



**IRBA**

**GEOLOGICAL  
ENGINEERING  
CONSULTANTS**

Geotechnical site  
investigations,  
252-256 High Street,  
Lower Hutt

April 2019

For Superloans Hutt Limited

**Project Number 1272**

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## Introduction

Ian R Brown Associates Ltd (IRBA) were engaged by Superloans Hutt Limited to investigate the ground conditions at 252-256 High Street, Lower Hutt (Figure 1).

Investigations were required to inform foundation design for the construction of a single storey commercial building.

The site is currently configured as uncovered car parks which house an ASB caravan. There is a small single storey structure on the north eastern boundary of the property. The current site coverage, and known underground obstacles limited the availability of suitable locations for subsurface investigations.

## Geological setting

This site is located in the lower reaches of the Hutt Valley, around 500m to the west of the active Wellington Fault.

The geology of the area comprises Holocene aged river deposits (sands, silts, clays and gravels), (Geology of the Wellington Area, 1:50 000).

Bedrock in this area is Wellington greywacke, undifferentiated Rakaia terrane Triassic sandstone and mudstone, and is found at significant depth in this part of the Hutt Valley.

The site is relatively flat and has been subject to anthropogenic modification due to previous land use as a petrol station and mechanical repair workshop.

## Investigations

On 17th of March 2019, Griffiths Drilling (NZ) Ltd sonically drilled one cored borehole (WGDH368), with Standard Penetration Tests (SPT's) being performed at 1.5m intervals.

On 24th of March, three cone penetration tests (CPT's) were pushed using a track mounted CPT rig fitted with a piezocone. Their locations are shown on Figure 1. CPT 1272\_1 was paired with WGDH368 enabling direct comparisons between the tests to be made. One CPT (1272\_2) was attempted several times but abandoned at 3m due to the cone resistance being greater than the loading achievable from the dyna bolts used to anchor the CPT rig. This resistance can most likely be attributed to the presence of fill material. Another planned CPT site also had to be abandoned as rubble/gravel could not be extracted from the upper 1.5m.

Investigation sites were located by measuring from features identifiable in georeferenced aerial photographs. The reduced levels of the investigation sites were estimated from Wellington Regional Council (WRC) LiDAR data.

The CPT data were processed using the software package CLiq v.2.0 ([www://geologismiki.gr/](http://www://geologismiki.gr/)).

Robertson's calculation method (Robertson and Wride 1998) was used to infer the soil behaviour from the CPT data (Appendix A).

Three soil samples were extracted from the core. These samples were collected from between; 3-4.5m (SPT), 3.9-4.1m and 4.9-5.1m. Particle size distribution analysis by wet sieving was undertaken by Materials Advisory and Testing Service Ltd (MATS), Figures 4-6.

All investigations were supervised by IRBA staff and performed in accordance with the land use consent - construct a bore, granted for this property.



Image 1. Site investigations with sonic drilling rig

## Contamination

This site features on the Selected Land Use Register (SLUR) and historically operated as a petrol station and mechanical repair workshop. As part of these operations, underground petrol storage tanks were installed. It is unclear whether these have been removed from the site and the ground remediated, however the Greater Wellington Regional Council (GWRC) concludes this has most likely been done.

A preliminary site investigation (PSI) into the contamination was conducted by Pattle Delamore Partners Ltd. Their report dated December 2016 contains more information.

During the course of our investigations a mild petroliferous odour was detectable when the pavement cover over the site was penetrated. An oily sheen and foam were observed when excavating the upper 1.5m of BH1. These observations show that some level of hydrocarbon contamination is present beneath the surface of this site (Image 2). Silts and clays within the core of the borehole appear to be contaminated to a depth of ~3.5m (Figure 2).

The excavation of a proposed CPT site had to be halted as large boulders/rubble were unable to be cleared from the hole (Figure 1). This could indicate the past location of the underground storage tank, subsequently backfilled when the tank was removed.



*Image 2. Hydrocarbon contamination*

## Ground conditions

The geology at the site has been confirmed to consist of soft alluvial materials, overlain by variable amounts and type of fill. A GWRC borelog for well R27/1196 on the adjacent side of High Street from this property intercepted the Waiwhetu Artesian Gravels at ~17m depth.

Groundwater was not measured at this site but is assumed for CPT cyclic liquefaction analysis, to be at ground level as a likely worst-case scenario.

Correlations between the drill hole and the CPT's show that the geology is consistent across the site, with some minor differences in bedding, attributable to the environment of deposition.

Soil descriptions are shown in Figure 2. Soil behaviour type (as assessed by CLiq, based on the CPT data) can be found in Appendix A. These show alternating clays, silts and occasional sands.

SPT blow counts measured during drilling were low. These range from N= 0 to N=11. Soils became stiffer/denser with depth. The densest layer encountered was between 4-4.5m with CPT cone point resistance of around 20 MPa. Another dense layer was encountered between 5.3 and 6m. The vertical extent of this layer was only sampled by the SPT as "seating blows". An indicative SPT N value for this unit would be N= ~20 with CPT resistances of ~10 MPa.

A 1m thick organic clay-peat layer is present between 6.1-7.2m.

This site should be considered as class D, deep or soft soil site for NZS 1170.5:2004 with a site period of >0.6 sec <1 sec as identified by Boon et al. 2011.

## Liquefaction

Liquefaction analyses have been based on earthquake parameters as outlined by the NZTA Bridge Manual (2018).

$$\begin{aligned} a_{\max} &= C_{0,1000} R/1.3 f g \\ &= 0.45 \cdot 1.5/1.3 \cdot 1 \\ &= 0.52g \end{aligned}$$

Earthquake magnitude,  $M_w = 7.1$

This is a 1/1000 year, Ultimate Limit State (ULS) earthquake event as required for a building with importance level 2 (IL2).

CLiq has predicted that under these ground shaking conditions, liquefaction may occur at this site (Appendix A). Any liquefaction however would be limited to thin, ~0.5m thick, mostly discrete, layers of sands-silty sands. Without continuity within the soil strata, damage from liquefaction is expected to be unlikely. The overall probability of liquefaction has been predicted by CLiq to be high for the investigated portion of this site.

Results from the particle size distribution testing for some of the layers identified as having a high probability of liquefaction show that the fines content (FC%) has been underestimated by CLiq. Soil layers with high fines content have increased resistance to liquefaction triggering, Leeves et al. (2015), which means that the probability of liquefaction for this site, as determined by CLiq calculations, is overestimated.

CLiq analysis predicts maximum vertical settlements of 7 cm at this site due to the ULS earthquake. Site conditions appear to be continuous across the site, at least in the east west direction meaning any differential settlement is likely to be minor.

It is unlikely that settlement occurred following the 2016 Kaikoura earthquake as no damage was reported in the area and no evidence of liquefaction is observable in the core. It would appear the program CLiq which is based on established relationships between point resistance and sleeve friction, is overestimating the potential for liquefaction at this site.

## Discussion

This site is underlain by soft alluvial soils. Sands are present; however, these are generally dense and not deemed to be at risk of liquefaction.

The site presents several constraints for construction of a piled foundation. We have identified a peat layer at 6.1m to 7.2m depth. The peat is compressible, so we recommend not to directly load that interval with short piles.

There is a gravel layer at around 17m depth forming the local aquifer. We have not investigated that as part of this study. Any penetrations of the aquifer, either during investigation or construction, requires special drilling techniques and consent from Wellington Regional Council.

We recommend that a stiff raft type foundation is constructed at the site with little disturbance of the current surface. This will also assist with limiting potential exposure to contaminated surficial soils.

This site should be considered to be a deep or soft soil site - site subsoil class D, with a site period greater than 0.6 seconds.

## References

Begg J.G, Mazengarb C. 1996 Geology of the Wellington area, scale 1:50 000. Institute of Geological & Nuclear Sciences geological map 22. 1 sheet + 128p. Lower Hutt, New Zealand: Institute of Geological & Nuclear Sciences Limited.

Boon D., Perrin N.D, Dellow G.D, Van Dissen R, Lukovic B. 2011 NZS1170.5:2004 Site subsoil classification of Lower Hutt. Proceedings of the Ninth Pacific Conference on Earthquake Engineering Building an Earthquake-Resilient Society 14-16 April, 2011, Auckland, New Zealand

Leeves j., Ballegooy S. van, Lees J, Wentz F. 2015 Effect of Fines Content Correlations and Liquefaction Susceptibility Thresholds on Liquefaction Consequence. 6th International Conference on Earthquake Geotechnical Engineering 1-4 November 2015 Christchurch, New Zealand

NZ Transport Agency (2018) Bridge manual – SP/M/022 3rd edition.

Robertson, P.K, Wride, C.E 1998 Evaluating cyclic liquefaction potential using the cone penetration test. Canadian Geotechnical Journal. Vol. 35, 1998.

## Applicability

This report has been prepared for the benefit of Superloans Hutt Ltd with respect to the brief given to Ian R Brown Associates Ltd. It may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Opinions and recommendations contained in this report have been derived from the information and data gathered during the course of our investigations.

No liability is accepted by Ian R Brown Associates Ltd nor by any Director, or any other servant or agent of the company, in respect of the use of this report (or any information contained therein) by any person for any purpose other than that specified in the brief.

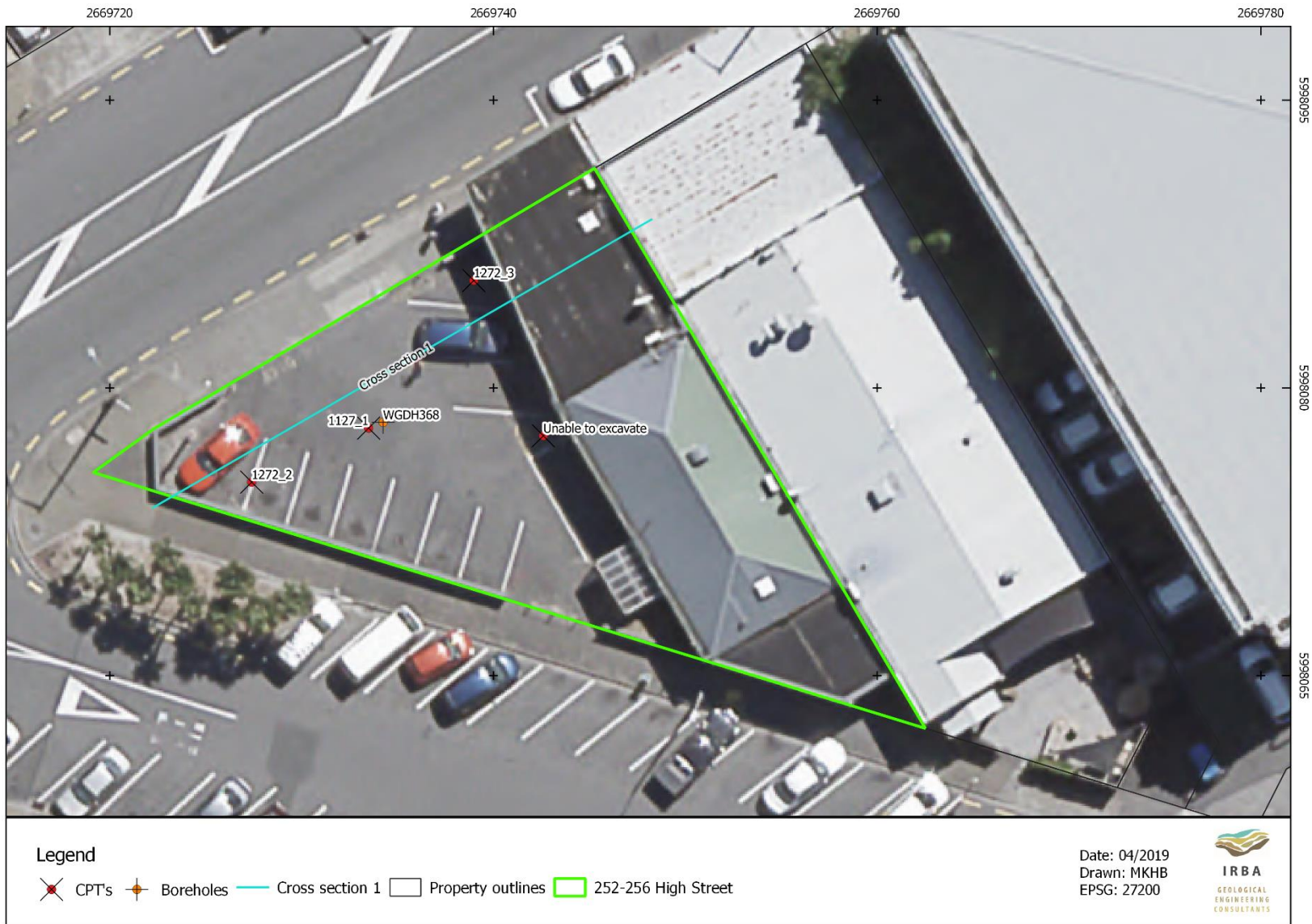


Figure 1. Location map



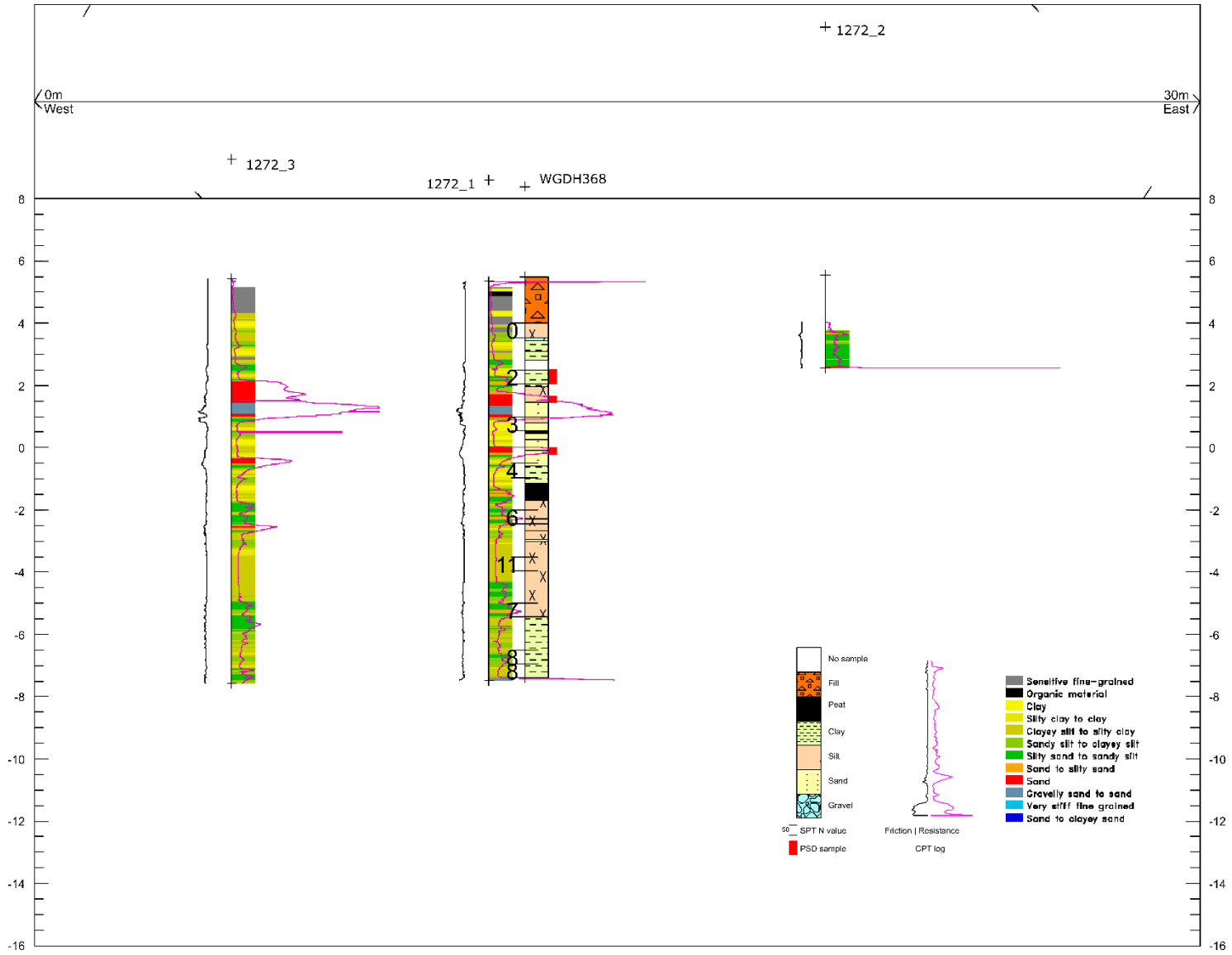


Figure 3. Cross section 1



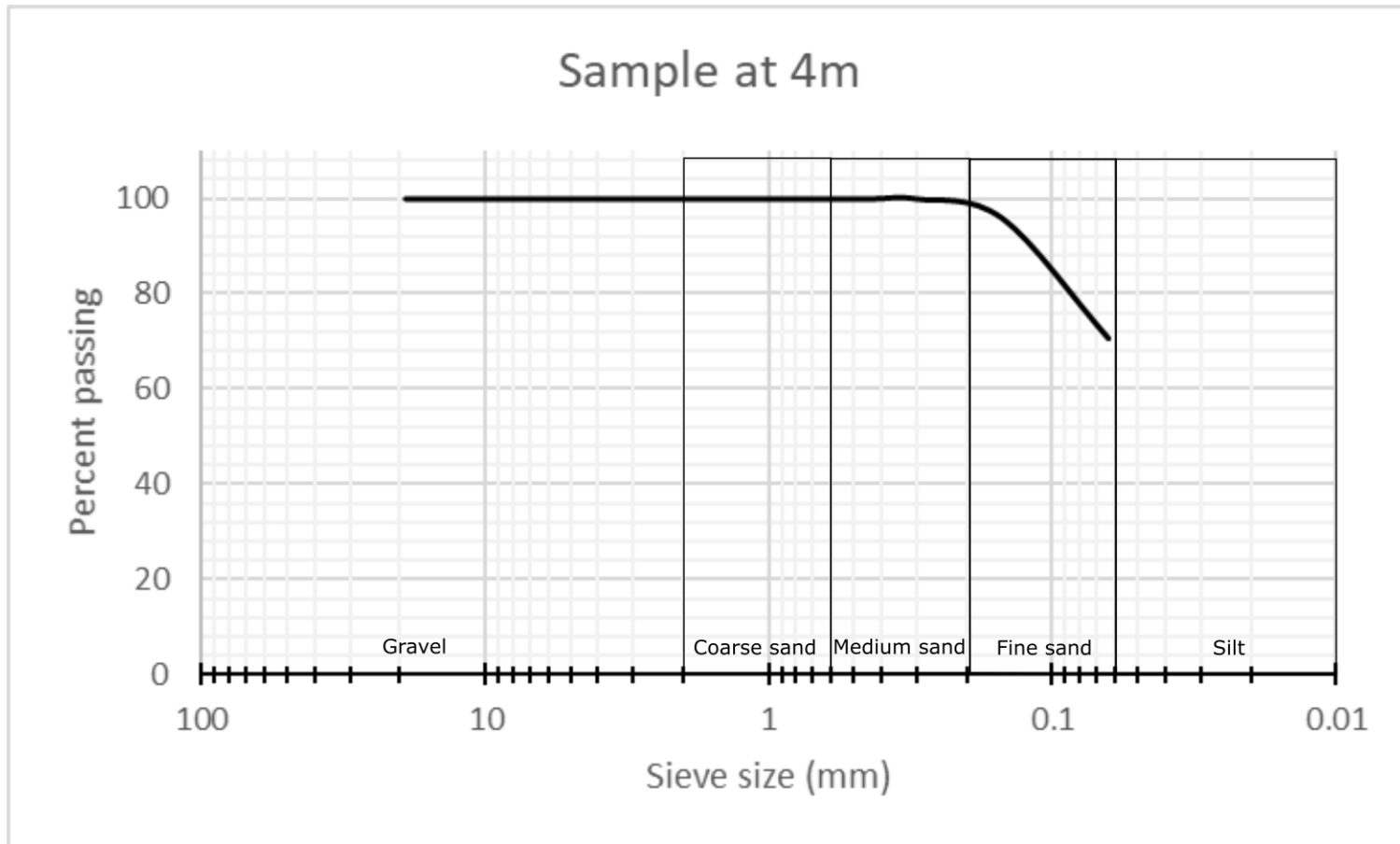


Figure 5. Sample 2, Soil size grading curve

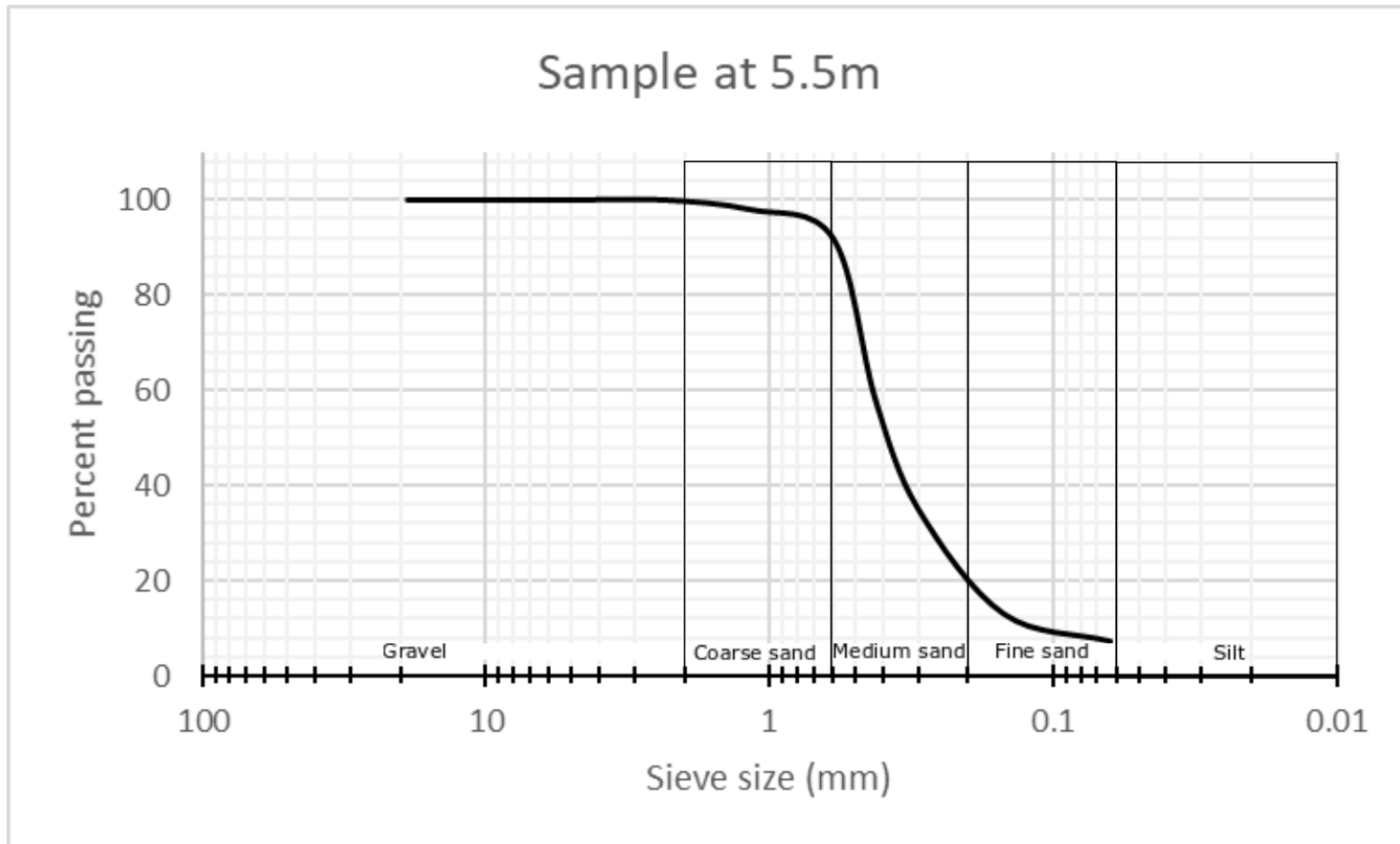
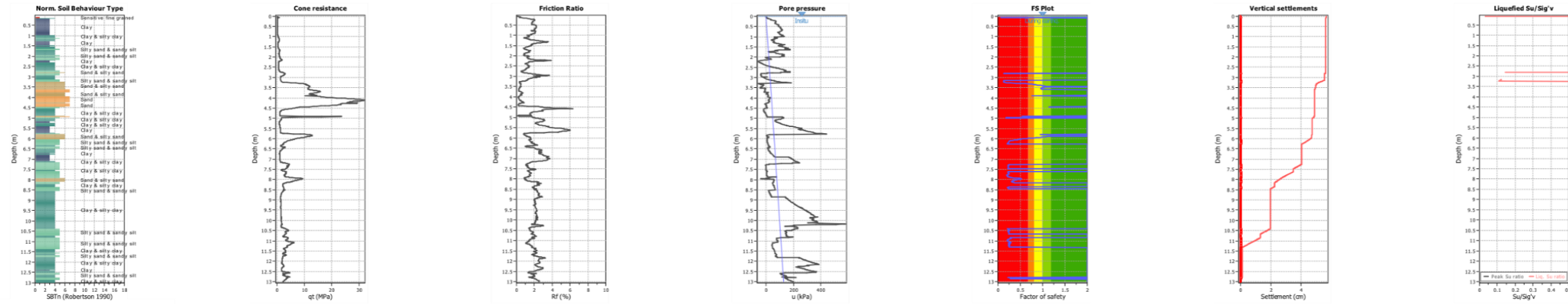


Figure 6. Sample 3, Soil size grading curve

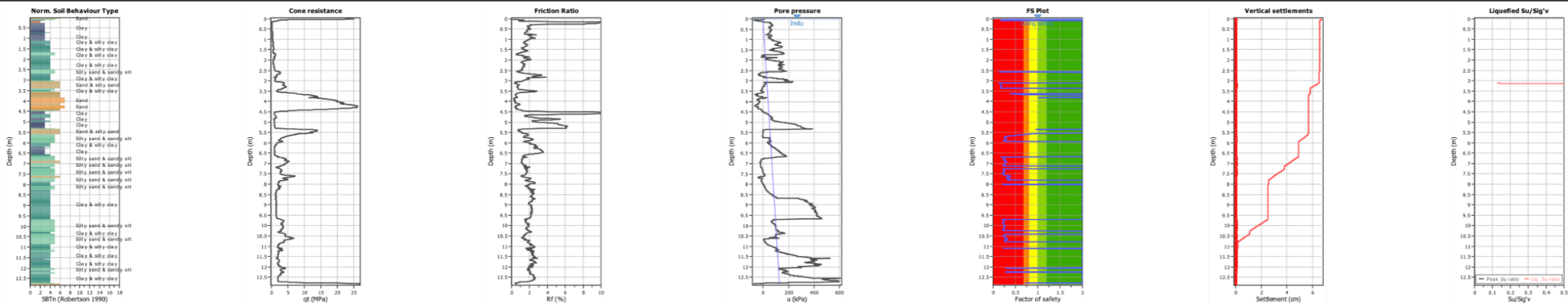
**CPT: 1272\_3 ULS**

Total depth: 13.00 m



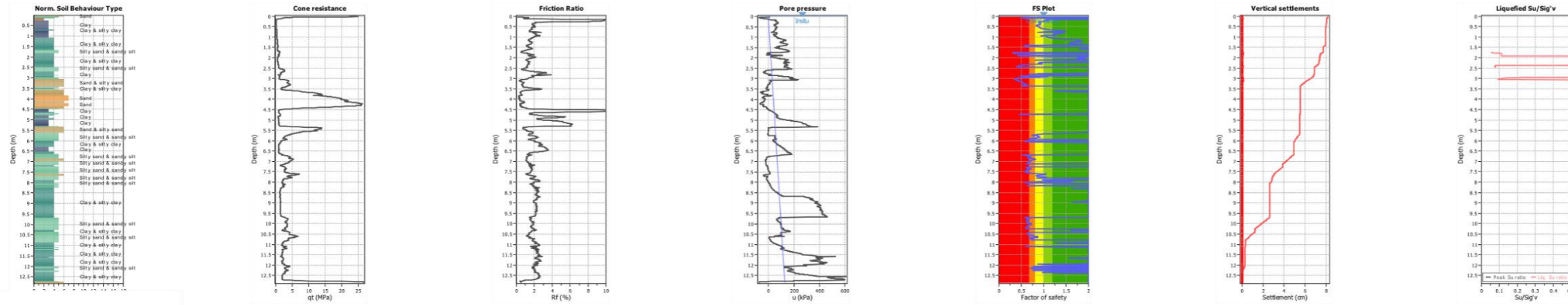
**CPT: 1272\_1 ULS**

Total depth: 12.83 m

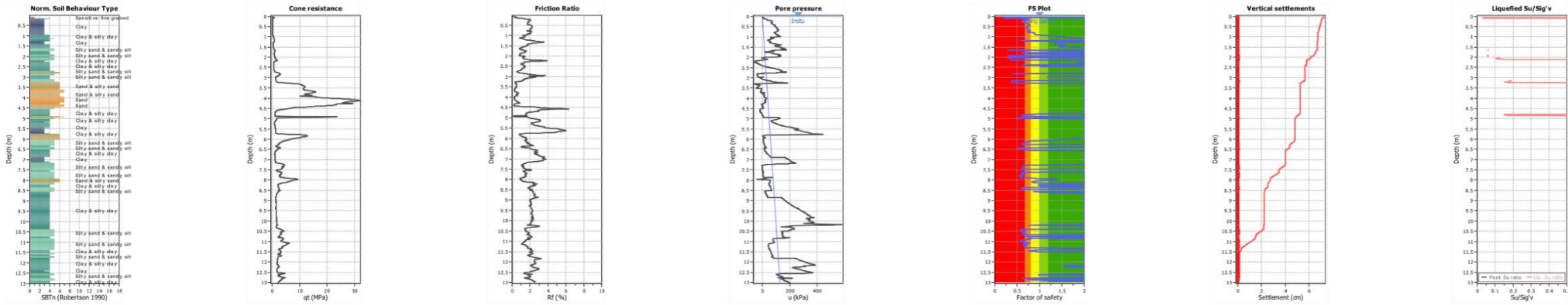


Analysis method:	NCEER (1998)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	0.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	7.10	Ic cut-off value:	2.50	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.52	Unit weight calculation:	Based on SBT	$K_v$ applied:	Yes	MSF method:	Method based

CPT: 1272\_1 Kaikoura  
Total depth: 12.83 m

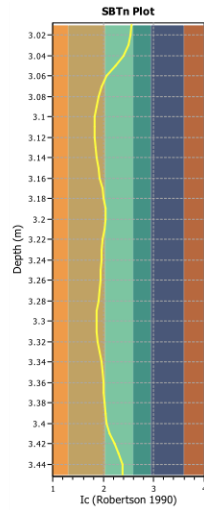
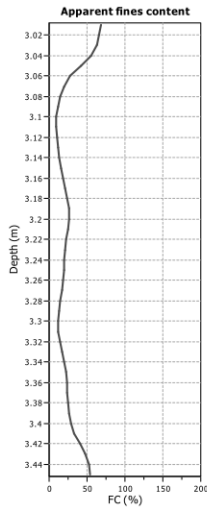


CPT: 1272\_3 Kaikoura  
Total depth: 13.00 m

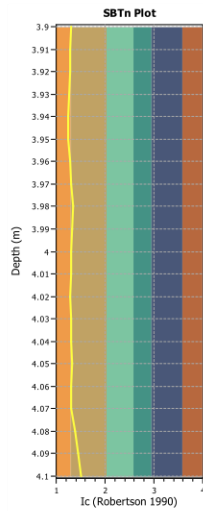
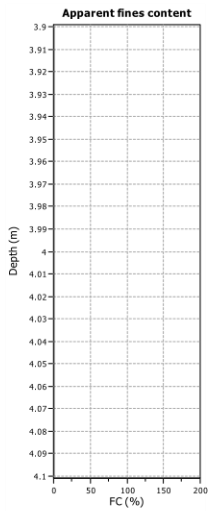


Analysis method:	Robertson (2009)	G.W.T. (in-situ):	0.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	0.00 m	Fill height:	N/A	applied:	All soils
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude $M_w$ :	7.82	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	$K_s$ applied:	No	MSF method:	Method based

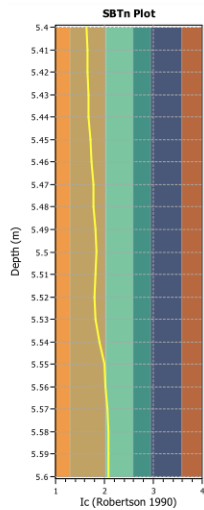
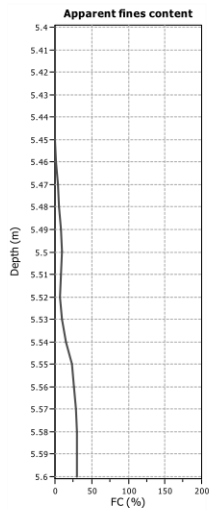
# Appendix A



Measured FC: 94.1%



Measured FC: 7.2%



Measured FC: 70.6%





The logo for Bayleys, featuring the word "BAYLEYS" in a bold, white, sans-serif font, centered within a dark blue rectangular box with a thin white border.

## **DISCLOSURE STATEMENT**

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