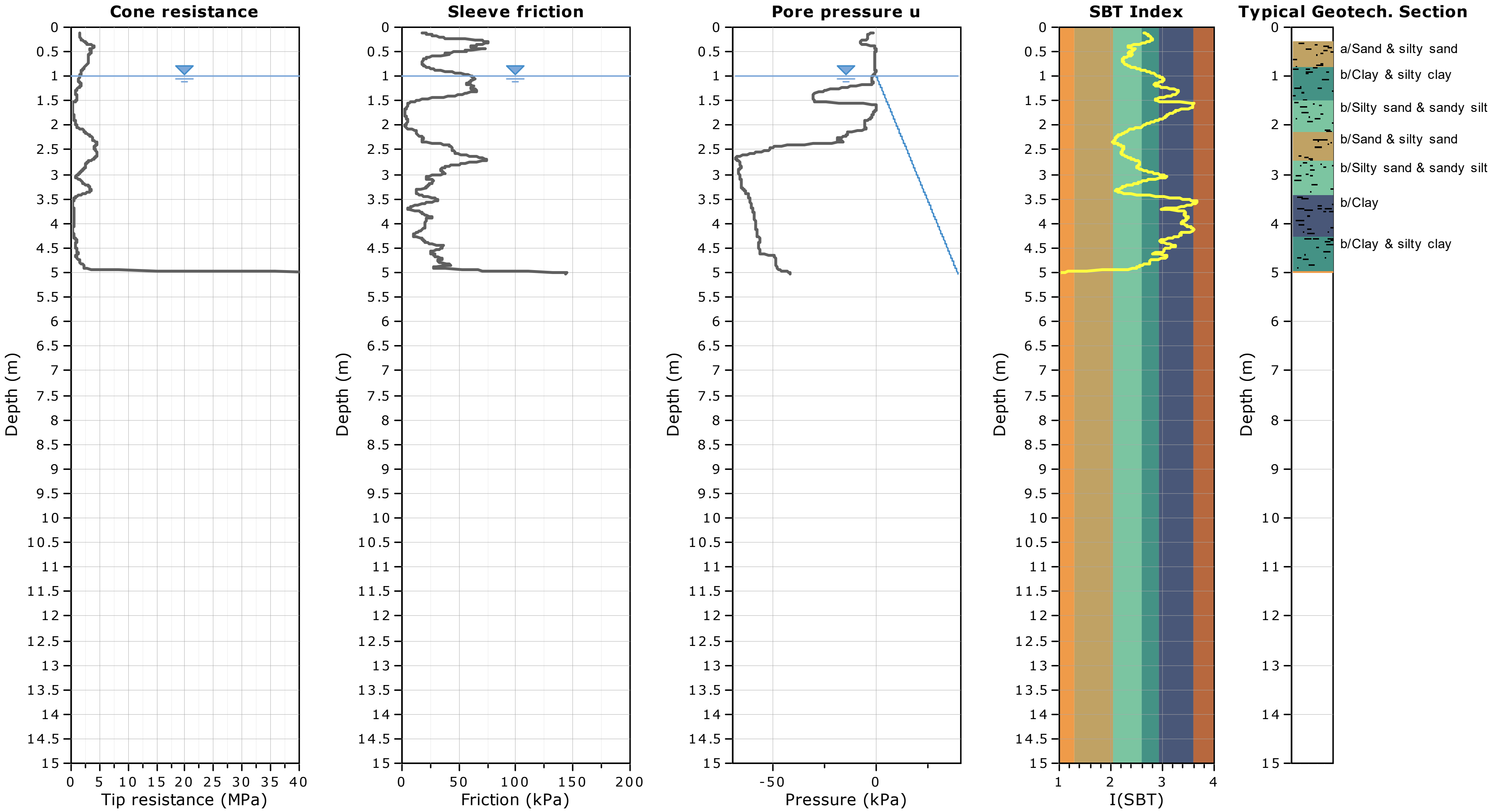
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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Cone Operator:

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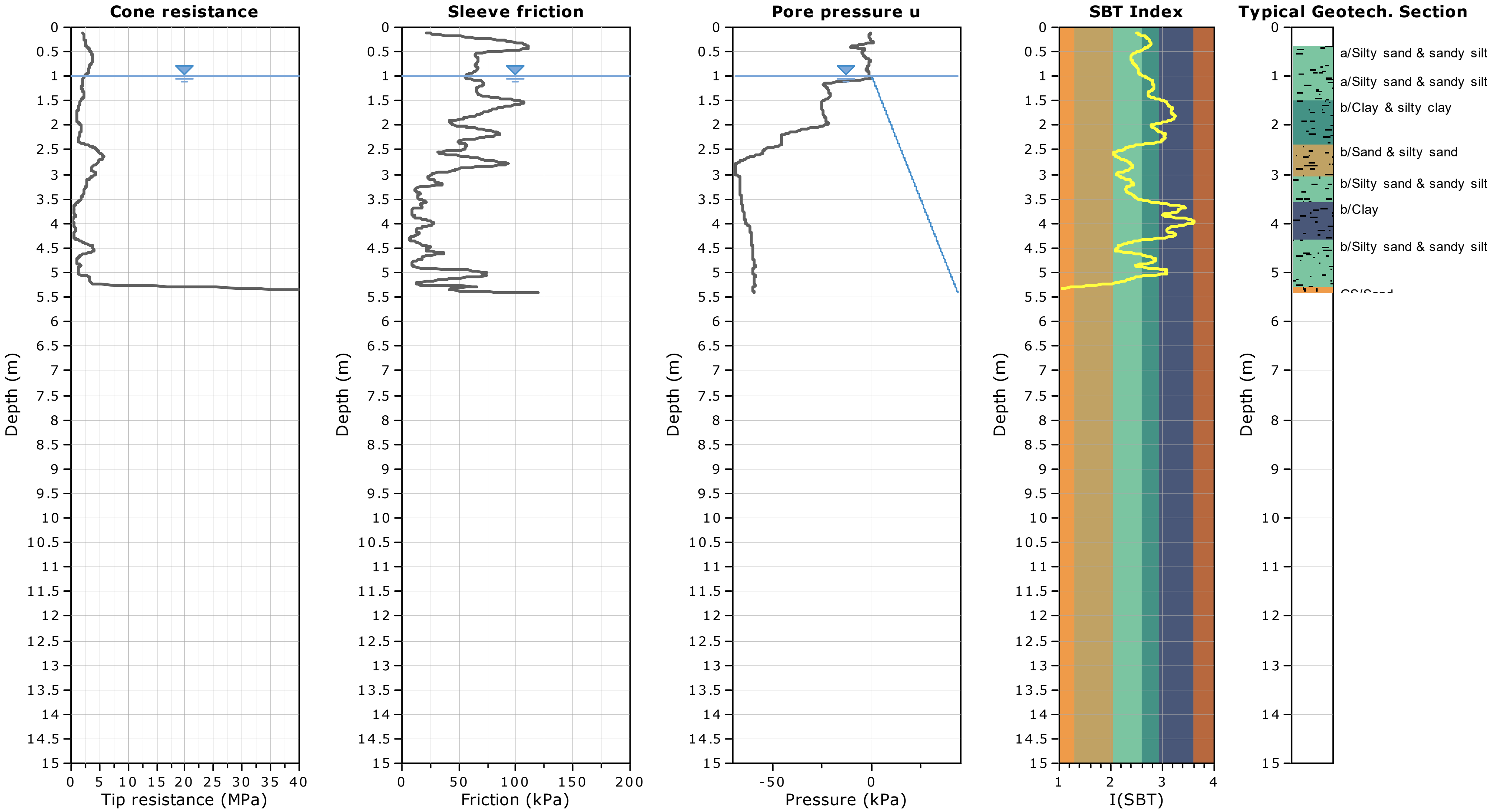
Location: **511 Halswell Road, Halswell, Christchurch**



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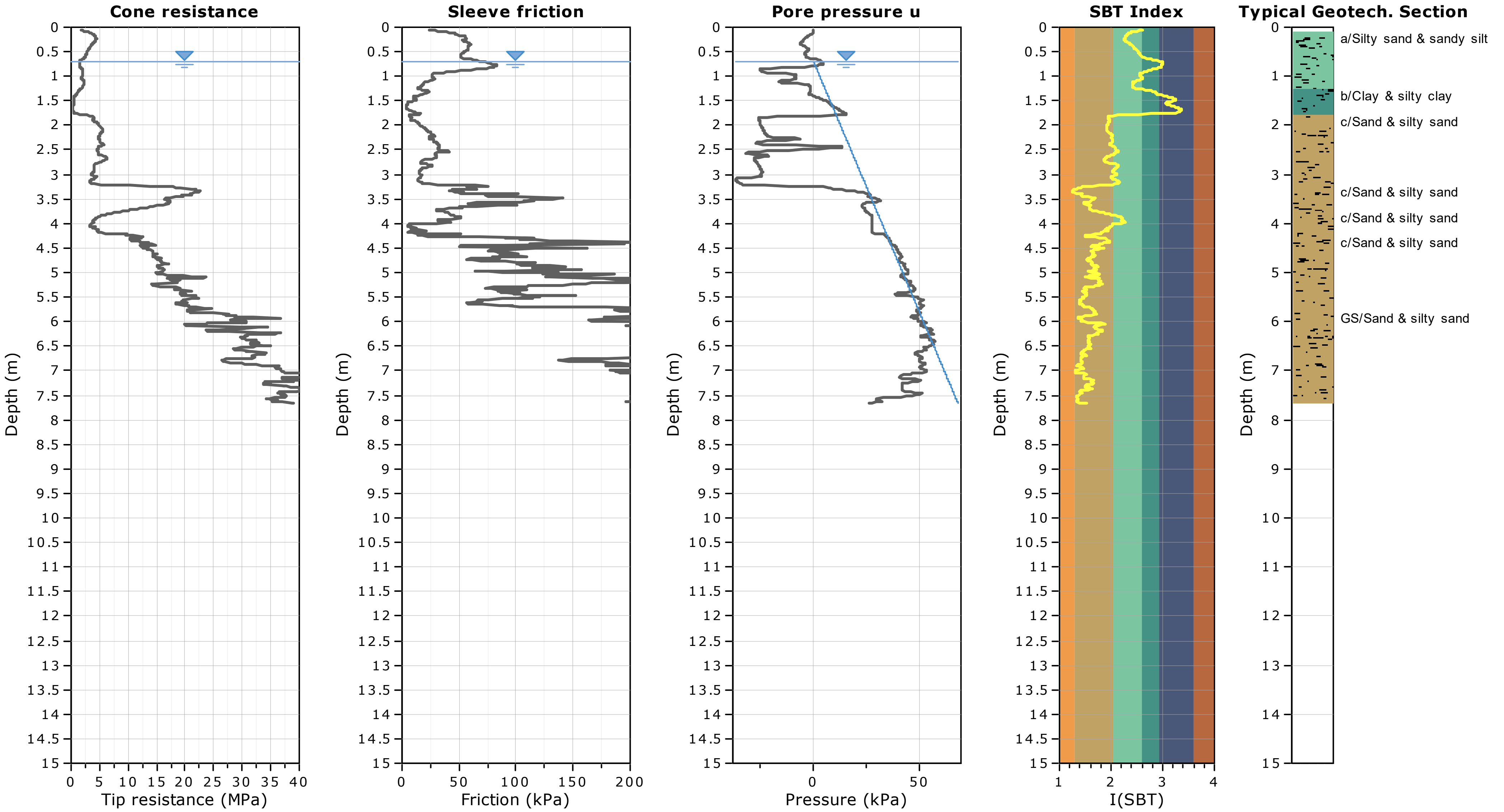
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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Cone Type:
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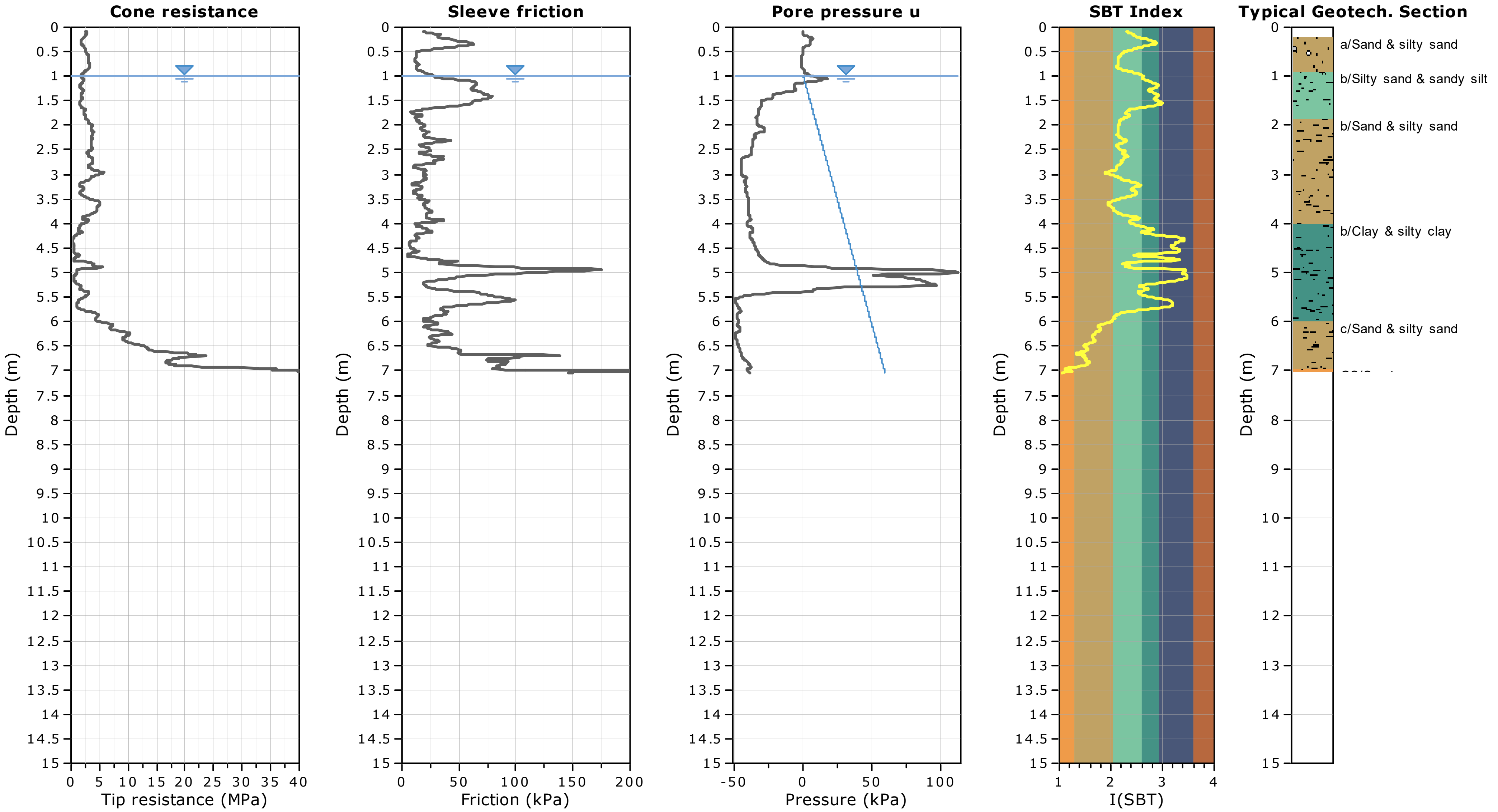
Location: 511 Halswell Road, Halswell, Christchurch



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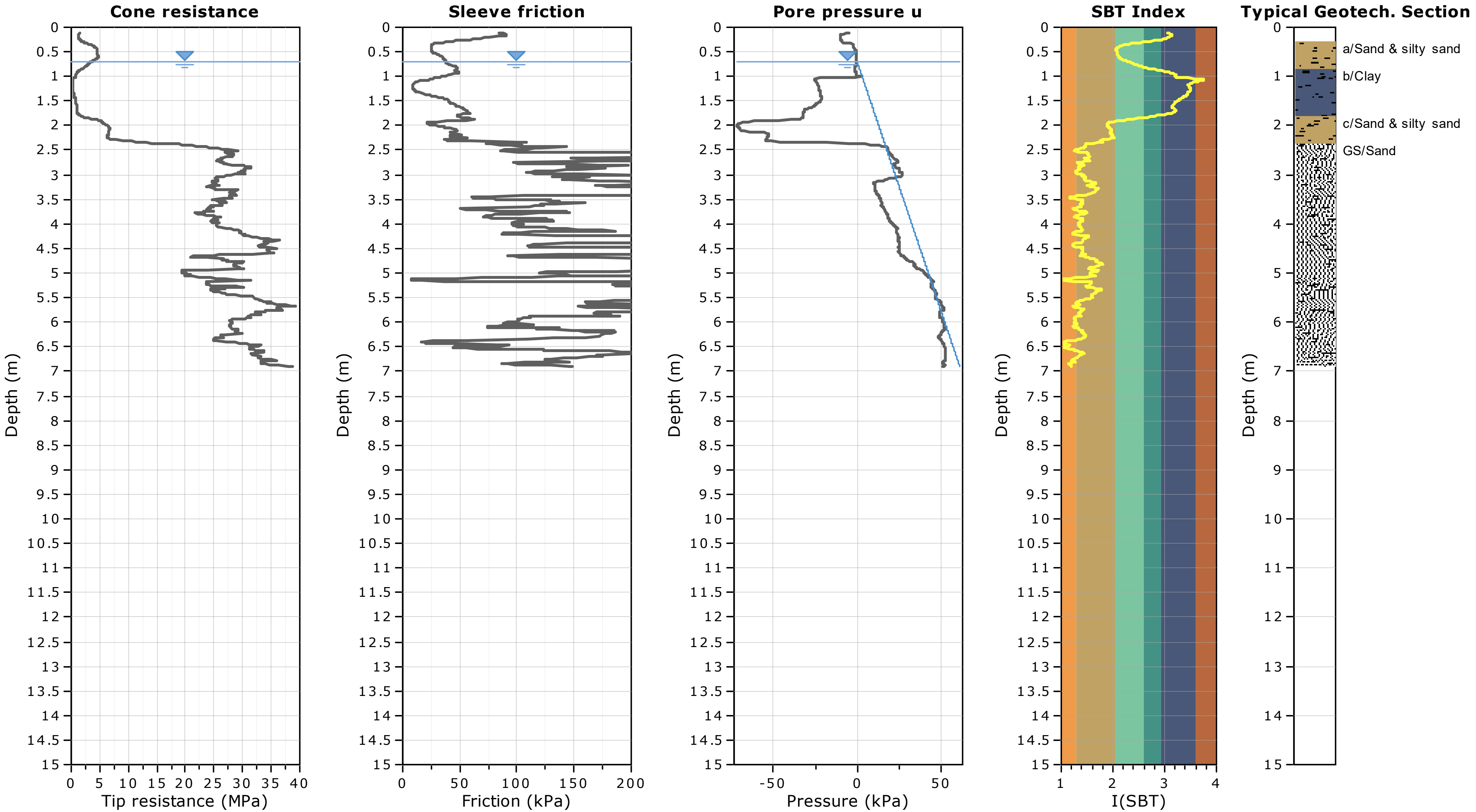
Location: **511 Halswell Road, Halswell, Christchurch**



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Cone Type:
Cone Operator:

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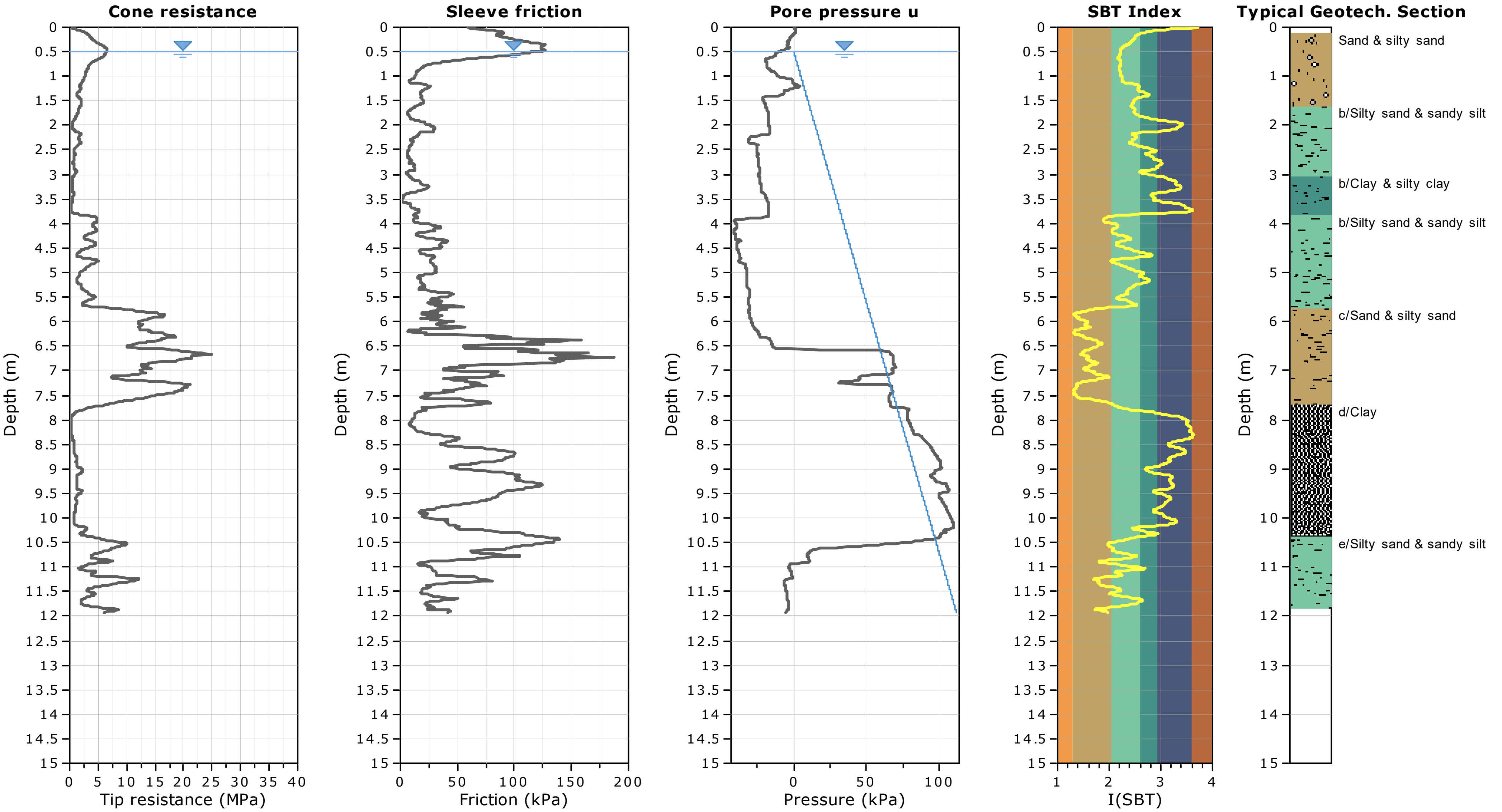
Location: **511 Halswell Road, Halswell, Christchurch**



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Cone Operator:

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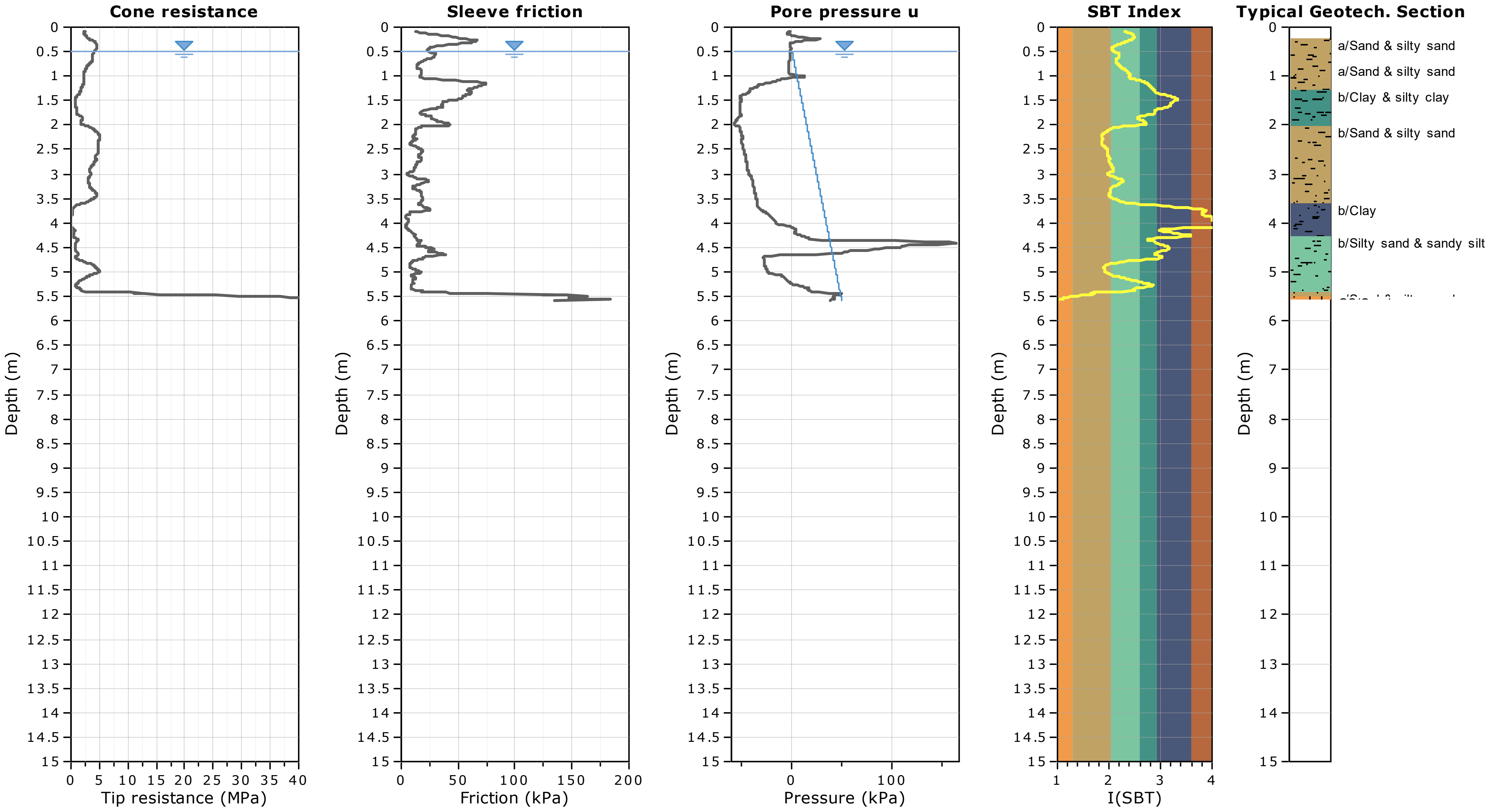
Location: **511 Halswell Road, Halswell, Christchurch**



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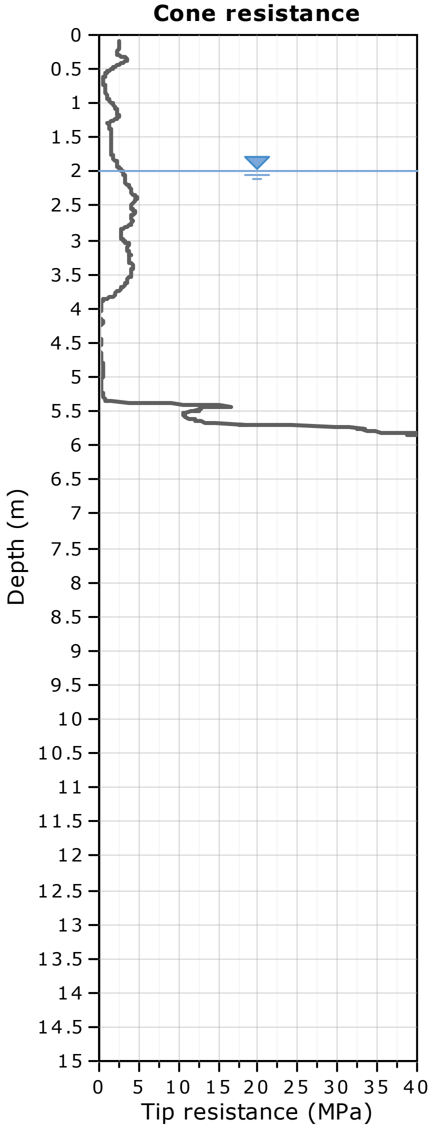
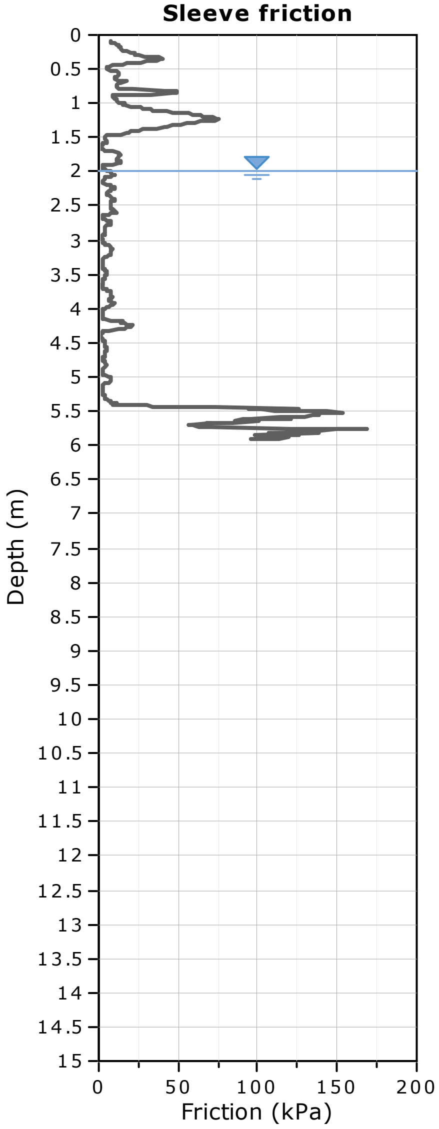
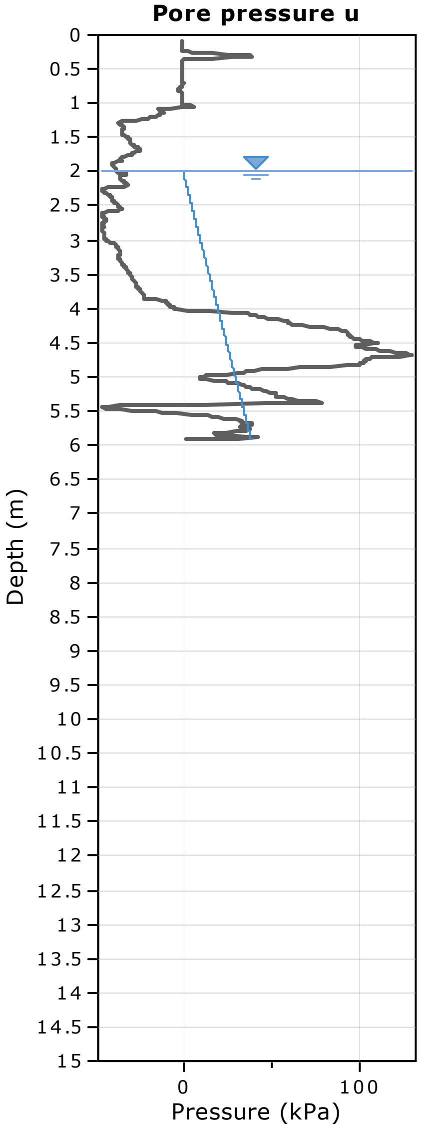
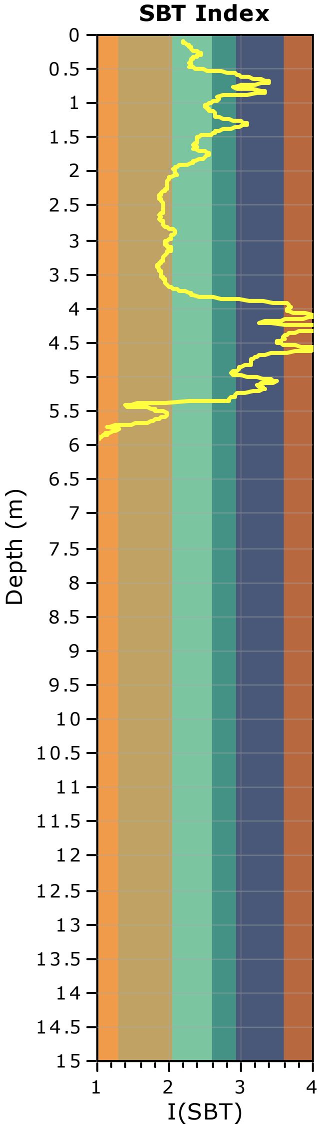
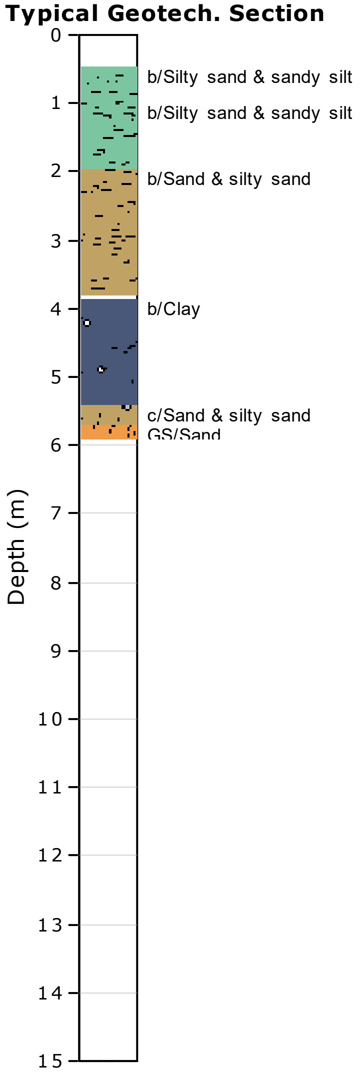
Location: **511 Halswell Road, Halswell, Christchurch**











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Surface Elevation: 12.50 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
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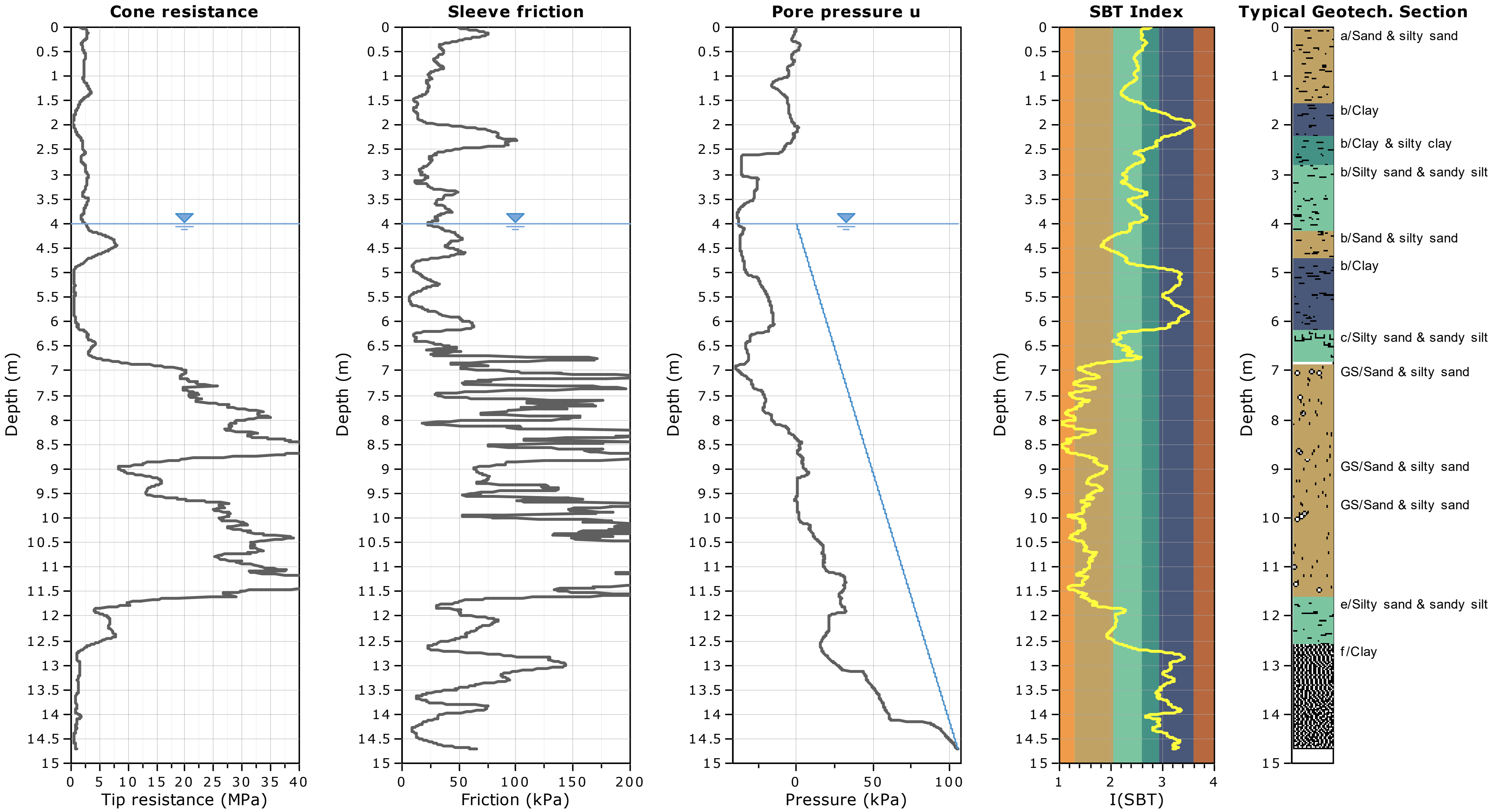

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Surface Elevation: 12.00 m
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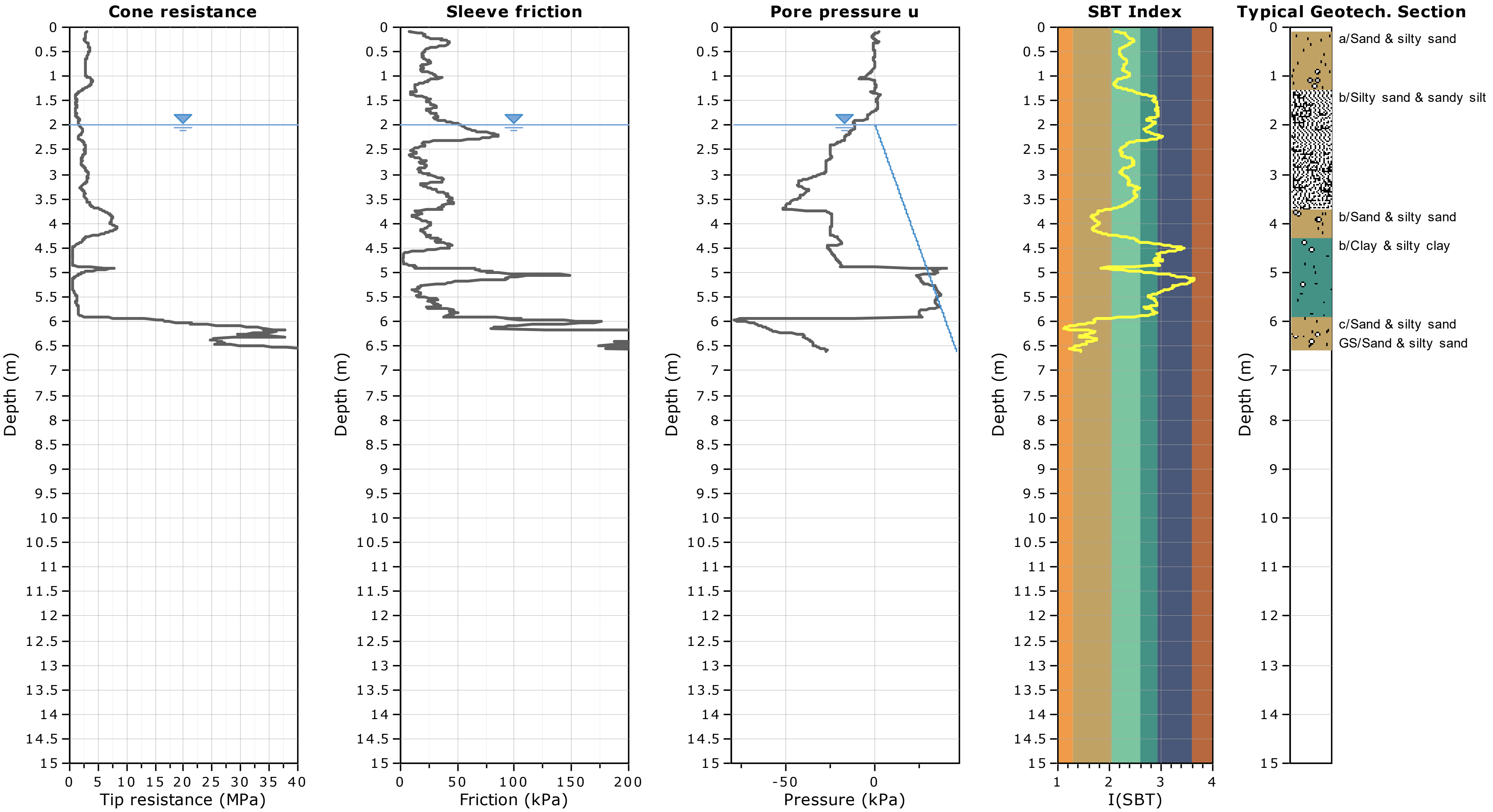
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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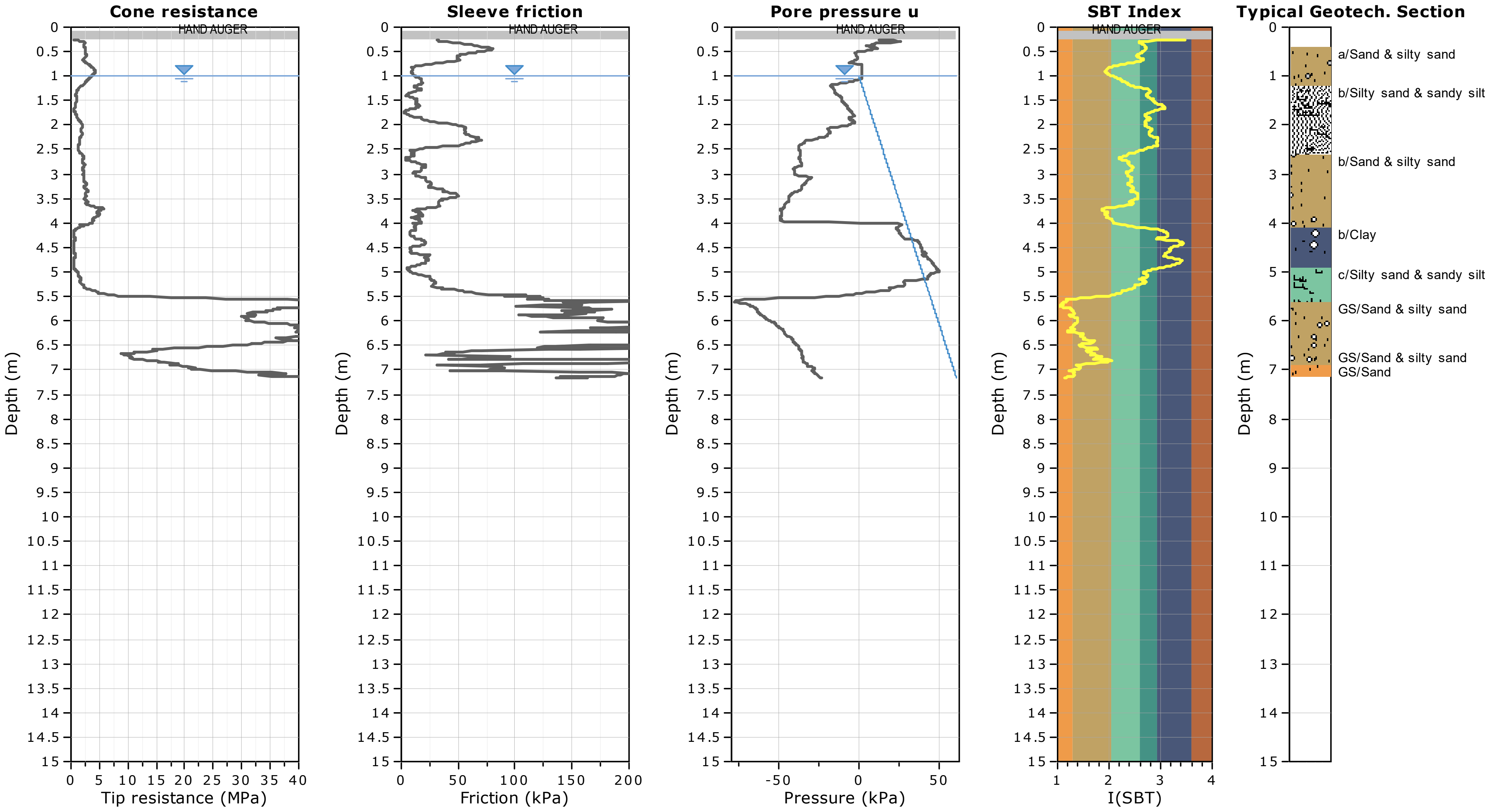
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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Surface Elevation: 11.50 m
Coords: X:0.00, Y:0.00
Cone Type:
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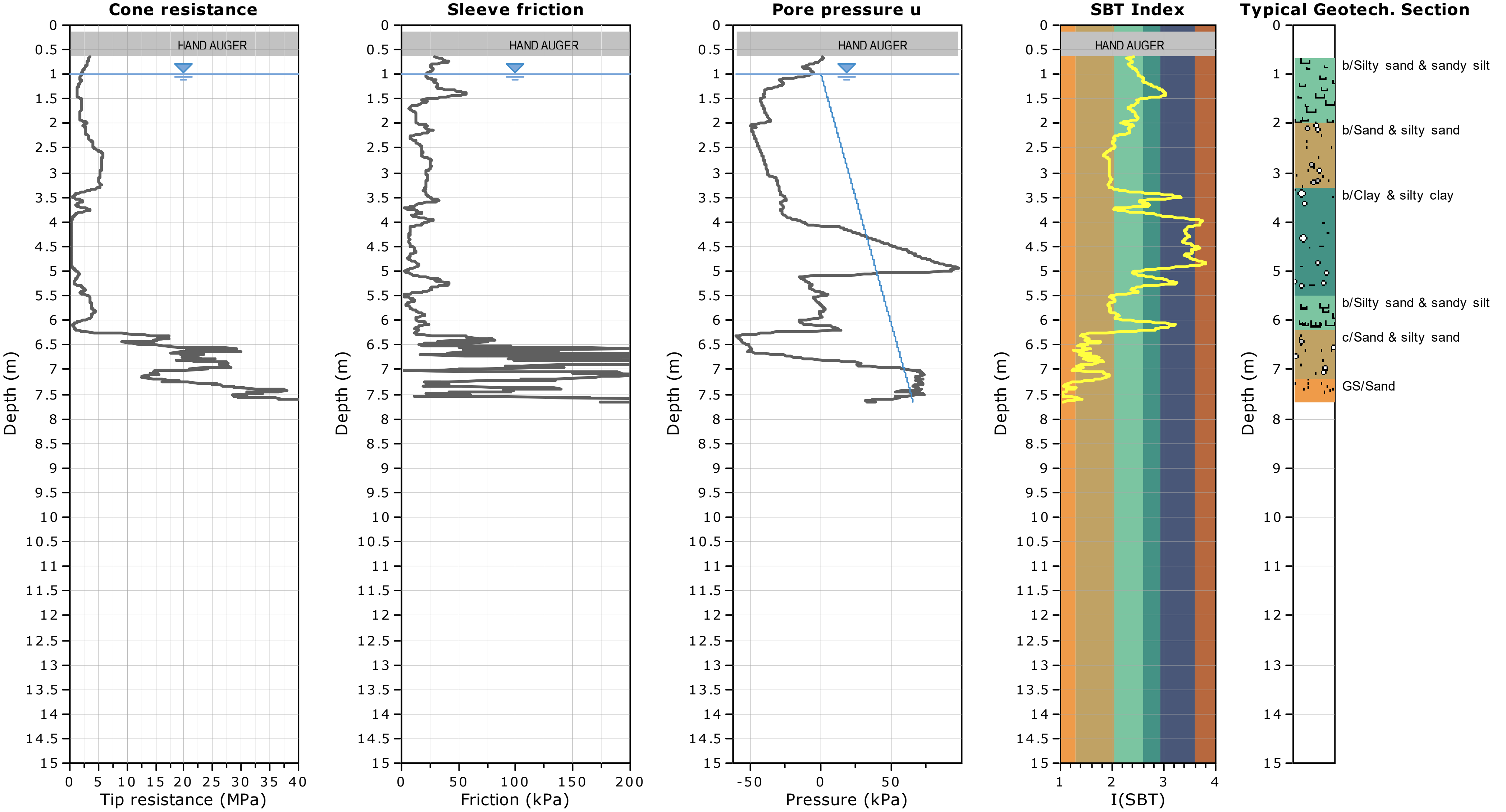
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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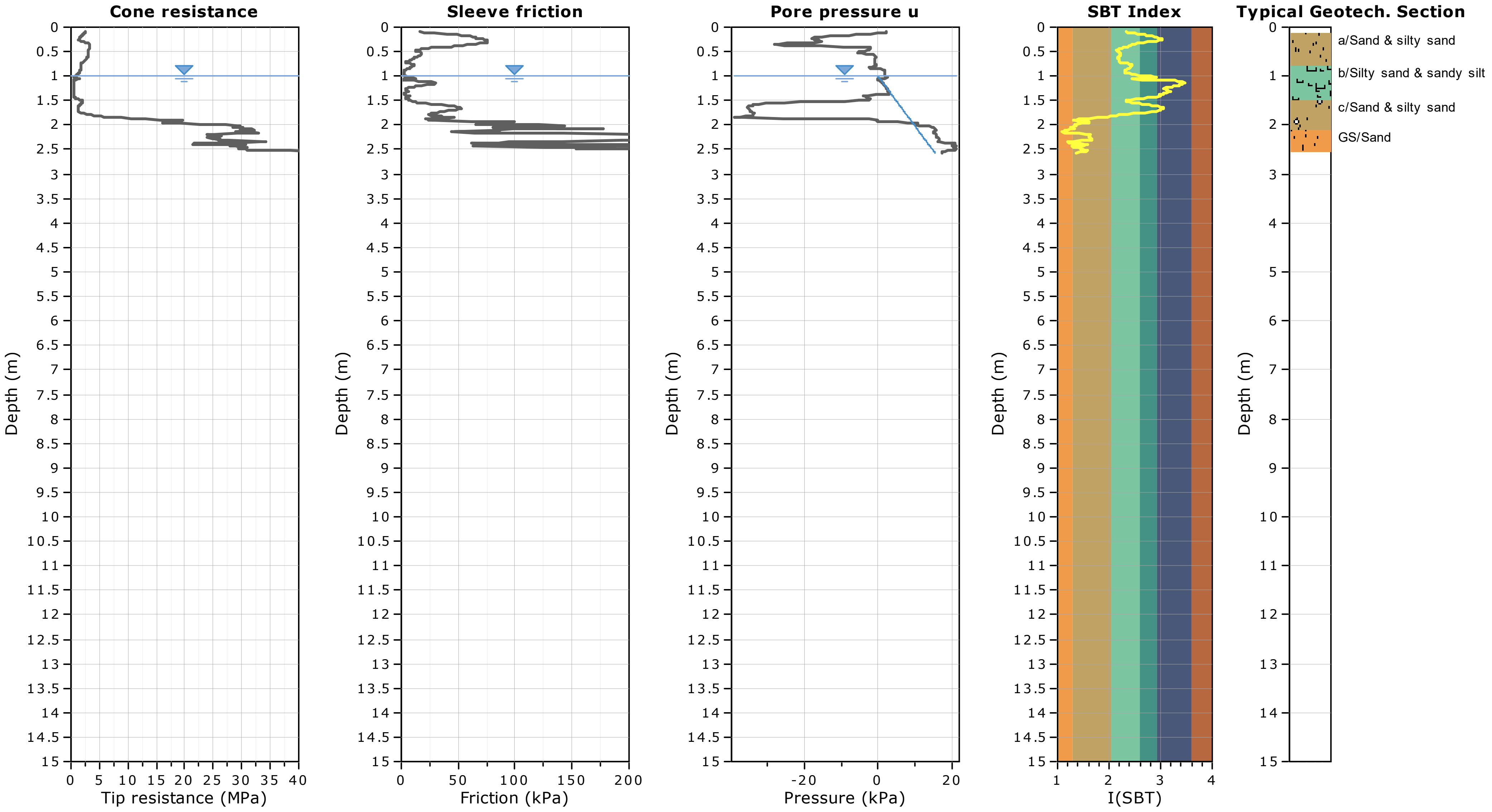
Surface Elevation: 11.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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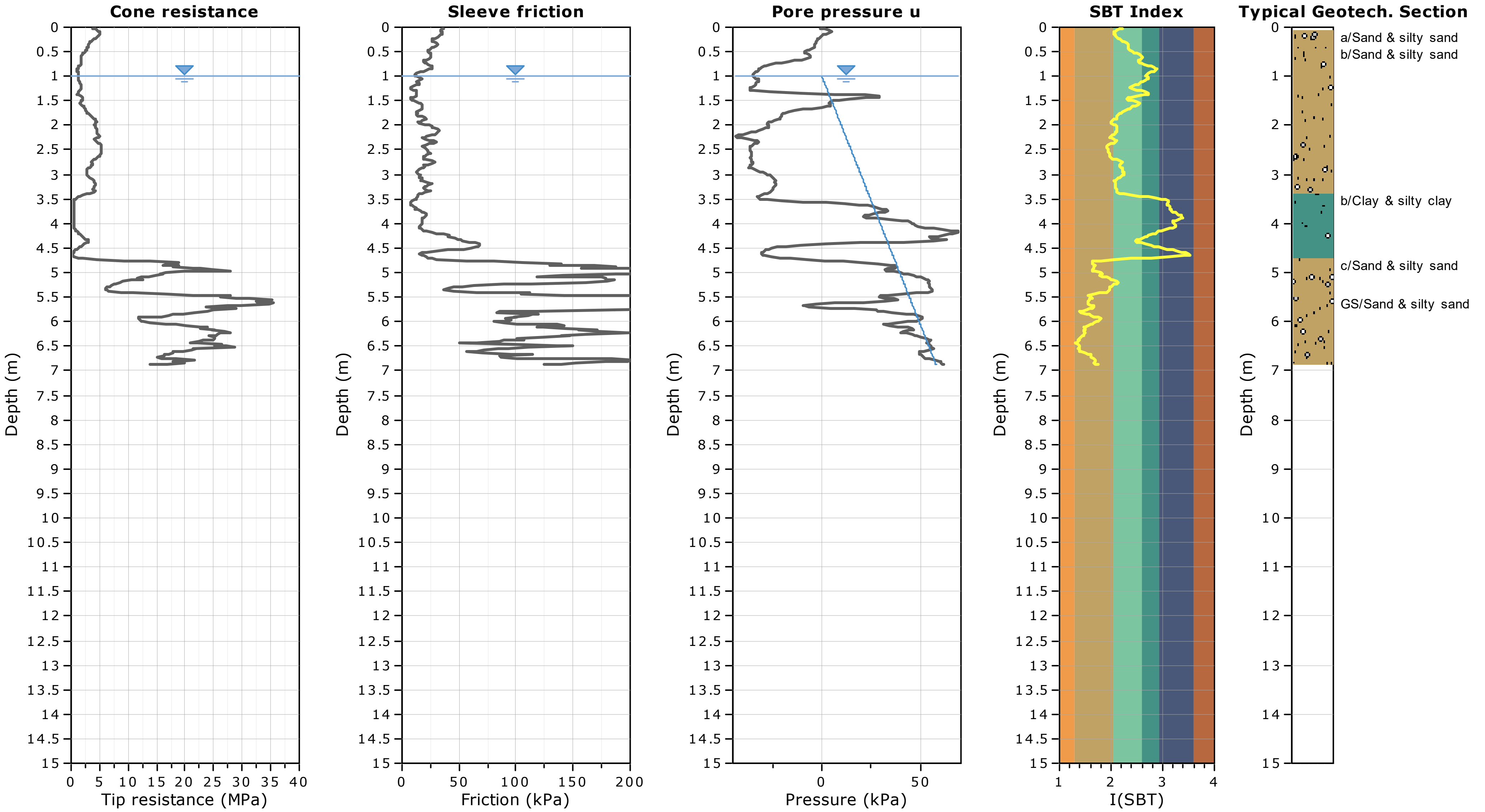
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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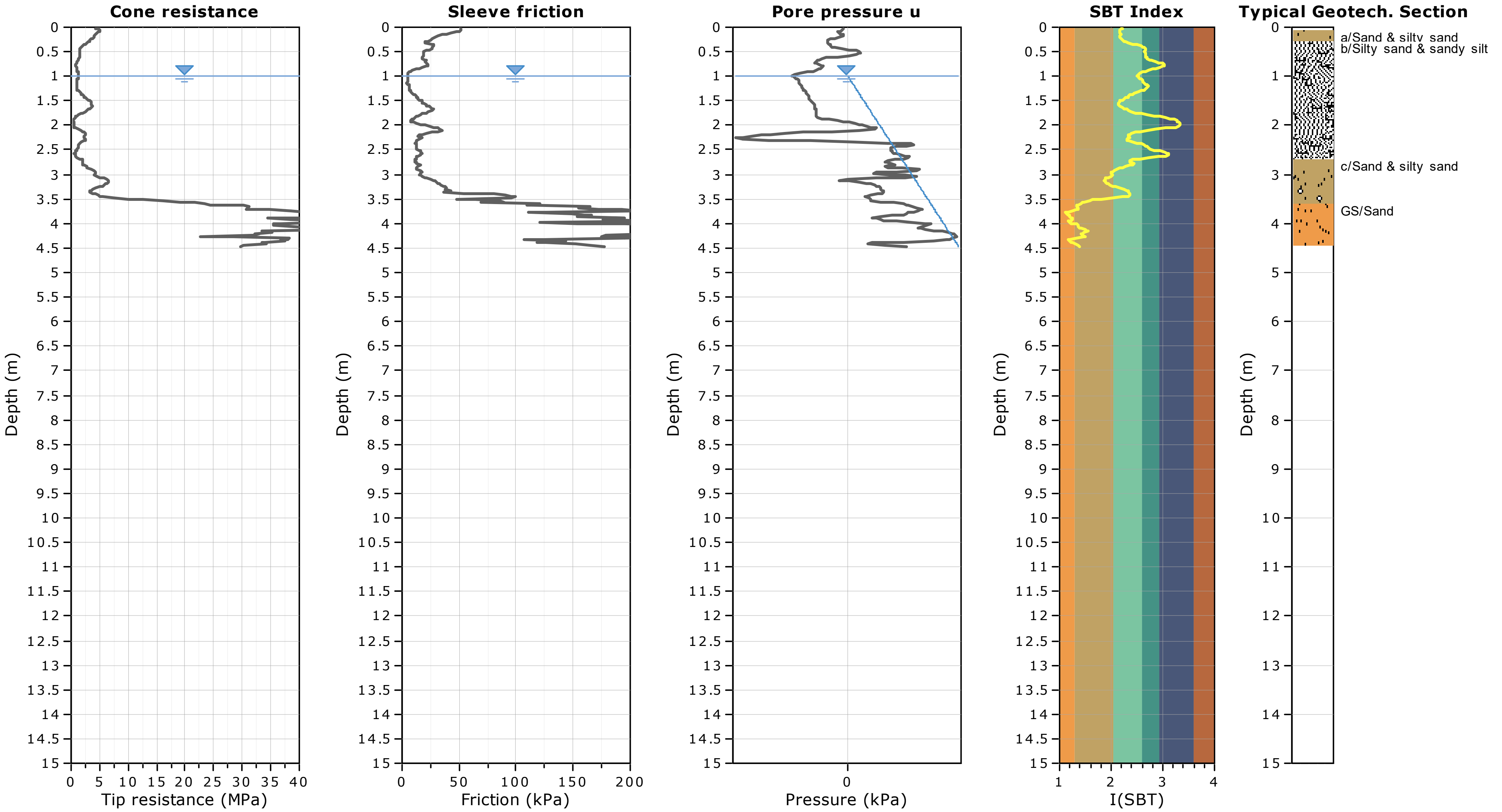
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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Surface Elevation: 11.50 m
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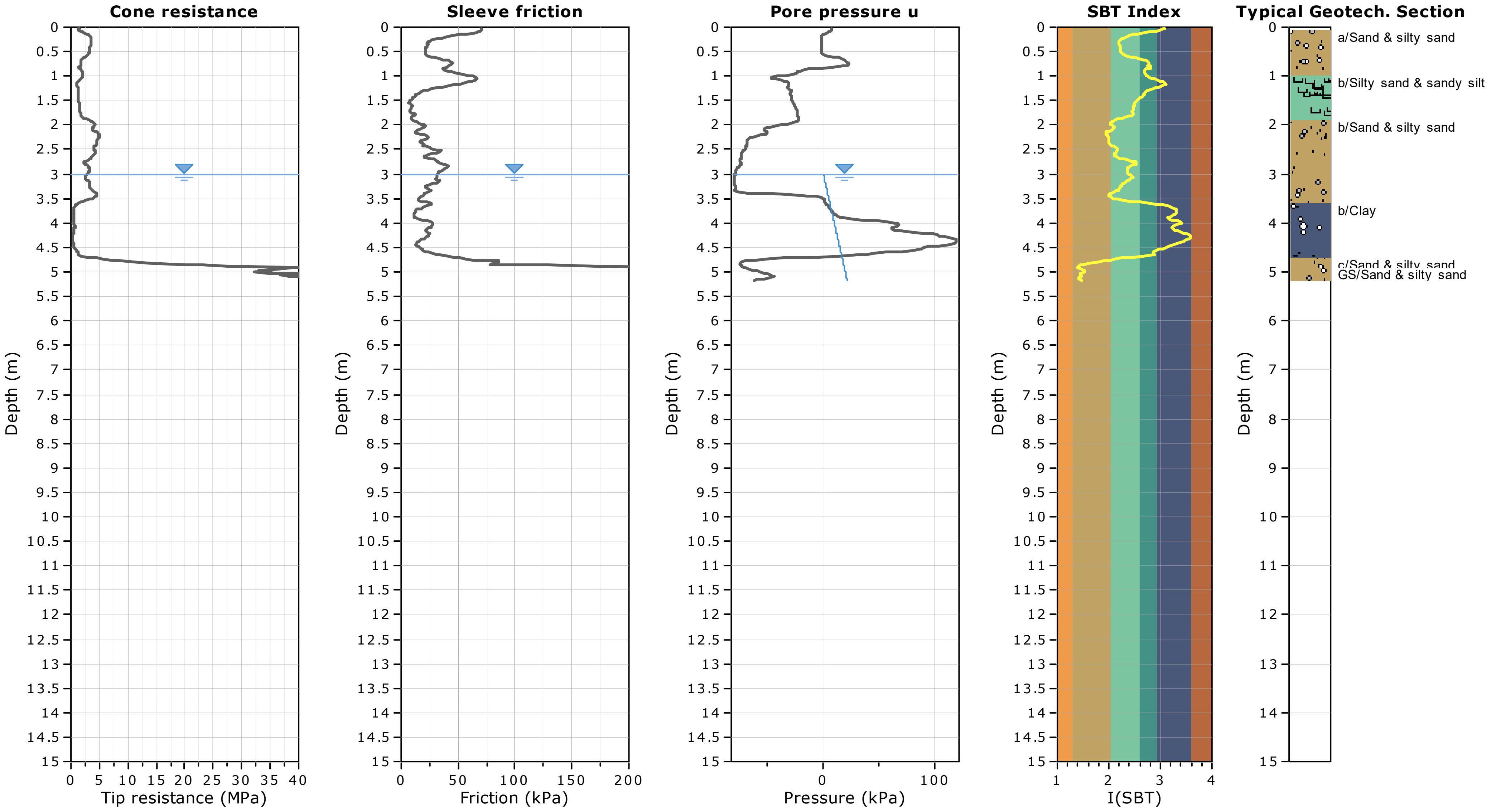
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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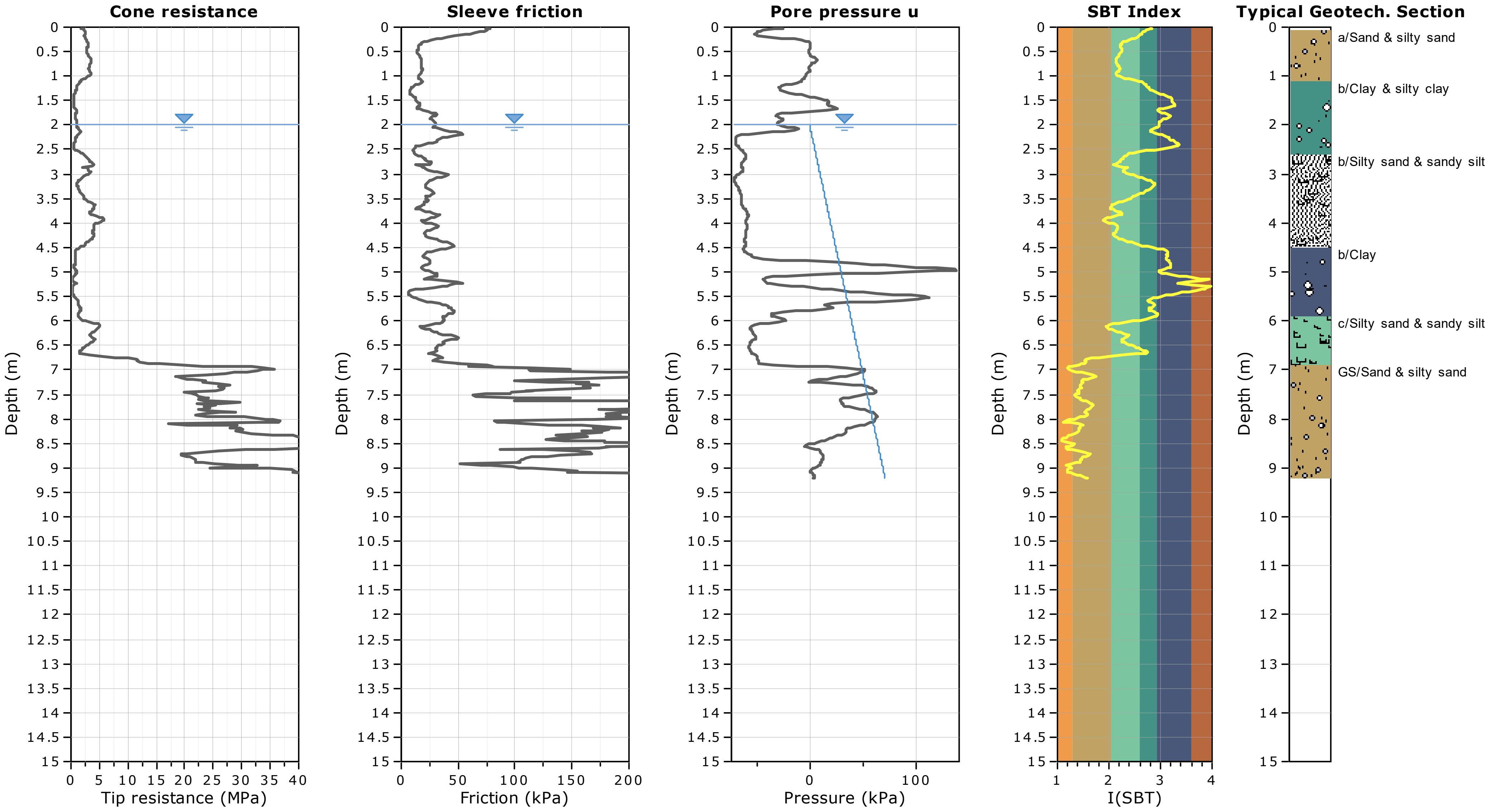
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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Level 3, 518 Colombo Street
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CPT: CPT_97674
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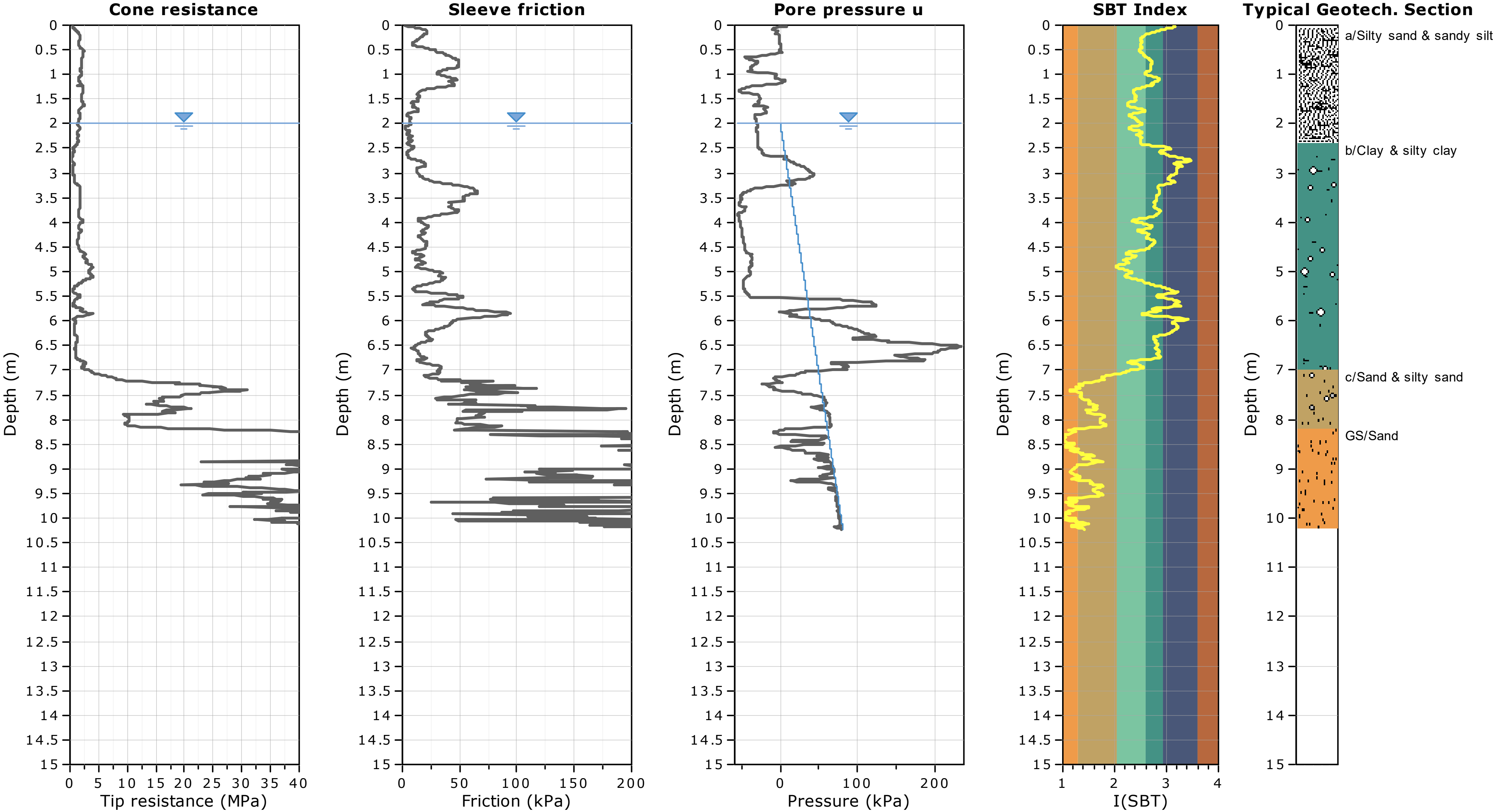
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



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Cone Operator:

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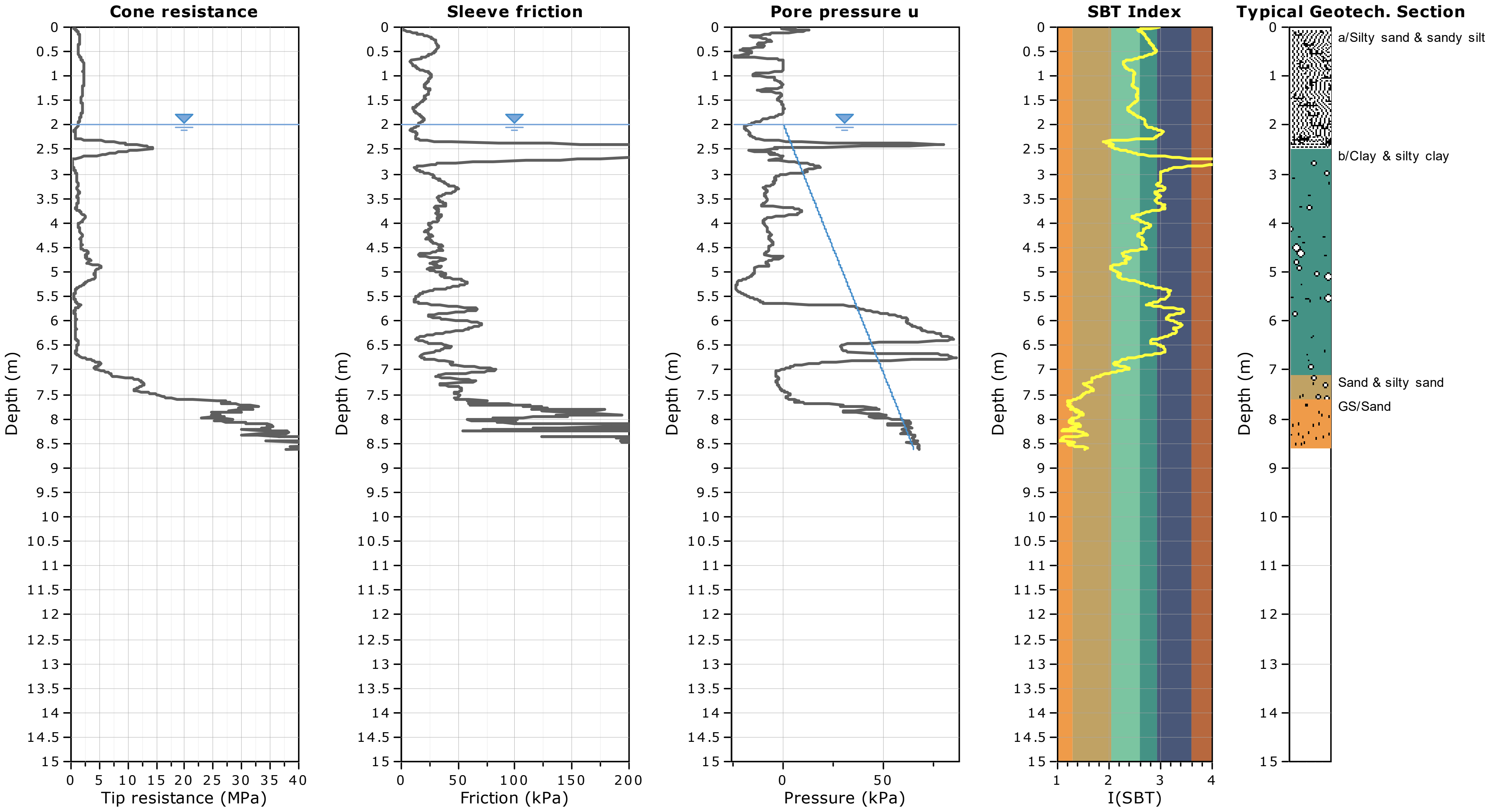
Location: **511 Halswell Road, Halswell, Christchurch**



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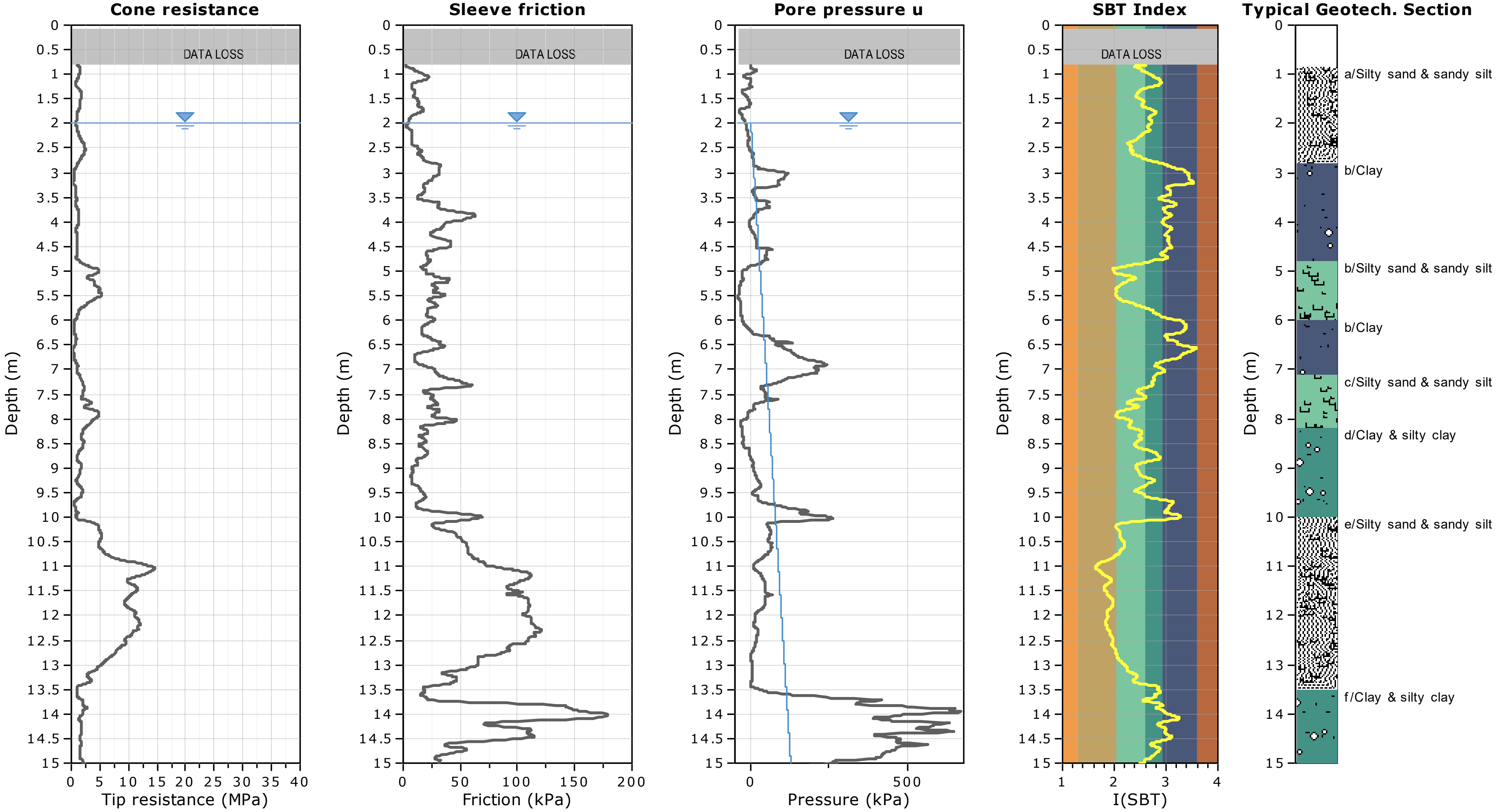
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

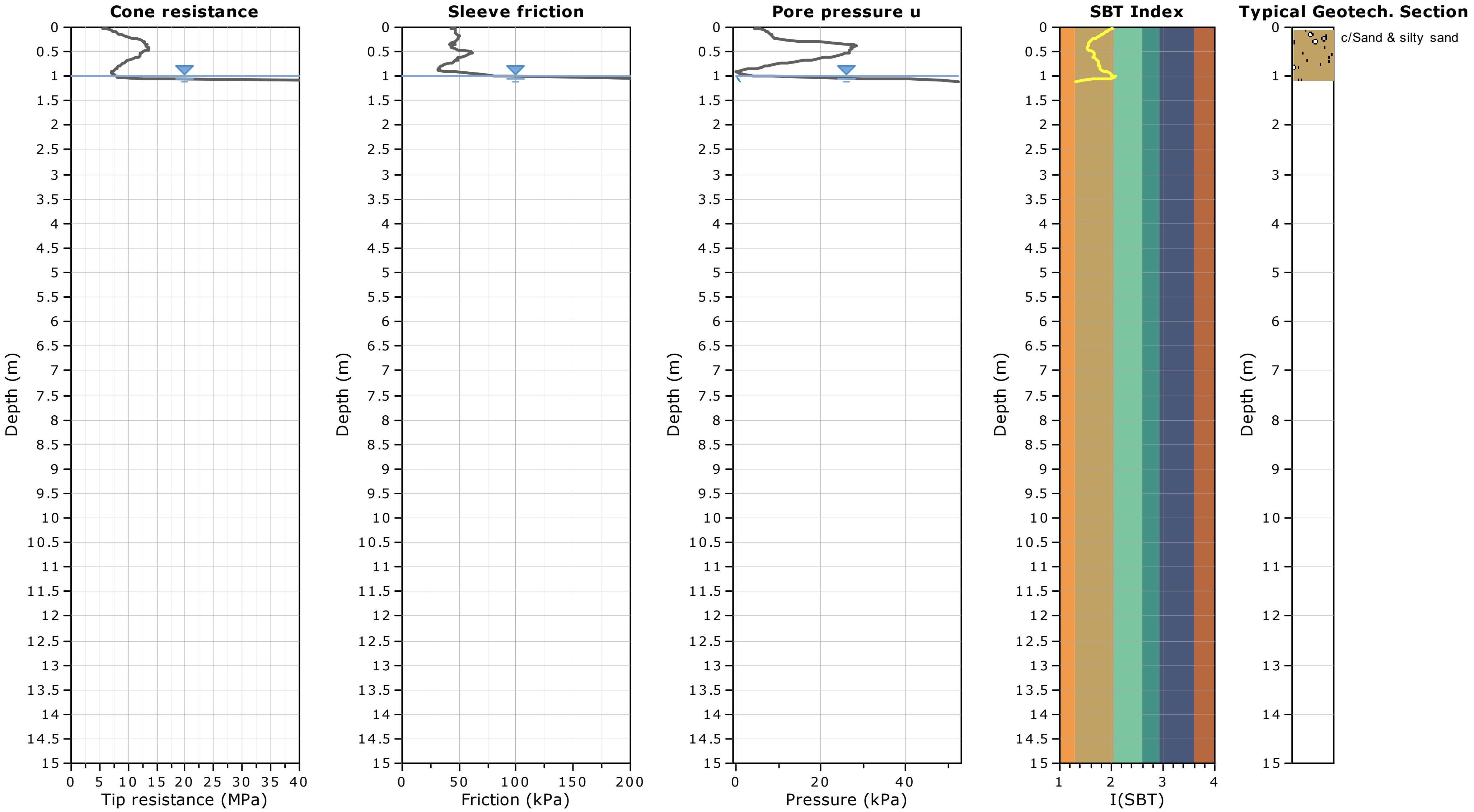
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPT_128308
Total depth: 1.10 m, Date: 29/08/2019
Surface Elevation: 11.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

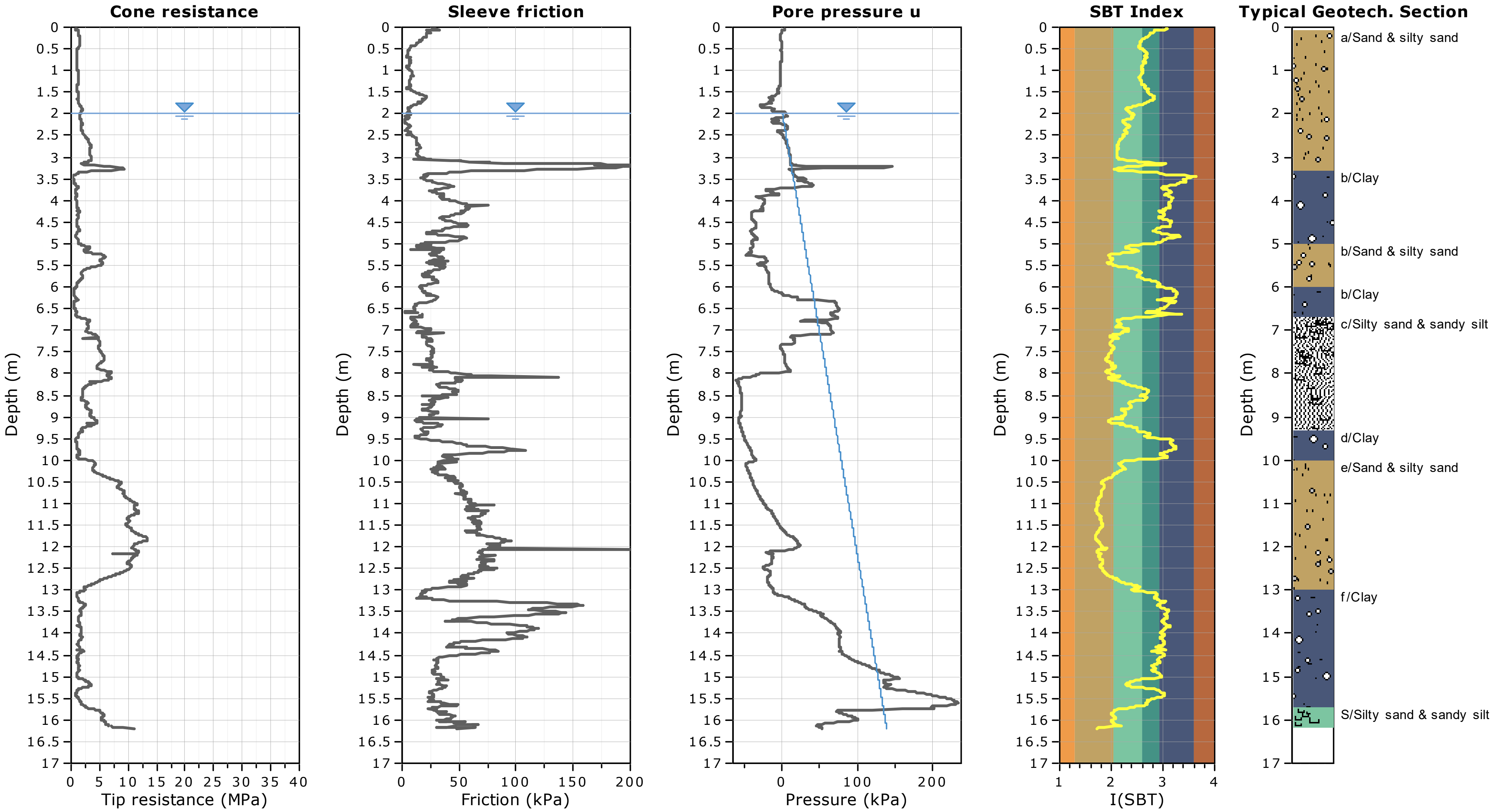
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPT_30015
Total depth: 16.19 m, Date: 29/08/2019
Surface Elevation: 13.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

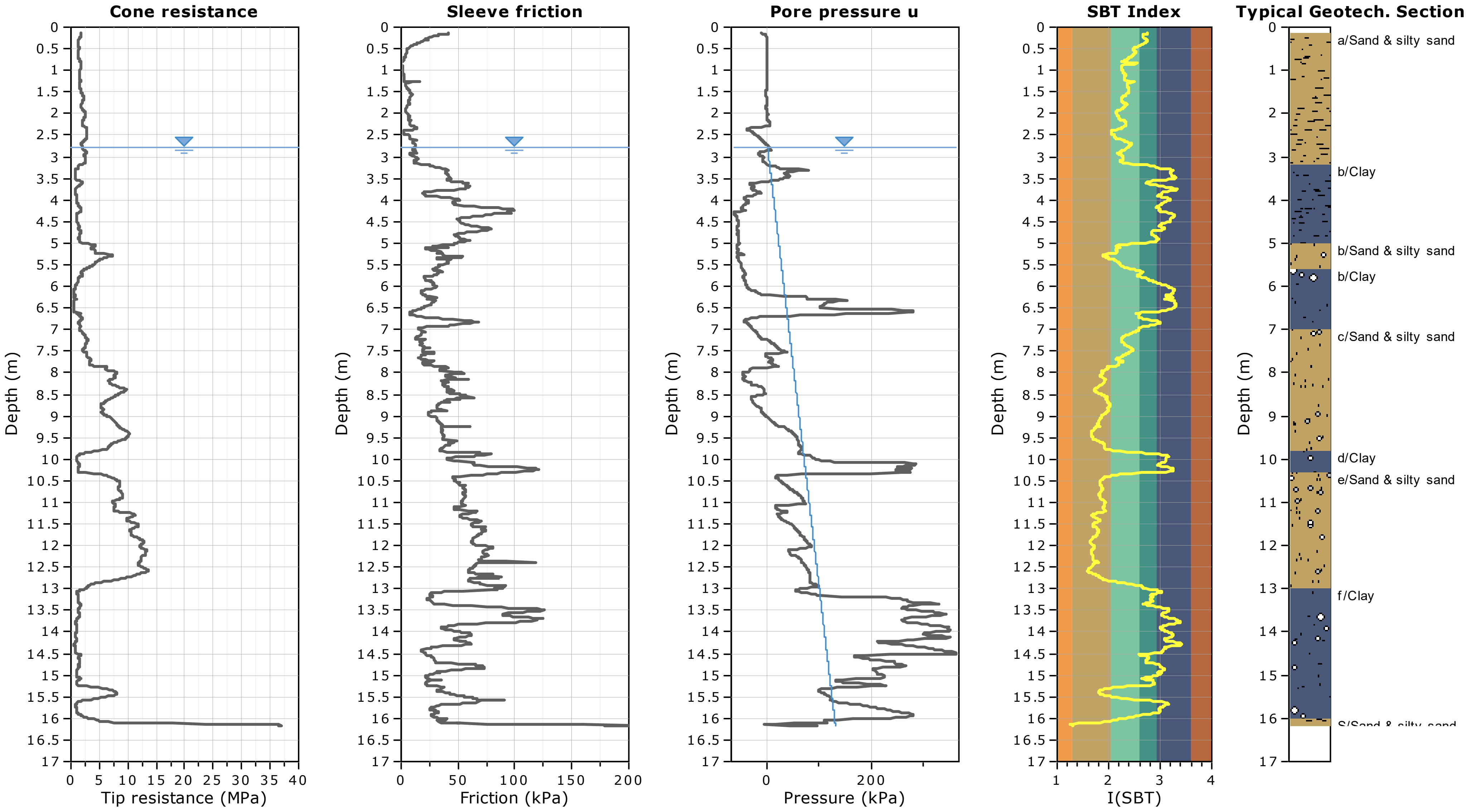
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPT_30018
Total depth: 16.17 m, Date: 29/08/2019
Surface Elevation: 13.50 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

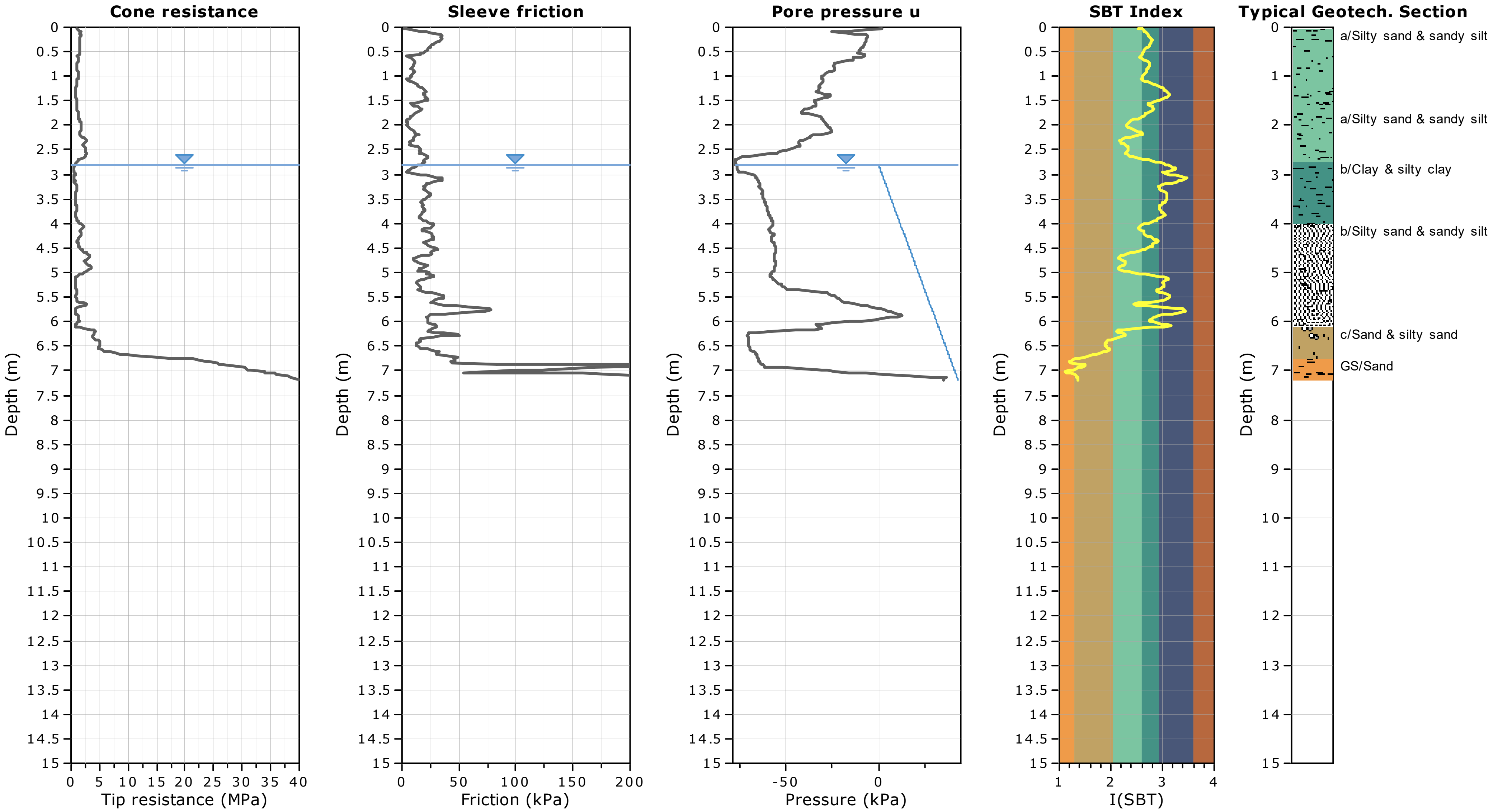
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPT_5670
Total depth: 7.18 m, Date: 29/08/2019
Surface Elevation: 13.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

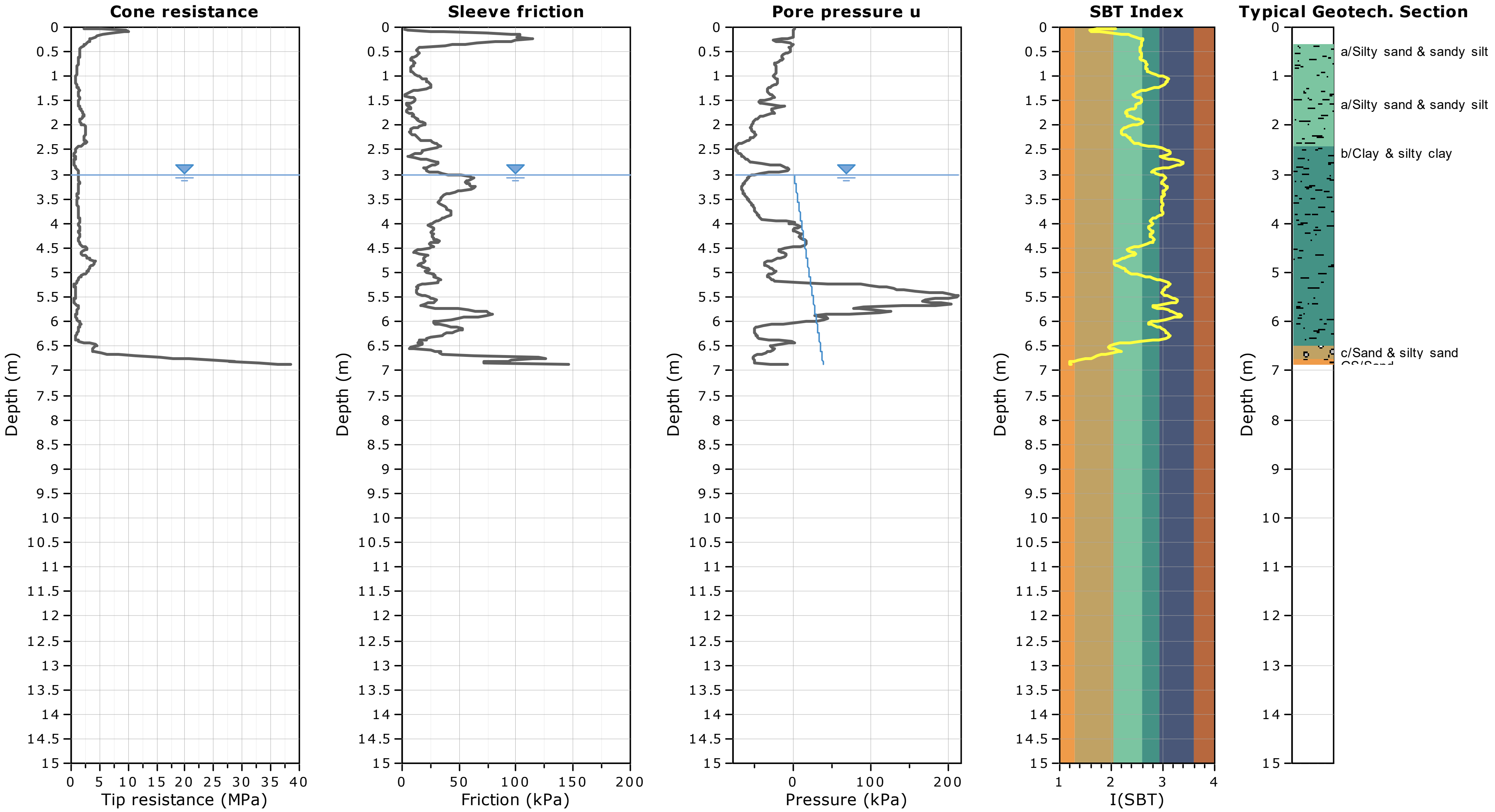
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPT_6322
Total depth: 6.88 m, Date: 29/08/2019
Surface Elevation: 13.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

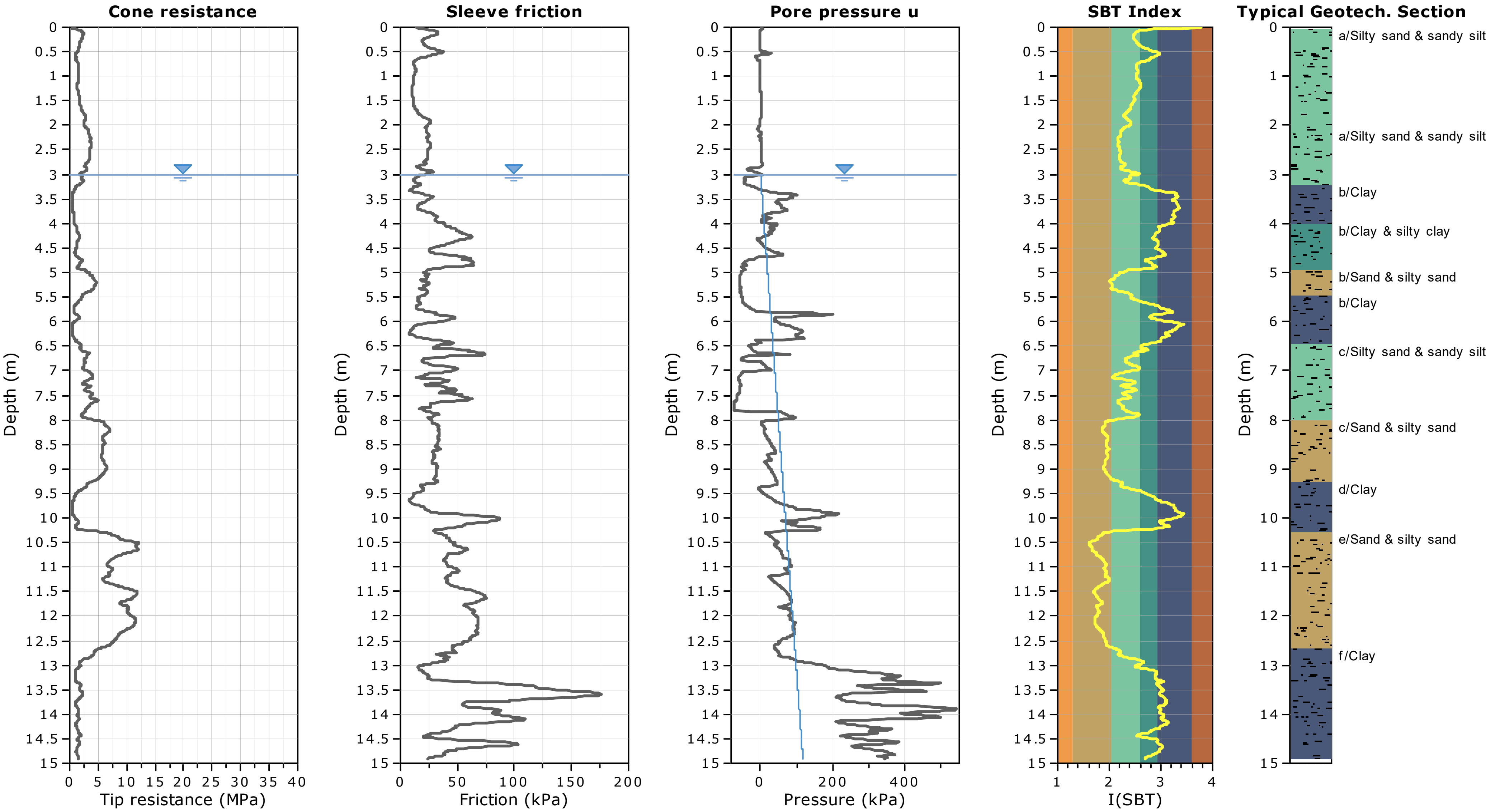
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPT_73086
Total depth: 14.90 m, Date: 29/08/2019
Surface Elevation: 13.50 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**



BOREHOLE No: BH05

MACHINE BOREHOLE LOG

SHEET 1 of 2

PROJECT: CCC Halswell ODP
SITE LOCATION: Halswell, Christchurch
JOB NUMBER: 3205665
CLIENT: Christchurch City Council

CIRCUIT: NZTM
COORDINATES: N 5,172,866.53 m
E 1,564,845.15 m
BOREHOLE LOCATION: 511 Halswell Rd
R L: 20.92 m
DATUM: Christchurch Drainage Datum

DEPTH (m)	CORE RECOVERY	METHOD	SPT 'N'
0.0–0.45	30 %	SPT	1 1 2 1 2 1 N=6
0.45–1.5	100 %	Sonic	
1.5–1.95	100 %	SPT	0 0 1 0 1 0 N=2
1.95–3.0	90 %	Sonic	
3.0–3.45	90 %	SPT	1 2 2 2 1 2 N=7
3.45–4.5	100 %	Sonic	
4.5–4.95	90 %	SPT	0 0 1 0 0 1 N=2
4.95–6.0	100 %	Sonic	
6.0–6.45	100 %	SPT	2 3 2 1 3 3 N=9
6.45–7.5	100 %	Sonic	
7.5–7.95	100 %	SPT	4 7 10 10 9 7 N=36
7.95–9.0	90 %	Sonic	
9.0–9.45	90 %	SPT	3 4 3 2 2 3 N=10
9.45–10.0	100 %	Sonic	

DEPTH (m)	USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT
0.0–0.2	MH	D	Firm, clayey SILT, trace organics; light brown; dry, high plasticity when wetted. Organics: rootlets [TOPSOIL].	
0.2–0.45			No recovery.	Springston Formation
0.45–2.0	MH	M	Soft, clayey SILT, some fine to medium sand; light brown; moist, high plasticity. 0.6m depth: brownish grey.	
		S	Saturated.	
2.0–2.4	SM	M	'Loose', silty fine SAND; greyish brown; moist, non plastic.	
2.4–3.45	SP	M	Loose, fine to medium SAND, some silt, trace rootlets; dark grey; moist, non plastic.	
3.45–4.2	SM	S	'Loose', silty fine SAND; light grey; saturated, non plastic. Trace organics: wood, bark.	
4.2–5.9	MH	S	Soft, clayey SILT, some organics, minor fine to medium sand; light grey; saturated, high plasticity. Organics: wood fragments	
		M	Moist. Organics absent. Some fine to medium sand.	
5.9–6.3	SM	S	Loose, silty fine to medium SAND, some clay; light grey; saturated, low plasticity.	
6.3–6.6	MH	S	Stiff, clayey SILT, minor fine to coarse sand, minor fine to coarse gravel, trace organics; light brown; saturated, high plasticity. Gravel: SW, subangular to subrounded, greywacke. Organics: wood fragments.	
6.6–9.6	GP	S	Dense, fine to medium sandy fine to coarse GRAVEL, trace cobbles, trace silt; grey; saturated, non plastic. Gravel/cobbles: SW, subangular to subrounded, greywacke. Sand: fine to coarse. Medium dense.	
9.6–	OH	S	'Soft to firm', organic clayey SILT, minor medium to coarse gravel; dark brown; saturated, high plasticity. Organics: amorphous peat, wood, rootlets. Gravel: subrounded, greywacke.	

R L (m): 20, 19, 18, 17, 16, 15, 14, 13, 12, 11

DATE STARTED: 28/1/14
DATE FINISHED: 28/1/14
LOGGED BY: BAE
SHEAR VANE No: N/A
DRILLED BY: Pro-Drill (Auck) Ltd
EQUIPMENT: Fraste XL2
DRILL METHOD: Sonic
DRILL FLUID: Water + drill pro
DIAMETER/INCLINATION: 120 mm / 90°

COMMENTS:
Coordinates and elevation data obtained from survey. Artesian conditions encountered in Sprinston Formation Gravel from 6.95 to 9m, water level not measured.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision B

A4 Scale 1:50

BOREHOLE No: BH05

MACHINE BOREHOLE LOG

SHEET 2 of 2

PROJECT:	CCC Halswell ODP	JOB NUMBER:	3205665
SITE LOCATION:	Halswell, Christchurch	CLIENT:	Christchurch City Council

CIRCUIT: NZTM
COORDINATES: N 5,172,866.53 m
E 1,564,845.15 m

BOREHOLE LOCATION: 511 Halswell Rd
R L: 20.92 m
DATUM: Christchurch Drainage Datum

DRILLING

CORE RECOVERY	METHOD	SPT 'N'
100 %	Sonic	
100 %	SPT	2 1 1 2 2 2 N=7
90 %	Sonic	
90 %	SPT	1 2 1 3 2 4 N=10
90 %	Sonic	
80 %	SPT	1 2 2 2 1 3 N=8
80 %	Sonic	
90 %	SPT	1 3 4 5 7 8 N=24

USCS	MOISTURE	SOIL / ROCK DESCRIPTION	GEOLOGICAL UNIT
GM	S	9.8m depth: grey. Loose, silty fine sandy fine to coarse GRAVEL; light grey; saturated, non plastic. Gravel: subangular to subrounded, greywacke.	**Springston Formation** *(Contd.)*
ML	M	Loose, fine sandy SILT; light grey; moist, non plastic.	
MH	M	'Stiff', clayey SILT; light grey; moist, high plasticity.	
PT	W	Stiff, fibrous PEAT; brownish black; wet, low plasticity. Organics: Moderately decomposed [H5]. Piece of wood (<100mm).	
MH	M	'Firm', clayey SILT, trace organics; light grey; moist, high plasticity. Organics: rootlets, wood.	
PT	W	'Soft', PEAT; dark brownish black; wet, high plasticity. Highly decomposed [H7].	
OH	M	'Firm', organic clayey SILT; brownish black; moist; high plasticity.	
MH	S	Firm, clayey SILT, some fine to medium sand; light grey; saturated, high plasticity when dried. Sand absent.	
SP	M	Medium dense, fine to medium SAND, minor silt; light grey; moist, non plastic.	
		END OF LOG @ 15.45 m	

DEPTH (m): 11, 12, 13, 14, 15, 16, 17, 18, 19

R L (m): 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

DATE STARTED:	28/1/14	DRILLED BY:	Pro-Drill (Auck) Ltd
DATE FINISHED:	28/1/14	EQUIPMENT:	Fraste XL2
LOGGED BY:	BAE	DRILL METHOD:	Sonic
SHEAR VANE No:	N/A	DRILL FLUID:	Water + drill pro
		DIAMETER/INCLINATION:	120 mm / 90°

COMMENTS:
Coordinates and elevation data obtained from survey. Artesian conditions encountered in Sprinston Formation Gravel from 6.95 to 9m, water level not measured.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision B

A4 Scale 1:50

MACHINE_BOREHOLE P:\320\3205665\PHASE 2\TGE\3. WORK PACKAGE PHASE GEOTECHNICAL\12. INPUTS, REFERENCE, RESEARCH AND DATA\BOREHOLE LOGS\HALSWELL PHASE 2 BOREHOLE LOGS.GPJ BECA.GDT 3/4/14

TONKIN & TAYLOR LTD

BOREHOLE LOG

SHEET 1 OF 2

BH No: HAL-POD01-BHCPT006
Hole Location: 616 Halswell Road

PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS
LOCATION: HALSWELL
JOB No: 52003.000

CO-ORDINATES: 5734670.24 mN
2474657.46 mE
R.L.: 12.79 m
DATUM: NZMG, MSL (CCC 20/01/12 Datum -9.043m)

DRILL TYPE: Roto-Sonic
DRILL METHOD: PQDT/Auto SPT
DRILL FLUID: LP2000

HOLE STARTED: 31/10/12
HOLE FINISHED: 31/10/12
DRILLED BY: Pro-Drill
LOGGED BY: HW-TA
CHECKED: BMcD

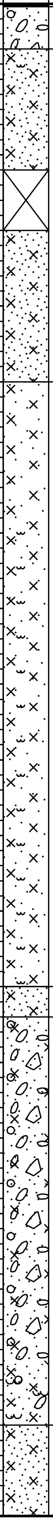
GEOLOGICAL

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.
ASPHALT
FILL
TOPSOIL
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)

WATER: water level at 2.3m

CORE RECOVERY (%)	METHOD	TESTS	SAMPLES
73	PQDT		
100	SPT	*FC@1.5m 0/0//1/1/1/2 N=5	B
100	PQDT		
100	SPT	*ATP@3.0m *FC@3.0m 1/1//1/2/2/2 N=7	B
100	PQDT		
100	SPT	1/1//1/1/1/1 N=4	
100	PQDT		
100	SPT	1/1//0/1/1/2 N=4	
100	PQDT		
100	SPT	1/1/5/4/4/4// 3/6/4/6/3/4/ 5/4/5/4/4/1 N=49	
100	PQDT		
100	SPT	1/1/1/0/1/1// 1/2/1/1/1/1/ 1/1/1/1/1/1 N=13	
100	PQDT		

ENGINEERING DESCRIPTION



CLASSIFICATION SYMBOL	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION
GW	M		ASPHALT. Sandy fine to coarse GRAVEL, grey, subrounded, moist, well graded. Sand is fine to coarse.
SM			Silty fine to medium SAND with trace organics, dark brown, moist, poorly graded. 0.5m- brownish grey, organics absent. 1.1 to 1.5m- no recovery.
		L	1.5m- loose.
	W		2.3m- wet.
ML		F	SILT with trace sand, grey, firm, wet, low plasticity. Sand is fine to medium. 3.4m- trace fibrous organics. 4.95 to 5.15m- minor fine to medium sand. 5.9 to 6.0m- fibrous organic layer.
SM		L	Silty fine to medium SAND, grey, loose, wet, poorly graded.
GW			Sandy fine to medium GRAVEL with some silt, grey, rounded, loose, wet, well graded. Sand is fine to coarse.
		D	7.5m- dense.
		MD	9.0 to 9.3m- some wood fragments, medium dense.
SM			Silty fine to medium SAND, grey, medium dense, wet, poorly graded.

Log Scale 1:50

T+T DATATEMPLATE-SPT.GDT rcb

TONKIN & TAYLOR LTD

BOREHOLE LOG

BH No: HAL-POD01-BHCPT006
Hole Location: 616 Halswell Road
SHEET 2 OF 2

PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS LOCATION: HALSWELL JOB No: 52003.000

CO-ORDINATES: 5734670.24 mN
2474657.46 mE
R.L.: 12.79 m
DATUM: NZMG, MSL (CCC 20/01/12 Datum -9.043m)

DRILL TYPE: Roto-Sonic
DRILL METHOD: PQDT/Auto SPT
DRILL FLUID: LP2000

HOLE STARTED: 31/10/12
HOLE FINISHED: 31/10/12
DRILLED BY: Pro-Drill
LOGGED BY: HW-TA CHECKED: BMcD

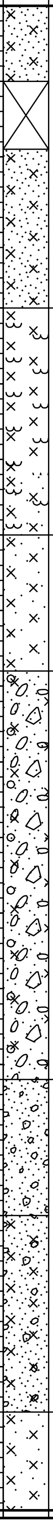
GEOLOGICAL

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION: YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)

CORE RECOVERY (%)	METHOD	TESTS	SAMPLES
100	PQDT		
0	SPT	2/2//2/3/2/3 N=10	
100	PQDT	✱ATP@12.0m ✱FC@12.0m	
100	SPT	1/1//2/2/1/3 N=8	B
100	PQDT		
100	SPT	0/0//0/0/1/1 N=2	
100	PQDT		
100	SPT	2/2/3/3/3/4// 4/3/5/5/4/4/ 4/4/4/4/5/4 for 75mm N>50	
100	PQDT		
100	SPT	1/2/1/0/0/0// 0/0/1/1/1/1/ 0/1/1/1/1/1 N=9	
100	PQDT		
100	SPT	1/1/1/1/1/1// 2/2/2/2/2/1/ 2/2/2/2/4/3 N=26	
100	PQDT		
100	SPT	0/0//0/0/0/0 N=0	

R.L. (m): 2, 1, 0, -1, -2, -3, -4, -5, -6, -7
DEPTH (m): 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

ENGINEERING DESCRIPTION



CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION
SM	W	MD	Silty fine to medium SAND, grey, medium dense, wet, poorly graded. 10.5m- loose. 10.5 to 10.95m- no recovery.
OH		St	Organic SILT, black, stiff, wet, high plasticity. Organics are amorphous. 13.1m- some fine to medium sand, grey.
ML		S	SILT with minor sand, grey, soft, wet, low plasticity. Sand is fine to medium.
GW		VL VD L	Sandy fine to coarse GRAVEL with some silt, grey, subrounded, very loose, wet, well graded. Sand is fine to coarse. 14.6m- minor silt. 15.0m- very dense. 16.5m- loose.
SP			Fine to coarse SAND with minor gravel, brownish grey, loose, wet, poorly graded. Gravel is fine to medium, subrounded.
		MD	Fine to coarse SAND with some silt and minor gravel, brown, medium dense, wet, poorly graded. Gravel is fine to medium, subrounded. 19.1m- grey.
ML		VSt VS	SILT with trace sand, grey, very stiff, wet, low plasticity. Sand is fine to medium. 19.5m- very soft. End of borehole at 19.8mbgl (target depth)

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.

T+T DATATEMPLATE-SPT.GDT rcb

Log Scale 1:50

GEOTECHNICS

15C Amber Crescent, Judea, Tauranga
New Zealand
p. +64 7 571 0280
f. +64 7 571 0282
w. www.geotechnics.co.nz

LAB REF: 884/12
JOB NO: 720018.575

TC3 GEOTECHNICAL LABORATORY TESTING, CHRISTCHURCH

TEST RESULTS

616 Halswell Road	Halswell	HAL-POD01-BHCPT06

SAMPLE IDENTIFICATION	TEST RESULTS				
	LL	PL	PI	FINES CONTENT PASSING 75µm (%)	WATER CONTENT (%)
1.5m*				34.77	27.4
3.0m	32	26	6	97.71	32.6
12.0m	192	144	48	56.89	136.6

* Sample insufficiently cohesive to prepare for liquid limit and plastic limit tests.

Note: Plasticity Index testing was performed by Earth Control Laboratory.

CHECKED:	
DATE:	04/02/13

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH-02
Hole Location:
HAL-POD01-BH02
(620 Halswell Road)
SHEET 1 OF 2

PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS LOCATION: HALSWELL JOB No: 52003.000

CO-ORDINATES 5734651.82 mN
2474630.73 mE
R.L. 12.67 m
DATUM NZMG, MSL (CCC 20/01/12 Datum -9.043m)

DRILL TYPE: Roto-Sonic
DRILL METHOD: PQDT/Auto SPT
DRILL FLUID: LP2000

HOLE STARTED: 1/10/12
HOLE FINISHED: 1/10/12
DRILLED BY: Pro-Drill
LOGGED BY: RDCL-BM CHECKED: BMcD

GEOLOGICAL 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.
TOPSOIL											ML	M					Sandy SILT with minor rootlets and trace organics, dark brown, moist, low plasticity. Sand is fine to medium.
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)			100	PQDT				12	1								0.45m- reddish brown, rootlets and organics absent.
		▼	100	SPT		0/0//1/0/1/0 *N=2 FC1.5	B	11					S				1.5m- soft.
									2			W					1.95m- light grey. 2.0m- wet.
			100	PQDT				10									
			100	SPT		0/0//0/0/1/1 *N=2 FC3.0 ATP3.0	B		3								SILT with trace sand, light grey, soft, wet, low plasticity. Sand is fine to medium.
			100	PQDT				9	4								
			100	SPT		1/1//1/1/0/0 N=2		8									
			100	PQDT				7	5								4.95 to 5.6m- dark brown, trace rootlets and organics.
			100	SPT		1/1//2/2/2/3 *N=9 FC6.0	B		6		SM		L				Silty fine to medium SAND, grey, loose, wet, poorly graded.
											SP						Fine to medium SAND with trace silt, dark grey, loose, wet, poorly graded.
			100	PQDT				6	7		GW						Sandy fine to coarse GRAVEL, dark grey, subrounded, loose, wet, well graded. Sand is medium to coarse.
			100	SPT		10/9// 7/9/10/12 N=38		5					D				7.5m- dense.
			100	PQDT				4	8								
			100	SPT		2/1/1/1/2/ 2//3/5/6/5/ 6/5/5/8/5/ 4/5/5 for 50mm N>50			9				VD				9.0m- very dense.
			100	PQDT				3	10		ML		H				SILT with minor sand, dark brown, hard, wet, low plasticity.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No: BH-02
Hole Location:
HAL-POD01-BH02
(620 Halswell Road)
SHEET 2 OF 2

PROJECT: CHCH TC3 GEOTECHNICAL INVESTIGATIONS
LOCATION: HALSWELL
JOB No: 52003.000

CO-ORDINATES 5734651.82 mN
2474630.73 mE
R.L. 12.67 m
DATUM NZMG, MSL (CCC 20/01/12 Datum -9.043m)

DRILL TYPE: Roto-Sonic
DRILL METHOD: PQDT/Auto SPT
DRILL FLUID: LP2000

HOLE STARTED: 1/10/12
HOLE FINISHED: 1/10/12
DRILLED BY: Pro-Drill
LOGGED BY: RDCL-BM CHECKED: BMcD

GEOLOGICAL: GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

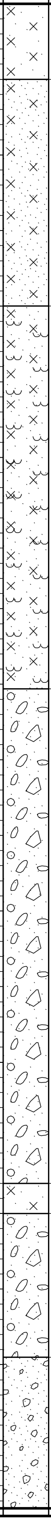
YALDHURST MEMBER OF THE SPRINGSTON FORMATION (ALLUVIAL)

ENGINEERING DESCRIPTION: 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.

Column headings: 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

Core recovery (%)	Method	Tests	Samples
100	PQDT		
100	SPT	2/3//3/4/5/6 N=18	
100	PQDT		
100	SPT	*2/1//1/2/2/2 N=7 FC12.0 ATP12.0	B
100	PQDT		
100	SPT	1/1/2/4/4 /3//4/6/5/5/ 5/5/5/5/4/ 5/1 for 10mm N>50	
100	PQDT		
100	SPT	1/1/2/3/2/ 3//3/2/3/3/ 3/4/2/3/3/ 2/3/3 N=34	
100	PQDT		
100	SPT	3/6// 11/15/15/9 for 60mm N>50	
100	PQDT		
100	SPT	2/2//3/3/4/5 N=15	

R.L. (m): 2, 1, 0, -1, -2, -3, -4, -5, -6, -7
DEPTH (m): 11, 12, 13, 14, 15, 16, 17, 18, 19, 20



Depth (m)	Classification symbol	Moisture condition	Strength/density	Description
10.0–10.5	ML	W	H	SILT with minor sand, dark brown, hard, wet, low plasticity.
10.5–12.0	SP		MD	Fine to medium SAND with some silt, dark brown, medium dense, wet, poorly graded.
12.0–14.5	ML		F	SILT with some sand and minor organics, brownish black, firm, wet, low plasticity. 13.5m- No SPT test due to ground conditions 13.5m- dark brown.
14.5–17.8	GW		L VD D	Sandy fine to coarse GRAVEL, light grey, sub-rounded, loose, wet, well graded. Sand is fine to coarse. 15.0m- very dense. 15.8m- light reddish brown. 16.5m- dense.
17.8–18.0	MH	S	H	SILT with minor sand, light reddish brown, hard, saturated, low plasticity.
18.0–19.0	GW		VD	Sandy fine to coarse GRAVEL, dark grey, sub-rounded, very dense, saturated, well graded. Sand is fine to medium.
19.0–19.95	SW		MD	Gravelly fine to medium SAND, light grey, very dense, saturated, well graded. Gravel is fine to medium. 19.5m- medium dense. End of borehole at 19.95mbgl (target depth)

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LAB REF: 871/12
JOB NO: 720018.575

TC3 GEOTECHNICAL LABORATORY TESTING, CHRISTCHURCH

TEST RESULTS

620 Halswell Road	Halswell	HAL-POD1-BH02

SAMPLE IDENTIFICATION	TEST RESULTS				
	LL	PL	PI	FINES CONTENT PASSING 75µm (%)	WATER CONTENT (%)
1.5m*				69.80	27.1
3.0m	35	28	7	97.51	35.3
6.0m*				37.08	28.9
12.0m	33	26	7	86.98	72.2

* Sample insufficiently cohesive and/or excessively dilatant to test for liquid limit. Unable to roll into a thread for plastic limit test.
Note: Plasticity Index testing was performed by Opus Hamilton Laboratory.

CHECKED:	
DATE:	16/10/12

Bore Log

McMILLAN Drilling

Client: Eliot Sinclair & Partners Ltd

Project: 511 Halswell Road, Christchurch

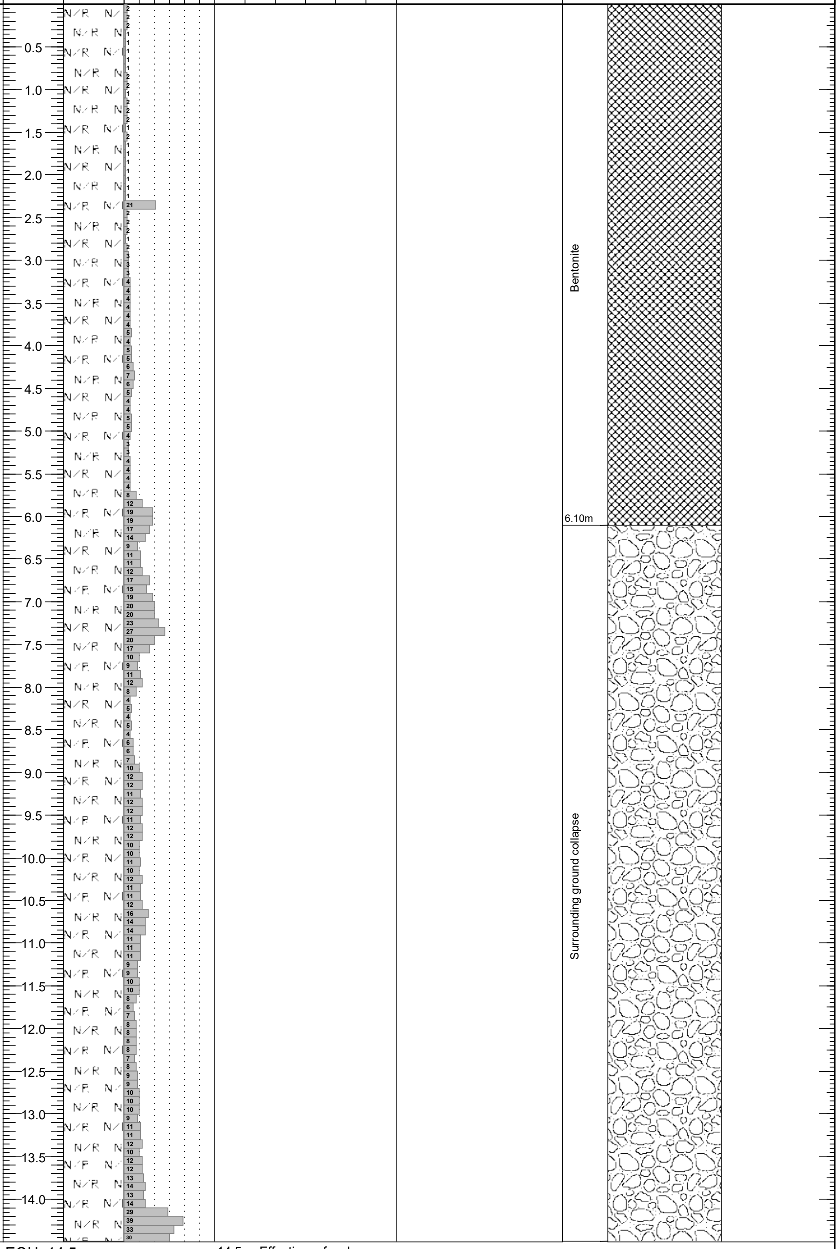
Bore No.: DPSH002

Job No.: 17918

Site Location: 511 Halswell Road, Christchurch
Grid Reference: 1564698.44mE 5172992.76mN NZTM
Rig Operator: S. Cardona
Rig Model & Mounting: AMS VTR9700D - truck

Date Commenced: 21/02/2019
Date Completed: 21/02/2019
Elevation (m): 0.00
Datum: Ground

Description	Method	Drivability	Recovery	Depth	Graphic Log	SPT N-value (Uncorrected) or Blows / 100mm (DPSH)	In-Situ Tests (Uncorrected)	Samples - Permeability tests	Installation & Resources
		1 2 3 4 5	25 50 75			10 20 30 40 50	10 20 30 40 50		
No sample recovery.	Dynamic cone penetrometer						14.5m: Effective refusal (80mm)		



EOH: 14.5m

14.5m: Effective refusal (80mm)

Remarks

Geotechnical investigation borehole with DPSH testing

Static water levels:
1.50m bgl

Safety auto trip hammer #398 used (energy ratio 84.0%)

Additional Resources:

Plastic Liner / PVC Splits	m	-
Core boxes	no.	
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Hole Depth: 14.5m

Bore Log

McMILLAN Drilling

Client: Eliot Sinclair & Partners Ltd

Project: 511 Halswell Road, Christchurch

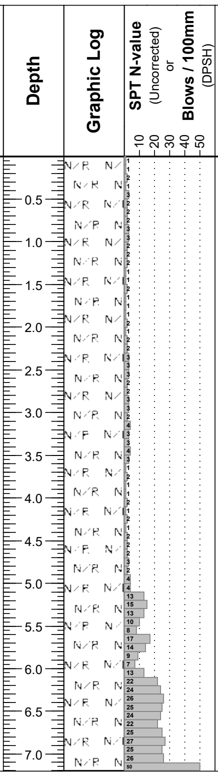
Bore No.: DPSH008

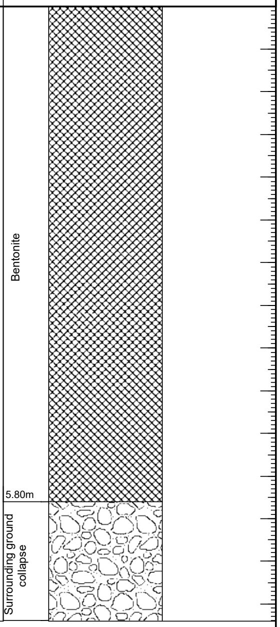
Job No.: 17918

Site Location: 511 Halswell Road, Christchurch
Grid Reference: 1564688.35mE 5172802.85mN NZTM
Rig Operator: S. Cardona
Rig Model & Mounting: AMS VTR9700D - truck

Date Commenced: 21/02/2019
Date Completed: 21/02/2019
Elevation (m): 0.00
Datum: Ground

Description	Method	Drivability	Recovery	Depth	Graphic Log	SPT N-value (Uncorrected) or Blows / 100mm (DPSH)	In-Situ Tests (Uncorrected)	Samples - Permeability tests	Installation & Resources
No sample recovery.	Dynamic cone penetrometer			0.0–7.2	N/R				Bentonite 5.80m Surrounding ground collapse





EOH: 7.2m

7.2m: Effective refusal (60mm)

Remarks

Geotechnical investigation borehole with DPSH testing

Static water levels:
1.10m bgl

Safety auto trip hammer #398 used (energy ratio 84.0%)

Additional Resources:

Plastic Liner / PVC Splits	m	-
Core boxes	no.	
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Hole Depth: 7.2m

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Created: 25/02/2019 3:58:26 PM

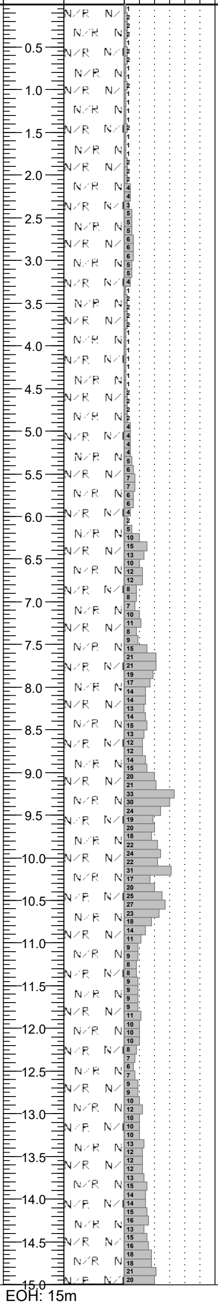
Bore Log

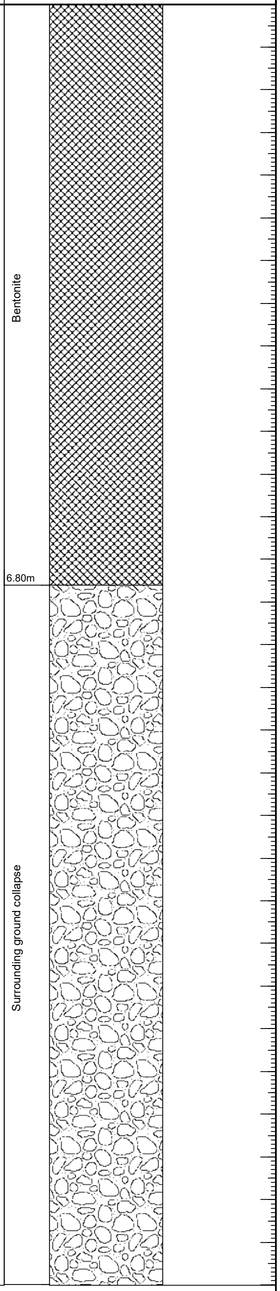
	Client: Eliot Sinclair & Partners Ltd	**Bore No.:** DPSH009
	Project: 511 Halswell Road, Christchurch	**Job No.:** 17918

Site Location: 511 Halswell Road, Christchurch
Grid Reference: 1564864.75mE 5172816.58mN NZTM
Rig Operator: S. Cardona
Rig Model & Mounting: AMS VTR9700D - truck

Date Commenced: 21/02/2019
Date Completed: 21/02/2019
Elevation (m): 0.00
Datum: Ground

Description	Method	Drivability 1 2 3 4 5	Recovery 25 50 75	Depth	Graphic Log	SPT N-value (Uncorrected) or Blows / 100mm (DPSH) 10 20 30 40 50	In-Situ Tests (Uncorrected) 10 20 30 40 50	Samples - Permeability tests	Installation & Resources
No sample recovery.	Dynamic cone penetrometer								





EOH: 15m

Remarks

Geotechnical investigation borehole with DPSH testing

Static water levels:
1.90m bgl

Safety auto trip hammer #398 used (energy ratio 84.0%)

Additional Resources:

Plastic Liner / PVC Splits	m	-
Core boxes	no.	
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

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Hole Depth: 15m

Created: 25/02/2019 3:58:26 PM

Bore Log

McMILLAN Drilling

Client: Eliot Sinclair & Partners Ltd

Project: 511 Halswell Road, Christchurch

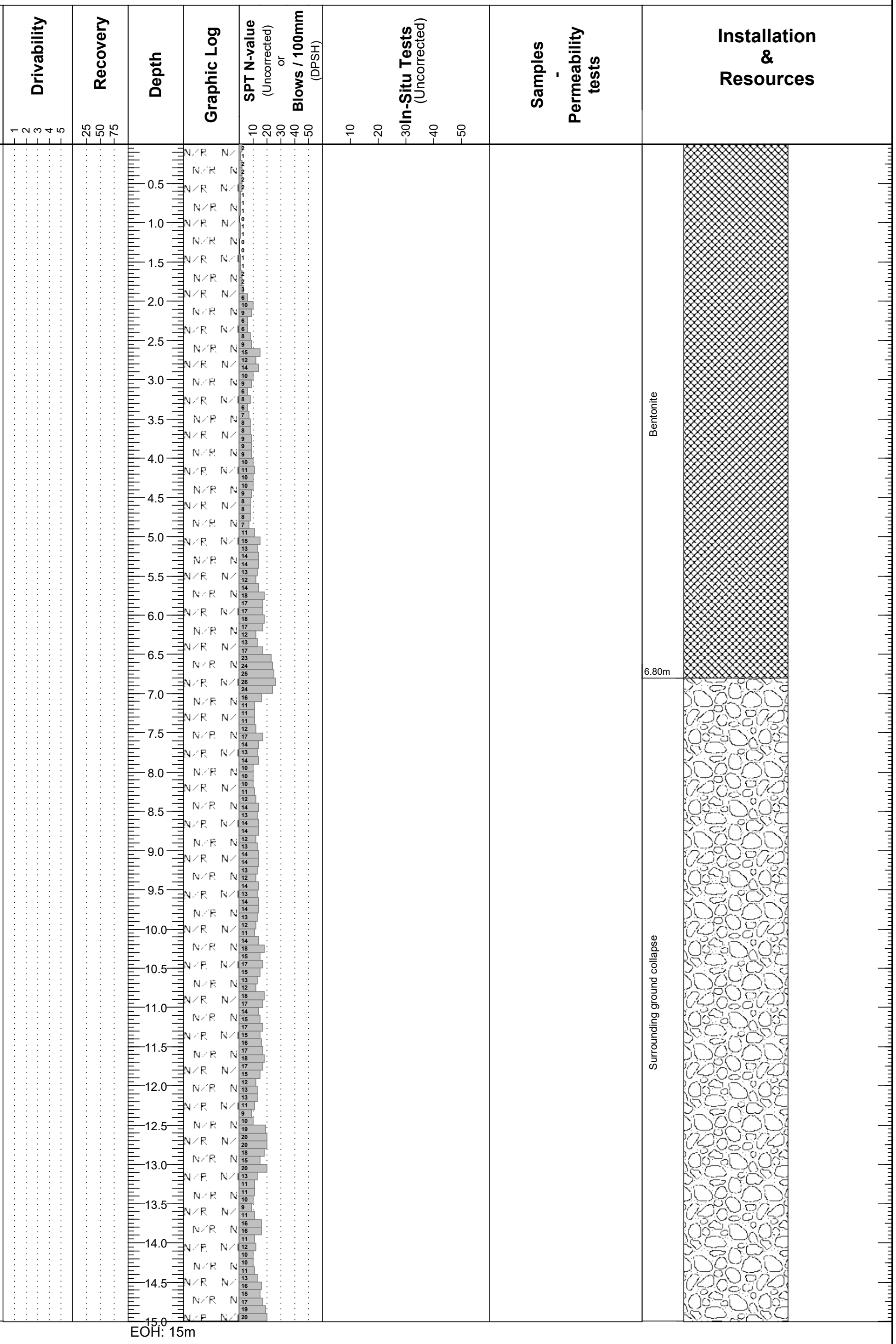
Bore No.: DPSH013

Job No.: 17918

Site Location: 511 Halswell Road, Christchurch
Grid Reference: 1564802.4mE 5172675.11mN NZTM
Rig Operator: S. Cardona
Rig Model & Mounting: AMS VTR9700D - truck

Date Commenced: 22/02/2019
Date Completed: 22/02/2019
Elevation (m): 0.00
Datum: Ground

Description	Method	Drivability	Recovery	Depth	Graphic Log	SPT N-value (Uncorrected) or Blows / 100mm (DPSH)	In-Situ Tests (Uncorrected)	Samples - Permeability tests	Installation & Resources
No sample recovery.	Dynamic cone penetrometer								



EOH: 15m

Remarks

Geotechnical investigation borehole with DPSH testing

Static water levels:
0.90m bgl

Safety auto trip hammer #398 used (energy ratio 84.0%)

Additional Resources:

Plastic Liner / PVC Splits	m	-
Core boxes	no.	
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

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Hole Depth: 15m

Created: 25/02/2019 3:58:26 PM

Bore Log

McMILLAN Drilling

Client: Eliot Sinclair & Partners Ltd

Project: 511 Halswell Road, Christchurch

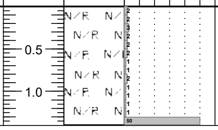
Bore No.: DPSH014a

Job No.: 17918

Site Location: 511 Halswell Road, Christchurch
Grid Reference: 1564661.19mE 5172610.65mN NZTM
Rig Operator: S. Cardona
Rig Model & Mounting: AMS VTR9700D - truck

Date Commenced: 22/02/2019
Date Completed: 22/02/2019
Elevation (m): 0.00
Datum: Ground

Description	Method	Drivability 1 2 3 4 5	Recovery 25 50 75	Depth	Graphic Log	SPT N-value (Uncorrected) or Blows / 100mm (DPSH) 10 20 30 40 50	In-Situ Tests (Uncorrected) 10 20 30 40 50	Samples - Permeability tests	Installation & Resources
No sample recovery.	Dynamic cone penetrometer								Bentonite



EOH: 1.4m

1.4m: Effective refusal (80mm)

Remarks

Geotechnical investigation borehole with DPSH testing

No static water level recorded

Safety auto trip hammer #398 used (energy ratio 84.0%)

Additional Resources:

Plastic Liner / PVC Splits	m	-
Core boxes	no.	
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Hole Depth: 1.4m

Created: 25/02/2019 3:58:26 PM

McMILLAN Drilling

Client: Eliot Sinclair & Partners Ltd

Project: 511 Halswell Road, Christchurch

Bore Log

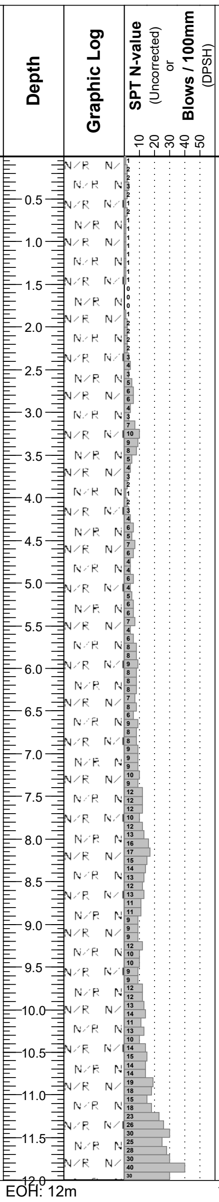
Bore No.: DPSH014b

Job No.: 17918

Site Location: 511 Halswell Road, Christchurch
Grid Reference: 1564659.1mE 5172608.51mN NZTM
Rig Operator: S. Cardona
Rig Model & Mounting: AMS VTR9700D - truck

Date Commenced: 22/02/2019
Date Completed: 22/02/2019
Elevation (m): 0.00
Datum: Ground

Description	Method	Drivability	Recovery	Depth	Graphic Log	SPT N-value (Uncorrected) or Blows / 100mm (DPSH)	In-Situ Tests (Uncorrected)	Samples - Permeability tests	Installation & Resources
No sample recovery.	Dynamic cone penetrometer								Bentonite 2.60m Surrounding ground collapse



EOH: 12m

12m: Effective refusal (20mm)

Remarks

Geotechnical investigation borehole with DPSH testing

Static water levels:
1.50m bgl

Safety auto trip hammer #398 used (energy ratio 84.0%)

Additional Resources:

Plastic Liner / PVC Splits	m	-
Core boxes	no.	
Flush Mounted Toby Box		
- Standard	ea	
- Environmental	ea	
Above Ground Protective Surround	ea	
Geotextile Sock	m	-
Hand Clear Location	ea	
Decontaminate Equipment	ea	

Drivability

1 Easy Push - No Hammer \ Fast Penetration
2 Relatively Easy Push - Light Hammer \ Relatively Fast
3 Medium Push - Consistent Hammer \ Medium
4 Hard Push - Full Hammer \ Somewhat Slow
5 Very Hard Push - Full Hammer \ Very Slow

Generated by GEROC Core-GS

Hole Depth: 12m

Created: 25/02/2019 3:58:26 PM

B. Geotechnical Investigation Results

MINZ Shallow Investigation Logs

Laboratory Soil Sample Test Results

PROJECT NUMBER:	**190666**
CLIENT:	**Yoursection Ltd**
TESTING COMPLETED:	**12 September 2019**

SHALLOW GROUND INVESTIGATION LOG

HA1/DCP1

PROJECT:	**511 Halswell Road, Halswell, Christchurch**				
LOGGED BY:	**CG/TW**	*TOTAL DEPTH OF HOLE:*	**1.7 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.0 mbgl**	This report may only be reproduced in full	

Depth (m)	DCP Test Results (Blows per 100mm)	GWL	USC	Soil Characteristics	Graphic Log	Sample Taken	LL	PL	PI	Gr	Sa	FC	WC (%)	UW	Vane shear strength (kPa) peak/remoulded
	0.5			SILT; low plasticity, brown. Moist, with minor rootlets (Topsoil).											
	0.5														
	1														
	2														
	2			SILT; low plasticity, grey. Moist, firm to stiff, with some fine sand.											79/32
0.5	2														
	3														
	1														
	2														38/24
	1			Silty SAND, fine to medium grained; grey. Wet, loose to medium dense.											
1.0	2	▽				Bulk Sample						13			
	2														39/24
	3														
	3			Becoming saturated from 1.3 mbgl.											
	3														
1.5	3														
	4														
	4			**EOH (collapse in saturated soil)**											
	4														
	5														
2.0	7														
	7														
	7														
	5														
	4														
2.5	1														
	2														
	5														
	6														
3.0															

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**190666**
CLIENT:	**Yoursection Ltd**
TESTING COMPLETED:	**12 September 2019**

SHALLOW GROUND INVESTIGATION LOG

HA2/DCP2

PROJECT:	**511 Halswell Road, Halswell, Christchurch**					
LOGGED BY:	**CG/TW**	*TOTAL DEPTH OF HOLE:*	**2.9**	**mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**		*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.8**	**mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
			USC	*Soil Characteristics*	*Graphic Log*		*Atterberg Limits LL*	*PL*	*PI*	*Grain Size Gr*	*Sa*	*FC*	*WC (%)*	*UW*	
	0.5			SILT; low plasticity, dark brown. Moist, with minor rootlets (Topsoil).											
	0.5														
	2														
	4														
	3			SILT low plasticity, brown. Moist, firm to stiff.											85/28
0.5	2														
	1														
	2	▽													
	2			Containing minor fine grained sand from 0.9 mbgl.											49/27
	2														
1.0	2														
	2			Becoming wet from 1.1 mbgl.											
	3			Sandy SILT; low plasticity, brown. Wet, firm to stiff, sand is fine to medium grained.											43/21
	3														
	4														
1.5	3														
	3			Containing minor roots from 1.6 mbgl.											25/19
	3														
	3			SILT; low plasticity, grey. Wet to saturated, firm, with minor dark brown organic silt and roots.											
	0.5														
2.0	0.5														32/21
	1														
	3														
	4														
	3														
2.5	5			Clayey SILT; low to medium plasticity, blue-grey. Moist, stiff.		Bulk Sample	41	24	17						
	7														
	6														
	6														
3.0				**EOH (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS+ CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:* **190666** *CLIENT:* **Yoursection Ltd** *TESTING COMPLETED:* **2 October 2019**

SHALLOW GROUND INVESTIGATION LOG

HA3/DCP3

PROJECT:	**511 Halswell Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**2.9 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.8 mbgl**	This report may only be reproduced in full	

Depth (m)	DCP Test Results (Blows per 100mm)	GWL	USC	Soil Characteristics	Graphic Log	Sample Taken	LL	PL	PI	Gr	Sa	FC	WC (%)	UW	Vane shear strength (kPa) peak/remoulded
	0.5			SILT: low plasticity, dark brown, moist, with minor rootlets (TOPSOIL)											
	0.5														
	1														
	2			SILT: low plasticity, brown, moist, with trace fine grained sand											
	1														74 / 21
0.5	1														
	2														
	2														
	1	▽													38 / 13
	2														
1.0	4			SAND: fine to medium grained, grey, wet, with minor silt											
	4														
	4														
	6														
	6														
1.5	7														
	6														
	4														
	3			SILT: low to medium plasticity, grey, saturated											
	2														
2.0	1														47 / 19
	1														
	1														
	2														
	2			PEAT: dark brown, amorphous, moist, with minor fibrous roots											
2.5	4														
	5			SILT: low to medium plasticity, blue-grey, wet, with minor dark brown, organic silt inclusions											
	5														
	6														
3.0				**EOH (Target Depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**190666**
CLIENT:	**Yoursection Ltd**
TESTING COMPLETED:	**12 September 2019**

SHALLOW GROUND INVESTIGATION LOG

HA4/DCP4

PROJECT:	**511 Halswell Road, Halswell, Christchurch**				
LOGGED BY:	**CG/TW**	*TOTAL DEPTH OF HOLE:*	**2.9 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.4 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
			USC	*Soil Characteristics*	*Graphic Log*		*Atterberg Limits*			*Grain Size*			*WC (%)*	*UW*	
							LL	*PL*	*PI*	*Gr*	*Sa*	*FC*			
	0			SILT; low plasticity, brownish-grey. Moist, with minor rootlets (Topsoil).	▨										
	1				▨										
	2				▨										
	3				▨										
	4	▽		SILT; low plasticity, grey streaked orange. Moist, stiff, with trace fine sand.	▨										85/25
0.5	3				▨										
	2			Silty SAND, fine grained; grey. Wet, loose to medium dense.	░										
	3				░										
	3				░										44/16
	5				░										
1.0	5			Sandy SILT; low plasticity, brownish-grey. Wet, stiff, sand is fine to medium grained.	▨										
	4				▨										
	3				▨										69/19
	4			Becoming saturated from 1.1 mbgl.	▨										
	5			SILT; low plasticity, grey streaked orange. Wet, very stiff, with trace fine sand.	▨										
1.5	5				▨										
	6				▨										177/41
	6				▨										
	6			Poor retrieval from 1.8 mbgl.	▨										
	3				▨										
2.0	2				▨										
	1			SILT; low plasticity, bluish-grey. Wet to saturated, soft to stiff, with some fine sand.	▨										
	3				▨										
	3				▨										
	3				▨										
2.5	5				▨										
	5				▨										
	5				▨										
	6				▨										
3.0				**EOH (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS+ CONSTRUCTION CONSULTANTS	
PROJECT NUMBER:	**190666**
CLIENT:	**Yoursection Ltd**
TESTING COMPLETED:	**2 October 2019**

SHALLOW GROUND INVESTIGATION LOG

HA5/DCP5

PROJECT:	**511 Halswell Road, Halswell, Christchurch**		
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**2.9 mbgl**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.8 mbgl**
HOLE DIAMETER:	**50mm**	*SHEAR VANE NUMBER:*	**2102**
This report may only be reproduced in full			

Depth (m)	***DCP Test Results (Blows per 100mm)***	***GWL***	***Soil Description***			***Sample Taken***	***Lab Testing***								***Vane shear strength (kPa) peak/remoulded***
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
	1			SILT: low plasticity, dark brown, moist, with minor rootlets (TOPSOIL)											
	1														
	1														
	3														
	2			SILT: low plasticity, brown, moist											104 / 22
0.5	2														
	3														
	2														
	2	▽		Sandy SILT: low plasticity, grey, moist, sand is fine to medium grained											32 / 16
	3														
1.0	4			Becomes wet at 1.0m bgl											
	3														
	3														52 / 21
	3			Becomes saturated at 1.3m bgl											
	3			SILT: low to medium grained, brown, saturated											
1.5	3														
	3			Becomes wet at 1.6m bgl											76 / 19
	4														
	4														
2.0	1			Becomes grey, saturated at 2.0m bgl											38 / 19
	1														
	2														
	1														
	2														
2.5	5														
	6														
	5			Becomes blue-grey, with minor fine to medium grained sand at 2.7m bgl											
	3														
3.0				**EOH (Target Depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

PROJECT NUMBER:	190666
CLIENT:	Yoursection Ltd
TESTING COMPLETED:	12 September 2019

SHALLOW GROUND INVESTIGATION LOG

HA6/DCP6

PROJECT:	**511 Halswell Road, Halswell, Christchurch**				
LOGGED BY:	**CG/TW**	*TOTAL DEPTH OF HOLE:*	**2.9 mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.4 mbgl**	This report may only be reproduced in full	

Depth (m)	DCP Test Results (Blows per 100mm)	GWL	Soil Description			Sample Taken	Lab Testing								Vane shear strength (kPa) peak/remoulded
			USC	Soil Characteristics	Graphic Log		Atterberg Limits			Grain Size			WC (%)	UW	
							LL	PL	PI	Gr	Sa	FC			
	0.5			SILT; low plasticity, brownish-grey. Moist, with minor rootlets (Topsoil).											
	0.5														
	2														
	2														
	2	▽		SILT; low plasticity, grey. Moist, firm to very stiff, with some fine sand.											47/19
0.5	2														
	3														
	2														
	3			Containing minor fine sand from 0.8 mbgl.											147/36
	5														
1.0	5			Becoming mottled orange from 1.0 mbgl.											
	7														
	7			SILT; low plasticity, brownish-grey. Wet, firm, with trace fine sand.											47/27
	7														
	7														
1.5	7														
	8			Becoming saturated from 1.6 mbgl.											32/22
	7														
	7			Becoming wet from 1.8 mbgl.											
	6														
2.0	2														33/17
	2														
	2			Clayey SILT; low plasticity, bluish-grey. Wet to saturated, firm to stiff, with minor fine sand.		Bulk Sample						54			
	4														
	5														
2.5	7														
	7														
	7														
	7														
3.0				**EOH (target depth)**											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**190666**
CLIENT:	**Yoursection Ltd**
TESTING COMPLETED:	**12 September 2019**

SHALLOW GROUND INVESTIGATION LOG

HA7/DCP7

PROJECT:	**511 Halswell Road, Halswell, Christchurch**					
LOGGED BY:	**CG/TW**	*TOTAL DEPTH OF HOLE:*	**2.9**	**mbgl**	*HOLE DIAMETER:*	**50mm**
CHECKED BY:	**CMD**	*DRILLING METHOD:*	**Hand Auger**		*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**0.3**	**mbgl**	This report may only be reproduced in full	

Depth (m)	***DCP Test Results (Blows per 100mm)***	***GWL***	***Soil Description***			***Sample Taken***	***Lab Testing***								***Vane shear strength (kPa) peak/remoulded***
			USC	***Soil Characteristics***	***Graphic Log***		***Atterberg Limits***			***Grain Size***			***WC (%)***	***UW***	
							LL	***PL***	***PI***	***Gr***	***Sa***	***FC***			
	0			SILT; low plasticity, dark brown. Moist, with minor rootlets (Topsoil).											
	1														
	2	▽													
	1			Clayey SILT; low to medium plasticity, brown-grey. Moist, firm to very stiff.											
	2														98/19
0.5	2														
	1			Containing minor fine grained sand from 0.7 mbgl.											
	2														
	3					Bulk Sample	31	21	10			88			47/17
	2														
1.0	5			Sand absent and becoming wet from 1.0 mbgl.											
	6														
	8			Becoming streaked orange from 1.2 mbgl.											177/19
	7														
	7			Poor retrieval from 1.4 mbgl.											
1.5	6														
	6														28/24
	6			Becoming saturated and containing minor fine to medium grained sand from 1.8 mbgl.											
	7														
	1														
2.0	2														43/21
	4			SILT; low plasticity, blue-grey. Wet, firm to stiff, with minor fine to medium grained sand.											
	5														
	6			Containing some fine to medium grained sand from 2.3 mbgl.											
	6														
2.5	6			Becoming saturated from 2.5 mbgl.											
	7														
	5														
	3														
3.0				**EOH (target depth)**											

LEGEND

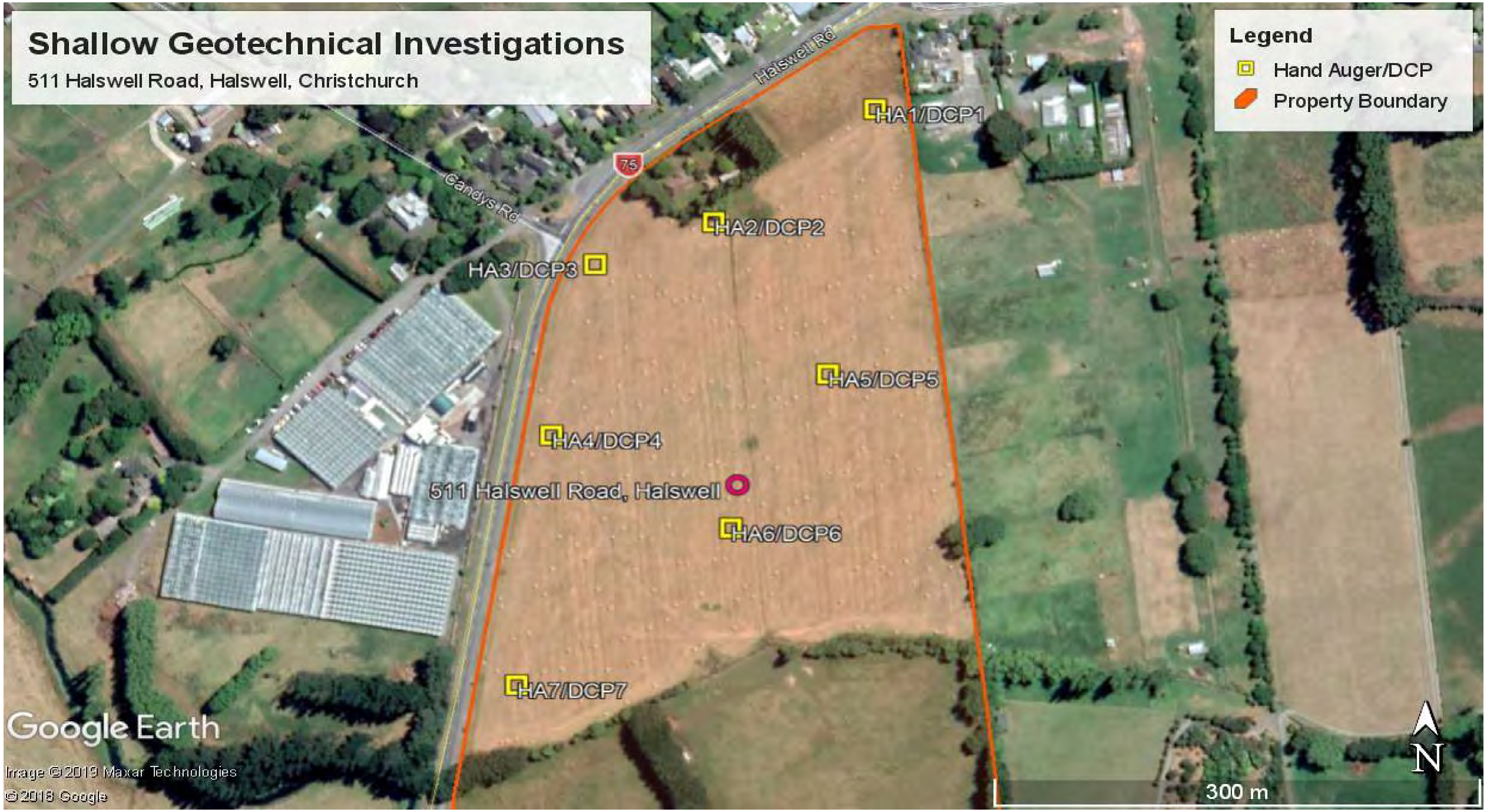
ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS	*PROJECT NUMBER:* **190666** *CLIENT:* **Yoursection Ltd** *TESTING COMPLETED:* **12 September 2019**
SITE INVESTIGATION PLAN	**511 Halswell Road, Halswell, Christchurch**



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TEST REPORT

Lab Job No:	8378-022
Your ref.:	190666
Date of Issue:	4/10/2019
Date of Re-Issue:	-
Page:	1 of 7

Test Report

C19-505

PROJECT:	511 Halswell Road
CLIENT:	Miyamoto International NZ Ltd 518 Colombo Street Christchurch, 8011
ATTENTION:	Clem Gibbens
INSTRUCTIONS:	Determination of Particle-Size Distribution-Wet Sieving method Determination of the liquid & plastic limits, Plasticity index.
TEST METHOD:	NZS 4402:1986 Test 2.8.1 NZS 4402:1986 Tests 2.2,2.3,2.4
SAMPLING METHOD:	Client - SNA
TEST RESULTS:	As per laboratory sheets attached

Ben Lucas
Laboratory Technician

Nick van Warmerdam
Approved Signatory

IANZ ACCREDITED LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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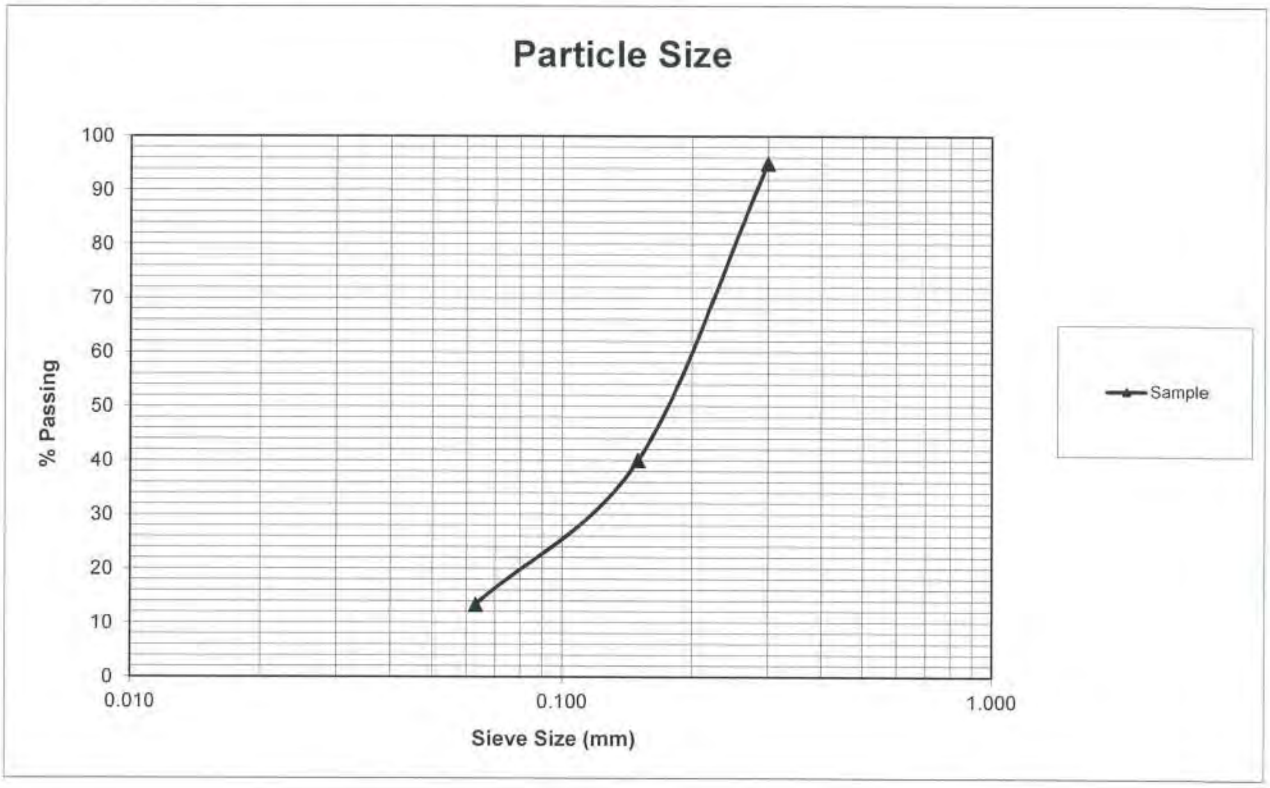
DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-022	**Sample No:**	C19-536
Client:	Miyamoto International	**Tested By:**	JB
Location:	511 Halswell Road	**Date:**	2/10/2019
	HA1, 1.0-1.7m	**Checked By:**	B.L
Date Received:	1/10/2019	**Date:**	4/10/2019
Report No:	C19-505	**Page:**	2 of 7
REF:	190666		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	1/10/2019		
Test Details:	Wet sieving method		
History:	Natural		

Description of Sample: SAND, some silt, brown, no plasticity

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	95
0.150	-	-	40
0.063	-	-	13



The percentage passing the finest sieve was obtained by difference

N.Warmerdam
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.1, 2.2, 2.3, 2.4

Lab Job No:	8378-022	**Sample No.:**	C19-537
Client:	Miyamoto International	**Tested By:**	JB
Location:	511 Halswell Road	**Date Tested:**	2/10/2019
	HA2, 2.5-2.9m	**Checked By:**	B.L
Date Received:	1/10/2019	**Date Checked:**	4/10/2019
Report No:	C19-505	**Page:**	3 of 7
REF:	190666		
Sampling Method:	Sampled by client – SNA	**Sampled By:**	Client
Date Sampled:	1/10/2019		

Test Details:

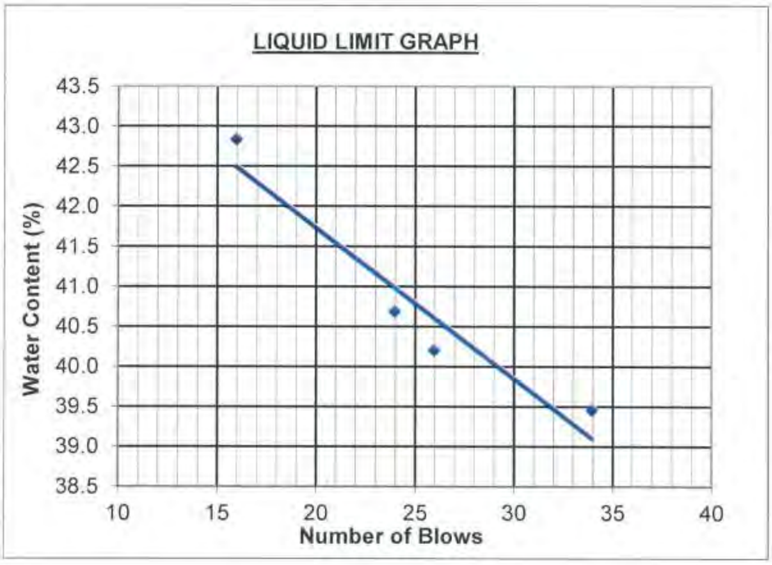
Test performed on: Fraction passing 425μm sieve

Sample history: Water content as received

Description of Sample: Silty CLAY, brownish grey, low plasticity

	Liquid Limit				Plastic Limit	
No. of blows	16	24	26	34		
Water content (%)	42.8	40.7	40.2	39.5	23.7	24.1

NWC	-
Liquid Limit	**41**
Plastic Limit	**24**
Plasticity Index	**17**



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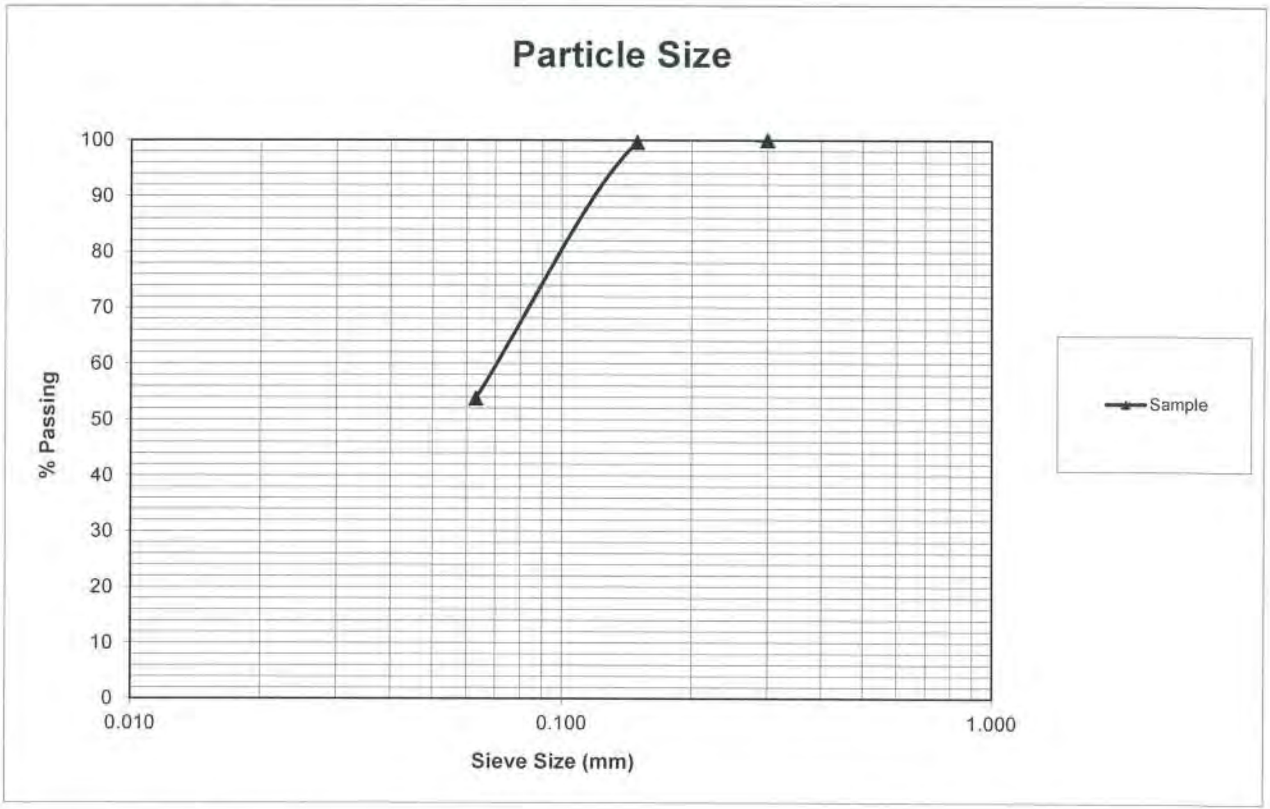
DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-022	**Sample No:**	C19-538
Client:	Miyamoto International	**Tested By:**	SPS/JB
Location:	511 Halswell Road HA6, 2.2-2.9m	**Date:**	2/10/2019
		Checked By:	B.L
Date Received:	1/10/2019	**Date:**	4/10/2019
Report No:	C19-505	**Page:**	4 of 7
REF:	190666		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	1/10/2019		
Test Details:	Wet sieving method		
History:	Natural		

Description of Sample: Sandy SILT, brownish grey, no plasticity

	% Passing		
Sieve Size	Max	Min	Sample
0.300	-	-	100
0.150	-	-	100
0.063	-	-	54



Note: Testing was done on fraction passing 425μm sieve

The percentage passing the finest sieve was obtained by difference

N.Warmerdam
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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.1, 2.2, 2.3, 2.4

Lab Job No:	8378-022	**Sample No.:**	C19-538
Client:	Miyamoto International	**Tested By:**	SPS
Location:	511 Halswell Road HA6, 2.2-2.9m	**Date Tested:**	2/10/2019
		Checked By:	B.L
Date Received:	1/10/2019	**Date Checked:**	4/10/2019
Report No:	C19-505	**Page:**	5 of 7
REF:	190666		
Sampling Method:	Sampled by client – SNA	**Sampled By:**	Client
Date Sampled:	1/10/2019		

Test Details:

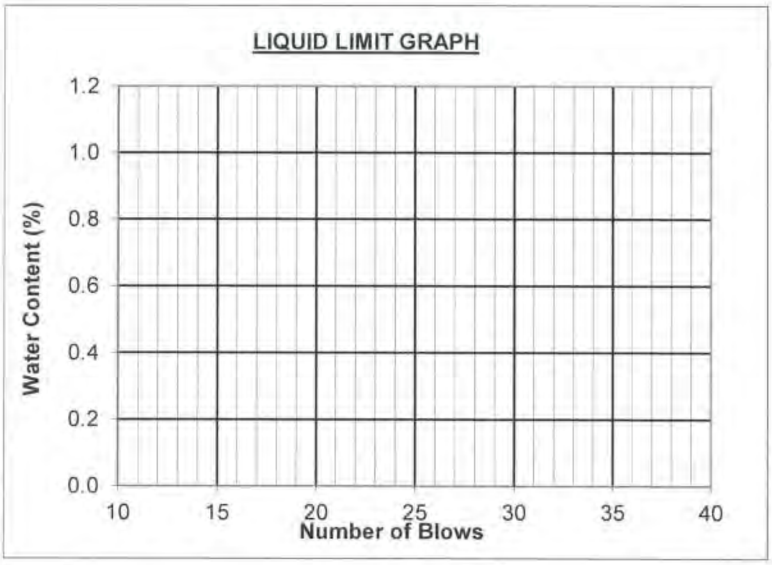
Test performed on: Fraction passing 425µm sieve

Sample history: Water content as received

Description of Sample: Sandy SILT, brownish grey, no plasticity

	Liquid Limit	Plastic Limit
No. of blows	NP	NP
Water content (%)		

NWC	-
Liquid Limit	-
Plastic Limit	-
Plasticity Index	-



Note: *Unable to to obtain Liquid Limit & Plastic Limit*

N. Warmerdam
Approved Signatory

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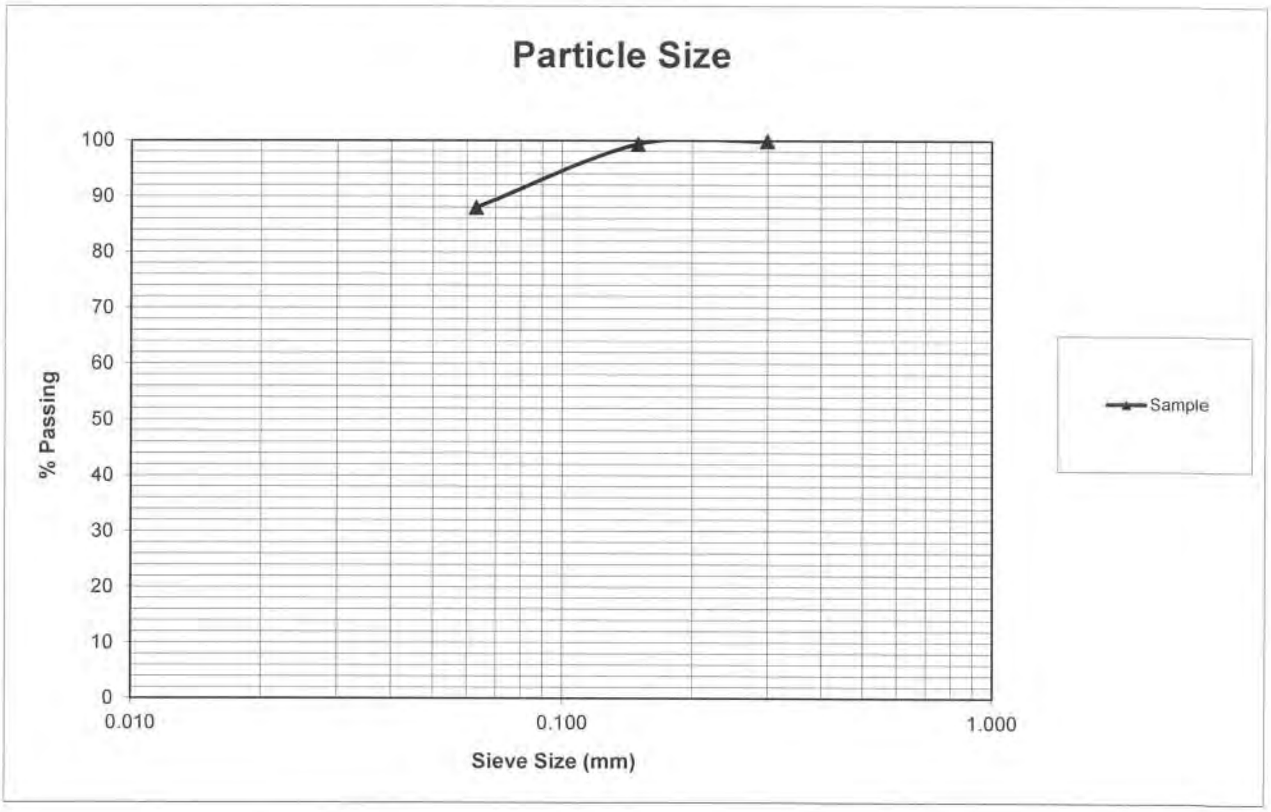
DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402:1986 Test 2.8.1

Lab Job No:	8378-022	**Sample No:**	C19-539
Client:	Miyamoto International	**Tested By:**	JB
Location:	511 Halswell Road	**Date:**	2/10/2019
	HA7, 0.8-1.2m	**Checked By:**	B.L
Date Received:	1/10/2019	**Date:**	4/10/2019
Report No:	C19-505	**Page:**	6 of 7
REF:	190666		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	1/10/2019		
Test Details:	Wet sieving method		
History:	Natural		

Description of Sample: Silty CLAY, minor sand, brownish grey, low plasticity

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	100
0.150	-	-	99
0.063	-	-	88



The percentage passing the finest sieve was obtained by difference

N.Warmerdam
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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.1, 2.2, 2.3, 2.4

Lab Job No:	8378-022	**Sample No.:**	C19-539
Client:	Miyamoto International	**Tested By:**	SPS
Location:	511 Halswell Road HA7, 0.8-1.2m	**Date Tested:**	2/10/2019
		Checked By:	B.L
Date Received:	1/10/2019	**Date Checked:**	4/10/2019
Report No:	C19-505	**Page:**	7 of 7
REF:	190666		
Sampling Method:	Sampled by client – SNA	**Sampled By:**	Client
Date Sampled:	1/10/2019		

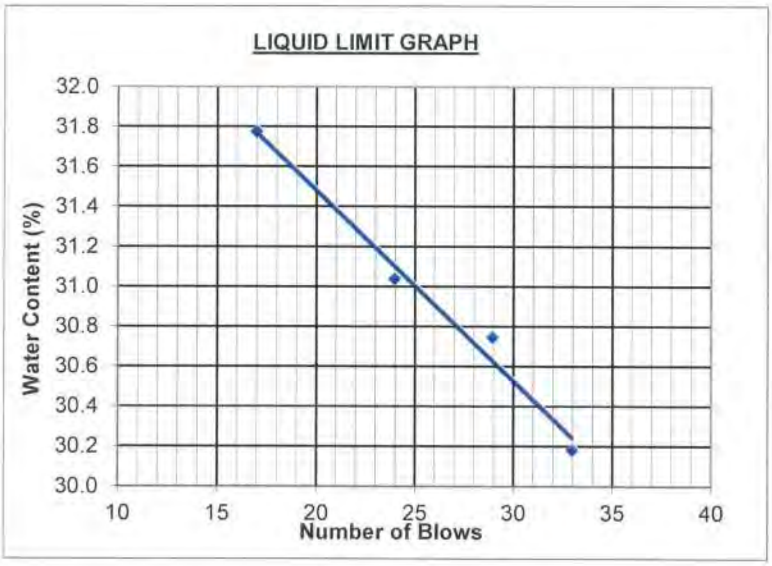
Test Details:

Test performed on:	Fraction passing 425µm sieve
Sample history:	Water content as received

Description of Sample: Silty CLAY, minor sand, brownish grey, low plasticity

	Liquid Limit				Plastic Limit	
No. of blows	17	24	29	33		
Water content (%)	31.8	31.0	30.8	30.2	21.3	20.9

NWC	-
Liquid Limit	**31**
Plastic Limit	**21**
Plasticity Index	**10**



N. Warmerdam
Approved Signatory

C. Southern Geophysical MASW and ERT Report

September 2019

GEOPHYSICAL REPORT

Geophysical Site Investigation:

511 Halswell Road, Christchurch

Report prepared for Miyamoto International NZ Ltd

Southern
Geophysical

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Christchurch 8062
Ph: 03 384 4302
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Data collected and report prepared for Southern Geophysical by:

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Nick McConachie (BSc), Geologist

Richard Mellis (MSc), Geoscientist

Report internally reviewed for Southern Geophysical by:

Mike Finnemore (PhD), Senior Geophysicist

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Figure 4: MASW profiles 7

Figure 5: ERT profiles 8

Disclaimer: 9

SGL Reference: 1875

Summary:

A series of Multi-channel Analysis of Surface Waves (MASW) surveys, Electrical Resistivity Tomography (ERT) and associated Ground Penetrating radar (GPR) lines were undertaken at 511 Halswell Road, Christchurch from on September 9 and 10, 2019. The geophysical testing included 5 MASW lines and 2 ERT lines. Overall the quality of the MASW data was good, with shear-wave velocities modelled to over 20 m depth across the site. The ERT lines achieved similar depth penetration. Shear-wave velocities are around 100 m/s in the surface soils, increasing to over 500 m/s at 25 m depth. Due to the long grass at the site the GPR system only had limited depth penetration (~2 m) and has therefore not been included in this report.

Site Description:

The site is located in a buried erosional valley of the Banks Peninsula volcanic complex. To the south the basalts are seen outcropping 160 m from the site. The site has a gentle north to south dip of approximately 2 m.

Methodology:

MASW

MASW is a geophysical technique that uses the dispersive nature of surface waves to model shear-wave velocity versus depth.

A MASW survey is undertaken as a series of lines or points across the surface of a site. The MASW lines in this survey were collected using a 24-channel towed seismic array, with 4.5 Hz geophones. The geophone spacing was 1 m and the source offset was 10 m. The active source was an 8 lb sledgehammer impacting an aluminium plate. Recording parameters for the MASW survey were set with a 0.25 ms sample interval, 1.5 s record length, high gains, and an electric trigger system. Shot records were collected at 5 m spacing along the lines.

The field records were processed using the Kansas Geological Survey software package SurfSeis5 ©. The geometry was set according to the survey parameters and the dispersion curves were generated and edited. The inversions were run using a 10 layer variable depth model. The velocity data was interpolated into 2D V_s profiles for the MASW lines (Figures 2 to 4). The output shear-wave velocity data is included as a series of data files (CSV format), supplementary to this report.

ERT

Stainless steel electrodes were placed in the ground along pre-determined lines, with each electrode spaced 2 m apart. Resistivity cables were run the length of the line and connected to the electrode array. Both lines were acquired with 128 channels, using a Campus Tigre system to record the data. The resistivity survey used a standard Wenner Alpha electrode configuration, current was induced in the two outer electrodes and the potential difference was measured between the two inner electrodes. All electrode contact resistances were maintained below 2000 ohms by careful electrode placement. The raw data was processed using the RES2DINV © software package.

The midpoint of the MASW seismic array at each shot record and the ERT electrode positions were recorded with a Trimble GeoXH GPS system. The GPS points were differentially corrected and output using the New Zealand Geodetic Datum (NZGD) 2000, with NZTM 2000 coordinates. The site did not appear to have significant changes in elevation, so the profiles have not been corrected for topography.

Results:

Five MASW lines were collected with a total surveyed line length of 1500 m. Three of the lines are aligned south to north (MASW 1, 3, and 4) and 2 lines are aligned west to east (MASW 2 and 5) (Figure 1). The site had low levels of cultural noise due to traffic on some MASW lines, this was mitigated by real time monitoring of seismic noise.

The MASW surveys imaged the substrate to over 20 m depth (Figures 2 to 4). In general, there appear to be three main shear-wave velocity units in the subsurface. The first is from the surface to 5 to 7 m depth, with a shear-wave velocity range from <100 m/s to 180 m/s. The second unit is defined by shear-wave velocities ranging from 180 m/s to 350 m/s and overlies the third higher velocity unit (350 m/s to >500 m/s). The depth to the third unit seems to be between 15 m and 20 m to the west and south, and 20 m to 30 m in the north and west.

The ERT lines primarily show a contrast between low resistivity and high resistivity soils at around 4 m depth. The marked increase in resistivity is likely related to the boundary between shear-wave velocity units 1 and 2. Confirmation of the site geology would require correlation of the shear-wave velocities with intrusive tests.

Figure 1: Geophysical Site Investigations

511 Halswell Road, Christchurch

NOTES- Coordinates NZ2000 TM Grid.
Aerial photograph sourced from LINZ, Crown Copyright ©

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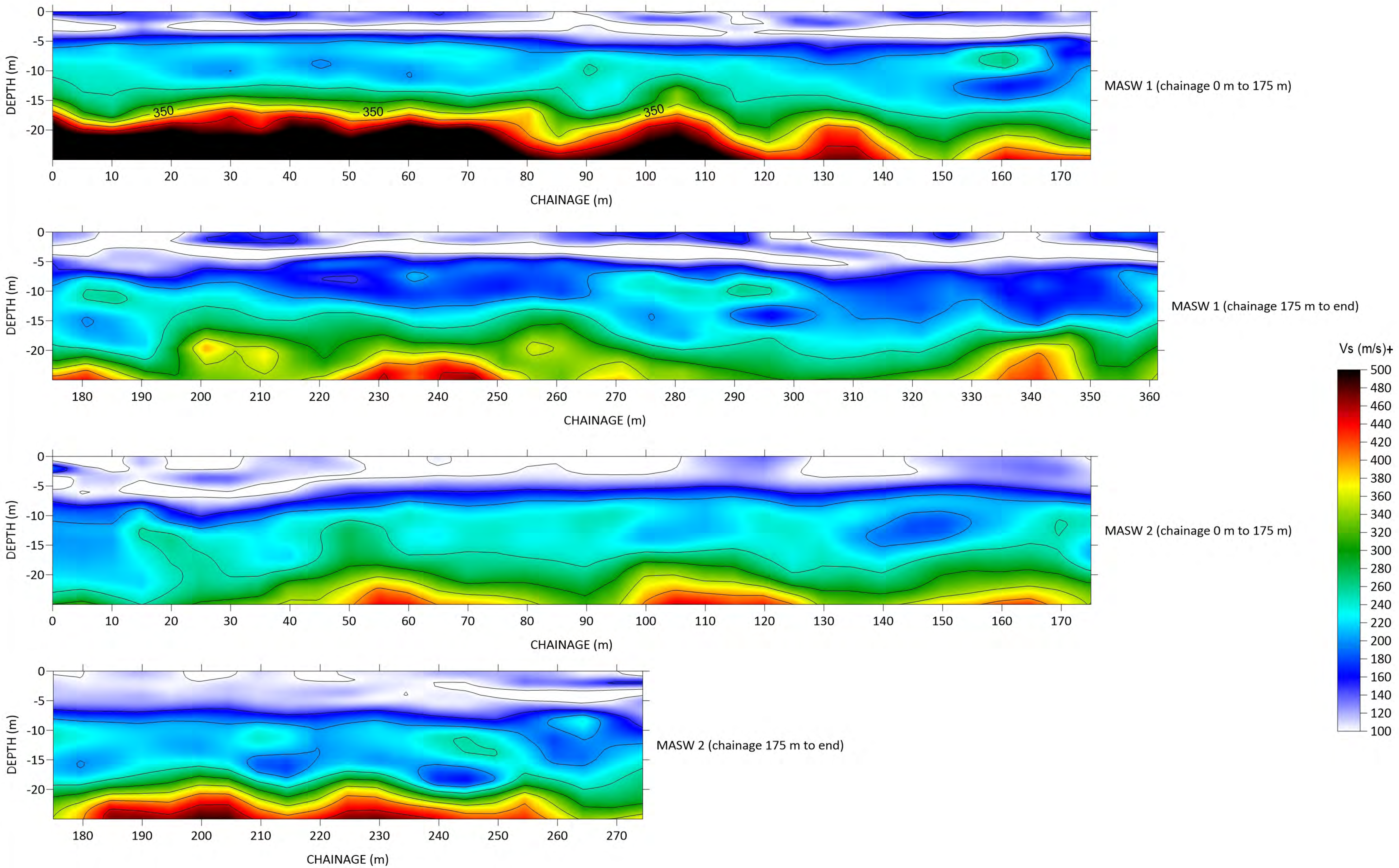

MASW 1 (chainage 0 m to 175 m)

MASW 1 (chainage 175 m to end)

MASW 2 (chainage 0 m to 175 m)

MASW 2 (chainage 175 m to end)

DRAWING- **Figure 2: MASW 2D Vs Profiles 1 to 2**

LOCATION- **511 Halswell Road, Christchurch**

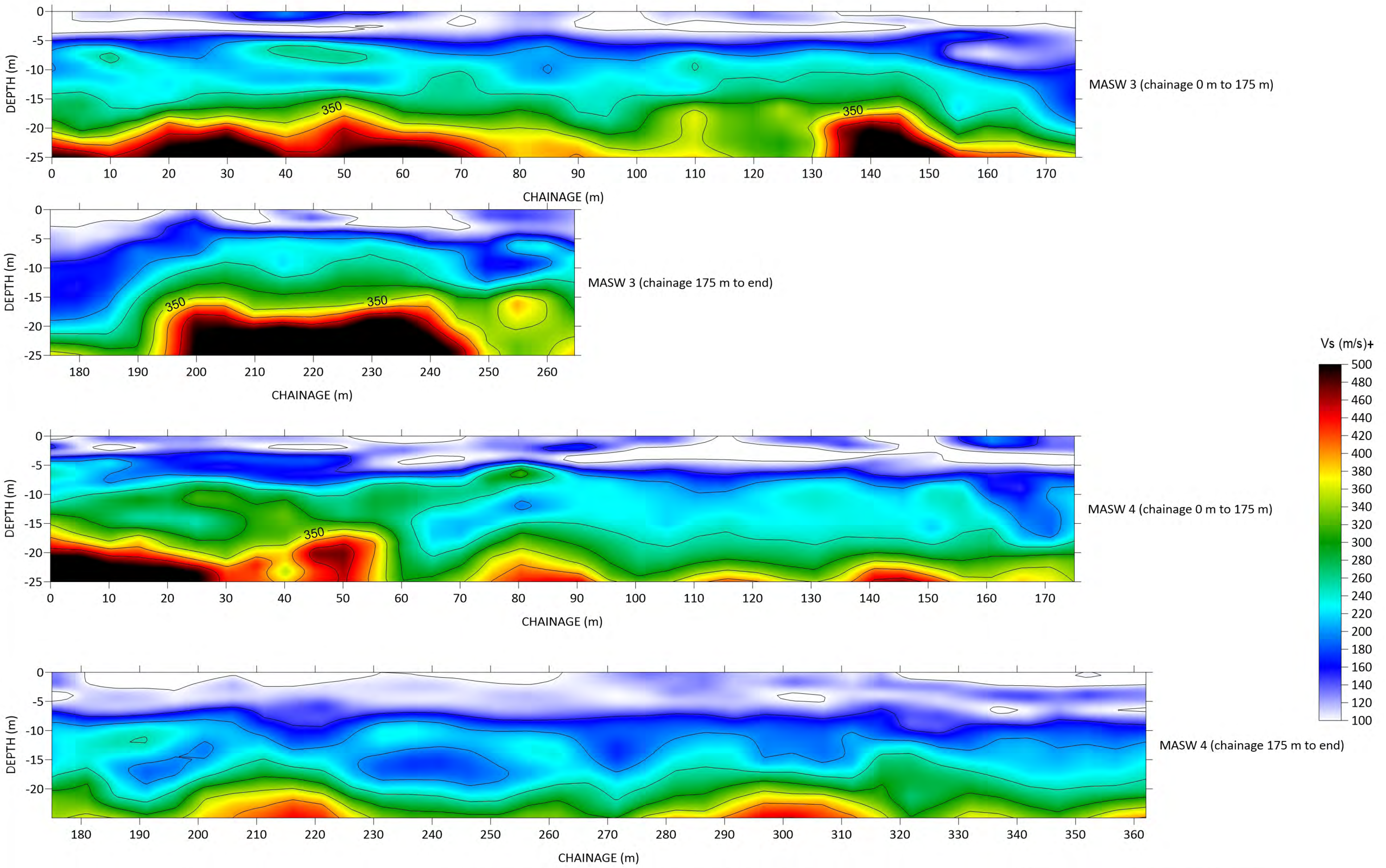
NOTES MASW Vs profile has contour intervals of 50 m/s (Vs).

See site map for location of points.

A3

Southern Geophysical Ltd

www.southerngeophysical.com



DRAWING- **Figure 3: MASW 2D Vs Profiles 3 to 4**

LOCATION- **511 Halswell Road, Christchurch**

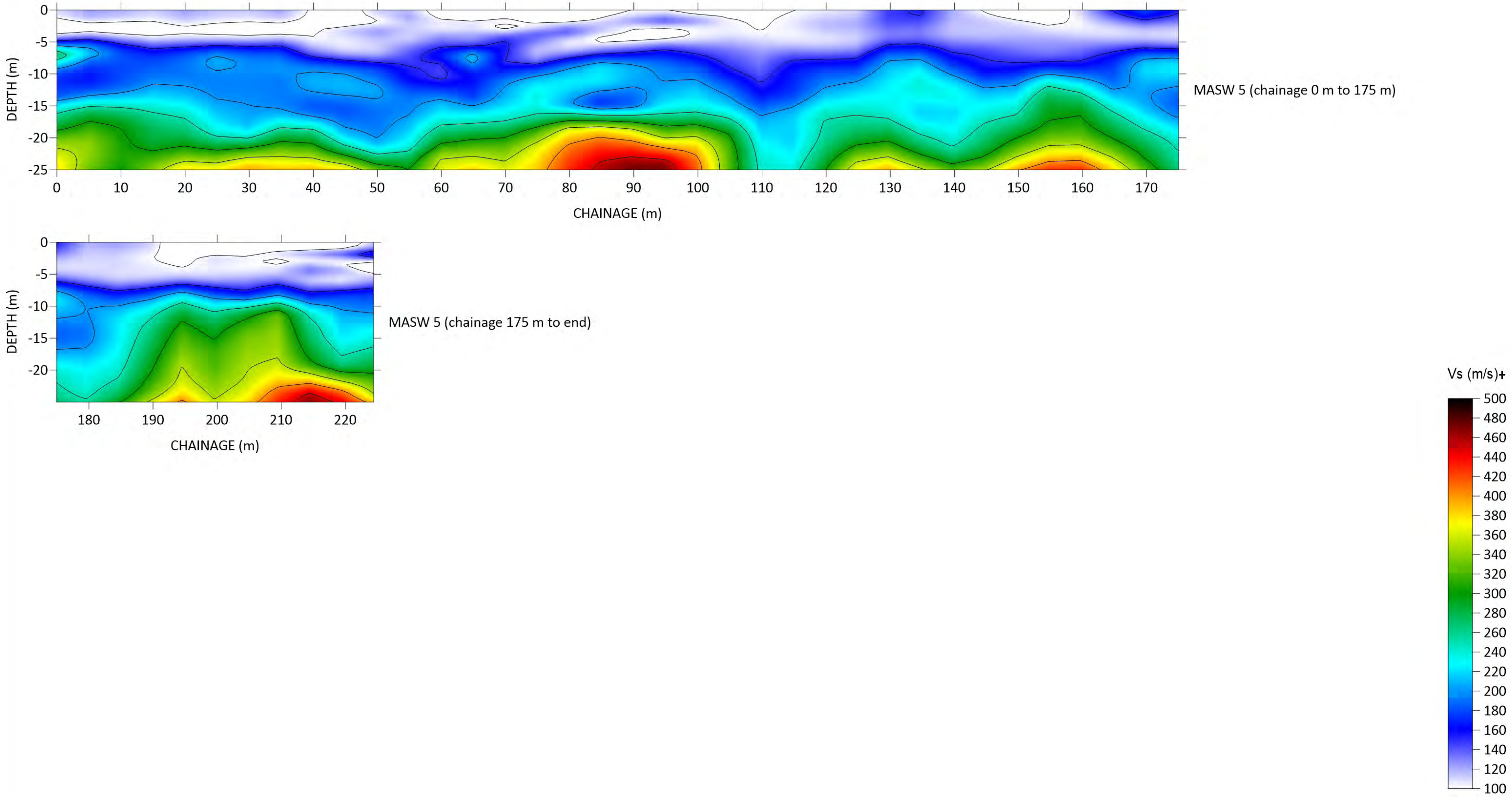
NOTES MASW Vs profile has contour intervals of 50 m/s (Vs).

See site map for location of points.

A3

Southern Geophysical Ltd

www.southerngeophysical.com



DRAWING- **Figure 4: MASW 2D Vs Profile 5**

LOCATION- **511 Halswell Road, Christchurch**

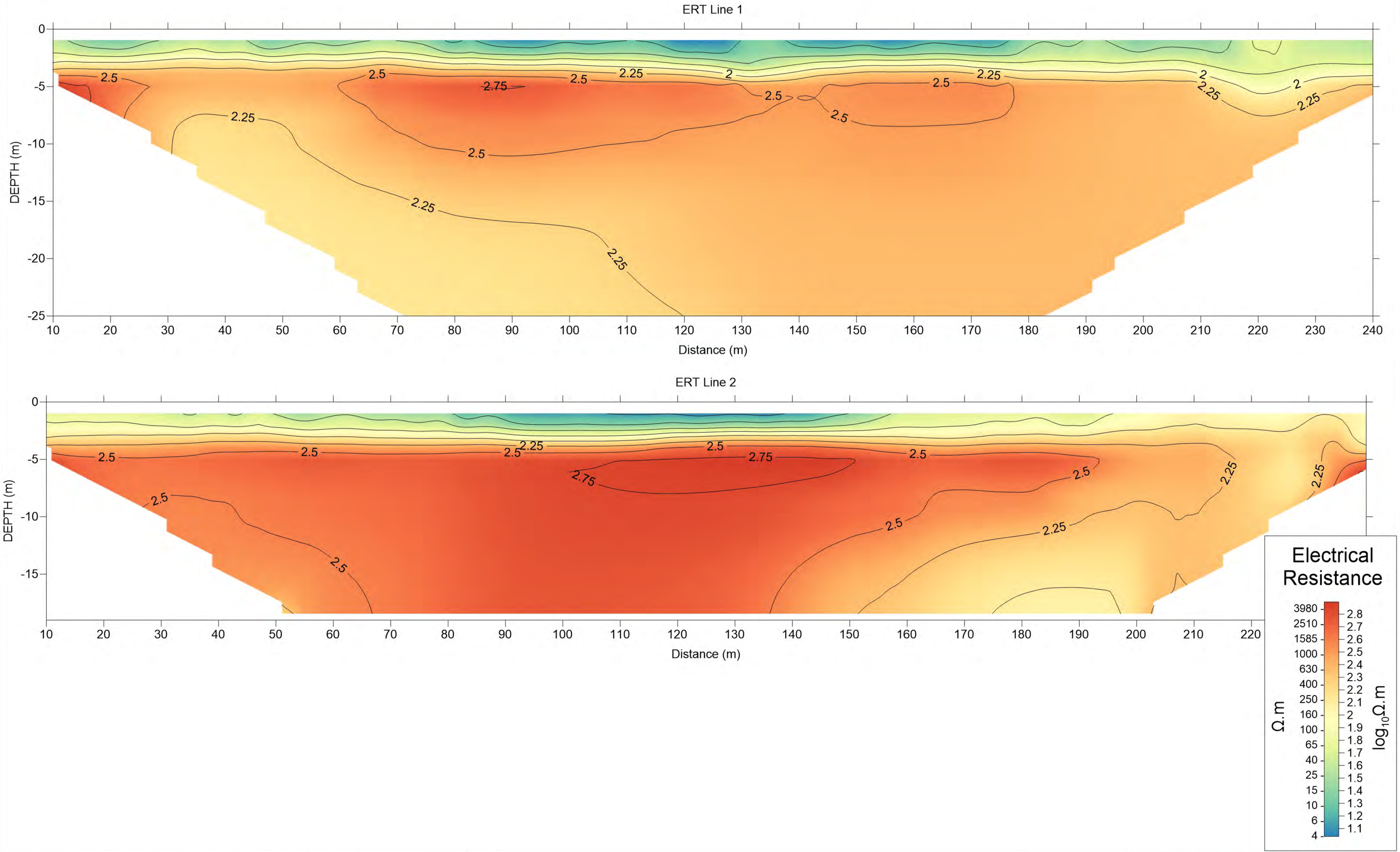
NOTES MASW Vs profile has contour intervals of 50 m/s (Vs).

See site map for location of points.

A3

Southern Geophysical Ltd

www.southerngeophysical.com



DRAWING-

Figure 5: Electrical Resistivity Tomography

LOCATION-

511 Halswell Road, Halswell

NOTES-

A3

Southern Geophysical Ltd

www.southerngeophysical.com

Disclaimer:

This document has been provided by Southern Geophysical Ltd subject to the following:

Non-invasive geophysical testing has limitations and is not a complete source of testing. Often there is a need to couple non-invasive methods with invasive testing methods, such as drilling, especially in cases where the non-invasive testing indicates anomalies.

This document has been prepared for the particular purpose outlined in the project proposal and no responsibility is accepted for the use of this document, in whole or in part, in other contexts or for any other purpose. Southern Geophysical Ltd did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited nature of the enquiry Southern Geophysical Ltd was retained to undertake with respect to the site. Variations in conditions often occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account. Accordingly, additional studies and actions may be required by the client.

We collected our data and based our report on information which was collected at a specific point in time. The passage of time affects the information and assessment provided by Southern Geophysical Ltd. It is understood that the services provided allowed Southern Geophysical Ltd to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes for whatever reason. Where data is supplied by the client or other sources, including where previous site investigation data have been used, it has been assumed that the information is correct. No responsibility is accepted by Southern Geophysical Ltd for incomplete or inaccurate data supplied by others. This document is provided for sole use by the client and is confidential to that client and its professional advisers. No responsibility whatsoever for the contents of this document will be accepted to any person other than the client. Any use which a third party makes of this document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Southern Geophysical Ltd accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

D. Geotechnical Cross Sections

Indicative Geotechnical Cross Sections

MASW Isometric Projection

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Christchurch 8140

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miyamo.nz
projects@miyamoto.nz

PROJECT No: 190666
GEOTECHNICAL CROSS-SECTIONS FOR 511 HALSWELL ROAD, CHRISTCHURCH 8025

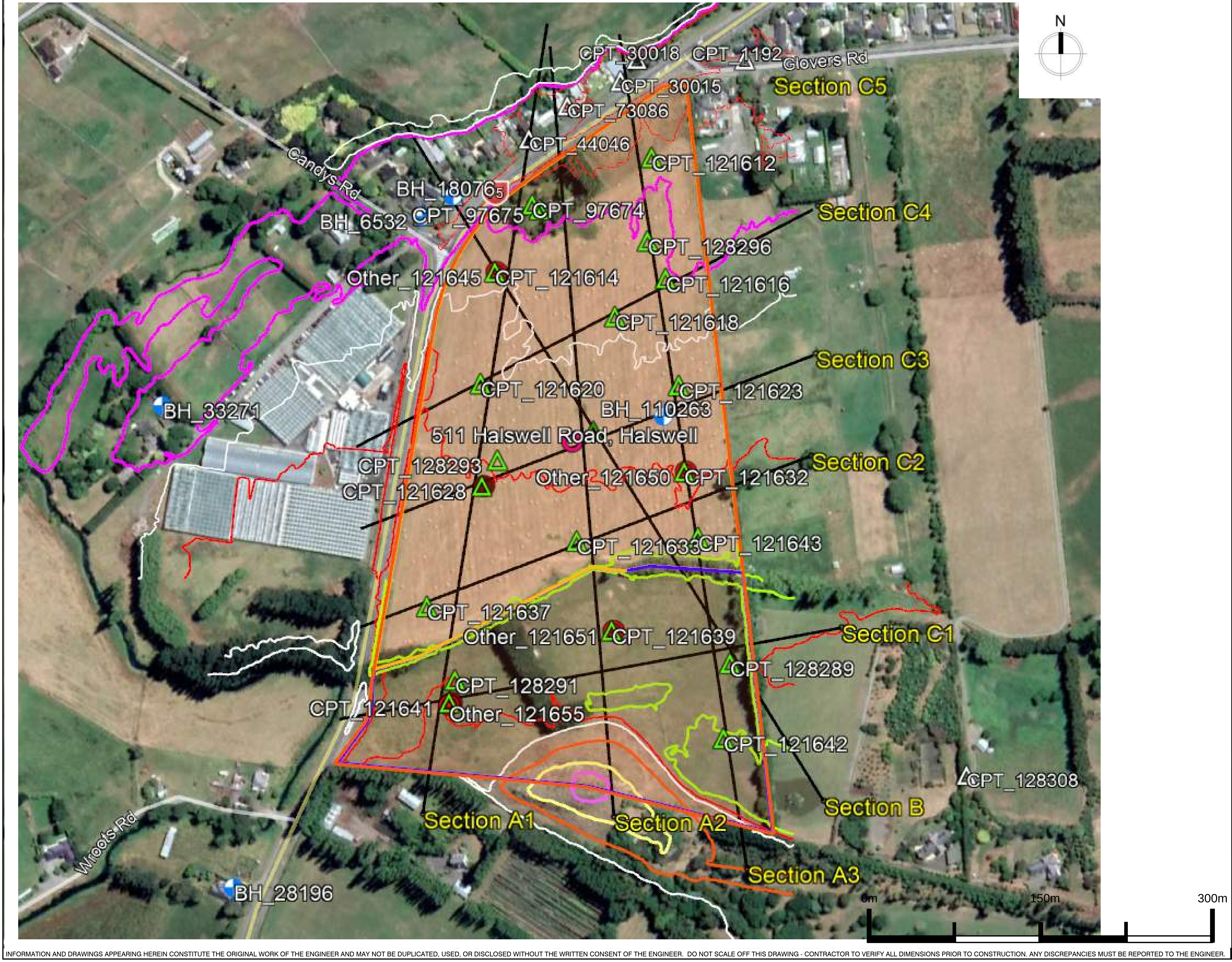
SHEET LIST

SHEET N°	SHEET NAME	REV.
S1	LOCATION PLAN	1
S2.1	GEOTECHNICAL CROSS-SECTION - SHEET 1	1
S2.2	GEOTECHNICAL CROSS-SECTION - SHEET 2	1
S2.3	GEOTECHNICAL CROSS-SECTION - SHEET 3	1
S2.4	GEOTECHNICAL CROSS-SECTION - SHEET 4	1
S2.5	GEOTECHNICAL CROSS-SECTION - SHEET 5	1
S3	MASW FENCE DIAGRAM	1

ISSUE DATE: 03/10/2019 REV: 1

ALL DIMENSIONS IN MILLIMETERS U.N.O. DO NOT SCALE

PLOTTED: 09/10/2019 9:32 AM



INFORMATION AND DRAWINGS APPEARING HEREIN CONSTITUTE THE ORIGINAL WORK OF THE ENGINEER AND MAY NOT BE DUPLICATED, USED, OR DISCLOSED WITHOUT THE WRITTEN CONSENT OF THE ENGINEER. DO NOT SCALE OFF THIS DRAWING - CONTRACTOR TO VERIFY ALL DIMENSIONS PRIOR TO CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER.

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GEOTECHNICAL
CROSS-SECTIONS
511 HALSWELL ROAD,
CHRISTCHURCH 8025

REVISION HISTORY

REV	DATE	DESCRIPTION
1	03/10/2019	FINAL

CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
REVIEWED: --
ENGINEER: CMD
APPROVED: --
SIZE: A3 SCALE: AS NOTED

LOCATION
PLAN

SHEET No.: S1 REV. 1

ALL DIMENSIONS IN MILLIMETERS U.N.O. DO NOT SCALE

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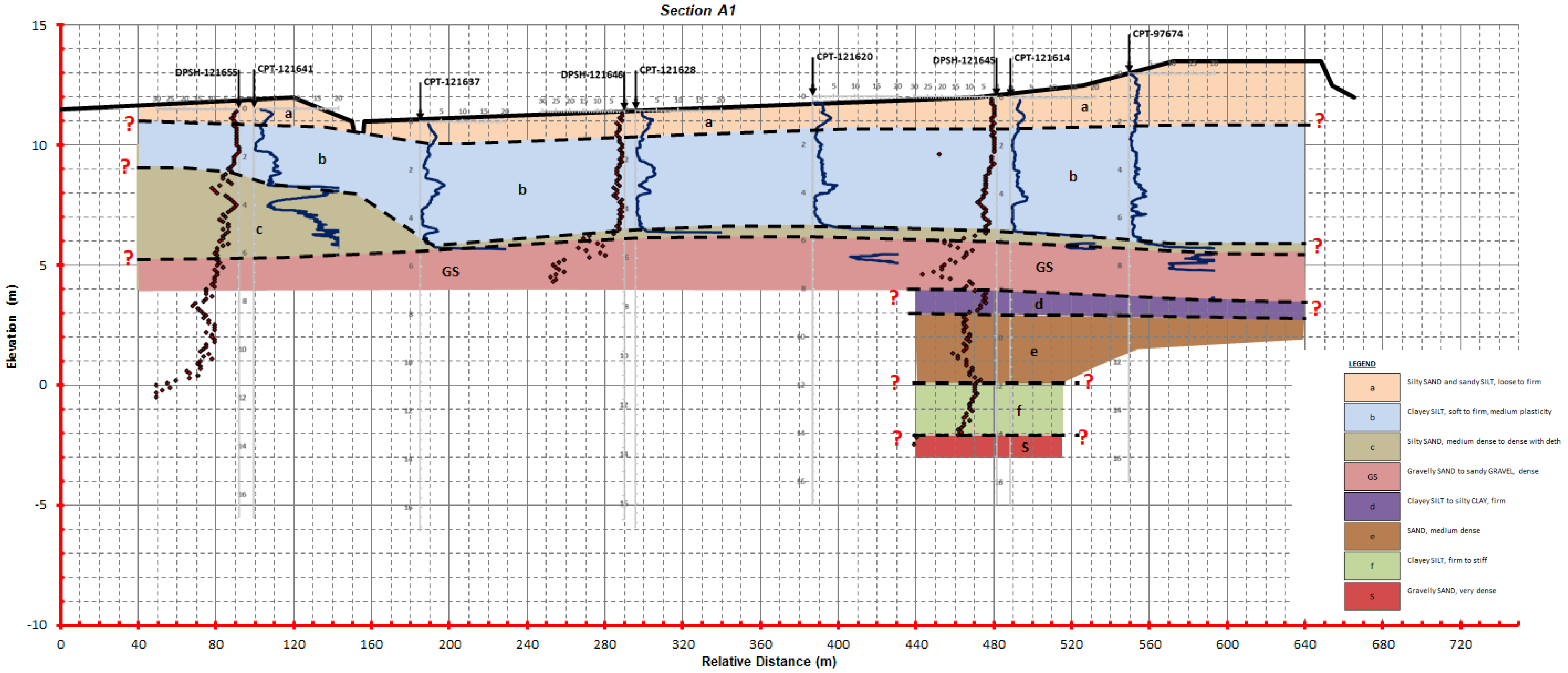
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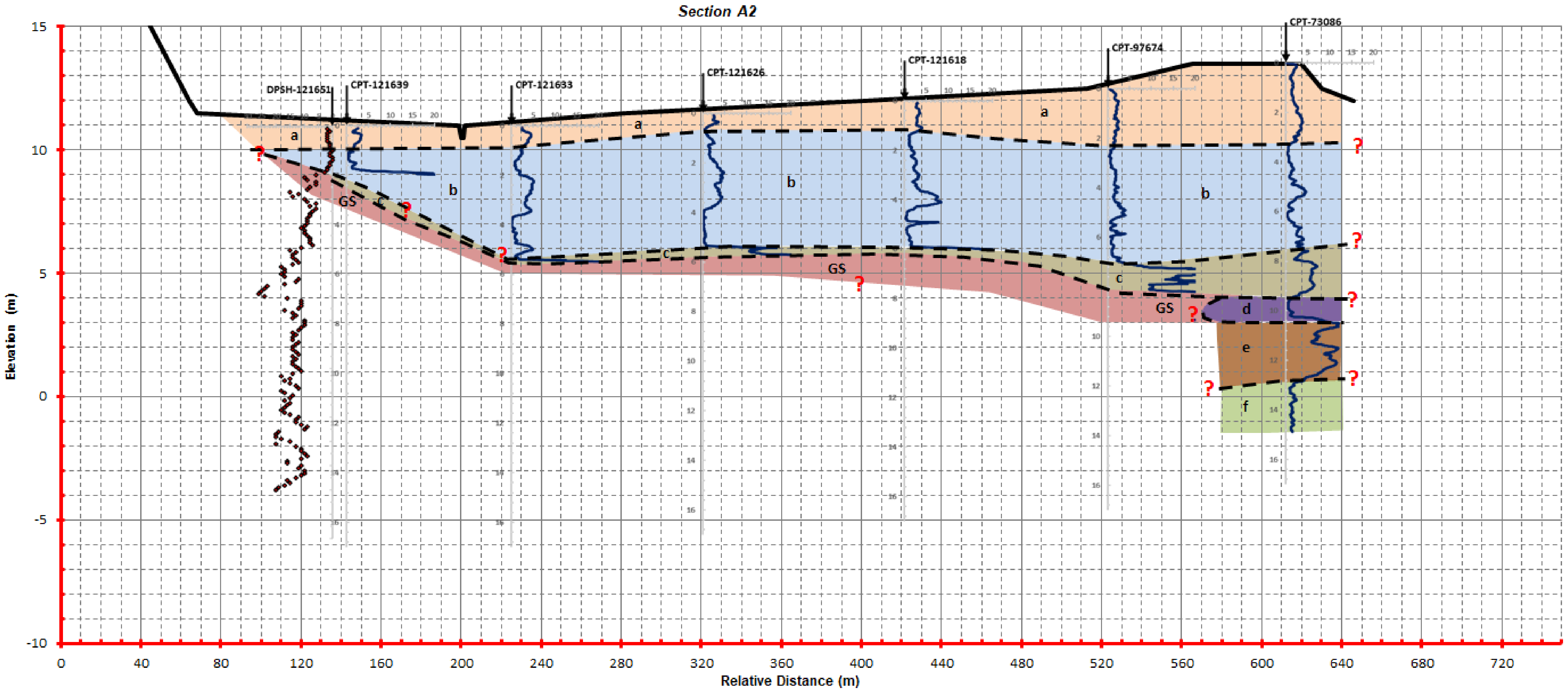
Section A2

ALL DIMENSIONS IN MILLIMETERS U.N.O. DO NOT SCALE

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GEOTECHNICAL CROSS-SECTIONS
511 HALSWELL ROAD, CHRISTCHURCH 8025

REVISION HISTORY

REV	DATE	DESCRIPTION
1	03/10/2019	FINAL

CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
REVIEWED: --
ENGINEER: CMD
APPROVED: --

SIZE: A3 SCALE: AS NOTED

GROUND
MODEL
SHEET 1

SHEET No.: S2.1 REV. 1

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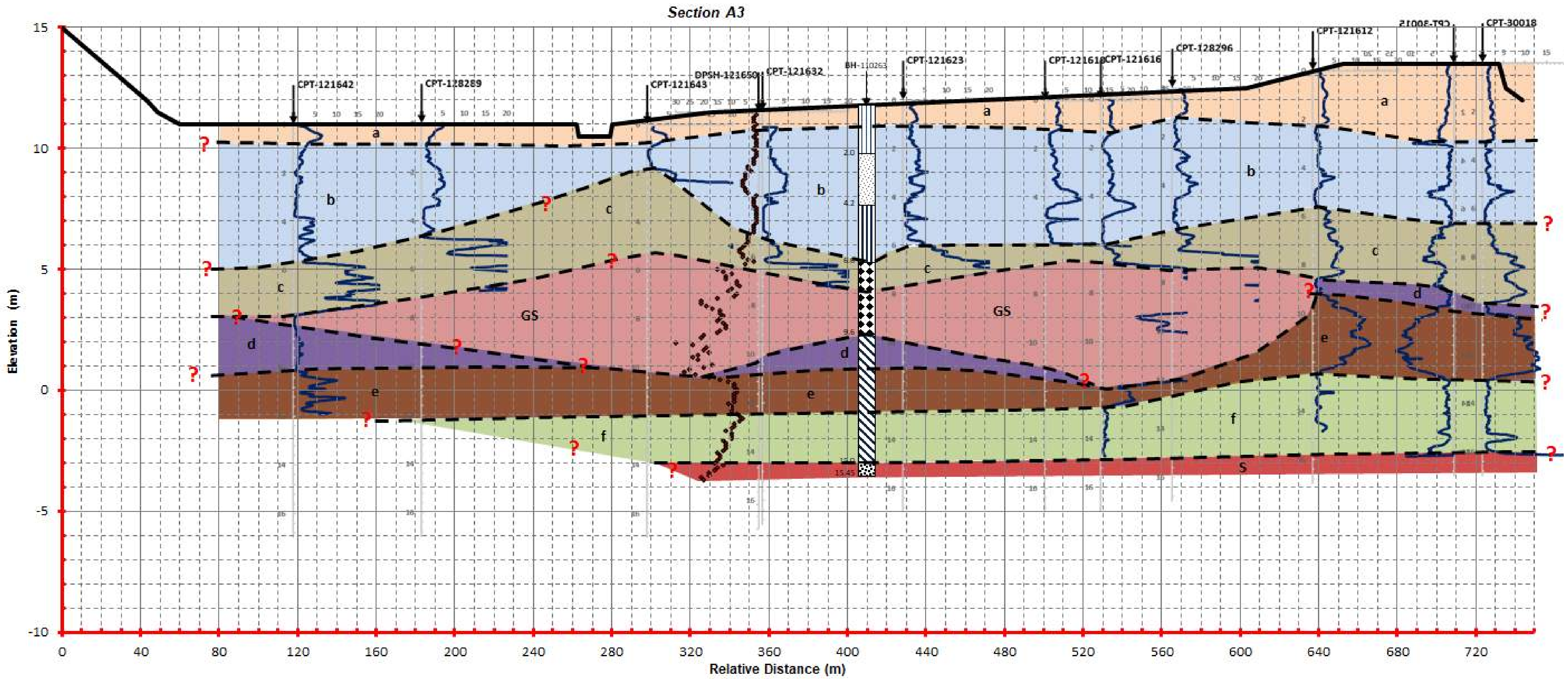

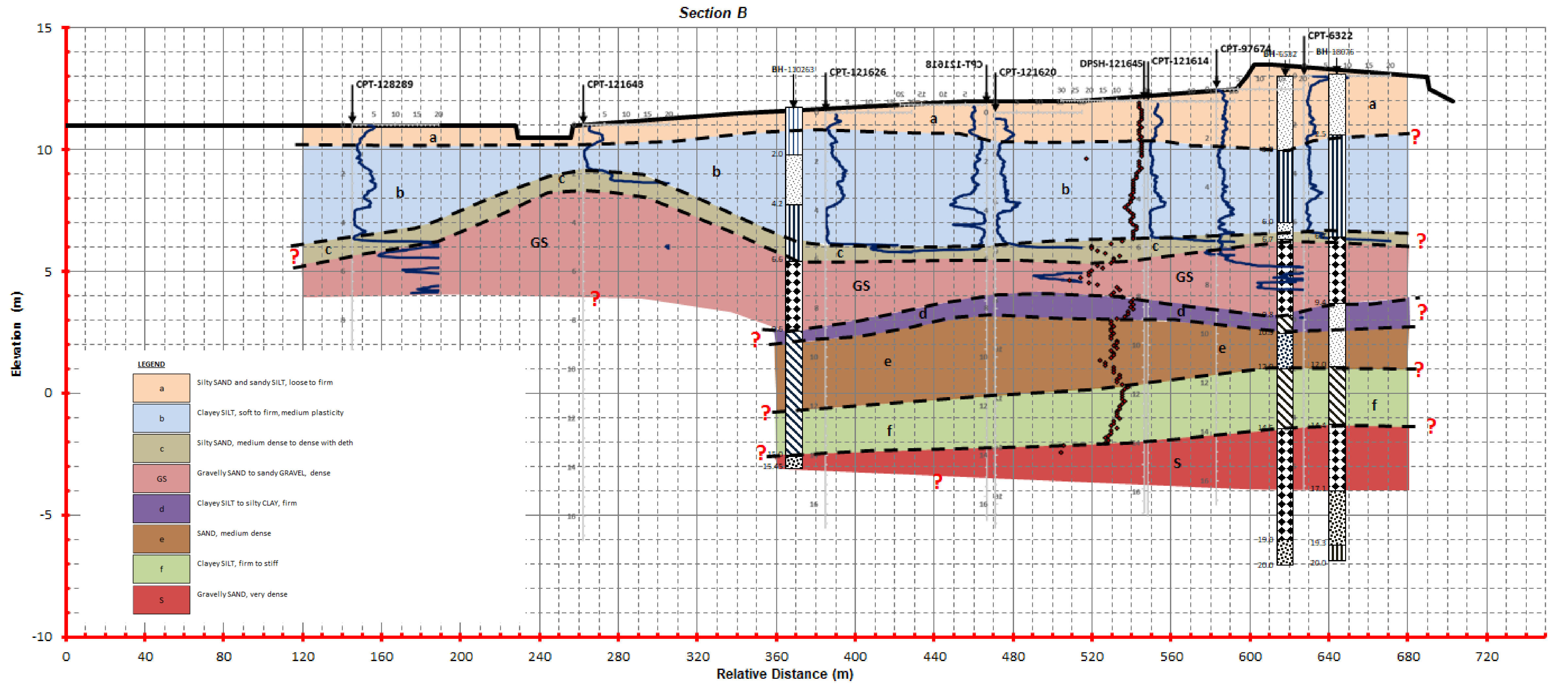

LEGEND

a	Silty SAND and sandy SILT, loose to firm
b	Clayey SILT, soft to firm, medium plasticity
c	Silty SAND, medium dense to dense with deth
GS	Gravelly SAND to sandy GRAVEL, dense
d	Clayey SILT to silty CLAY, firm
e	SAND, medium dense
f	Clayey SILT, firm to stiff
S	Gravelly SAND, very dense

INFORMATION AND DRAWINGS APPEARING HEREIN CONSTITUTE THE ORIGINAL WORK OF THE ENGINEER AND MAY NOT BE DUPLICATED, USED, OR DISCLOSED WITHOUT THE WRITTEN CONSENT OF THE ENGINEER. DO NOT SCALE OFF THIS DRAWING - CONTRACTOR TO VERIFY ALL DIMENSIONS PRIOR TO CONSTRUCTION. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER.

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GEOTECHNICAL CROSS-SECTIONS
511 HALSWELL ROAD, CHRISTCHURCH 8025

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1	03/10/2019	FINAL

CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
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ENGINEER: CMD
APPROVED: --
SIZE: A3 SCALE: AS NOTED

GROUND
MODEL
SHEET 2

SHEET No.: S2.2 REV. 1

ALL DIMENSIONS IN MILLIMETERS U.N.O.   DO NOT SCALE

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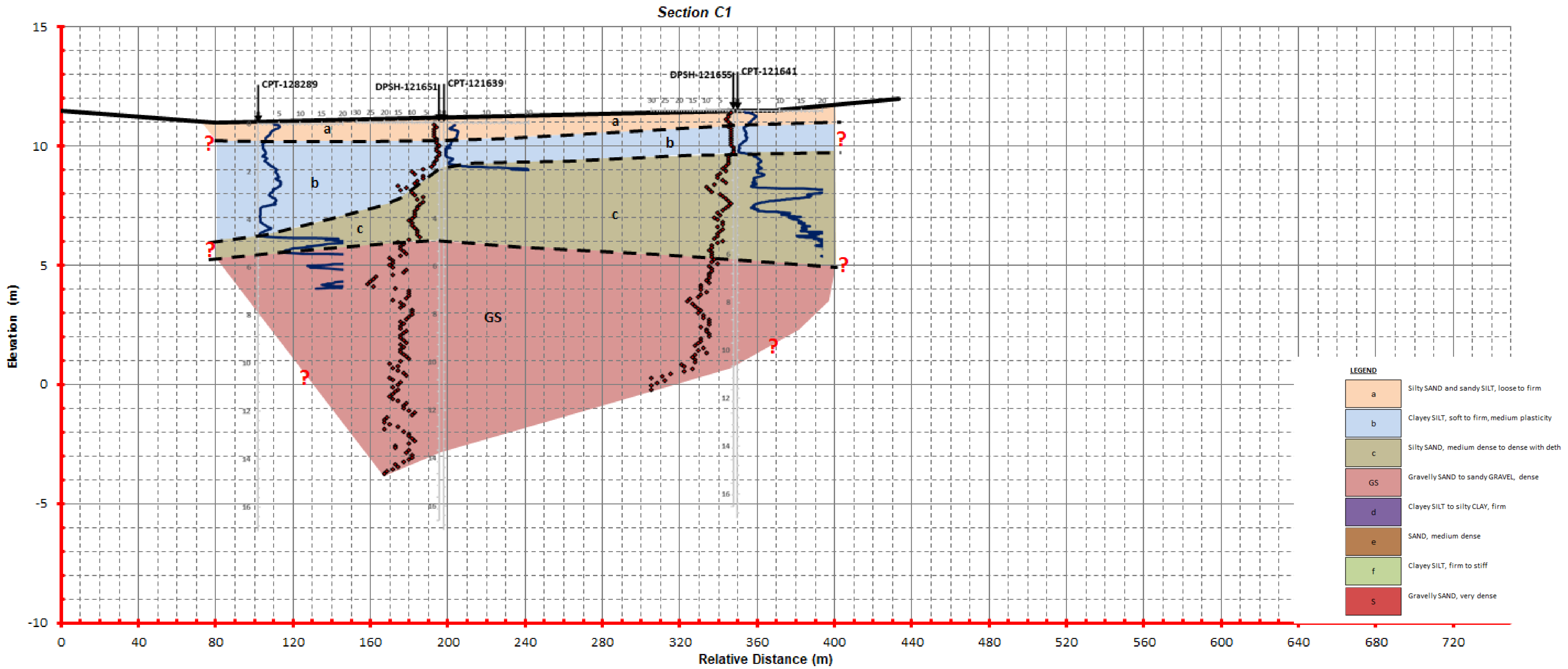

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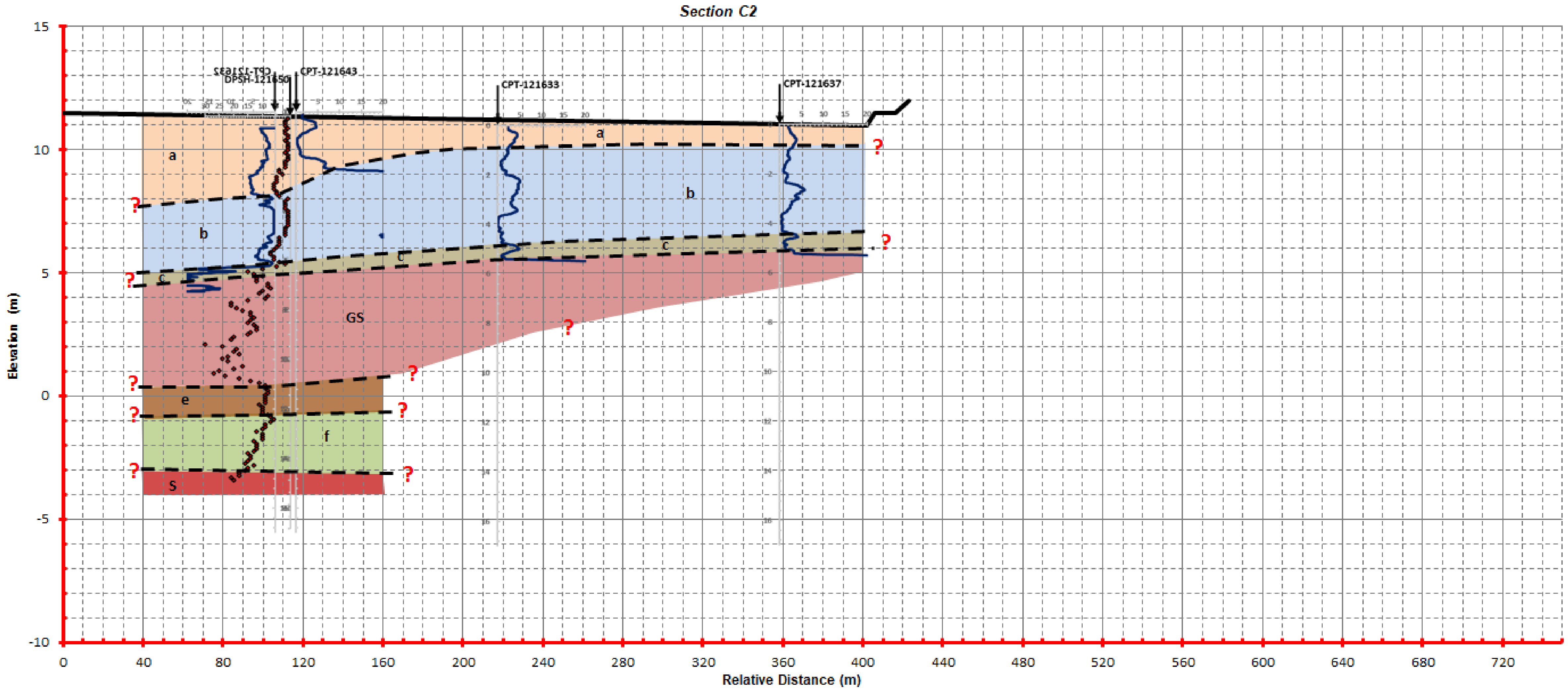

Section C2

DO NOT SCALE

ALL DIMENSIONS IN MILLIMETERS U.N.O.

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GEOTECHNICAL CROSS-SECTIONS 511 HALSWELL ROAD, CHRISTCHURCH 8025

REVISION HISTORY

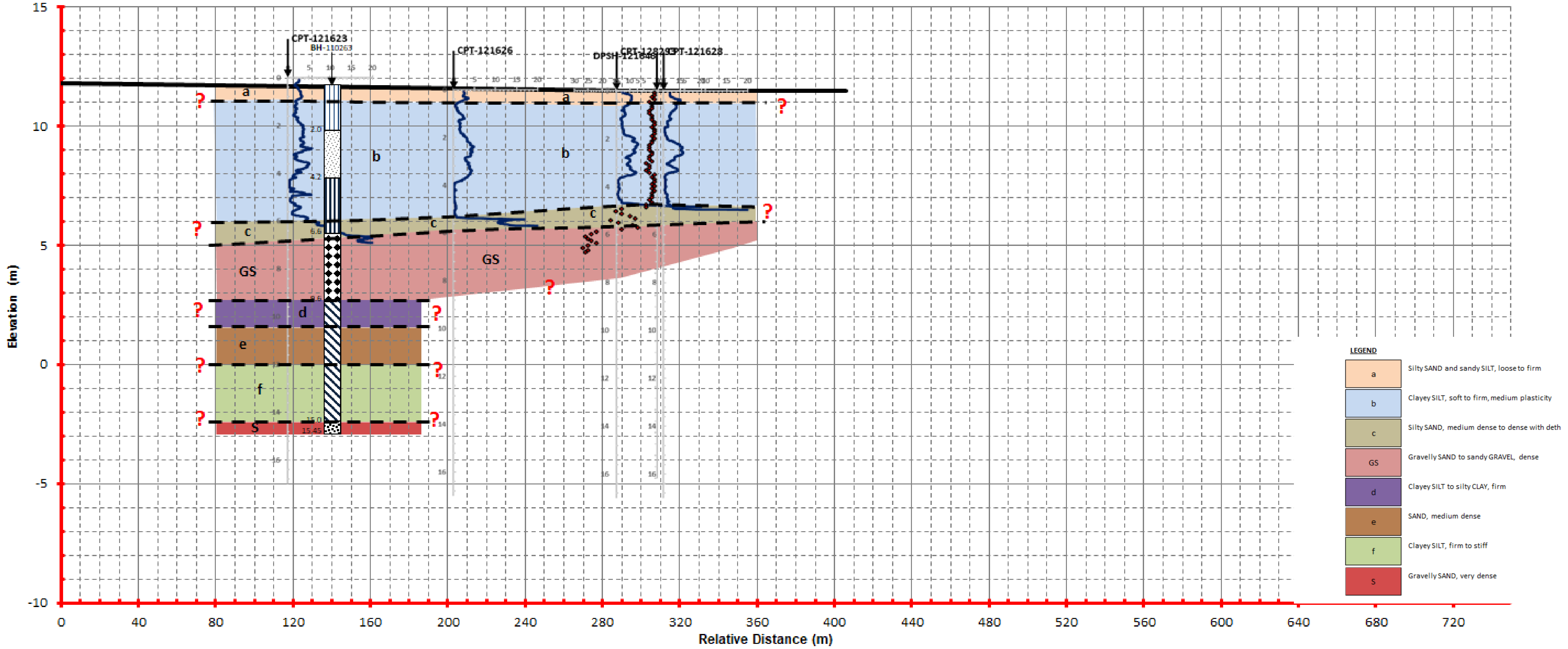
REV	DATE	DESCRIPTION
1	03/10/2019	FINAL

CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
REVIEWED: --
ENGINEER: CMD
APPROVED: --
SIZE: A3 SCALE: AS NOTED

GROUND
MODEL
SHEET 3

SHEET No.: S2.3 REV. 1

Section C3



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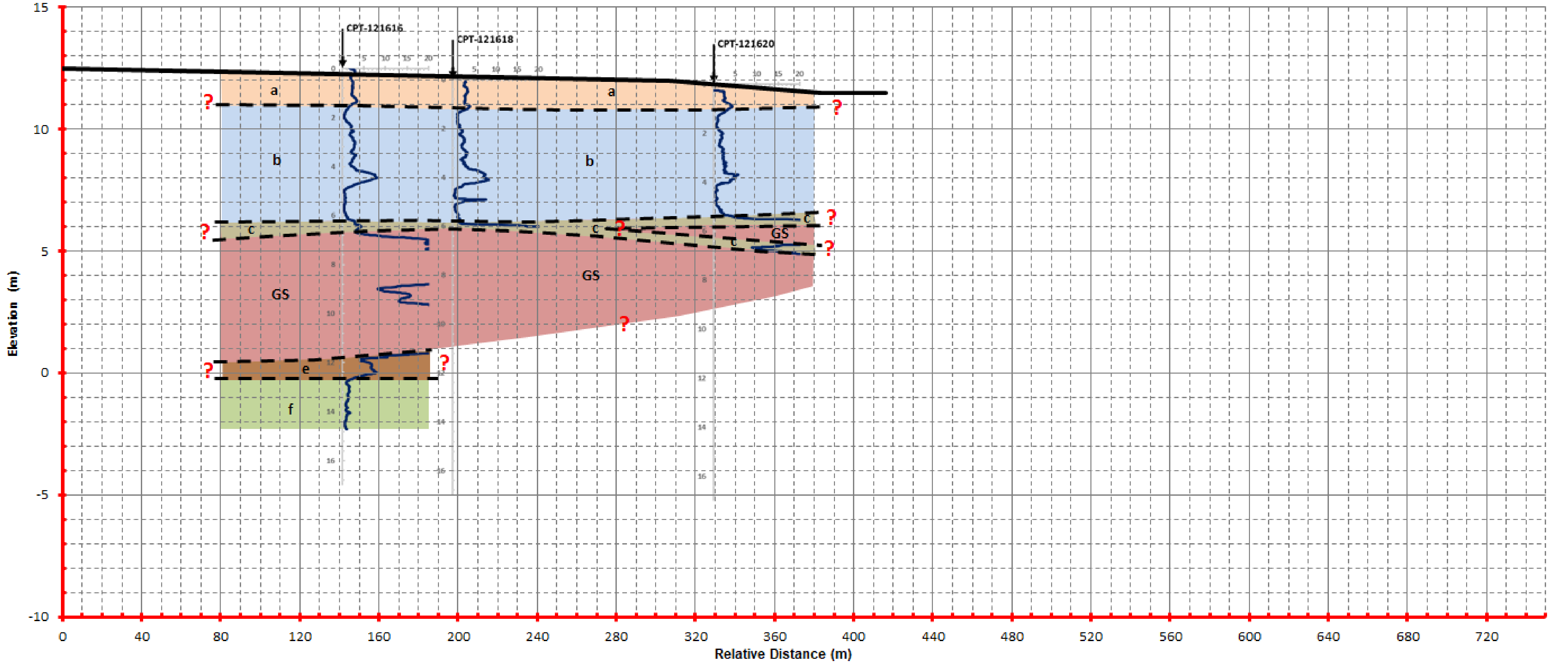

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GEOTECHNICAL CROSS-SECTIONS 511 HALSWELL ROAD, CHRISTCHURCH 8025

REVISION HISTORY

REV	DATE	DESCRIPTION
1	03/10/2019	FINAL

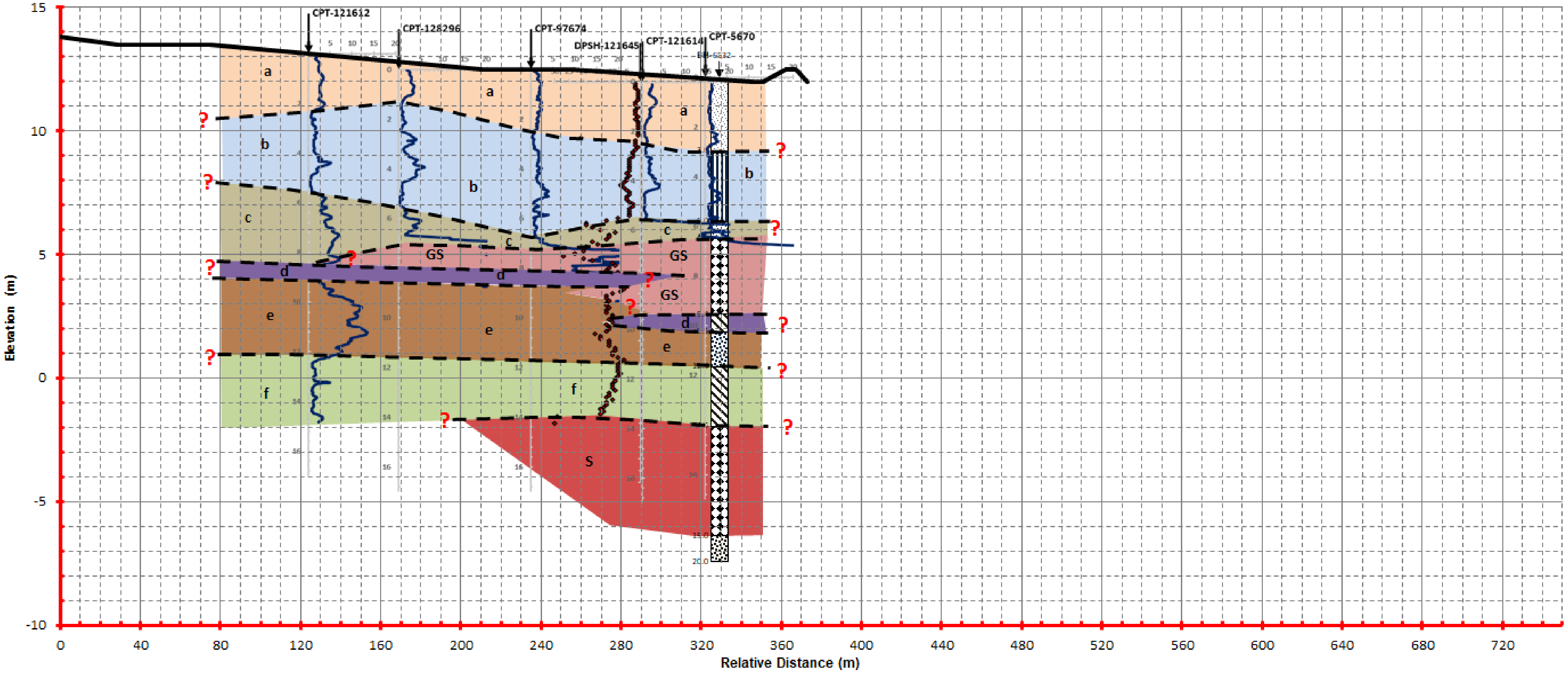
CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
REVIEWED: --
ENGINEER: CMD
APPROVED: --

SIZE: A3 SCALE: AS NOTED

GROUND
MODEL
SHEET 4

SHEET No.: S2.4 REV. 1

Section C5



LEGEND

a	Silty SAND and sandy SILT, loose to firm
b	Clayey SILT, soft to firm, medium plasticity
c	Silty SAND, medium dense to dense with deth
GS	Gravelly SAND to sandy GRAVEL, dense
d	Clayey SILT to silty CLAY, firm
e	SAND, medium dense
f	Clayey SILT, firm to stiff
S	Gravelly SAND, very dense

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GEOTECHNICAL CROSS-SECTIONS 511 HALSWELL ROAD, CHRISTCHURCH 8025

REVISION HISTORY

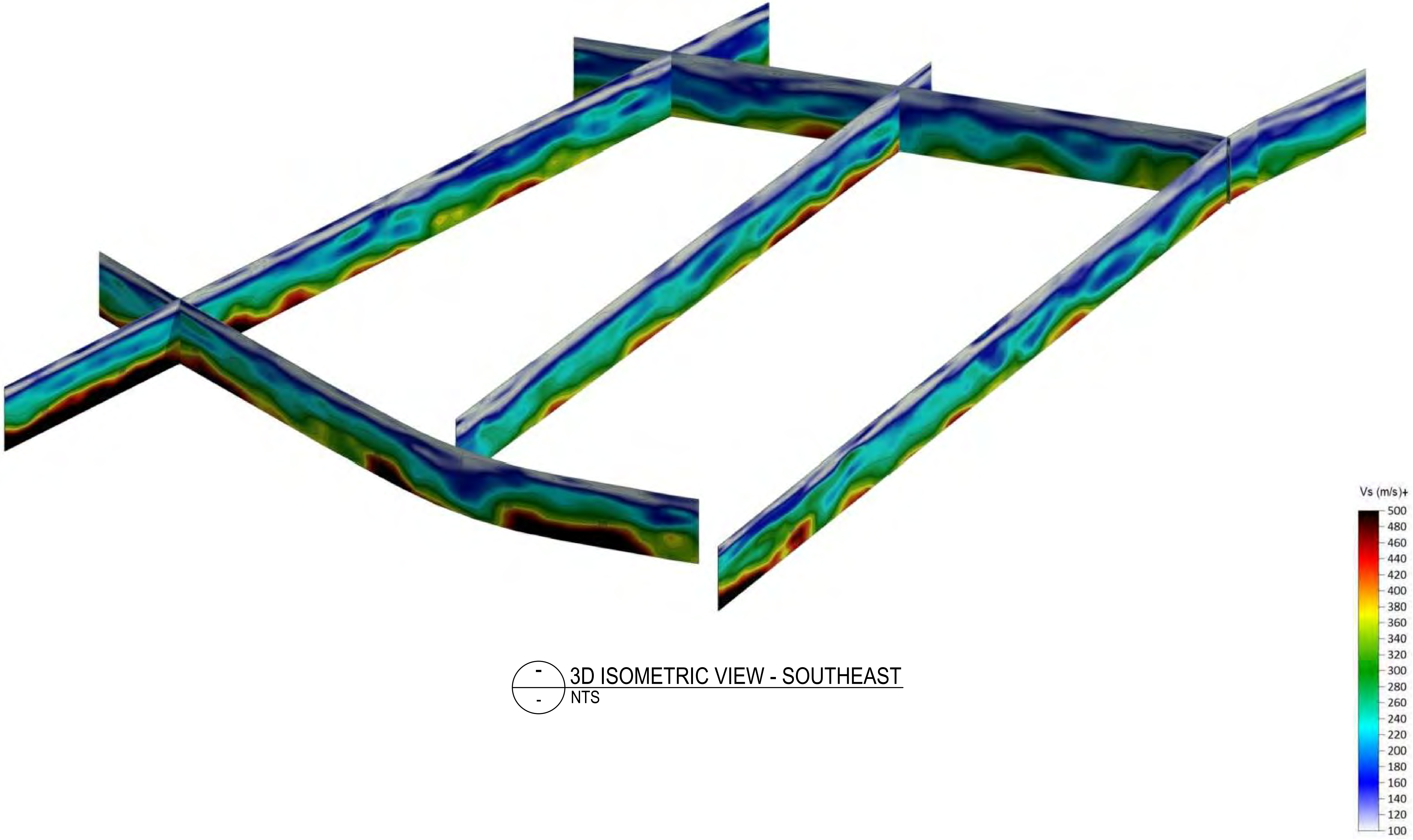
REV	DATE	DESCRIPTION
1	03/10/2019	FINAL

CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
REVIEWED: --
ENGINEER: CMD
APPROVED: --
SIZE: A3 SCALE: AS NOTED

GROUND
MODEL
SHEET 5

SHEET No.: S2.5 REV. 1

PLOTTED: 09/10/2019 11:15 AM



- / -

3D ISOMETRIC VIEW - SOUTHEAST

NTS

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GEOTECHNICAL CROSS-SECTIONS
511 HALSWELL ROAD, CHRISTCHURCH 8025

REVISION HISTORY

REV	DATE	DESCRIPTION
1	09/10/2019	FINAL

CLIENT: YOURSECTION LIMITED
PROJECT No.: 190666
DRAWN: AG
REVIEWED: --
ENGINEER: CMD
APPROVED: --

SIZE: A3 SCALE: AS NOTED

MASW
ISOMETRIC
PROJECTION

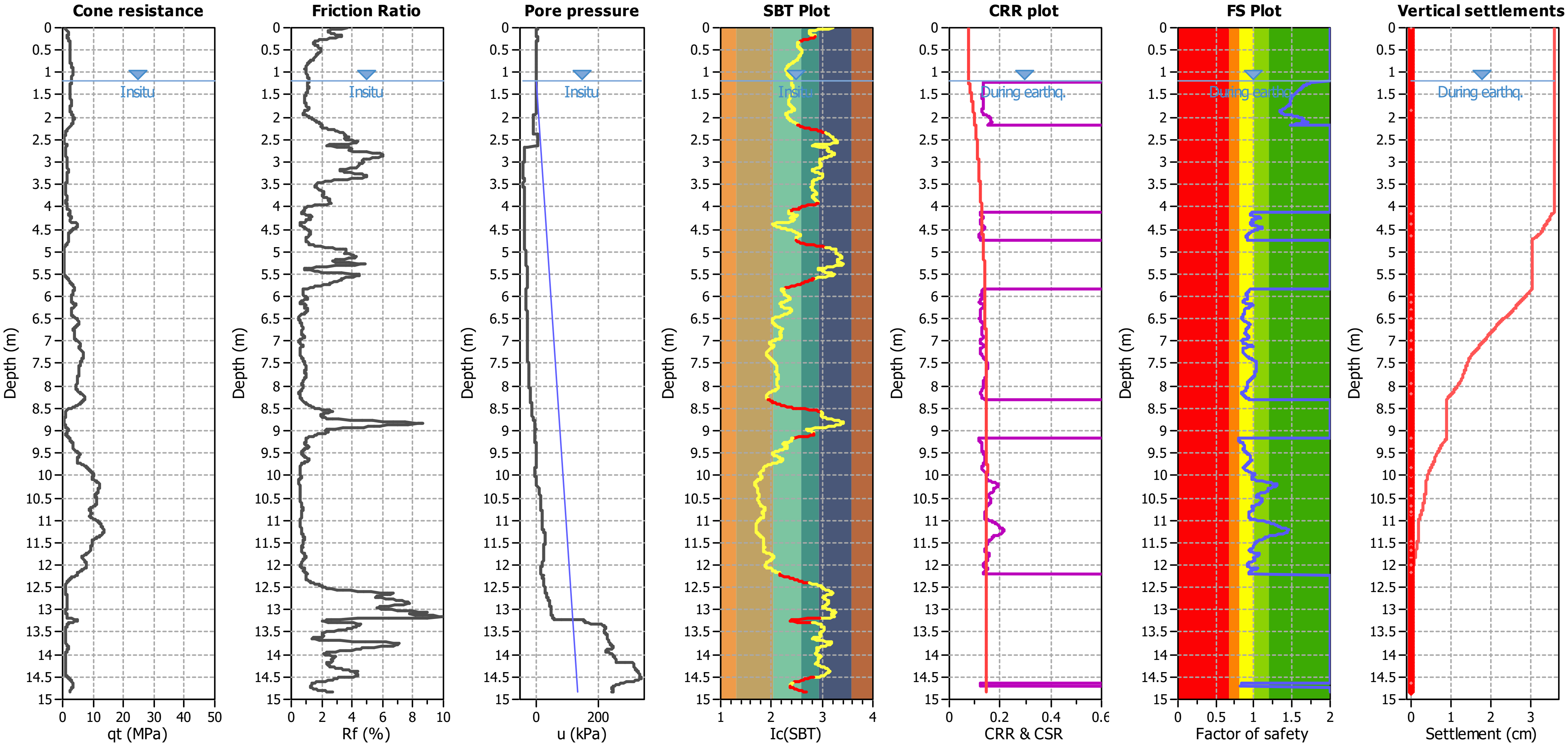
SHEET No.: S3 REV. 1

E. Liquefaction Analyses

Miyamoto International NZ Ltd
Level 3, 518 Colombo Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

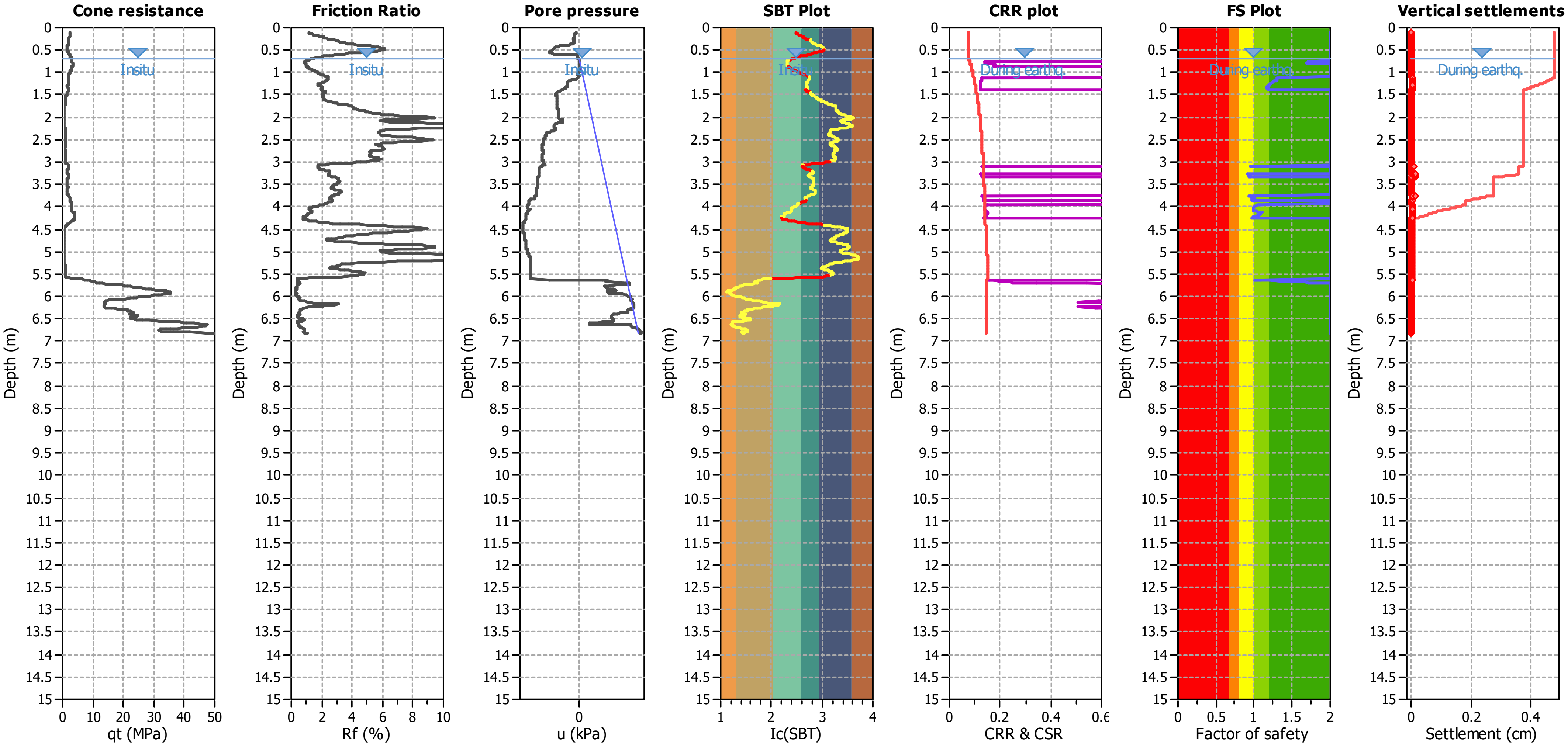
CPT: CPT_121612
Total depth: 14.84 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.20 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121614
Total depth: 6.82 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
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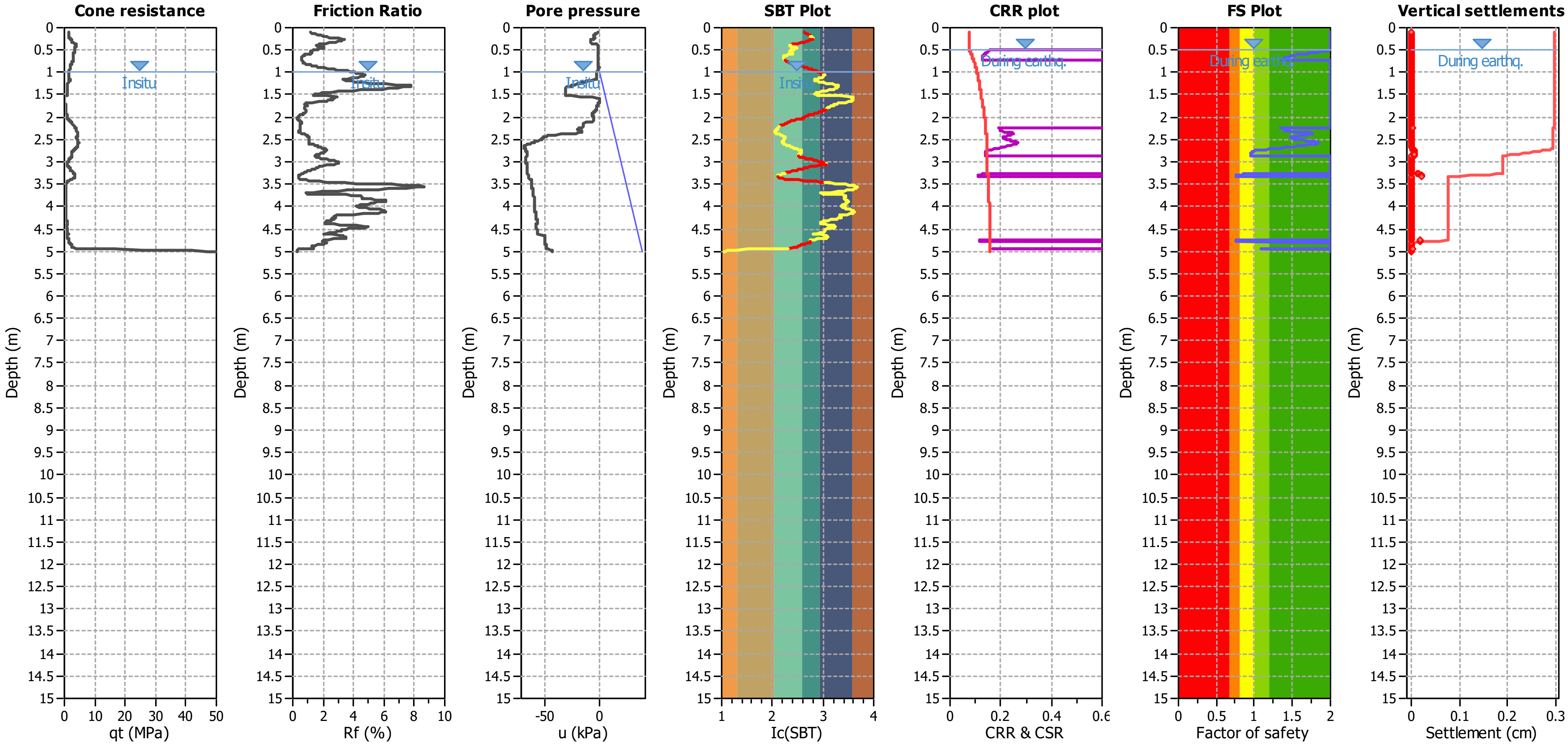
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121628
Total depth: 5.02 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
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Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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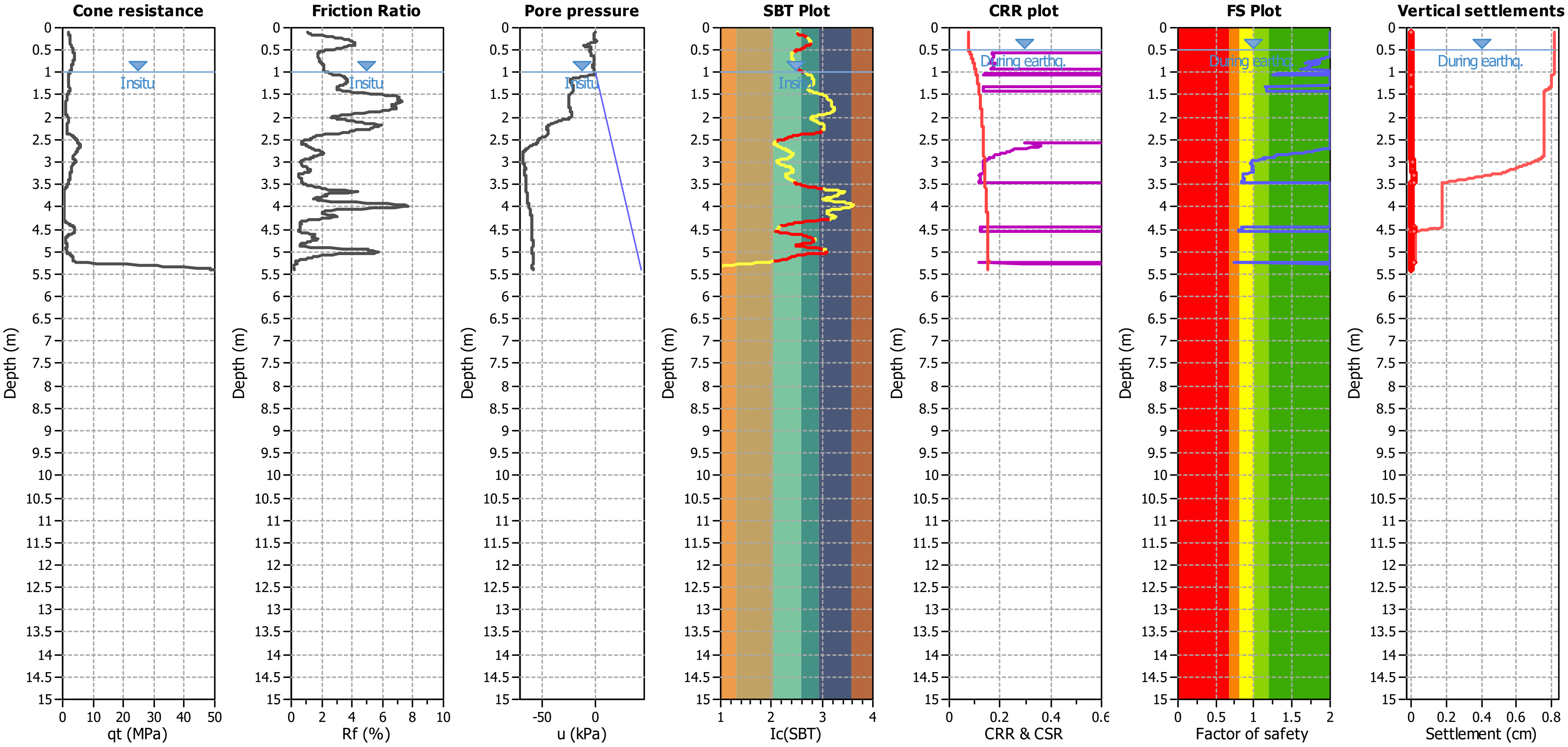
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121637
Total depth: 5.42 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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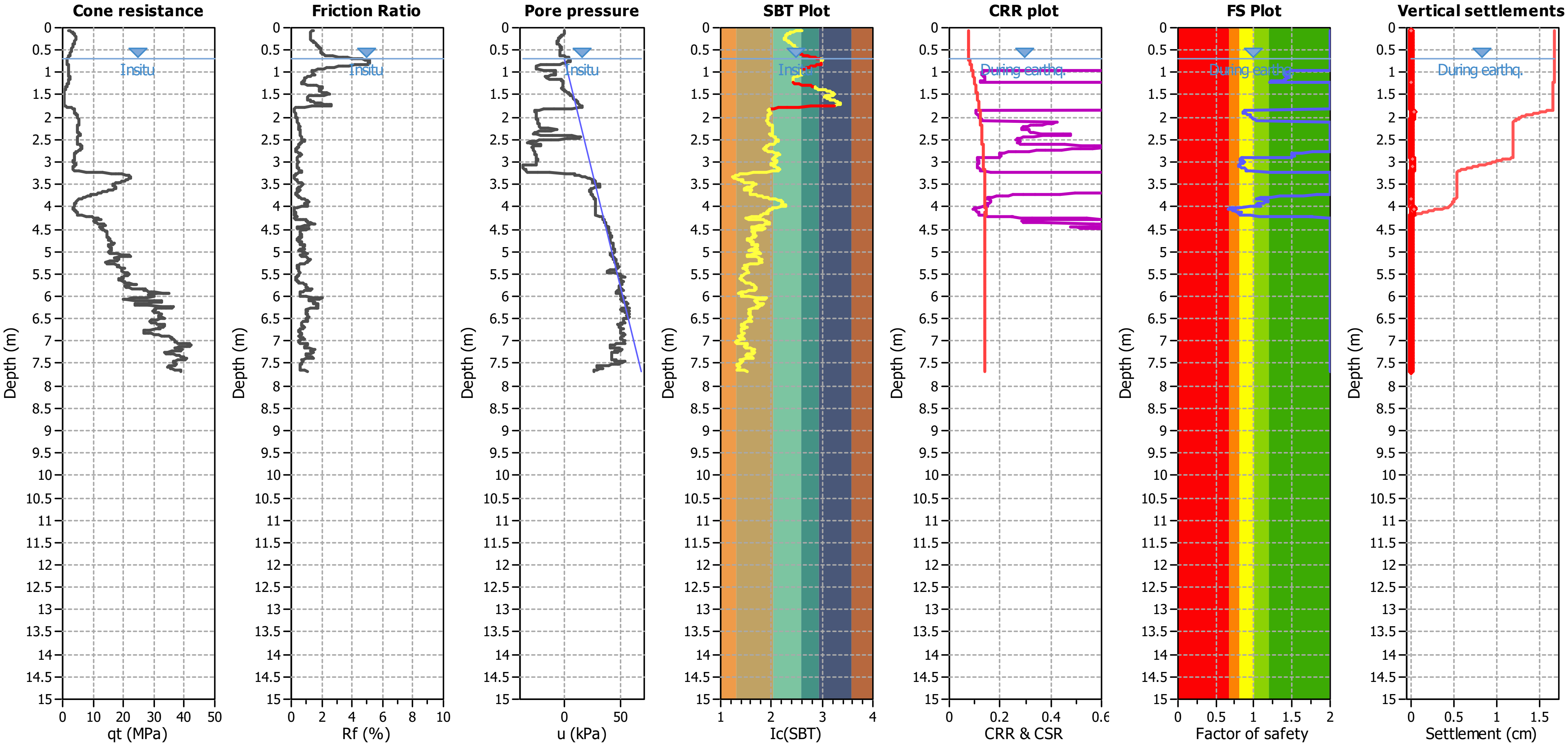
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121641
Total depth: 7.67 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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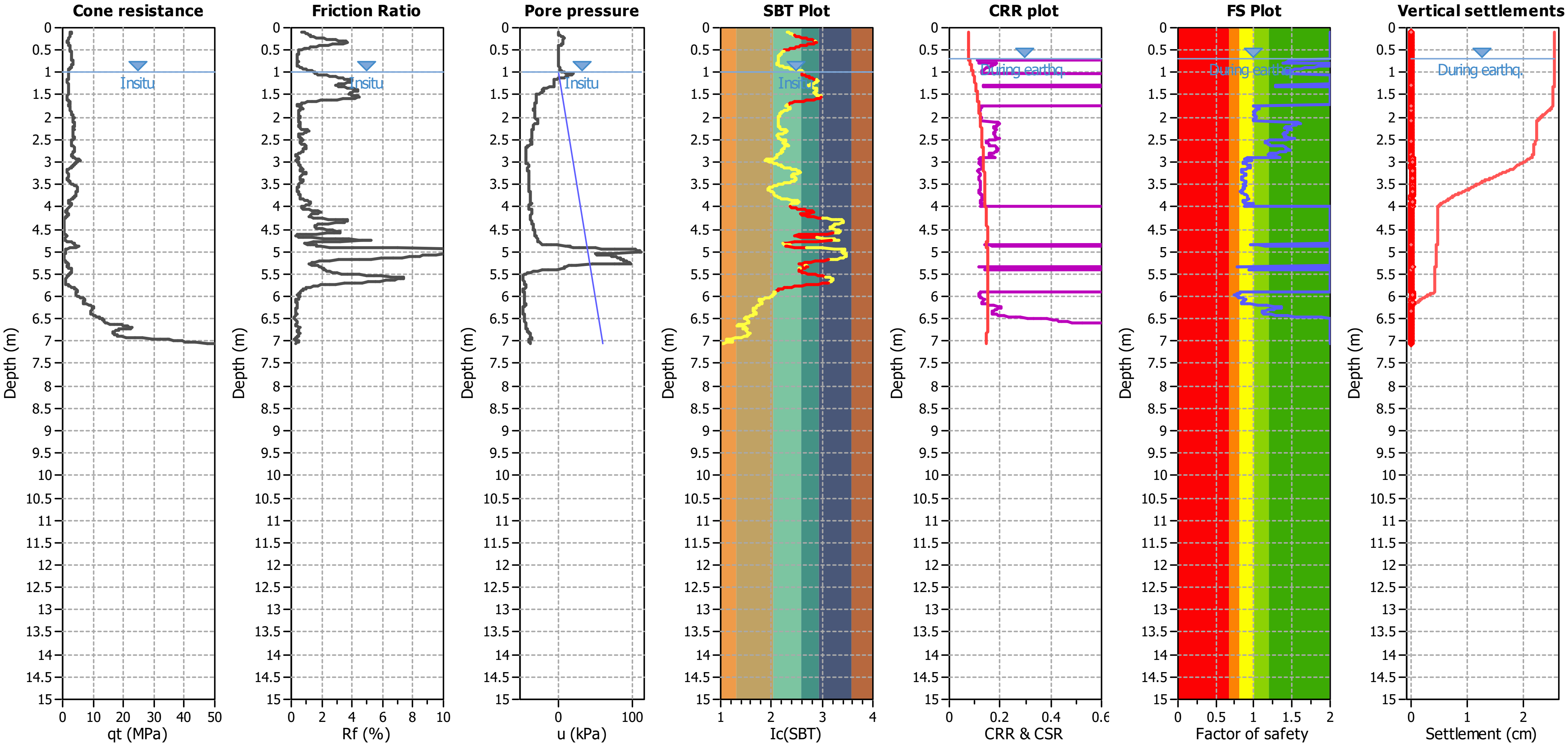
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121623
Total depth: 7.05 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
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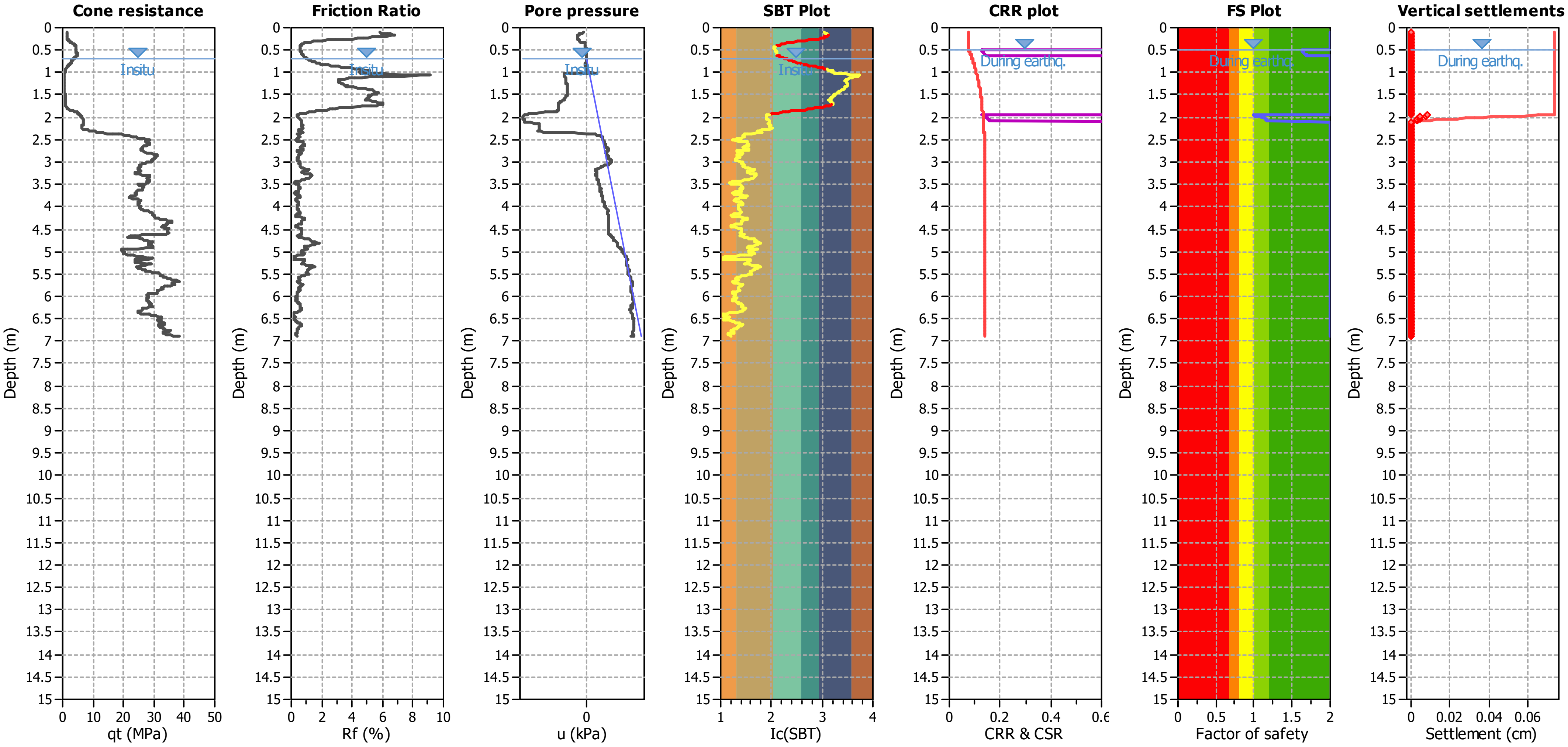
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121643
Total depth: 6.90 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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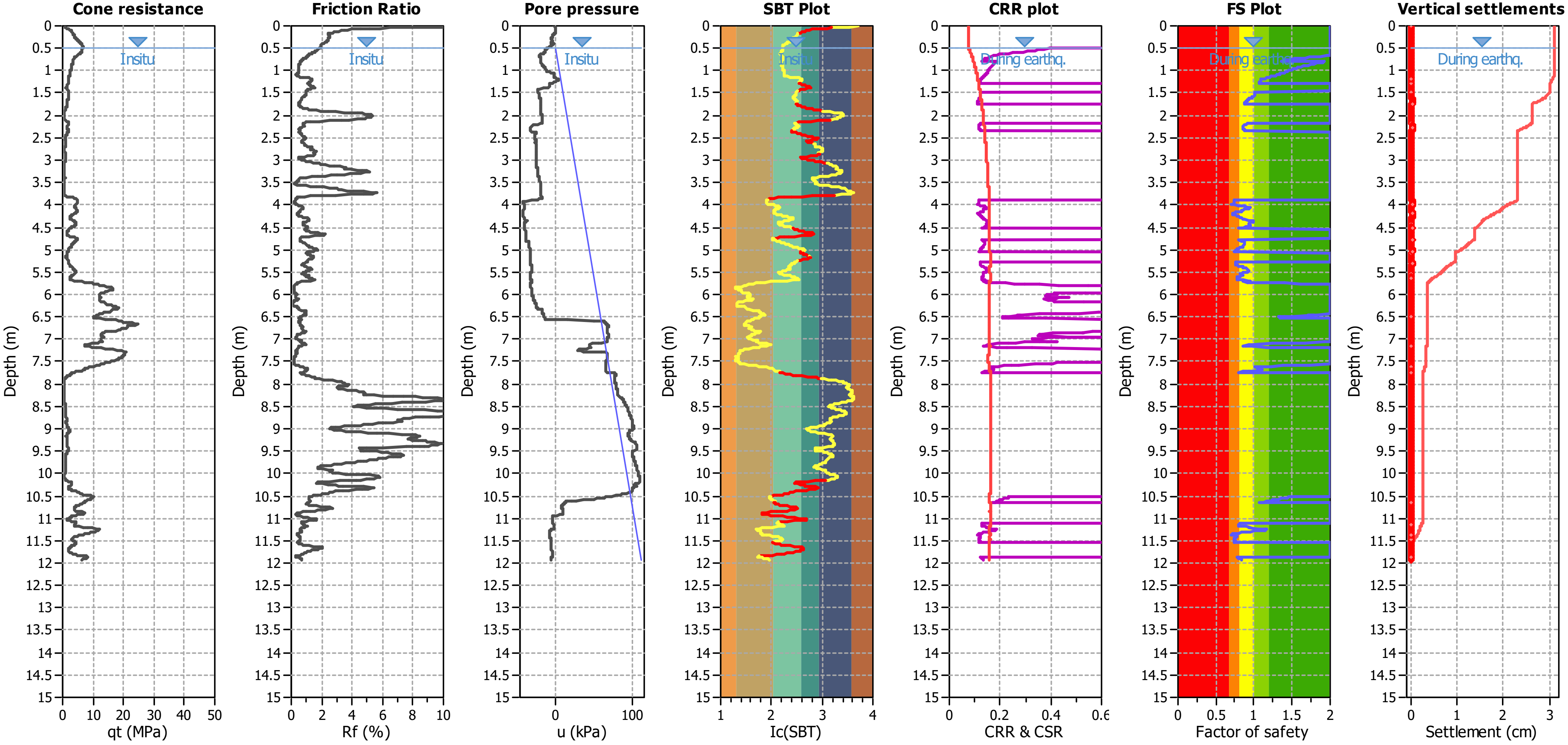
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

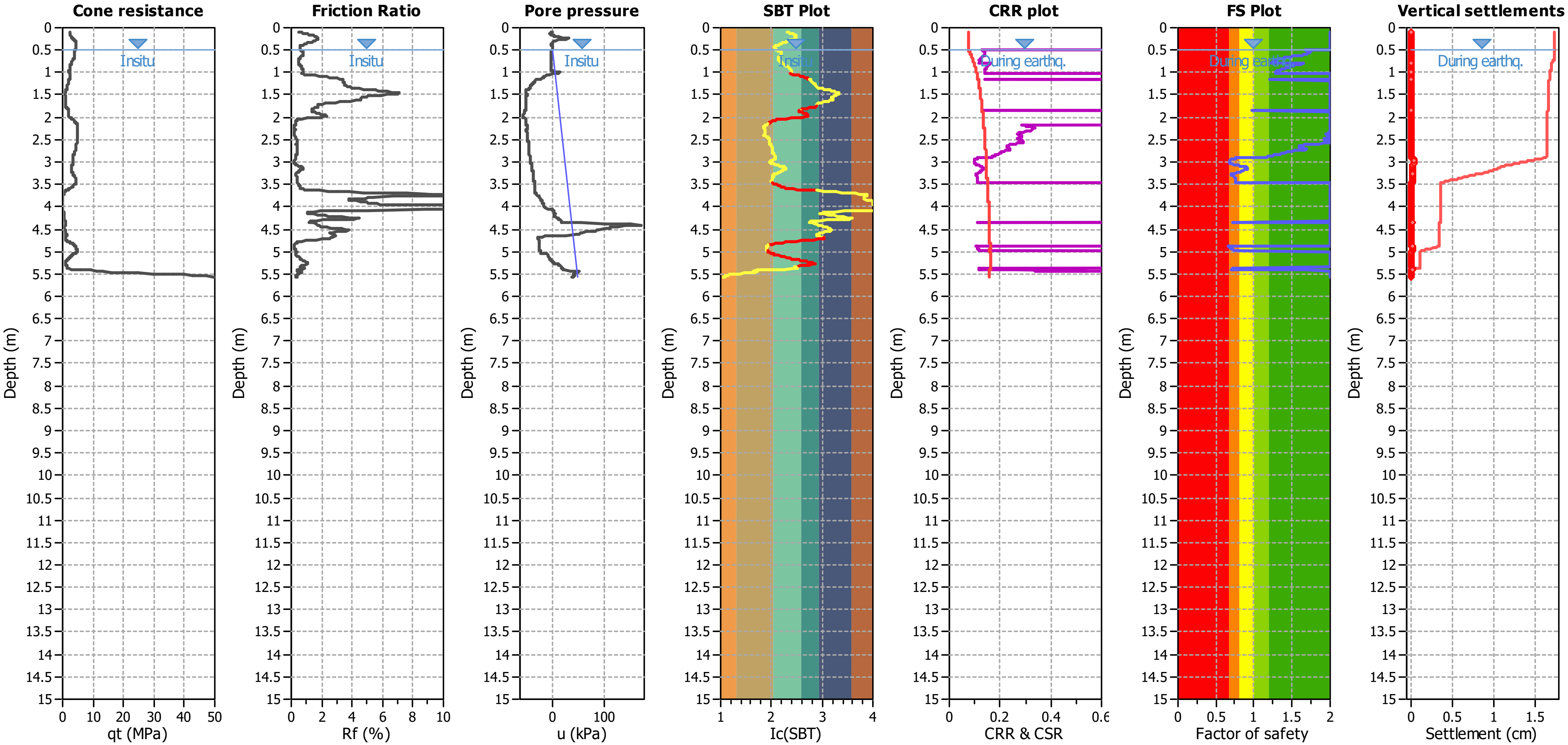
CPT: CPT_121642
Total depth: 11.92 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121633
Total depth: 5.58 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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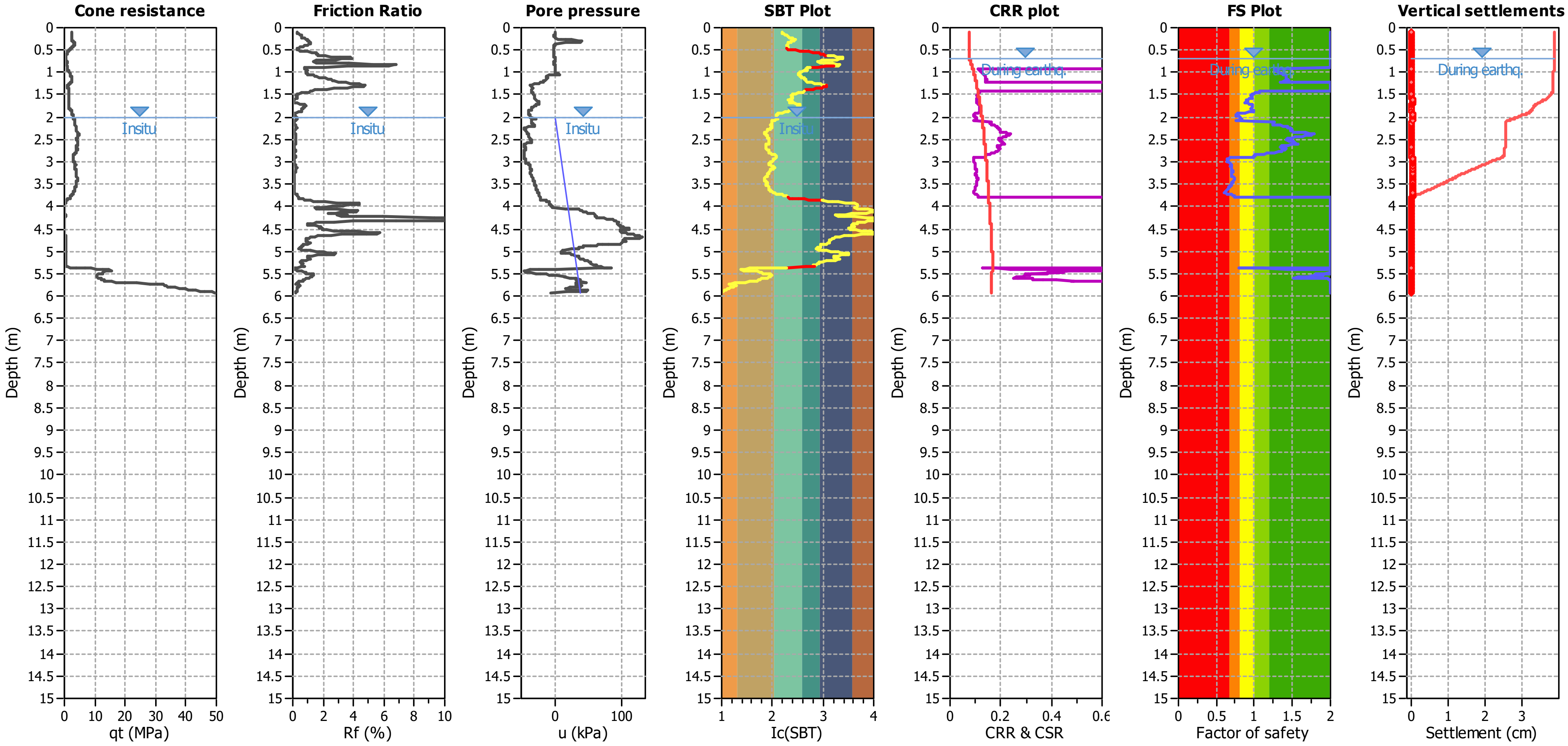
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**

Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121626

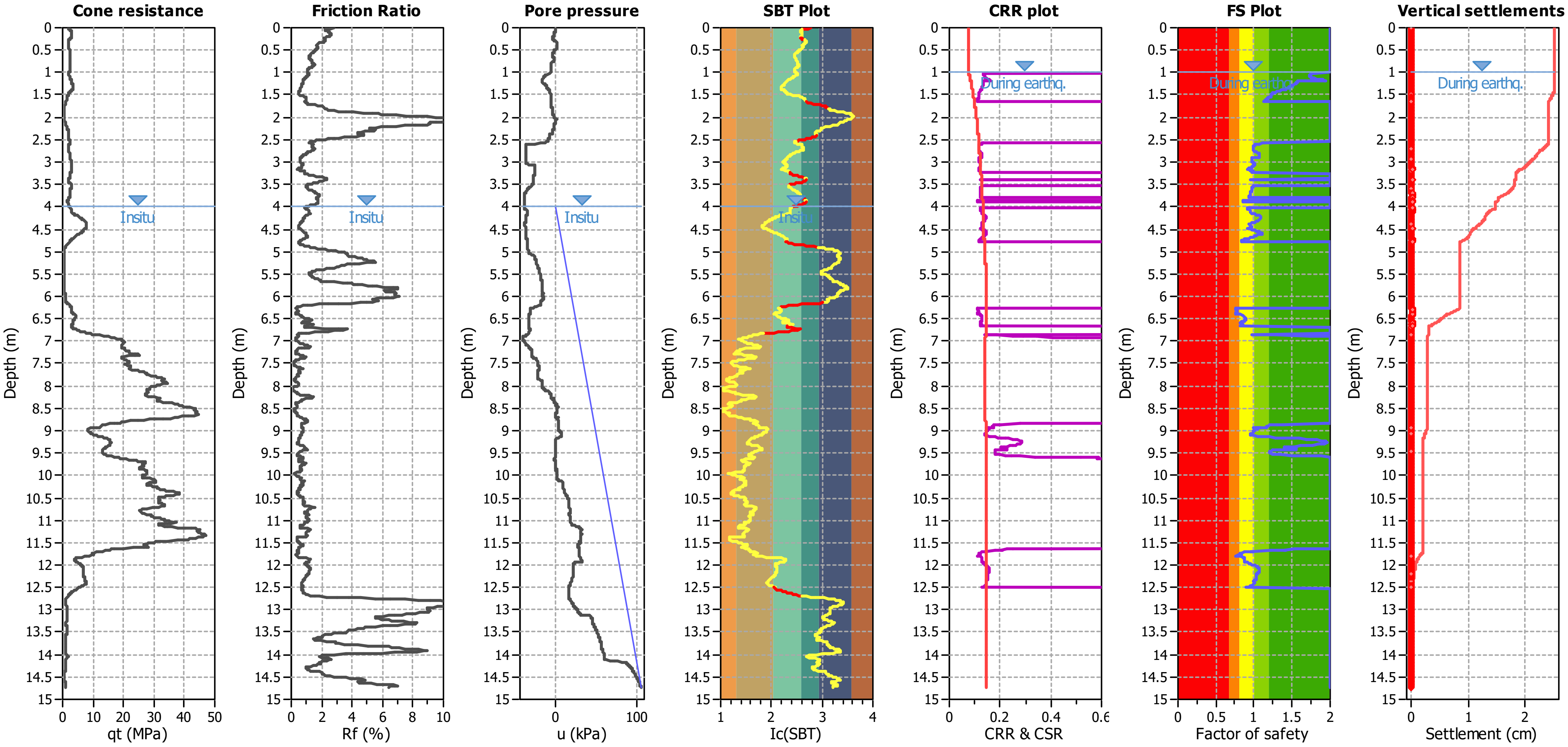
Total depth: 5.92 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121616
Total depth: 14.72 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.13

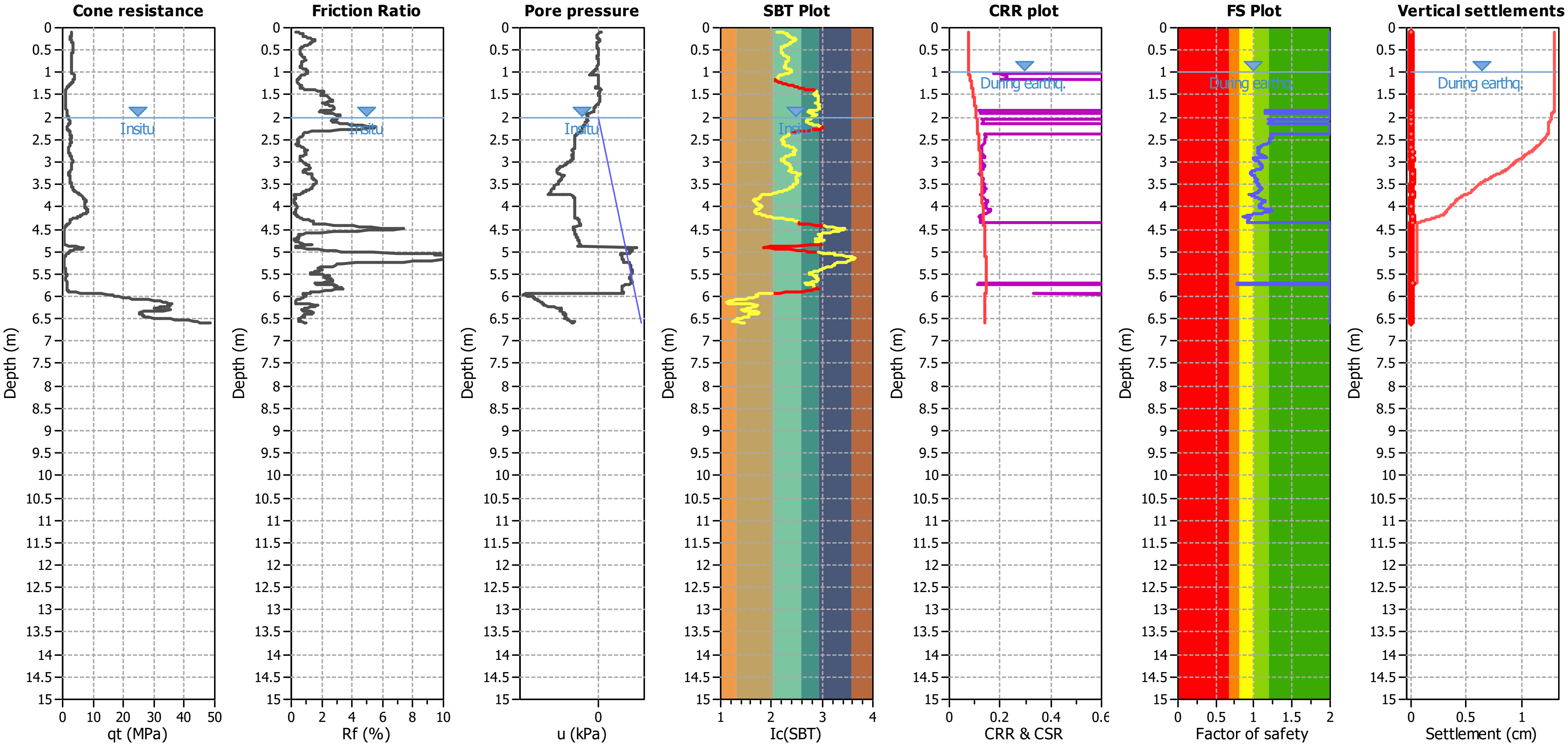
G.W.T. (in-situ): 4.00 m
G.W.T. (earthq.): 1.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

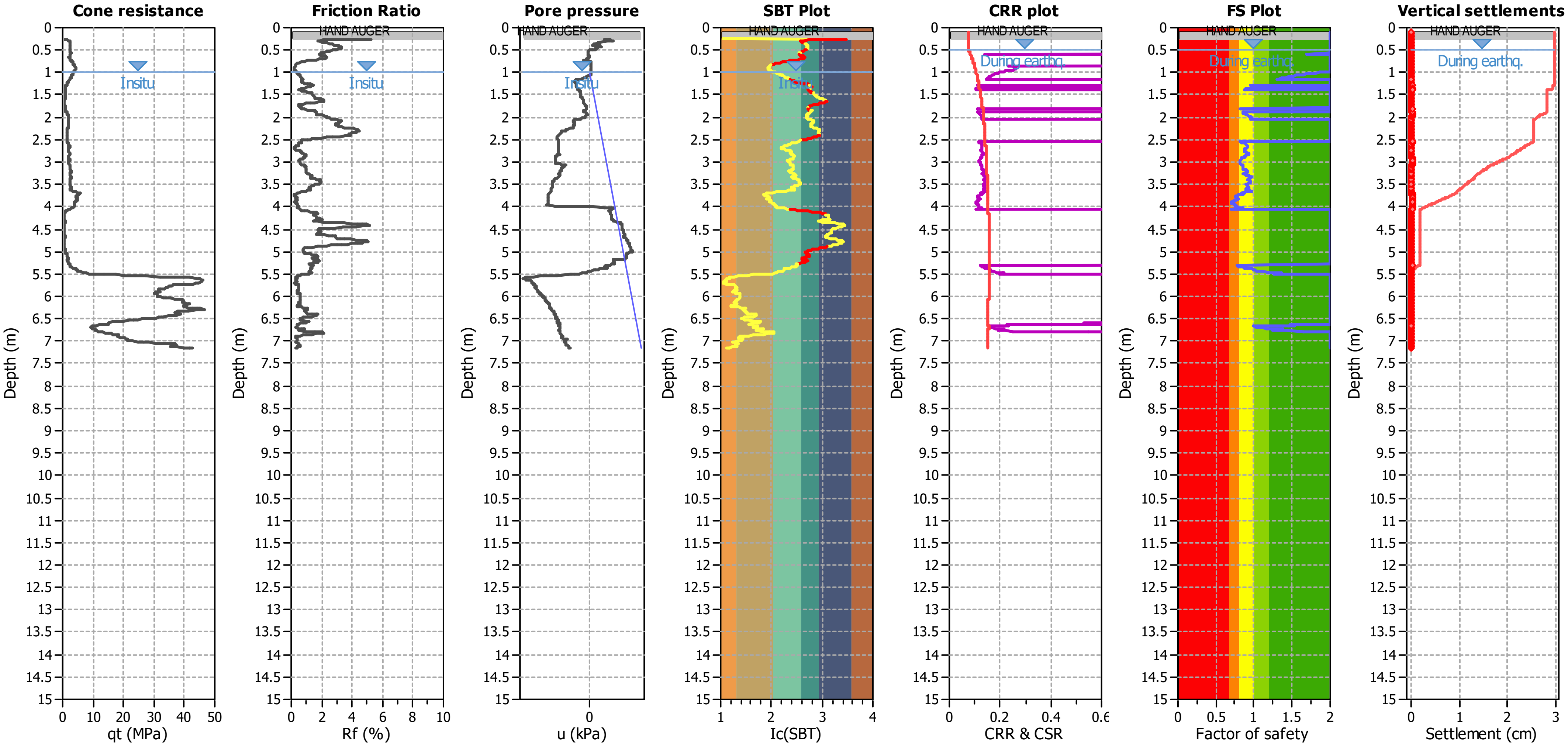
CPT: CPT_121618
Total depth: 6.60 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

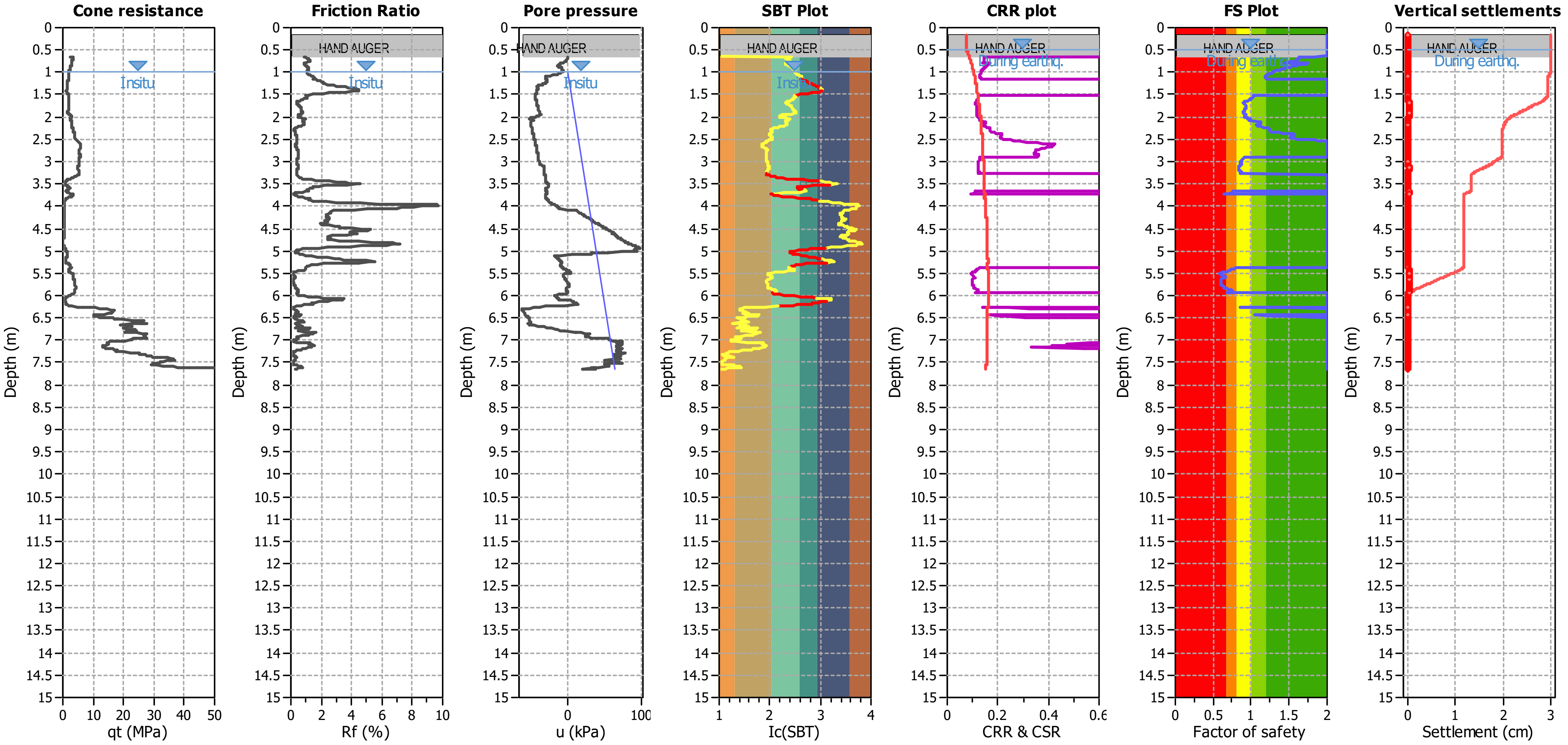
CPT: CPT_121620
Total depth: 7.16 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

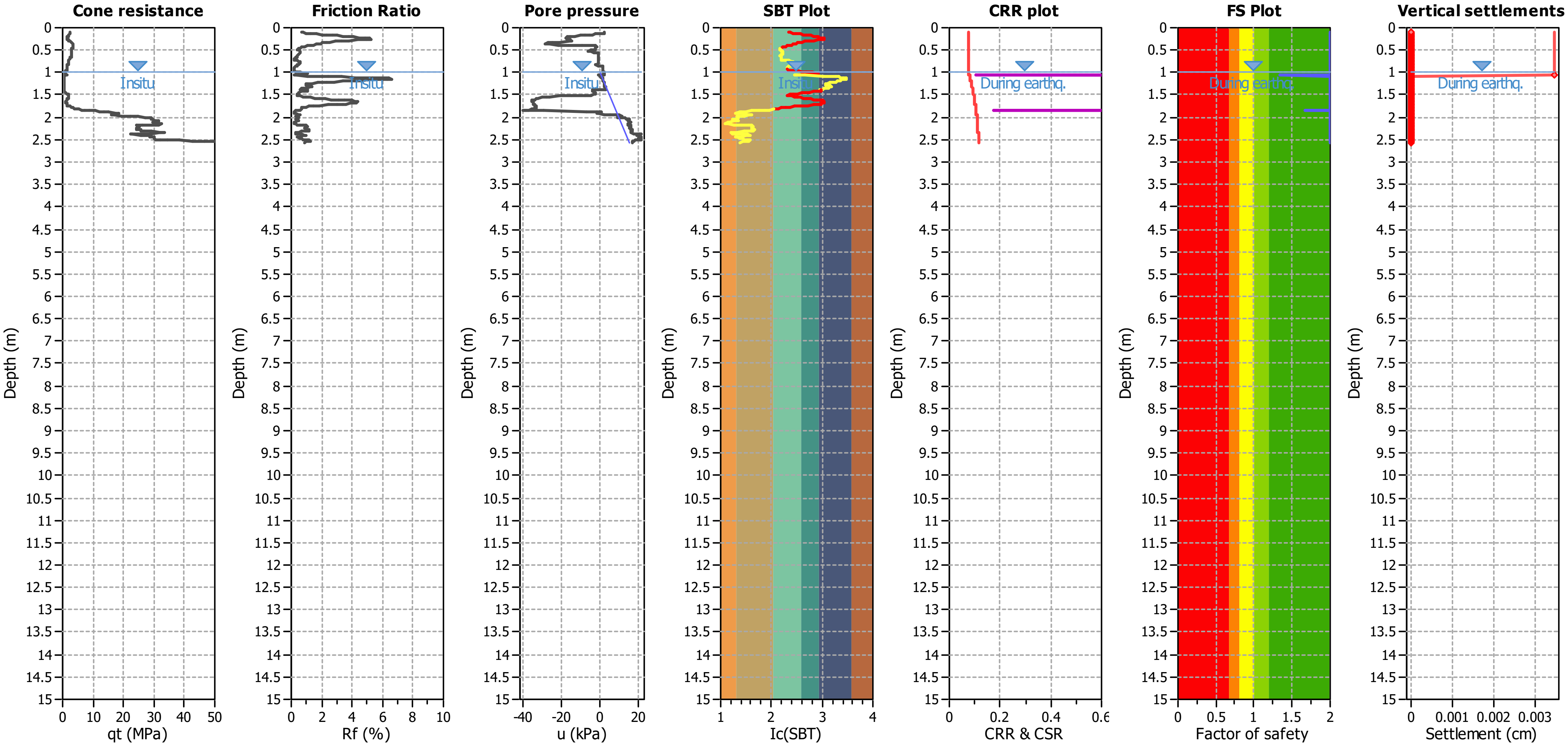
CPT: CPT_121632
Total depth: 7.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

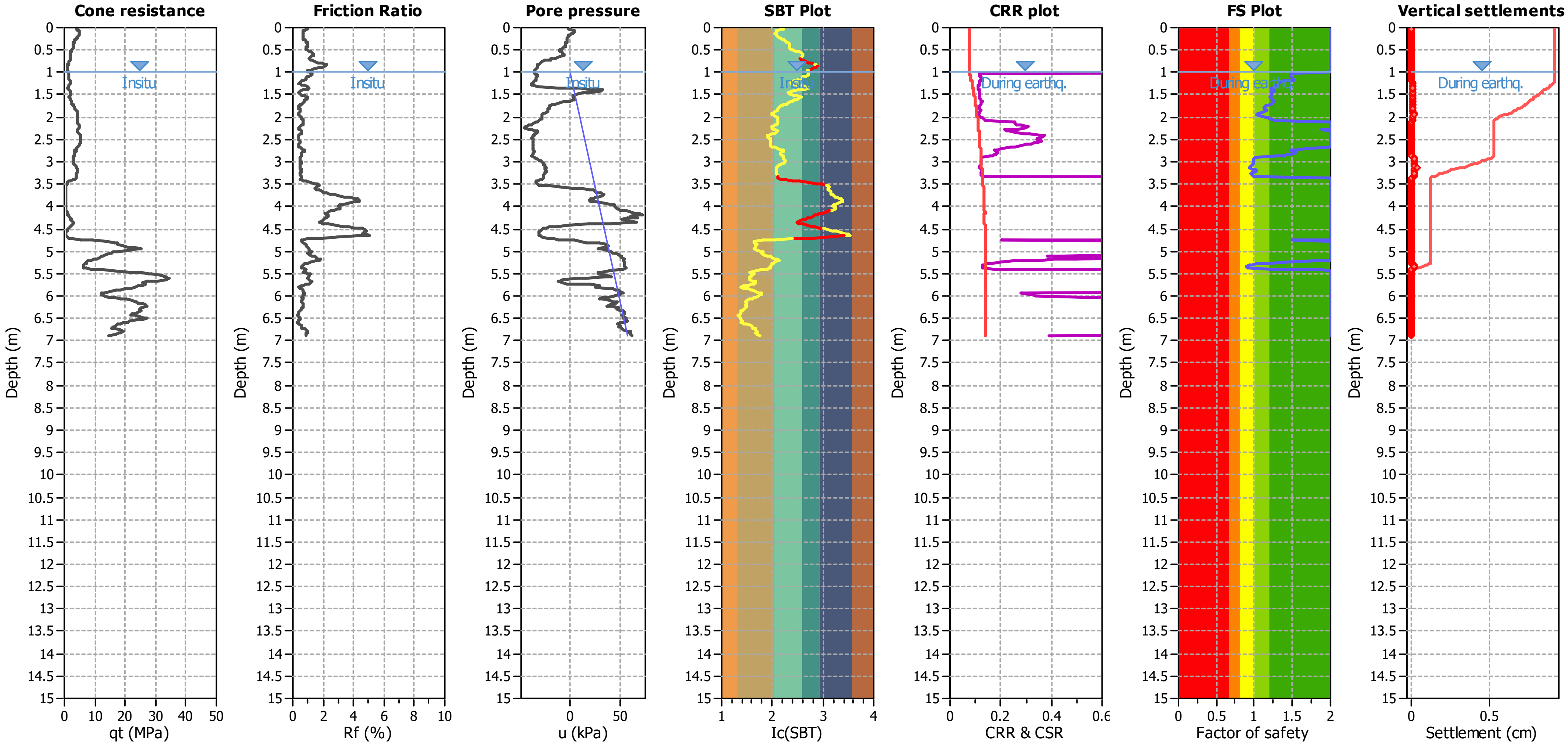
CPT: CPT-121639
Total depth: 2.56 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128289
Total depth: 6.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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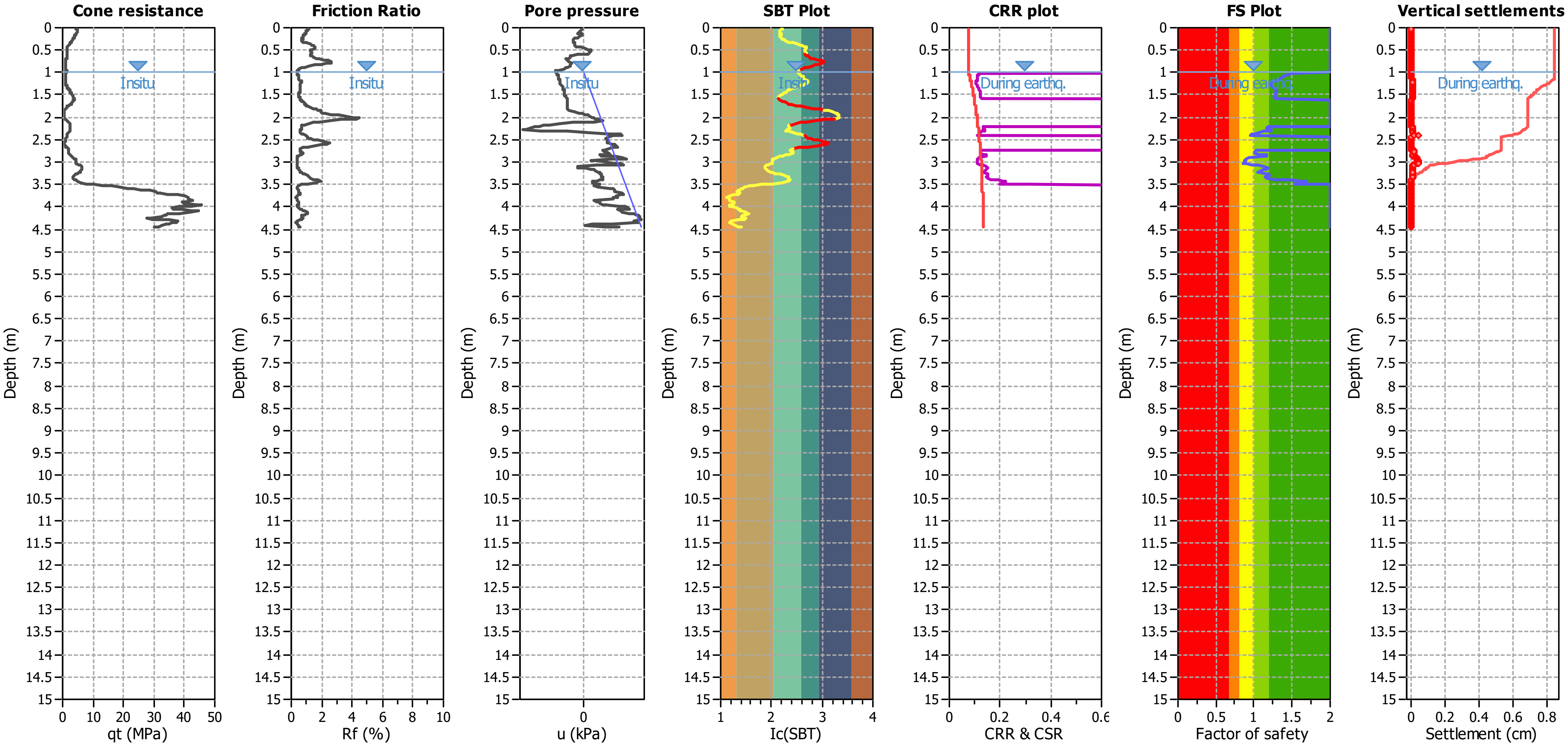
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128291
Total depth: 4.46 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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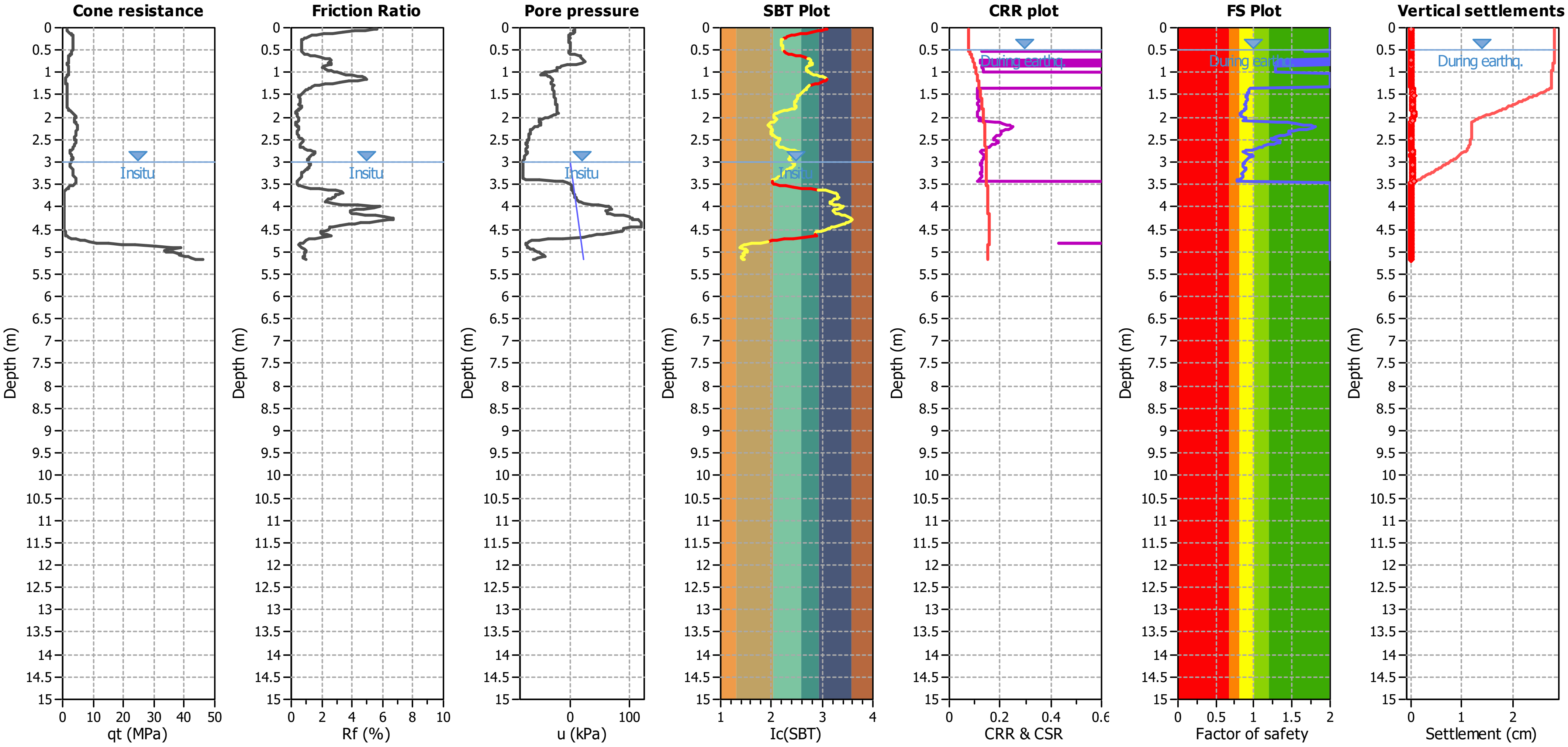
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

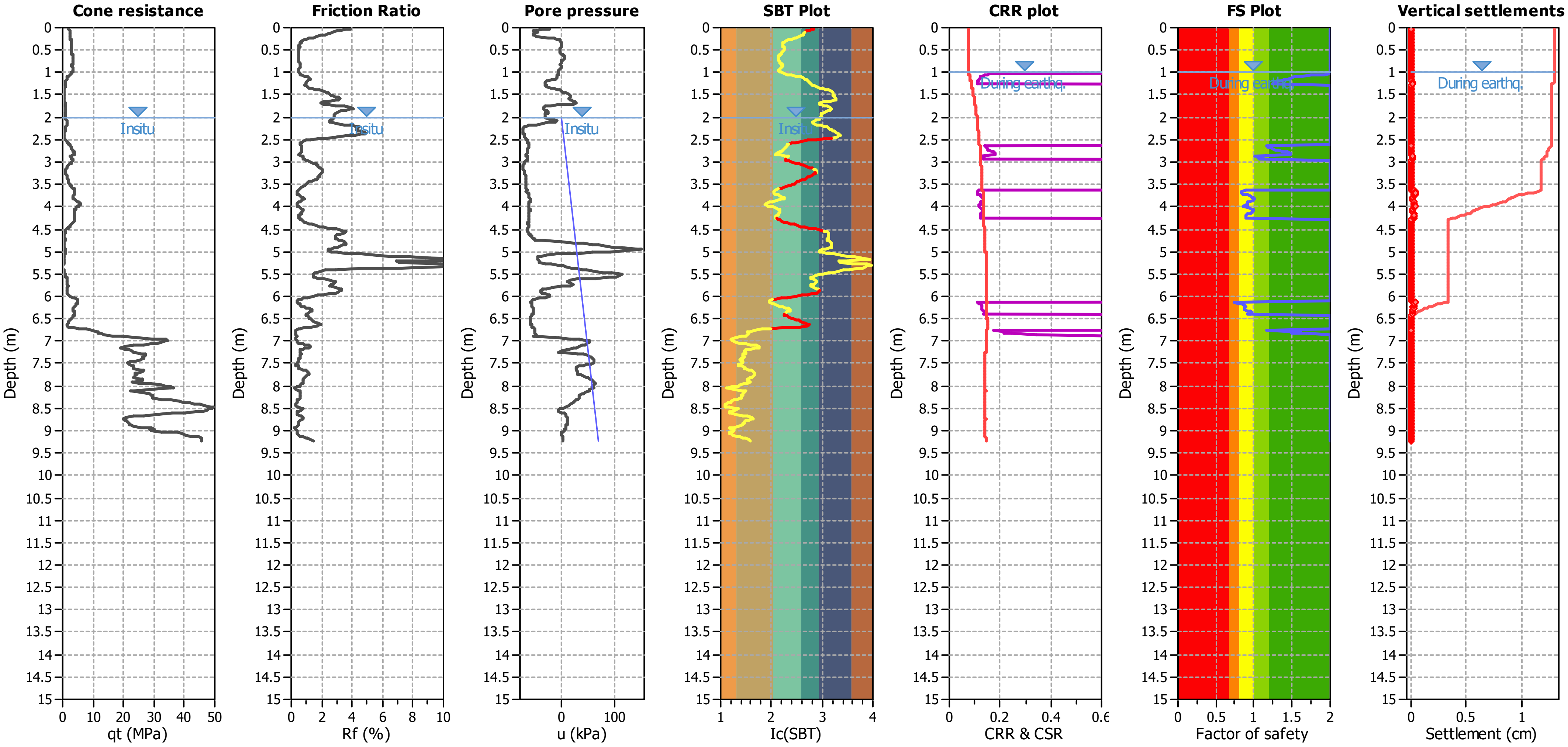
CPT: CPT_128293
Total depth: 5.18 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

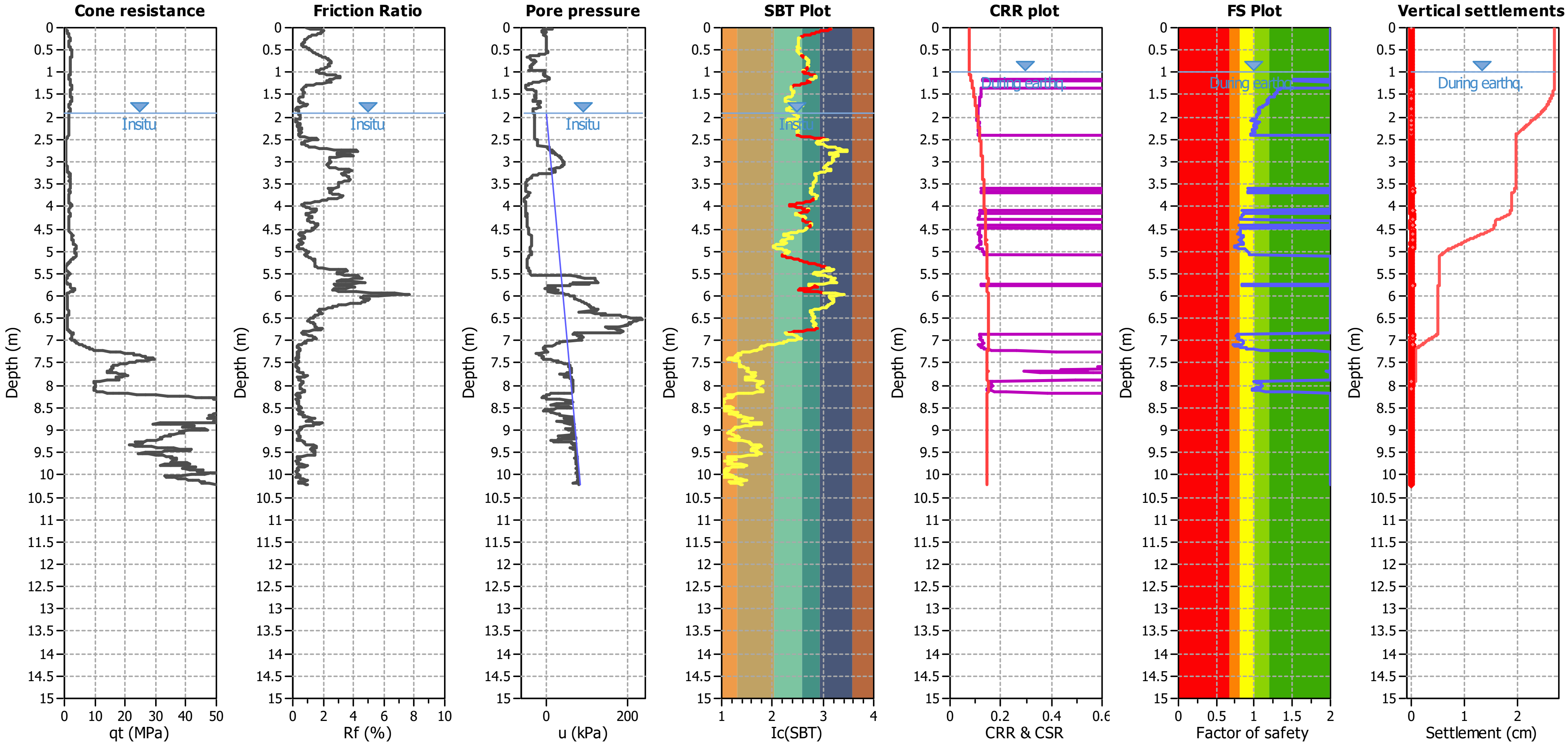
CPT: CPT_128296
Total depth: 9.22 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_97674
Total depth: 10.22 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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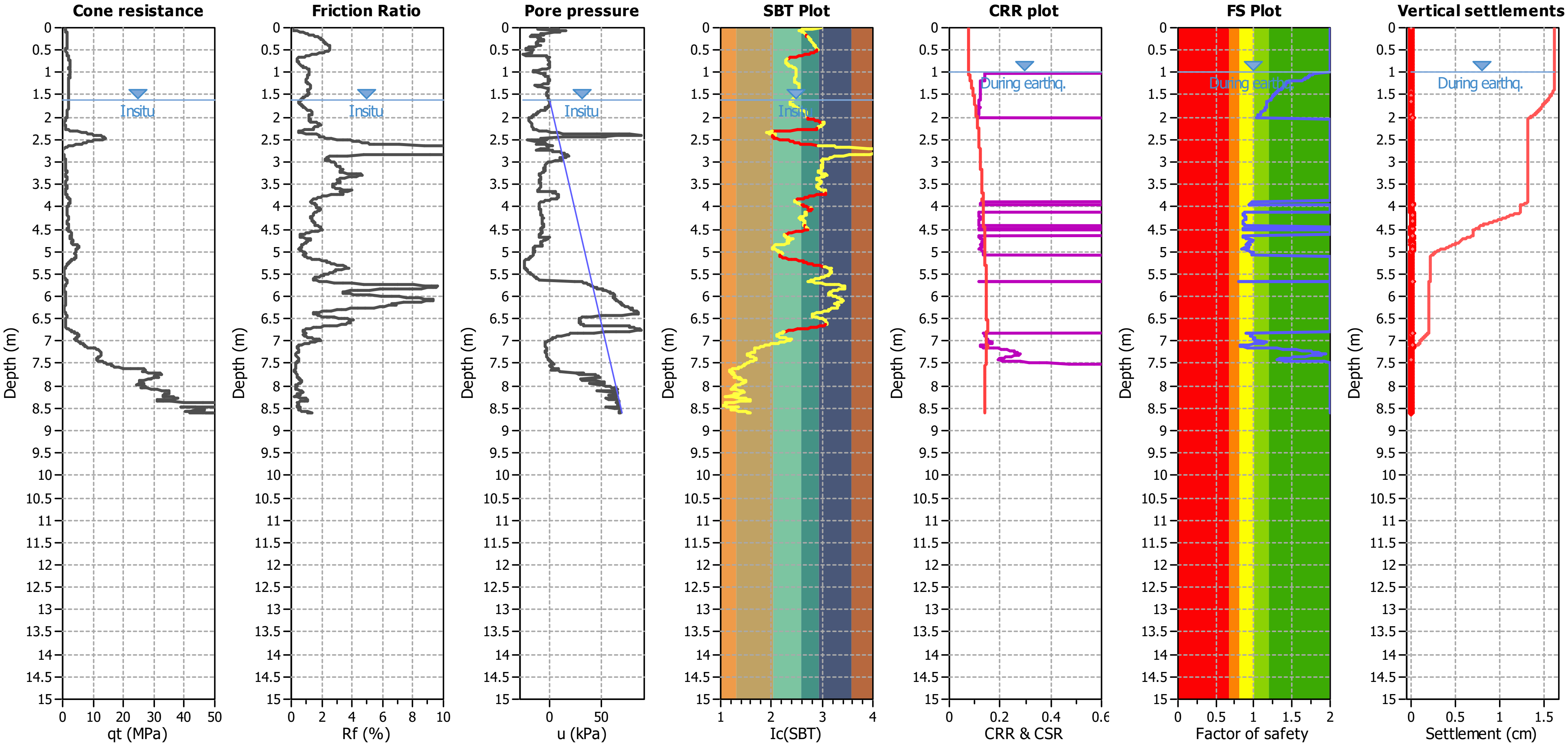
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_97675
Total depth: 8.62 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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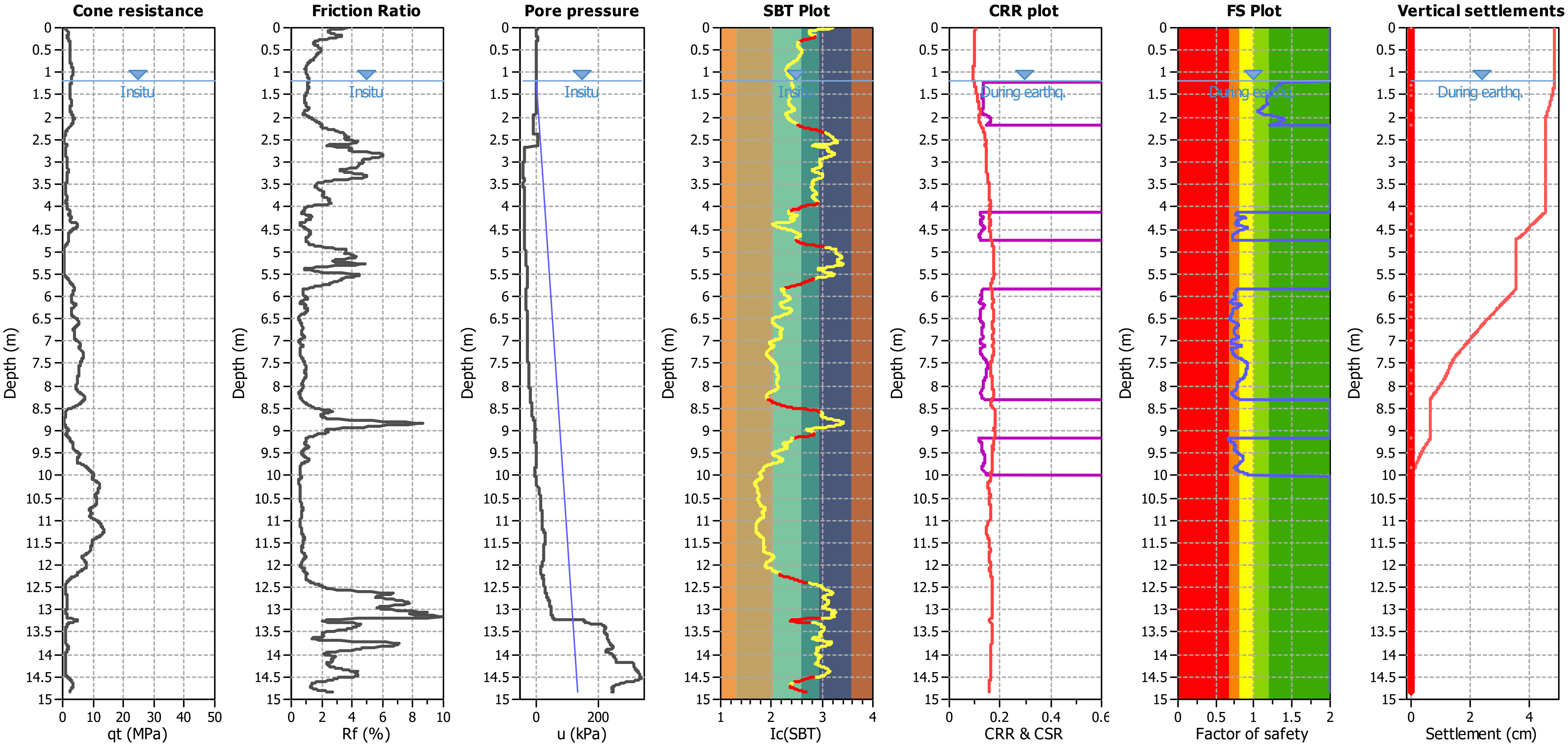
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121612
Total depth: 14.84 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.00
Peak ground acceleration: 0.19

G.W.T. (in-situ): 1.20 m
G.W.T. (earthq.): 1.20 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: Yes
Limit depth applied: Yes
Limit depth: 10.00 m
MSF method: Method based

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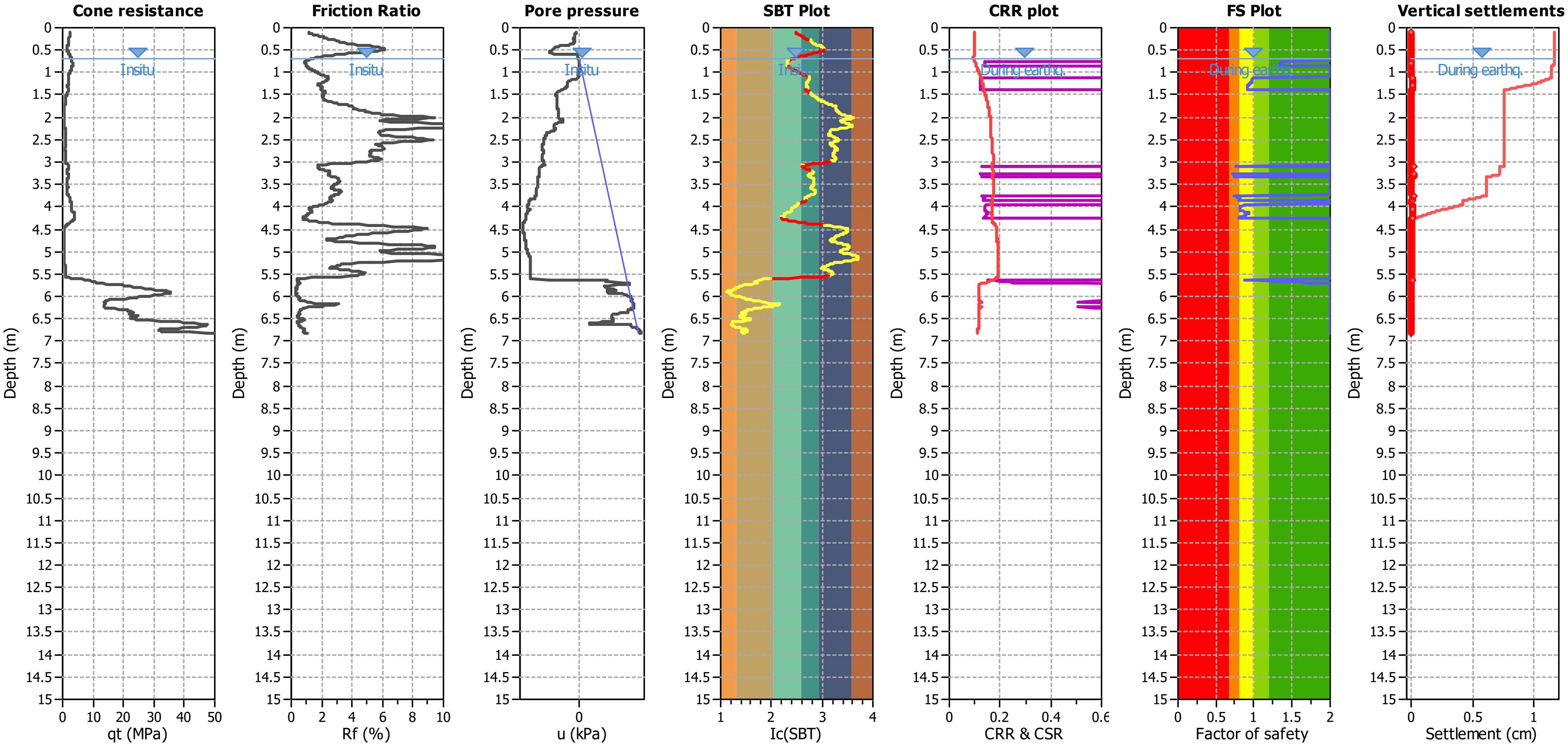
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121614
Total depth: 6.82 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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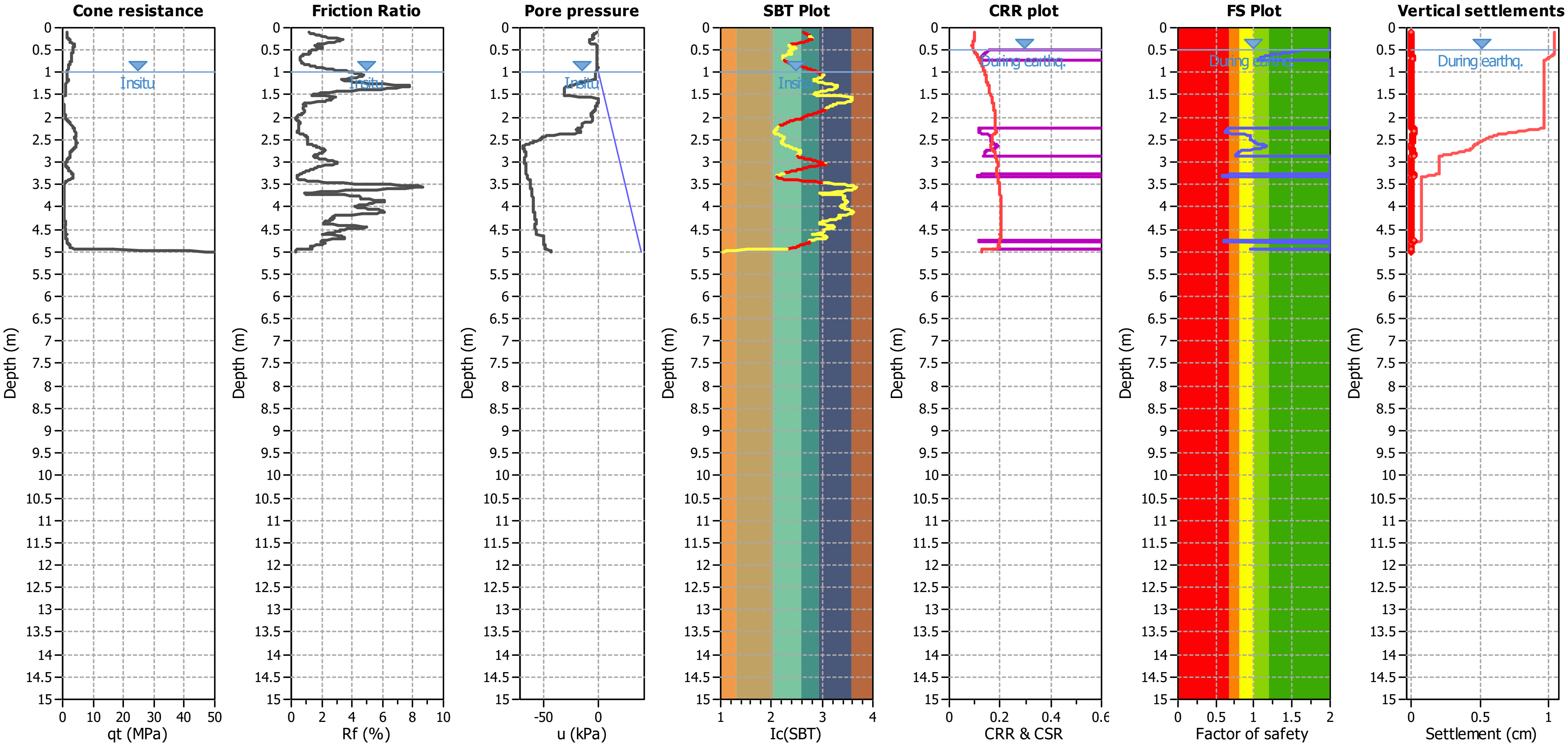
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121628
Total depth: 5.02 m


Cone resistance **Friction Ratio** **Pore pressure** **SBT Plot** **CRR plot** **FS Plot** **Vertical settlements**

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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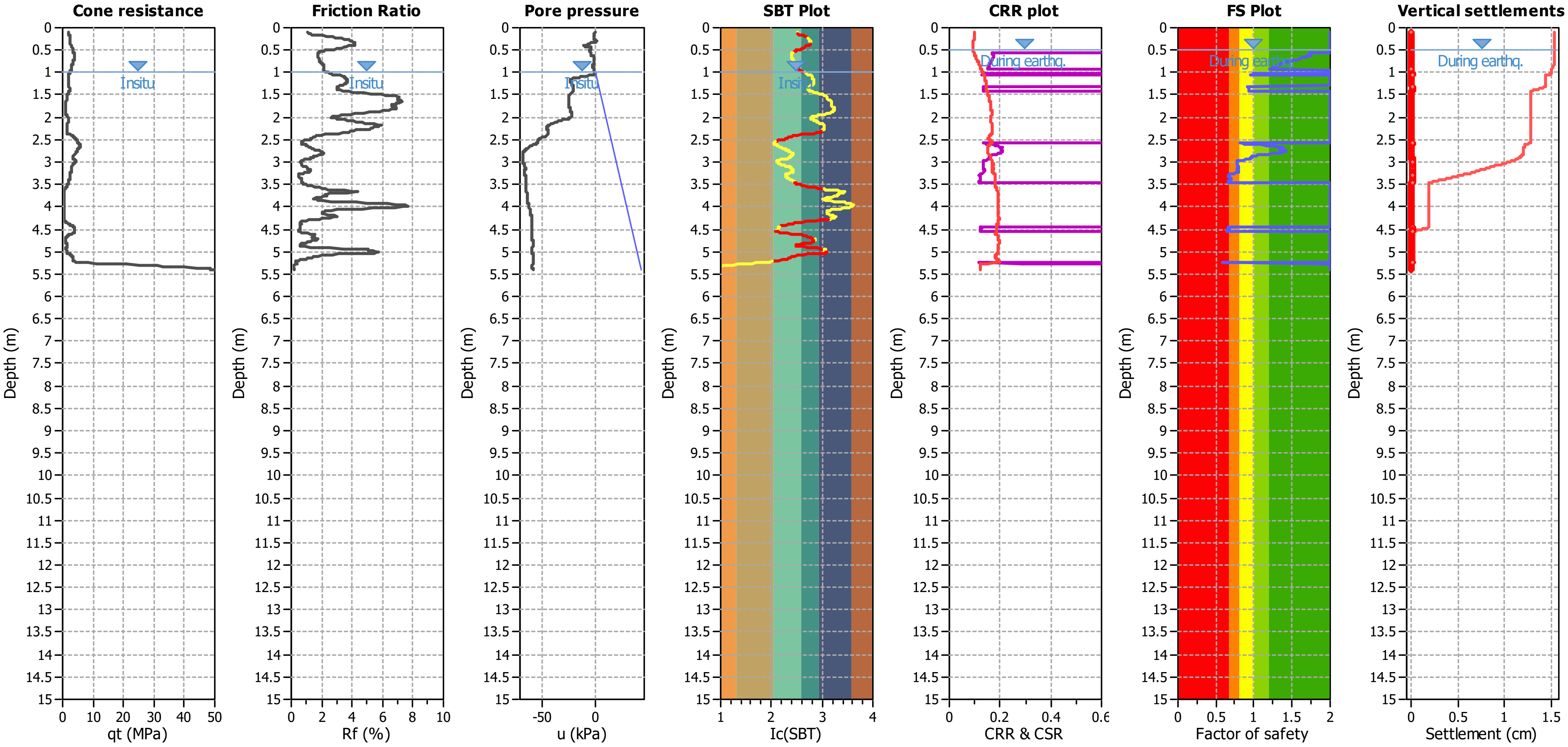
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

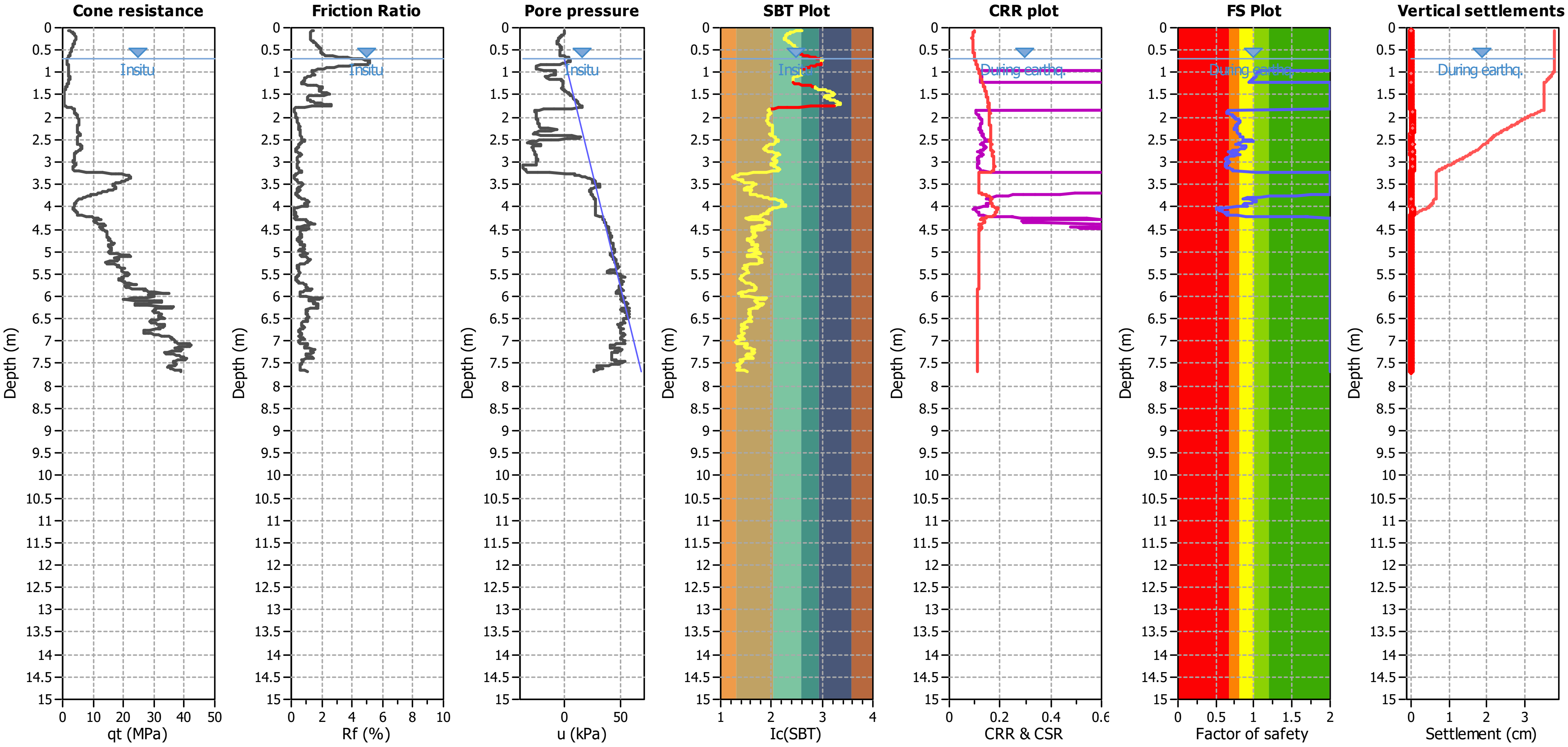
CPT: CPT_121637
Total depth: 5.42 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

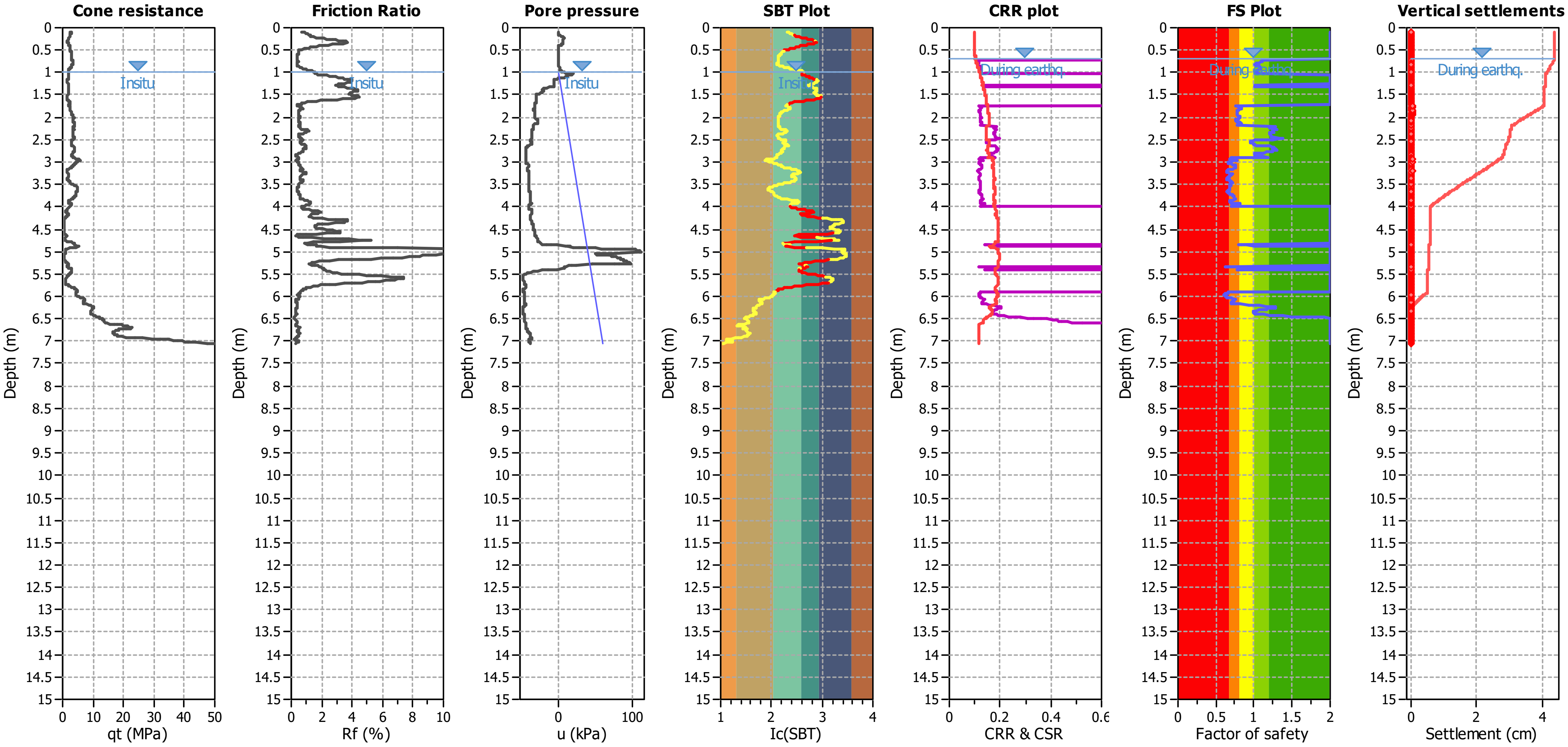
CPT: CPT_121641
Total depth: 7.67 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

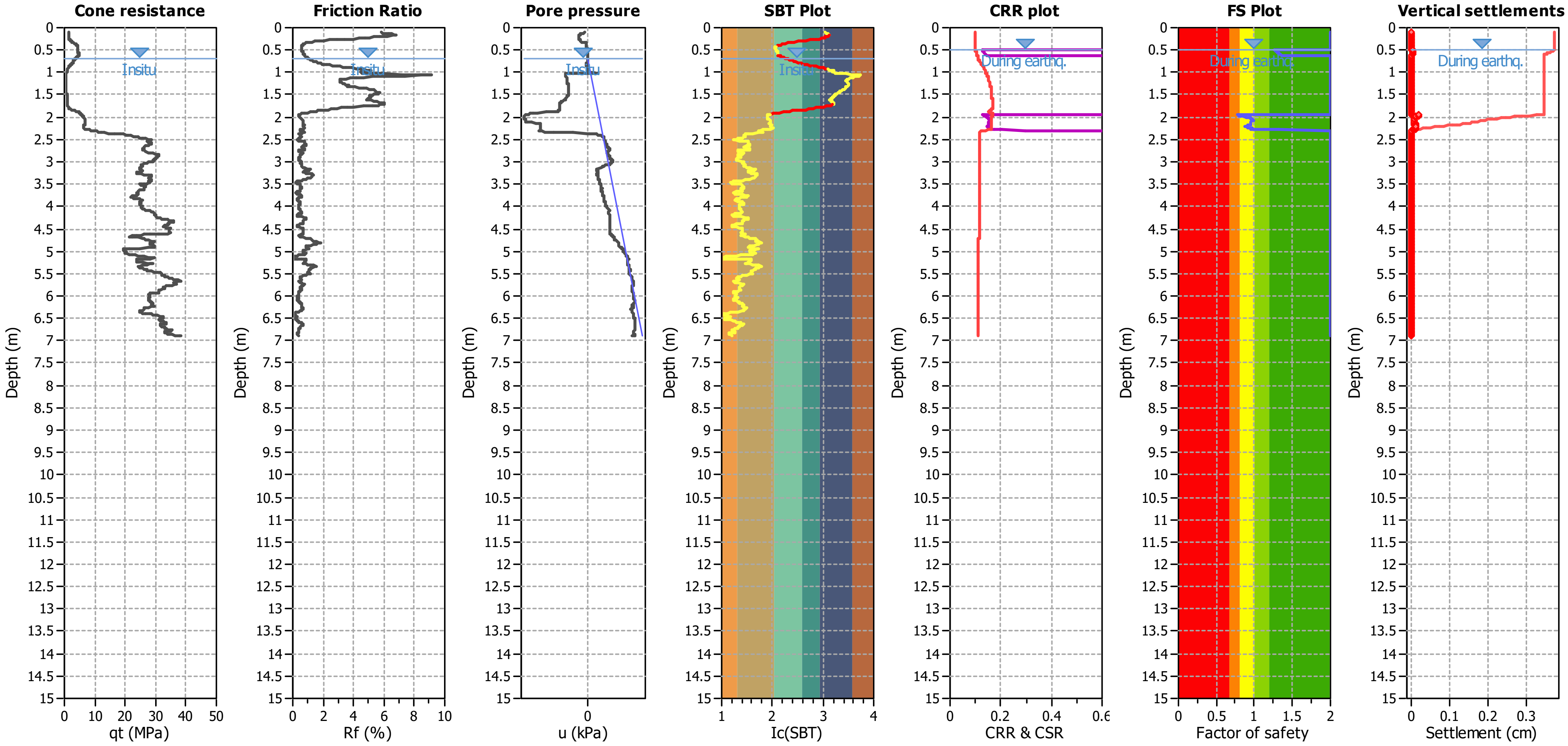
CPT: CPT_121623
Total depth: 7.05 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121643
Total depth: 6.90 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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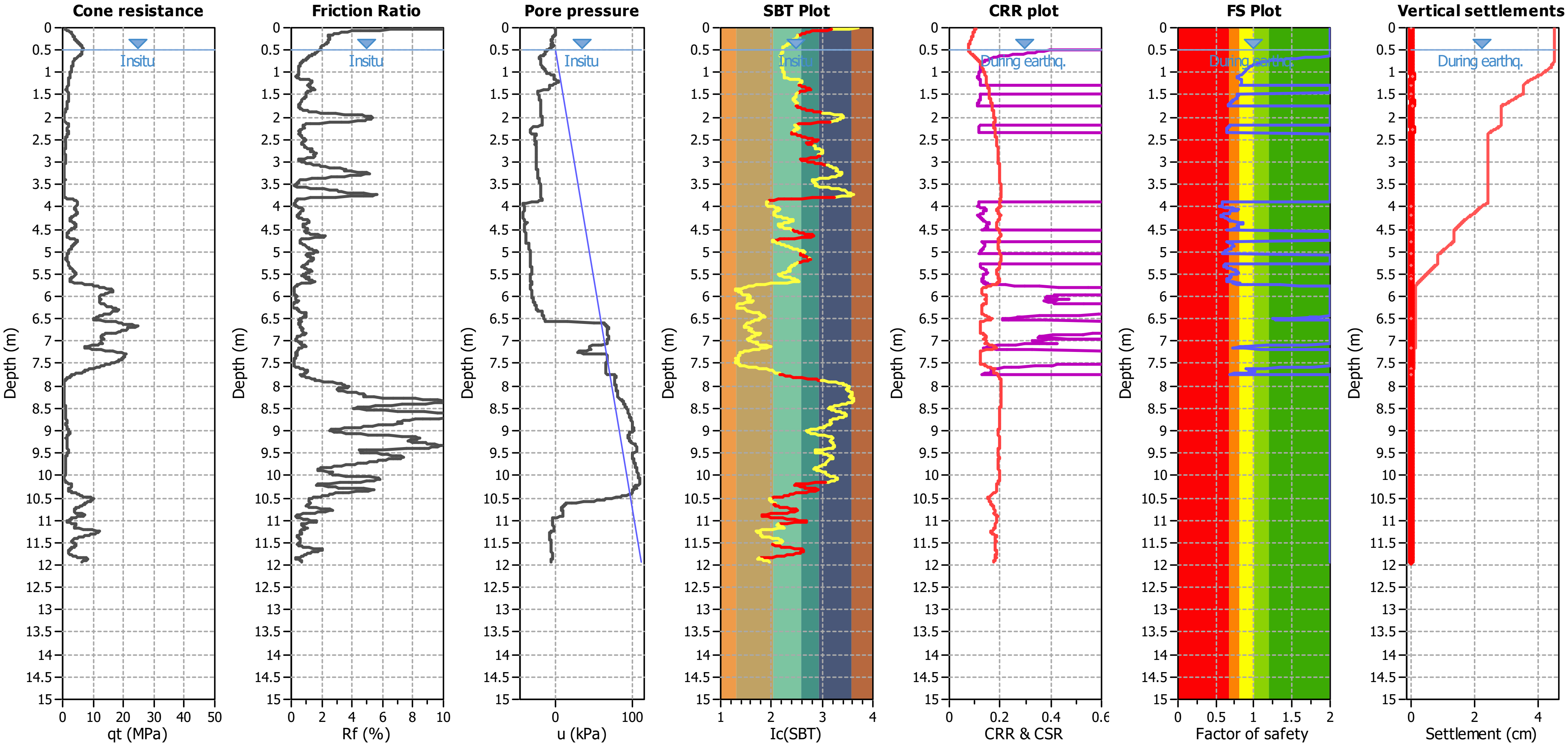
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

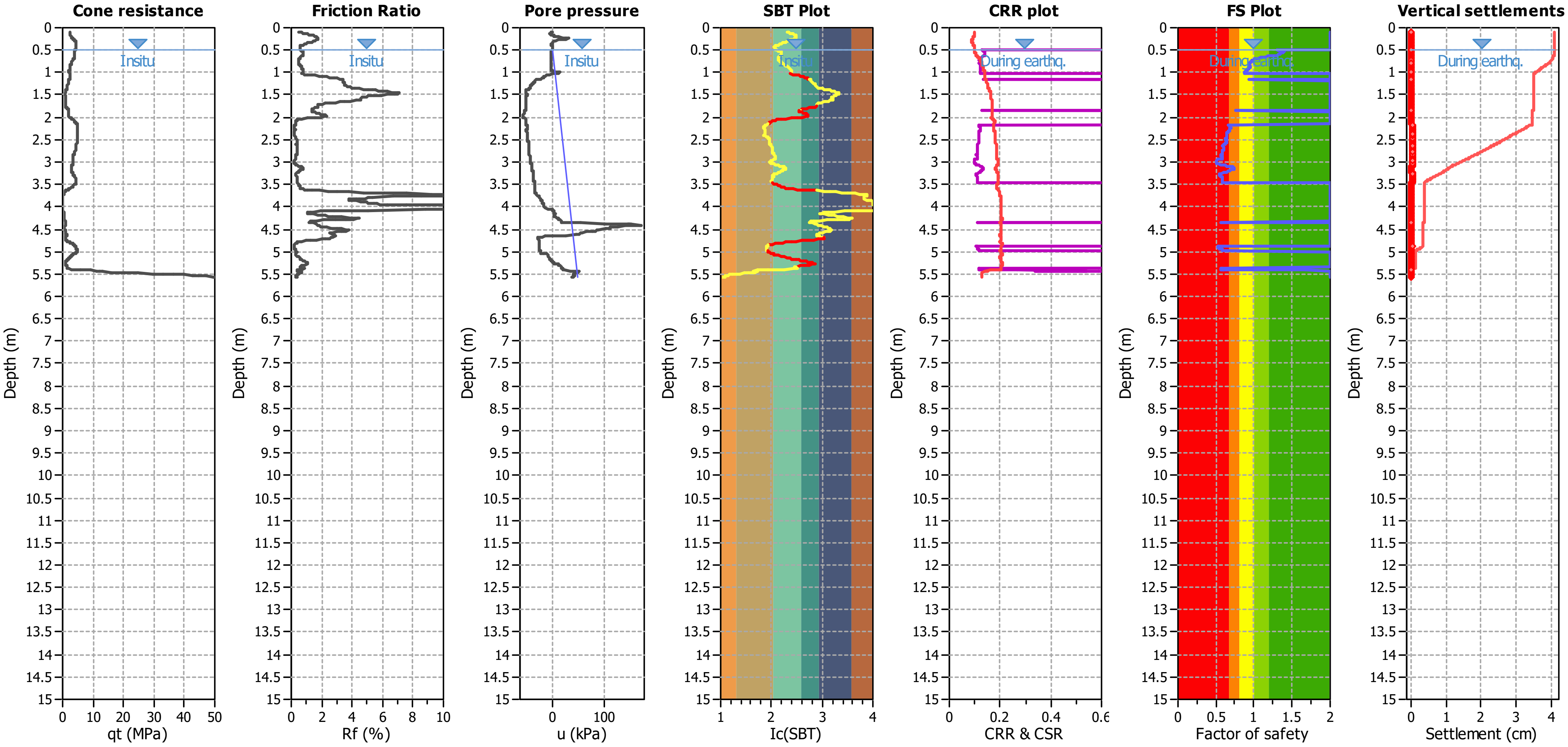
CPT: CPT_121642
Total depth: 11.92 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121633
Total depth: 5.58 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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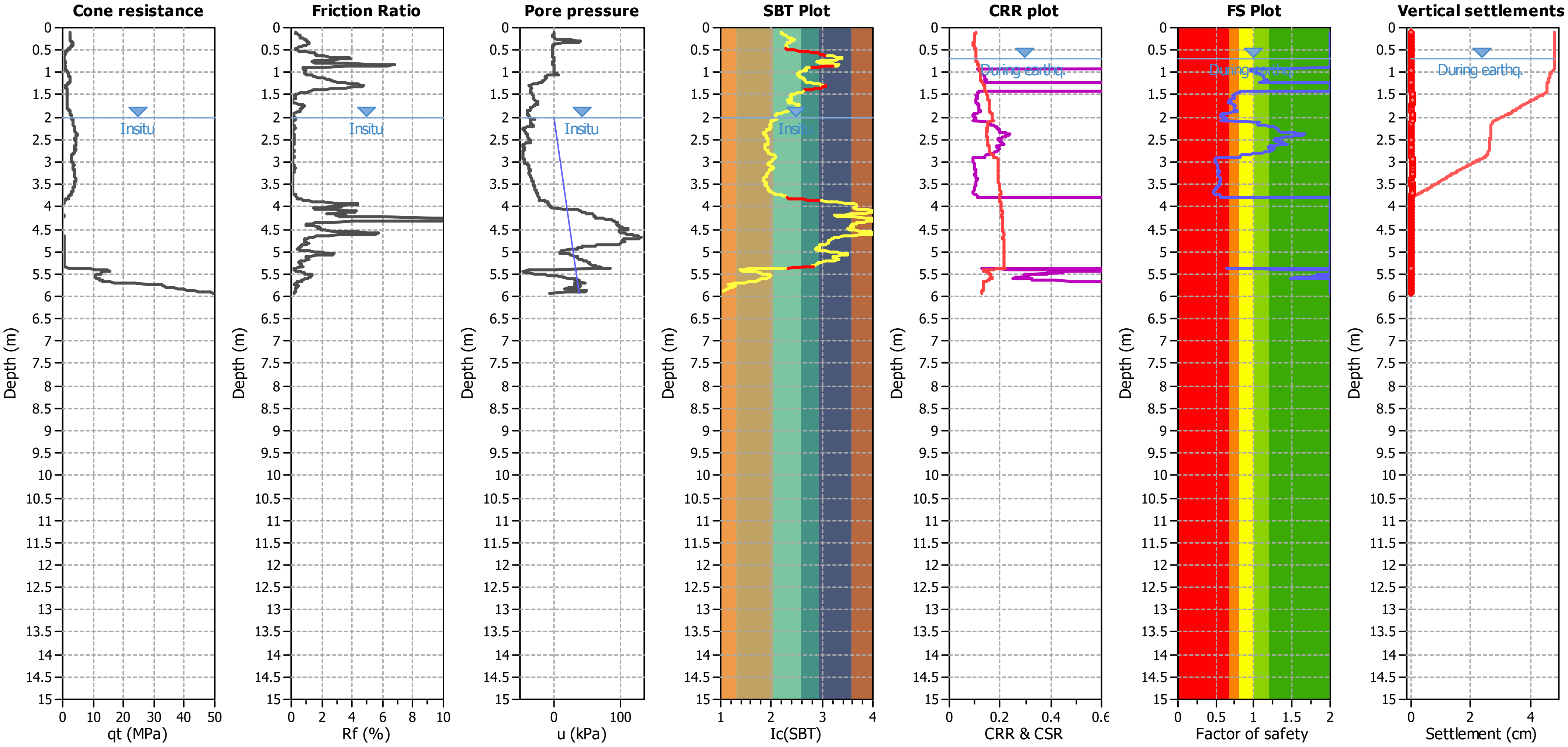
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121626
Total depth: 5.92 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.00
Peak ground acceleration: 0.19

G.W.T. (in-situ): 2.00 m
G.W.T. (earthq.): 0.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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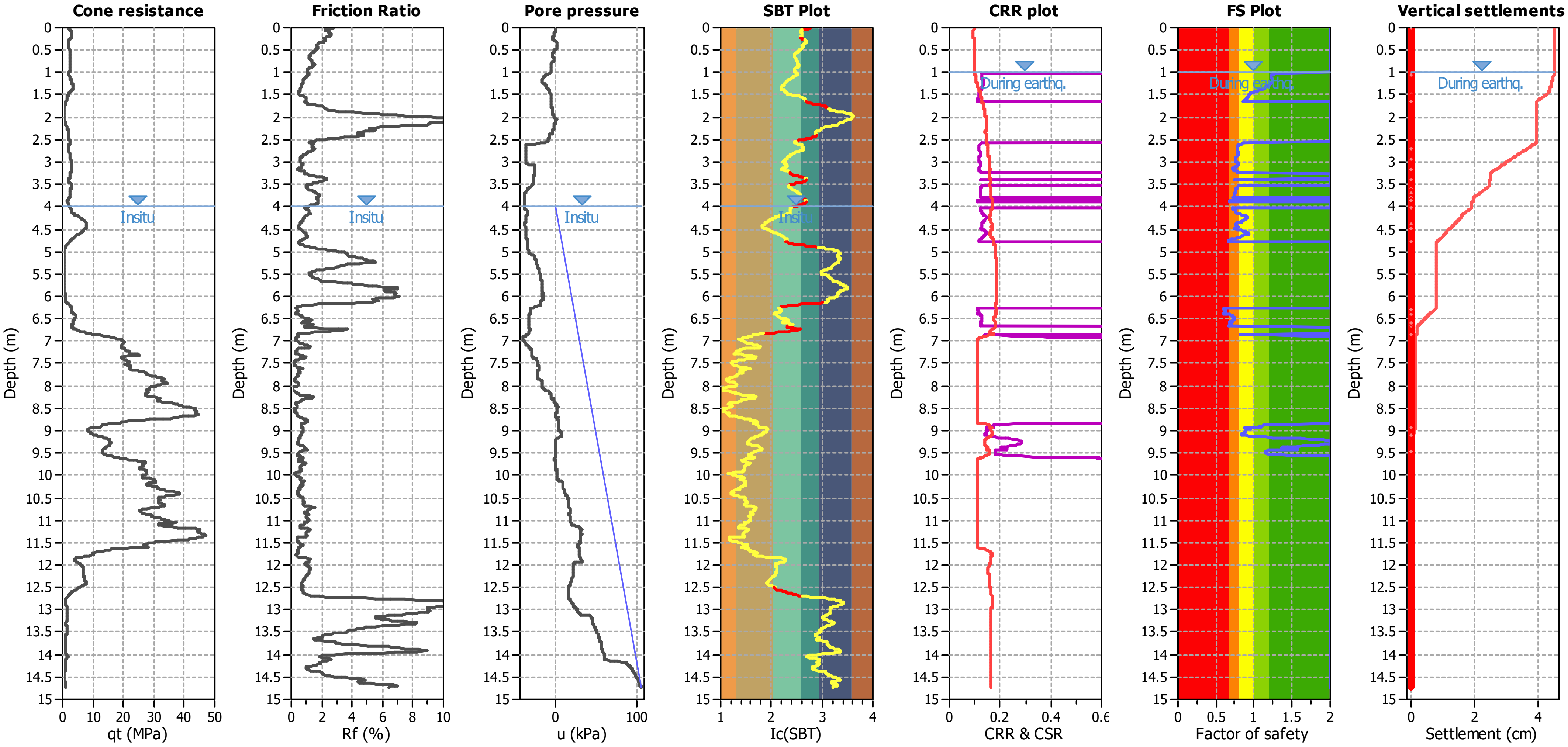
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121616
Total depth: 14.72 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.00
Peak ground acceleration: 0.19

G.W.T. (in-situ): 4.00 m
G.W.T. (earthq.): 1.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: Yes
Limit depth applied: Yes
Limit depth: 10.00 m
MSF method: Method based

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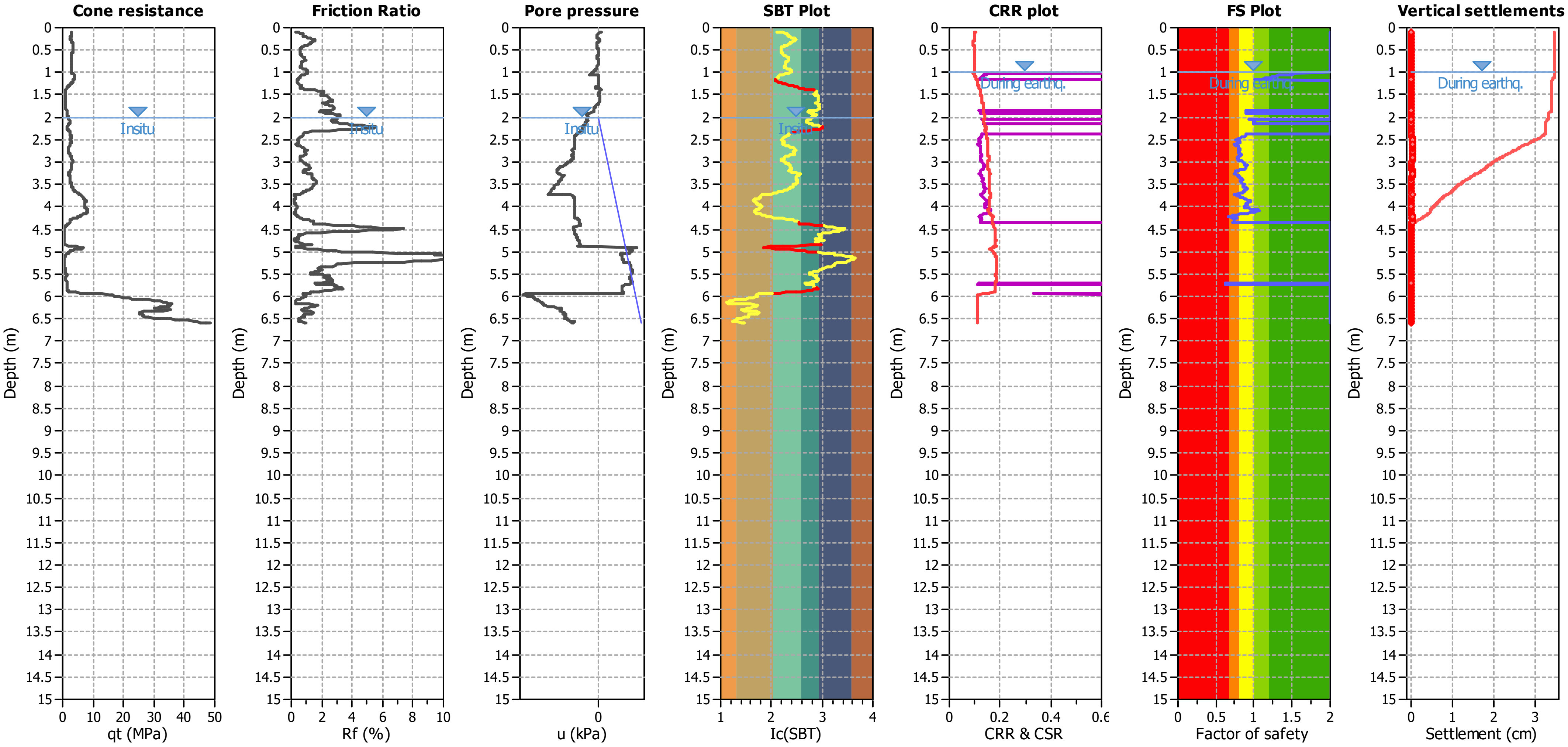
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

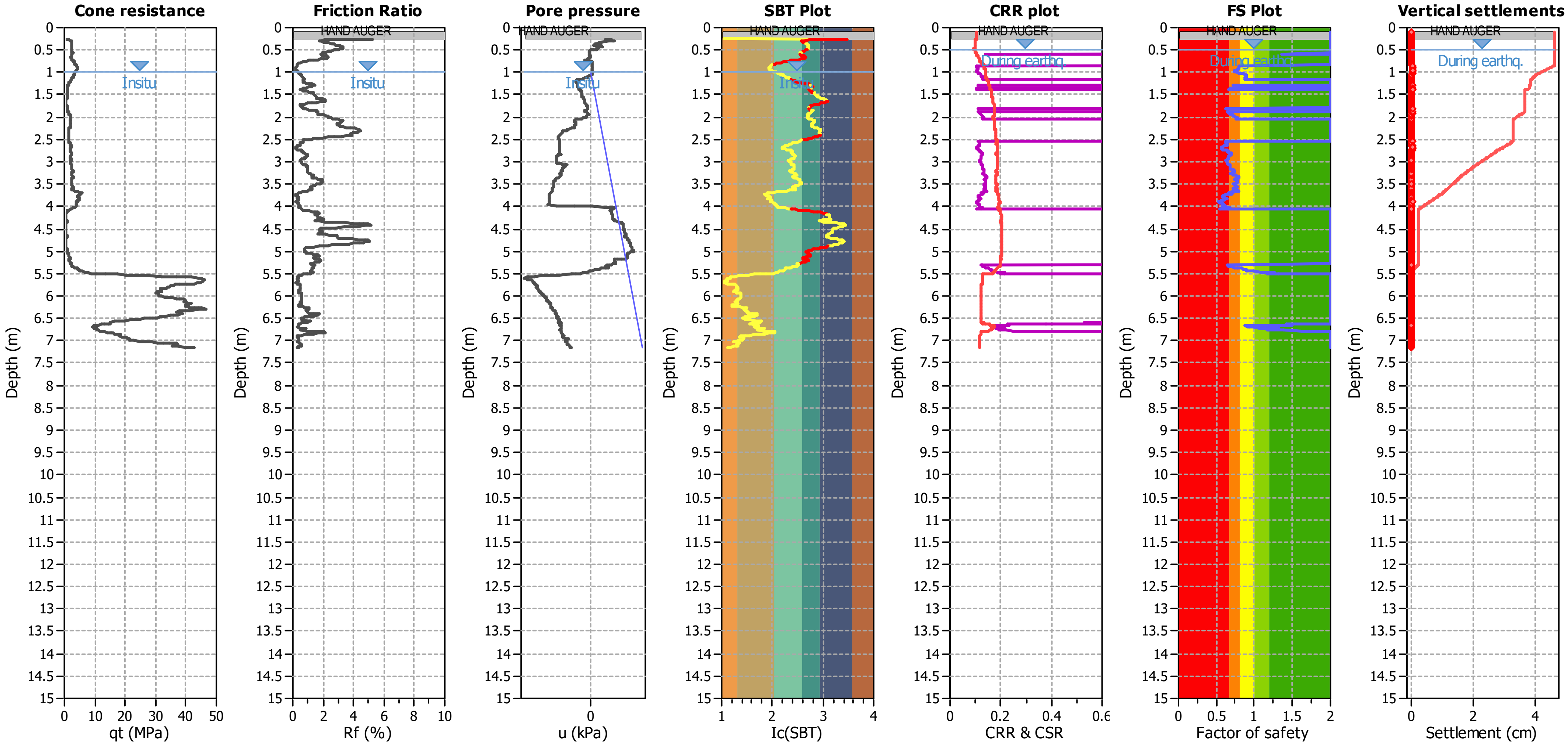
CPT: CPT_121618
Total depth: 6.60 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

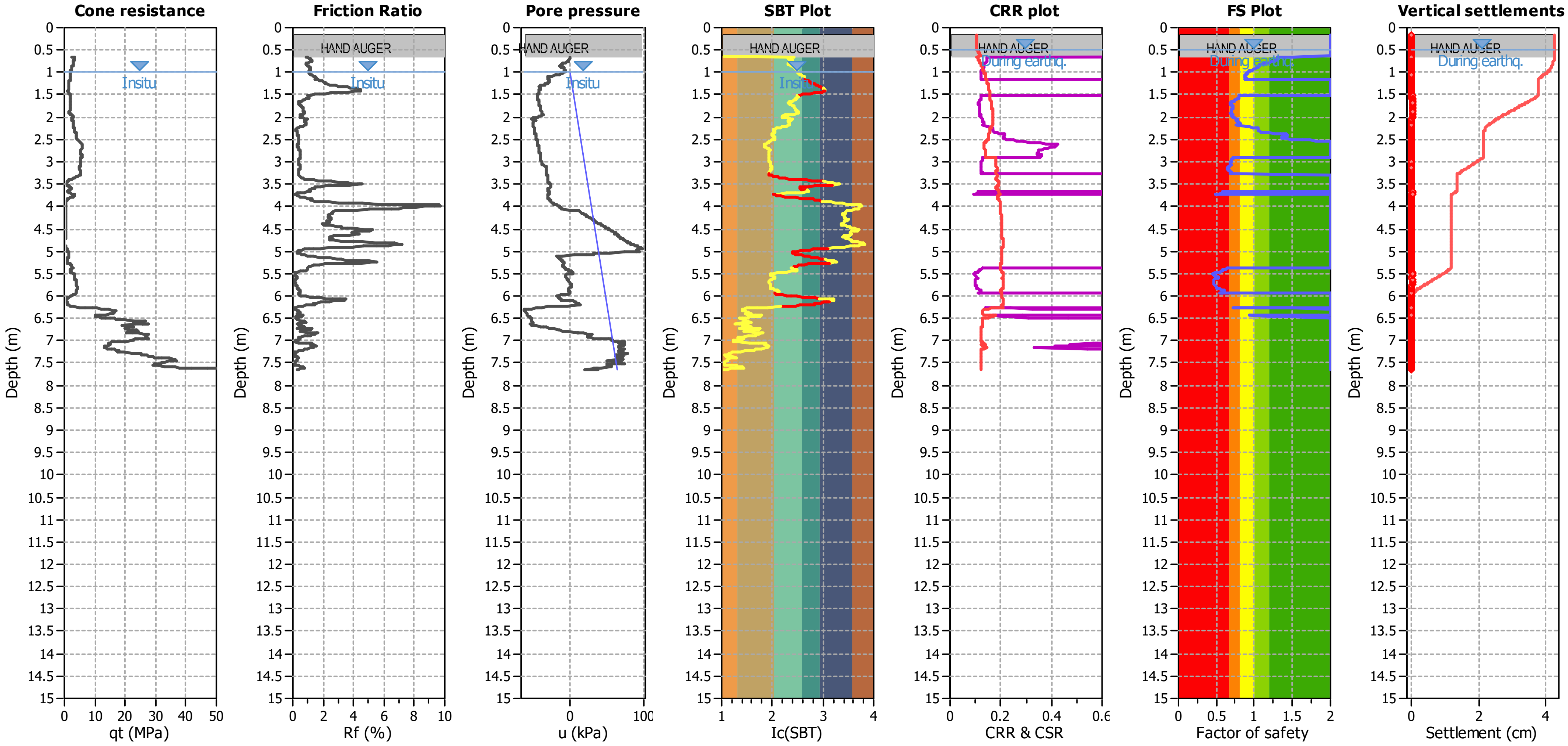
CPT: CPT_121620
Total depth: 7.16 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	applied:	.
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121632
Total depth: 7.66 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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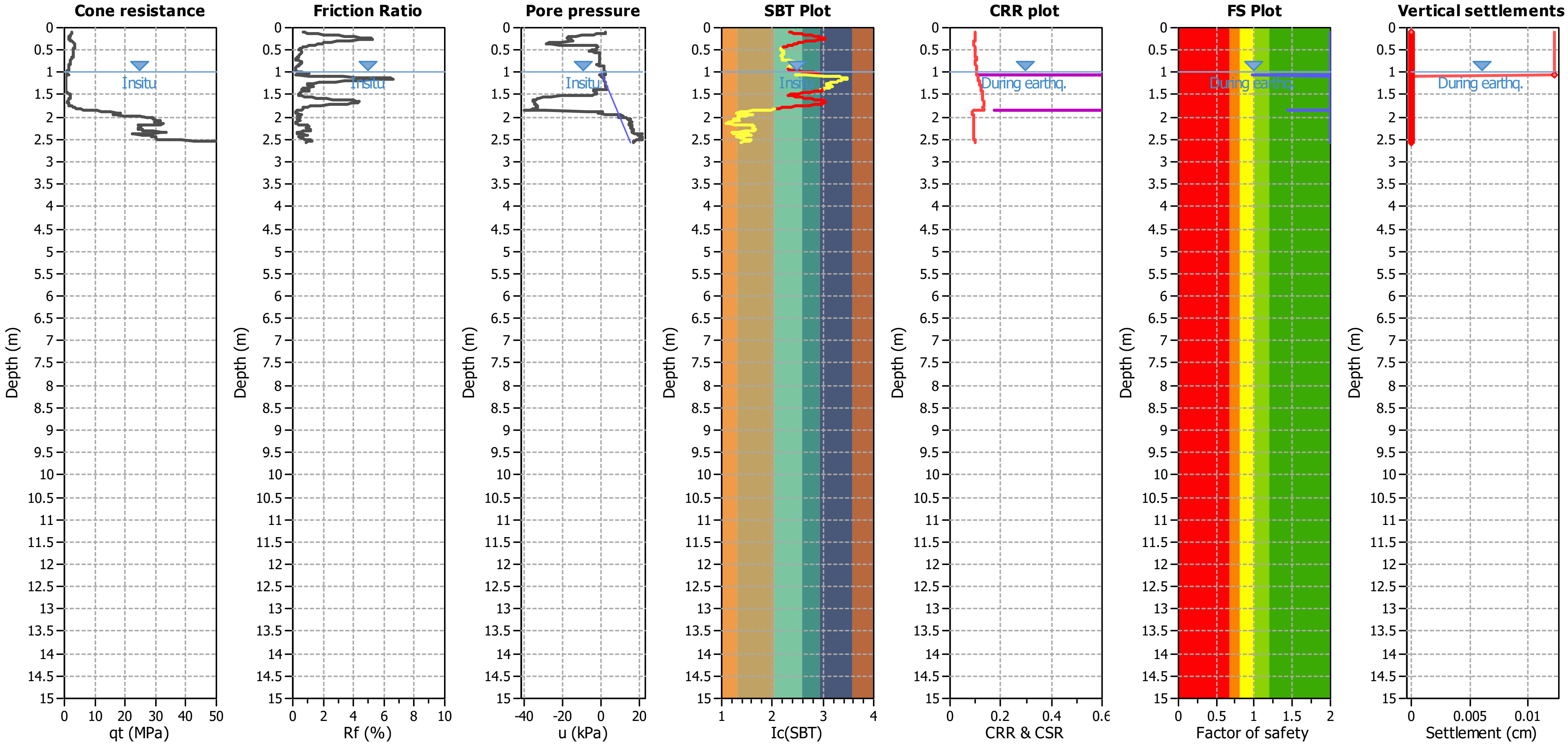
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT-121639
Total depth: 2.56 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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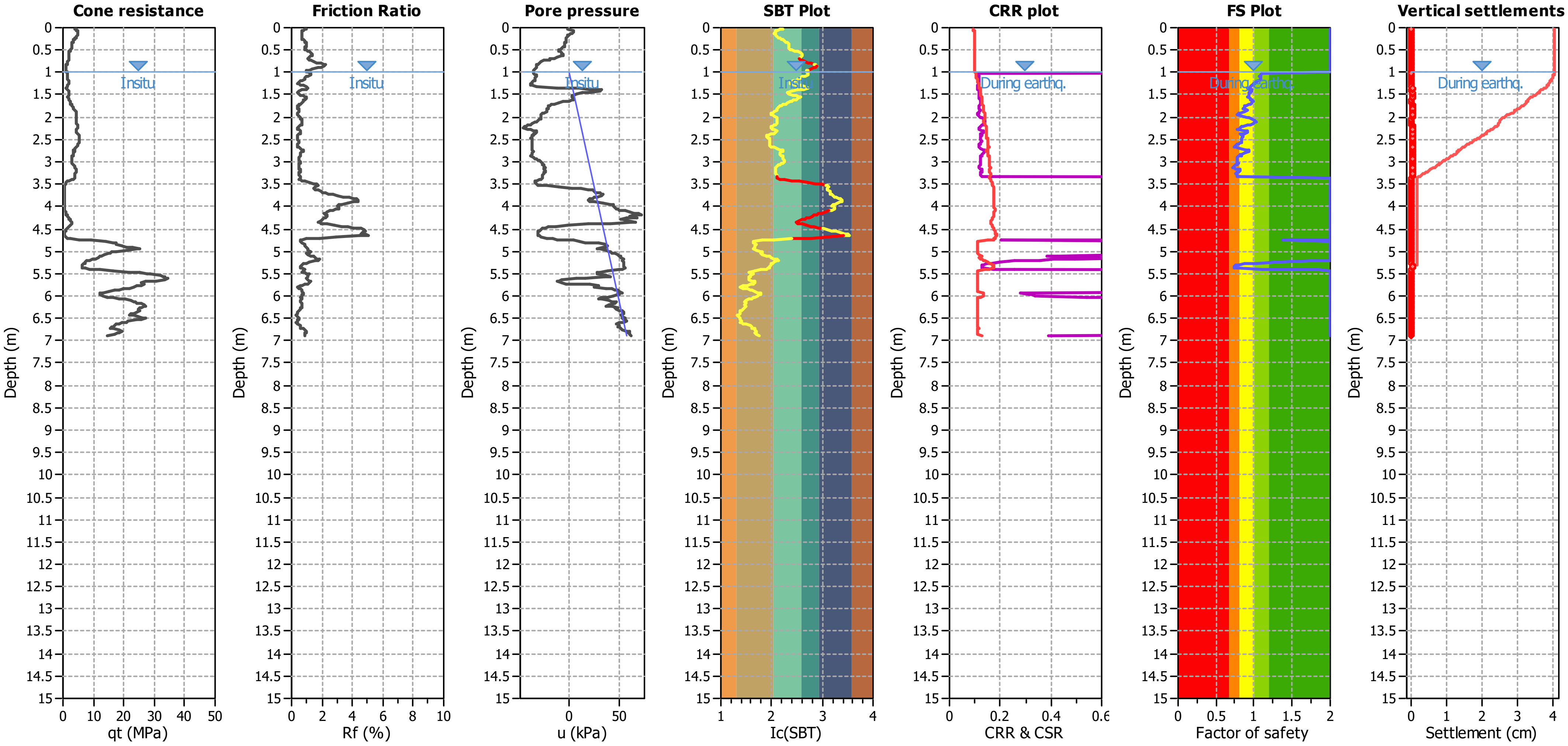
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128289
Total depth: 6.88 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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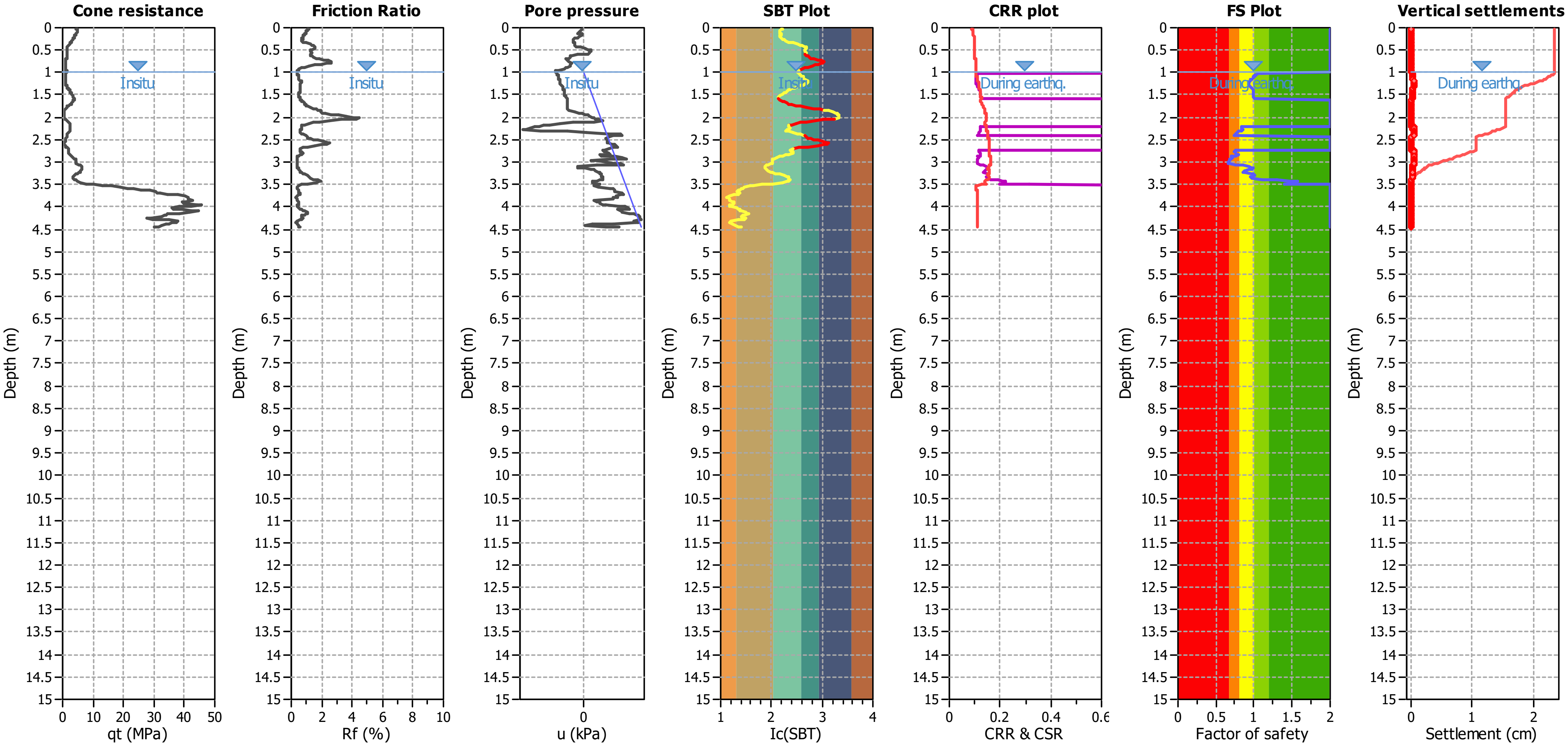
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128291
Total depth: 4.46 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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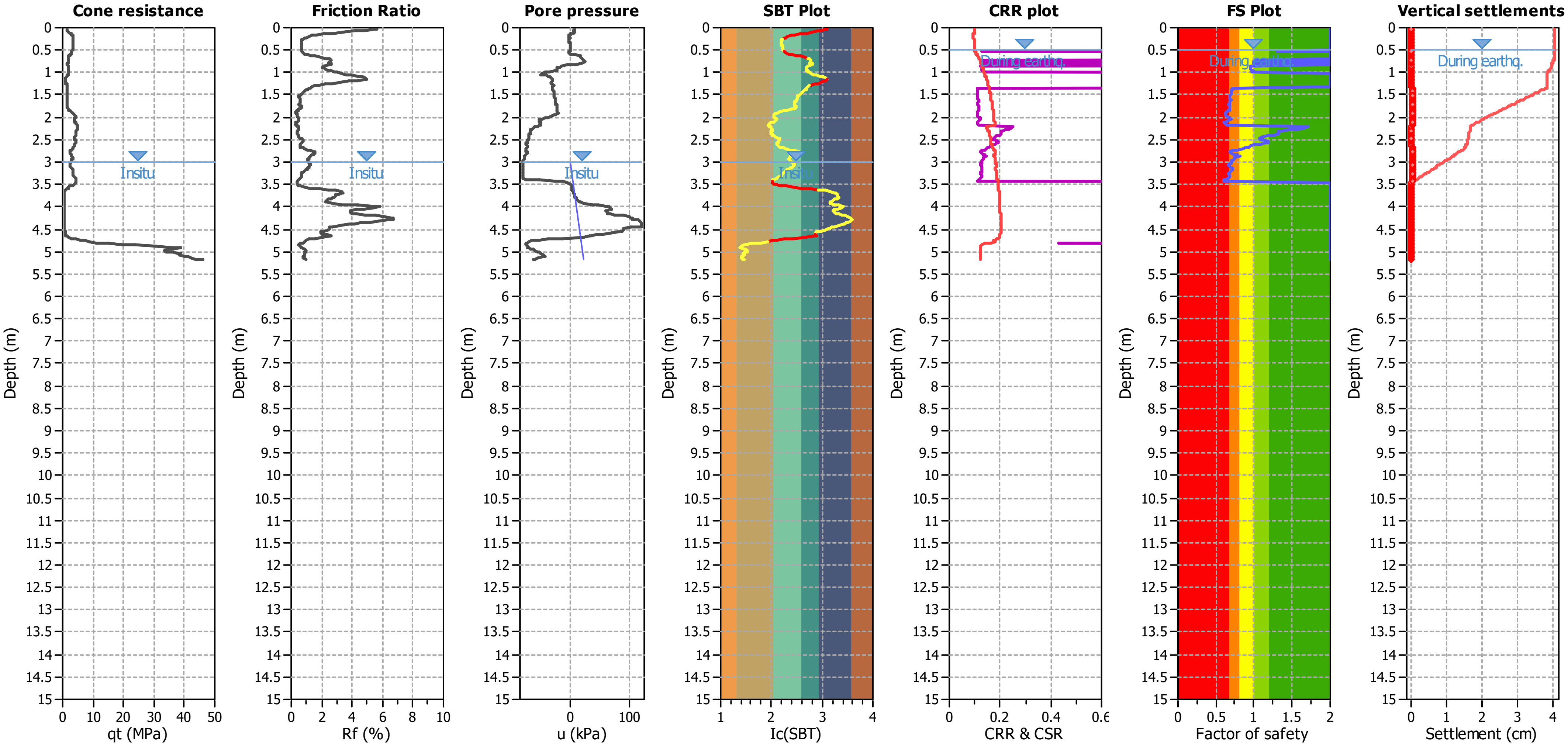
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

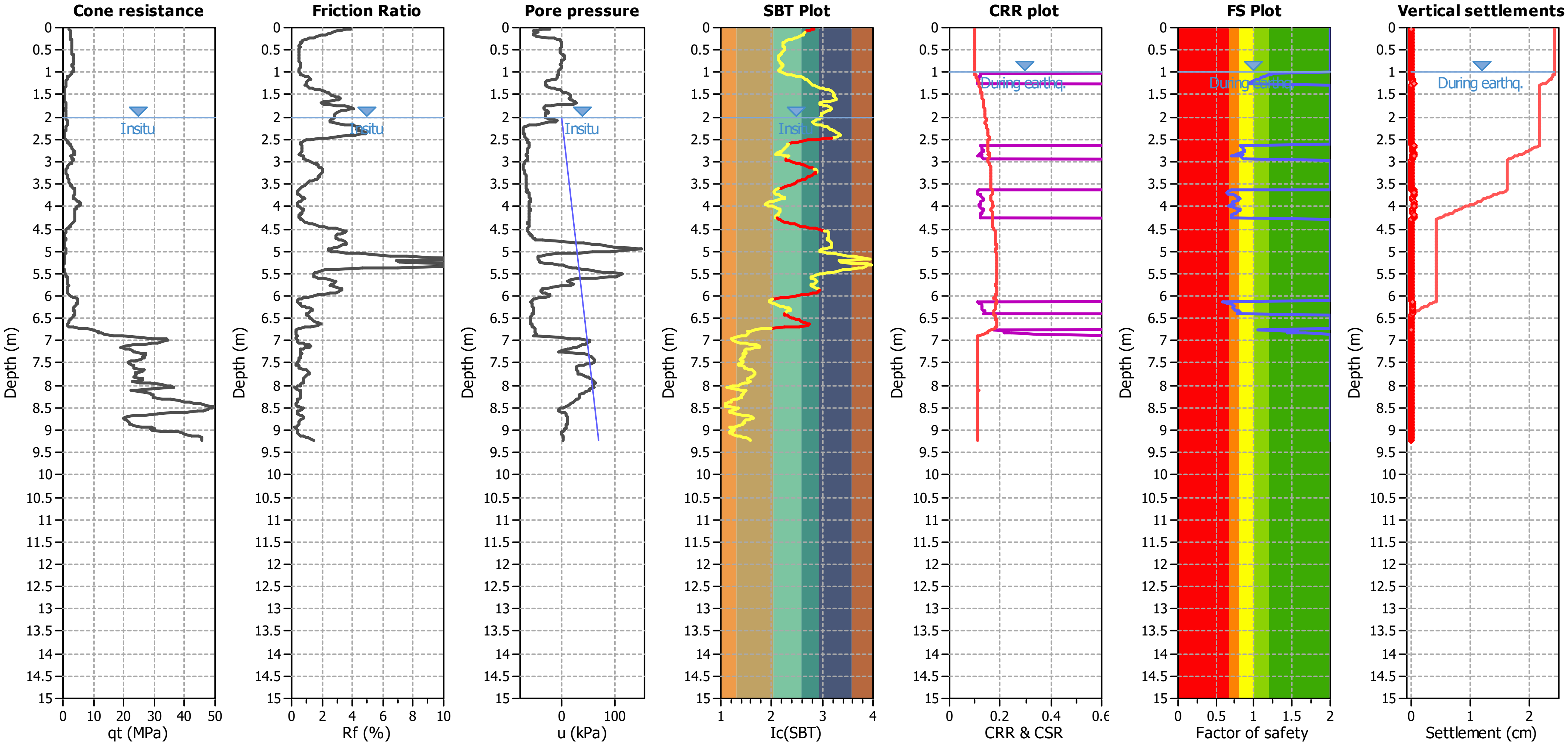
CPT: CPT_128293
Total depth: 5.18 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128296
Total depth: 9.22 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	.
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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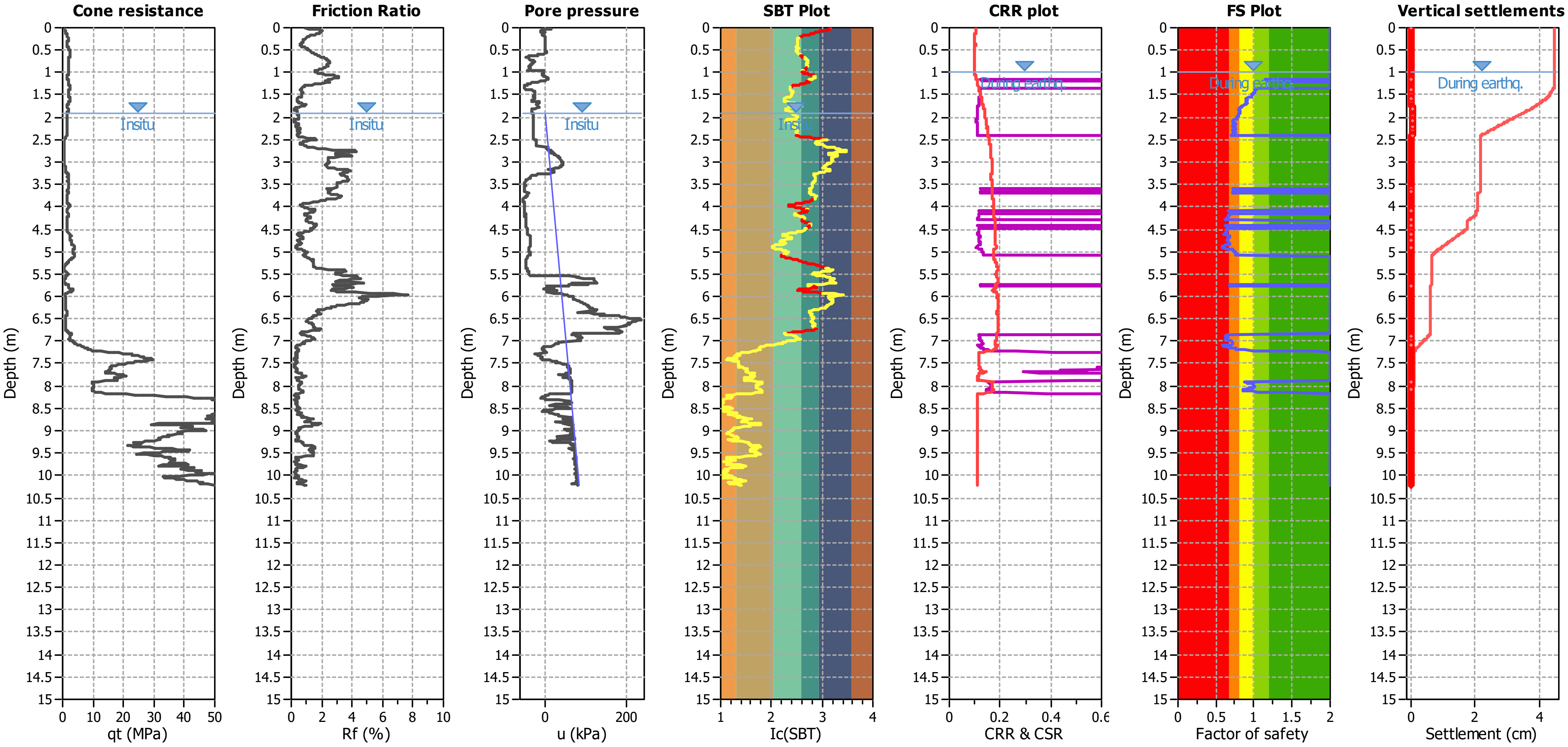
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_97674
Total depth: 10.22 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.90 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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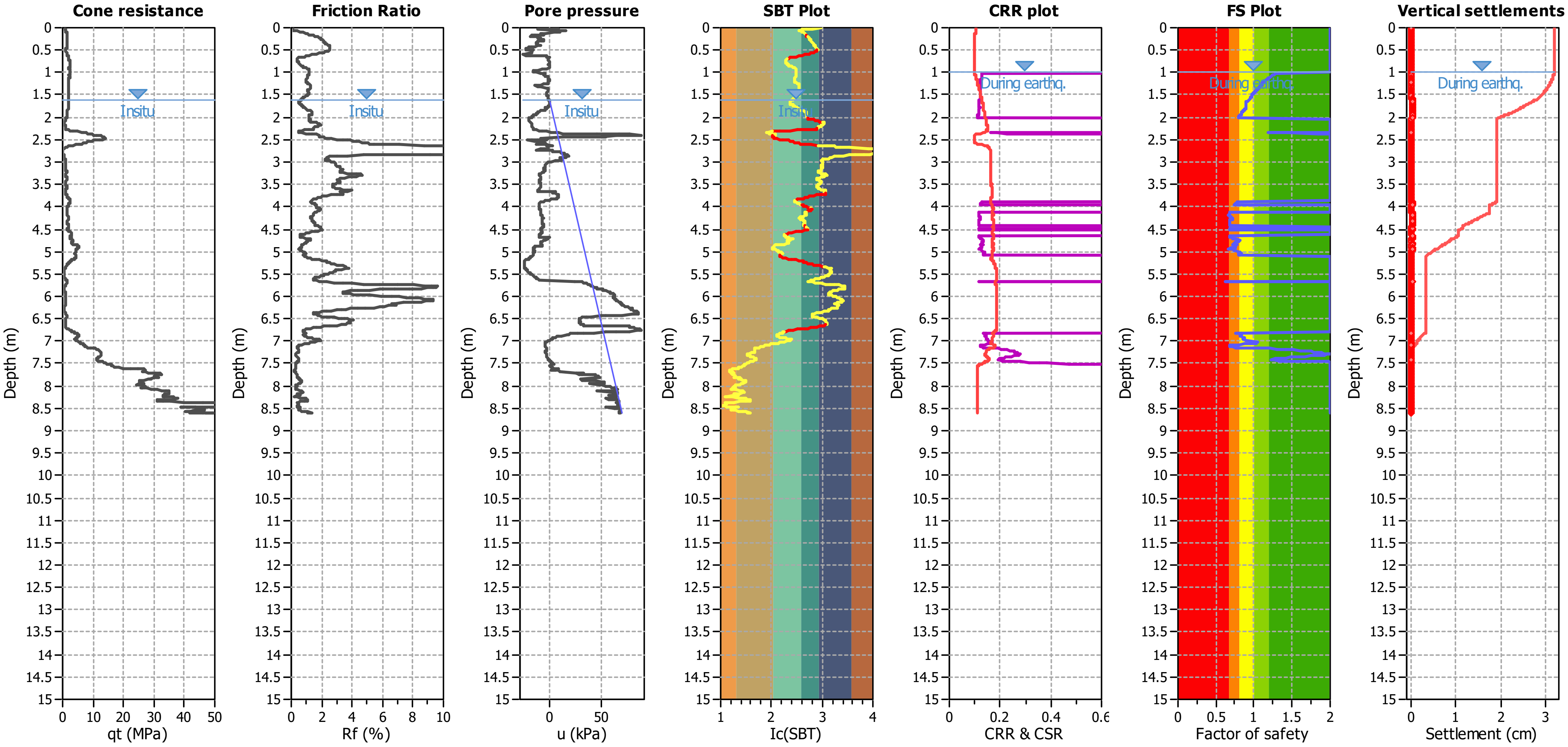
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_97675
Total depth: 8.62 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.60 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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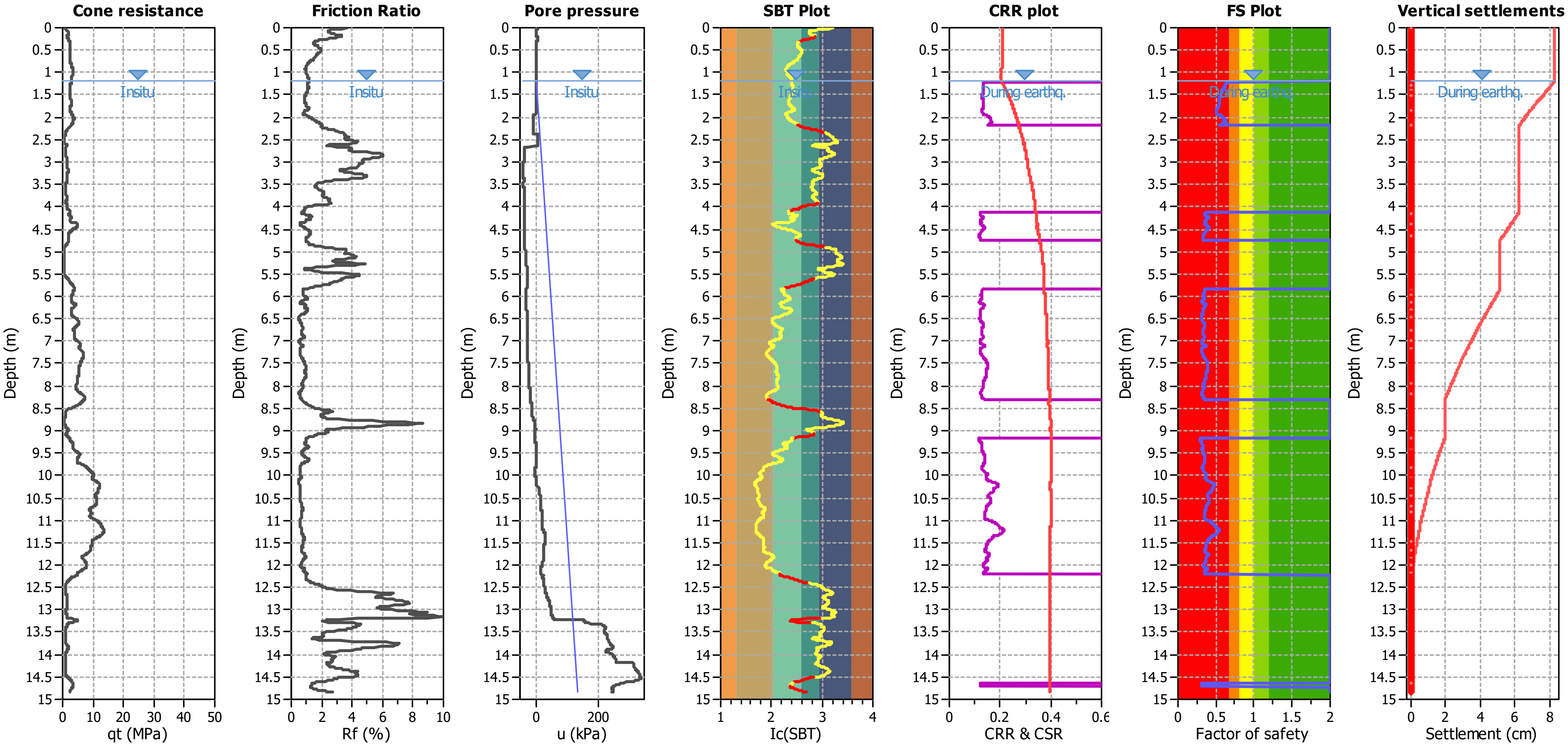
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121612
Total depth: 14.84 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.20 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.20 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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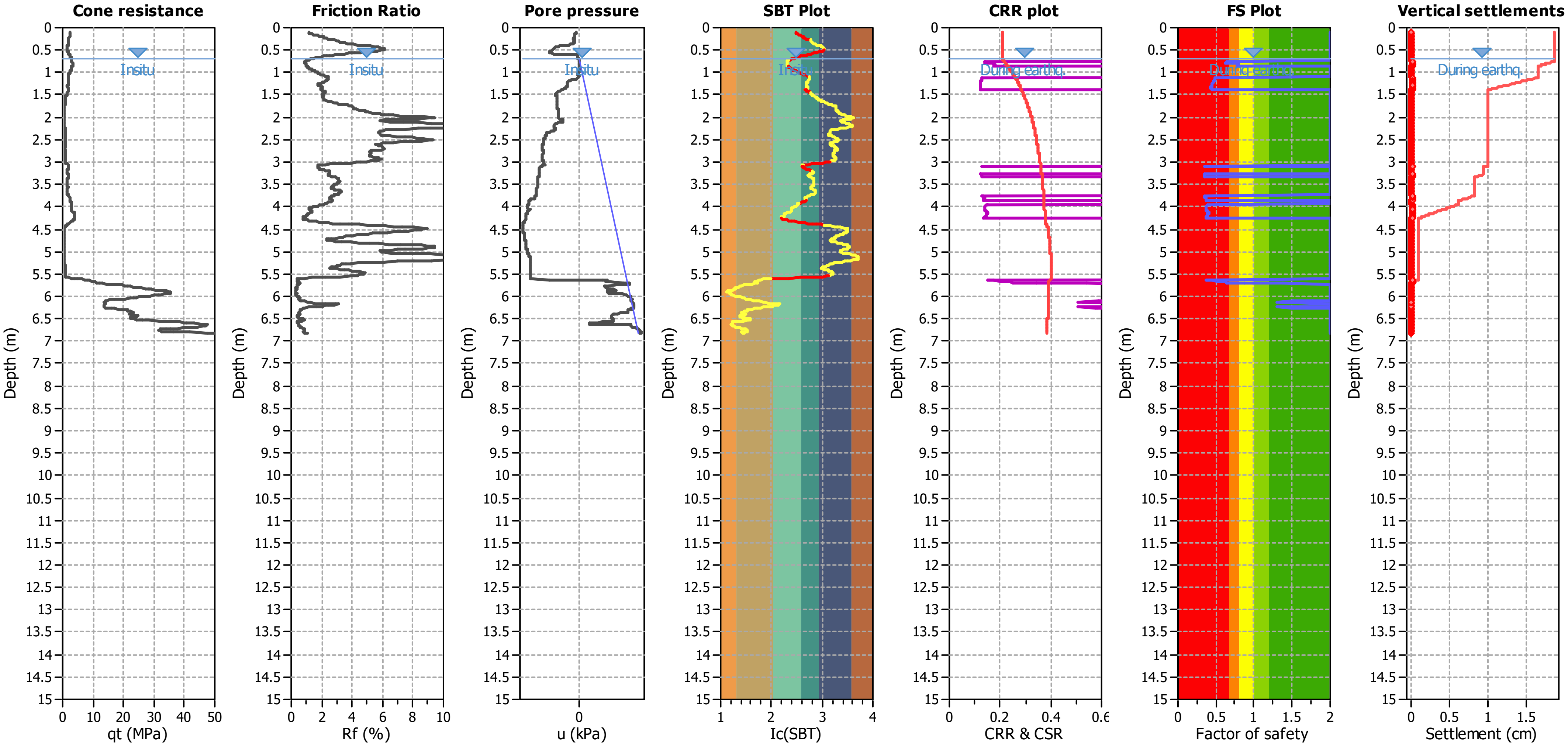
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121614
Total depth: 6.82 m



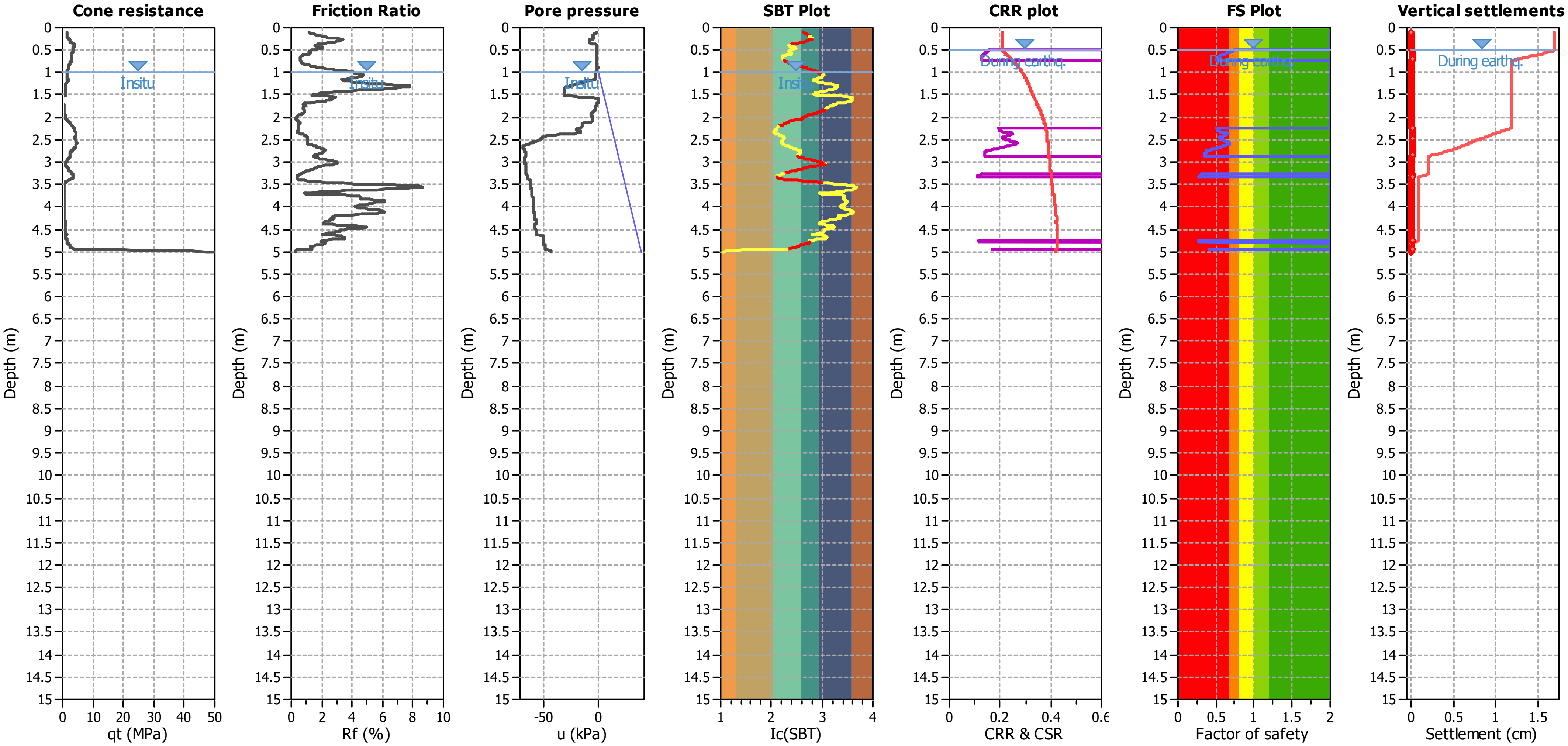
Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**

Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121628

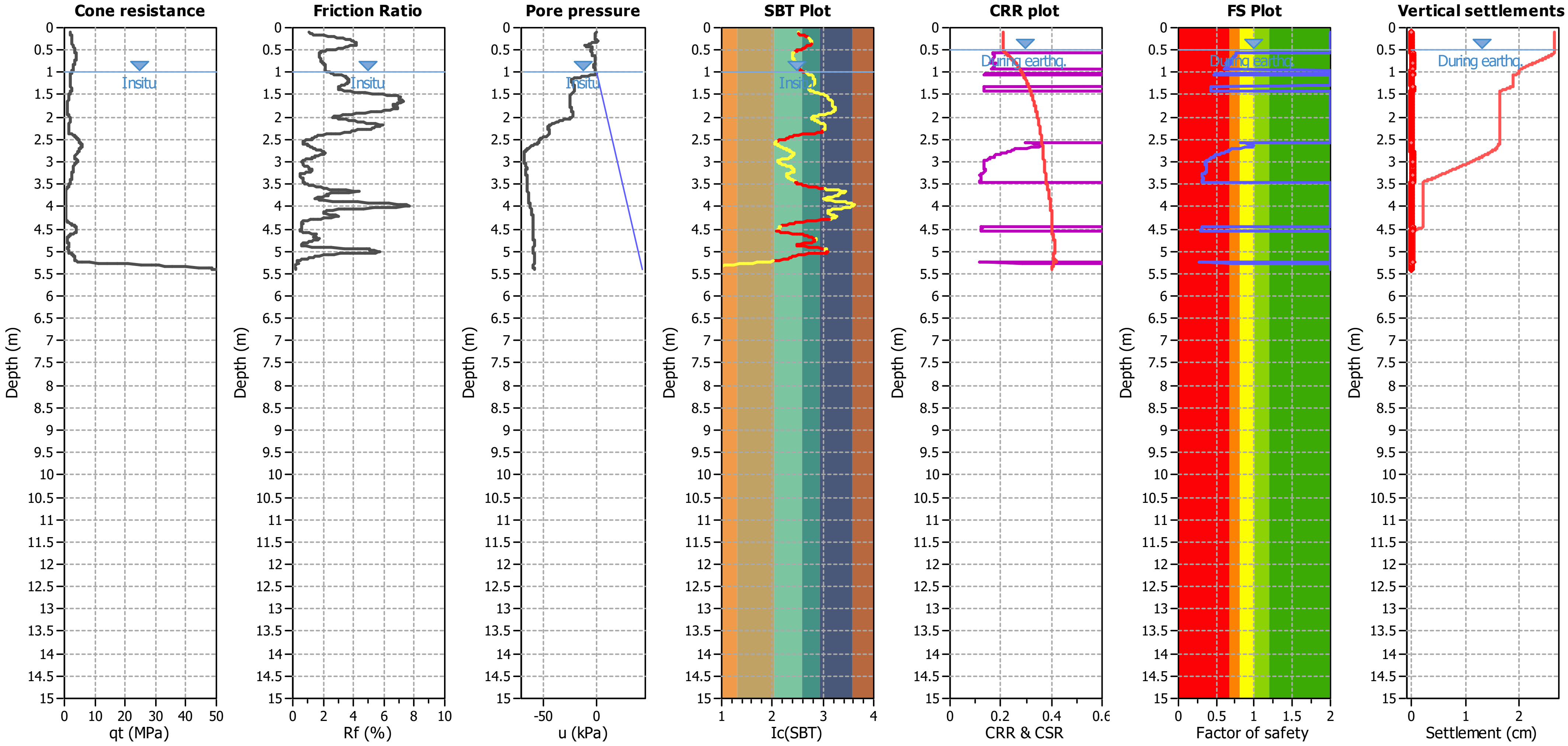
Total depth: 5.02 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

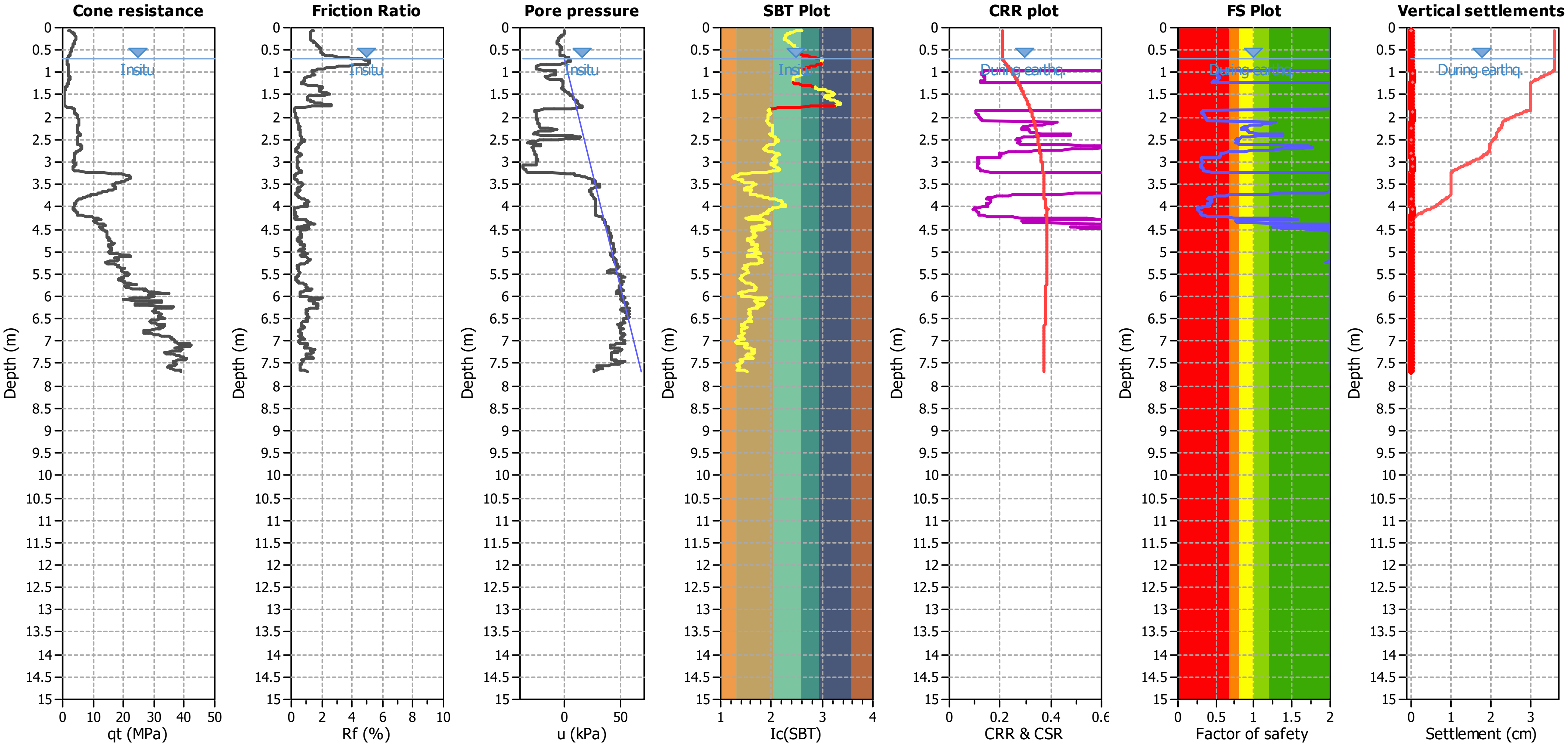
CPT: CPT_121637
Total depth: 5.42 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121641
Total depth: 7.67 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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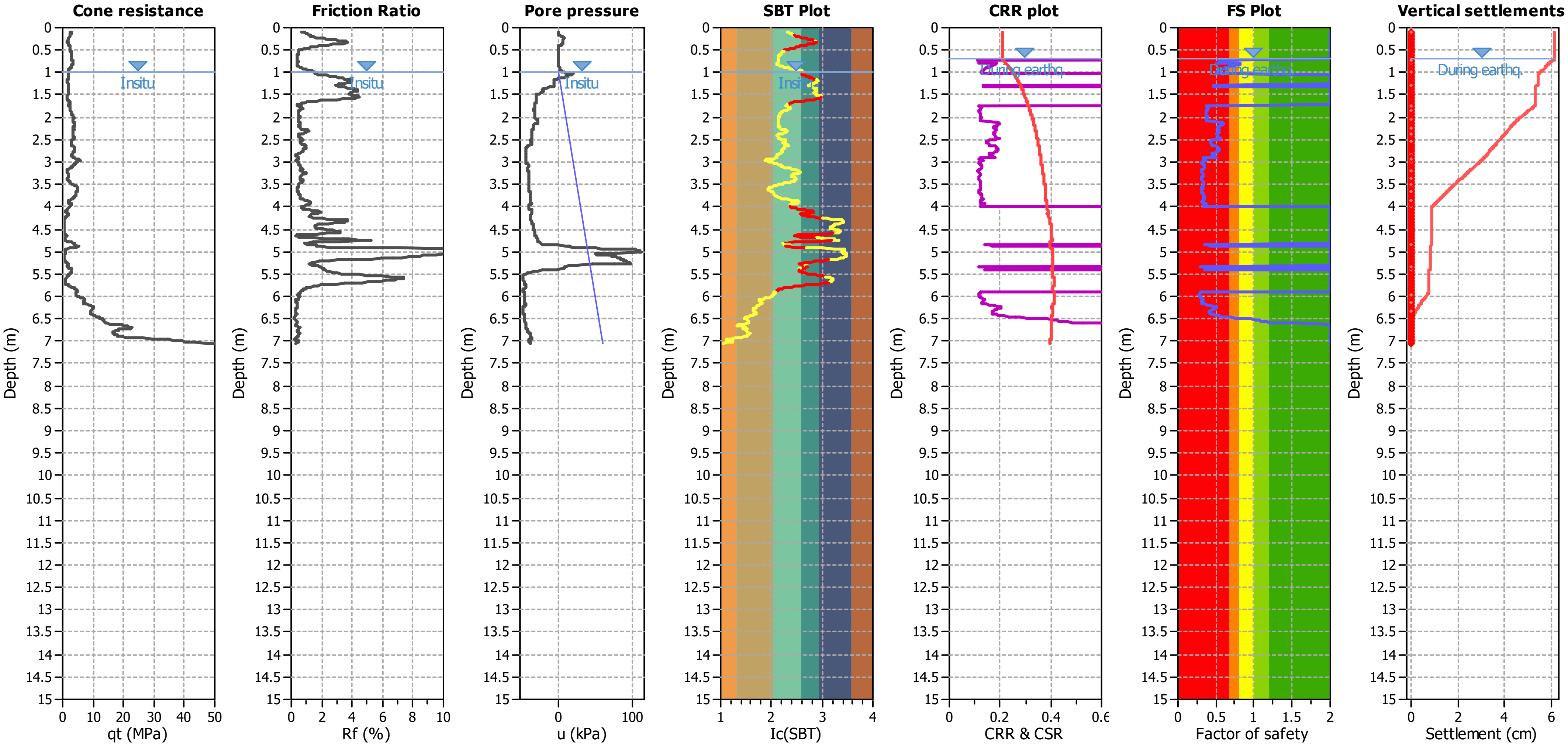
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121623
Total depth: 7.05 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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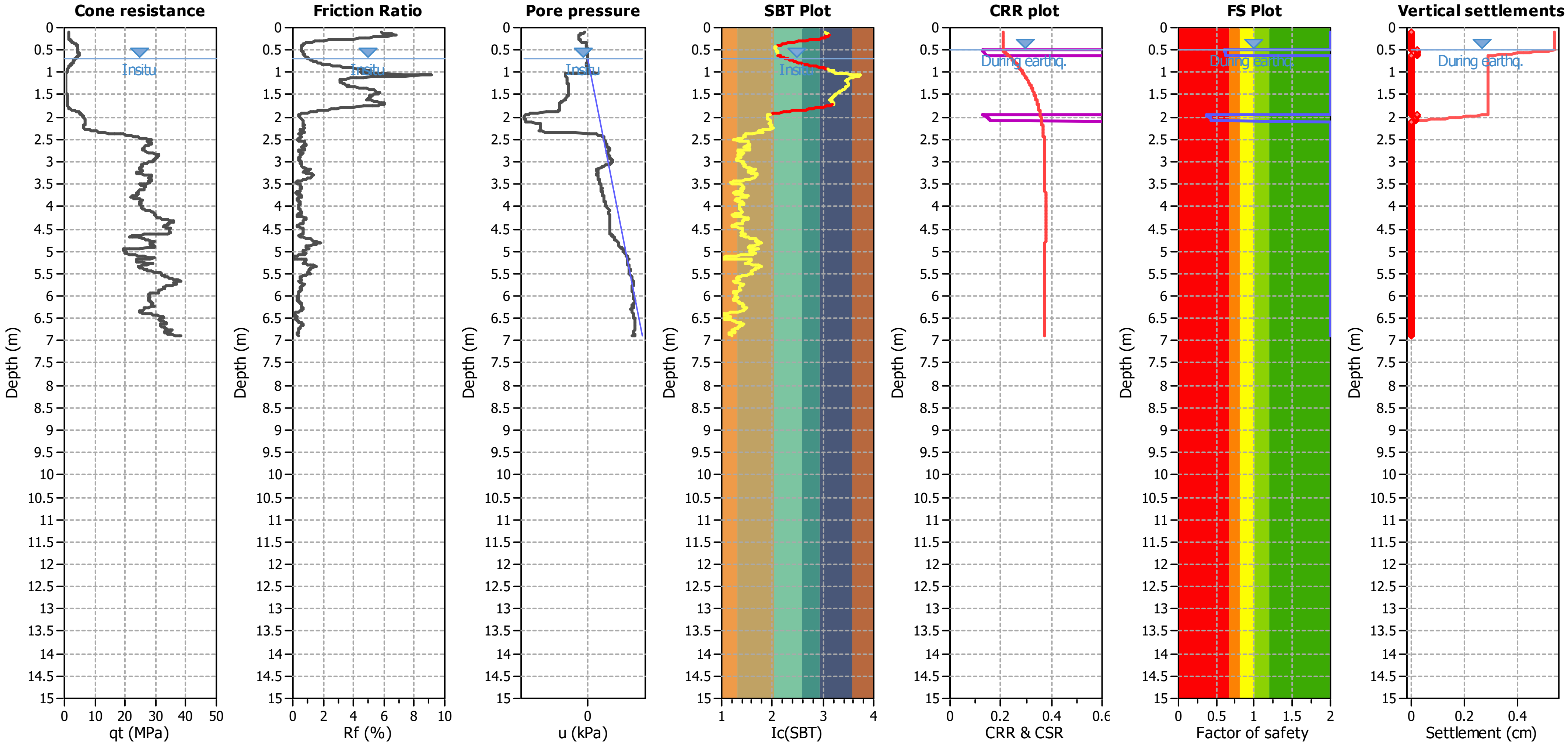
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121643
Total depth: 6.90 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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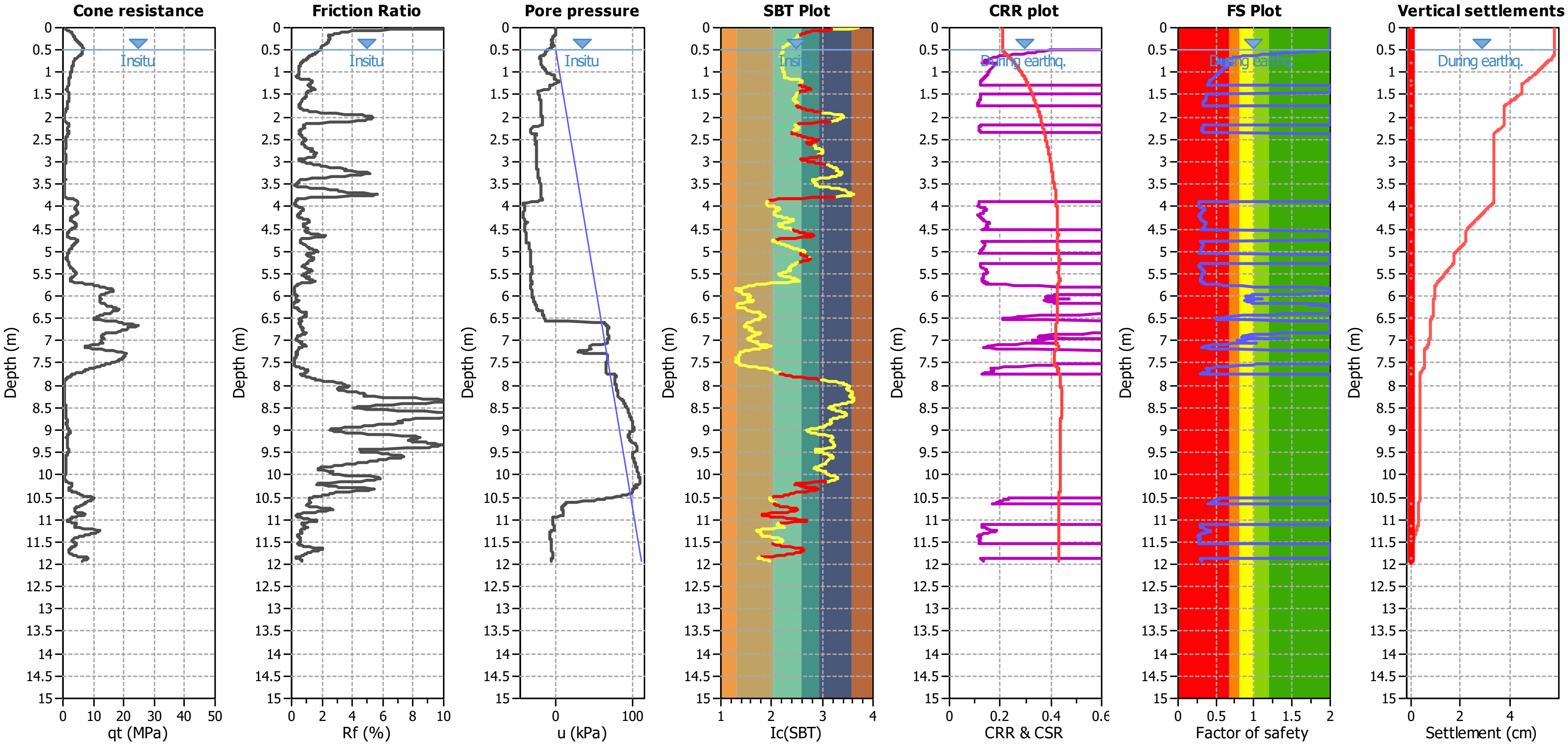
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

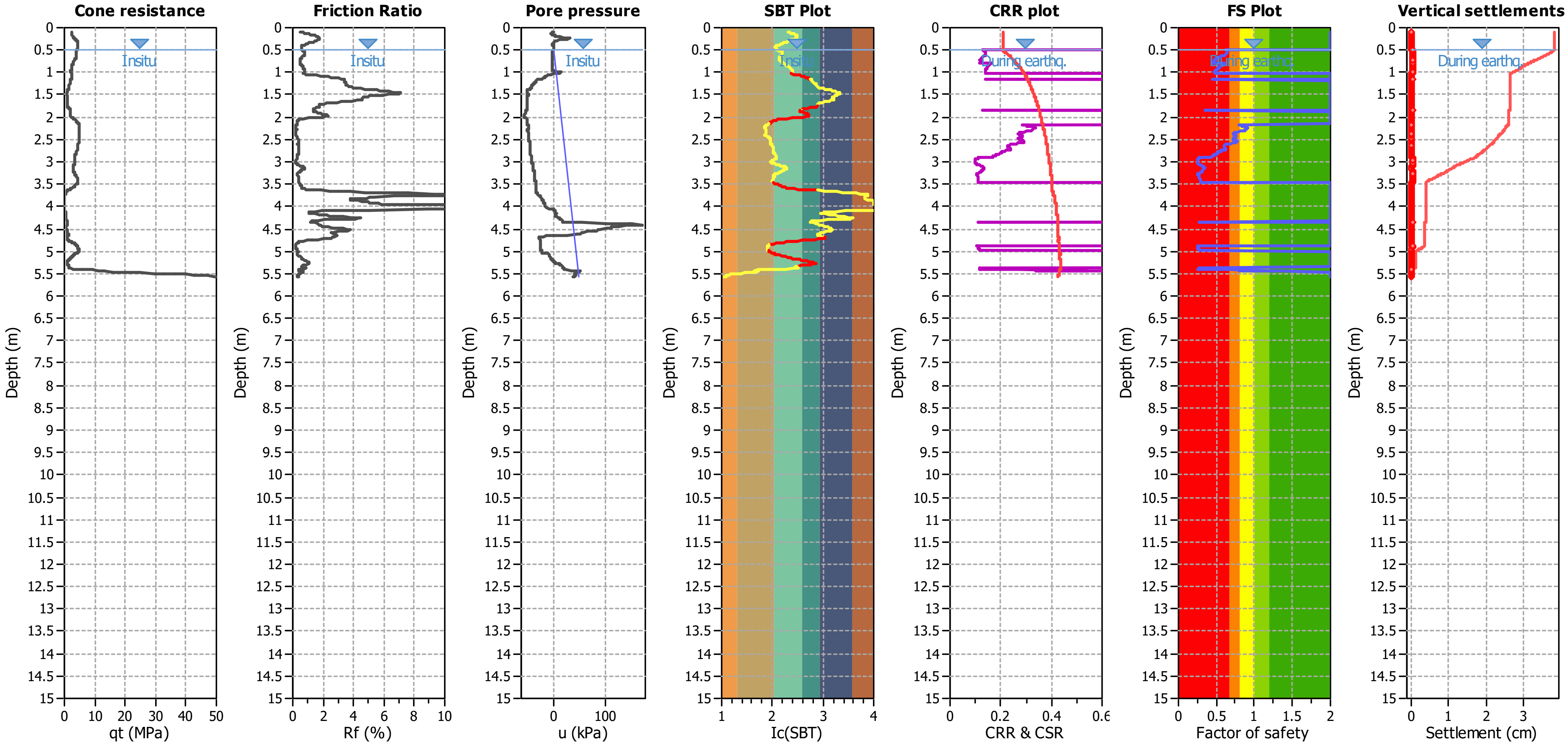
CPT: CPT_121642
Total depth: 11.92 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121633
Total depth: 5.58 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.35

G.W.T. (in-situ): 0.50 m
G.W.T. (earthq.): 0.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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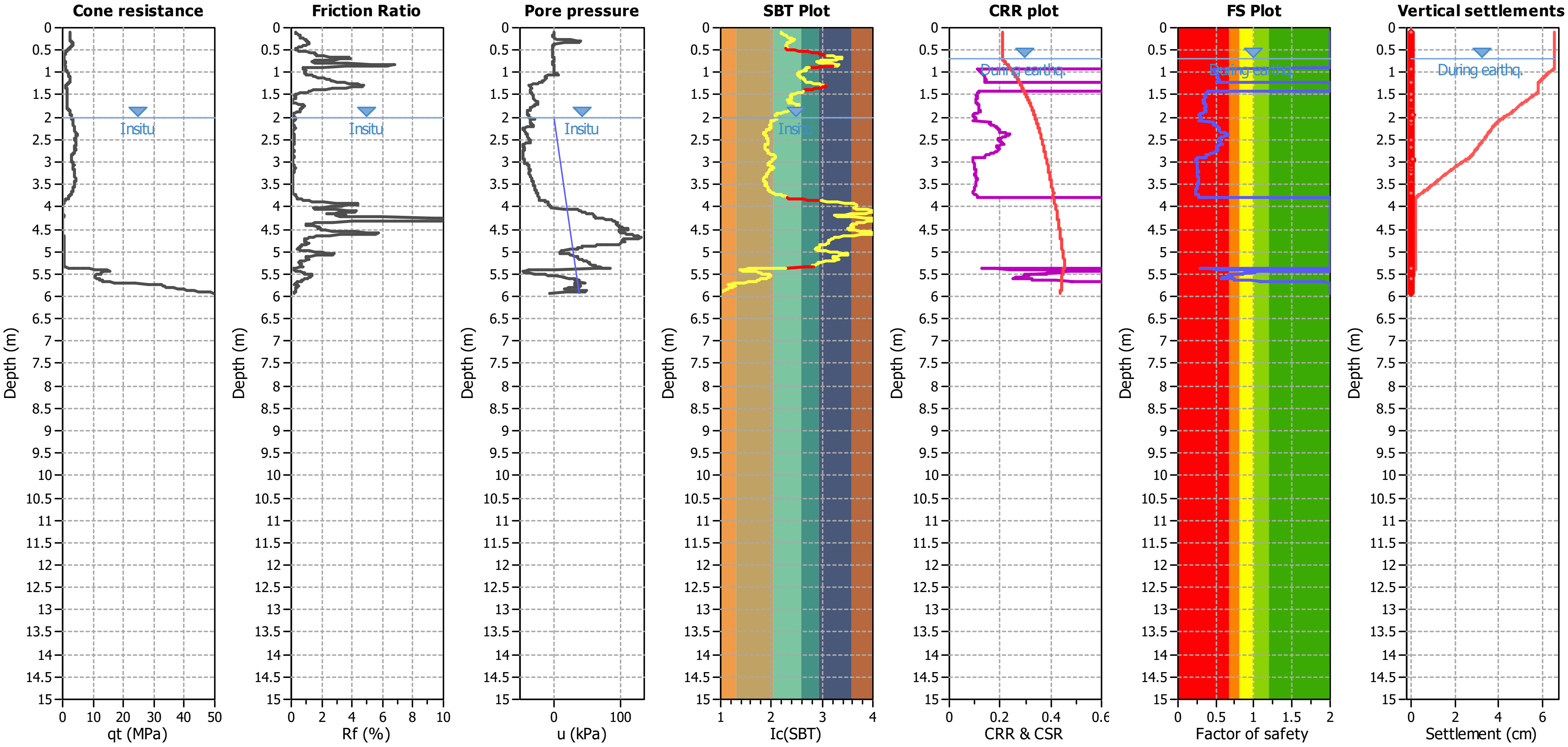
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121626
Total depth: 5.92 m



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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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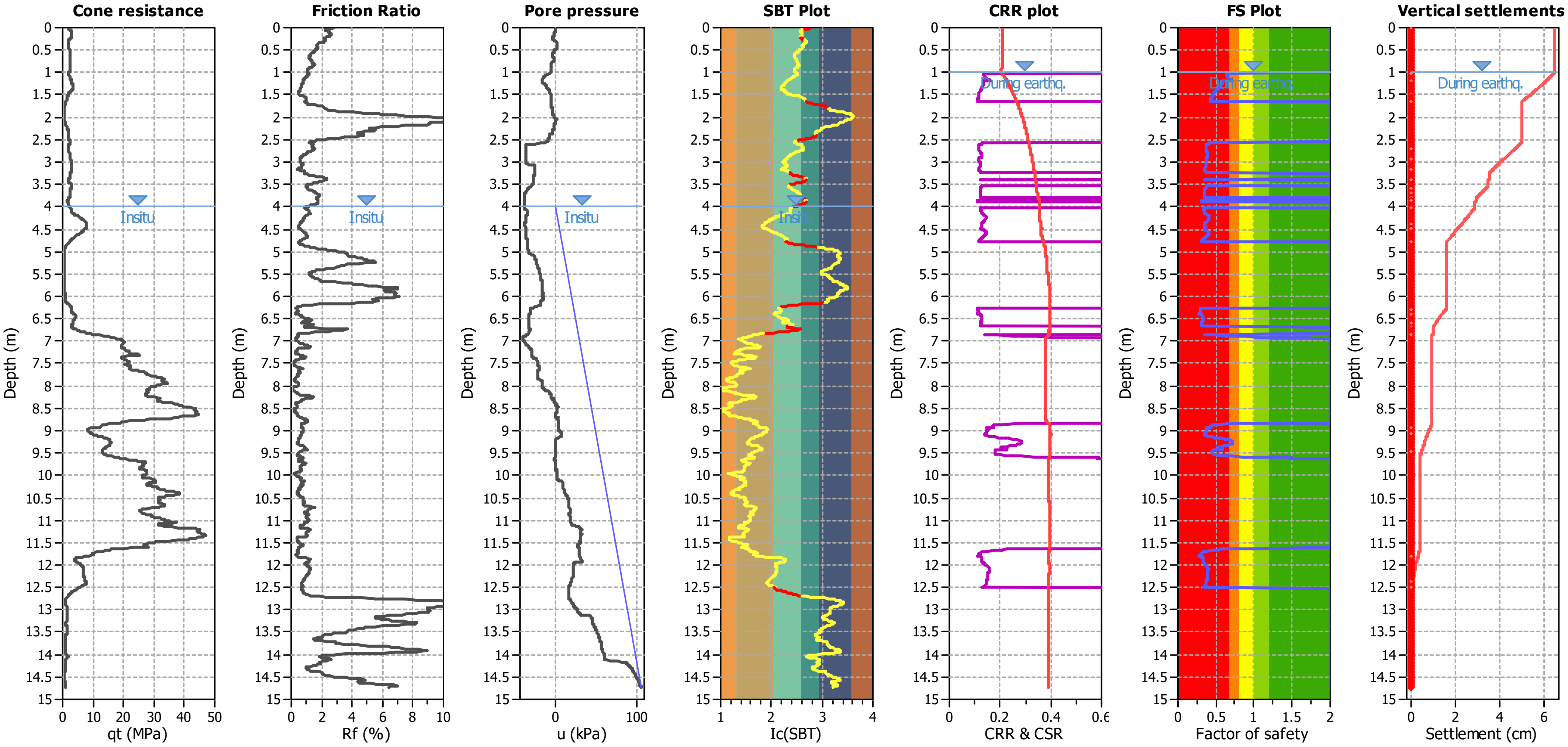
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**

Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121616

Total depth: 14.72 m



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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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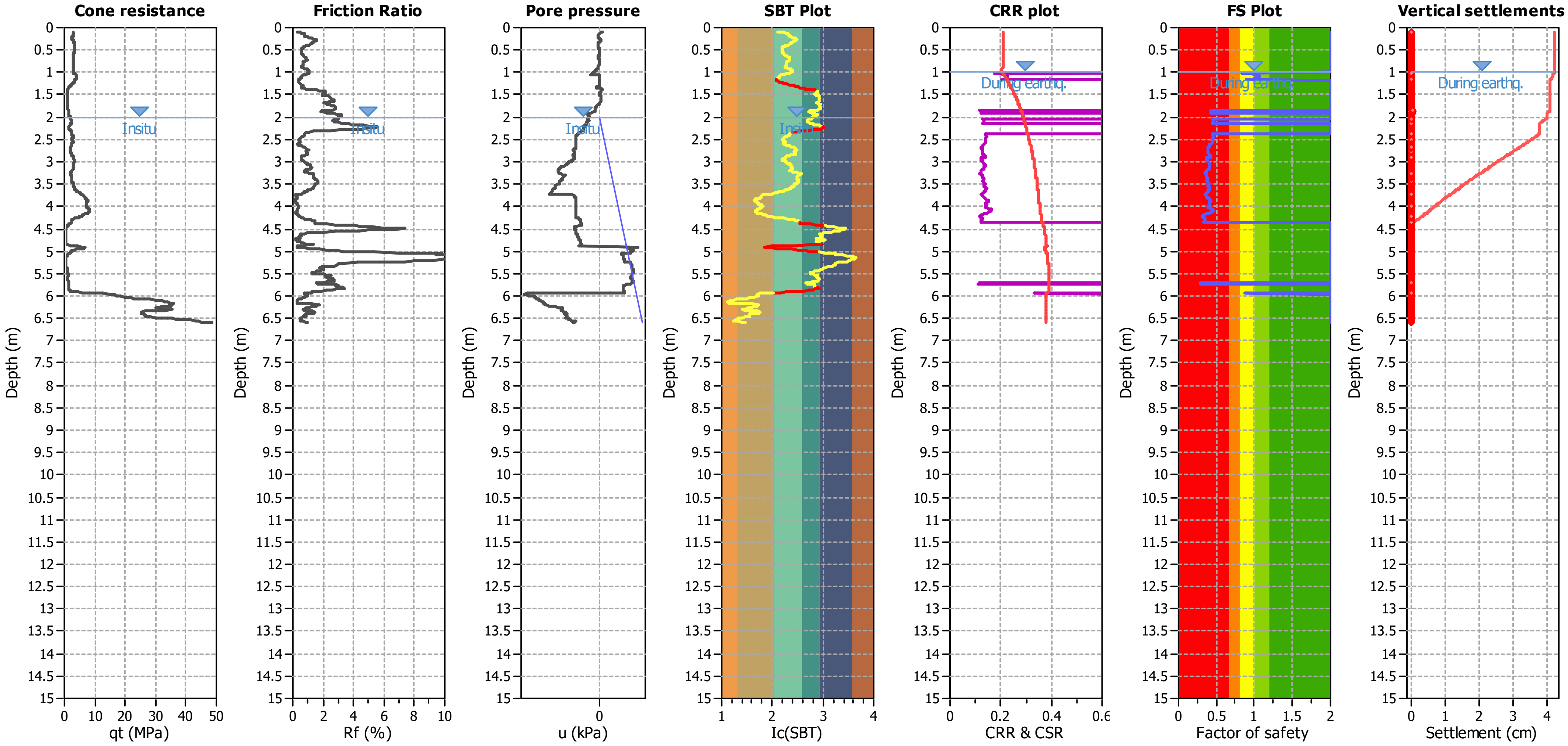
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121618
Total depth: 6.60 m



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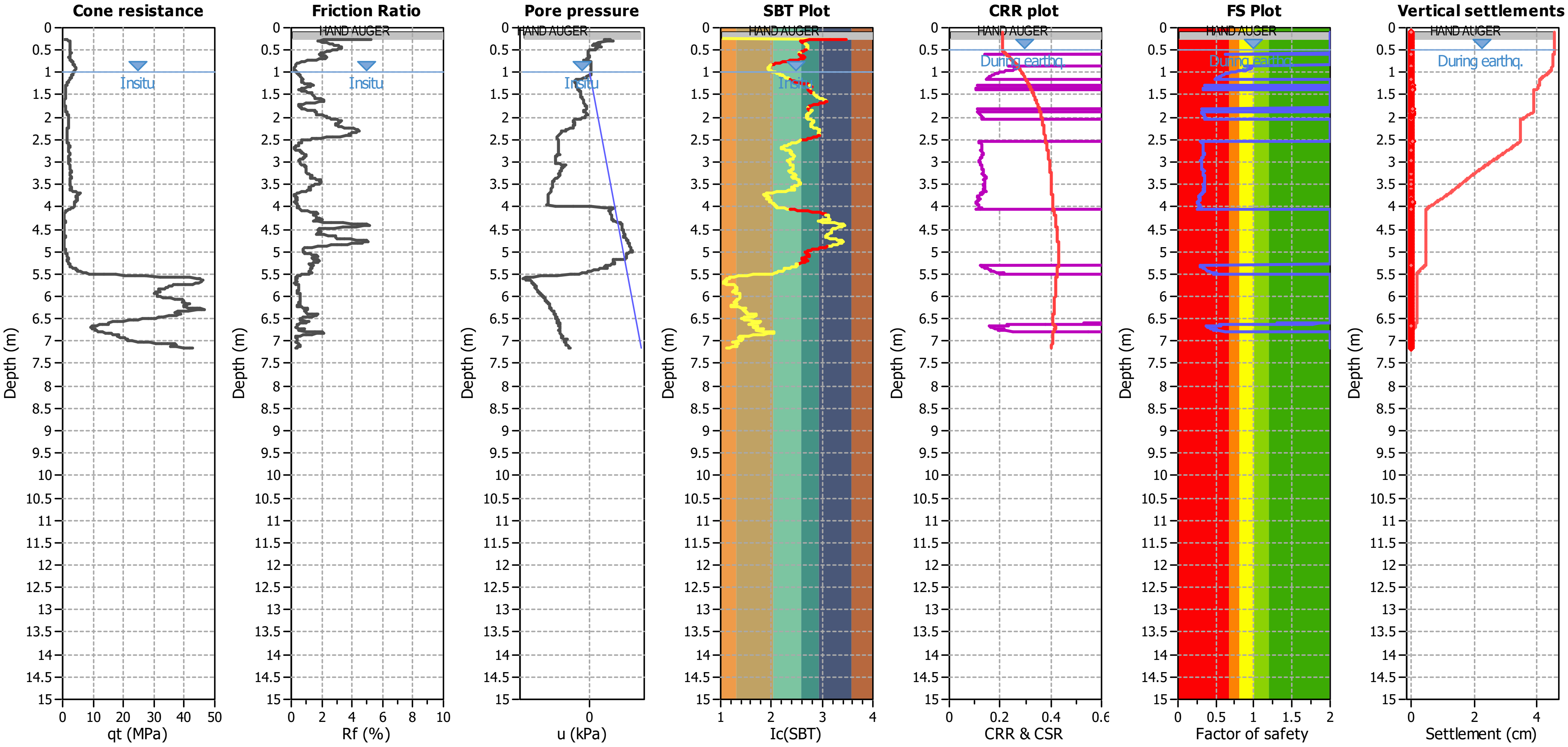
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121620
Total depth: 7.16 m



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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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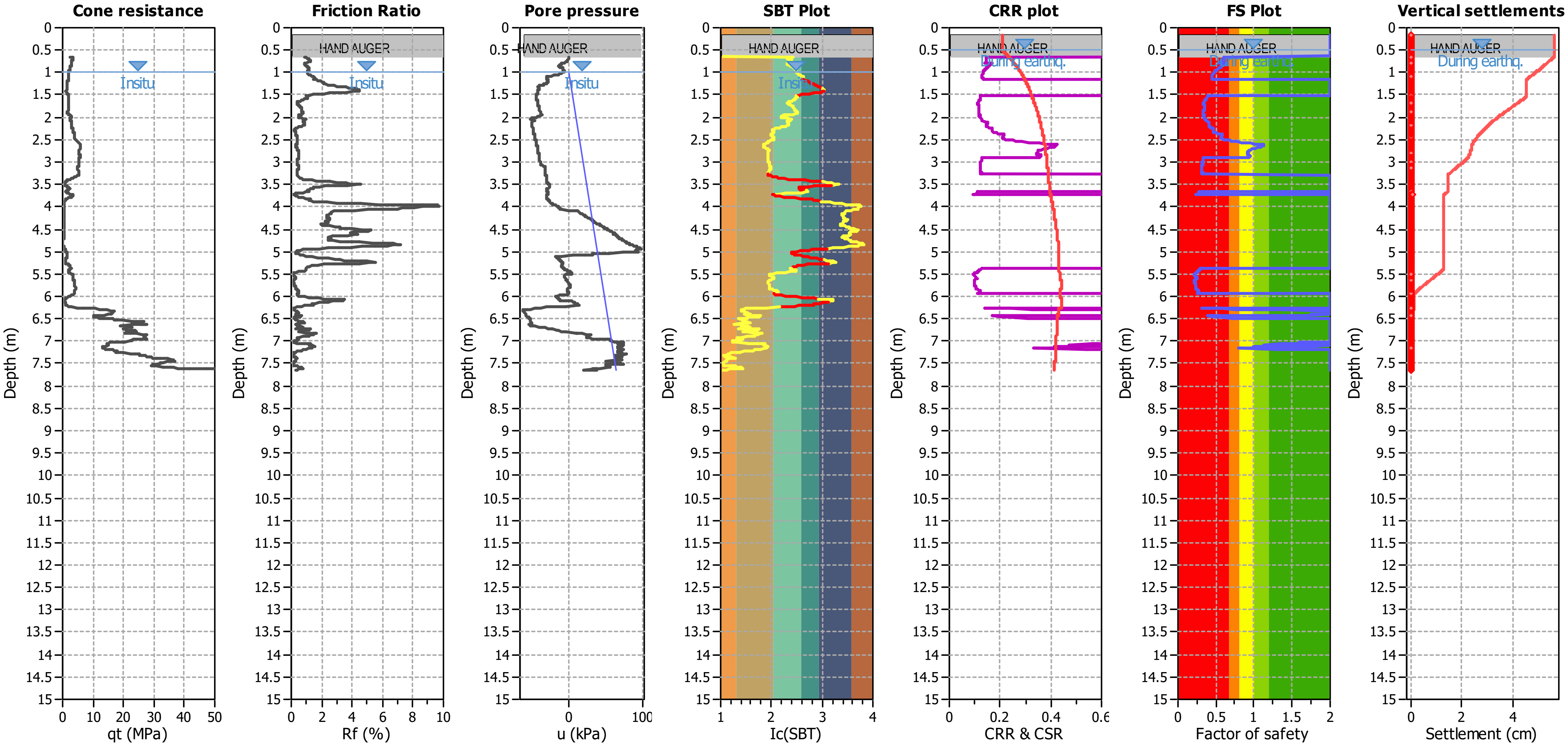
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_121632
Total depth: 7.66 m



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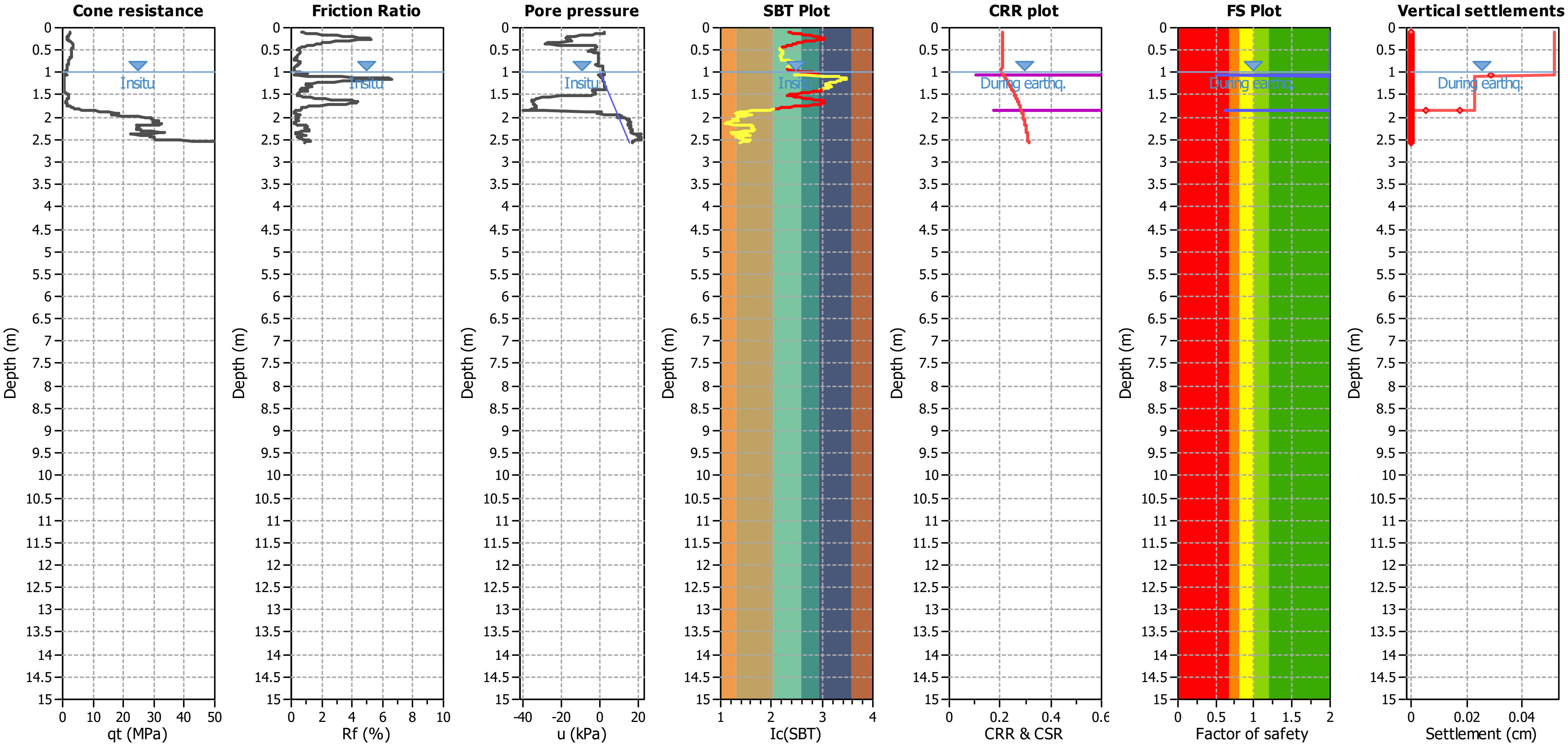
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT-121639
Total depth: 2.56 m



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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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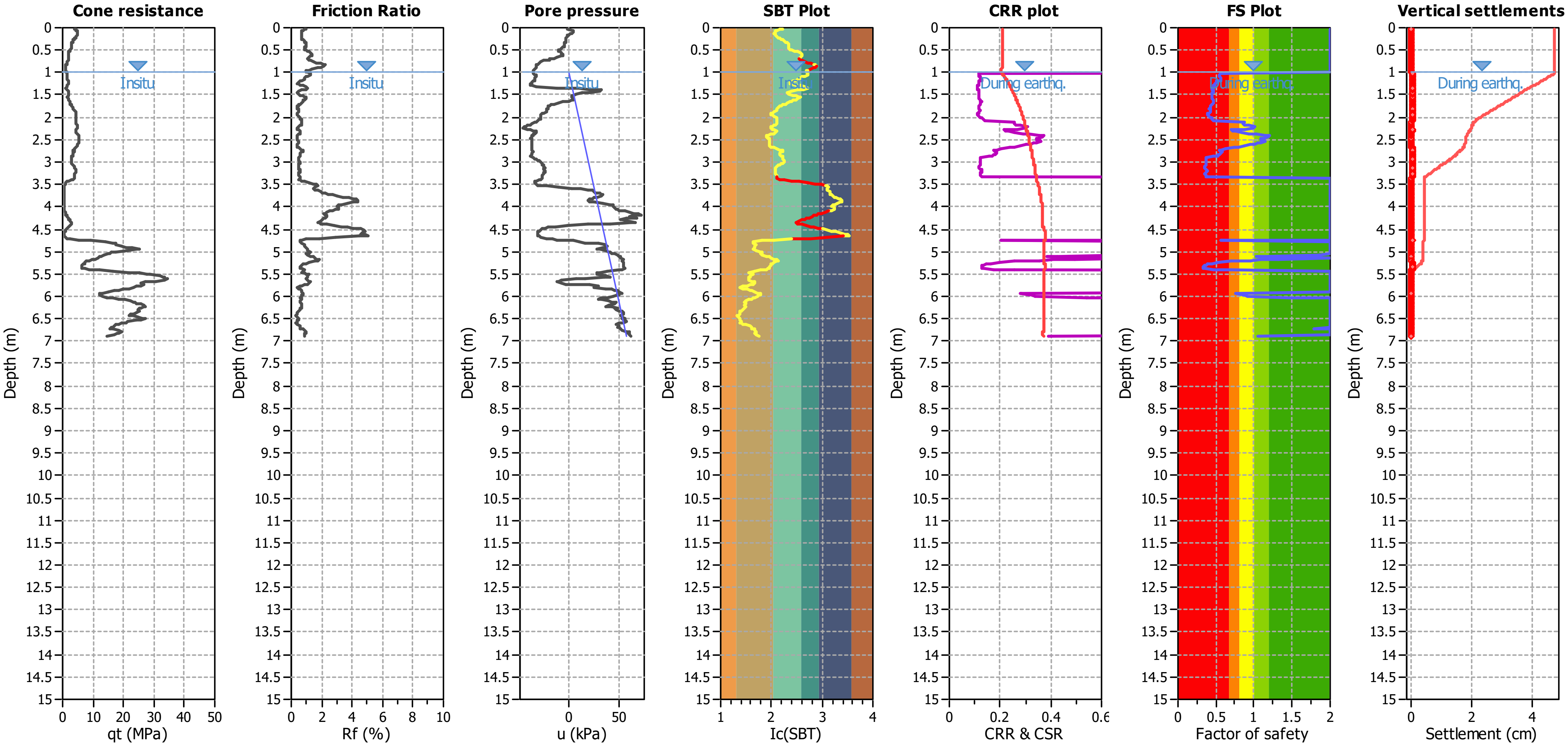
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128289
Total depth: 6.88 m



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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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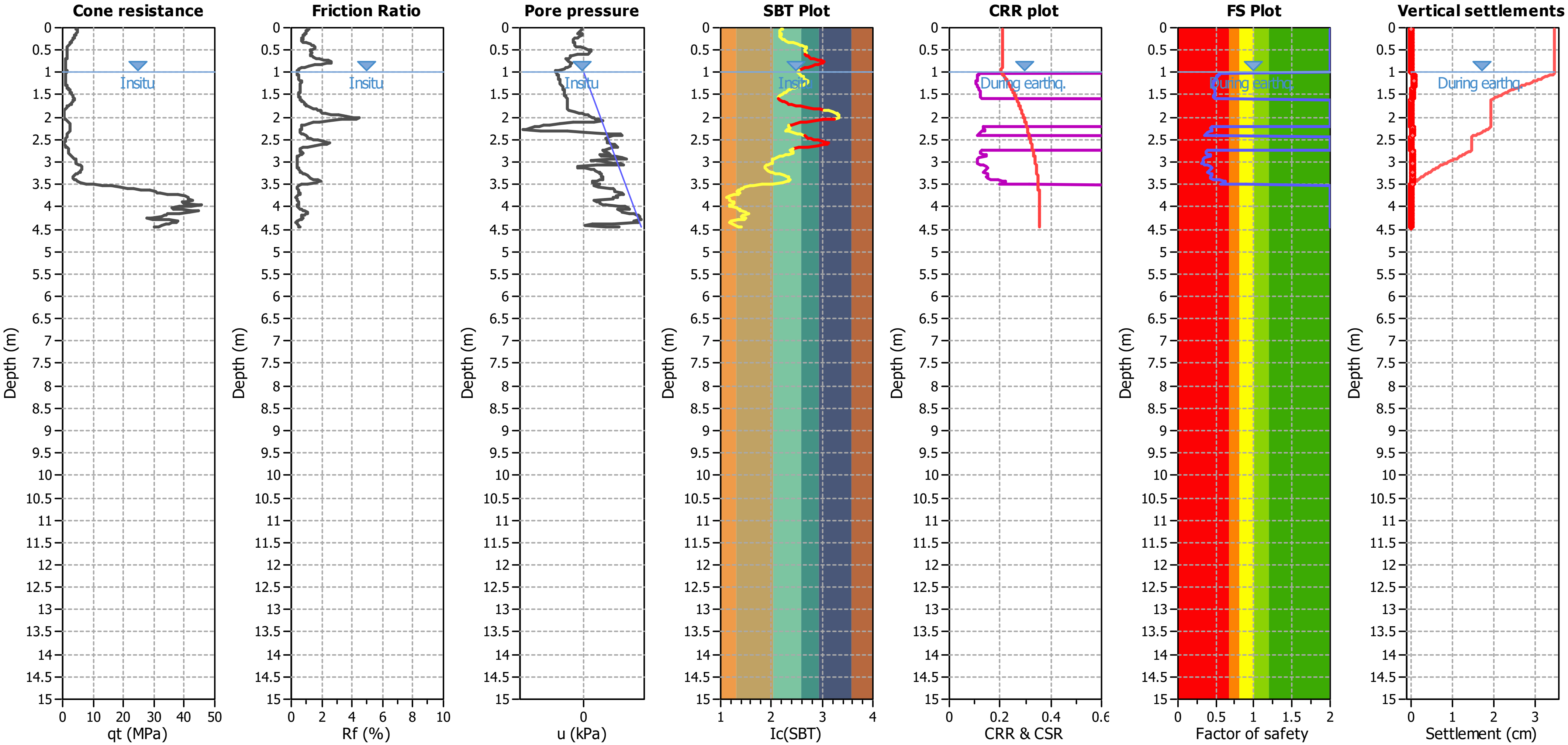
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128291
Total depth: 4.46 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
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Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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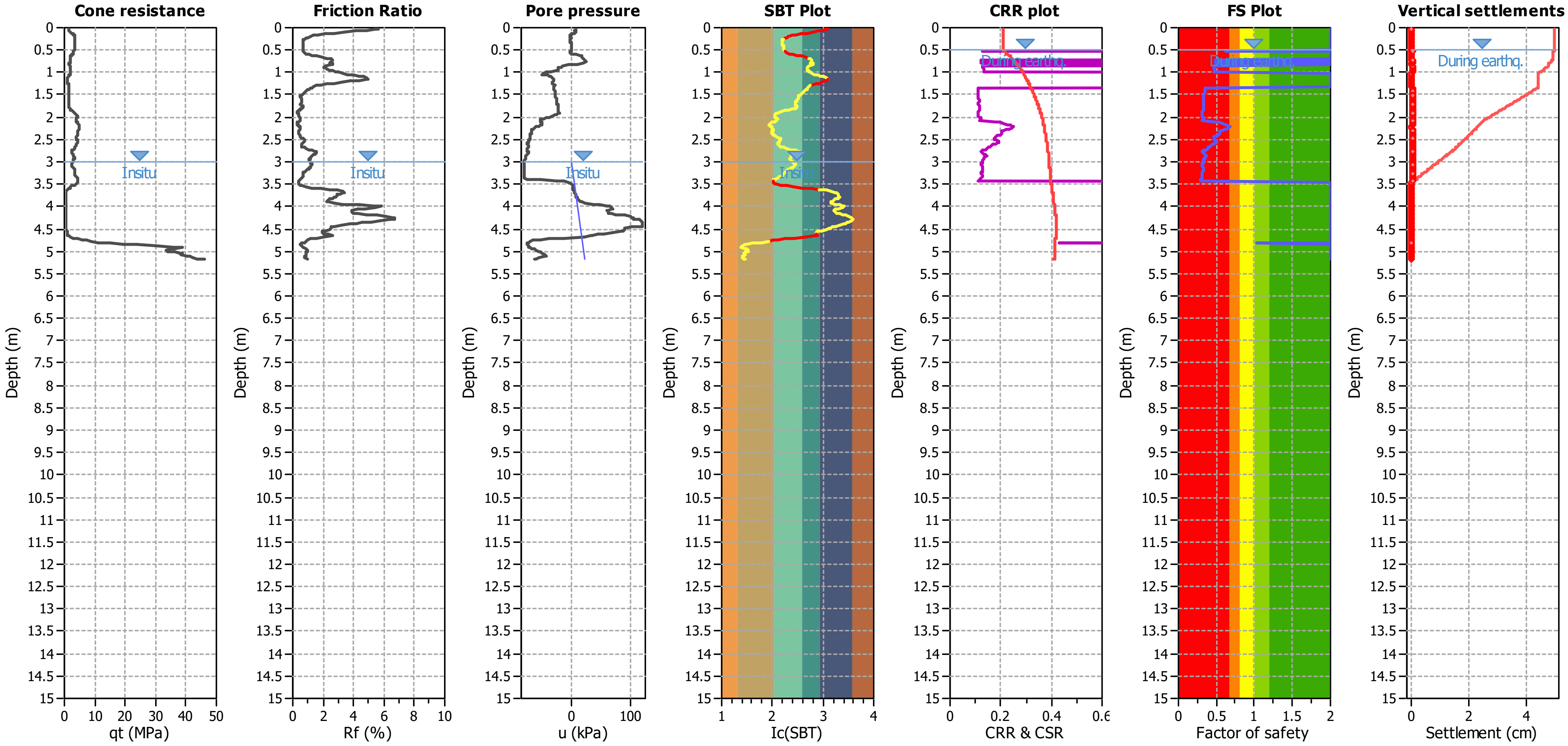
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128293
Total depth: 5.18 m



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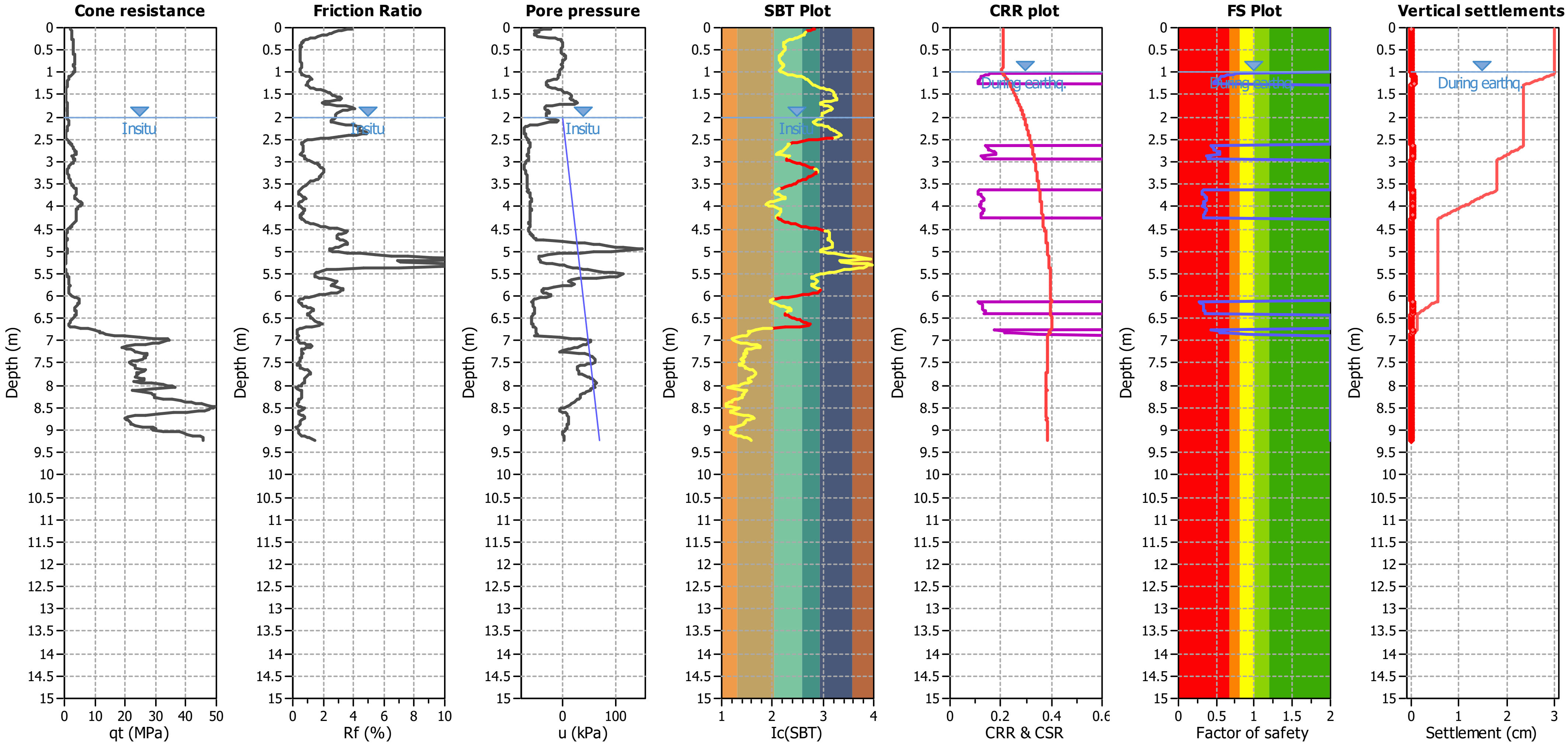
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_128296
Total depth: 9.22 m



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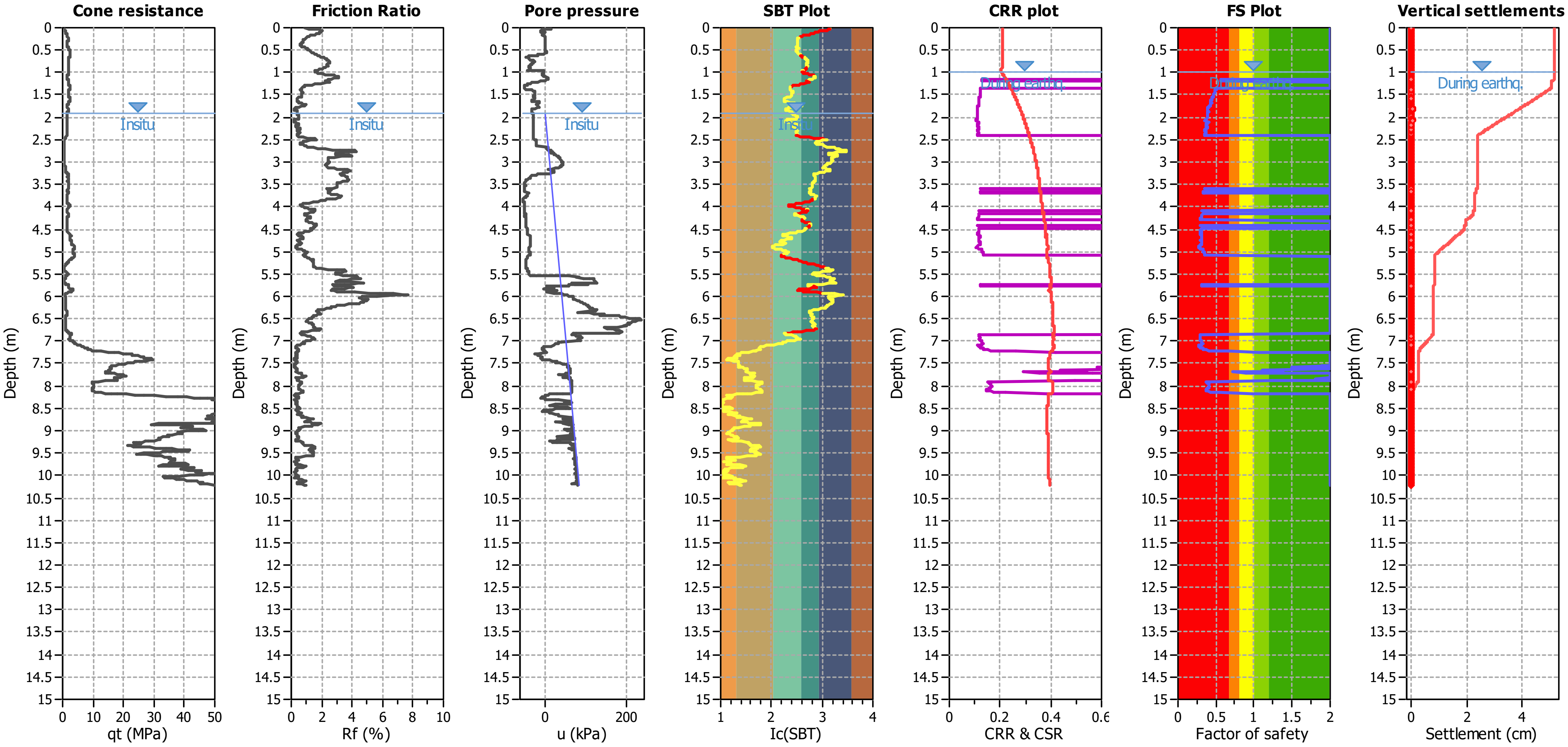
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_97674
Total depth: 10.22 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.35
G.W.T. (in-situ): 1.90 m
G.W.T. (earthq.): 1.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes
Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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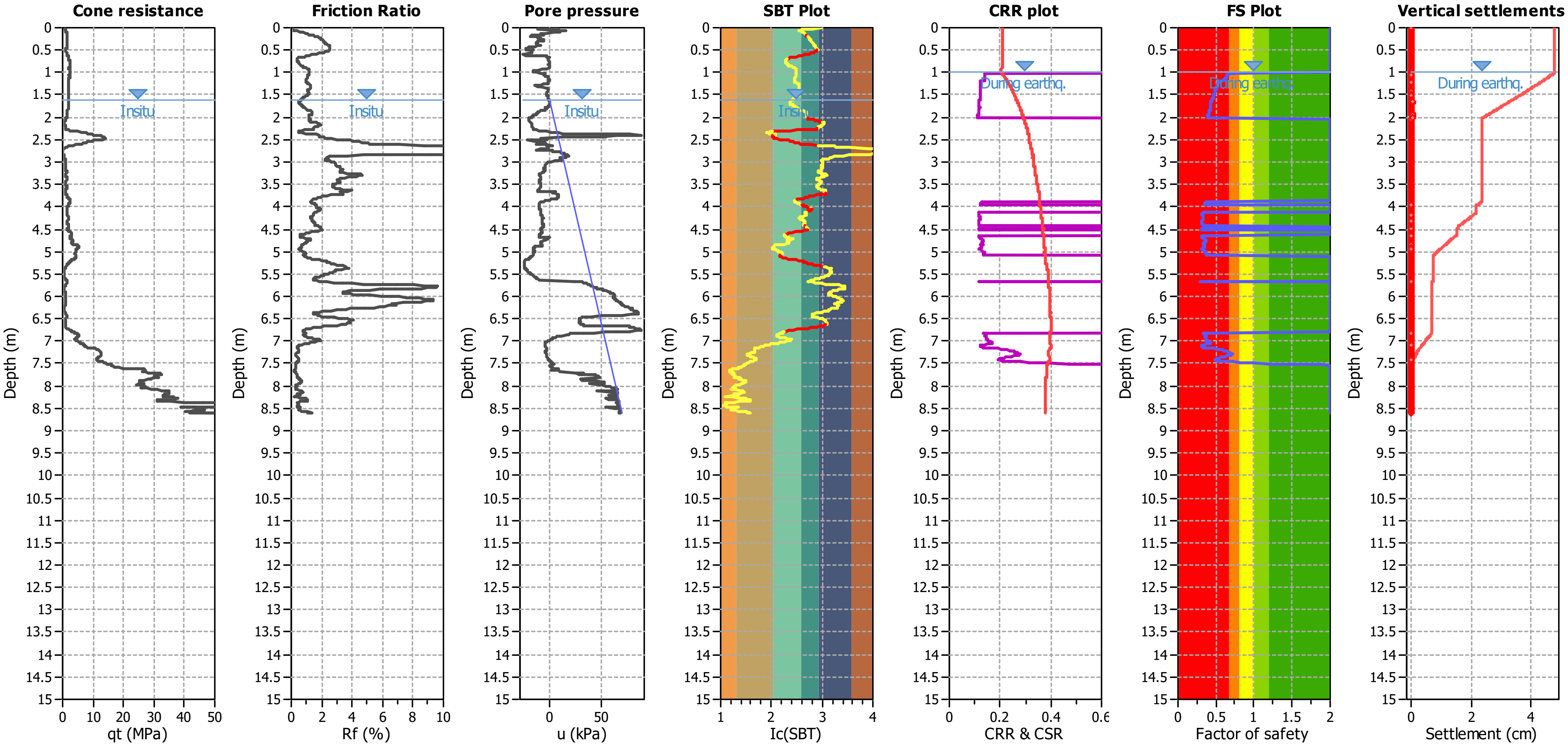
Project: **MINZ 19066.01 - Geotechnical Subdivision Evaluation and Assessment**
Location: **511 Halswell Road, Halswell, Christchurch**

CPT: CPT_97675
Total depth: 8.62 m



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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project file: C:\Andreas_Data\Projects\190666-511 Halswell Road_Subdivision\CLiq_MINZ190666-511 Halswell Road_ULS.clq

Geotechnical Investigation and Assessment Report for Subdivision

Riverstone Subdivision, 2 & 4 Glovers Road, Halswell, Christchurch

Issue Date: **20 October 2020**

Document Ref: **200357-RP-001[A]**

Prepared for: **Yoursection Ltd**

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Report Tracking - 2 & 4 Glovers Road, Halswell, Christchurch

Revision	Status	Date	Prepared by	Reviewed by
A	Final	20 October 2020	C. Gibbens	A. Giannakogiorgos

Authorisation

Author's Signature		**Approver's Signature**	
Name	Clem Gibbens	**Name**	Andreas Giannakogiorgos
Title	Engineering Geologist BSc MSc (Hons) MEngNZ	**Title**	Chartered Professional Engineer (Geotechnical) BSc MSc DIC CMEngNZ CPEng IntPE (NZ)

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Executive Summary

Miyamoto International NZ Ltd (MINZ) has been engaged by Yoursection Ltd to undertake a geotechnical land suitability assessment for the proposed residential subdivision at 2 & 4 Glovers Road, Halswell, Christchurch. The key findings of our evaluation and assessment are outlined below.

GROUND CONDITIONS	**Ground profile**	The sub-surface conditions comprise mainly topsoil over sand-silt mixtures underlain by soft clayey silts and shallow gravel. The ground conditions are variable in horizontal and vertical spread.	
	Soil classification as per NZS 1170.5:2004	Residential Subdivision Area: Class 'D' (deep or soft soil site)	
	Depth to water table	Perched water tables and shallow saturated soils were encountered within the top 1.0 to 2.0m bgl. Permanent ground water is anticipated below the soft silts within the underlying sands and gravels.	
SEISMIC ASSESSMENT	**Design Earthquake Event**	**SLS/SLS2**	**ULS**
	Estimated "free-field" Index post-liquefaction volumetric settlements	< 50mm	< 80mm
	Liquefaction Severity Number (LSN) Value	< 15 Little to minor expression of liquefaction	< 25 Little to moderate expression of liquefaction
	MBIE Technical Categorization (TC)	**Mapped MBIE**	Rural & Unmapped
		Site Specific Foundation TC	TC2
GEOTECHNICAL CONSIDERATIONS	Our assessment of the site under RMA Section 106 found that the subsidence hazard is present on-site due to presence of soft/loose soil layers and liquefiable deposits, though these hazards can be mitigated by the options listed in this report. As the site is located within an FMA set out by CCC, a portion of the site will require filling to raise the ground level to a suitable level for the proposed development by around 1.0m close to Green's Stream. Filling of the site will likely cause static some consolidation settlements in the soft compressible soils underlying the site, though this is not expected to be a significant risk to the development, based on the pre-loading trial undertaken by MINZ previously. A period of monitoring of the site filling works during the raising of the site levels and for a period (~6 months) is advised to be safeguard against the anticipated static settlements.		

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C. Geotechnical Investigation Results
D. Southern Geophysical MASW and GPR Report
E. Geotechnical Cross Sections
F. Liquefaction Analyses

1. Introduction

Miyamoto International NZ Ltd (Miyamoto) has been engaged by Yoursection Ltd to undertake a geotechnical evaluation and assessment as part of a land suitability assessment for the proposed new extension of the residential Riverstone Subdivision at 2 & 4 Glovers Road, Halswell, Christchurch.

Miyamoto have previously completed a geotechnical assessment for resource consenting purposes for the initial stage of the Riverstone Subdivision located at 511 Halswell Road, Christchurch (190666-RP-001[A] – 511 Halswell Road, dated 10 October 2019), as well as undertaking a trial pre-load assessment for the same property (190666-TM-001[A]_511 Halswell Road_Pre-load Trial, dated 28 January 2020). Both documents are referenced as part of this assessment, with this report supplementing and expanding on the work already undertaken.

The scope of this geotechnical engineering assessment was to evaluate the geotechnical conditions at the site and to provide preliminary recommendations for development of the sections. This assessment comprised the following:

- Research of the available information from the New Zealand Geotechnical Database (NZGD), Christchurch City Council (CCC) and Environment Canterbury (ECan);
- Site walkover inspection of the land;
- Shallow field investigation comprising hand-augered boreholes (HA) with associated dynamic cone penetrometer (DCP) and shear vane (SV) tests;
- Deep field investigation comprising Cone Penetration Tests (CPT) with accompanying Dynamic Probe Super Heavy (DPSH) testing;
- Multichannel Analysis of Surface Waves (MASW) geophysical survey;
- Ground Penetrating Radar (GPR) geophysical survey;
- Liquefaction analyses using CPT-based liquefaction triggering procedures;
- Reporting of the findings.

The geotechnical investigation and assessment were carried out considering the Ministry of Business, Innovation & Employment (MBIE) Guidance documents “Planning and engineering guidance for potentially liquefaction-prone land” - Version 1, dated September 2017, “Repairing and rebuilding houses affected by the Canterbury earthquakes” - Version 3, dated December 2012, and “Earthquake geotechnical engineering practice - Modules 2 & 3”. This report presents our findings and conclusions which are provided to facilitate the development of the extended subdivision plan for the site.

2. Site Description

The site, legally described as Lot 1 (2 Glovers) and Lot 2 (4 Glovers) DP 83635, is in Halswell, Christchurch and is approximately 8.3 hectares (ha) in total area. There is an approximate elevation change of 2.0m over 460m at an average gradient of 0.4%. The site generally slopes from north to south, with the low point at the southern boundary of both sections. The property is bound by Glovers Road along the northern boundaries and is bound by rural properties on the south and east boundaries, and the 511 Halswell Road section to the west. Green's Stream runs through the southern end of both sections.

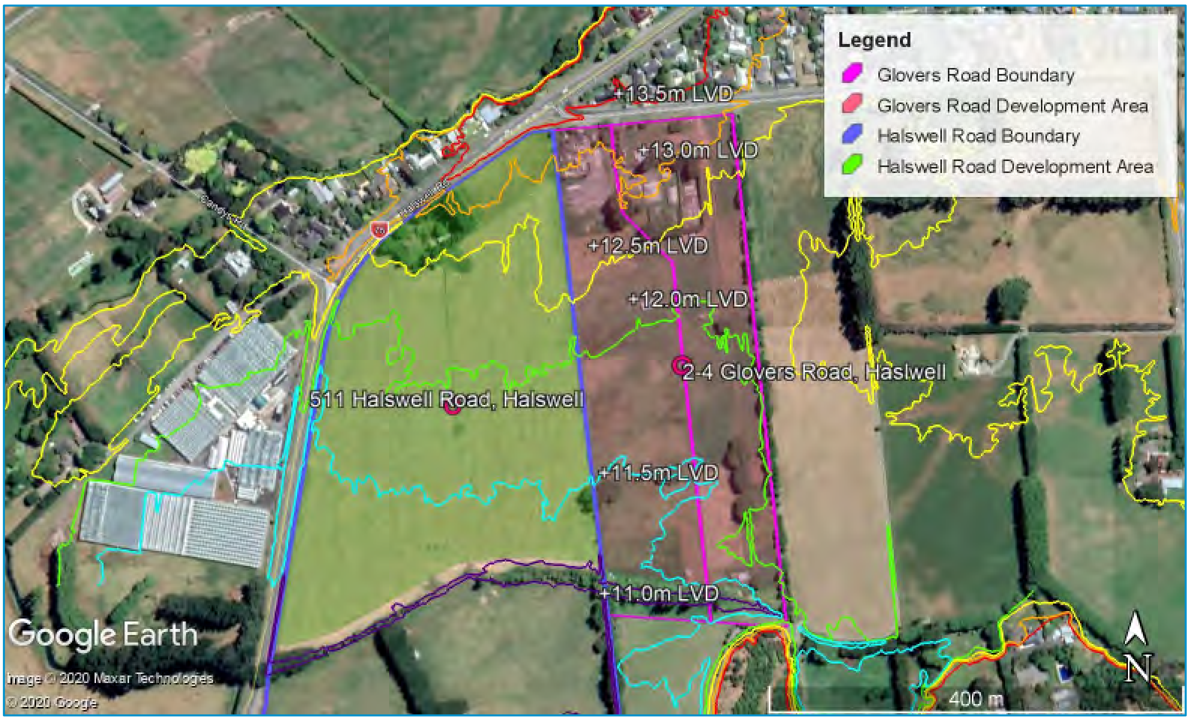

Figure 1: Proposed Site Layout with (Scale as Shown)

The property is located within the "Rural and Unmapped" category listed under the MBIE Technical Categories Map. The site location with reference to the MBIE Technical Categories is shown in Figure 2.

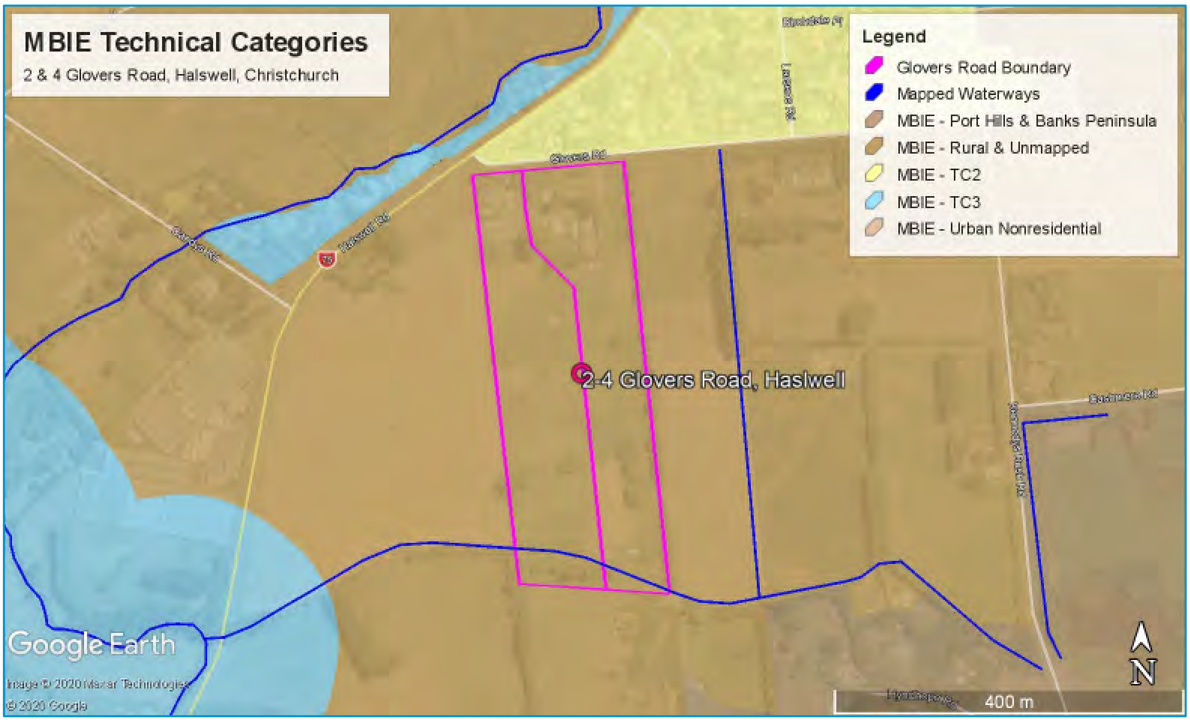

Figure 2: Site Location Plan Showing MBIE Technical Categories and Mapped Waterways (Scale as Shown)

The Riverstone Subdivision is proposed to, currently, be comprised of 239 residential lots with reserves located throughout. A draft plan of the subdivision, including the Glovers Road properties, is presented in Appendix A.

3. Desk Study

The following sources of third-party information were considered and are referenced in this report:

- New Zealand Geotechnical Database (NZGD);
- Environment Canterbury (ECan);
- Christchurch City Council (CCC).

New Zealand Geotechnical Database

The NZGD website was reviewed to identify any additional information related to the extent of land damage after the CES on the site and in the immediate surrounding areas. The results of this review indicate that no significant land damage was observed across the site. Table 1 provides a summary of the information obtained from our review of the NZGD.

Table 1: Desk Study Information Summary (NZGD)

	September 2010 (M_w 7.1)	**February 2011 (M_w 6.2)**	**June 2011 (M_w 6.0)**	**December 2011 (M_w 5.9)**
Aerial Photography Review	Outside of photographed area	Areas of likely ejecta identified in the central and northern areas of both properties, though mainly confined to 2 Glovers Road	Outside of photographed area	Outside of photographed area
Land damage observations	Minor ground cracking but no observed ejected liquefied material was recorded on the properties on the opposite side of Glovers Road in the September 2010 CES event and along Halswell Road and sections of Glovers Road during the June 2011 CES event.			
Observed ground cracking	No cracks mapped on the properties, 10mm – 200mm ground cracks mapped ~65m west of the northernmost boundary of the site within the residential area on the opposite side of Halswell Road			
PGA (g) ± SD	0.294 ± 0.390	0.356 ± 0.435	0.145 ± 0.465	0.139 ± 0.250
Scaled $PGA_{7.5}$ $PGA_{16\%ile}$ to $PGA_{84\%ile}^{(I)}$ (g)	0.179 to 0.394	0.164 to 0.391	0.061 to 0.156	0.071 to 0.117

(I) Scaled to M7.5 using Idriss and Boulanger recommendations (2008); 68% confidence $PGA_{7.5}$ range

Contaminated Land Considerations

The ECan Listed Land Use Register (LLUR) was reviewed and holds records of potentially Hazardous Activities and Industrial List (HAIL) sites. At this time, a small area that intersects the southern end of both sections is listed as a potential HAIL site. The LLUR lists this small area (in the vicinity of a storage shed) as an A10-classified area, which relates to "persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds", though this has not been investigated by ECan. The property reports for both sections are included in Appendix B.

An environmental assessment is outside the scope of this assessment and has been undertaken by others.

Flood Hazard

Christchurch is a low-lying city and there have always been areas that are prone to flooding during heavy rainfall. The CES has worsened flood risk in many areas of the city through damage to waterways and land. Flood Management Areas (FMAs) have been identified by CCC in the District Plan and take into consideration the impacts of the CES.

At the time of writing this report the site is located within a FMA as indicated by the CCC District Plan.

It is understood that a Finished Floor Level (FFL) of 21.25m above Christchurch Drainage Datum (CDD) is a requirement for development of the site.

Ground Motion

Using the MBIE and Bradley & Hughes (2012) procedures, we have found that the site was "sufficiently tested" to the Serviceability Limit State (SLS) level of earthquake demand during the September 2010 and February 2011 events of the CES. This indicates that land and building damage in a future SLS event is likely to be similar to these individual events.

Additionally, based on the SLS2 level of shaking (M_w 6.0 and PGA of 0.19g) which was introduced by MBIE following the updated liquefaction triggering CPT-based procedure by Boulanger & Idriss (2014), it is our opinion the site was "sufficiently tested" to the SLS2 level of earthquake demand during the September 2010 and February 2011 events of the CES.

Utilising a derivation of the Bradley and Hughes method, we can suggest that the site was not tested to Ultimate Limit State (ULS) level of shaking during the CES. Based on the probabilistic analysis of the PGAs experienced at the site, the nature of land and building damage is likely to be more severe during a future ULS event than that already experienced during the individual CES events.

4. Subsurface Conditions

Geological Setting

The geological map of the area (GNS 1:250,000 QMap) indicates that most of the site has surface geology consisting of "modern (Quaternary) river floodplain and low-level degradation terraces (<2° slopes) comprised of unweathered, variably sorted gravel/sand/silt/clay".

Field Investigations

The NZGD website was reviewed to identify relevant geotechnical investigations completed within the site vicinity, additional to the data identified for use in the original site assessment for the neighbouring section, though nothing for inclusion was identified.

Miyamoto undertook the following site-specific ground investigations and testing:

- Five (5) hand-augered boreholes (referenced HA1 to HA5) with in-situ shear vane testing;
- Five (5) Dynamic Cone Penetrometer (DCP) tests (referenced DCP1 to DCP5);
- Laboratory testing including fines content (FC) and Atterberg Limits;
- Twelve (12) Cone Penetration Tests (CPTu) with porewater pressure measurements;
- Multichannel Analysis of Surface Waves (MASW) geophysical survey;
- Ground Penetrating Radar (GPR) geophysical survey.

The general details of the ground investigations are summarised in Table 2, the test locations are shown in Figure 3 and Figure 4, and the HA/DCP logs and CPT plots are presented in Appendix C and the geophysical survey report is presented in Appendix D.

Table 2: Summary of Ground Investigations

Test Ref.	Source	Source Ref.	Test Type	Depth (m bgl)
HA1/DCP1 to HA5/DCP5	MINZ	200357	Hand Auger/ DCP	1.8 to 3.9
CPTu001 to CPTu012	LandTest	19096	CPT	10.0 to 15.0
MASW 1 to MASW 3	Southern Geophysical Ltd	2050	MASW	Up to 40.0
GPR 1 to GPR 11			GPR	Up to 4.0

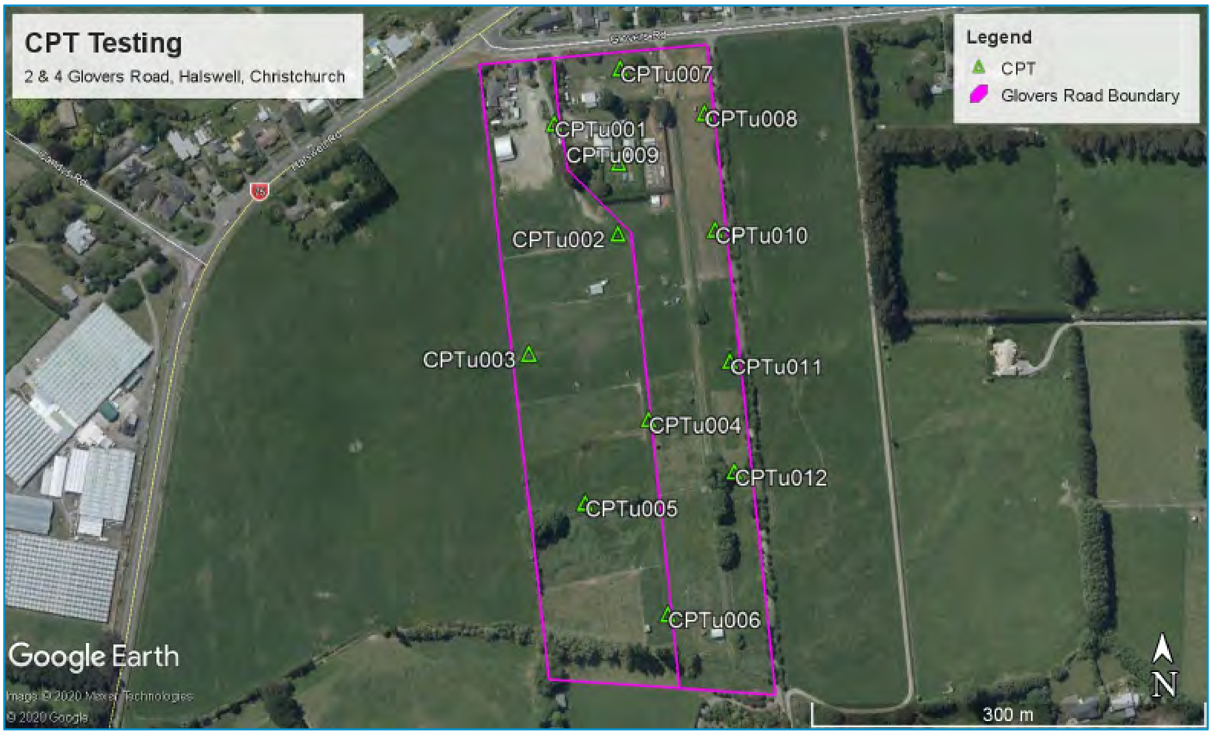

Figure 3: CPT Investigation Location Plan (Scale as Shown)

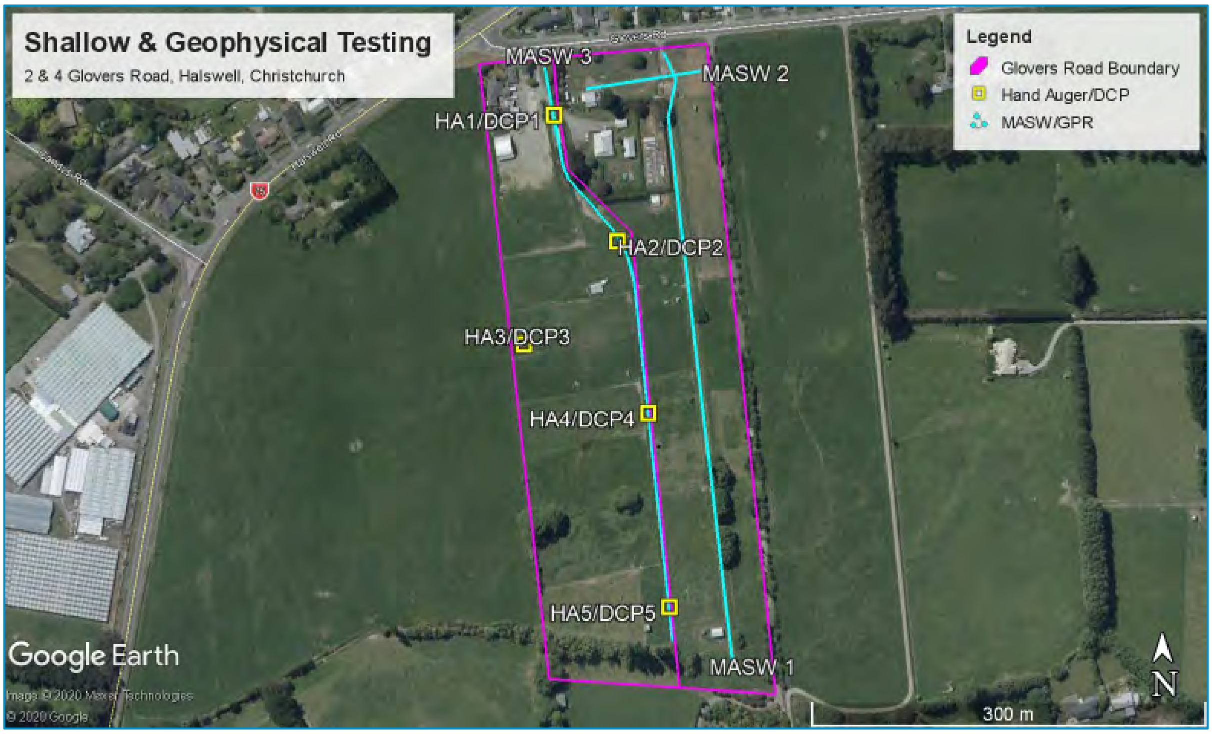

Figure 4: Other Geotechnical Investigation Location Plan (Scale as Shown)

Laboratory Test Results

Laboratory testing was undertaken on samples obtained from our shallow ground investigation to assess the soil characteristics across the site. The testing undertaken includes wet sieving to determine the fines content, and Atterberg limits tests to determine the plastic and liquid limits. A summary of the test results is presented in Table 3, with the full results presented in Appendix C.

Table 3: Laboratory Test Results

Sample Ref.	Depth of sample (m)	Soil Description	Plasticity Index	% Passing		
				0.3 mm	0.15 mm	0.063 mm
C20-319	HA1 1.5m – 2.3m	Silty SAND, brownish grey, wet, non-plastic	-	100	90	49
C20-320	HA1 2.3m – 3.8m	Silty SAND, brownish grey, saturated, non-plastic	-	100	91	49
C20-321	HA2 2.7m – 4.0m	Silty CLAY, some sand, dark grey, saturated, low plasticity	9	99	96	85
C20-312	HA3 2.0m – 3.4m	Sandy SILT, dark grey, saturated, non-plastic	NP	100	99	59
C20-323	HA5 1.5m – 1.8m	Silty SAND, brownish grey, wet, non-plastic	-	99	77	42

Ground Conditions

The ground conditions interpreted from the existing data and investigations undertaken as part of this assessment are presented graphically in the geotechnical cross sections included in Appendix E and the basic soil descriptions are outlined in Table 4.

A near-surface paleo-feature (old river terrace or paleochannel) was identified during the site testing with the CPT's completed at the southern end of the site (CPTu004 to CPTu006 and CPTu012) refusing in dense soils within the upper 5m, before testing was continued with the DPSH. The shallow investigation (HA5/DCP5) also refused at a shallow depth due to dense soils. The testing at the northern end of the site all reached the target depths and were consistent in their findings.

Table 4: Ground Conditions Summary

Layer	Soil Name
a	Silty SAND and Sandy SILT, loose to firm
b	Clayey SILT, soft to firm, medium plasticity
c	Silty SAND, medium dense to dense with increasing depth
GS	Gravelly SAND to Sandy GRAVEL, dense
d	Clayey SILT to silty CLAY, firm
e	Medium dense SAND with silt and gravels
f	Clayey SILT, firm to stiff
S	Silty SAND to Sandy SILT, medium dense to very stiff

MASW & GPR Geophysical Survey

The shear wave velocity (V_S) measurement was assessed with a MASW survey. The results of the survey were used to refine the boundaries and extents between the shallow, softer soils and denser sandy/gravelly layers with the MASW survey reflecting the findings of the intrusive investigations, with 2 clearly defined areas for the north and south of the site. The soils in the northern part of the site had a generally lower shear wave velocity ($V_S < 180m/s$) to approximately 20.0m depth, though discrete layers of denser, higher V_S soils were identified above this depth before becoming lower velocity again. For the southern part of the site, the lower V_S soils are generally terminated shallower (<5m depth) before the V_S increased in the gravelly dense material.

Additionally, the measured cone tip resistance (q_c) and interpreted shear wave velocity from the CPT data generally shows a consistent pattern with the recorded values from the MASW survey as seen in the CPT profiles in Appendix C. It should be noted that due to the high velocity layers towards the south, thin lower velocity layers were not picked up as seen in the DPSH data. This is reflected in the cross sections presented in Appendix E.

The GPR survey was undertaken to further supplement the MASW surveys for the near-surface soils. The primary objective of this survey was to assist in identifying softer or denser layers that may not have been picked up in the MASW survey. The results generally show a consistent correlation with the MASW survey. The softer soils generally had a poor reflection, with denser material showing a clearer reflection. The shallow gravelly soils at the southern end of the site were also clear within the upper 4.0m of the soil profile.

Groundwater

Our site-specific shallow investigation encountered groundwater levels between 1.0m and 1.8m bgl, however the cohesive soils below the recorded depth were noted to not be saturated, indicating that a perched water table is likely present on-site. The CPT data shows variable piezometric conditions indicating a groundwater table depth between 0.7m and 2.4m bgl, due to the differing depth of cohesive soils in the upper soil profile and different elevations. The shallower groundwater depths were generally confined to the lower elevations of the property.

Based on the above, a groundwater depth range of between 0.7m to 2.4m bgl was adopted for the liquefaction triggering and free-field settlement assessment, depending on the location of the test across the site.

Site Subsoil Class

Based on the site-specific investigation, geological maps and other available information, the site is classified as a Class D (deep or soft soil) site.

Shallow Soils

The geotechnical investigations indicate the existence of low velocity ($V_s \leq 180$m/s), soils between approximately 4.0m and 20.0m depth, with the lower V_S soils encountered at greater depths towards the north of the sections. There are also locations where denser pockets of material were identified within these lower V_S layers. Those layers have lower strength and have the potential for long-term consolidation settlements from loads, such as residential dwellings. This is further discussed later in this report.

5. Liquefaction Assessment

Methodology

An assessment of the earthquake-induced free-field post-liquefaction volumetric settlement at the site has been carried out in accordance with the MBIE Guidance and using proprietary liquefaction assessment software, for SLS and ULS earthquake scenarios.

The seismic design requirements adopted for use in the analyses are defined in MBIE/NZGS Earthquake Geotechnical Engineering Practice Module 3 (May 2016), and Part C of the MBIE Guidelines “Repairing and rebuilding houses affected by the Canterbury earthquakes” and its subsequent updates - clarifications. These are:

- Buildings of normal use (Importance Level 2);
- Deep or soft soil sites (Class D) as specified previously;

- Boulanger and Idriss (2014) methodology for liquefaction triggering, as per the MBIE Guidance subsequent updates (Issue 7, October 2014);
- Zhang et al. (2002) post-liquefaction volumetric strain calculation for estimating the free-field settlements;

Calculations were performed for the full depth of the CPTs and the upper 10m of the soil profile (as per the MBIE Guidance "index value" estimations). It should be noted that the settlement estimates only account for the free-field component of the expected settlement. Actual total settlements under SLS or ULS earthquake loading may be greater or less.

The Liquefaction Severity Number (LSN[1]) has been calculated and used in our assessment as it tends to better reflect the more damaging effects of shallow liquefaction, which is more critical for shallow founded structures. The level of ground damage associated with LSN is summarised in Table 5.

Table 5: Liquefaction Severity Number Ranges and Related Effects

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

Liquefaction Assessment Results

Due to the rapid changes at the interface between fine and coarse-grained soils, a layer correction was applied. The cone tip penetration, and subsequently, the ability to resist liquefaction of a sandy material, is reduced by the surrounding silty layers, while the I_c[2] of the silt layers is reduced due to the presence of the surrounding sandy layers and hence the susceptibility of the fine layers is overestimated. For our analysis, an I_c change of >0.05 per 10mm has been adopted, which eliminates the liquefaction potential for the layer.

The results of our liquefaction triggering analyses utilising the CPT data are presented in Appendix F and summarised in Table 6.

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[1] **LSN = Liquefaction Severity Number**. LSN (van Ballegooy et al., 2014) is a vulnerability indicator (damage index) quantifying liquefaction-induced damage developed to reflect more damaging effects of shallow liquefaction on residential land and foundations following the Canterbury Earthquakes (2010-11). LSN considers depth weighted calculated volumetric densification strain within soil layers as a proxy for the severity of liquefaction land damage likely at the ground surface.

[2] **I_c = Soil Behaviour Classification Index -** Robertson & Wride 1998.

Table 6: Estimated “Free-Field” Post-Liquefaction Volumetric Ground Surface Settlements

Earthquake scenario	Moment magnitude (M_w) / PGA (g)	MBIE “Index Value” (mm)	MBIE Technical Category	LSN Values
GWD = varying (in-situ) and 0.5m to 1.2m (earthquake); Layer transition applied				
SLS SLS2	7.5/0.13 6.0/0.19	< 35 5 – 50	TC2 TC2	1 – 5 2 – 16
ULS	7.5/0.35	5 – 80	TC2	5 – 25

In accordance with the MBIE Guidance, the analysis indicates that under SLS and ULS loading conditions the predicted index value settlements fall within the expected future land performance values for a TC2 category site. The higher settlements were located on the land at the northern area of the 2 Glovers Road section, which generally correlates with observed liquefaction ejecta in the aerial photographs.

Based on the LSN estimated for the design events, ‘little to minor’ expression of liquefaction may be expected for a future SLS design event, and ‘little to moderate’ expression of liquefaction may be expected for a future ULS design event. The values of LSN at the upper end of the ranges estimated are generally located in the central portion of the development area (where ejecta has been observed following the CES events).

Lateral Spreading

Given the generally flat topography of the site, and the assumption that the site will be levelled further during the development of the subdivision, there is unlikely to be significant height differences, apart from the area immediately adjacent to Green’s Stream. As the area needs to be developed with the FMA in mind, and land levels lifted, there is the potential for a more pronounced ‘free-face’ that could create a risk of lateral spreading. Options to address this are discussed later in the report.

6. Site Designation Assessment

Based on the findings of our desk study, our site-specific ground investigation and observations, and assessment of the performance of the land, we consider the MBIE TC2 category generally appropriate for the site. Despite the deformation characteristics of TC2, the land does not meet the definition of ‘Good Ground’ as per the New Zealand Standards without modification to standard foundation systems and specific engineering design to account for this due to the soft soils.

7. Geotechnical Considerations for Subdivision

Geotechnical Hazards

The most significant geotechnical hazards at the site comprise the potential for earthquake-induced soil liquefaction and potential static subsidence of the soft compressible soils. These hazards can be partly mitigated by providing strengthened foundations, which reduce the potential for differential settlement of the buildings and are designed to be re-levellable.

However, as part of the land development it is understood that, in order to meet the CCC FFL requirements, the site grade will need to be raised by filling. Site filling works can induce additional loading of the underlying soft compressible deposits and potentially lead to consolidation settlement of the fill and / or construction above. To assess the likely influence of filling, a pre-load trial was undertaken by Miyamoto. This trial indicates that static settlements are not believed to pose a significant risk to the Halswell Road section of the development. Given the similar soil conditions found, it is our professional opinion that this statement also applies to the Glovers Road properties. It is still recommended that settlement plates are installed during the site filling works and these should be founded at the base of the fill with upstands extending through the top of the fill. It is advised that the settlement plates are monitored during the raising of the site levels and for a period (up to 6 months) to assess any static settlements and ensure performance is in line with the pre-loading trial findings.

The current subdivision plan for the entire site is not currently finalised and until it is further developed, specific detailed recommendations cannot be provided, however, the following sections outline general considerations for future development.

Development Considerations

Based on the land survey data (provided by others), a maximum level of approximately 22.3m CDD was identified at the northern extent of property. The land drops to approximately 19.6m CDD next to Green's Stream, though the development does not extend to this point. The low point of the development area is at approximately 20.4m CDD. As discussed above, the site will require filling to meet the CCC FFL requirements (FFL = 21.25m CDD based on the Halswell Road site), particularly if the preferred foundation options comprise concrete slab foundations. It is anticipated that maximum filling would be in the proximity of 1.2m.

Currently, there is no indication of cutting or removal of material to the north of the site. All earthworks should be undertaken in accordance with NZS 4431:1989 (code of practice for earth fill for residential development) prior to the construction of any foundations. The monitoring scheme (mentioned earlier) should be fully developed once the final details of the proposed earthworks are known.

The southern extent of the filling (in proximity of Green's Stream) will be the maximum height of fill required and will require detailed design to ensure stability. It is our understanding the development area is to extend to within 15m of Green's Stream. A shallow vegetated slope is considered suitable given the height of filling is not likely to exceed 1.2m, and provided the slope is not at a gradient exceeding 1.0m vertical to 2.0m horizontal.

Based on the above and the previously completed works, the following foundation solutions would be considered suitable for the construction of NZS3604 compliant structures for the subdivision:

- MBIE TC2 (Options 1 to 4) enhanced foundation slab;
- Specifically designed, enhanced NZS 3604 perimeter foundation wall and shallow piles.

Based on development works proposed, a geotechnical ultimate bearing capacity of 200kPa can be assumed at a high level, though this value is indicative only. The available bearing capacity must be confirmed on-site prior to construction works at the time of any building consent application.

The foundation types detailed above are also preliminary and should be further developed and optimised in collaboration with the structural engineer once further details of any proposed structure are finalised.

Stormwater Management

Stormwater management is outside the scope of our works. However, it is understood the southern section of the Halswell Road site (area south of Green's Stream) will be utilised for stormwater detention and treatment for the Riverstone subdivision as a whole, with shallow basins excavated through this area. As mentioned in the initial assessment undertaken, this material is unlikely to be suitable for filling of the development area.

Services

Buried services are vulnerable to ground deformations when located within and/or in proximity of potentially liquefiable and compressible soils. Services for the residential development should be designed by a suitably qualified person in collaboration with the geotechnical engineers to accommodate the likelihood of future ground deformations.

Pavement/Roading Infrastructure

As for the services at the site, pavements will require detailed design by a suitably experienced person in collaboration with the geotechnical engineer, the finished ground levels and compaction characteristics of the filling material.

It is currently understood that the new areas of development will link into the Halswell Road property as well as having its own access onto Glovers Road, and it is assumed that filling in this area will be required to raise the grade. The underlying soils in this area are generally typical for the site with the upper 1.0m comprising topsoil over soft silt (loosely corresponding to a CBR of ~2 to 3 below the topsoil).

8. Assessment Against RMA Section 106

As per the requirements of Section 106 of the Resource Management Act (RMA) (2017), we have undertaken a high-level assessment of the significant geotechnical hazards that may affect the site, outside of the hazards already discussed in this report (i.e. static and earthquake-induced subsidence, and lateral spreading). These hazards include, but are not limited to:

- Erosion;
- Falling debris;
- Slippage;
- Inundation.

At the time of our site visit, there was no evidence of erosion. Likewise, no evidence was observed to suggest that lateral movement is an issue on the site, given the site is generally flat. Rock Fall or slope movement are also not considered a risk to this area of the development.

As part of the site is identified as being within a Flood Management Area (FMA) as defined by the CCC, inundation is likely to be a risk, as the site currently stands. If the site is built up to ensure the FFLs set by the CCC are met and suitable stormwater drainage is in place, then inundation is not considered an imminent risk to the development.

Based on our assessment, we consider that the “significant” geotechnical hazards may be mitigated to an acceptable standard, provided that the geotechnical recommendations given in this report are followed, and the appropriate engineering measures implemented, we consider that the development is unlikely to be affected nor worsen, accelerate or result in material damage.

9. Limitations

This report is subject to the following limitations:

- This report has been prepared by Miyamoto for the Client for the purpose/s agreed with the Client (Purpose). Miyamoto accepts no responsibility for the validity, appropriateness, sufficiency or consequences of the Client using the report for purposes other than for the Purpose.
- This report is not intended for general publication or circulation. This report is not to be reproduced by the Client except in relation to the Purpose, without Miyamoto’s prior written permission. Miyamoto disclaims all risk and all responsibility to any third party.
- This report is provided based on the various assumptions contained in the report.
- Miyamoto’s professional services are performed using a degree of care and skill reasonably exercised by reputable consultants providing the same or similar services as at the date of this report.
- The Client is responsible for ensuring that the design of any foundations ensures the functionality of the building under SLS level loads.
- The sub surface information has been obtained from investigation carried out at discrete locations, which by their nature only provide information about a relatively small volume of subsoils. While Miyamoto has taken reasonable skill and care in carrying out the investigation to determine the subsoil condition, the subsoil condition could differ substantially from the results of any sampling investigation. Miyamoto is not responsible for and does not accept any liability in respect of any difference between the actual subsoil conditions and the results of our investigation.
- Any susceptibility analysis carried out in respect of liquefaction is based on Miyamoto’s current understanding as an experienced professional engineering consultant of the data, methods etc. Future seismic events may change our understanding of liquefaction and its affects, which may affect the content of this report. Miyamoto is not responsible for and does not accept any liability where the content of this report is changed due to a change in industry knowledge of matters relating to liquefaction.
- This report specifically excludes assessment or advice relating to hazardous materials, such as asbestos.

- Where the Client provides information to Miyamoto, including design calculations and drawings of the as-built structure, or where the report indicates that we have obtained and/or relied upon information provided from a third party, Miyamoto has not made any independent verification of this information except as expressly stated in the report. Miyamoto assumes no responsibility for any inaccuracies in, or omissions to, that information.
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If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact Miyamoto International (NZ) Ltd.

10. References

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Appendices

A. Updated Indicative Subdivision Plan (Davie Lovell Smith)

AMENDMENTS :		
AMENDMENT	DATE	DESCRIPTION

Total Area : 23.1161 ha

Comprised in: RT's CB10B/654, CB48C/117
& CB48C/118

DAVIE LOVELL-SMITH
PLANNING SURVEYING ENGINEERING

116 Wrights Road P O Box 679 Christchurch 8140. New Zealand
Telephone: 03 379-0793 Website: www.dls.co.nz E-mail: office@dls.co.nz

JOB TITLE:

Halswell Road

SHEET TITLE:

Proposed Subdivision of
Pt RS 1593, RS 772 &
Lots 1 & 2 DP 83635

DRAWING STATUS

For Discussion Purposes

SCALE : 1:1000@A1
1:2000@A3

DATE : October 2020

CAD FILE : J:\20017\Concept_R6.dwg

REVISION :

DRAWING No : **C20017**

SHEET No: 1 OF 1

R6

NOTES :

1. Areas and dimensions are approximate only and are subject to final survey and deposit of plans.
2. Service easements to be created as required.
3. This plan has been prepared for discussion purposes only. No liability is accepted if the plan is used for any other purposes.
4. The position of Greens Drain is approximate and subject to survey.

B. ECan Listed Land Use Register Files

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry in regards to our Listed Land Use Register (LLUR) which holds information about sites that have been used, or are currently used for activities which have the potential to have caused contamination.

The LLUR statement provided indicates the location of the land parcel(s) you enquired about and provides information regarding any LLUR sites within a radius specified in the statement of this land.

Please note that if a property is not currently entered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; other information relevant to potential contamination may be held in other files (for example consent and enforcement files).

If your enquiry relates to a farm property, please note that many current and past activities undertaken on farms may not be listed on the LLUR. Activities such as the storage, formulation and disposal of pesticides, offal pits, foot rot troughs, animal dips and underground or above ground fuel tanks have the potential to cause contamination.

Please contact and Environment Canterbury Contaminated Sites Officer if you wish to discuss the contents of the LLUR statement, or if you require additional information.
For any other information regarding this land please contact Environment Canterbury Customer Services.

Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit www.ecan.govt.nz/HAIL for more information about land uses.

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
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PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Date:	13 October 2020	
Land Parcels:	Lot 1 DP 83635	Valuation No(s): 2356209300

The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
26587	26587	Halswell West	A10 - Persistent pesticide bulk storage or use;	Not Investigated

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry only.

Information held about the sites on the Listed Land Use Register

---

Site 26587: 26587 (Intersects enquiry area.)

Site Address:	Halswell West
Legal Description(s):	Lot 1 DP 83635,Lot 2 DP 83635

Site Category:	Not Investigated
Definition:	Verified HAIL has not been investigated.

Land Uses (from HAIL):

Period From	Period To	HAIL land use
Pre 1994	Pre 2004	Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds

---

Notes:

17 Oct 2013 Area defined from: 1994-2004 ECan Aerial Photographs

Note: Multiple glass houses were noted in aerial photographs reviewed.

Investigations:

There are no investigations associated with this site.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ265562.

Disclaimer: ***The enclosed information is derived from Environment Canterbury's Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987 and Environment Canterbury's Contaminated Land Information Management Strategy (ECan 2009).***

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

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Yours sincerely

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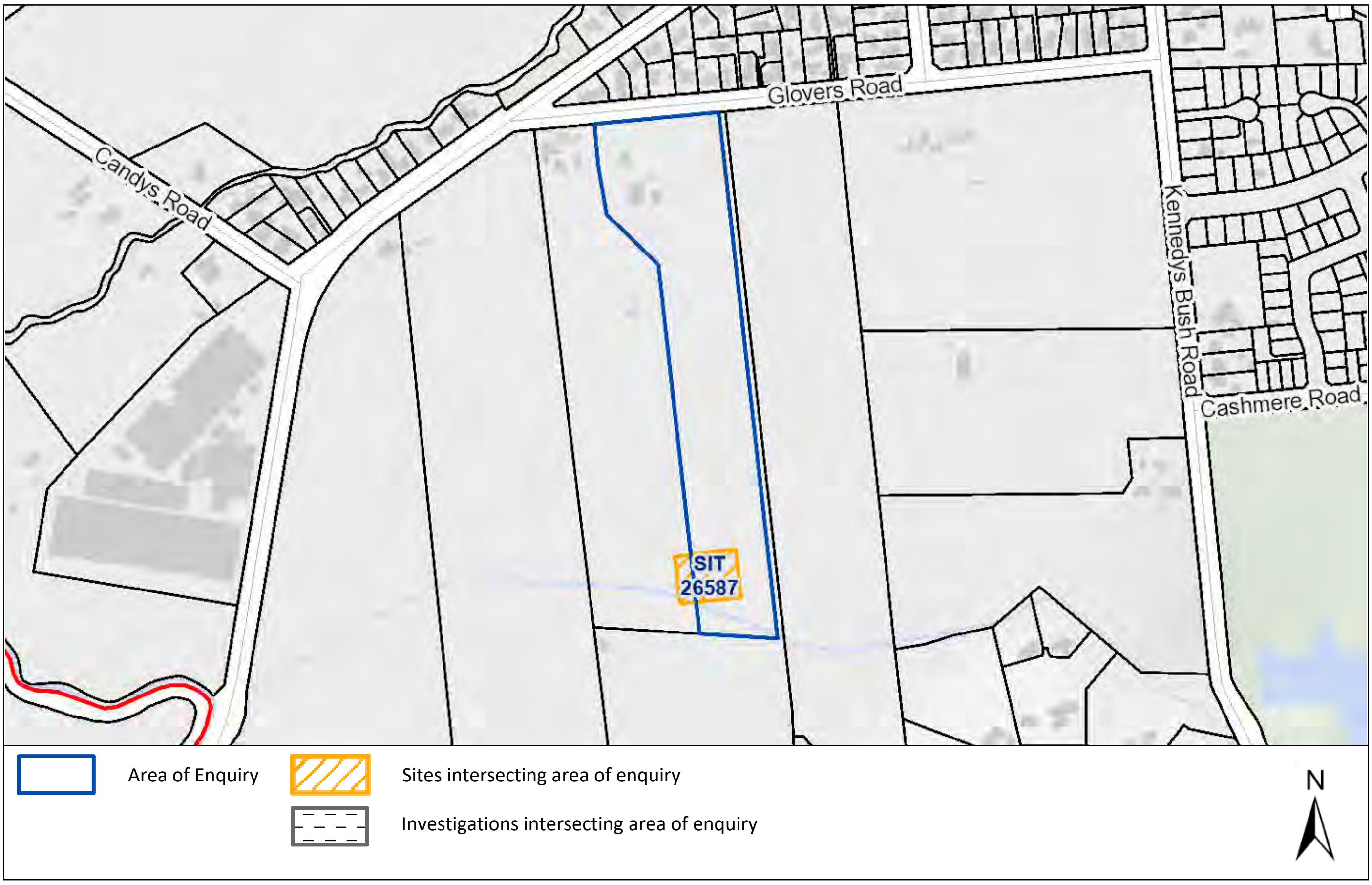
www.ecan.govt.nz

Date: 13 October 2020
Land Parcels: Lot 2 DP 83635 Valuation No(s): 2356209301



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Summary of sites:

Site ID	Site Name	Location	HAIL Activity(s)	Category
26587	26587	Halswell West	A10 - Persistent pesticide bulk storage or use;	Not Investigated

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry only.

Information held about the sites on the Listed Land Use Register

---

Site 26587: 26587 (Intersects enquiry area.)

Site Address: Halswell West
Legal Description(s): Lot 1 DP 83635,Lot 2 DP 83635

Site Category:	Not Investigated
Definition:	Verified HAIL has not been investigated.

Land Uses (from HAIL):

Period From	Period To	HAIL land use
Pre 1994	Pre 2004	Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds

---

Notes:

17 Oct 2013 Area defined from: 1994-2004 ECan Aerial Photographs

Note: Multiple glass houses were noted in aerial photographs reviewed.

Investigations:

There are no investigations associated with this site.

Information held about other investigations on the Listed Land Use Register

For further information from Environment Canterbury, contact Customer Services and refer to enquiry number ENQ265560.

Disclaimer: ***The enclosed information is derived from Environment Canterbury's Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987 and Environment Canterbury's Contaminated Land Information Management Strategy (ECan 2009).***

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

C. Geotechnical Investigation Results

MINZ Shallow Investigation Logs

Laboratory Soil Sample Test Results

LandTest CPT/DPSH Plot

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**200357**
CLIENT:	**Yoursection Ltd.**
TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA1/DCP1

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**2.9 mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.65 mbgl**	This report may only be reproduced in full	

Depth (m)	DCP Test Results (Blows per 100mm)	GWL	Soil Description: USC	Soil Description: Soil Characteristics	Graphic Log	Sample Taken	Lab Testing: Atterberg Limits LL	PL	PI	Grain Size Gr	Sa	FC	WC (%)	UW	Vane shear strength (kPa) peak/remoulded
	1			SILT: low plasticity, dark brown, moist, with minor rootlets (TOPSOIL)											
	1														
	1														
	1														
	3			SILT: low plasticity, brown, moist, with minor fine sand											
0.5	2														
	1														
	2														
	1														
	2														
1.0	2														
	2														
	2														
	2														
	1														
1.5	2			Silty SAND: fine to medium, brown-grey, wet											
	2	▽													
	2														
	2					DIST. SAMPLE					51%	49%			
	2														
2.0	3			at 2.0m: becomes blue-grey, saturated											
	3														
	2														
	1														
	1														
2.5	2														
	2					DIST. SAMPLE					51%	49%			
	3														
	4														
	5			...contd on next page											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

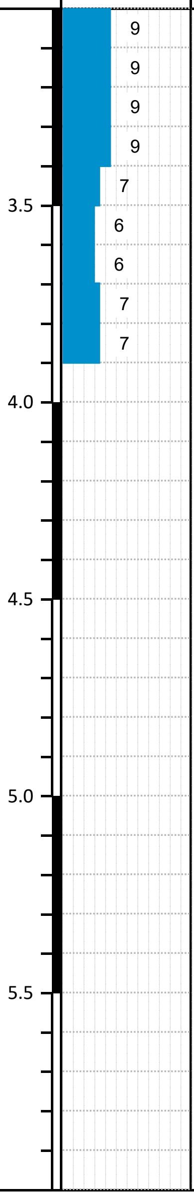
As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS		
	PROJECT NUMBER:	**200357**
	CLIENT:	**Yoursection Ltd.**
	TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA1/DCP1 (contd.)

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**					
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**3.9**	**mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**		*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.65**	**mbgl**	This report may only be reproduced in full	



Depth (m)	DCP Test Results (Blows per 100mm)	GWL	Soil Description			Sample Taken	Lab Testing								Vane shear strength (kPa) peak/remoulded
							Atterberg Limits			Grain Size			WC (%)	UW	
			USC	Soil Characteristics	Graphic Log		LL	PL	PI	Gr	Sa	FC			
	9 9 9 9 7 6 6 7	1.65m bgl --->		Silty SAND: fine to medium, blue-grey, saturated (contd.)		DIST. SAMPLE					51%	49%			
	7			SILT: low plasticity, blue-grey, saturated											
			EOH (Target Depth Reached)												

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**200357**
CLIENT:	**Yoursection Ltd.**
TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA2/DCP2

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**3.9 mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.3 mbgl**	This report may only be reproduced in full	

Depth (m)	*DCP Test Results (Blows per 100mm)*	*GWL*	*Soil Description*			*Sample Taken*	*Lab Testing*								*Vane shear strength (kPa) peak/remoulded*
							Atterberg Limits			*Grain Size*			*WC (%)*	*UW*	
			USC	*Soil Characteristics*	*Graphic Log*		*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*			
	1			SILT: non-plastic, dark brown, moist, with some sand and rootlets (TOPSOIL)											
	2														
	1														
	2			SILT: low plasticity, yellow-brown, moist, with some sand											
0.5	2														66 / 16
	3														
	3			SAND: fine to medium, orange-brown, moist, with trace of silt											
	3														
	2														
1.0	2														
	4														
	3														
	2	∇													
	3														
1.5	2														
	2			Clayey SILT: low to medium plasticity, grey, moist, with some sand											
	3														
	4														
	3			at 1.9m: becomes wet, mottled orange											
2.0	Self Weight														63 / 16
	1														
	3			at 2.2m: mottling absent											
	3														
	3			at 2.3m: becomes saturated											
2.5	4														
	4														
	5														
	5					DIST. SAMPLE	29	20	9	-	15%	85%			
	7														
	7			...contd on next page											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	∇	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

PROJECT NUMBER:	**200357**
CLIENT:	**Yoursection Ltd.**
TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA2/DCP2 (contd.)

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**3.9 mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.3 mbgl**	This report may only be reproduced in full	

Depth (m)	DCP Test Results (Blows per 100mm)	GWL	Soil Description: USC	Soil Description: Soil Characteristics	Graphic Log	Sample Taken	Atterberg Limits: LL	Atterberg Limits: PL	Atterberg Limits: PI	Grain Size: Gr	Grain Size: Sa	Grain Size: FC	WC (%)	UW	Vane shear strength (kPa) peak/remoulded
	7	1.3m bgl --->		Clayey SILT: low to medium plasticity, grey, saturated, with some sand (contd.)	× × ×										
	7														
	8														
	7														
	7					DIST. SAMPLE	29	20	9	-	15%	85%			
3.5	6														
	7														
	8														
	7														
			EOH (Target Depth Reached)												
4.0															
4.5															
5.0															
5.5															

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS		
	PROJECT NUMBER:	**200357**
	CLIENT:	**Yoursection Ltd.**
	TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA3/DCP3

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**4.1 mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.8 mbgl**	This report may only be reproduced in full	

Depth (m)	DCP Test Results (Blows per 100mm)	GWL	Soil Description: USC	Soil Description: Soil Characteristics	Soil Description: Graphic Log	Sample Taken	Lab Testing: Atterberg Limits: LL	Atterberg Limits: PL	Atterberg Limits: PI	Grain Size: Gr	Grain Size: Sa	Grain Size: FC	WC (%)	UW	Vane shear strength (kPa) peak/remoulded
	2			SILT: non-plastic, dark brown, dry, with some sand and rootlets (TOPSOIL)											
	1														
	2														
	2														
0.5	2			SILT: low plasticity, light brown, moist											
	2														
	2			SAND: fine to medium, orange brown, moist											
	2														
	2														
1.0	2														
	2														
	2														
	3														
	1			Sandy SILT: low plasticity, orange brown, wet											
1.5	2														
	3			SILT: medium plasticity, brown, wet											
	3														
	3	∇													
	5														
2.0	2														
	2			Sandy SILT: non-plastic, dark grey, saturated		DIST. SAMPLE	Non-Plastic			-	41%	59%			
	2														
	3														
	4														
2.5	4														
	5														
	5														
	2														
	4														
	5			...contd on next page											

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	∇	STANDING GWL

NOTES

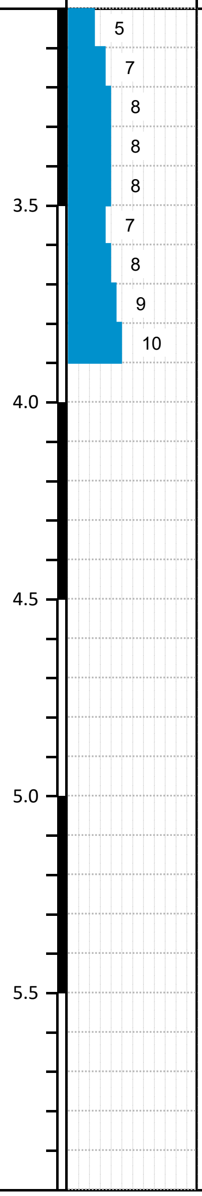
As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

PROJECT NUMBER:	**200357**
CLIENT:	**Yoursection Ltd.**
TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA3/DCP3 (contd.)

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**4.1 mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.8 mbgl**	This report may only be reproduced in full	



GWL	Soil Description			Sample Taken	Lab Testing								Vane shear strength (kPa) peak/remoulded
					Atterberg Limits			Grain Size			WC (%)	UW	
	USC	Soil Characteristics	Graphic Log		LL	PL	PI	Gr	Sa	FC			
1.8m bgl --->		Sandy SILT: non-plastic, dark grey, saturated (contd.)		DIST. SAMPLE	Non-Plastic			-	41%	59%			

EOH (Target Depth Reached)

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

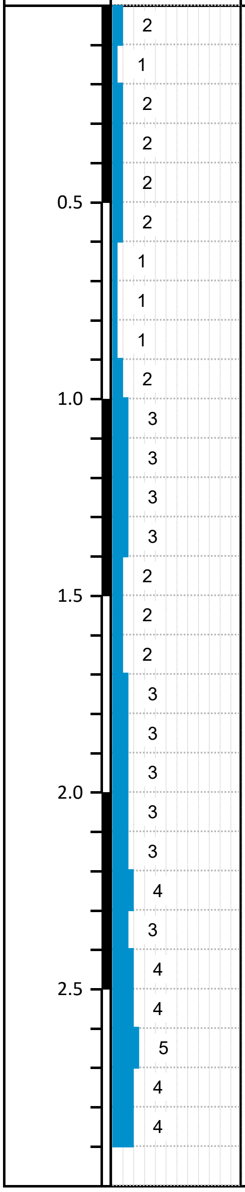
miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**200357**
CLIENT:	**Yoursection Ltd.**
TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA4/DCP4

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**					
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**2.9**	**mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**		*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.2**	**mbgl**	This report may only be reproduced in full	



Depth (m)	DCP Test Results (Blows per 100mm)
0.0–0.1	2
0.1–0.2	1
0.2–0.3	2
0.3–0.4	2
0.4–0.5	2
0.5–0.6	2
0.6–0.7	1
0.7–0.8	1
0.8–0.9	1
0.9–1.0	2
1.0–1.1	3
1.1–1.2	3
1.2–1.3	3
1.3–1.4	3
1.4–1.5	2
1.5–1.6	2
1.6–1.7	2
1.7–1.8	3
1.8–1.9	3
1.9–2.0	3
2.0–2.1	3
2.1–2.2	3
2.2–2.3	4
2.3–2.4	3
2.4–2.5	4
2.5–2.6	4
2.6–2.7	5
2.7–2.8	4
2.8–2.9	4

Depth (m)	GWL	USC	Soil Characteristics	Sample Taken	LL	PL	PI	Gr	Sa	FC	WC (%)	UW	Vane shear strength (kPa) peak/remoulded
0.0–0.3			Sandy SILT: non-plastic, brown, moist, with minor rootlets (TOPSOIL)										
0.3–1.0			SAND: fine to medium, grey, moist, with some silt at 0.8m: becomes wet										
1.0–2.0	∇ (1.2)		Sandy SILT: low plasticity, brown-grey, wet, sand is fine at 1.2m: becomes saturated										
2.0–2.4			SILT: low to medium plasticity, blue-grey, saturated										
2.4–2.9			Silty SAND: fine to medium, grey, saturated										
			EOH (Target Depth Reached)										

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	∇	STANDING GWL

NOTES

As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

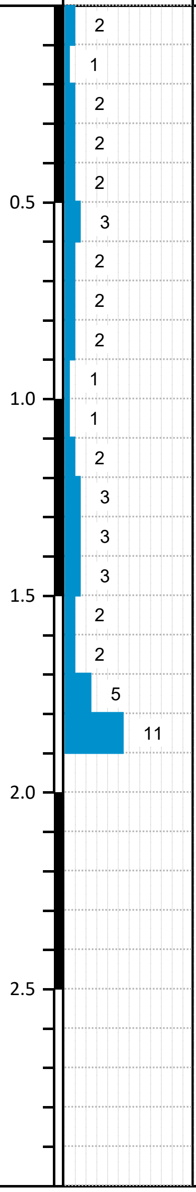
miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER:	**200357**
CLIENT:	**Yoursection Ltd.**
TESTING COMPLETED:	**3 September 2020**

SHALLOW GROUND INVESTIGATION LOG

HA5/DCP5

PROJECT:	**2 & 4 Glovers Road, Halswell, Christchurch**				
LOGGED BY:	**CG**	*TOTAL DEPTH OF HOLE:*	**1.9 mbgl**	*HOLE DIAMETER:*	**50 mm**
PROCESSED BY:	**CG**	*DRILLING METHOD:*	**Hand Auger**	*SHEAR VANE NUMBER:*	**2102**
LOCATION:	**REFER TO SITE PLAN**	*GROUNDWATER LEVEL:*	**1.0 mbgl**	This report may only be reproduced in full	



GWL	*USC*	*Soil Characteristics*	*Sample Taken*	*LL*	*PL*	*PI*	*Gr*	*Sa*	*FC*	*WC (%)*	*UW*	*Vane shear strength (kPa) peak/remoulded*
		SILT: low plasticity, brown, moist, with minor fine sand (TOPSOIL)										
▽ (1.0)		Sandy SILT: low plasticity, grey, moist, sand is fine at 1.0m: becomes wet at 1.2m: becomes saturated										
		Silty SAND: fine to medium, grey, saturated at 1.8m: with minor fine to medium gravel	DIST. SAMPLE				-	58%	42%			
		EOH (Practical Refusal on Gravel)										

LEGEND

ABBREVIATIONS

DCP	DYNAMIC CONE PENETROMETER	HA	HAND AUGER	LL	LIQUID LIMIT	Gr	GRAVEL
GWL	GROUNDWATER LEVEL	UTP	UNABLE TO PENETRATE	PL	PLASTIC LIMIT	Sa	SAND
mbgl	METERS BELOW GROUND LEVEL	EOH	END OF HOLE	PI	PLASTICITY INDEX	FC	FINES CONTENT
WC	WATER CONTENT	UW	UNIT WEIGHT (kN/m³)	NE	NOT ENCOUNTERED	▽	STANDING GWL

NOTES

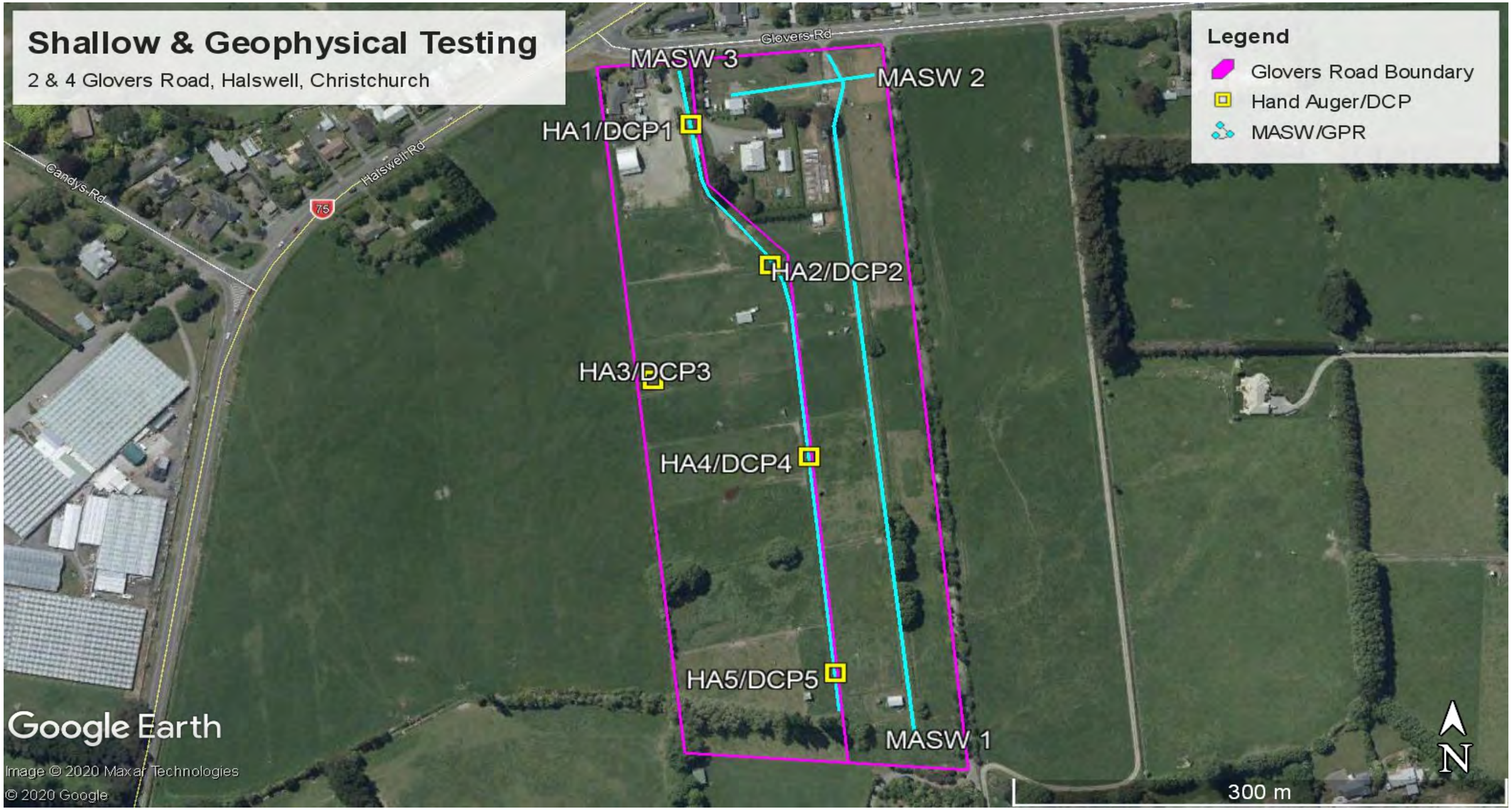
As per MINZ policy, the DCP was transferred to the base of the hand auger borehole at 1.9m depth

miyamoto. ENGINEERS + CONSTRUCTION CONSULTANTS

PROJECT NUMBER: **200357**
CLIENT: **Yoursection Ltd.**
TESTING COMPLETED: **3 September 2020**

SITE INVESTIGATION PLAN

2 & 4 Glovers Road, Halswell, Christchurch



GEO CIVIL
TEST RIGHT • BUILD RIGHT

18B Birmingham Drive
Middleton
Christchurch
E: info@geocivil.co.nz
M: 027 6565 317

TEST REPORT

Lab Job No: 8378-032

Your ref.: -

Date of Issue: 14/09/2020

Date of Re-Issue: -

Page: 1 of 8

Test Report

C20-450

PROJECT: 2 Glovers Road – Laboratory Testing

CLIENT: Miyamoto International NZ Ltd,
518 Colombo Street,
Christchurch, 8011

ATTENTION: Clem Gibbens

INSTRUCTIONS: Determination of Particle-Size Distribution-Wet Sieving method
Determination of the Liquid & Plastic Limits, Plasticity Index and Water Content
Determination of the Water Content of Soils

TEST METHOD: NZS 4402:1986 Test 2.8.1
NZS 4402:1986 Tests 2.2, 2.3, 2.4
NZS 4402:1986 Test 2.1

SAMPLING METHOD: Client - SNA

TEST RESULTS: As per Laboratory sheets attached

Jeremy Brokenshire
Laboratory Technician

Nick van Warmerdam
Approved Signatory

ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

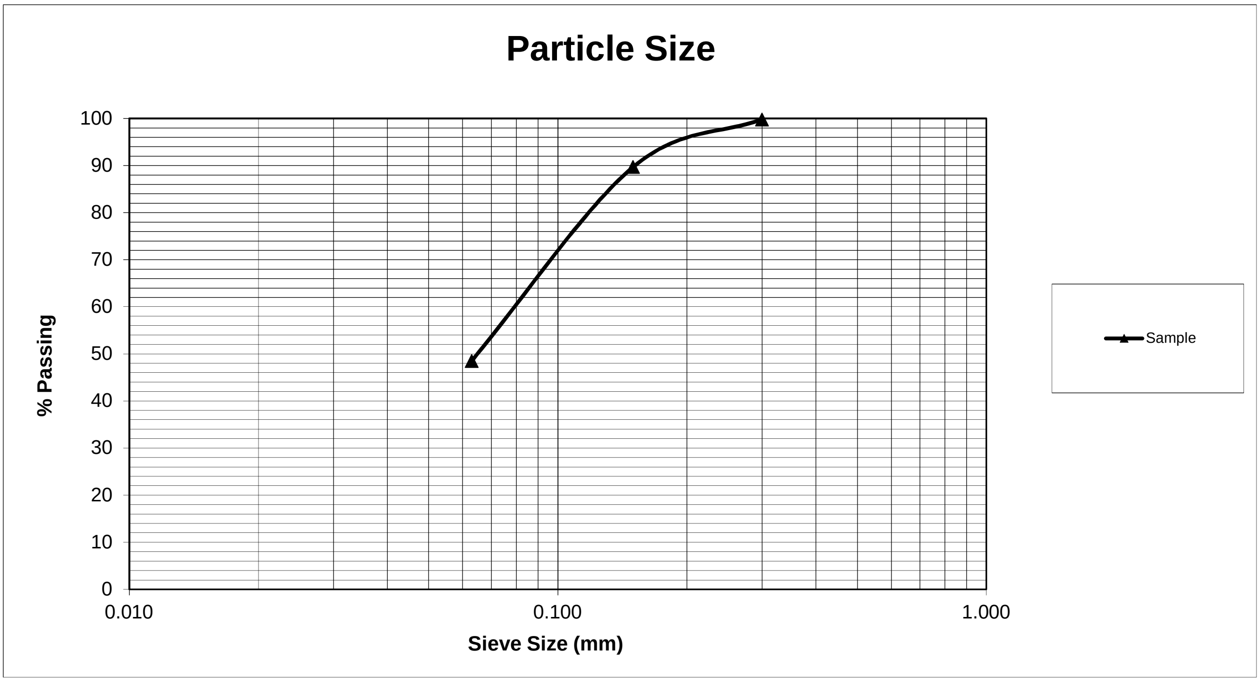
Christchurch Laboratory
18B Birmingham Drive
Middleton, Christchurch
E: info@geocivil.co.nz
M: 027 6565 317

DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402: 1986 Test 2.8.1, 2.8.2

Lab Job No:	8378-032	**Sample No:**	C20-319
Client:	Miyamoto International NZ Ltd	**Tested By:**	D.P
Location:	2 Glovers Road	**Date:**	9/09/2020
	HA01 (1.5-2.3m)	**Checked By:**	J.B
Date Received:	8/09/2020	**Date:**	14/09/2020
Report No:	C20-450	**Page:**	2 of 8
REF:	-		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	4/09/2020		
Test Details:	Wet sieving method		
History:	Natural		
Description of Sample:	Silty SAND, brownish grey, wet, no plasticity		

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	100
0.150	-	-	90
0.063	-	-	49



The percentage passing the finest sieve was obtained by difference.

N. van Warmerdam
Approved Signatory

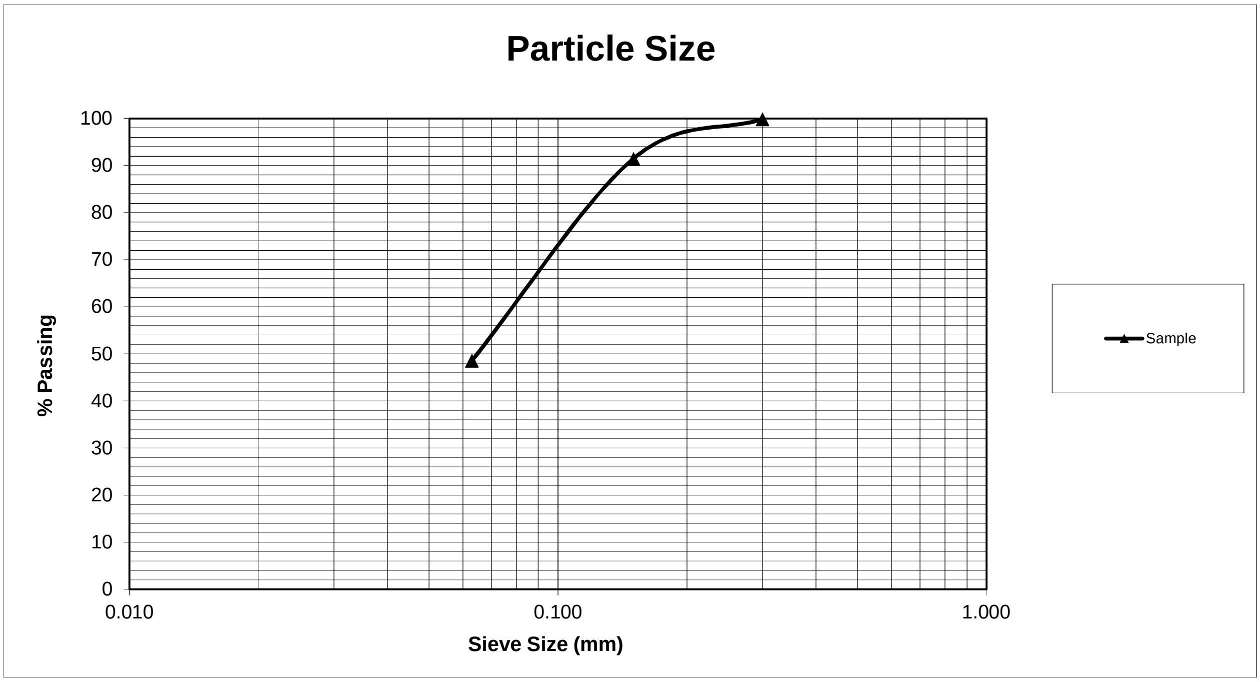
Christchurch Laboratory
18B Birmingham Drive
Middleton, Christchurch
E: info@geocivil.co.nz
M: 027 6565 317

DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402: 1986 Test 2.8.1, 2.8.2

Lab Job No:	8378-032	**Sample No:**	C20-320
Client:	Miyamoto International NZ Ltd	**Tested By:**	D.P
Location:	2 Glovers Road	**Date:**	9/09/2020
	HA01 (2.3-3.8m)	**Checked By:**	J.B
Date Received:	8/09/2020	**Date:**	14/09/2020
Report No:	C20-450	**Page:**	3 of 8
REF:	-		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	4/09/2020		
Test Details:	Wet sieving method		
History:	Natural		
Description of Sample:	Silty SAND, brownish grey, saturated, no plasticity		

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	100
0.150	-	-	91
0.063	-	-	49



The percentage passing the finest sieve was obtained by difference.

N. van Warmerdam
Approved Signatory

Christchurch Laboratory
18B Birmingham Drive
Middleton, Christchurch
E: info@geocivil.co.nz
M: 027 6565 317

DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

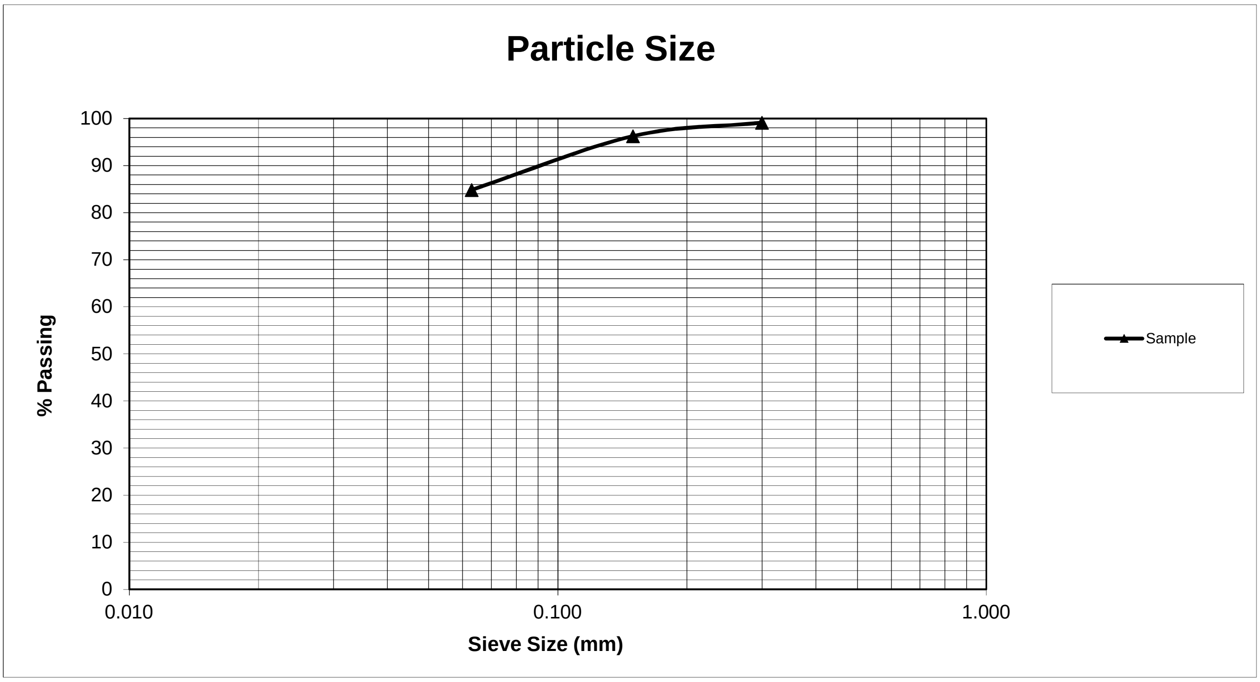
NZS 4402: 1986 Test 2.8.1, 2.8.2

Lab Job No:	8378-032	**Sample No:**	C20-321
Client:	Miyamoto International NZ Ltd	**Tested By:**	D.P
Location:	2 Glovers Road	**Date:**	9/09/2020
	HA02 (2.7-4.0m)	**Checked By:**	J.B
Date Received:	8/09/2020	**Date:**	14/09/2020
Report No:	C20-450	**Page:**	4 of 8
REF:	-		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	4/09/2020		

Test Details: Wet sieving method
History: Natural

Description of Sample: Silty CLAY, some sand, dark grey saturated, low plasticity

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	99
0.150	-	-	96
0.063	-	-	85



***The percentage passing the finest sieve was obtained by difference.**

N. van Warmerdam
Approved Signatory

Christchurch Laboratory
18B Birmingham Drive
Middleton, Christchurch
E: info@geocivil.co.nz
M: 027 6565 317

DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402: 1986 Test 2.2, 2.3, 2.4

Lab Job No: 8378-032
Client: Miyamoto International NZ Ltd
Location: 2 Glovers Road
HA02 (2.7-4.0m)
Date Received: 8/09/2020
Report No: C20-450
REF: -

Sample No.: C20-321
Tested By: S.P.S
Date Tested: 11/09/2020
Checked By: J.B
Date Checked: 14/09/2020
Page: 5 of 8

Sampling Method: Sampled by client - SNA
Date Sampled: 4/09/2020

Sampled By: Client

Test Details:

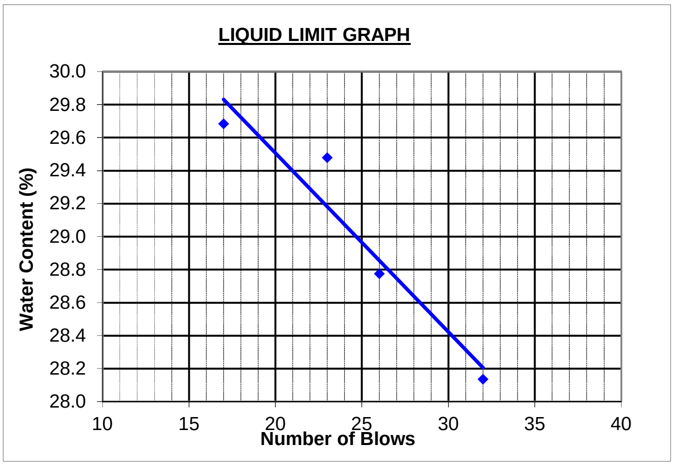
Test performed on: Fraction passing 425mm sieve

Sample history: Natural state

Description of Sample: Silty CLAY, some sand, dark grey saturated, low plasticity

	Liquid Limit				Plastic Limit	
No. of blows	17	23	26	32		
Water content (%)	29.7	29.5	28.8	28.1	20.0	19.2

NWC	**30.5**
Liquid Limit	**29**
Plastic Limit	**20**
Plasticity Index	**9**



N. van Warmerdam
Approved Signatory

Christchurch Laboratory
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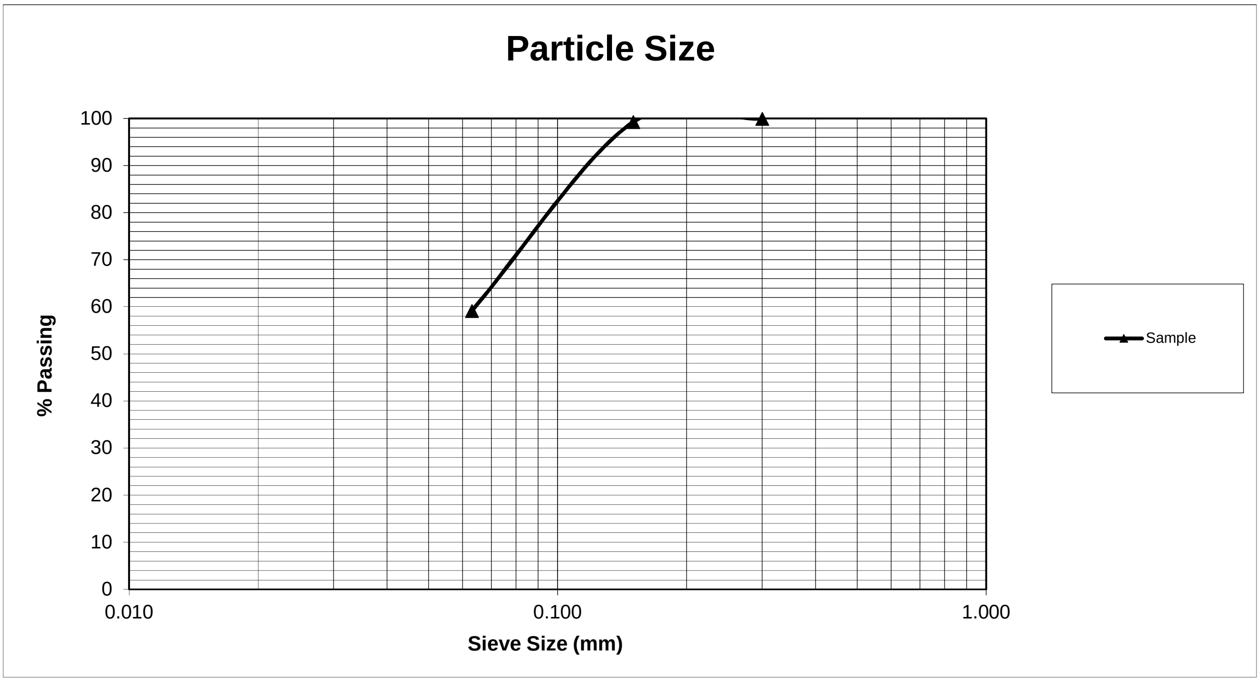
M: 027 6565 317

DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402: 1986 Test 2.8.1, 2.8.2

Lab Job No:	8378-032	**Sample No:**	C20-322
Client:	Miyamoto International NZ Ltd	**Tested By:**	D.P
Location:	2 Glovers Road	**Date:**	9/09/2020
	HA03 (2.0-3.4m)	**Checked By:**	J.B
Date Received:	8/09/2020	**Date:**	14/09/2020
Report No:	C20-450	**Page:**	6 of 8
REF:	-		
Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	4/09/2020		
Test Details:	Wet sieving method		
History:	Natural		
Description of Sample:	Sandy SILT, dark grey, saturated, no plasticity		

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	100
0.150	-	-	99
0.063	-	-	59



The percentage passing the finest sieve was obtained by difference.

N. van Warmerdam
Approved Signatory

Christchurch Laboratory
18B Birmingham Drive
Middleton, Christchurch
E: info@geocivil.co.nz
M: 027 6565 317

DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402: 1986 Test 2.2, 2.3, 2.4

Lab Job No:	8378-032	**Sample No.:**	C20-322
Client:	Miyamoto International NZ Ltd	**Tested By:**	S.P.S
Location:	2 Glovers Road	**Date Tested:**	11/09/2020
	HA03 (2.0-3.4m)	**Checked By:**	J.B
Date Received:	8/09/2020	**Date Checked:**	14/09/2020
Report No:	C20-450	**Page:**	7 of 8
REF:	-		

Sampling Method:	Sampled by client - SNA	**Sampled By:**	Client
Date Sampled:	4/09/2020		

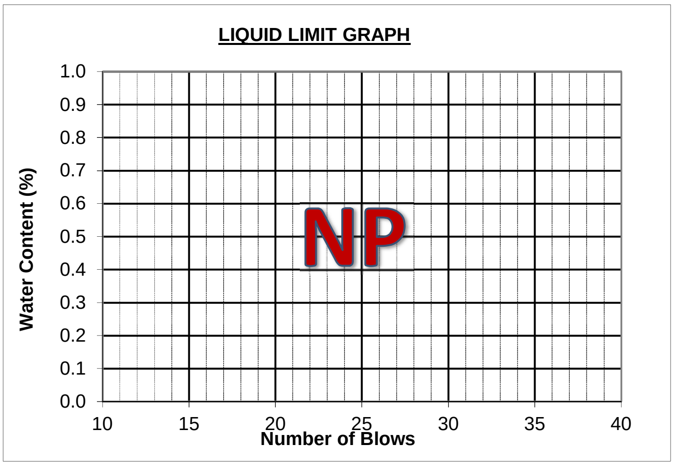
Test Details:

Test performed on:	Fraction passing 425mm sieve
Sample history:	Natural state

Description of Sample: Sandy SILT, dark grey, saturated, no plasticity

	Liquid Limit	Plastic Limit
No. of blows	NP	NP
Water content (%)		

NWC	**28.9**
Liquid Limit	-
Plastic Limit	-
Plasticity Index	-



Unable to obtain Liquid Limit or Plastic Limit.

N. van Warmerdam
Approved Signatory

Christchurch Laboratory
18B Birmingham Drive
Middleton, Christchurch
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M: 027 6565 317

DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION - GRAPH

NZS 4402: 1986 Test 2.8.1, 2.8.2

Lab Job No: 8378-032
Client: Miyamoto International NZ Ltd
Location: 2 Glovers Road
HA05 (1.5-1.8m)
Date Received: 8/09/2020
Report No: C20-450
REF: -

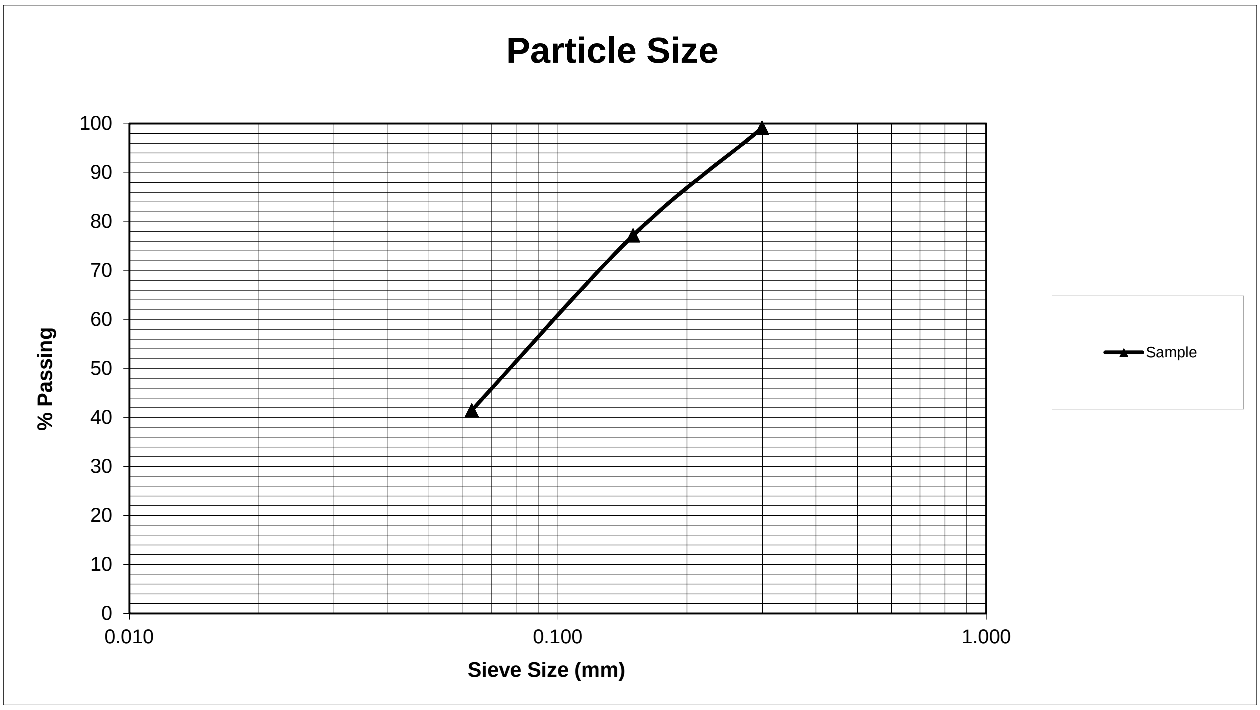
Sample No: C20-323
Tested By: D.P
Date: 9/09/2020
Checked By: J.B
Date: 14/09/2020
Page: 8 of 8

Sampling Method: Sampled by client - SNA
Date Sampled: 4/09/2020
Sampled By: Client

Test Details: Wet sieving method
History: Natural

Description of Sample: Silty SAND, brownish grey, wet, no plasticity

	% Passing		
Sieve Size	**Max**	**Min**	**Sample**
0.300	-	-	99
0.150	-	-	77
0.063	-	-	42



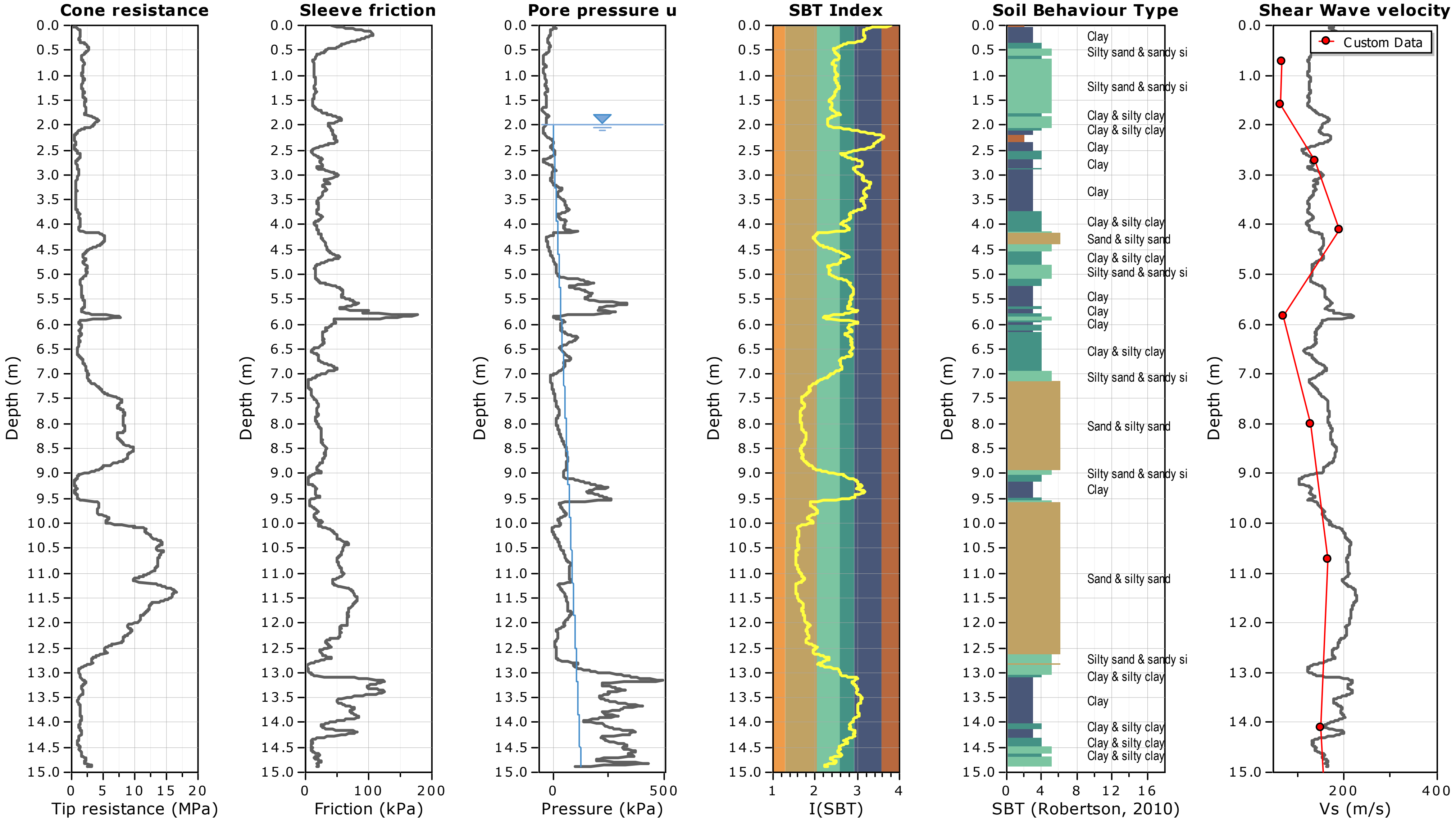
The percentage passing the finest sieve was obtained by difference.

N. van Warmerdam
Approved Signatory

Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu001 Edited
Total depth: 14.89 m, Date: 7/10/2020
Surface Elevation: 12.90 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

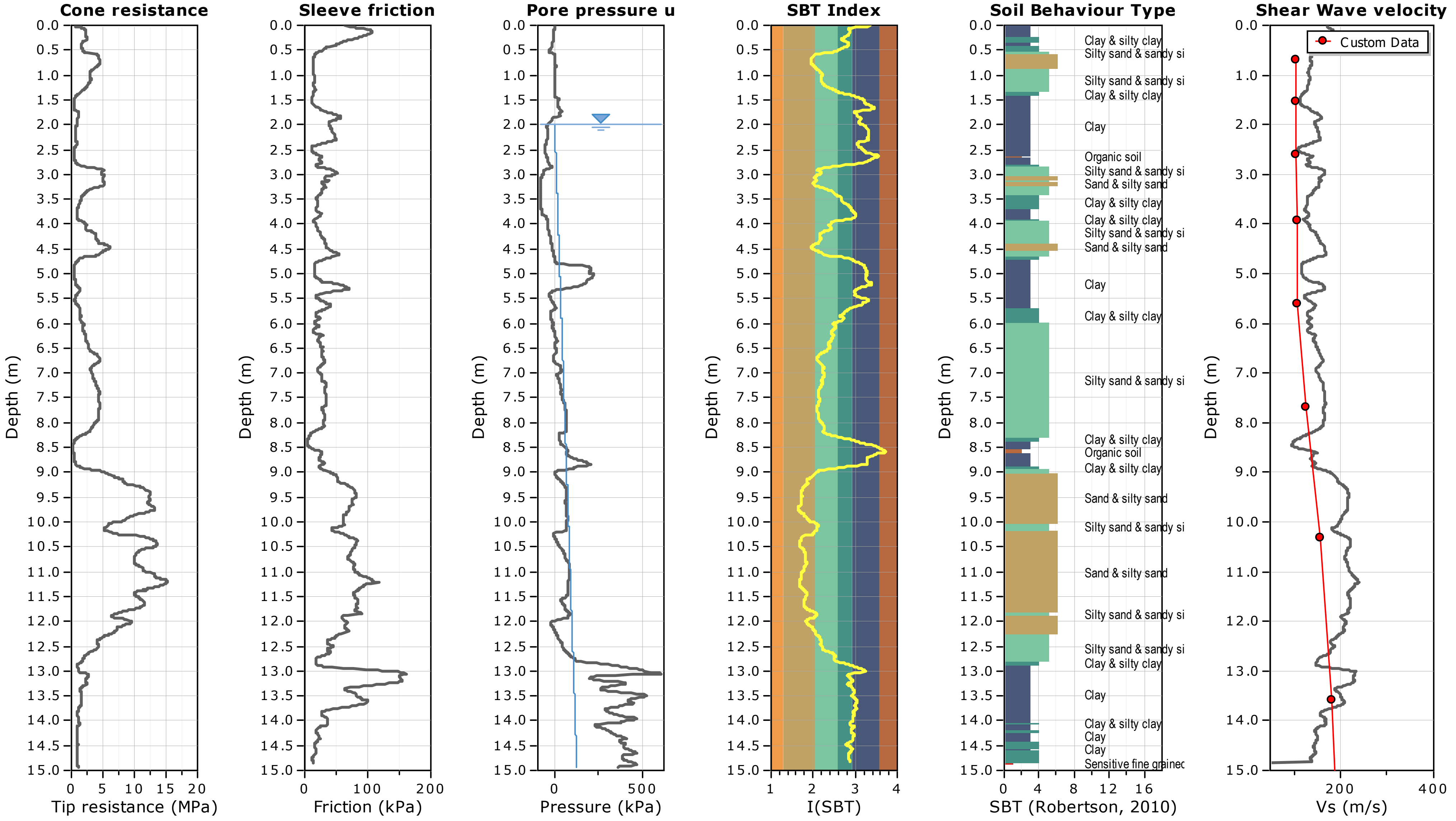
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu002
Total depth: 14.93 m, Date: 24/08/2020
Surface Elevation: 12.40 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

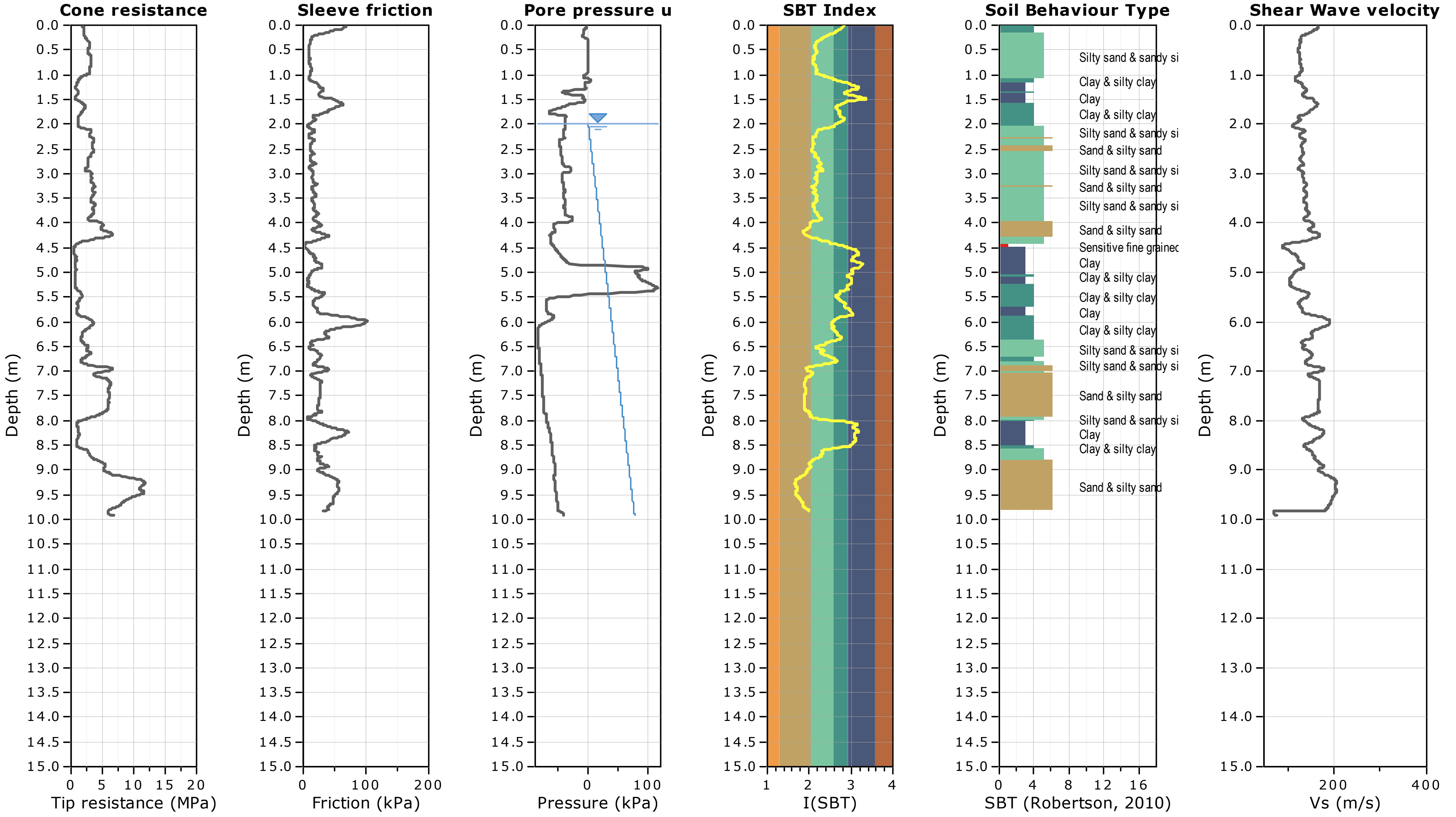
Project: MINZ200357 - Geotechnical Investigation and Assessment
Location: 2 & 4 Glovers Road Subdivision, Halswell, Christchurch



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu003
Total depth: 9.91 m, Date: 24/08/2020
Surface Elevation: 12.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

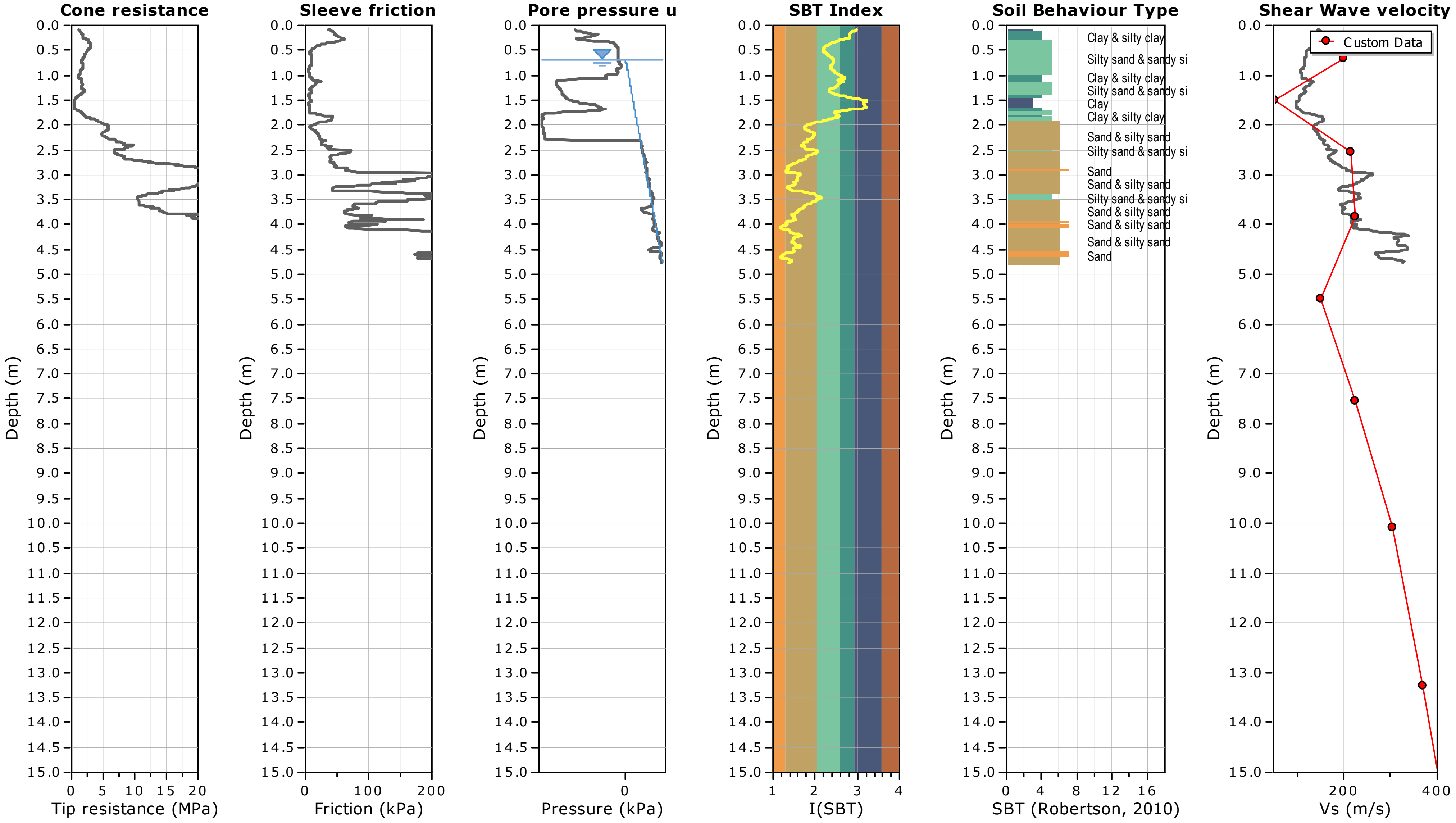
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu004
Total depth: 4.78 m, Date: 24/08/2020
Surface Elevation: 11.70 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

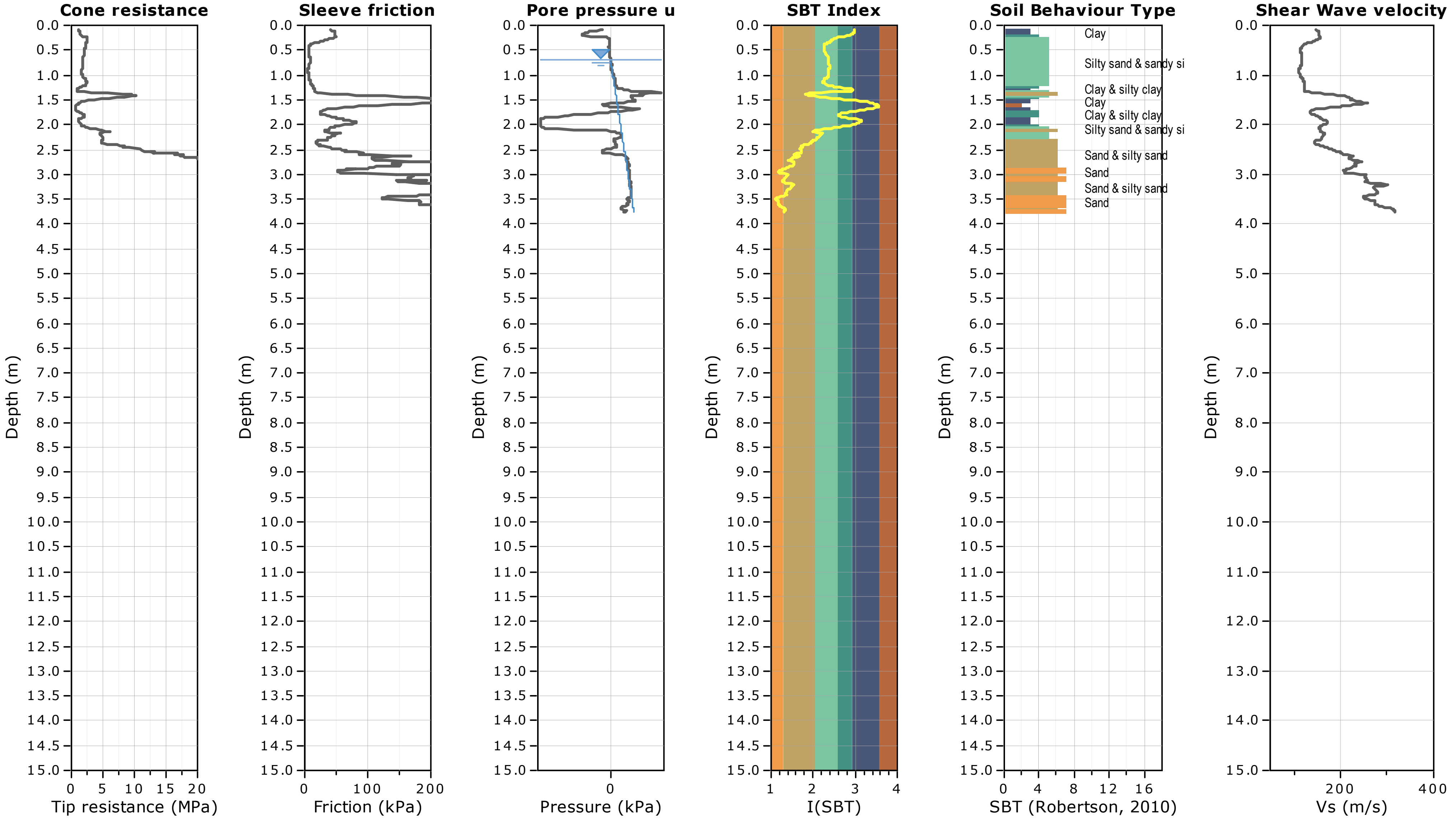
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu005
Total depth: 3.76 m, Date: 24/08/2020
Surface Elevation: 11.50 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

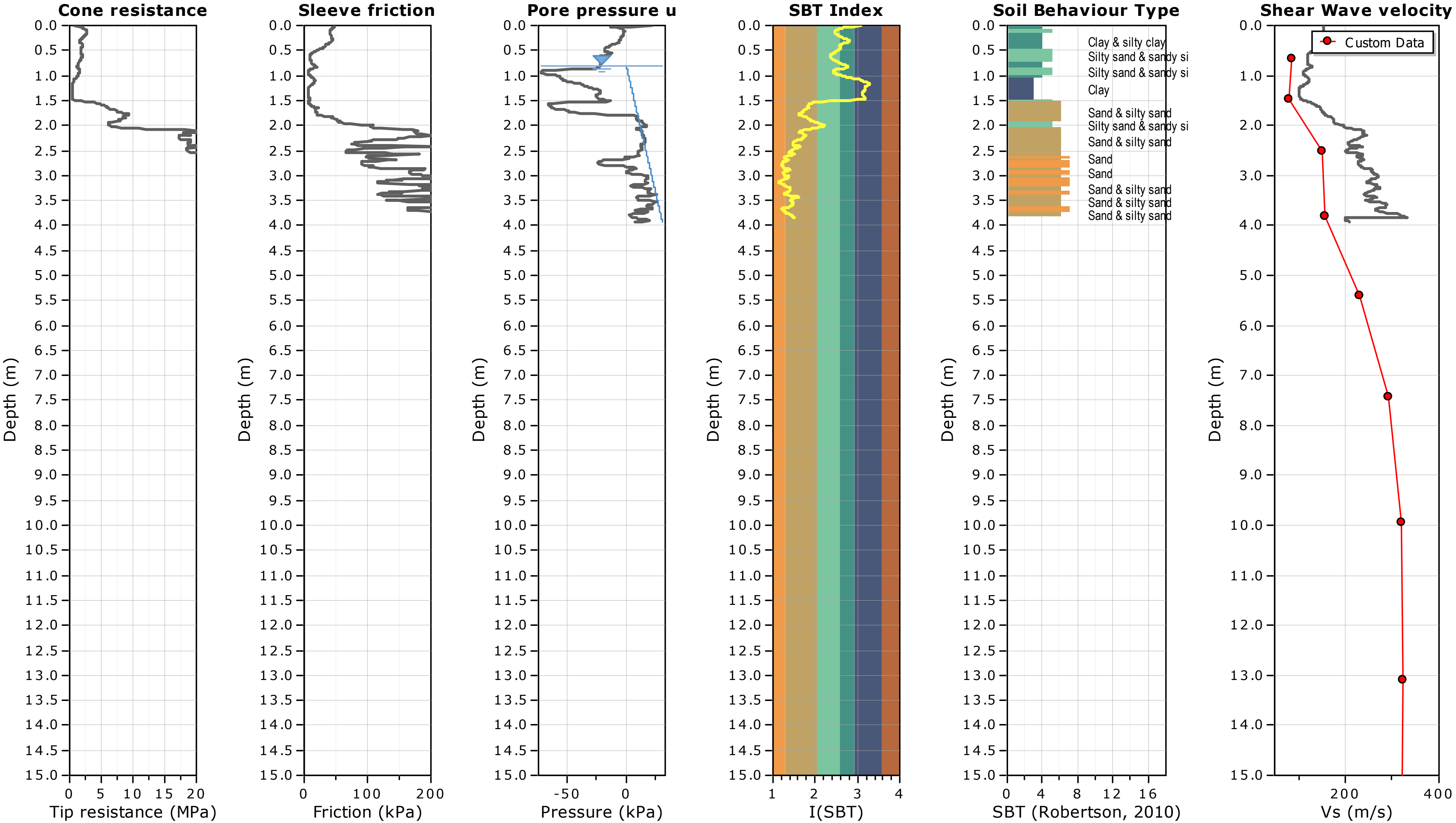
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu006
Total depth: 3.93 m, Date: 24/08/2020
Surface Elevation: 11.70 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

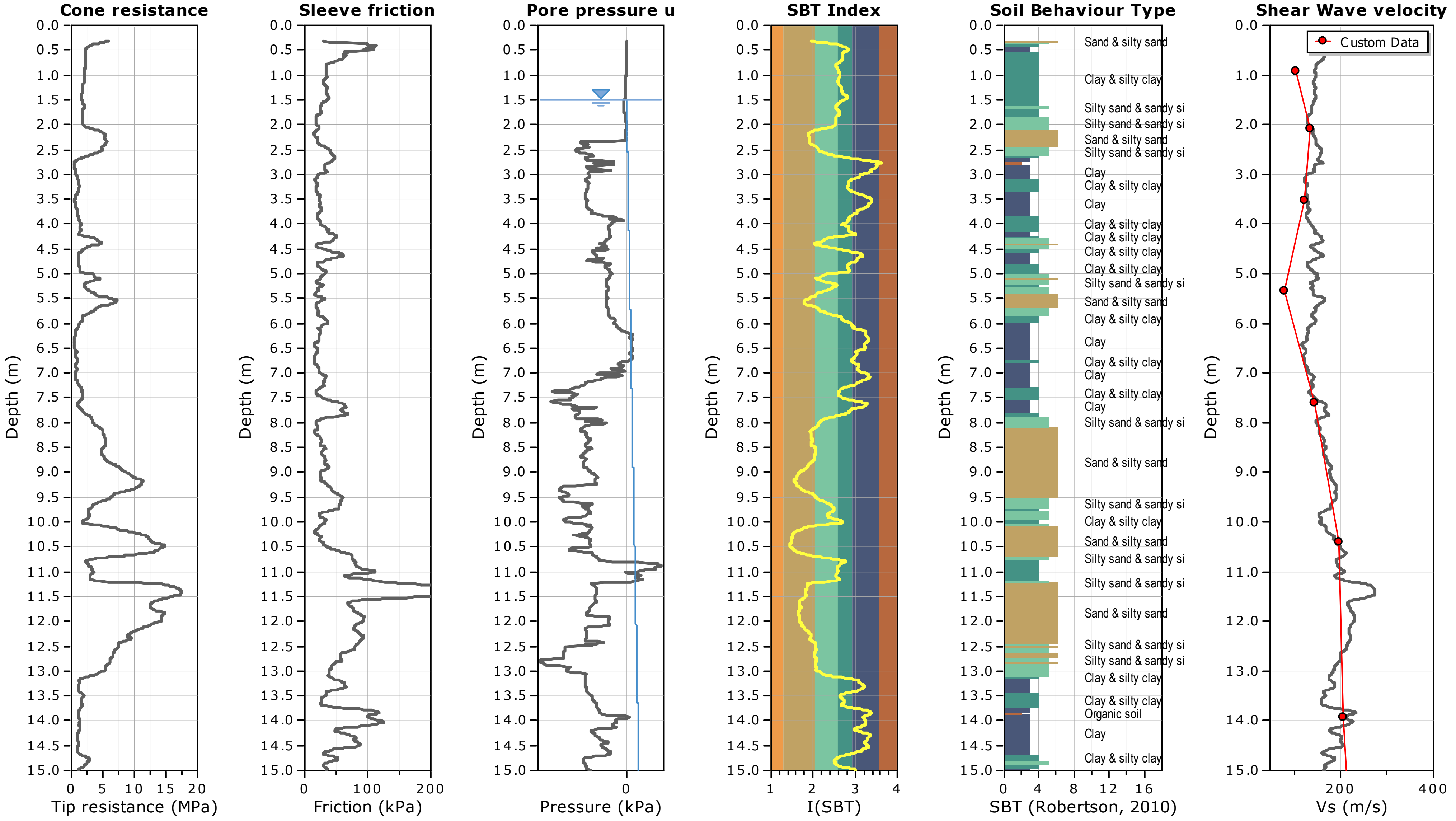
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu007
Total depth: 15.00 m, Date: 1/10/2020
Surface Elevation: 13.20 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

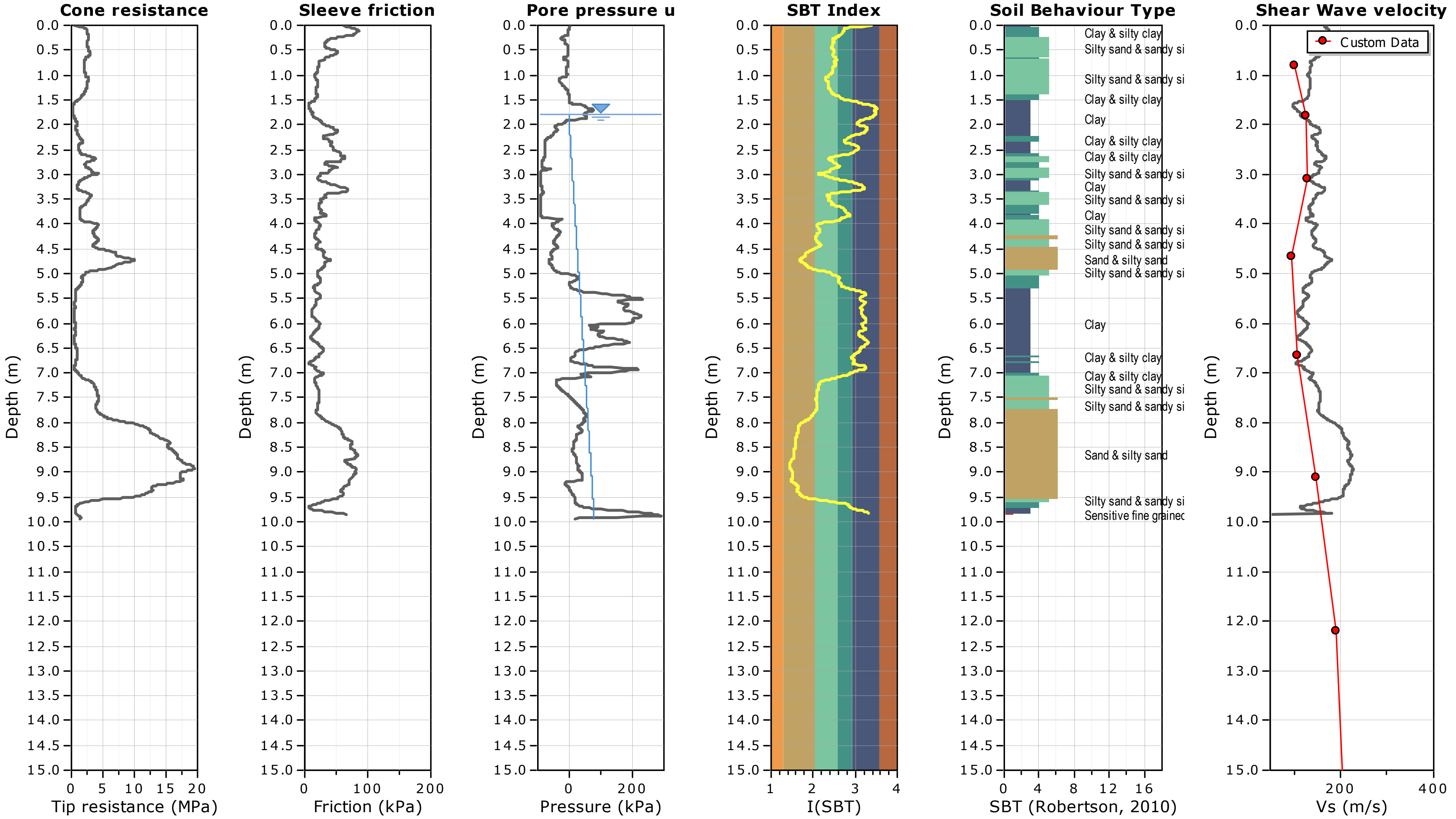
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu008
Total depth: 9.93 m, Date: 1/10/2020
Surface Elevation: 12.60 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

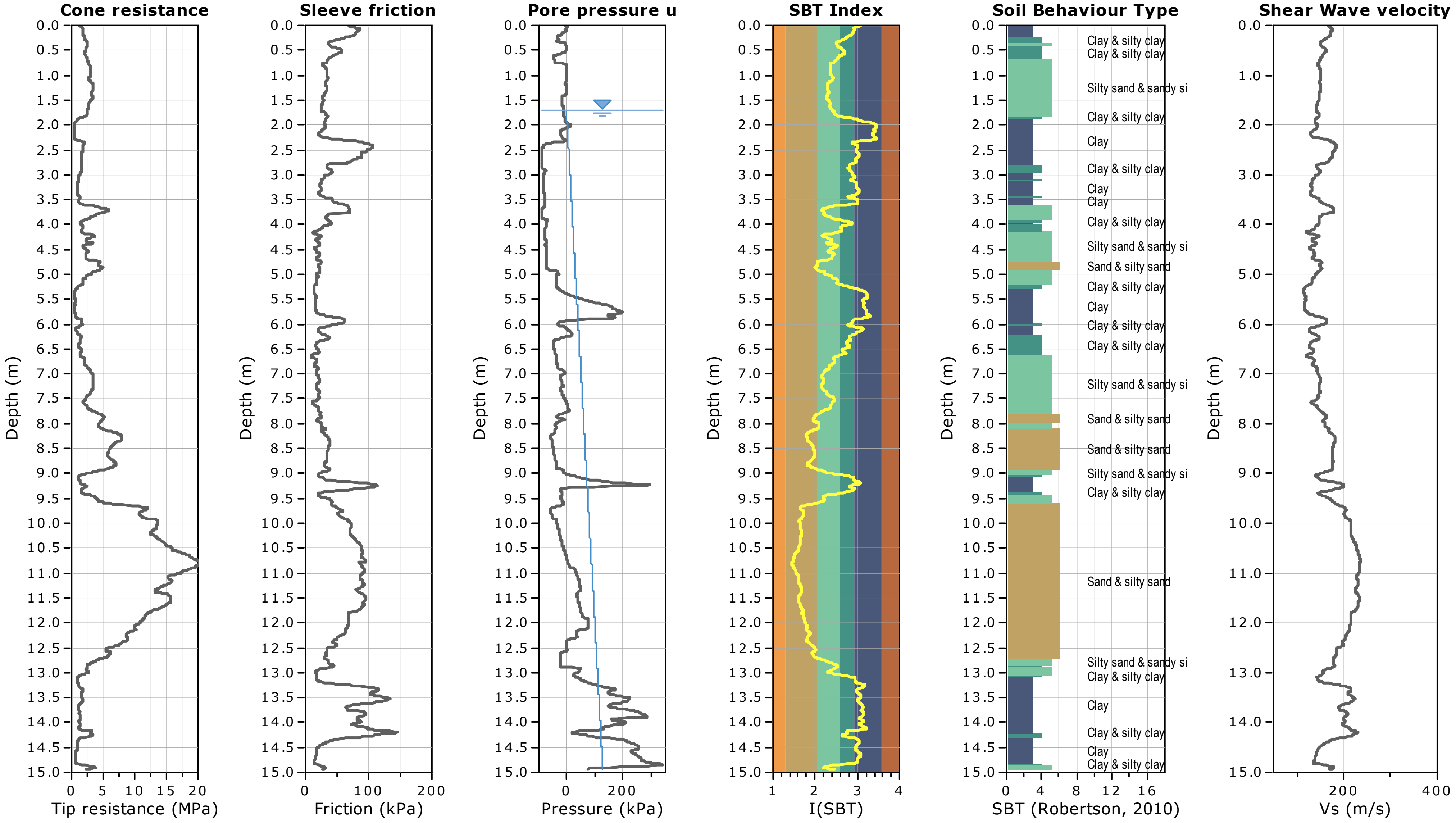
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu009
Total depth: 14.95 m, Date: 1/10/2020
Surface Elevation: 12.80 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

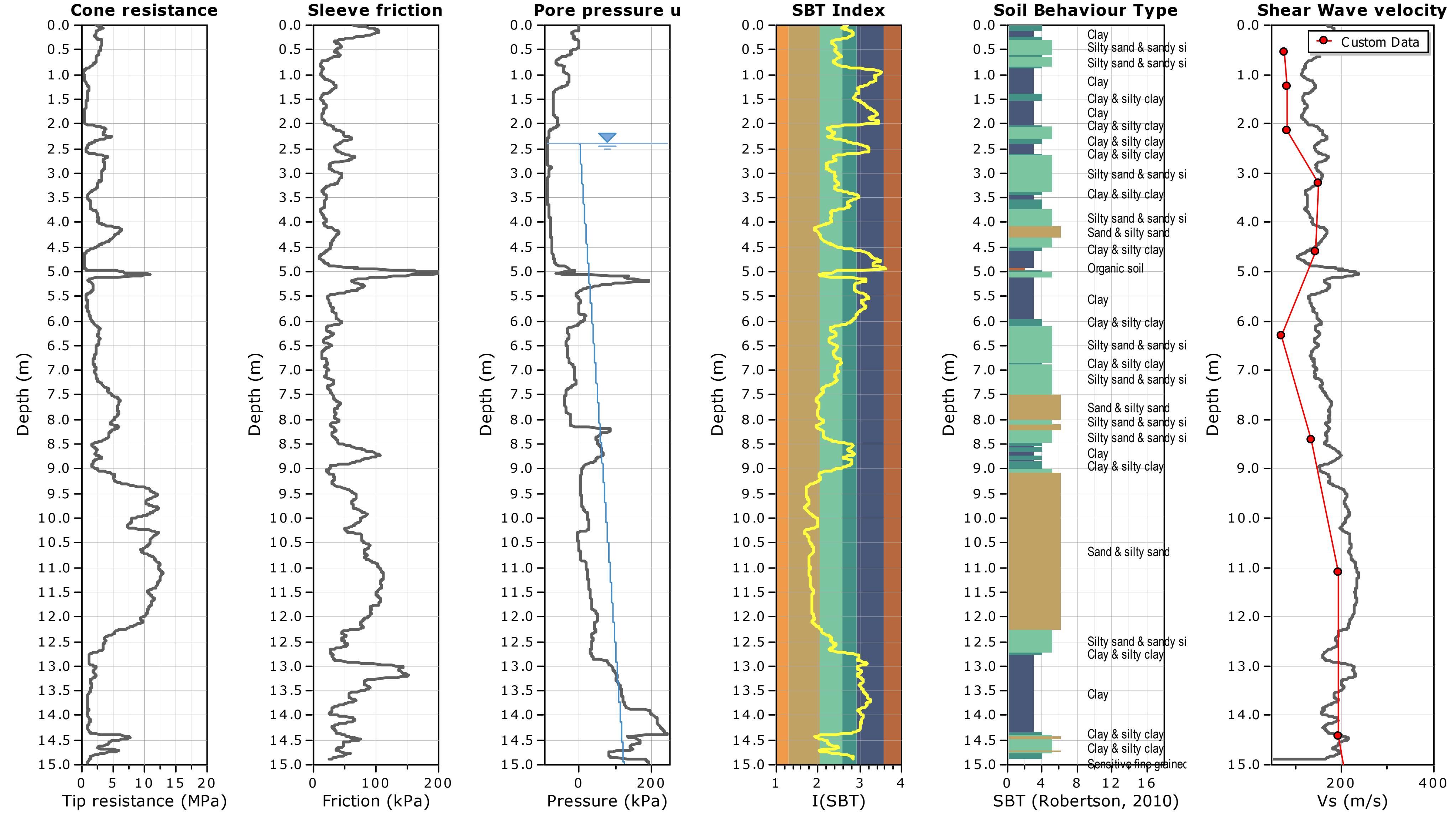
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu010
Total depth: 14.97 m, Date: 1/10/2020
Surface Elevation: 12.30 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

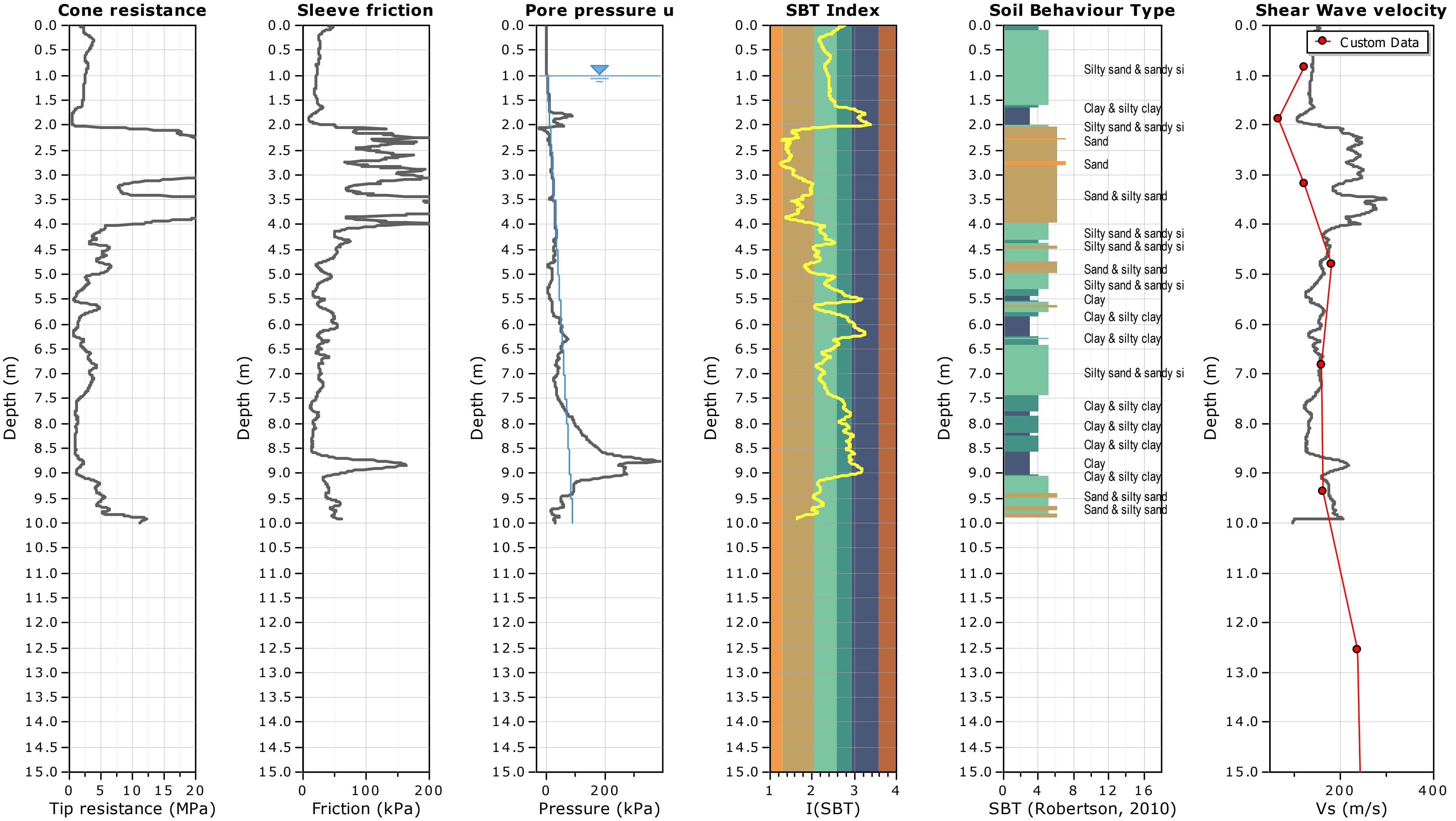
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu011
Total depth: 9.99 m, Date: 1/10/2020
Surface Elevation: 12.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

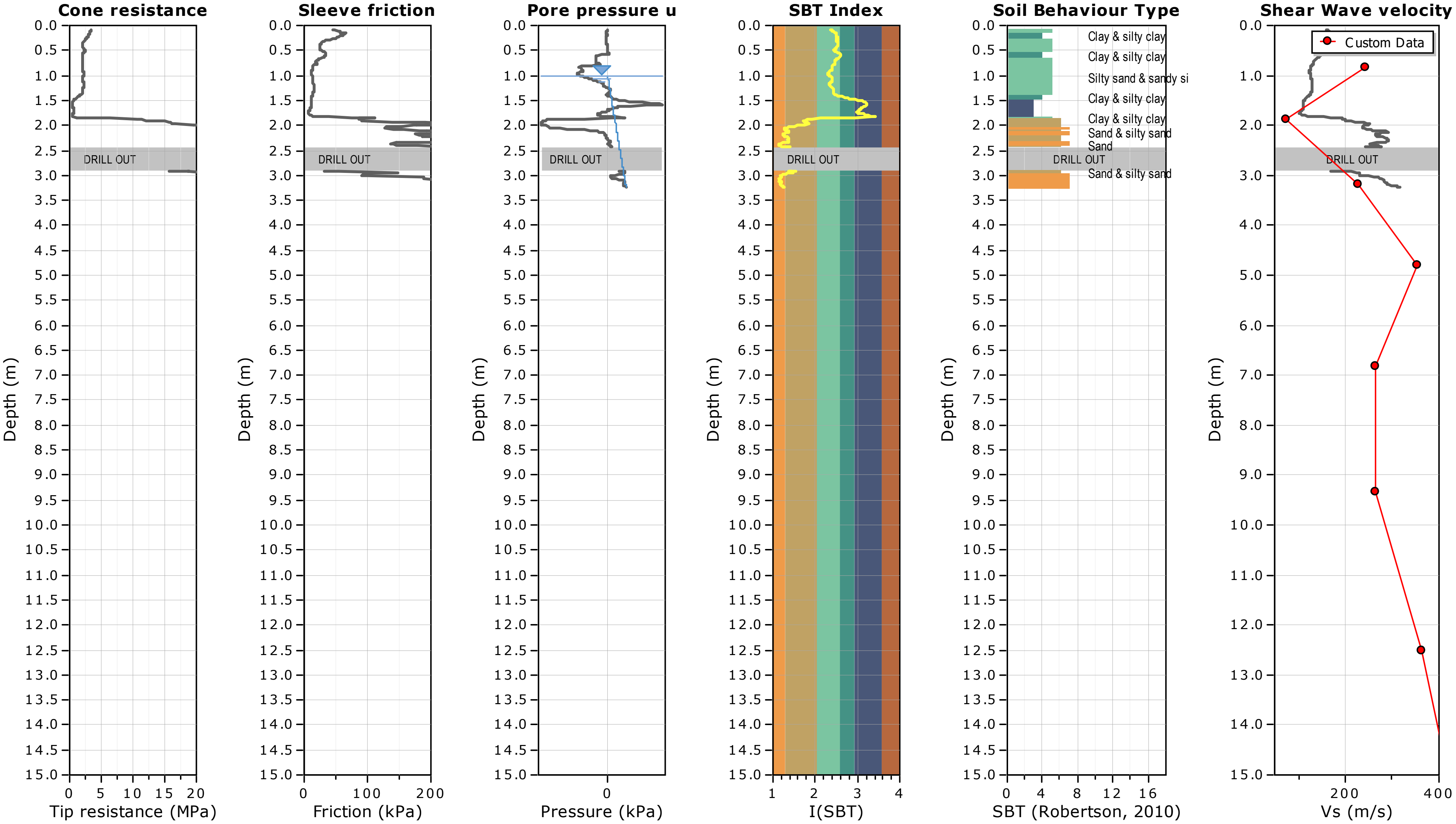
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

CPT: CPTu012
Total depth: 3.25 m, Date: 1/10/2020
Surface Elevation: 11.90 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 & 4 Glovers Road Subdivision, Halswell, Christchurch**



CONE PENETRATION TEST (CPT) REPORT

Client: Miyamoto International NZ

Location: 2 Glovers Road, Christchurch

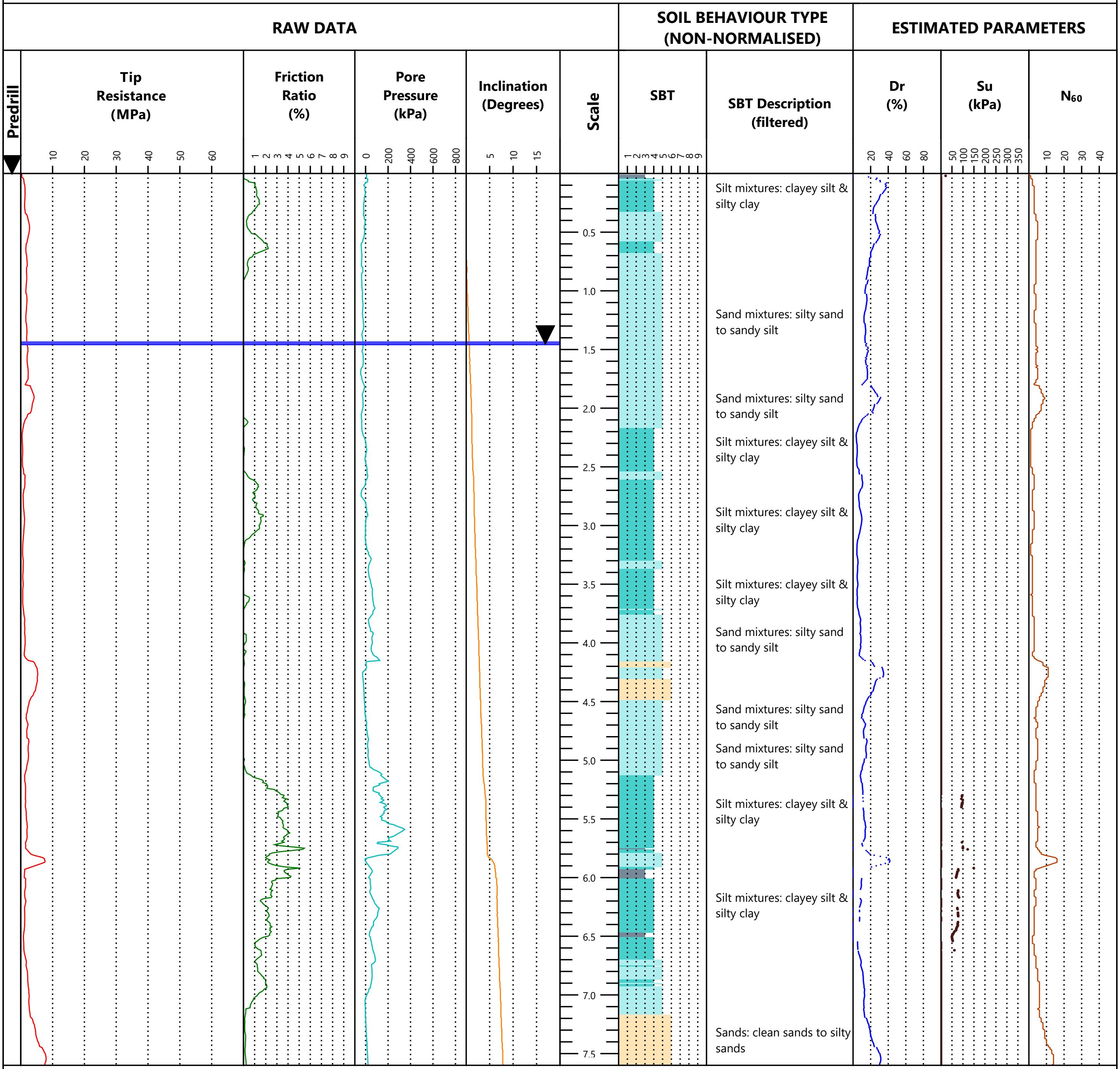
Printed: 20/08/2020

Generated with Core-GS by Geroc

McMILLAN Drilling LandTest

Client: Miyamoto International NZ	**Bore No.:** CPTu001
Project: 2 Glovers Road, Christchurch	**Job No.:** 19096

Site Location: 2 Glovers Road, Christchurch
Date: 18/8/2020
Grid Reference: 1564920.46m E, 5173116.23m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS711
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.45m
Collapse: 1.60m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	20.4528	20.369
Local Friction	0.2535	0.2535
Pore Pressure	3.0597	3.0579

Termination

Target Depth: ☑

Effective Refusal

Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Client: Miyamoto International NZ

Bore No.: CPTu001

Project: 2 Glovers Road, Christchurch

Job No.: 19096

Site Location: 2 Glovers Road, Christchurch

Date: 18/8/2020

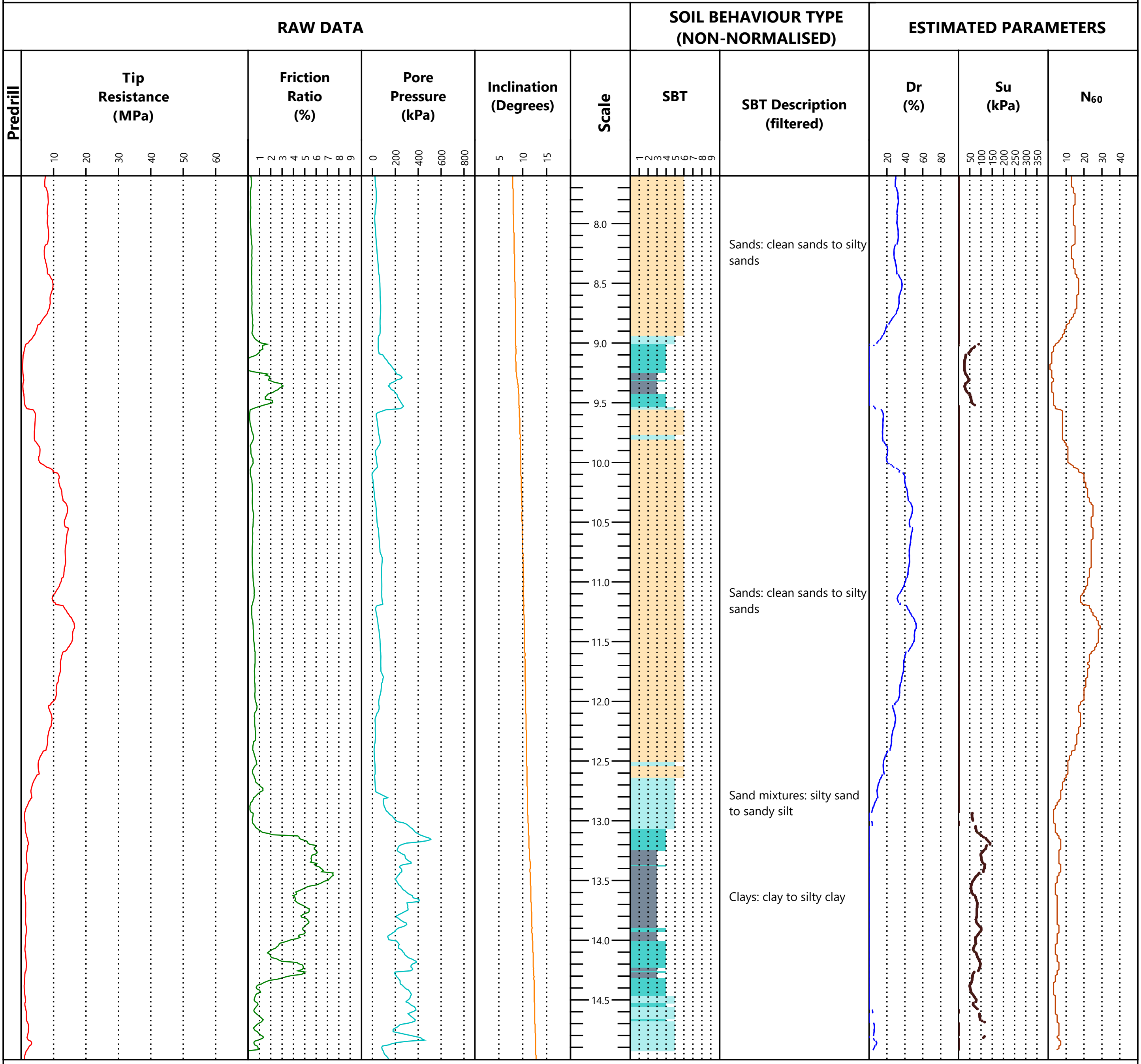
Grid Reference: 1564920.46m E, 5173116.23m N (NZTM) - Map or aerial photograph

Rig Operator: E. Diaz

Elevation: 0.00m

Datum: Ground

Equipment: Pagani TG63-150



EOH: 15m

Cone Type: Pagani Piezocone - Compression

Cone Reference: MKS711

Cone Area Ratio: 0.79

Standards: ISO 22476-1:2012

Predrill: -

Water Level: 1.45m

Collapse: 1.60m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	20.4528	20.369
Local Friction	0.2535	0.2535
Pore Pressure	3.0597	3.0579

Termination

Target Depth: ☑

Effective Refusal

Tip: ☐

Gauge: ☐

Inclinometer: ☐

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

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

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

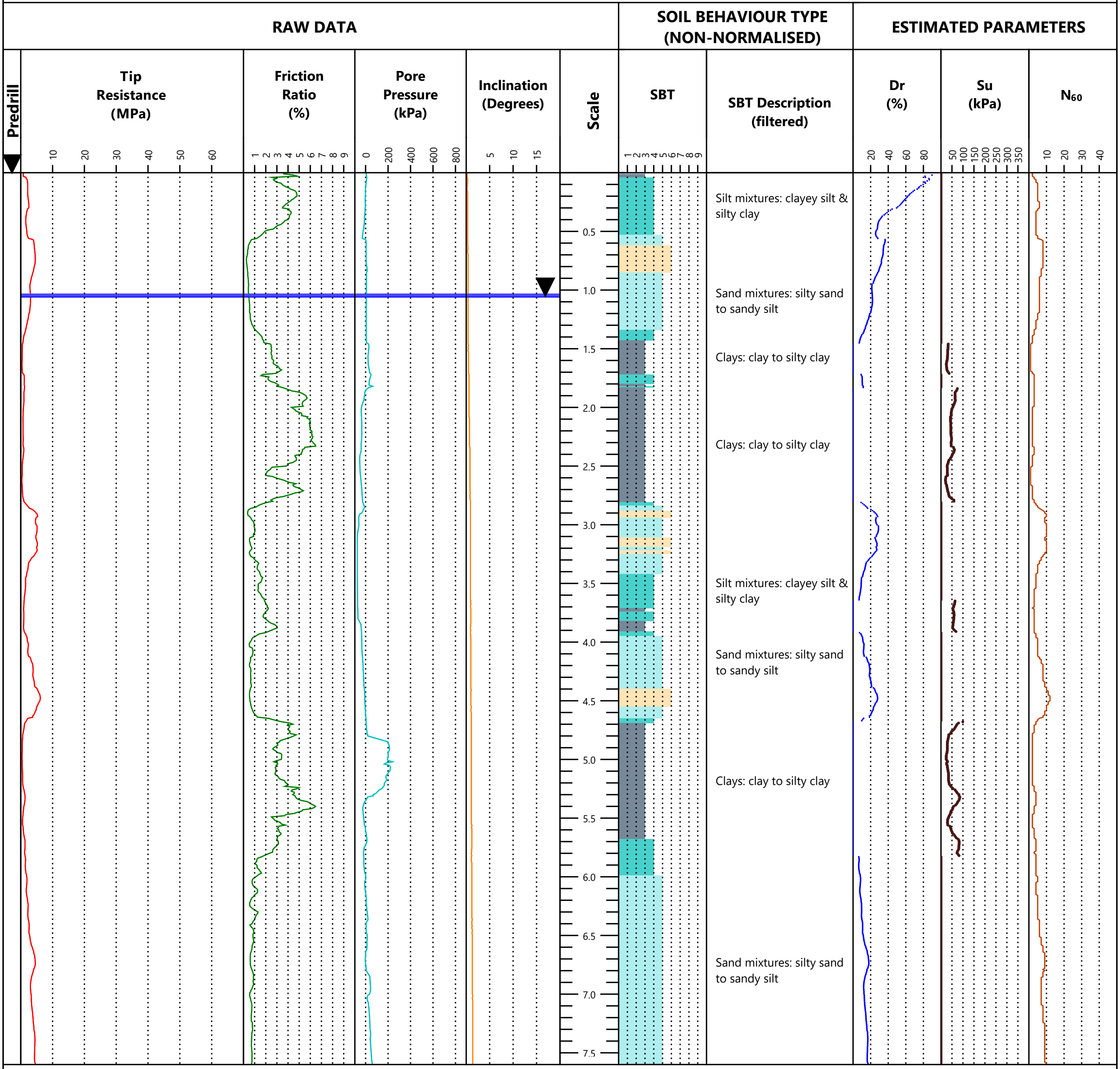
McMILLAN Drilling
LandTest

Client:	**Bore No.:**
Miyamoto International NZ	CPTu002
Project:	**Job No.:**
2 Glovers Road, Christchurch	19096

Site Location: 2 Glovers Road, Christchurch **Date:** 17/8/2020

Grid Reference: 1564969.32m E, 5173033.19m N (NZTM) - Map or aerial photograph **Rig Operator:** E. Diaz

Elevation: 0.00m **Datum:** Ground **Equipment:** Pagani TG63-150



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS711
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.05m
Collapse: 2.45m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	20.4004	20.348
Local Friction	0.2537	0.2536
Pore Pressure	3.0612	3.0605

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

McMILLAN Drilling LandTest

Client: Miyamoto International NZ

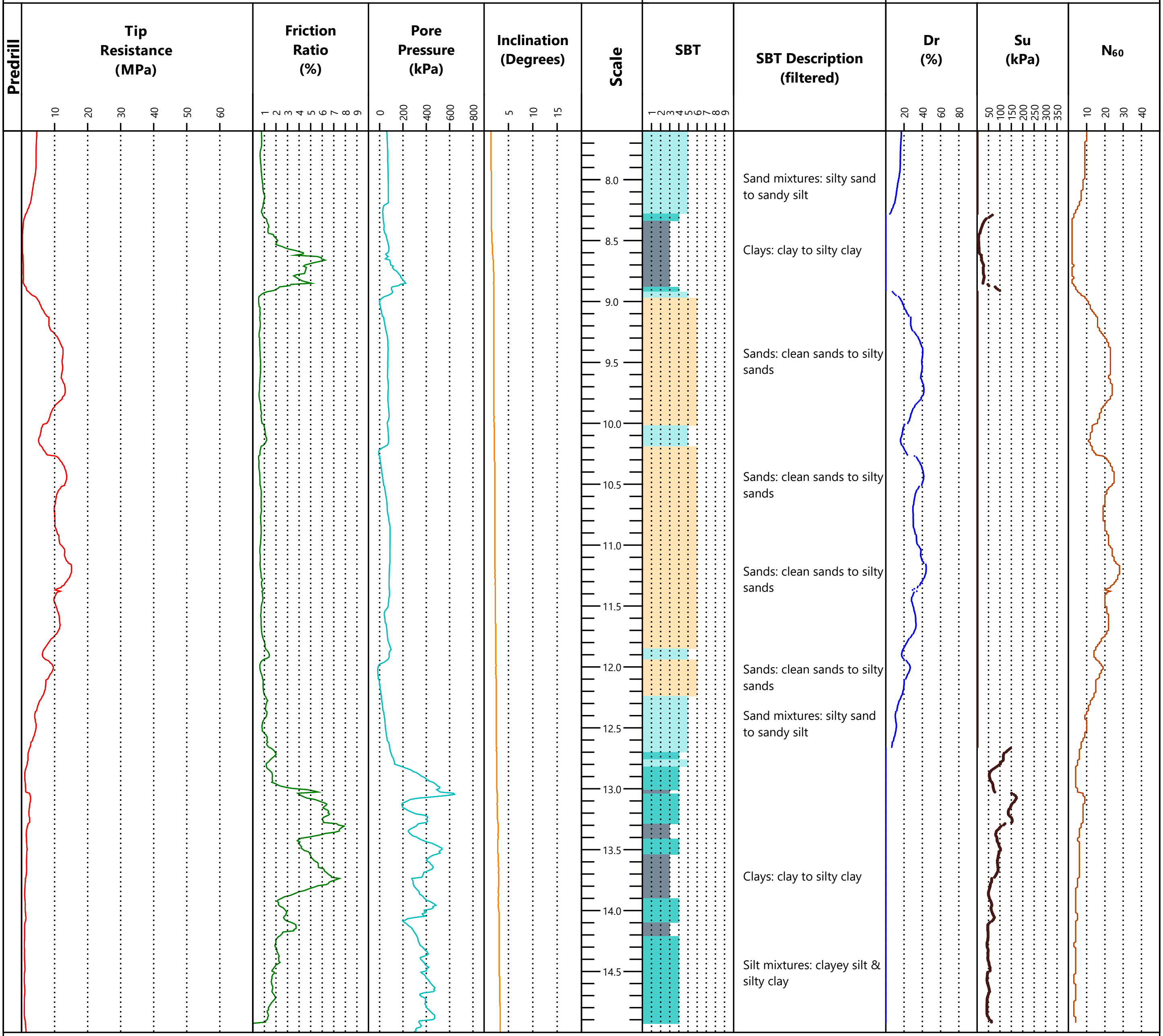
Bore No.: CPTu002

Project: 2 Glovers Road, Christchurch

Job No.: 19096

Site Location: 2 Glovers Road, Christchurch
Date: 17/8/2020
Grid Reference: 1564969.32m E, 5173033.19m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150

RAW DATA | **SOIL BEHAVIOUR TYPE (NON-NORMALISED)** | **ESTIMATED PARAMETERS**



EOH: 15m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS711
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.05m
Collapse: 2.45m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	20.4004	20.348
Local Friction	0.2537	0.2536
Pore Pressure	3.0612	3.0605

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

McMILLAN Drilling
LandTest

Client: Miyamoto International NZ

Bore No.: CPTu003

Project: 2 Glovers Road, Christchurch

Job No.: 19096

Site Location: 2 Glovers Road, Christchurch

Date: 13/8/2020

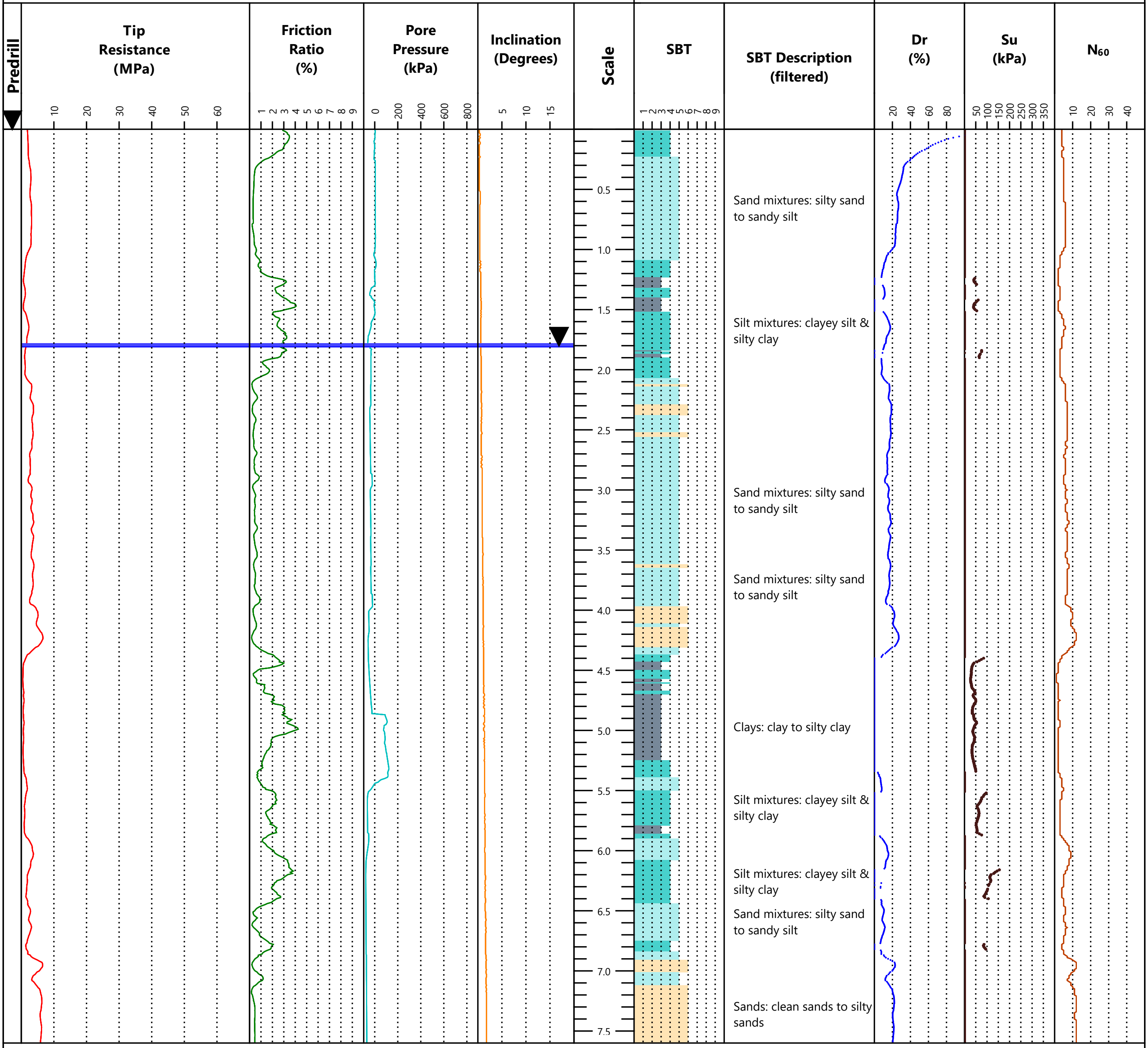
Grid Reference: 1564902m E, 5172941.77m N (NZTM) - Map or aerial photograph

Rig Operator: B. Wilson

Elevation: 0.00m **Datum:** Ground

Equipment: Pagani TG63-150

RAW DATA | **SOIL BEHAVIOUR TYPE (NON-NORMALISED)** | **ESTIMATED PARAMETERS**



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.8m
Collapse: 2.70m

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3554	11.3094
Local Friction	0.1187	0.1186
Pore Pressure	0.9596	0.9557

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

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

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

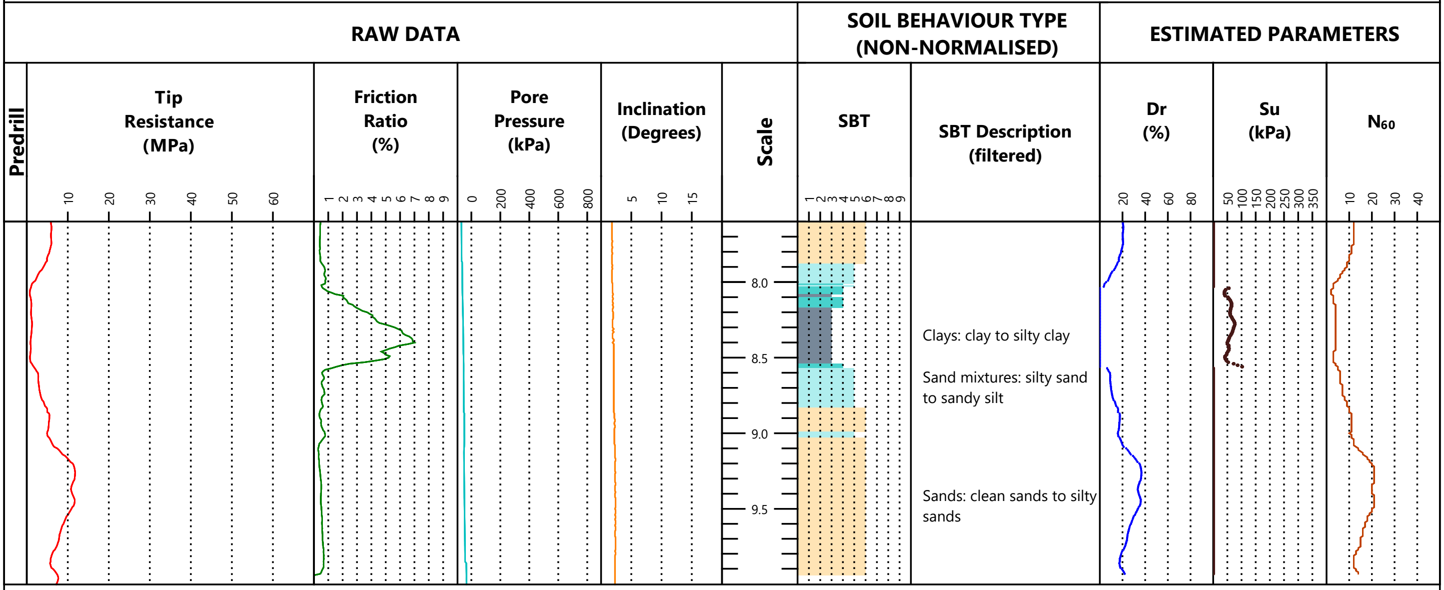
Remarks

Generated with Core-GS by Geroc

McMILLAN Drilling
LandTest

Client:	Miyamoto International NZ
Project:	2 Glovers Road, Christchurch
Bore No.:	CPTu003
Job No.:	19096

Site Location: 2 Glovers Road, Christchurch
Date: 13/8/2020
Grid Reference: 1564902m E, 5172941.77m N (NZTM) - Map or aerial photograph
Rig Operator: B. Wilson
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 10m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.8m
Collapse: 2.70m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3554	11.3094
Local Friction	0.1187	0.1186
Pore Pressure	0.9596	0.9557

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

MCMILLAN Drilling LandTest

Client: Miyamoto International NZ

Bore No.: CPTu004

Project: 2 Glovers Road, Christchurch

Job No.: 19096

Site Location: 2 Glovers Road, Christchurch

Date: 19/8/2020

Grid Reference: 1564993.47m E, 5172892.27m N (NZTM) - Map or aerial photograph

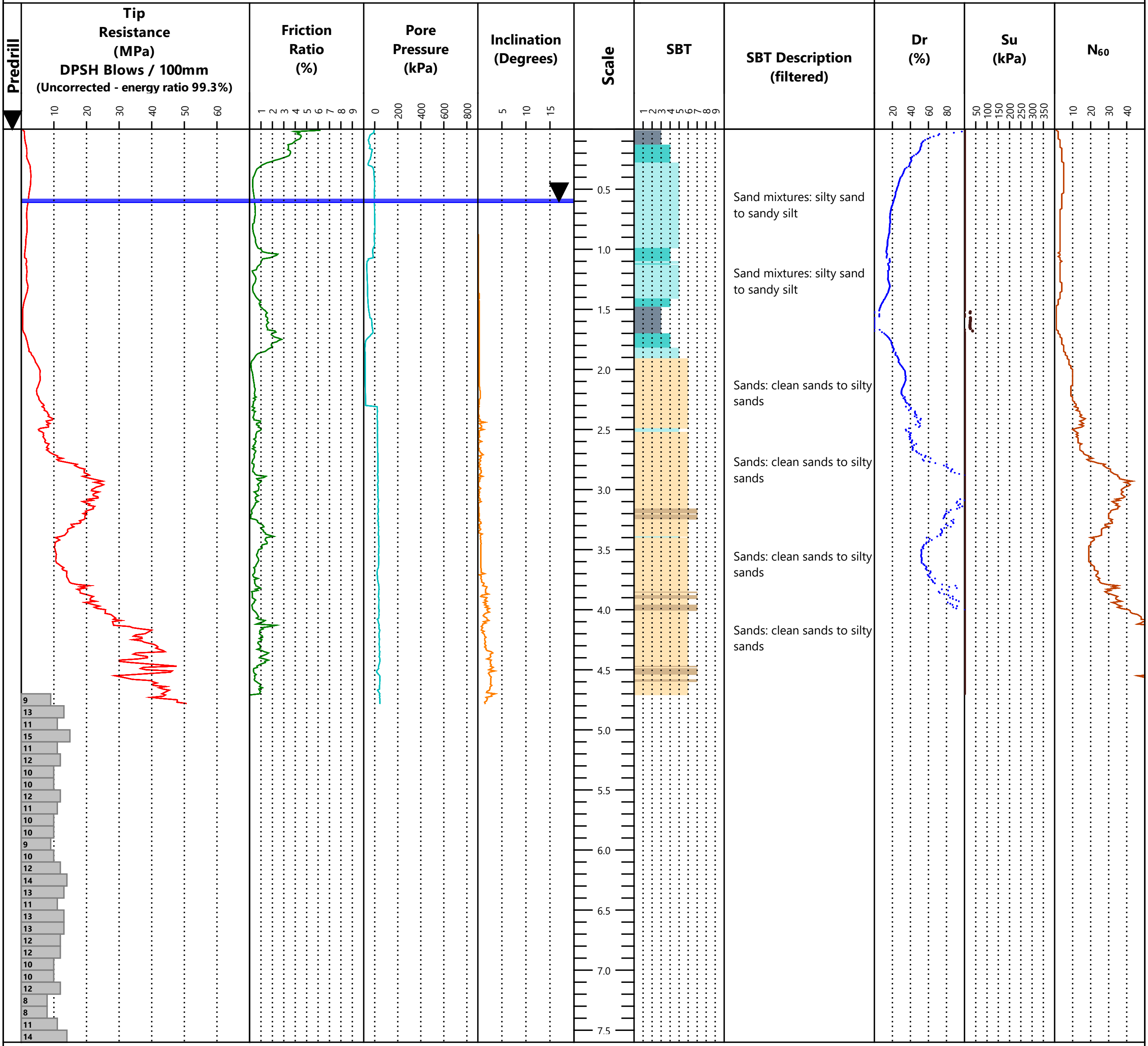
Rig Operator: B. Wilson

Elevation: 0.00m

Datum: Ground

Equipment: Pagani TG63-150

RAW DATA	SOIL BEHAVIOUR TYPE (NON-NORMALISED)	ESTIMATED PARAMETERS



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 0.6m
Collapse: 1.95m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	11.3452	11.2685
Local Friction	0.1186	0.1191
Pore Pressure	0.9595	0.9554

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations

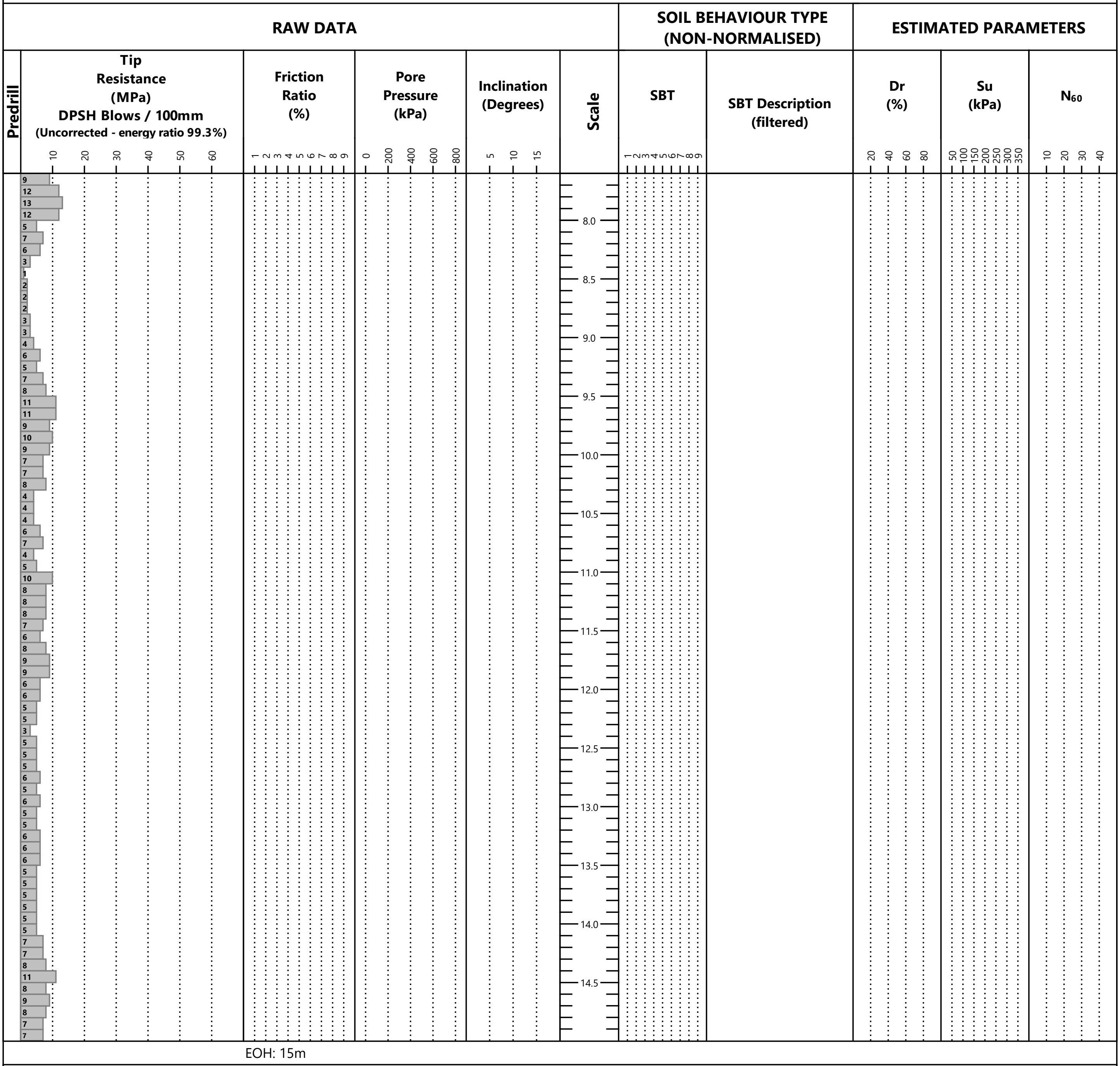
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

McMILLAN Drilling LandTest	**Client:** Miyamoto International NZ	**Bore No.:** CPTu004
	Project: 2 Glovers Road, Christchurch	**Job No.:** 19096

Site Location: 2 Glovers Road, Christchurch
Date: 19/8/2020
Grid Reference: 1564993.47m E, 5172892.27m N (NZTM) - Map or aerial photograph
Rig Operator: B. Wilson
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 0.6m
Collapse: 1.95m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3452	11.2685
Local Friction	0.1186	0.1191
Pore Pressure	0.9595	0.9554

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

Client: Miyamoto International NZ

Bore No.: CPTu005

Project: 2 Glovers Road, Christchurch

Job No.: 19096

Site Location: 2 Glovers Road, Christchurch

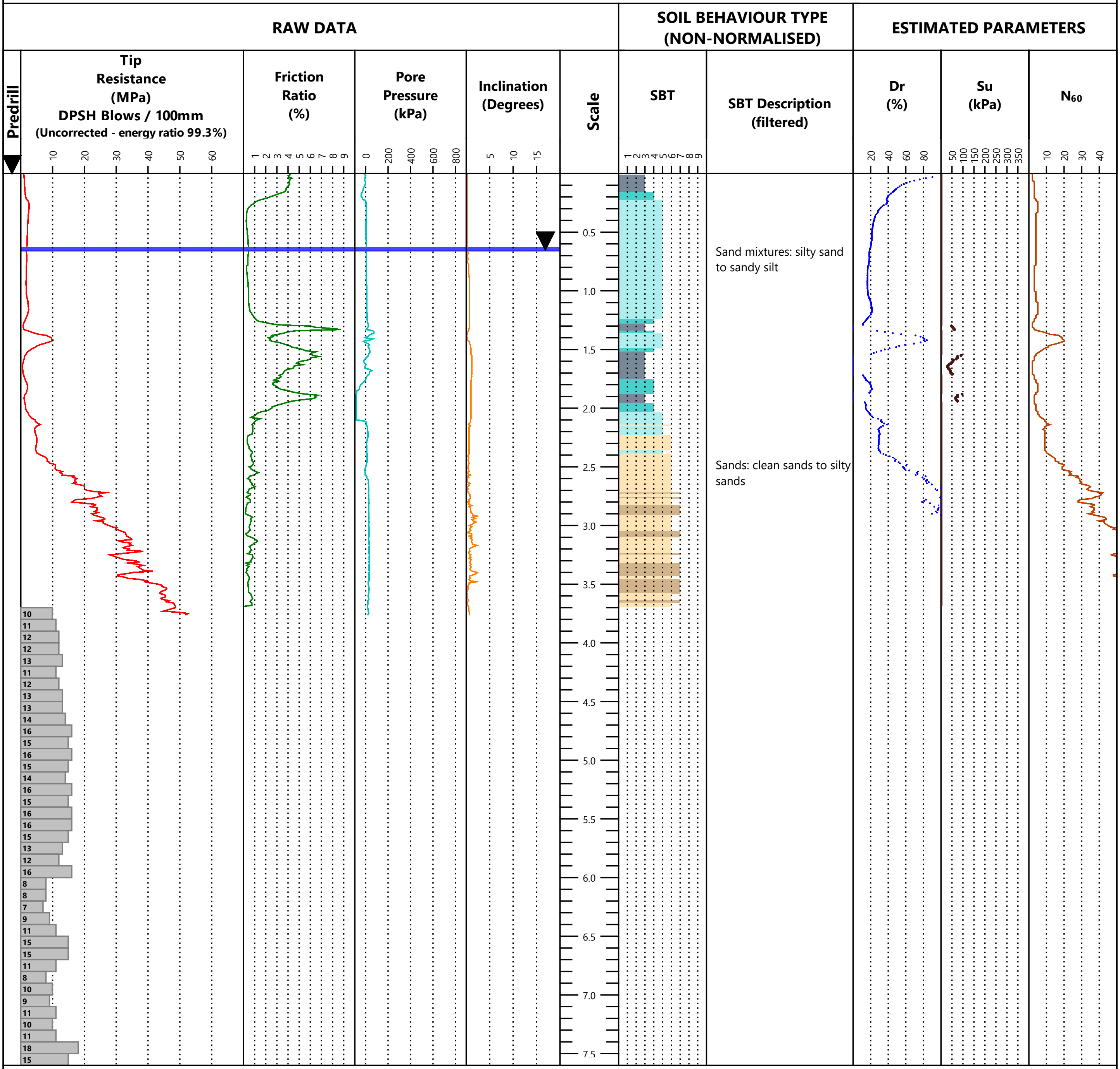
Date: 19/8/2020

Grid Reference: 1564945.37m E, 5172828.71m N (NZTM) - Map or aerial photograph

Rig Operator: B. Wilson

Elevation: 0.00m **Datum:** Ground

Equipment: Pagani TG63-150



Cone Type: Pagani Piezocone - Compression

Cone Reference: MKJ328

Cone Area Ratio: 0.80

Standards: ISO 22476-1:2012

Predrill: -

Water Level: 0.65m

Collapse: 1.45m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.4066	11.2583
Local Friction	0.1183	0.1192
Pore Pressure	0.9587	0.9583

Termination

Target Depth: ☐

Effective Refusal

Tip: ☑

Gauge: ☐

Inclinometer: ☐

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

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

Notes & Limitations

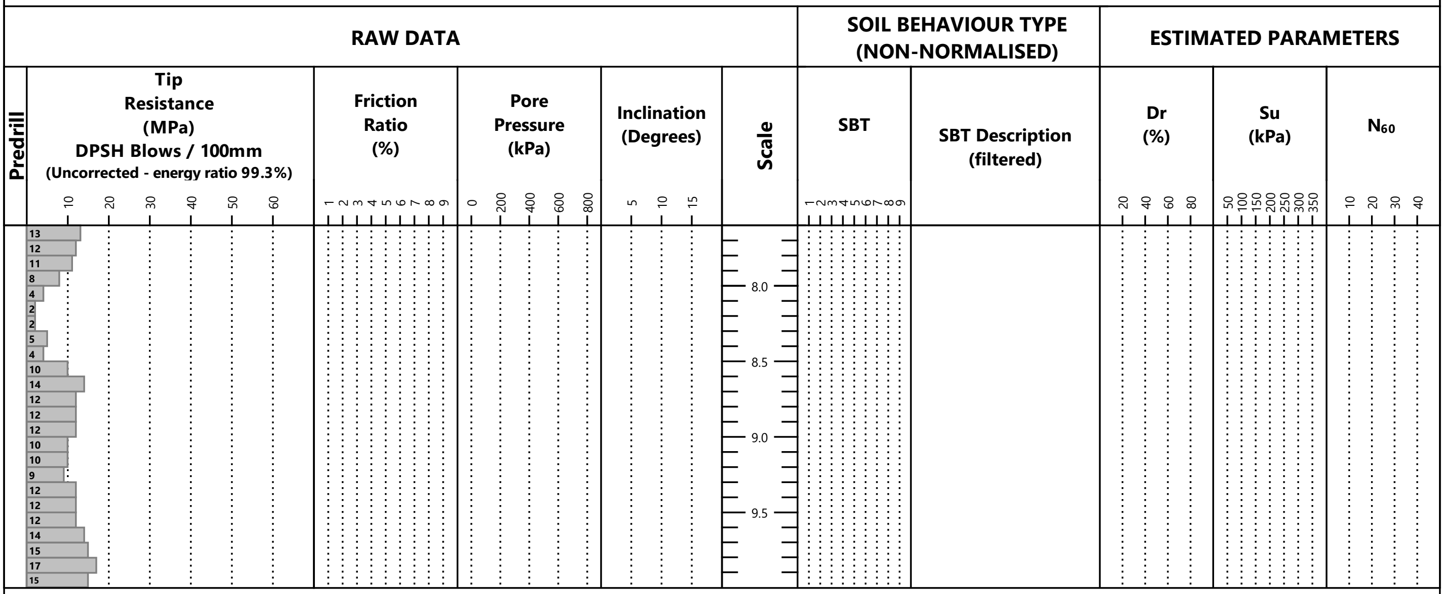
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

McMILLAN Drilling LandTest	**Client:** Miyamoto International NZ	**Bore No.:** CPTu005
	Project: 2 Glovers Road, Christchurch	**Job No.:** 19096

Site Location: 2 Glovers Road, Christchurch
Date: 19/8/2020
Grid Reference: 1564945.37m E, 5172828.71m N (NZTM) - Map or aerial photograph
Rig Operator: B. Wilson
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 10m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 0.65m
Collapse: 1.45m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	11.4066	11.2583
Local Friction	0.1183	0.1192
Pore Pressure	0.9587	0.9583

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

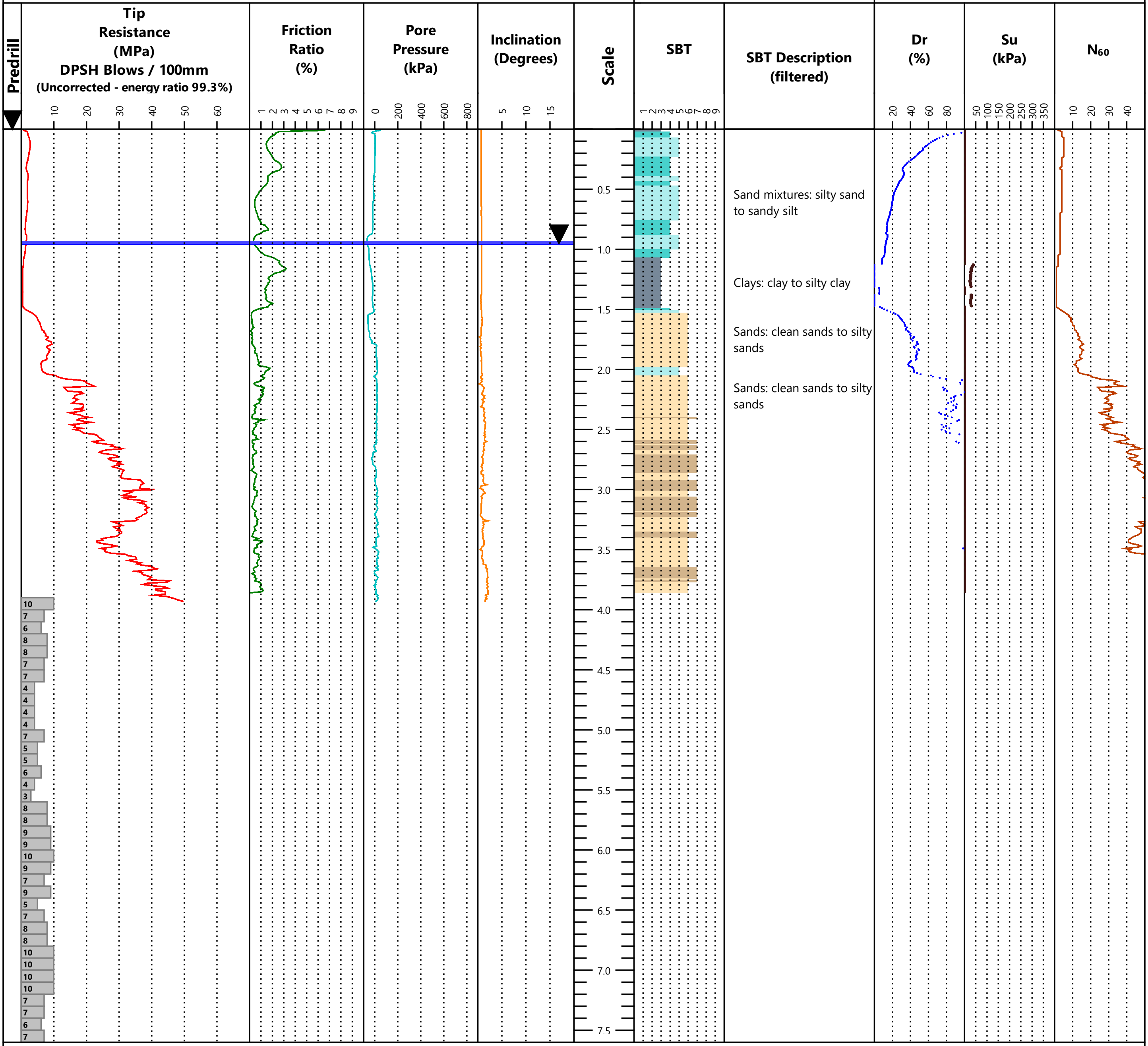
	Client: Miyamoto International NZ	**Bore No.:** **CPTu006**
	Project: 2 Glovers Road, Christchurch	**Job No.:** **19096**

Site Location: 2 Glovers Road, Christchurch
Date: 13/8/2020
Grid Reference: 1565008.77m E, 5172744.63m N (NZTM) - Map or aerial photograph
Rig Operator: B. Wilson
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150

RAW DATA

SOIL BEHAVIOUR TYPE (NON-NORMALISED)

ESTIMATED PARAMETERS



Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 0.95m
Collapse: 1.40m

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3708	11.2634
Local Friction	0.1178	0.119
Pore Pressure	0.9592	0.9542

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

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

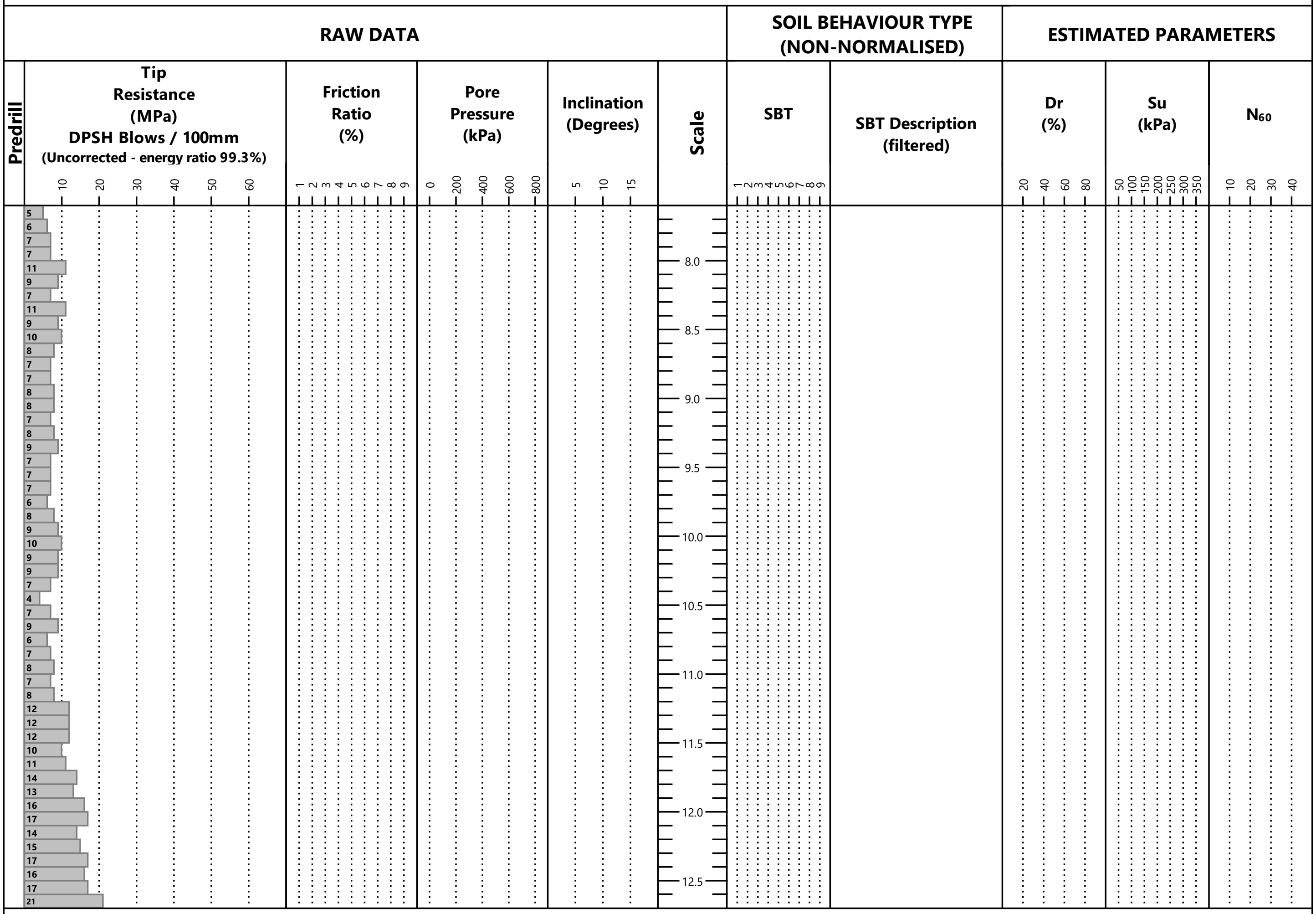
Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

McMILLAN Drilling LandTest	**Client:** Miyamoto International NZ	**Bore No.:** CPTu006
	Project: 2 Glovers Road, Christchurch	**Job No.:** 19096

Site Location: 2 Glovers Road, Christchurch
Date: 13/8/2020
Grid Reference: 1565008.77m E, 5172744.63m N (NZTM) - Map or aerial photograph
Rig Operator: B. Wilson
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 12.7m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 0.95m
Collapse: 1.40m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3708	11.2634
Local Friction	0.1178	0.119
Pore Pressure	0.9592	0.9542

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

TEST DETAIL

PointID: CPTu001
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS711
Cone Area Ratio: 0.79

Date: 18/8/2020
Predrill: -
Water Level: 1.45m
Collapse: 1.60m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	20.4528	20.369
Local Friction	0.2535	0.2535
Pore Pressure	3.0597	3.0579

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

PointID: CPTu002
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKS711
Cone Area Ratio: 0.79

Date: 17/8/2020
Predrill: -
Water Level: 1.05m
Collapse: 2.45m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	20.4004	20.348
Local Friction	0.2537	0.2536
Pore Pressure	3.0612	3.0605

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

PointID: CPTu003
Sounding: 1

Operator: B. Wilson
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80

Date: 13/8/2020
Predrill: -
Water Level: 1.8m
Collapse: 2.70m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3554	11.3094
Local Friction	0.1187	0.1186
Pore Pressure	0.9596	0.9557

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

PointID: CPTu004
Sounding: 1

Operator: B. Wilson
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80

Date: 19/8/2020
Predrill: -
Water Level: 0.6m
Collapse: 1.95m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3452	11.2685
Local Friction	0.1186	0.1191
Pore Pressure	0.9595	0.9554

Termination
Target Depth: ☐
Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

PointID: CPTu005
Sounding: 1

Operator: B. Wilson
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ328
Cone Area Ratio: 0.80

Date: 19/8/2020
Predrill: -
Water Level: 0.65m
Collapse: 1.45m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.4066	11.2583
Local Friction	0.1183	0.1192
Pore Pressure	0.9587	0.9583

Termination
Target Depth: ☐
Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

TEST DETAIL

PointID: CPTu006
Sounding: 1

Operator:	B. Wilson	**Date:**	13/8/2020	**Termination**	
Cone Type:	Pagani Piezocone - Compression	**Predrill:**	-		
Cone Reference:	MKJ328	**Water Level:**	0.95m	**Target Depth:**	☐
Cone Area Ratio:	0.80	**Collapse:**	1.40m		

Effective Refusal

Tip: ☑
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.3708	11.2634
Local Friction	0.1178	0.119
Pore Pressure	0.9592	0.9542

CPT CALIBRATION AND TECHNICAL NOTES

These notes describe the technical specifications and associated calibration references pertaining to the Pagani piezocone types measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm²)

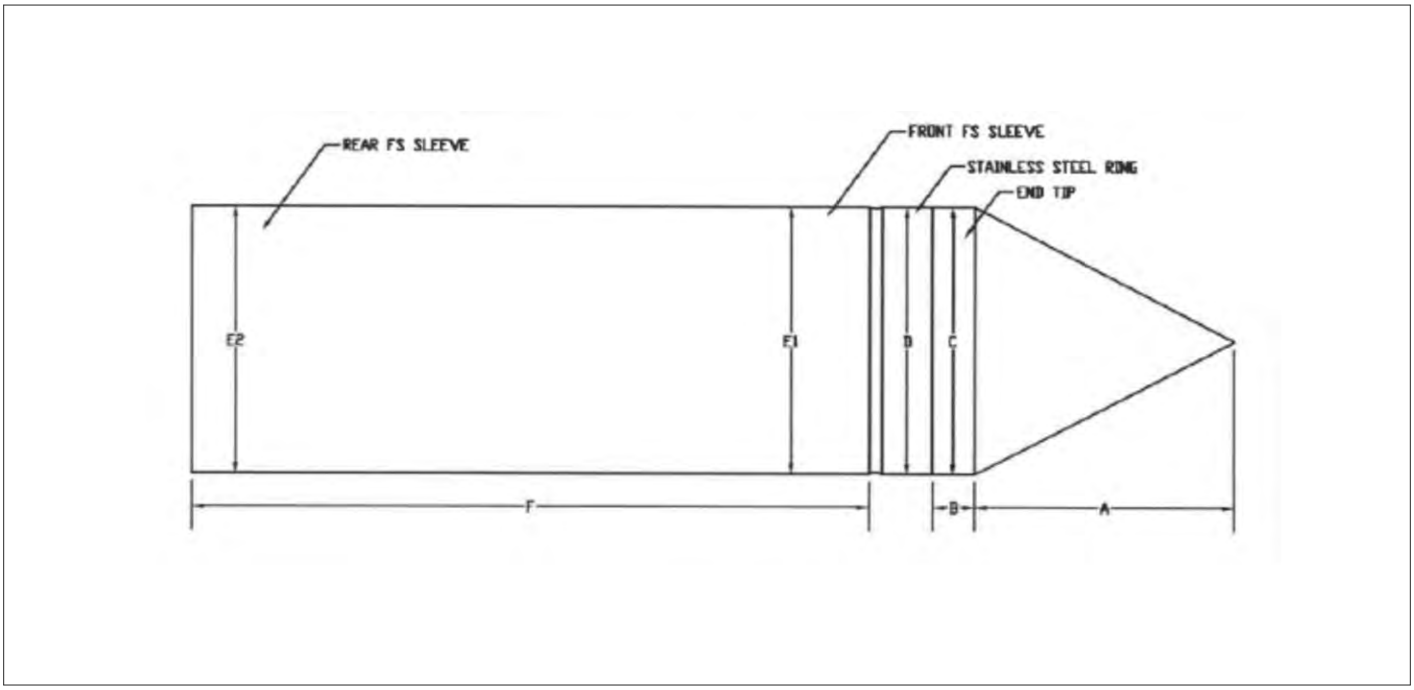
Dimensions

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

Technical specifications

	Tip	Friction	Pore Pressure	Inclination
Maximum Measuring Range:	50 - 100 MPa	1.60 MPa	2.50 MPa	0° - 20°
Resolution:	24 bit	24 bit	24 bit	12 bit
Accuracy:	0.005 MPa	0.04 MPa	0.04 MPa	0.5°

Length:	320 mm	**Weight:**	1.8 kg
Diameter:	35.8 mm	**Opening angle of bit:**	60°
Cone base area:	10 cm²	**Side sleeve surfaces:**	150 cm²
Cone area ratio:	0.80	**Tip and Local Friction sensor displacement:**	80 mm



PAGANI®
GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE

N° Z087/19

Calibrated system *(Sistema tarato)* :

Serial number	Mkj328
Sensor	TIP RESISTANCE
Max. Capacity [MPa]:	100
Scaling Factor:	195500
Tip net area ratio (a_n):	0,80
Sleeve net ratio (b_n):	0,00

Addressee *(destinatario)* :
LANDTEST
307 Cashel street, Christchurch
New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:

Manufacturer	AEP transducers
Model	KAL 200 kN
Serial Number	138913
Power press:	
Manufacturer	Easydur Italiana
Model	Aura 20T
Serial Number	29084

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date:	15/01/2019
Certificate N.	LAT 091 2019-014
Temperature of calibration	22°C
Humidity	53%

Factory calibration in accordance with ASTM D5778-12

PAGANI®
GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE

N° Z087/19

Calibrated system *(Sistema tarato)* :

Serial number	Mkj328
Sensor	SLEEVE FRICTION
Max. Capacity [kPa]:	1600
Scaling Factor:	30696

Addressee *(destinatario)* :
LANDTEST
307 Cashel street, Christchurch
New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:

Manufacturer	AEP transducers
Model	KAL 50 kN
Serial Number	65495
Power press:	
Manufacturer	Easydur Italiana
Model	Aura 10T
Serial Number	29002

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

PAGANI®
GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE

N° Z087/19

Calibrated system *(Sistema tarato)* :

Serial number	Mkj328
Sensor	PORE PRESSURE
Max. Capacity [kPa]:	2500
Scaling Factor	16963
Sensor	TILT ANGLE
Max. Inclination [°]:	20
Scaling Factor:	140137

Addressee *(destinatario)* :
LANDTEST
307 Cashel street, Christchurch
New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Pressure Generator:

Manufacturer	AEP transducers
Model	GPM500
Digital Indicator:	
Manufacturer	AEP transducers
Model	LAB DMM
Serial Number	301796

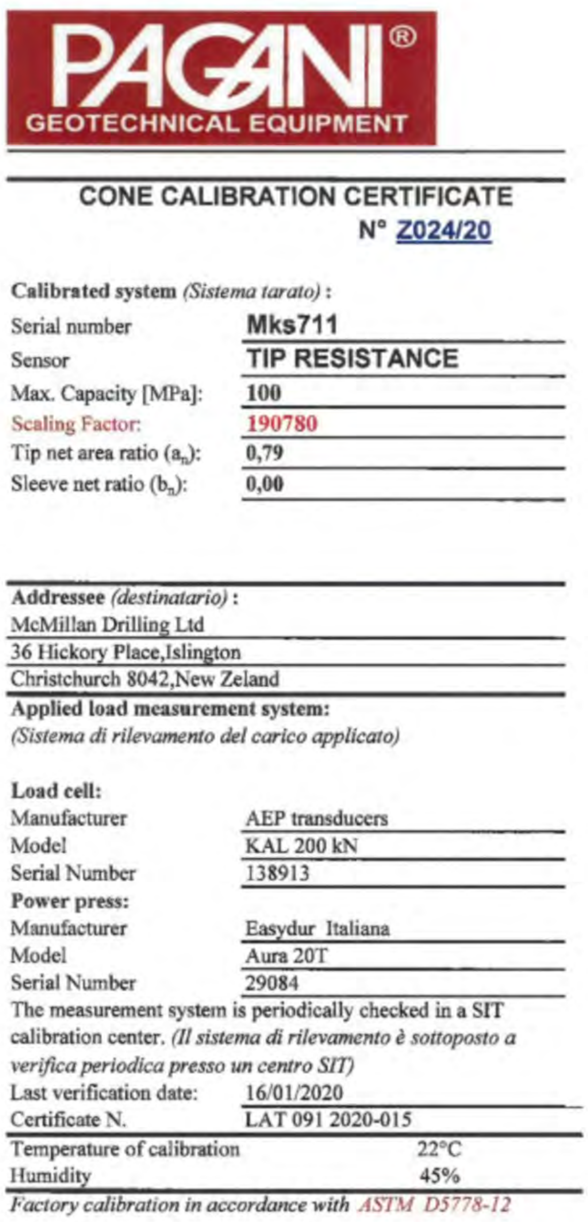
The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

The adopted calibration procedure has been developed according to the suggestions given by Prof. Paul W. Mayne (Georgia Institute of technology) and Prof. Diego Lo Presti (University of Pisa)

Cone calibrated by Claudio C.

Date of issue 27/06/2019

CONE CERTIFICATES



PAGANI®
GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE
N° Z024/20

Calibrated system *(Sistema tarato)* :

Serial number	**Mks711**
Sensor	**TIP RESISTANCE**
Max. Capacity [MPa]:	100
Scaling Factor:	190780
Tip net area ratio (a_n):	0,79
Sleeve net ratio (b_n):	0,00

Addressee *(destinatario)* :
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:

Manufacturer	AEP transducers
Model	KAL 200 kN
Serial Number	138913

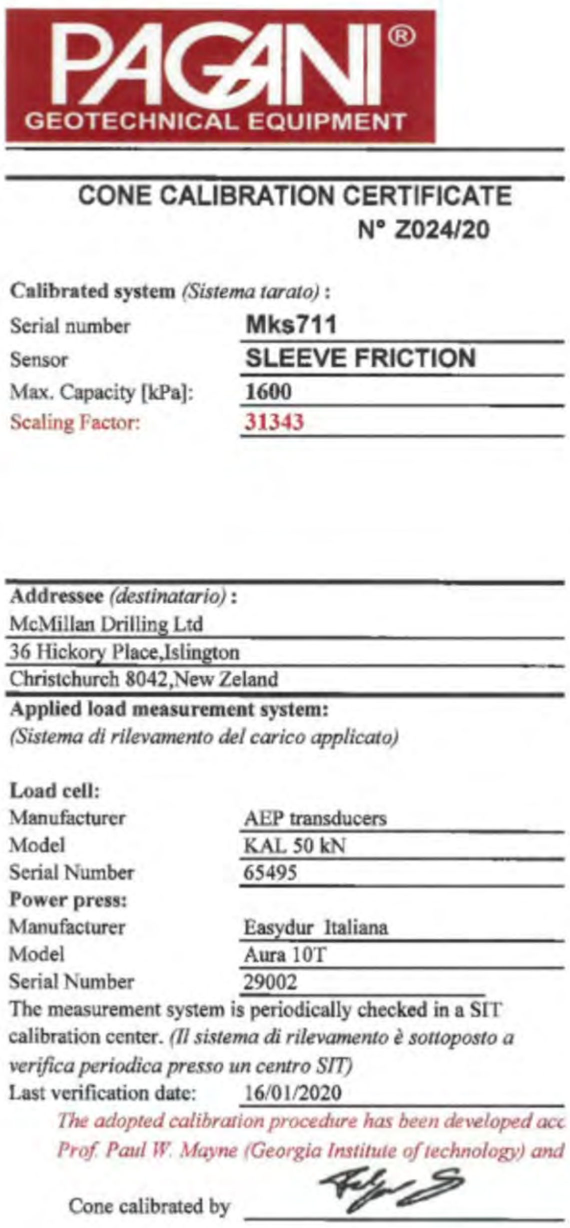
Power press:

Manufacturer	Easydur Italiana
Model	Aura 20T
Serial Number	29084

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date:	16/01/2020
Certificate N.	LAT 091 2020-015
Temperature of calibration	22°C
Humidity	45%

Factory calibration in accordance with ASTM D5778-12



PAGANI®
GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE
N° Z024/20

Calibrated system *(Sistema tarato)* :

Serial number	**Mks711**
Sensor	**SLEEVE FRICTION**
Max. Capacity [kPa]:	1600
Scaling Factor:	31343

Addressee *(destinatario)* :
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:

Manufacturer	AEP transducers
Model	KAL 50 kN
Serial Number	65495

Power press:

Manufacturer	Easydur Italiana
Model	Aura 10T
Serial Number	29002

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date: 16/01/2020

The adopted calibration procedure has been developed acc
Prof. Paul W. Mayne (Georgia Institute of technology) and

Cone calibrated by

PAGANI®
GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE
N° Z024/20

Calibrated system *(Sistema tarato)* :

Serial number	**Mks711**
Sensor	**PORE PRESSURE**
Max. Capacity [kPa]:	2500
Scaling Factor:	10298
Sensor	**TILT ANGLE**
Max. Inclination [°]:	20
Scaling Factor:	280277

Addressee *(destinatario)* :
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Pressure Generator:

Manufacturer	MENSOR
Model	CPC 4000
Serial Number	41000V56
Sensor Descr	Silicon Pressure Transducer
Sensor Serial Number	41000SYF

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date:	28/02/2019
Certificate N.	162632
Temperature of calibration	22°C
Humidity	45%

Factory calibration in accordance with ASTM D5778-12

CONE PENETRATION TEST (CPT) REPORT

McMILLAN Drilling

LandTest

Client: Miyamoto International NZ

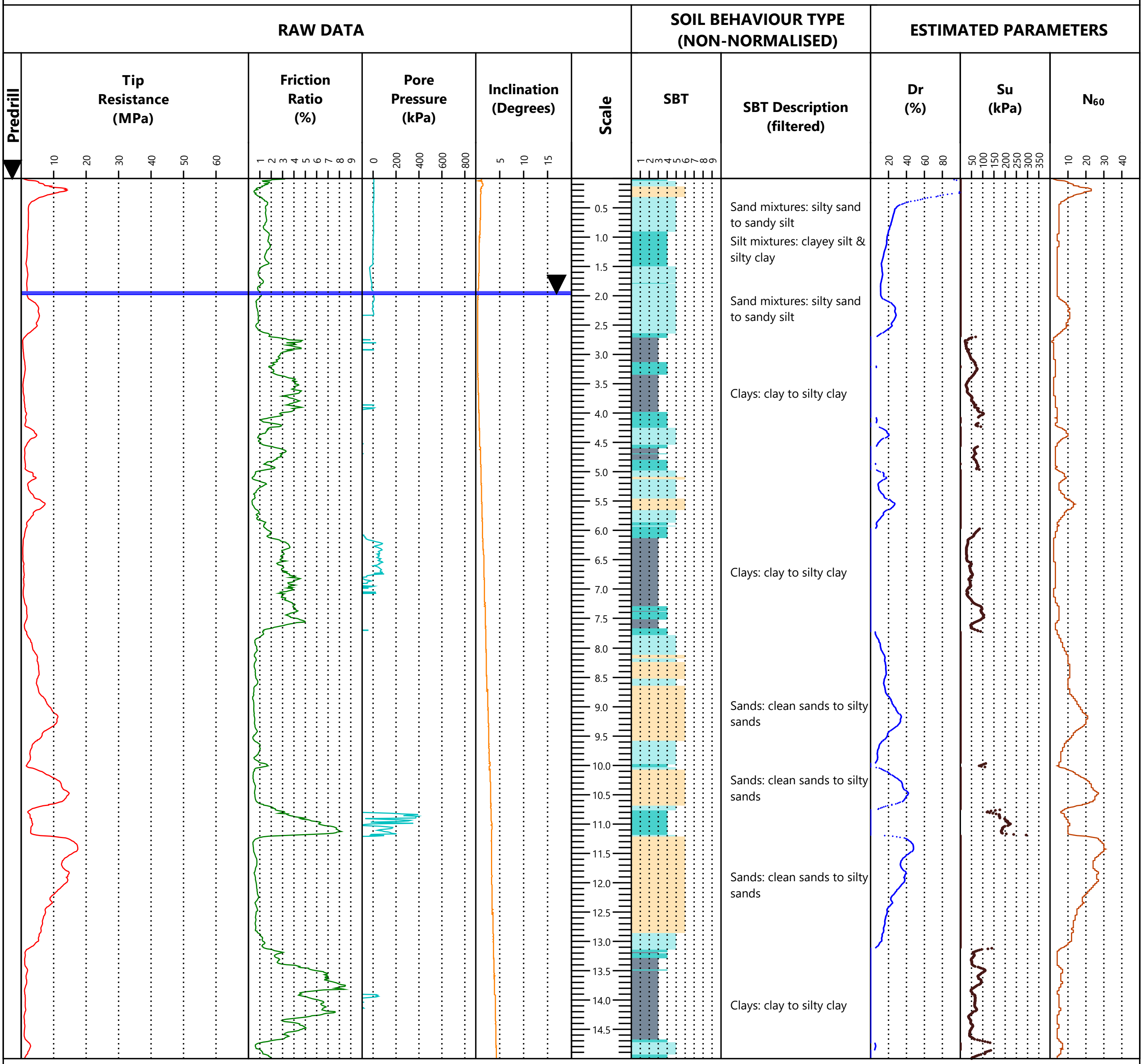
Location: 2-4 Glovers Road, Christchurch

Printed: 29/09/2020

McMILLAN Drilling
LandTest

Client:	**Bore No.:**
Miyamoto International NZ	**CPTu007**
Project:	**Job No.:**
2-4 Glovers Road, Christchurch	**19096**

Site Location: 2-4 Glovers Road, Christchurch
Date: 24/9/2020
Grid Reference: 1564970.4m E, 5173158.32m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 15m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.96m
Collapse: 2.0m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9412	11.8737
Local Friction	0.1606	0.161
Pore Pressure	1.4594	1.262

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks
Invalid pore water pressure data from 2.33m.

Generated with Core-GS by Geroc

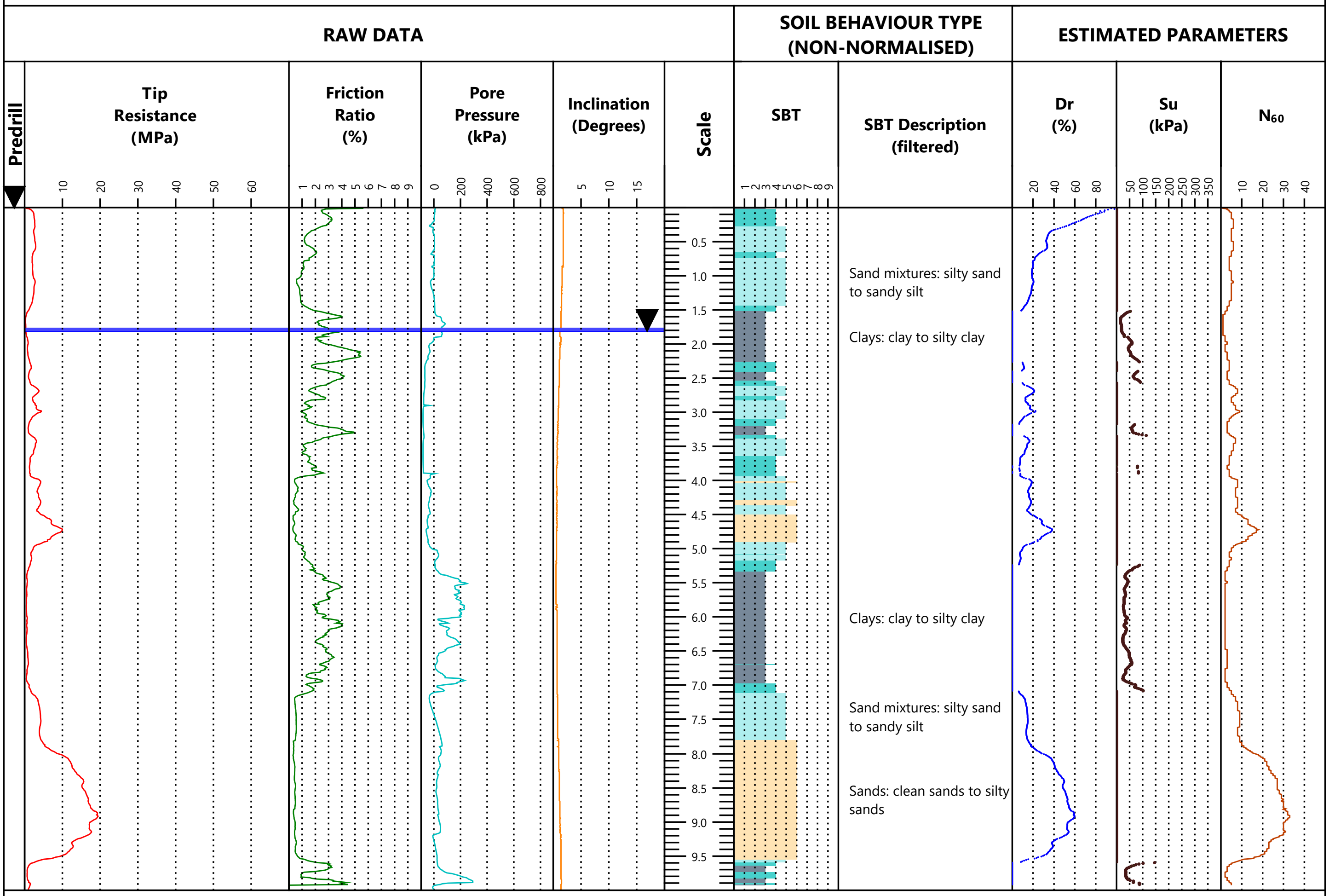
Client: Miyamoto International NZ

Bore No.: **CPTu008**

Project: 2-4 Glovers Road, Christchurch

Job No.: **19096**

Site Location: 2-4 Glovers Road, Christchurch
Date: 24/9/2020
Grid Reference: 1565034.78m E, 5173124.87m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 10m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.8m
Collapse: 2.2m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	11.9516	11.8425
Local Friction	0.1609	0.1614
Pore Pressure	1.459	1.4561

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

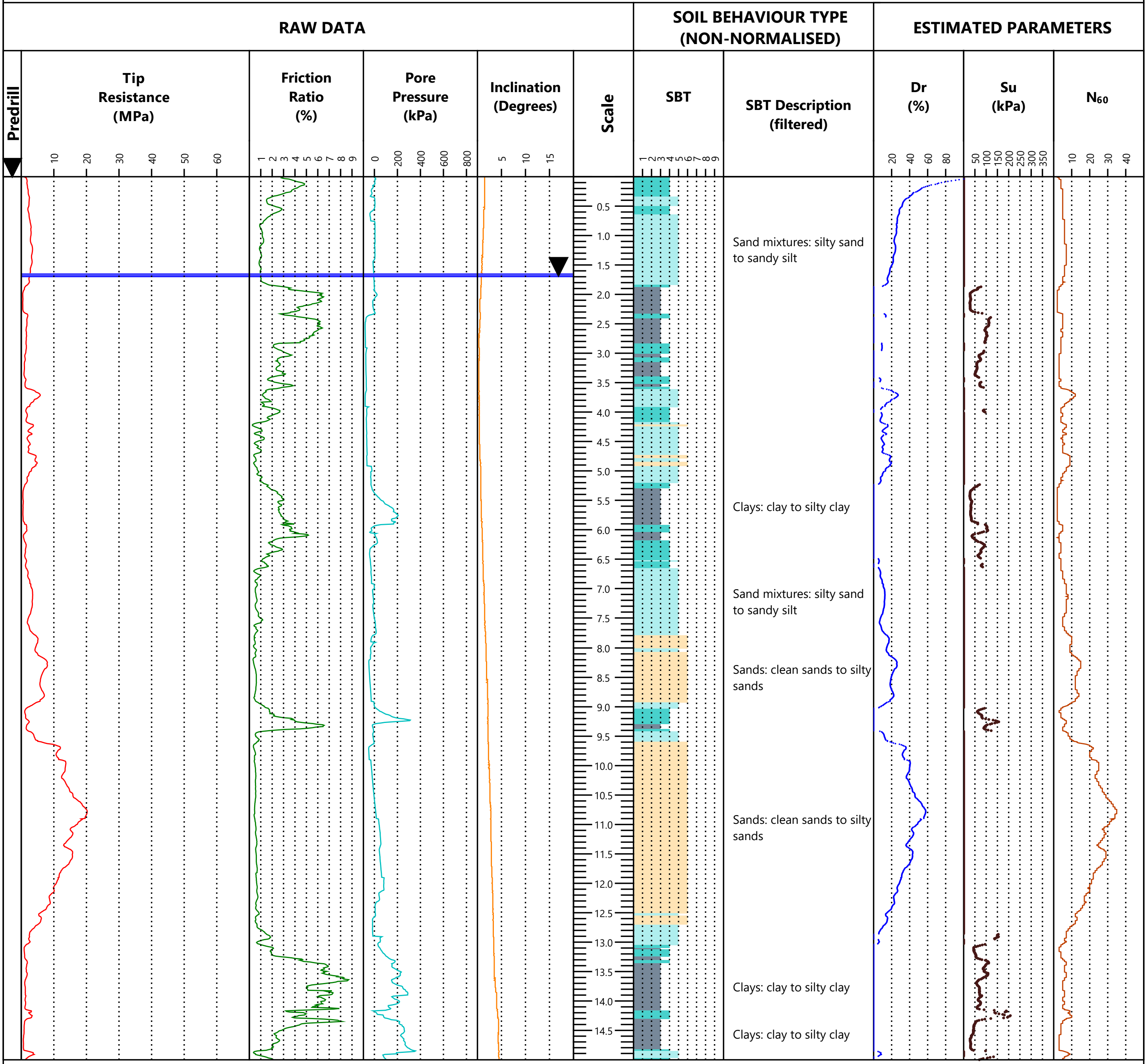
Remarks

Sheet 1 of 1

McMILLAN Drilling
LandTest

Client:	Miyamoto International NZ	**Bore No.:**	**CPTu009**
Project:	2-4 Glovers Road, Christchurch	**Job No.:**	**19096**

Site Location: 2-4 Glovers Road, Christchurch
Date: 24/9/2020
Grid Reference: 1564969.64m E, 5173086.81m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 15m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1.68m
Collapse: 1.80m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9464	11.801
Local Friction	0.1604	0.1611
Pore Pressure	1.4592	1.4568

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

McMILLAN Drilling

LandTest

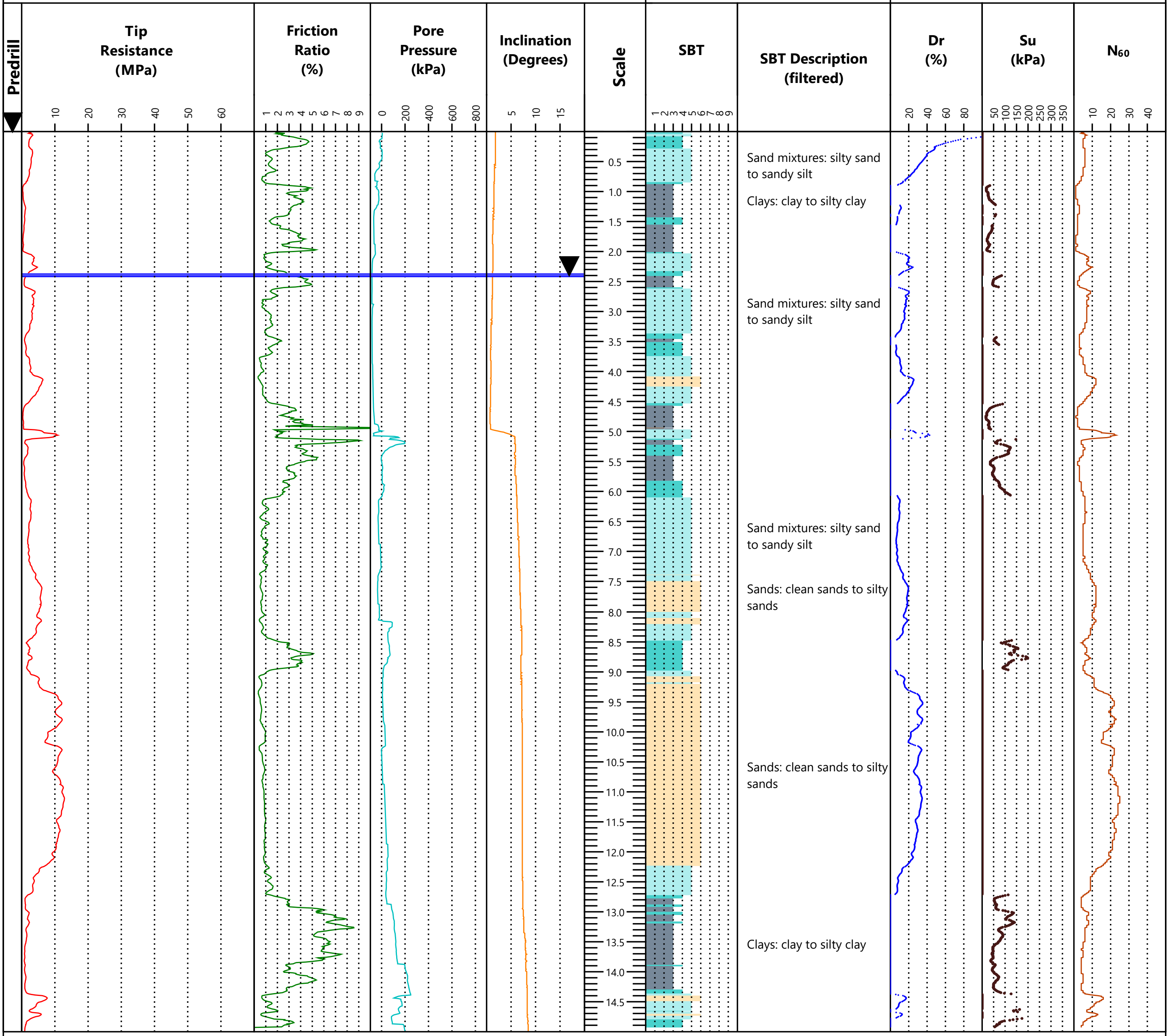
Client: Miyamoto International NZ	**Bore No.:** **CPTu010**
Project: 2-4 Glovers Road, Christchurch	**Job No.:** **19096**

Site Location: 2-4 Glovers Road, Christchurch
Date: 25/9/2020
Grid Reference: 1565043.16m E, 5173036.65m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150

RAW DATA

SOIL BEHAVIOUR TYPE (NON-NORMALISED)

ESTIMATED PARAMETERS



EOH: 15m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 2.4m
Collapse: 2.50m

Termination

Target Depth: ☑

Effective Refusal

Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9568	11.8166
Local Friction	0.1618	0.1622
Pore Pressure	1.4599	1.4582

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

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

Notes & Limitations

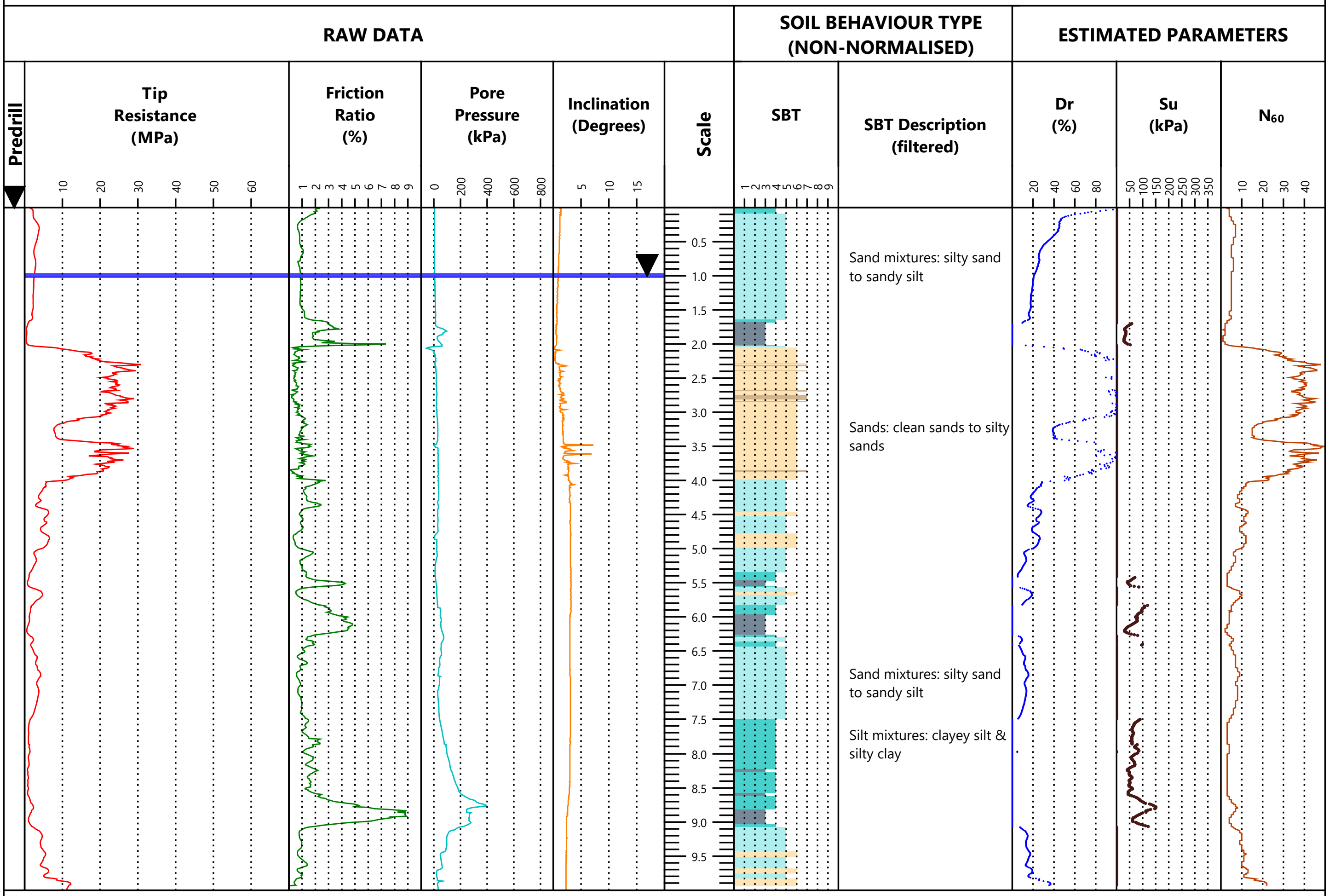
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

McMILLAN Drilling
LandTest

Client:	Miyamoto International NZ	**Bore No.:**	**CPTu011**
Project:	2-4 Glovers Road, Christchurch	**Job No.:**	**19096**

Site Location: 2-4 Glovers Road, Christchurch
Date: 25/9/2020
Grid Reference: 1565055.15m E, 5172937.04m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 10m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: -
Water Level: 1m
Collapse: 5.1m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9464	11.8166
Local Friction	0.1615	0.1621
Pore Pressure	1.4598	1.455

Termination

Target Depth: ☑

Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

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

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

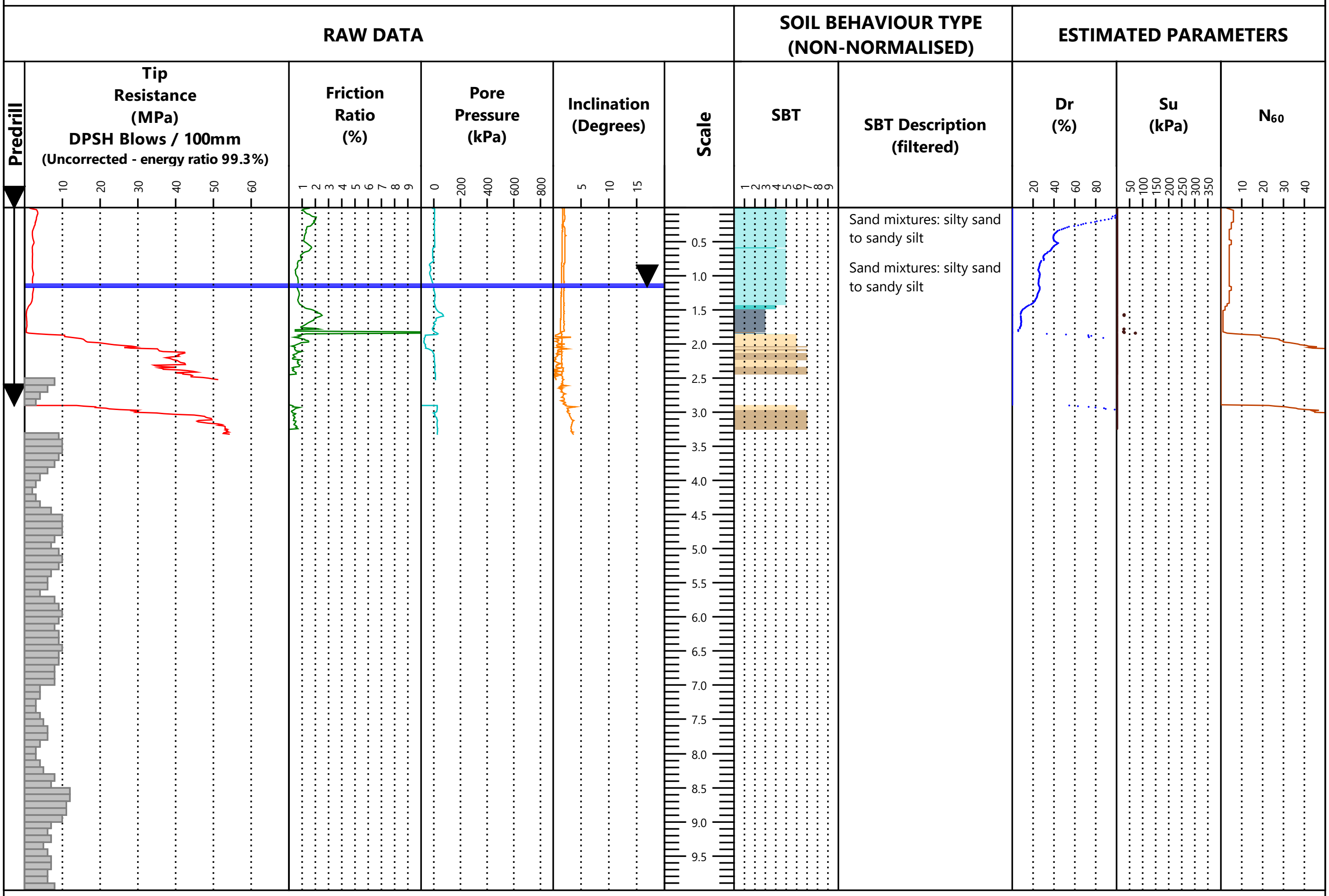
Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

McMILLAN Drilling LandTest

Client: Miyamoto International NZ		**Bore No.:** CPTu012
Project: 2-4 Glovers Road, Christchurch		**Job No.:** 19096

Site Location: 2-4 Glovers Road, Christchurch
Date: 29/9/2020
Grid Reference: 1565058.83m E, 5172852.91m N (NZTM) - Map or aerial photograph
Rig Operator: E. Diaz
Elevation: 0.00m
Datum: Ground
Equipment: Pagani TG63-150



EOH: 10m

Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79
Standards: ISO 22476-1:2012

Predrill: 2.9m
Water Level: 1.15m
Collapse: 2.2m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	11.8737	11.8321
Local Friction	0.1612	0.1611
Pore Pressure	1.4542	1.4556

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

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

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

Notes & Limitations
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

TEST DETAIL

PointID: CPTu007
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 24/9/2020
Predrill: -
Water Level: 1.96m
Collapse: 2.0m

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9412	11.8737
Local Friction	0.1606	0.161
Pore Pressure	1.4594	1.262

PointID: CPTu008
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 24/9/2020
Predrill: -
Water Level: 1.8m
Collapse: 2.2m

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9516	11.8425
Local Friction	0.1609	0.1614
Pore Pressure	1.459	1.4561

PointID: CPTu009
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 24/9/2020
Predrill: -
Water Level: 1.68m
Collapse: 1.80m

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9464	11.801
Local Friction	0.1604	0.1611
Pore Pressure	1.4592	1.4568

PointID: CPTu010
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 25/9/2020
Predrill: -
Water Level: 2.4m
Collapse: 2.50m

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9568	11.8166
Local Friction	0.1618	0.1622
Pore Pressure	1.4599	1.4582

PointID: CPTu011
Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 25/9/2020
Predrill: -
Water Level: 1m
Collapse: 5.1m

Termination
Target Depth: ☑
Effective Refusal
Tip: ☐
Gauge: ☐
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9464	11.8166
Local Friction	0.1615	0.1621
Pore Pressure	1.4598	1.455

TEST DETAIL

PointID: CPTu012

Sounding: 1

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 29/9/2020
Predrill: -
Water Level: -
Collapse: -

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.9568	11.8062
Local Friction	0.1607	0.1609
Pore Pressure	1.4567	1.4562

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

Sounding: 2

Operator: E. Diaz
Cone Type: Pagani Piezocone - Compression
Cone Reference: MKJ329
Cone Area Ratio: 0.79

Date: 29/9/2020
Predrill: 2.9m
Water Level: 1.15m
Collapse: 2.2m

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	11.8737	11.8321
Local Friction	0.1612	0.1611
Pore Pressure	1.4542	1.4556

Termination

Target Depth: ☐

Effective Refusal
Tip: ☑
Gauge: ☐
Inclinometer: ☐

CPT CALIBRATION AND TECHNICAL NOTES

These notes describe the technical specifications and associated calibration references pertaining to the Pagani piezocone types measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm^2)

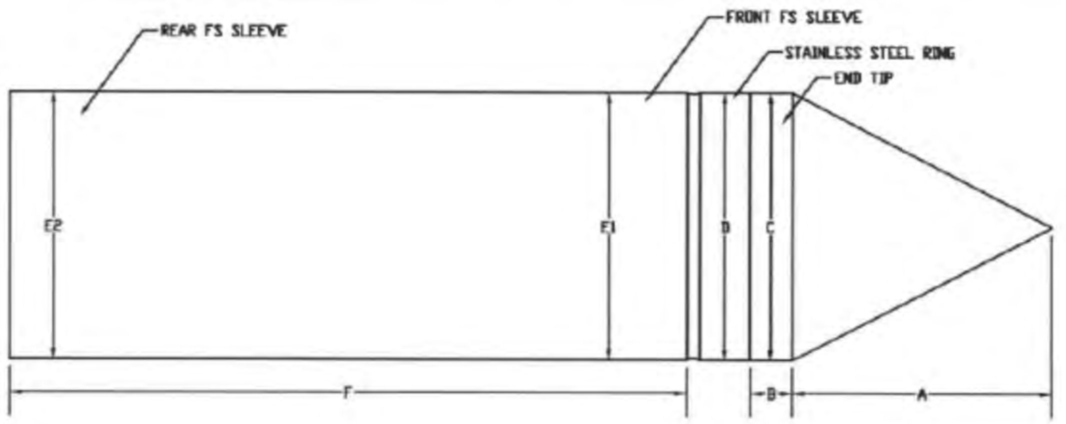
Dimensions

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

Technical specifications

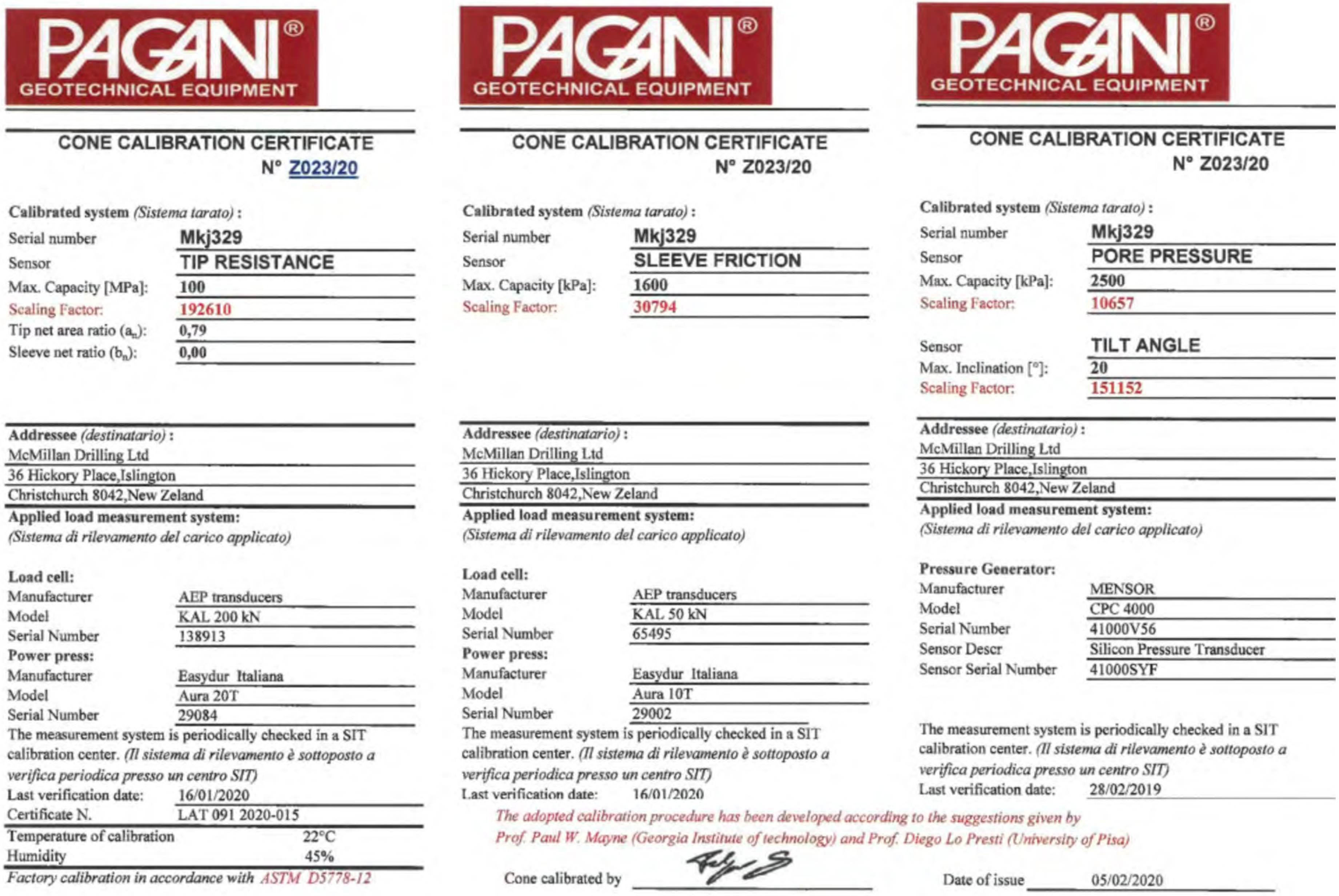
	Tip	Friction	Pore Pressure	Inclination
Maximum Measuring Range:	50 - 100 MPa	1.60 MPa	2.50 MPa	0° - 20°
Resolution:	24 bit	24 bit	24 bit	12 bit
Accuracy:	0.005 MPa	0.04 MPa	0.04 MPa	0.5°

Length:	320 mm	**Weight:**	1.8 kg
Diameter:	35.8 mm	**Opening angle of bit:**	60°
Cone base area:	10 cm^2	**Side sleeve surfaces:**	150 cm^2
Cone area ratio:	0.80	**Tip and Local Friction sensor displacement:**	80 mm



McMILLAN Drilling
LandTest

CONE CERTIFICATES



PAGANI® GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE

N° Z023/20

Calibrated system *(Sistema tarato)* **:**

Serial number	**Mkj329**
Sensor	**TIP RESISTANCE**
Max. Capacity [MPa]:	**100**
Scaling Factor:	**192610**
Tip net area ratio (a_n):	**0,79**
Sleeve net ratio (b_n):	**0,00**

Addressee *(destinatario)* **:**
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:	
Manufacturer	AEP transducers
Model	KAL 200 kN
Serial Number	138913
Power press:	
Manufacturer	Easydur Italiana
Model	Aura 20T
Serial Number	29084

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date:	16/01/2020
Certificate N.	LAT 091 2020-015
Temperature of calibration	22°C
Humidity	45%

Factory calibration in accordance with ASTM D5778-12

PAGANI® GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE

N° Z023/20

Calibrated system *(Sistema tarato)* **:**

Serial number	**Mkj329**
Sensor	**SLEEVE FRICTION**
Max. Capacity [kPa]:	**1600**
Scaling Factor:	**30794**

Addressee *(destinatario)* **:**
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Load cell:	
Manufacturer	AEP transducers
Model	KAL 50 kN
Serial Number	65495
Power press:	
Manufacturer	Easydur Italiana
Model	Aura 10T
Serial Number	29002

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date: 16/01/2020

PAGANI® GEOTECHNICAL EQUIPMENT

CONE CALIBRATION CERTIFICATE

N° Z023/20

Calibrated system *(Sistema tarato)* **:**

Serial number	**Mkj329**
Sensor	**PORE PRESSURE**
Max. Capacity [kPa]:	**2500**
Scaling Factor:	**10657**
Sensor	**TILT ANGLE**
Max. Inclination [°]:	**20**
Scaling Factor:	**151152**

Addressee *(destinatario)* **:**
McMillan Drilling Ltd
36 Hickory Place,Islington
Christchurch 8042,New Zeland

Applied load measurement system:
(Sistema di rilevamento del carico applicato)

Pressure Generator:	
Manufacturer	MENSOR
Model	CPC 4000
Serial Number	41000V56
Sensor Descr	Silicon Pressure Transducer
Sensor Serial Number	41000SYF

The measurement system is periodically checked in a SIT calibration center. *(Il sistema di rilevamento è sottoposto a verifica periodica presso un centro SIT)*

Last verification date: 28/02/2019

The adopted calibration procedure has been developed according to the suggestions given by Prof. Paul W. Mayne (Georgia Institute of technology) and Prof. Diego Lo Presti (University of Pisa)

Cone calibrated by

Date of issue 05/02/2020

D. Southern Geophysical MASW and GPR Report

October 2020

Geophysical Site Investigation:

2-4 Glovers Road, Christchurch

Report prepared for Miyamoto International NZ Ltd

GEOPHYSICAL REPORT

Southern Geophysical

3/28 Tanya St, Bromley, Christchurch 8062

Ph: 03 384 4302

Web: www.southerngeophysical.com

Data collected and report prepared for Southern Geophysical Ltd by:

Christian Ruegg, MSc, Geophysicist

Nick McConachie, BSc, Geologist

Report internally reviewed for Southern Geophysical by:
Mike Finnemore, PhD, Senior Geophysicist

Table of Contents

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Methodology: 2

Results: 3

Conclusions: 3

Disclaimer: 5

SGL Reference: 2050

Report Version 1

Summary:

Southern Geophysical Ltd was contracted to undertake a geophysical survey using Multi-channel Analysis of Surface Waves (MASW) at 2-4 Glovers Road, Christchurch. The geophysical survey was conducted on September 24th, 2020 and includes three MASW lines (Figure 1). The aim of the survey was to assess the shear-wave velocities and structure of the subsurface to a depth of over 20 m. The MASW results show low shear-wave velocities to a depth of 10 m in the northern part of the site (100 m/s to 150 m/s), with higher velocities to the south (100 m/s to 300 m/s). The boundary between these two zones is a feature characteristic of the edge of a paleochannel, buried valley, or dipping volcanic strata, crossing the site east to west and dipping to the north. It is possible that high velocities imaged by the MASW survey to the south (>500 m/s from approximately 20 m depth) are associated with volcanic rock, but there are no boreholes available for ground truthing to that depth.

Methodology:

MASW is a geophysical technique that uses the dispersive nature of surface waves to model shear-wave velocity versus depth.

A MASW survey is undertaken as a series of lines or points across the surface of the site. The MASW points in this survey were collected using a 24-channel towed seismic array, with 4.5 Hz geophones. The geophone spacing was 1 m and the source offset was 10 m. The seismic source was a 16 lb sledgehammer impacting an aluminium plate. Recording parameters for the MASW survey were set with a 0.125 ms sample interval, 1.5 s record length, 24 dB gains, and a geophone trigger system.

The field records were processed using the Kansas Geological Survey software package SurfSeis6++ ©. The geometry for each point was set according to the survey parameters and the dispersion curves were generated and edited. The inversions were run using a 10 layer variable depth model. The velocity data was interpolated into 2D profiles showing V_s variations with depth (Figures 2 to 3). The output shear-wave velocity data is included as data files (CSV format), supplementary to this report.

Supplementary to the MASW profiles, a series of Ground Penetrating Radar lines were acquired with a GSSI 200 MHz antenna (Figure 1). The radargrams are included in (Figures 4 and 5).

Survey positions were recorded using a Geo 7X Trimble GNSS system with a Tornado antenna. The GNSS positions were differentially corrected using a local GeoNet base station. The GNSS points were output in NZTM2000, with heights in Mean Sea Level (MSL). The accuracy of the survey positions is +/- 0.1 m. The site had no significant topographic changes, and the lines have not been corrected for elevation.

Results:

A total of three MASW lines were acquired at the site with a total MASW survey length of approximately 1 km (Figure 1). The ground surface was well compacted farm tracks and farm yards. A series of GPR lines were acquired along each MASW line to provide a high resolution image of the substrate (Figures 4 and 5).

In homogenous soils, with gradually increasing shear-wave velocities and no sharp lateral discontinuities, the accuracy of the shear-wave velocities derived from the MASW processing is considered to be +/- 10%.[1] The quality of the seismic data and the dispersion curves used in this report is very good, with a good signal-to-noise ratio. If there is a velocity inversion present in the shear-wave profile (decreasing velocity with depth), the shear-wave velocity of the reduced velocity zone and the thickness of that zone can often be underestimated by the inversion process.

Conclusions:

The MASW survey was considered to be of good quality, with modelled shear-wave velocities accurate to +/- 10%. The velocities in the top 5 m are likely to be more accurate then the deeper velocities, due to the presence of multiple velocity inversions. The MASW survey indicates a horizontal layer defined by a sharp increase in shear-wave velocity (180 m/s to 220 m/s) at around 5 m depth in the southern part of the site, consistent with the surface of dense gravels or sands. In the northern part of the site a similar 180 m/s to 220 m/s surface was observed at 20 m depth. There is a well-defined dipping surface dividing the south and the north, possibly associated with a buried valley edge, paleochannel, or

---

[1] Stephenson, W.J., Louie, J.N., Pullammanappallil, S., Williams, R.A., and Odum, J.K. 2005. Blind Shear-wave Velocity Comparison of ReMi and MASW Results with Boreholes to 200 m in Santa Clara Valley: Implications for Earthquake Ground-Motion Assessment. *Bulletin of the Seismological Society of America*, Vol. 95, pp. 2506-2516.

bedrock interface. This edge feature is apparent in both MASW 1 and MASW 3, as well as GPR 4 and GPR 10.

While the limitations of the MASW method should be considered when evaluating these results, the quality of the data collected at the site and the confidence in the shear-wave velocities derived from the MASW data is good.

Disclaimer:

This document has been provided by Southern Geophysical Ltd subject to the following:

Non-invasive geophysical testing has limitations and is not a complete source of testing. Often there is a need to couple non-invasive methods with invasive testing methods, such as drilling, especially in cases where the non-invasive testing indicates anomalies.

This document has been prepared for the particular purpose outlined in the project proposal and no responsibility is accepted for the use of this document, in whole or in part, in other contexts or for any other purpose. Southern Geophysical Ltd did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited nature of the enquiry Southern Geophysical Ltd was retained to undertake with respect to the site. Variations in conditions often occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account. Accordingly, additional studies and actions may be required by the client.

We collected our data and based our report on information which was collected at a specific point in time. The passage of time affects the information and assessment provided by Southern Geophysical Ltd. It is understood that the services provided allowed Southern Geophysical Ltd to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes for whatever reason. Where data is supplied by the client or other sources, including where previous site investigation data have been used, it has been assumed that the information is correct. No responsibility is accepted by Southern Geophysical Ltd for incomplete or inaccurate data supplied by others. This document is provided for sole use by the client and is confidential to that client and its professional advisers. No responsibility whatsoever for the contents of this document will be accepted to any person other than the client. Any use which a third party makes of this document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Southern Geophysical Ltd accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

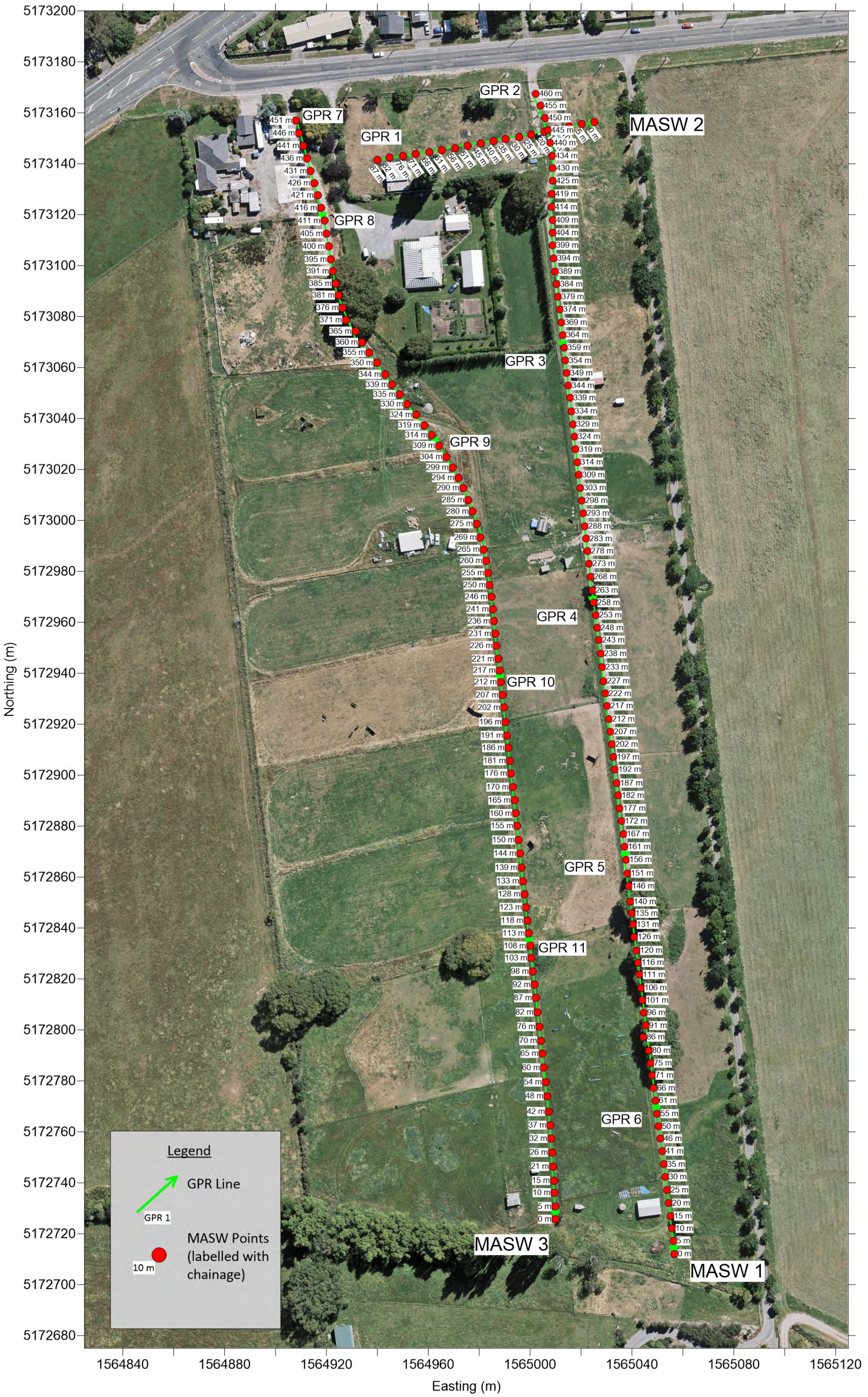

Figure 1: Site Map

2-4 Glovers Road, Christchurch

NOTES- Coordinates NZ2000 TM Grid.
Aerial photograph sourced from LINZ, Crown Copyright ©

SCALE (m)

0 25 50 75 100 125

N

A3

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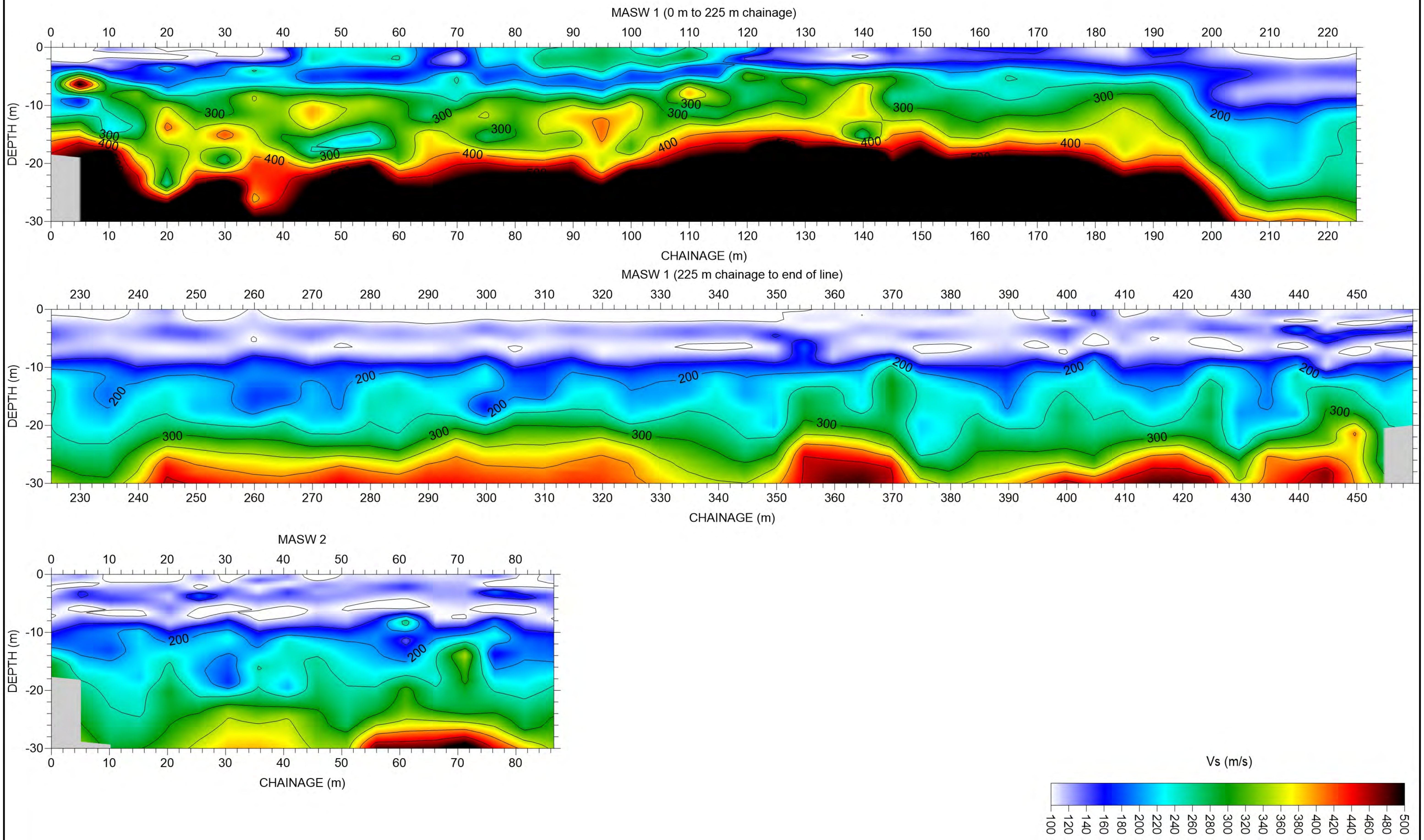

DRAWING- **Figure 2: MASW 1 and 2**

LOCATION- **2-4 Glovers Road, Christchurch**

NOTES MASW Vs profile has contour intervals of 50 m/s (Vs).

See site map for location of points.

A3

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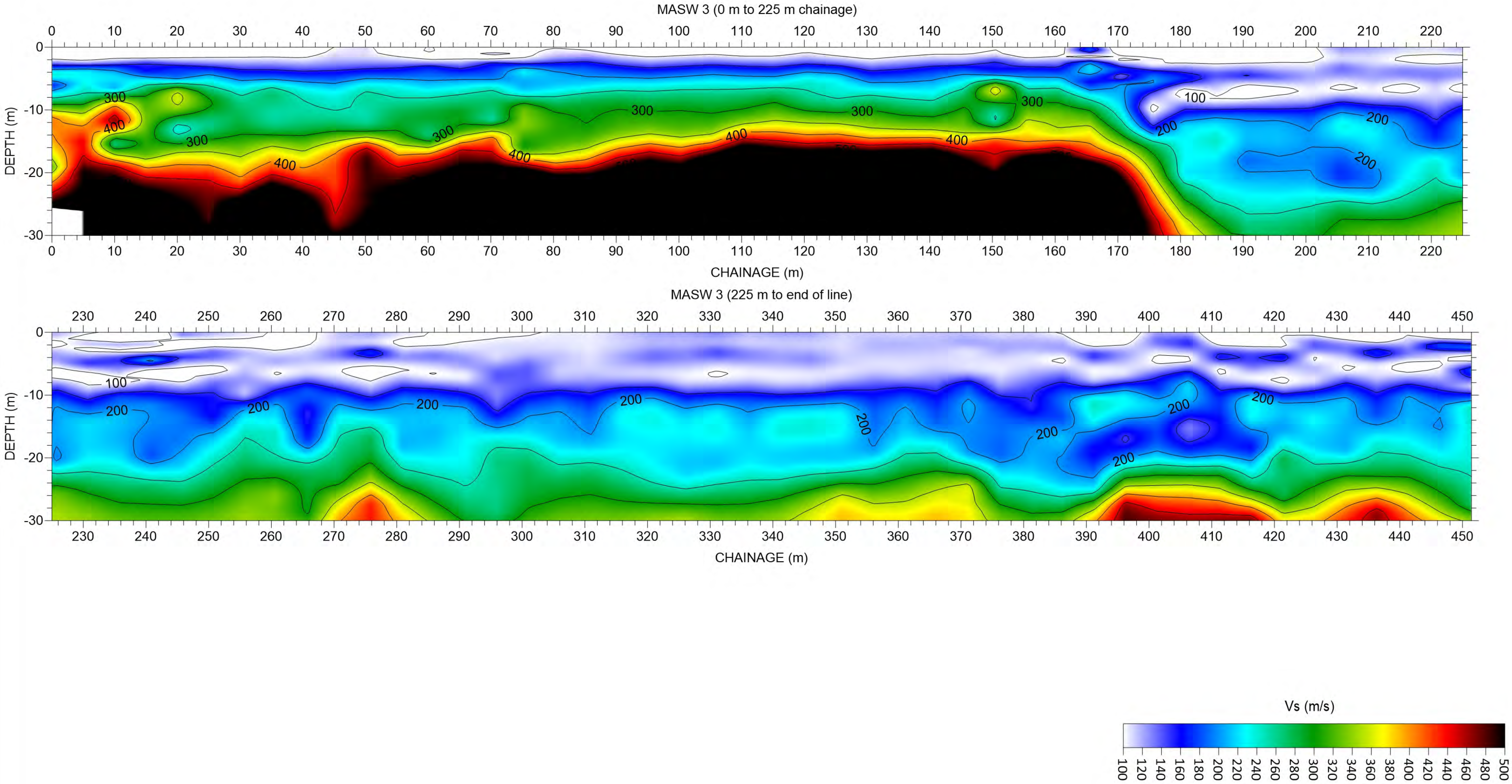

DRAWING- **Figure 3: MASW 3**

LOCATION- **2-4 Glover Street, Christchurch**

NOTES MASW Vs profile has contour intervals of 50 m/s (Vs).

See site map for location of points.

A3

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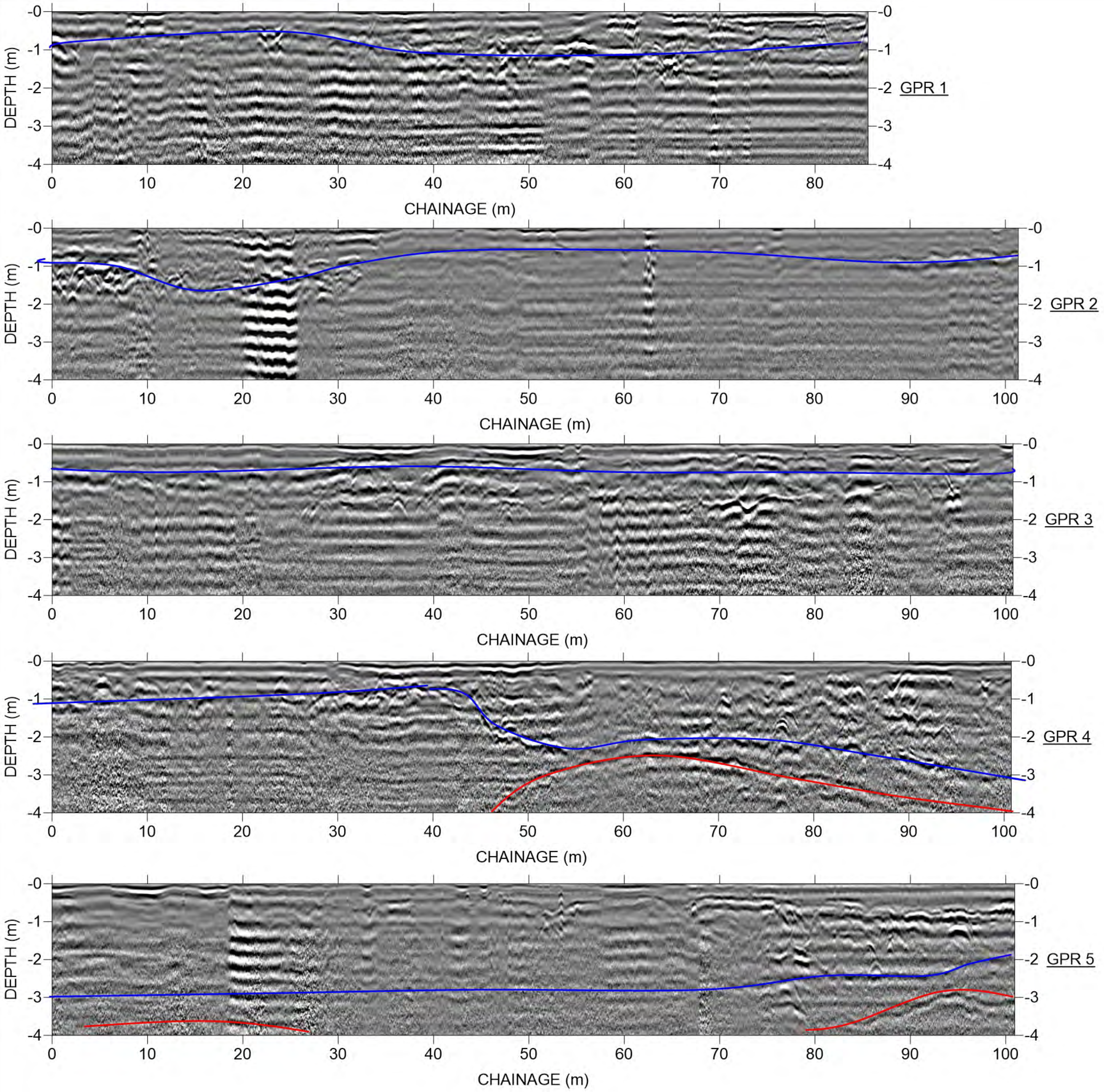

Some reflectors are annotated for reference. Note the profiles have been plotted with a 4:1 vertical exaggeration. See site map for line locations.

DRAWING- **Figure 4: GPR Radargrams 1 to 5**

LOCATION- **2-4 Glover Street, Christchurch**

NOTES

A3

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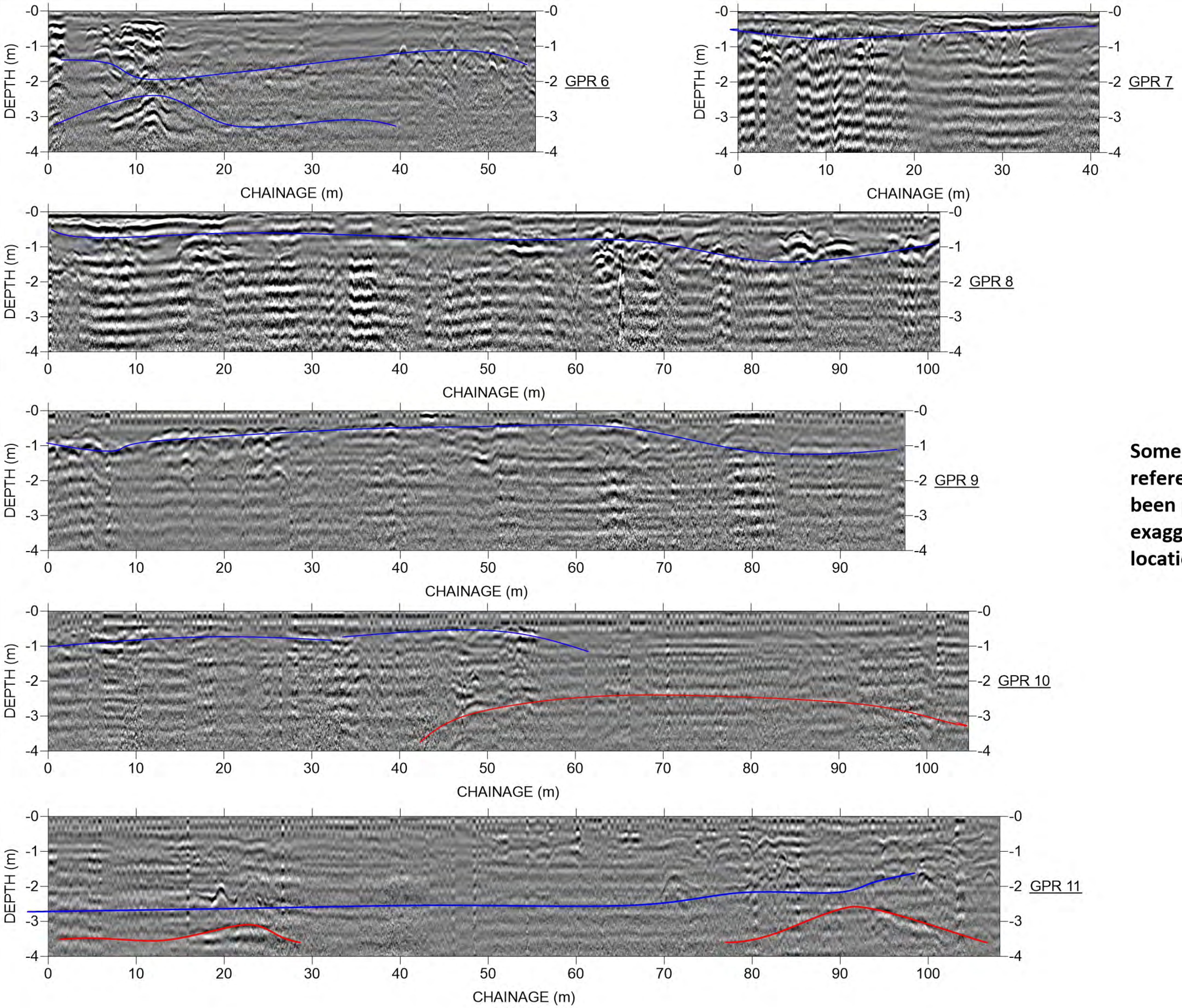


Some reflectors are annotated for reference. Note the profiles have been plotted with a 4:1 vertical exaggeration. See site map for line locations.

DRAWING- **Figure 5: GPR Radargrams 6 to 11**

LOCATION- **2-4 Glover Street, Christchurch**

NOTES

A3

Southern Geophysical Ltd

www.southerngeophysical.com

E. Geotechnical Cross Sections

miyamoto.

236 Hereford Street,
PO BOX 137 Cashel Street
Christchurch 8011

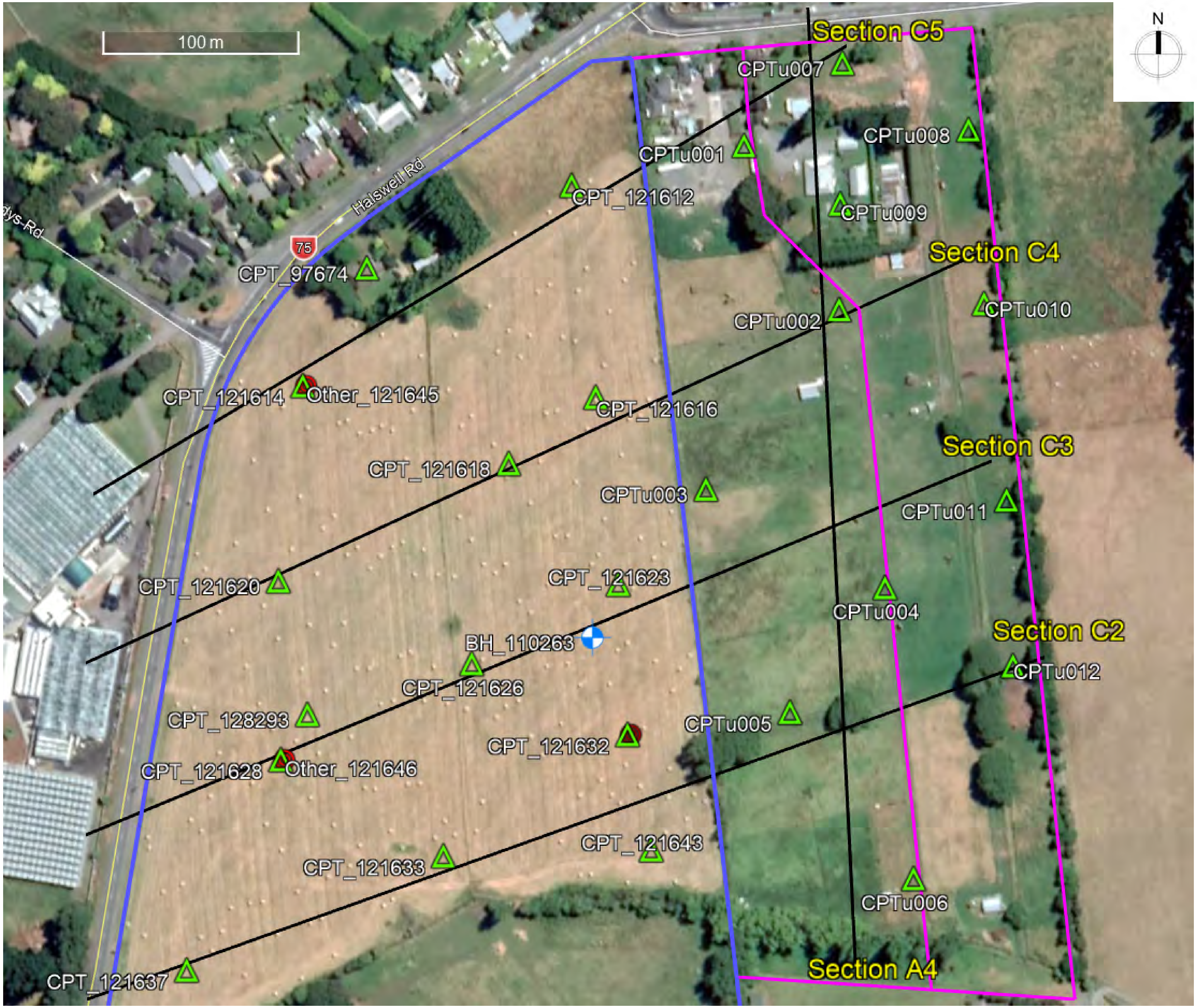
T: 64 03 377 4095
miyamoto.nz
projects@miyamoto.nz

PROJECT No: 200357
GEOTECHNICAL CROSS SECTIONS FOR 2&4 GLOVERS ROAD, HALSWELL, CHRISTCHURCH 8025

SHEET LIST

SHEET N°	SHEET NAME	REV.
S1	LOCATION PLAN	1
S2.1	GEOTECHNICAL CROSS-SECTION 1	1
S2.2	GEOTECHNICAL CROSS-SECTION 2	1
S2.3	GEOTECHNICAL CROSS-SECTION 3	1

ISSUE DATE: 19/10/20 REV: 1



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SITE SURVEY DRAWINGS FOR 2&4 GLOVERS ROAD, HALSWELL, CHRISTCHURCH 8025

REVISION HISTORY

REV	DATE	DESCRIPTION
1	19/10/20	FINAL

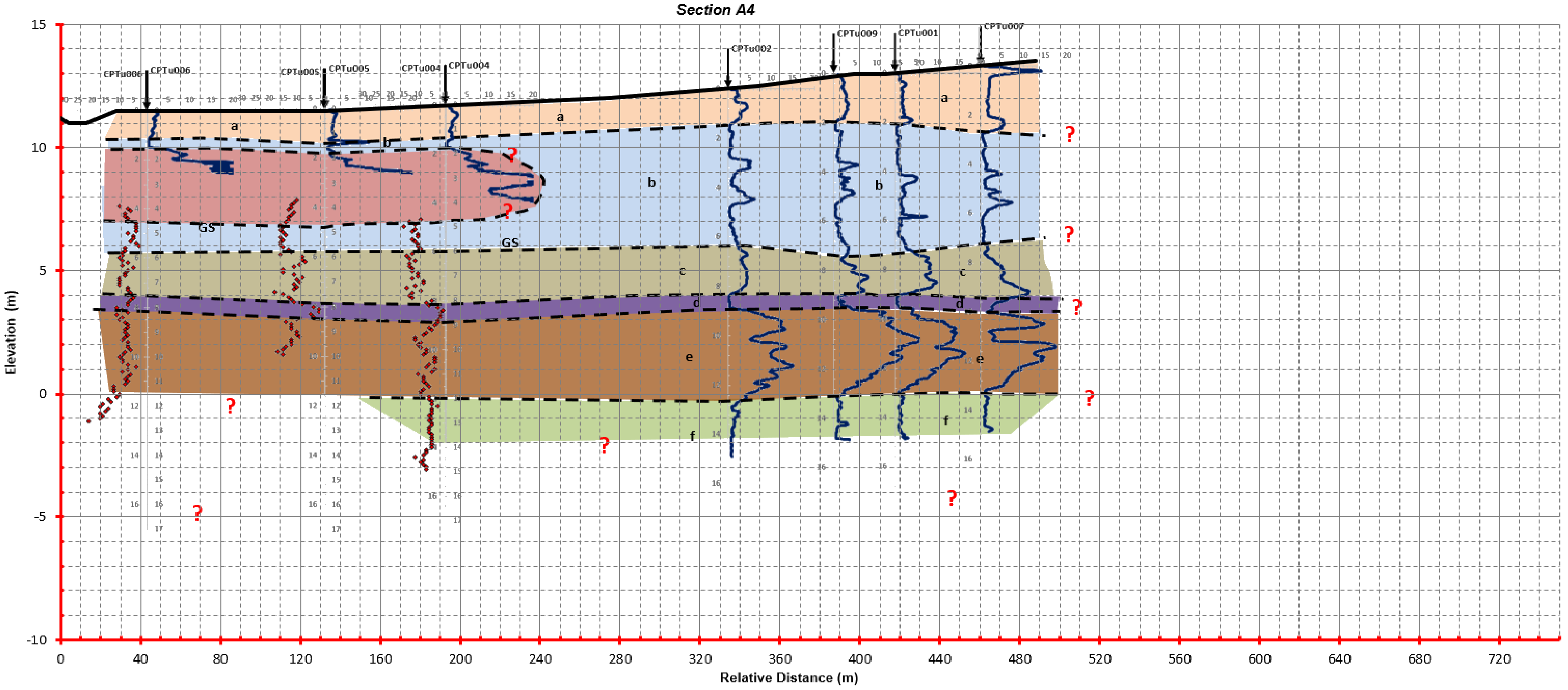
CLIENT: YOURSECTION LTD	
PROJECT No.:	200357
VERSION DATE:	16/10/2020
DRAWN:	CG
ENGINEER:	CG
APPROVED:	AG

SIZE: A3

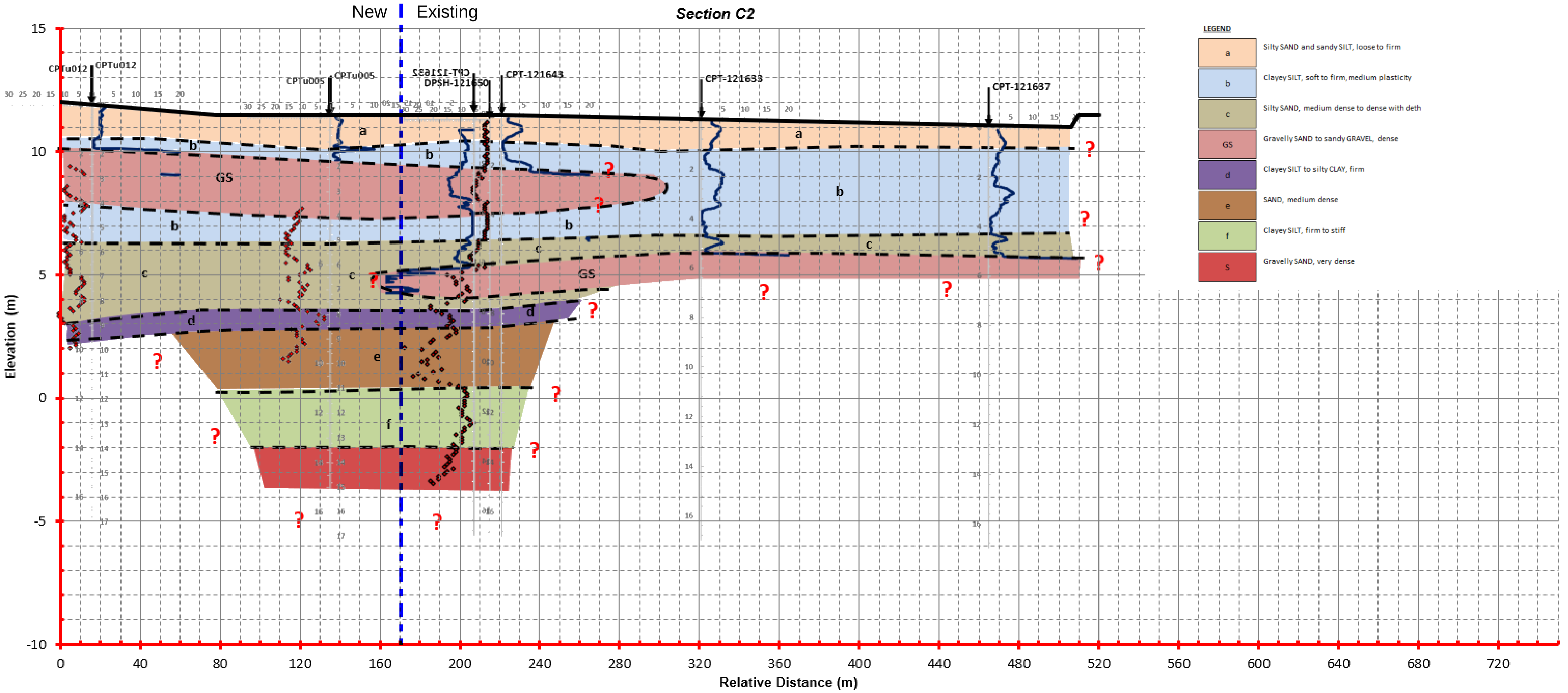
LOCATION PLAN

SHEET No.: S1 REV. 1

Section A4



Section C2



LEGEND

a	Silty SAND and sandy SILT, loose to firm
b	Clayey SILT, soft to firm, medium plasticity
c	Silty SAND, medium dense to dense with deth
GS	Gravelly SAND to sandy GRAVEL, dense
d	Clayey SILT to silty CLAY, firm
e	SAND, medium dense
f	Clayey SILT, firm to stiff
S	Gravelly SAND, very dense

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SITE SURVEY DRAWINGS FOR
2&4 GLOVERS ROAD,
HALSWELL,
CHRISTCHURCH 8025

REVISION HISTORY

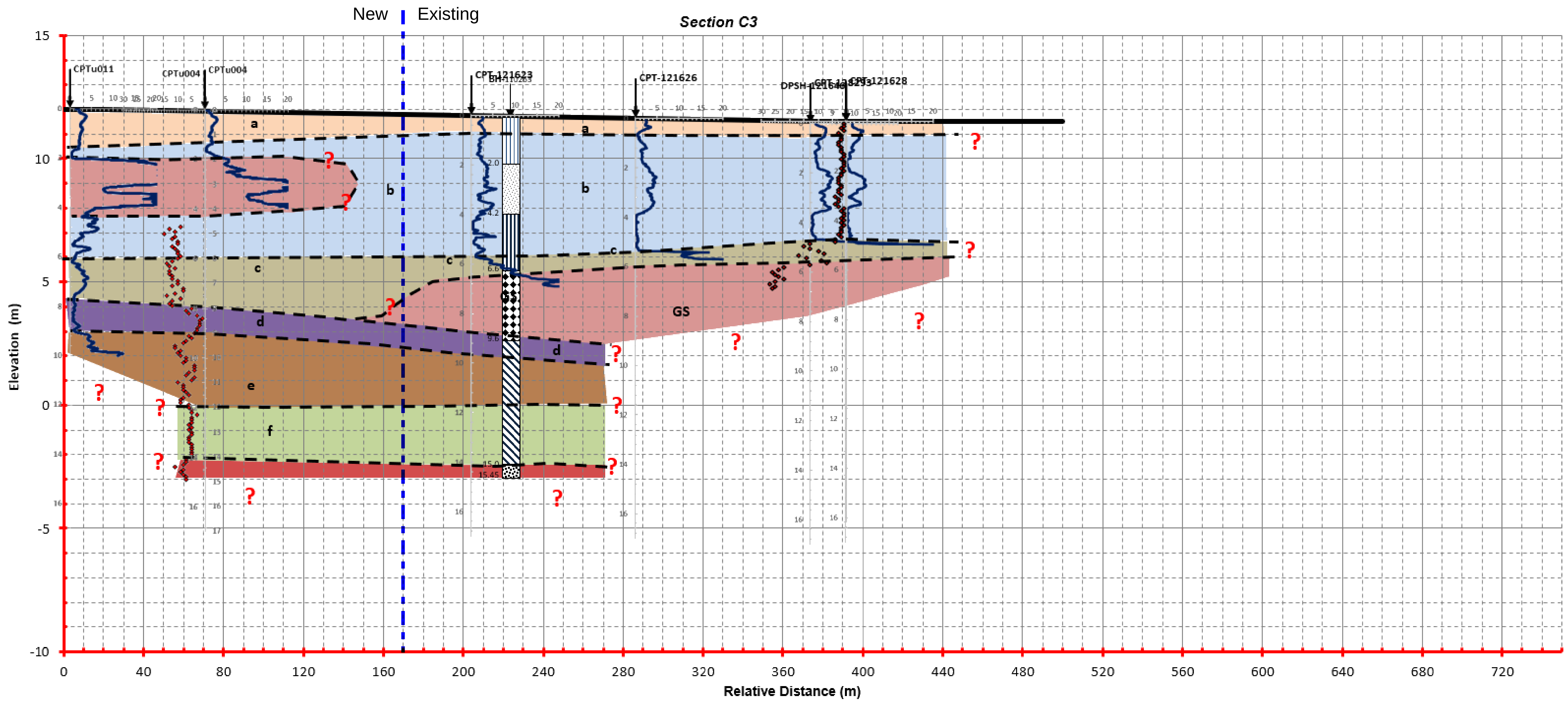
REV	DATE	DESCRIPTION
1	19/10/20	FINAL

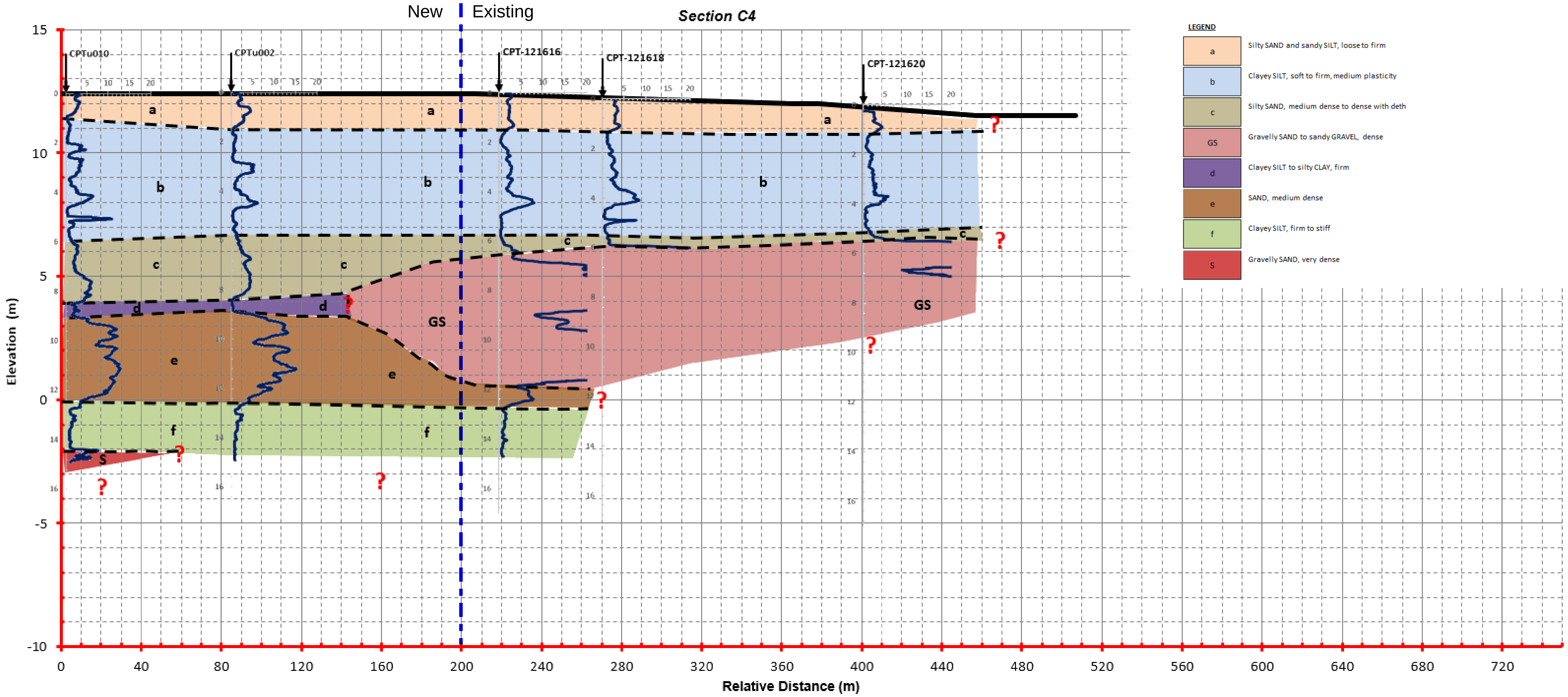
CLIENT:	YOURSECTION LTD
PROJECT No.:	200357
VERSION DATE:	16/10/2020
DRAWN:	CG
ENGINEER:	CG
APPROVED:	AG

SIZE: A3

GROUND MODEL
SHEET 1

SHEET No.: S2.1 REV. 1





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SITE SURVEY DRAWINGS FOR 2&4 GLOVERS ROAD, HALSWELL, CHRISTCHURCH 8025

REVISION HISTORY

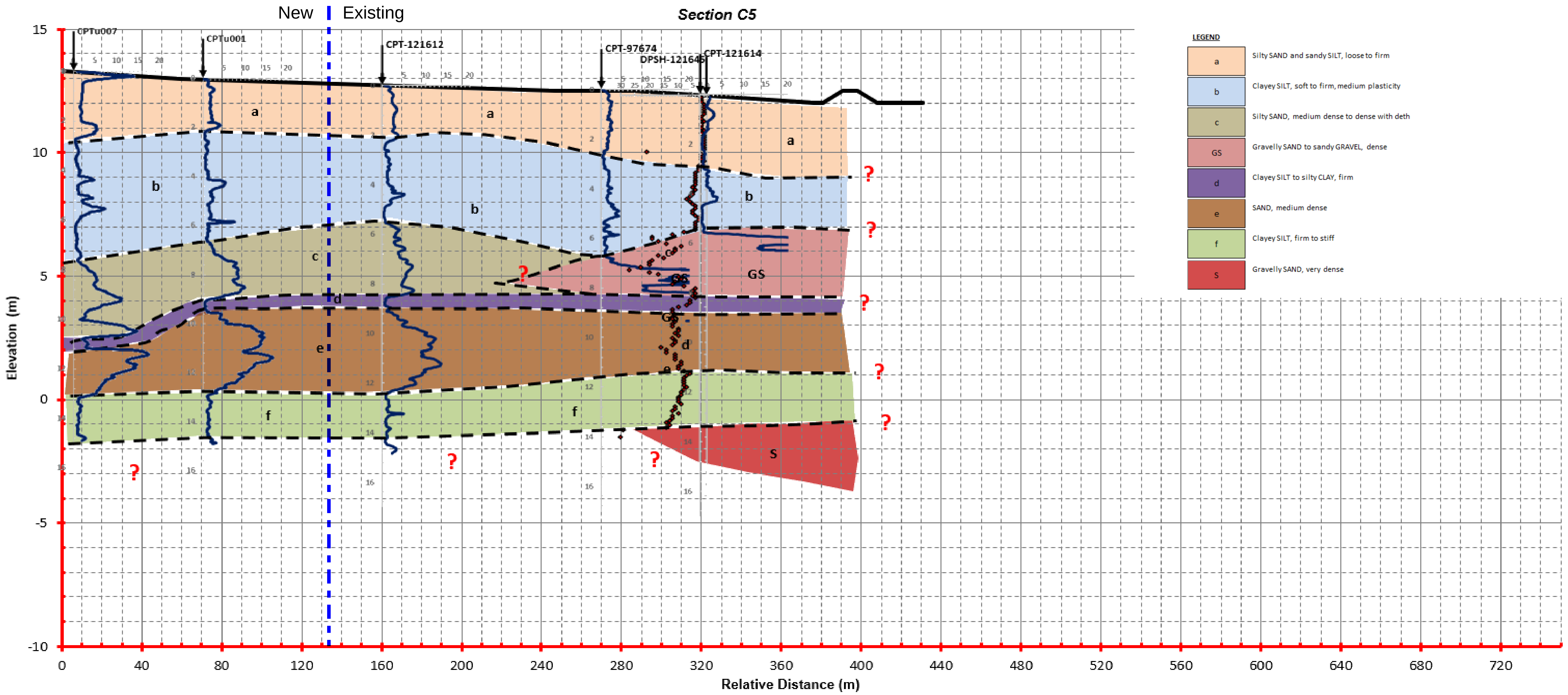
REV	DATE	DESCRIPTION
1	19/10/20	FINAL

CLIENT: YOURSECTION LTD
PROJECT No.: 200357
VERSION DATE: 16/10/2020
DRAWN: CG
ENGINEER: CG
APPROVED: AG

SIZE: A3

GROUND MODEL SHEET 2

SHEET No.: S2.2 REV. 1



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SITE SURVEY DRAWINGS FOR 2&4 GLOVERS ROAD, HALSWELL, CHRISTCHURCH 8025

REVISION HISTORY

REV	DATE	DESCRIPTION
1	19/10/20	FINAL

CLIENT: YOURSECTION LTD
PROJECT No.: 200357
VERSION DATE: 16/10/2020
DRAWN: CG
ENGINEER: CG
APPROVED: AG

SIZE: A3

GROUND MODEL SHEET 3

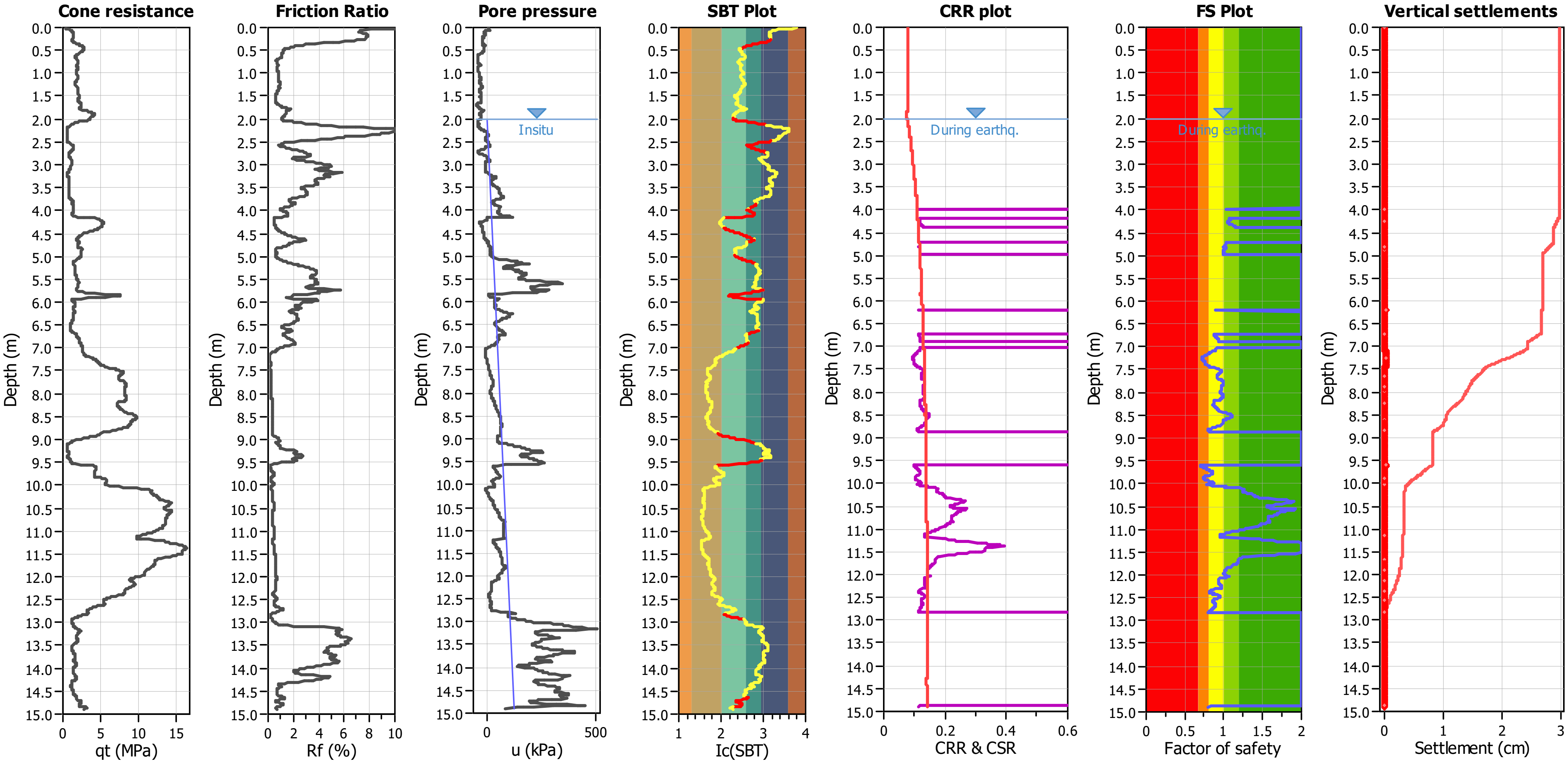
SHEET No.: S2.3 REV. 1

F. Liquefaction Analyses

Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu001 SLS
Total depth: 14.89 m

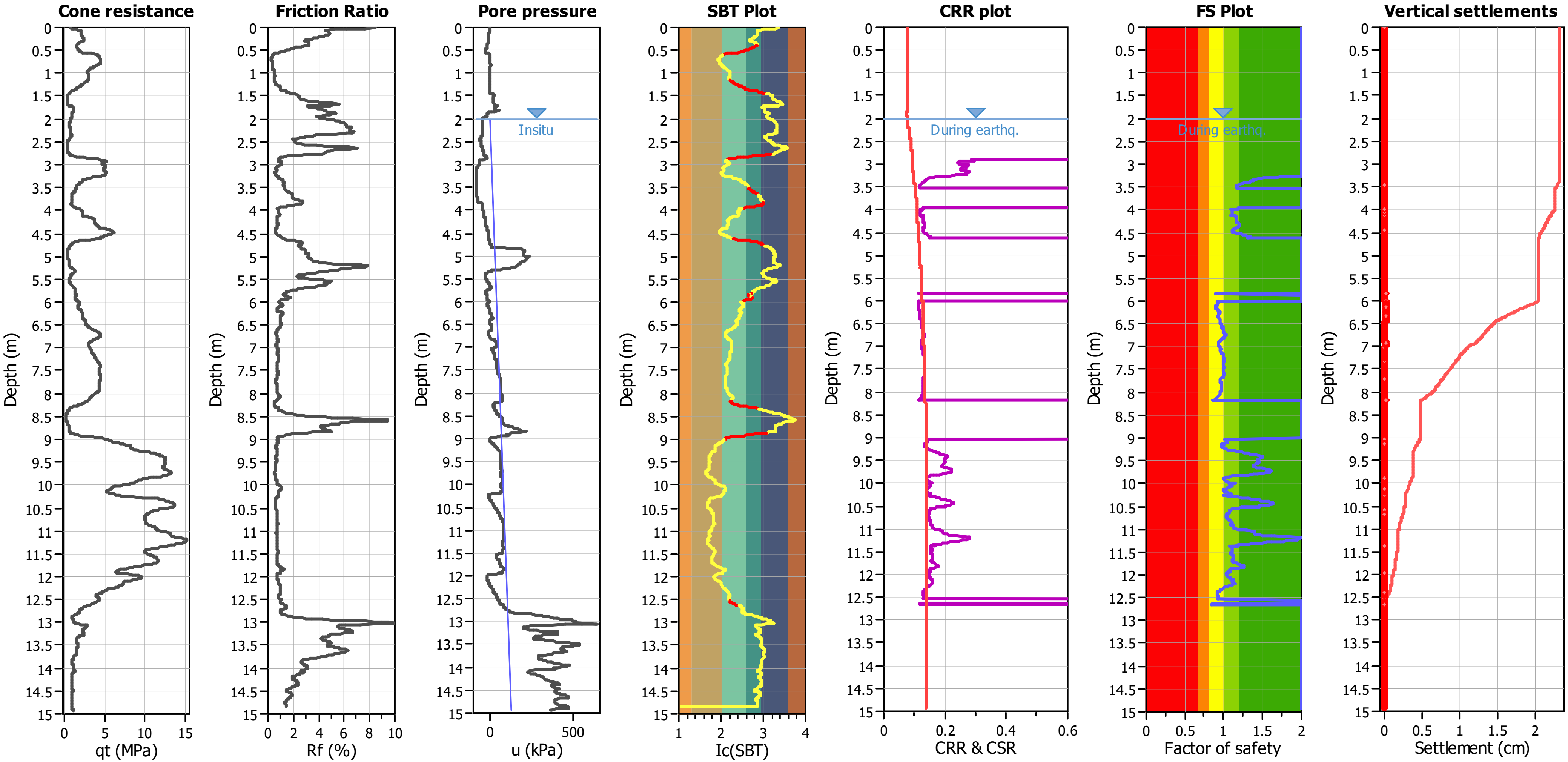


Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu002 SLS
Total depth: 14.93 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.13

G.W.T. (in-situ): 2.00 m
G.W.T. (earthq.): 2.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

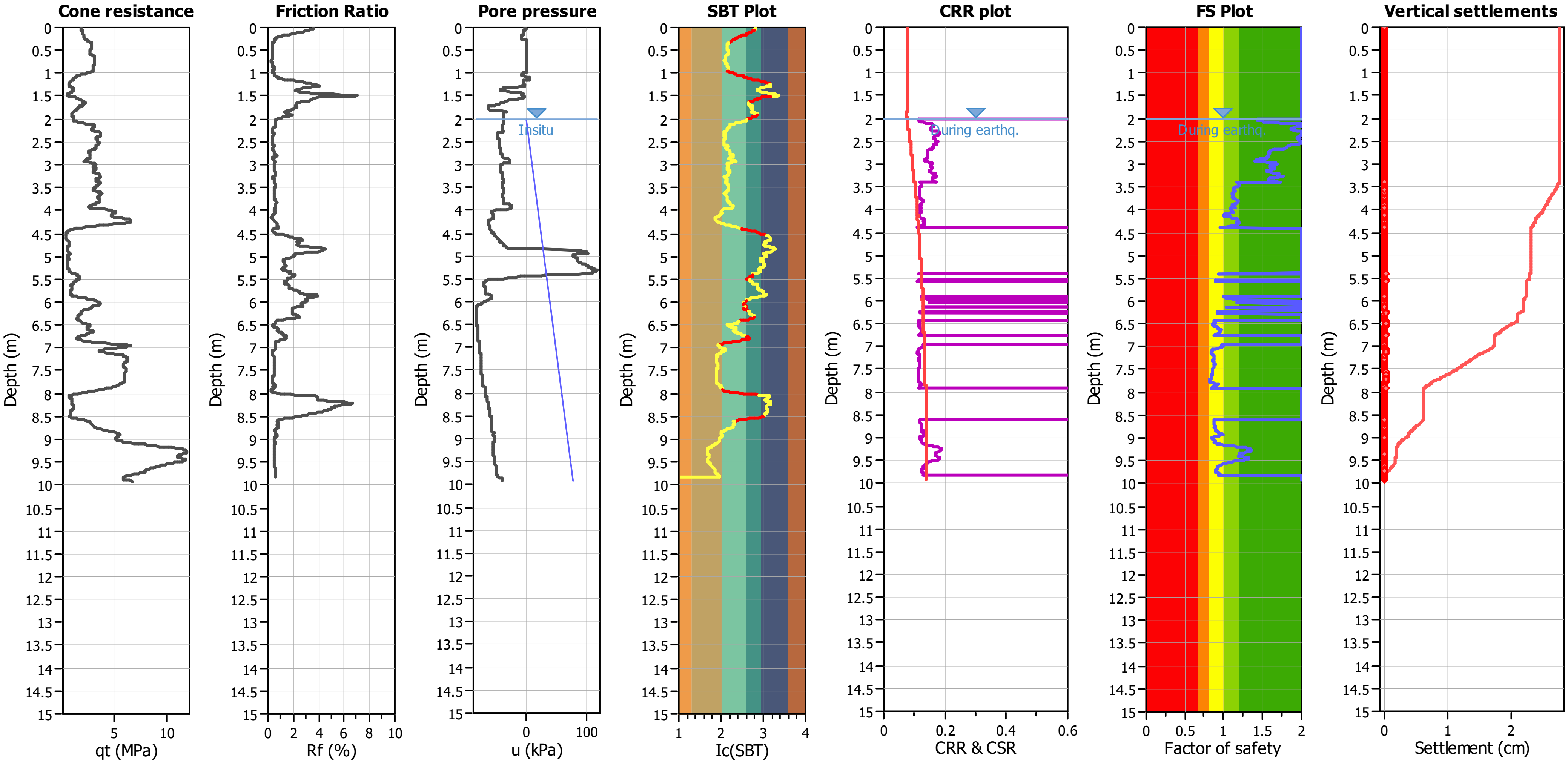
Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu003 SLS
Total depth: 9.91 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.13

G.W.T. (in-situ): 2.00 m
G.W.T. (earthq.): 2.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: No
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

Miyamoto International NZ Ltd
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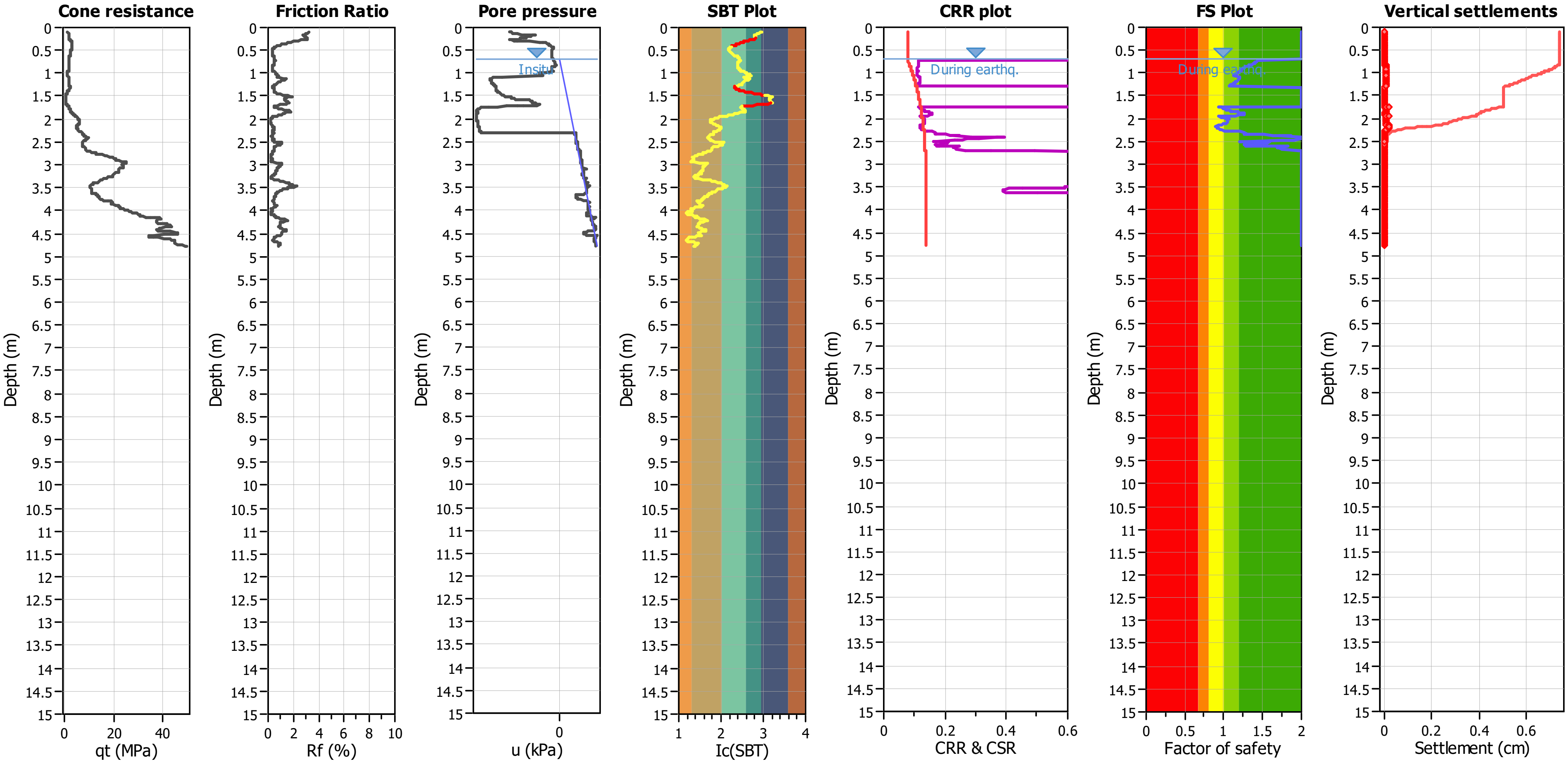
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu004 SLS

Total depth: 4.78 m

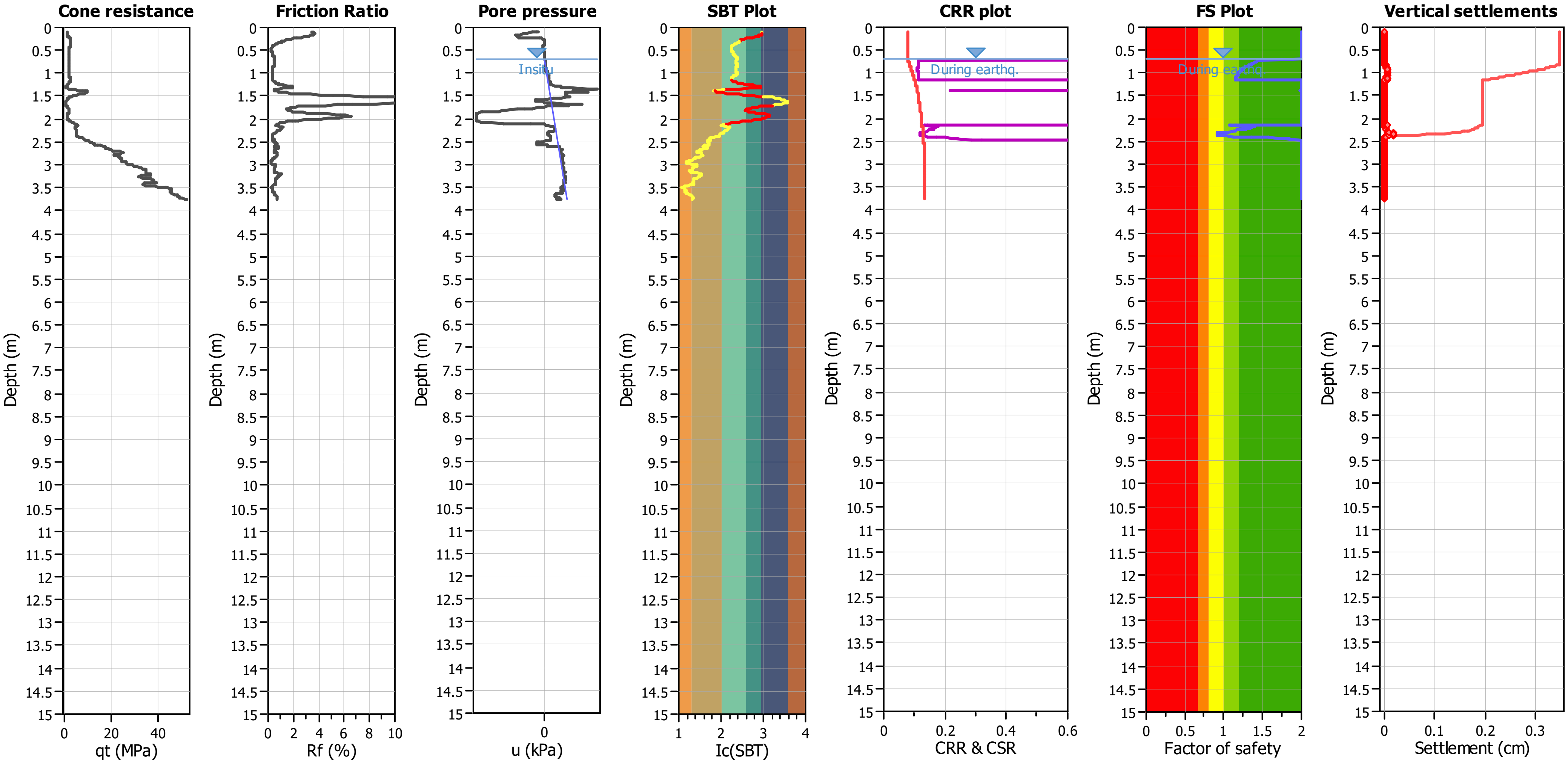


Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu005 SLS
Total depth: 3.76 m

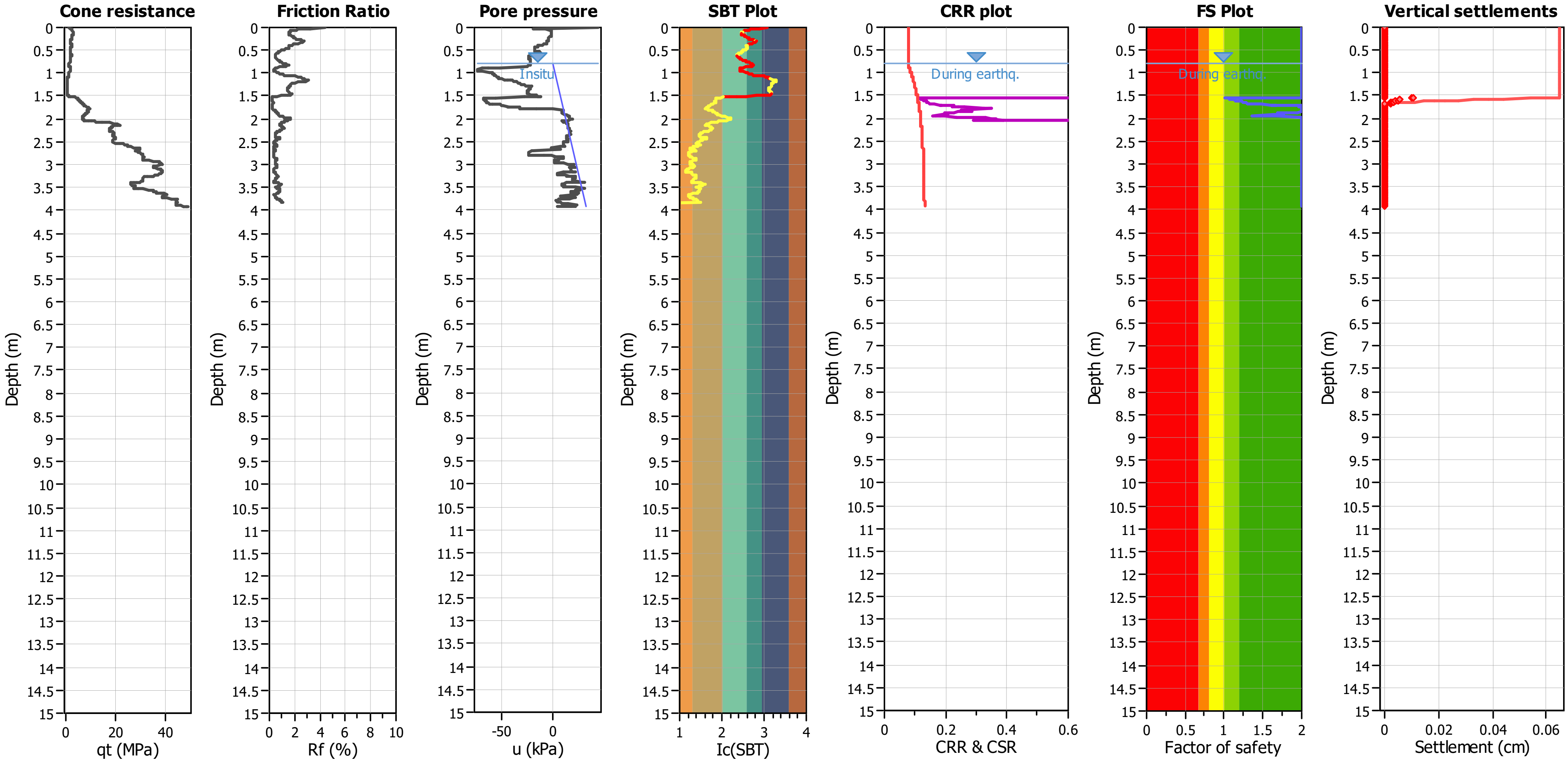


Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Miyamoto International NZ Ltd
Level 1, 236 Hereford Street
Christchurch Central, Christchurch
http://www.miyamoto.nz

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu006 SLS
Total depth: 3.93 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.13

G.W.T. (in-situ): 0.80 m
G.W.T. (earthq.): 0.80 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: Yes
Limit depth applied: Yes
Limit depth: 10.00 m
MSF method: Method based

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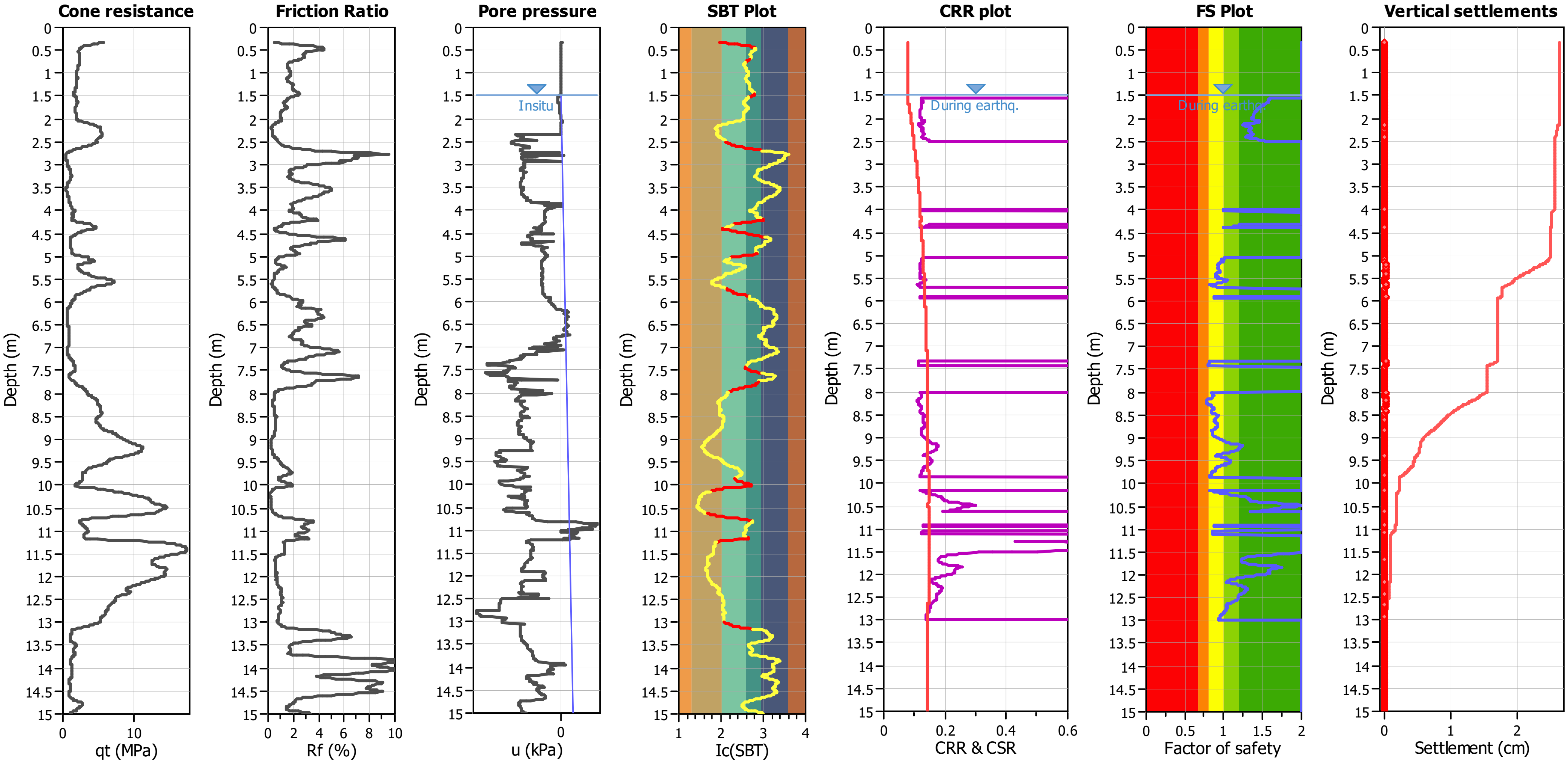
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

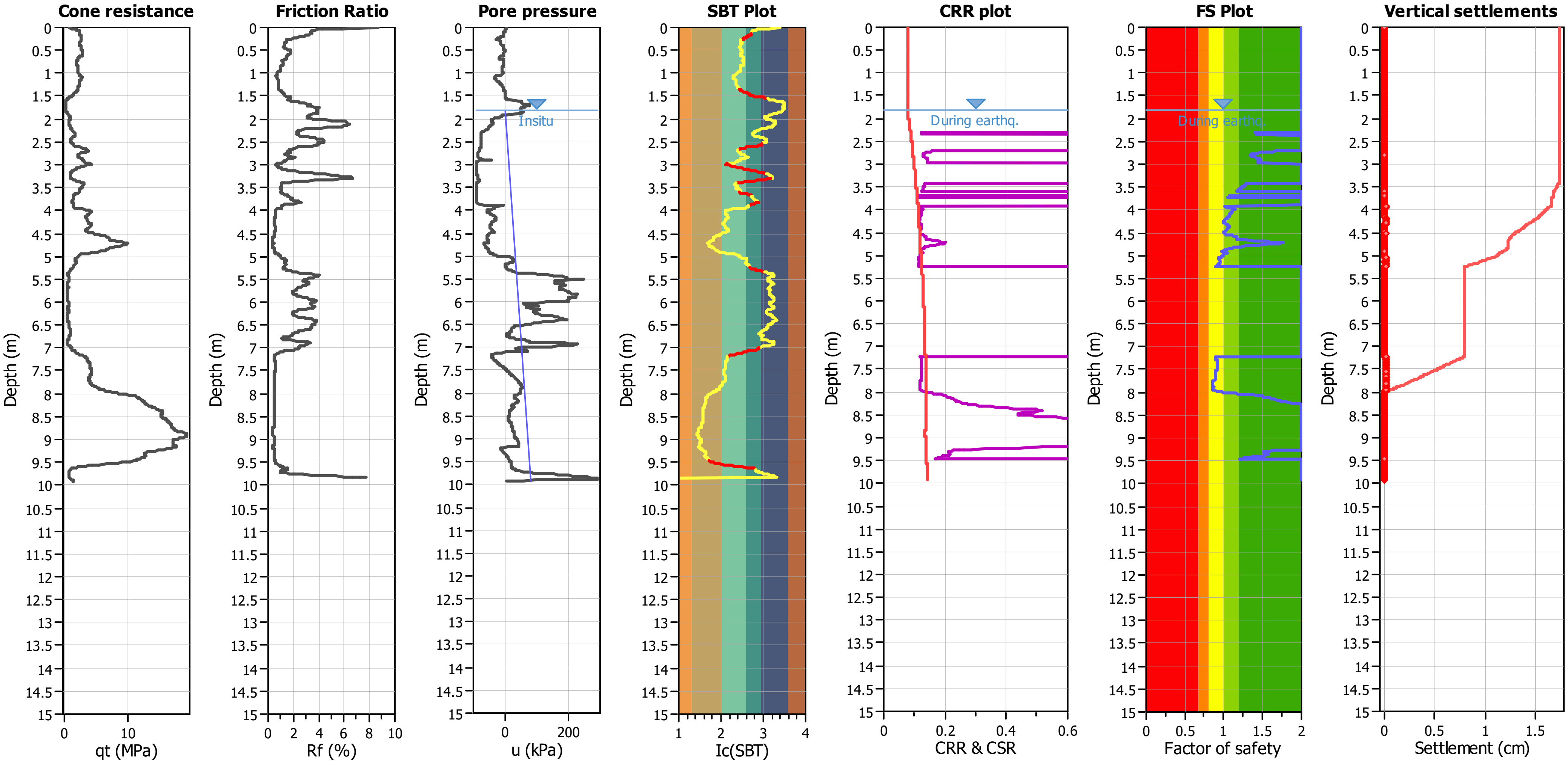
CPT: CPTu007 SLS
Total depth: 15.00 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No		
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Clay like behavior applied:	.
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

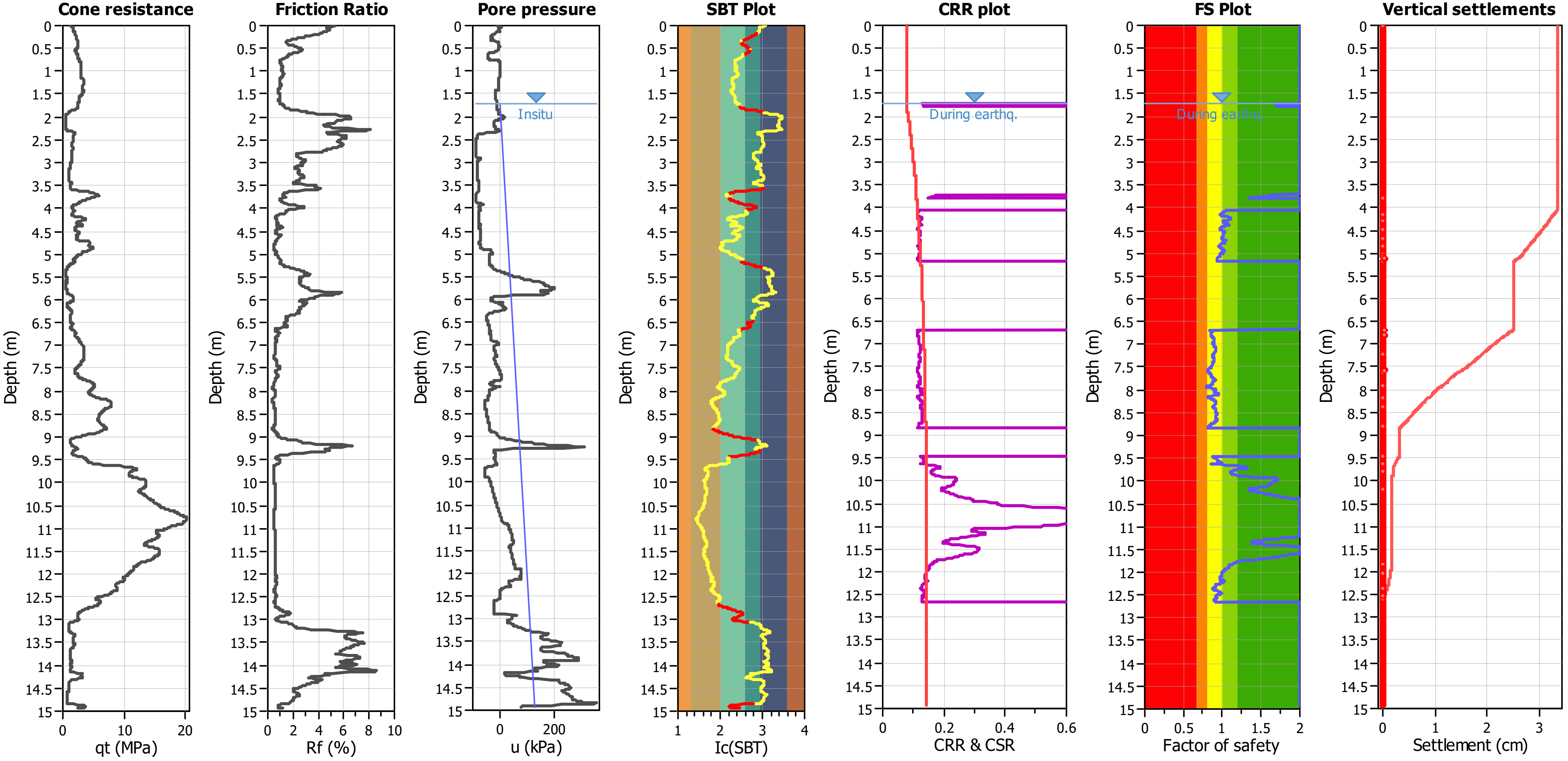
CPT: CPTu008 SLS
Total depth: 9.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	. Yes
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.80 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu009 SLS
Total depth: 14.95 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.13

G.W.T. (in-situ): 1.70 m
G.W.T. (earthq.): 1.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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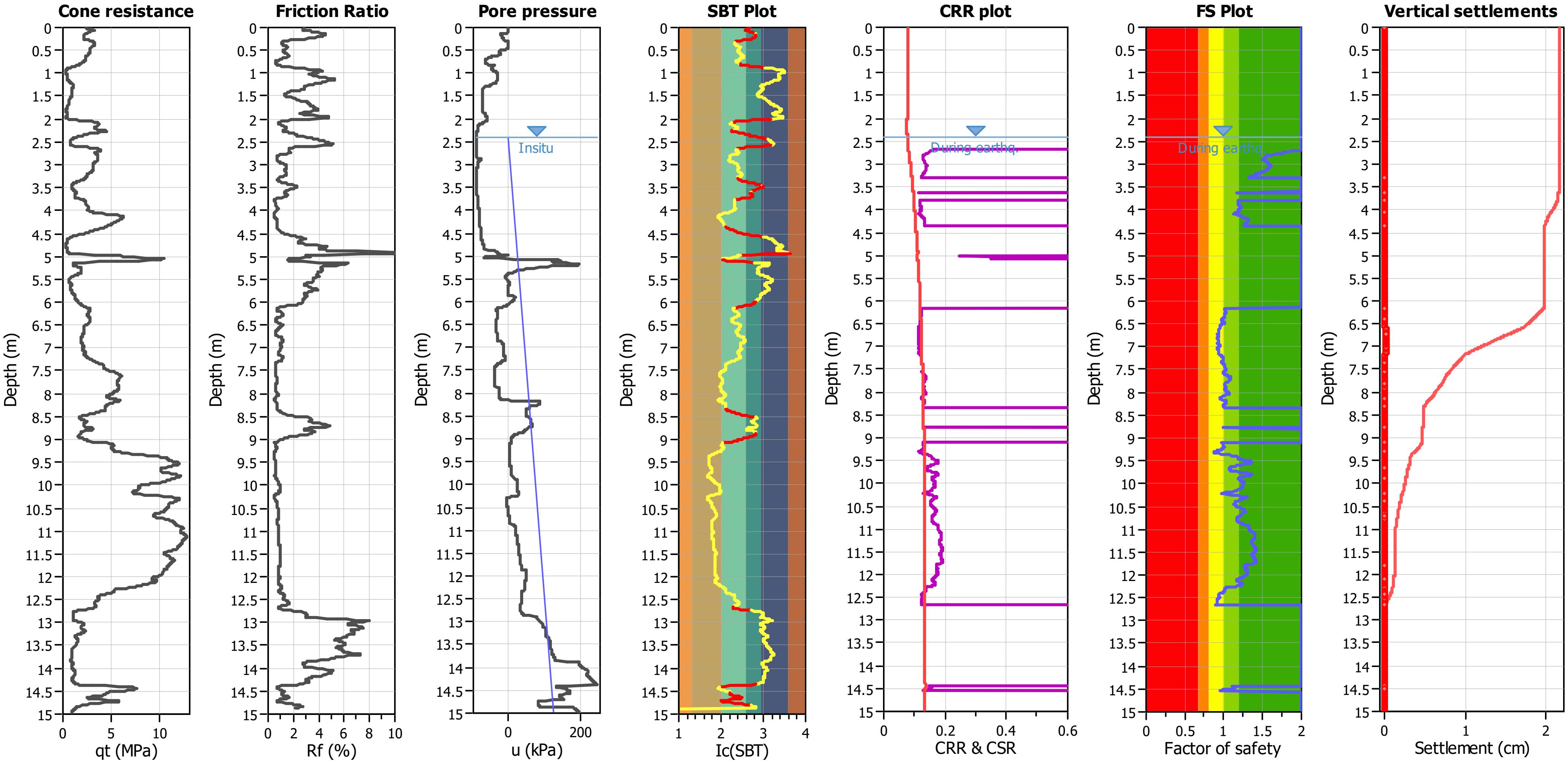
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu010 SLS
Total depth: 14.97 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.13

G.W.T. (in-situ): 2.40 m
G.W.T. (earthq.): 2.40 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: No
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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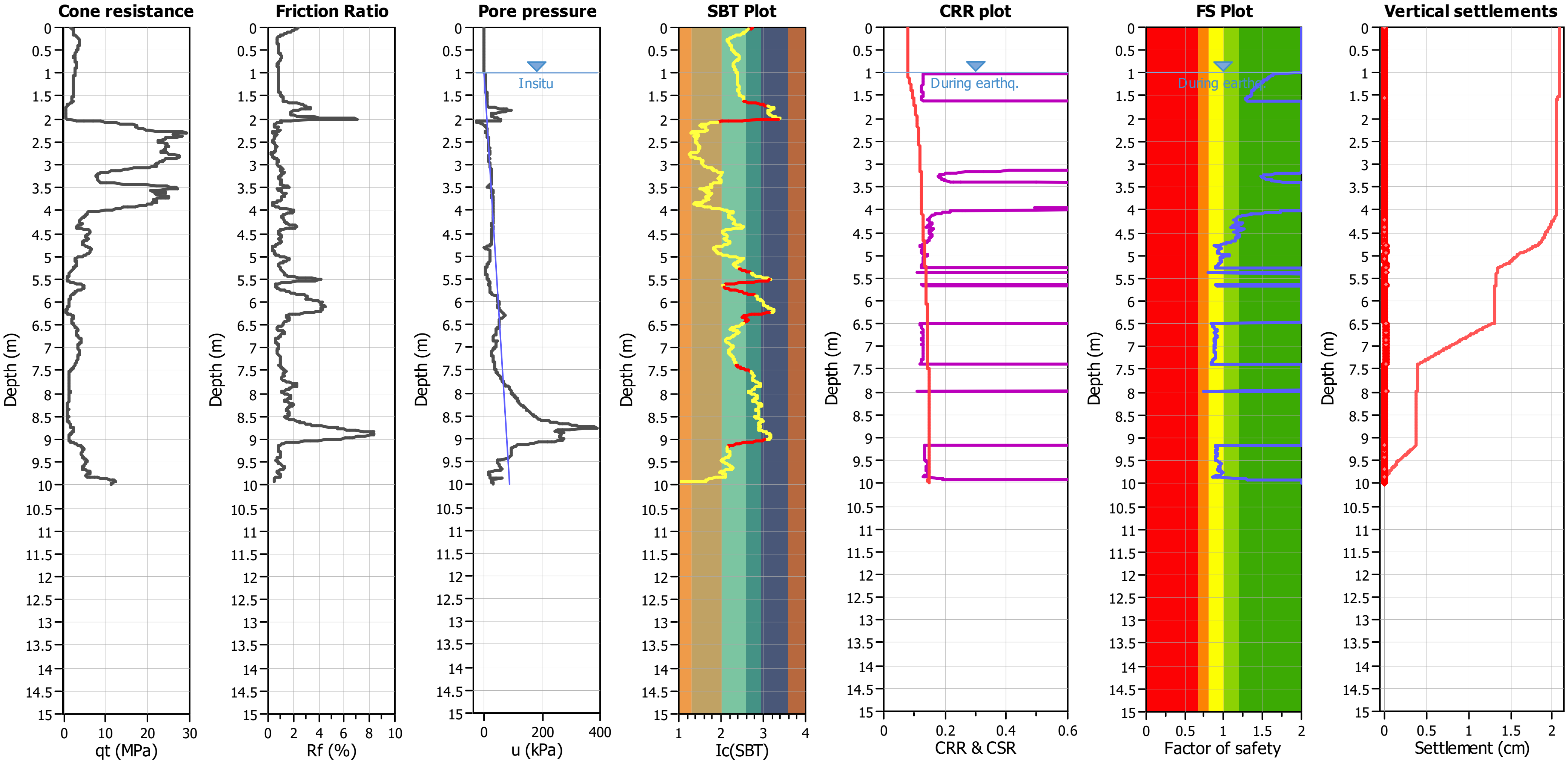
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

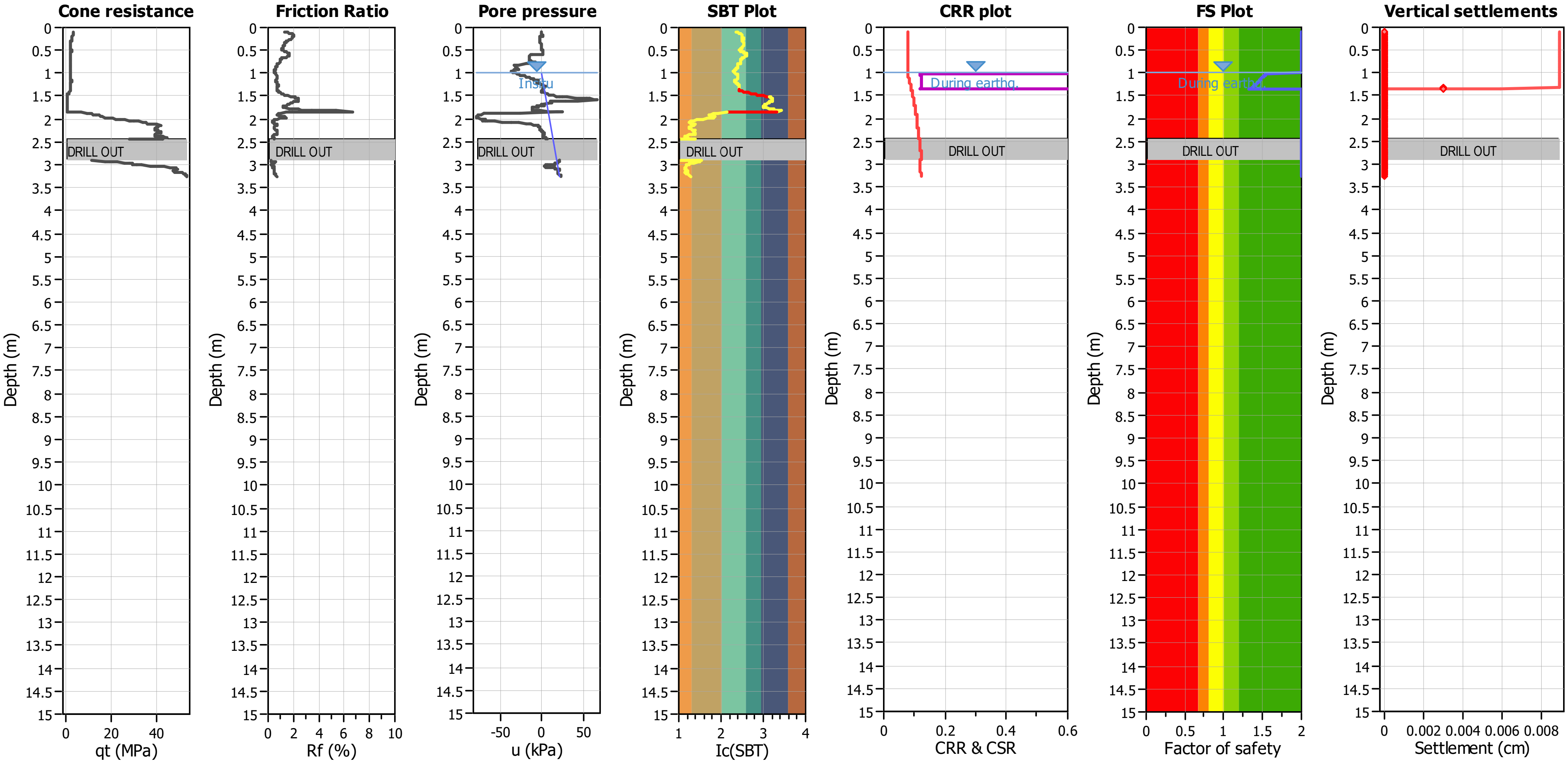
CPT: CPTu011 SLS
Total depth: 9.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

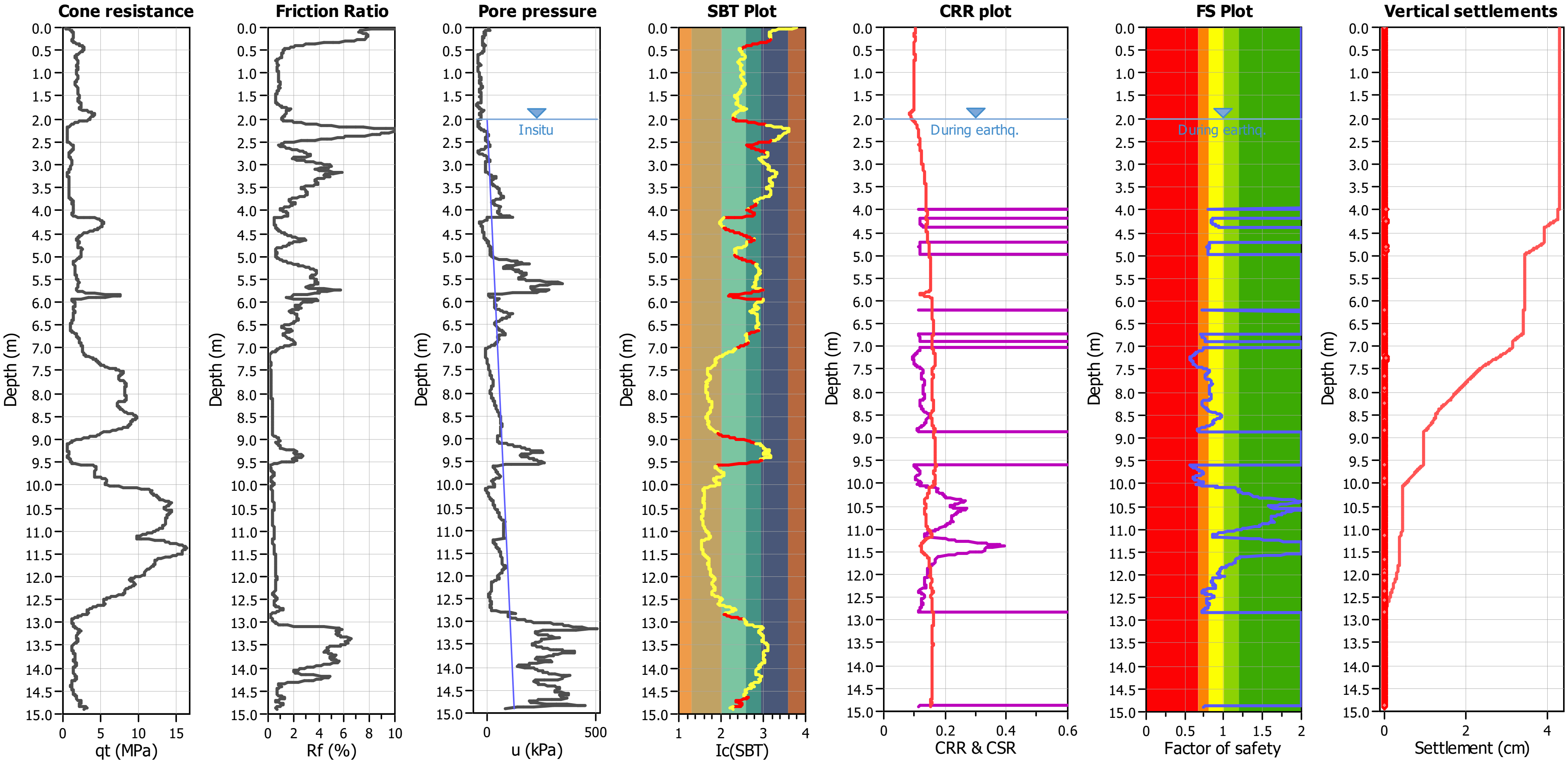
CPT: CPTu012 SLS
Total depth: 3.25 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu001 SLS2
Total depth: 14.89 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.00
Peak ground acceleration: 0.19

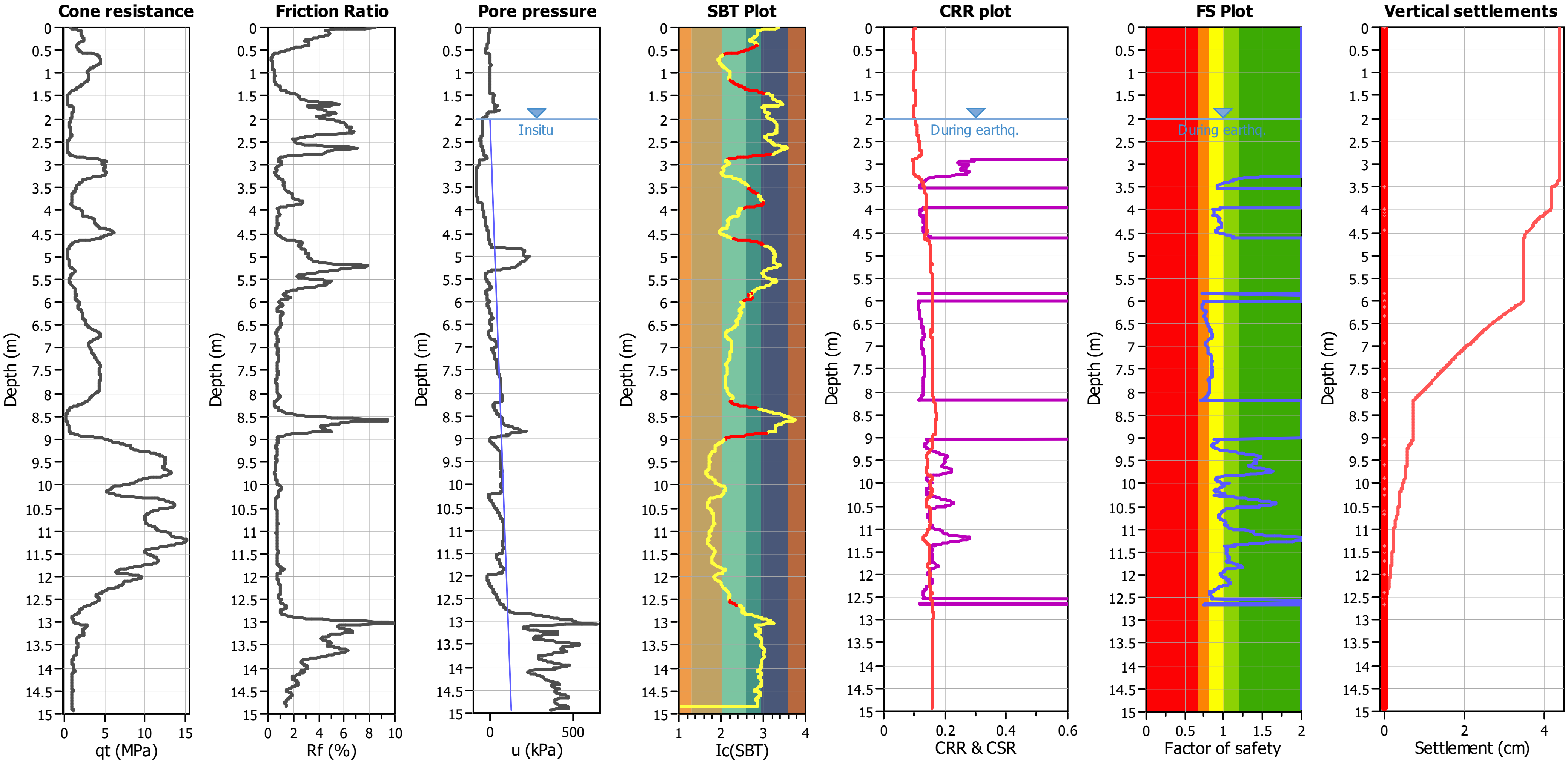
G.W.T. (in-situ): 2.00 m
G.W.T. (earthq.): 2.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

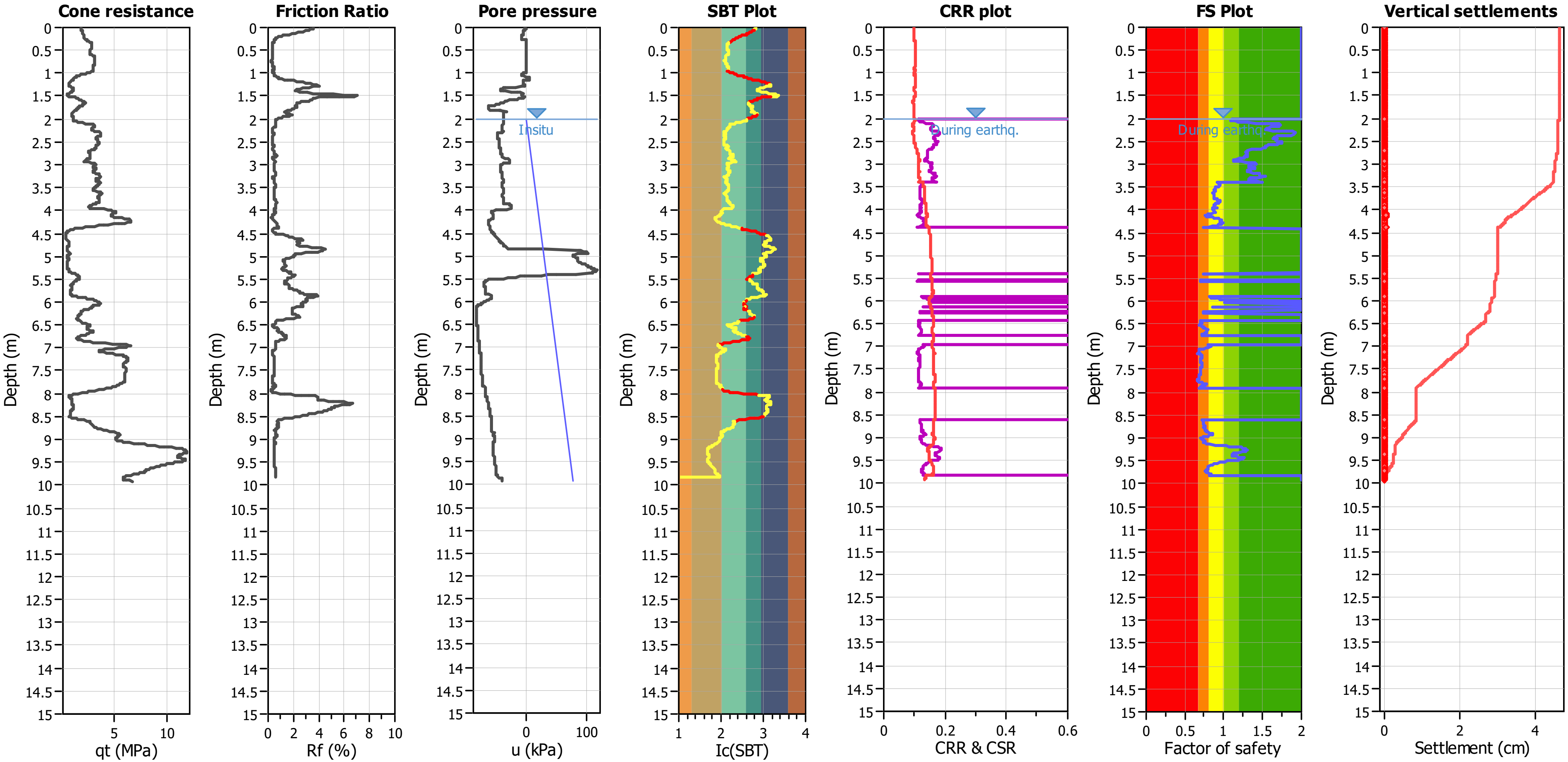
CPT: CPTu002 SLS2
Total depth: 14.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

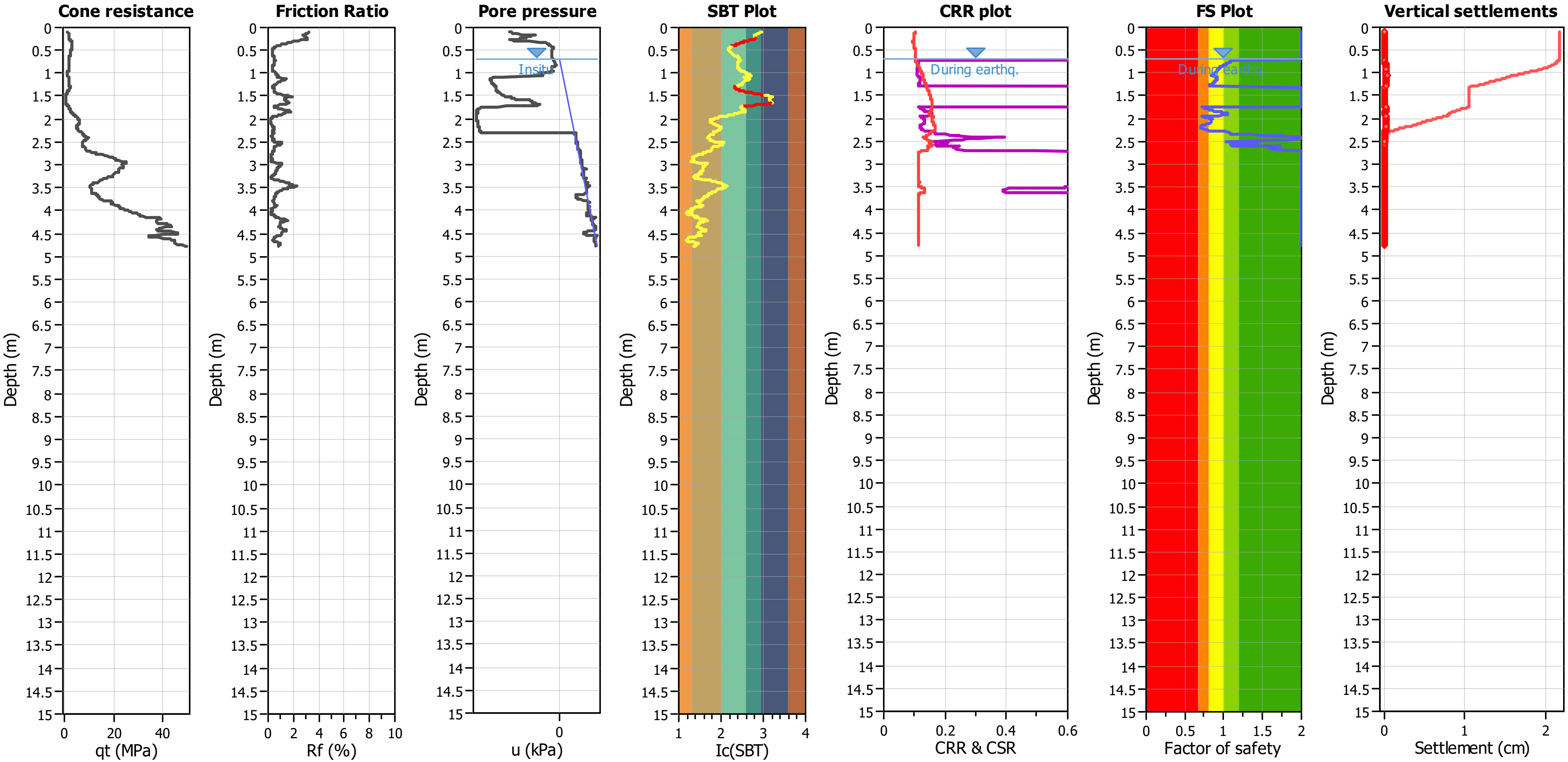
CPT: CPTu003 SLS2
Total depth: 9.91 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

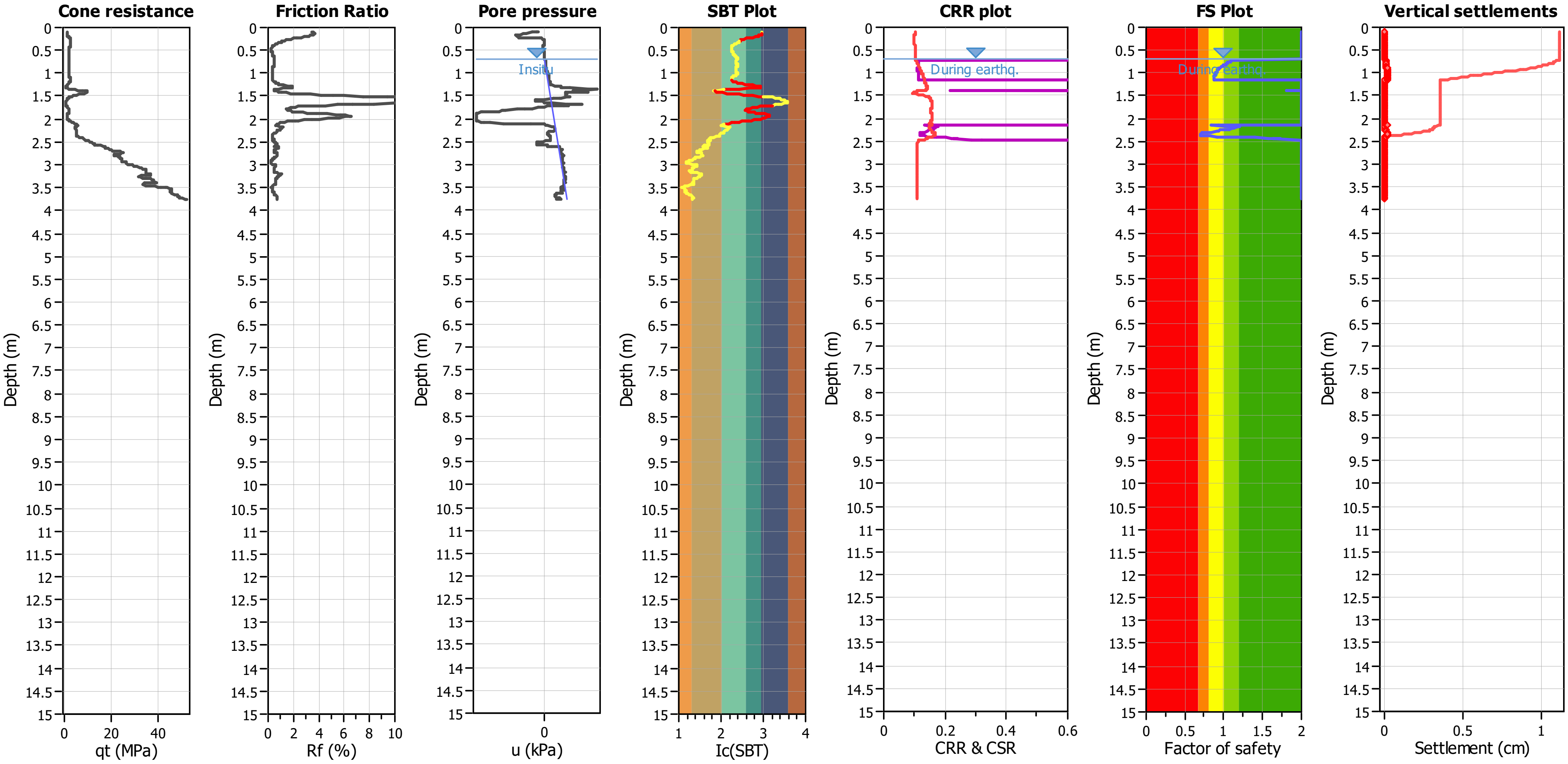
CPT: CPTu004 SLS2
Total depth: 4.78 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

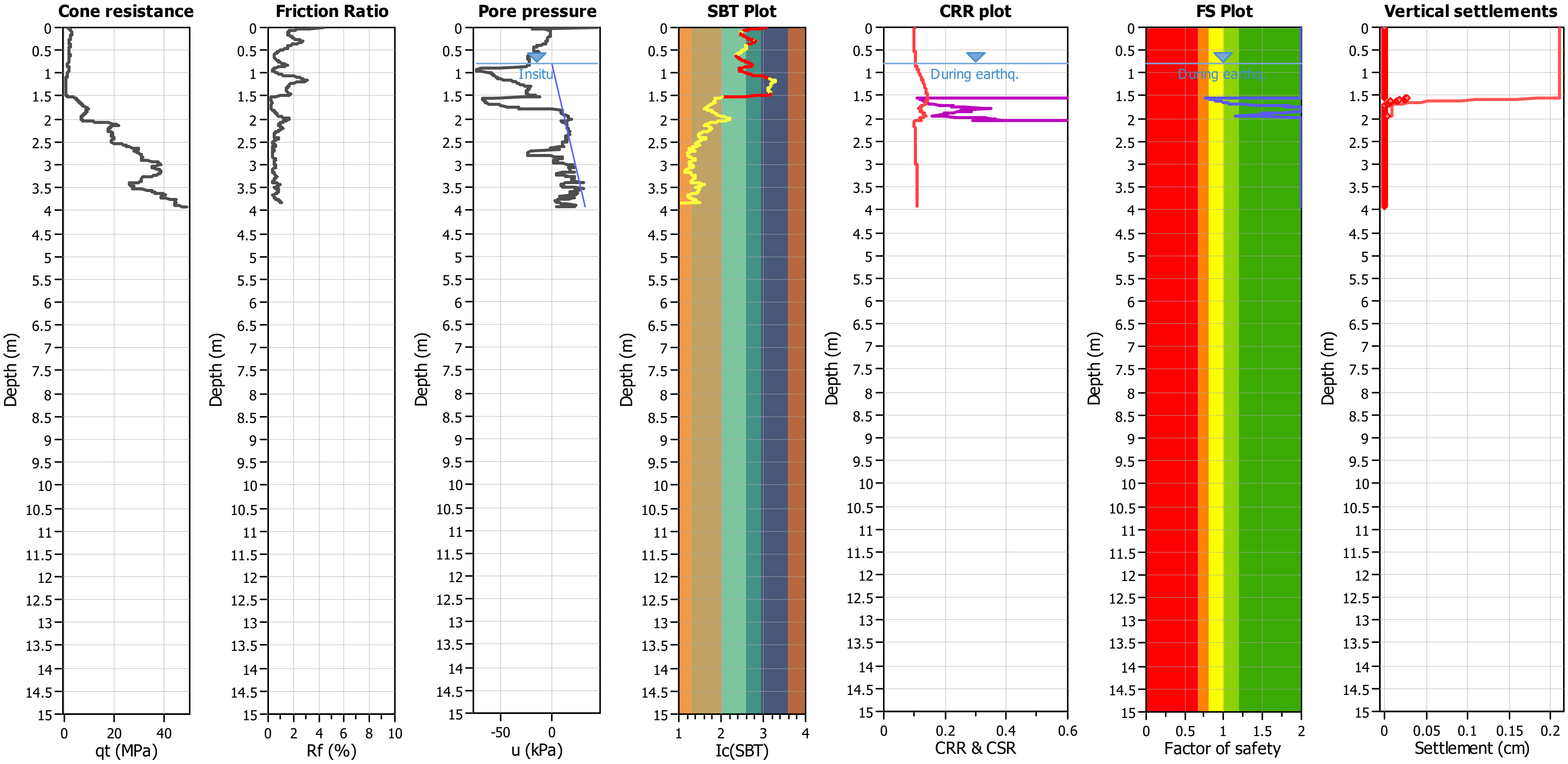
CPT: CPTu005 SLS2
Total depth: 3.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

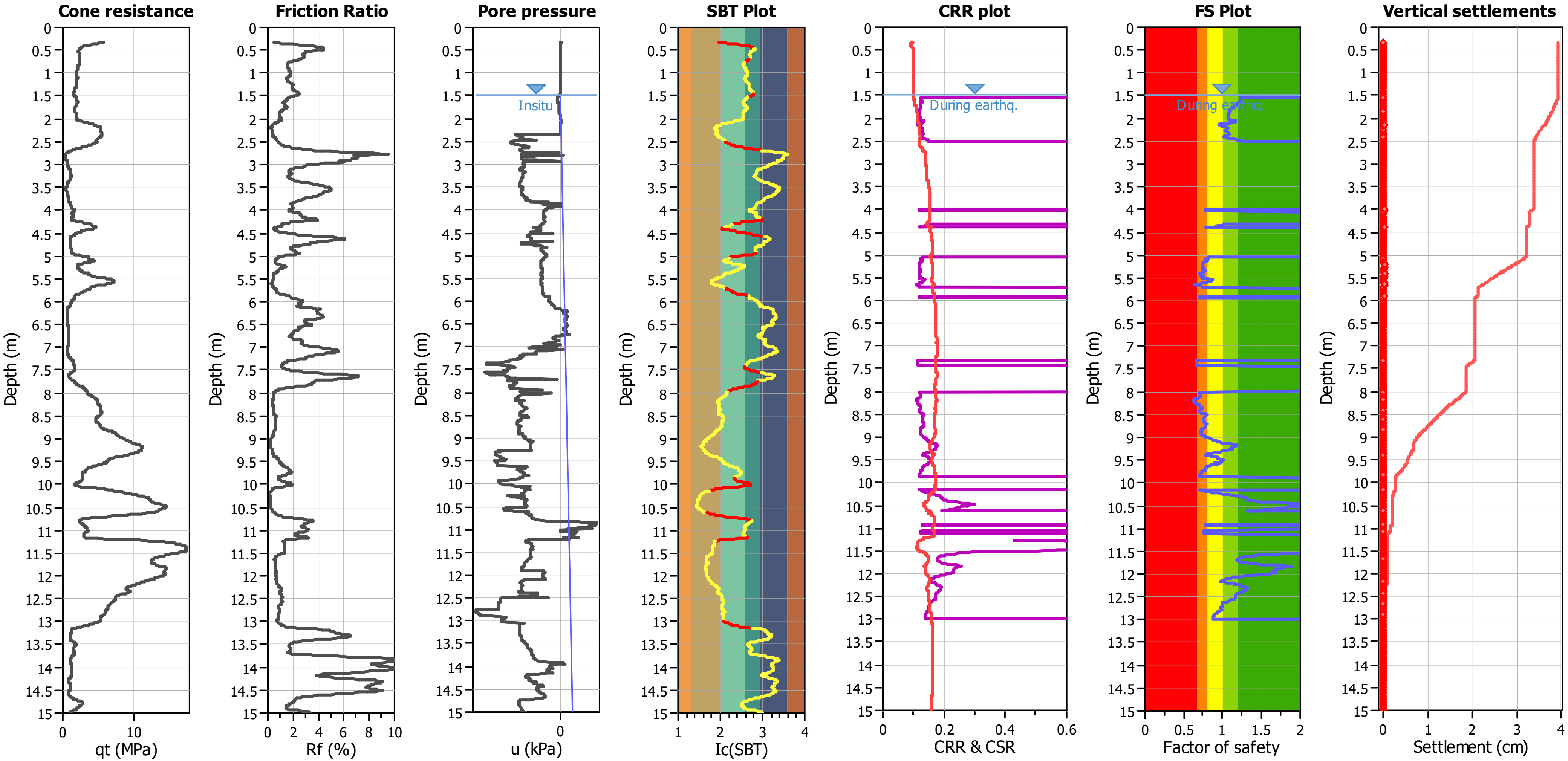
CPT: CPTu006 SLS2
Total depth: 3.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.80 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu007 SLS2
Total depth: 15.00 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.00
Peak ground acceleration: 0.19

G.W.T. (in-situ): 1.50 m
G.W.T. (earthq.): 1.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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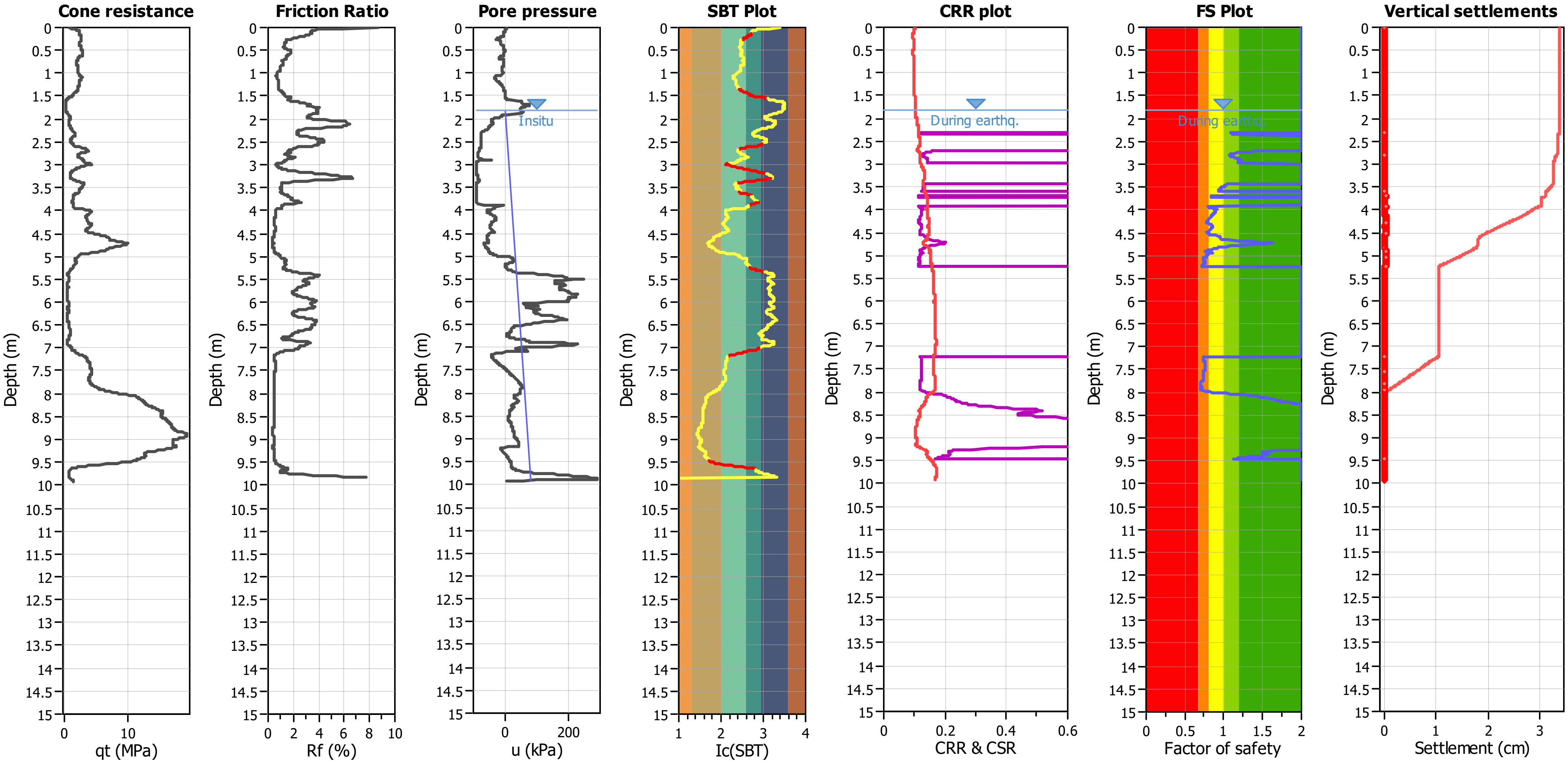
Project: **MINZ200357 - Geotechnical Investigation and Assessment**

Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu008 SLS

Total depth: 9.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.80 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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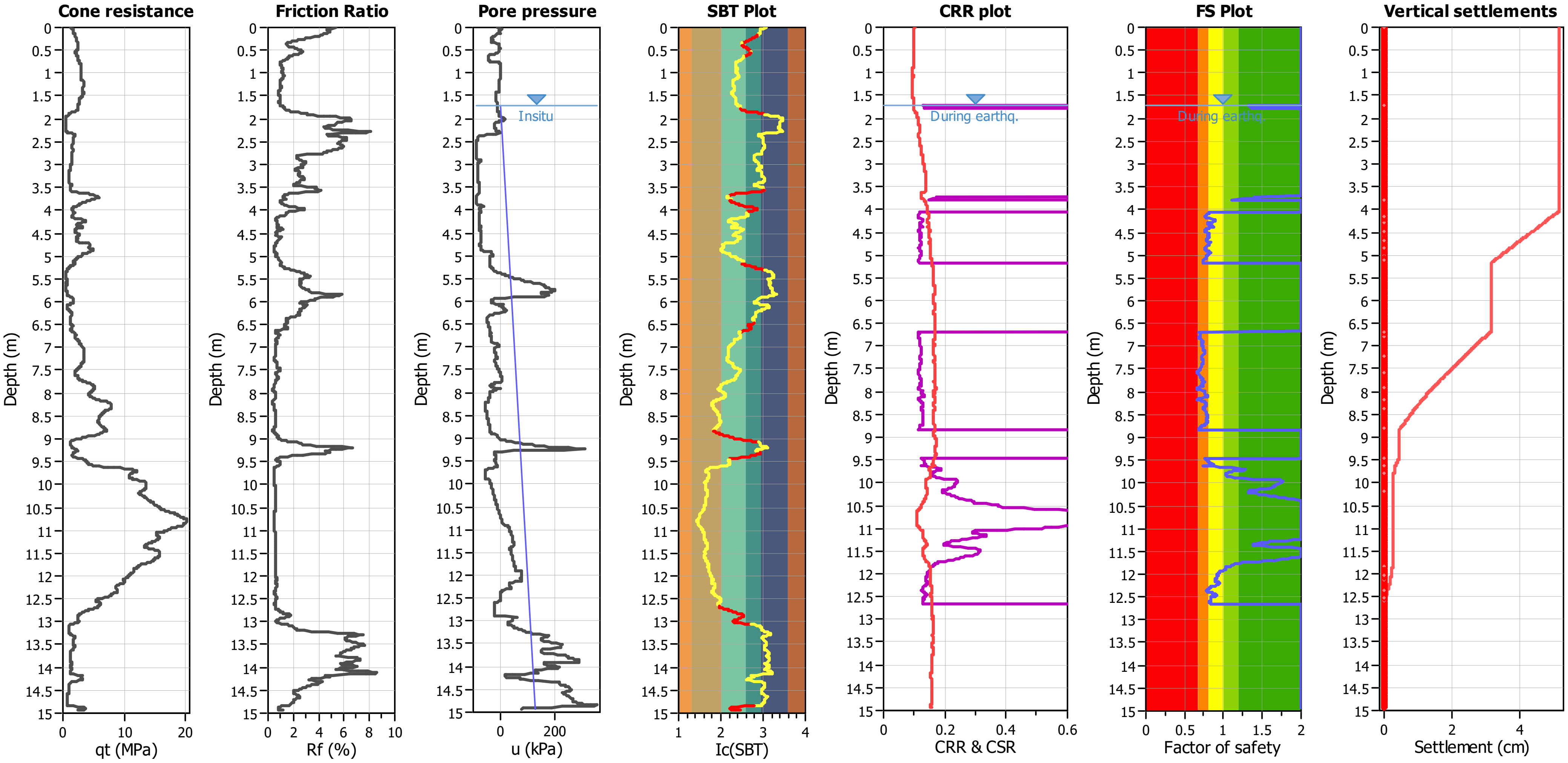
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

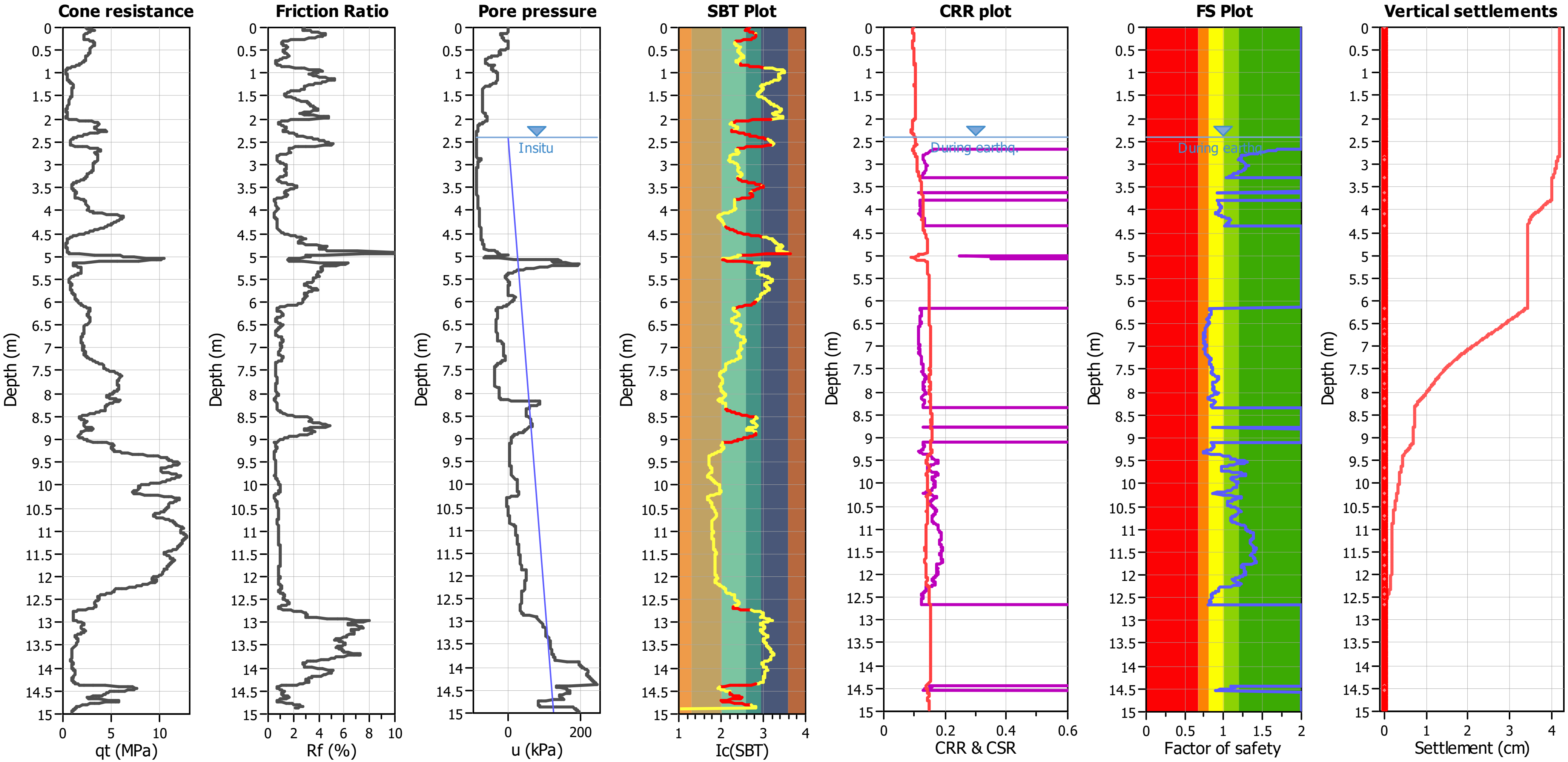
CPT: CPTu009 SLS2
Total depth: 14.95 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu010 SLS2
Total depth: 14.97 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.00
Peak ground acceleration: 0.19

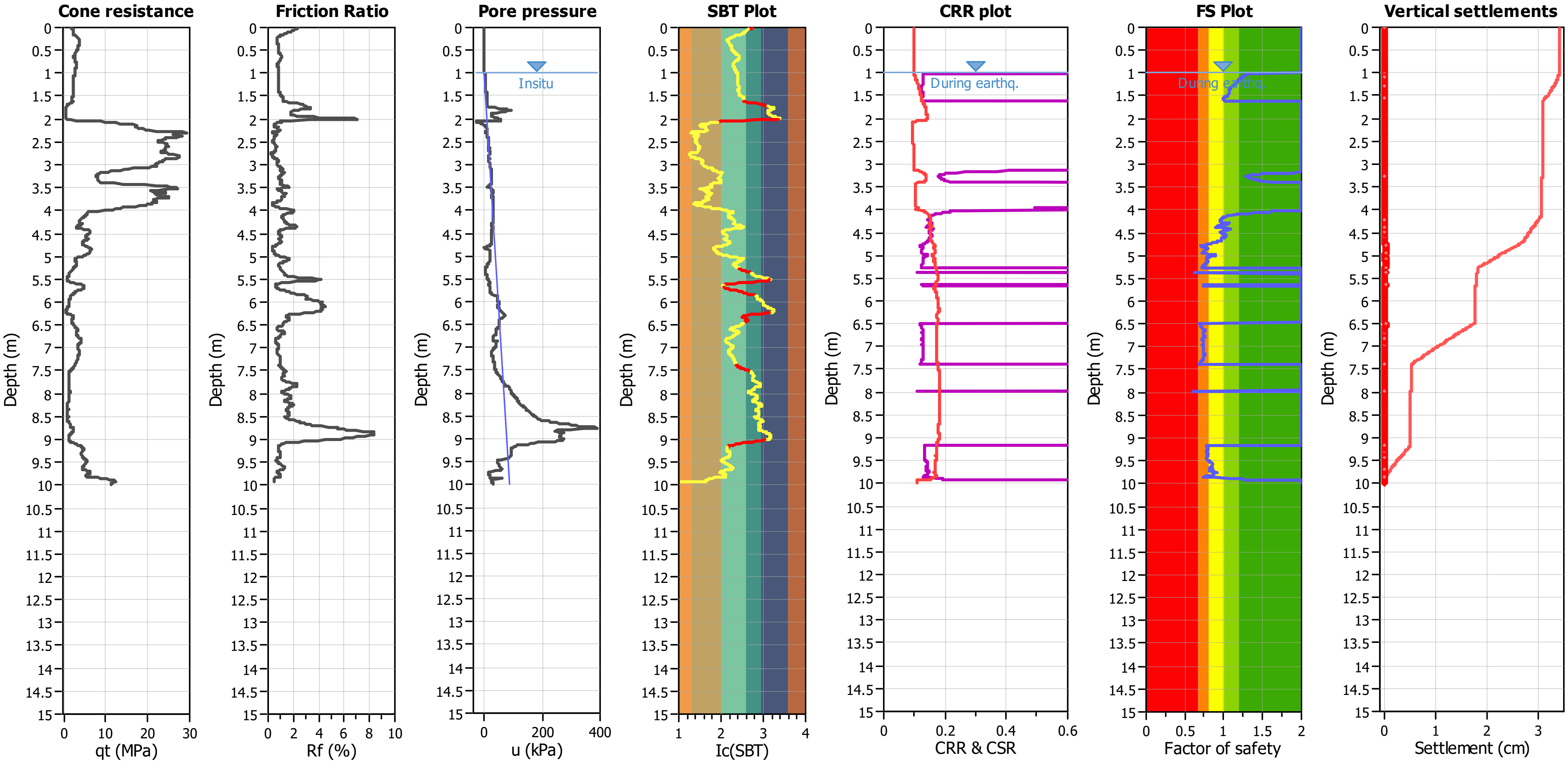
G.W.T. (in-situ): 2.40 m
G.W.T. (earthq.): 2.40 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: No
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

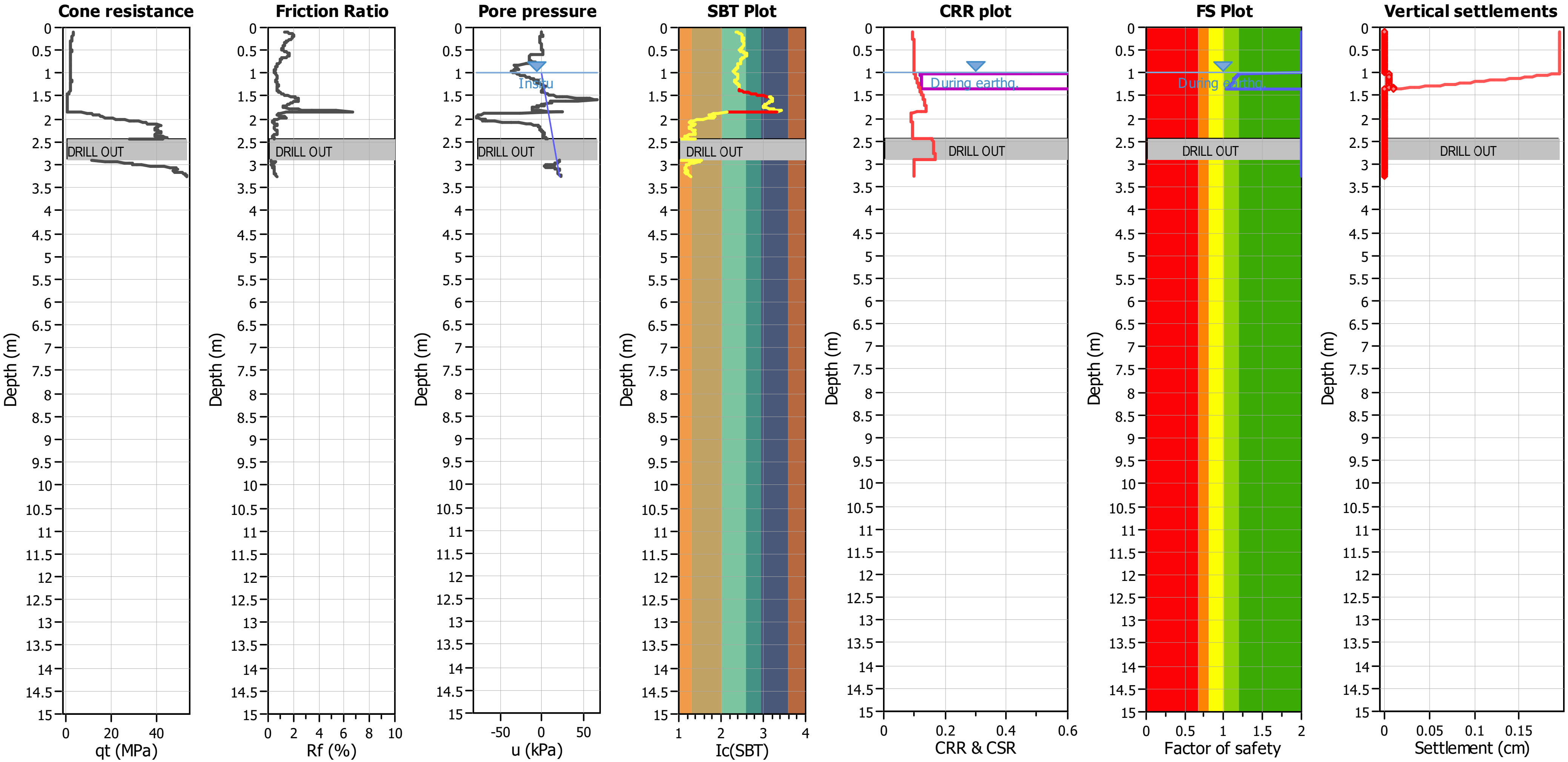
CPT: CPTu011 SLS2
Total depth: 9.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu012 SLS2
Total depth: 3.25 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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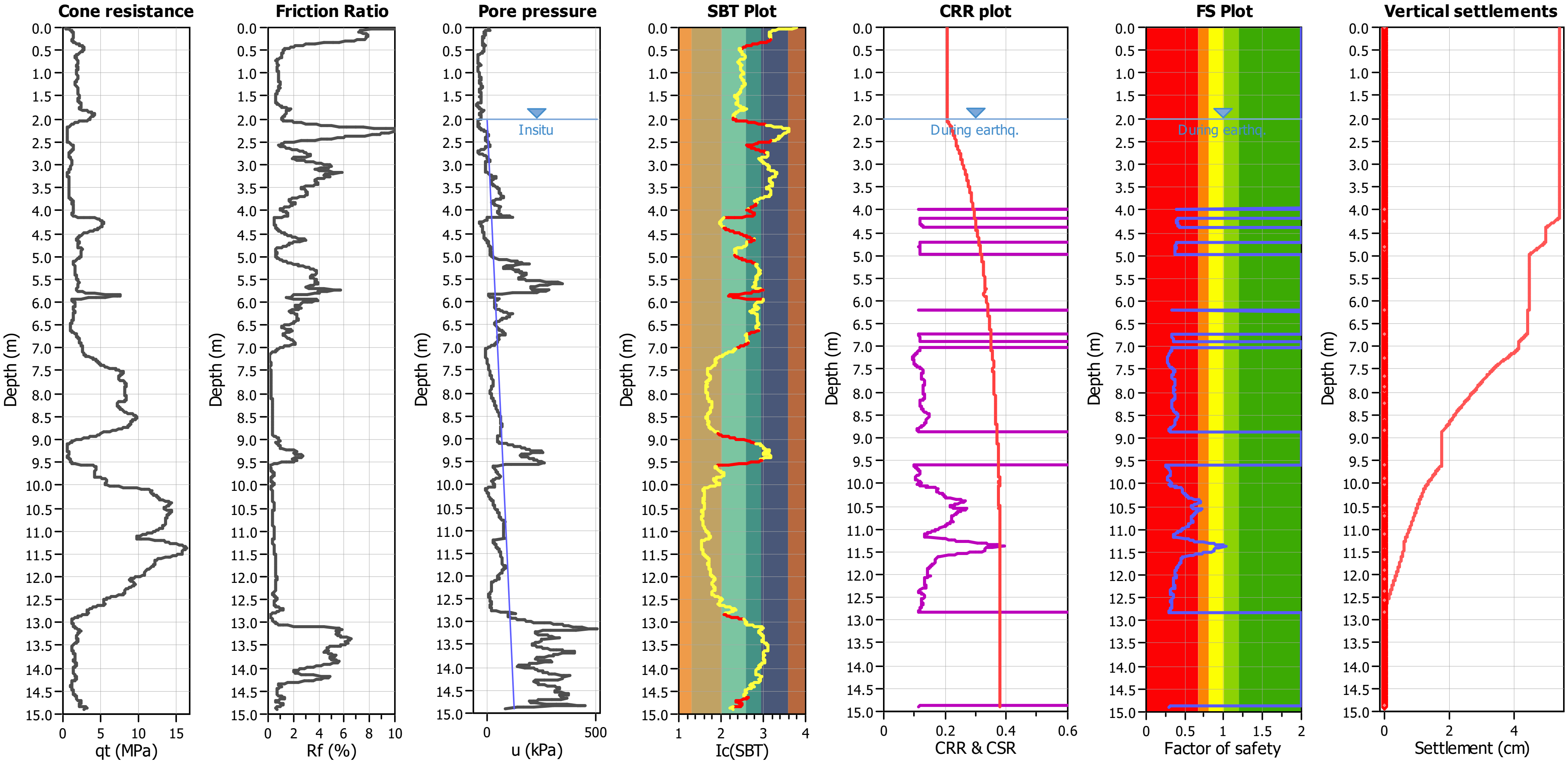
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu001 ULS
Total depth: 14.89 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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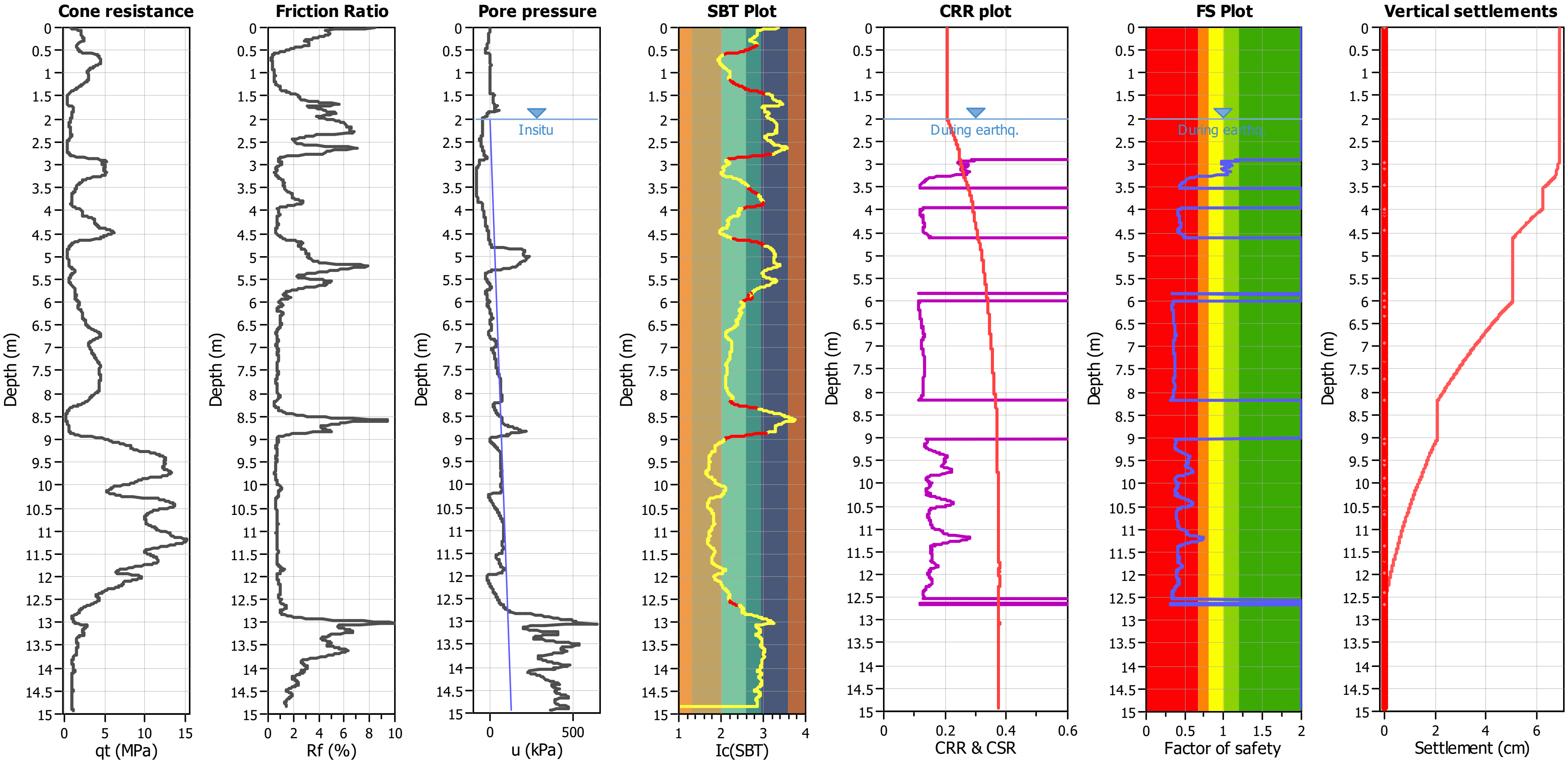
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu002 ULS
Total depth: 14.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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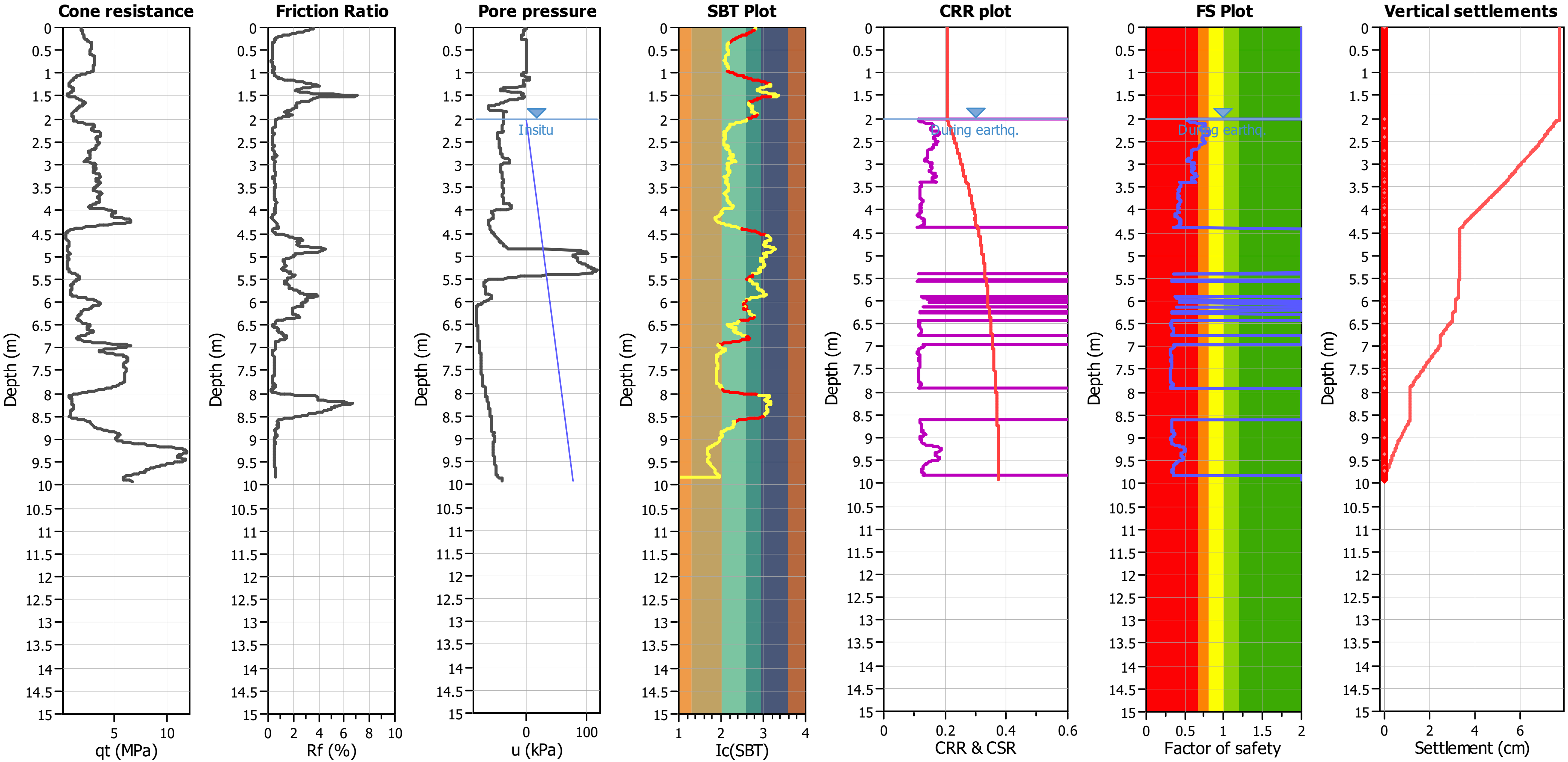
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu003 ULS
Total depth: 9.91 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.35

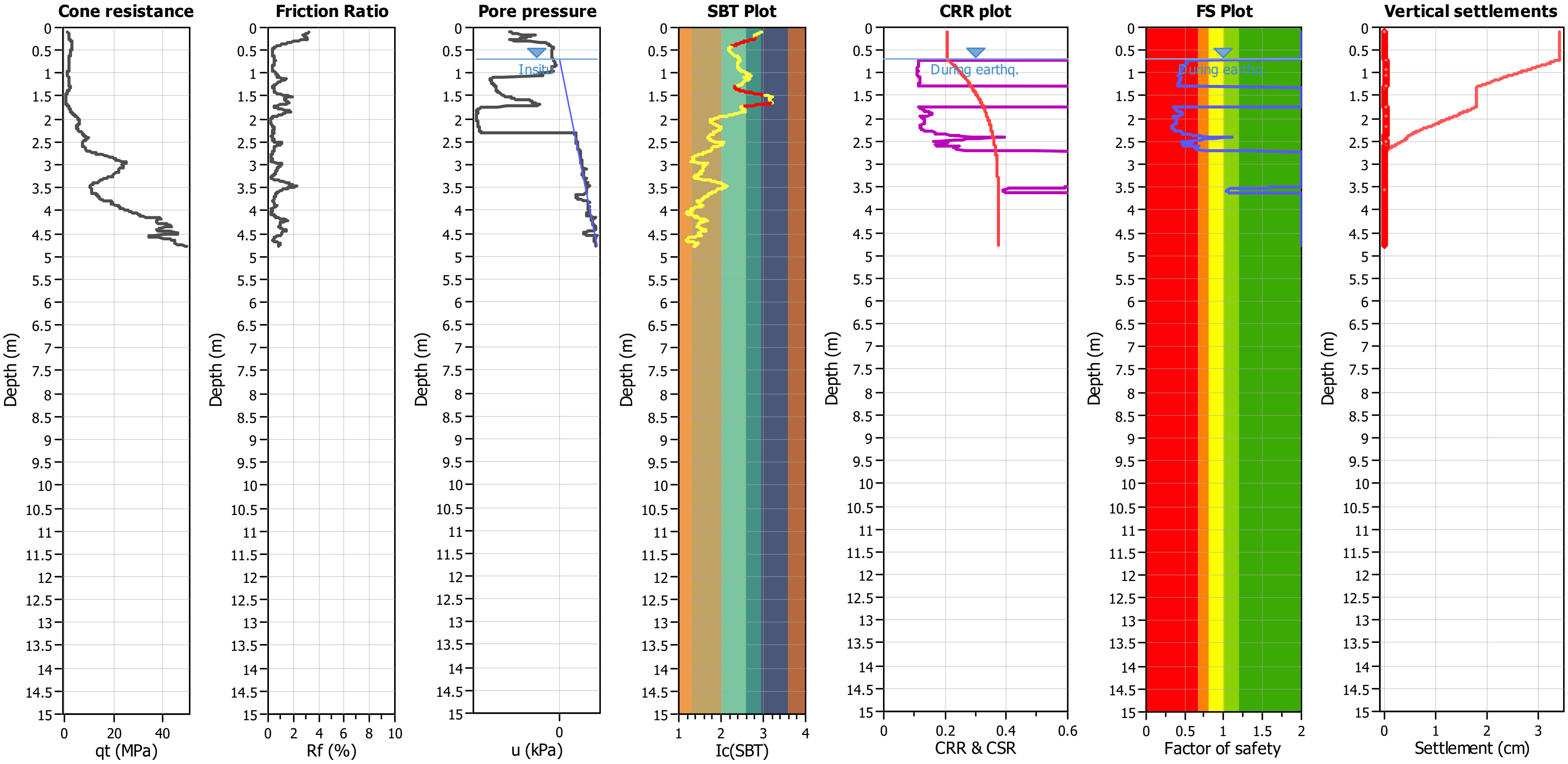
G.W.T. (in-situ): 2.00 m
G.W.T. (earthq.): 2.00 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: No
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu004 ULS
Total depth: 4.78 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.35

G.W.T. (in-situ): 0.70 m
G.W.T. (earthq.): 0.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: Yes
Limit depth applied: Yes
Limit depth: 10.00 m
MSF method: Method based

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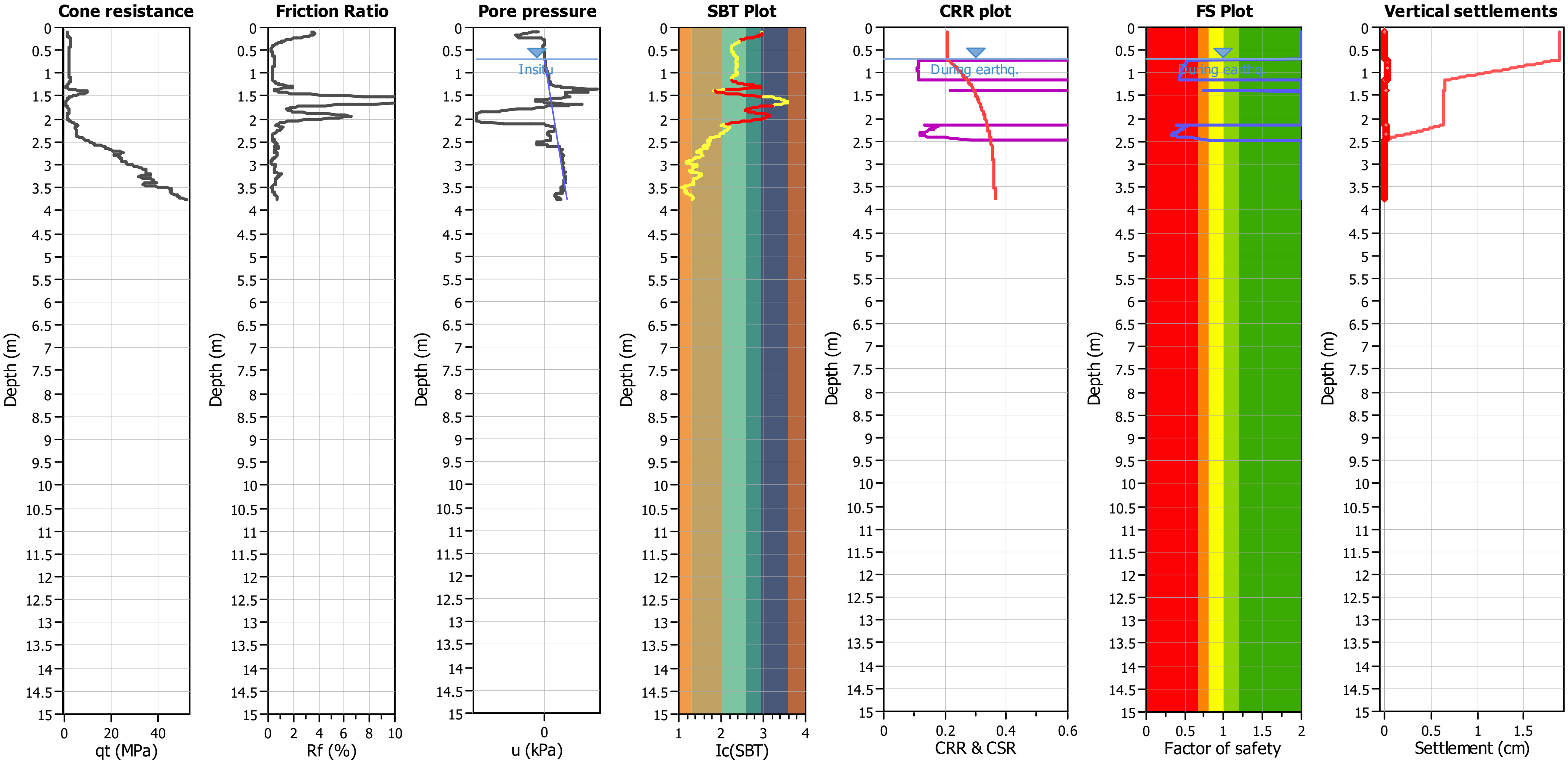
Project: MINZ200357 - Geotechnical Investigation and Assessment
Location: 2 Glovers Road Subdivision, Halswell, Christchurch

CPT: CPTu005 ULS
Total depth: 3.76 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.70 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

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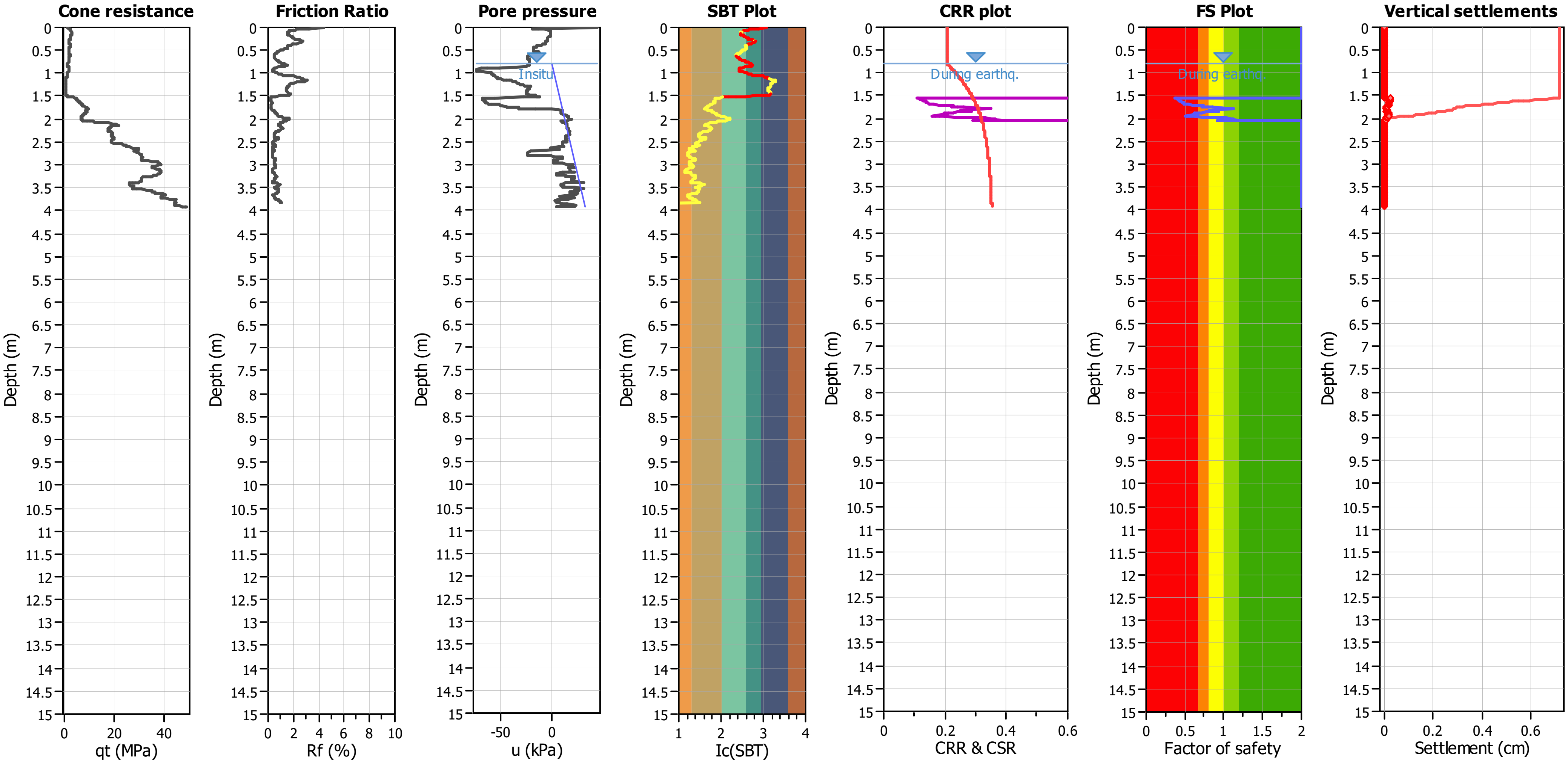
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

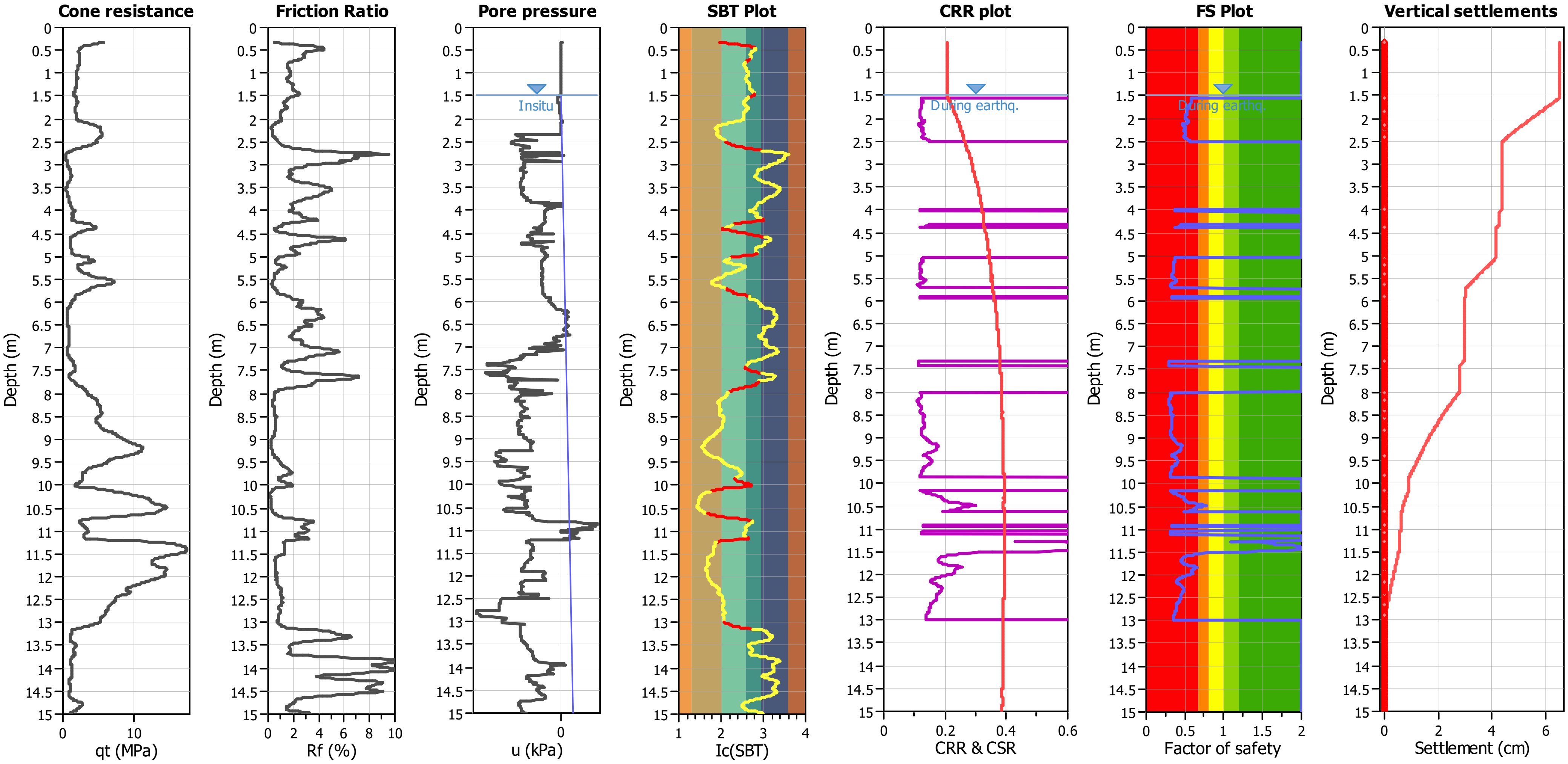
CPT: CPTu006 ULS
Total depth: 3.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	0.80 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	0.80 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	10.00 m
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu007 ULS
Total depth: 15.00 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.35

G.W.T. (in-situ): 1.50 m
G.W.T. (earthq.): 1.50 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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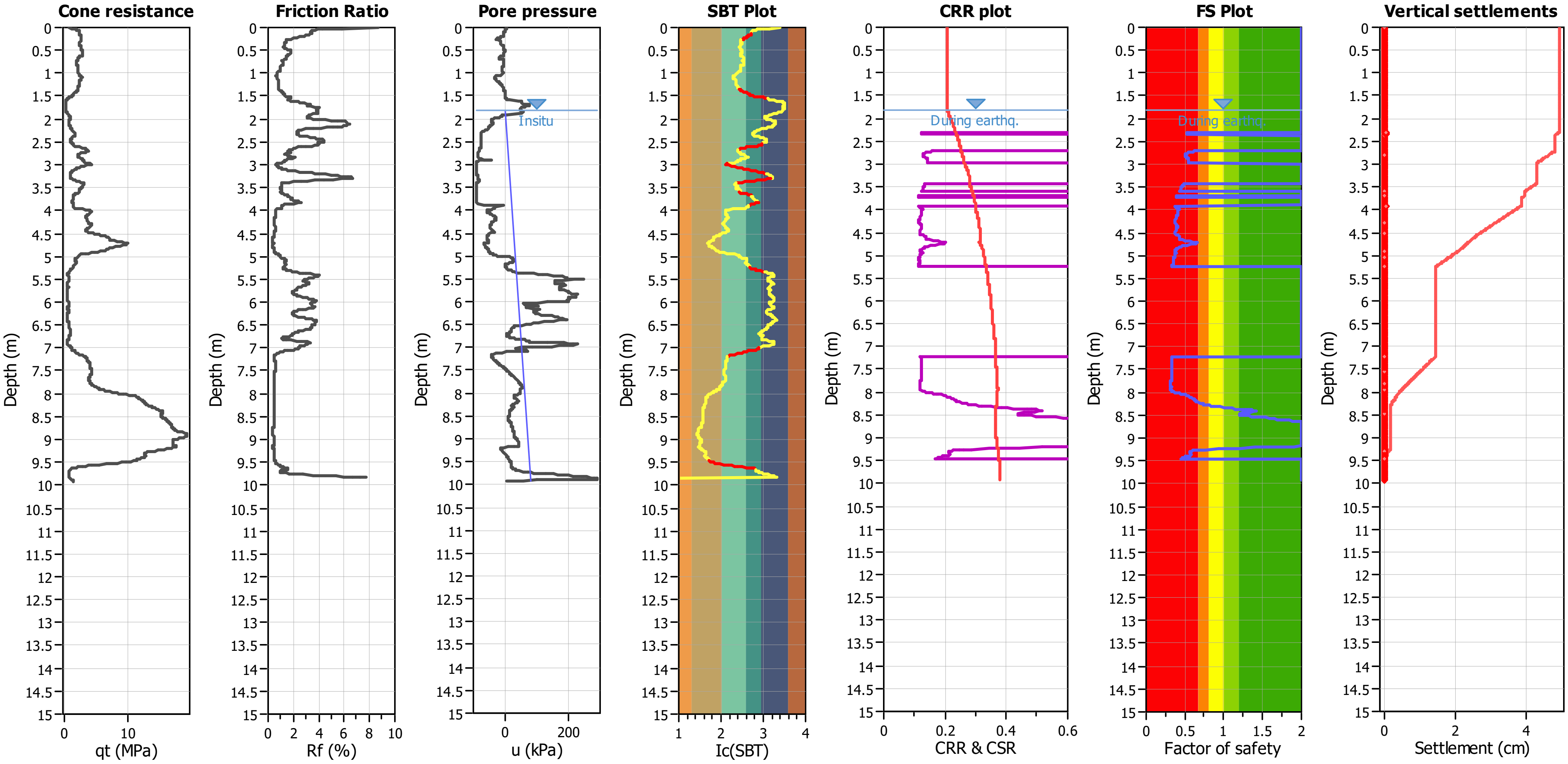
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

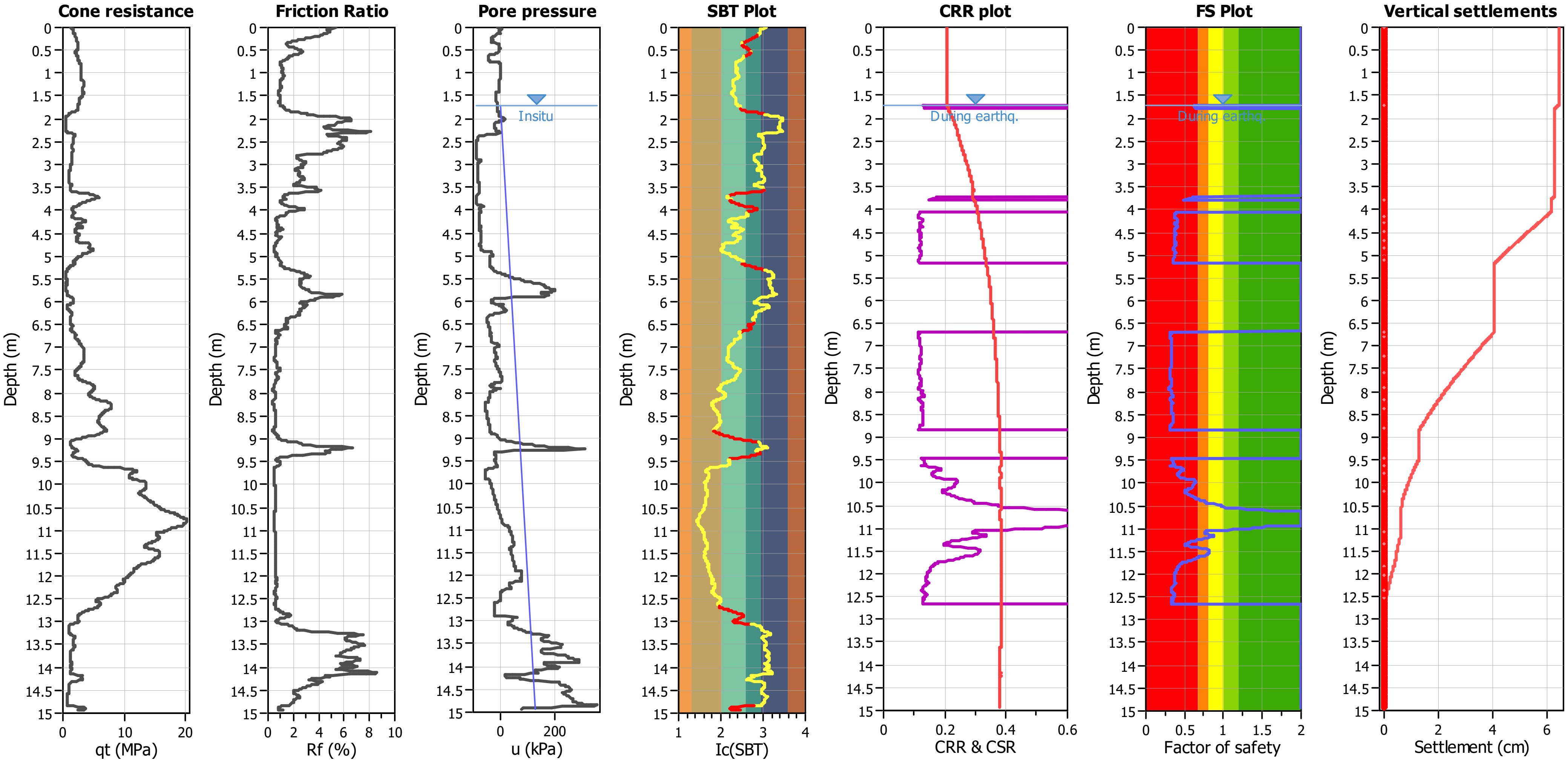
CPT: CPTu008 ULS
Total depth: 9.93 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.80 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.80 m	Fill height:	N/A	applied:	.
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu009 ULS
Total depth: 14.95 m



Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.35

G.W.T. (in-situ): 1.70 m
G.W.T. (earthq.): 1.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: Yes
K_σ applied: Yes

Clay like behavior applied: .
Limit depth applied: No
Limit depth: N/A
MSF method: Method based

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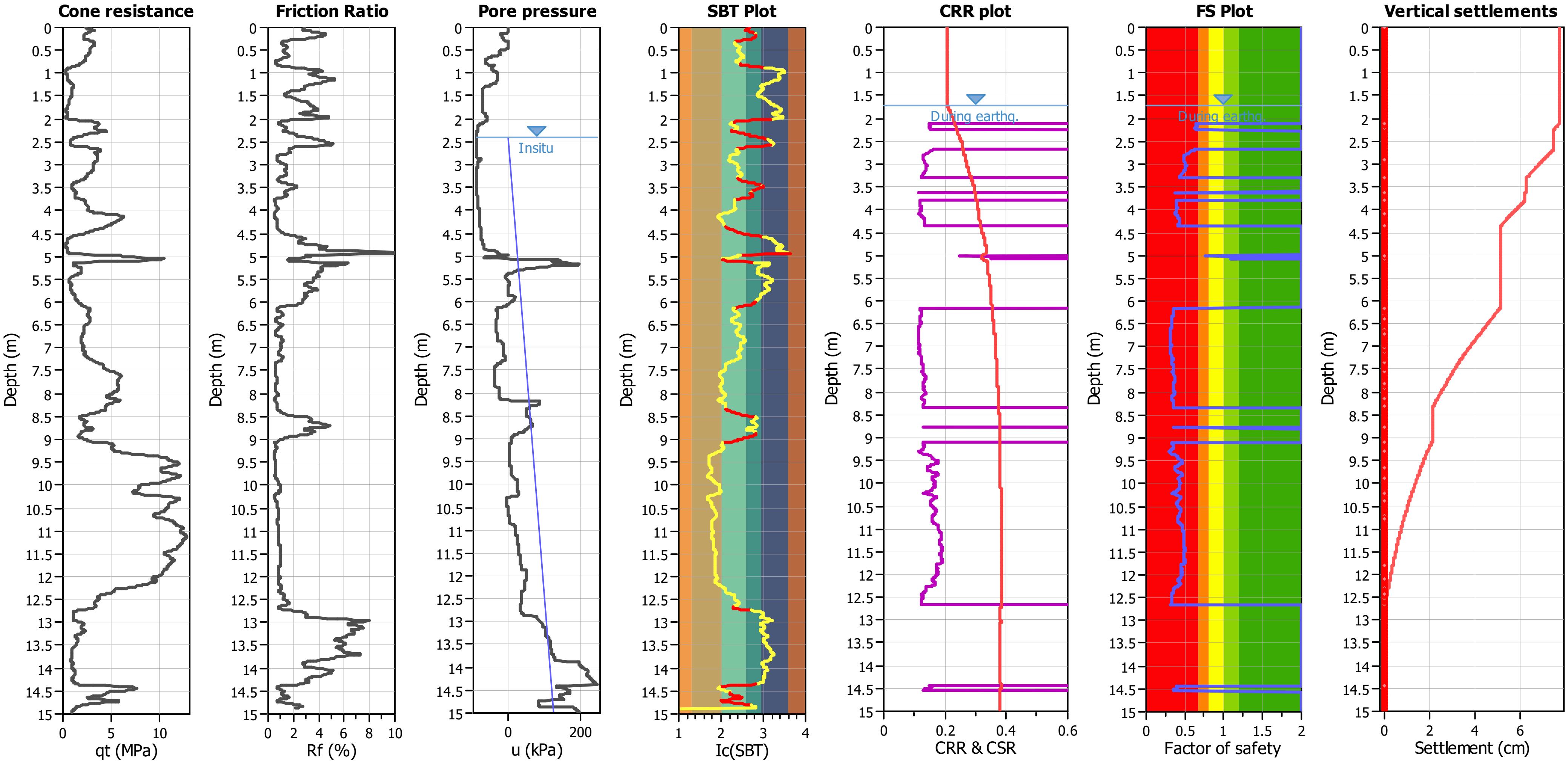
Project: MINZ200357 - Geotechnical Investigation and Assessment
Location: 2 Glovers Road Subdivision, Halswell, Christchurch

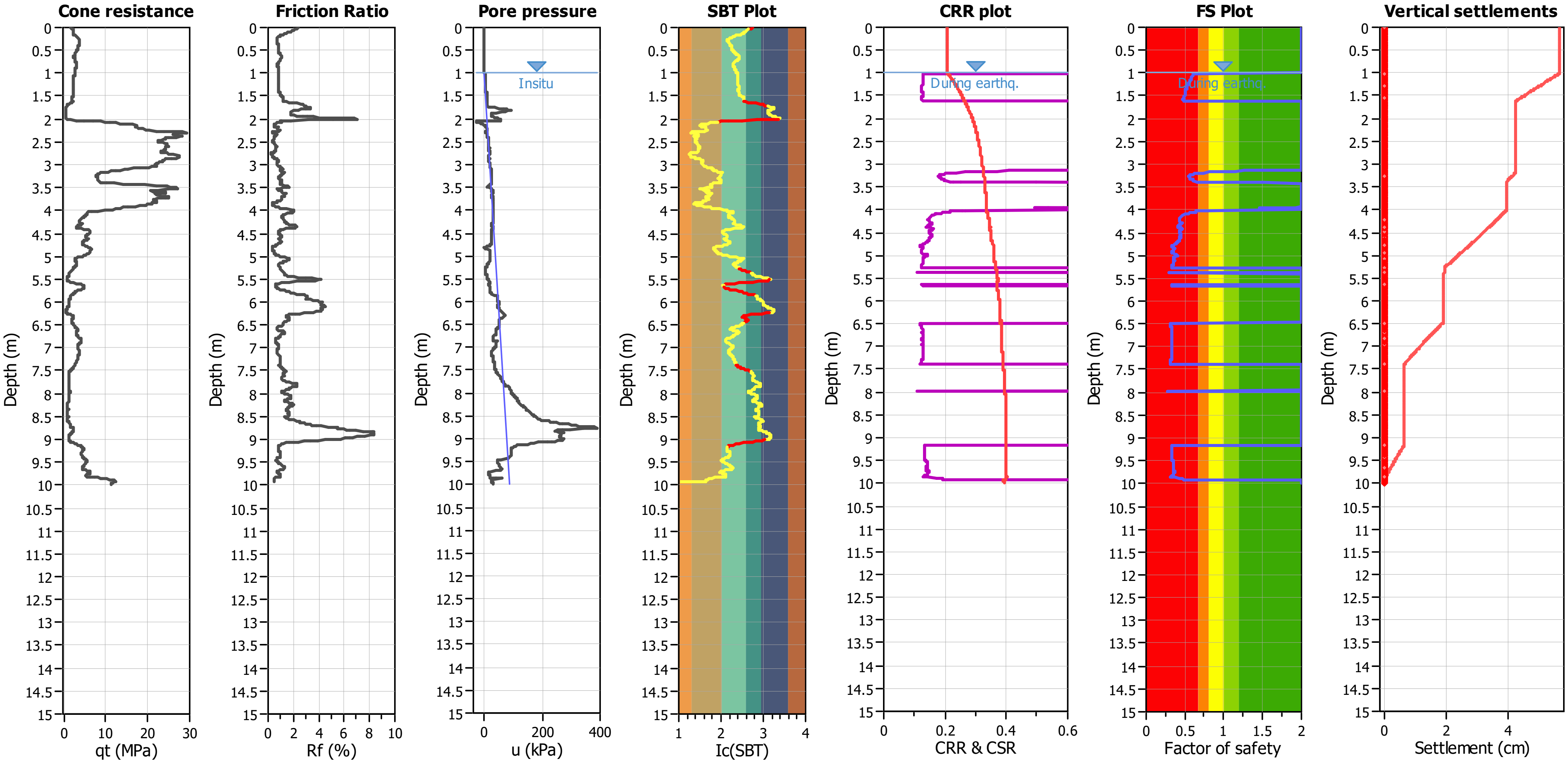
CPT: CPTu010 ULS
Total depth: 14.97 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.40 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu011 ULS
Total depth: 9.99 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	.
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

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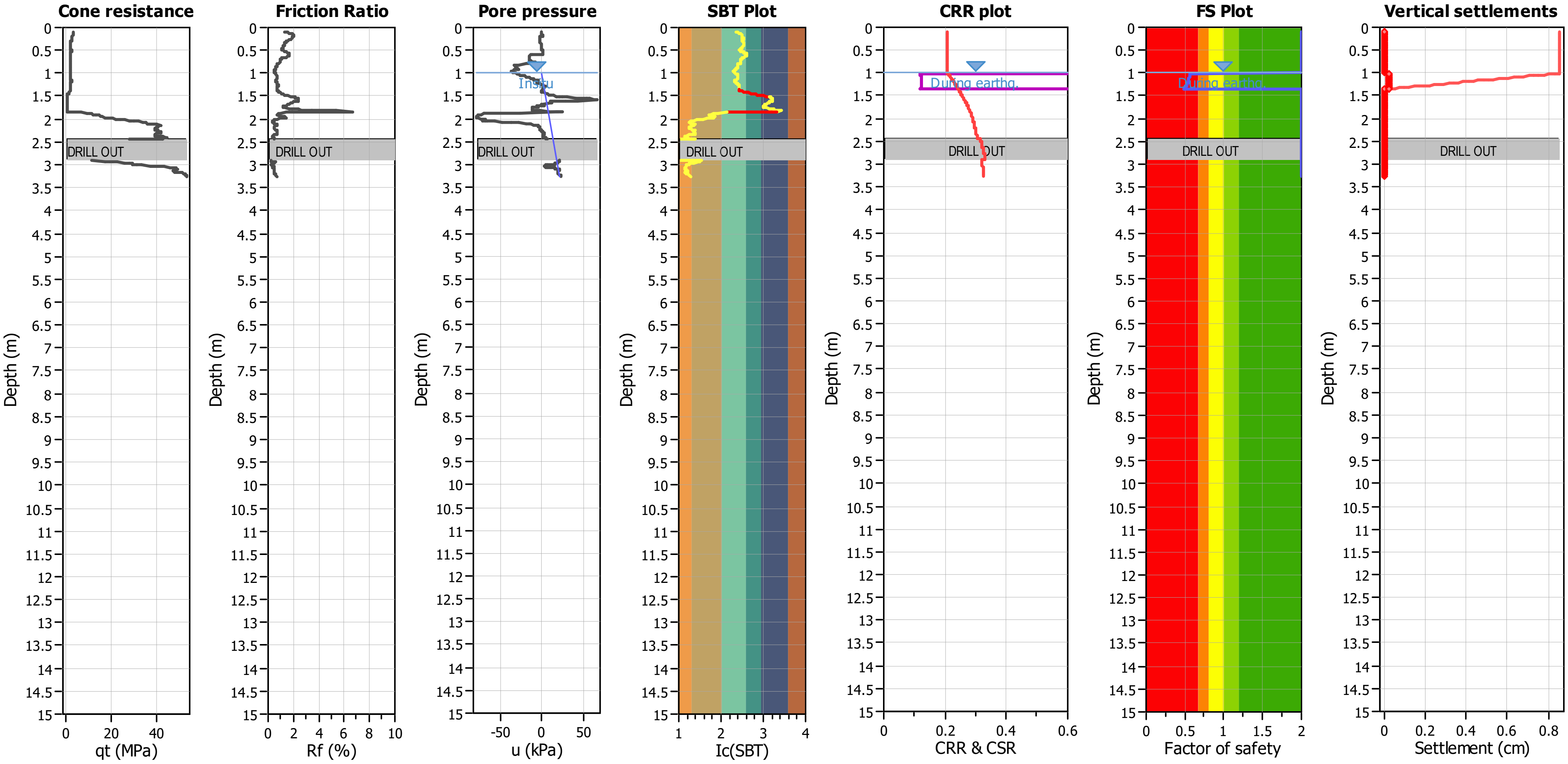
Project: **MINZ200357 - Geotechnical Investigation and Assessment**
Location: **2 Glovers Road Subdivision, Halswell, Christchurch**

CPT: CPTu012 ULS

Total depth: 3.25 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	.
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	Yes
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	10.00 m
Peak ground acceleration:	0.35	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based