Project Number: 2-9Z729.01

Te Puna Container Co
297 Te Puna Station Road

2 December 2022

CONFIDENTIAL

Geotechnical Assessment Report

wsp

150 YEARS IN AOTEAROA

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Te Puna Industrial Ltd. ('**Client**') in relation to the preparation of a Geotechnical Assessment Report for the proposed development at 297 Te Puna Station Road, Te Puna ('**Purpose**') and in accordance with the Offer of Service dated 18 May 2022. The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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The findings and recommendations given in this report are based on geotechnical investigations carried out at discrete locations. As the factual evidence has been obtained from discrete test locations, which by their nature only provide information about a small volume of soils, there may be conditions pertaining to the site which have not been disclosed by the investigation and which have not been taken into account in the report.

1 Introduction

WSP New Zealand Limited (WSP) have been engaged by Te Puna Industrial Ltd to carry out a geotechnical assessment and provide recommendations for the proposed industrial development at 297 Te Puna Station Road, Te Puna.

We understand that an application for resource consent was previously submitted in January 2022 based a geotechnical report prepared by others, although several requests for information (RFIs) were received from the Western Bay of Plenty District Council (WBOPDC) and the Bay of Plenty Regional Council (BOPRC).

This Geotechnical Assessment Report (GAR) presents the findings of the ground investigations together with an assessment of the geotechnical hazards at the subject site. The report has been prepared in response to the RFIs prepared by WBOPDC and BOPRC, and is considered to be appropriate for resource consent purposes. The report shall be read in conjunction with the previous reports discussed in Section 4 below.

Further geotechnical inputs will be required for Building Consent and during construction, as discussed in Section 11 below.

2 Site Description

The subject site is situated at 297 Te Puna Station Road, Te Puna, and is legally described as *'Lot 3 DP 22158'*. The site covers a plan area of approximately 12 hectares and is situated on the southern side of Te Puna Station Road. The frontage to Te Puna Station Road is approximately 445m long along the northern boundary.

The majority of the site is relatively flat and low-lying, being situated at an elevation of approximately RL 1.5m to 3m (NZVD2016). These areas of the site are generally vacant and are used as pasture for cattle. Some fencing and drains extend across the site, and a landscape supplies yard is situated in the southern portion of the site.

In the south-western corner of the site, the ground surface ascends by approximately 10m towards a relatively flat building platform. The slope increases at an overall gradient of approximately 1V:3H to the building platform, although some areas are as steep as approximately 1:1H. The building platform is occupied by a single storey dwelling near the southern site boundary. The sloping ground above and below the dwelling may be part of a gully head feature or a relict landslide scarp. This is evidenced by the horseshoe shaped crest at the top of the slope, with the house possibly being constructed on the landslide debris.

The landscape supplies yard and the dwelling are accessed by a gravel driveway which extends south from Te Puna Station Road.

Several open stormwater drains were observed extending through and nearby to the site. This includes open drains running east-west along the northern and southern boundaries of Te Puna Station Road, as well as open drains running north-south and east-west through the site itself. Groundwater appeared to be situated at an elevation of approximately RL 1.5m in the open drains. Several natural and potentially man-made ponds were also observed in the northern portion of the site. We understand that the site is prone to flooding following periods of heavy and prolonged rain.

The wider area surrounding the site generally consists of rural residential properties, although an established industrial property is situated to the north on the opposite side of Te Puna Station Road. The Wairoa River is situated approximately 1.3km to the east of the site, and the East Coast Main Trunk Railway lines runs east-west approximately 50m north of the site on the opposite side of Te Puna Station Road.

Photographs of the site at the time of our site observations are presented in Appendix A. The location of the site is shown on the appended Site Plan in Appendix C. The Geomorphology of the site is also depicted in Appendix C.

3 Proposed Development

3.1 General

Development plans indicate that it is proposed to construct an industrial business park on the site. The final development and leading plans are still subject to confirmation, however we understand that the development will be constructed in three stages and may include at least seven leases.

We understand that the main use of the site will be for the storage and leasing of shipping containers for Te Puna Industrial Ltd. The containers will be empty and stacked up to three-high. We estimate that the containers may be up to approximately 3m high and weigh approximately 4.2 tonnes.

The development will include a container workshop area at a location which is still to be finalised. The workshop area will be approximately 30m by 30m in size and will be constructed with four containers, stacked two-high on the sides with a covered roof in between. We understand that the workshop area will be considered to be a 'building' as per the Building Code. We expect that the building will be an Importance Level (IL) 2 structure with a 50-year design life.

We understand that regular plant operating at the site will consist of container forklifts and trucks. The forklifts may weigh between approximately 23 to 45 tonnes.

The potential location of the proposed leases are shown on the Site Plan in Appendix C.

3.2 Site Access

The site is to be accessed by a new 8m-wide road which extends south from Te Puna Station Road and curves east, before culminating into a cul-de-sac. We understand that the road will be sealed.

We understand from the transportation assessment report[1] that WBOPDC plan to widen Te Puna Station Road. The civil plans indicate that this will be carried out by widening the road by a distance of 3m to the north, in order to form a 9m-wide road. The 9m-wide road will consist of two 3m-wide through lanes, and a 3m-wide right turn bay. The existing stormwater drain on the northern side of Te Puna Station Road will need to be relocated in order to construct the expanded roadway. The civil plans indicate that the road widening will extend over a distance of approximately 150m on the western side of the new access intersection, and approximately 85m on the eastern side, totalling approximately 235m of modification to Te Puna Station Road.

[1] *'Transportation Assessment Report'*, report by Harrison Transportation reference 461TAv2, dated December 2021

3.3 Earthworks and Landscaping

Bulk earthworks will be required in order to form the proposed ground surface, stormwater management, establish bunding, and for ground improvement.

We understand from the civil plans[2] that the ground surface will generally be constructed at an elevation of between approximately RL 0.8m in the south-eastern portion of the site, to approximately RL 2.5m in the north-eastern portion. Cuts and fills of up to approximately 1m will be required to form this ground elevation.

The access roadway will be slightly elevated above the surrounding surface, with the centreline being constructed at an elevation of approximately RL2.0m near the intersection with Te Puna Station Road, to approximately RL 3.4m further south. Cuts and fills of up to approximately 2m will be required to form the access road. New swale drains will be constructed on each side of the new road.

We understand that landscape and acoustic bunding will be required along the northern and southern boundaries of the site as per the Structural Plan. These bunds will be 6m wide, 1.5m to 2.0m high, and will be planted with appropriate vegetation. New swale drains approximately 1m wide will be constructed on the internal sides of the bunds, which will flow downslope to the east. Stormwater from the new swale drains are shown to discharge into two stormwater ponds which are to be constructed in the north-eastern, and south-eastern corners of the site.

We understand from discussions with the Client that the existing dwelling in the south-western portion of the site may be removed, and the elevated topography may be cut down in order to be used as a borrow area.

4 Previous and Concurrent Reporting

4.1 Previous Geotechnical Report

A Geotechnical Baseline Report[3] (GBR) was prepared by Tetra Tech Coffey (NZ) Limited (Coffey) in December 2021. The report included an investigation consisting of 13 hand auger boreholes drilled to depths of up to 2.5m below ground level (mbgl).

Key findings and recommendations presented in the report are summarised below:

- The hand auger boreholes generally encountered approximately 1.4m to 1.8m of undocumented fill, overlying natural organic and alluvial deposits. The natural deposits were soft to stiff.
- Groundwater was encountered at a depth of approximately 0.3mbgl to 0.5mbgl.
- The subsoils were identified as being prone to liquefaction and static settlement.
- Various earthworks and filling recommendations were provided for the lease and roadway areas, which generally consisted of remove and replace earthworks.

[2] *'Te Puna Station Road'*, 6 sheets by WSP reference 2-9Z729.01, Work in Progress
[3] *'297 Te Puna Station Road, Te Puna Geotechnical Baseline Report'*, report by Coffey reference 773-TRGGE290446 Rev 1, dated 3 December 2021

4.2 Assessment for Land-use Consent Reporting

In addition to the geotechnical report discussed in Section 4.1 above, technical reports were also prepared to address transportation, infrastructure, land development, district plan compliance, hapu and iwi engagement, other stakeholder engagement, and planning.

These technical reports were presented and summarised in a land-use consent report[4] prepared by Momentum Planning & Design Limited (Momentum) in January 2022.

4.3 Council RFIs

Following the submission of the land-use consent report discussed above, RFIs were presented by WBOPDC[5] and BOPDC[6].

RFI items which are relevant to the geotechnical scope are summarised below:

- I would recommend including all 3 stages of the development for consideration under this application in order to fully understand the potential adverse effects of the entire proposed development. The works can be undertaken in stages, but the overall effects of the proposed development are best understood and managed as a whole.
- Please provide a detailed cut/fill plan including volumes of the entire site to be included in the consent, along with any details on pre-loading of sites in preparation for development.
- Provide an assessment of the safety of Te Puna Station Road as it relates to existing width and ability to safely accommodate heavy vehicles along with cyclists and pedestrians. Should the above assessment determine that road widening is required, we note that the existing road-side drains could hinder the ability to do so.
- For any accessway upgrades, please provide a geotechnical investigation to confirm ground conditions in this area (including the drain) and confirmation the design will not be at risk of subsidence, slumping, slipping or failure as a result of seismic (including liquefaction), flooding, erosion or surcharge activity.
- Note: the proposed container workshop facility, constructed out of stacked shipping containers and with roof added, is classed as a building pursuant to the Building Act.

5 Desktop Study

5.1 Historic Aerial Imagery

A review of historic aerial photographs sourced from Retrolens[7] was undertaken to understand the history of the site. A selection of the historic aerial images is included in Appendix B

Images from 1943 show the site and wider area being relatively vacant. Te Puna Station Road, Te Puna Road, and the nearby railway line existed at the time, following the same alignment as they do today.

Subsequent images indicate that the site remained relatively unchanged over the following decades.

[4] *'Application for Land-Use Consent Assessment of Environmental Effects'*, report by Momentum reference 20282, dated 21 January 2022
[5] *'RC13360L – Te Puna Industrial Limited, 297 Te Puna Station Road – Request for Further Information'*, dated 10 March 2022
[6] *'Resource Consent Application RM22-0010 – Earthworks and the permanent stormwater discharge to land – Request for further information'*, dated 14 February 2022
[7] https://retrolens.co.nz/

An image from 1986 shows the dwelling occupying the south-western portion of the site, as well as a small building in the area which is currently used as the landscape supplies area. The current accessway doesn't appear in the image, with the dwelling instead being accessed via a driveway further west. The site itself appears to be used for horticulture purposes in the image.

An image from 2002 shows the driveway being situated in its current alignment, and the landscaping yard shed constructed in the southern portion of the site. The land use appears to have changed from horticulture to pastoral between 1993 and 2002 aerial photographs.

The 2006 aerial shows that earthworks were undertaken in the areas directly to the east and west of the main driveway. Grass was grown over this area between 2006 and 2012. It appears that further earthworks were undertaken between 2016 to 2019.

5.2 Geotechnical Database

The New Zealand Geotechnical Database[8] indicates that a geotechnical investigation was carried out in August 2018 on the property directly to the east of the subject site. The investigation consisted of hand auger boreholes, test pits, and Cone Penetrometer Tests (CPTs).

The investigations generally encountered up to approximately 2.5m of fill overlying low strength alluvial deposits. It can be inferred from the CPTs that the low strength deposits may extend to depths of up to approximately 20mbgl.

6 Scope of Investigations

6.1 Geotechnical Investigation Summary

Site specific geotechnical investigations have been carried out by WSP between September to October 2022 and comprised the following:

- Thirteen (13) CPTs pushed to depths of up to 20mbgl.
- Five (5) hand auger boreholes drilled to depths of up to 5mbgl.
- Three (3) plate load tests.
- Geophysical testing comprising 4 sections of Multi-channel Analysis of Surface Waves (MASW)

The approximate locations of the investigations are shown on the Site Plan in Appendix C. Tests were located using a handheld GPS, with ±3m positional accuracy.

6.2 Cone Penetrometer Testing

Cone Penetrometer Testing was carried out on 12 and 13 September 2022 by Perry Geotechnical Limited. The testing was carried out using a track mounted 200kN capacity hydraulic rig fitted with a 10cm^2 probe to measure cone resistance, sleeve friction, and pore water pressure. Testing was conducted following the test standard ASTM D5778-12 *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils* (ASTM, 2012).

The CPTs were generally carried out to assess the geotechnical conditions across the site. CPT10 was carried out to assess the geotechnical conditions beneath the proposed container workshop facility, and CPTs 12 and 13 were carried out to understand the geotechnical conditions near the proposed Te Puna Station Road intersection.

Test results are presented in Appendix D.

[8] https://www.nzgd.org.nz/

6.3 Hand Auger Boreholes

Five hand auger boreholes were drilled and logged by WSP engineering geologists on 6 October 2022. The soil descriptions in the logs are generally in accordance with the New Zealand Geotechnical Society Guidelines for Field Description of Soil and Rock 2005 (NZGS, 2005).

Undrained shear strength measurements were obtained with a hand-held shear vane and extension rods. Measurements were taken in accordance with the techniques described in the New Zealand Geotechnical Society Guideline 2001 (NZGS, 2001).

Hand augers HA01 to HA03 were drilled to depths of 4.6mbgl in order to assess the soil conditions in the elevated south-western portion of the site, where it may be proposed to use material as a borrow area. Hand augers HA04 and HA05 were drilled to depths of 4mbgl to assess the soil conditions beneath the proposed container workshop facility.

The hand auger logs are presented in Appendix D.

6.4 Plate Load Testing

Plate load testing (PLT) was carried out by a Senior Laboratory Technician from the WSP Hamilton Laboratory, using an Anix AX-01a electronic plate bearing tester and developing a reaction load from the 20 tonne mechanical excavator. The PLT testing was performed in accordance with DIN 18134 :2012-04 Soil - Testing procedures and testing equipment - Plate load test. (2012). German Institute for Standardisation.

The PLT results are presented in Appendix D. The test results will be used to carry out a specific pavement design at the Detailed Design stage of the project.

6.5 Geophysical Testing

A geophysical survey across the site was carried out by WSP on 6 and 7 October 2022. The survey consisted of four rows of MASW lines.

The geophysical survey was carried out to assess the geotechnical conditions across the site. The results of the testing will be presented in due course.

7 Soil Profile

7.1 Regional Geology and Faulting

The GNS Online Geology Webmaps[9] show the majority of site to be underlain by Holocene Fan Deposits, consisting of poorly sorted, poorly consolidated gravel, sand and clay. The elevated area and slope along the south western boundary of the site is comprised of Early-Mid Pleistocene River Deposits, including “poorly to moderately sorted gravel with minor sand and silt underlying terraces; includes minor fan deposits and loess”.

The closest major active fault to the site is the Kerepehi Fault, located approximately 60km West of the site. According to de Lange and Lowe (1990)[10] “based on the return period of 2500 years, there are 2%, 18%, and 33% probabilities of a major earthquake affecting the Kerepehi Fault at Kopouatai bog in the next 50, 500, and 1000 years, respectively”.

[9] https://data.gns.cri.nz/geology/
[10] de Lange, P.J. & Lowe, D.J. (1990). History of vertical displacement of Kerepehi Fault at Kopouatai bog, Hauraki Lowlands, New Zealand, since c. 10 700 years ago. New Zealand Journal of Geology and Geophysics, 33(2), 277-283.

7.2 Investigation Findings

The surficial material over a large portion of the site consists of approximately 1m to 2m of uncertified fill, overlying a thick sequence of soft, saturated clay and organic material. Below approximately 15m to 20m depth, a harder sandy unit was inferred. This is likely to represent either the Chimp Ignimbrite or Matua Subgroup. This unit was encountered at a shallower depth (approximately 6m) towards the slope in CPT01. The hand augers carried out near the residential dwelling appear to show a cut/fill platform, and at depth, possible landslide deposits. The geological units are described in greater detail below.

7.2.1 Uncertified filling

Historic aerial photographs of the site show filling of the northern half of the site. Coffey carried out 13 Hand Augers across this area during their investigation. WSP carried out a further two hand augers near the site entrance, in the vicinity of the proposed workshop facility.

To the west of the main accessway, hand augers (HA02 - 05) carried out by Coffey showed the upper 0.25m to 1.3m comprise uncertified filling material, including slightly plastic, soft to hard clayey silts. To the west of the main driveway (HA06 - 13), fill was encountered between 0m to 1.8mbgl.

The material generally comprised slightly to moderately plastic silts, silty clays and organic silts (buried topsoil). Undrained shear strengths recorded by shear vanes returned variable values, ranging from 34 kPa to greater than 172 kPa. On average, undrained shear strengths in the uncertified filling were greater than 70 kPa.

Below the proposed workshop facility (HA 04 - 05, WSP) up to approximately 2.5m of filling was encountered. Shear vane readings in these hand augers ranged from 53 kPa peak undrained shear strength, to 193 kPa. During drilling, an unidentifiable object was encountered during the first several attempts of drilling Hand Auger 04 (WSP). The object was encountered at shallow depths, approximately 1.0m, in 2 different locations within 1.0m spacing. The hole was moved to the north towards CPT10 to avoid hitting the object. The approximate location of the object is marked on the Site Investigation Plan (Appendix C).

7.2.2 Soft, saturated clay

It can be inferred from the CPT cone tip resistance results that the filling is underlain by soft (generally less than 1MPa) possibly sensitive or organic clays to depths of approximately 15mbgl to 20mbgl. The material appeared to have consistently low cone tip resistance across the site.

7.2.3 Matua Subgroup

A unit with higher cone tip resistance (Qt) was encountered below the soft clay. The unit was encountered at a relatively similar depth across the CPTs, with the exception of CPT01, where it was encountered at approximately 6.0mbgl. Variable IC values were recorded in the unit, which is indicative of interbedding of silts, clays, and sands, characteristic of the Matua Subgroup. Cone tip resistance generally ranged between 1MPa to 10MPa with values as high as 30MPa.

Matua Subgroup was also encountered at depth in Hand Augers 01 - 03, located near the existing residential dwelling. The Matua Subgroup soils in these locations comprised clean sand, silty sand, and clayey silts. Undrained shear strengths ranged from 69kPa to 193 kPa. Scala Penetrometer blows per 100 mm varied between 2 to 4 blows in the upper 2m, increasing to 5 to 10 blows at depth.

7.2.4 Landslide Debris

Possible land slide debris material was encountered between 2.5mbgl to 3.5mbgl in Hand Auger 03. The material comprised silty clay, and had mottled colours. Strengths of the material ranged from 90 - 185 kPa undrained shear strength.

7.3 Groundwater

Groundwater was difficult to assess from the WSP hand auger boreholes due to the saturated nature of the site. Standing groundwater was dipped as between 0.2 mbgl to 2.0 mbgl in the Coffey report.

Standing groundwater was dipped in the CPTs. The measured levels are presented below in Table 1. It should be noted that CPT measurements of the water table are generally less accurate than Hand Auger measurements.

Table 1. Groundwater levels dipped in CPTs

CPT No.	01	02	04	05	06	07	08	09	10	11	12	13
CPT RL (m)	3.2	2.9	2.8	1.8	2.6	2.2	1.4	1.6	2.8	2.0	2.0	1.9
Groundwater (m) bgl	2.0	0.0	0.6	0.1	1.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1
Groundwater RL (m)	>1.2	2.9	2.2	1.7	1.6	2.1	1.3	1.5	2.8	2.0	2.0	2.0

8 Evaluation of Geotechnical Hazards

8.1 Soil Contamination

A Detailed Site Investigation (DSI) report[11] by Pennan & Co Limited in June 2022. This geotechnical report shall be read in conjunction with the DSI report.

8.2 Static Settlement

A preliminary static settlement analysis has been undertaken using the CPT interpretation software CPT-IT v.2.3.1.9, which estimates soil modulus values from tip and sleeve measurements and assumes a Boussinesq load distribution beneath the foundation. A rectangular foundation was considered for the assessment.

The analysis has been undertaken to simulate the loads for the following scenarios:

- Lease sites (We have assumed typical loads for future buildings in these areas).
- Fill areas (We have estimated loads from earthworks and proposed bunding on site).
- Container workshop facility. We have assumed the loading from filling to achieve flood level requirements plus loads from containers stacked 2 high.

The loads assumed in the analysis are summarised in the table below. We have not analysed CPT's where there is no net loading proposed.

[11] *'Detailed Site Investigation 297 Te Puna Station Road, Te Puna, Tauranga'*, report by Pennan & Co Limited dated 3 June 2022

Table 2: Settlement Analysis Results

CPT Location	Scenario	Load	Assumed footprint area in analysis	Estimated Settlement
CPT01 (south western portion of site)	Possible lease area	15kPa	50 x 20m	90mm
CPT04 (central portion of site, proposed roadway	Close to access road with up to 2m filling proposed	36kPa	10 x 10m	1170mm
CPT05 (southern portion of site)	1m of filling from earthworks plan	18kPa	10 x10m	850mm
CPT10 (northern portion adjacent to Te Puna Station Road)	Possible Workshop facility location - Cut although close to workshop facility assumes 1m fill above flood level (18kPa) + Empty Containers (5kPa)+ Building load (5kPa)	28kPa	30 x 30m	1450mm
CPT11 (northern portion adjacent to Te Puna Station Road, bunding proposed)	1m filling for proposed bunding	18kPa	100 x 2m	580mm
CPT12 (northern portion adjacent to Te Puna Station Road, bunding proposed)	1m filling for proposed bunding	18kPa	100 x 2m	500mm
CPT13 (northern portion adjacent to Te Puna Station Road, bunding proposed)	1m filling for proposed bunding	18kPa	100 x 2m	390mm

As can be seen above, the predicted total settlements are high ranging from 90mm at the southern portion of the site to up to 1450mm at the northern portion of the site. The larger settlements are due to the underlying soft alluvial soils and high loads due to the placement of fill materials for proposed earthworks, to achieve flood levels and proposed roading.

As the settlements are excessive it will be necessary to undertake ground improvement works at the site. At this stage we would recommend preloading the ground to induce static settlements and consolidate the ground and manage any future load induced settlements to tolerable levels.

Settlement analysis results are contained in Appendix E.

Further detailed settlement analysis will be required including odometer testing at a later stage to refine the parameters and preliminary analysis results.

8.3 Seismic Design and Liquefaction

8.3.1 Subsoil Class

In accordance with the seismic design code, NZS1170.5, Clause 3.1.3, the results of the investigations suggest that the subsoil flexibility can be characterised as class 'D' deep or soft soil sites.

8.3.2 Peak Ground Acceleration

As stated above, we understand that the workshop area will be considered a 'building' as per the Building Code. We expect that the building will be an Importance Level (IL) 2 structure with a 50-year design life.

Design ground accelerations were adopted from the NZGS/MBIE publication "Earthquake geotechnical engineering practice – Module 1", dated November 2021 for two design limit states:

- Ultimate Limit State (ULS) considers the 1 in 500-year event, and under these conditions, a building should not collapse but may suffer significant damage to the point that its not economic to repair.
- Serviceability Limit State (SLS) considers the 1 in 25-year event. A building should still remain functional under these conditions.

We have assumed a 50-year structural design life for the structure. The PGAs are shown in Table 3.

Table 3: PGA's for an Importance Level 2 structure (from Appendix A, Module 1).

Case	Structural Design Life	Importance Level	PGA	Magnitude (M_w)
Ultimate Limit State (ULS, 1 in 500 year event)	50 years	2	0.07 (a_{max})	5.9
Serviceability Limit State (SLS, 1 in 25 year event)	50 years	2	0.3 (a_{max})	5.9

8.4 Liquefaction Assessment

8.4.1 Introduction

Liquefaction is a term used to describe the strength loss experienced by a saturated cohesionless soil when subjected to cyclic loading (i.e. earthquakes). Soil that is susceptible to liquefaction tends to contract when subject to cyclic stresses, which induces excess pore water pressure that leads to a reduction in shear strength.

The four primary factors that contribute to liquefaction potential are loose uniformly graded soils, high groundwater table, high earthquake-induced ground acceleration and sustained shaking. Liquefiable soils at shallow depth may cause bearing capacity failures of building foundations.

8.4.2 Methodology

We have assessed the liquefaction risk and consequent ground movements in general accordance with the NZGS/MBIE publication "Earthquake geotechnical engineering practice - Module 3: identification, assessment, and mitigation of liquefaction hazards", dated November 2021.

The CPT data was analysed using CLiq (v 3.3.1.14), developed by Geologismiki. This software was used to calculate the soil resistance against liquefaction using the Boulanger and Idriss (2014) method, including clay-like behaviour[12] (cyclic softening). The analysis assumes that volumetric strain (volume change) can occur within the clay like soils along with sandy soils. The fines content and soil behaviour index (Ic) have been estimated based on the Robertson and Wride (1998) method. The soils have been assumed to be non-liquefiable when the Ic value is greater than 2.6.

The Zhang et al (2004) method was used to calculate liquefaction-induced reconsolidation settlements. It should be noted that this is for free field settlements only and additional vertical settlement may occur if there is bearing capacity failure or a loss of material beneath foundations.

For the purposes of the liquefaction analyses presented in this report, a groundwater depth of 0.3m was assumed, with a water level at the ground surface assumed for the analyses.

8.4.3 Liquefaction Analysis Results

The analyses indicate there is a low probability of liquefaction being triggered under SLS conditions, however the analysis indicates some volumetric strain during the SLS event. The calculated settlement for the SLS case ranges from 3mm to 15mm.

Under ULS conditions, the analyses indicate there is high risk of liquefaction or cyclic softening within the sand, sensitive fine grained or clay deposits below the groundwater table. Predicted settlements range from 16mm to 231mm across the site.

Overall lateral displacements range from 0mm at CPT positions on the southern side of the site to a maximum of 1.1m closer to the drain which follows the northern boundary.

With reference to the CPT tests in vicinity of the proposed container workshop facility (i.e., CPT's 10 & 13), the ULS settlement was 65mm and 55mm respectively while lateral displacements were calculated to be 600mm and 900mm respectively.

For our assessment we have limited the analysis of the ULS case to the upper 10m to assess the index criteria for foundation technical category (e.g., TC1, TC2 or TC3). The foundation categories were developed by the Ministry of Business, Innovation and Employment (MBIE)for the Canterbury Region and may also be adopted for assessing liquefaction prone land in New Zealand. The guidance provides design guidance for mitigating the effects of liquefaction through ground improvement and specific foundation design.

Based on the results above, according to table 16.1 of the canterbury guidance document[13] referenced below, the site in vicinity of the proposed contained workshop facility (building) would be classified as TC3 which requires specific design to mitigate effects of liquefaction induced settlement and lateral spreading.

Liquefaction assessment results are presented in Appendix F.

8.5 Slope Stability

The site is generally flat to gently sloping, although the topography ascends relatively steeply towards the southern boundary. The contour plans indicate that the slope ascends by up to approximately 10m towards the existing dwelling, with gradients as steep as approximately 1V:1H in some areas.

[12] MBIE (2021). Earthquake geotechnical engineering practice. Module 1. Overview of the guidelines.
[13] Part D: Guidelines for the geotechnical investigation and assessment of subdivisions in the Canterbury region (MBIE 2012).

The steepest portion of this slope appears to be on the eastern side of the slope. We note that the proposed Leases 4 and 5 may be situated immediately below this slope.

In order to assess the stability of the slope, a section through the steepest portion of the slope was assessed using the limit equilibrium programme 'Slide'[14]. The slope was modelled under static and seismic load conditions.

For the static load case, the models considered the prevailing or 'normal' groundwater levels and inferred elevated or 'storm' groundwater levels within the slope. The prevailing groundwater condition was modelled by assuming a groundwater level which generally coincided with the groundwater level observed in the investigations.

The seismic load condition was simulated by applying a PGA of 0.3g, as was calculated in Section 8.3 above. The fine-grained soils were modelled assuming undrained or total stress conditions for the seismic case.

The effective stress (drained) soil parameters used for the static case analyses are summarised in Table 3 below. The parameters were derived from WSP's experience with similar materials on nearby sites. Undrained parameters were used for the fine grained materials in the seismic case due to the rapid loading expected in such a case.

Table 3: Slope Model Parameters

Material	Cohesion (kPa)	Friction Angle (°)	Density (kN/m³)	Undrained Shear Strength (kPa)
Existing Fill	2	28	16	50
Soft Alluvial Soils	2	22	15	20
Volcanic Ash Soils	5	32	16	80
Matua Subgroup Soils	5	32	16	-

The results of the analyses are summarised in Table 4 below. Target factors of safety (FOS) were taken from the New Zealand Building Code.

Table 4: Slope Stability Results

Section	Scenario	Target FOS	Assessed FOS
Current	Prevailing Groundwater	1.5	1.26
	Elevated Groundwater	1.2	1.12
	Seismic Case	1.0	1.16
Altered to 1V : 1.75H	Prevailing Groundwater	1.5	1.62
	Elevated Groundwater	1.2	1.46
	Seismic Case	1.0	1.15

The results indicate that the slope does not achieve the required FOS in its current state. Remedial measures will therefore be required in order to develop leasing beneath the slope.

We understand that it may be proposed to alter portions of the slope in order to use the material as a borrow area. If this is proposed, then our analyses indicate that a 1V:1.75H slope would achieve the target FOS as shown in Table 4.

[14] Rocscience Inc. computer program, '*Slide*', version 6.038.

Other methods to address the potential for slope instability may include:

- Installing a catchfence or bund beneath the slope, in order to protect the proposed leasing areas.
- Placing fill at the base of the slope, which could buttress the slope and increase the FOS.
- Installing retaining walls or other retention methods.

Outputs of the slope stability analyses are included in Appendix G.

8.6 Flooding

According to BOPRC the site is prone to flooding (WSP, email correspondence, 18/10/22). BOPRC advised that below SH2, flooding will be dominated by harbour inundation and sea level rise, rather than flooding of the Wairoa River.

BOPRC have provided 1% and 2% AEP flood levels at the site for different climate change scenarios. The BOPRC flood levels provided are presented in Table 5 below.

Table 5. Flood levels provided by BOPRC.

Modelled storm-tide sea levels	2% AEP + 0.13 m SLR	2% AEP + 1.25 m SL	1% AEP + 0.13 m SLR	1% AEP + 1.25 m SLR
Wairoa River below SH2 Bridge	2.39	3.66	2.72	3.87

Regarding geotechnical aspects of the proposed development that will be affected by flooding, WSP consider the following items:

- Any fill placed shall be designed to be resistant to the effects of erosion or buoyancy effects of flooding. WSP recommend that fill placed during preloading should be left in place to form the final fill material, to avoid having to remove and replace preload. Erosion resistant fill design options are presented in the earthworks section below.
- At this stage of the development, the final location of the Container Workshop facility is still to be finalised. The proposed Container Workshop Facility shall have a minimum finished ground level of no less than 300mm (freeboard) above the 2% AEP storm event so as to meet the requirements for an industrial building of the WBOPDC Development Code 2009.

9 Construction Methodology

9.1 General Fill Placement and Preloading

As discussed in Section 7 above, the site is underlain by soft, compressible, and potential organic soils extending to depths of up to approximately 20m. The earthworks plans indicate that its proposed to placed up to approximately 2.6m of fill to raise the proposed ground surface to the proposed level.

Settlement analyses indicate that the additional loading imposed by the filling will induce significant settlement in the soft soils. It will therefore be required to preload the fill areas prior to constructing the pavement, services, or structures on site. The intention of the preloading is to reduce the residual settlement between the end of construction and the end of the design life of the project to within tolerable levels.

The filling across the general site shall therefore be placed as below:

- Remove all topsoil (estimated to be 200mm to 300mm thick).
- A 300mm thick layer of sand fill shall be placed on the surface. The sand shall be placed in 150mm thick lifts and compacted using a track roller. This will form a stable platform and drainage layer for the structural fill.
- Prefabricated drains such as wick drains may also be required to speed up the consolidation process.
- Settlement plates shall be installed on top of the sand layer across the fill areas. For preliminary purposes, we estimate that approximately 10 settlement plates may be required.
- Vibrating Wire piezometers may also be required dependent on the final detailed design.
- Structural filling shall be placed across the site to raise the ground surface to the required level.
- The surface shall then be 'over-filled' in order to form a preload embankment. The preload embankment shall consist of the same material in order to enable savings in the earth moving be requiring trimming of the excess portion at the end of the preload period.

Due to the variable depth of the proposed filling to be placed across the site, variable heights of preloading will be required. The preload may need to be left in place for approximately 12 months, although this time frame could be reduced by installing prefabricated drains to speed up the consolidation process.

The preload estimates provided above have been calculated based on the results of the geotechnical investigations, and typical soil parameters. Additional investigations and testing will be carried out during the Detailed Design stage of the project, which may improve these results.

Settlement monitoring shall be carried out by a surveyor, with the results to be regularly assessed by a geotechnical engineer. The results would be used to assess when the preload embankment could be removed.

The settlement shall be measured twice per week during the first month after constructing the preload embankment, and potentially reduce in frequency afterwards.

9.2 Landscape and Acoustic Bund Construction

The proposed 2m high landscape and acoustic bunds will also induce significant settlement. We recommend that the bunds be constructed as follows:

- The proposed bund areas shall be cleared and stripped of vegetation prior to construction.
- A 500mm-thick layer shall be placed. This layer shall be considered to be a sacrificial layer that will settle into the soft soils, and as such, only nominal compaction will be required.
- The bunds shall then be constructed with properly compacted fill, to a height of 2.5m. The sides of the bunds shall be constructed with batter slopes of 1V:4H or flatter.
- The bunds shall be allowed to settle into the soft ground. The height of the bund shall be measured on a monthly basis so that it can be assessed whether the bund requires additional fill added or trimmed.

9.3 Pavement Design

Due to the soft soils which underlie the site, we consider that ground improvement will be required to develop the pavement for the access road and leasing areas. This ground improvement will need to be carried out in addition to the preloading discussed in Section 9.2 above.

The pavement ground improvement shall consist of the following:

- Undercut the ground to a depth of 1.2m.
- Place one layer of geotextile (e.g. Bidim A39 or equivalent) on the exposed subgrade.
- Backfill the excavation with compacted GAP65 or a similar granular fill. The fill shall be placed in 200mm thick lifts and compacted to at least 95% relative compaction.
- Layers of geogrid reinforcement (e.g. Geogrid Duragrid 40/40 or an approved equivalent) to be placed within the backfill layer.

With the completion of these items, a geotechnical ultimate bearing capacity of 300kPa would be available for the temporarily loads.

We note that the 1.2m deep undercut may be challenging due to the shallow groundwater conditions. The undercut could be reduced by installing additional layers of geogrid reinforcement within the backfill.

9.4 Te Puna Station Road Extension

We understand that it's proposed to extend Te Puna Station Road to the north by approximately 3m in order to include a turning bay into the roadway. This area is currently occupied by an open swale drain which is positioned approximately 1.5m below the existing roadway surface.

CPTs 12 and 13 indicate that this area of the site is underlain by soft soils extending to depths of approximately 15m. Placing fill across this area will result in significant static settlement, as well as differential settlement between the new and existing portions of the road embankment.

The roadway extension shall be constructed as follows:

- The topsoil and recent deposits in the open drain shall be trimmed beneath the proposed extension area. Dewatering and rerouting of the drain will be required.
- A layer of geotextile (e.g. Bidim A39 or equivalent) shall be placed on the exposed subgrade.
- The new embankment shall be constructed with compacted rock fill, such as AP65 or an approved equivalent. The rock fill will also need to be keyed into the slope.
- At least three layers of geogrid reinforcement (e.g. Geogrid Duragrid 40/40 or an approved equivalent) shall be placed within the backfill.
- A preload shall be placed on top of the constructed embankment, to induce settlement.
- The preload will need to be designed so that it doesn't hinder the flow of traffic on the existing portion of the road, and to be adequately stable. For preliminary purposes, we consider that a 1m-high preload may be suitable, which will need to be placed in stages. The preload would need to be 'topped up' as the embankment settles. Other heavy items such as concrete blocks could also be used if there are space constraints.
- It must be accepted that the construction of the roadway extension and the preload above it, will cause some cracking and deterioration of the existing pavement. The pavement will need to be maintained through this preloading period.
- Settlement monitoring will need to be carried out though this period. Once the monitoring indicates that the settlement has reduced to tolerable levels, the preload can be removed and the embankment level raised to the proposed level with engineered fill.
- Basecourse and other road subgrade materials shall be placed, before placing the pavement.

Even with the measures above carried out, it must be accepted that there will likely be long term differential settlement between the existing and new roadway embankments, which will result in cracking to the pavement. The pavement will therefore need to be maintained by the asset owner.

The stability of the embankment will need to be specifically designed at the Detailed Design stage of the project. We anticipate that this may involve a cantilever retaining wall (e.g. timber pole wall), a gravity wall (e.g. MSE wall or crib wall), or an engineered batter slope.

9.5 Foundation Design for the Container Workshop Facility

As discussed in Section 8 above, the construction of the container workshop facility will need to consider the following items:

- The ground surface will need to be raised in order to construct the container workshop facility above the flood level. Depending on the final development plans and facility location, up to approximately 2m of fill may need to be placed to raise the ground level.
- Settlement analyses indicate that the proposed loads may induce up to approximately 1,450mm of static settlement.
- Liquefaction analyses indicate that the proposed building platform may suffer from liquefaction and lateral spreading under ULS conditions. Up to approximately 65mm of liquefaction settlement may occur, and up to approximately 900mm of lateral spreading may occur. This would be equivalent to a TC3 site as per the Canterbury Region technical category.

Based on these conditions, we consider that the facility will need to be constructed on improved ground. This is described below:

- A preload shall be placed on the container workshop facility building platform. Depending on the final location, we estimate that the preload may need to be approximately 2m high and may need to be left in place for up to approximately 12 months. Settlement markers shall be installed on the building platform so that the settlement can be assessed.
- Once the preload-induced settlement has been induced, the preload can be removed.
- One layer of geotextile (e.g. Bidim A39 or equivalent) shall be placed on the exposed subgrade.
- Filling shall be placed to raise the building platform to the proposed level. The filling shall consist of compacted, lightweight engineered fill (e.g. lightweight pumice) placed and compacted to at least 95% relative compaction.
- At least three layers of geogrid reinforcement (e.g. Geogrid Duragrid 40/40 or an approved equivalent) shall be placed within the filling.

10 Earthworks Considerations

10.1 Underground Services and Existing Structures

There are likely to be areas of underground services that traverse the proposed leasing areas. Trench backfills are often of poor quality and can result in differential movements when the ground is loaded. These underground services should be located and completed removed prior to any ground improvement earthworks being carried out.

Any existing foundations and infrastructure will also need to be completely removed from the leasing areas, and the ground appropriately undercut and reconciled under observation from WSP to ensure that no loose spots remain.

10.2 Compaction Testing

In accordance with good engineering practice, in-situ testing and compaction of subgrades should be undertaken prior to the placement of fill.

Quality assurance compaction testing should also be carried out in the consecutively placed fill layers to ensure that the fill meets an engineer approved standard. This may consist of Nuclear Densometer (NDM), Dynamic Cone Penetrometer and/or Clegg tests depending on the fill materials used. Any areas which demonstrate unacceptable compaction should be undercut to the satisfaction of WSP and replaced with approved fill.

10.3 Subgrade Protection

Our experience with the types of subsoils at the site suggests that the subgrade material may be sensitive to disturbance. We therefore recommend that the ground improvement excavation only be carried out prior to immediate backfill, to avoid water ponding during rain events and thereby limiting the need for additional undercutting and filling.

11 Further Work

11.1 Developed and Detail Design

Further geotechnical input will be required through various iterations as the design is further developed and detailed. A Producer Statement PS1-Design for the geotechnical aspects of the site would be provided as part of the documentation for Building Consent.

Further geotechnical input may be required to suit the requirements of various tenant operations as the business park expands.

11.2 Construction Observations and Testing

Depending on the finalised design methodology, it is important that we are given the opportunity of observing the site clearing, bulk excavation operations, reinforced-raft fill placement/testing, preloading and settlement monitoring, and road embankment construction to ensure that the ground conditions encountered are as anticipated from the findings of this report. If they are not, we would be available to provide design and/or construction modifications.

Upon satisfactory completion of these aspects of the works, we would be in a position to issue the appropriate Producer Statement PS4 – Construction Review to Council.

Appendix A - Site Photographs

Site entrance

Photo 1 Looking west from the entrance across the drain

Photo 2 Looking East on opposite side of Te Puna Station Rd from site

Photo 3 Site entrance, looking east

Photo 4 Looking east from site entrance

Front of site

Photo 5 Looking towards the current landscape yard

Photo 6 looking south towards landscape yard

Photo 7 Accessway at front of site

Photo 8 Farm track looking east adajcent open stormwater drain

Rear of site	
 *Photo 9 Looking toward landscape supply yard*	 *Photo 10 open stormwater drain looking east*
 *Photo 11 stormwater drains either side of track looking east*	 *Photo 12 farm track access*
 *Photo 13*	 *Photo 14*

Residential dwelling

Photo 15 pond by driveway

Photo 16 accessway to residential dwelling

Photo 17 retaining wall on driveway

Photo 18 residential welling looking north

Photo 19 slope behind residential dwelling

Photo 20 accessway and driveway

Appendix B - Historic aerial photographs

1943 Aerial - Retrolens

1953 Aerial - Retrolens

1963 Aerial - Retrolens

1986 - Aerial Retrolens

1993 Aerial - Retrolens

2002 Aerial - WBOPDC Mapi

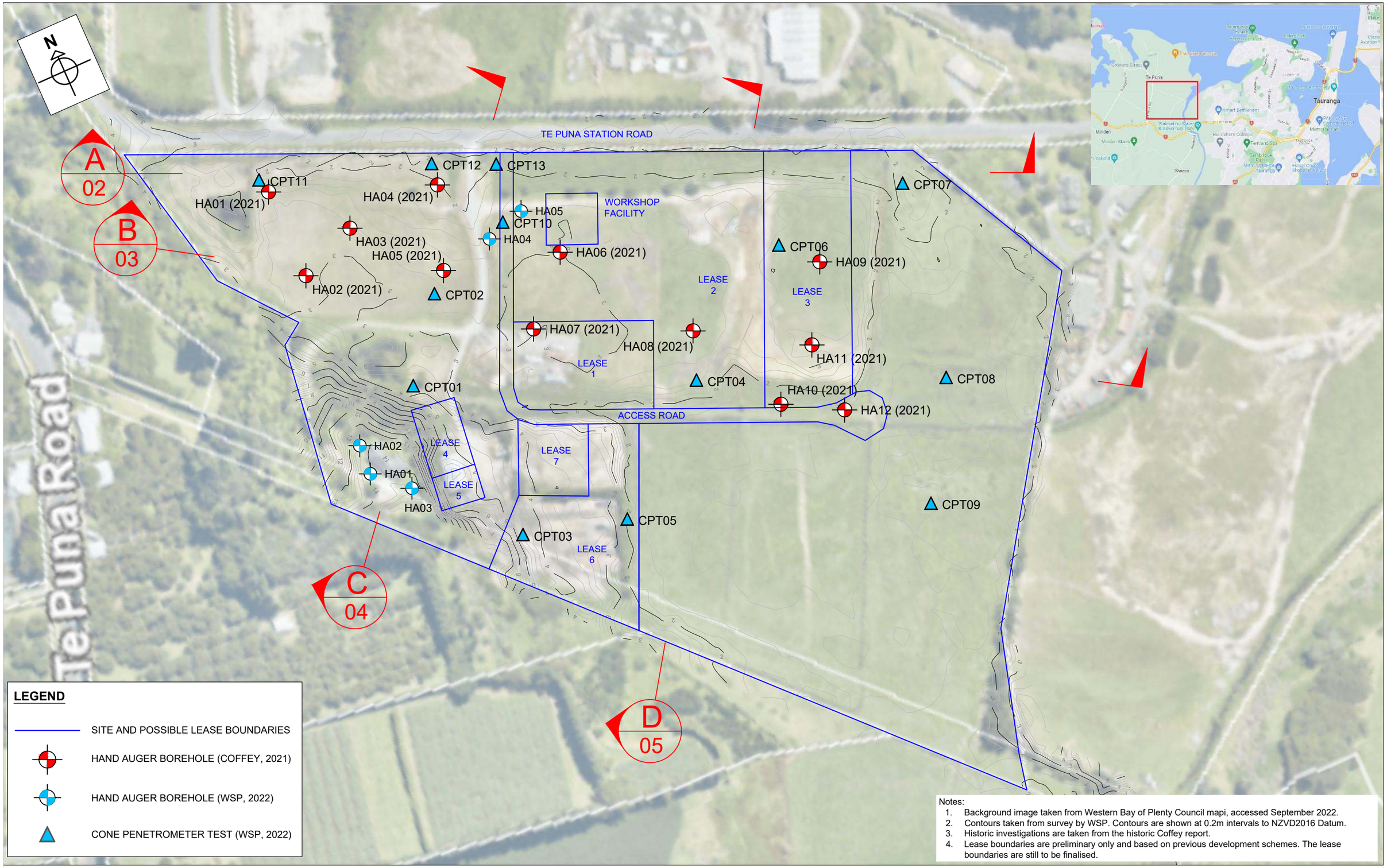
2006 Aerial - WBOPDC Mapi

2010/2012 Aerial - BOPLASS

2014/2015 Aerial - BOPLASS

2019 Aerial - BOPLASS

Appendix C - Site plans



LEGEND

- SITE AND POSSIBLE LEASE BOUNDARIES
- HAND AUGER BOREHOLE (COFFEY, 2021)
- HAND AUGER BOREHOLE (WSP, 2022)
- CONE PENETROMETER TEST (WSP, 2022)

Notes:

1. Background image taken from Western Bay of Plenty Council mapi, accessed September 2022.
2. Contours taken from survey by WSP. Contours are shown at 0.2m intervals to NZVD2016 Datum.
3. Historic investigations are taken from the historic Coffey report.
4. Lease boundaries are preliminary only and based on previous development schemes. The lease boundaries are still to be finalised.

REVISION	AMENDMENT	APPROVED	DATE
0	Site Plan	AM	11/11/2022

0 40 80 120

Scale (metres)

Auckland Office
+64 9 355 9500

PO Box 5848
Auckland 1141
New Zealand

GEOTECHNICAL

REPORT

SCALES: 1:2000

ORIGINAL SIZE: A3

DRAWN	DESIGNED	APPROVED
SWH	SWH	AM

DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
AM	AM	11/11/2022

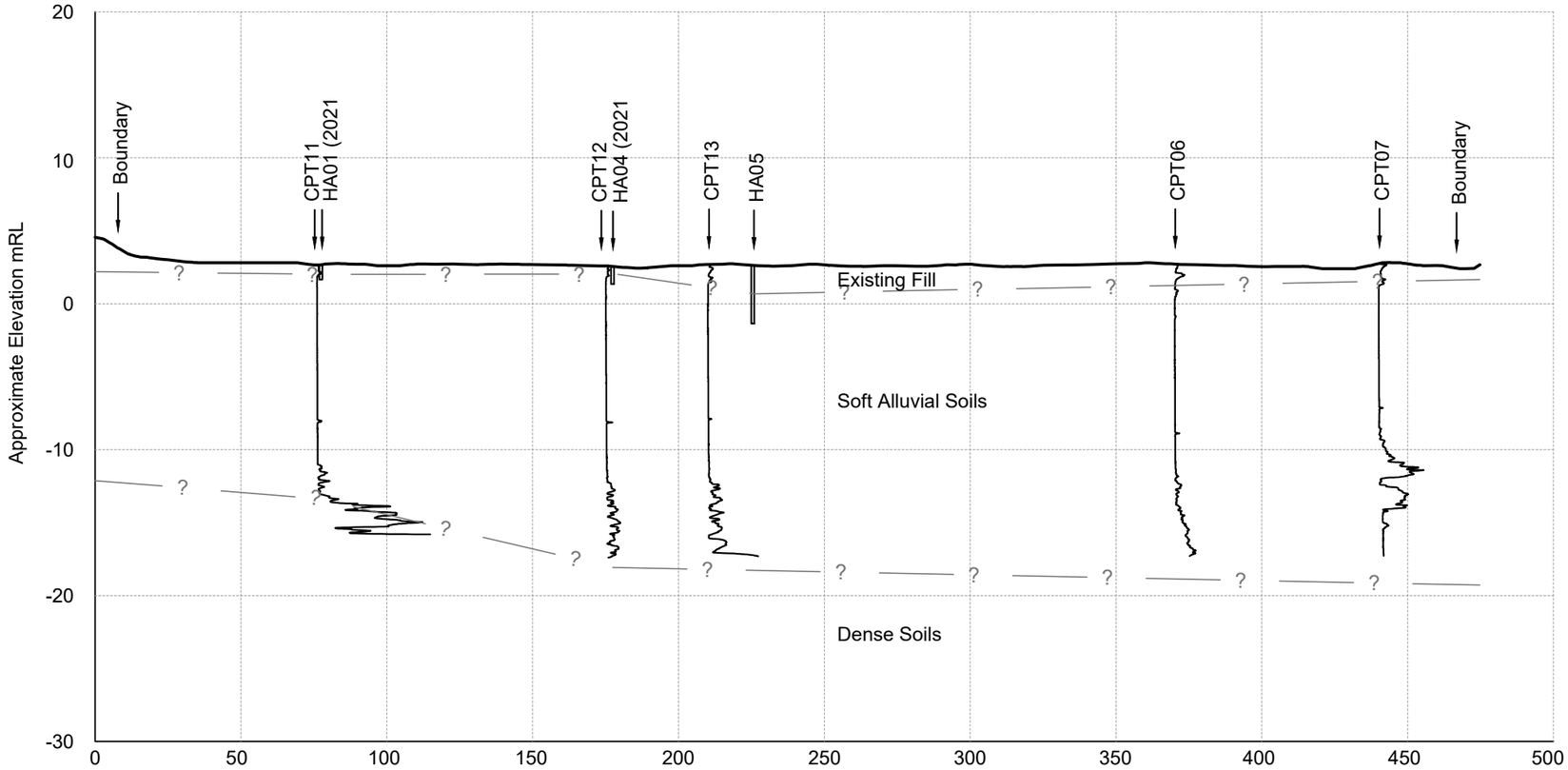
PROJECT
CONTAINER CO
297 TE PUNA STATION ROAD, TE PUNA
PROPOSED CONTAINER DEPOT

TITLE
SITE PLAN

WSP PROJECT NO. (SUB-PROJECT): 2-9Z729.01

SHEET NO.: 01

REVISION: 0



CROSS SECTION A-A

LEGEND

- INFERRED GEOLOGICAL BOUNDARY
- HAND AUGER BOREHOLE
- CPT QC TRACE

Note:
1. Geological boundaries, where shown, have been drawn between known data points to assist in the geological interpretation and should not be considered to represent actual boundaries which may vary from these lines.
2. The cross section has horizontal scale of 1:2000 and a vertical scale of 1:400. The drawing has a vertical exaggeration of 5 for clarity.

REVISION	AMENDMENT	APPROVED	DATE
0	Cross Section A-A	AM	11/11/2022

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Horizontal Scale (metres)

0 8 16 24
Vertical Scale (metres)

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New Zealand

GEOTECHNICAL

SCALES: 1:2000 (Horiz.), 1:400 (Vert.)
ORIGINAL SIZE: A3

DRAWN	DESIGNED	APPROVED
SWH	SWH	AM

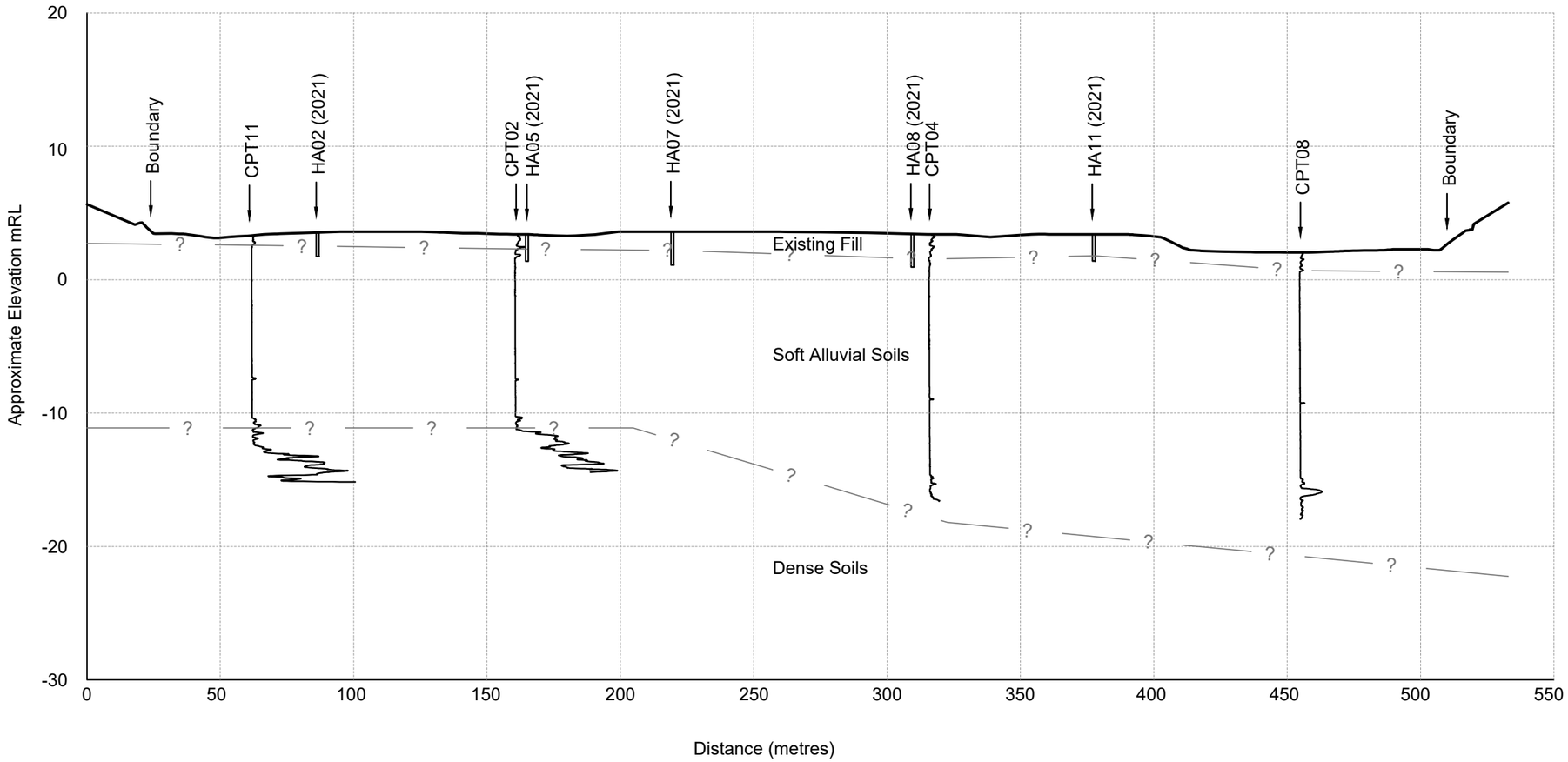
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
AM	AM	11/11/2022

REPORT

PROJECT
CONTAINER CO
297 TE PUNA STATION ROAD, TE PUNA
PROPOSED CONTAINER DEPOT

TITLE
CROSS SECTION A-A

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
2-9Z729.01	02	0



CROSS SECTION B-B

LEGEND

- INFERRED GEOLOGICAL BOUNDARY
- HAND AUGER BOREHOLE
- CPT QC TRACE

Note:
1. Geological boundaries, where shown, have been drawn between known data points to assist in the geological interpretation and should not be considered to represent actual boundaries which may vary from these lines.
2. The cross section has horizontal scale of 1:2000 and a vertical scale of 1:400. The drawing has a vertical exaggeration of 5 for clarity.

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Horizontal Scale (metres)

0 8 16 24
Vertical Scale (metres)

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GEOTECHNICAL

SCALES: 1:2000 (Horiz.), 1:400 (Vert.)
ORIGINAL SIZE: A3

DRAWN	DESIGNED	APPROVED
SWH	SWH	AM

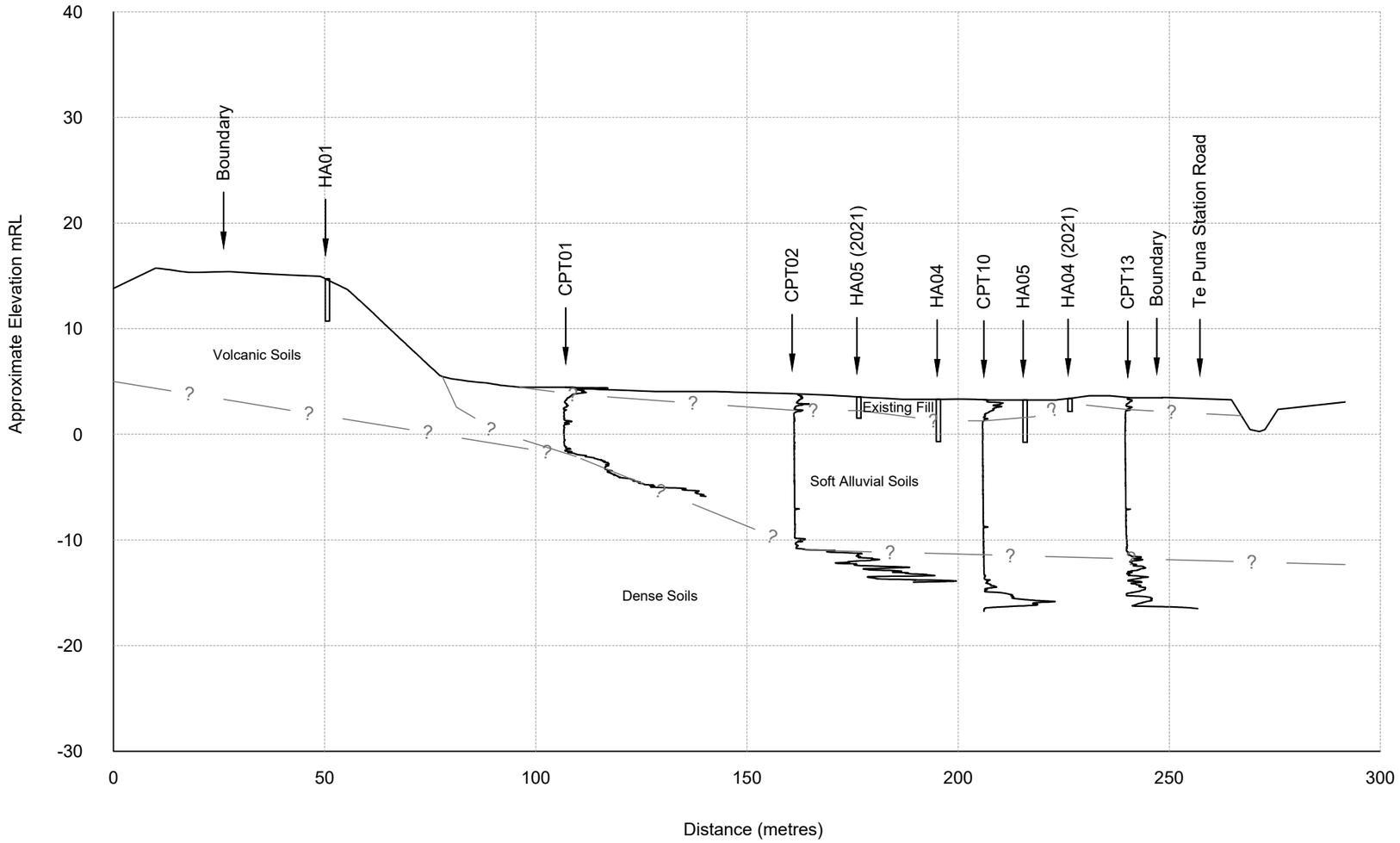
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
AM	AM	11/11/2022

REPORT

PROJECT
CONTAINER CO
297 TE PUNA STATION ROAD, TE PUNA
PROPOSED CONTAINER DEPOT

TITLE
CROSS SECTION B-B

WSP PROJECT NO. (SUB-PROJECT): 2-9Z729.01
SHEET NO.: 03
REVISION: 0



CROSS SECTION C-C

LEGEND

- INFERRED GEOLOGICAL BOUNDARY
- HAND AUGER BOREHOLE
- CPT QC TRACE

Note:
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2. The cross section has horizontal scale of 1:1250 and a vertical scale of 1:500. The drawing has a vertical exaggeration of 2.5 for clarity.

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Horizontal Scale (metres)

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Vertical Scale (metres)

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GEOTECHNICAL

SCALES: 1:1250 (Horiz.), 1:500 (Vert.)
ORIGINAL SIZE: A3

DRAWN	DESIGNED	APPROVED
SWH	SWH	AM

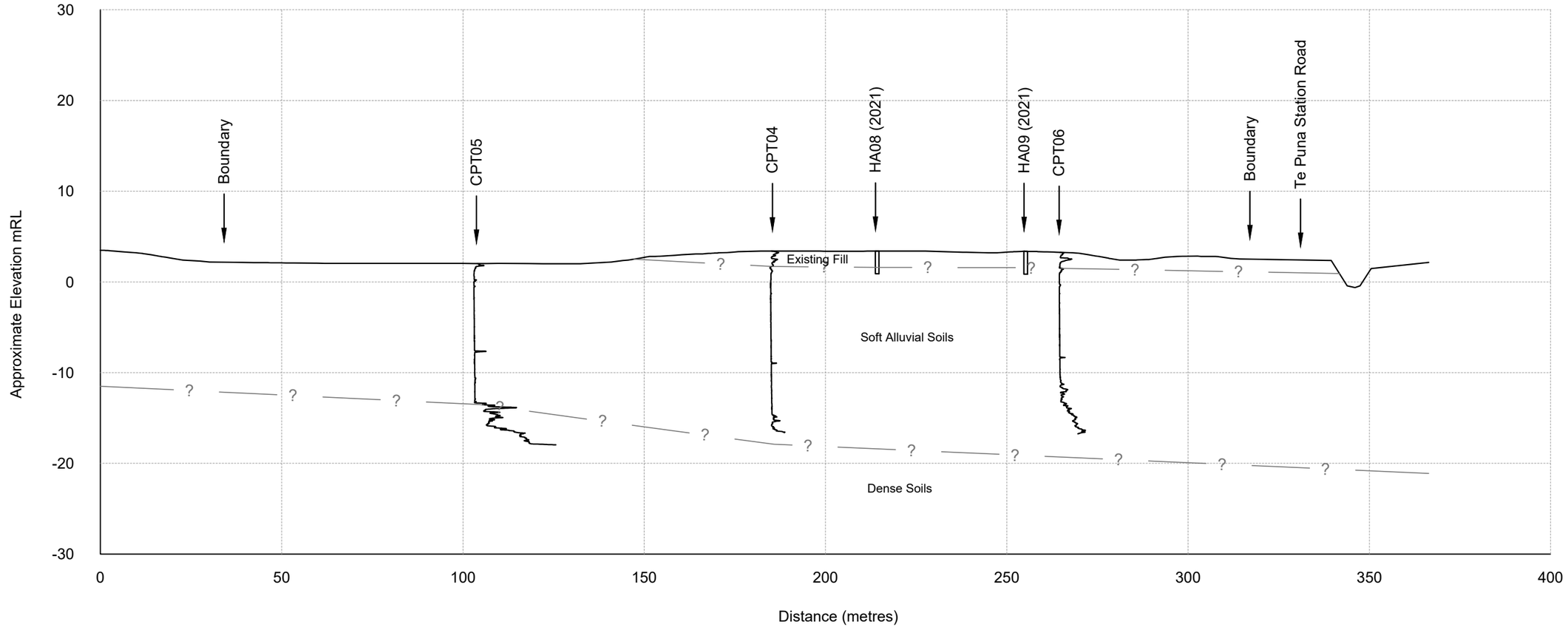
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
AM	AM	11/11/2022

REPORT

PROJECT
CONTAINER CO
297 TE PUNA STATION ROAD, TE PUNA
PROPOSED CONTAINER DEPOT

TITLE
CROSS SECTION C-C

WSP PROJECT NO. (SUB-PROJECT): 2-9Z729.01
SHEET NO.: 04
REVISION: 0



CROSS SECTION D-D

LEGEND

- INFERRED GEOLOGICAL BOUNDARY
- HAND AUGER BOREHOLE
- CPT QC TRACE

Note:

1. Geological boundaries, where shown, have been drawn between known data points to assist in the geological interpretation and should not be considered to represent actual boundaries which may vary from these lines.
2. The cross section has horizontal scale of 1:1250 and a vertical scale of 1:500. The drawing has a vertical exaggeration of 2.5 for clarity.

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Horizontal Scale (metres)
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Vertical Scale (metres)

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+64 9 355 9500
PO Box 5848
Auckland 1141
New Zealand

GEOTECHNICAL REPORT

SCALES: 1:1250 (Horiz.), 1:500 (Vert.)
ORIGINAL SIZE: A3

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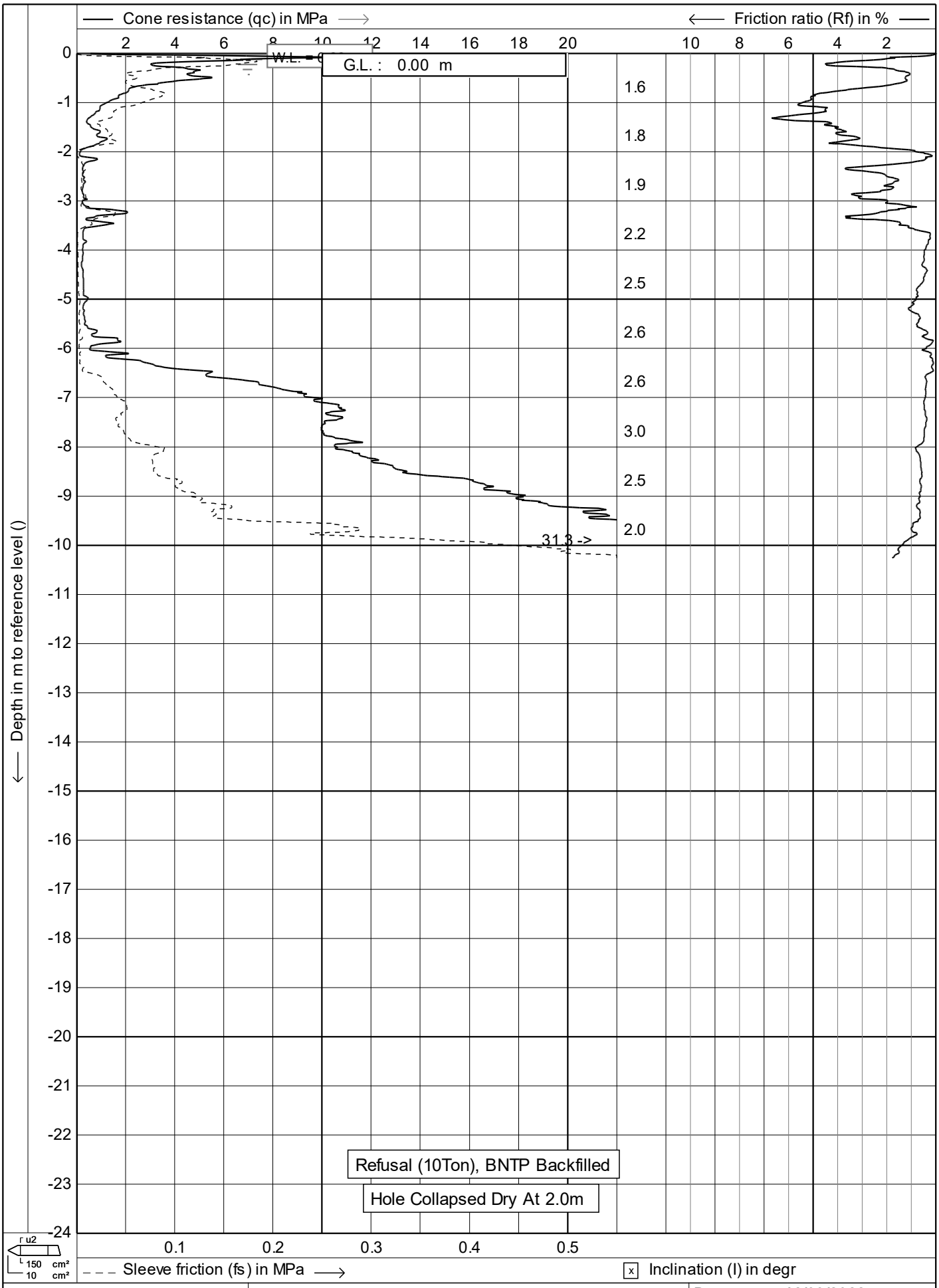
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
AM	AM	11/11/2022

PROJECT
CONTAINER CO
297 TE PUNA STATION ROAD, TE PUNA
PROPOSED CONTAINER DEPOT

TITLE
CROSS SECTION D-D

WSP PROJECT NO. (SUB-PROJECT): 2-9Z729.01
SHEET NO.: 05
REVISION: 0

Appendix D - Site investigation data



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **01**

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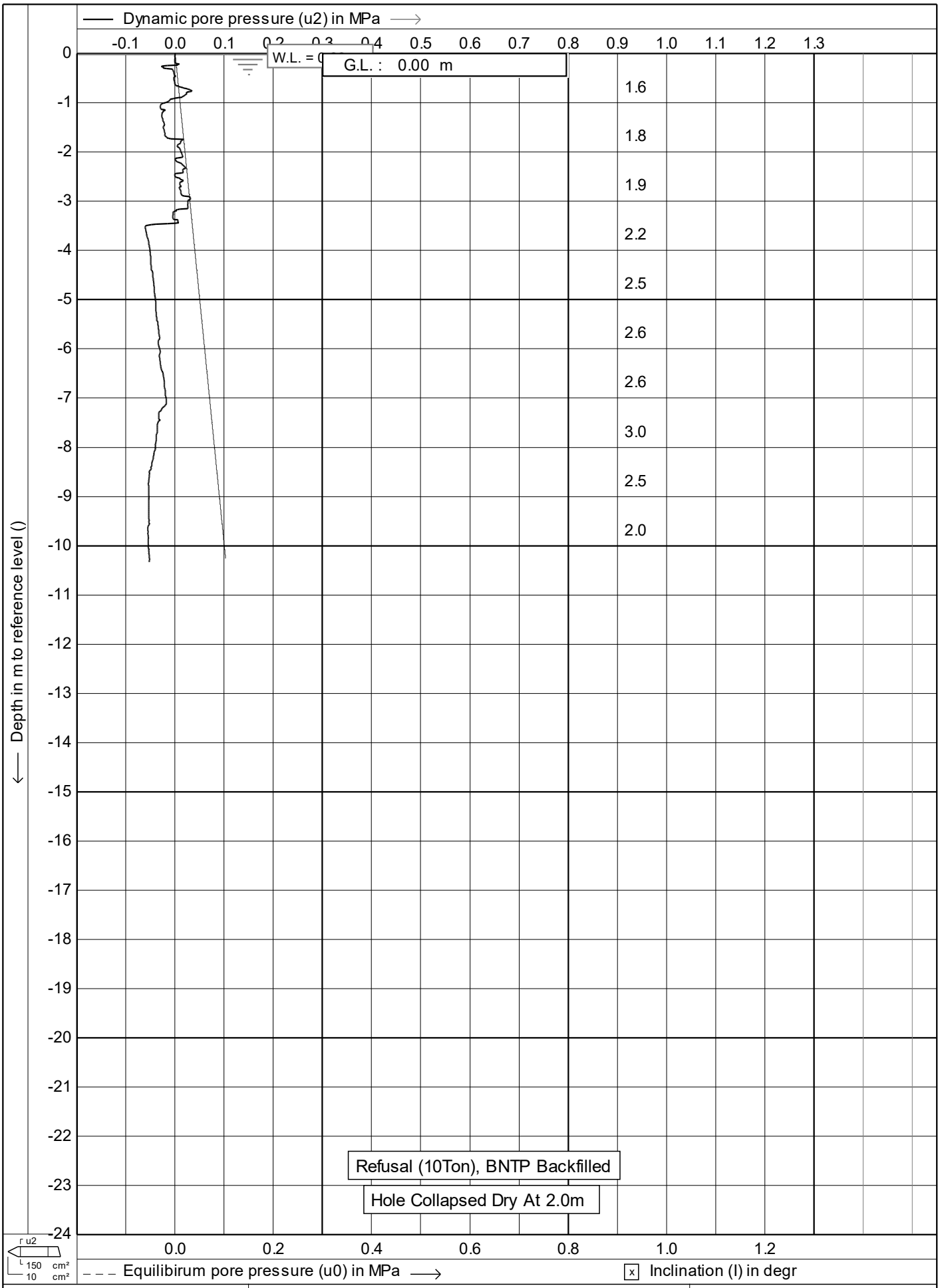

PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

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Project no. : **01WSP031**

CPT no. : **01**

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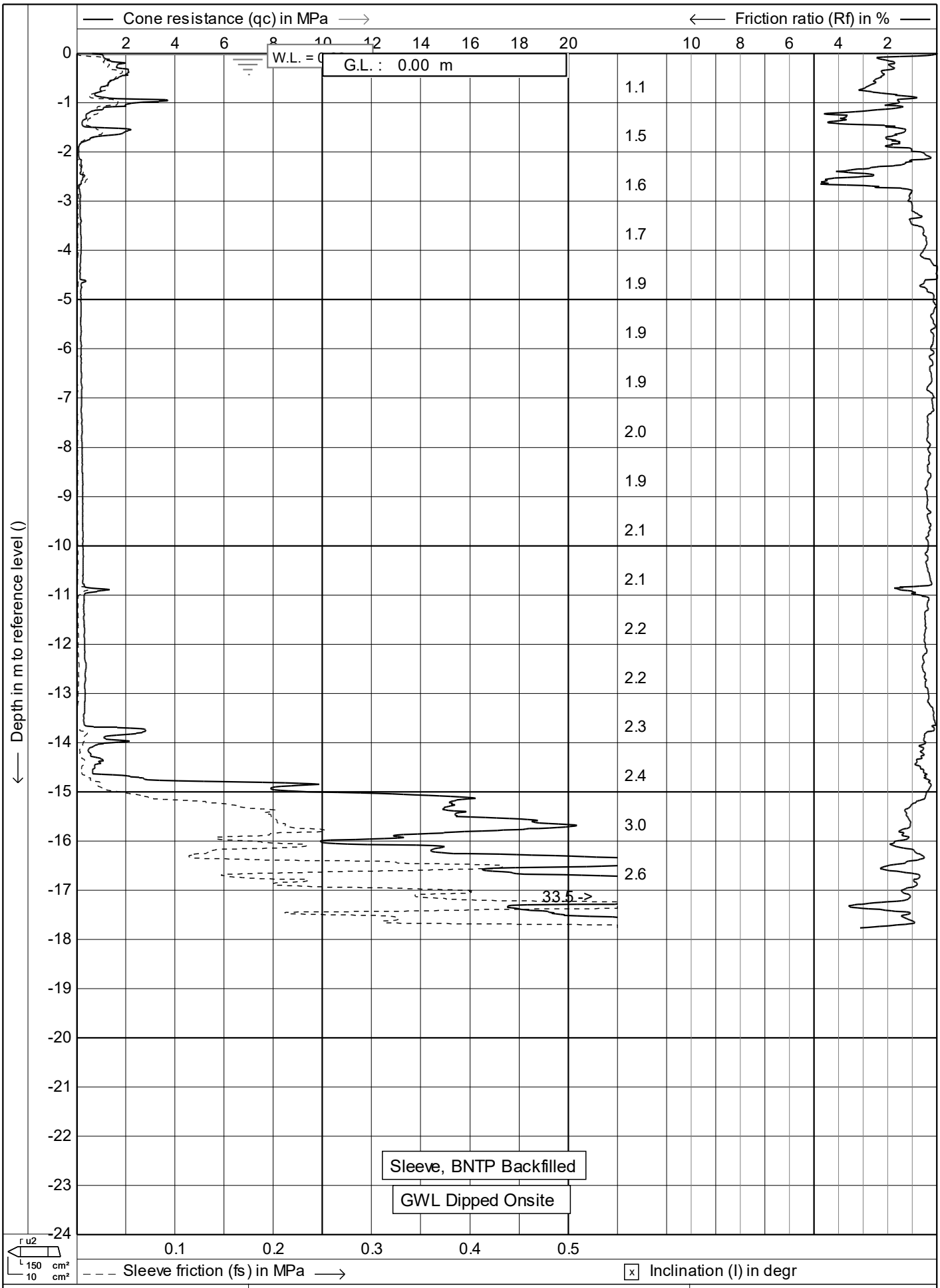

PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **02**

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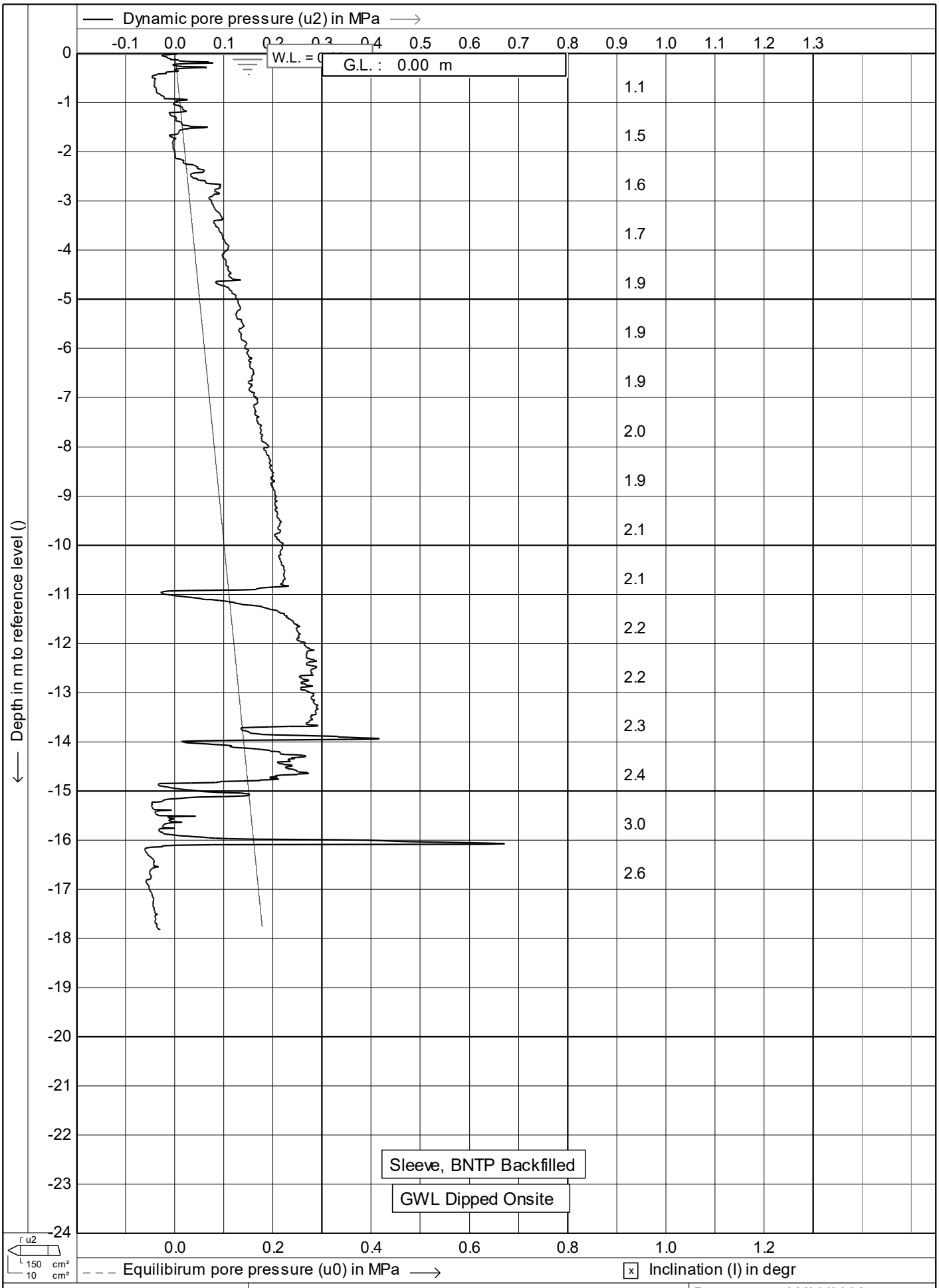

PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **02**

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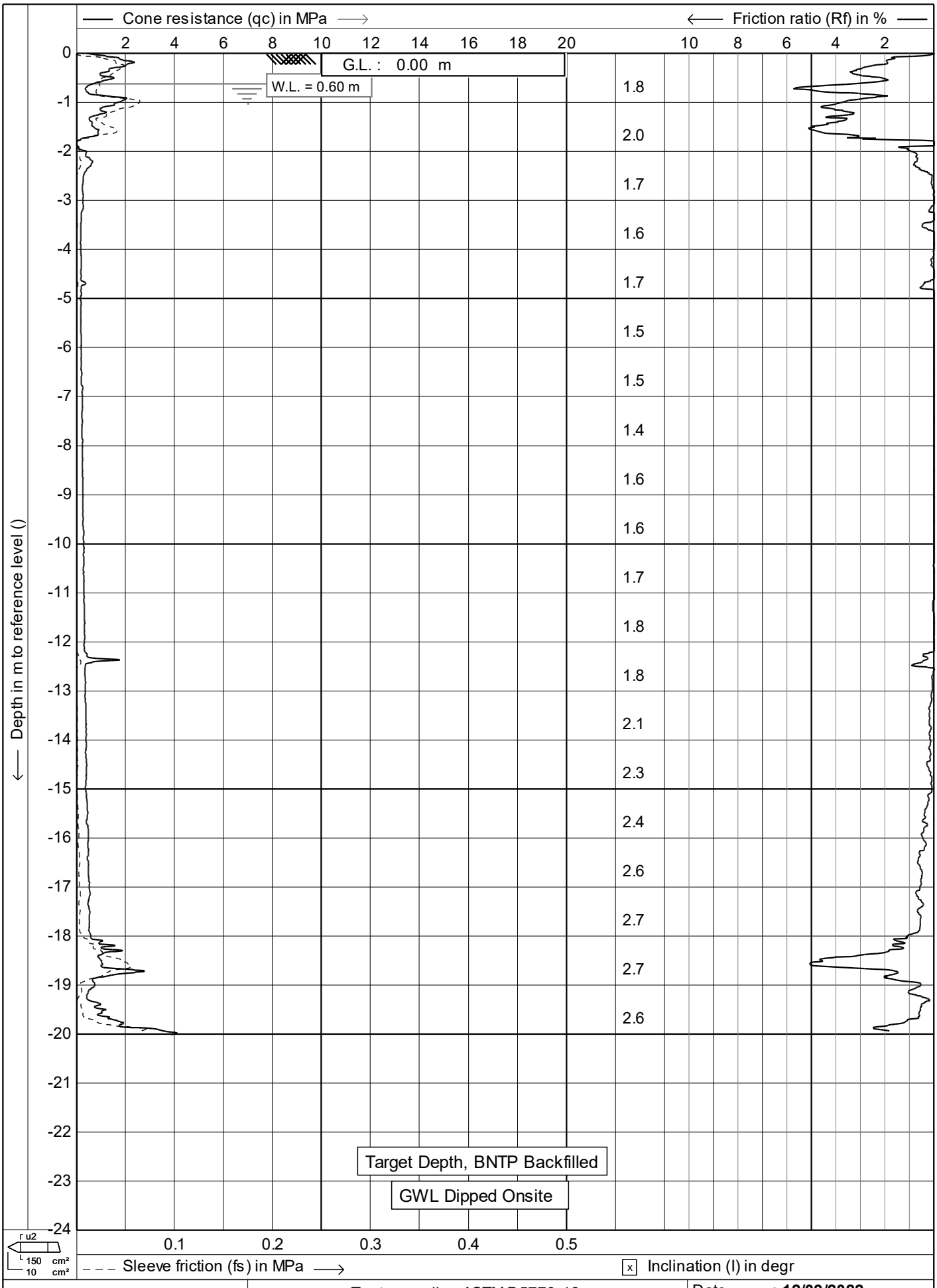

PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **04**

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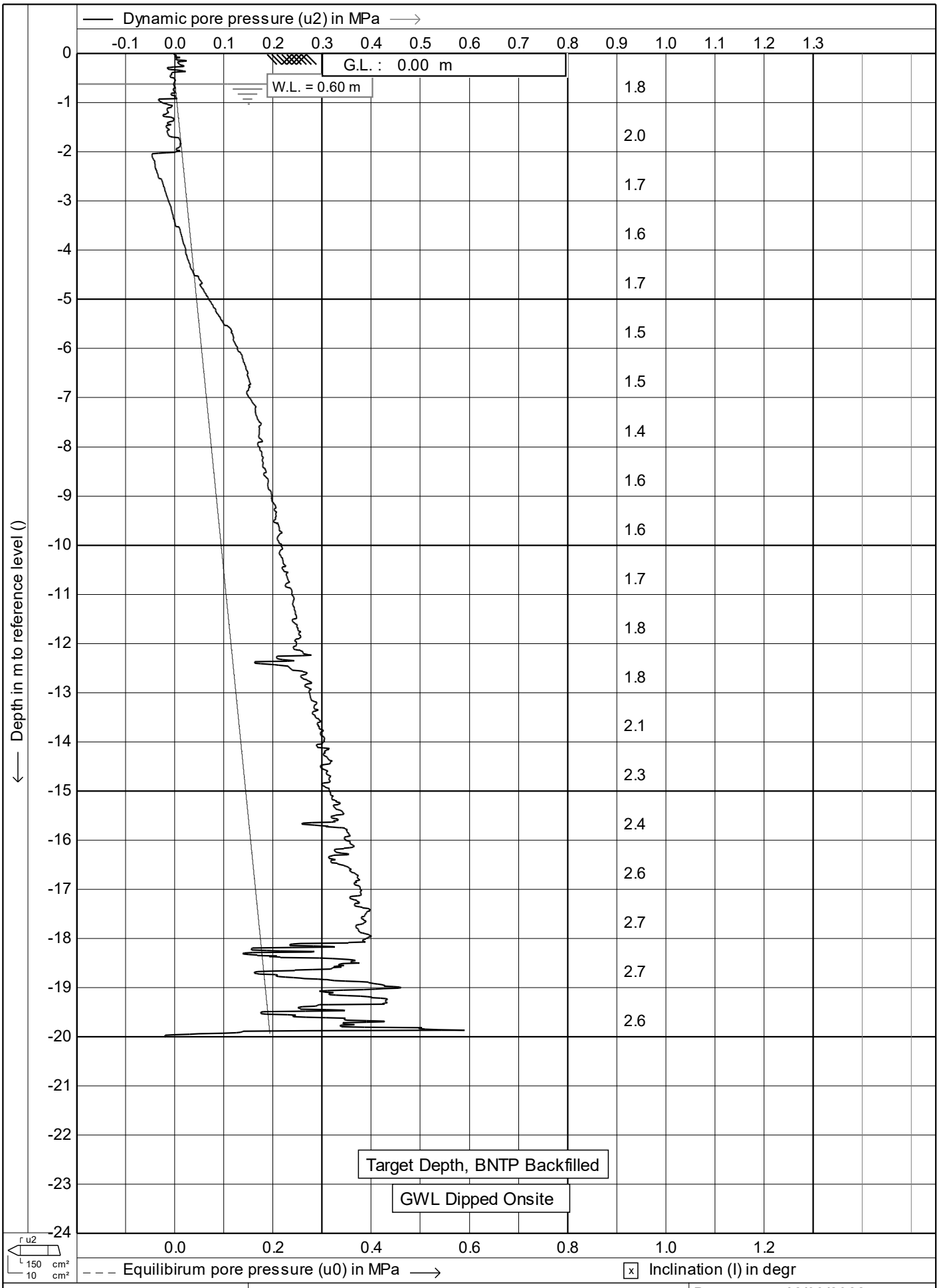


PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

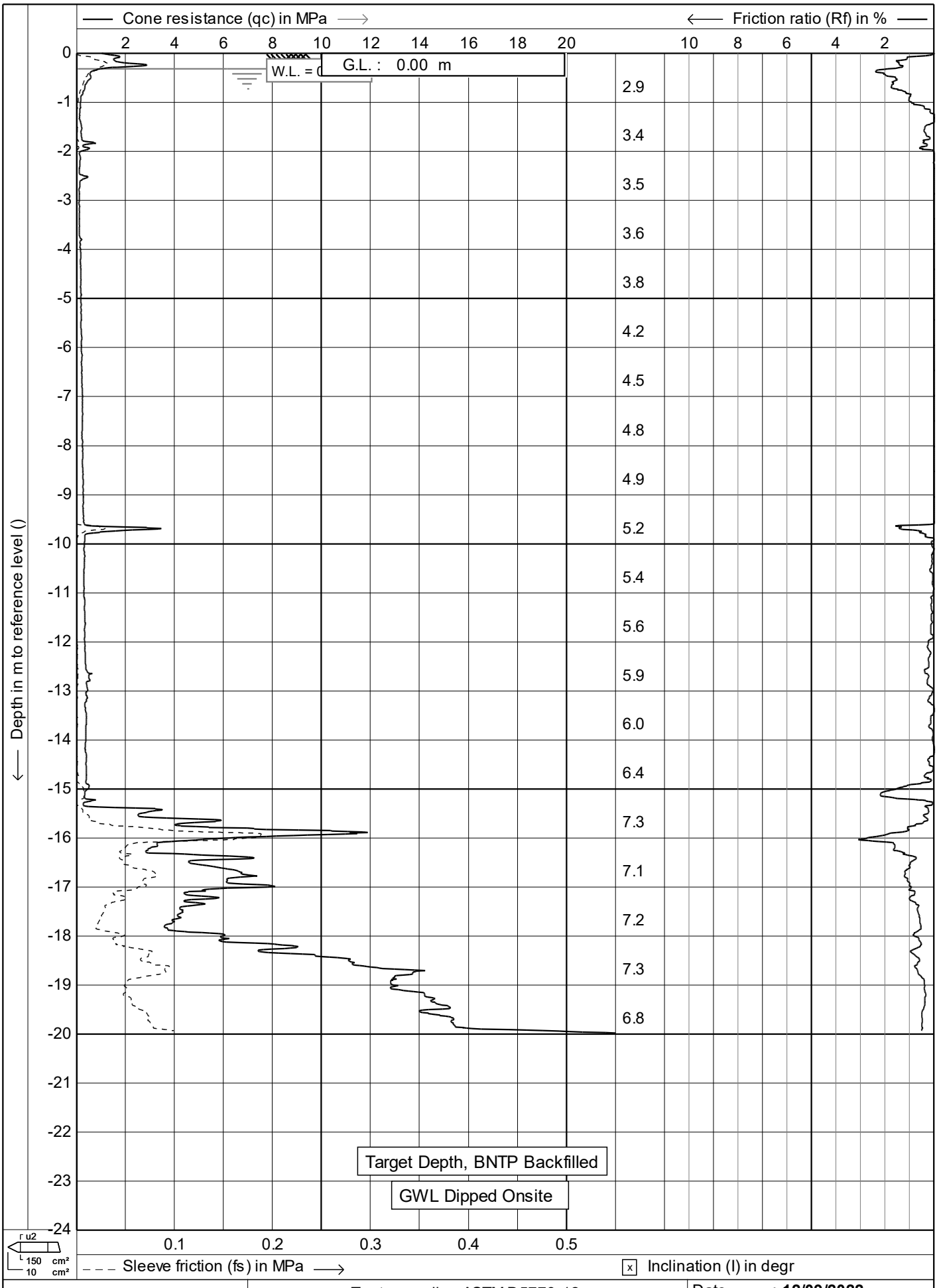
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **04**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

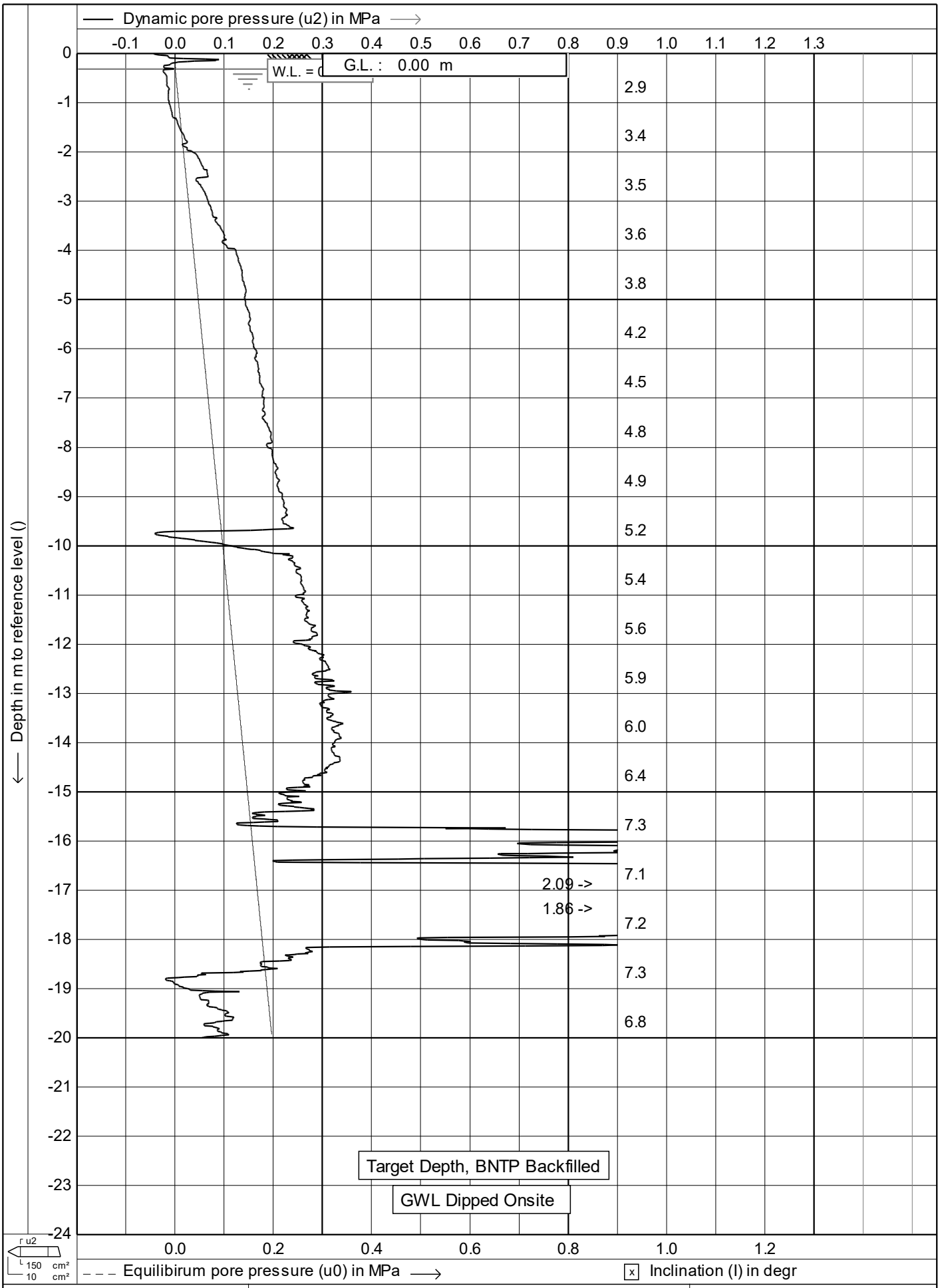
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **05**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

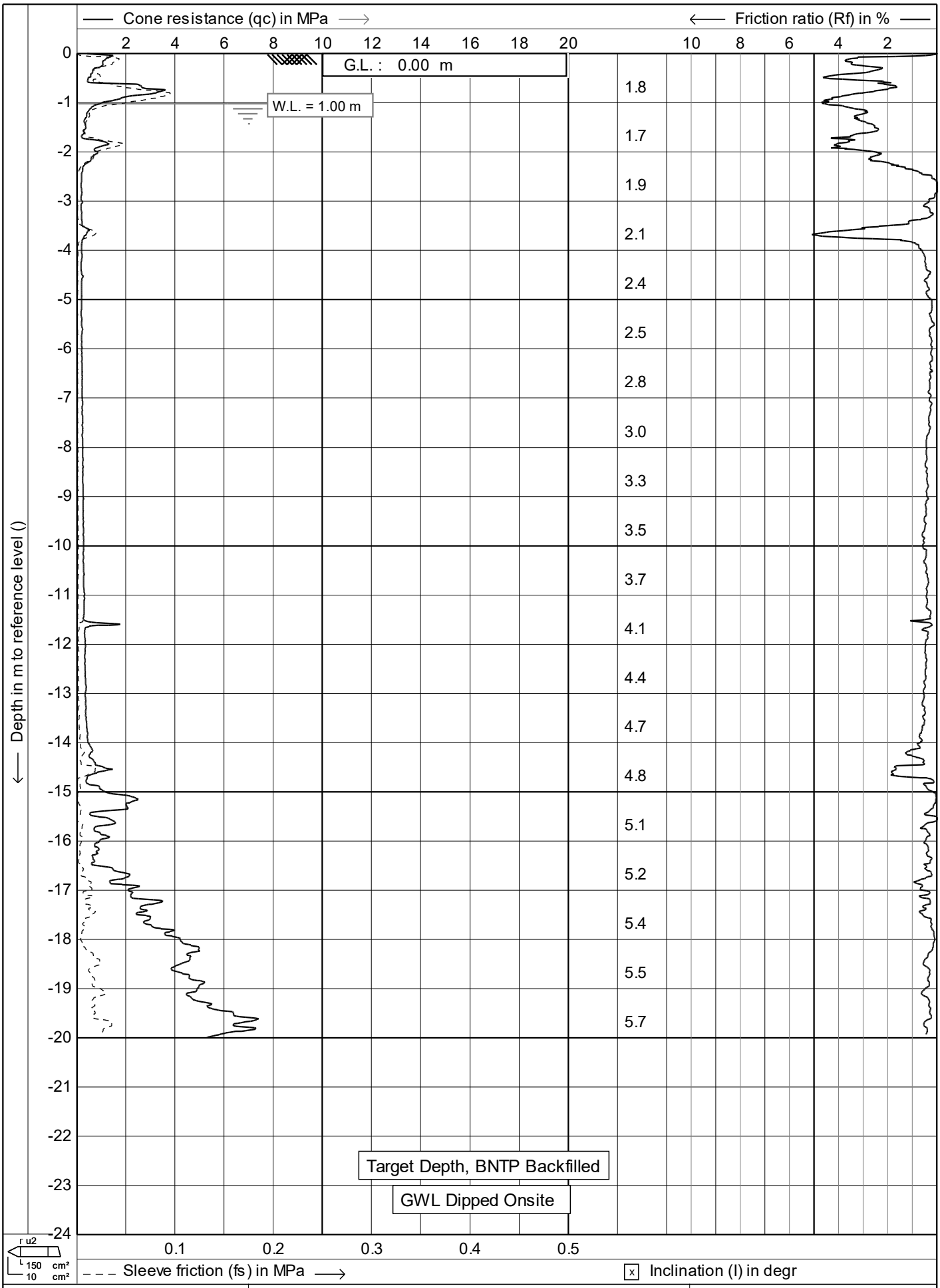
Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date	: **12/09/2022**
Cone no.	: **C10CFIIP.C13082**
Project no.	: **01WSP031**
CPT no.	: **05**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

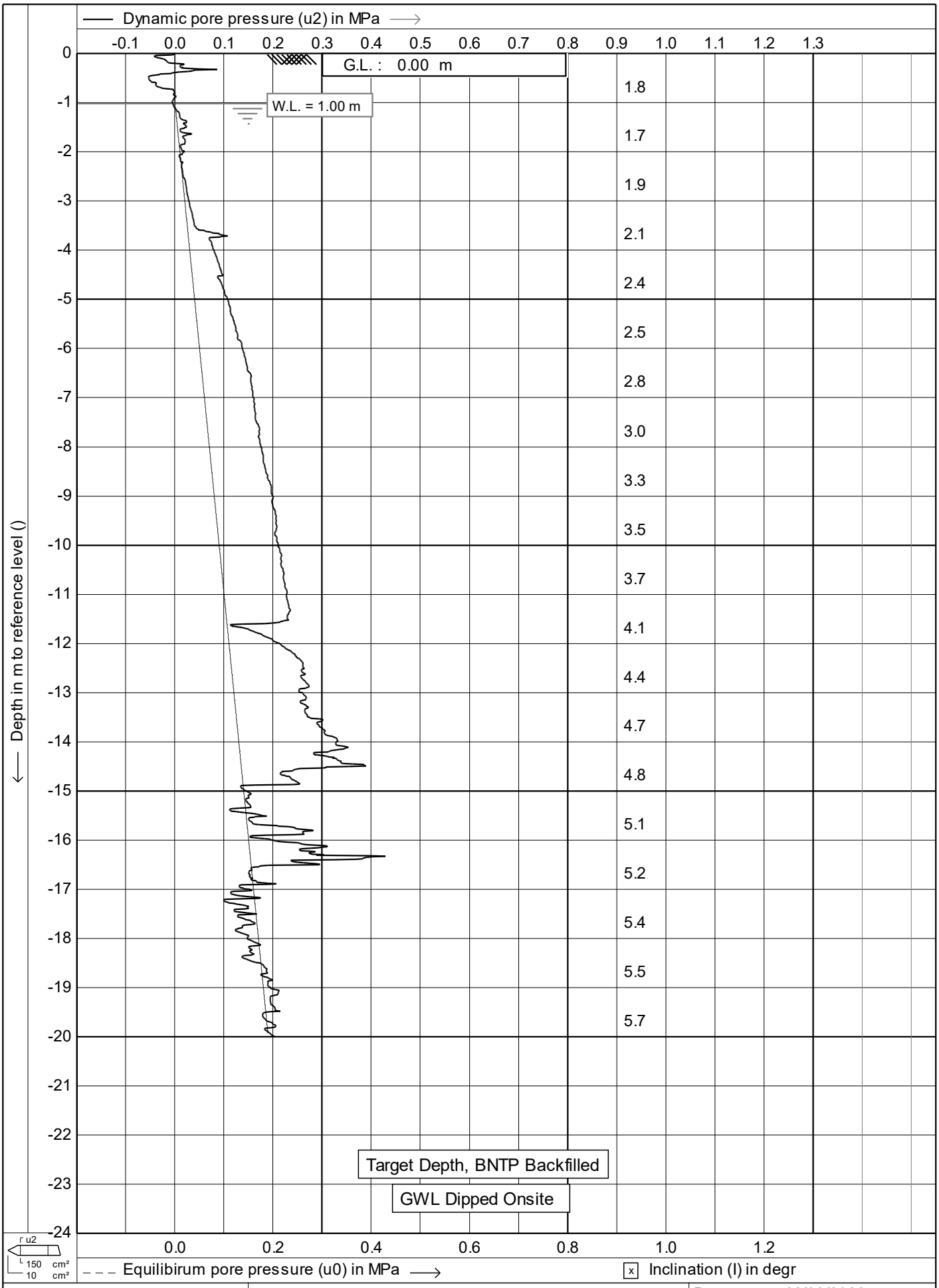
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **06**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

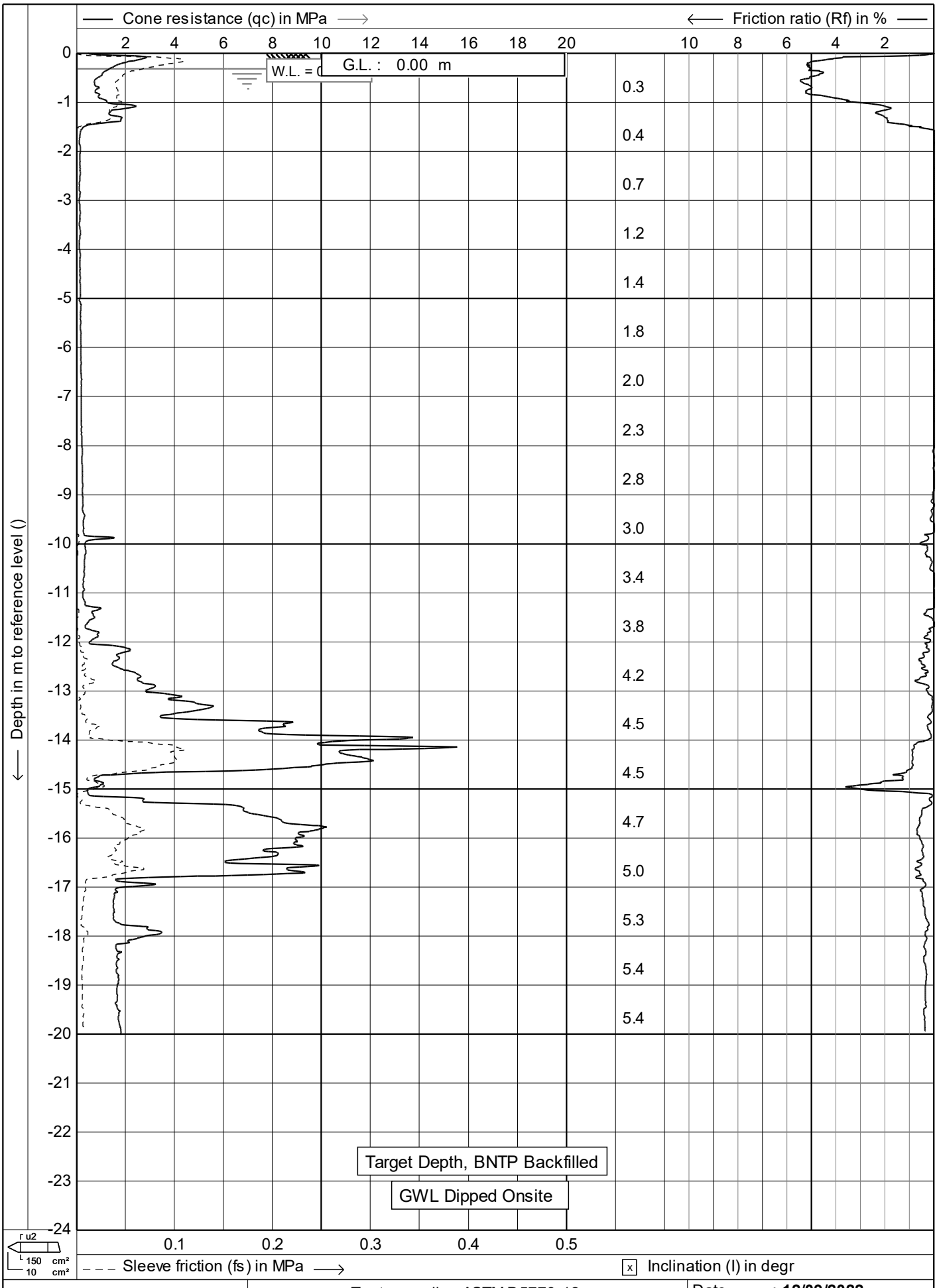
Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date	: **12/09/2022**
Cone no.	: **C10CFIIP.C13082**
Project no.	: **01WSP031**
CPT no.	: **06**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

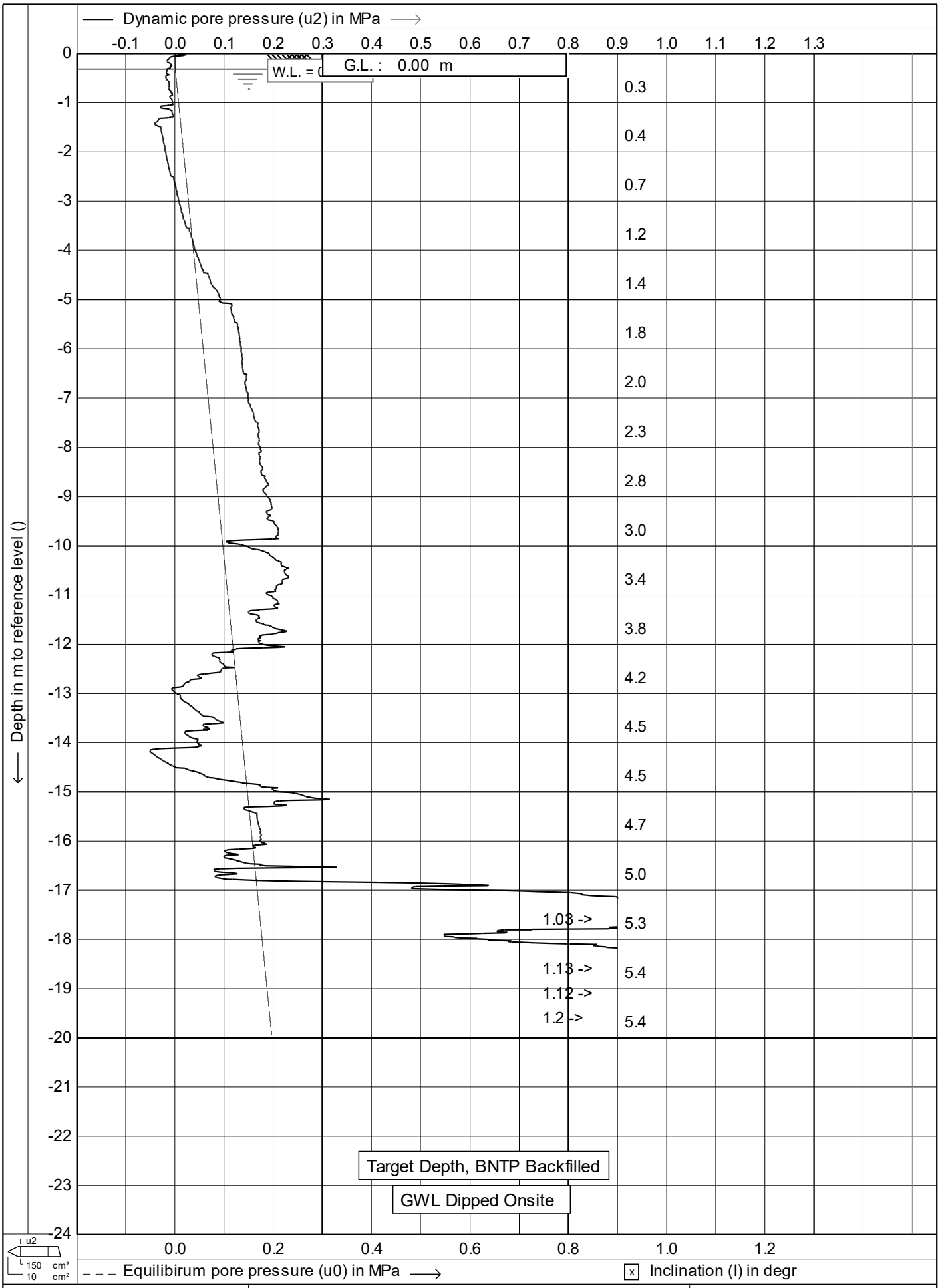
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **07**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

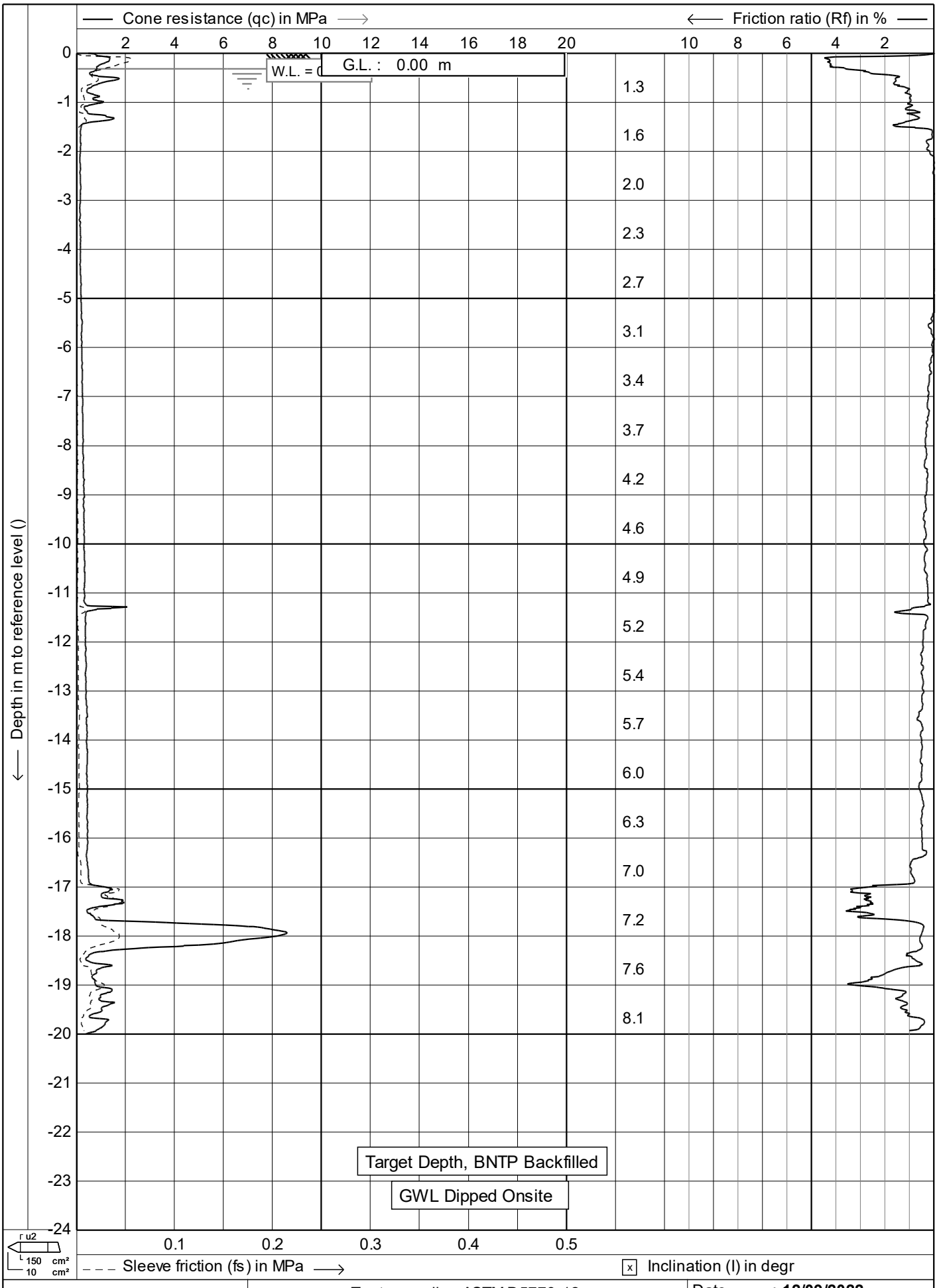
Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date	: **12/09/2022**
Cone no.	: **C10CFIIP.C13082**
Project no.	: **01WSP031**
CPT no.	: **07**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

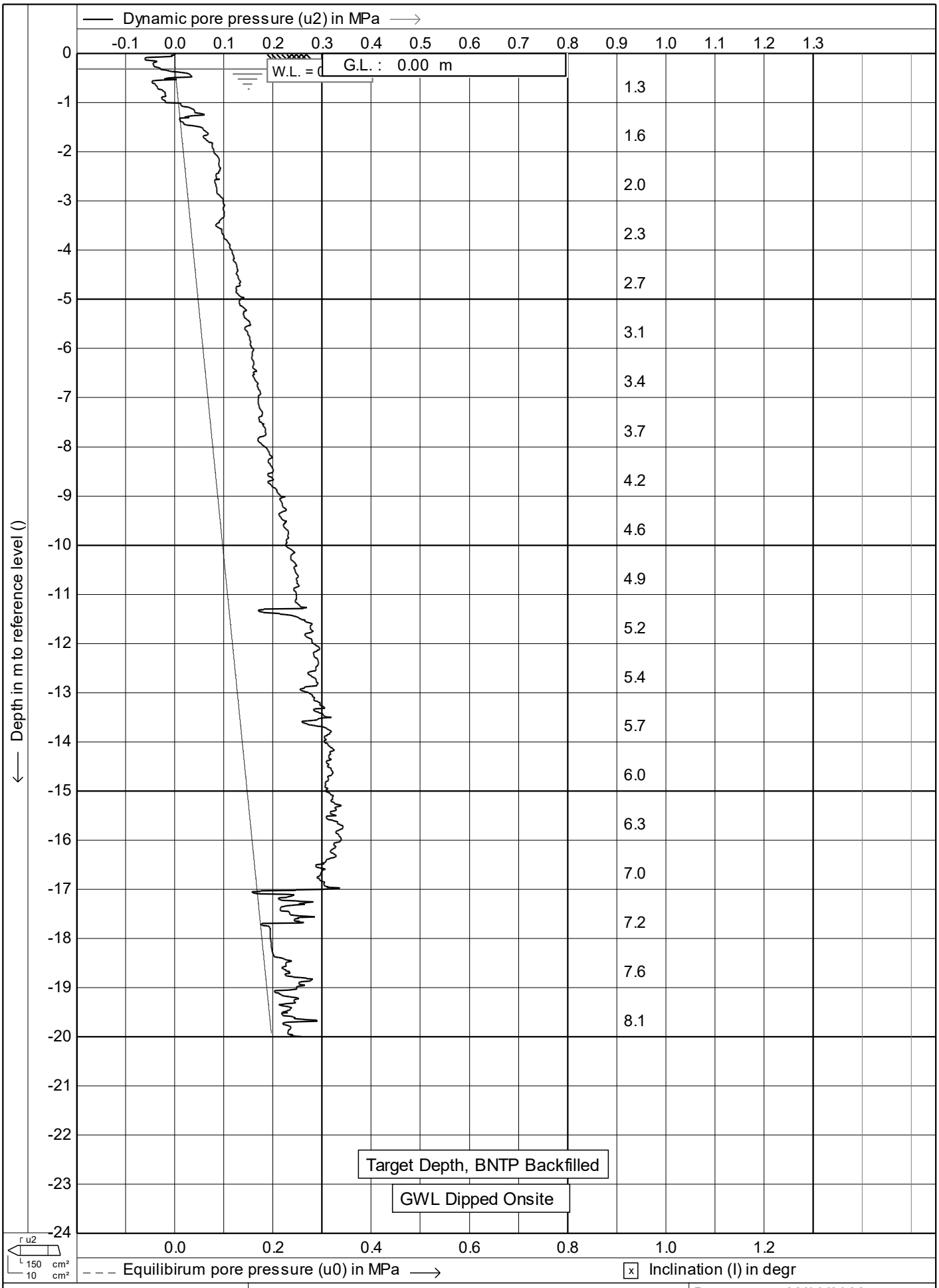
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **08**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

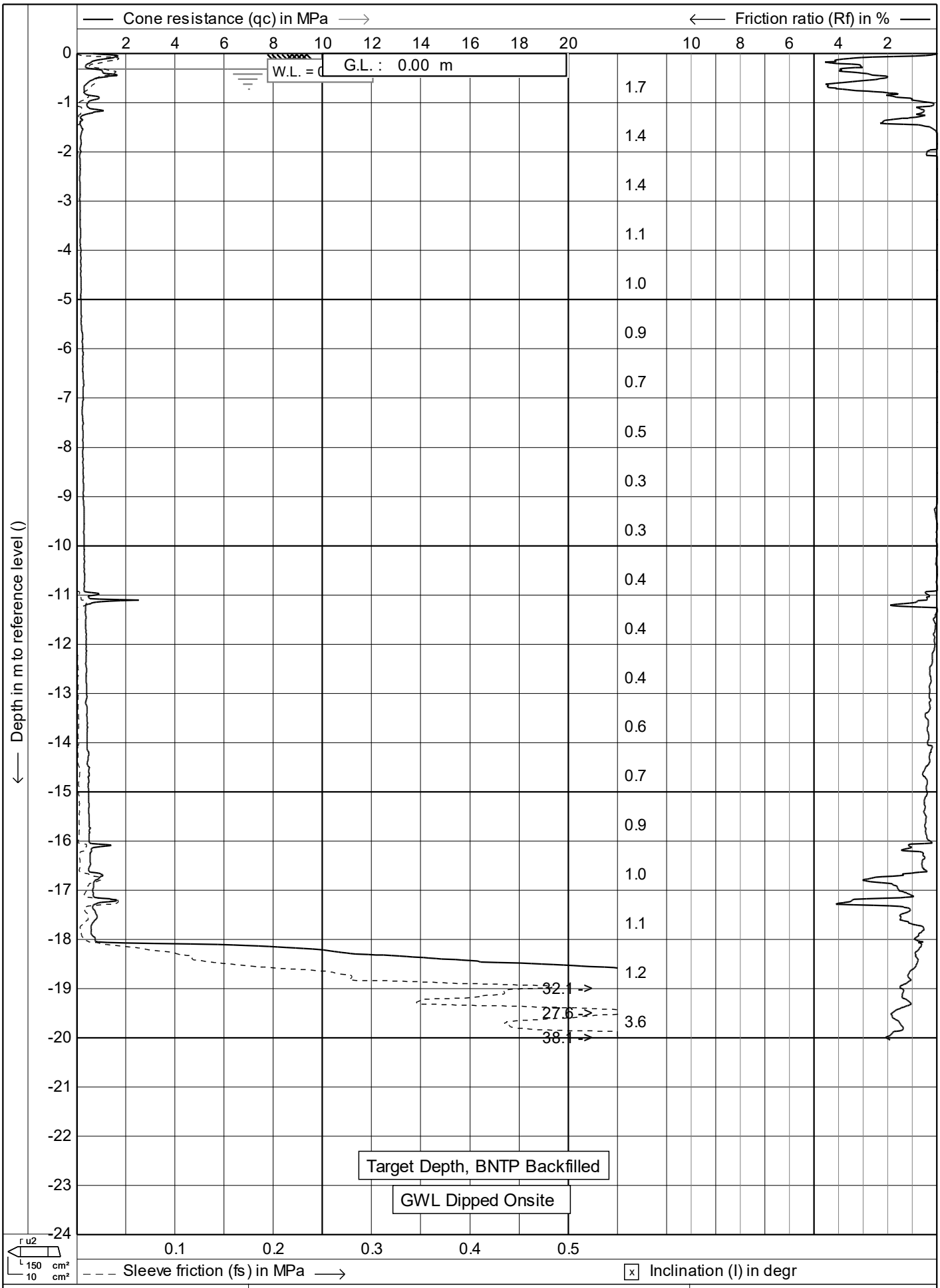
Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date	: **12/09/2022**
Cone no.	: **C10CFIIP.C13082**
Project no.	: **01WSP031**
CPT no.	: **08**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

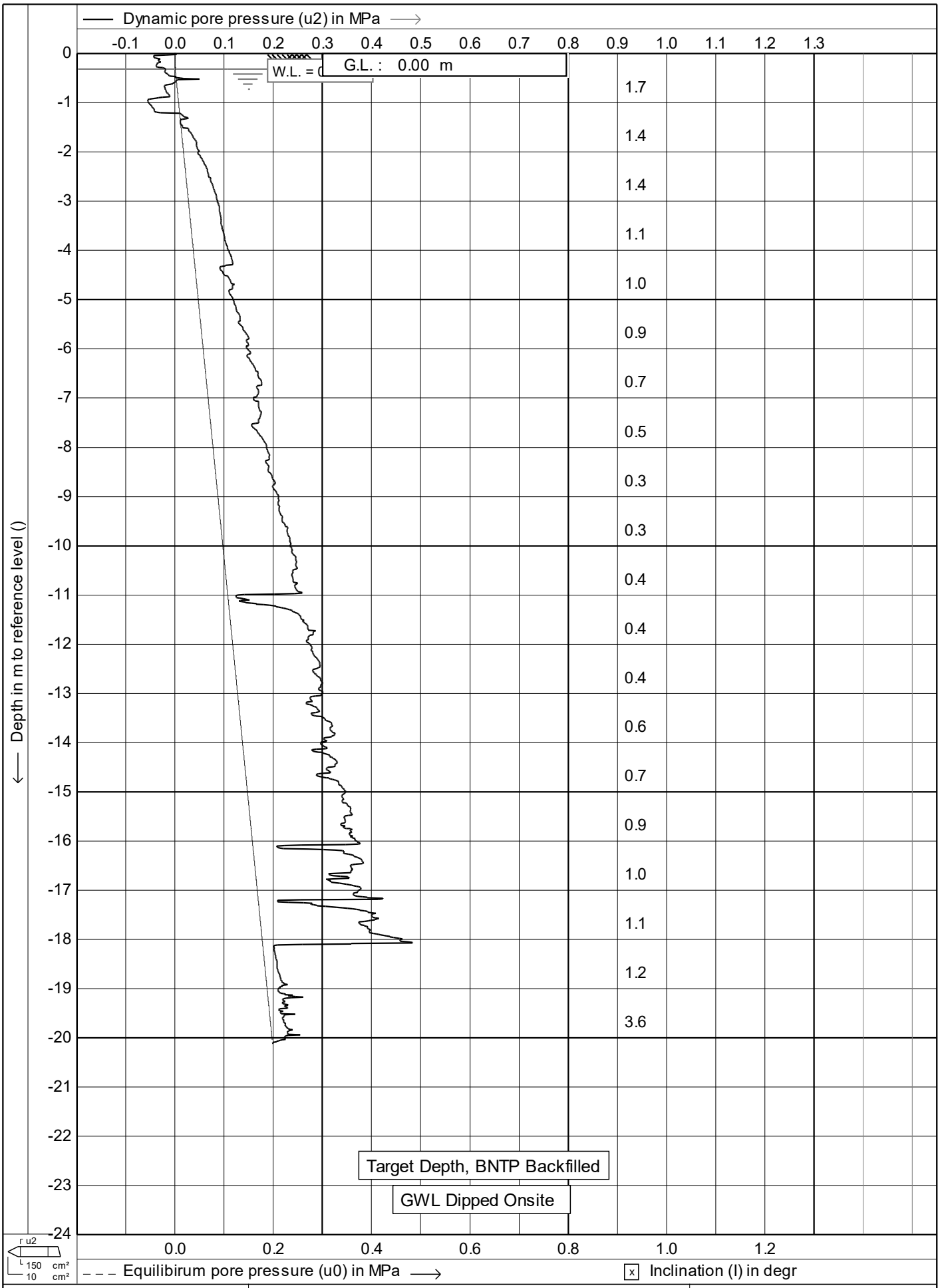
Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **09**

1/14

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

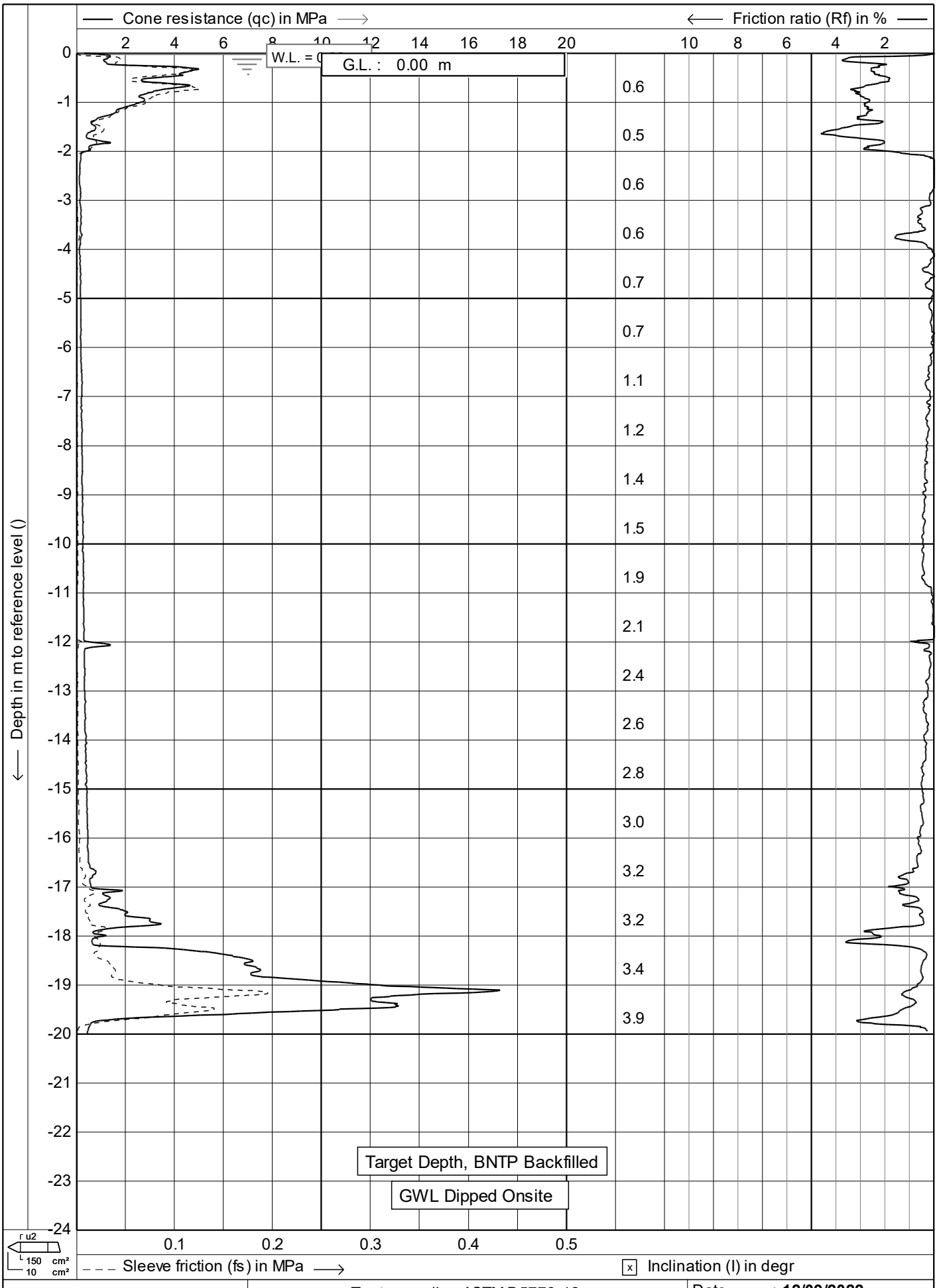
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **09**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

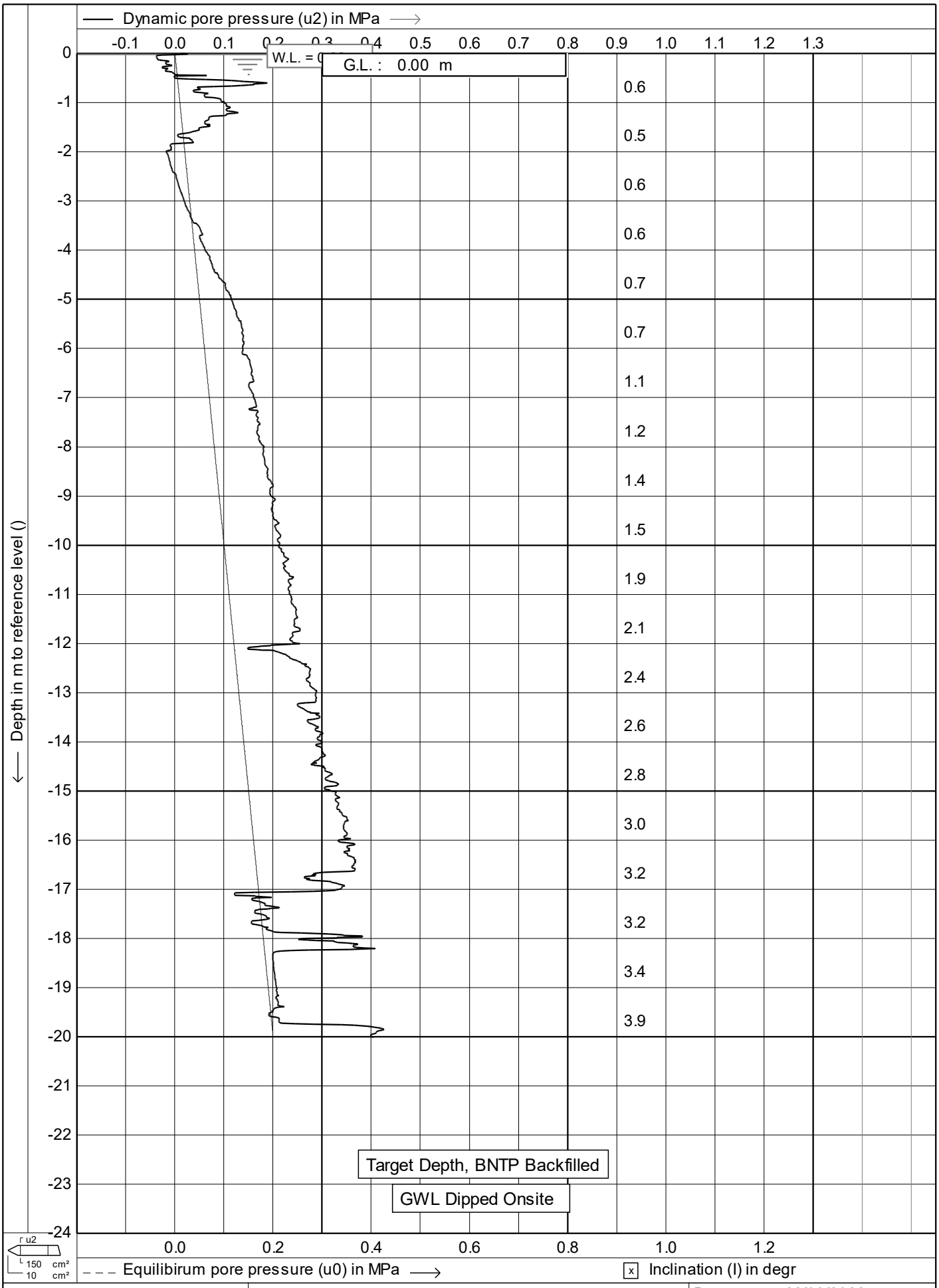
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **10**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

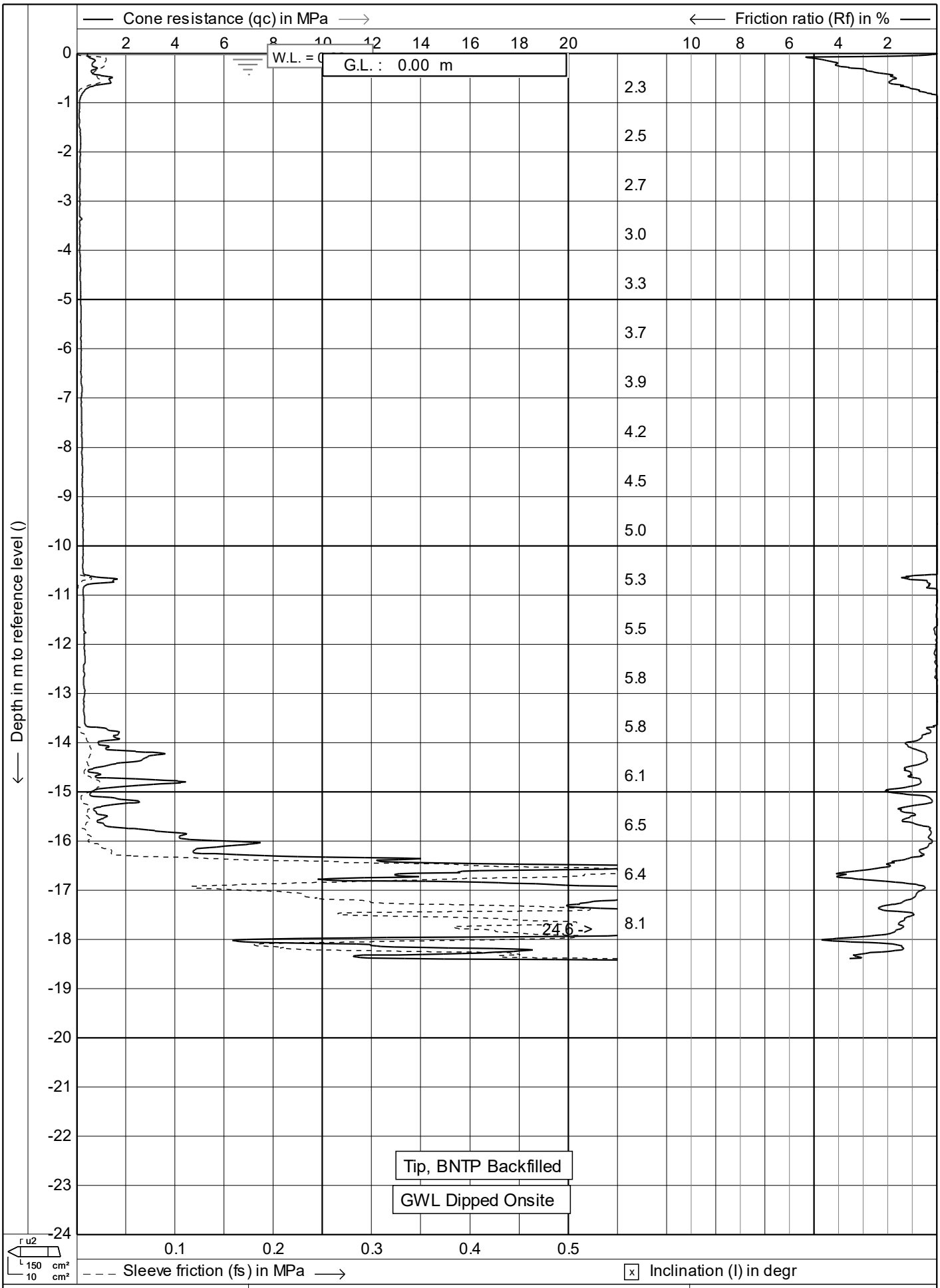
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **10**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

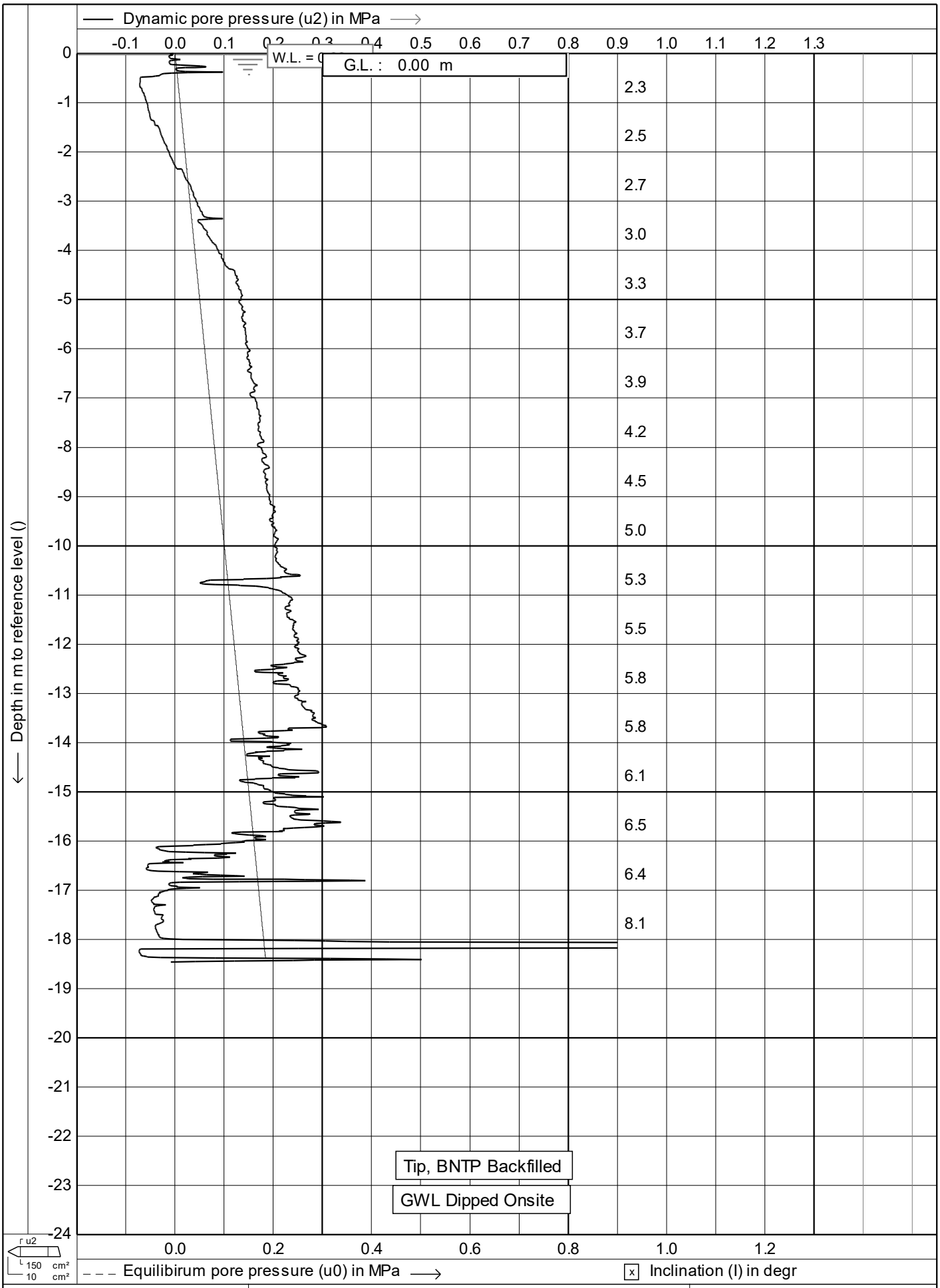
Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **11**

1/14

1.49



PERRY GEOTECH

Test according ASTM D5778-12

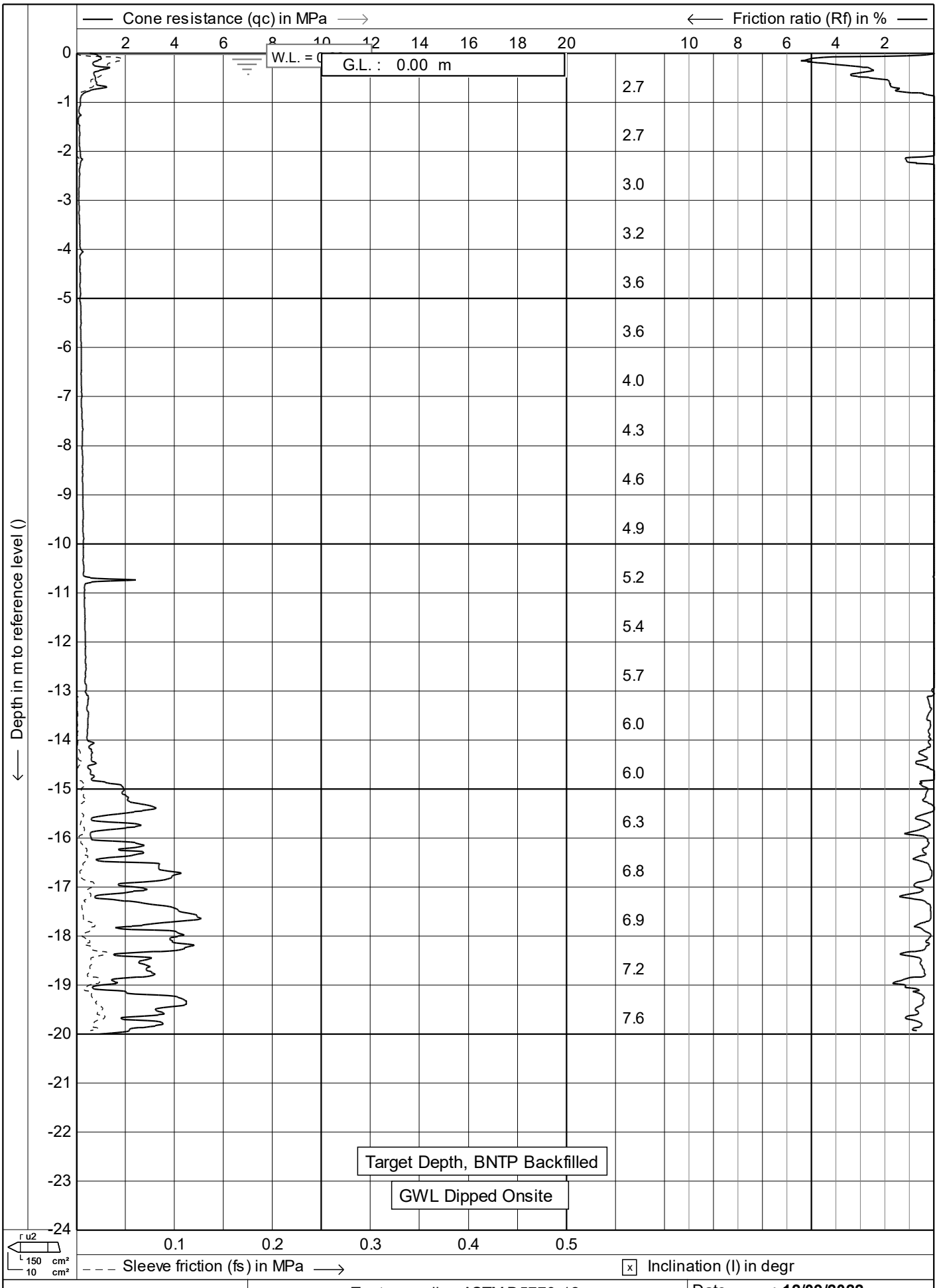
Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date	: **12/09/2022**
Cone no.	: **C10CFIIP.C13082**
Project no.	: **01WSP031**
CPT no.	: **11**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

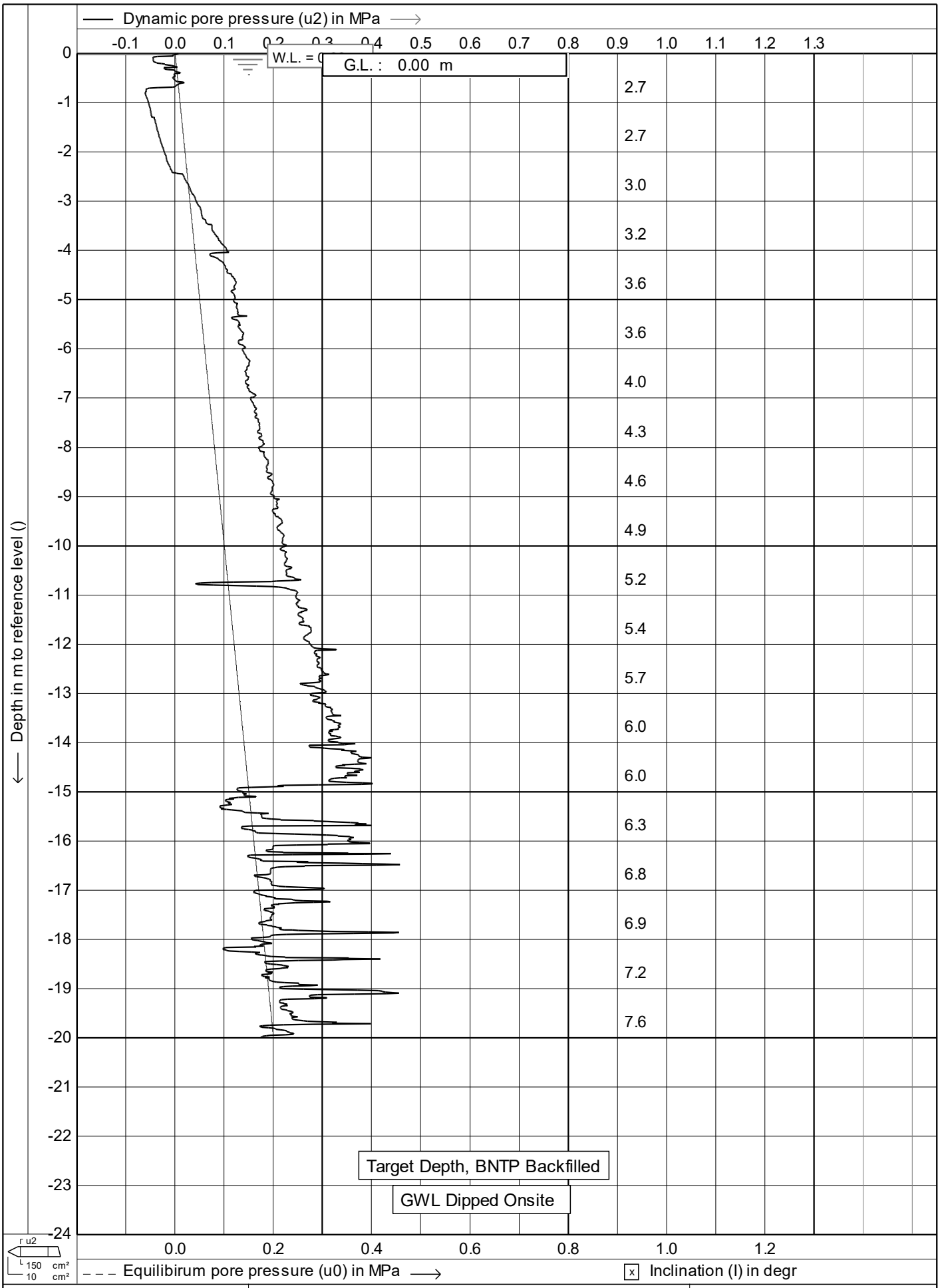
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **12**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

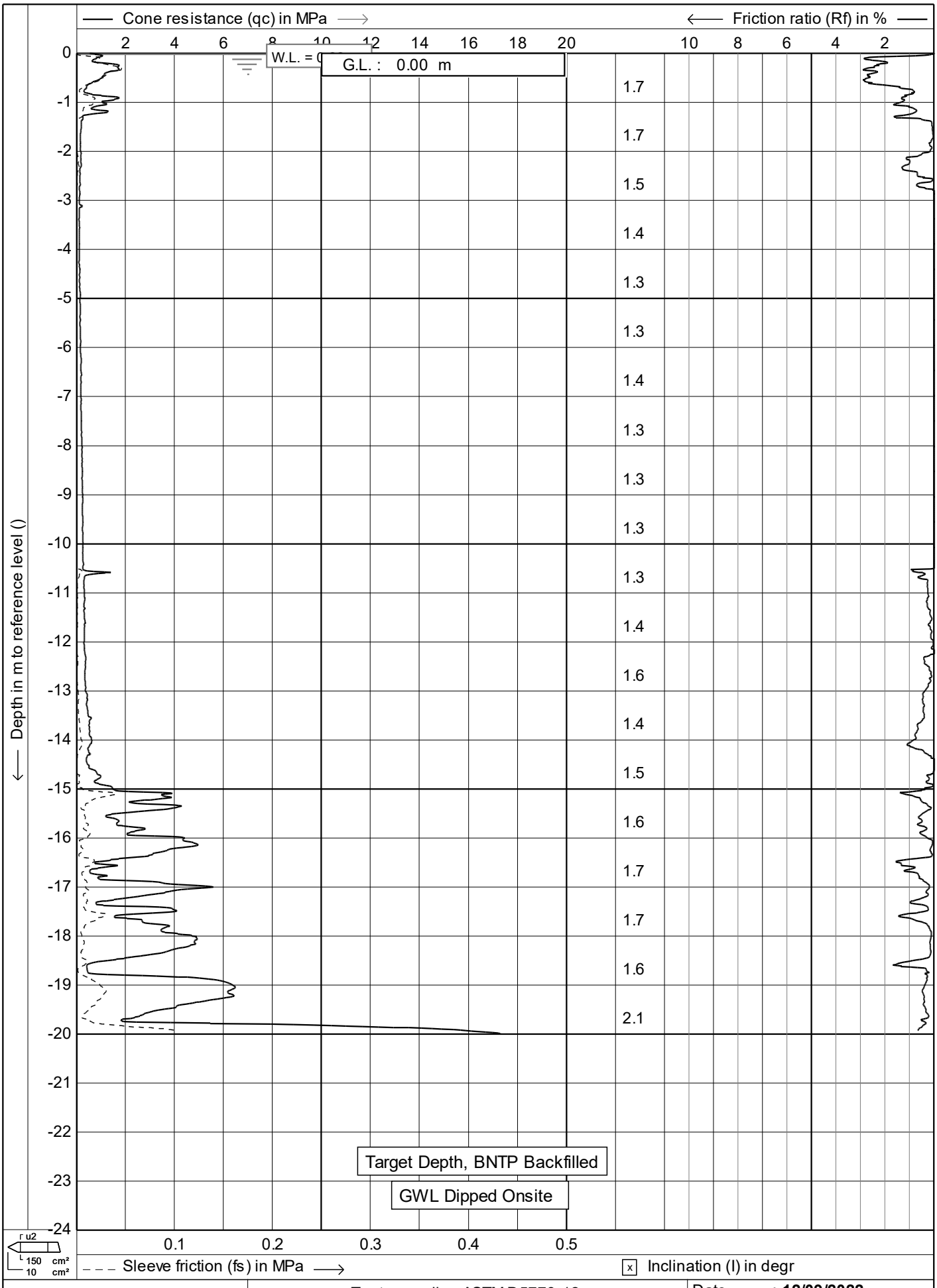
Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **12**

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

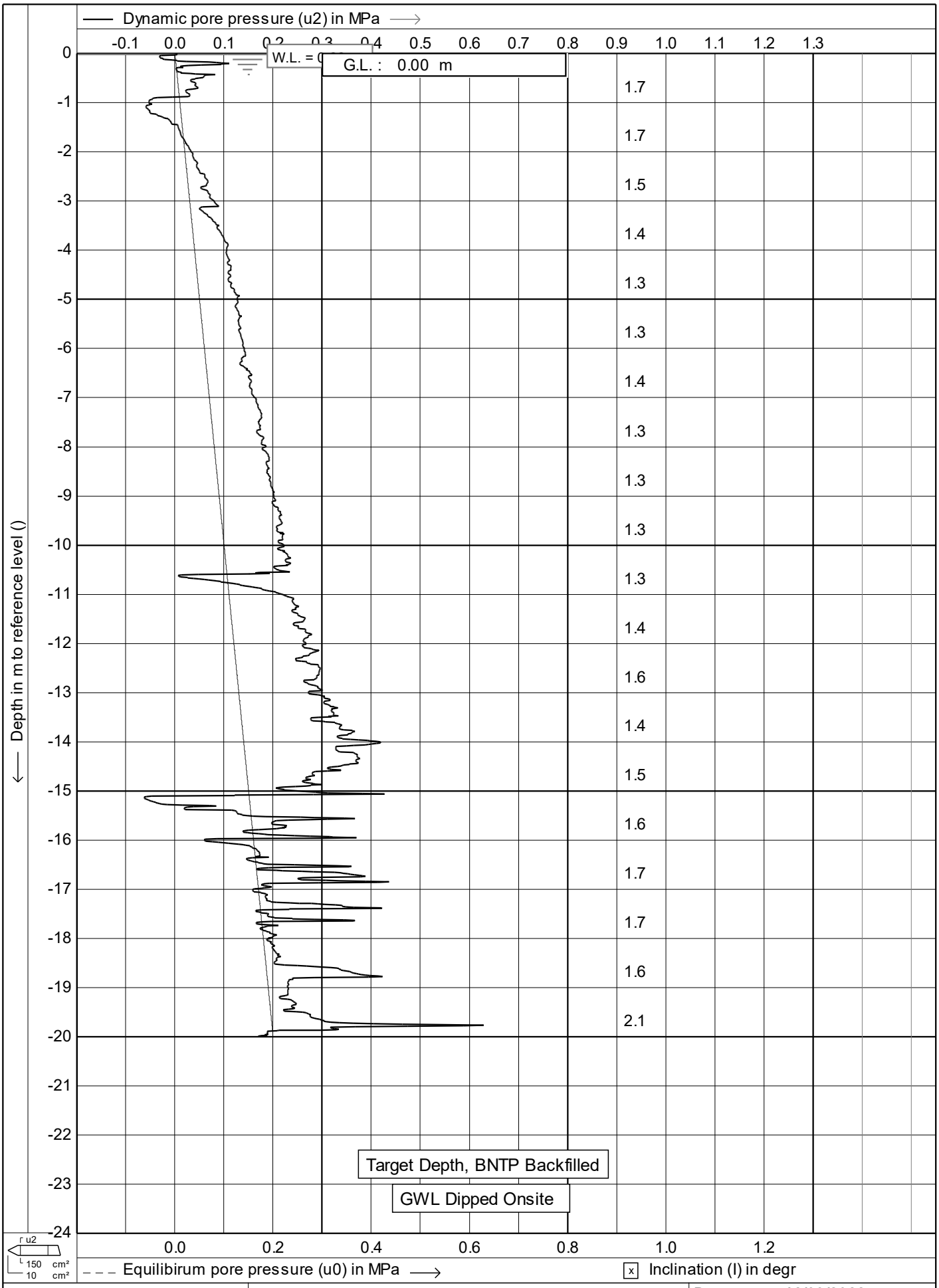
Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **13**

1/14

1.49



PERRY GEOTECH

Test according ASTM D5778-12

Project : **Site Investigations**

Location: **297 Te Puna Station Rd - Te Puna**

Position: **0, 0**

Date : **12/09/2022**

Cone no. : **C10CFIIP.C13082**

Project no. : **01WSP031**

CPT no. : **13**

1.49

Auger Scala No. HA01

Project:	Te Puna ContainerCo	*Coordinates:*	1871378 E 5824775 N
Client:	ContainerCo	*Ref. Grid:*	NZTM
Project No.:	2-9Z729.01	*R.L.:*	13 m
Location:	297 Te Puna Station Road		

GEOLOGY	DEPTH (m)	DESCRIPTION	GRAPHIC LOG	WATER LEVEL	R.L. (m)	DEPTH (m)	SOIL TESTS: SCALA PENETROMETER (Blows per 100mm) 0 2 4 6 8 10 12 14 16 18 20	SHEAR STRENGTH (kPa)	OTHER TESTS	SAMPLES
TS		TOPSOIL.								
Pleistocene Alluvial Deposits		Silty CLAY with trace sand; orange brown mottled dark brown and pale brown. Stiff; moist; moderately plastic; sand, fine to coarse grained.								
		0.4m: Becoming sensitive.						107/12		
		0.7m: With fine to coarse sand.						92/29		
		Clayey SAND with some silt; white brown mottled light orange. Very loose; moist to wet; slightly plastic; sand, fine to coarse grained.								
	1	Silty CLAY with trace sand; white mottled black (manganese). Very stiff; moist; slightly to moderately plastic; sensitive; sand, fine to coarse grained.			12	1		130/23		
		Silty SAND with minor clay; white brown mottled black (manganese). Loose to medium dense; moist to wet; slightly to moderately dilatant; slightly plastic; sand, fine to medium grained.						87/55		
		SAND; white mottled pale pink. Medium dense; moist to wet; non-plastic; sand, fine to coarse grained.								
	2					2				
		2.5m: With some silt; dilatant.								
		2.7m: Becoming saturated; limited recovery.								
	3				10	3				
		3.7m: Hole collapse.								
	4	END OF AUGER AT 4m - Collapse				4				
	5				8	5				

Notes:
No groundwater encountered
Shear Vane No. 954; Calibration no. 1.445

Test Methods:
Determination of the Penetration Resistance of a Soil, NZS 4402 Test 6.5.2:1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Soc., 2001

Date Tested: 6/10/2022
Tested by: PM
Checked by: PM

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:27.5 @ A4

Auger Scala No. HA02

Project:	Te Puna ContainerCo	*Coordinates:*	1871381 E 5824792 N
Client:	ContainerCo	*Ref. Grid:*	NZTM
Project No.:	2-9Z729.01	*R.L.:*	13 m
Location:	297 Te Puna Station Road		

GEOLOGY	DEPTH (m)	DESCRIPTION	GRAPHIC LOG	WATER LEVEL	R.L. (m)	DEPTH (m)	SOIL TESTS: SCALA PENETROMETER (Blows per 100mm) 0 2 4 6 8 10 12 14 16 18 20	SHEAR STRENGTH (kPa)	OTHER TESTS	SAMPLES
TS		TOPSOIL.								
Fill		SAND with trace silt; yellow brown mottled brown. Loose; moist; non-plastic; silt, non-dilatant; sand, fine to medium grained.								
Pleistocene Alluvial Deposits		Sandy SILT with some clay; light grey mottled pink. Stiff; wet; slightly plastic; slightly dilatant; sand, fine grained.						69/6		
		0.4m: Becoming minor clay, light grey and highly dilatant.								
		Clayey SILT; light grey mottled light orange. Very stiff; moist; slightly plastic; non-dilatant.						163/11		
	1				12	1		193/28		
		1.5m: With manganese nodules.								
		1.6m: With minor fine to medium sand.						193/11		
		1.8m: Becoming light orange.								
	2	2.0m: Becoming light grey.				2		124/11		
		Sandy SILT with minor clay; light grey mottled white. Stiff; wet; slightly plastic; slightly dilatant; sand, fine grained.						105/30		
		SAND; grey. Medium dense to dense; moist; non-plastic; sand, fine to coarse grained.								
	3				10	3				
		Clayey SILT with some sand and trace gravel; light grey. Very stiff; wet; slightly plastic; slightly dilatant; gravel, fine, pumice; sand, fine grained.						110/41		
								102/33		
		3.8m: Becoming highly dilatant and with trace fine sand.								
	4					4		121/39		
								UTP		
		4.5m: Becoming grey white.						UTP		
		END OF AUGER AT 4.6m - Unable to Advance Auger - Too Hard								
	5				8	5				

AUGER SCALA 5M 1 PHOTO - WSP TE PUNA HA'S.GPJ WSP-OPUS2018_TEM.GDT 19/10/22

Notes:
No groundwater encountered
Shear Vane No. 2542; Calibration no. 1.378

Test Methods:
Determination of the Penetration Resistance of a Soil, NZS 4402 Test 6.5.2:1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Soc., 2001

Date Tested: 6/10/2022
Tested by: CFK
Checked by: PM

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:27.5 @ A4

Auger Scala No. HA03

Project:	Te Puna ContainerCo	*Coordinates:*	1871398 E 5824765 N
Client:	ContainerCo	*Ref. Grid:*	NZTM
Project No.:	2-9Z729.01	*R.L.:*	13 m
Location:	297 Te Puna Station Road		

GEOLOGY	DEPTH (m)	DESCRIPTION	GRAPHIC LOG	WATER LEVEL	R.L. (m)	DEPTH (m)	SOIL TESTS: SCALA PENETROMETER (Blows per mm) 0 2 4 6 8 10 12 14 16 18 20	SHEAR STRENGTH (kPa)	OTHER TESTS	SAMPLES
TS		TOPSOIL.								
Fill		FILL: Silty CLAY with trace sand; brown. Stiff; moist; slightly plastic; sand, fine grained.						72/23		
	1	FILL: Silty CLAY with trace sand; brown. Stiff; moist; slightly to moderately plastic; sand, fine grained.			12	1		95/12		
		1.5m: Becoming moderately plastic.						87/14		
	2					2		81/17		
Landslide Deposit		Sandy CLAY with some silt; pale brown. Very stiff; wet; slightly to moderately plastic; sand, fine to medium grained.						52/29		
		Silty CLAY with trace sand; orange brown mottled brown, pale brown, and white. Very stiff; moist; moderately plastic; sand, fine grained.						185/46		
	3	Silty CLAY with minor sand; dark brown. Stiff; moist to wet; slightly to moderately plastic; sand, fine to medium grained.			10	3		153/55		
		Silty CLAY with trace sand; white brown. Stiff to very stiff; moist to wet; sensitive; slightly to moderately plastic; sand, fine to medium grained. 3.2m: Becoming brown mottled dark brown.						90/43		
Alluvial Deposit		Silty CLAY with minor sand; grey white pink. Stiff; wet; sensitive; slightly plastic; sand, fine to medium grained.						70/40		
Pleistocene	4	END OF AUGER AT 4m - Target Depth Reached				4				
	5				8	5				

Notes:
No groundwater encountered
Shear Vane No. 954; Calibration no. 1.445

Test Methods:
Determination of the Penetration Resistance of a Soil, NZS 4402 Test 6.5.2:1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Soc., 2001

Date Tested: 6/10/2022
Tested by: PM
Checked by: PM

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:27.5 @ A4

Auger Scala No. HA04

Project:	Te Puna ContainerCo	*Coordinates:*	1871501 E 5824866 N
Client:	ContainerCo	*Ref. Grid:*	NZTM
Project No.:	2-9Z729.01	*R.L.:*	2 m
Location:	297 Te Puna Station Road		

GEOLOGY	DEPTH (m)	DESCRIPTION	GRAPHIC LOG	WATER LEVEL	R.L. (m)	DEPTH (m)	SOIL TESTS: SCALA PENETROMETER (Blows per mm) 0 2 4 6 8 10 12 14 16 18 20	SHEAR STRENGTH (kPa)	OTHER TESTS	SAMPLES
TS		TOPSOIL.								
Fill		FILL: Clayey SILT with minor sand and trace gravel; orange brown. Very stiff; moist; slightly plastic; non-dilatant; friable; sand, fine grained; gravel, grey, fine, sub-angular.		0.3m 6/10				UTP		
								193/11		
	1	FILL: Clayey SILT with trace sand; brown grey mottled orange. Very stiff; moist; slightly plastic; non-dilatant; manganese nodules; sand, fine grained.				1		124/22		
		1.2m: With minor fine to coarse sand.								
		FILL: Clayey SILT with trace sand; dark brown grey. Very stiff; moist; moderately plastic; non-dilatant; slight organic odour; sand, fine grained. 1.5m: Becoming mottled black and white.						165/22		
								124/28		
Holocene Alluvial Deposit	2	Silty CLAY; brown (Buried topsoil). Stiff; moist; moderately plastic; non-dilatant.			0	2		110/28		
		Organic silty CLAY; grey brown. Soft to firm; saturated; slightly plastic; sensitive; organic odour; non-dilatant.						63/11		
	3	3.0m: Becoming very soft to soft.				3		28/14		
	4	END OF AUGER AT 4m - Target Depth Reached			-2	4		30/17		
	5					5				

Notes:
Shear Vane No. 2542; Calibration no. 1.378

Date Tested: 6/10/2022
Tested by: CFK
Checked by: PM

Test Methods:
Determination of the Penetration Resistance of a Soil, NZS 4402 Test 6.5.2:1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Soc., 2001

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:27.5 @ A4

Auger Scala No. HA05

Project:	Te Puna ContainerCo	*Coordinates:*	1871517 E 5824873 N
Client:	ContainerCo	*Ref. Grid:*	NZTM
Project No.:	2-9Z729.01	*R.L.:*	2 m
Location:	297 Te Puna Station Road		

GEOLOGY	DEPTH (m)	DESCRIPTION	GRAPHIC LOG	WATER LEVEL	R.L. (m)	DEPTH (m)	SOIL TESTS: SCALA PENETROMETER (Blows per mm) 0 2 4 6 8 10 12 14 16 18 20	SHEAR STRENGTH (kPa)	OTHER TESTS	SAMPLES
TS		TOPSOIL.								
Fill		FILL: Clayey SILT with trace sand; prange brown mottled pale brown. Very stiff; moist; slightly plastic; sand, fine grained.		0.3m 6/10				202+		
		0.5m: With some fine to coarse sand; mottled dark brown. 0.6m: Slight organic odour.						202+		
	1	FILL: Clayey SILT with some sand; pale brown mottled orange brown. Stiff; moist; slightly to moderately plastic; sand, fine grained.				1				
		FILL: Silty CLAY; dark brown. Stiff; moist; slightly to moderately plastic; organic odour.						121/17		
		1.8m: Buried topsoil.						130/26		
Holocene Alluvial Deposit	2	Organic CLAY with trace sand; pale brown. Soft to firm; saturated; slightly plastic; organic odour; sand, fine grained.			0	2		49/26		
		2.3m: Very limited recovery.								
	3					3				
	4	END OF AUGER AT 4m - Target Depth Reached			-2	4		72/49		
	5					5				

AUGER SCALA 5M 1 PHOTO - WSP TE PUNA HA'S.GPJ WSP-OPUS2018_TEM.GDT 19/10/22

Notes:
Shear Vane No. 954; Calibration no. 1.445

Date Tested: 6/10/2022
Tested by: PM
Checked by: PM

Test Methods:
Determination of the Penetration Resistance of a Soil, NZS 4402 Test 6.5.2:1988
Guideline for Hand Held Shear Vane Test, NZ Geotechnical Soc., 2001

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:27.5 @ A4

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA01***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 2 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2855

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕remoulded ⊙peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		08/05/21	VS 73/ 26 kPa		0.5			**ORGANIC SILT**: non plastic, dark brown.	M				**ORGANIC SILTS**
									M	St	⊕⊙		
			VS 31/ 5 kPa		1.0			**SAND**: fine to medium grained, rounded, pale brown grey, with minor silt.	M to W				**ALLUVIAL SOILS**
								Clayey SILT: low plasticity, pale brown grey.	W	F	⊕⊙		
								Hand Auger HA01 terminated at 1.0 m Collapse					
					1.5								
					2.0								
					2.5								

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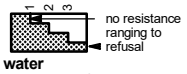
method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

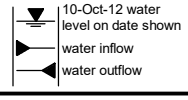
support
- M mud
- C casing
- N nil

penetration



no resistance ranging to refusal

water



10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA02***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 2 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2855

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded / peak) (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA, N			VS >172/ 29 kPa		0			**ORGANIC SILT**: non plastic, dark brown.	M				**TOPSOIL / FILL**
			VS 147/ 5 kPa		0.5			**SILT**: non plastic, pale brown mottled orange and black, with some clay and minor fine to coarse grained sand.	M	VSt			**FILL**
		08/05/21						0.8 m: becoming dark brown					
			VS 42/ 11 kPa		1.0			**ORGANIC SILT**: non plastic, black.	M	F to St			**ORGANIC SILTS**
			VS 56/ 14 kPa		1.5			**SILT**: low plasticity, pale grey, with minor clay.	W to S				**ALLUVIAL SOILS**
					2.0			Hand Auger HA02 terminated at 1.8 m Collapse					
					2.5								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration (1 2 3) — no resistance ranging to refusal

water — 10-Oct-12 water level on date shown; water inflow; water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA03***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client: ***Te Puna Industrial Limited***	date started: ***11 Aug 2021***
principal:	date completed: ***11 Aug 2021***
project: ***297 Te Puna Station Road, Te Puna***	logged by: ***AT***
location: ***Stage 2 area. See plan.***	checked by: ***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2855

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA, N		08/05/21 ▽	VS >172 kPa		0.5			**SILT**: low plasticity, pale brown mottled orange and black, with some clay and minor fine to medium grained sand.	M to W	St to H	⊙		**FILL**
			VS >172 kPa								⊙		
			VS 53/ 14 kPa		1.0			1.0 m: with trace fine to medium grained pumaceaous gravel			⊕		
			VS UTP								VS UTP		
			VS 78/ 31 kPa		1.5			**ORGANIC SILT**: non plastic, dark brown black.	W	St	⊕⊙		**ORGANIC SILTS**
								SILT: medium plasticity, dark grey.	M to W				**ALLUVIAL SOILS**
					2.0			Hand Auger HA03 terminated at 1.8 m Collapse					
					2.5								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration (1 2 3) — no resistance ranging to refusal

water — 10-Oct-12 water level on date shown; water inflow; water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA04***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 2 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2855

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) ⊕ remoulded ⊙ peak (50 100 150 200)	DCP (blows/100 mm) (2 4 6 8 10)	structure and additional observations
HA N					0.0			**ORGANIC SILT**: non plastic, dark brown.	M				**TOPSOIL / FILL**
								SILT: low plasticity, pale brown mottled orange and black, with minor clay.	M				**FILL**
			VS 59/ 11 kPa					**ORGANIC SILT**: non plastic, black.	M to S	St to VSt	⊕⊙		**ORGANIC SILTS**
			VS 53/ 11 kPa		0.5						⊕⊙		
		08/05/21 ▽	VS 111/ 17 kPa								⊕ ⊙		
					1.0			**SILT**: low plasticity, pale brown grey, with some clay.	S				**ALLUVIAL SOILS**
								Hand Auger HA04 terminated at 1.2 m Collapse					
					1.5								
					2.0								
					2.5								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration (1 2 3) — no resistance ranging to refusal

water — 10-Oct-12 water level on date shown; water inflow; water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA05***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 2 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2855

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕remoulded ⊙peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA, N		08/05/21	VS 123/ 29 kPa		0.0			**SILT**: medium plasticity, pale brown mottled orange and black, with some clay and minor fine to medium grained sand.	M to S	St to VSt	⊕ ⊙		**FILL**
			VS 59/ 11 kPa		0.5			0.5 m: with some fine to coarse grained sand			⊕ ⊙		
			VS 56/ 8 kPa		1.0						⊕ ⊙		
			VS >172/ 42 kPa					**ORGANIC SILT**: non plastic, dark brown black.	W	VSt	⊕ ⊙		**ORGANIC SILTS**
			VS 134/ 37 kPa		1.5						⊕ ⊙		
			VS 70/ 29 kPa		2.0			**SILT**: low plasticity, pale brown grey mottled black, with some clay. 1.9 m: becoming grey	M	St			**ALLUVIAL SOILS**
					2.5			Hand Auger HA05 terminated at 2.0 m Collapse			⊕ ⊙		

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA06***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: DR4523

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	vane shear ⊕remoulded ⊙peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		08/06/21 ▽	VS UTP		0.5			**ORGANIC SILT**: non plastic, dark brown black.	M to W				**TOPSOIL / FILL**
			VS UTP					**SILT**: medium plasticity, orange brown mottled black yellow, with trace fine to medium grained sand.	M to W	H	VS UTP		**FILL**
			VS >203 kPa		1.0			0.9 m: poor recovery 1.2 m: with black grey mottling			VS UTP		
			VS 121/ 34 kPa		1.5			1.5 m: becoming pale grey and dark brown					
								Sandy SILT: low plasticity, dark grey brown mottled black, sand is fine to medium grained.	M to W	VSt	⊕ ⊙		**ALLUVIAL SOILS**
			VS 87/ 23 kPa		2.0			**ORGANIC SILT**: low plasticity, black dark grey.	M to W	St	⊕ ⊙		**ORGANIC SILTS**
								SILT: low plasticity, pale grey, with minor clay.	M to W				**ALLUVIAL SOILS**
					2.5			Hand Auger HA06 terminated at 2.5 m					

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA07***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***NI***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2459

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) remoulded ⊕ peak ⊙ 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA / N		08/06/21 ▽	VS >195/ 23 kPa		0.0			**ORGANIC SILT**: low plasticity, dark brown.	W				**TOPSOIL / FILL**
								SILT: low plasticity, pale brown mottled orange brown and dark brown, with minor clay and minor fine to coarse grained sand.	W	VSt	⊕ ⊙		**FILL**
			VS 192/ 6 kPa		0.5			**Clayey SILT**: low plasticity, orange brown mottled dark brown and red brown, with minor fine to coarse grained sand.	W	VSt	⊕ ⊙		
			VS >195 kPa					**Sandy SILT**: low plasticity, brown mottled dark brown, sand is fine to coarse grained with minor clay.	W	VSt	⊙		
			VS 141/ 33 kPa		1.0			**Clayey SILT**: low plasticity, orange brown mottled dark brown and pale grey, with some fine to coarse grained sand.	W to S	VSt	⊕ ⊙		
			VS 108/ 33 kPa		1.5			**ORGANIC SILT**: low plasticity, black.	W to S	VSt	⊕ ⊙		**ORGANIC SILTS**
			VS 47/ 10 kPa		2.0			**SILT**: low plasticity, pale brown, with trace clay. 2.2 m: poor recovery	W	F	⊕ ⊙		**ALLUVIAL SOILS**
			VS 33/ 6 kPa		2.5			Hand Auger HA07 terminated at 2.5 m					

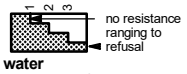
CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

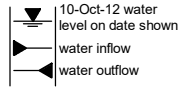
support
- M mud
- C casing
- N nil

penetration



no resistance ranging to refusal

water


10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA08***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: DR4523

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		Not Encountered	VS UTP VS 121/ 28 kPa VS 72/ 14 kPa VS UTP VS 118/ 14 kPa VS 118/ 34 kPa VS 121/ 18 kPa		0.5 1.0 1.5 2.0 2.5			**ORGANIC SILT**: low plasticity, black dark brown.	M				**TOPSOIL / FILL**
								SILT: low plasticity, orange brown speckled yellow black orange white, with minor clay. 0.7 m: becoming mottled black yellow 1.0 m: with trace fine to medium grained sand	D to M	St to H	VS UTP		**FILL**
								SILT: non plastic, dark grey mottled black white orange brown, with some fine to medium grained sand. 1.4 m: sand is becoming minor fine to medium grained 1.6 m: with trace fine to medium grained pumaceous gravel 1.7 m: becoming pale grey	M	VSt to H	VS UTP		
								SILT: low plasticity, pale grey mottled blue.	M	VSt			**ALLUVIAL SOILS**
								ORGANIC SILT: low plasticity, black. 2.1 to 2.3 m: with trace fine to medium grained sand	M				**ORGANIC SILTS**
								SILT: medium plasticity, pale grey, with minor clay.	M	VSt			**ALLUVIAL SOILS**
								Hand Auger HA08 terminated at 2.5 m					

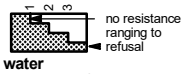
CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

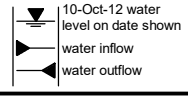
support
- M mud
- C casing
- N nil

penetration



no resistance ranging to refusal

water



10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA09***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***AT***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: DR4523

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	vane shear ⊕remoulded ⊙peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		08/06/21	VS >203 kPa VS 34/ 0 kPa VS >203 kPa VS 75/ 28 kPa VS 75/ 22 kPa VS UTP		0.5 1.0 1.5 2.0 2.5			**ORGANIC SILT**: non plastic, black.	M				**TOPSOIL / FILL**
								Clayey SILT: low plasticity, orange brown mottled pale yellow orange.	M	F to H			**FILL**
								0.7 m: with trace fine to medium grained sand					
								1.5 m: with minor fine to medium grained sand					
								SILT: low plasticity, pale grey mottled blue, with minor clay.	M	VSt			**ALLUVIAL SOILS**
								ORGANIC SILT: low plasticity, black.	M				**ORGANIC SILTS**
								SILT: low plasticity, pale grey, with minor clay.	M	H	VS UTP		**ALLUVIAL SOILS**
								Hand Auger HA09 terminated at 2.5 m					

CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA10***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***NI***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2459

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	vane shear ⊕remoulded ⊙peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		08/06/21			0.0			**ORGANIC SILT**: low plasticity, dark brown.	W to S				**ORGANIC SILTS**
			VS 53/ 3 kPa		0.5			**SILT**: low plasticity, pale grey mottled orange, with minor clay.	W to S	S to F	⊕		**ALLUVIAL SOILS**
			VS 39/ 10 kPa					0.8 m: becoming pale brown, non-plastic, poor recovery			⊕		
					1.0			1.0 m: very poor recovery					
			VS 17/ 6 kPa								⊕		
			VS 20/ 6 kPa		1.5			1.6 m: becoming blue grey, traces of fine rootlets			⊕		
			VS 20/ 6 kPa		2.0						⊕		
			VS 50/ 10 kPa								⊕		
					2.5			Hand Auger HA10 terminated at 2.5 m					

CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA11***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***NI***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2459

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) ⊕ remoulded ⊙ peak (50 100 150 200)	DCP (blows/ 100 mm) (2 4 6 8 10)	structure and additional observations
HA / N		Not Encountered	VS 183/ 78 kPa		0.0			**ORGANIC SILT**: non plastic, dark brown.	M				**TOPSOIL / FILL**
								SILT: low plasticity, orange brown mottled dark brown, with minor clay and minor fine to coarse grained sand.	M				**FILL**
								CLAY: high plasticity, yellow orange.	M	VSt	⊕ ⊙		
			VS 47/ 6 kPa		0.5			**SILT**: low plasticity, orange brown mottled dark brown, with minor clay and minor fine to coarse grained sand.	W	F	⊕ ⊙		
			VS 97/ 39 kPa					**CLAY**: high plasticity, orange brown.	W	St	⊕ ⊙		
					1.0			1.0 m: becoming wet, slightly plastic					
			VS 72/ 23 kPa					**Clayey SILT**: low plasticity, orange brown mottled yellow dark brown.	W to S	St	⊕ ⊙		
			VS 125/ 33 kPa		1.5			**ORGANIC SILT**: low plasticity, black.	W	VSt	⊕ ⊙		**ORGANIC SILTS**
								SILT: low plasticity, pale grey, with minor clay.	W	H			**ALLUVIAL SOILS**
			VS >195 kPa		2.0			Hand Auger HA11 terminated at 2.0 m			⊙		
					2.5								

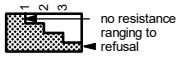
CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

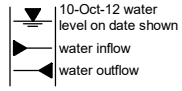
support
- M mud
- C casing
- N nil

penetration



no resistance ranging to refusal

water


10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA12***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***NI***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2459

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		08/06/21			0.0			**ORGANIC SILT**: low plasticity, dark brown.	W				**ORGANIC SILTS**
								0.3 m: with minor fine to coarse grained sand					
			VS 141/ 6 kPa		0.5			**SILT**: non plastic to low plasticity, pale grey mottled orange, with minor clay.	W	S to VSt	⊕ ⊙		**ALLUVIAL SOILS**
								0.7 m: becoming pale brown, poor recovery					
			VS 47/ 6 kPa								⊕⊙		
					1.0			1.0 m: clay absent, becoming non-plastic					
			VS 27 kPa								⊙		
					1.5			1.5 m: becoming blue grey			⊕		
			VS 20/ 3 kPa					1.6 m: very poor recovery					
			VS 17/ 6 kPa		2.0						⊙		
			VS 17/ 6 kPa								⊙		
					2.5			Hand Auger HA12 terminated at 2.5 m					

CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

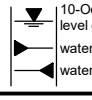
* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration

no resistance ranging to refusal

water



10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TETRA TECH COFFEY

Engineering Log - Hand Auger

Borehole ID.	***HA13***
sheet:	1 of 1
project no.	***773-TRGGE290946***
client:	***Te Puna Industrial Limited***
date started:	***11 Aug 2021***
principal:	
date completed:	***11 Aug 2021***
project:	***297 Te Puna Station Road, Te Puna***
logged by:	***NI***
location:	***Stage 1 area. See plan.***
checked by:	***DBC***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: Hand Auger | drilling fluid: | hole diameter : 50 mm | vane id.: 2459

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N		08/06/21			0.0			**ORGANIC SILT**: low plasticity, dark brown.	W				**ORGANIC SILTS**
			VS 136/ 33 kPa		0.5			**SILT**: non plastic to low plasticity, pale brown grey mottled pale grey orange, minor clay. 0.5 m: becoming pale grey	W to S	F to VSt	⊕ ⊙		**ALLUVIAL SOILS**
			VS 56/ 6 kPa					0.8 m: poor recovery			⊕ ⊙		
			VS 33/ 3 kPa		1.0			1.0 m: becoming pale brown, clay absent 1.1 m: very poor recovery, traces of fine rootlets			⊕ ⊙		
			VS 47/ 6 kPa		1.5			1.6 m: becoming blue grey, non-plastic			⊕ ⊙		
			VS 33/ 6 kPa		2.0						⊕ ⊙		
			VS 30/ 6 kPa								⊕ ⊙		
					2.5			Hand Auger HA13 terminated at 2.5 m					

CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED + DCP FIELDLOG_2021_08_05.GPJ <<DrawingFile>> 17/08/2021 11:06

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

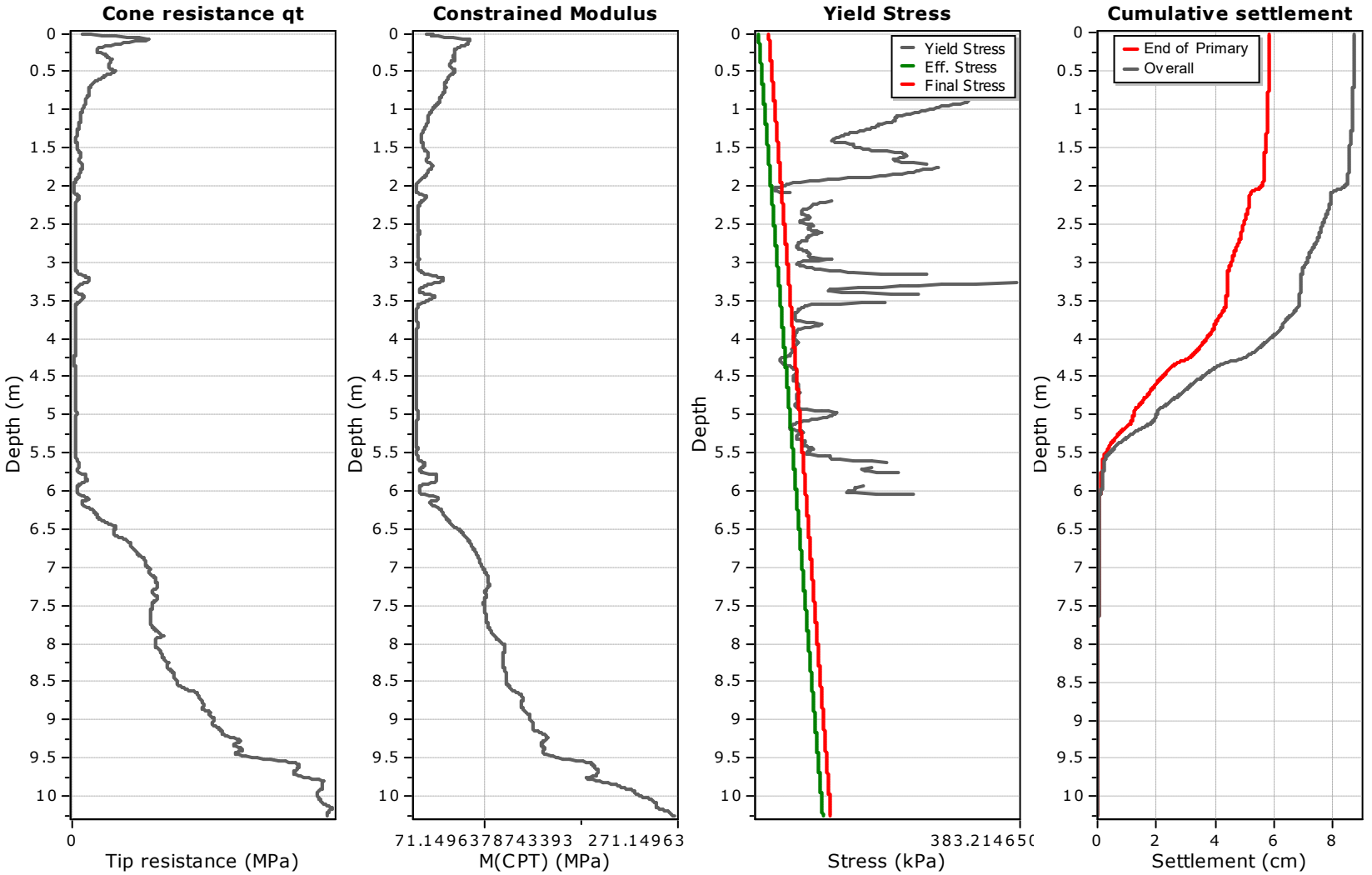
Appendix E- Settlement Analysis

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: CPT01
Total depth: 10.26 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 297 Te Puna Station Road
Location: 297 Te Puna Station Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 20.00 (m)
L/B: 2.0
Footing pressure: 15.00 (kPa)
Embedment depth: 0.00 (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

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1013	10.13	10.14	0.01	10.14	11.92	249.00	0.79	0.000	0.000	0.000
1014	10.14	10.15	0.01	10.15	11.92	249.05	0.79	0.000	0.000	0.000
1015	10.15	10.16	0.01	10.16	11.91	249.69	0.79	0.000	0.000	0.000
1016	10.16	10.17	0.01	10.17	11.91	250.50	0.79	0.000	0.000	0.000
1017	10.17	10.18	0.01	10.18	11.90	252.37	0.79	0.000	0.000	0.000
1018	10.18	10.19	0.01	10.19	11.90	254.85	0.79	0.000	0.000	0.000
1019	10.19	10.20	0.01	10.20	11.89	258.09	0.79	0.000	0.000	0.000
1020	10.20	10.21	0.01	10.21	11.88	260.46	0.79	0.000	0.000	0.000
1021	10.21	10.22	0.01	10.22	11.88	262.35	0.79	0.000	0.000	0.000
1022	10.22	10.23	0.01	10.23	11.87	263.14	0.79	0.000	0.000	0.000
1023	10.23	10.24	0.01	10.24	11.87	263.64	0.79	0.000	0.000	0.000
1024	10.24	10.25	0.01	10.25	11.86	264.35	0.79	0.000	0.000	0.000
1025	10.25	10.26	0.01	10.26	11.86	266.04	0.79	0.000	0.000	0.000

Total primary settlement: 5.83
Total secondary settlement: 2.88

Total calculated settlement: 8.72

Abbreviations

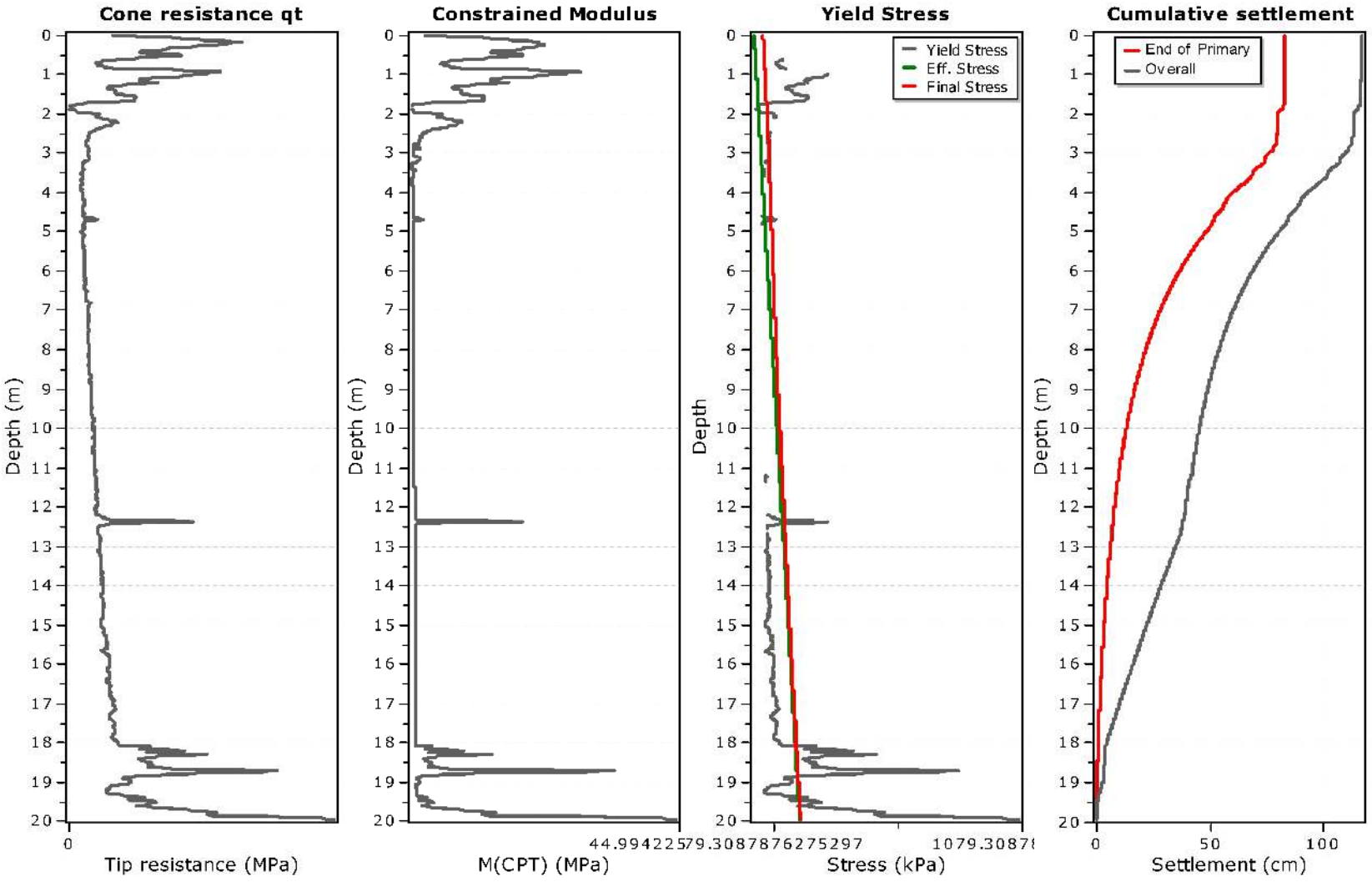
Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: CPT04
Total depth: 19.94 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **297 Te Puna Station Road**
Location: **297 Te Puna Station Road**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 10.00 (m)
L/B: 1.0
Footing pressure: 36.00 (kPa)
Embedment depth: 0.00 (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:

where t_p is the duration of primary consolidation

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1979	19.79	19.80	0.01	19.80	3.96	12.94	0.11	0.000	0.003	0.003
1980	19.80	19.81	0.01	19.81	3.96	12.25	0.11	0.000	0.003	0.003
1981	19.81	19.82	0.01	19.82	3.96	11.76	0.11	0.000	0.003	0.003
1982	19.82	19.83	0.01	19.83	3.95	11.83	0.11	0.000	0.003	0.003
1983	19.83	19.84	0.01	19.84	3.95	11.90	0.11	0.000	0.003	0.003
1984	19.84	19.85	0.01	19.85	3.95	12.96	0.11	0.000	0.003	0.003
1985	19.85	19.86	0.01	19.86	3.94	15.90	0.11	0.000	0.002	0.003
1986	19.86	19.87	0.01	19.87	3.94	21.22	0.11	0.000	0.002	0.002
1987	19.87	19.88	0.01	19.88	3.94	28.20	0.11	0.000	0.001	0.001
1988	19.88	19.89	0.01	19.89	3.93	35.17	0.11	0.000	0.001	0.001
1989	19.89	19.90	0.01	19.90	3.93	38.48	0.11	0.000	0.001	0.001
1990	19.90	19.91	0.01	19.91	3.92	40.45	0.11	0.000	0.001	0.001
1991	19.91	19.92	0.01	19.92	3.92	41.85	0.11	0.000	0.001	0.001
1992	19.92	19.93	0.01	19.93	3.92	42.75	0.11	0.000	0.001	0.001
1993	19.93	19.94	0.01	19.94	3.91	43.77	0.11	0.000	0.001	0.001

Total primary settlement: 83.19
Total secondary settlement: 33.67

Total calculated settlement: 116.86

Abbreviations

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

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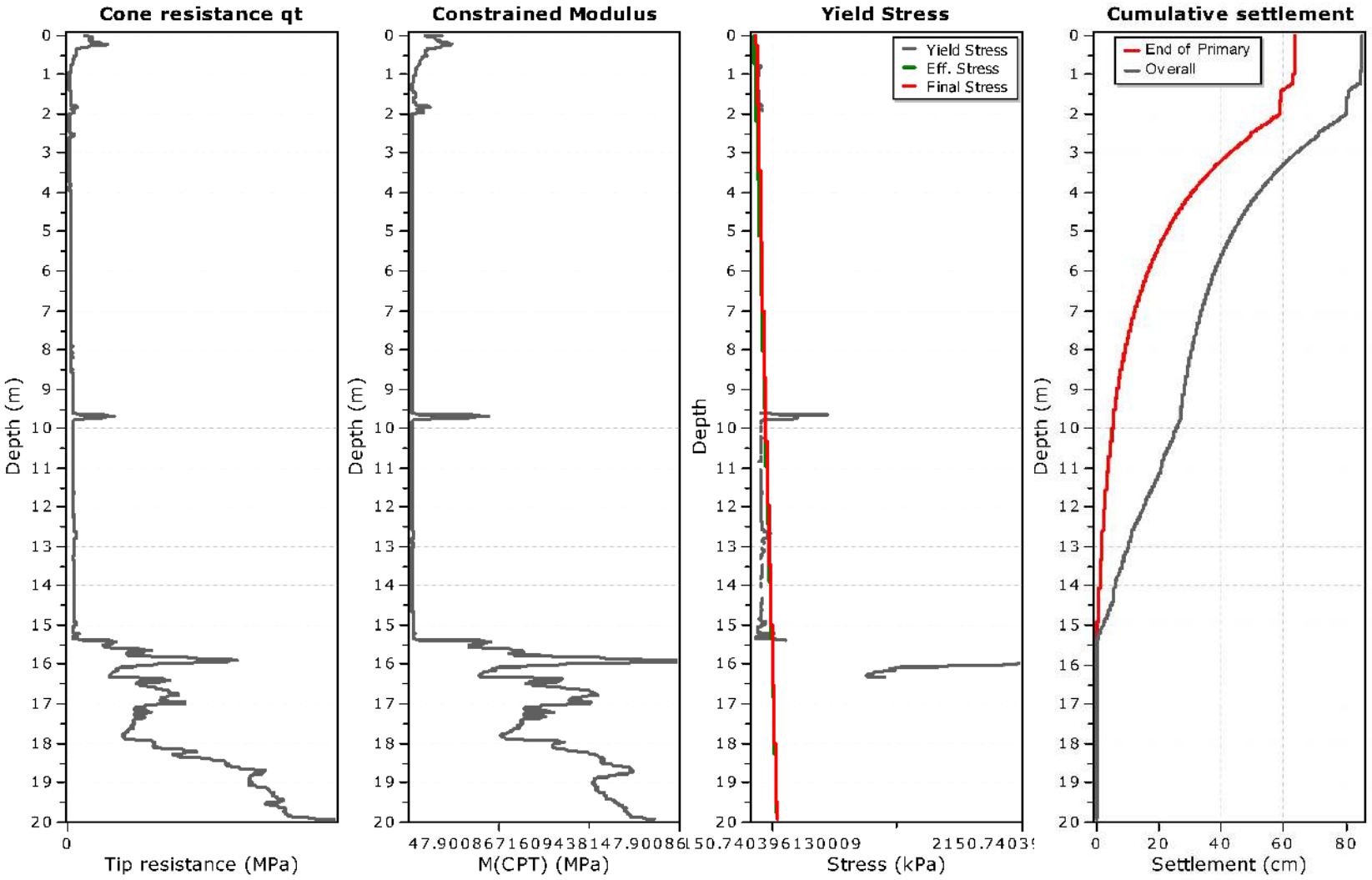
CPT: CPT05
Total depth: 19.93 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **297 Te Puna Station Road**
Location: **297 Te Puna Station Road**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 10.00 (m)
L/B: 1.0
Footing pressure: 18.00 (kPa)
Embedment depth: 0.00 (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:

where t_p is the duration of primary consolidation

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1979	19.79	19.80	0.01	19.80	1.98	119.38	0.11	0.000	0.000	0.000
1980	19.80	19.81	0.01	19.81	1.98	119.80	0.11	0.000	0.000	0.000
1981	19.81	19.82	0.01	19.82	1.98	120.24	0.11	0.000	0.000	0.000
1982	19.82	19.83	0.01	19.83	1.98	120.52	0.11	0.000	0.000	0.000
1983	19.83	19.84	0.01	19.84	1.97	120.64	0.11	0.000	0.000	0.000
1984	19.84	19.85	0.01	19.85	1.97	120.64	0.11	0.000	0.000	0.000
1985	19.85	19.86	0.01	19.86	1.97	120.78	0.11	0.000	0.000	0.000
1986	19.86	19.87	0.01	19.87	1.97	120.91	0.11	0.000	0.000	0.000
1987	19.87	19.88	0.01	19.88	1.97	121.13	0.11	0.000	0.000	0.000
1988	19.88	19.89	0.01	19.89	1.97	121.86	0.11	0.000	0.000	0.000
1989	19.89	19.90	0.01	19.90	1.96	123.53	0.11	0.000	0.000	0.000
1990	19.90	19.91	0.01	19.91	1.96	126.37	0.11	0.000	0.000	0.000
1991	19.91	19.92	0.01	19.92	1.96	129.30	0.11	0.000	0.000	0.000
1992	19.92	19.93	0.01	19.93	1.96	132.51	0.11	0.000	0.000	0.000

Total primary settlement: 63.60
Total secondary settlement: 21.50

Total calculated settlement: 85.10

Abbreviations

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

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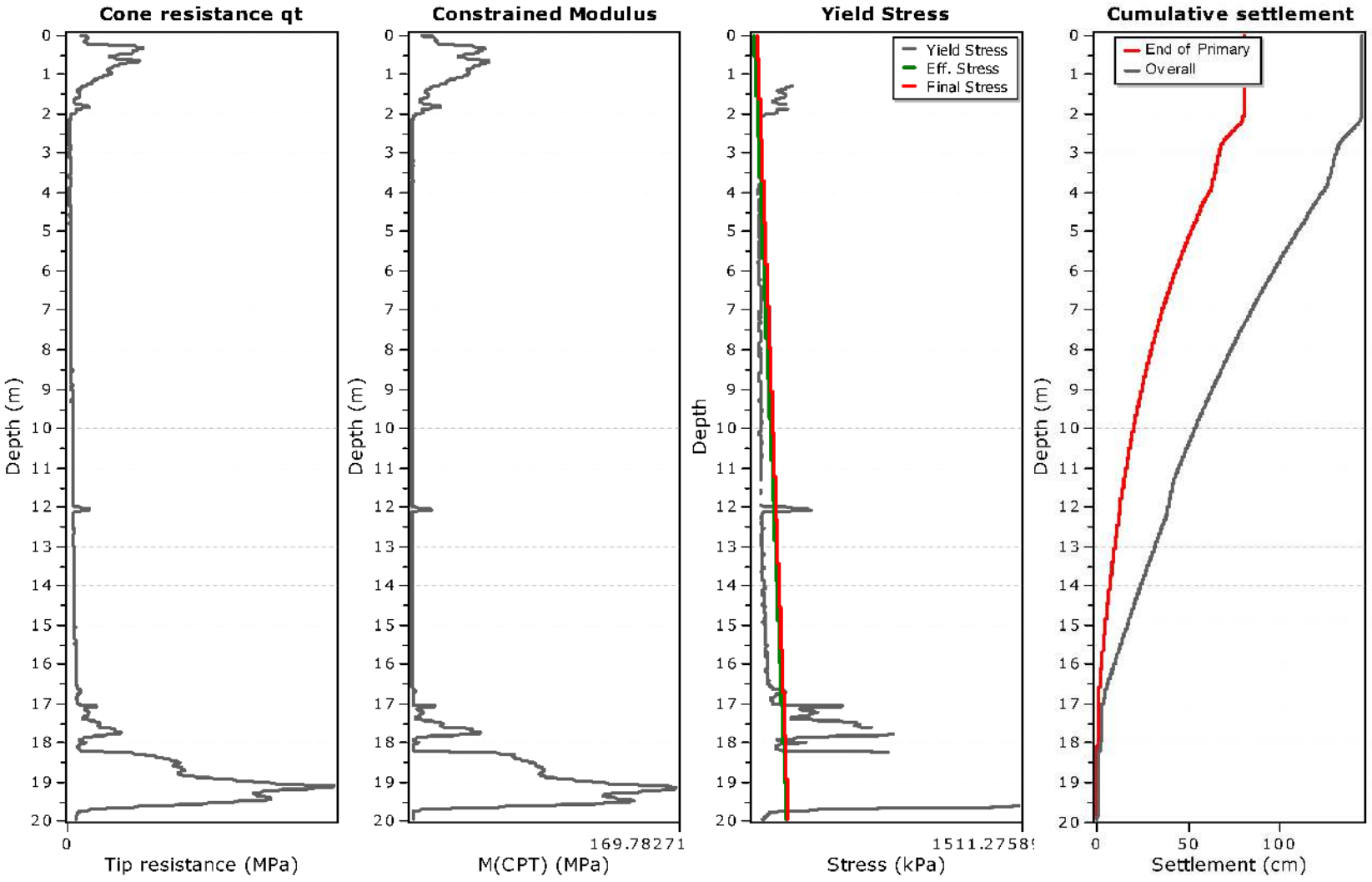
CPT: CPT10
Total depth: 19.94 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **297 Te Puna Station Road**
Location: **297 Te Puna Station Road**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 30.00 (m)
L/B: 1.0
Footing pressure: 18.00 (kPa)
Embedment depth: 0.00 (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:

where t_p is the duration of primary consolidation

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1979	19.79	19.80	0.01	19.80	9.98	0.73	0.55	0.014	0.050	0.064
1980	19.80	19.81	0.01	19.81	9.98	0.73	0.55	0.014	0.050	0.064
1981	19.81	19.82	0.01	19.82	9.97	0.73	0.55	0.014	0.050	0.064
1982	19.82	19.83	0.01	19.83	9.97	0.73	0.55	0.014	0.050	0.064
1983	19.83	19.84	0.01	19.84	9.96	0.73	0.55	0.014	0.050	0.064
1984	19.84	19.85	0.01	19.85	9.96	0.73	0.55	0.014	0.050	0.064
1985	19.85	19.86	0.01	19.86	9.95	0.73	0.55	0.014	0.050	0.064
1986	19.86	19.87	0.01	19.87	9.95	0.73	0.55	0.014	0.050	0.064
1987	19.87	19.88	0.01	19.88	9.94	0.73	0.55	0.014	0.050	0.064
1988	19.88	19.89	0.01	19.89	9.94	0.73	0.55	0.014	0.050	0.064
1989	19.89	19.90	0.01	19.90	9.93	0.73	0.55	0.014	0.050	0.064
1990	19.90	19.91	0.01	19.91	9.93	0.73	0.55	0.014	0.050	0.064
1991	19.91	19.92	0.01	19.92	9.92	0.73	0.55	0.014	0.050	0.064
1992	19.92	19.93	0.01	19.93	9.92	0.73	0.55	0.014	0.050	0.064
1993	19.93	19.94	0.01	19.94	9.91	0.73	0.55	0.014	0.050	0.064

Total primary settlement: 80.36
Total secondary settlement: 64.24

Total calculated settlement: 144.60

Abbreviations

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

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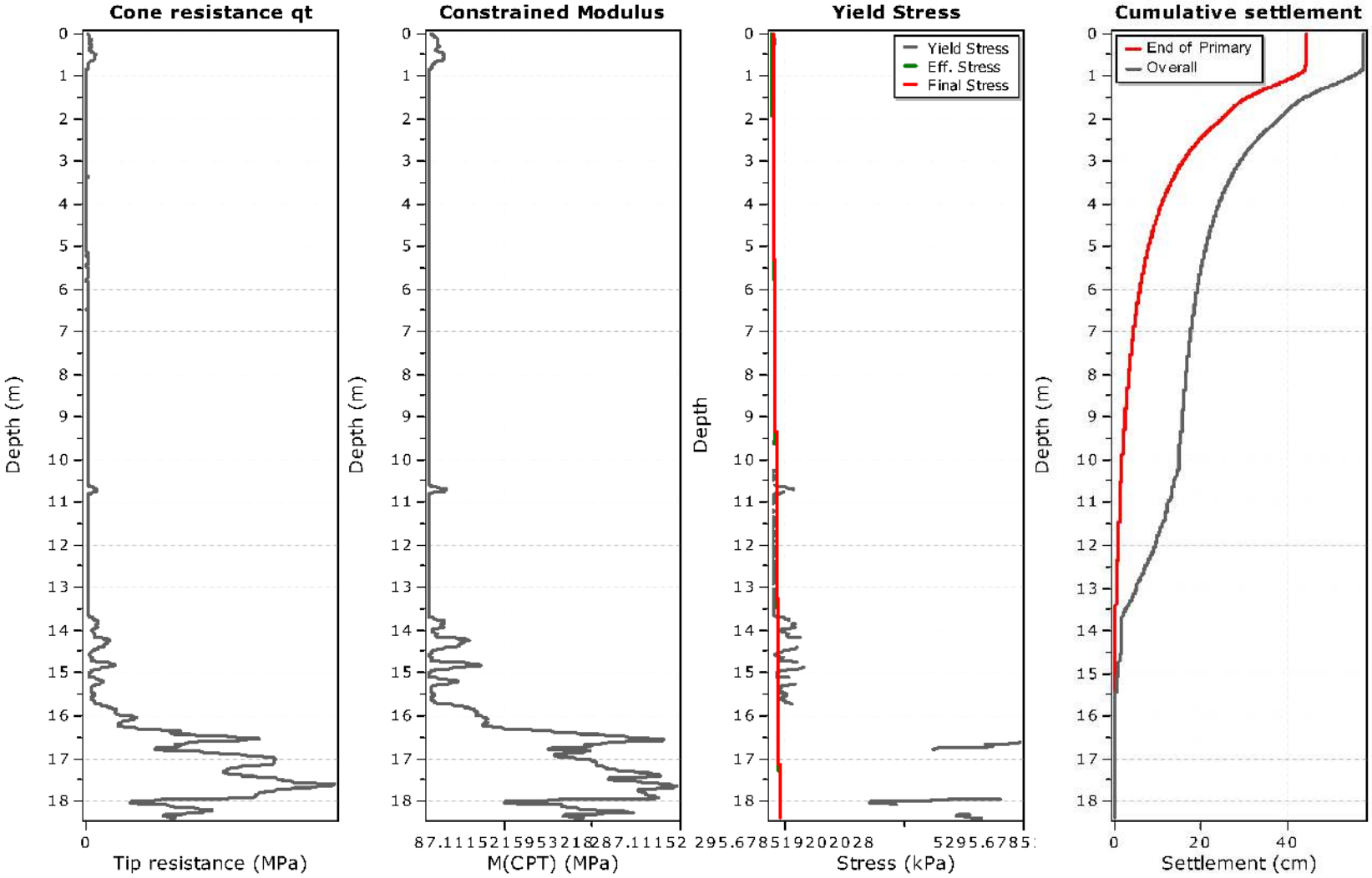
CPT: CPT11
Total depth: 18.39 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 297 Te Puna Station Road
Location: 297 Te Puna Station Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 2.00 (m)
L/B: 50.0
Footing pressure: 18.00 (kPa)
Embedment depth: 0.00 (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:

where t_p is the duration of primary consolidation

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)

Total primary settlement: 44.42
Total secondary settlement: 13.29

Total calculated settlement: 57.72

Abbreviations

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

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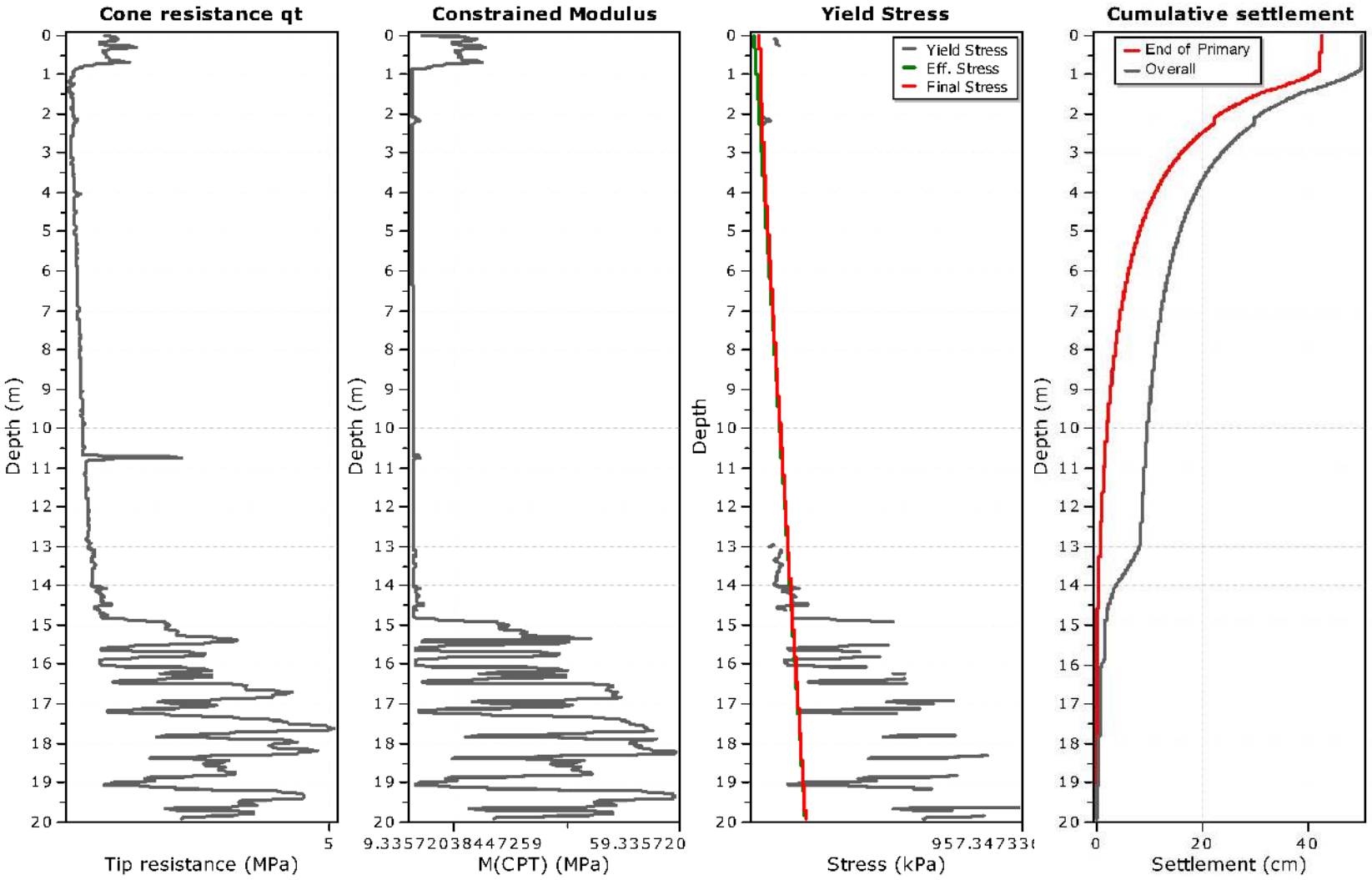
CPT: CPT12
Total depth: 19.93 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: 297 Te Puna Station Road
Location: 297 Te Puna Station Road

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 2.00 (m)
L/B: 50.0
Footing pressure: 18.00 (kPa)
Embedment depth: 0.00 (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:

where t_p is the duration of primary consolidation

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1979	19.79	19.80	0.01	19.80	1.15	44.52	0.06	0.000	0.000	0.000
1980	19.80	19.81	0.01	19.81	1.15	43.55	0.06	0.000	0.000	0.000
1981	19.81	19.82	0.01	19.82	1.15	42.06	0.06	0.000	0.000	0.000
1982	19.82	19.83	0.01	19.83	1.15	40.81	0.06	0.000	0.000	0.000
1983	19.83	19.84	0.01	19.84	1.15	39.41	0.06	0.000	0.000	0.000
1984	19.84	19.85	0.01	19.85	1.14	37.75	0.06	0.000	0.000	0.000
1985	19.85	19.86	0.01	19.86	1.14	35.44	0.06	0.000	0.000	0.000
1986	19.86	19.87	0.01	19.87	1.14	32.27	0.06	0.000	0.001	0.001
1987	19.87	19.88	0.01	19.88	1.14	27.36	0.06	0.000	0.001	0.001
1988	19.88	19.89	0.01	19.89	1.14	23.05	0.06	0.000	0.002	0.002
1989	19.89	19.90	0.01	19.90	1.14	20.18	0.06	0.000	0.002	0.002
1990	19.90	19.91	0.01	19.91	1.14	18.85	0.06	0.000	0.002	0.002
1991	19.91	19.92	0.01	19.92	1.14	18.34	0.06	0.000	0.002	0.002
1992	19.92	19.93	0.01	19.93	1.14	18.27	0.06	0.000	0.002	0.002

Total primary settlement: 42.62
Total secondary settlement: 7.73

Total calculated settlement: 50.35

Abbreviations

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

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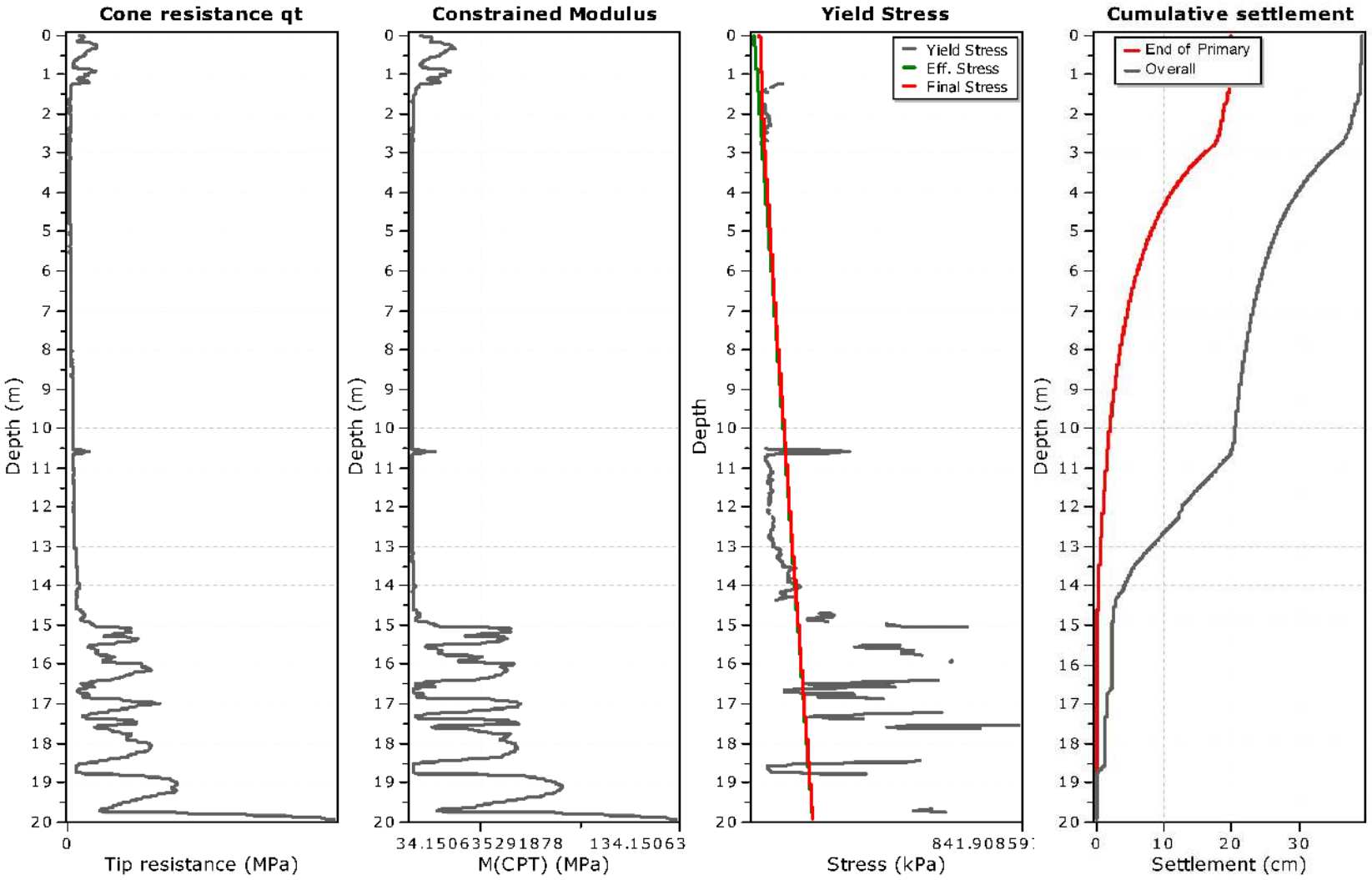
CPT: CPT13
Total depth: 19.93 m, Date: 25/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **297 Te Puna Station Road**
Location: **297 Te Puna Station Road**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 2.00 (m)
L/B: 50.0
Footing pressure: 18.00 (kPa)
Embedment depth: 0.00 (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:

where t_p is the duration of primary consolidation

:: Tabular results ::

Point No	Start depth (m)	End depth (m)	Thickness (m)	Relative depth (m)	Delta P (kPa)	$M_{(CPT)}$ (MPa)	Iz	Settlement (cm)	Second. settlement (cm)	Overall settlement (cm)
1979	19.79	19.80	0.01	19.80	1.15	77.16	0.06	0.000	0.000	0.000
1980	19.80	19.81	0.01	19.81	1.15	84.16	0.06	0.000	0.000	0.000
1981	19.81	19.82	0.01	19.82	1.15	89.89	0.06	0.000	0.000	0.000
1982	19.82	19.83	0.01	19.83	1.15	94.89	0.06	0.000	0.000	0.000
1983	19.83	19.84	0.01	19.84	1.15	98.93	0.06	0.000	0.000	0.000
1984	19.84	19.85	0.01	19.85	1.14	102.69	0.06	0.000	0.000	0.000
1985	19.85	19.86	0.01	19.86	1.14	107.15	0.06	0.000	0.000	0.000
1986	19.86	19.87	0.01	19.87	1.14	111.89	0.06	0.000	0.000	0.000
1987	19.87	19.88	0.01	19.88	1.14	116.40	0.06	0.000	0.000	0.000
1988	19.88	19.89	0.01	19.89	1.14	120.10	0.06	0.000	0.000	0.000
1989	19.89	19.90	0.01	19.90	1.14	123.54	0.06	0.000	0.000	0.000
1990	19.90	19.91	0.01	19.91	1.14	126.50	0.06	0.000	0.000	0.000
1991	19.91	19.92	0.01	19.92	1.14	128.99	0.06	0.000	0.000	0.000
1992	19.92	19.93	0.01	19.93	1.14	131.11	0.06	0.000	0.000	0.000

Total primary settlement: 19.86
Total secondary settlement: 19.46

Total calculated settlement: 39.32

Abbreviations

Start depth:	Start depth of soil layer (penetration depth measured from ground free surface)
End depth:	End depth of soil layer (penetration depth measured from ground free surface)
Thickness:	Thickness of soil layer
Relative depth:	Depth of calculation relative to footing
Iz:	Stress influence factor
Delta P:	Footing impossed stress:
Eff. stress:	Effective stress
$M_{(CPT)}$:	Constrained modulus from CPT
Settlement:	Primary settlement
Second. settlement:	Secondary settlemends due to creep

Appendix F - Liquefaction analysis

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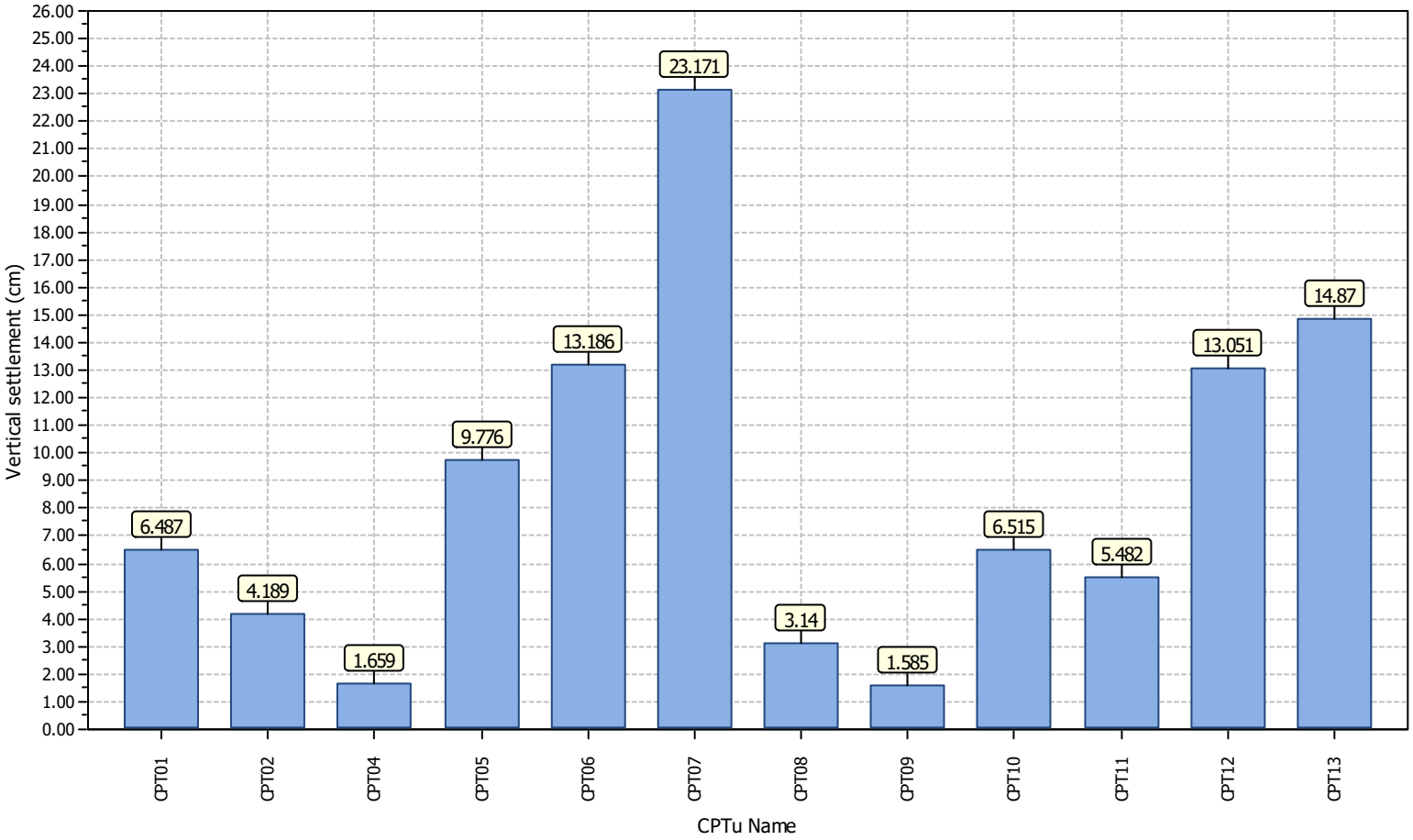
Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall vertical settlements report



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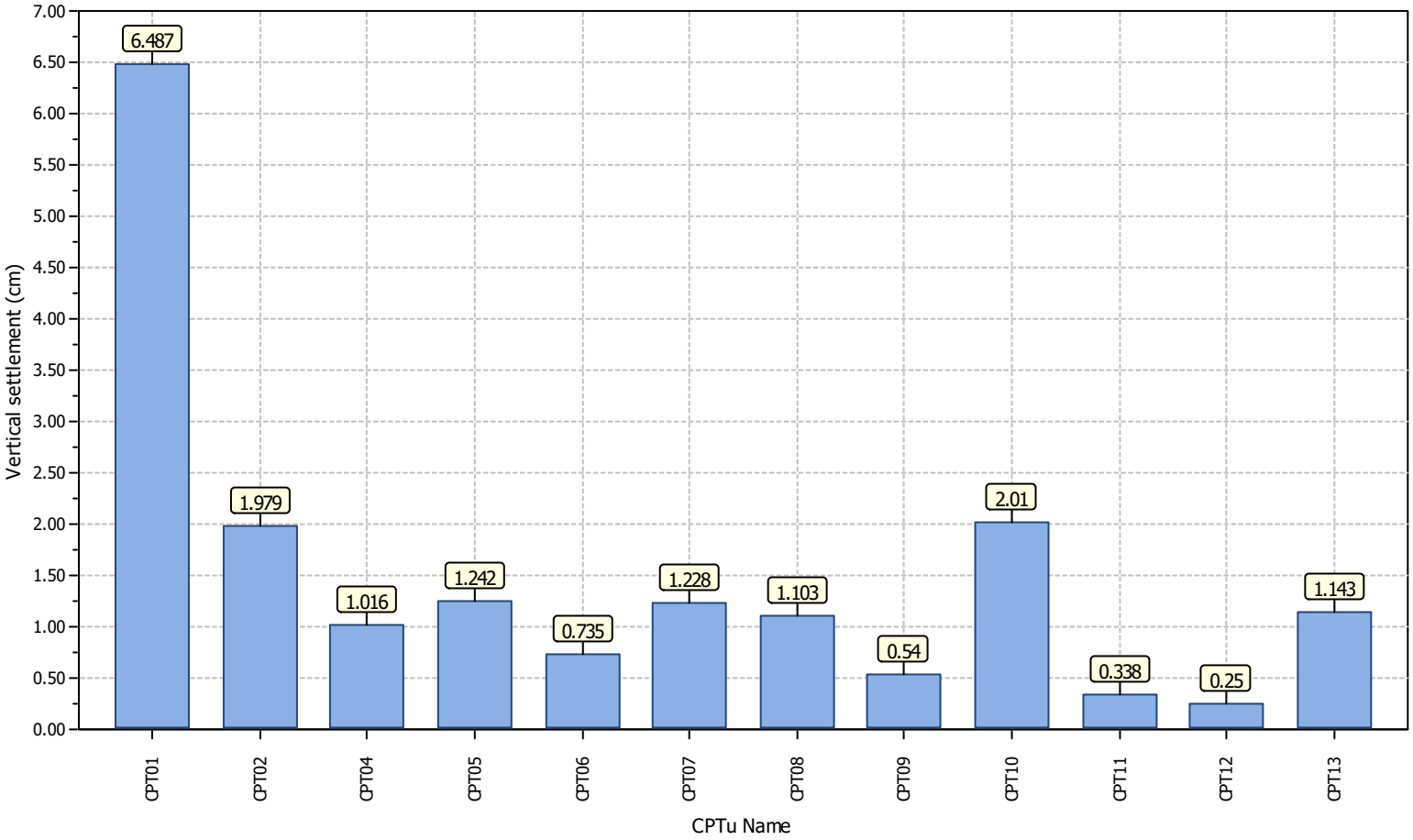
http://www.geologismiki.gr

Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall vertical settlements report



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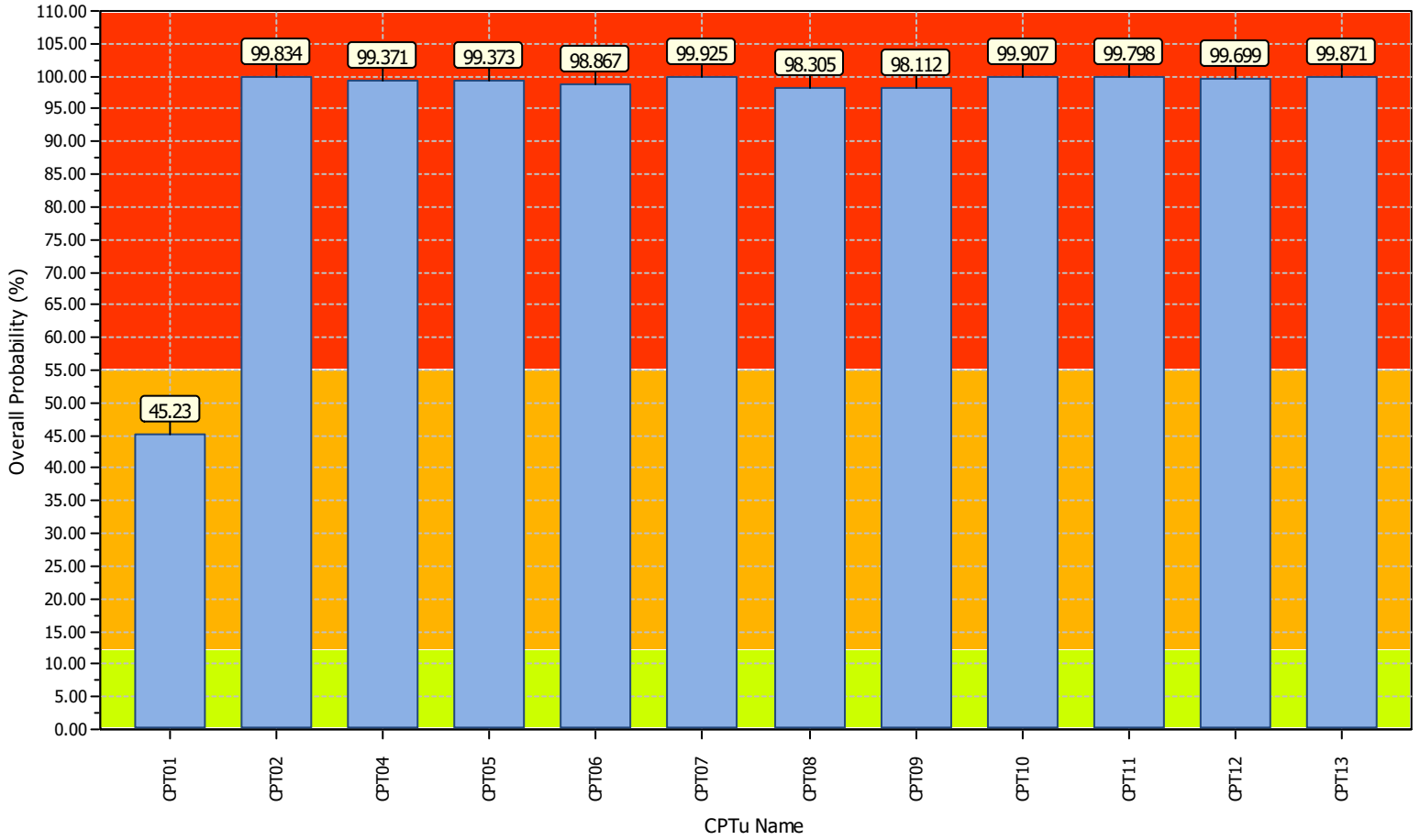
http://www.geologismiki.gr

Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall Probability for Liquefaction report



Probability color scheme

- Very High Probability
- High Probability
- Low Probability

Basic statistics

Total CPT number: 12
0% low probability
8% high probability
92% very high probability

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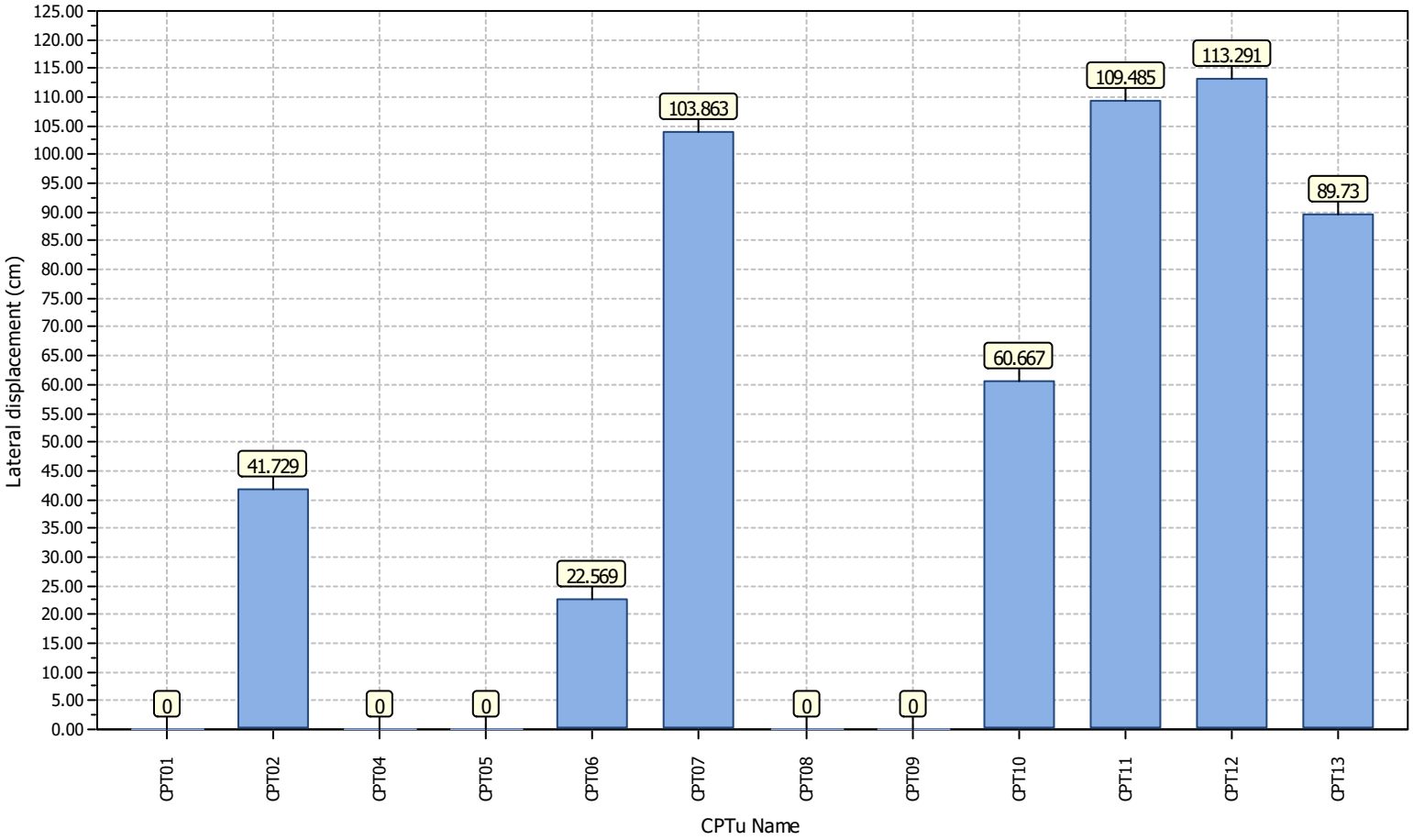
Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall lateral displacements report



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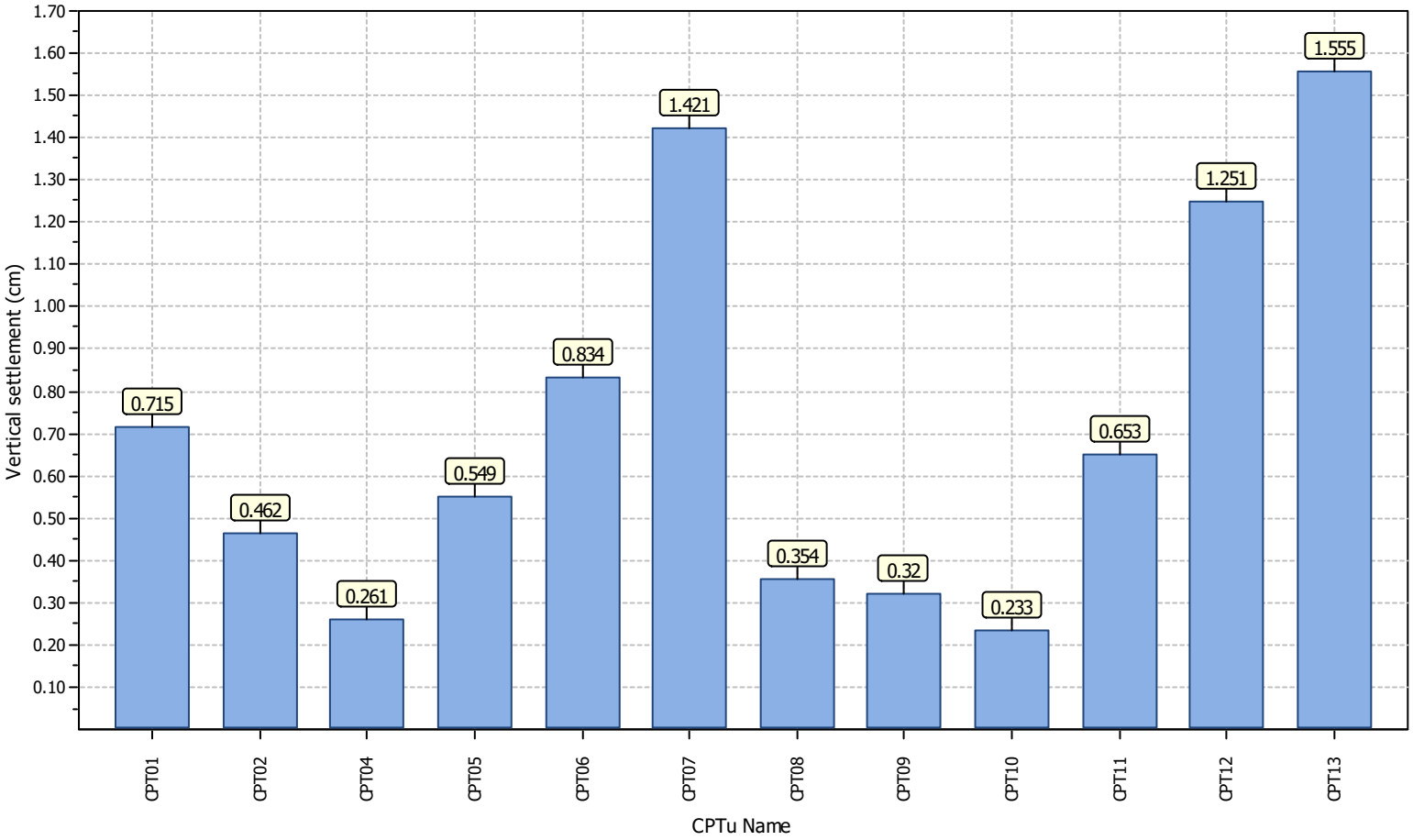
Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall vertical settlements report



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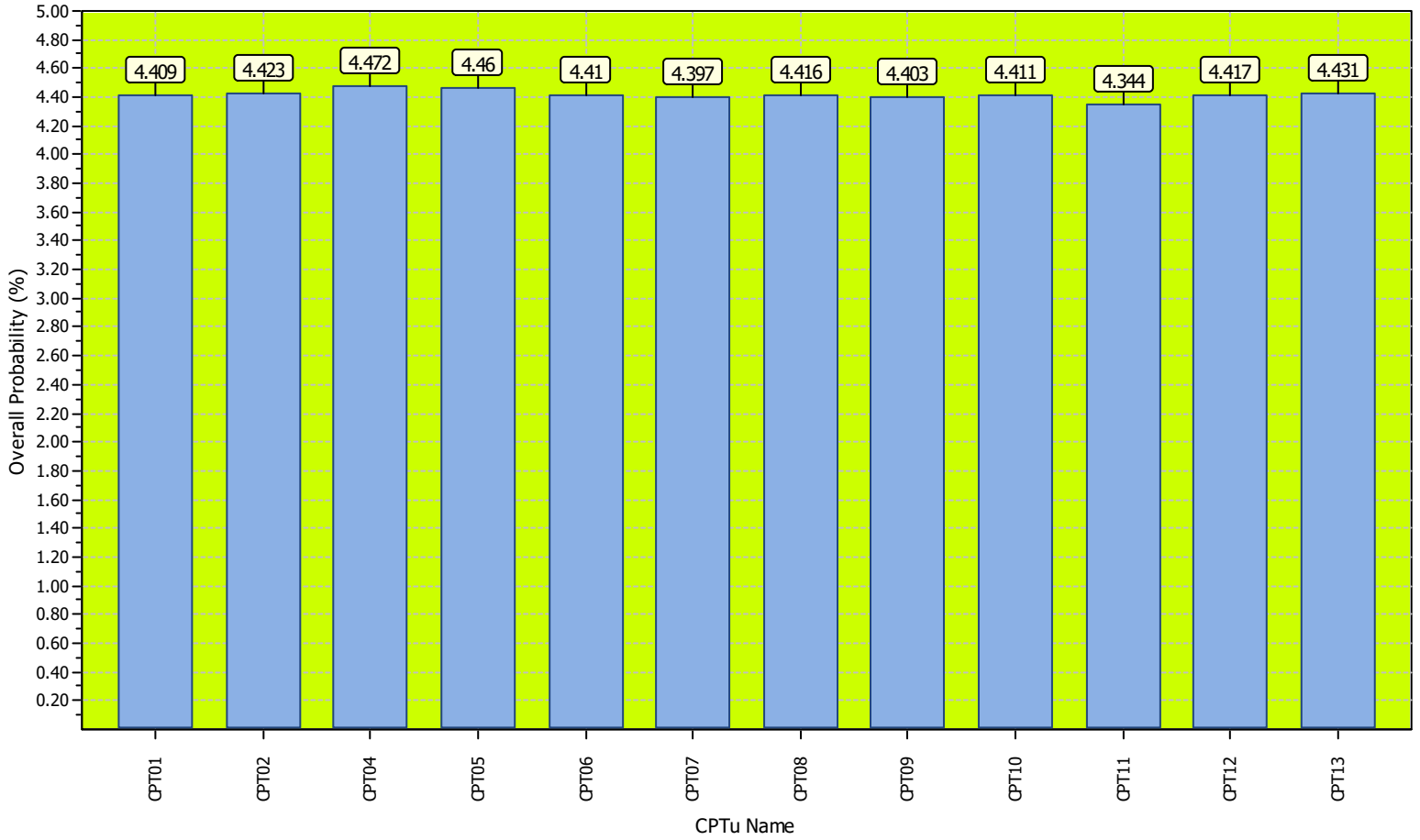
Merarhias 56
http://www.geologismiki.gr

Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall Probability for Liquefaction report



Probability color scheme

- Very High Probability
- High Probability
- Low Probability

Basic statistics

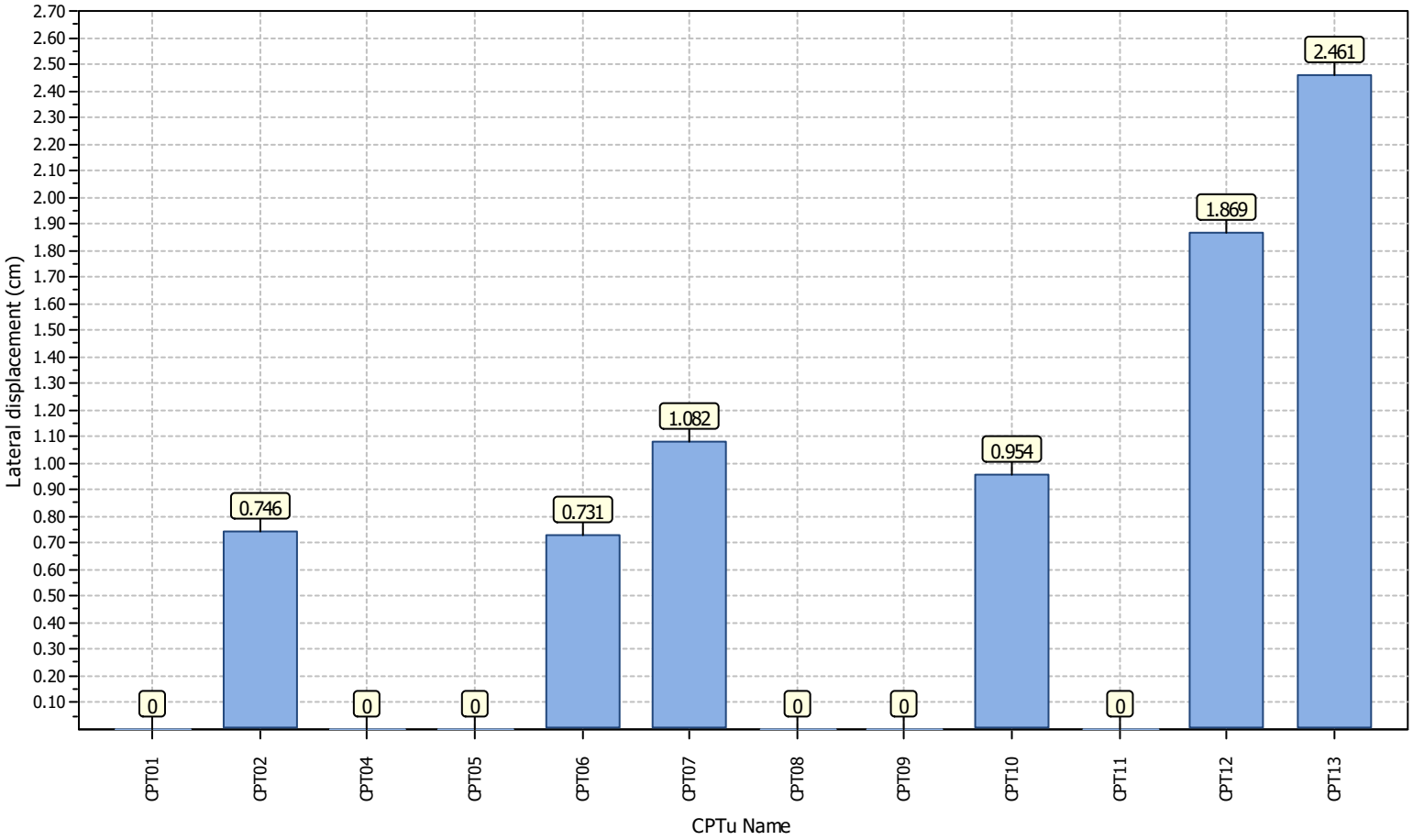
Total CPT number: 12
100% low probability
0% high probability
0% very high probability

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall lateral displacements report



GeoLogismiki
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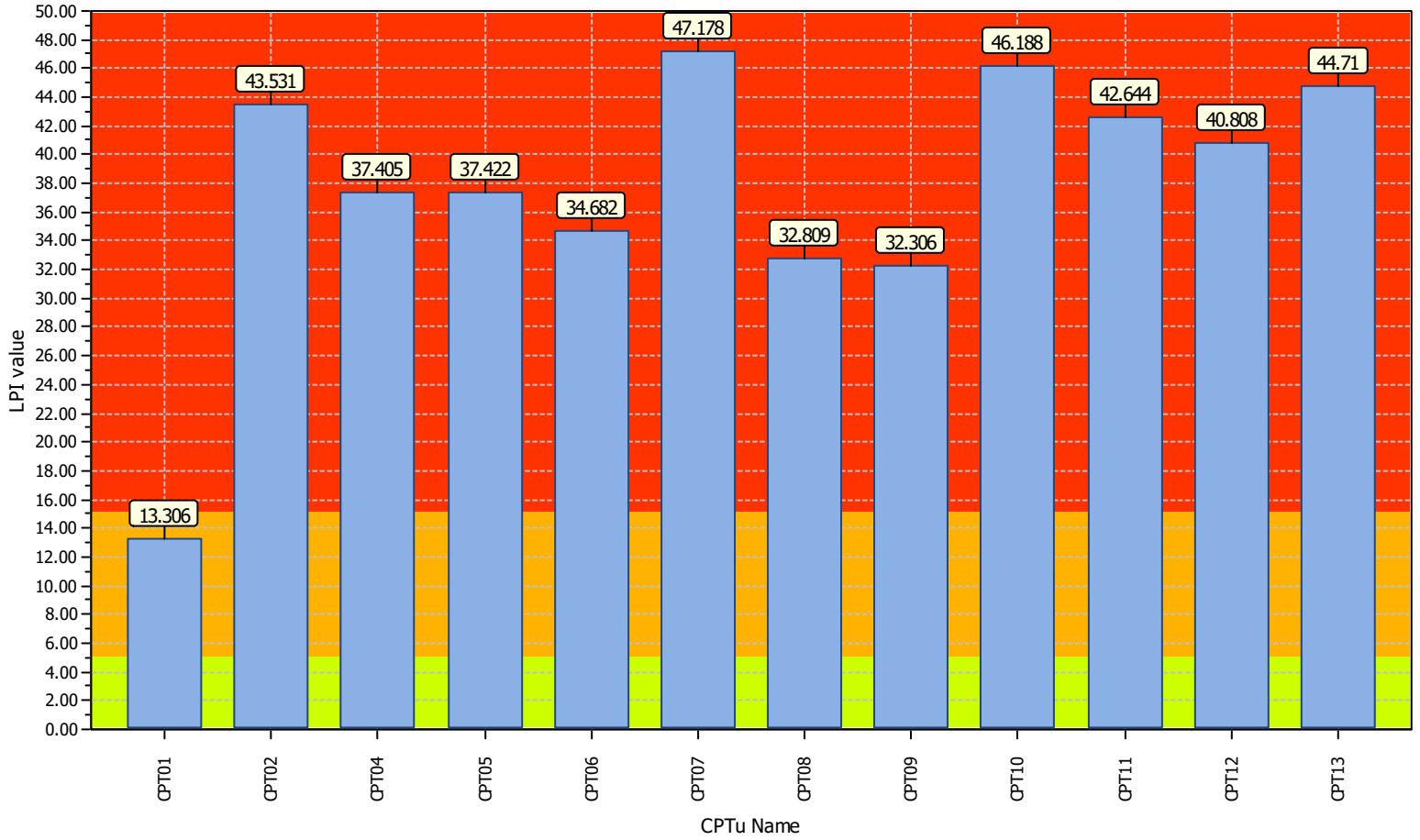
http://www.geologismiki.gr

Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

Total CPT number: 12
0% low risk
8% high risk
92% very high risk

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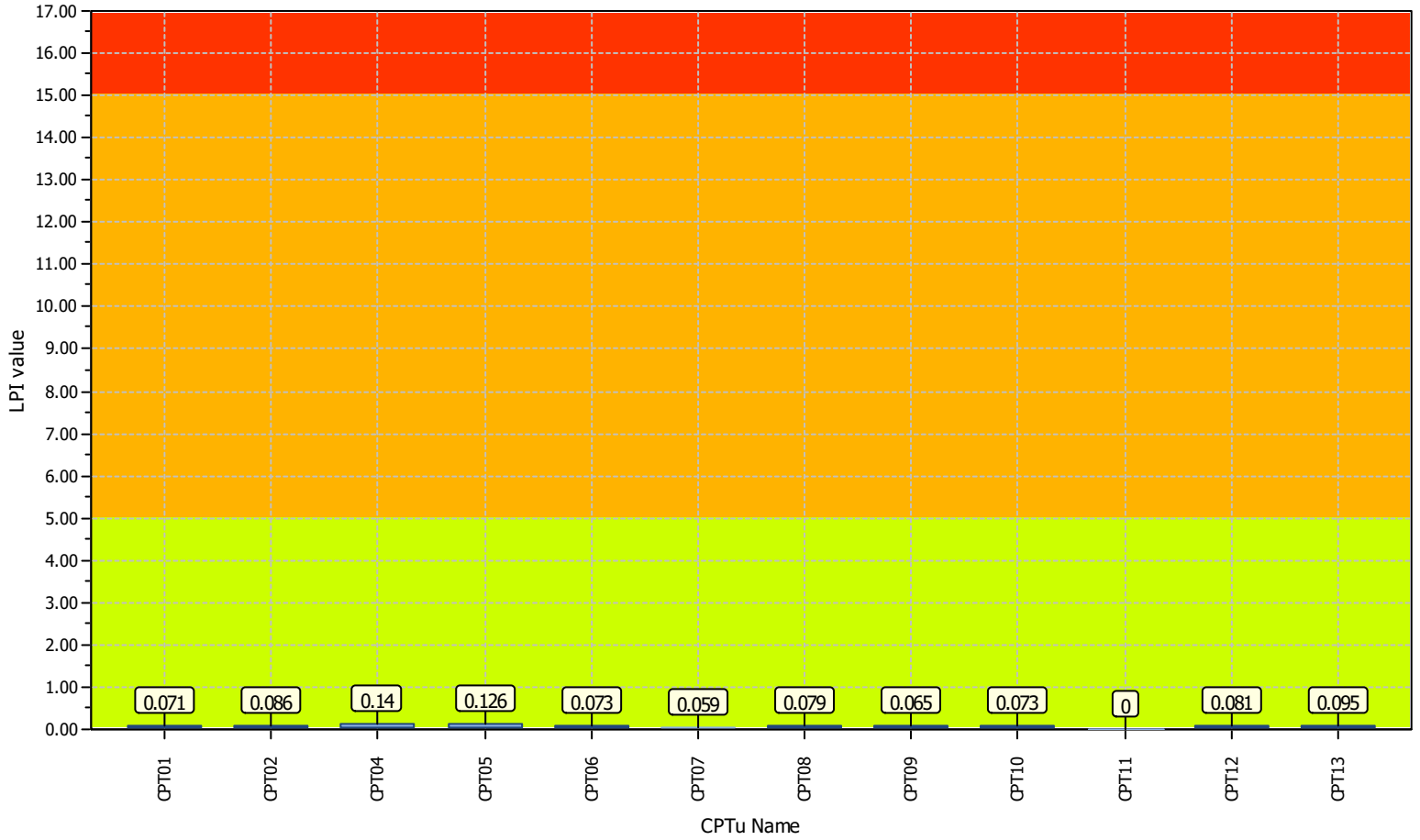
Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station Road

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

Total CPT number: 12
100% low risk
0% high risk
0% very high risk

GeoLogismiki
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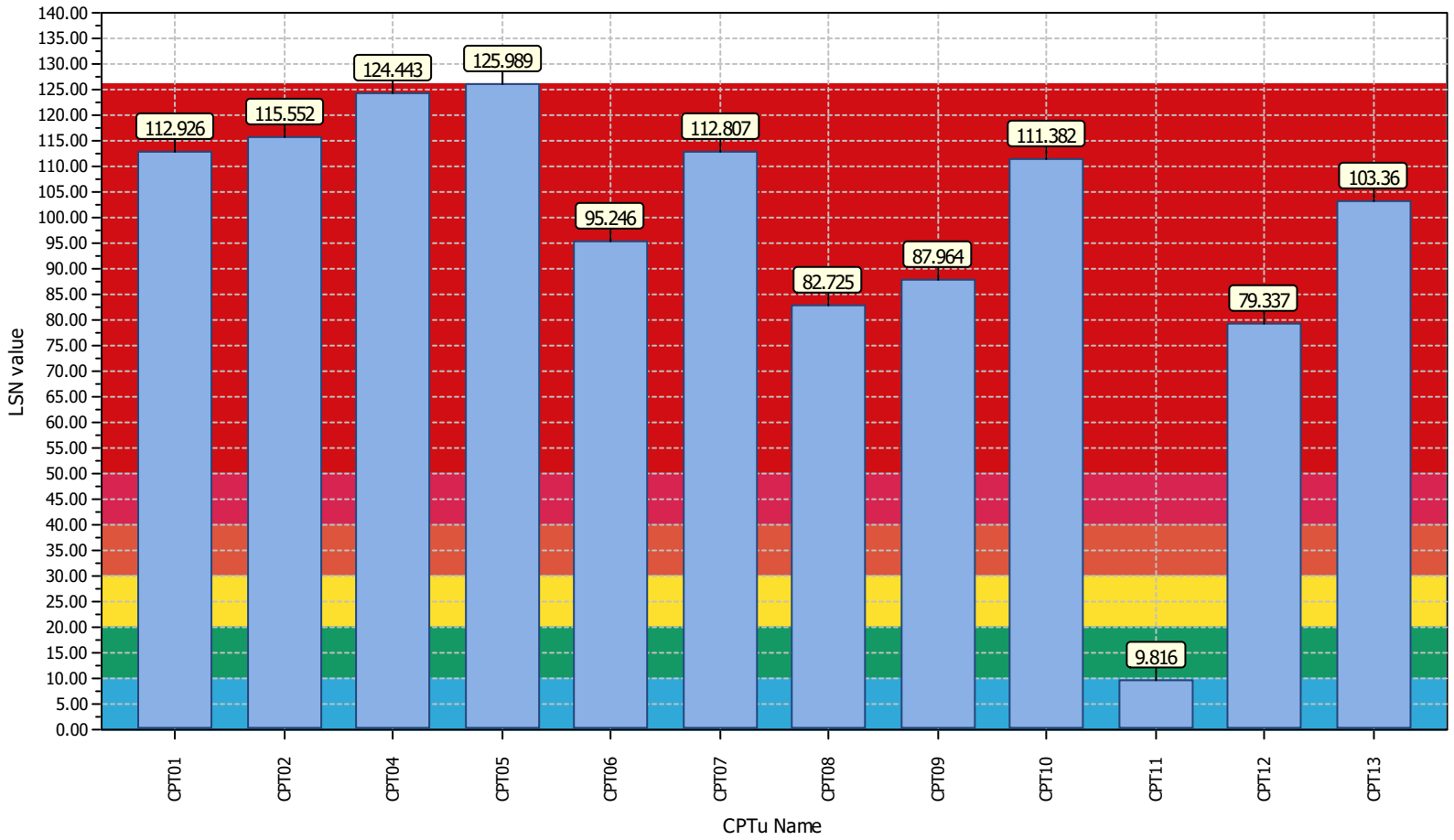
http://www.geologismiki.gr

Project title : 297 Te Puna Station Road

Location : 297 Te Puna Station 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

8% little liquefaction

0% minor liquefaction

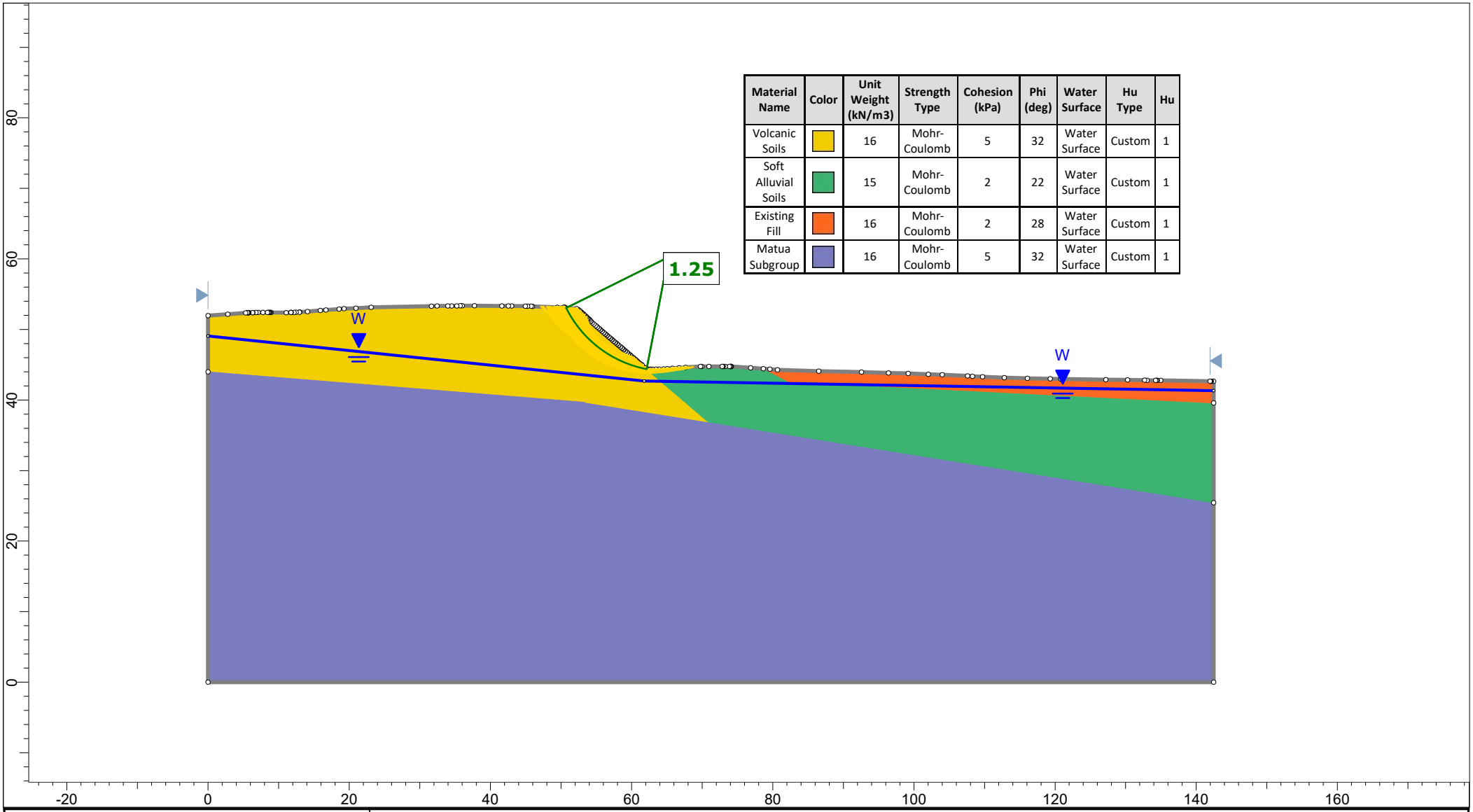
0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

92% severe liquefaction

Appendix G - Slope stability analysis



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Volcanic Soils		16	Mohr-Coulomb	5	32	Water Surface	Custom	1
Soft Alluvial Soils		15	Mohr-Coulomb	2	22	Water Surface	Custom	1
Existing Fill		16	Mohr-Coulomb	2	28	Water Surface	Custom	1
Matua Subgroup		16	Mohr-Coulomb	5	32	Water Surface	Custom	1

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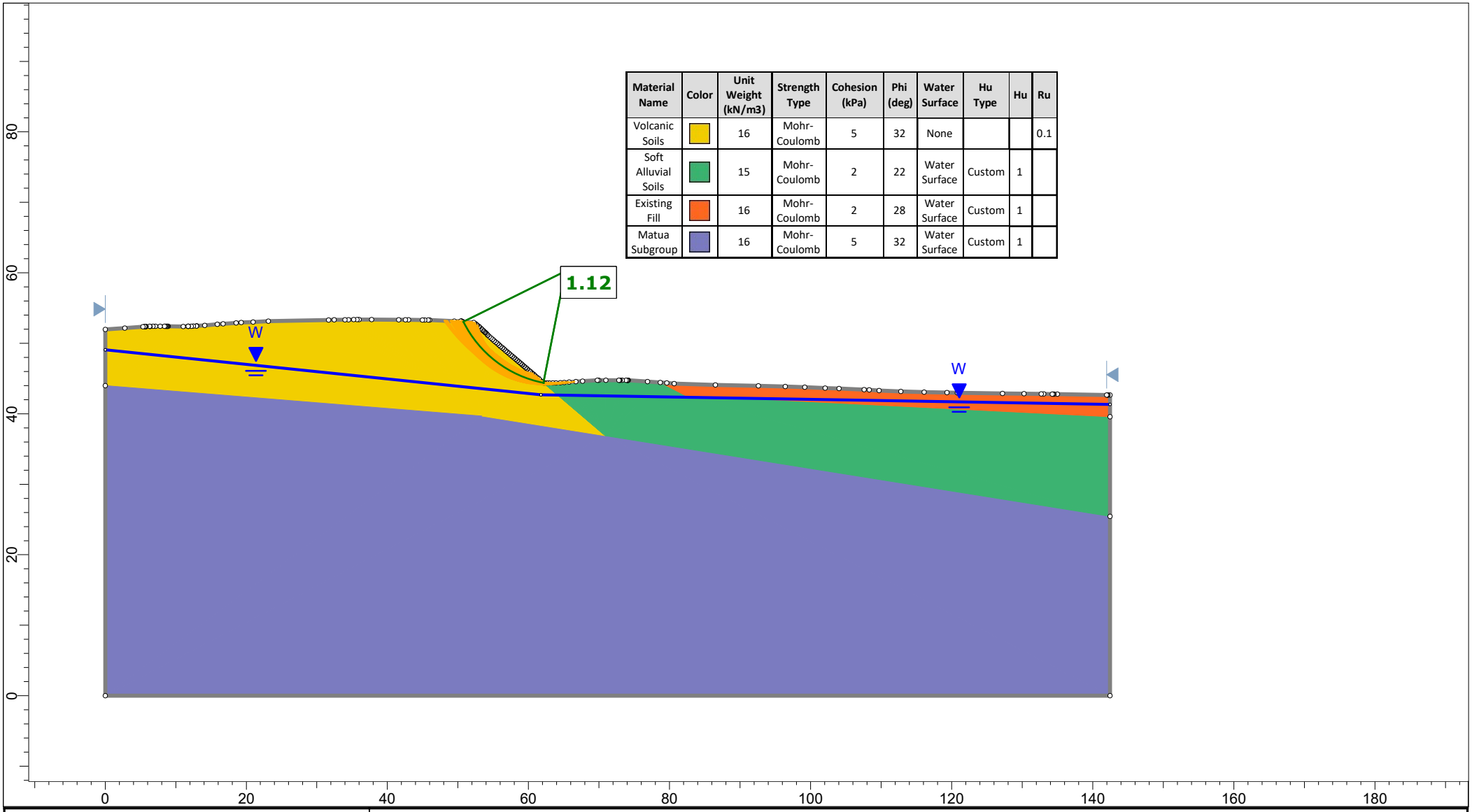
SLIDEINTERPRET 9.011

Project	Southern Boundary Slope		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	Scott Higginson	*Company*	WSP NZ Ltd.
Date	25/10/2022, 5:04:51 pm	*File Name*	Prevailing Case Current.slmd

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Volcanic Soils		16	Mohr-Coulomb	5	32	None			0.1
Soft Alluvial Soils		15	Mohr-Coulomb	2	22	Water Surface	Custom	1	
Existing Fill		16	Mohr-Coulomb	2	28	Water Surface	Custom	1	
Matua Subgroup		16	Mohr-Coulomb	5	32	Water Surface	Custom	1	



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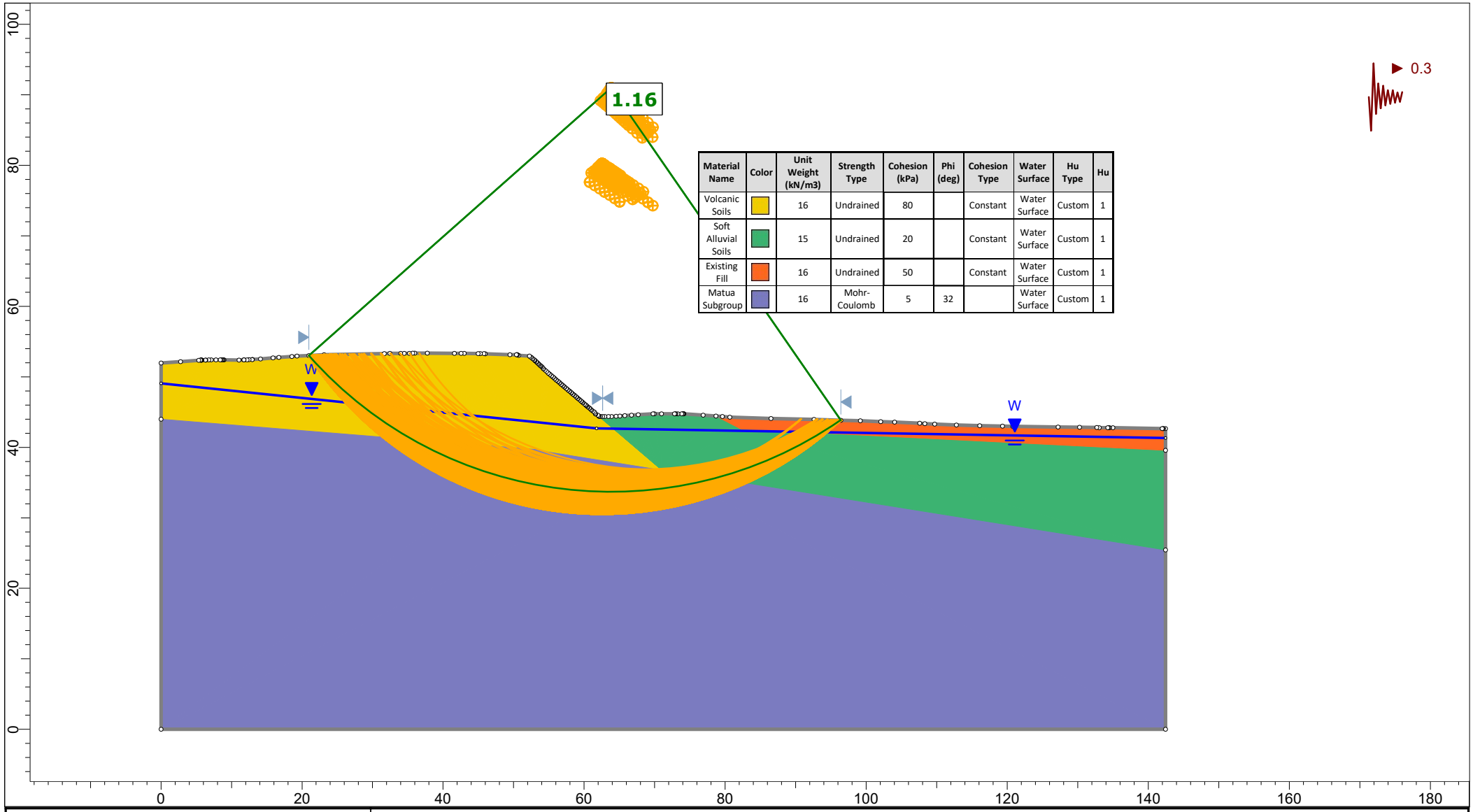
SLIDEINTERPRET 9.011

Project	Southern Boundary Slope		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	Scott Higginson	*Company*	WSP NZ Ltd.
Date	25/10/2022, 5:04:51 pm	*File Name*	Elevated Case Current.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
Volcanic Soils		16	Undrained	80		Constant	Water Surface	Custom	1
Soft Alluvial Soils		15	Undrained	20		Constant	Water Surface	Custom	1
Existing Fill		16	Undrained	50		Constant	Water Surface	Custom	1
Matua Subgroup		16	Mohr-Coulomb	5	32		Water Surface	Custom	1

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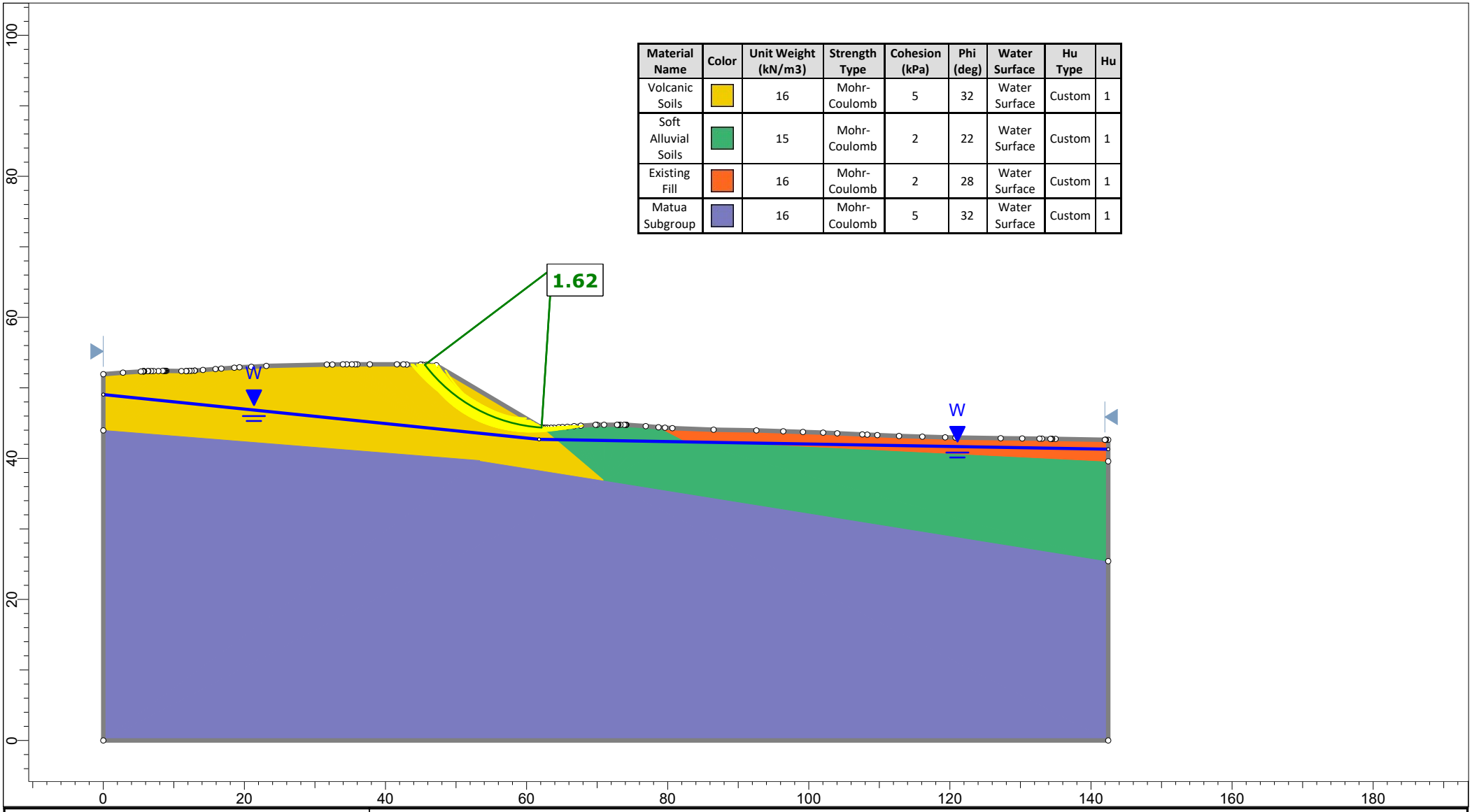
SLIDEINTERPRET 9.011

Project	Southern Boundary Slope		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	Scott Higginson	*Company*	WSP NZ Ltd.
Date	25/10/2022, 5:04:51 pm	*File Name*	Seismic Case Current.slmd

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu
Volcanic Soils		16	Mohr-Coulomb	5	32	Water Surface	Custom	1
Soft Alluvial Soils		15	Mohr-Coulomb	2	22	Water Surface	Custom	1
Existing Fill		16	Mohr-Coulomb	2	28	Water Surface	Custom	1
Matua Subgroup		16	Mohr-Coulomb	5	32	Water Surface	Custom	1



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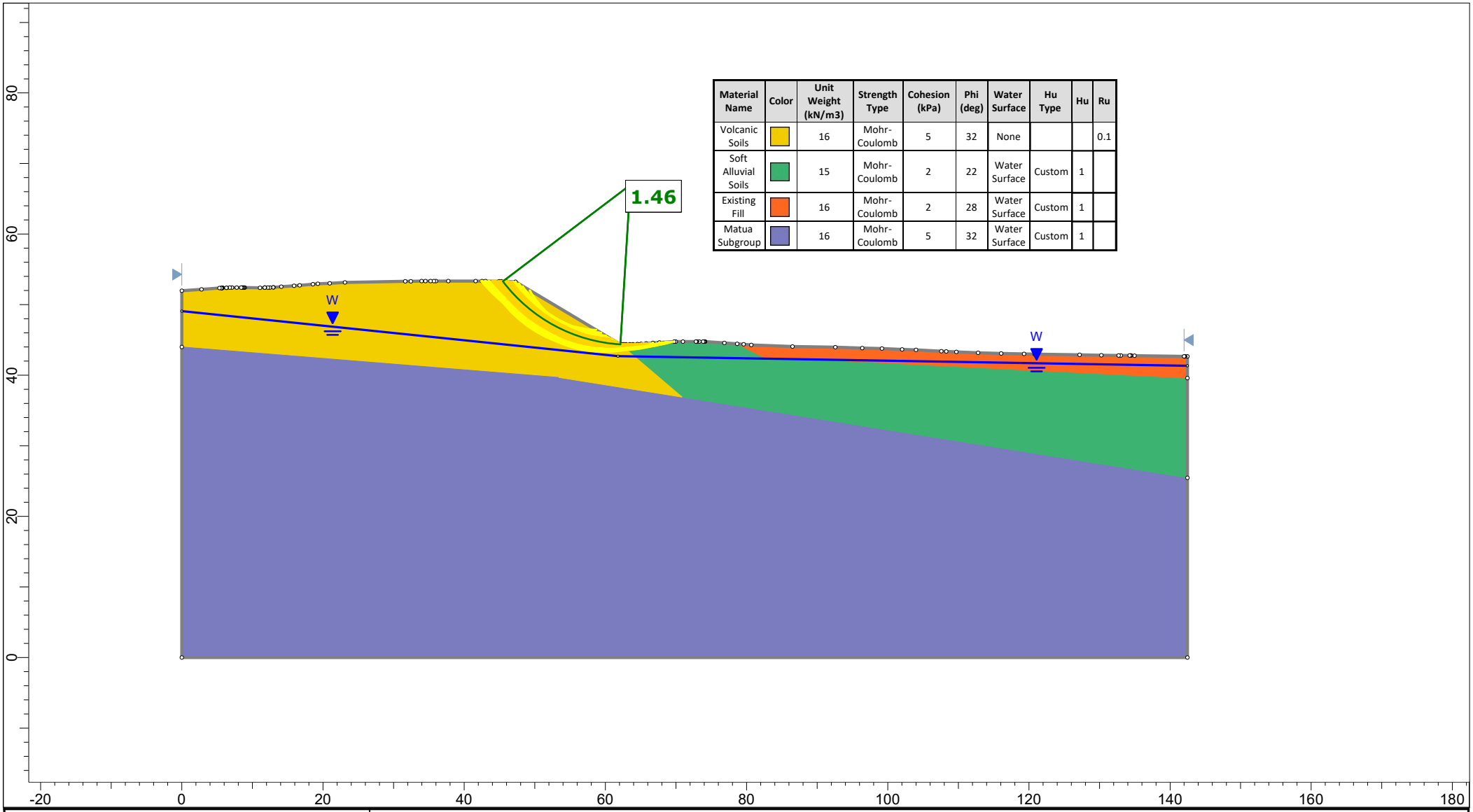
SLIDEINTERPRET 9.011

Project	Southern Boundary Slope		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	Scott Higginson	*Company*	WSP NZ Ltd.
Date	25/10/2022, 5:04:51 pm	*File Name*	Prevailing Case Proposed.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
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Soft Alluvial Soils		15	Mohr-Coulomb	2	22	Water Surface	Custom	1	
Existing Fill		16	Mohr-Coulomb	2	28	Water Surface	Custom	1	
Matua Subgroup		16	Mohr-Coulomb	5	32	Water Surface	Custom	1	

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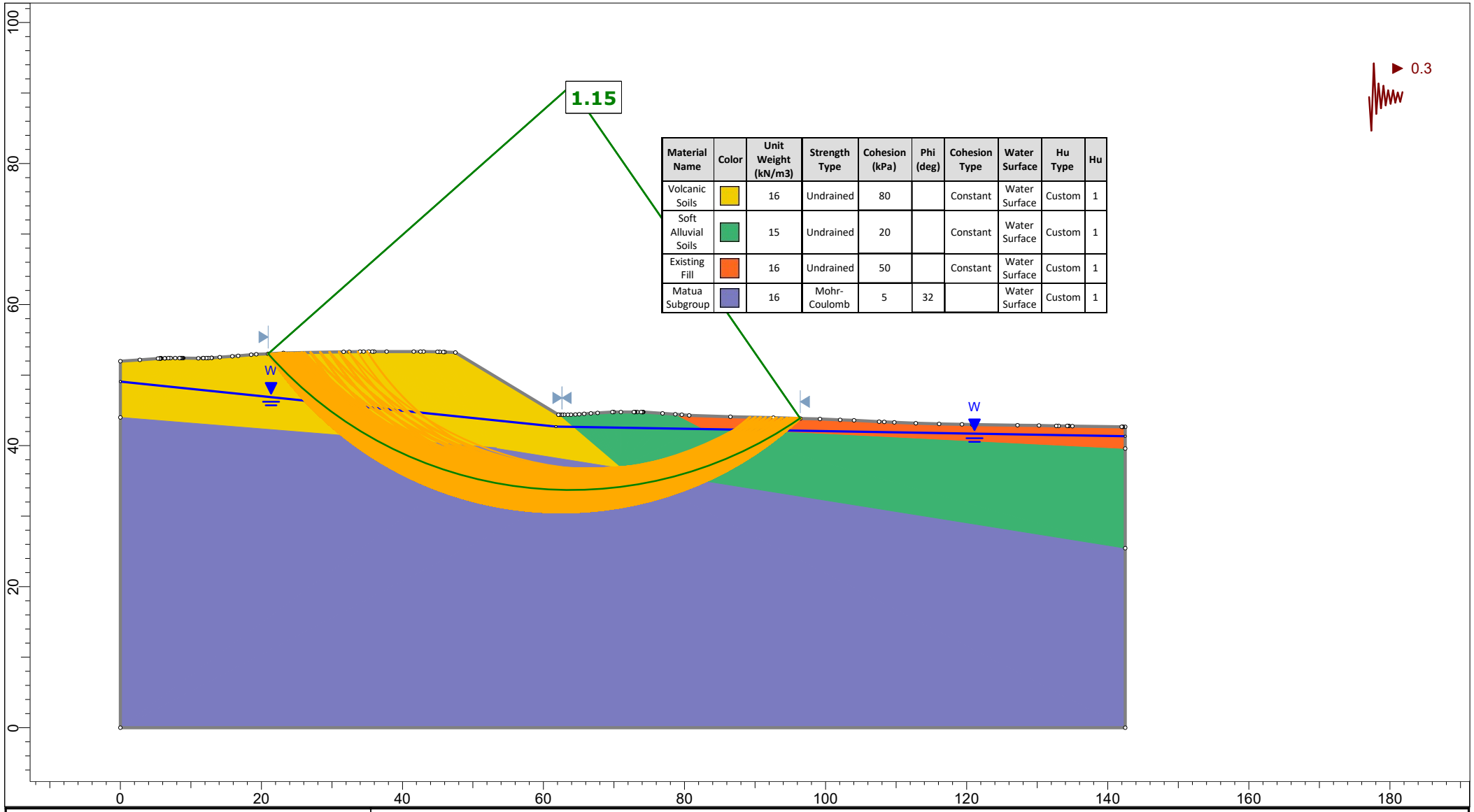
SLIDEINTERPRET 9.011

Project	Southern Boundary Slope		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	Scott Higginson	*Company*	WSP NZ Ltd.
Date	25/10/2022, 5:04:51 pm	*File Name*	Elevated Case Proposed.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
Volcanic Soils		16	Undrained	80		Constant	Water Surface	Custom	1
Soft Alluvial Soils		15	Undrained	20		Constant	Water Surface	Custom	1
Existing Fill		16	Undrained	50		Constant	Water Surface	Custom	1
Matua Subgroup		16	Mohr-Coulomb	5	32		Water Surface	Custom	1

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SLIDEINTERPRET 9.011

Project	Southern Boundary Slope		
Group	Group 1	*Scenario*	Master Scenario
Drawn By	Scott Higginson	*Company*	WSP NZ Ltd.
Date	25/10/2022, 5:04:51 pm	*File Name*	Seismic Case Proposed.slmd

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