EB Developments Limited

GEOTECHNICAL SUITABILITY REPORT FOR PROPOSED SUBDIVISION

Tamure Place and Peter Snell Road, Ruakaka

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

Based on the investigation and appraisal of the site reported herein, the subject site has been assessed as suitable for residential development.

The geotechnical investigaiton encountered generally moderately dense to dense dune sand undelying most of the site, with shallow zones of loose sand and organics encountered in some areas.

Based on our assessment of stability and other natural hazards, we consider that there are no significant geotechnical constraints at the proposed building sites, provided that earthworks are undertaken in accordance with our recommendations below with specific regard to stripping and undercutting of loose and organic soils.

Specific assessment will likely be required for development over sloping areas particularly to the north of the central ridge area.

Adequate provision for access to the proposed sites is provided in the scheme plan and access to building sites can be formed with only minor earthworks required.

The developed subdivision design including design earthworks should be subject to geotechnical review to confirm that the works are generally in accordance with this report and to provide any supplimentary recommendations where required.

CONTENTS

1 INTRODUCTION

LDE Ltd has been engaged by EB Developments Limited to undertake a geotechnical suitability assessment for Stage 3 of a proposed subdivision at Tamure Place and Peter Snell Road, Ruakaka (Figure 1).

The development will create approximately 81 residential lots generally in the range of 400 – 600m^2, along with several drainage reserves and vested road reserves. The proposed scheme plan is shown in Figure 2 below and attached as Appendix A. It is expected that the scheme plan will be refined prior to submission for resource consent, however the overall layout is expected to be broadly similar.

The purpose of the investigation was to determine the geotechnical suitability of the new vacant lots for development in accordance with the Resource Management Act (1991) and the Whangarei District Council (WDC) Environmental Engineering Standards (EES, 2022). The scope of our suitability assessment included consideration of any existing or potential geotechnical hazards at the nominated building sites, consideration of engineering requirements for residential construction.

Figure 1: Location of the subject site and surrounding features (LINZ Aerial Basemap, LINZ Data Service).

Figure 2: Proposed scheme plan. Modified from supplied Reyburn and Bryant C16471b Rev B.

2 Site Description

The subject site is legally described as Lot 1 and 2 DP 154366 comprising a total area of approximately 7.6ha between Tamure Place and Peter Snell Drive in Ruakaka, approximately 20km southeast of Whangarei. The currently proposed development is the third stage of development, occupying the bulk of the site with a residential area of approximately 5.4ha. Stage 1, now completed, comprised the development of 10 residential lots alongside Tamure Place, and Stage 2 being 6 residential lots off Peter Snell Drive.

The site is set amongst moderate density residential housing and is in close proximity to both the Ruakaka River, some 120m to the west, and Bream Bay some 650m to the east. The proposed subdivision will occupy the land formerly used by an equestrian park (Northgate Lodge).

2.1 GIS Mapping

Northland Regional Council (NRC)[1] and Whangarei District Council (WDC)[2] GIS Hazards Maps show the site as being:

[1] https://localmaps.nrc.govt.nz/LocalMapsGallery/
[2] https://gismaps.wdc.govt.nz/GISMapsGallery/

- Mapped as entirely within the acid sulphate soil risk area. This mapping is based on the Opus International Consultants *Acid Sulphate Soil planning policy basic guide (2015)*, which classifies the risk area as being any land below RL20m (OTPD) and underlain by recent (Holocene age) geological units.
- Mapped as outside of the 10-, 50- and 100-year river flood hazard zone (NRC), with the exception of Lot 84 which comprises a natural basin area and is entirely within the mapped 10-year flood zone (Figure 2).
- Mapped as outside of the coastal flood (inundation) hazard areas. The peak coastal inundation level in the Ruakaka River, adjacent to the site, is shown as 3.2m (NZVD) for the 100-year scenario (CFHZ2).
- Mapped "Orange Inundation Zone" for tsunami hazard. This zone represents the approximate inundation extent from a 500-year return period tsunami.

Figure 3: NRC Mapped flood susceptibility of the proposed subdivision

The WDC Assets Map shows no public services within the site. There are however several existing residential and agricultural buildings within the site, which are expected to be interconnected with private services. On-site wastewater systems are expected to service the existing dwellings at the site.

2.2 Historical Imagery Review

A review of historical and recent aerial imagery has been undertaken, with images sourced from Retrolens[3] and Google Earth. The site remained in a natural state of dune vegetation until at least 1985. The equestrian development was constructed prior to 2001. It is unknown when and how the site was developed between 1985 and 2001 due to the absence of historical imagery. Since 2001 the equestrian development has generally remained in a similar condition, with only minor changes to the development occurring. Two paddocks were subsequently developed into dressage arenas involving the placing of sand. The dwelling present within the proposed Lot 17 was constructed during 2018. The site appears to have remained in a similar condition since the construction of this dwelling.

2.3 Published Geology

The 1:250,000 geological map of the region[4] (Figure 4) shows the site as being underlain by Holocene windblown deposits across most of the site with this unit extending east towards the coast. Late Pleistocene stable dune deposits are mapped along the western margins of the site, extending west to the Ruakaka River and beyond. Descriptions of these materials are found in Table 1 below.

The Holocene stable dune deposits within the site mark the land-ward extent of the Holocene dune belt and are therefore expected to have accumulated initially during the recent sea-level maximum, approximately 7000 years ago. These dunes are inferred to have been left inactive by the recent fall in sea-level from approximately 3000 years ago. The high-standing parallel dune crest through the centre of the site is inferred to mark the true land-ward boundary of the Holocene deposits.

The Pleistocene dune deposits are inferred to have accumulated through the previous interglacial period approximately 115,000 – 125,000 years ago[5]. An elevated dune ridge is present to the west and have been eroded to steep cliffs on the western bank of the Ruakaka River, while the area between the river and the subject site appears to comprise lower-crested, aggrading dune ridges.

[3] Retrolens.co.nz
[4] Edbrooke, S.W.; Brook, F.J. (compilers) 2009: Geology of the Whangarei area: scale 1:250 000. Lower Hutt: GNS Science. Institute of Geological & Nuclear Sciences 1:250,000 geological map 2. 68 p. + 1 folded map
[5] Hayward, B. W. 2017: Out of the Ocean, Into the Fire. Geoscience Society of New Zealand.

Table 1: Summary of GNS mapped geology at the site. Inferred age based on Hayward (2017).

Key name (shaded to Figure 4)	GNS Description	GNS absolute age (years)	Inferred age
OIS1 (Holocene) parabolic dunes	Loose to poorly consolidated sand in fixed parabolic and local transverse dunes; minor sand, mud and peat in interdune deposits.	0 – 14,000	5,000
OIS5 (Late Pleistocene) stable dune deposits	Weakly cemented sand in fixed transverse dune ridges.	71,000 – 128,000	115,000

Figure 4: GNS mapped lithologies beneath the site. The dotted line is indicative on an inferred boundary between the units.

2.4 Previous Reporting

Two previous geotechnical reports have been prepared for the site, relating to Stages 1 and 2 of the development.

A subdivision (geotechnical) suitability assessment was prepared by RSEng (ref. 17367, dated 17/05/2021) for the first stage of the development, creating 10 lots at the western edge of the property, adjacent to Tamure Place. The

site investigation included six hand augered boreholes with Scala penetrometer tests, and six CPT tests, along the western edge of the site.

The investigation encountered dense sand from the surface across all test sites. Auger holes generally refused at around 2m depth against dense sand, with Scala penetrometer tests showing dense to very dense sand to at least~2.5m depth. All CPTs but one refused at shallow depth (1-2m), with refusal noted due to anchor failure.

CPT02 reached a target depth of 15m, encountering consistent dense sand through this depth. Cone resistance (qc) was generally in the range of 6-12MPa within the upper 10m of the soil profile, increasing to 12-15MPa below this. The assessment of the site included liquefaction analysis based on the above CPT, with settlements under ULS loads predicted at less than 1cm, indicating negligible liquefaction hazard at the site.

A geotechnical suitability report was prepared by LDE Ltd (ref 18319, dated 30/9/21) for the second stage of the development. This stage created 6 new lots on the north-eastern property boundary, immediately south of Peter Snell Road. The investigation of these lots included six hand auger boreholes to a target depth of 3m and six Scala penetrometer tests adjacent to each borehole, one of each test per lot.

The investigation encountered a generally consistent profile of topsoil underlying dune sands. The hand auger boreholes each terminated short of 3m upon striking the groundwater table. Scala penetrometer testing identified an increasing penetration resistance with depth, increasing from 1-2 blows/50mm penetration in the upper sands, to 2 – 5 blows/50mm penetration in the remaining soil profile.

2.5 Site Characteristics

The site is presently occupied by an equestrian park, consisting of various farm buildings, a dressage arena, paddocks and associated fencing, connected with a series of gravel tracks. An existing dwelling is present within Lot 14 and is anticipated to remain throughout the development process. All other buildings are expected to be removed as part of the development.

The site has been broadly divided into three separate topographic areas, as summarised below and shown in Figure 5.

2.5.1 Western low-lying area

This area is bound by the Stage 1 development to the west and the central dune to the east. This area comprises generally flat paddock areas lying at approximately RL4.0m (NZVD2016). The paddocks have gentle fall towards a constructed channel which is assumed to have been constructed to drain the land for grazing. The drain was re-aligned to follow the eastern boundary of Stage 1 and is proposed to be vested as a drainage reserve. The area appears to receive overland flows from the north.

This area is inferred to be the eastern extent of Pleistocene age dunes (as described in Section 2.3).

2.5.2 Central dune ridge

The ridge runs north to south through the centre of the site. The area is predominantly occupied by farmland but includes the recently constructed dwelling to the north (to remain in currently proposed Lot 14) and a small dwelling to the south. The ridge crest is elevated at approximately RL8.5m and varies in width from 15-25m. Western side slopes are gentle (generally 5-10°). Eastern side slopes are steeper at up to approximately 20° but are limited in height up to approximately 2.5m.

The ridge crest rises to approximately RL15m at the northern boundary of the site and continues at this elevation for a significant distance to the north through undeveloped land and then through a recreation reserve between older residential areas. It is inferred that the ridge has historically been cut down within the site to create usable land.

The dune ridge is inferred to be the western margin of the Holocene age dune belt which developed at the early stages of the recent sea level maximum, as discussed in Section 2.3.

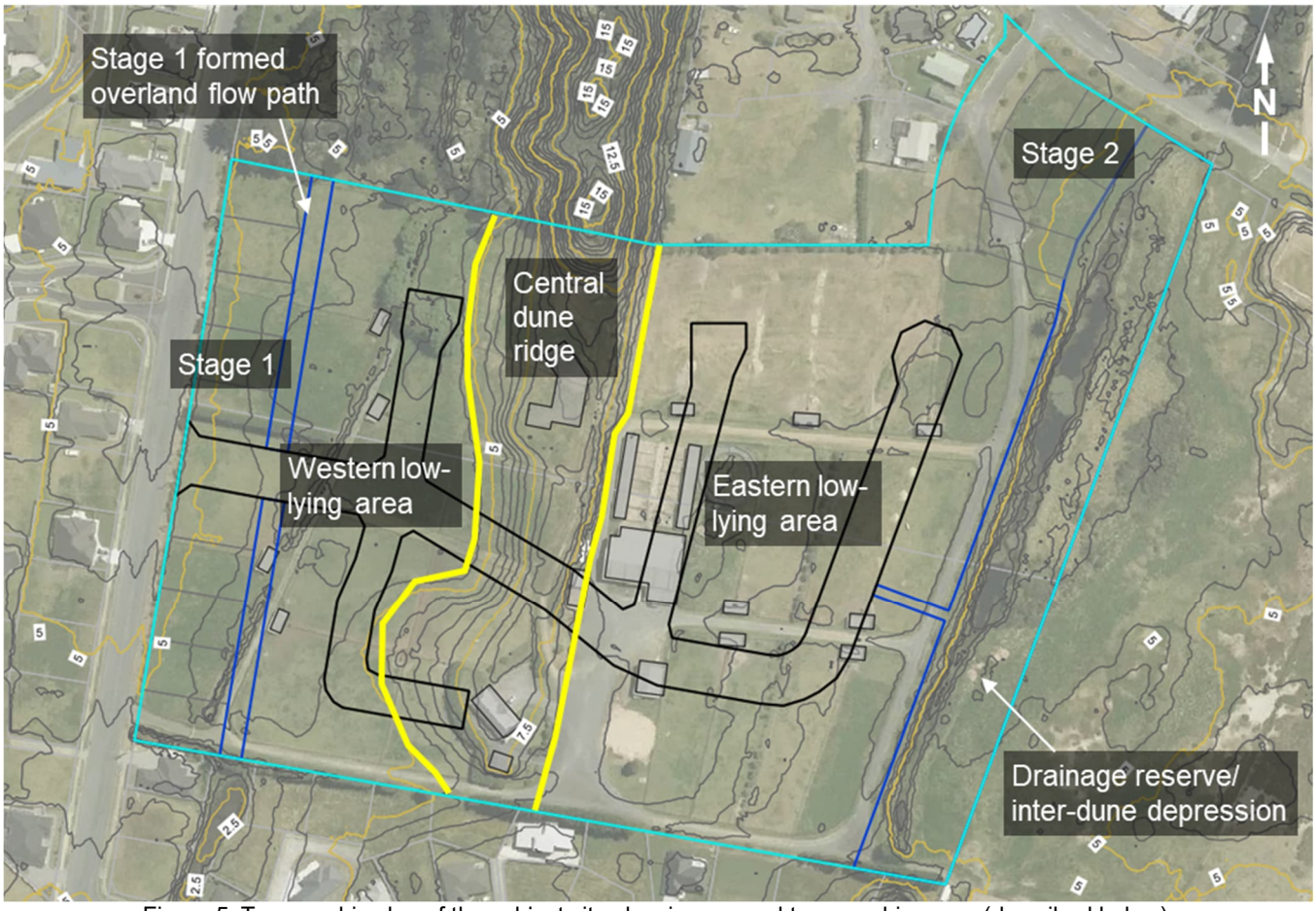


Figure 5: Topographic plan of the subject site showing general topographic areas (described below).

2.5.3 Eastern low-lying area

The area is bound by the central ridge to the west and the interdune depression area (proposed drainage reserve) to the east. The area comprises broadly flat paddock areas elevated at between RL5.5m and 6.5m. The paddocks

appear to be graded with even fall to central overland flow paths. A built-up stable area and large hardstand area centrally and to the south on the western boundary of the area. The area appears to drain east towards the drainage reserve.

This area is expected to have had a natural geomorphology of inactive parabolic dunes undulating around RL5 - 7m, similar to adjacent undeveloped land to the north. The site is expected to have been cleared and levelled to form paddock during early agricultural development.

3 Ground Conditions

3.1 Subsurface Investigations

Our investigation of the site included the following work:

- Nineteen 50mm hand augered boreholes (HA101 to HA119) put down to a target depth of 3m or refusal. Dynamic Cone Penetrometer (DCP) tests were performed in 1m increments ahead of the hand auger. DCP results are shown on the corresponding borehole logs.
- Twelve Cone Penetrometer Tests (CPT01 - CPT03, CPT06 - CPT14) put down to a target depth of 15m or refusal. CPT04 and CPT05 refused at shallow depth and were not recorded or presented herein. DPSH tests were carried out at these locations instead. Three dissipation tests were carried out, at the base of CPT02, CPT06, and CPT12.
- Two Dynamic Probe-Super Heavy tests (DPSH04 – DPSH05) were performed where CPTs could not penetrate beyond 2m depth.

The locations of the subsurface investigations are shown on the Geotechnical Investigation Plan in Appendix B. Test logs are attached in Appendix C. The field work was completed across May to June 2022.

3.2 Subsurface Conditions

3.2.1 Western low-lying area

Testing within this location included:

- HA116 – HA119
- CPT03
- DPSH04 – DPSH05

Hand augers encountered a thin veneer of topsoil and loose to medium dense sand, underlain at shallow depth (0.4 to 0.8m) by a ‘hardpan’ of very dense cemented sand, leading to shallow auger refusal. Scala penetrometer testing refused immediately on the hardpan.

CPT testing refused on the hardpan at the locations of DPSH04 and 05. DPSH tests were able to penetrate the hardpan and show generally loose ground above the hardpan, located at 2.0m depth at DPSH04 and at 0.6m depth at DPSH05. The testing generally showed consistent medium dense to dens ground below the hardpan, to at least 10.0m depth.

Perched groundwater was encountered above the hardpan at two of the hand auger borehole locations. Groundwater levels were recorded in DPSH05, closer to the swale, as 1.03m, while no groundwater was recorded above 2.4m in DPSH04, closer to the central ridge.

CPT03 reached a depth of 2.84m depth before refusing within the hardpan. Refusal was due to limit of reaction force (i.e. anchor pull-out).

The ground conditions within the western low-lying area are generally consistent with the findings of the Stage 1 (RSEng) geotechnical investigation.

3.2.2 Central Ridge

Testing within this location included:

- HA111 - 115
- CPT01, CPT02, CPT06, CPT07

Hand augers generally encountered topsoil up to approximately 200mm depth across this area.

Towards the north of the ridge (HA111 and HA112), topsoil was underlain by generally homogenous loose to medium dense sand to the base of boreholes. Scala testing from the base of HA112 encountered sharp refusal at 2.7m depth which may be the extension of the hardpan from the west beneath the dune ridge.

The underlying sand was more variable to the south. An extended zone of very loose sand was identified in HA114 between 1.0m and 2.2m depth, and interdune peat/organic sand was encountered in both HA113 and HA114, at a depth of 1.1m and 2.2m respectively.

HA113 and HA114 reached the target depth of 3.0m, with no groundwater encountered. The remaining boreholes refused at between 1.7m and 2.6m depth, due to borehole collapse. Saturated ground was encountered around refusal depth in HA112 and HA115, indicative of groundwater level.

CPT01, CPT02 and CPT06, located on the western side of the ridge, refused at relatively shallow depth likely on the hardpan horizon extending from the western low-lying area. The tests show a profile of loose to medium dense sand and silty sand above the hardpan, with low strength organic soils likely peat also shown at CPT02 from 0.7 to 1.2m depth.

CPT07, located on the eastern side of the ridge crest, reached a target depth of 15m, and showed a profile of very dense clean sand to 6m depth. This was underlain by lower strength silt and clay from 6.0m to 8.0m depth with a very dense horizon at 8.0m, indicative of a possible hardpan. Dense sand continued below this to 15m depth.

3.2.3 Eastern Low-Lying Ground

Testing within this location included:

- HA101 - HA110
- CPT08 - CPT14

Hand augers generally encountered topsoil to a depth of 200mm across this area, with exception of HA101 – HA104 where topsoil appears to have been stripped from the dressage area.

The topsoil was found to be underlain by generally clean dune sands, comprising of typically medium dense to dense fine sand with a minor proportion of silt.

A very loose layer of sand was encountered in HA104 between 1.95m and 2.25m depth, extending beyond the depth of the borehole, at or about the groundwater table level. The sands otherwise showed a trend of increasing density with depth, with HA101 to HA103 and HA107 showing sharp Scala refusal generally beyond 3.5m depth.

Buried organic soils were encountered in HA103 and HA109, which comprises highly organic sands with a variable clay content. The material was encountered from between 1.1m and 1.5m depth in HA103 as thin lenses, and 0.8m and 1.0m in HA109 as a discrete layer.

CPT08 to CPT11 reached a target depth of 15m and show a consistent profile of high density (generally q_c >12MPa) clean sand through to roughly 11-12m depth, with lower density (q_c = 4 - 8MPa) sand below this. Discrete layers of even lower density sand were encountered in CPT08 and CPT09, around 13.5 to 14.5m depth (q_c = 2 - 4MPa).

CPT12 to CPT14 all refused at shallower depth (5.0 to 7.0m), reaching the limit of reaction force (anchor pull-out) when pushing into very dense sand at around these depths.

3.3 Synthesis

The ground conditions across the site are broadly consistent with the mapped geology of the area.

- The western low-lying area is underlain by Pleistocene age dune sands with a podsolised ‘hardpan’ at shallow depth, and generally dense sands below.
- The central ridge is underlain by variable loose to medium dense dune sands. This is inferred to be the western boundary of the recent Holocene dune sands, pushed up into a high ridge as sea-levels began to fall from their recent maximum. Pleistocene dune sands appear to slope towards the east beneath these deposits.
- The eastern low-lying area is underlain by Holocene dune sand, which appears to have been relevelled to form paddocks. This comprises predominantly medium dense sand with some lenses of lower density or organic material. The sands generally increase in density with depth. The Pleistocene age dunes

may continue to slope east-wards beneath these deposits, based on CPT strength profiles, however this has not been confirmed.

While not encountered during our testing it is likely that uncontrolled sand fill is present in isolated areas across the site. This material is likely beneath the existing concrete slab buildings and the metalled accessways across the site, and may exist in small patches across paddock areas where levelling has been carried out. Clean sand placed as fill is unlikely to be differentiated from natural loose sand and is therefore not shown on test logs.

Bedrock was not encountered in the testing but is expected to be Waipapa Group basement terrace (greywacke), and is expected to lie at greater than 30m depth beneath the site.

Figure 6: Exposure of the hardpan within a surface drain. Image taken looking approximately north on the western boundary of Lot 78.

3.4 Soil Moisture Profile and Groundwater Conditions

Testing was performed during winter and over a period of wet weather. As a result, the groundwater observations are expected to be consistent with ‘design’ winter groundwater levels.

The apparent groundwater depth shows significant variation around the site. Hand auger boreholes put down in clean sand generally collapsed after a short depth in saturated sand, typically in the range of 1.5m to 3.0m depth, however several boreholes reached 3m depth without encountering saturated ground. The fine sand soils at the site are expected to be subject to significant capillary rise of groundwater, creating a zone of saturated soils above the hydrostatic groundwater level or phreatic surface. The depth of saturation noted on borehole logs is therefore expected to be some height above the groundwater table.

Three dissipation tests were performed in conjunction with the CPTs, in CPT02, CPT06, and CPT12, to establish in-situ equilibrium pore pressures to help characterise the groundwater conditions at the site. The results and interpretation and summarised in Table 2 below.

Table 2: Dissipation test results and inferred groundwater levels. Inferred ground water depth taken as test depth plus equilibrium pore pressure head (u_0 x 9.81 kPa). Note pore pressure rise observed towards end of dissipation at CPT02, indicating that equilibrium may not have been met.

CPT ID	Dissipation test depth (m)	Initial pore pressure (u_i, kPa)	Equilibrium pore pressure (u_0, kPa)	Inferred ground water depth (m)	Groundwater elevation (mRL, NZVD 2016).
CPT02	4.68	29.2	17.1*	2.93*	1.5
CPT06	4.27	85.5	0.00	>4.27	<1.0
CPT12	7.01	121.4	8.1	6.18	0.2

Based on the results of the dissipation testing, consideration of the topographic constraints at the site, and the observations from boreholes, a groundwater level of RL 3.0m (NZVD2016) has been adopted for analysis, being approximately 1.5m depth across the western low-lying area, 2.5m depth across the easter low lying area, and up to approximately 6.0m depth below the crest of the central ridge.

The near surface soils are expected to be well draining and are unlikely to be subject to surface saturation from rainfall (i.e. development of wetting front). During the extended periods of wet weather, the static groundwater level may rise somewhat, however with the site developed and being largely impervious, complete saturation of the ground is considered unlikely to occur.

3.5 Seismic Subsoil Category

The depth to basement rock has not been established in our investigation but is expected to lie at greater than 30m depth. The Stage 1 geotechnical report prepared by RSEng refers to a deep borehole at the refinery site, encountering bedrock at 30 to 50m depth, and classified the site as Class D on this basis.

Based on the geomorphology of the site, the expected depth to bedrock and the strength profile observed in CPT testing, we consider that the site is a Class D ‘deep or soft soil site’ as defined by NZS 1170.5 (2004) “Structural Design Actions: Part 5: Earthquake actions – New Zealand”.

4 Natural Hazards and Ground Deformation Potential

4.1 Definition and Legislation

This section summarises our assessment of the natural hazards within the property as broadly required by Section 106 of the Resource Management Act (1991 and subsequent amendments) and including geotechnical and coastal hazards given Section 71(3) of the Building Act (2004). This includes erosion, inundation, subsidence, and slippage.

This section also includes our assessment of ground beneath the building site which is outside the definition of "Good Ground" as defined by NZS3604 (2011) "Timber Framed Buildings".

4.1.1 Tsunami

Tsunami pose a risk to any low-lying coastal areas of New Zealand and can pose a risk of expected loss of life greater than (double) that of the near-source earthquake event itself. However, tsunami is not specifically identified under the Building Act (2004) in comparison to the specified inundation sources (flooding, overland flow, storm surge, tidal effects, and ponding).

Although tsunami will result in inundation of coastal lowlands, there are currently no prescriptive methods or specific code designs that need to be considered in building design, and it should be appreciated that to date some form of tsunami risk is knowingly or unknowingly accepted by the wider population and society of New Zealand for any low-lying titled land adjacent to the coast.

The site is mapped as within the orange zone for tsunami hazard, representing the zone of inundation from a 1 in 500-year tsunami event. It is therefore considered that additional design considerations are not required to mitigate against the potential adverse effects of wave heights associated with tsunami inundation at the site given the low likelihood of event occurrence.

Although no additional design consideration is required, it is considered good practise for the owners of the property to be familiar with evacuation routes to the nearest point of significantly higher ground should evacuation be required. Further information on tsunami preparedness can be found on the NRC CDEM website[6].

4.2 Acid Sulphate Soils

The site is within an acid sulphate soil risk area as identified on the WDC Hazards Maps and described in the Opus Acid Sulphate Soils Planning Policy Guide 6. The site is included in the risk area on the basis that it is at less than RL20m elevation and is mapped as underlain by recent sedimentary deposits.

The Acid Sulphate Soil Planning Policy Guide gives risk-based criteria for the classification of developments based on earthworks elevations and volumes. Most of the subject site is elevated above RL5.0m, with only the western

[6] https://www.nrc.govt.nz/civildefence/tsunami-evacuation-zones/

low-lying ground below this level. This incorporates Lots 1 – 7, the lower half of Lots 9 – 12, Lot 65 and Lots 74 – 81. Earthworks removing surficial organics may result in only the lower edges of Lots 3, 5 and 6 being below this level. Any bulk earthworks associated with the development of the lots is expected to above RL5.0m, and any earthworks below this level are expected to be topsoil stripping and fill only and would therefore present little acid sulphate soil risk.

The installation of services may involve minor excavations below RL5.0m, however given that these would be in clean sand material, would be above the water table with no de-watering, and be limited to plastic (PE or PVC) pipes for lot connections, we do not consider that acid sulphate soils present a significant risk to the proposed development.

This should be re-assessed based on the final subdivision design at the time of detailed design, with particular attention given to any concrete infrastructure below RL5.0m and below the groundwater table.

4.3 Liquefaction

Liquefaction is the term used to describe the severe strength loss which can occur when saturated loose to medium dense sands and low plasticity silts are subject to seismic shaking.

In addition to strength loss, liquefaction may also result in the expulsion of sand, silt and water at the surface, post seismic settlement, and lateral movement towards areas of lower elevation such as rivers or streams, referred to as lateral spreading. Differences in the amount of liquefaction due to variations in the ground can result in differential surface settlement. In addition, significant building settlement can occur due to the severe loss of strength and subsequent bearing capacity failure of the ground.

The site is in a region of low seismicity, accordingly the potential deformations associated with earthquake shaking are expected to be low. However, due to the presence of saturated clean sand and silty sand identified in the CPT and hand auger investigations a preliminary liquefaction analysis was undertaken.

MBIE Earthquake Geotechnical Engineering Practice – Module 1, titled “Overview of the guidelines” (dated November 2021, Version 1) provides recommended peak ground acceleration (a_{max}) and Earthquake Magnitude (M) based on the New Zealand seismic hazard model and the calculation method outlined in the NZTA Bridge Manual. The Bridge Manual recommends ‘lower bound’ seismic parameters for analysis in Auckland and Northland, based on a magnitude 6.5 earthquake at 20km distance, in addition to the ULS values predicted from the seismic hazard model. These parameters are shown below in Table 2 and were used for the liquefaction analysis of the site.

The liquefaction potential of soils has been assessed in accordance with MBIE Earthquake Geotechnical Engineering Practice - Module 3[7]. CLiq v3.4 has been used for numerical analysis of CPT data, with the procedure of Boulanger & Idriss (2014) adopted. Liquefaction-induced free-field vertical volumetric strains were estimated for the SLS and ULS design seismic events using the method of Zhang et al. (2002). Default assessment values were utilised within the CLiq software during the liquefaction analyses. These include, but are not limited to, assuming

[7] https://www.building.govt.nz/building-code-compliance/b-stability/b1-structure/module-3-identify-liquefaction-hazards/

the existing ground is level, utilising an Ic cut-off of 2.6, applying clean sand and overburden corrections, automatic calculations for soil unit weights and applying automatic corrections to the input data at soil transition layers.

The groundwater levels presented in Section 3.4 have been adopted for analysis, with the groundwater level raised by 0.5m for the earthquake event.

Table 3: Seismic parameters adopted for liquefaction analysis, based on MBIE Module 1.

Seismic Parameter	SLS (25-year)	ULS (500-year)	ULS Lower Bound (500-year)
Peak ground acceleration (a_{max})	0.03	0.13	0.19
Magnitude M	5.8	5.8	6.5

4.3.1 Susceptibility

The site is underlain by predominantly clean fine to medium sand and silty sand. The groundwater level is relatively shallow across most of the site.

The central ridge and eastern low-lying area are inferred to be underlain by Holocene age inactive dune sands, deposited shortly after the recent sea-level maximum, with an inferred age of approximately 5000 years (as discussed in Section 2.3). The western low-lying area is underlain by Pleistocene age dune sands with an inferred age of approximately 115,000 years, being deposited at or around the last interglacial sea-level maximum.

While the composition of the Pleistocene age dunes is consistent with liquefaction susceptibility, the age of the deposit, the strength and cementation of the sands all indicate low susceptibility.

The Holocene age sands underlying the central ridge and eastern low-lying area are considered to have high liquefaction susceptibility.

Given the low seismicity of region, the inactive nature of the dune deposits, and the relatively short period that the soils have been exposed to groundwater at or around current levels, it is considered unlikely that the soils at the site have previously been subject to liquefaction. It is therefore considered appropriate to apply an aging factor to cyclic resistance ratio for assessment of liquefaction triggering.

Aging factors have been calculated in accordance with the empirical formation given in Safter et al. 2015[8]. Aging factors K_{DR} of 1.58 and 1.83 have been calculated for the Holocene and Pleistocene age sediments respectively.

[8] Safter, D.A, Green, R.A., Hryciw, R.D., 2015. *Use of explosives to investigation liquefaction resistance of aged sand deposits.* Engineering Geology 199 (2015) 140 – 147.

4.3.2 Liquefaction Analysis

All CPT tests have been included in the analysis, although it is primarily the CPTs located on the eastern low-lying area (CPT08 to CPT14) where soils are expected to be reasonably susceptible to liquefaction.

As expected, significant liquefaction was limited to CPTs on the eastern side of the site, and was only predicted for those CPTs which reached target depth (CPT08 to CPT11). CPT12 – CPT14 are expected to be underlain by similar ground conditions but had shallow refusal.

Liquefaction induced settlements became significant only in the 'lower bound' ULS event. At both the conventional (i.e. hazard based) ULS and SLS event no liquefaction is predicted.

For the lower bound event, liquefaction induced settlement of 12 – 15mm is predicted for CPT08 to CPT10, up to a maximum of 25mm for CPT11. Liquefaction is confined to the lower density sands at 10-15m depth below the site. Given the relatively low settlements and the depth of liquefaction, no surface expression of liquefaction is predicted. LPIs are in the range of 'low risk' (0 or near 0) for all CPTs, and LSNs are in the range of 0 to 2, indicative little liquefaction.

Parametric analysis in CLiq shows total vertical settlements becoming significant (i.e. >50mm settlement) from above approximately 0.25g, however given the significant depth of non-liquefied dense sand, surface expressions are expected to remain limited. Parametric analysis of LSN shows minor liquefaction (LSN <20) up to and exceeding 0.5g for all CPTs.

Analysis was undertaken without the aging factor applied as a sensitive check, and found liquefaction induced settlements in the eastern low-lying area to be on the order of 100mm (90 – 110mm) for the 'lower bound' ULS case, however this remains primarily at depth within the soil profile, with LSNs remaining in the range of little to minor liquefaction (LSN of 7 – 11). It is considered conservative to both ignore aging and to apply an earthquake action greatly exceeding the calculated probabilistic seismic hazard for the site, however this shows no significant step-change into moderate or severe liquefaction induced damage when considering these factors in combination.

4.3.3 Conclusion

Based on the results of the analysis, minor liquefaction may occur in the design ULS event, exceeding the 500-year return period seismic hazard for the site. Liquefaction induced settlement is within conventional design tolerance, and surface expression of liquefaction is expected to be minimal given the significant depth at which significant settlements are modelled to occur. Specific design against liquefaction is therefore not required.

A tabulated summary of all liquefaction analyses is shown in Table 4 below. Analysis outputs are shown in Appendix D. Full analysis printouts are supplied only for the ULS lower bound case. Summaries are provided for all other cases.

Table 4: Summary of liquefaction analysis results. Highlighted rows indicate CPTs where shallow refusal was met.

Area	CPT	ULS (0.13g / M5.8)		Lower bound ULS (0.19g / M6.5)		Lower bound, no aging factor	
		Vertical settlement (mm)	LSN	Vertical settlement (mm)	LSN	Vertical settlement (mm)	LSN
West low-lying	CPT01	0	0	0	0	1	0
	CPT02	0	0	5	1	22	6
	CPT03	0	0	0	0	13	13
	CPT06	0	0	0	0	1	1
Ridge	CPT07	0	0	0	0	18	1
East low-lying (Holocene)	CPT08	0	0	14	1	106	9
	CPT09	0	0	12	1	112	11
	CPT10	0	0	15	1	89	7
	CPT11	0	0	24	2	112	10
	CPT12	0	0	0	0	1	0
	CPT13	0	0	0	0	3	1
	CPT14	0	0	0	0	0	0

4.3.4 Lateral Spreading

While free faces exist to the east and west of the development area, the liquefaction analysis shows very limited liquefaction occurring a depth at which it could not affect lateral spreading at the site. The lateral spreading hazard at the site is therefore considered to be negligible.

4.4 Slope Instability

The site is for the most part flat or gently sloping. The only slopes of significance within the site are the steep eastern flank of the central ridge area (up to 28°), and the short, steep bank slopes into the drainage reserve areas.

The slopes were found to be underlain by generally moderately dense sands which are expected to have a stable angle of repose on the order of 34°. The slopes are therefore expected to be stable in their existing condition, and are expected to have an adequate factor of safety against failure (i.e. >1.5).

The slopes are expected to be highly sensitive to surcharging, changes in angles, and erosion from uncontrolled stormwater. As a result, care will be required during subdivision design to ensure that the stability of the slopes is maintained.

It is anticipated that the subdivision earthworks will generally flatten the site (i.e lower the ridgeline and raise lower lying areas), however it is understood that the existing dwelling is to remain which will limit earthworks on the northern side of the central ridge.

Preliminary earthworks design recommendations are given below for

4.5 Compressible Ground and Consolidation Settlement

CPTs and hand auger boreholes completed across the proposed development identified various potentially compressible soils, including loose sand, organics, and low strength clay. These materials were generally confined to the upper soil profile, although some loose zones were encountered at depth (e.g. HA104, HA114).

Any such compressible materials exposed at the surface should be stripped during earthworks and replaced with engineered fill where necessary, in accordance with requirements of the relevant earthworks and residential construction standards (NZS4431 and NZS3604).

Where deeper loose clean sand exists (i.e. as encountered in HA114), partial stripping, wetting, subgrade compaction, and proof rolling may be sufficient to mitigate any further settlement hazard, however this will depend on final fill levels and loads.

Given the significant variability in the depth and extent of compressible materials across the site, it will be necessary to undertake detailed subgrade inspection and verification testing during initial earthworks to confirm undercut requirements.

4.5.1 Preliminary 1D Analysis

As an initial check of the settlement potential of the deeper loose soils, preliminary 1-dimensional consolidation analysis was undertaken for each of the CPTs, using CPeT-IT Version 3. Primary settlement is calculated based on constrained modulus values interpreted from CPT results. Secondary settlement is calculated based on interpretated non-linear secondary compression index (C_a), over a period of 50 years, being the typical design life of a dwelling.

Two load cases have been considered in the analysis

- 10kPa rigid load applied over a 12m by 12m square, representing a typical residential building on a raft slab foundation.
- 36kPa flexible load over a 50m by 50m area, representing a 2m earthfill with a unit weight of 18kN/m^3.

An embedment depth for foundations and fill of 300mm was applied to each CPT. This represents both the removal of topsoil which occurs during the normal construction procedure and removes potentially unreliable data gathered within the surficial materials by the CPT.

The settlement analysis outputs are presented in Appendix E and are summarised in Table 5.

Static settlements are largely negligible across the entire site, with settlement being within tolerance for both the dwelling load and earthworks load.

CPT02 shows the greatest settlement, with 20mm predicted under the earthworks load. Given that the settlement is occurring in well-draining sand and expected to be near immediate, it is expected that no appreciable settlement will occur following completion of earthworks.

Table 5: Calculated static settlement for typical dwelling and nominal earthwork loads.

CPT	CPT depth (m bgl)	Total predicted static settlement (mm)	
		Dwelling load (10kPa)	Earthworks load (36kPa)
CPT01	3.48	0.18	6.3
CPT02	4.68	6	20.0
CPT03	2.84	0.8	3.1
CPT04	4.27	2	6.7
CPT07	15.23	3.3	10.5
CPT08	15.11	2	8.8
CPT09	15.1	1.3	7.2
CPT10	15.07	1.4	7.5
CPT11	15.08	0.9	6.2
CPT12	7.01	0.7	3.5
CPT13	4.97	0.6	2.8
CPT14	6.2	0.4	3

4.6 Erosion

The site is underlain by fine sand soils which are expected to be highly erodible under flowing water, making piping erosion a significant hazard associated with the development of the site. Care will be required to ensure pipes are adequately sealed and trench fills are well compacted to minimise the risk of piping around service trenches. Site-sourced sand is considered unsuitable for trench backfill.

4.7 Conclusions

From our assessment of the natural hazard and ground deformation risks presented to the proposed development we consider that the site is suitable for development, provided that the recommendations given in Section 5 are adhered to.

5 ENGINEERING RECOMMENDATIONS

5.1 Site Preparation and Earthworks

Bulk earthworks are expected to be limited to down-cutting off the central ridge area where possible to provide level roadways through the development area, and likely filling of the western low-lying area to raise building platform levels. Other minor cuts and fills are expected for platform grading and for the formation of right of ways.

5.1.1 Stripping and Proof Rolling

All surficial organics, loose sand and uncontrolled fill should be removed beneath any residential lots, road carriageways, and engineered fill areas. Stripped ground should be inspected and proof rolled prior to any filling. Where deemed necessary by the project geotechnical engineer, subgrade should be wetted and compacted in situ to increase subgrade density, and proof rolled to verify adequate density.

CPT02 appears to show deeper organic soils extending to approximately 1.3m below ground level. Similar ground was encountered in lenses across the Stage 1 area and should be anticipated to exist above the hardpan across the low-lying western area. Bulk stripping up to 1.3m, but more typically on the order of 0.5m depth, should be anticipated in this area.

Suitable subgrade is expected to exist across the remainder of the site, below topsoil and surficial loose sand, with the exception of HA114, which shows very loose sand extending to over 2.0m depth. This borehole is located on the central ridge landform and in close proximity to the proposed road alignment. It is expected that the road will be cut down through the ridge, which will ideally remove most of the loose sand identified in this area. Where this is not the case, deepened undercutting will likely be required to provide adequate road subgrade.

5.1.2 Cuts

Any cuts should be formed to a batter slope no steeper than 1V:6H for a maximum height of 2m, or otherwise retained by engineered retaining walls.

Steeper slopes may be suitable where surface water is carefully controlled, however this should be subject to specific assessment.

5.1.3 Fills

Earth fills for building platforms should be limited to 2m depth and should be battered at a maximum of 1V:6H without specific geotechnical assessment or otherwise retained by an engineered retaining wall.

All fill forming part of the building platform needs to be placed in a controlled manner to an engineering specification that follows the general methodology given in NZS4431 (2022) “Engineered fill construction for lightweight structures”. This includes the design, inspection, and certification of the fill by a Chartered Professional Engineer or

Professional Engineering Geologist. This will be particularly important to enable the building proposed for the site to be able to be constructed in accordance with NZS3604 (2011) “Timber Framed Buildings”.

The following specification is recommended for earth fills:

- All topsoil and unsuitable materials, including low strength ground, uncontrolled fill, rubbish etc shall be stripped from the footprint area of the fill.
- Where fill is placed on subgrade slopes steeper than 1V:6H the subgrade shall be benched. Fill should not be placed on slopes steeper than 1V:4H without specific assessment.
- Underfill drainage should be provided where any fills are placed over hardpan areas (generally to the west of the site),
- The stripped subgrade surface should be inspected by the certifying engineer prior to placing any fill.
- Compaction control should be principally in terms of a minimum dry density percentage and maximum allowable air voids. Where fills are less than 1m deep, verification by Scala penetrometer testing may be appropriate, however this will be at the certifying engineers’ discretion. Recommended compaction control criteria are presented in the table below.
- The testing frequency and specification should be confirmed with the contractor prior to commencing work.

Inorganic site won material is expected to be generally suitable for placement as earth fill, provided it is not allowed to become too wet or too dry. Compaction at or around natural moisture content is expected to be suitable based on our experience with similar materials.

Provision should be made to ensure that the earthworks are conducted with due respect for the weather. The fill should not be placed on to wet ground, especially if ponded water is present.

Table 6: Recommended fill compaction criteria

Air voids percentage		
	Average value not more than	10%
	Maximum single value	12%
Maximum dry density percentage		
	Average value not less than	95%
	Minimum single value	92%

Specific gravity and NZ Standard (or heavy) Compaction laboratory tests will be required to be undertaken prior to the commencement of earthworks to establish the compaction criteria associated with the air voids and dry density earthworks controls.

5.1.4 Retaining Walls

The following material strength parameters may be adopted for the design of retaining walls embedded into and supporting medium dense sand or sand fill. Specific geotechnical assessment is recommended for any specific retaining walls proposed as part of the development, to account for locally loose zones, organic materials, hardpans etc. Retaining walls should be designed for drained strength parameters.

- Unit weight 18kN/m^3
- Friction angle 34°
- Cohesion 0 kPa

Retaining walls should include adequate behind wall drainage include provision of filter cloth to minimise piping of find sand into drainage units.

5.1.5 Site Contouring and Topsoiling

As soon as possible, all final cut-slopes and fill slopes should be covered with topsoil a minimum of 0.10m thick to minimise erosion of the fine sand soils at the site.

The finished ground level should be graded so that water cannot pond against, beneath or around any buildings and retaining walls for the economic life of structure. To achieve this, it will be important that the building platform beneath the topsoil grades away from the site. Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

5.2 Preliminary Foundation Design Recommendations

Preliminary foundation recommendations are provided below for information only. Foundation recommendations and any further specific investigation requirements should be confirmed as part of the geotechnical completion report.

Based on our investigation and appraisal of the building site, we expect that conventional shallow pile, concrete slab-on-grade, or raft-slab foundations will be suitable for the sites.

Provided that building platforms are adequately stripped, undercut where required, and supported by medium dense natural ground or engineering fill, ‘Good Ground’ is expected to exist as defined in NZS3604 (2011).

Where deeper zones of loose or organic material exist, it may be preferable to leave sites as being outside of ‘Good Ground’ and requiring specific foundation design. Driven timber piles foundations are expected to be suitable for such sites, with piles driven to adequate bearing in medium dense to dense sand.

Where ‘Good Ground’ is provided, conventional shallow timber pile or slab-on-grade foundations are considered suitable.

Standard design raft-slab foundations are also expected to be suitable (e.g. RibRaft, Cupolex, XRaft etc.), subject to confirmation from the supplier.

5.3 Roading

Based on the findings of the investigation, road subgrades are expected to comprise predominantly clean sand. Undercutting of shallow organics and loose sand is likely to be required over the eastern and western low-lying areas, to depths on the order of 300-400mm. More significant undercutting may be required through the central ridge where very loose soils were encountered to significant depth.

A subgrade CBR of 5-7% is expected to be available over most of the road alignment subject to shallow surface stripping, however this will depend on final road levels.

5.4 Geotechnical Design Review

The final scheme plan and resource consent level earthworks design should be subject to review to confirm that the design is generally in accordance with our assumptions and to confirm any recommendations for any earthworks not addressed herein.

5.5 Stormwater Management

The stormwater design for the proposed subdivision is addressed in a separate LDE report. This is expected to include assessment of design flow levels in drains which may govern floor levels or platform design for some of the low-lying sites.

6 LIMITATIONS

This report has been prepared exclusively for EB Developments Limited with respect to the particular brief given to us. Information, opinions, and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

This report was prepared in general accordance with current standards, codes, and practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods, and subsurface investigations at discrete locations. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from that described in this report.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

APPENDIX A

SUBDIVISION SCHEME PLAN

CAUTION:

1. THIS DRAWING SHOULD NOT BE AMENDED MANUALLY.
2. AREAS & DIMENSIONS ARE APPROXIMATE ONLY AND ARE SUBJECT TO FINAL SURVEY.
3. THE VENDOR & PURCHASER MUST CONTACT THE SURVEYOR IF SALE & PURCHASE AGREEMENTS ARE ENTERED INTO USING THIS PLAN.
4. ALL SERVICES SHOWN ARE EXISTING AND TAKEN FROM WDC GIS.
5. SERVICES MUST NOT BE POSITIONED USING THIS PLAN.
6. DO NOT SCALE OFF DRAWINGS.
7. THIS PLAN IS COPYRIGHT TO REYBURN & BRYANT (1999) LIMITED.
8. DESIGNED BY REYBURN & BRYANT - WHANGAREI - NEW ZEALAND
9. 04m 2014-2016 RURAL AERIAL SOURCED FROM AERIAL SURVEYS LTD INFORMATION AVAILABLE ON LINZ DATA SERVICE.
10. BOUNDARIES SOURCED FROM QUICKMAP. COORDINATES IN TERMS OF MOUNT EDEN 2000.

REV	DATE	DESCRIPTION
B	10.02.22	REFINE OPTION 2 CONCEPT FOR CLIENT - PL/SB
A	02.02.22	CONCEPT FOR CLIENT CONSIDERATION - PL/SB

REF. DATA: 15779

reyburn & bryant
Ph: 09 438 3563
7 Selwyn Ave, Whangarei
PO Box 191, Whangarei 0140
www.reyburnandbryant.co.nz

CLIENT

EB DEVELOPMENTS LTD
TAMURE PLACE/PETER SNELL ROAD, RUAKAKA

TITLE

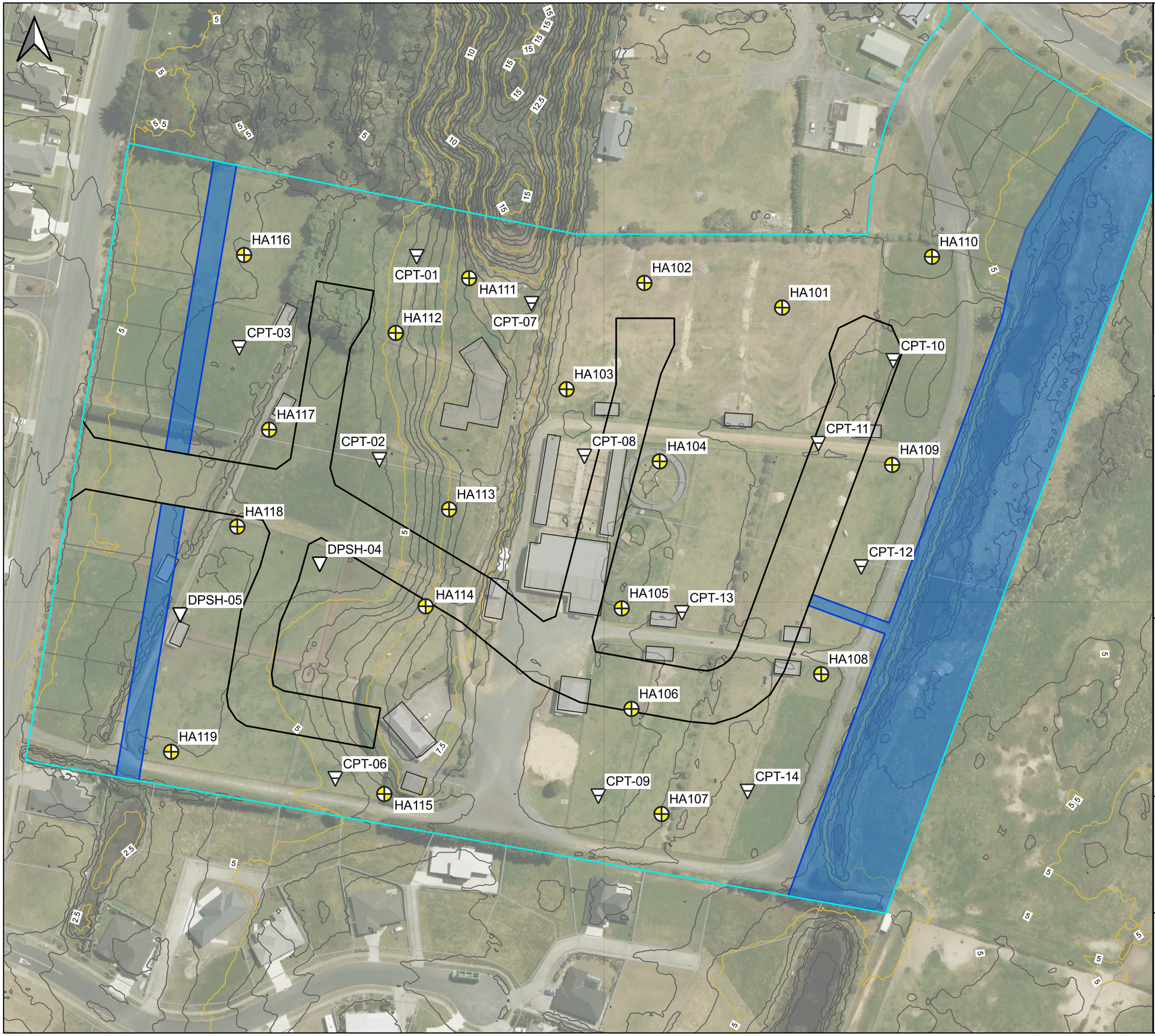
STAGE 3 CONCEPT PLAN

DATE	FEB 2022	SCALE	1:1250 @A3	
NO.	C16471b	SHEET	1/1	Rev. B

LOCAL AUTHORITY: WHANGAREI DISTRICT COUNCIL

APPENDIX B

GEOTECHNICAL INVESTIGATION PLAN



LEGEND

- Hand auger + Scala
- DPSH
- CPT
- Site boundary
- Stage 3 drainage
- Stage 3 road
- Stage 1 + 2 boundaries
- Proposed drainage reserves
- building outlines
- 2.5m contour
- 0.5m contour

0 20 40 60 80 m

SCALE A3: 1:1250

NOTES

1. Aerial basemap and property boundaries sourced from LINZ Data Service (CC-BY 4.0).
2. Topographic contours derived from NRC LiDAR DEM (2018-2019 survey).
3. Investigation locations shown approximately only.
4. Subdivision layout from supplied Reyburn and Bryant Plans, dated Feb 2022, reference C16471b, revision B.

CLIENT
EB Developments Limited

PROJECT
EB Ruakaka Stage 3
Tamure Place and Peter Snell Road
Ruakaka

DRAWING TITLE
Geotechnical Investigation Plan

LAND DEVELOPMENT & ENGINEERING LTD.

PROJECT REF	DRAWING REF	REVISION
18319	G01	A
DATE	PREPARED BY	CHECKED BY
20/07/2022	JMN	GH

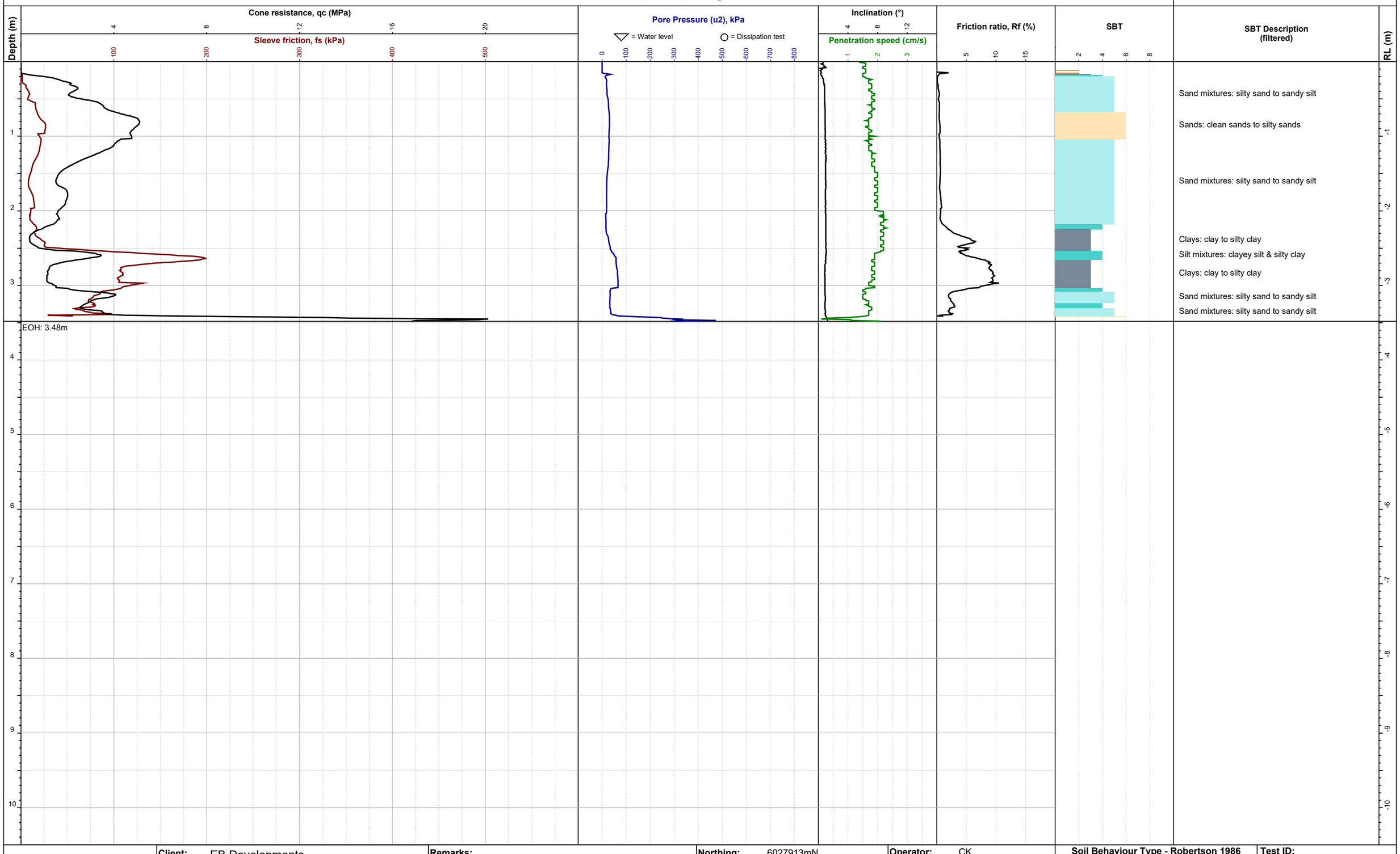
FILE PATH
M-FILES\LDE - Project\198322\18319\LDE Base Data v3.1.qgz

APPENDIX C

GEOTECHNICAL INVESTIGATION DATA

Cone Penetration Test (CPTu) Log

Test ID: CPT-01



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:27 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 1.33m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027913mN
Easting:	1731505mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

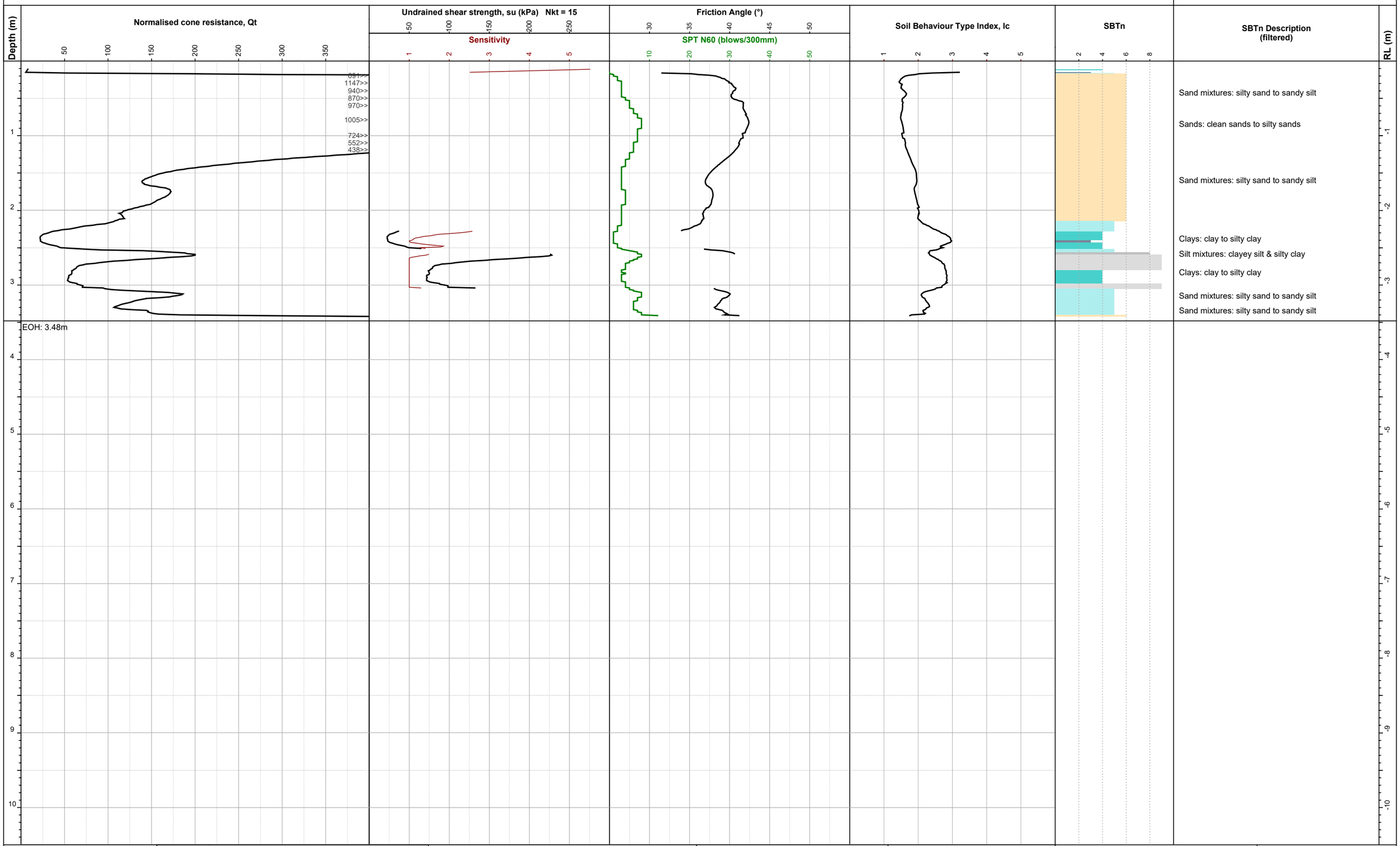
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-01

Project ID:	18319
Depth:	3.48m
Sheet:	1 of 1
Date:	09/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-01



Client:	EB Developments	**Remarks:** Collapse of hole at 1.33m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	6027913mN	**Operator:** CK
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731505mE	**Rig:** Pagani TG63-150
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:** MKS650
			Elevation:	Ground	**Type:** Comp. piezo cone
			Located By:	Phone GPS	**Cone Area:** 10 cm²
			Location:		**Sleeve Area:** 150 cm²
					Area Ratio: 0.78

Soil Behaviour Type - Robertson 1986

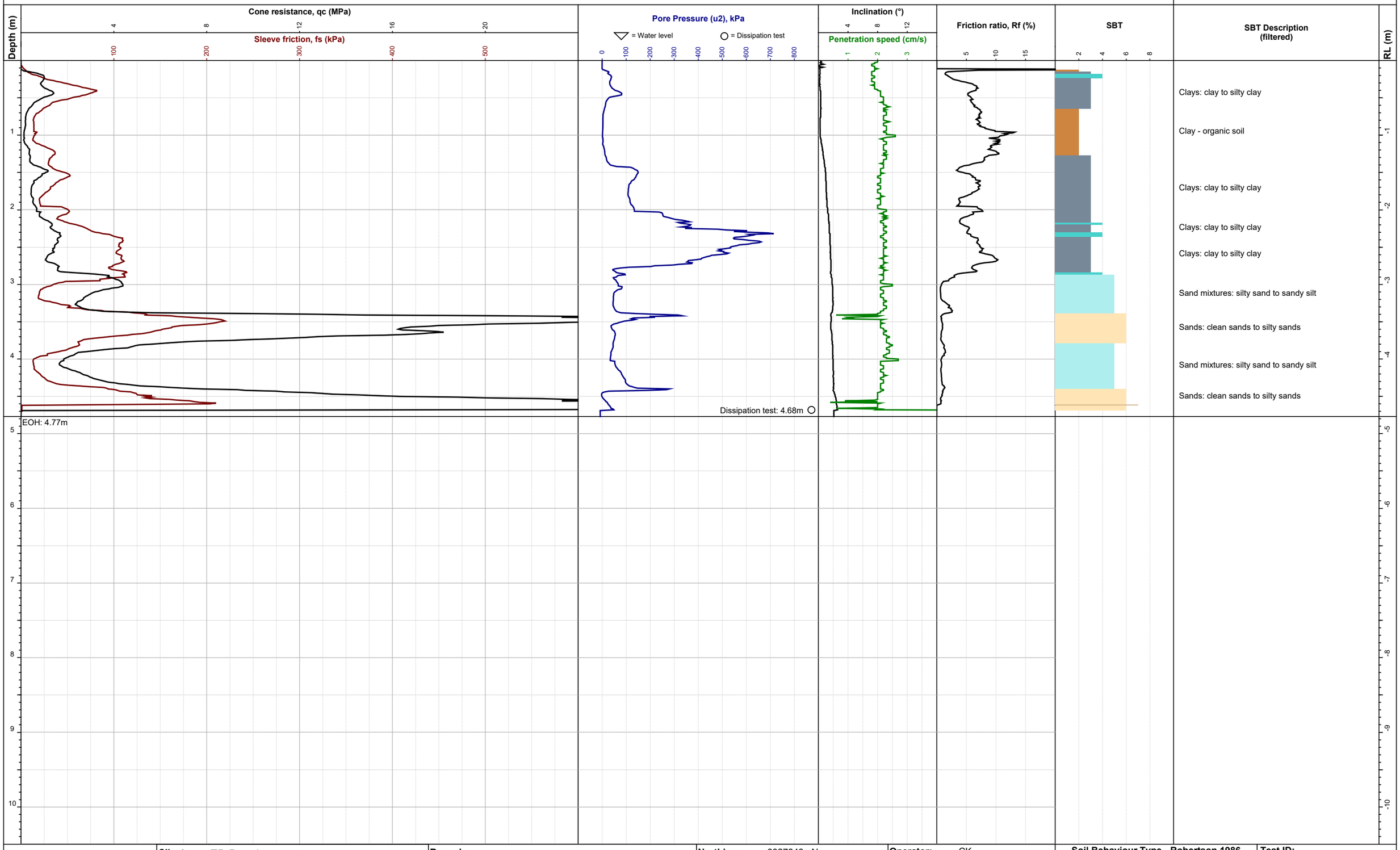
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-01

Project ID: 18319
Depth: 3.48m
Sheet: 1 of 1
Date: 09/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-02



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:30 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Ground water level located at 0.59m
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027843mN
Easting:	1731492mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

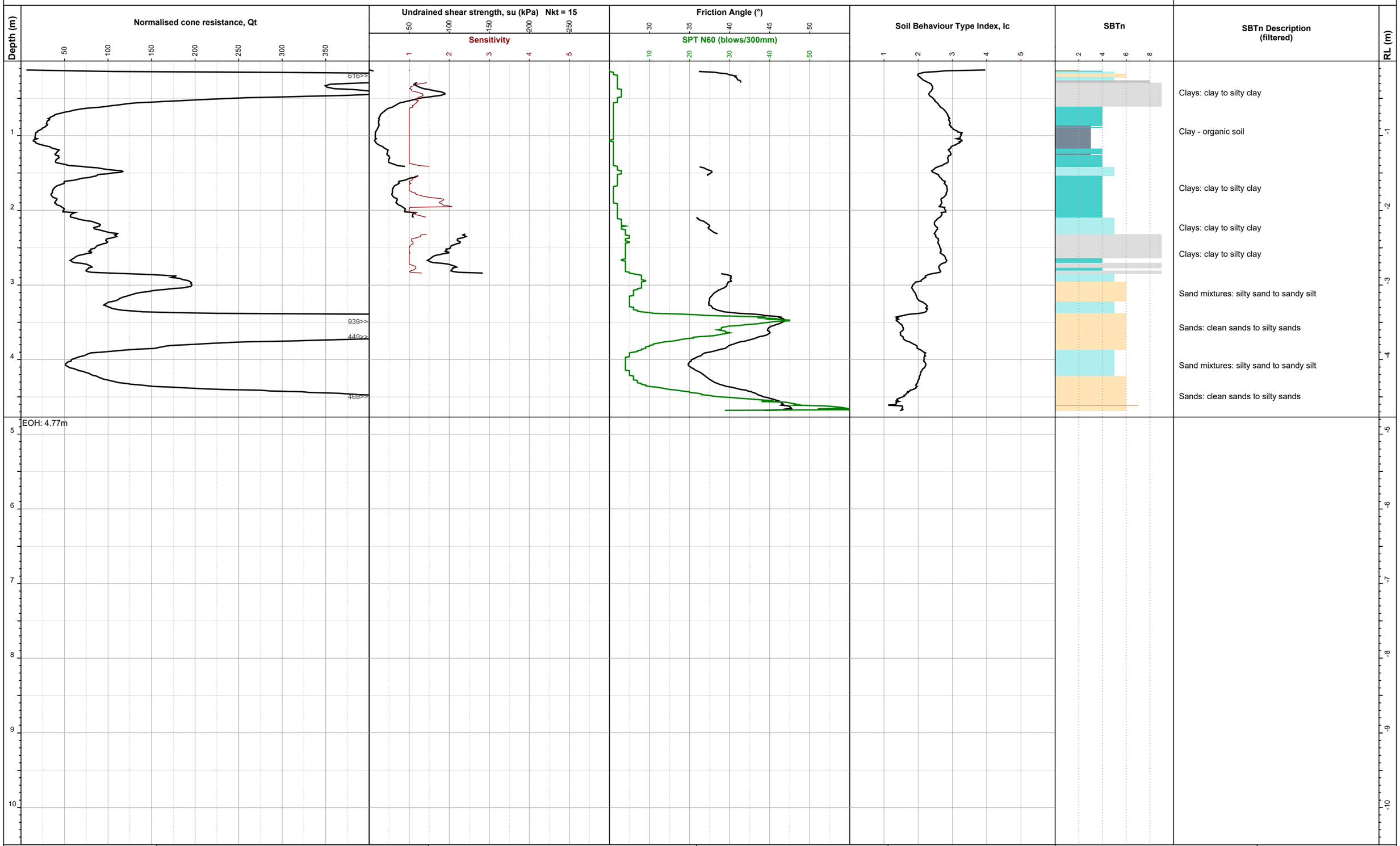
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-02

Project ID:	18319
Depth:	4.77m
Sheet:	1 of 1
Date:	09/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-02



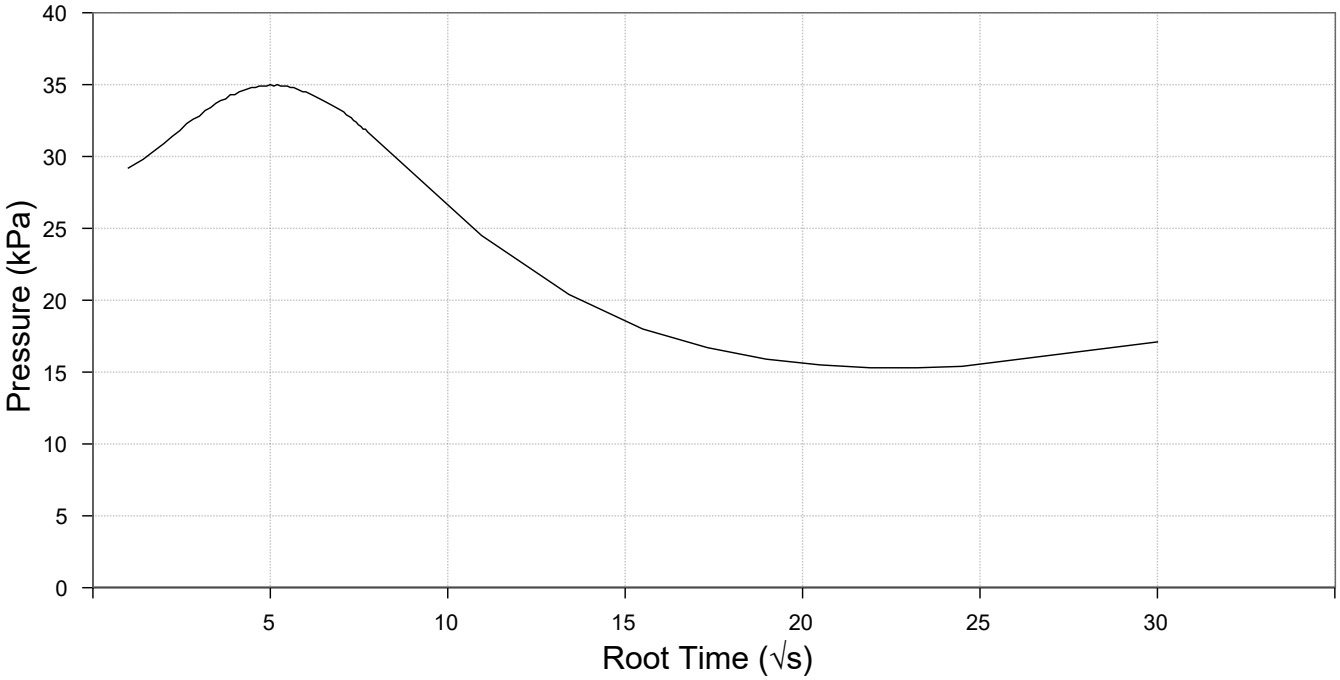
Client:	EB Developments	**Remarks:** Ground water level located at 0.59m Test according to ISO 22476-1:12	**Northing:**	6027843mN	**Operator:**	CK	**Test ID:** CPT-02
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731492mE	**Rig:**	Pagani TG63-150	**Project ID:** 18319
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:**	MKS650	**Depth:** 4.77m
			Elevation:	Ground	**Type:**	Comp. piezo cone	**Sheet:** 1 of 2
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Date:** 09/04/2022
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.78	

Soil Behaviour Type - Robertson 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

CPT-02 Dissipation Testing

Test at: 4.68m



Cone Penetration Test (CPTu) Log

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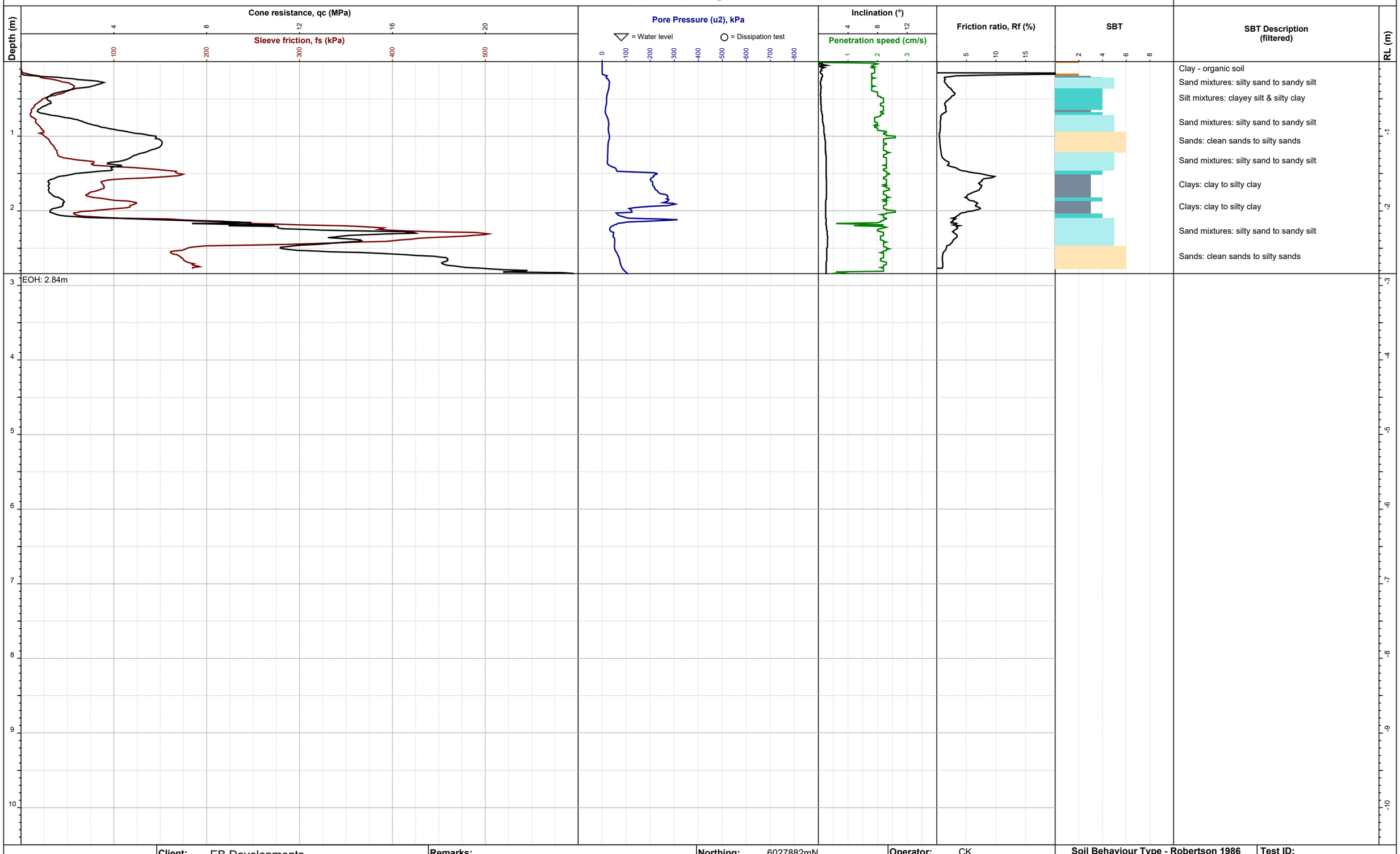

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Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731444mE	**Rig:** Pagani TG63-150
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:** MKS650
			Elevation:	Ground	**Type:** Comp. piezo cone
			Located By:	Phone GPS	**Cone Area:** 10 cm²
			Location:		**Sleeve Area:** 150 cm²
					Area Ratio: 0.78

Soil Behaviour Type - Robertson 1986

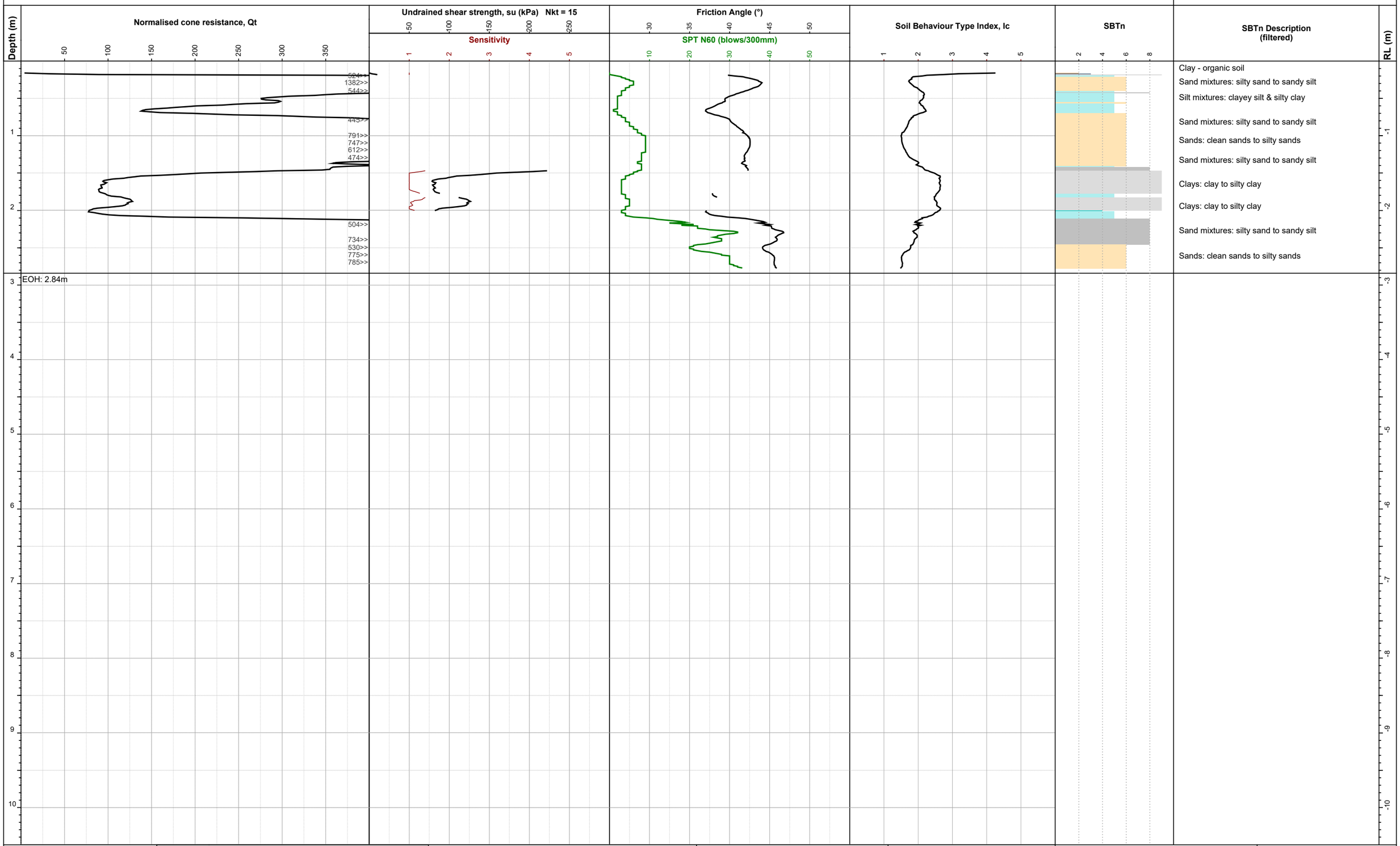
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-03

Project ID: 18319
Depth: 2.84m
Sheet: 1 of 1
Date: 09/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-03



SBTn Description (filtered)

- Clay - organic soil
- Sand mixtures: silty sand to sandy silt
- Silt mixtures: clayey silt & silty clay
- Sand mixtures: silty sand to sandy silt
- Sands: clean sands to silty sands
- Sand mixtures: silty sand to sandy silt
- Clays: clay to silty clay
- Clays: clay to silty clay
- Sand mixtures: silty sand to sandy silt
- Sands: clean sands to silty sands

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 0.58m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027882mN
Easting:	1731444mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

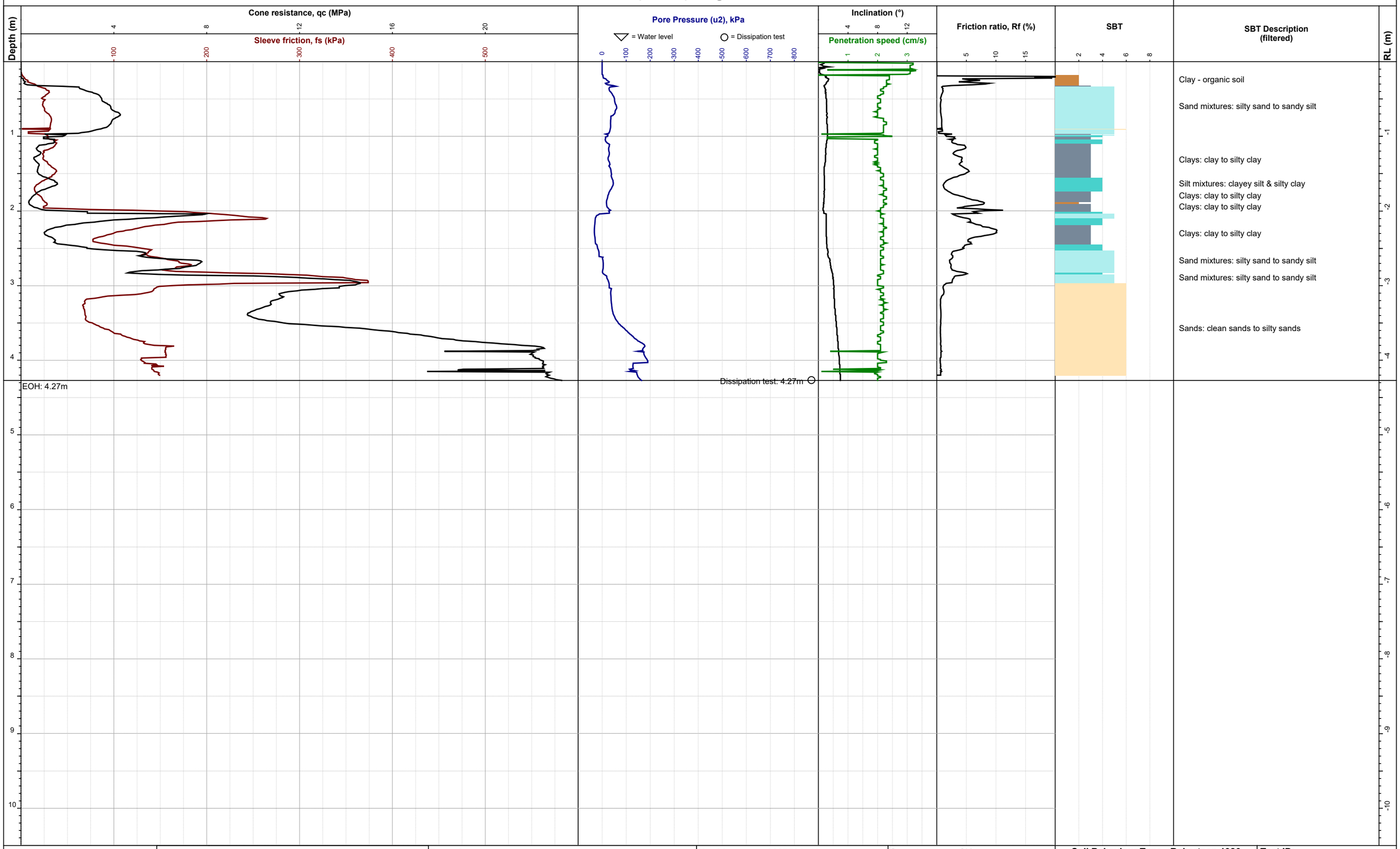
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-03

Project ID:	18319
Depth:	2.84m
Sheet:	1 of 1
Date:	09/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-06



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 8/07/2022 11:28:59 am

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Ground water level located at 1.34m
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027734mN
Easting:	1731477mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

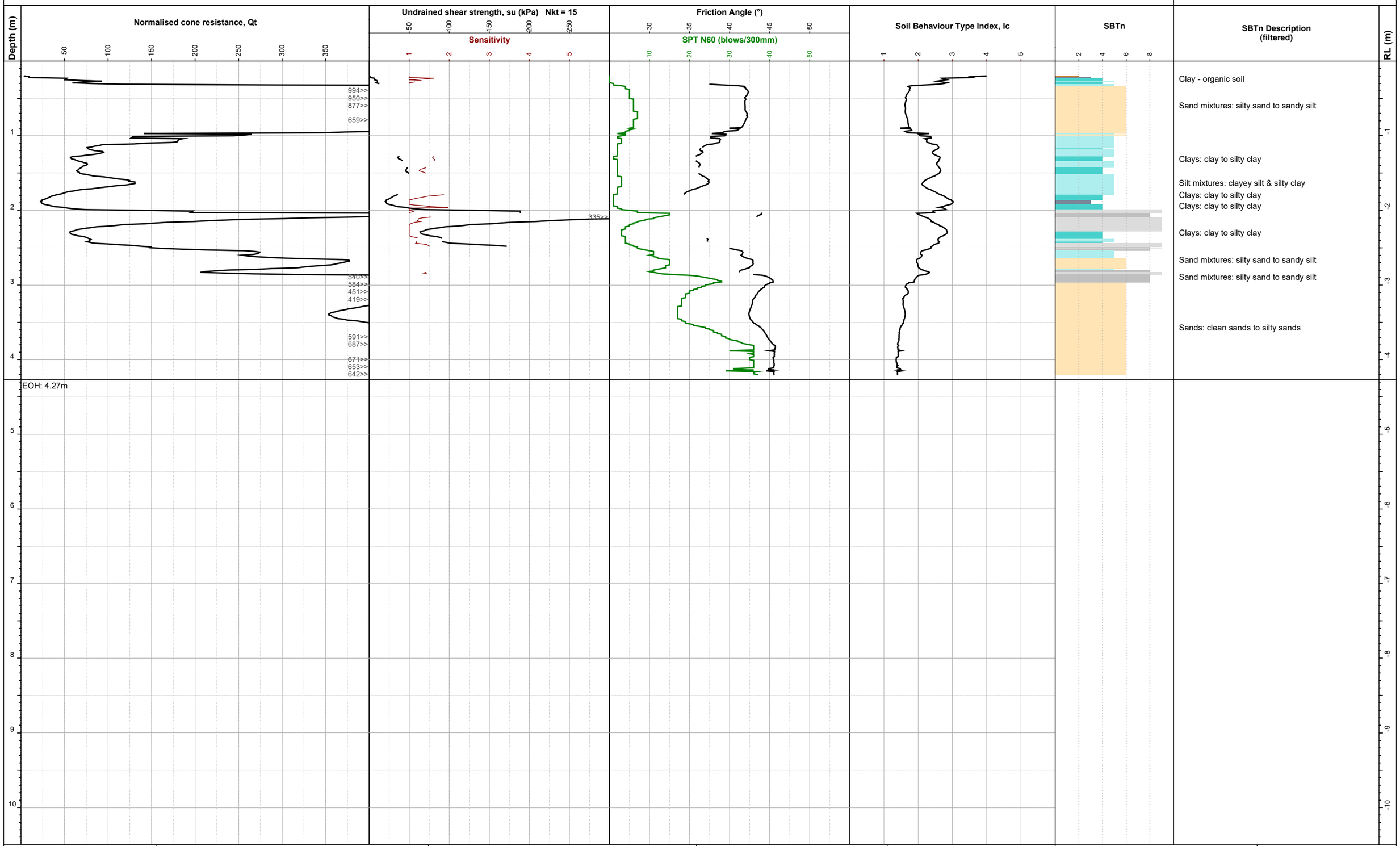
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-06

Project ID:	18319
Depth:	4.27m
Sheet:	1 of 1
Date:	11/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-06



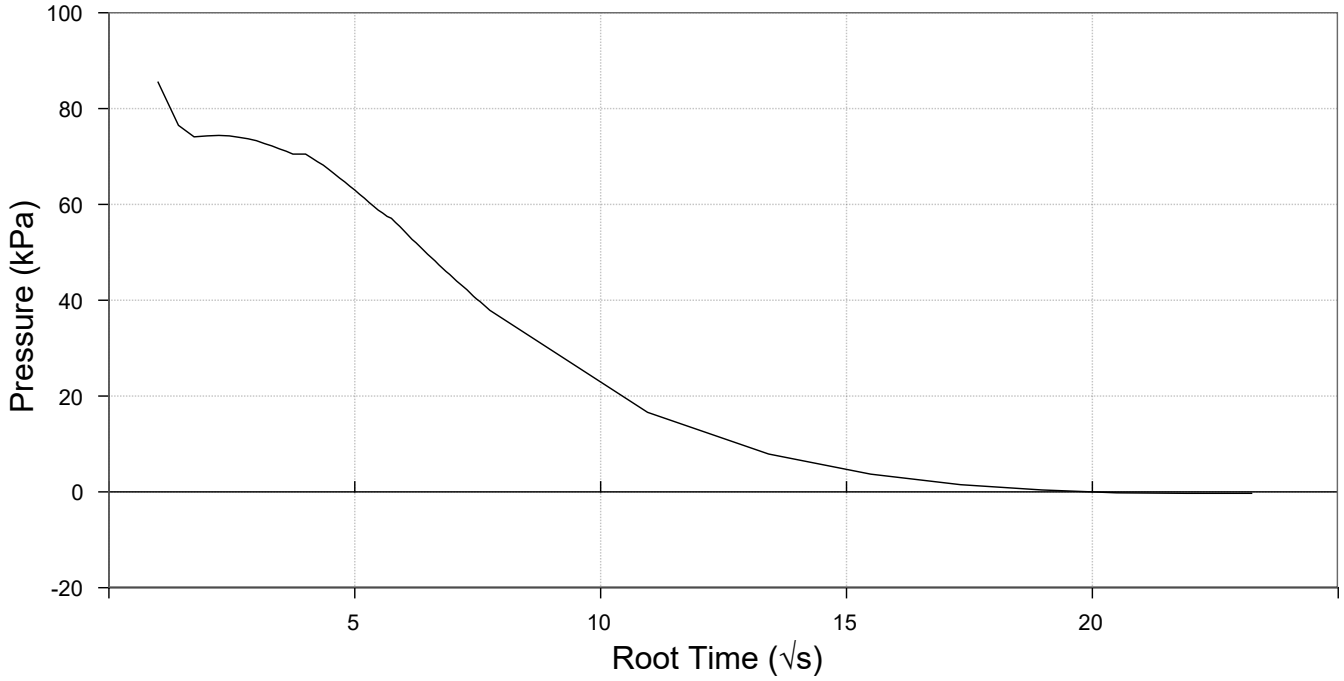
Client:	EB Developments	**Remarks:** Ground water level located at 1.34m Test according to ISO 22476-1:12	**Northing:**	6027734mN	**Operator:**	CK	**Test ID:** CPT-06
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731477mE	**Rig:**	Pagani TG63-150	**Project ID:** 18319
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:**	MKS650	**Depth:** 4.27m
			Elevation:	Ground	**Type:**	Comp. piezo cone	**Sheet:** 1 of 2
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Date:** 11/04/2022
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.78	

Soil Behaviour Type - Robertson 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

CPT-06 Dissipation Testing

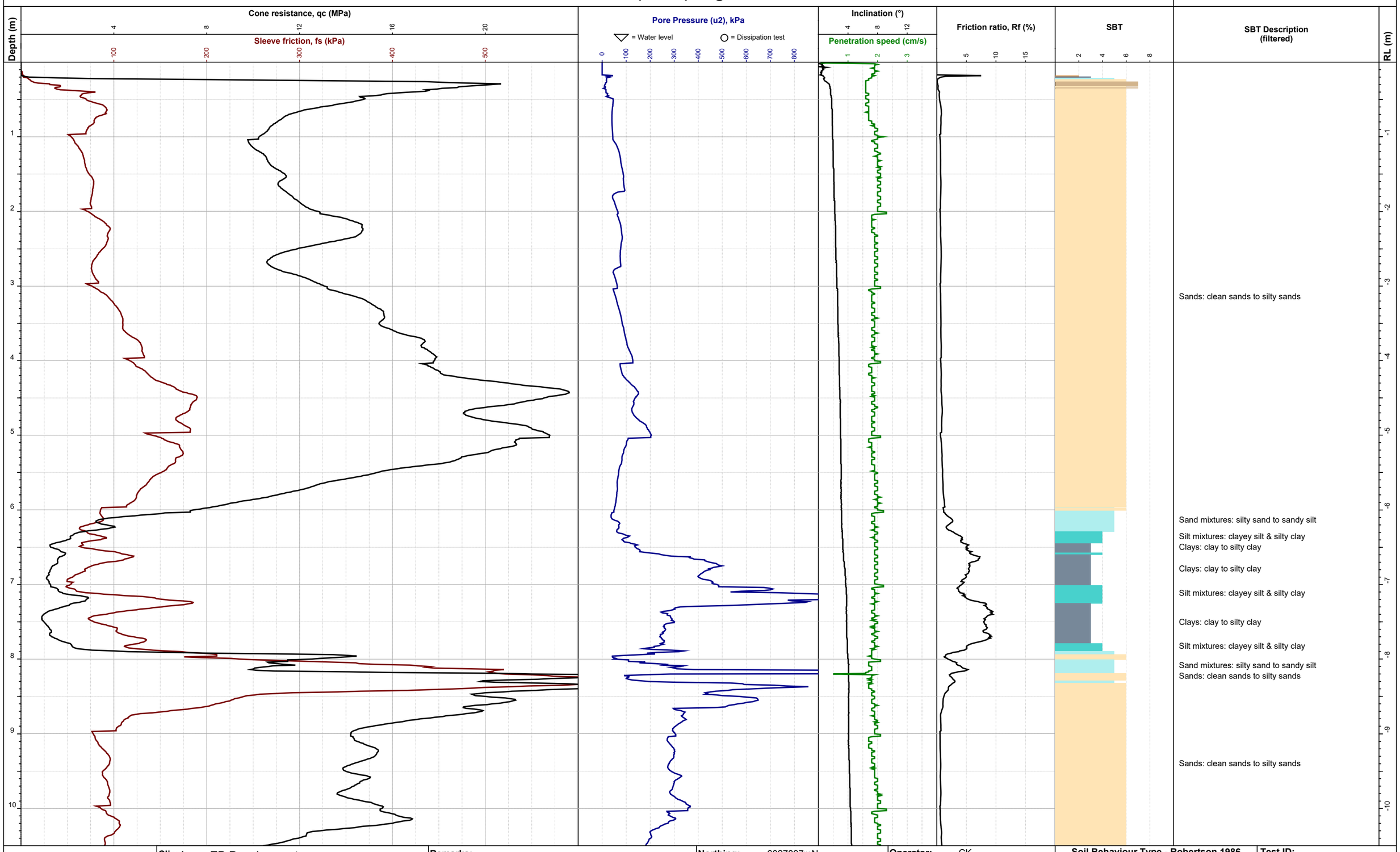
Test at: 4.27m



Cone Penetration Test (CPTu) Log

Test ID: CPT-07

Depth (m) | Cone resistance, qc (MPa) | Sleeve friction, fs (kPa) | Pore Pressure (u2), kPa | = Water level | = Dissipation test | Inclination (°) | Penetration speed (cm/s) | Friction ratio, Rf (%) | SBT | SBT Description (filtered) | RL (m)



Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay
Clays: clay to silty clay

Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay

Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt
Sands: clean sands to silty sands

Sands: clean sands to silty sands

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:37 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 4.76m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027897mN
Easting:	1731544mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

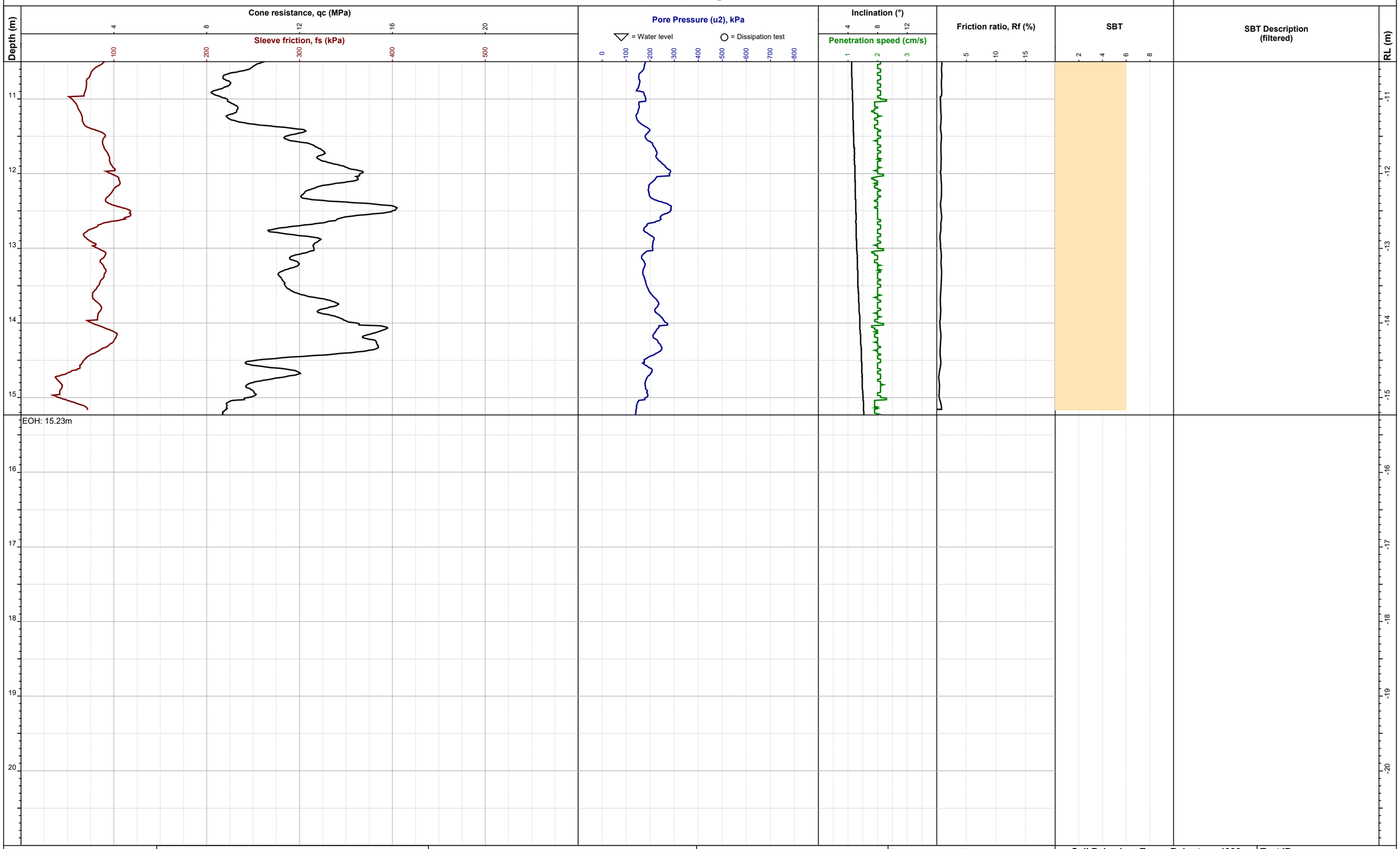
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-07

Project ID:	18319
Depth:	15.23m
Sheet:	1 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-07



Client:	EB Developments	**Remarks:** Collapse of hole at 4.76m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	6027897mN	**Operator:**	CK	**Test ID:** CPT-07
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731544mE	**Rig:**	Pagani TG63-150	**Project ID:** 18319
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:**	MKS650	**Depth:** 15.23m
			Elevation:	Ground	**Type:**	Comp. piezo cone	**Sheet:** 2 of 2
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Date:** 11/04/2022
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.78	

Soil Behaviour Type - Robertson 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

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-07

Depth (m)

Normalised cone resistance, Qt

50 100 150 200 250 300 350

7966>>
4917>>
3405>>
2455>>
1553>>
1152>>
1009>>
963>>
916>>
851>>
780>>
710>>
714>>
744>>
742>>
623>>
526>>
460>>
433>>
468>>
479>>
493>>
511>>
481>>
508>>
493>>
482>>
468>>
472>>
526>>
573>>
536>>
446>>
476>>
483>>
442>>
412>>

Undrained shear strength, su (kPa) Nkt = 15

50 100 150 200 250

Sensitivity

1 2 3 4 5

Friction Angle (°)

30 35 40 45 50

SPT N60 (blows/300mm)

10 20 30 40 50

Soil Behaviour Type Index, Ic

1 2 3 4 5

SBTn

2 4 6 8

SBTn Description (filtered)

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay

Clays: clay to silty clay

Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay

Clays: clay to silty clay

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sands: clean sands to silty sands

RL (m)

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LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 4.76m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027897mN
Easting:	1731544mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

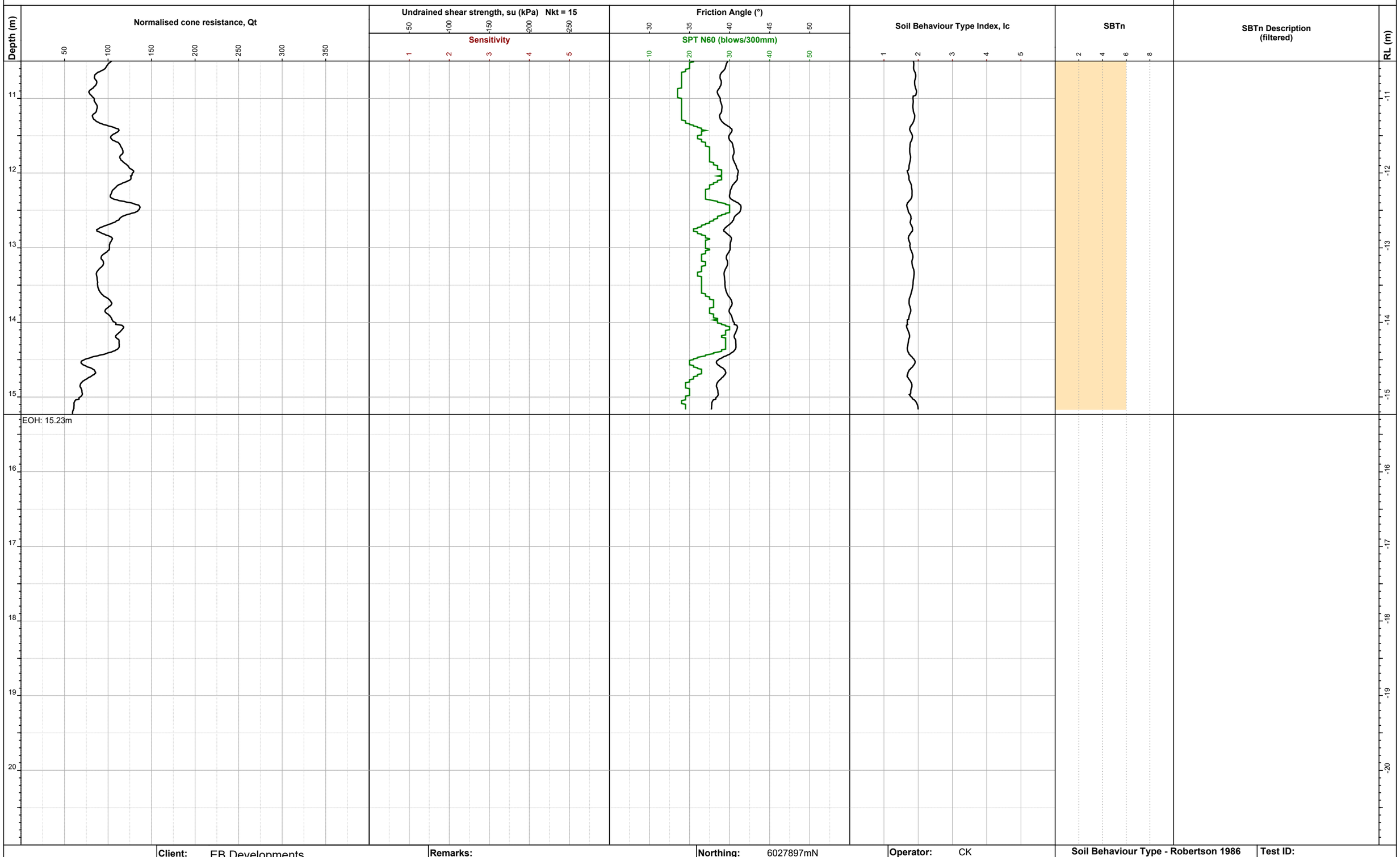
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-07

Project ID:	18319
Depth:	15.23m
Sheet:	1 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-07



LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 4.76m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027897mN
Easting:	1731544mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

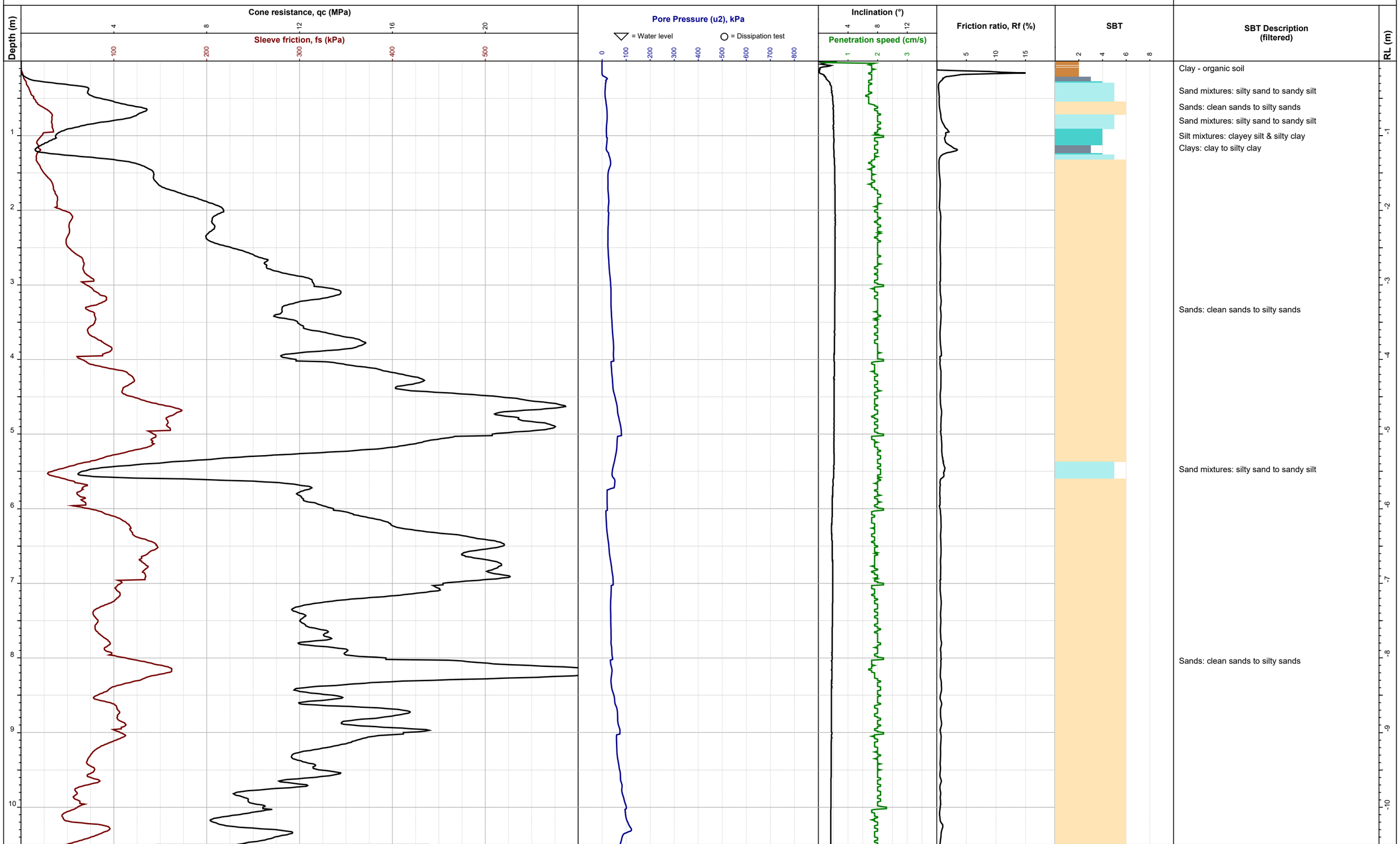
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-07

Project ID:	18319
Depth:	15.23m
Sheet:	2 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-08



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:40 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 1.56m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027844mN
Easting:	1731563mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

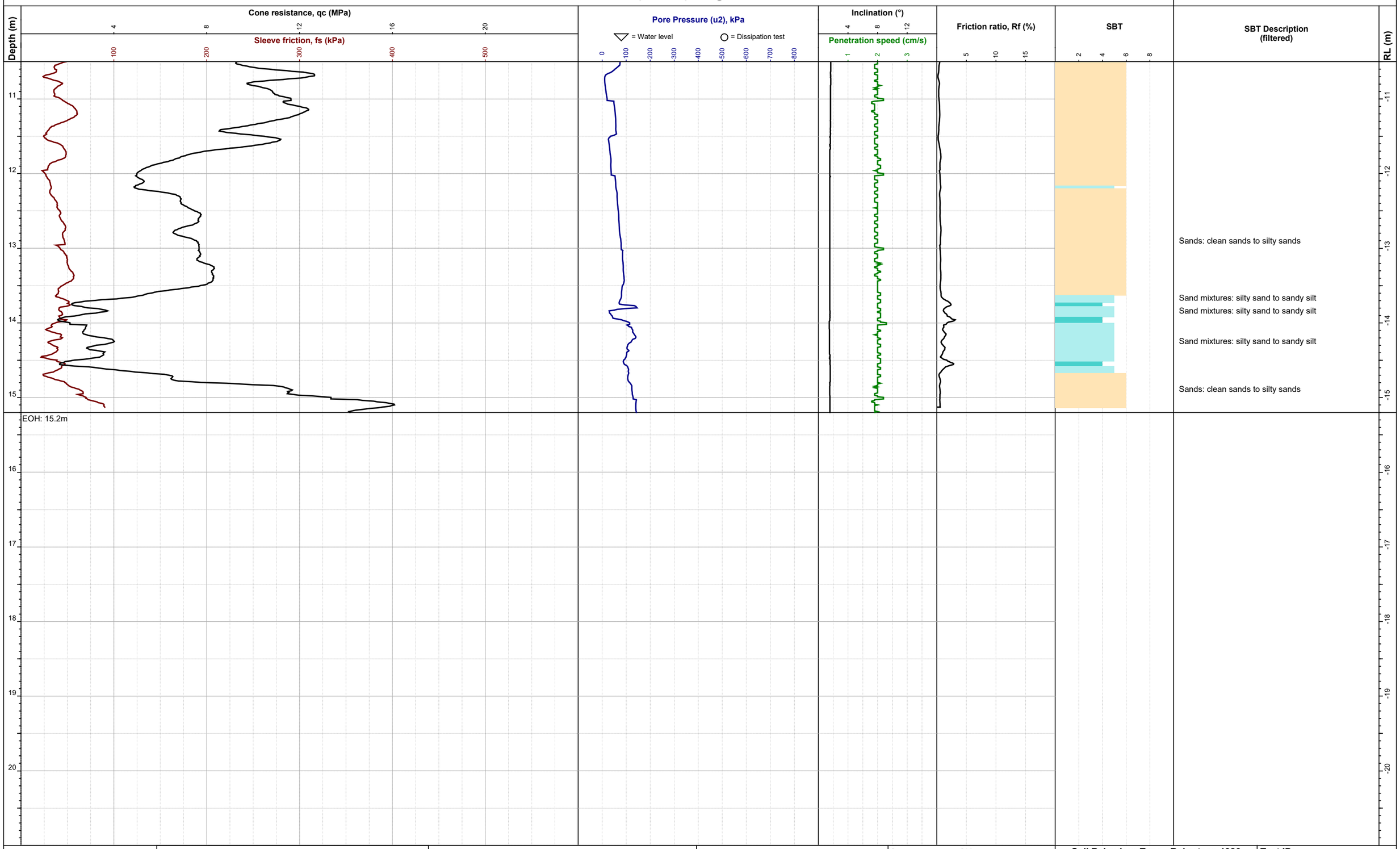
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-08

Project ID:	18319
Depth:	15.2m
Sheet:	1 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-08



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:40 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 1.56m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027844mN
Easting:	1731563mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-08

Project ID:	18319
Depth:	15.2m
Sheet:	2 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-08

Depth (m)

Normalised cone resistance, Qt

50 100 150 200 250 300 350

430>>
2139>>
2215>>
1763>>
1817>>
934>>
427>>
624>>
580>>
657>>
662>>
587>>
559>>
485>>
518>>
547>>
545>>
582>>
575>>
602>>
525>>
448>>
493>>
502>>
461>>
497>>
506>>
467>>
573>>
548>>
574>>
493>>
411>>

Undrained shear strength, su (kPa) Nkt = 15

50 100 150 200 250

Sensitivity

1 2 3 4 5

Friction Angle (°)

30 35 40 45 50

SPT N60 (blows/300mm)

10 20 30 40 50

Soil Behaviour Type Index, Ic

1 2 3 4 5

SBTn

2 4 6 8

SBTn Description (filtered)

Clay - organic soil

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay

Clays: clay to silty clay

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

RL (m)

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:40 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 1.56m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027844mN
Easting:	1731563mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

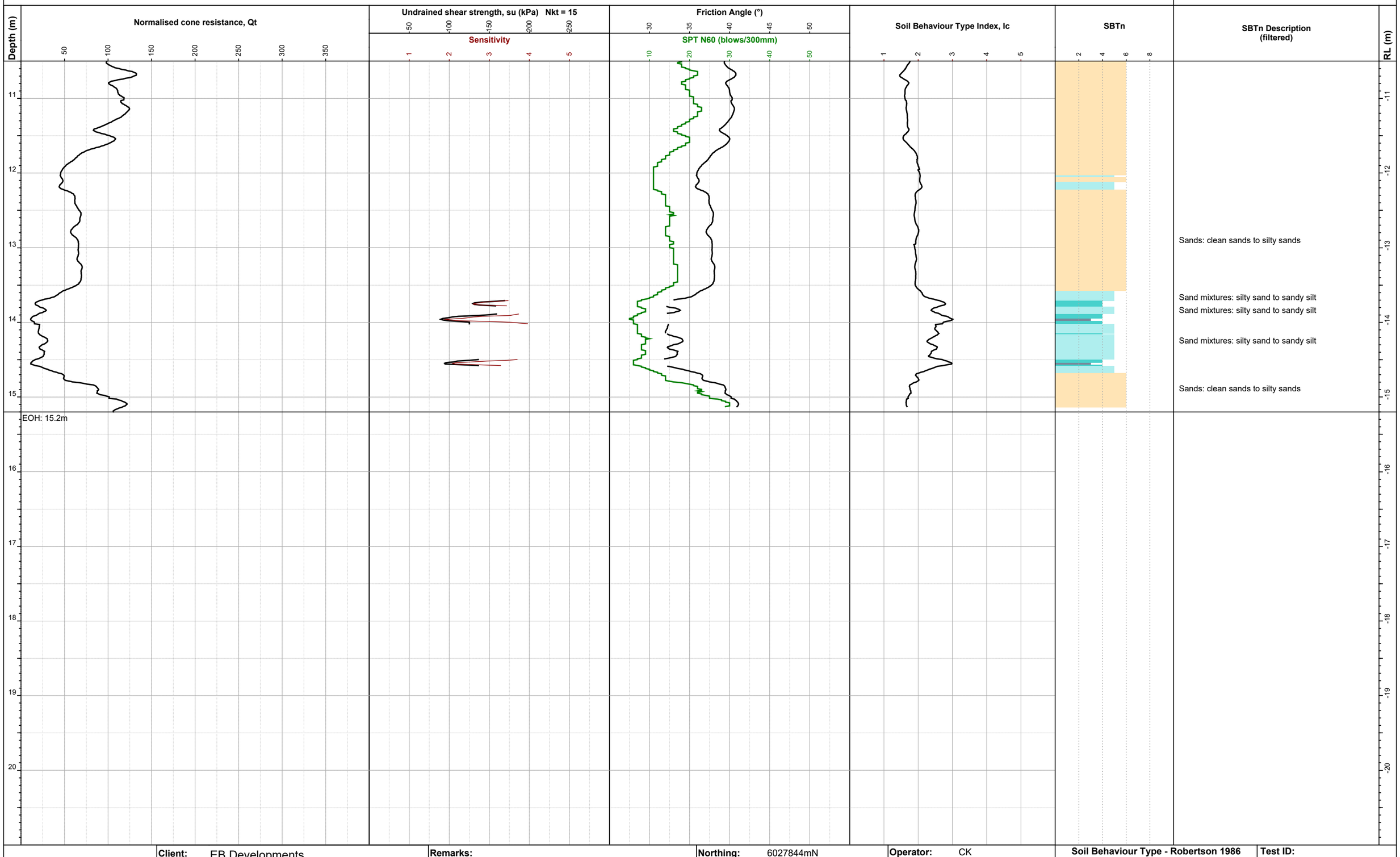
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-08

Project ID:	18319
Depth:	15.2m
Sheet:	1 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-08



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:41 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 1.56m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027844mN
Easting:	1731563mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

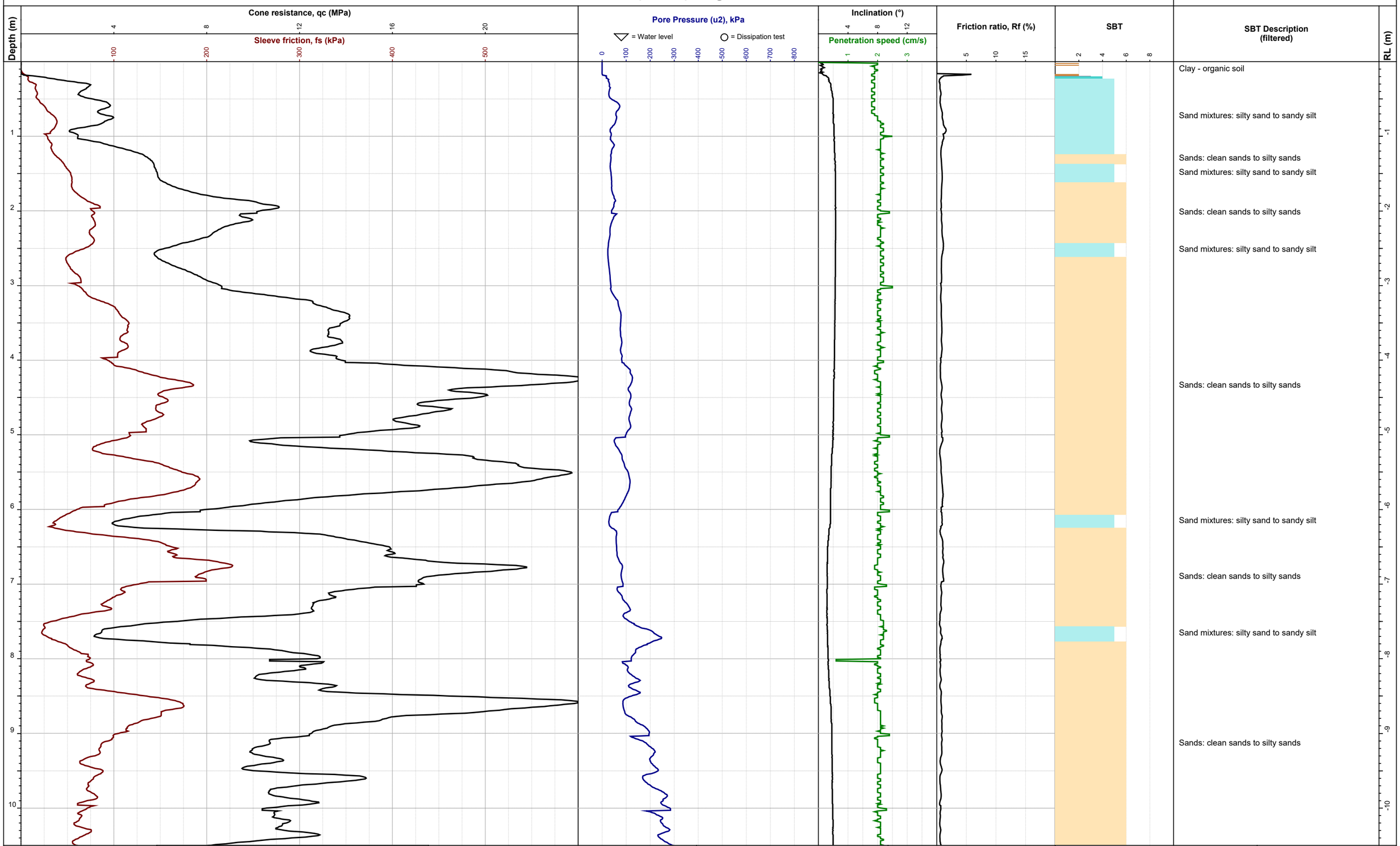
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-08

Project ID:	18319
Depth:	15.2m
Sheet:	2 of 2
Date:	11/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-09



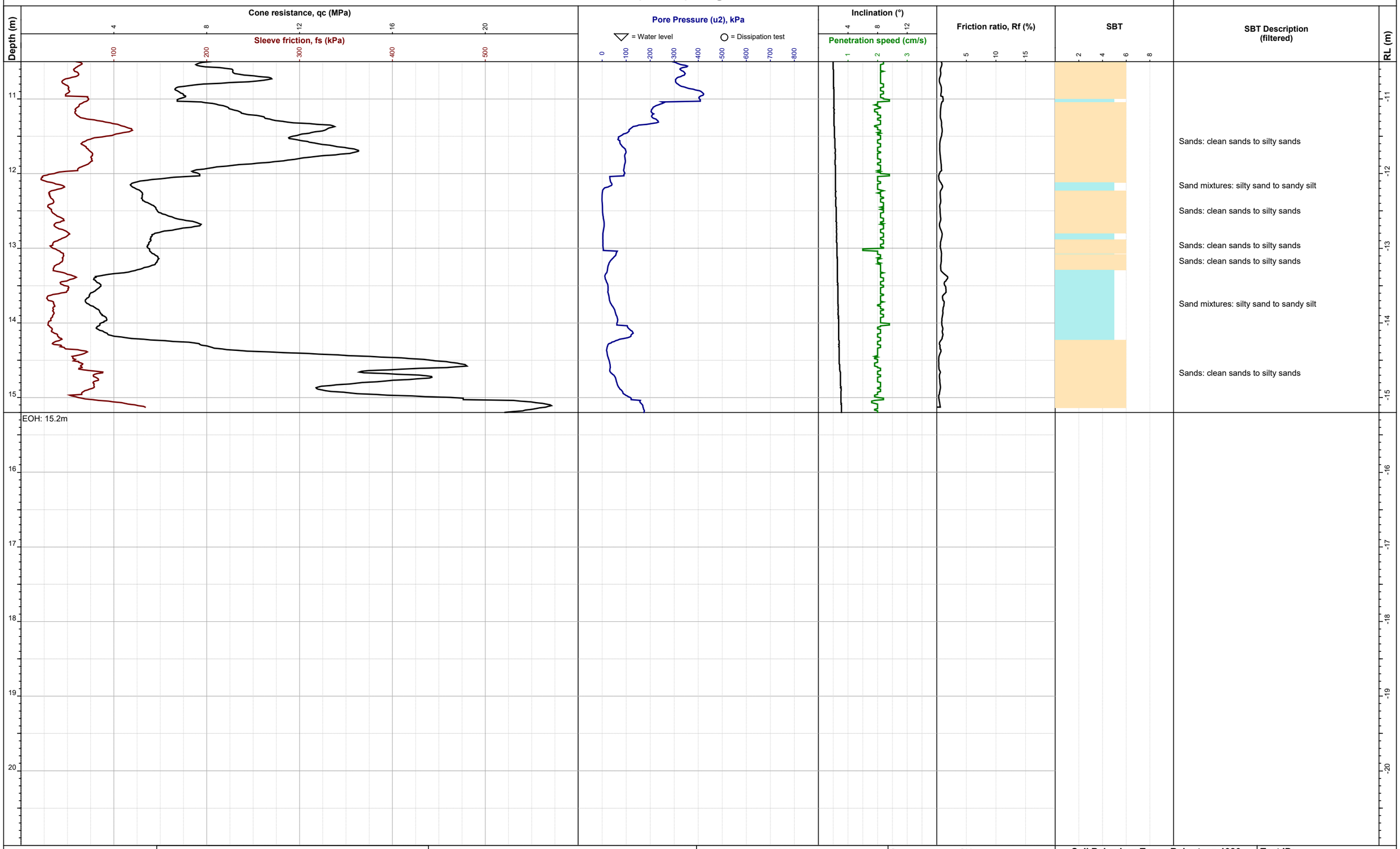
Client:	EB Developments	**Remarks:** Collapse of hole at 2.13m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	6027728mN	**Operator:**	CK	**Test ID:** CPT-09
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731567mE	**Rig:**	Pagani TG63-150	**Project ID:** 18319
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:**	MKS650	**Depth:** 15.2m
			Elevation:	Ground	**Type:**	Comp. piezo cone	**Sheet:** 1 of 2
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Date:** 10/04/2022
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.78	

Soil Behaviour Type - Robertson 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

Cone Penetration Test (CPTu) Log

Test ID: CPT-09



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:43 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.13m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027728mN
Easting:	1731567mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-09

Project ID:	18319
Depth:	15.2m
Sheet:	2 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-09

Normalised cone resistance, Qt

Undrained shear strength, su (kPa) Nkt = 15

Sensitivity

Friction Angle (°)

SPT N60 (blows/300mm)

Soil Behaviour Type Index, Ic

SBTn

SBTn Description (filtered)

Depth (m)

RL (m)

Clay - organic soil

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:43 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.13m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027728mN
Easting:	1731567mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

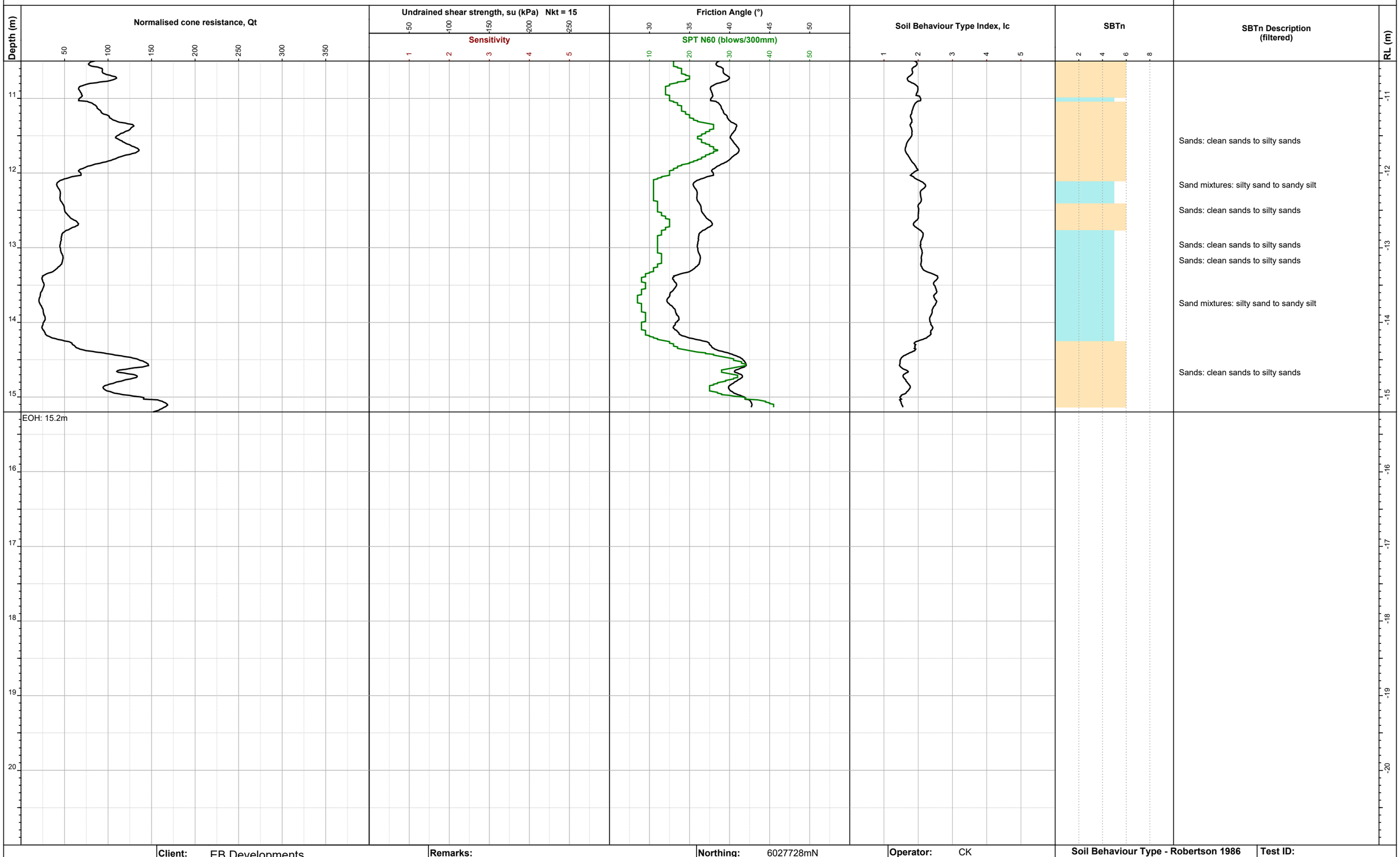
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-09

Project ID:	18319
Depth:	15.2m
Sheet:	1 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-09



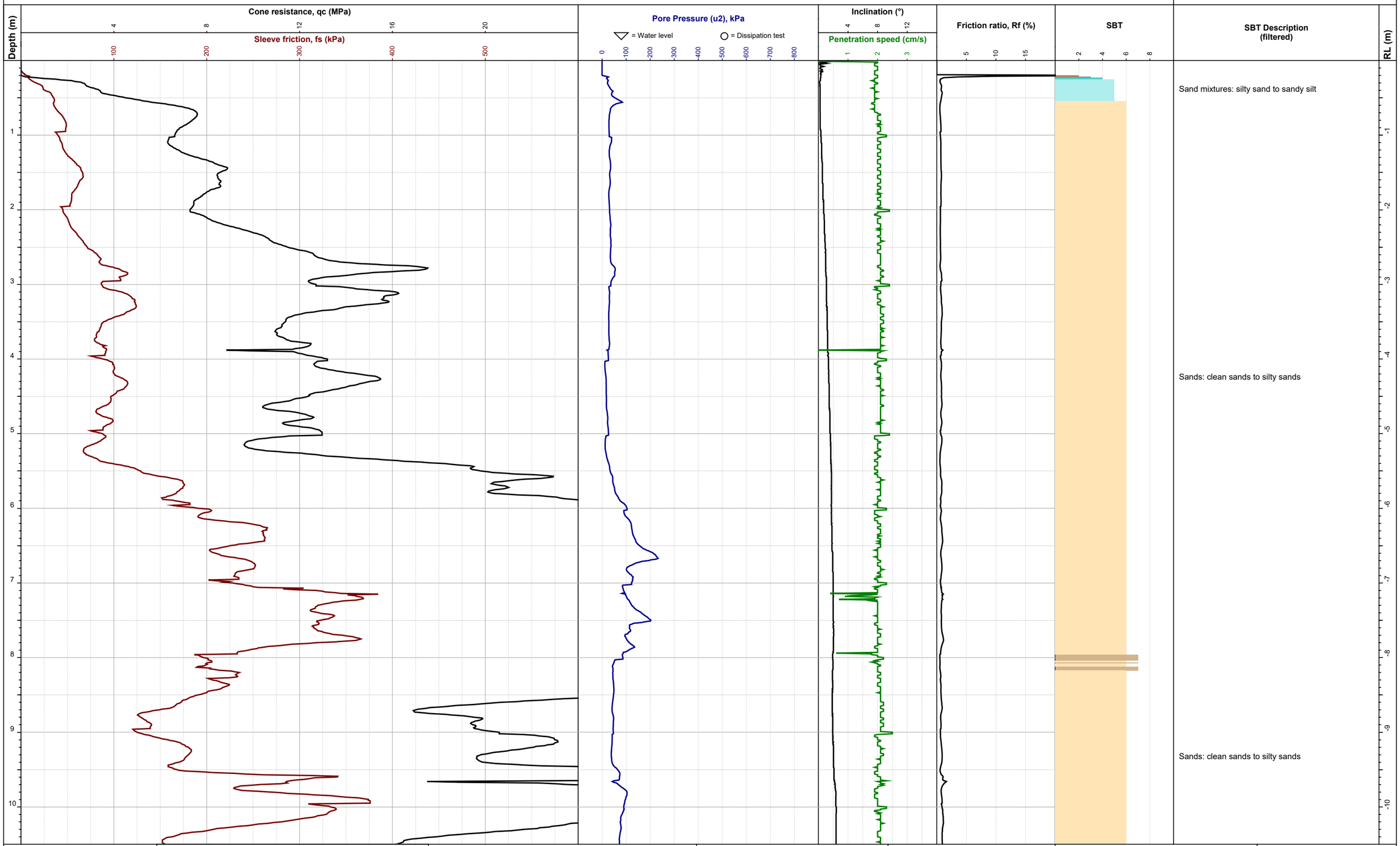
Client:	EB Developments	**Remarks:** Collapse of hole at 2.13m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	6027728mN	**Operator:**	CK	**Test ID:** CPT-09
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731567mE	**Rig:**	Pagani TG63-150	**Project ID:** 18319
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:**	MKS650	**Depth:** 15.2m
			Elevation:	Ground	**Type:**	Comp. piezo cone	**Sheet:** 2 of 2
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Date:** 10/04/2022
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.78	

Soil Behaviour Type - Robertson 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

Cone Penetration Test (CPTu) Log

Test ID: CPT-10



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:45 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 0.74m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027877mN
Easting:	1731669mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

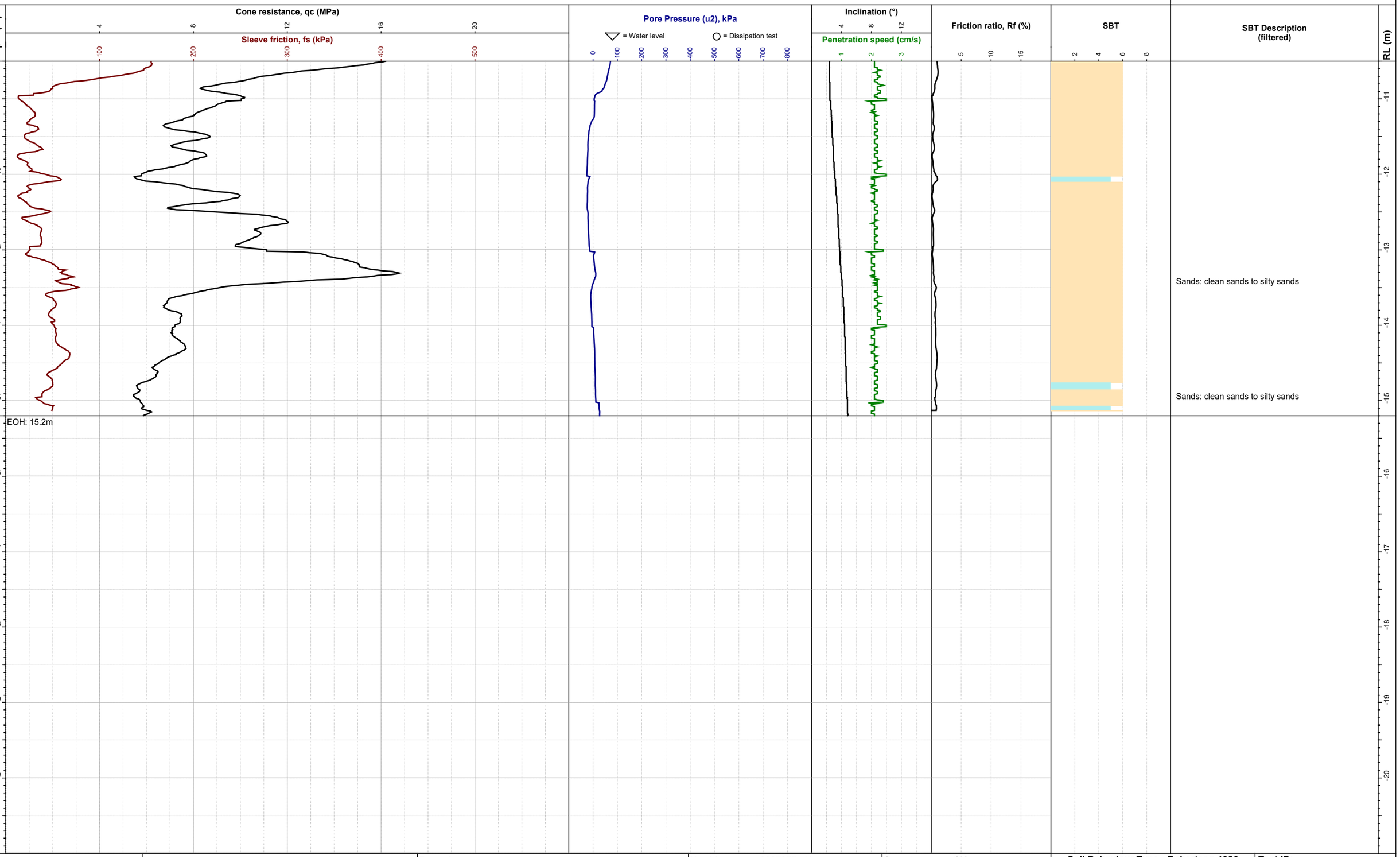
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-10

Project ID:	18319
Depth:	15.2m
Sheet:	1 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-10



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:46 pm

Client:	EB Developments	**Remarks:** Collapse of hole at 0.74m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	6027877mN	**Operator:** CK
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731669mE	**Rig:** Pagani TG63-150
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:** MKS650
			Elevation:	Ground	**Type:** Comp. piezo cone
			Located By:	Phone GPS	**Cone Area:** 10 cm²
			Location:		**Sleeve Area:** 150 cm²
					Area Ratio: 0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-10

Project ID: 18319
Depth: 15.2m
Sheet: 2 of 2
Date: 10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-10

Normalised cone resistance, Qt

Undrained shear strength, su (kPa) Nkt = 15

Sensitivity

Friction Angle (°)

SPT N60 (blows/300mm)

Soil Behaviour Type Index, Ic

SBTn

SBTn Description (filtered)

Depth (m)

RL (m)

1033>>
1030>>
1113>>
1362>>
1132>>
809>>
702>>
690>>
713>>
689>>
641>>
466>>
433>>
453>>
472>>
528>>
543>>
572>>
598>>
527>>
491>>
601>>
559>>
400>>
506>>
516>>
589>>
526>>
463>>
431>>
501>>
547>>
585>>
592>>
617>>
586>>
546>>
466>>
471>>
497>>
470>>
433>>

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sands: clean sands to silty sands

Client:	EB Developments	**Remarks:** Collapse of hole at 0.74m prevented measurement of ground water. Test according to ISO 22476-1:12	**Northing:**	6027877mN	**Operator:**	CK	**Test ID:** CPT-10
Project:	Geotechnical Investigation	**Termination Reason:** Limit of reaction force	**Easting:**	1731669mE	**Rig:**	Pagani TG63-150	**Project ID:** 18319
Location:	Tamure Place and Peter Snell Road, Ruakaka		**System:**	NZTM	**Cone ID:**	MKS650	**Depth:** 15.2m
			Elevation:	Ground	**Type:**	Comp. piezo cone	**Sheet:** 1 of 2
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Date:** 10/04/2022
			Location:		**Sleeve Area:**	150 cm²	
					Area Ratio:	0.78	

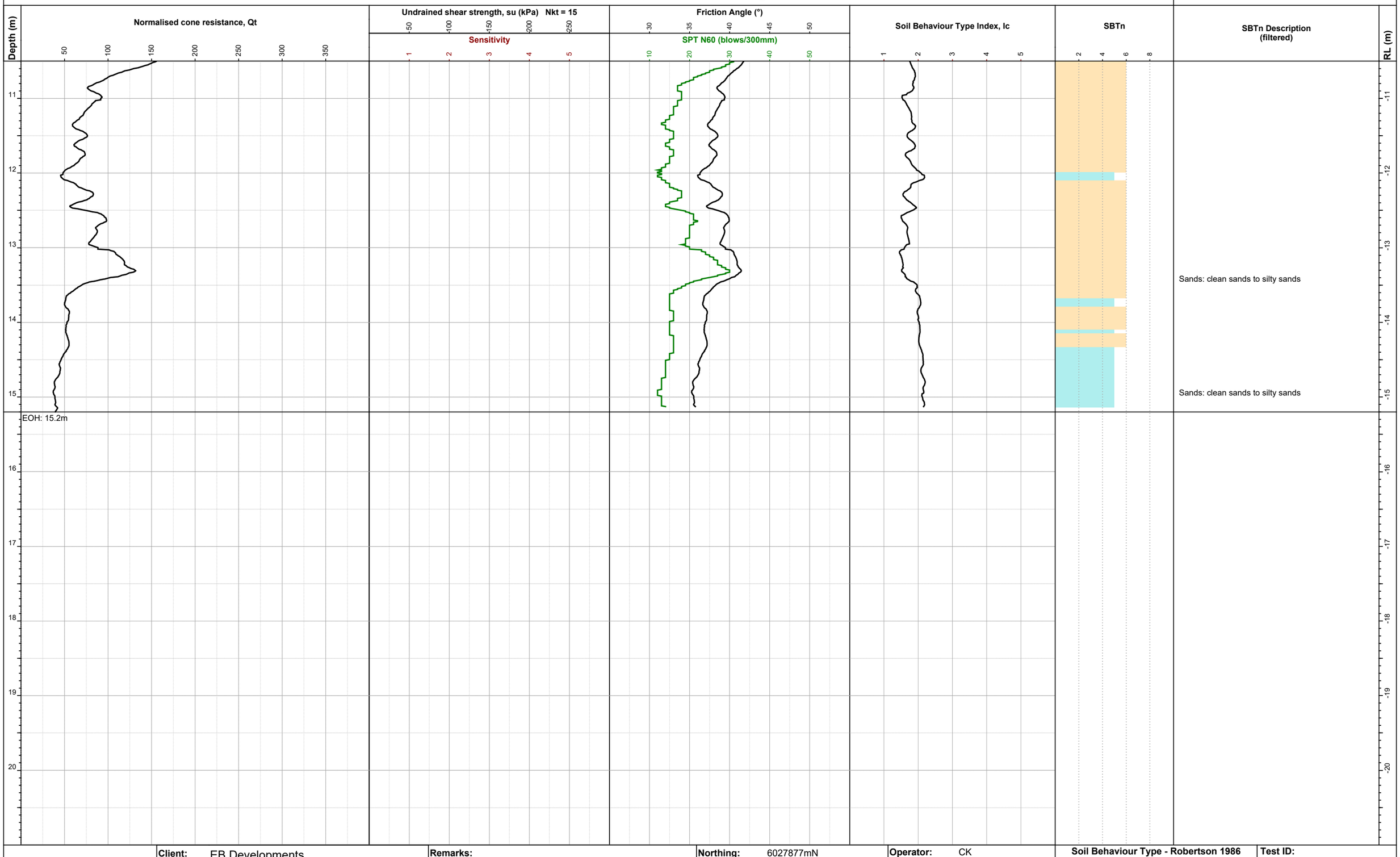
Soil Behaviour Type - Robertson 1986

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

LDE LAND DEVELOPMENT & ENGINEERING

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-10



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:46 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 0.74m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027877mN
Easting:	1731669mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-10

Project ID:	18319
Depth:	15.2m
Sheet:	2 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-11

Cone resistance, qc (MPa) | Sleeve friction, fs (kPa) | Depth (m)

Pore Pressure (u2), kPa — = Water level — = Dissipation test

Inclination (°) | Penetration speed (cm/s)

Friction ratio, Rf (%)

SBT

SBT Description (filtered)

RL (m)

Sands: clean sands to silty sands

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:48 pm

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.82m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027849mN
Easting:	1731643mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

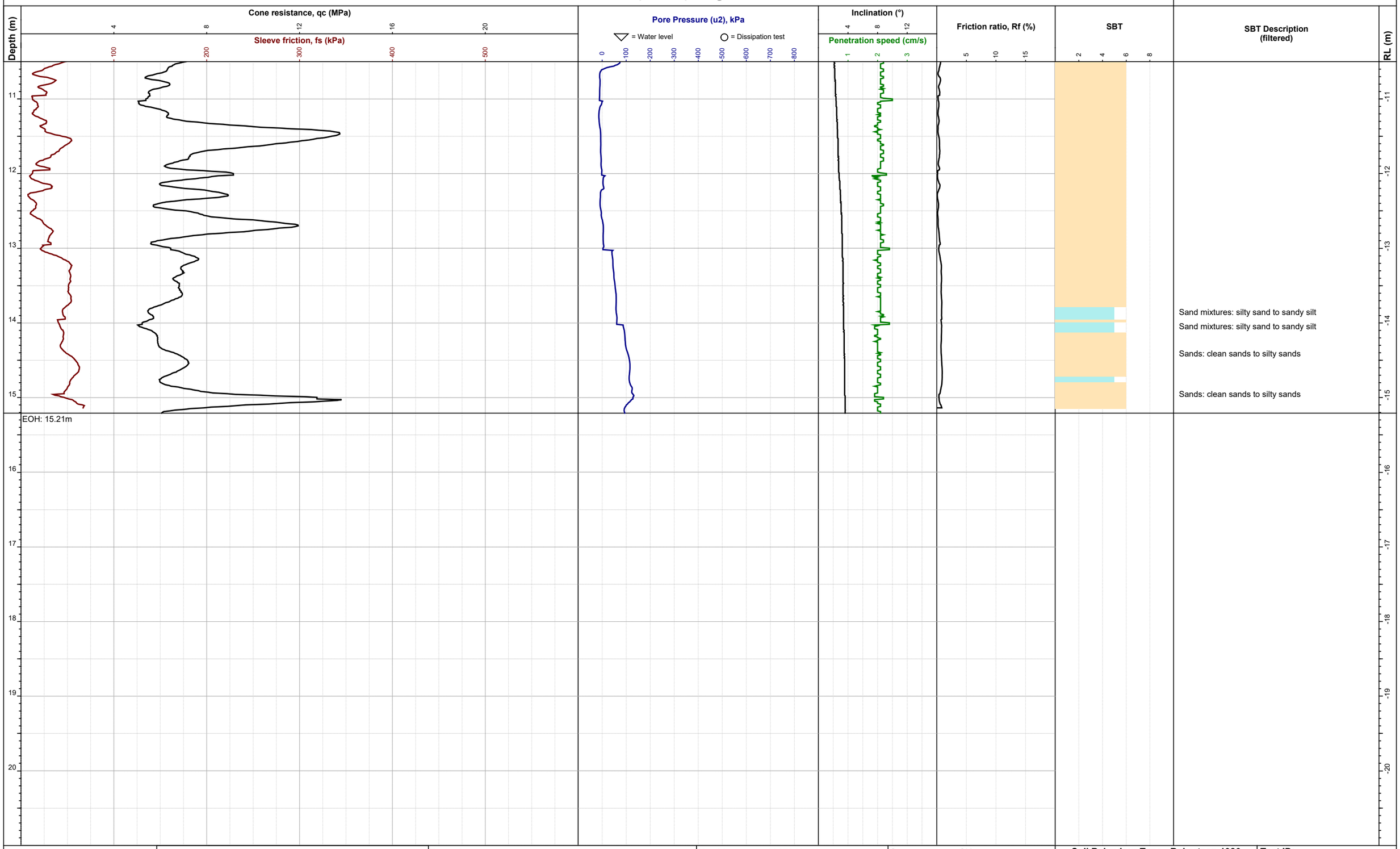
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-11

Project ID:	18319
Depth:	15.21m
Sheet:	1 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-11



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:49 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.82m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027849mN
Easting:	1731643mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-11

Project ID:	18319
Depth:	15.21m
Sheet:	2 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-11

Depth (m)

Normalised cone resistance, Qt

50 100 150 200 250 300 350

516>>
1873>>
1525>>
1518>>
1513>>
1196>>
914>>
864>>
803>>
731>>
657>>
632>>
613>>
603>>
600>>
648>>
934>>
742>>
662>>
534>>
459>>
474>>
451>>
403>>
486>>
454>>
426>>
427>>
467>>
516>>
532>>
593>>
598>>
465>>
411>>
424>>
411>>
416>>
470>>
513>>
480>>
508>>
490>>
457>>
411>>

Undrained shear strength, su (kPa) Nkt = 15

50 100 150 200 250

Sensitivity

1 2 3 4 5

Friction Angle (°)

30 35 40 45 50

SPT N60 (blows/300mm)

10 20 30 40 50

Soil Behaviour Type Index, Ic

1 2 3 4 5

SBTn

2 4 6 8

SBTn Description (filtered)

Sands: clean sands to silty sands

RL (m)

1 2 3 4 5 6 7 8 9 10

-1 -2 -3 -4 -5 -6 -7 -8 -9 -10

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:49 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.82m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027849mN
Easting:	1731643mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

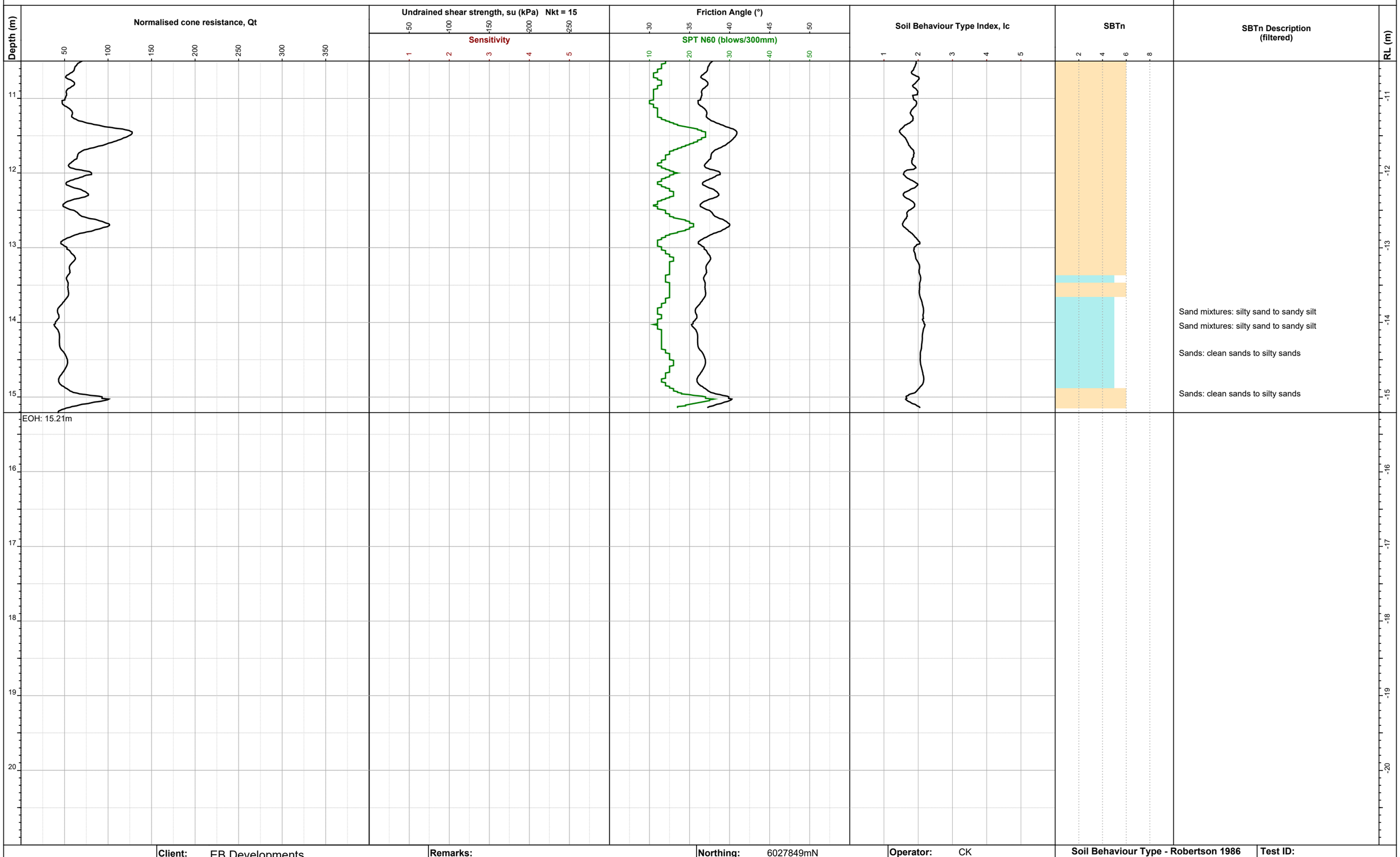
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-11

Project ID:	18319
Depth:	15.21m
Sheet:	1 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-11



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:49 pm

LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.82m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027849mN
Easting:	1731643mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-11

Project ID:	18319
Depth:	15.21m
Sheet:	2 of 2
Date:	10/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-12

Depth (m) | Cone resistance, qc (MPa) / Sleeve friction, fs (kPa) | Pore Pressure (u2), kPa | Inclination (°) / Penetration speed (cm/s) | Friction ratio, Rf (%) | SBT | SBT Description (filtered) | RL (m)

= Water level = Dissipation test

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Dissipation test: 7.01m

Dense sand to gravelly sand

Sands: clean sands to silty sands

EOH: 7.01m

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:51 pm

LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.63m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027806mN
Easting:	1731658mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-12

Project ID:	18319
Depth:	7.01m
Sheet:	1 of 1
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-12

Depth (m)

Normalised cone resistance, Qt

50 100 150 200 250 300 350

2450>>
2499>>
1264>>
800>>
767>>
785>>
732>>
692>>
655>>
577>>
558>>
464>>
427>>
401>>
408>>
406>>
430>>
457>>
466>>
432>>
414>>
412>>
403>>
403>>
425>>
439>>
538>>
514>>
455>>
574>>
616>>
613>>

EOH: 7.01m

Undrained shear strength, su (kPa) Nkt = 15

50 100 150 200 250

Sensitivity

1 2 3 4 5

Friction Angle (°)

30 35 40 45 50

SPT N60 (blows/300mm)

10 20 30 40 50

Soil Behaviour Type Index, Ic

1 2 3 4 5

SBTn

2 4 6 8

SBTn Description (filtered)

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Dense sand to gravelly sand

Sands: clean sands to silty sands

RL (m)

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:52 pm

LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.63m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027806mN
Easting:	1731658mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

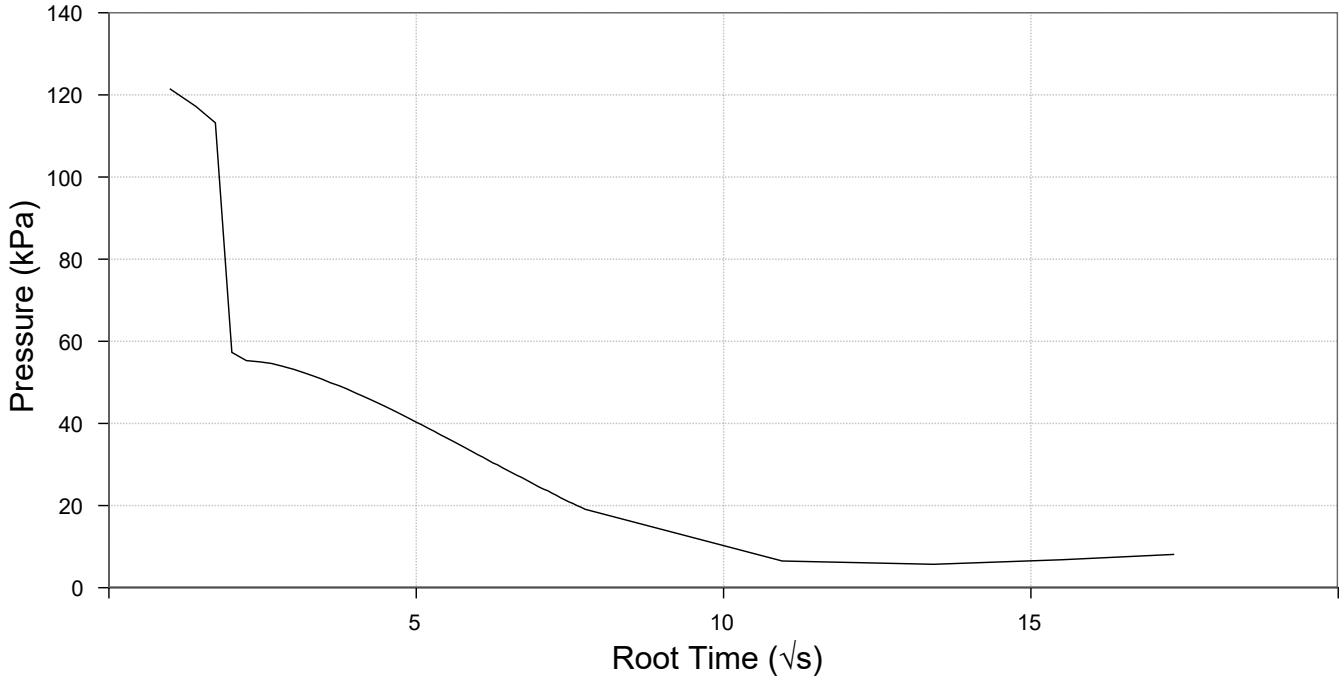
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-12

Project ID:	18319
Depth:	7.01m
Sheet:	1 of 2
Date:	10/04/2022

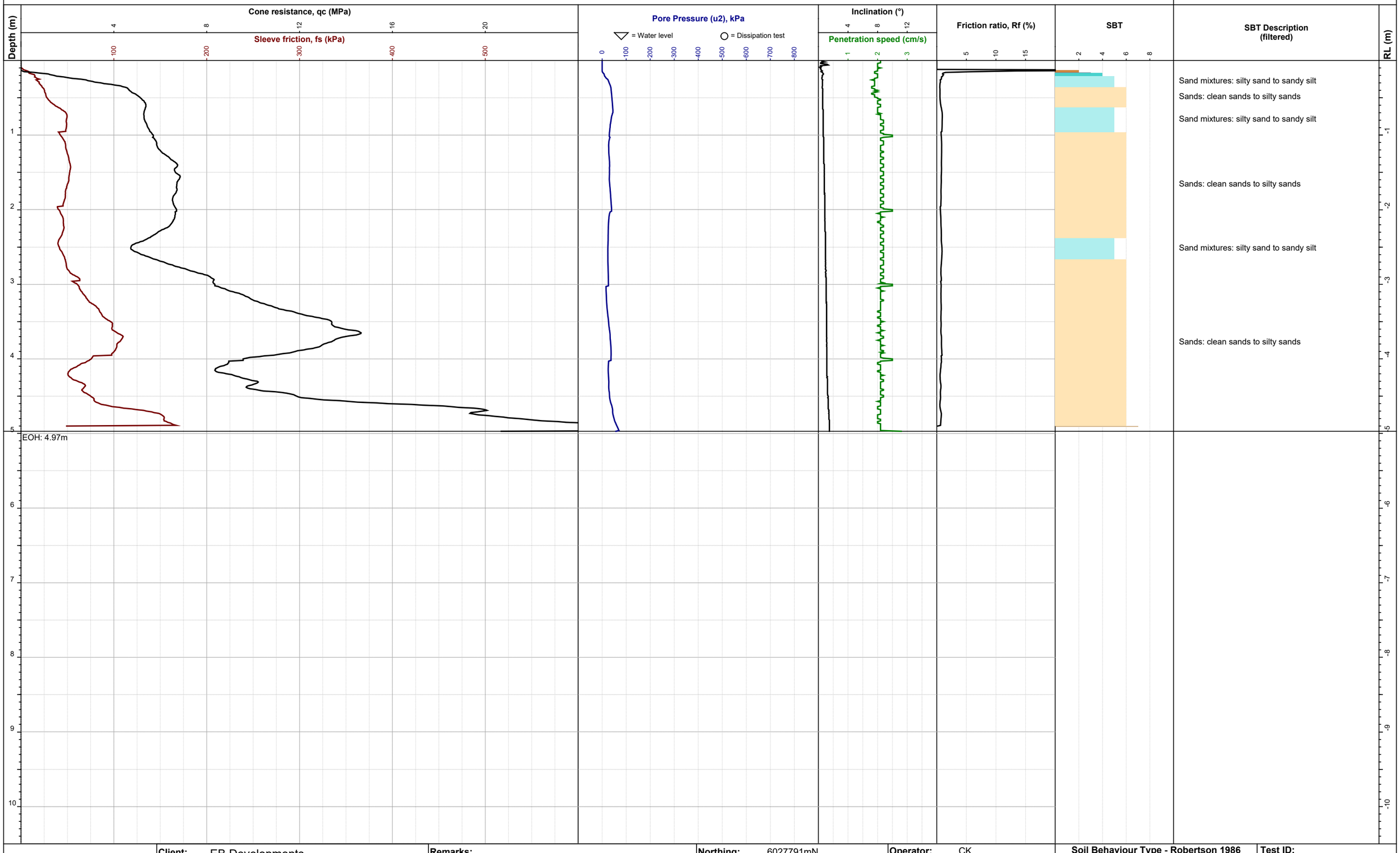
CPT-12 Dissipation Testing

Test at: 7.01m



Cone Penetration Test (CPTu) Log

Test ID: CPT-13



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:54 pm

LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.43m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027791mN
Easting:	1731596mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

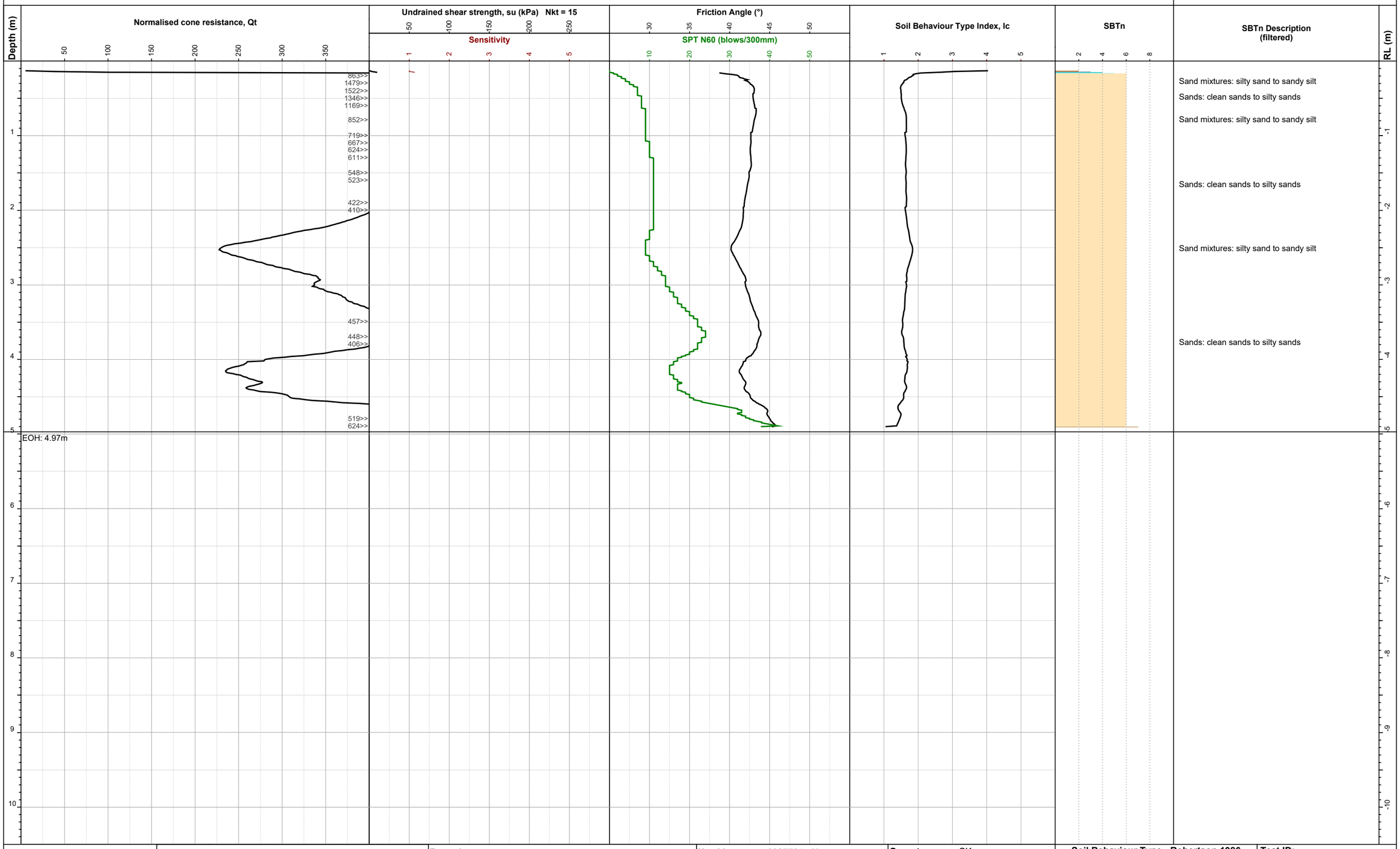
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-13

Project ID:	18319
Depth:	4.97m
Sheet:	1 of 1
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-13



SBTn Description (filtered)

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Sand mixtures: silty sand to sandy silt

Sands: clean sands to silty sands

Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:54 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client:	EB Developments
Project:	Geotechnical Investigation
Location:	Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.43m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027791mN
Easting:	1731596mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

Test ID: CPT-13

Project ID:	18319
Depth:	4.97m
Sheet:	1 of 1
Date:	10/04/2022

Cone Penetration Test (CPTu) Log

Test ID: CPT-14

Cone resistance, qc (MPa) / Sleeve friction, fs (kPa)

Pore Pressure (u2), kPa — = Water level, = Dissipation test

Inclination (°) / Penetration speed (cm/s)

Friction ratio, Rf (%)

SBT

Depth (m)	SBT Description (filtered)	RL (m)
0	Sand mixtures: silty sand to sandy silt	
1	Sands: clean sands to silty sands	-1
2	Sand mixtures: silty sand to sandy silt	-2
3		-3
4	Sands: clean sands to silty sands	-4
5		-5
6	Sands: clean sands to silty sands	-6
EOH: 6.2m		
7		-7
8		-8
9		-9
10		-10

LDE LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.62m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027729mN
Easting:	1731619mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 1986

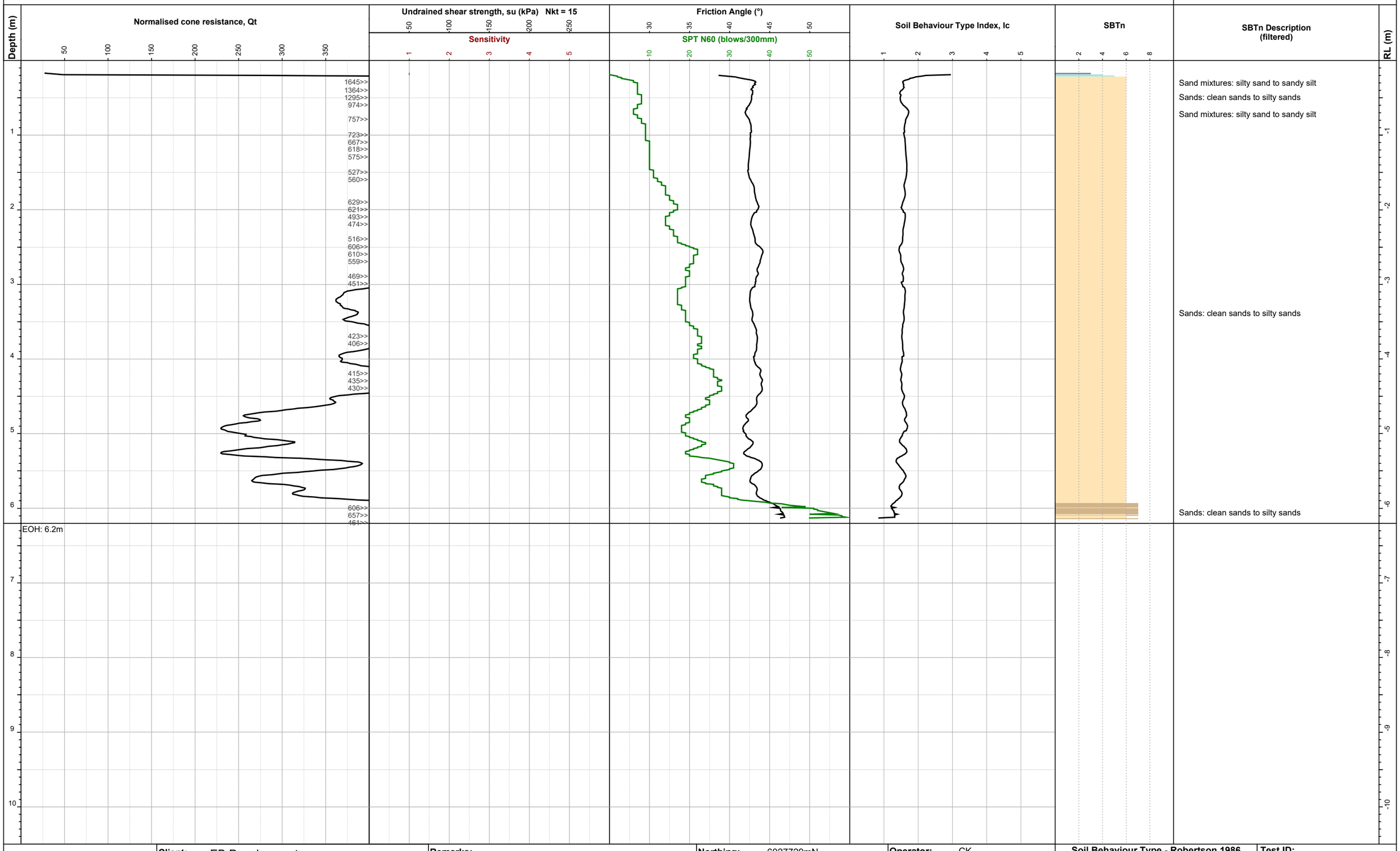
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-14

Project ID:	18319
Depth:	6.2m
Sheet:	1 of 1
Date:	10/04/2022

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-14



Generated with CORE-GS by Geroc - CPT Combined A3 v1 - 29/06/2022 2:17:56 pm

LDE LAND DEVELOPMENT & ENGINEERING

Client: EB Developments

Project: Geotechnical Investigation

Location: Tamure Place and Peter Snell Road, Ruakaka

Remarks:
Collapse of hole at 2.62m prevented measurement of ground water.
Test according to ISO 22476-1:12

Termination Reason:
Limit of reaction force

Northing:	6027729mN
Easting:	1731619mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	

Operator:	CK
Rig:	Pagani TG63-150
Cone ID:	MKS650
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.78

Soil Behaviour Type - Robertson 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

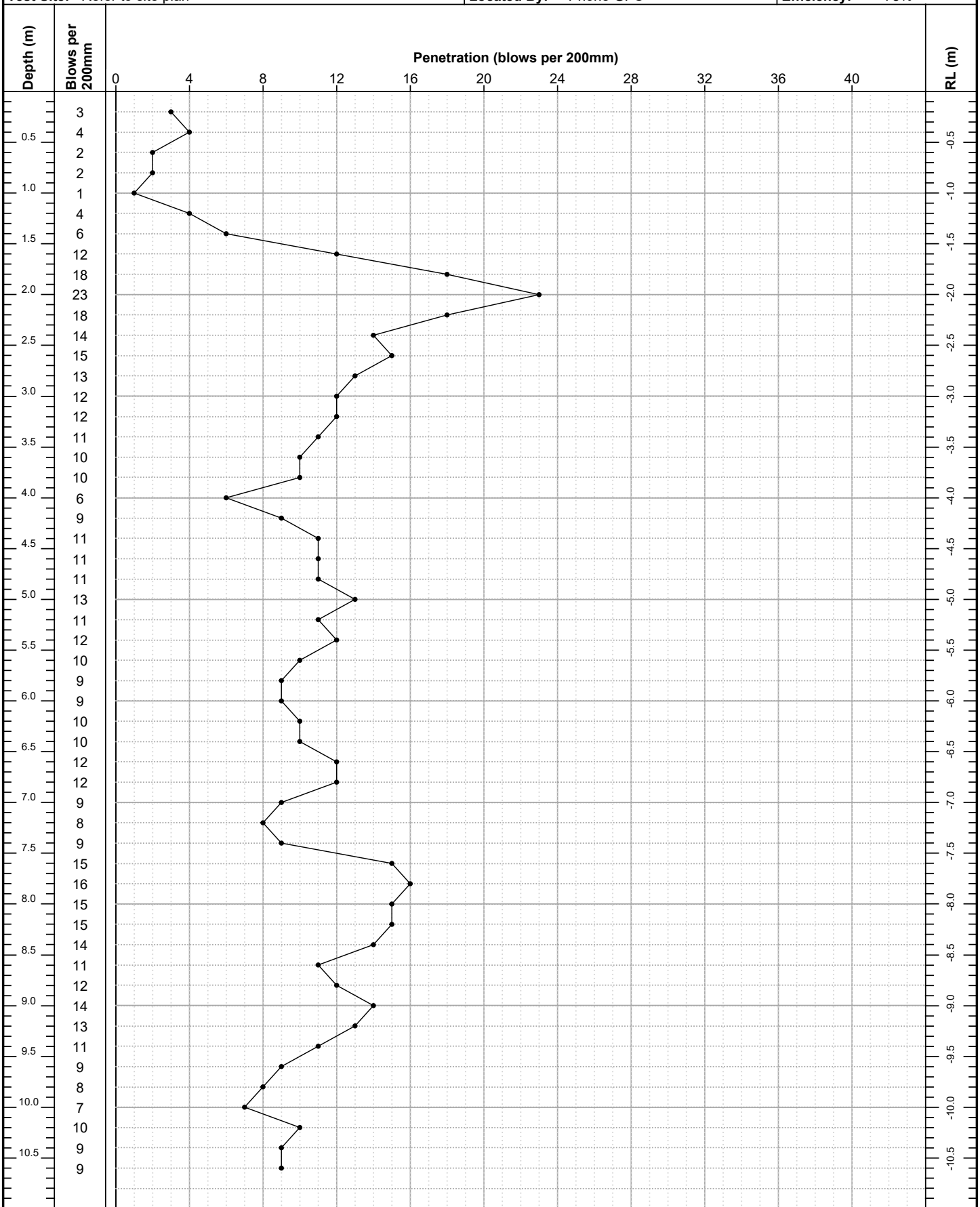
Test ID: CPT-14

Project ID:	18319
Depth:	6.2m
Sheet:	1 of 1
Date:	10/04/2022

DPSH-B Test Log

Test ID:	**DPSH-04**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027807mN, 1731472mE	**Test Date:**	10/04/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Operator:**	
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Rig:**	Pagani TG63-
Test Site:	Refer to site plan	**Located By:**	Phone GPS	**Efficiency:**	~73%

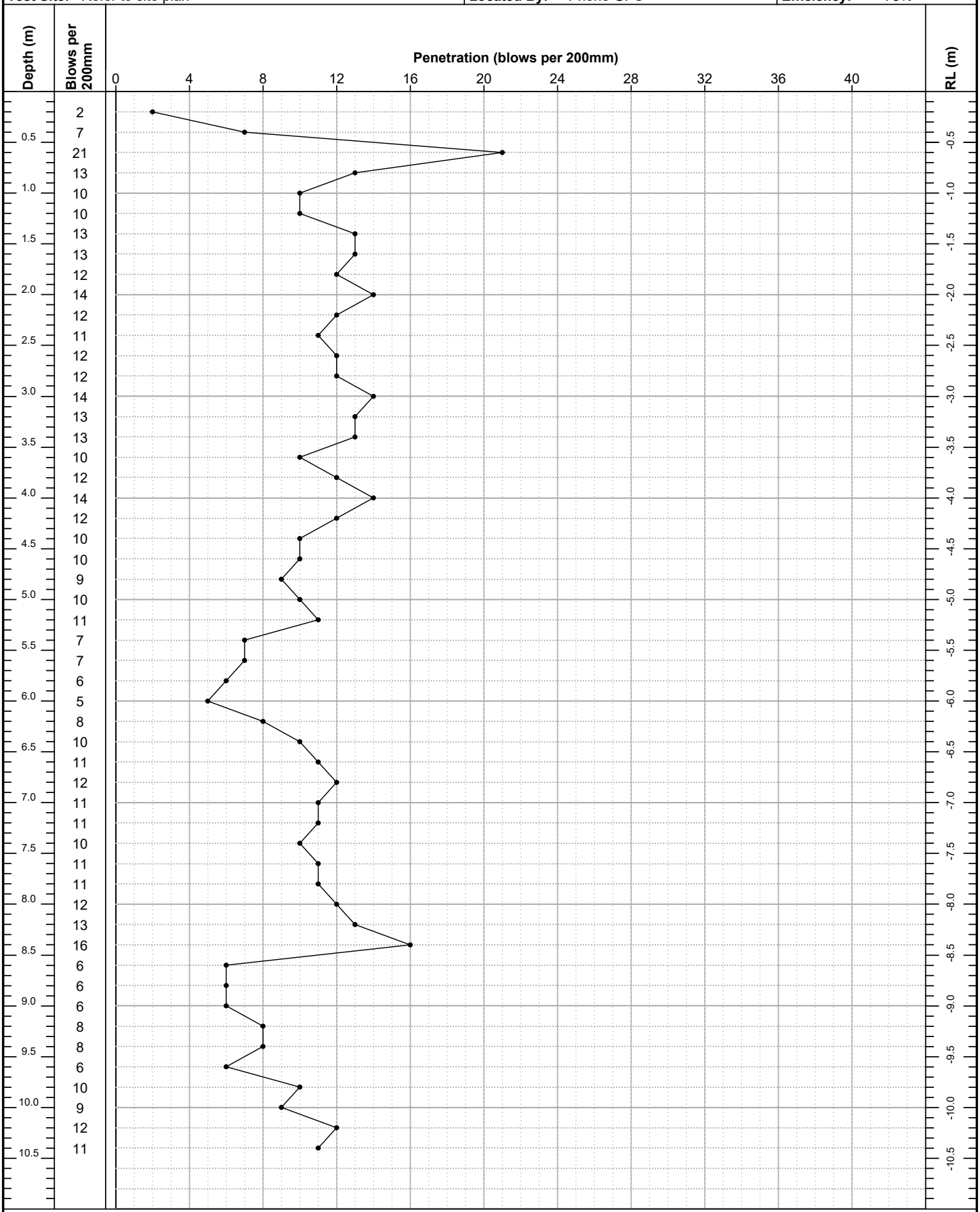


Remarks: Collapse of hole at 2.43m prevented measurement of ground water.. Results have not been corrected for skin friction or depth. These factors should be considered in interpreting test results.

DPSH-B Test Log

Test ID:	**DPSH-05**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027790mN, 1731424mE	**Test Date:**	10/04/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Operator:**	
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Rig:**	Pagani TG63-
Test Site:	Refer to site plan	**Located By:**	Phone GPS	**Efficiency:**	~73%



Remarks: Ground water level located at 1.03m
. Results have not been corrected for skin friction or depth. These factors should be considered in interpreting test results.

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA101**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027896mN, 1731631mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 37/38/39	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0	SAND; brownish grey. Medium dense; moist. SAND; medium; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
	0.10m - 0.30m: Becoming light grey with brown spots	
0.3	Highly organic SILT with trace sand; dark brown. Very weak; dry	Interdune Peat -
0.5	Slightly organic sandy SILT; greyish brown. Medium dense; moist. SAND; fine; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
	Slightly organic silty SAND; greyish brown. Medium dense; moist. SAND; fine; poorly graded	
	0.60m - 1.00m: Becoming light greyish brown; moist; no organics	
1.0	1.00m - 1.30m: Becoming yellowish brown	
	1.30m - 2.20m: Becoming yellowish grey; some medium sand	
1.8	1.80m: Becoming wet	
2.1	2.10m: Becoming saturated	
2.2		

Water: ▼ 2.1

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

15

Test Values

peak / residual (sensitivity)

Hole Depth:	2.20m
Termination:	Collapse of borehole at 2.2m
Remarks:	

● Vane peak ○ Vane residual ◆ Vane UTP

▼ Standing water level ◁ Groundwater inflow ▷ Groundwater outflow

UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA102**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027904mN, 1731583mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 23/24	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	SAND; dark brownish grey. Medium dense; moist to wet. SAND; medium; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
0.10	0.10m - 0.20m: Organic silty lens	
0.30	0.30m - 0.70m: Becoming dark yellowish brown; very hard to auger	
0.70	0.70m - 1.40m: Becoming yellowish grey	
1.20	1.20m: Lenses of quartz sand	
1.40	1.40m - 2.20m: Becoming light yellowish grey; dry to moist; highly quartzose	
1.80	1.80m: Becoming wet	
2.00	2.00m: Becoming saturated	
2.20		

Water: ▼ 2.00

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values

peak / residual (sensitivity)

10
10
10

Hole Depth: 2.20m

Termination: Collapse of borehole at 2.2m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

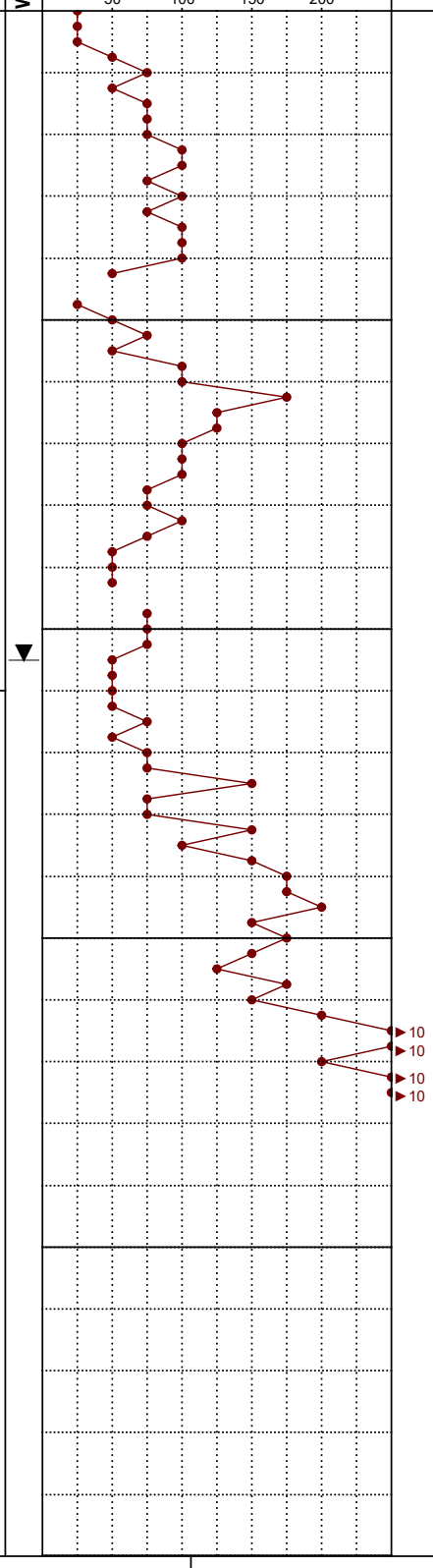
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA103**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027868mN, 1731556mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 18/19	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	SAND; brownish grey. Medium dense; moist. SAND; fine to medium; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
0.5	Slightly organic silty SAND; dark brownish grey. Medium dense; moist. SAND; fine; poorly graded	
1.0	1.10m - 1.50m: Black organic lenses; woody	
	1.20m - 1.50m: Becoming light grey	
1.5	1.50m - 2.20m: Becoming grey	
	1.80m: Becoming wet	
2.0	2.10m: Becoming saturated	
2.5		
3.0		
3.5		
4.0		
4.5		



Test Values
peak / residual (sensitivity)

Hole Depth: 2.20m

Termination: Collapse of borehole at 2.2m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

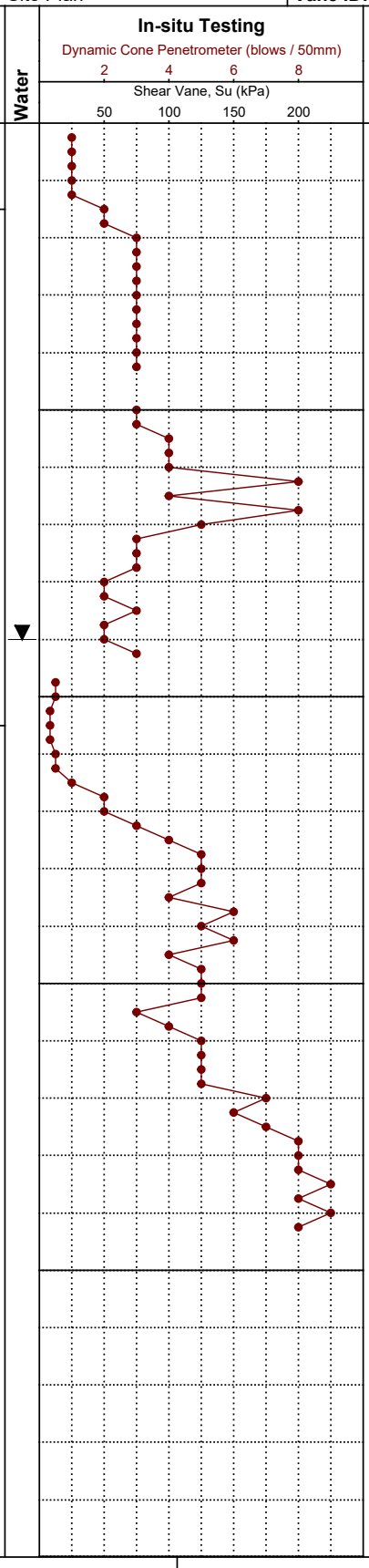
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA104**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027843mN, 1731588mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 27/28	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	Slightly organic SILT with some sand; brown. Loose; moist. SAND; fine; poorly graded	Interdune Peat - Holocene Windblown Deposits
0.5	SAND; orangish yellow. Medium dense; moist. SAND; fine to medium; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
	0.40m - 0.50m: Organic silty lense	
1.0	1.10m - 2.10m: Becoming light greyish brown; SAND; medium	
1.5	1.60m: Becoming wet	
	1.80m: Becoming saturated	
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		



Hole Depth: 2.10m **Termination:** Collapse of borehole at 2.1m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Vane peak | Vane residual | Vane UTP | Standing water level | Groundwater inflow | Groundwater outflow

UTP = Unable to Penetrate

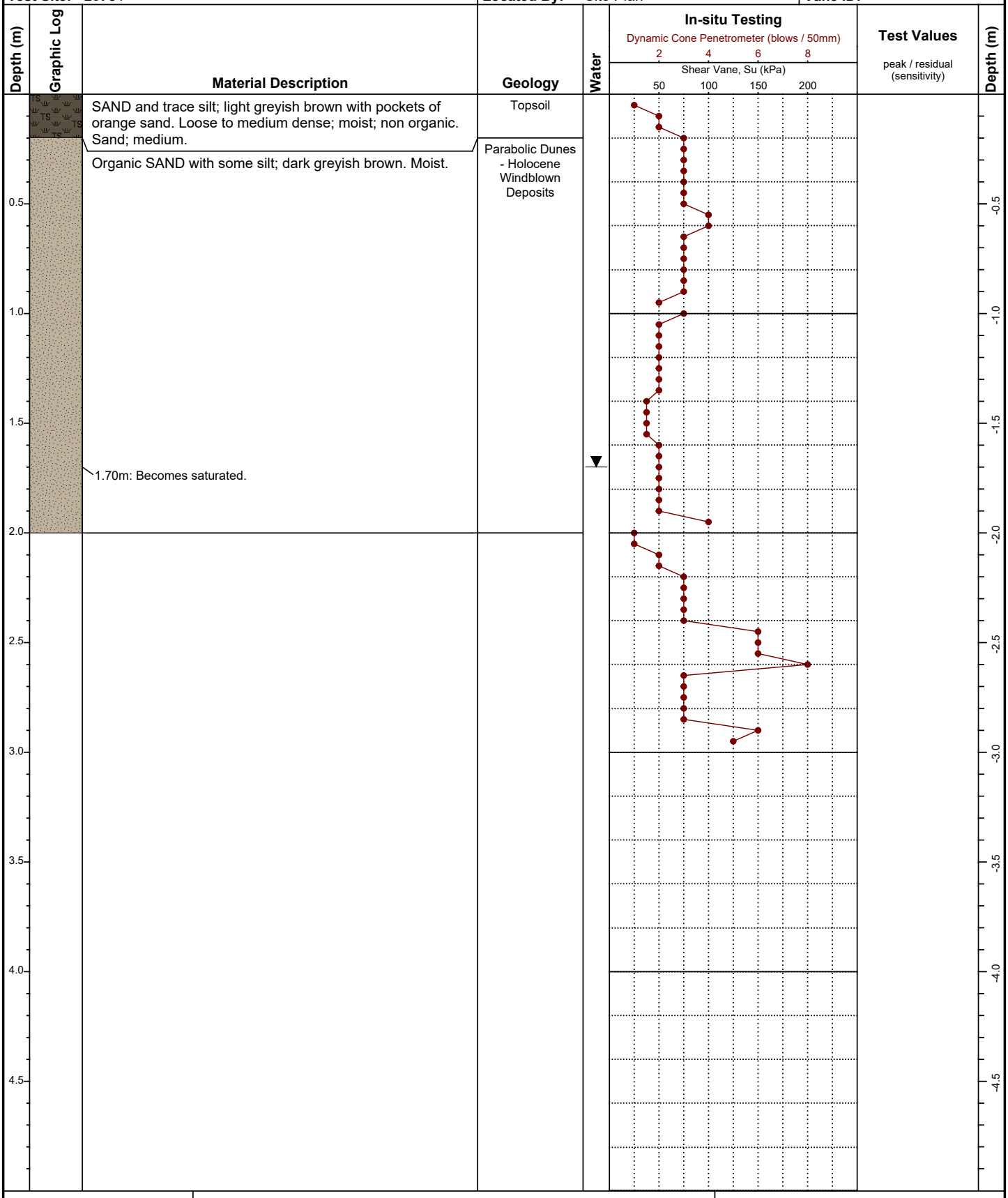
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA105**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027792mN, 1731575mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 31	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	SAND and trace silt; light greyish brown with pockets of orange sand. Loose to medium dense; moist; non organic. Sand; medium.	Topsoil
	Organic SAND with some silt; dark greyish brown. Moist.	Parabolic Dunes - Holocene Windblown Deposits
1.70	1.70m: Becomes saturated.	



Hole Depth: 2.00m

Termination: Collapse of borehole.

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

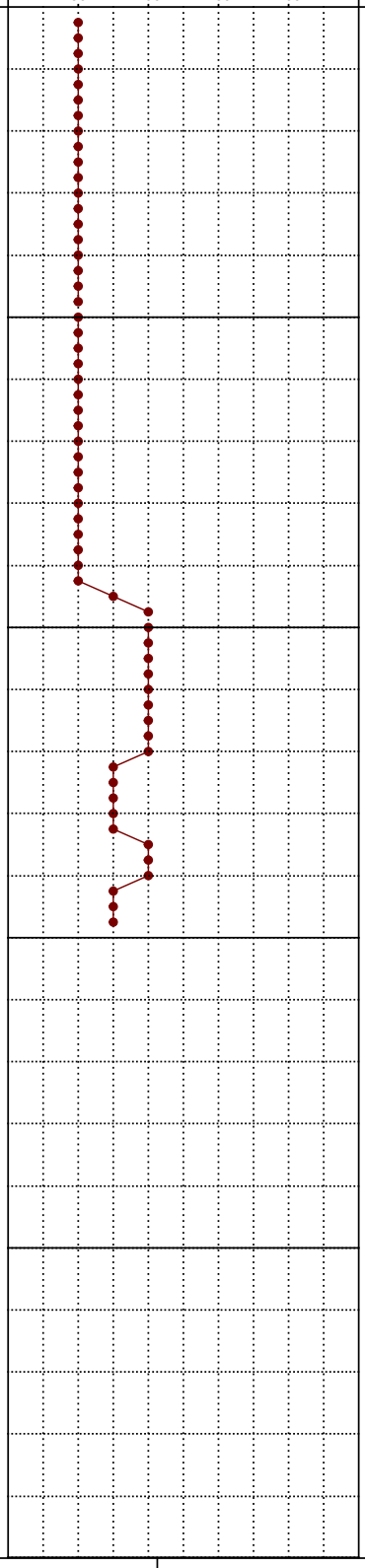
Method: 50mm Hand Auger

Test ID:	**HA106**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027758mN, 1731579mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 58/57	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Graphic Log	Material Description	Geology
0.0	TS TS TS TS	Organic SAND with some silt; dark greyish brown. Moist.	Topsoil
		SAND and trace silt; light greyish brown with pockets of orange sand. Loose to medium dense; moist; non organic. Sand; medium.	Parabolic Dunes - Holocene Windblown Deposits
3.0			

Water: Groundwater Not Encountered



Test Values: peak / residual (sensitivity)

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

Hole Depth: 3.00m **Termination:** Target depth.

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA107**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027722mN, 1731589mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 55/56	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	Organic silty sand; brown. Moist; rootlets	Interdune Peat - Holocene Windblown
0.2	Slightly organic silty SAND; brownish grey. Medium dense; moist. SAND; fine; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
0.5	SAND; yellowish brown. Medium dense; moist. SAND; fine to medium; poorly graded	
0.6	0.60m - 2.00m: Becoming light yellowish grey	
0.8	0.80m: One greywacke gravel; medium; subangular	
2.0		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

10
10
10

Test Values

peak / residual (sensitivity)

Hole Depth: 2.00m

Termination: Collapse of borehole at 2.0m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA108**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027770mN, 1731644mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 50	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	Organic SAND with some silt and trace clay; mottled brown, black and some orange. Moist.	Topsoil
0.5	SAND and trace silt; light greyish brown with pockets of orange sand. Loose to medium dense; moist; non organic. Sand; medium.	Parabolic Dunes - Holocene Windblown Deposits
2.5	2.70m: Becomes saturated.	
3.0		
4.5		

Water

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm)

2 4 6 8

Shear Vane, Su (kPa)

50 100 150 200

Test Values

peak / residual (sensitivity)

Depth (m)

Hole Depth: 2.90m

Termination: Collapse of borehole.

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA109**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027842mN, 1731668mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 41	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	Organic SAND with some silt; dark greyish brown. Moist.	Topsoil
0.5	SAND and trace silt; light greyish brown with pockets of orange sand. Loose to medium dense; moist; non organic. Sand; medium.	Parabolic Dunes - Holocene Windblown Deposits
	0.70m: Becomes dark grey and organic.	
	0.80m - 1.00m: Becomes black, highly organic with trace clay.	
1.0	1.10m: Becomes light greyish brown and non organic.	
1.5		
2.0		
2.5	2.70m: Becomes saturated.	
3.0		
3.5		
4.0		
4.5		

Water

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm)

2 4 6 8

Shear Vane, Su (kPa)

50 100 150 200

Test Values

peak / residual (sensitivity)

Depth (m)

-0.5 -1.0 -1.5 -2.0 -2.5 -3.0 -3.5 -4.0 -4.5

Hole Depth: 3.00m **Termination:** Target depth.

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA110**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027913mN, 1731682mE	**Test Date:**	09/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 45	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Graphic Log	Material Description	Geology	Water
0.0	TS TS TS	SAND with some silt; dark greyish brown. Moist.	Topsoil	
		SAND and trace silt; light greyish brown with pockets of orange sand. Loose to medium dense; moist; non organic. Sand; medium.	Parabolic Dunes - Holocene Windblown Deposits	
1.80		1.80m: Becomes saturated.		▼
2.00				

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values

peak / residual (sensitivity)

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

Hole Depth:	2.00m
Termination:	Collapse of borehole.
Remarks:	

● Vane peak ▼ Standing water level

○ Vane residual ◁ Groundwater inflow

◆ Vane UTP ▷ Groundwater outflow

UTP = Unable to Penetrate

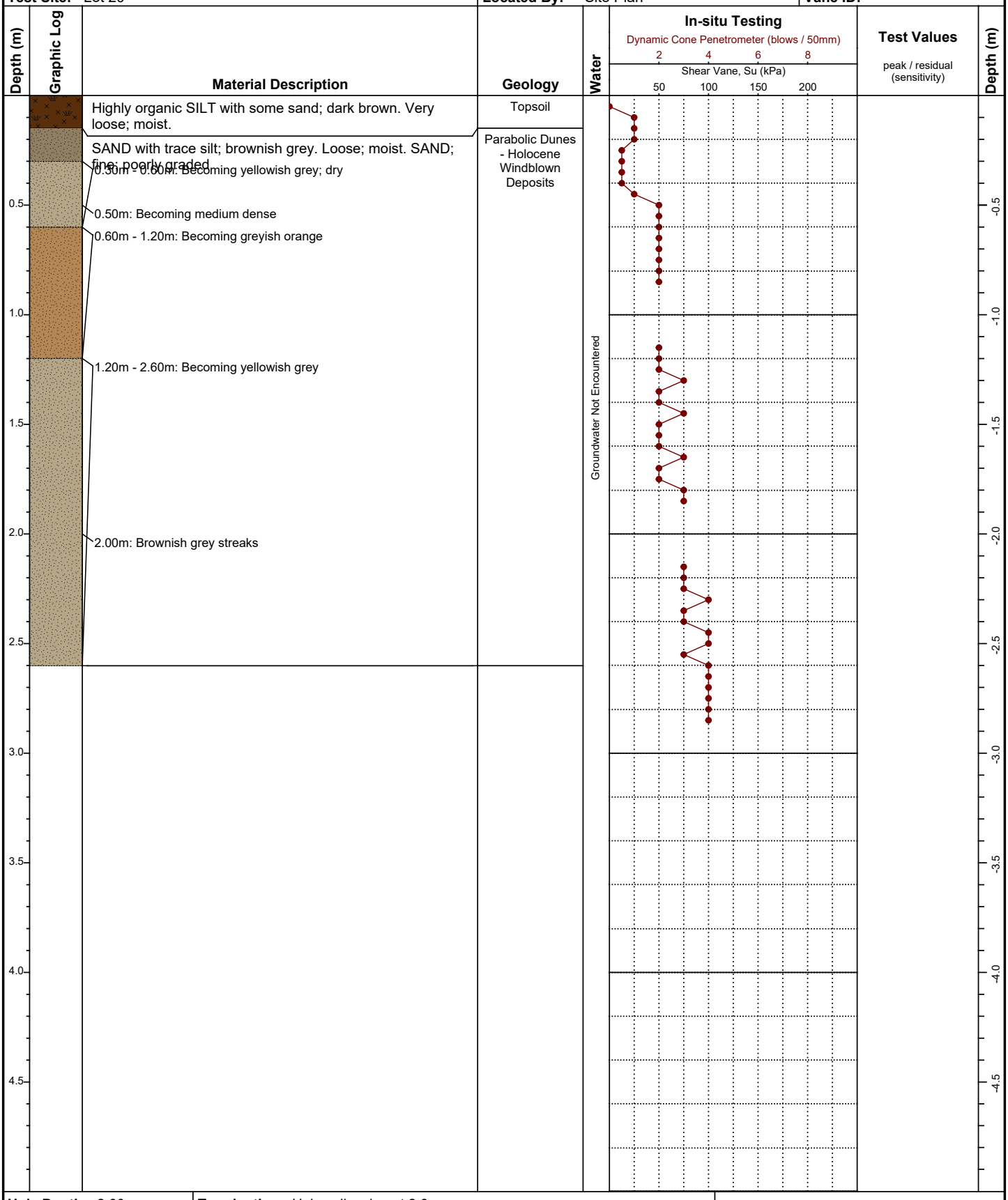
Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA111**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027906mN, 1731523mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 20	**Located By:**	Site Plan	**Vane ID:**	



Hole Depth: 2.60m **Termination:** Hole collapsing at 2.6m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

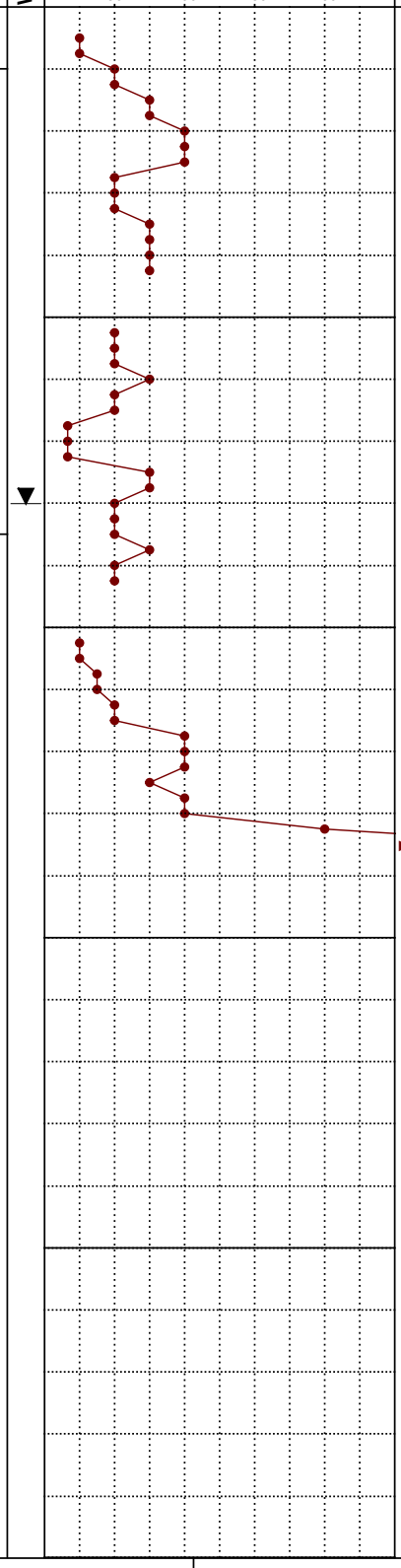
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA112**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027887mN, 1731498mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 9/10	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology
0	Silty SAND; brownish grey. Loose; moist. SAND; fine; poorly graded	Interdune Peat - Holocene Windblown
0.5	SAND with some silt; yellowish grey. Loose to medium dense; moist. SAND; fine; poorly graded	Parabolic Dunes - Holocene Windblown Deposits
0.5	0.60m - 0.80m: Greyish orange lenses	
1.0	1.10m - 1.70m: Becoming light grey with brown streaks	
1.0	1.20m: Becoming wet	
1.5	1.60m: Becoming saturated	



Test Values: peak / residual (sensitivity)

Depth (m): 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

Hole Depth: 1.70m

Termination: Hole collapsing at 1.7m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HA/TP Log v8.1 - 19/07/2022 11:06:36 am

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA113**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027826mN, 1731516mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 13	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Material Description	Geology
0	Silty organic SAND; black with brown mottles. Moist.	Topsoil
0.5	SAND with trace silt; light greyish brown. Medium dense; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown Deposits
1.0	Silty organic SAND with some clay; black. Loose; moist; highly organic; sticky.	Interdune Peat - Holocene Windblown Deposits
1.5	SAND with trace silt; light greyish brown. Loose; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown Deposits
2.0	1.90m: Becoming medium dense	
2.5		
3.0		
3.5		
4.0		
4.5		

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values

peak / residual (sensitivity)

Hole Depth: 3.00m

Termination: Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA114**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027793mN, 1731508mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 64	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Material Description	Geology
0.0	Silty organic SAND; black with brown mottles. Moist.	Topsoil
	SAND with trace silt; light greyish brown. Very loose to loose; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown Deposits
2.0	Silty organic SAND with some clay; black. Very loose; moist; highly organic.	Interdune Peat - Holocene
2.2	SAND with trace silt; light greyish brown. Loose to medium dense; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown Deposits

Water: Groundwater Not Encountered

In-situ Testing

Dynamic Cone Penetrometer (blows / 50mm): 2, 4, 6, 8

Shear Vane, Su (kPa): 50, 100, 150, 200

Test Values

peak / residual (sensitivity)

Hole Depth: 3.00m

Termination: Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

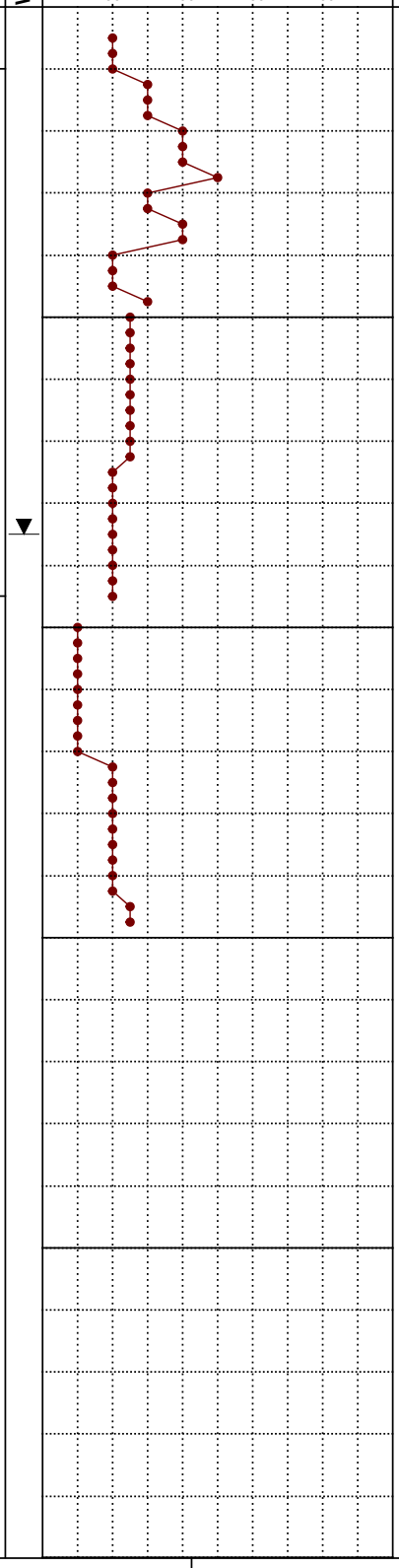
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA115**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027729mN, 1731494mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 72	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Graphic Log	Material Description	Geology
0.0	TS	Silty organic SAND; black with brown mottles. Moist.	Topsoil
0.5		SAND with trace silt; greyish brown. Medium dense; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown Deposits
1.5		1.70m: Becomes saturated.	



Hole Depth: 1.90m **Termination:** Collapse of borehole.

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Vane peak | Vane residual | Vane UTP | Standing water level | Groundwater inflow | Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA116**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027914mN, 1731446mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 5	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm) 2 4 6 8 / Shear Vane, Su (kPa) 50 100 150 200	Test Values: peak / residual (sensitivity)	Depth (m)
0.0		Highly organic SILT with some sand; dark brown. Very loose; moist.	Interdune Peat - Holocene Windblown Deposits	dwater Not Encou	▶15		0.0
		Silty SAND; dark reddish brown. Very dense; dry					
0.5							-0.5
1.0							-1.0
1.5							-1.5
2.0							-2.0
2.5							-2.5
3.0							-3.0
3.5							-3.5
4.0							-4.0
4.5							-4.5

Hole Depth: 0.35m

Termination: Auger spinning on hard material at 0.35m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA117**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027854mN, 1731454mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	JMN
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 1/2	**Located By:**	Site Plan	**Vane ID:**	

Depth (m)	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm)	In-situ Testing: Shear Vane, Su (kPa)	Test Values: peak / residual (sensitivity)
0.0	Highly organic SILT with some sand; dark brown. Very loose; moist.	Interdune Peat - Holocene Windblown Deposits	▼			
0.35	Becoming wet					
0.45	Becoming saturated					15

Hole Depth: 0.45m

Termination: Auger spinning on hard material at 0.45m

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- ● Vane peak
- ○ Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA118**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027820mN, 1731443mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 81	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm)	In-situ Testing: Shear Vane, Su (kPa)	Test Values: peak / residual (sensitivity)	Depth (m)
0.0	TS	Silty organic SAND; black with brown mottles. Moist.	Topsoil					0.0
0.4		SAND with trace silt; greyish brown. Medium dense; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown	▼		10		-0.4
0.5								-0.5
1.0								-1.0
1.5								-1.5
2.0								-2.0
2.5								-2.5
3.0								-3.0
3.5								-3.5
4.0								-4.0
4.5								-4.5

Hole Depth: 0.40m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA119**
Project ID:	18319
Sheet:	1 of 1

Client:	EB Developments	**Coordinates:**	6027743mN, 1731420mE	**Test Date:**	24/06/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	AT
Location:	Tamure Place and Peter Snell Road, Ruakaka	**Elevation:**	Ground	**Checked By:**	GH
Test Site:	Lot 76	**Located By:**	Phone GPS	**Vane ID:**	

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing: Dynamic Cone Penetrometer (blows / 50mm) 2 4 6 8 / Shear Vane, Su (kPa) 50 100 150 200	Test Values: peak / residual (sensitivity)	Depth (m)
0.0	TS	Silty organic SAND; black with brown mottles. Moist.	Topsoil	Groundwater Not Encountered	10		0.0
0.5		SAND with trace silt; dark brown. Medium dense; moist. Sand; medium, well graded.	Parabolic Dunes - Holocene Windblown Deposits				-0.5
1.0							-1.0
1.5							-1.5
2.0							-2.0
2.5							-2.5
3.0							-3.0
3.5							-3.5
4.0							-4.0
4.5							-4.5

Hole Depth: 0.80m

Termination: Auger spinning on hard material.

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

APPENDIX D

STATIC SETTLEMENT ANALYSES

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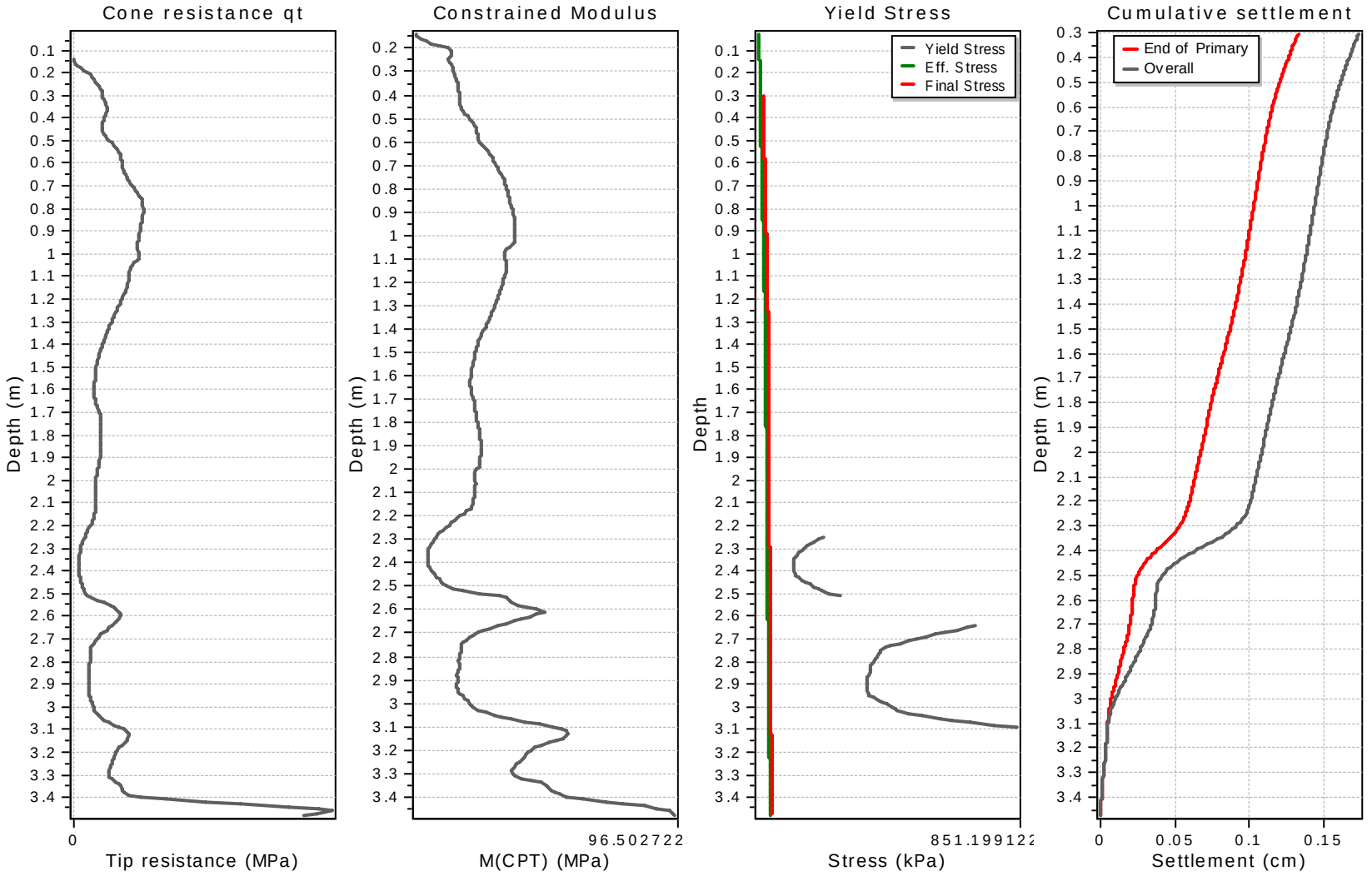
CPT: CPT1
Total depth: 3.48 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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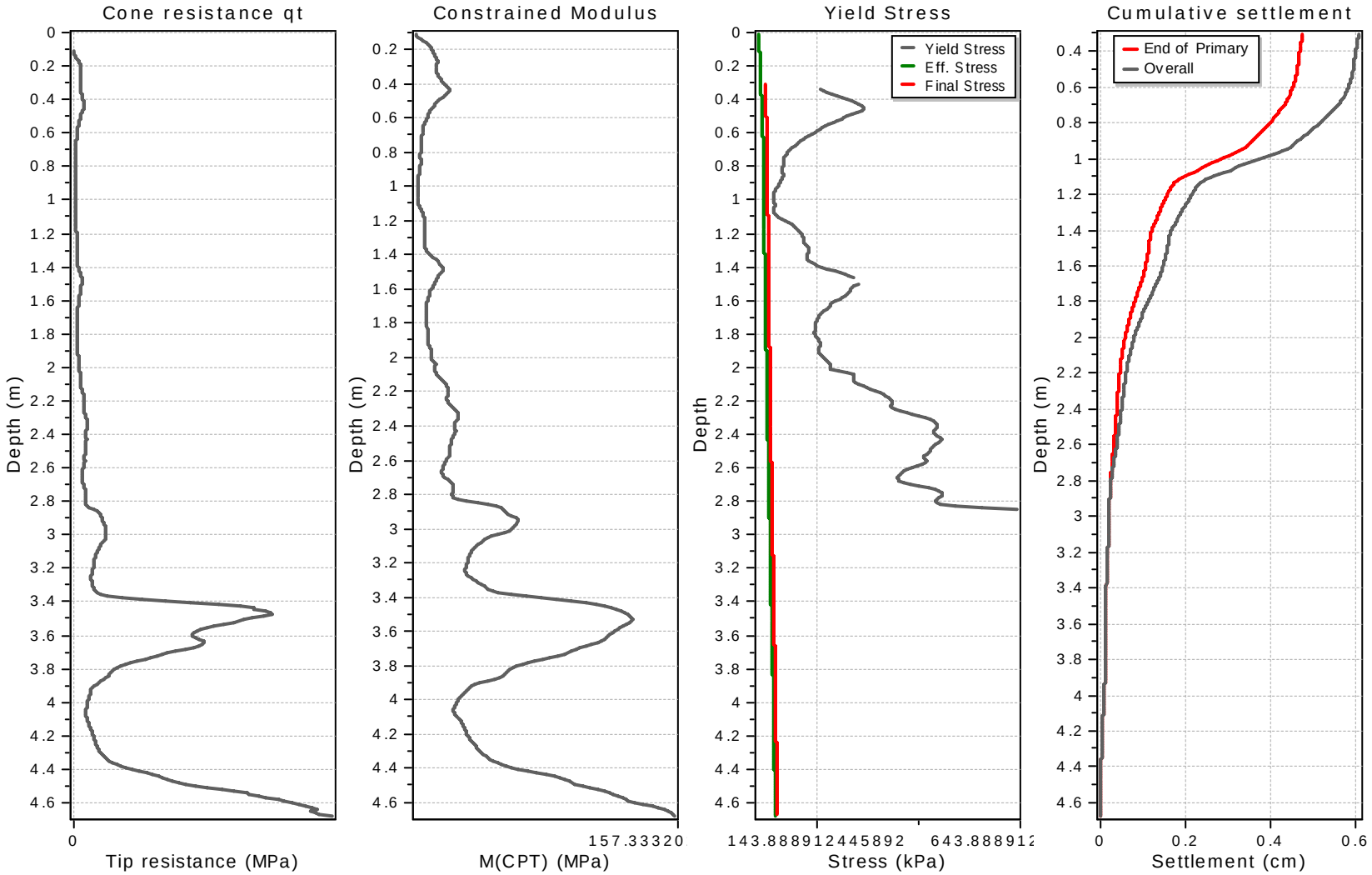
http://www.lde.co.nz

CPT: CPT2
Total depth: 4.68 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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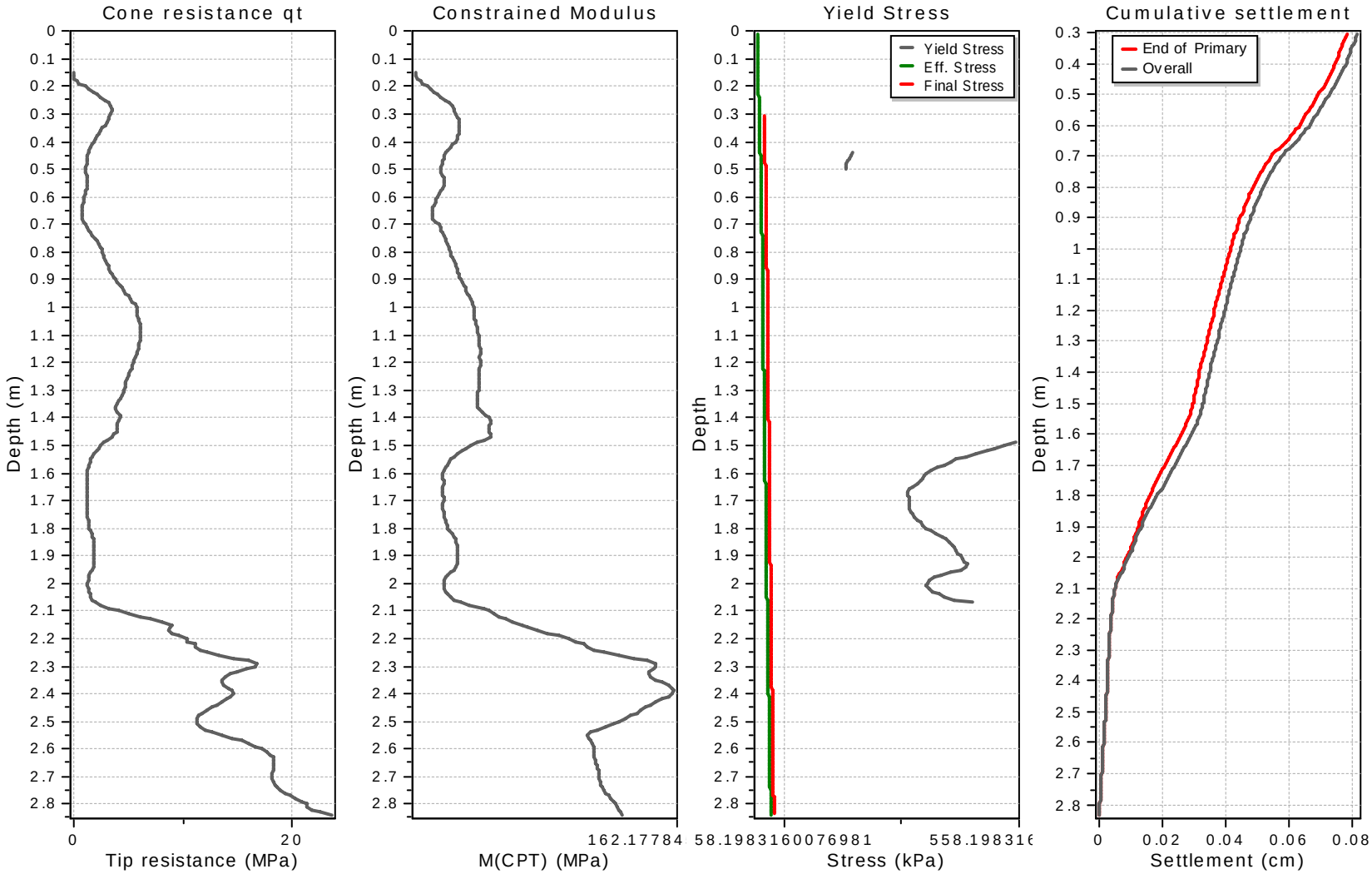
CPT: CPT3
Total depth: 2.84 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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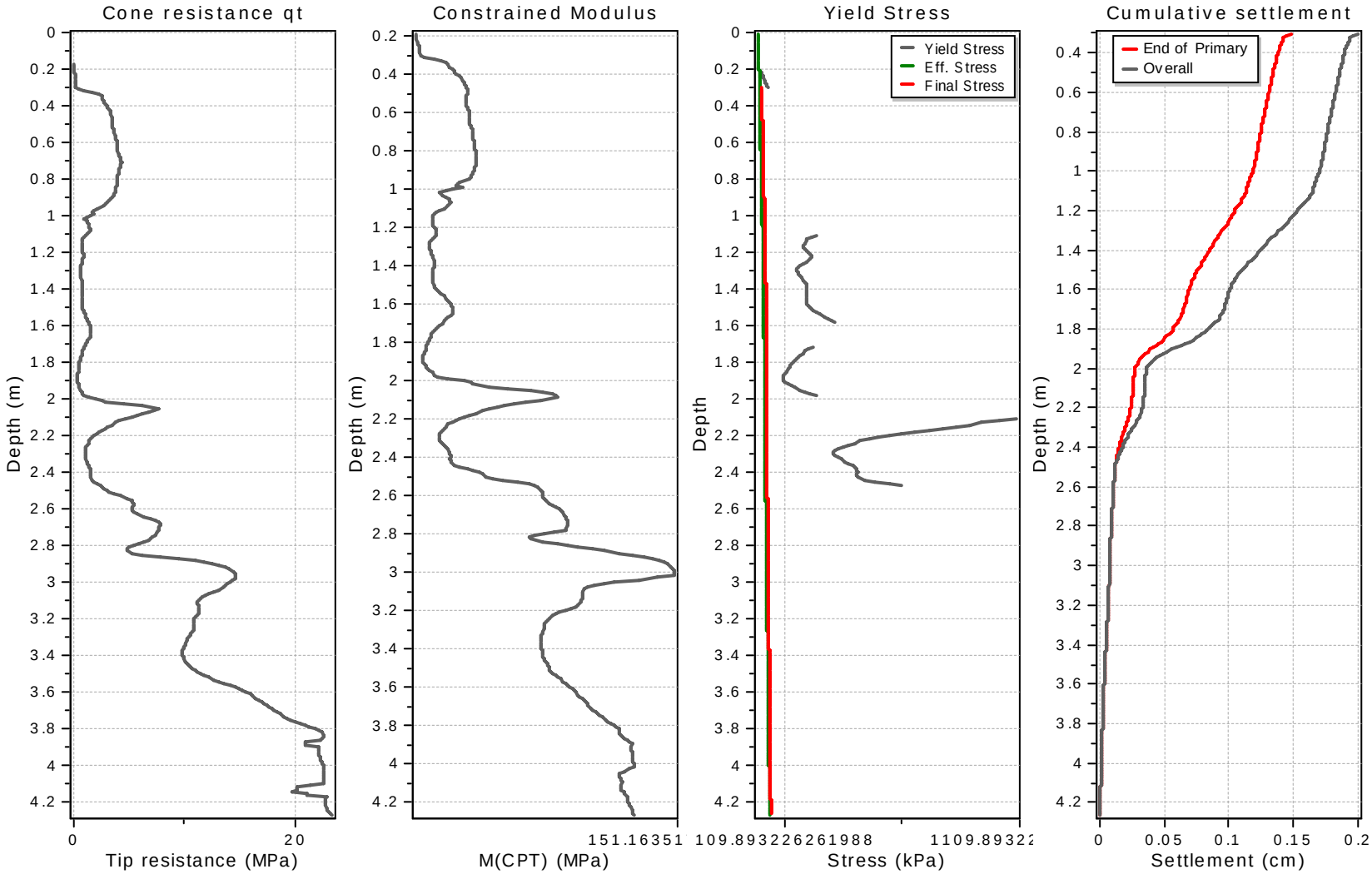
CPT: CPT4
Total depth: 4.27 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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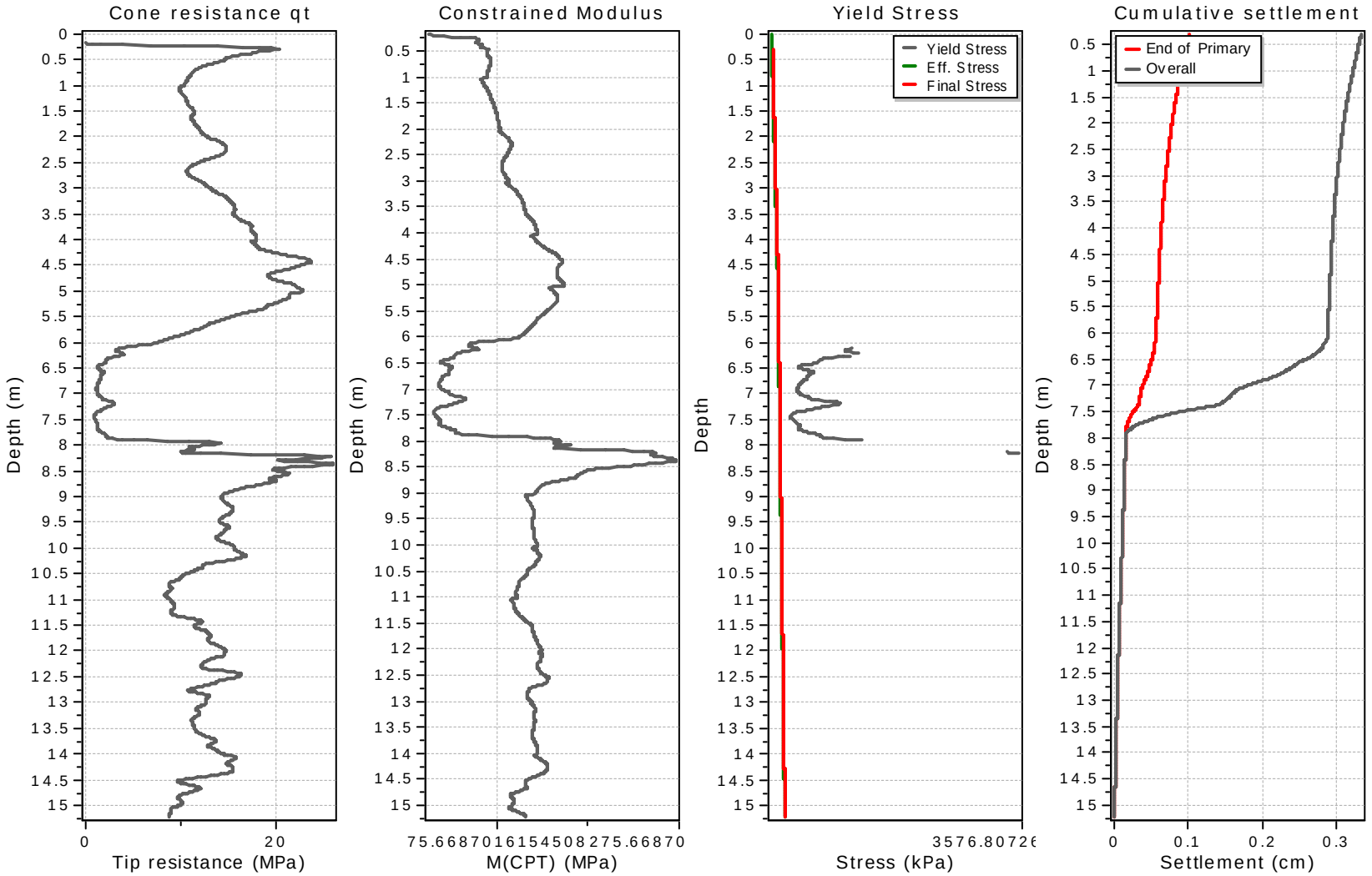
CPT: CPT7
Total depth: 15.23 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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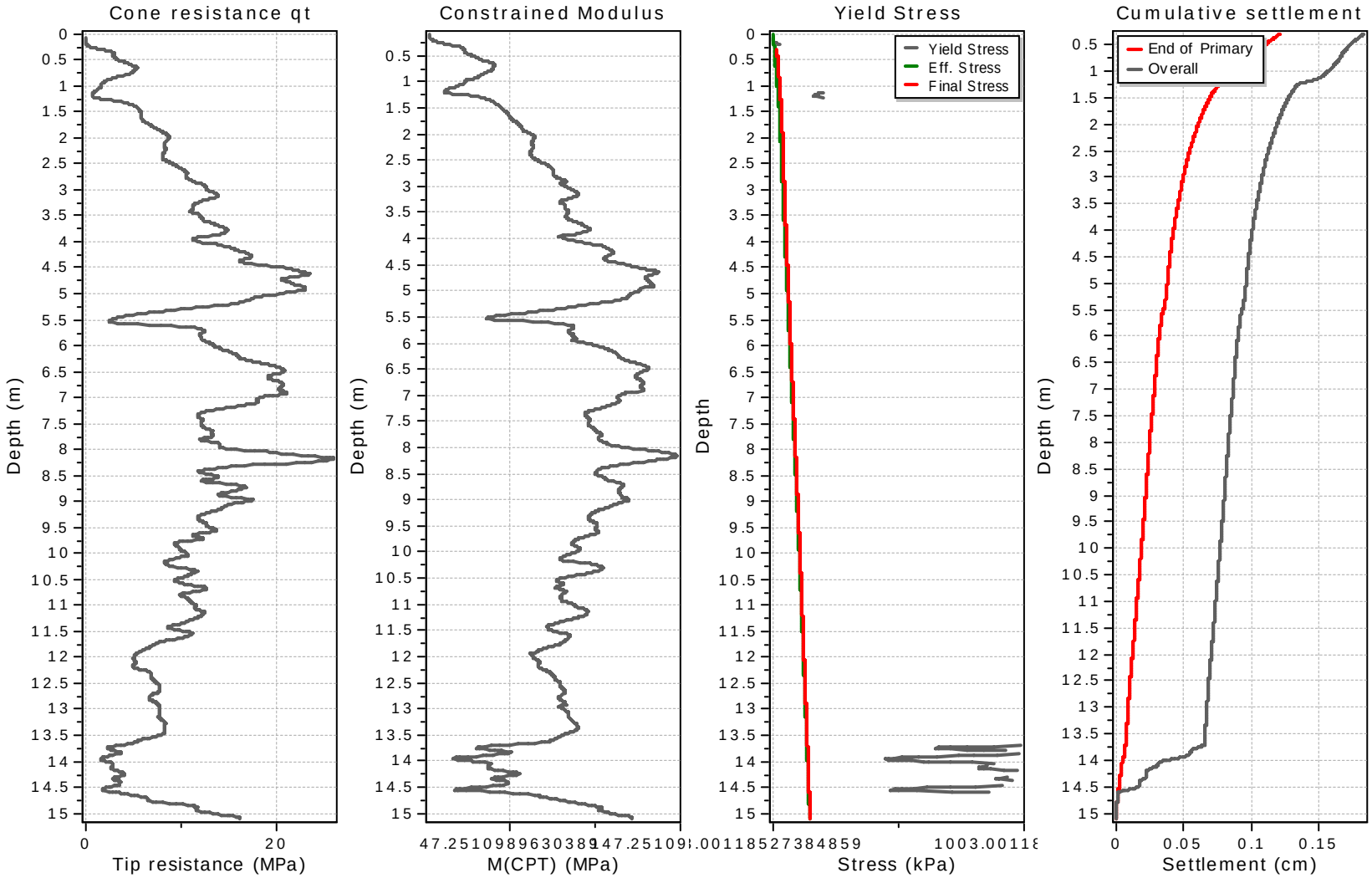
CPT: CPT8
Total depth: 15.11 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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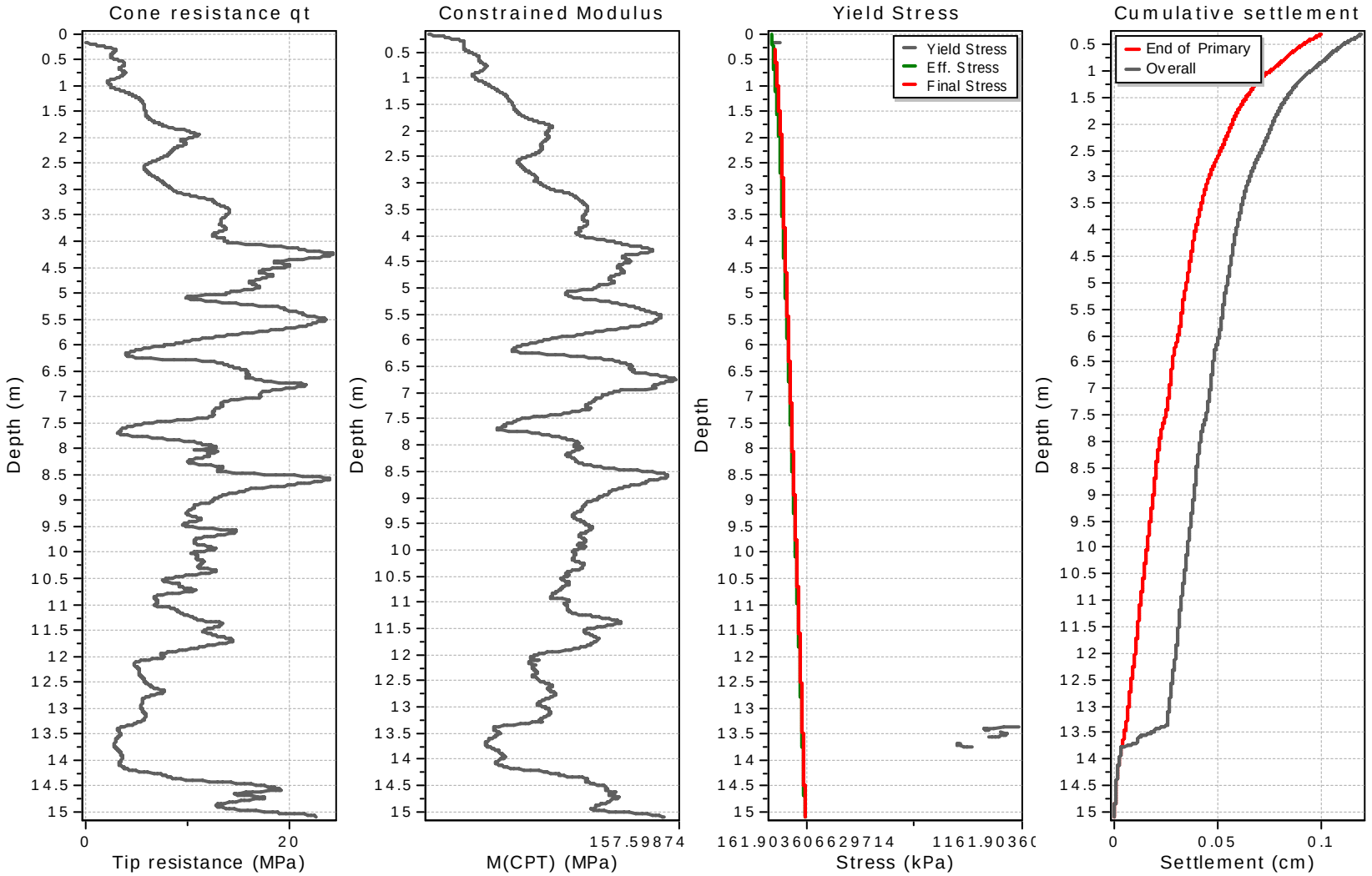
CPT: CPT9
Total depth: 15.10 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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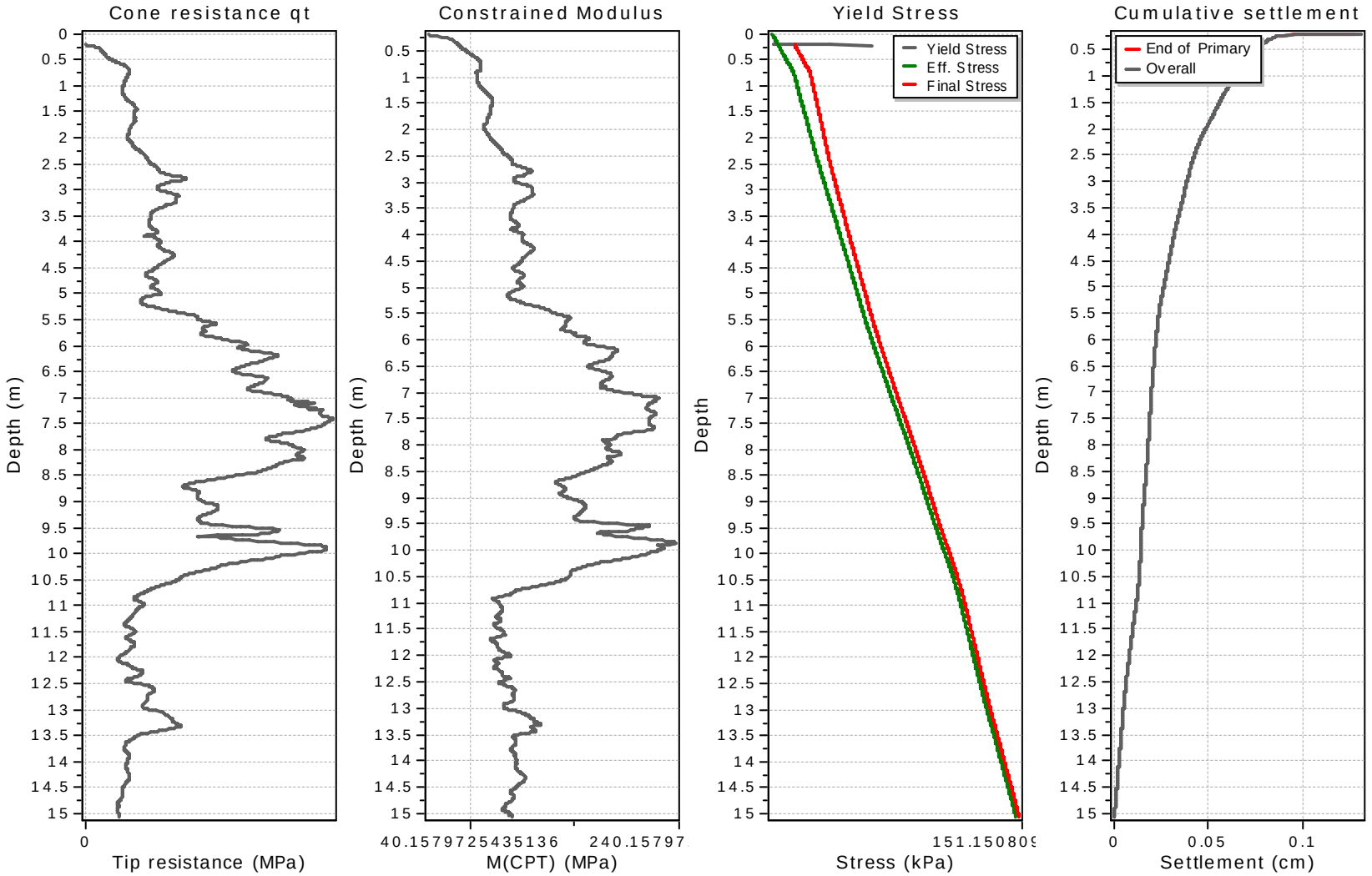
CPT: CPT10
Total depth: 15.07 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.20 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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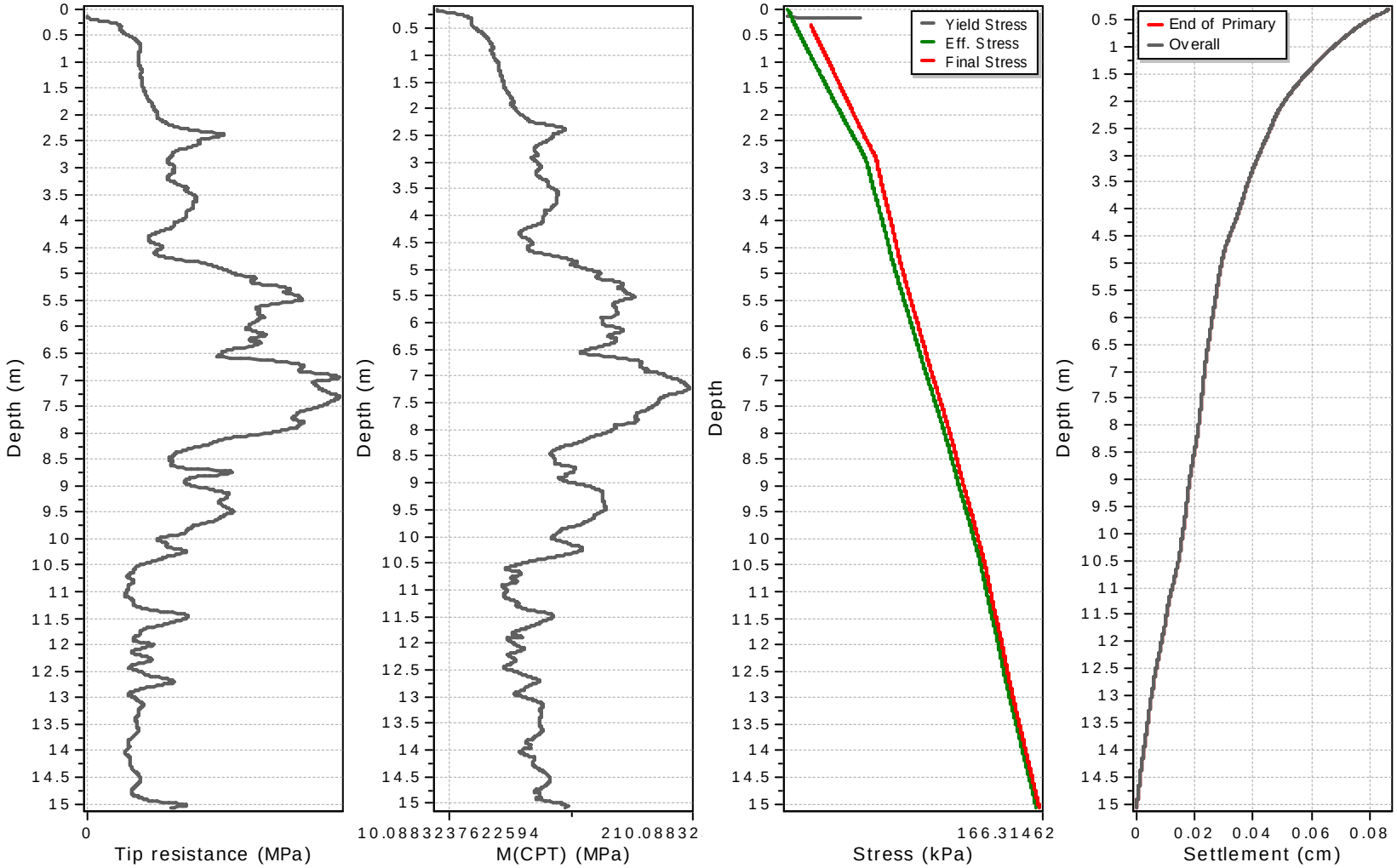
CPT: CPT11
Total depth: 15.08 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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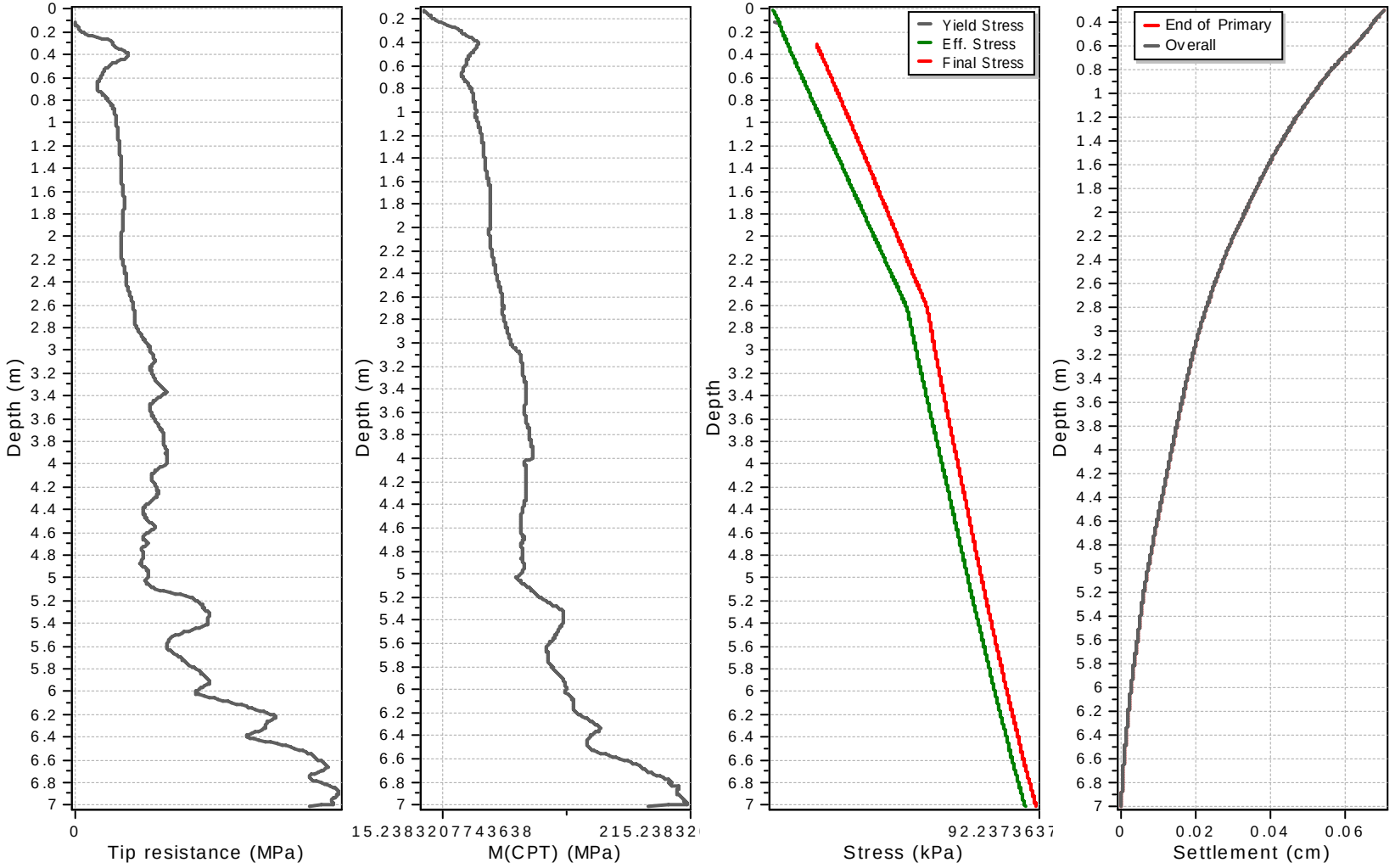
CPT: CPT12
Total depth: 7.01 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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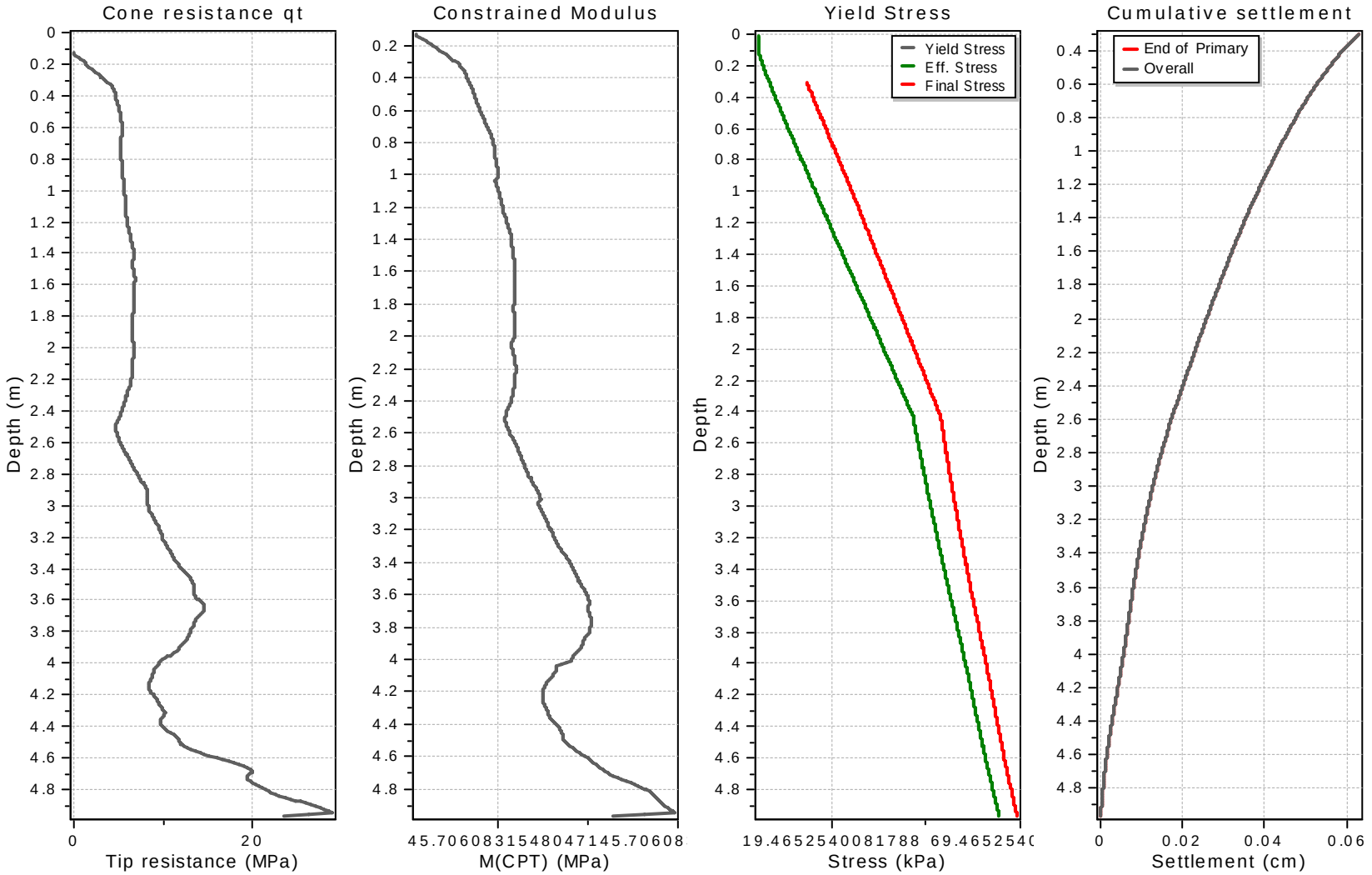
CPT: CPT13
Total depth: 4.97 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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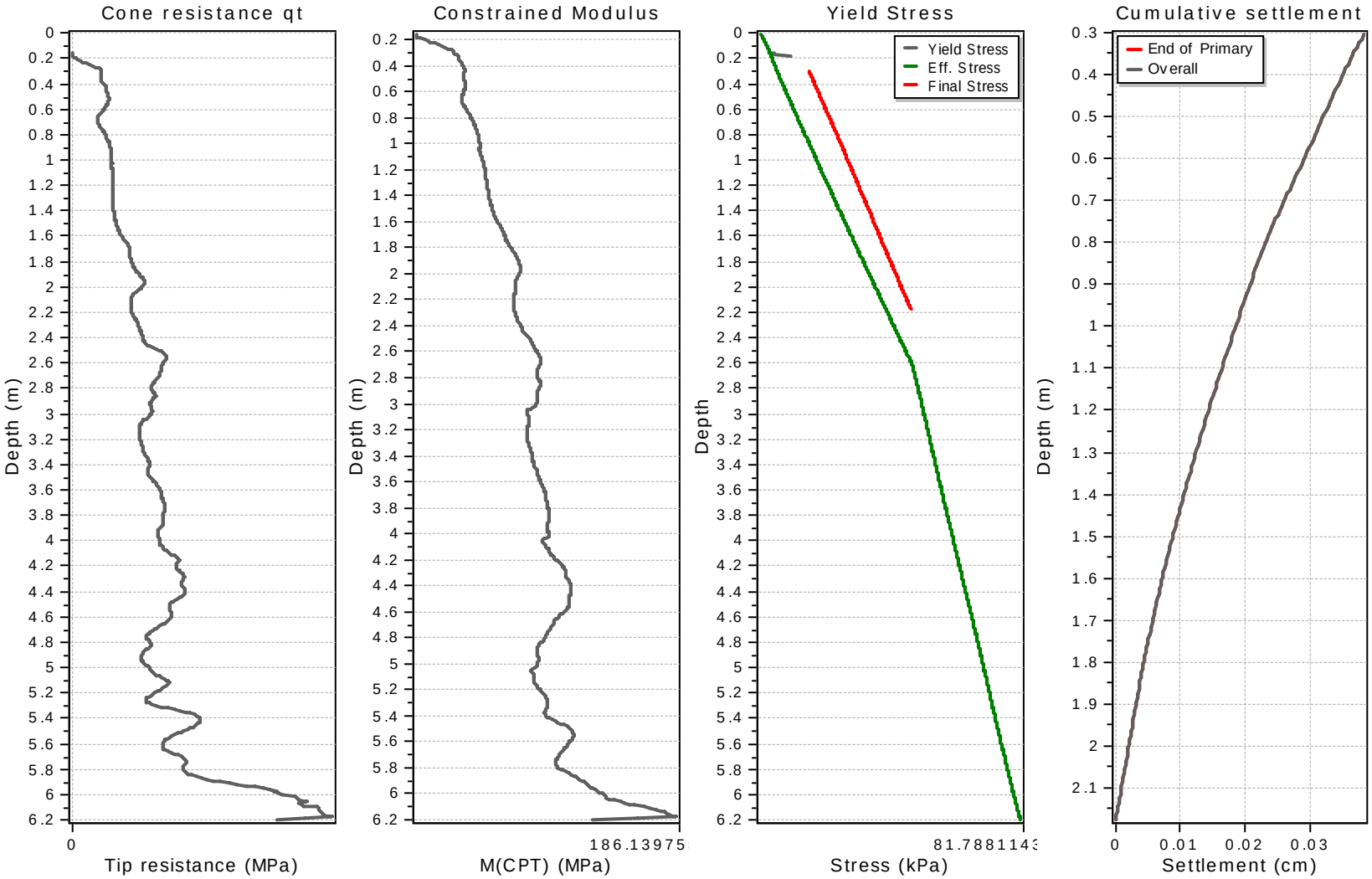
CPT: CPT14
Total depth: 6.20 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 12.00 (m)
L/B: 1.0
Footing pressure: 10.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: Yes
Remove excavation load: No
Apply 20% rule: Yes
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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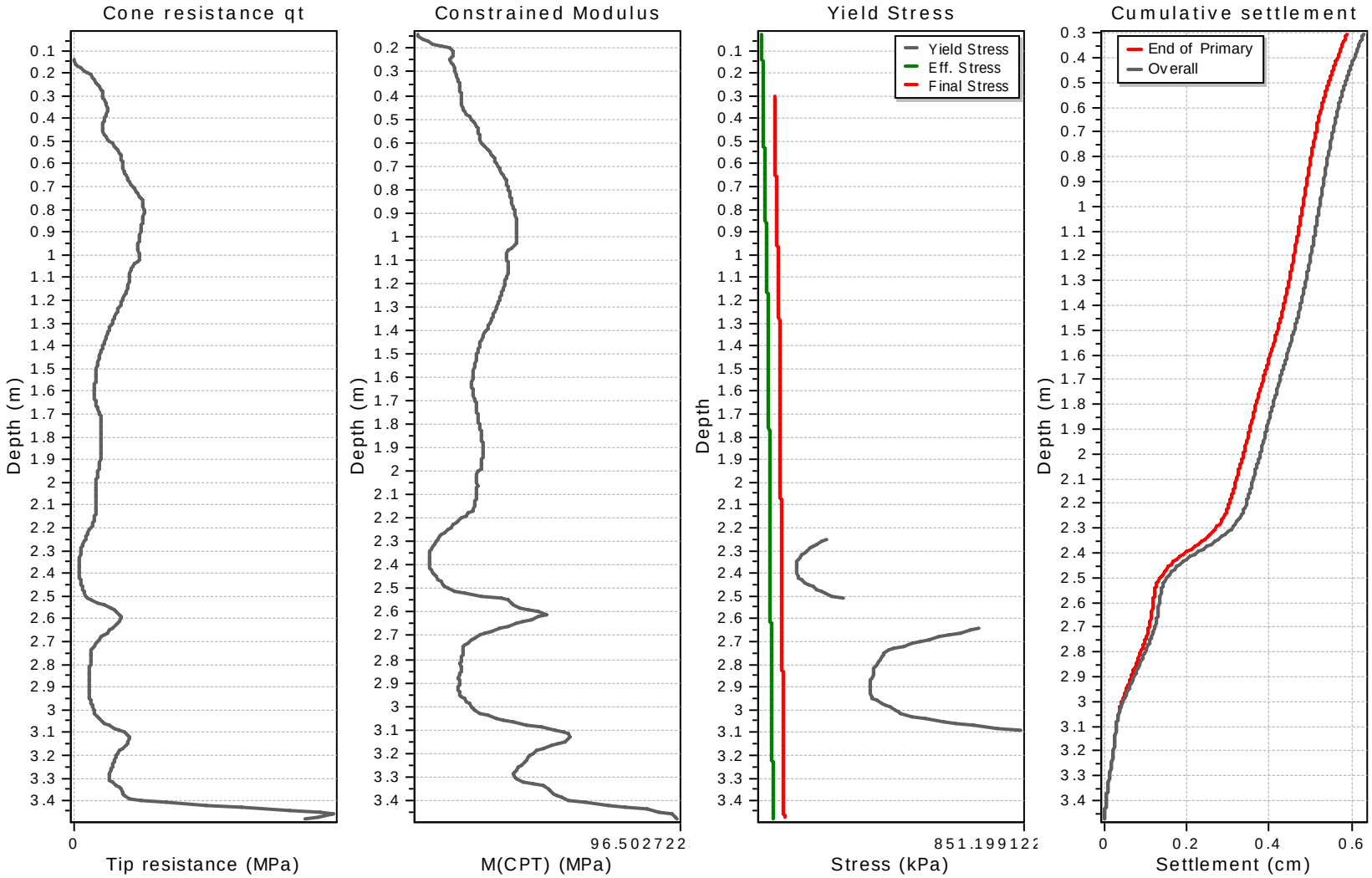
CPT: CPT1
Total depth: 3.48 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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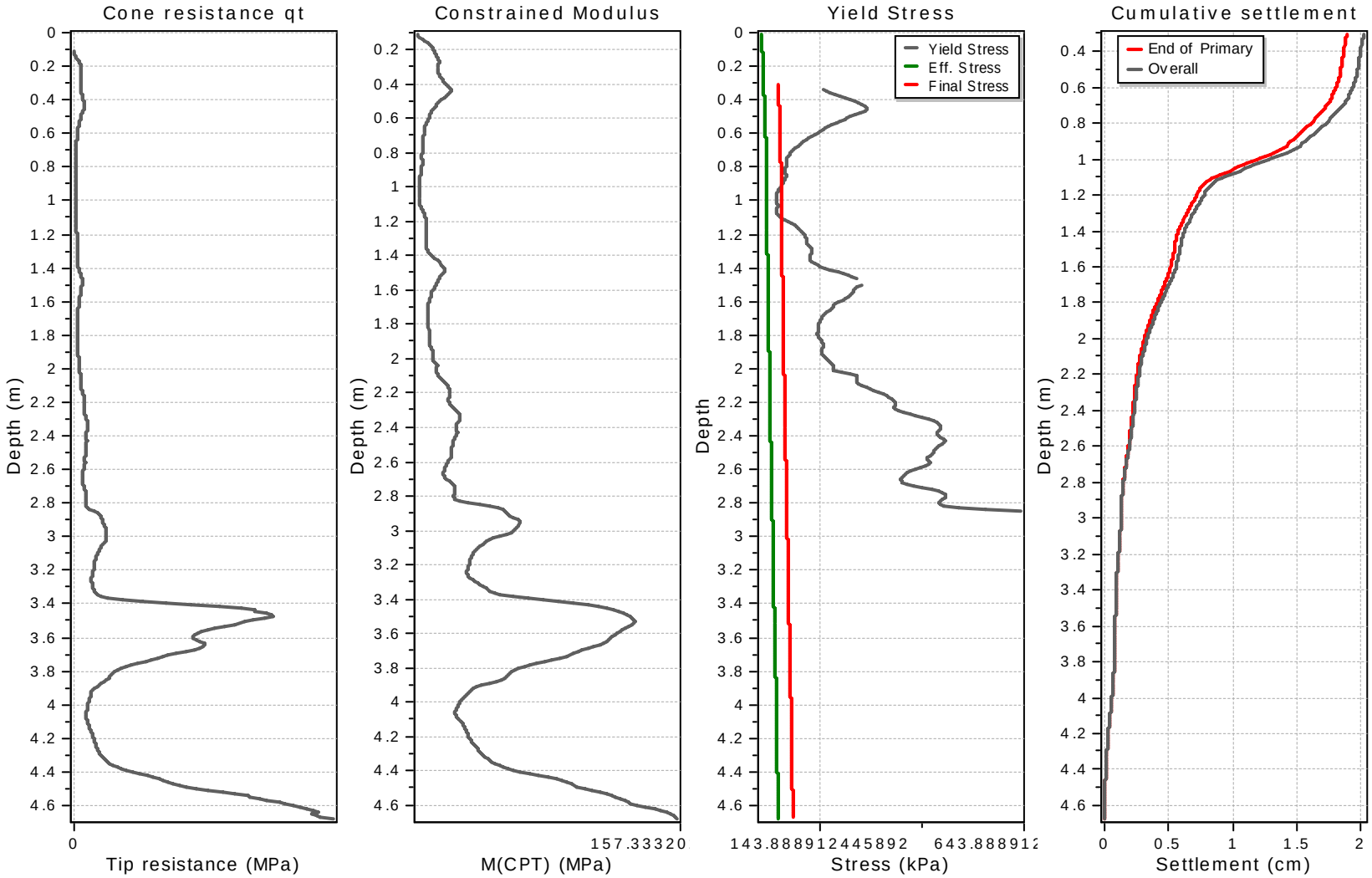
CPT: CPT2
Total depth: 4.68 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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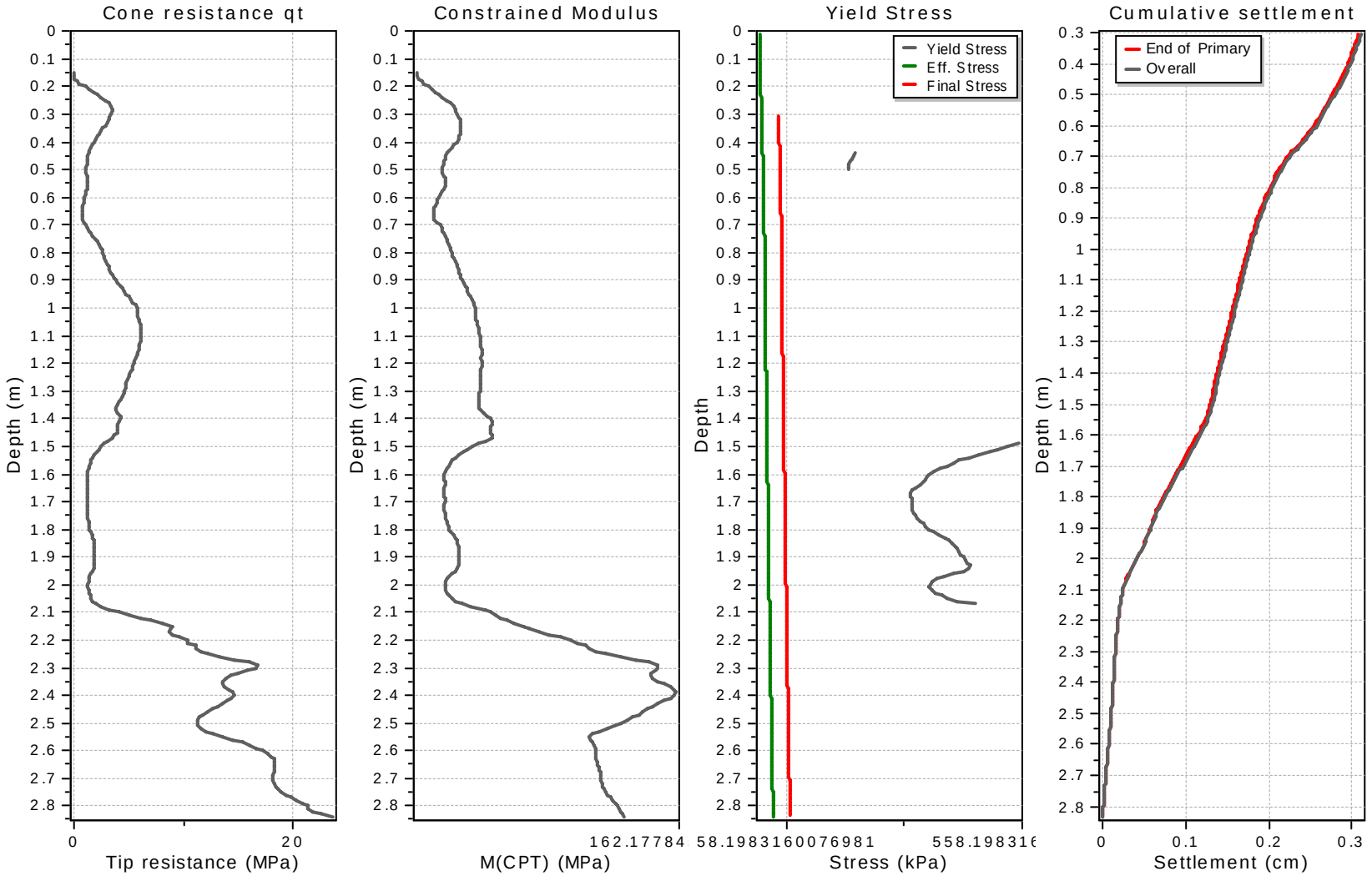
CPT: CPT3
Total depth: 2.84 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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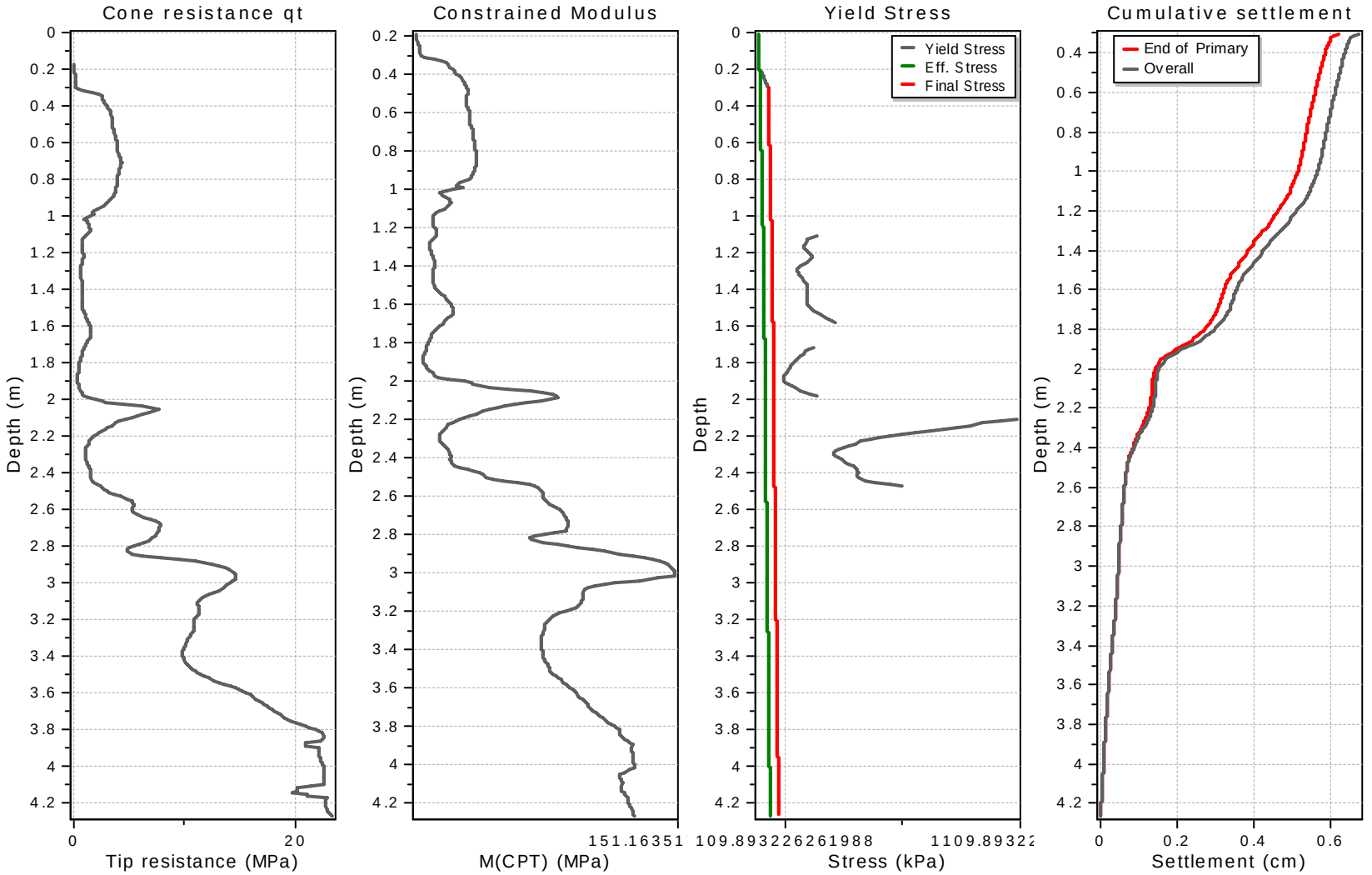
CPT: CPT4
Total depth: 4.27 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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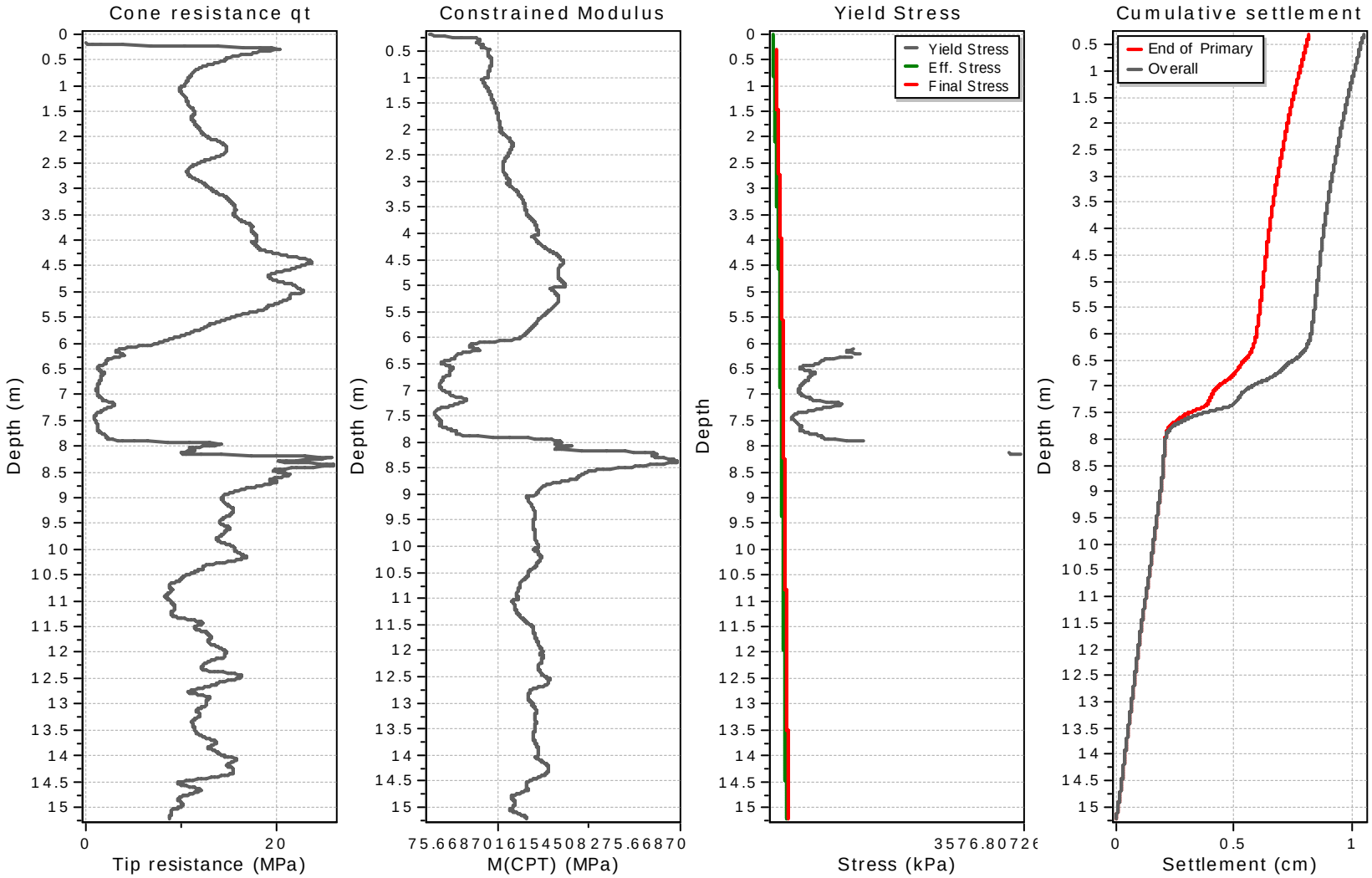
CPT: CPT7
Total depth: 15.23 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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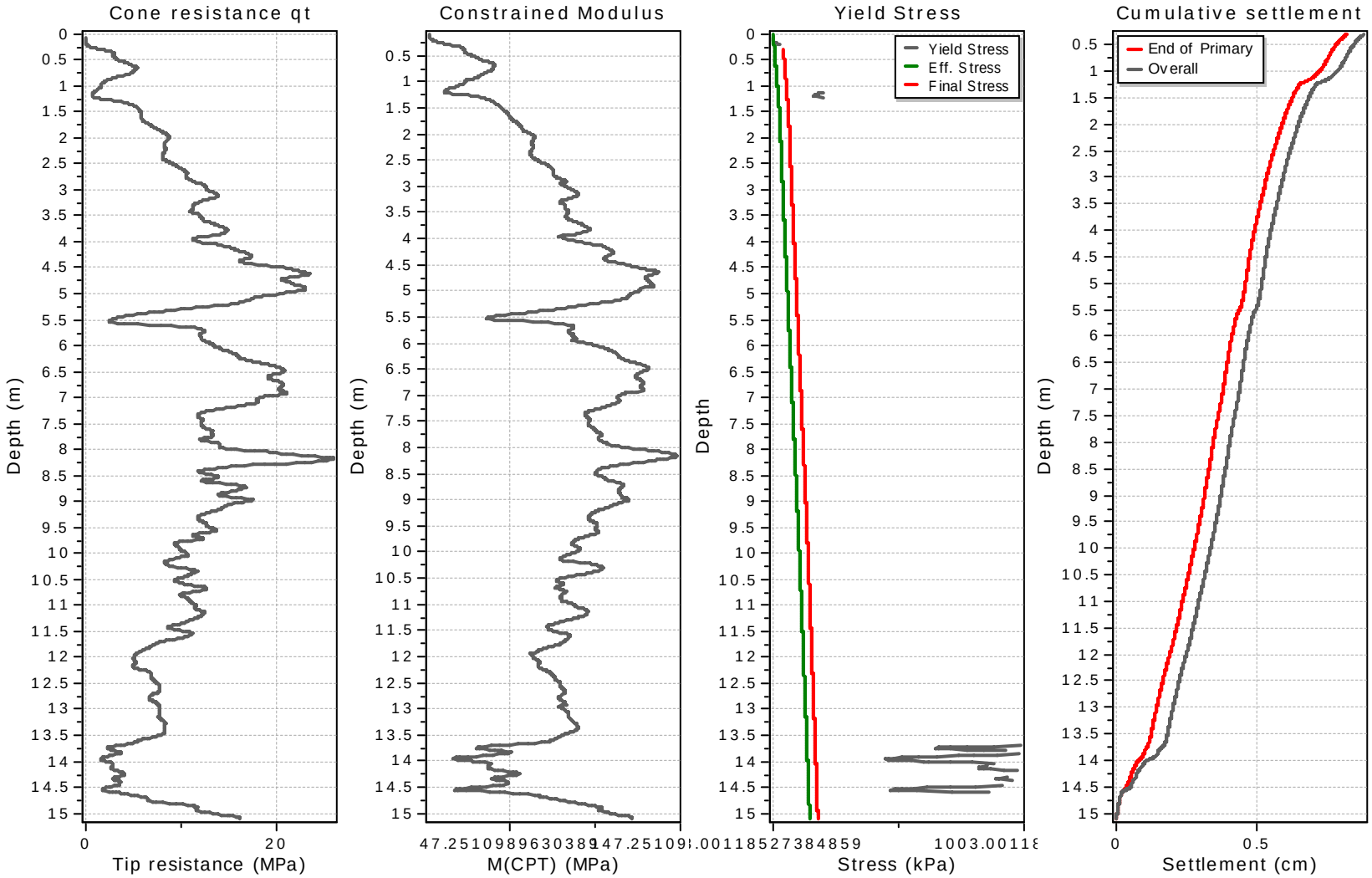
CPT: CPT8
Total depth: 15.11 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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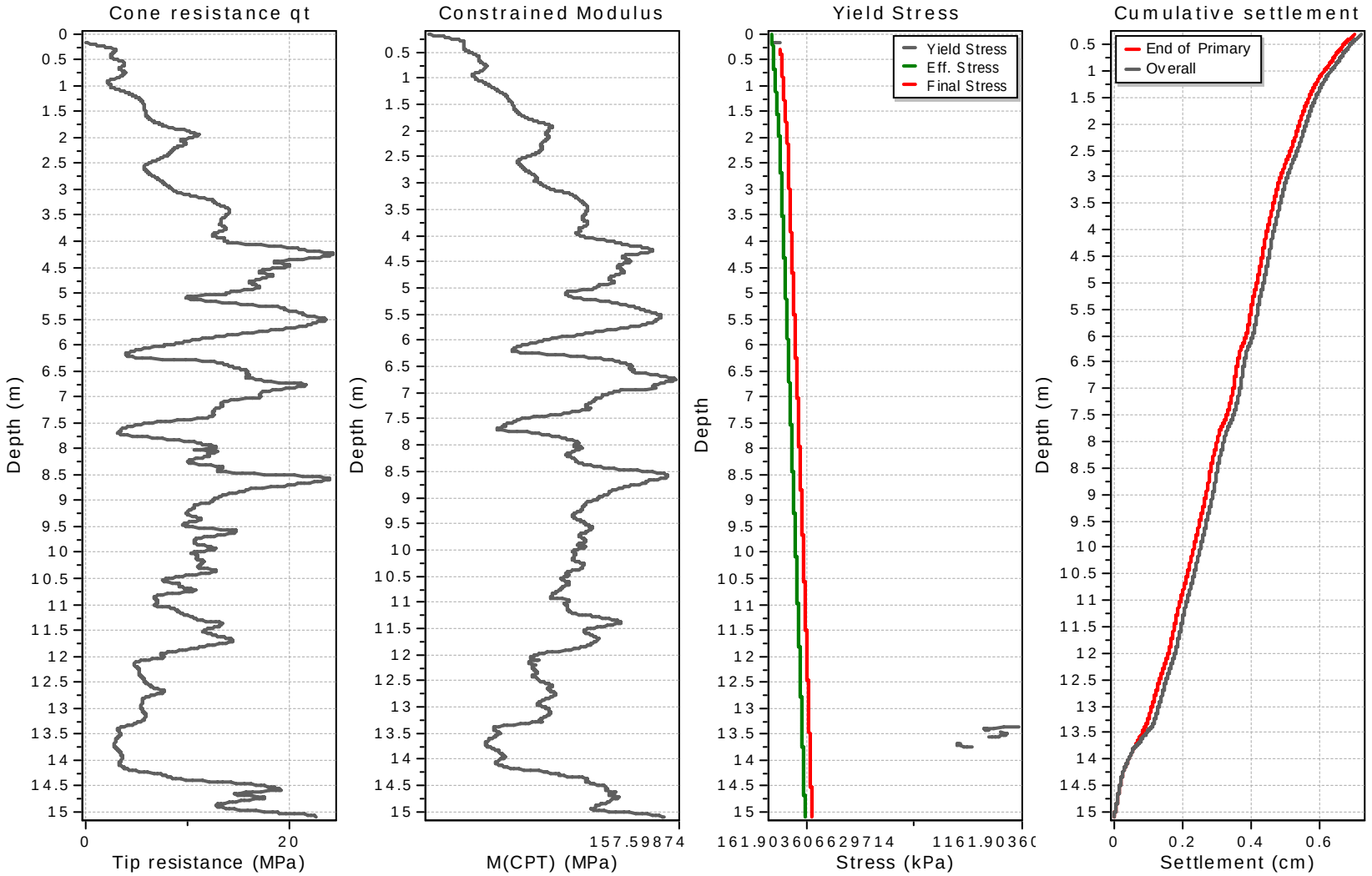
CPT: CPT9
Total depth: 15.10 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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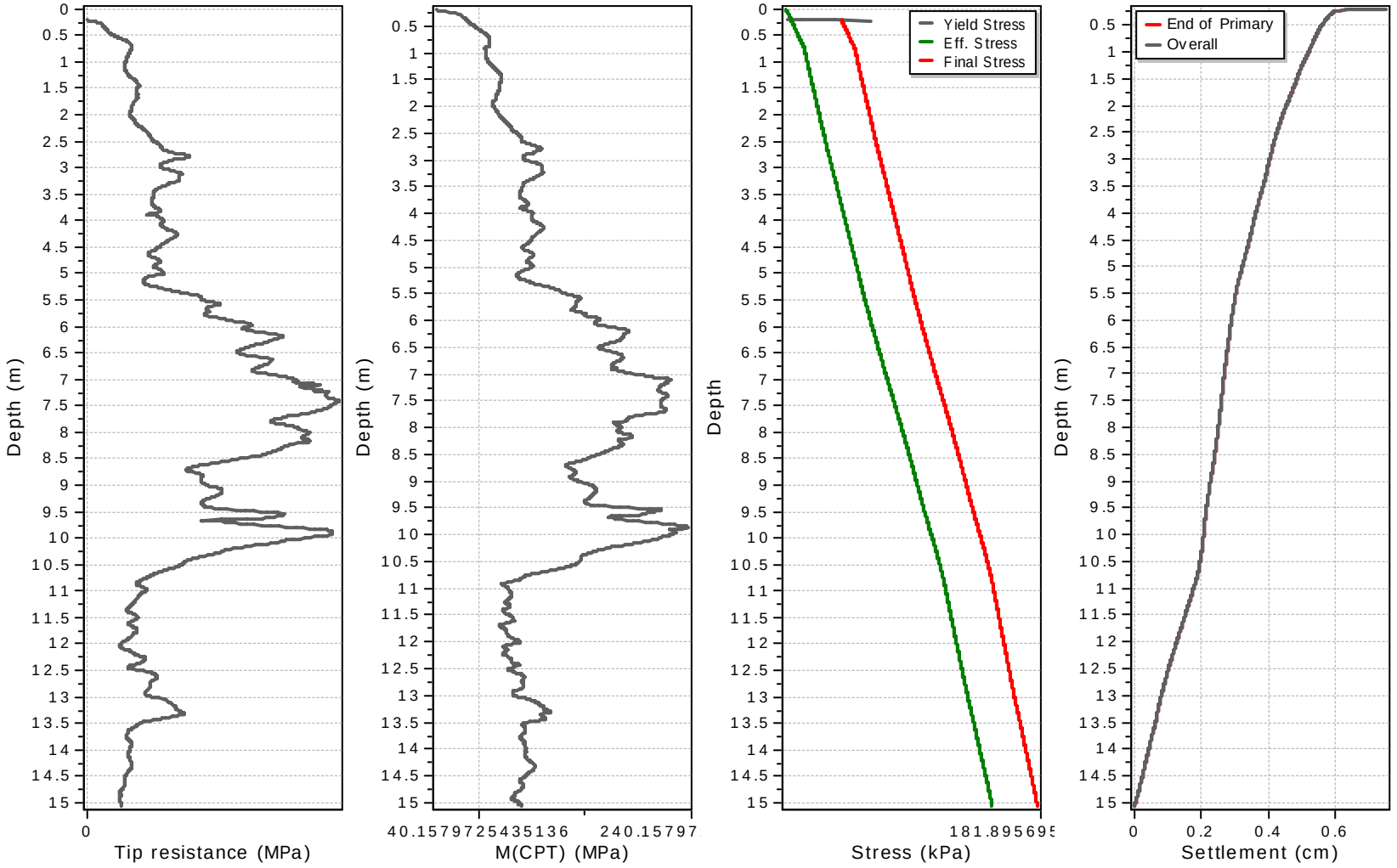
CPT: CPT10
Total depth: 15.07 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.20 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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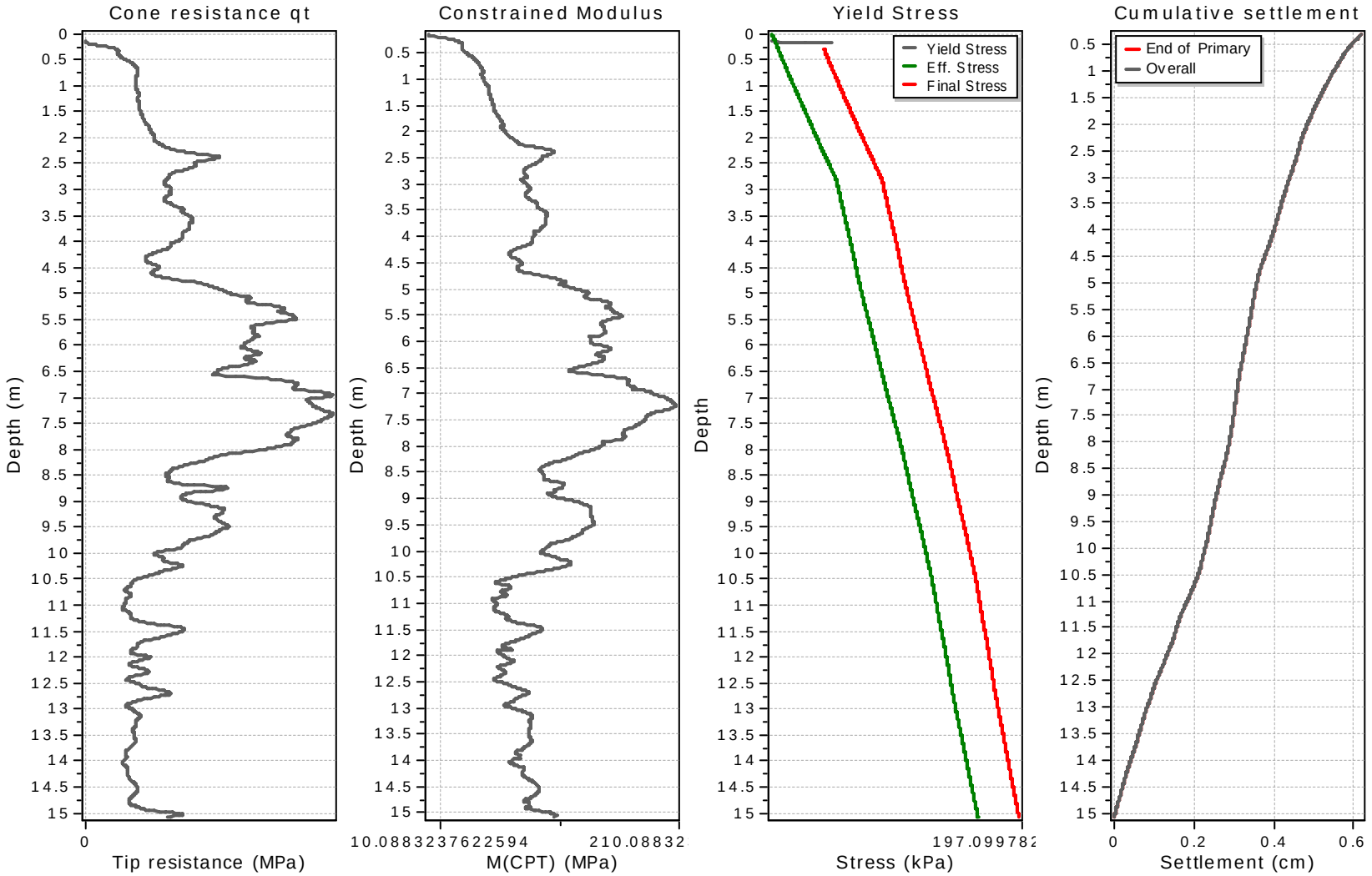
CPT: CPT11
Total depth: 15.08 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

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* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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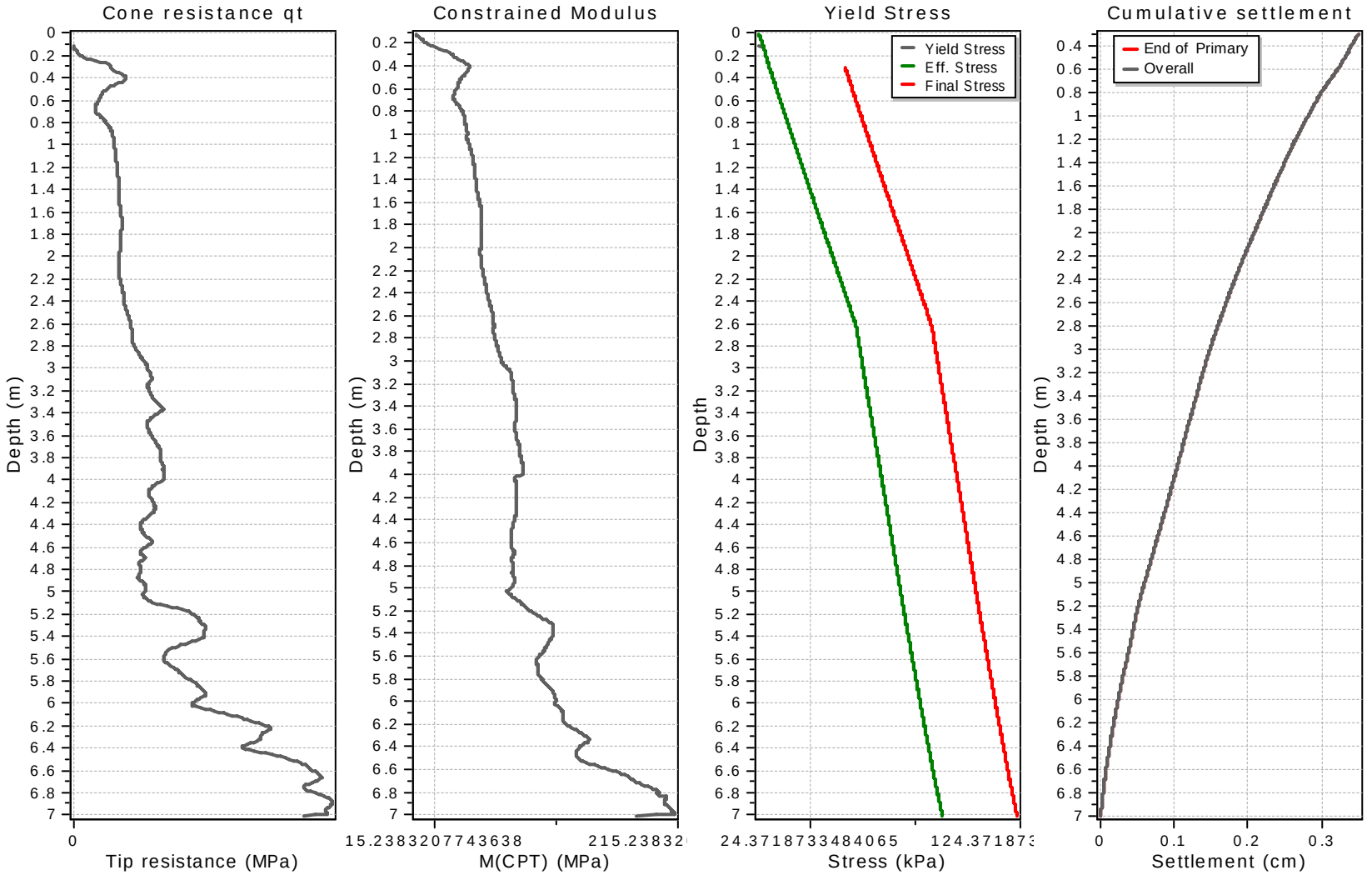
CPT: CPT12
Total depth: 7.01 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

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* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

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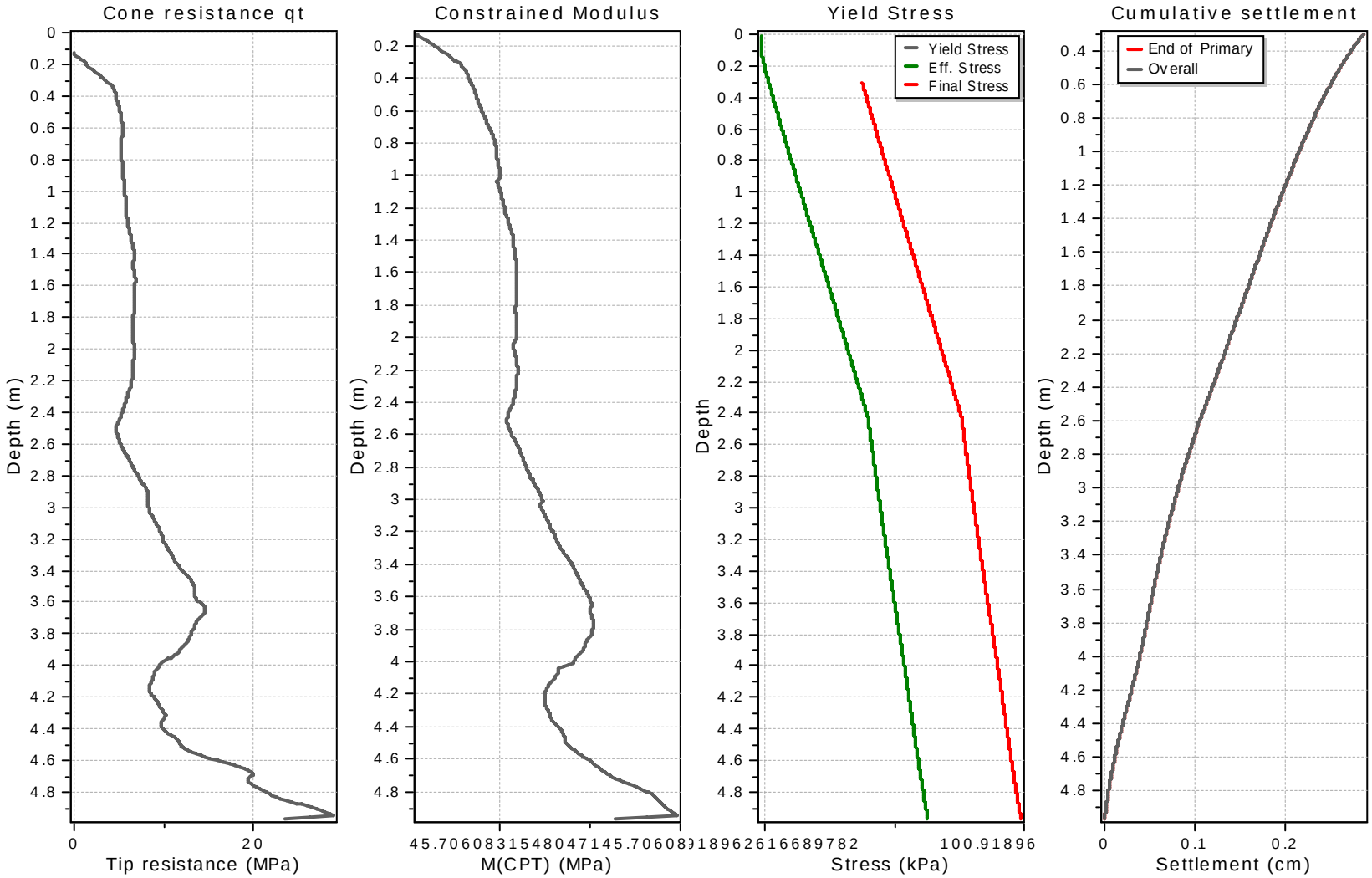
CPT: CPT13
Total depth: 4.97 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

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* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

LDE Ltd
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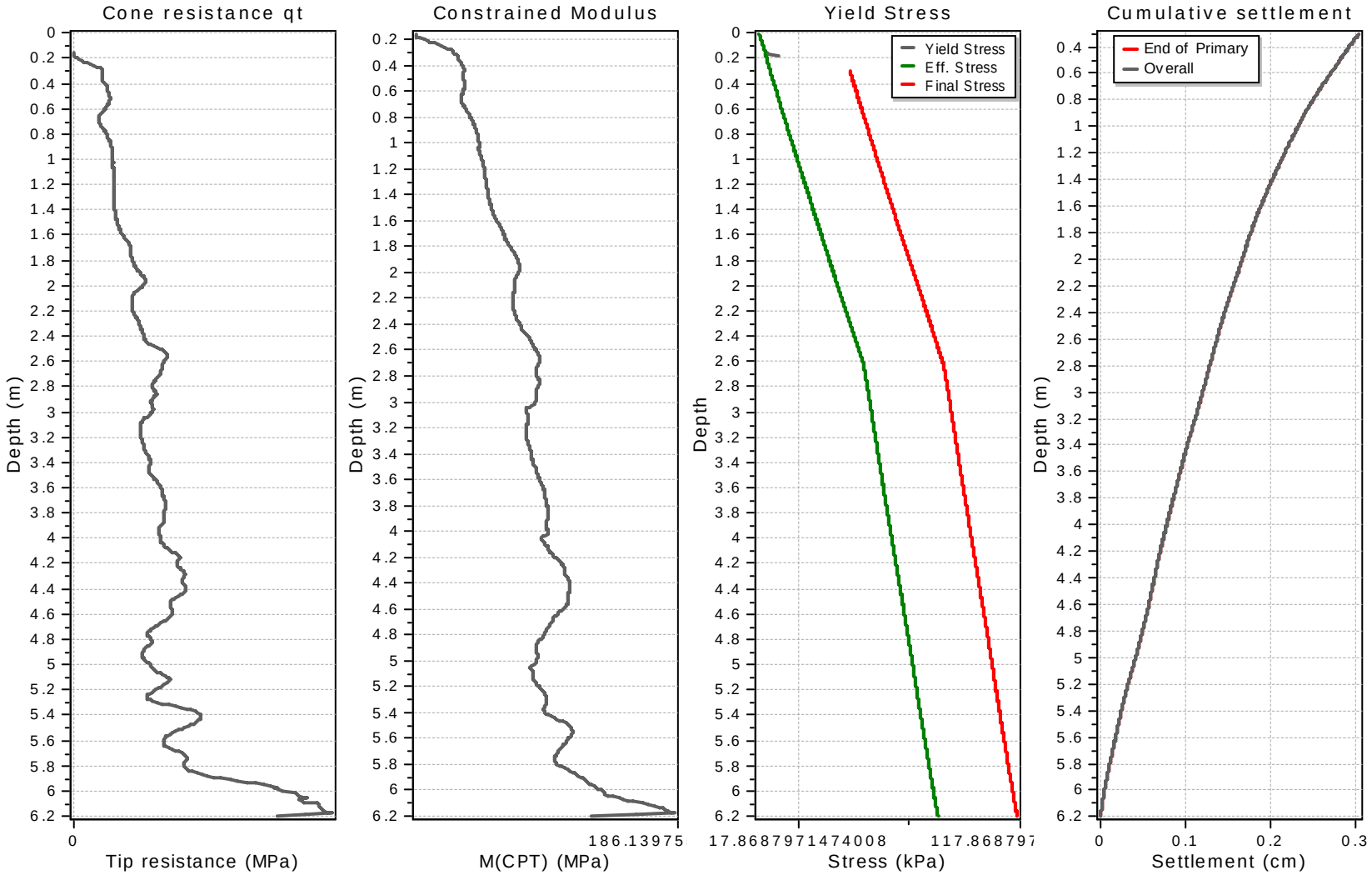
CPT: CPT14
Total depth: 6.20 m, Date: 30/05/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 18319 Static Settlement Analysis
Location: Tamure Place and Peter Snell Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.30 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: Yes
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

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$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

$$S = C_\alpha \cdot \Delta z \cdot \log(t/t_p)$$

where t_p is the duration of primary consolidation

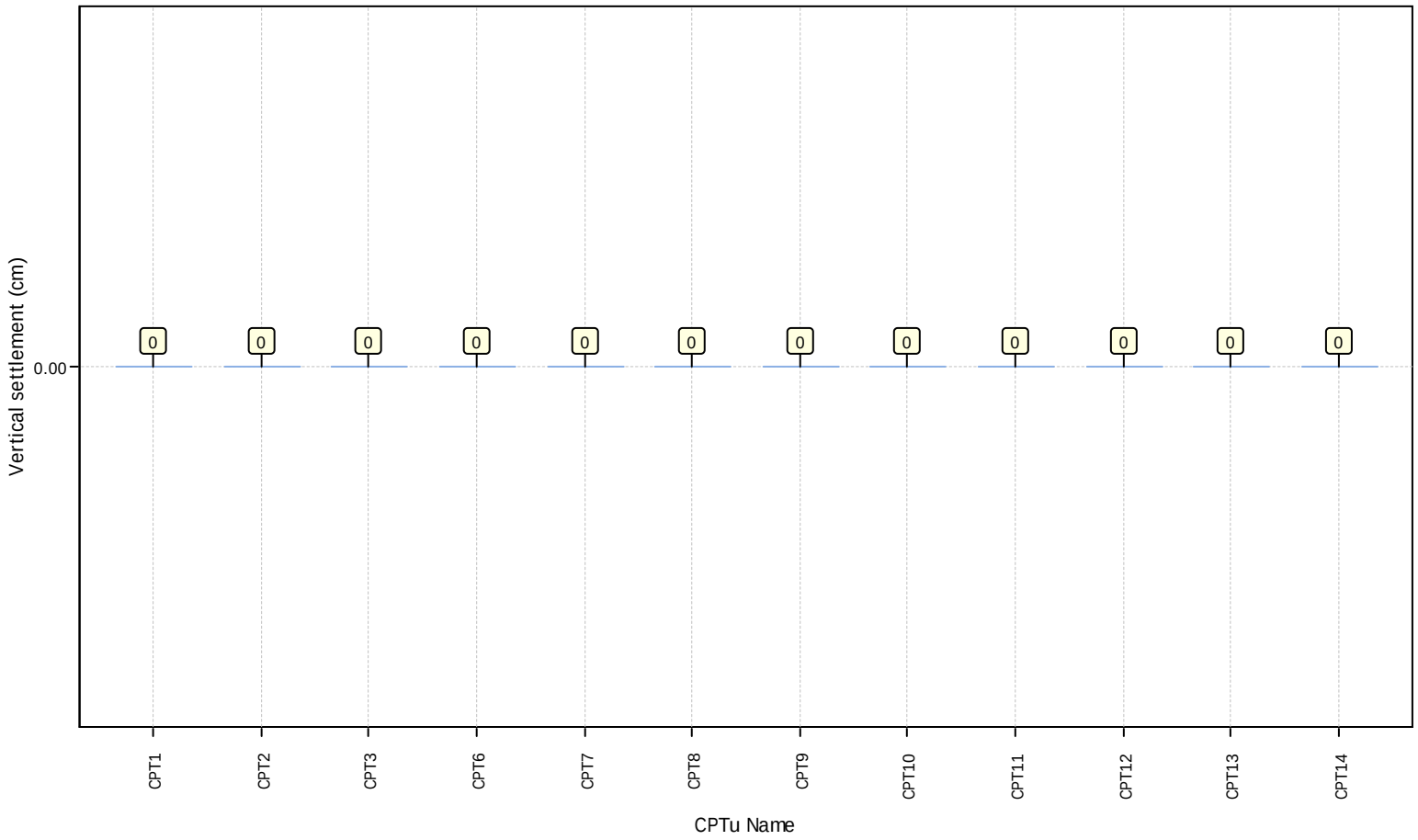
APPENDIX E

LIQUEFACTION ANALYSES

Project title : 18319 Liquefaction Settlement Analysis ULS (0.13g/5.8)

Location : Tamure Place and Peter Snell Road

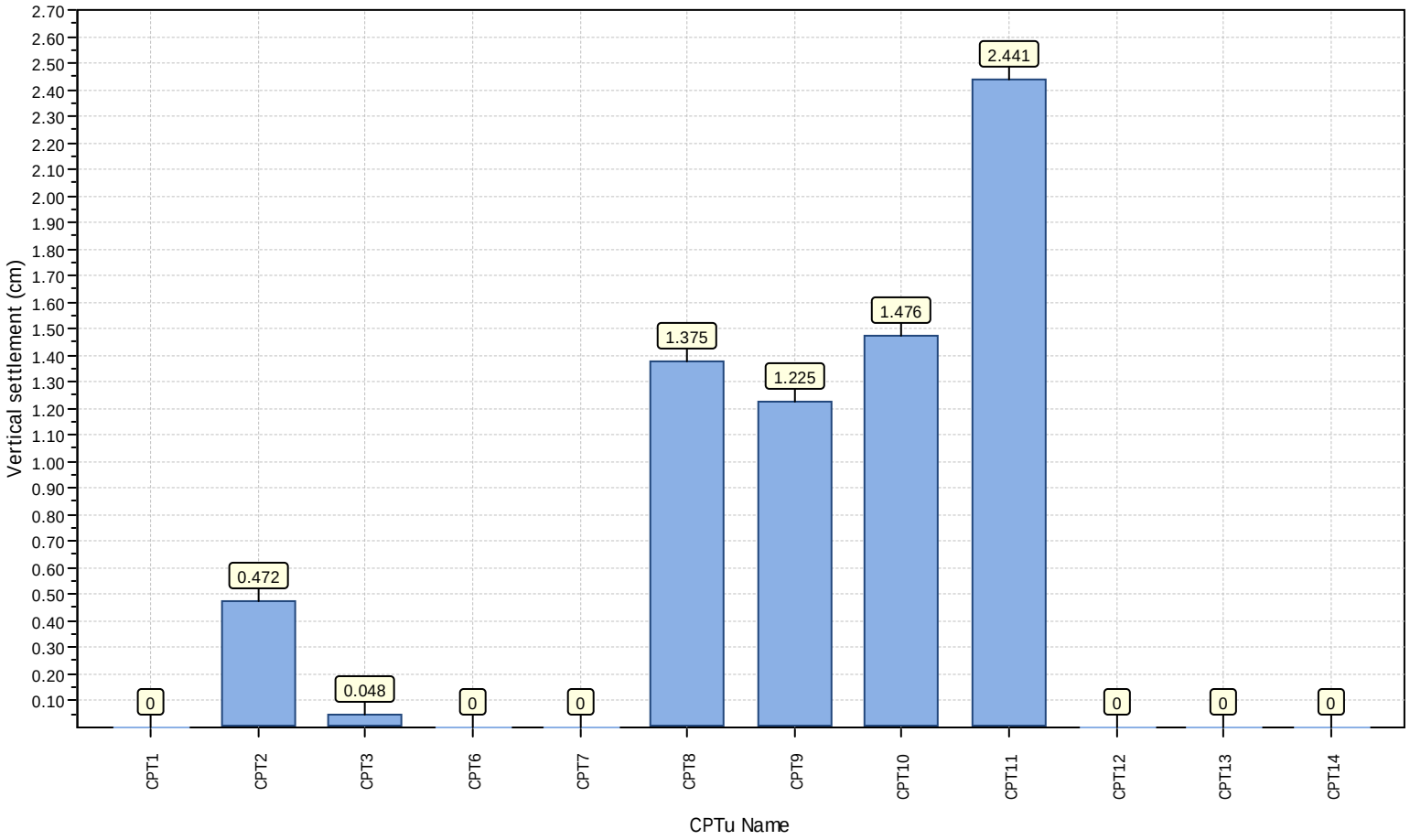
Overall vertical settlements report



Project title : 18319 Liquefaction Settlement Analysis ULS Lower Bound

Location : Tamure Place and Peter Snell Road

Overall vertical settlements report



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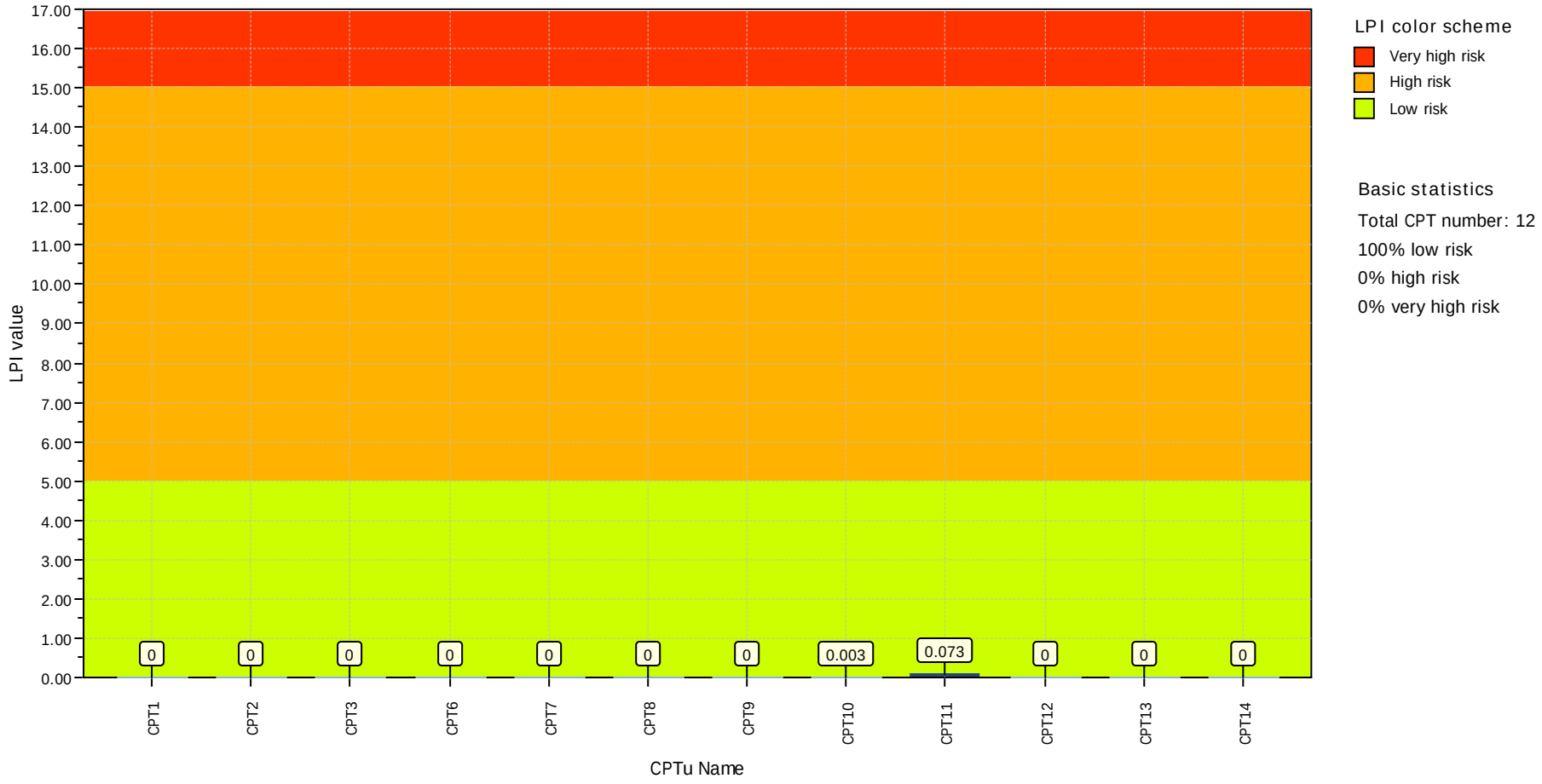
Project title : 18319 Liquefaction Settlement Analysis ULS Lower Bound

Location : Tamure Place and Peter Snell Road

Overall Liquefaction Potential Index report



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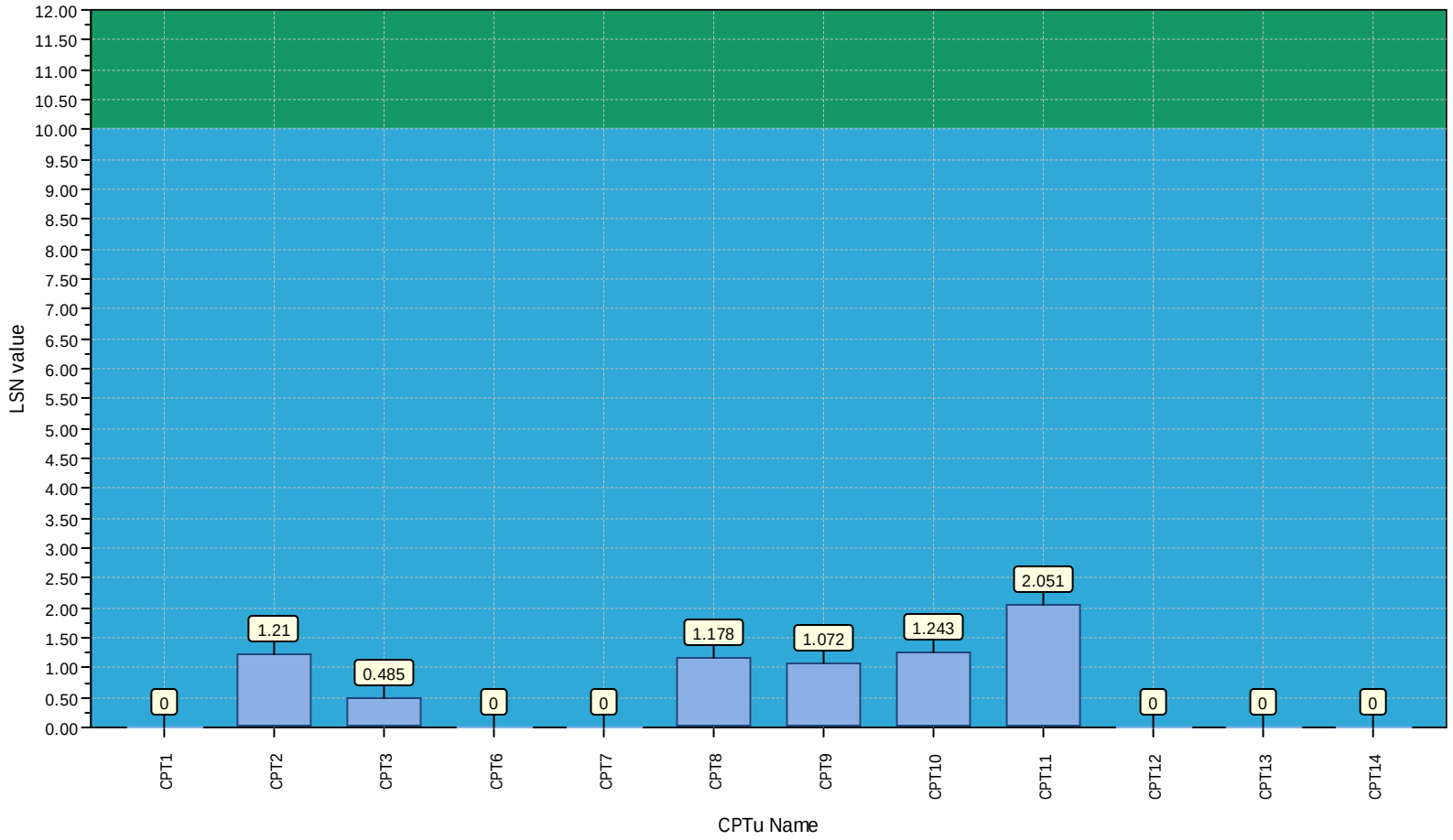
http://www.lde.co.nz

Project title : 18319 Liquefaction Settlement Analysis ULS Lower Bound

Location : Tamure Place and Peter Snell Road

Overall Liquefaction Severity Number report



LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 12

100% little liquefaction

0% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

0% severe liquefaction

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Land Development and Engineering
http://www.lde.co.nz

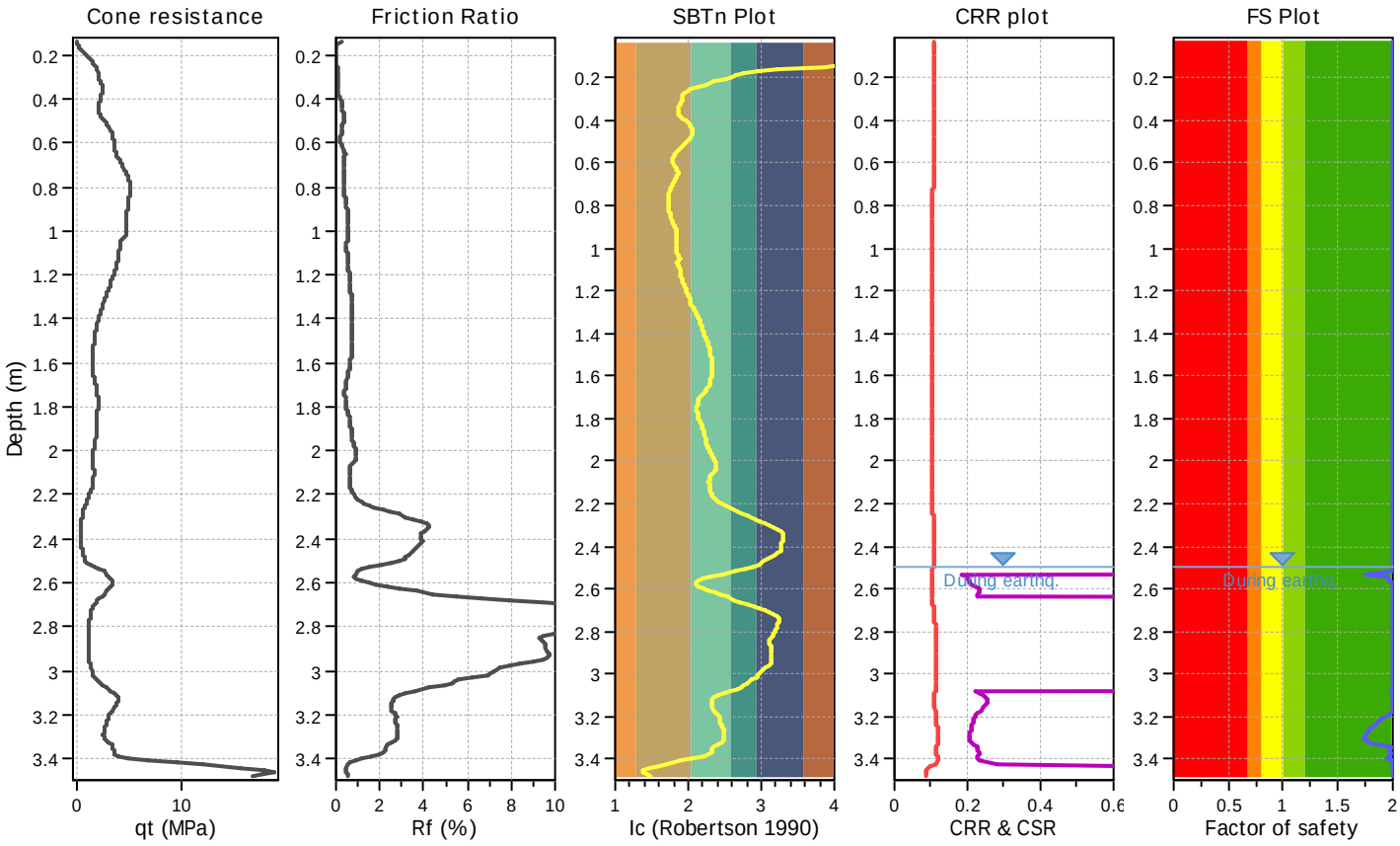
LIQUEFACTION ANALYSIS REPORT

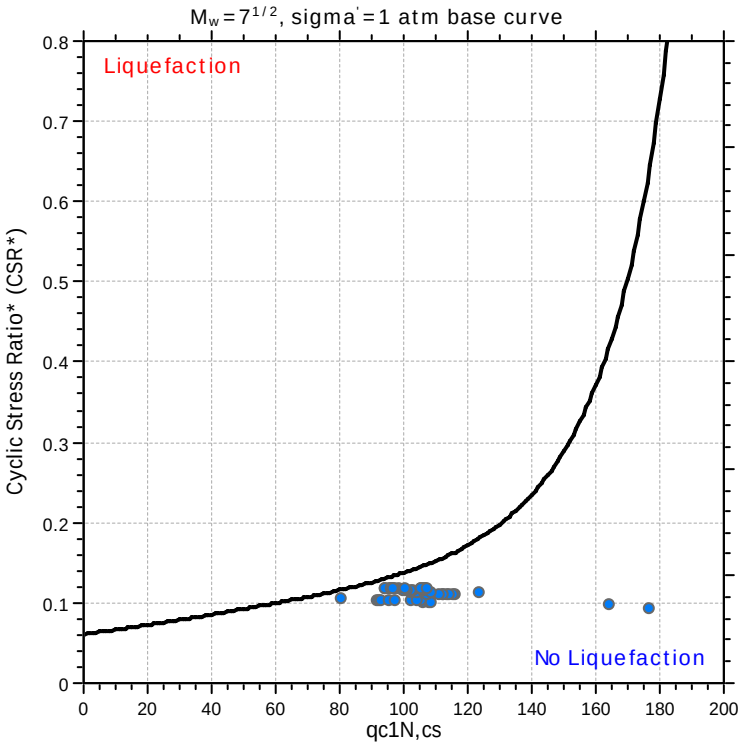
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

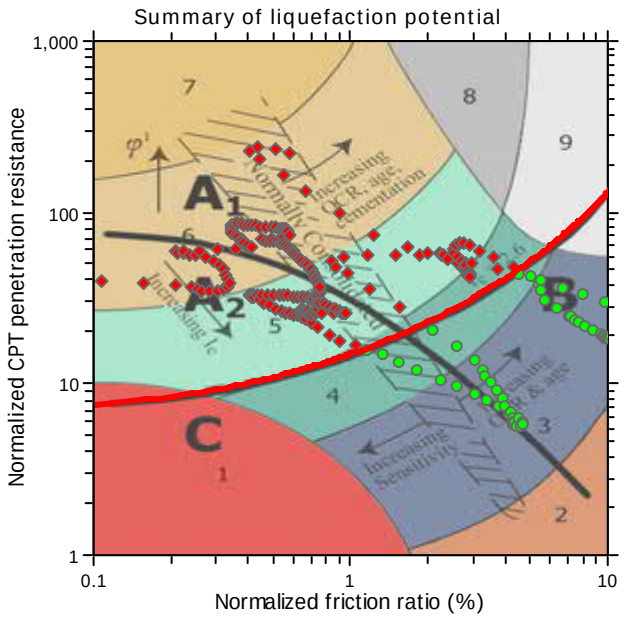
CPT file : CPT1

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.50 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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

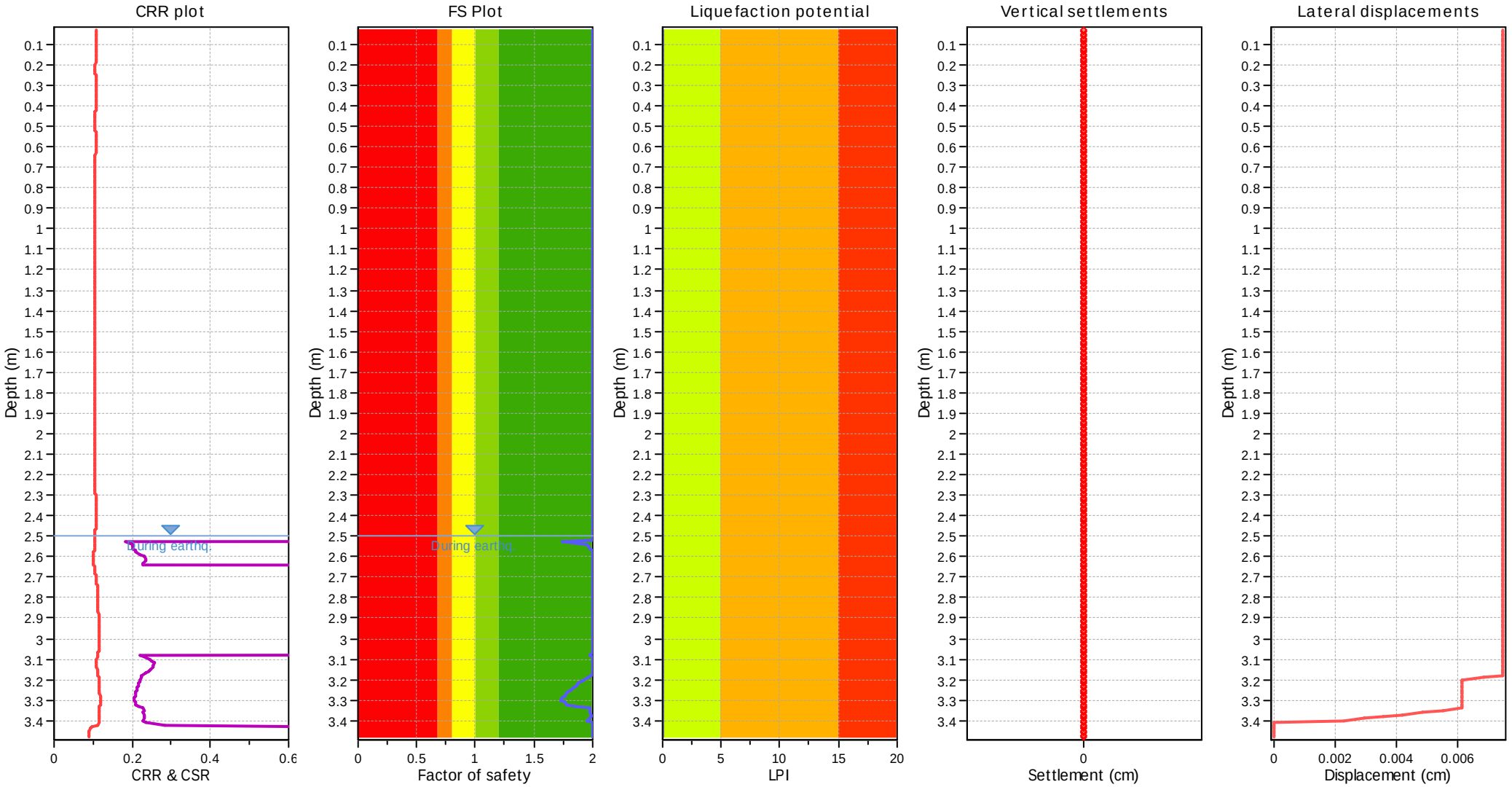






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

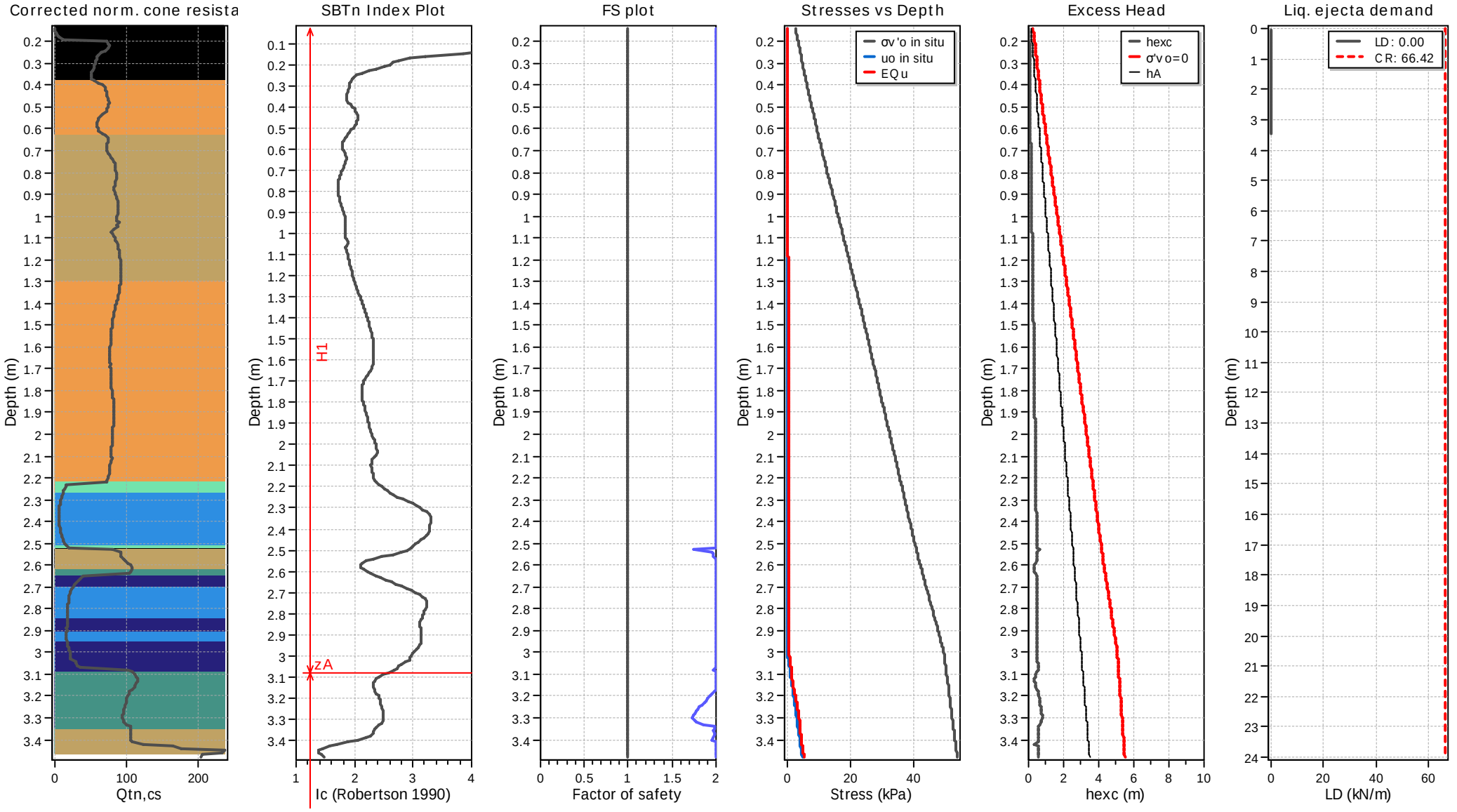
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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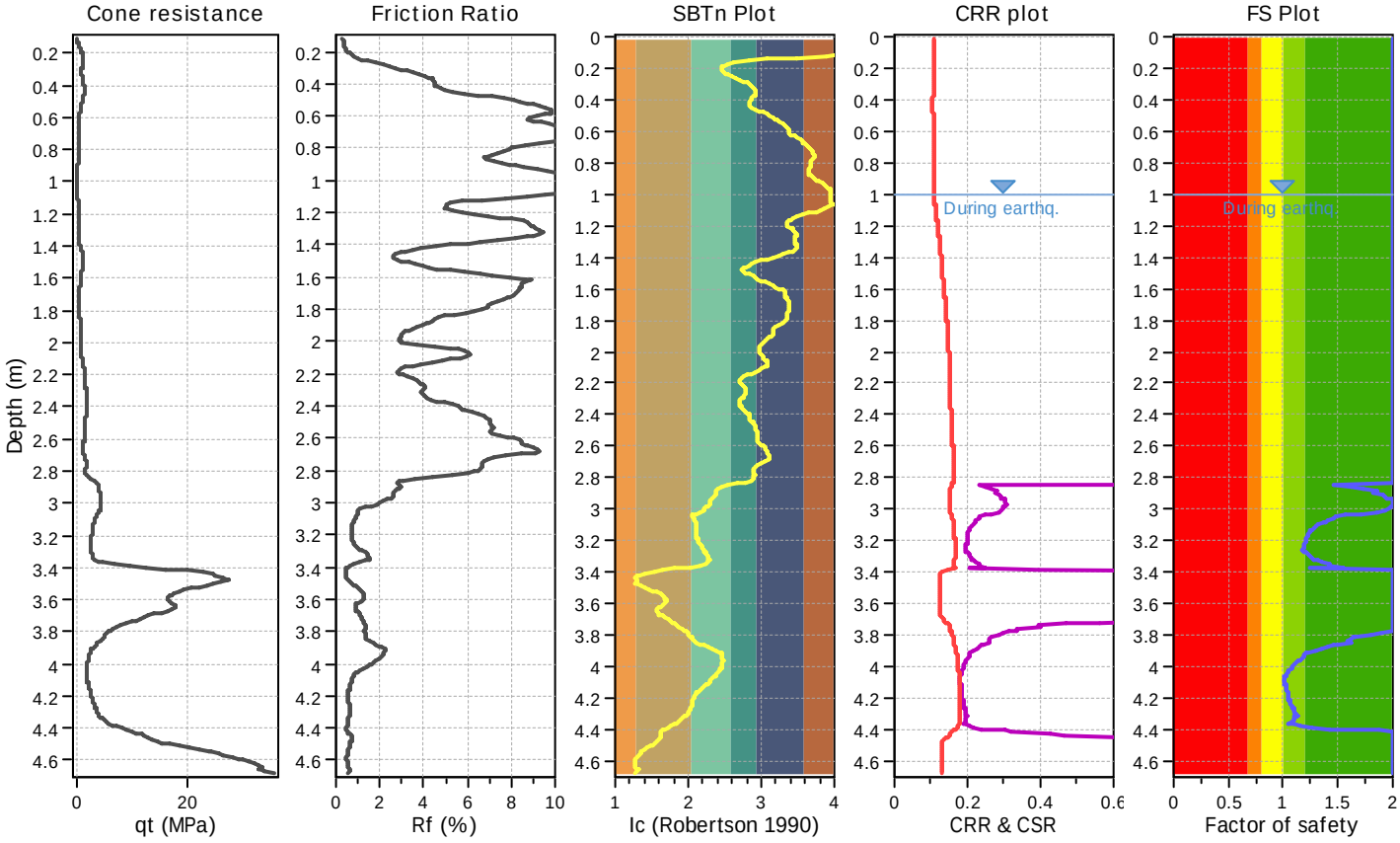
LIQUEFACTION ANALYSIS REPORT

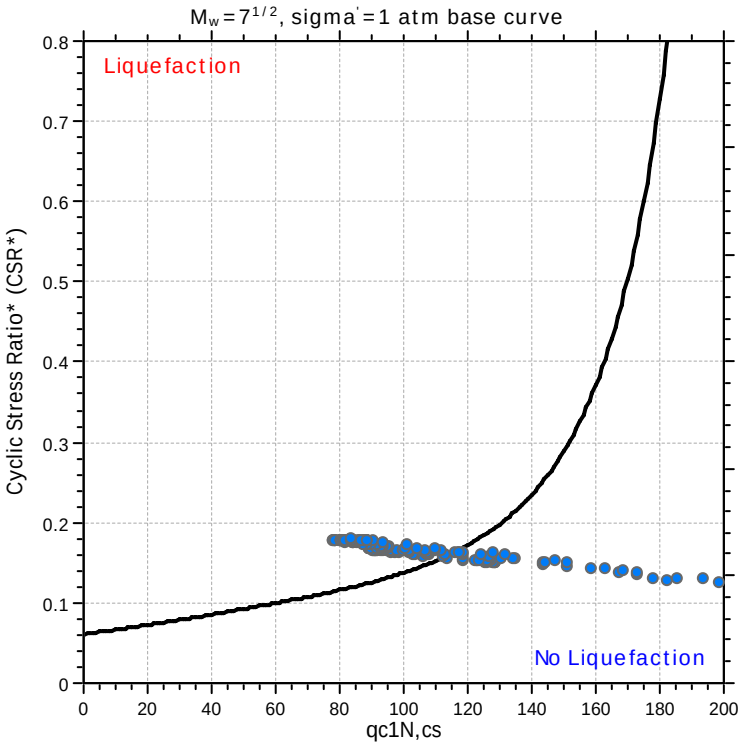
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

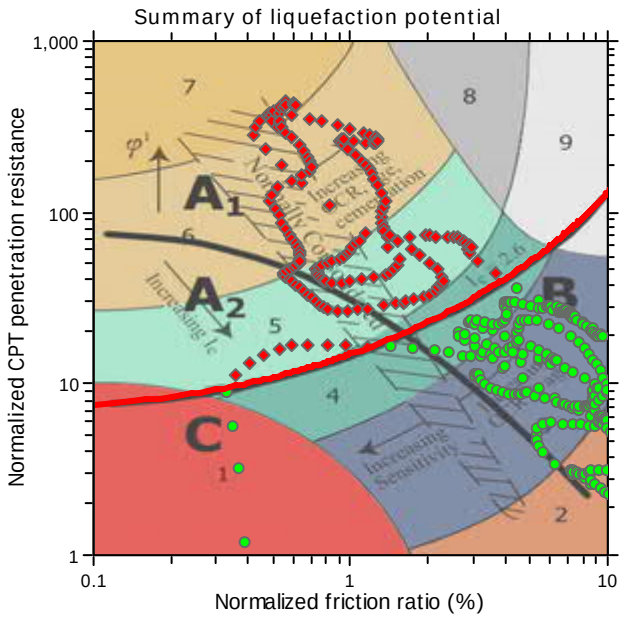
CPT file : CPT2

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

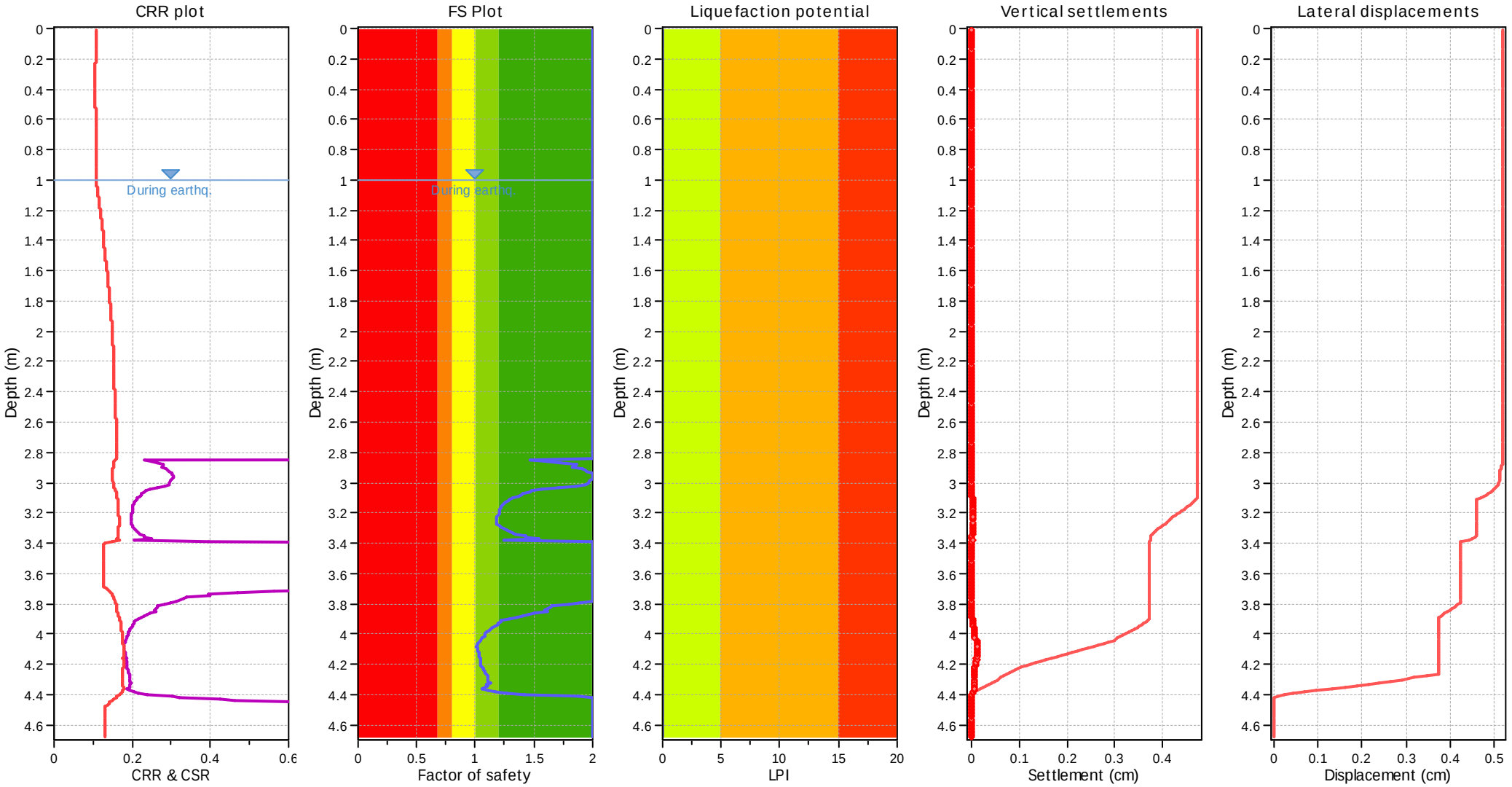






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

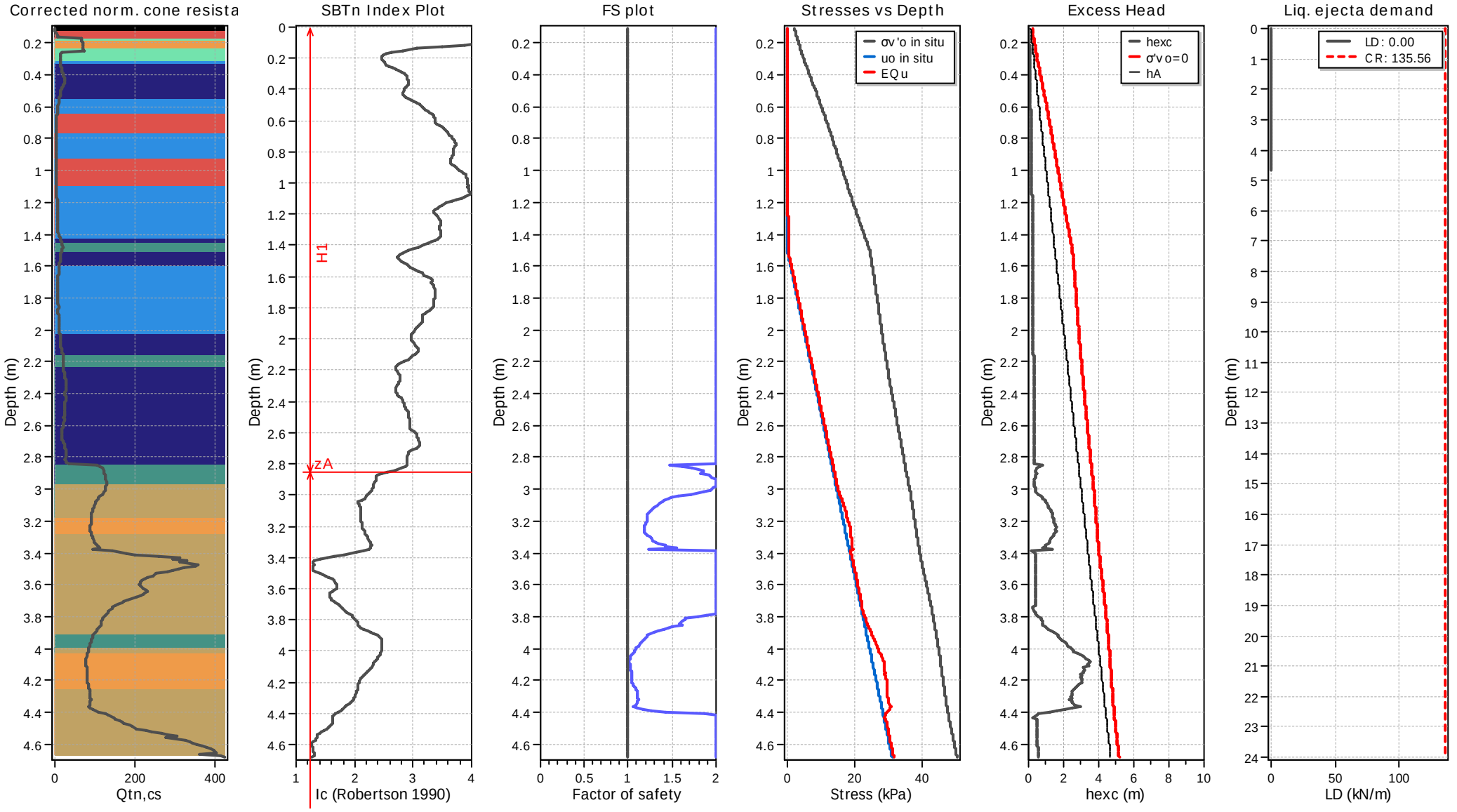
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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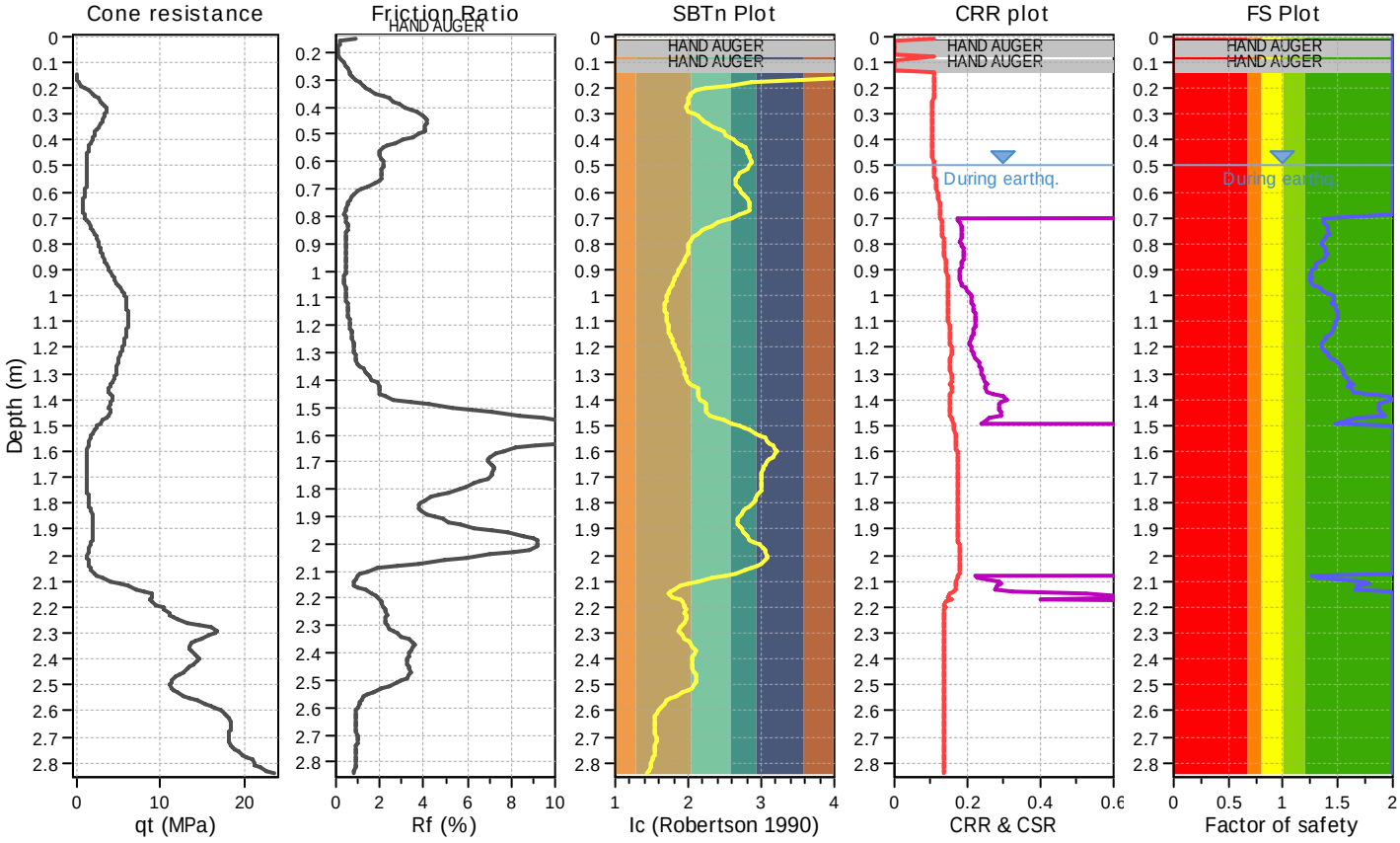
LIQUEFACTION ANALYSIS REPORT

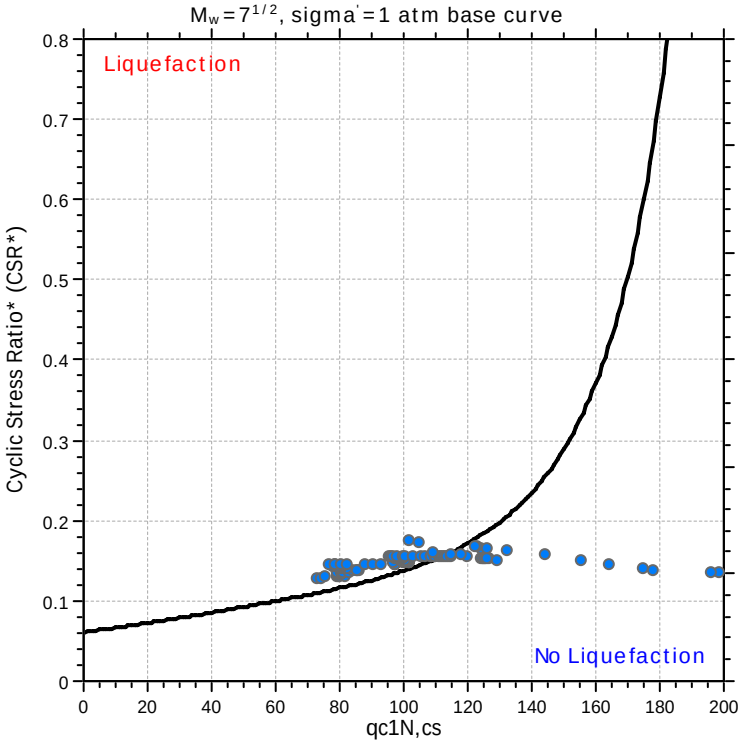
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

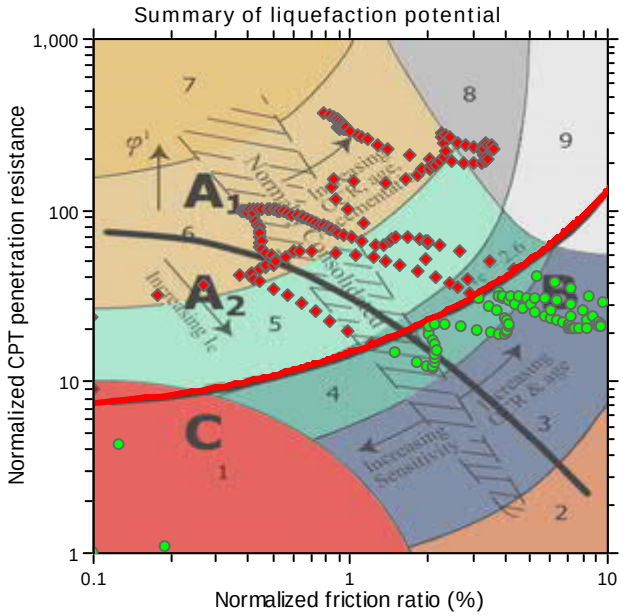
CPT file : CPT3

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

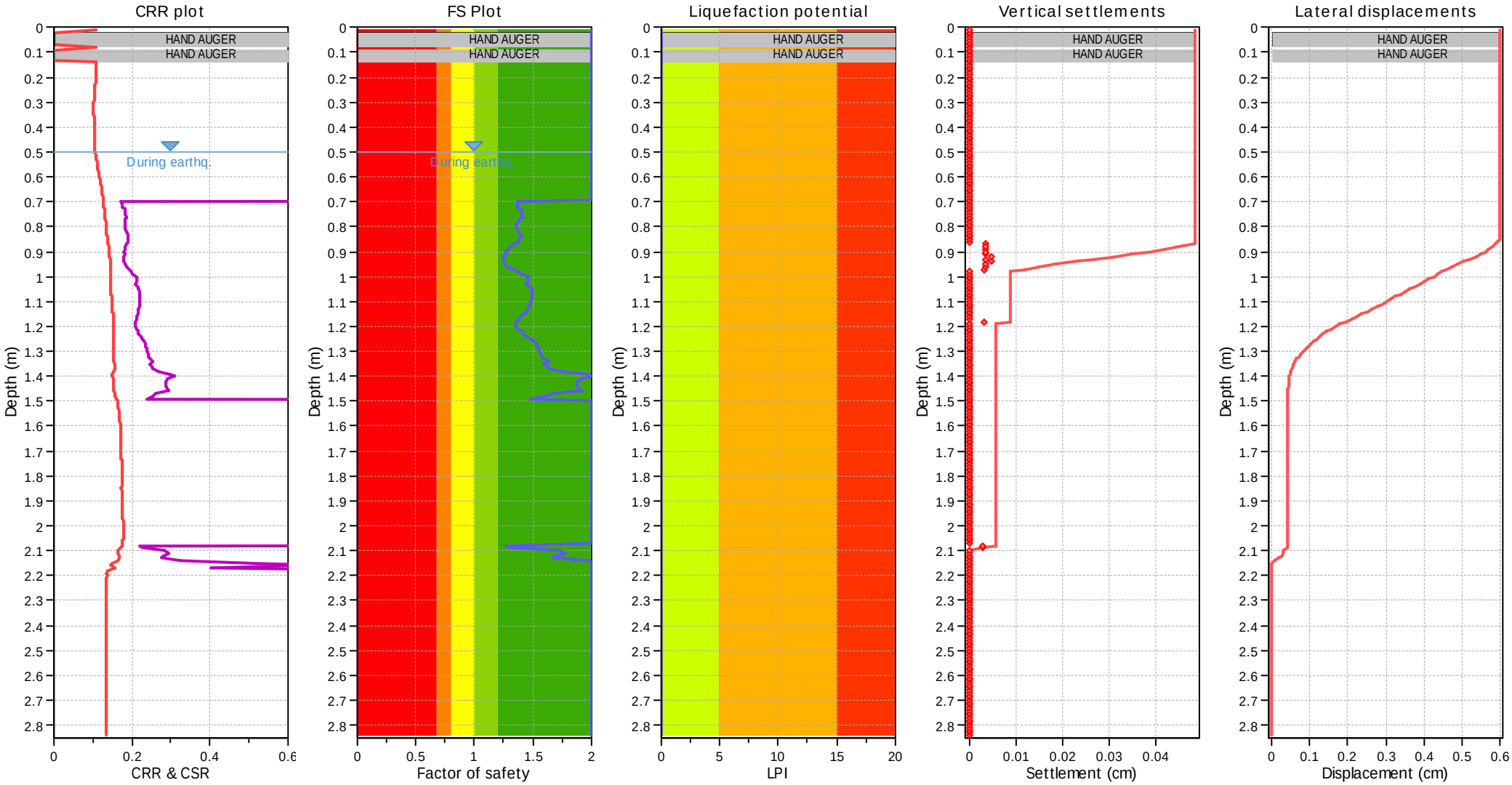






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

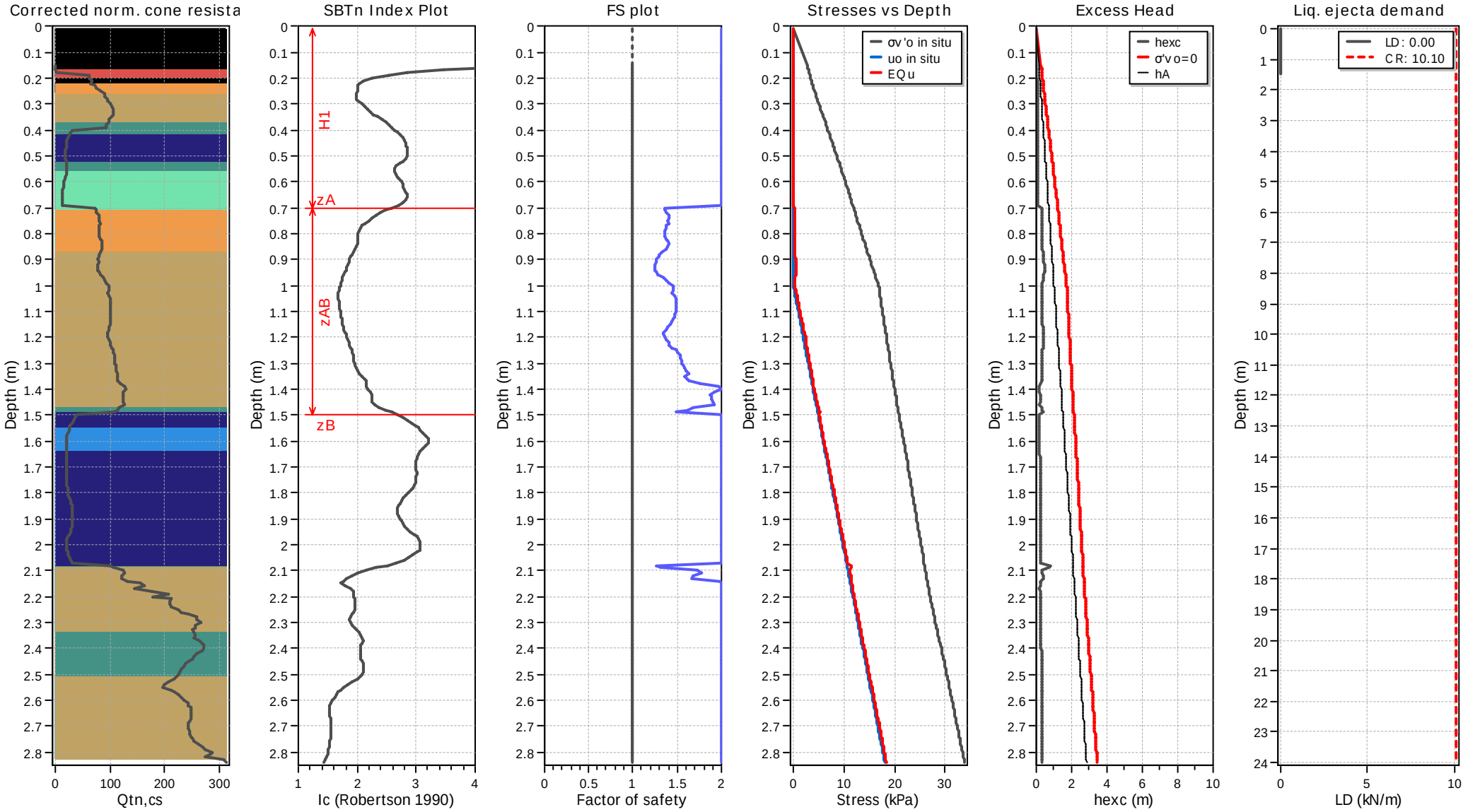
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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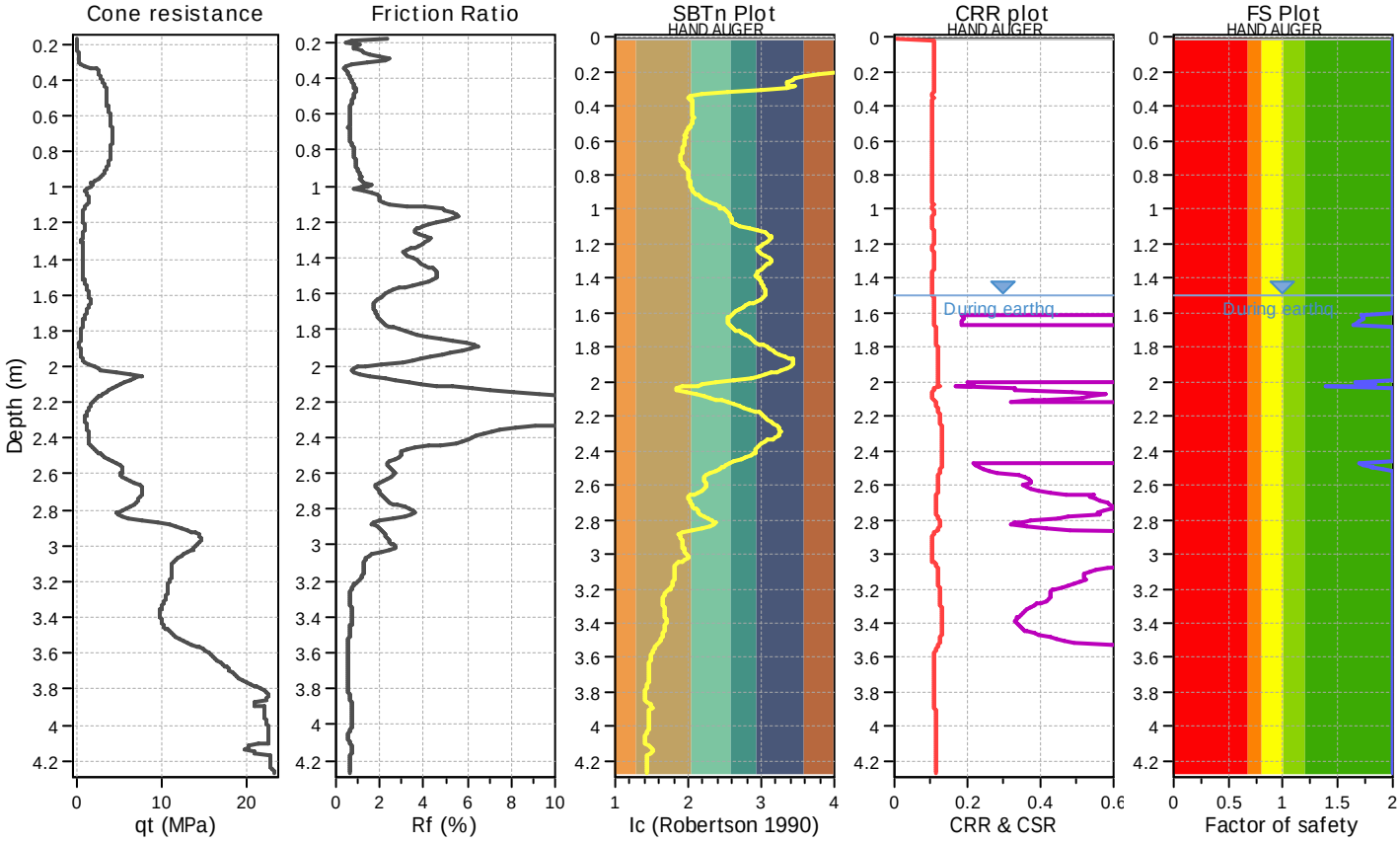
LIQUEFACTION ANALYSIS REPORT

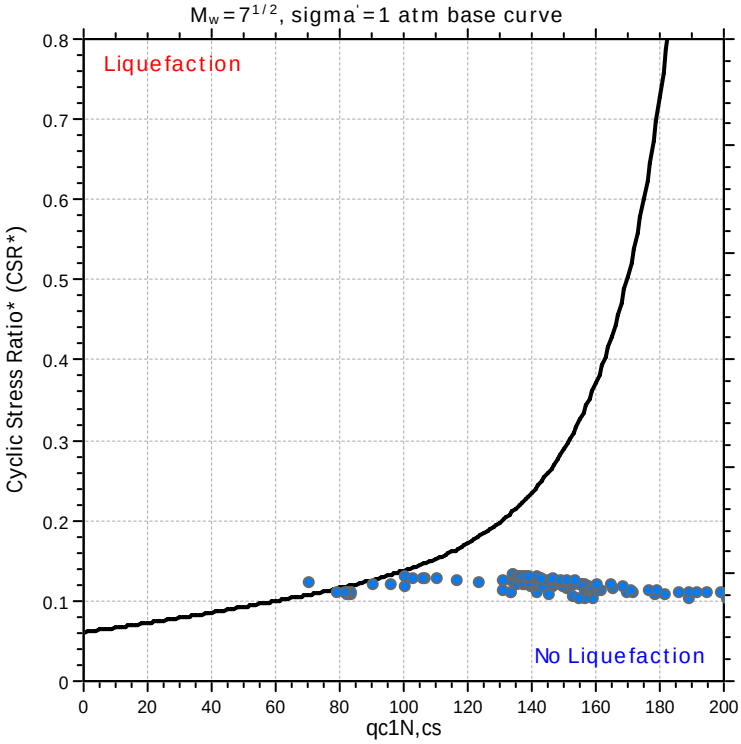
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

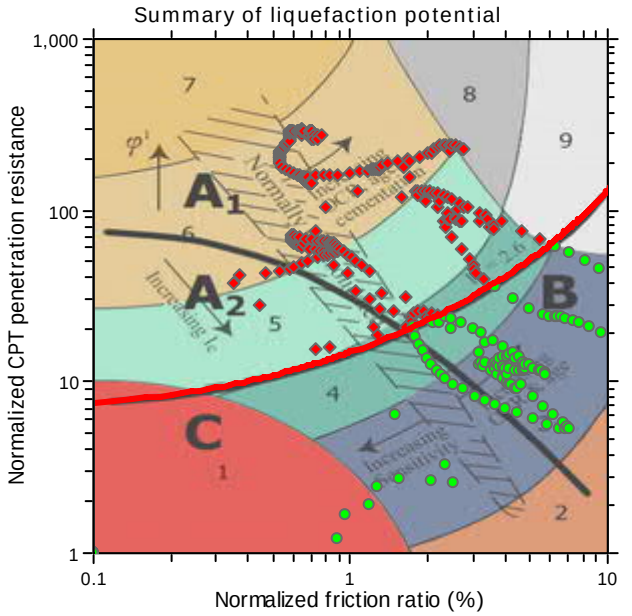
CPT file : CPT6

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

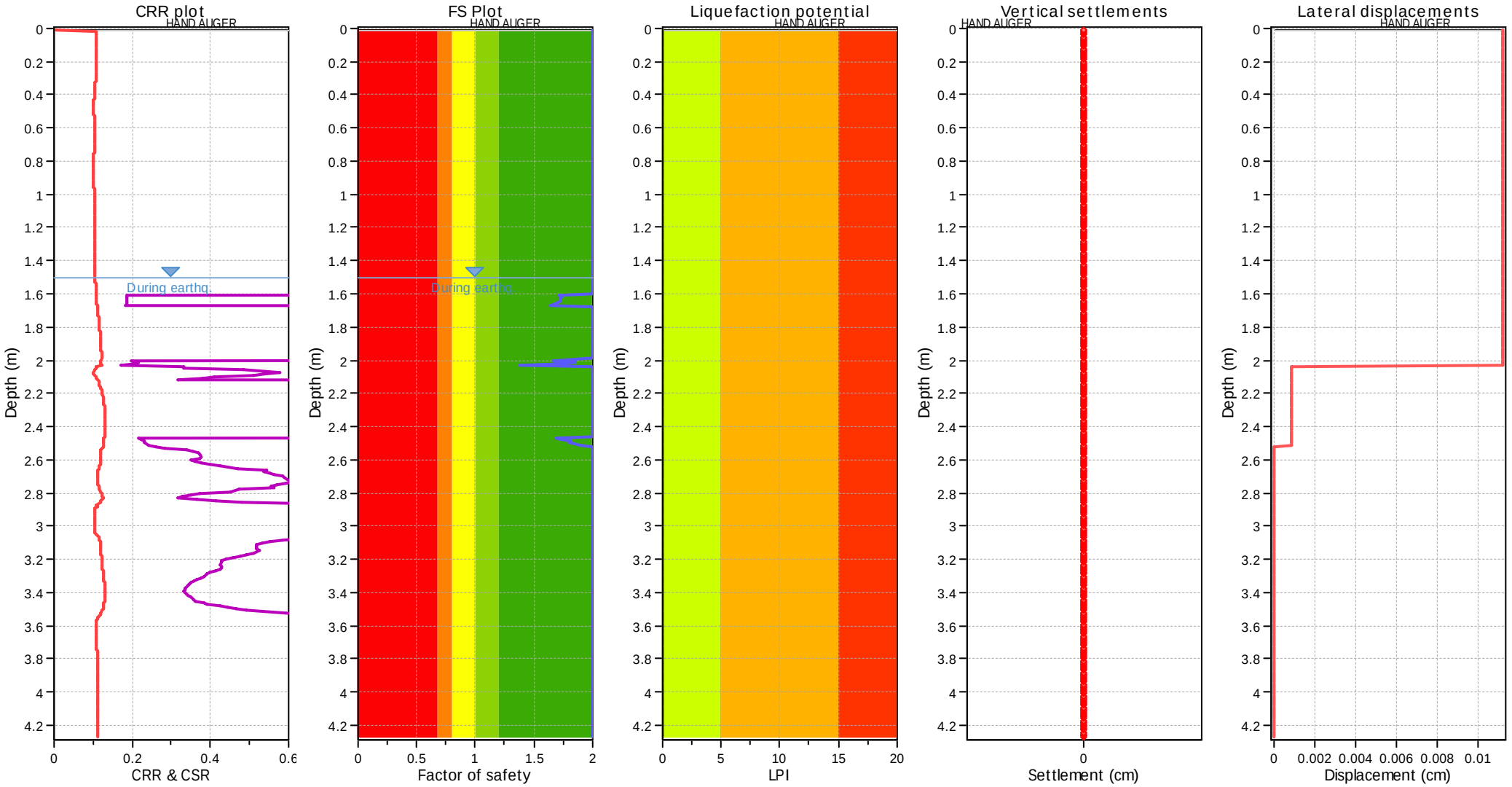






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

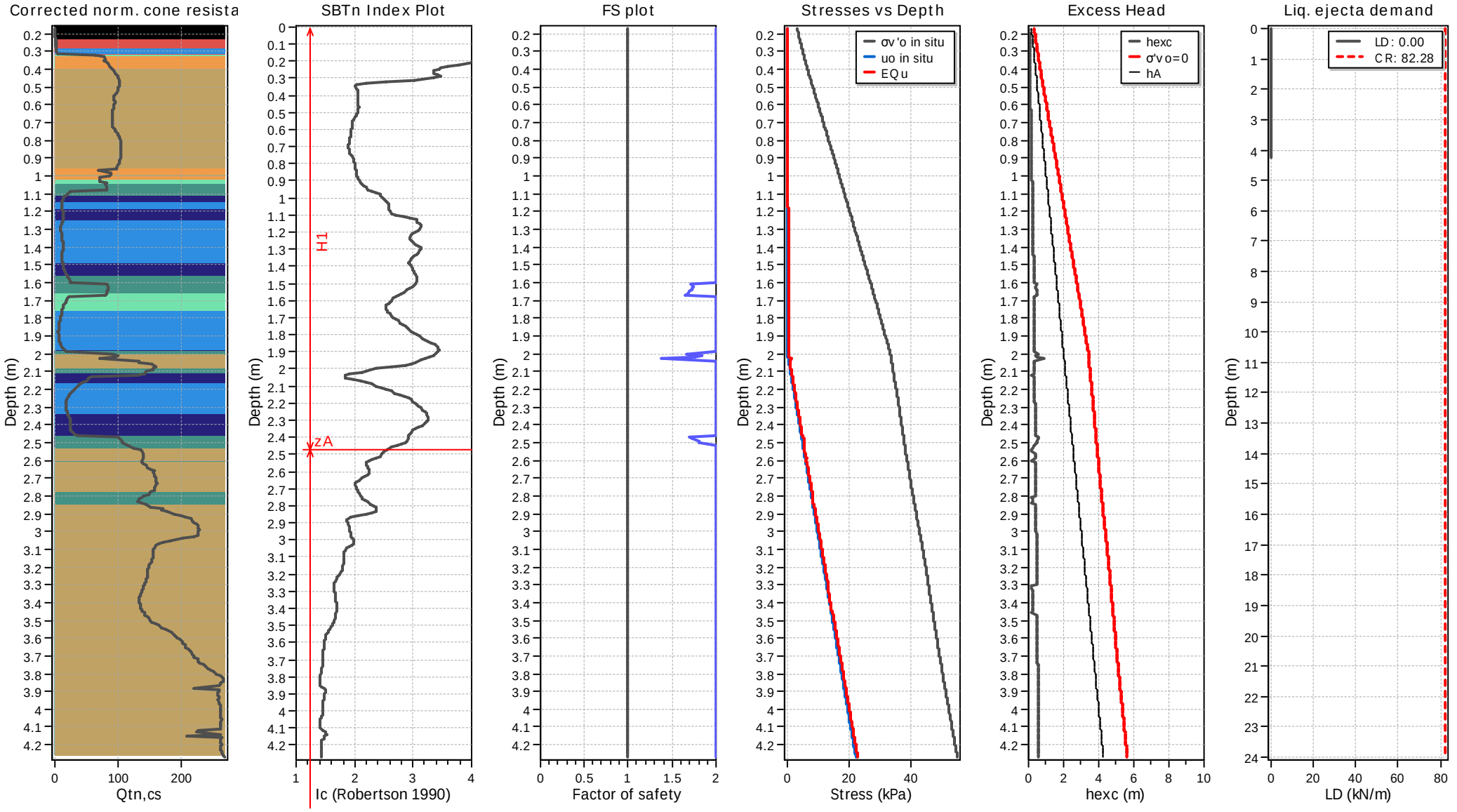
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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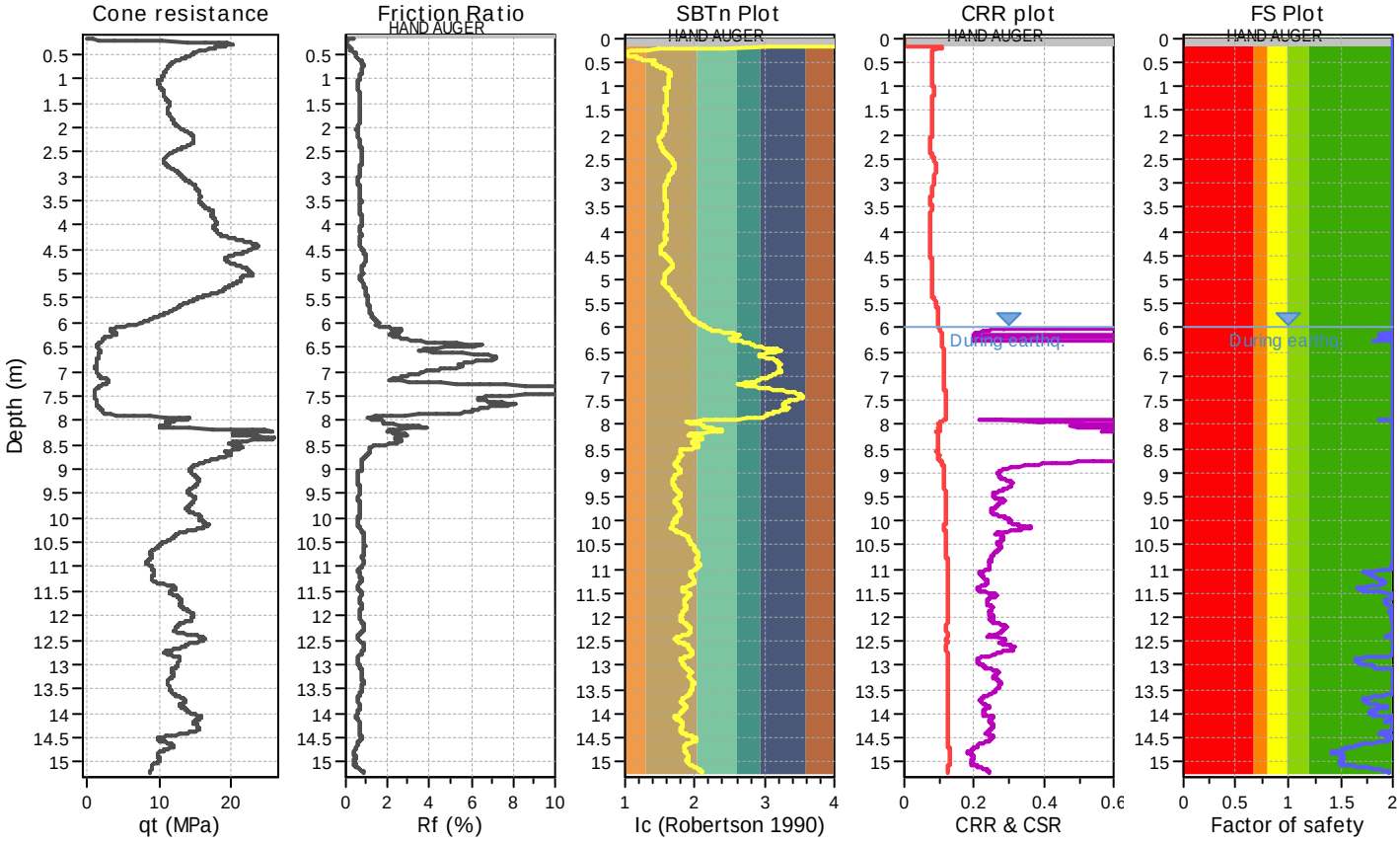
LIQUEFACTION ANALYSIS REPORT

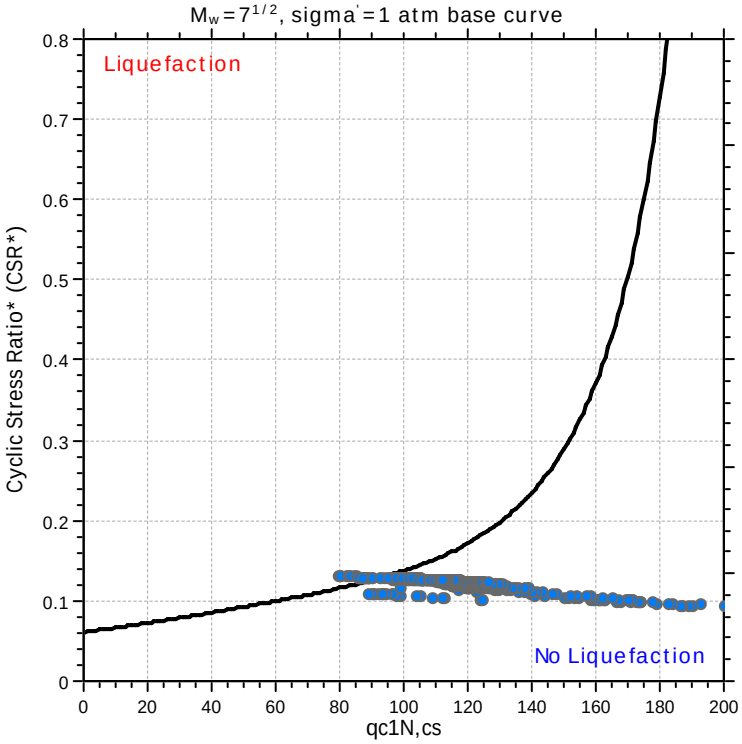
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

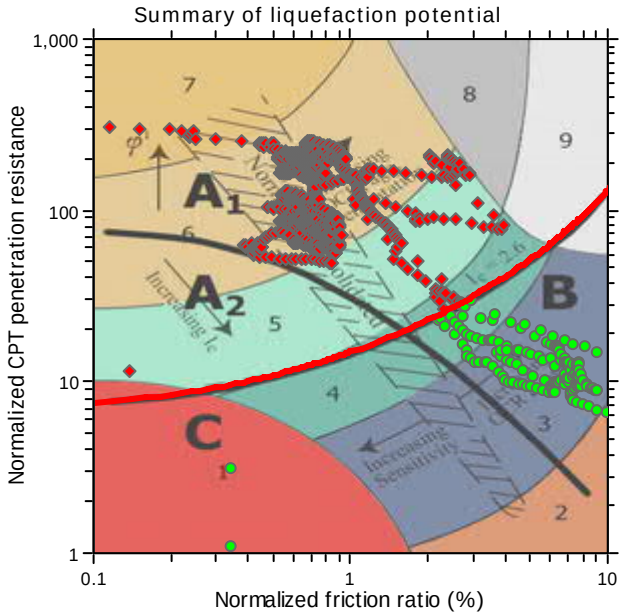
CPT file : CPT7

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

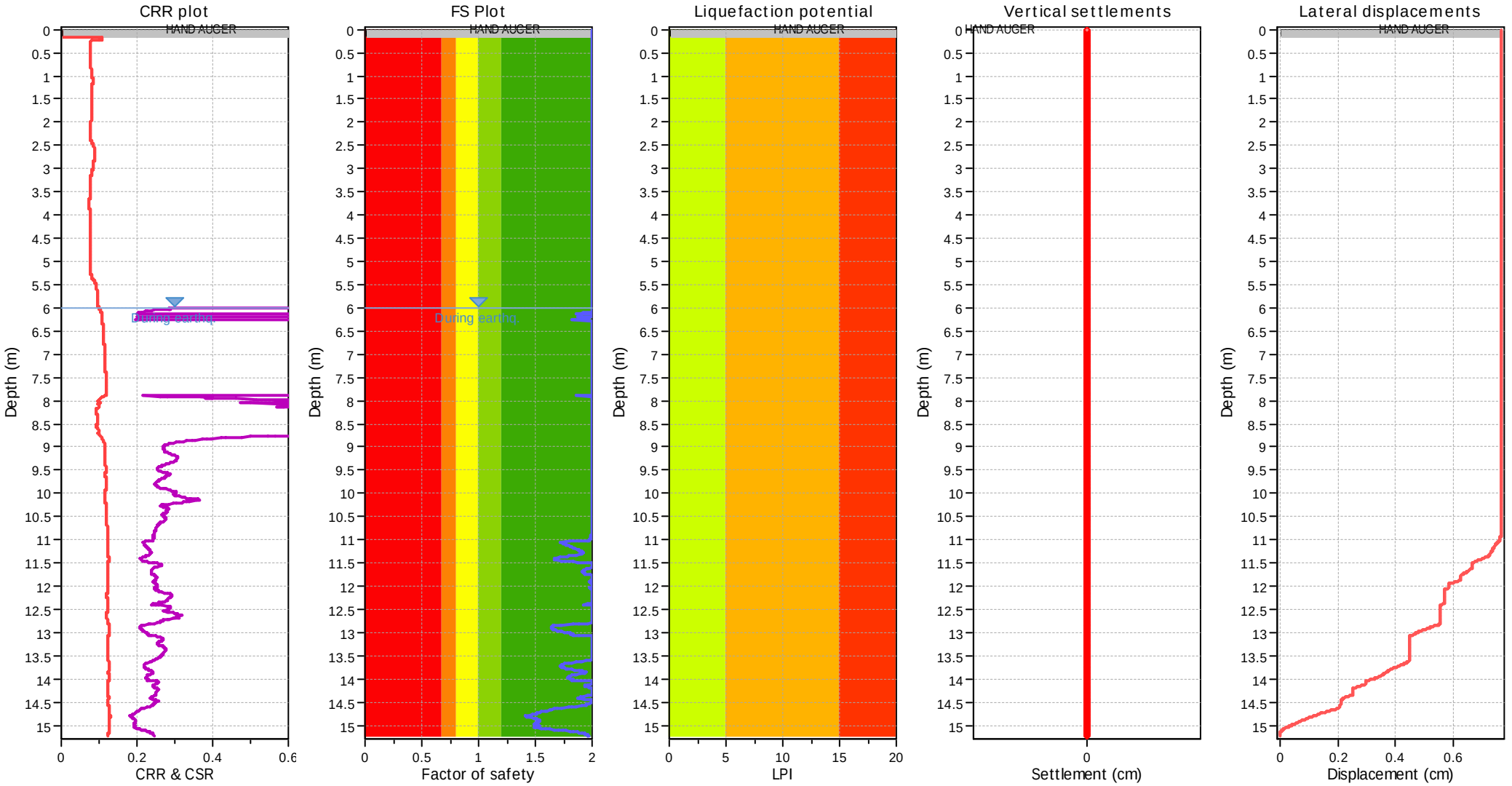






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	6.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

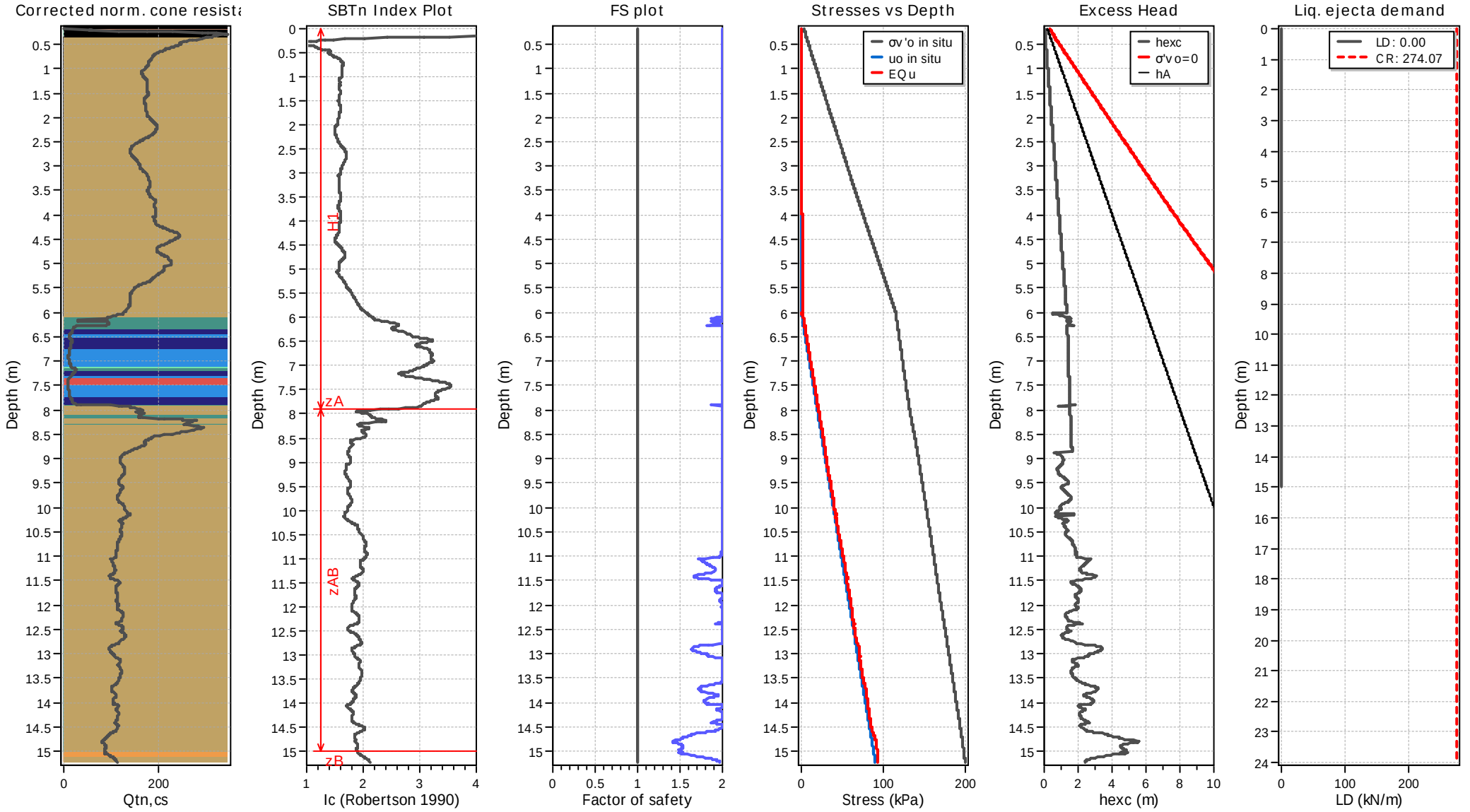
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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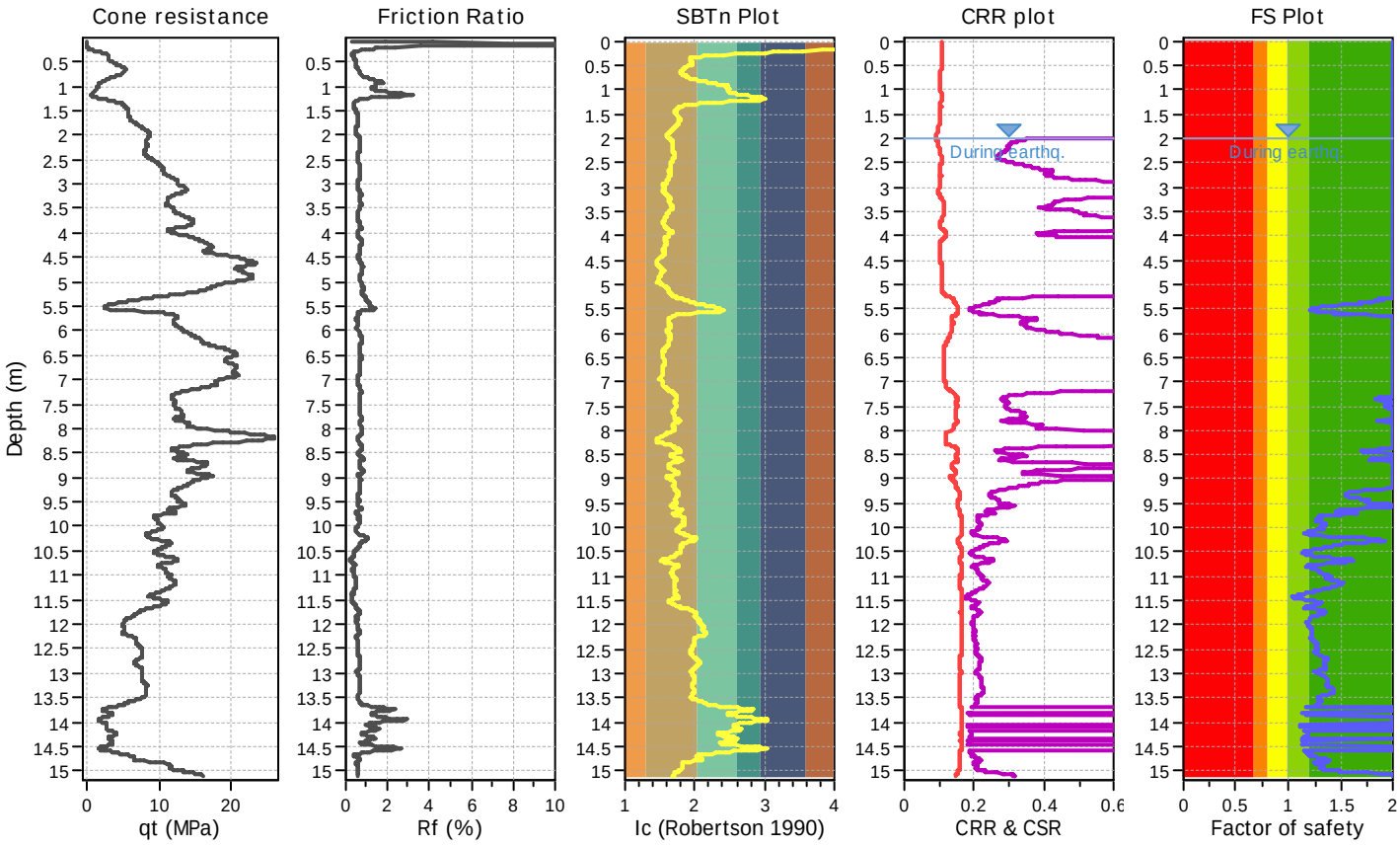
LIQUEFACTION ANALYSIS REPORT

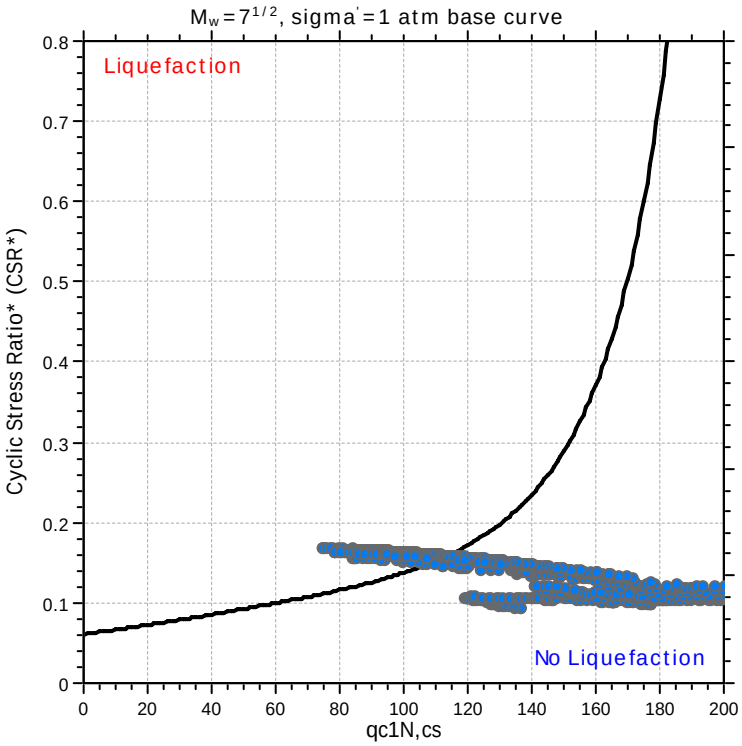
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

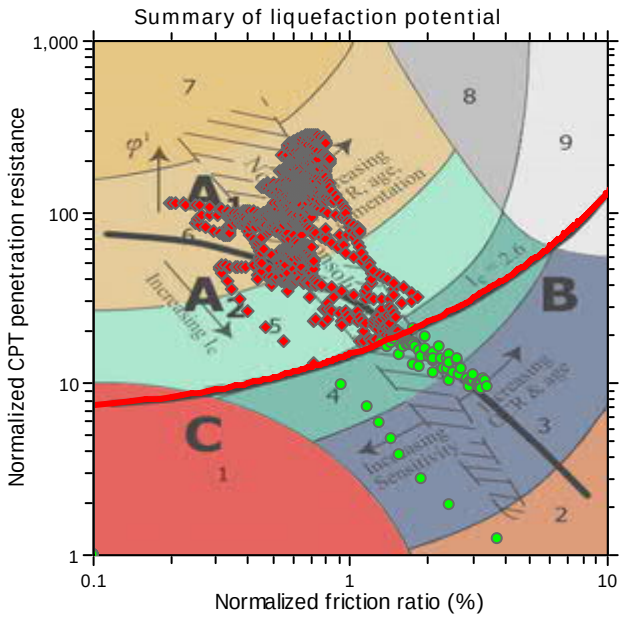
CPT file : CPT8

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

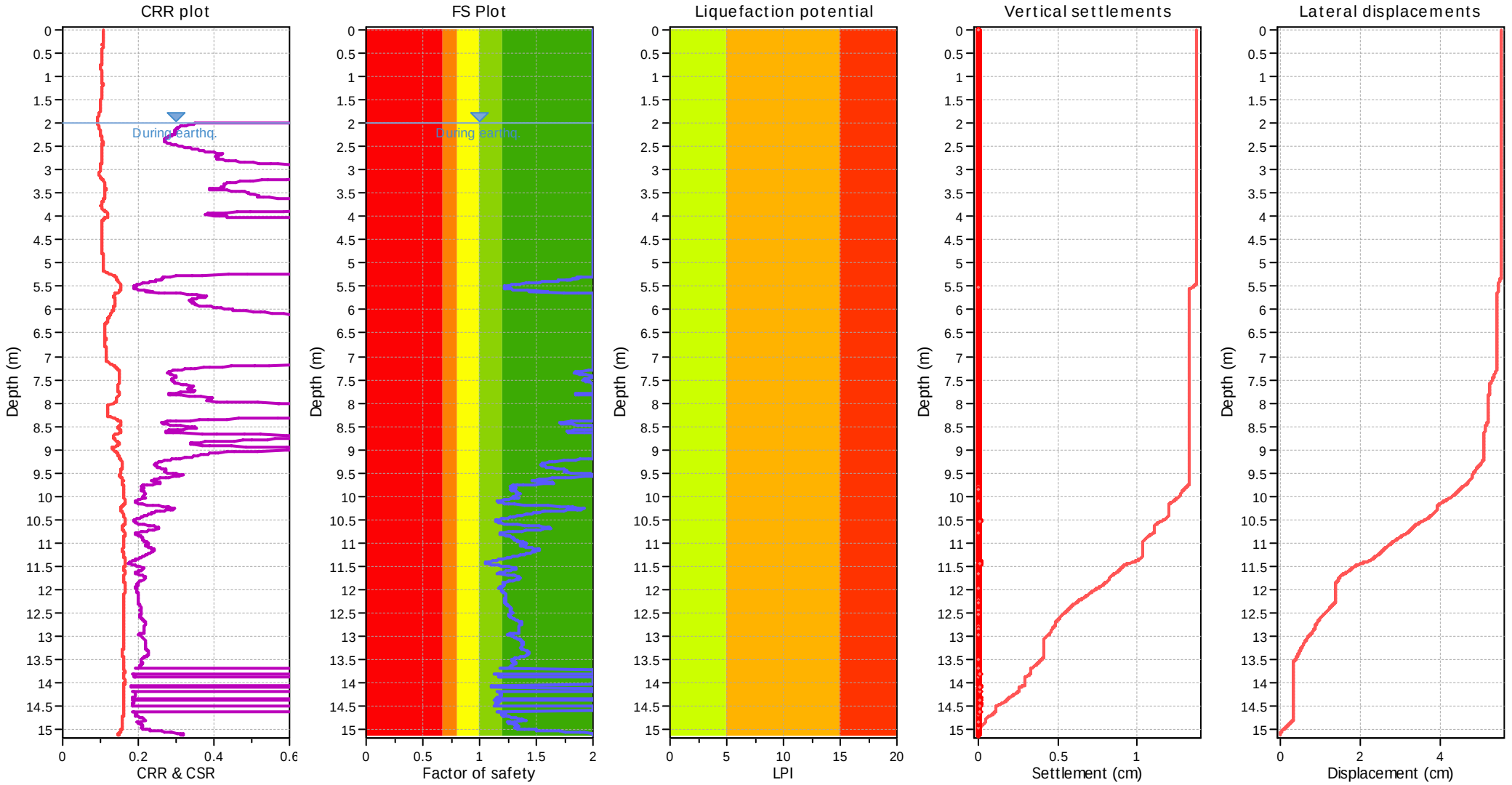






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

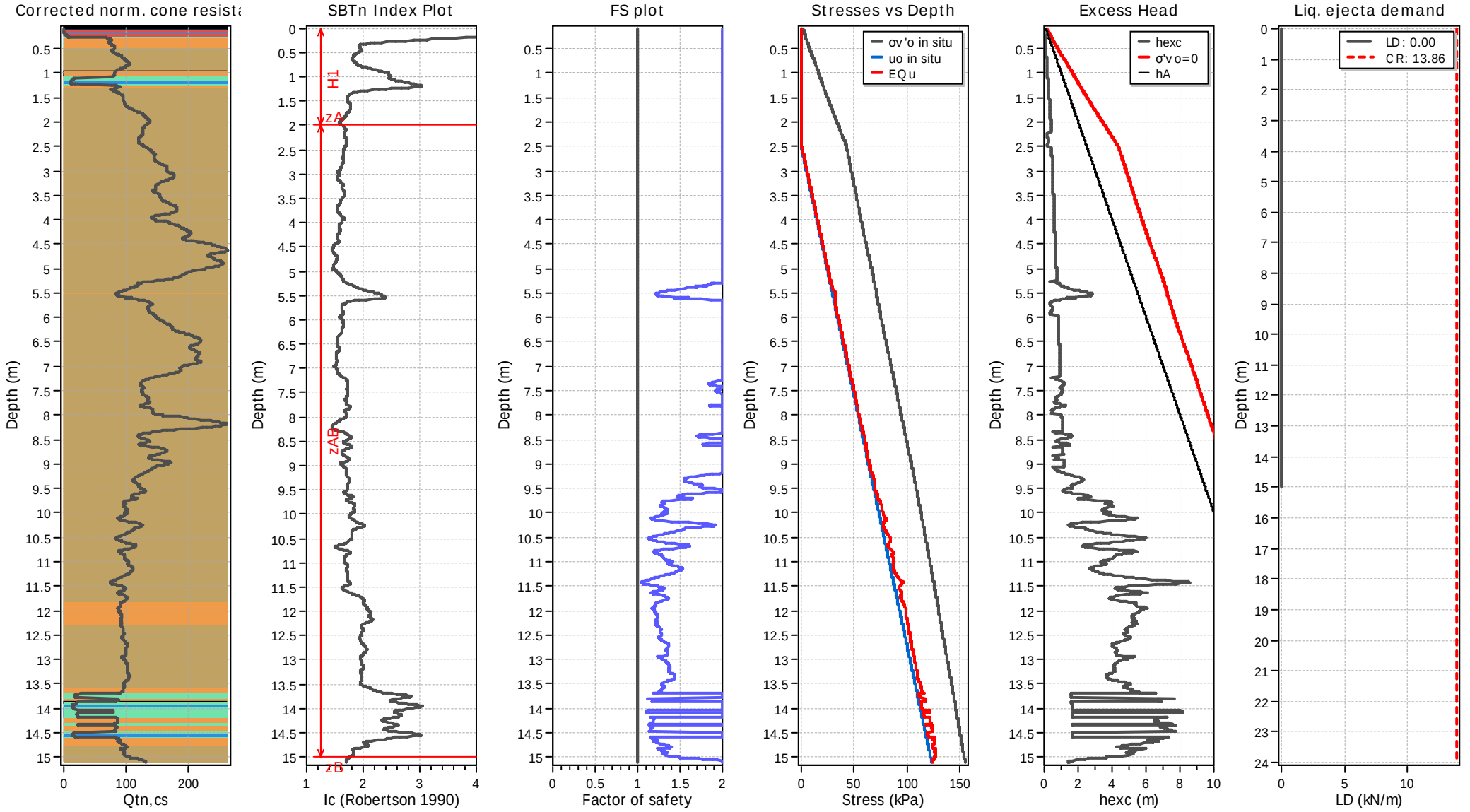
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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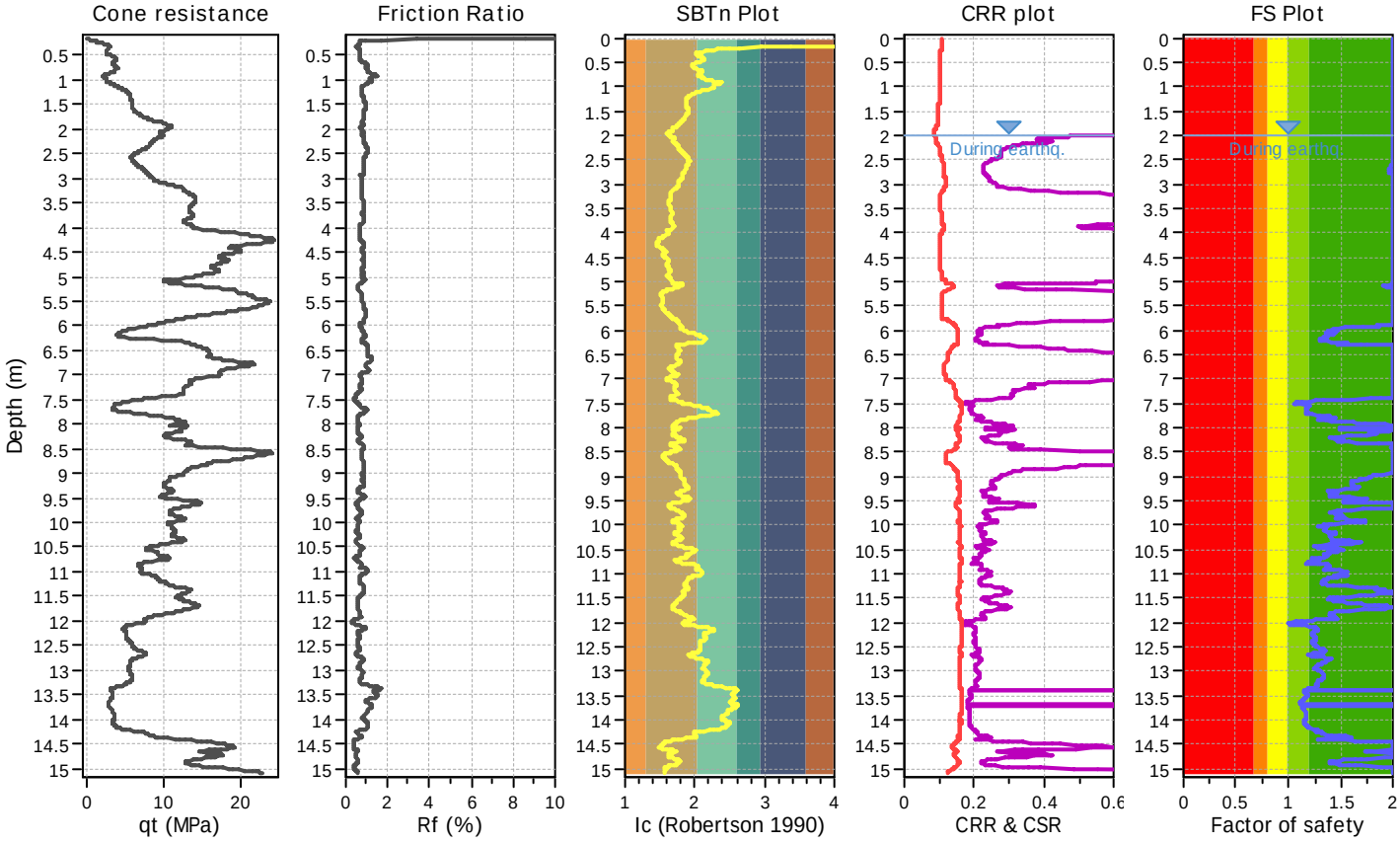
LIQUEFACTION ANALYSIS REPORT

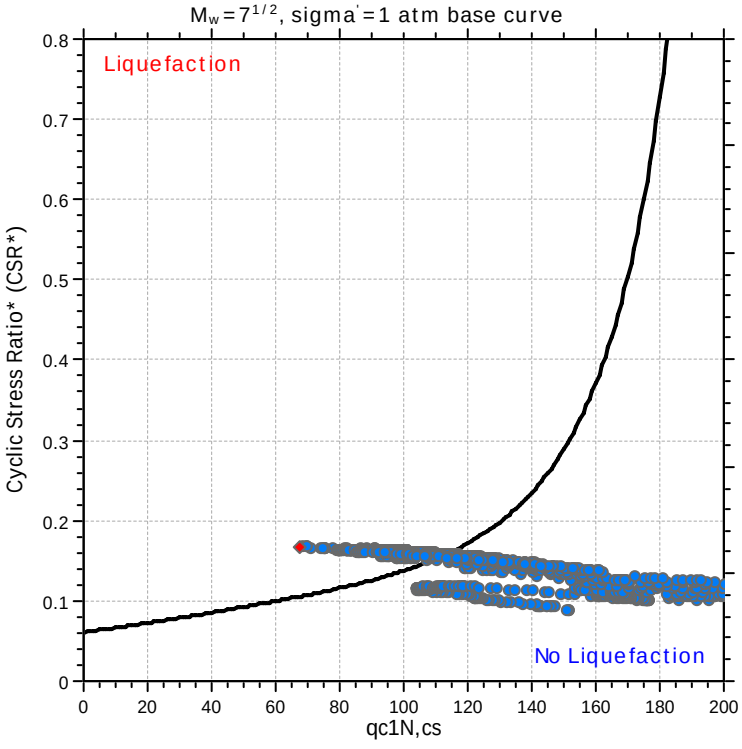
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

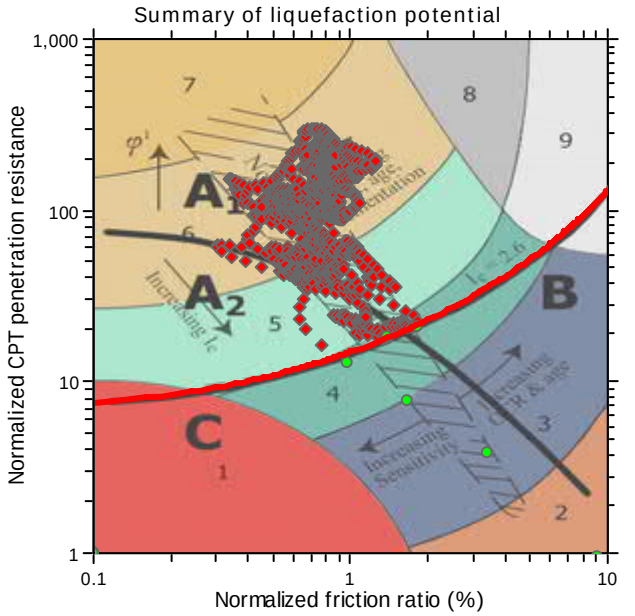
CPT file : CPT9

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

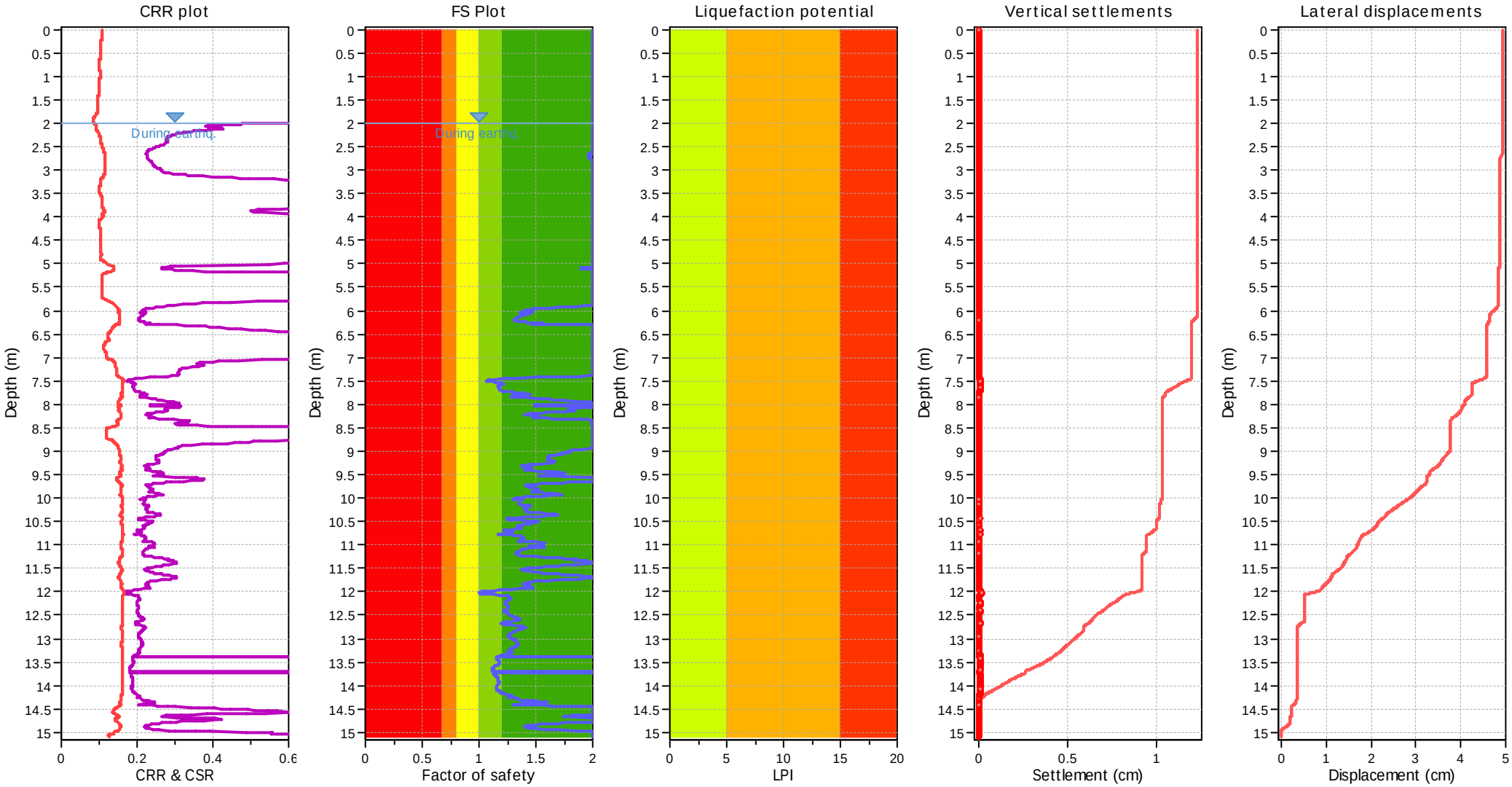






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

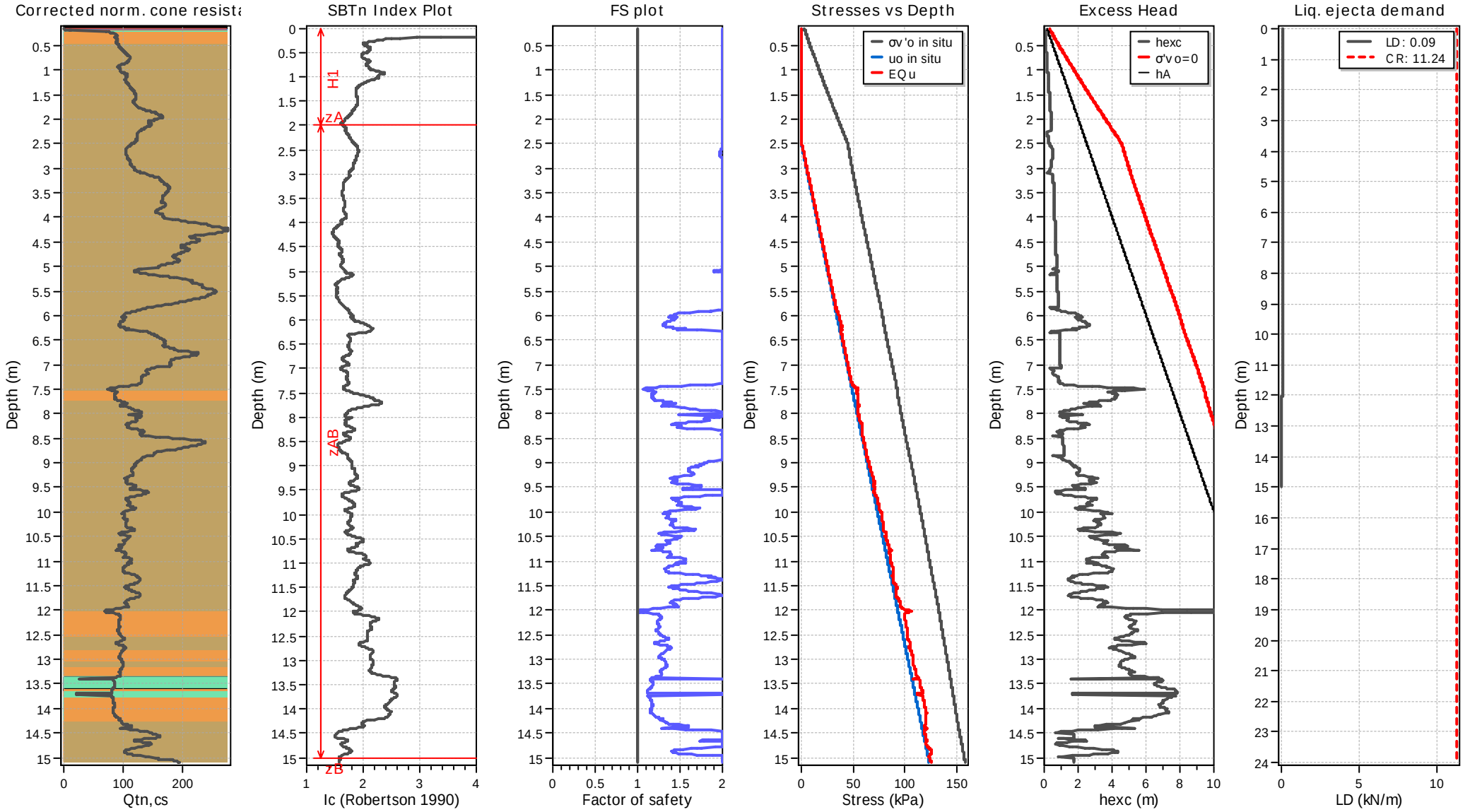
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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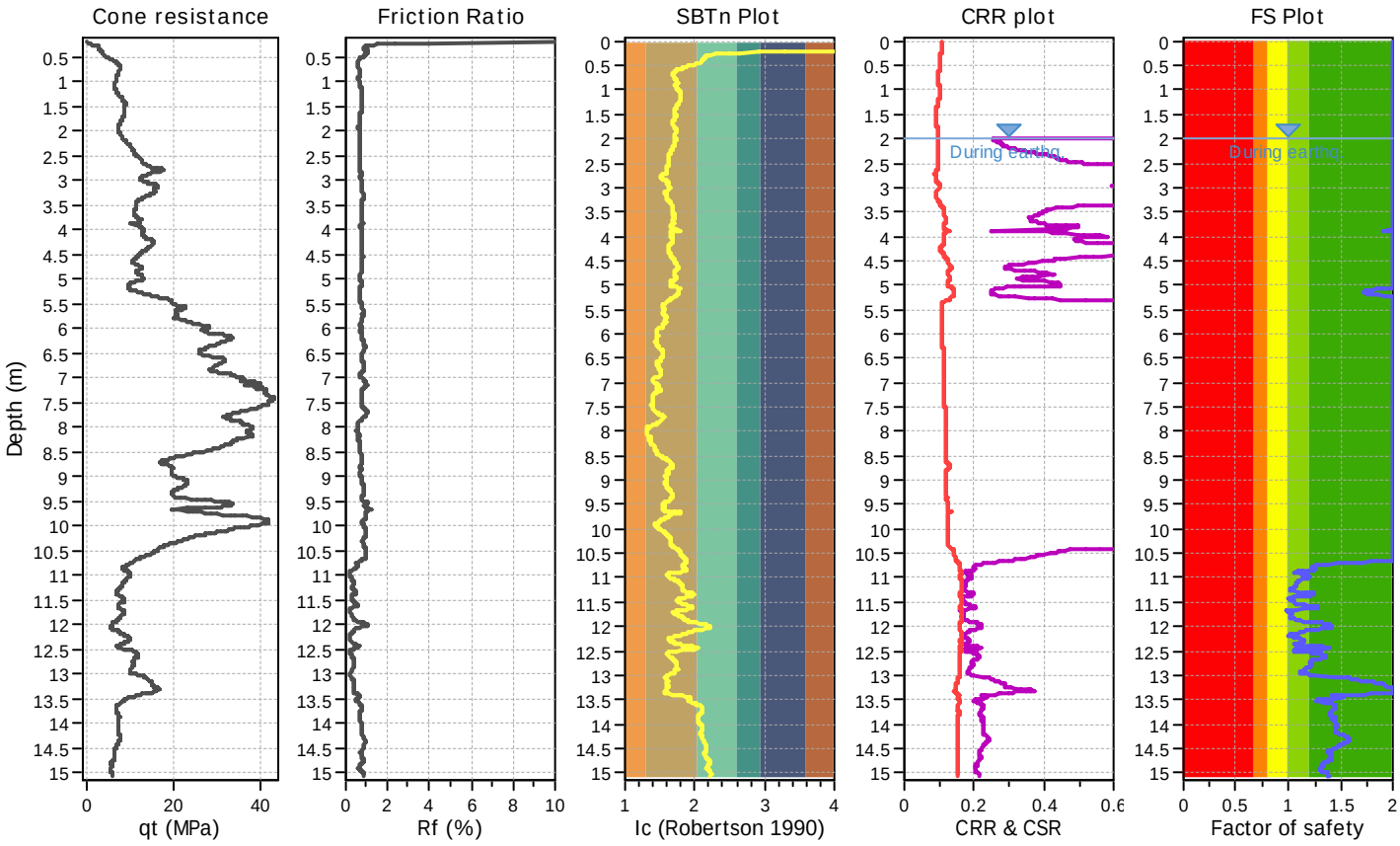
LIQUEFACTION ANALYSIS REPORT

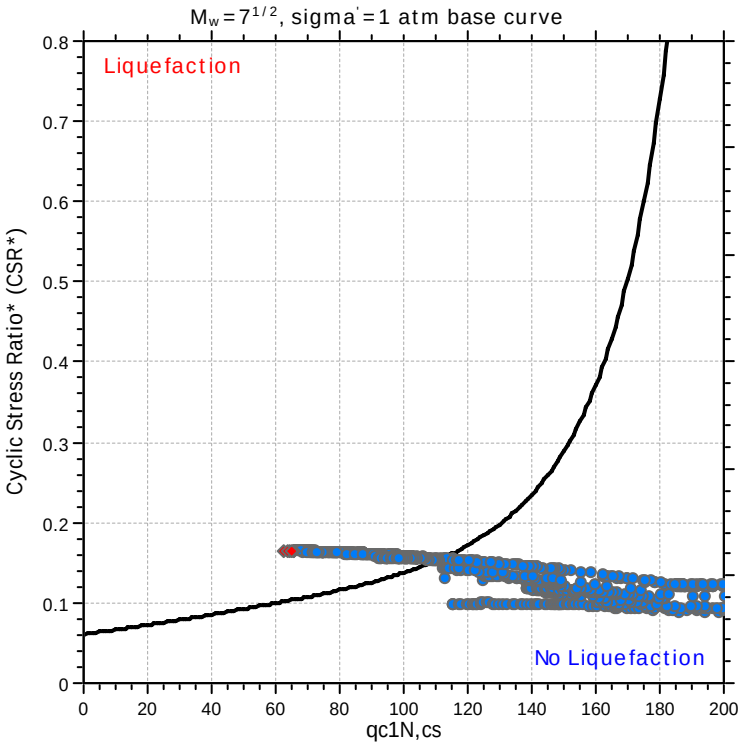
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

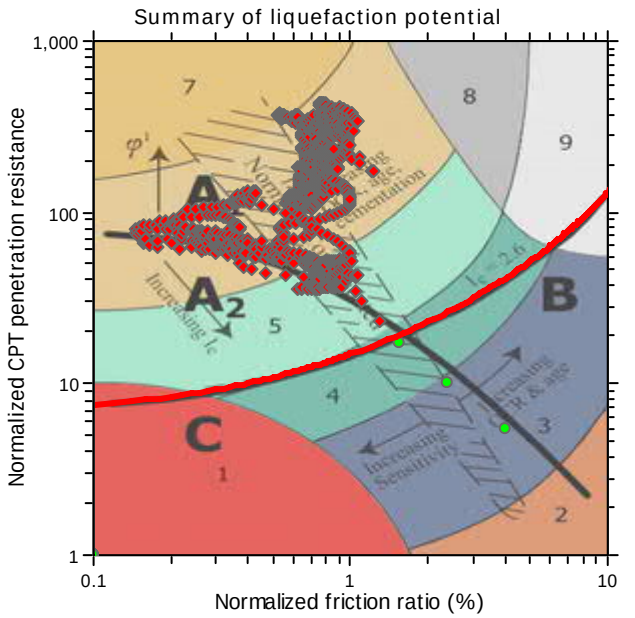
CPT file : CPT10

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

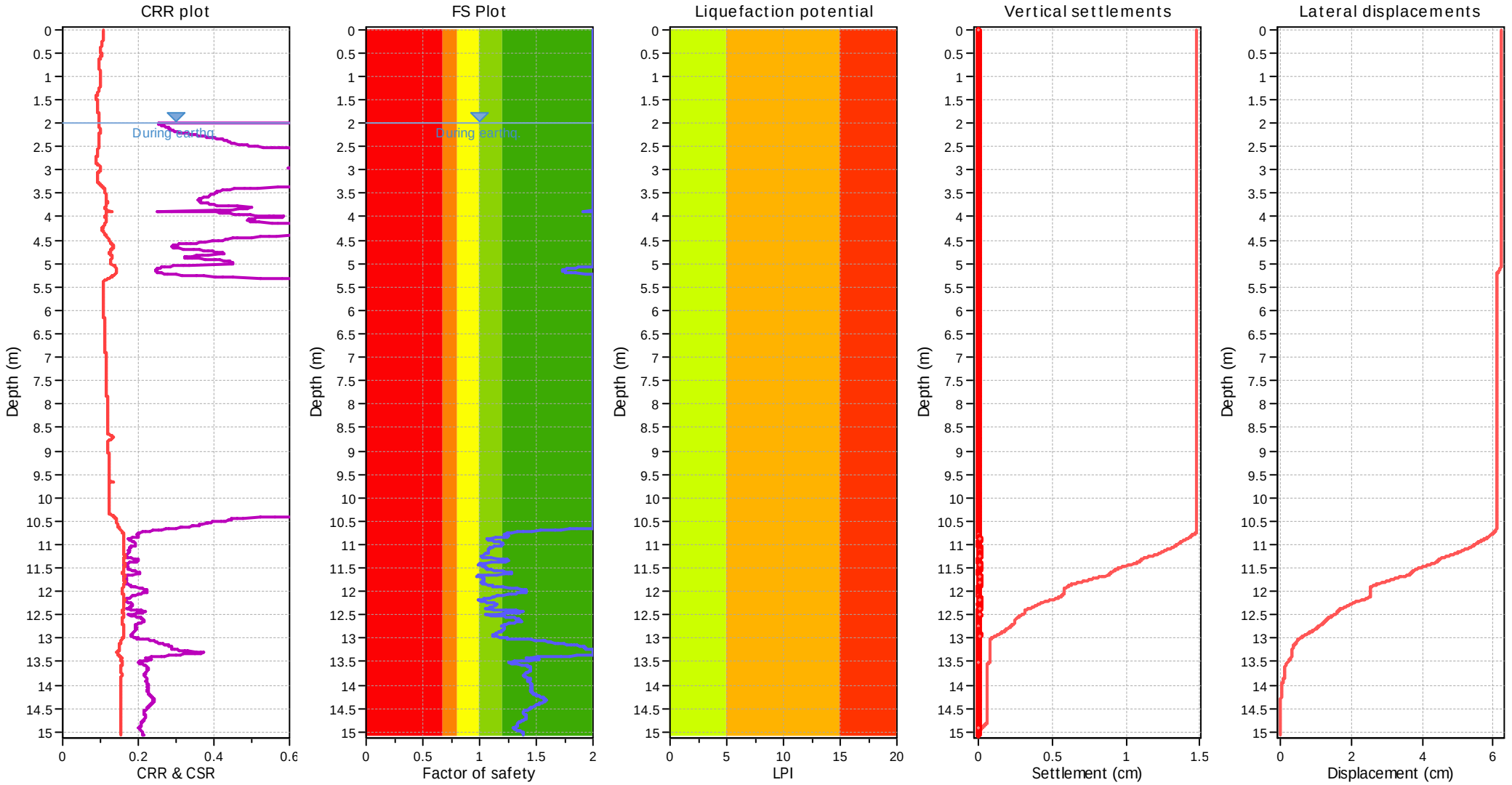






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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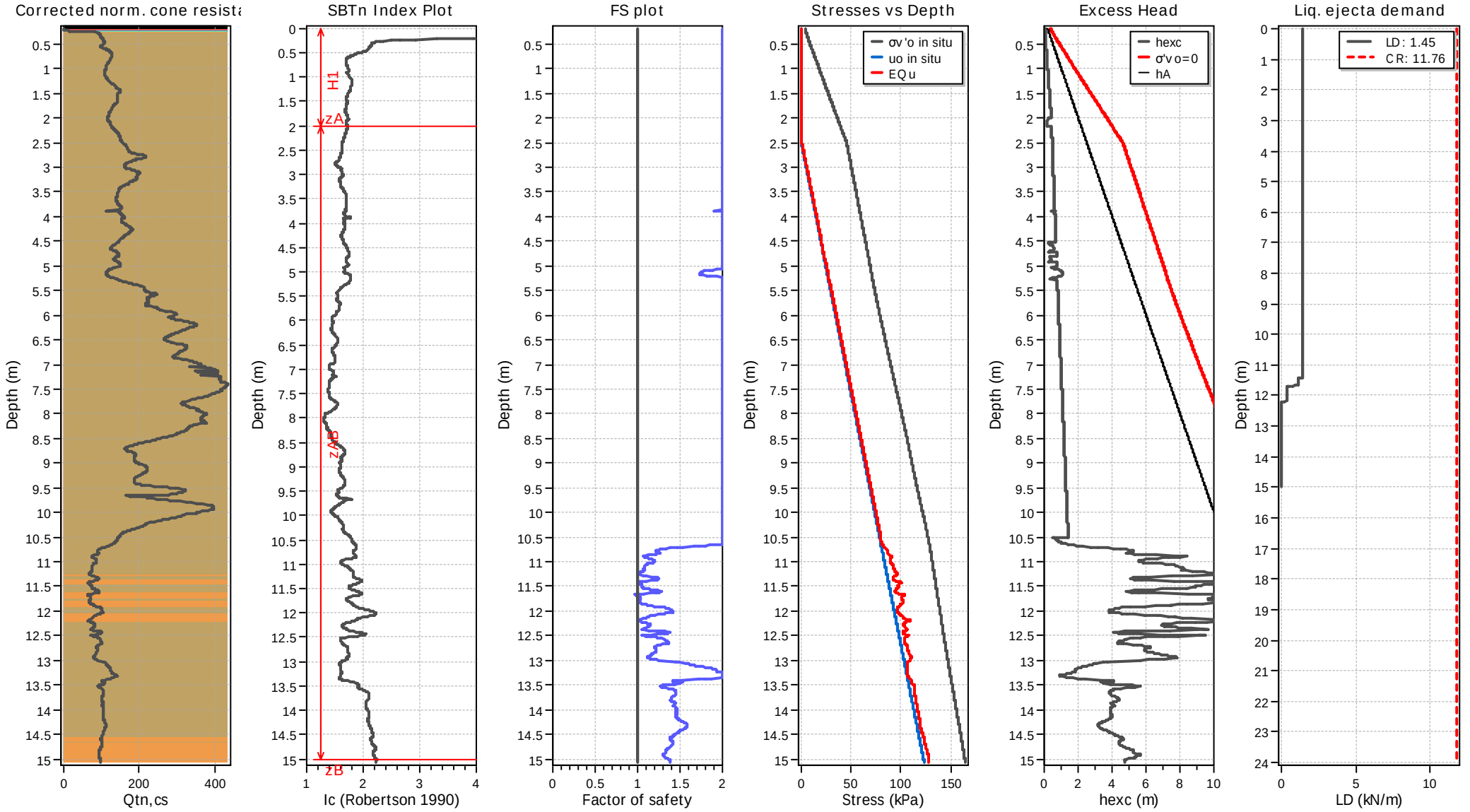
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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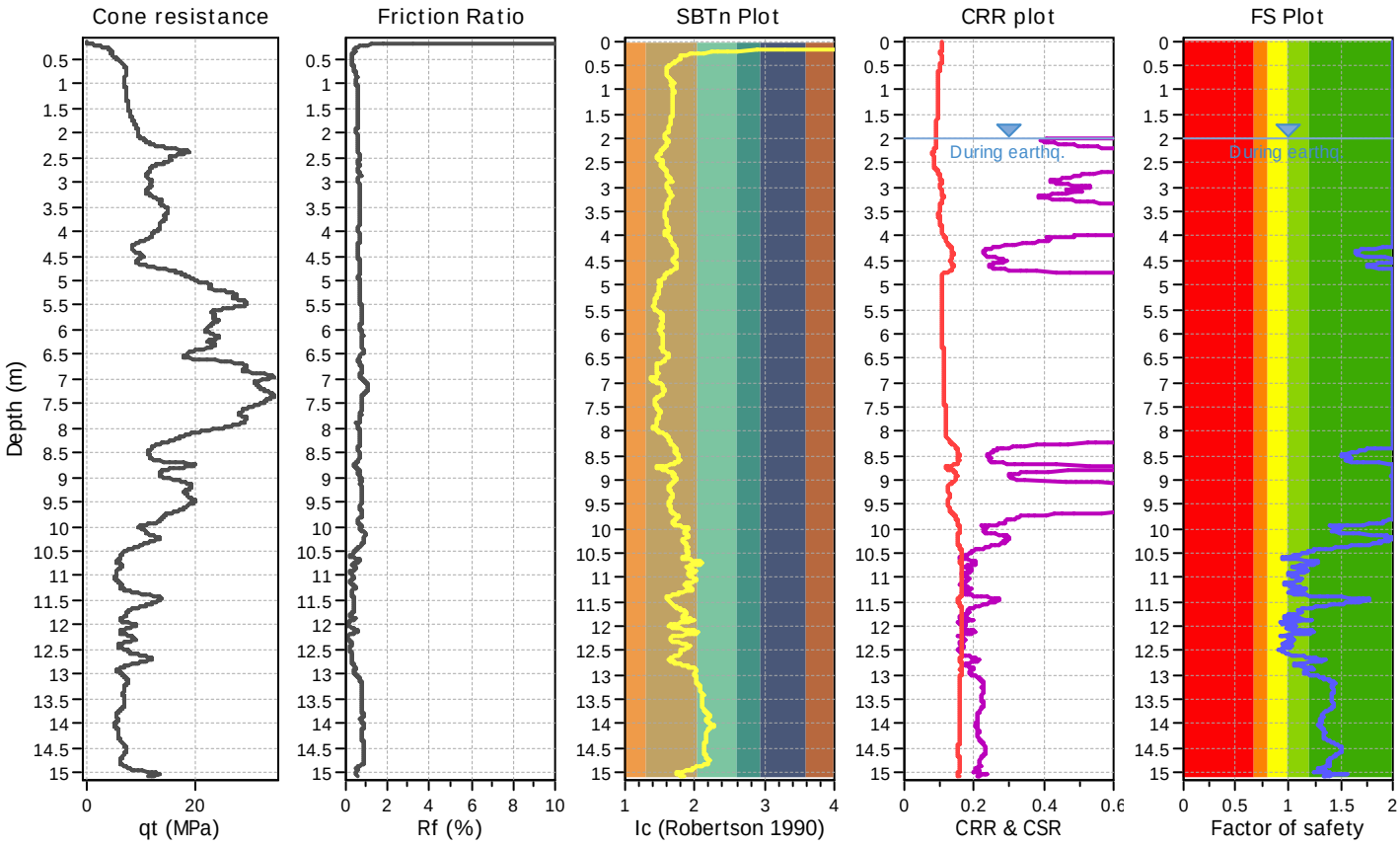
LIQUEFACTION ANALYSIS REPORT

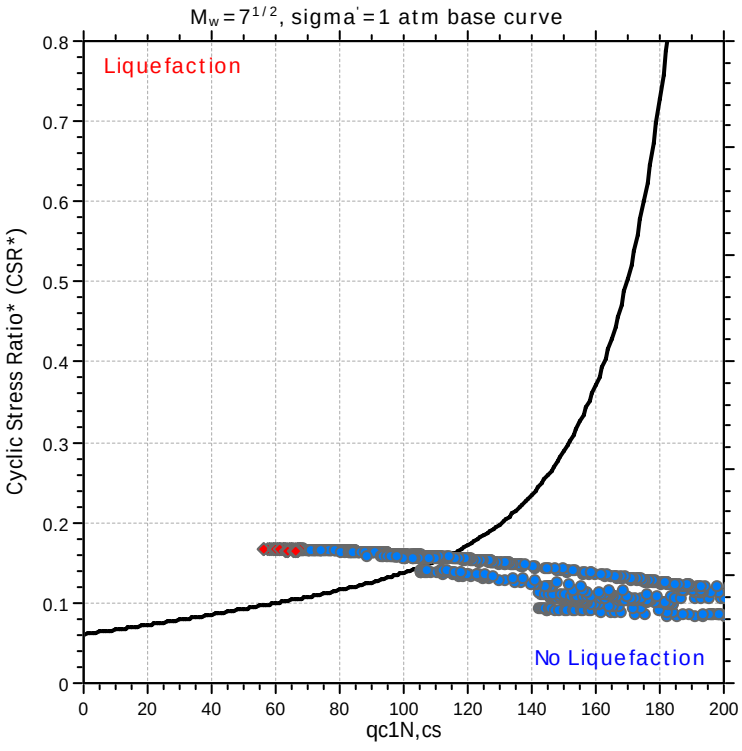
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

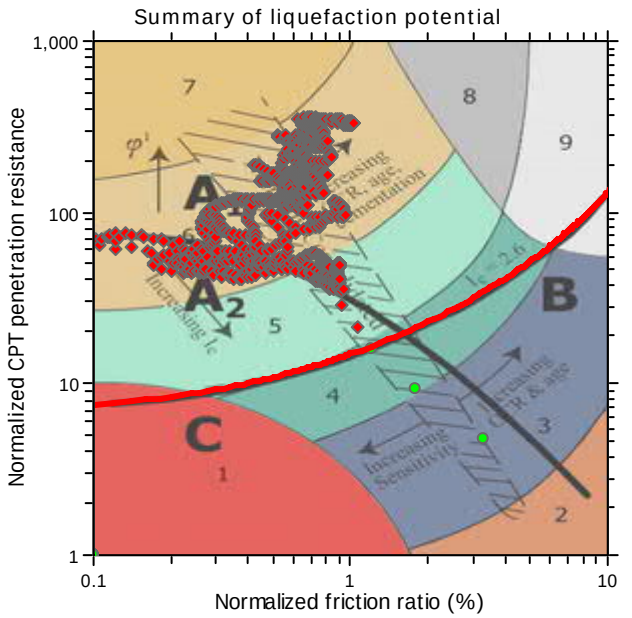
CPT file : CPT11

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

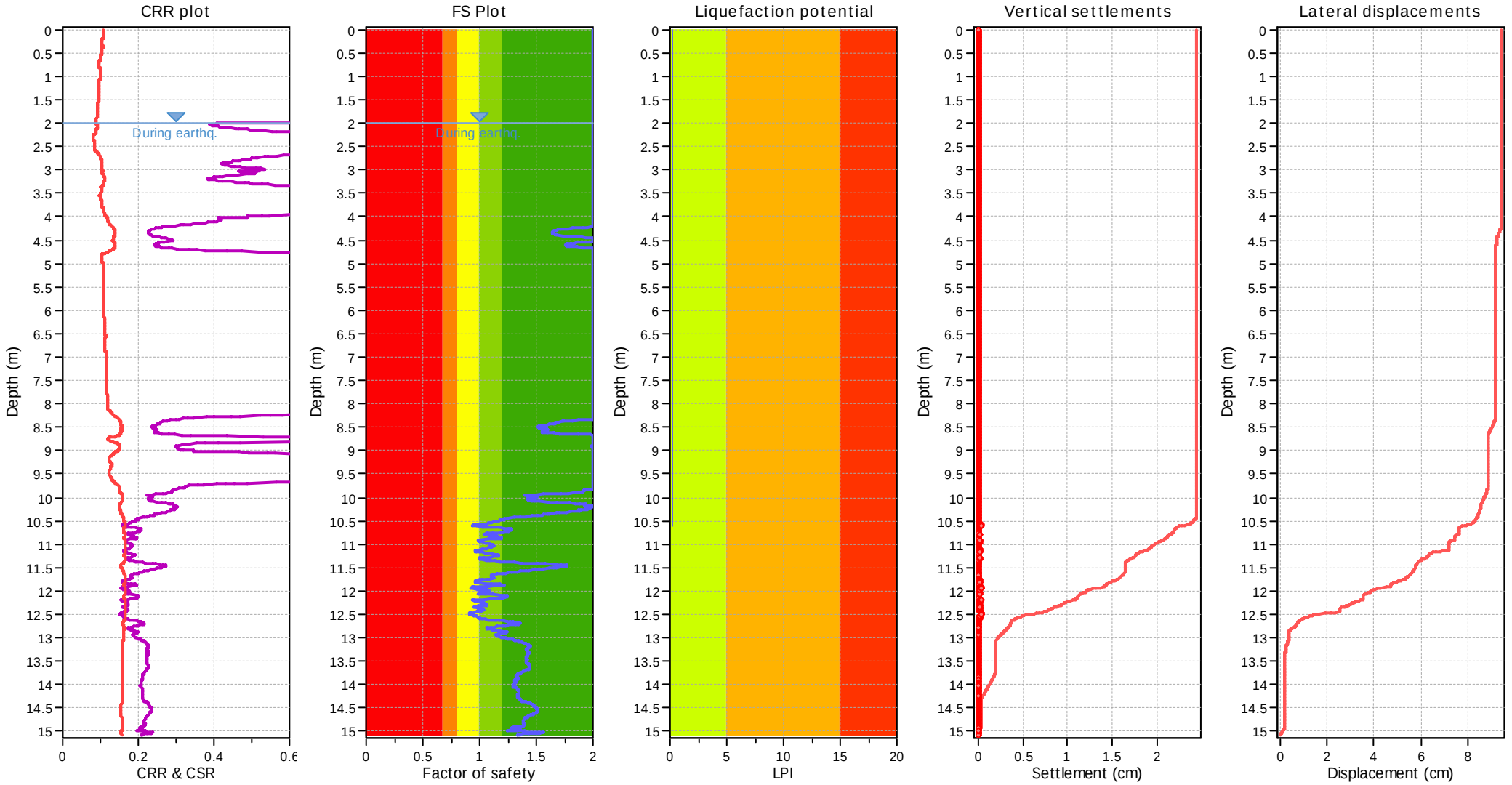






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

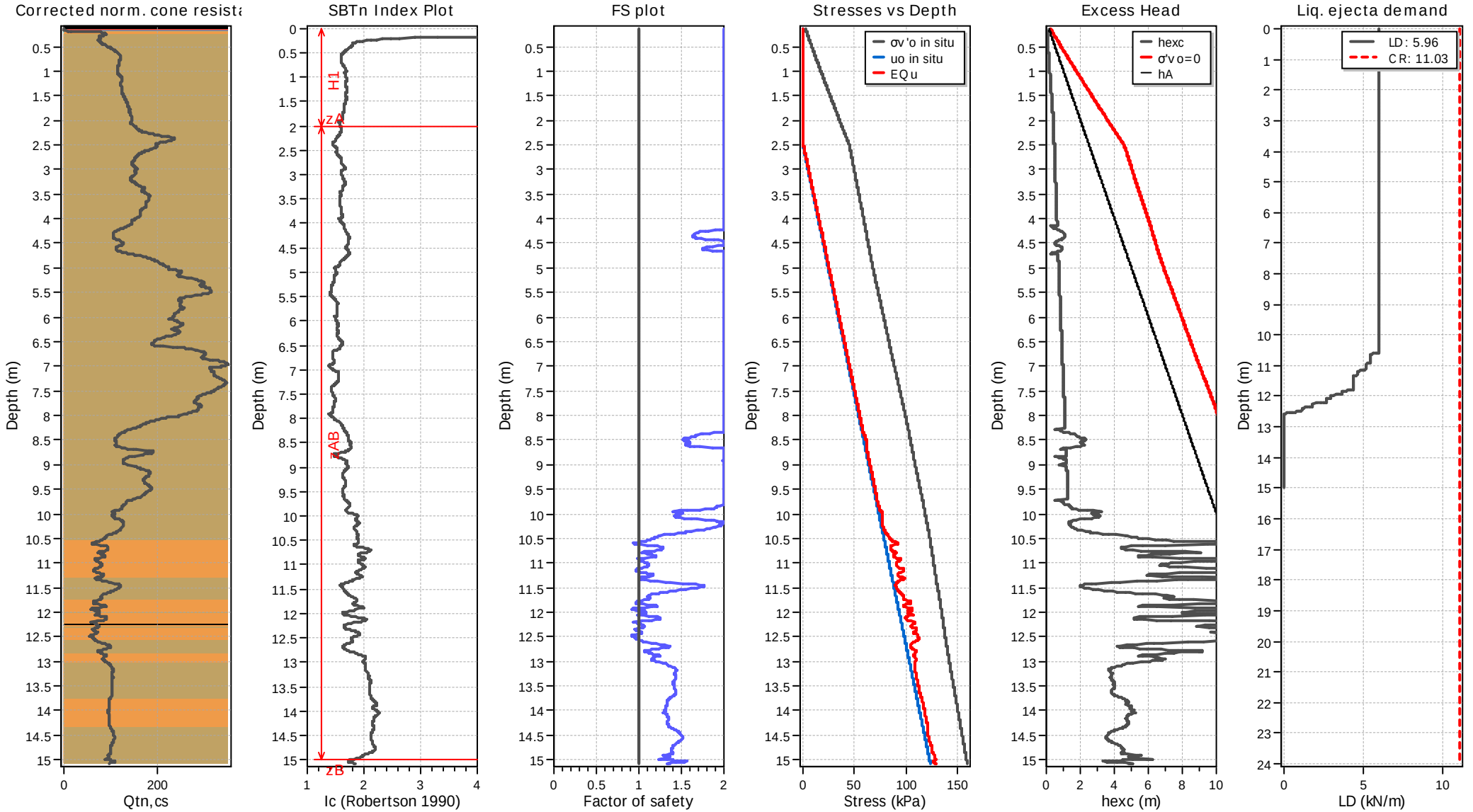
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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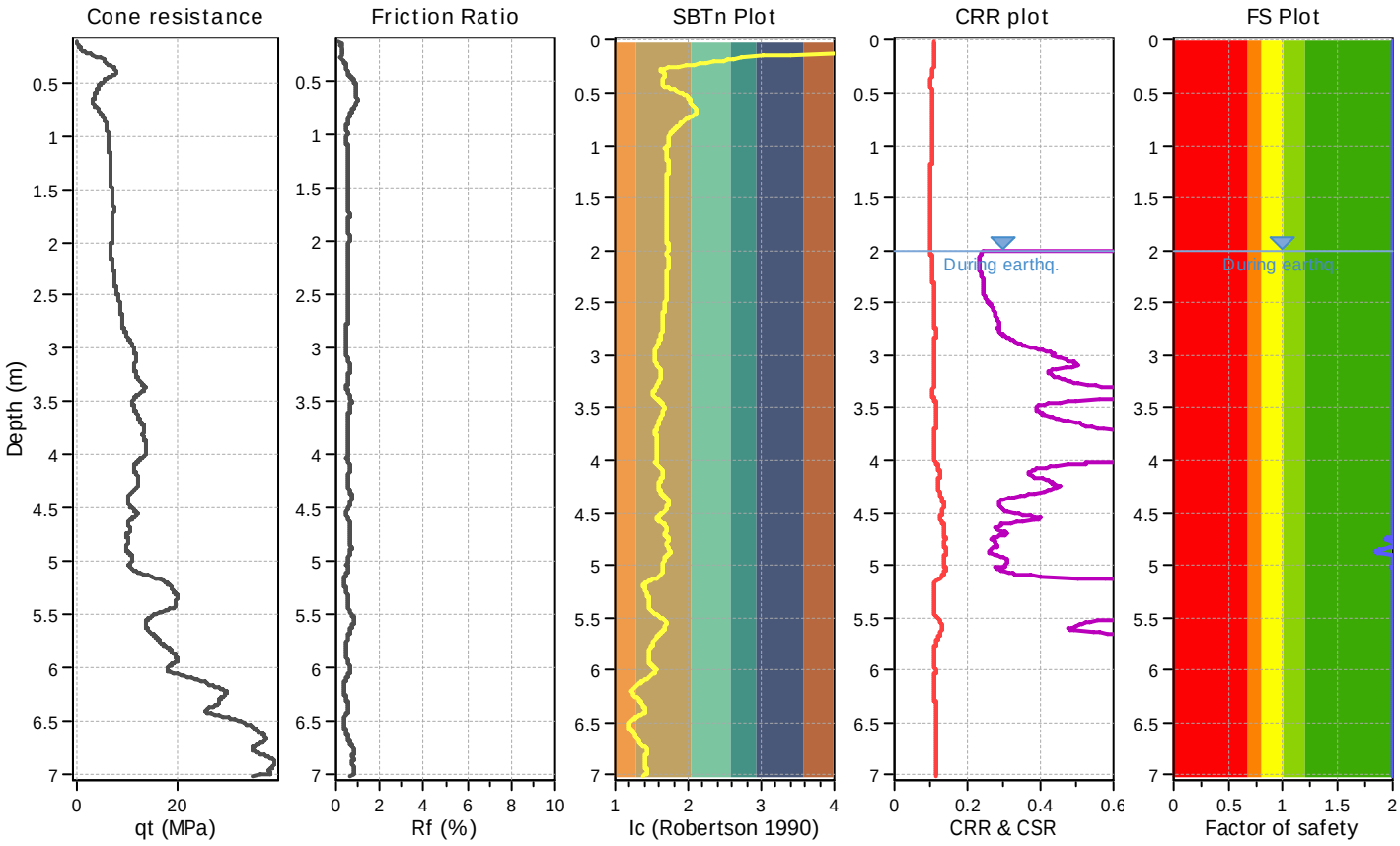
LIQUEFACTION ANALYSIS REPORT

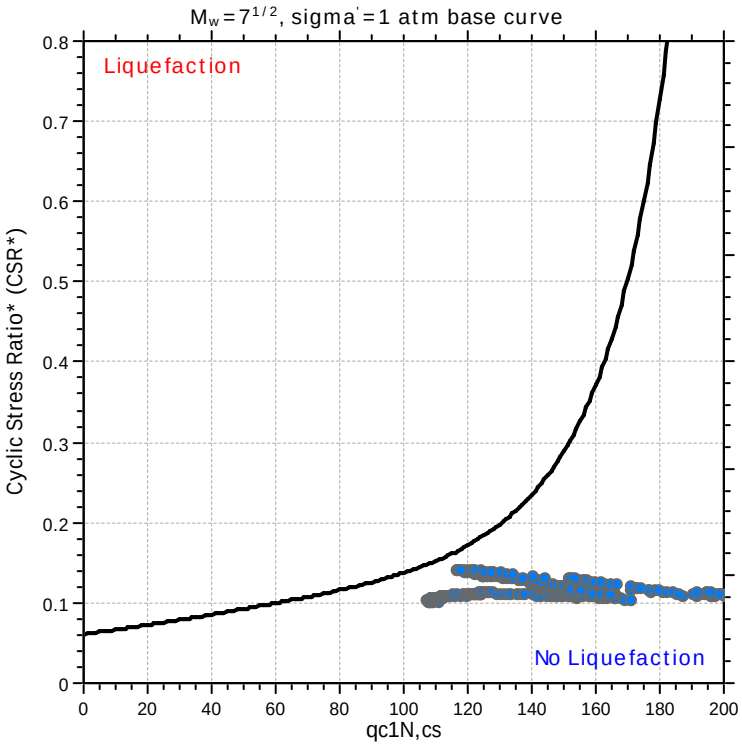
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

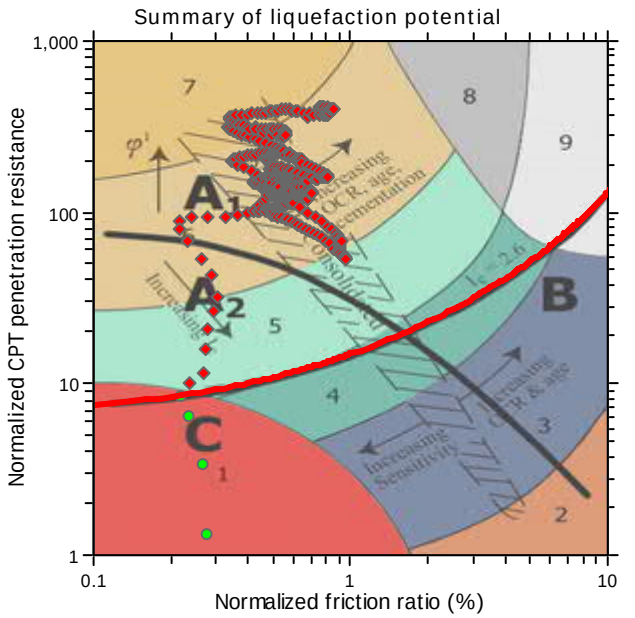
CPT file : CPT12

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

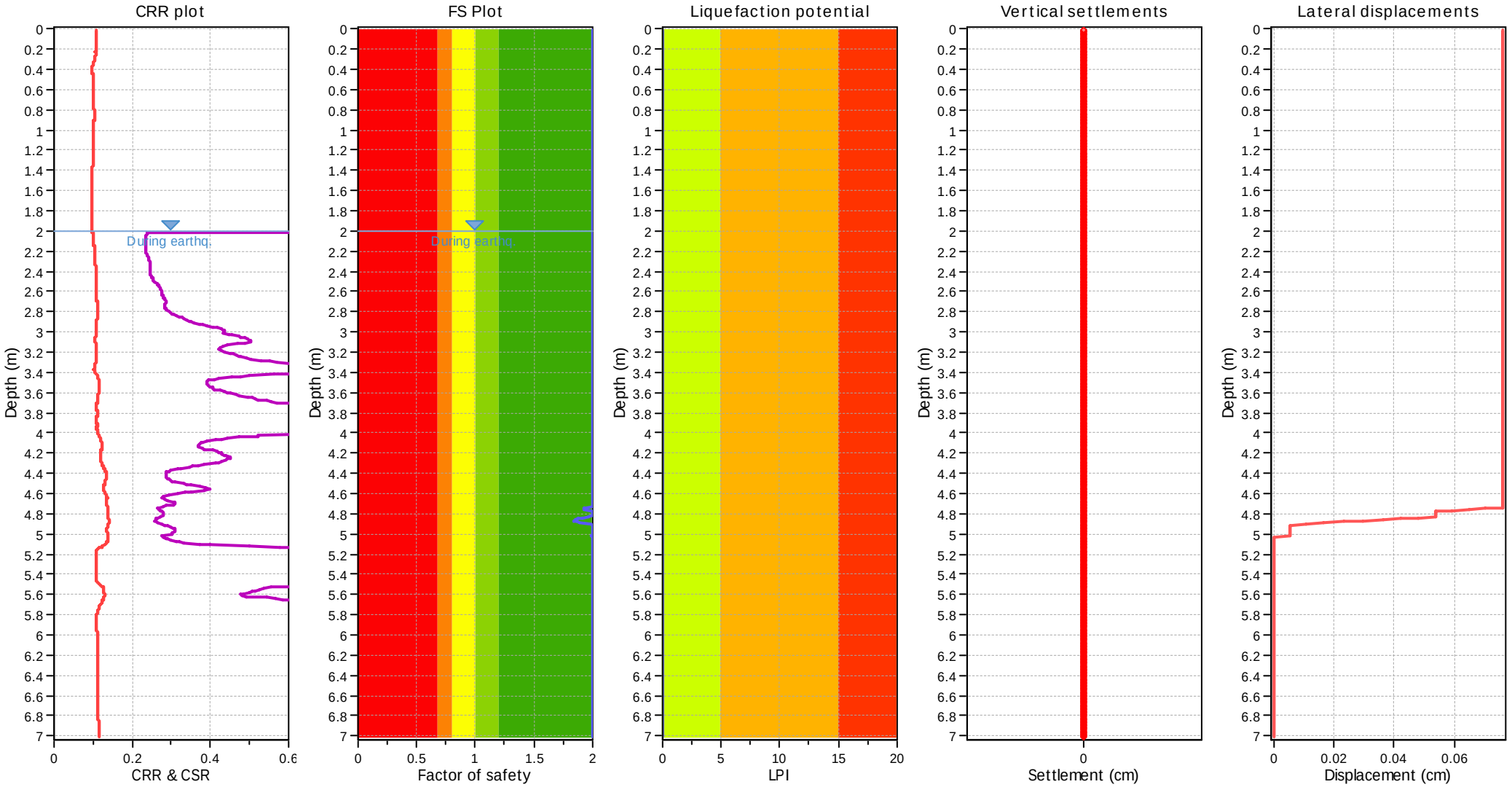






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

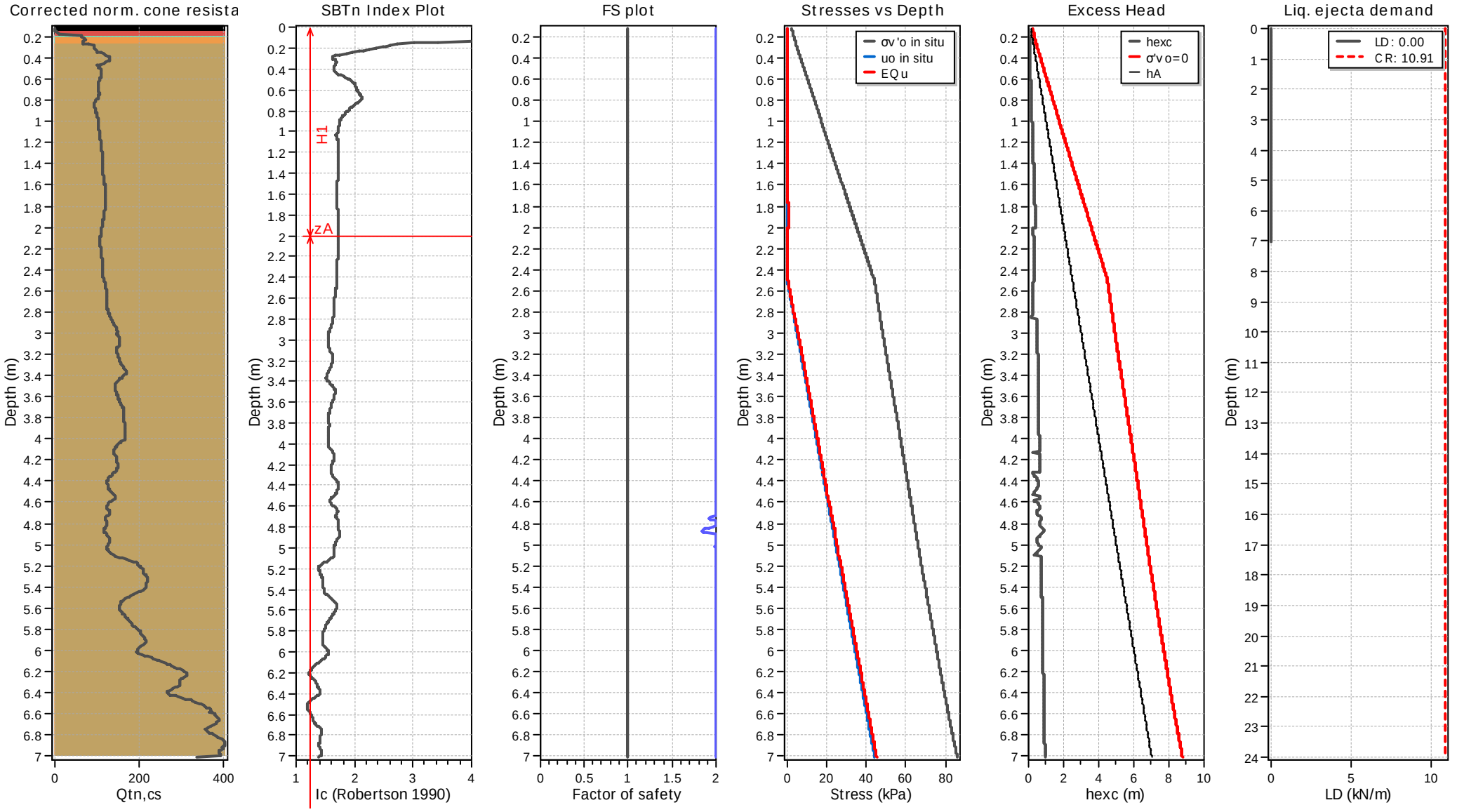
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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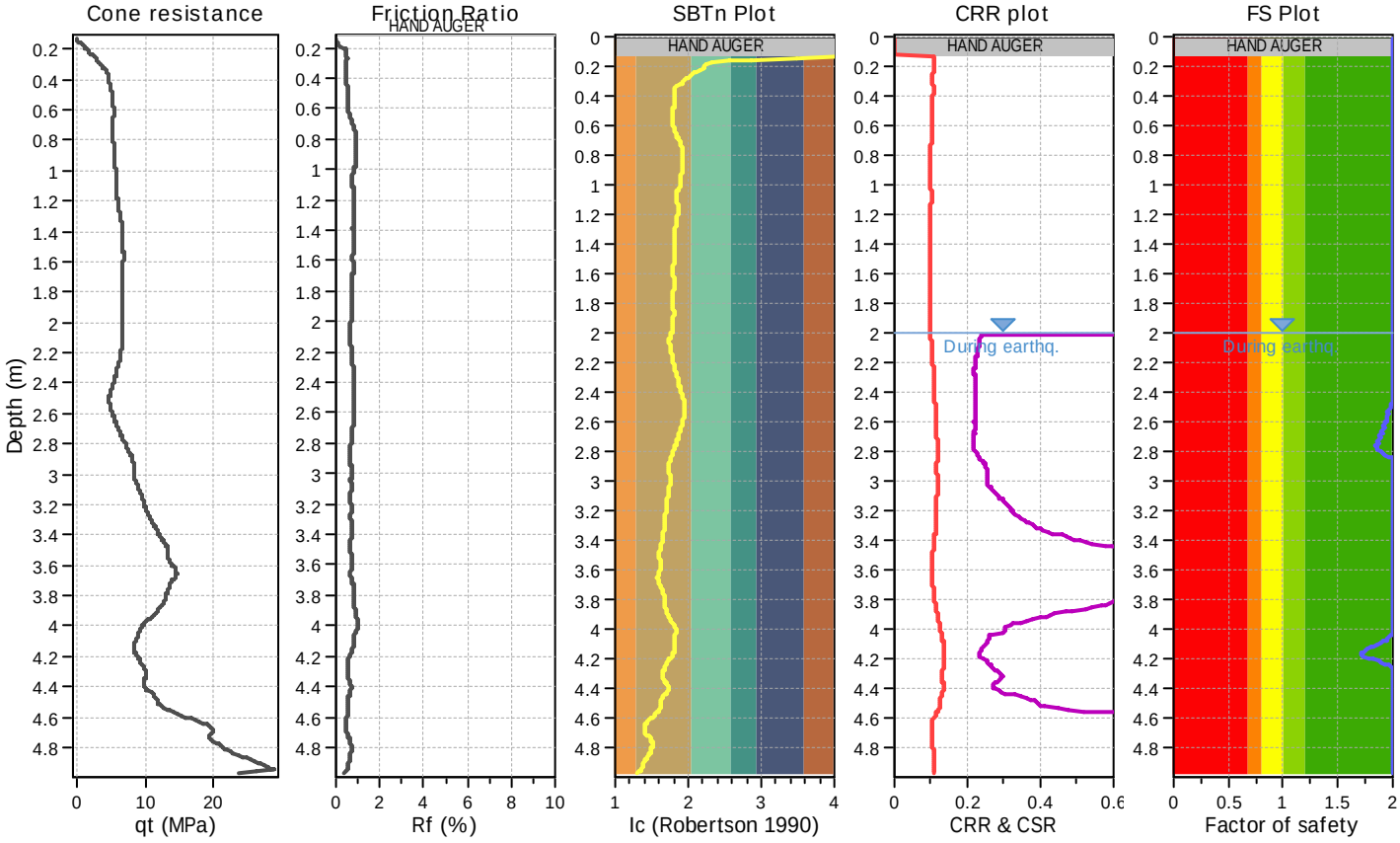
LIQUEFACTION ANALYSIS REPORT

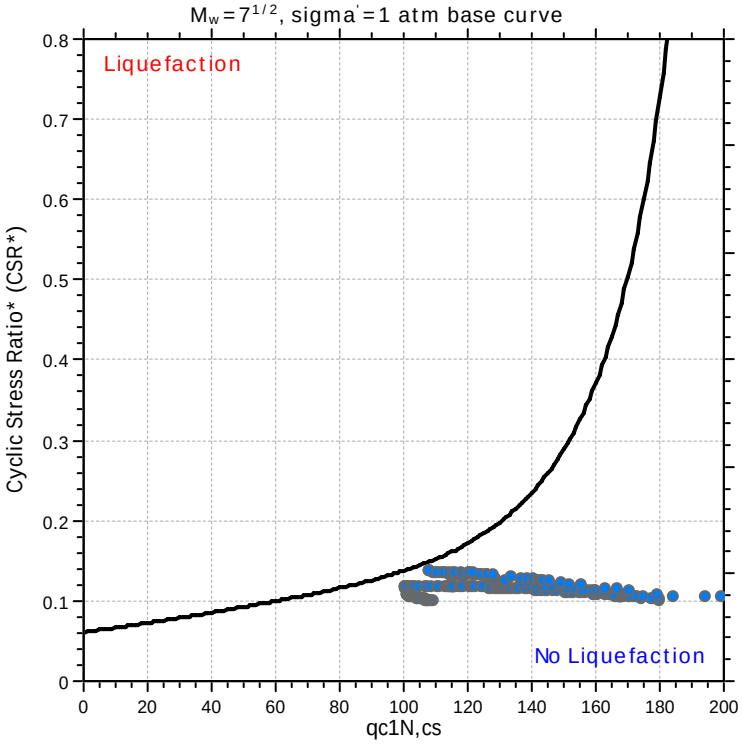
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

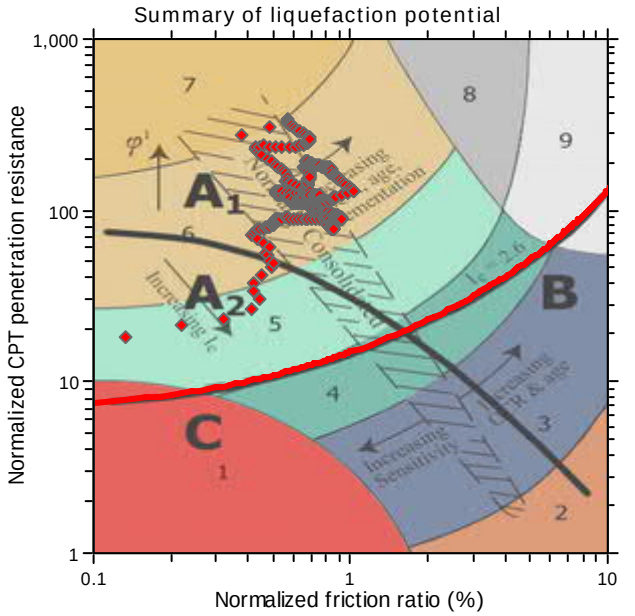
CPT file : CPT13

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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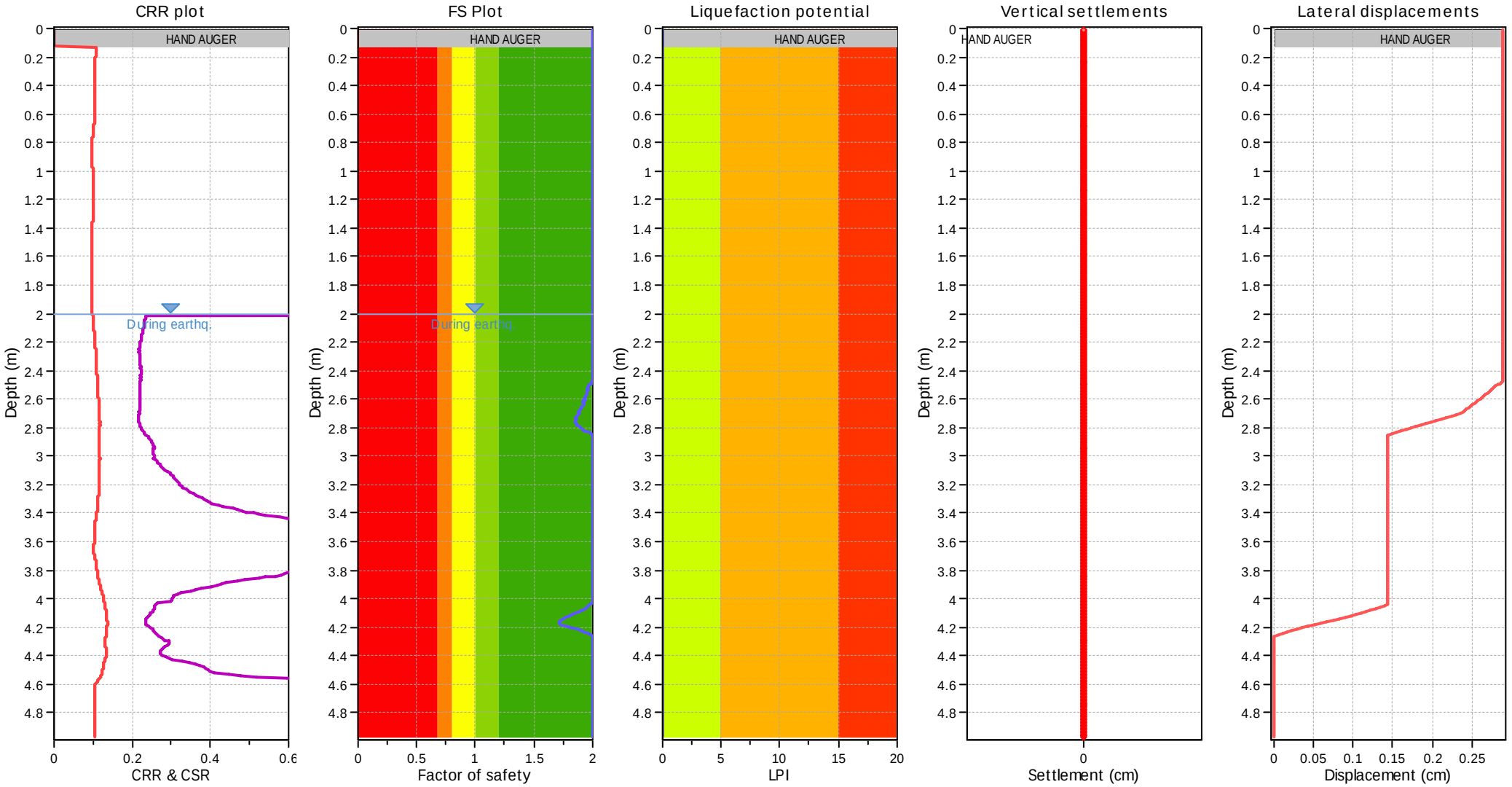
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
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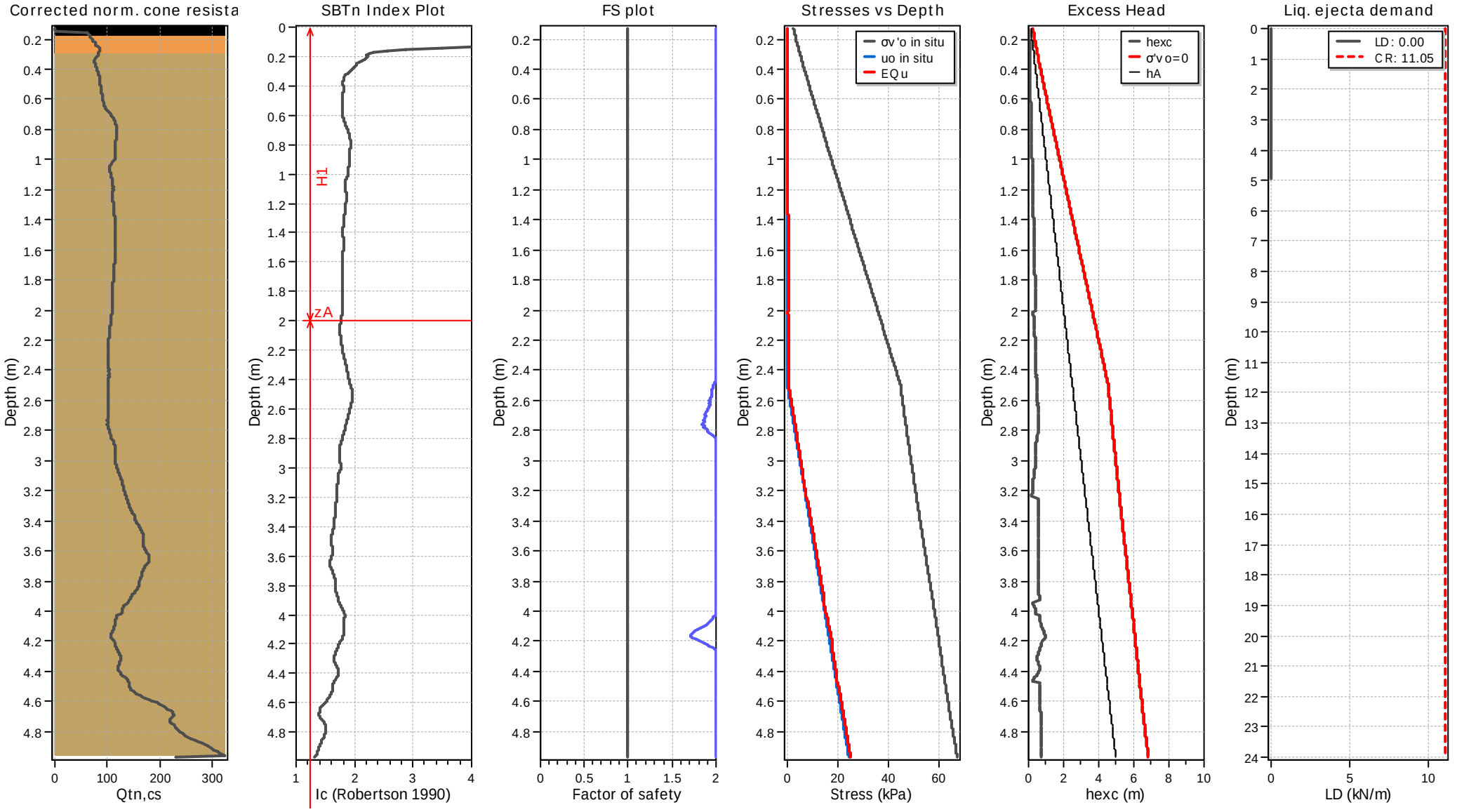
LPI color scheme

- Very high risk
- High risk
- Low risk

Ejecta Severity Estimation



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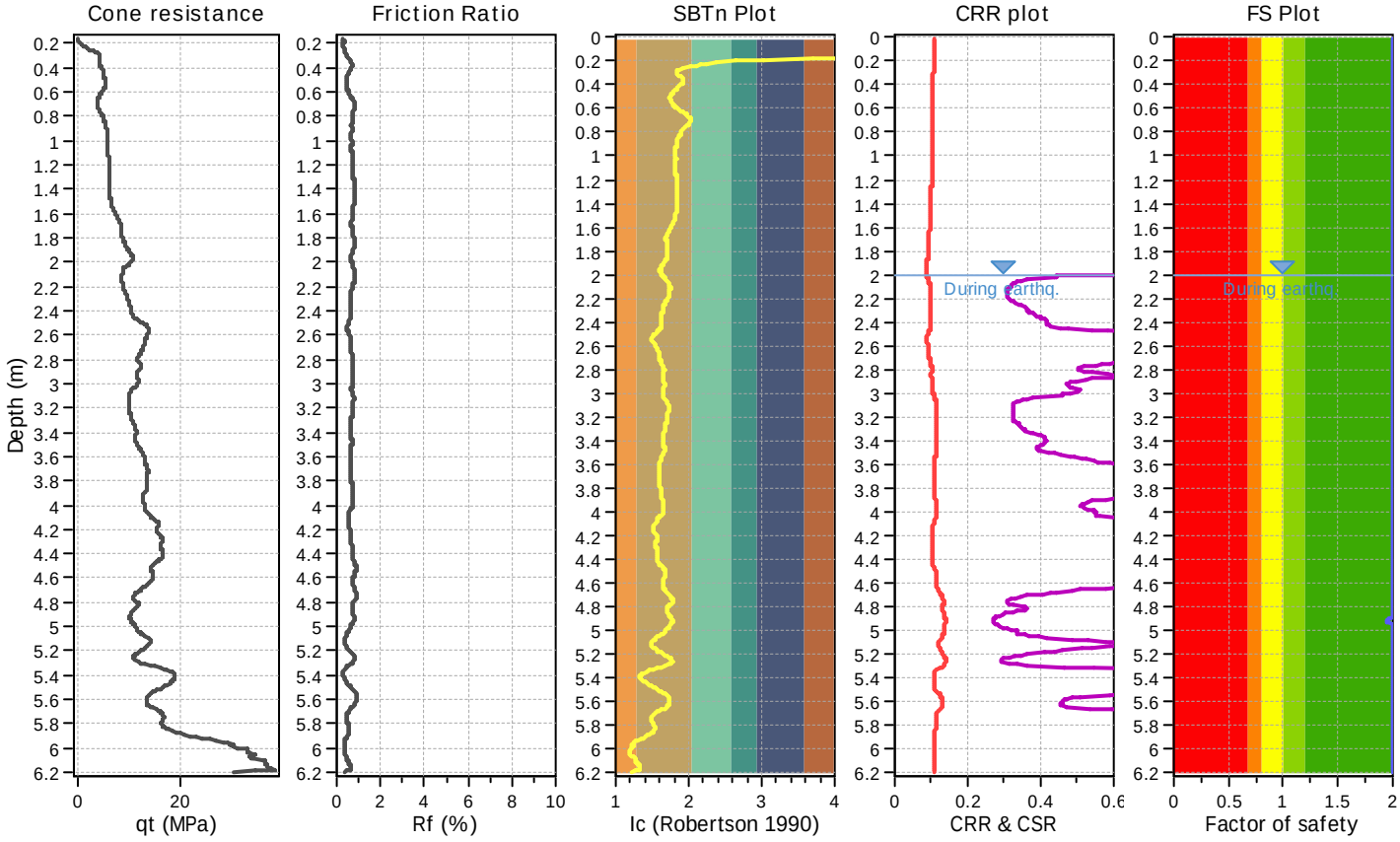
LIQUEFACTION ANALYSIS REPORT

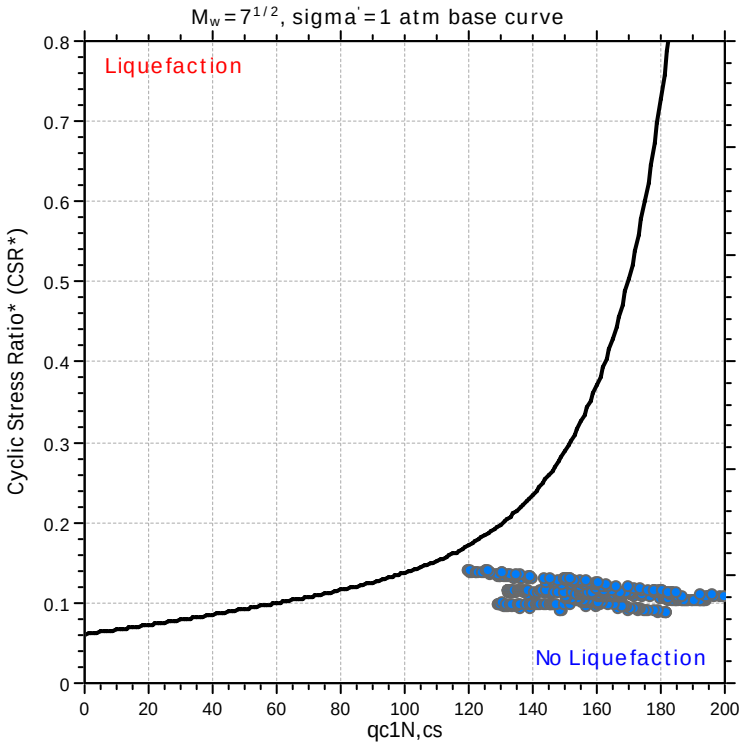
Project title : 18319 Liquefaction Settlement Analysis ULS Location : Tamure Place and Peter Snell Road

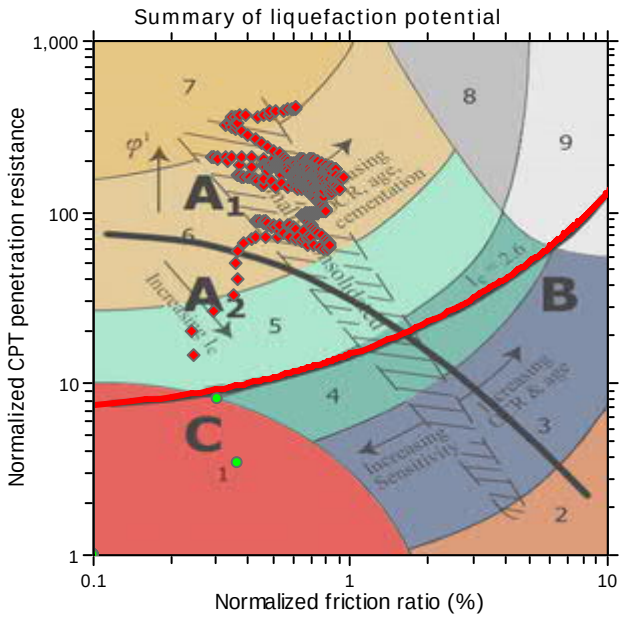
CPT file : CPT14

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.50 m	Use fill:	No	Clay like behavior applied:	Sands only
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:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.19	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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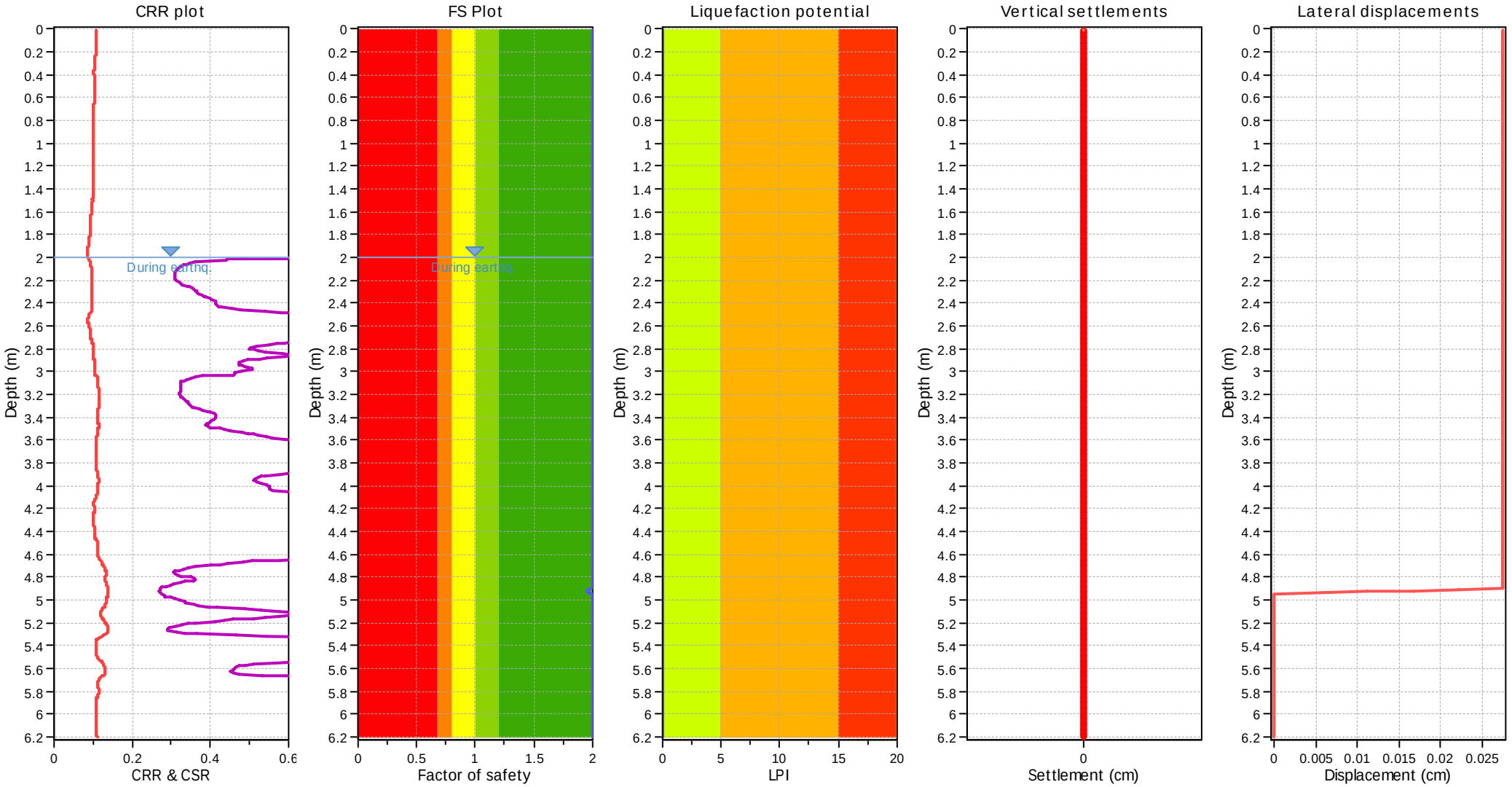
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.19	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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LPI color scheme

- Very high risk
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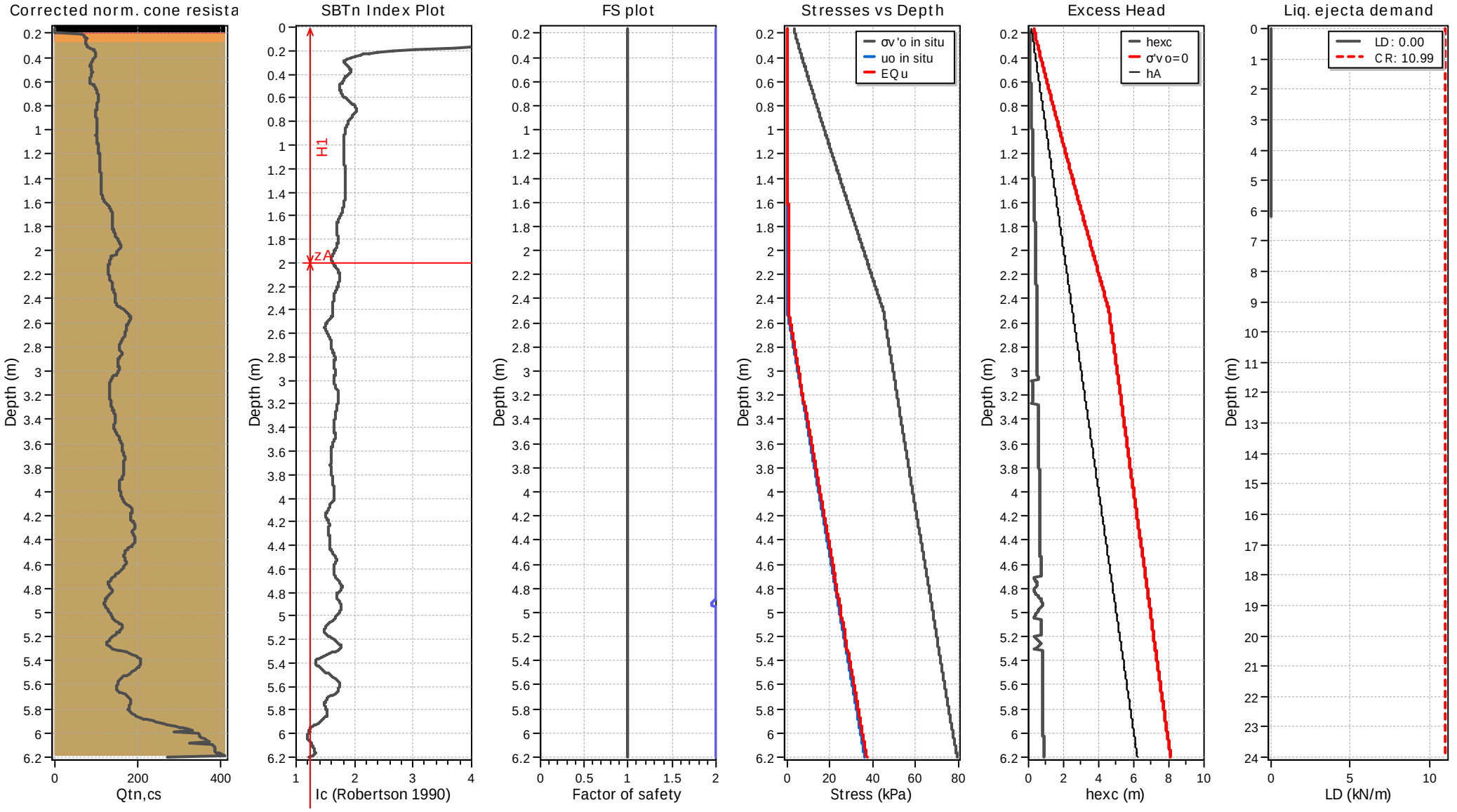
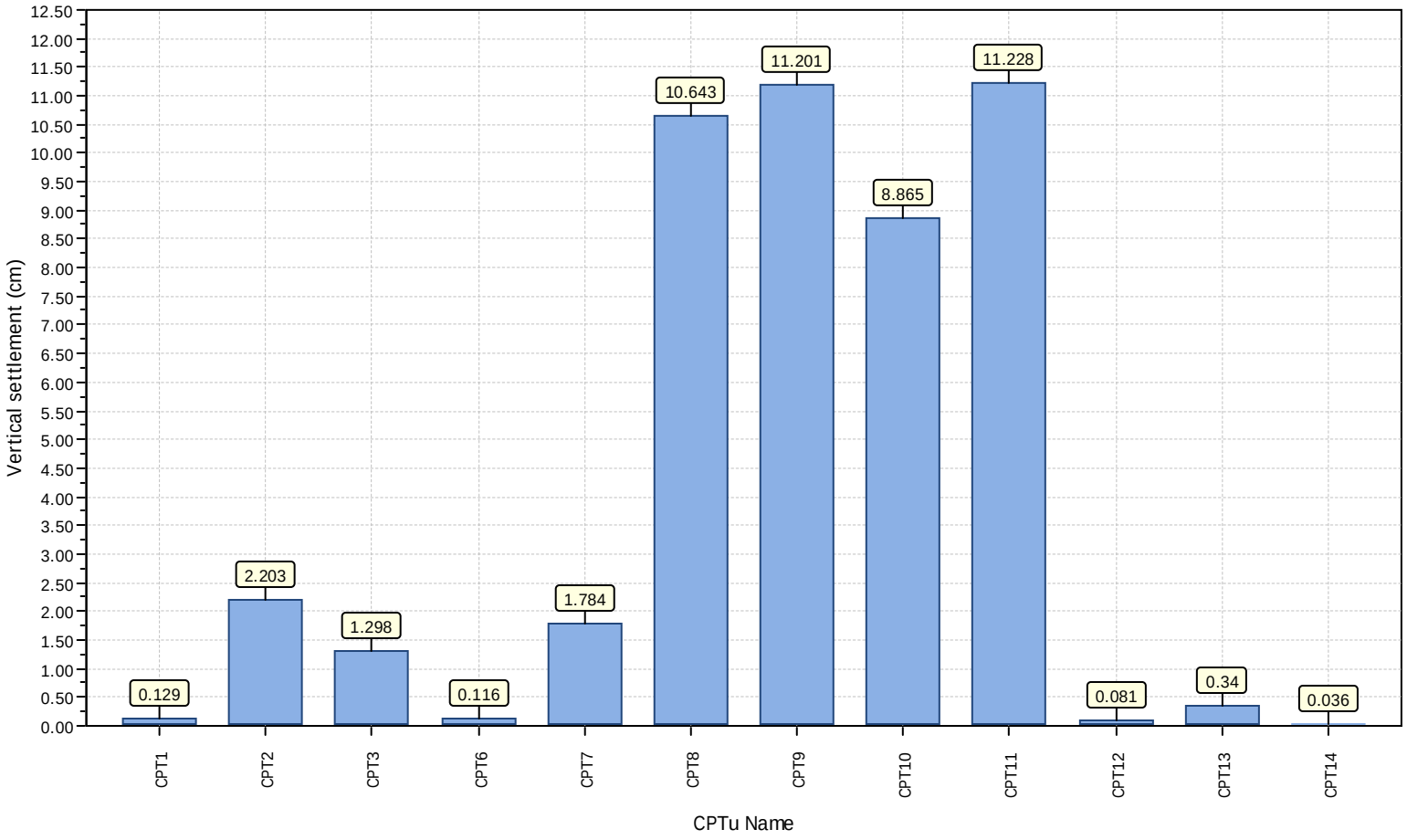
Ejecta Severity Estimation



Project title : 18319 Liquefaction Settlement Analysis ULS Lower Bound, no aging factor

Location : Tamure Place and Peter Snell Road

Overall vertical settlements report



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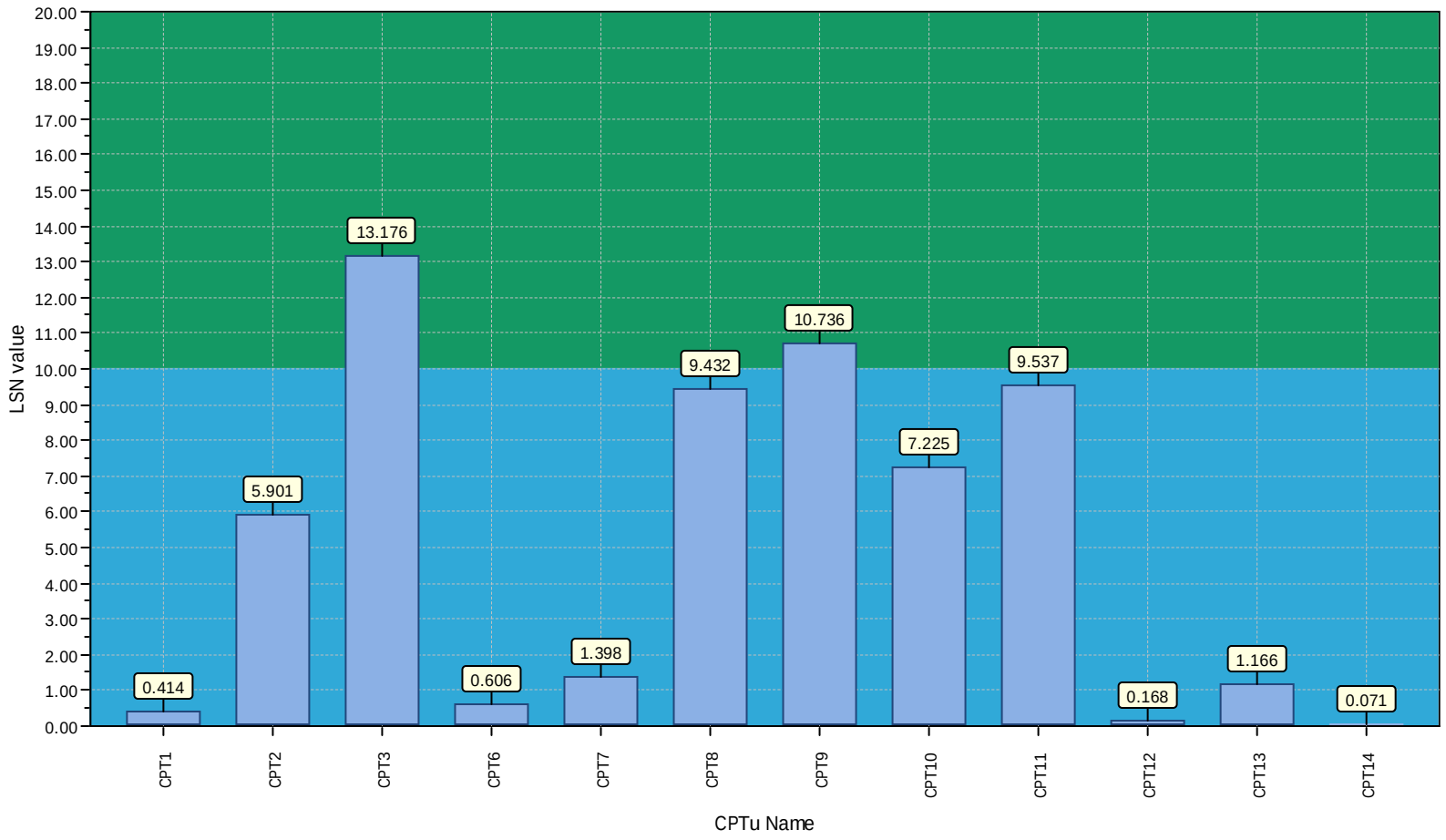
Project title : 18319 Liquefaction Settlement Analysis ULS Lower Bound, no aging factor

Location : Tamure Place and Peter Snell Road

Overall Liquefaction Severity Number report



LSN color scheme

- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 12

83% little liquefaction

17% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

0% severe liquefaction