GEOTECHNICAL INVESTIGATION REPORT

LOT 3, 136 STATE HIGHWAY 26, HAMILTON

(PROJECT)

MARTIN CAMERON

(CLIENT)

29.03.2016

PROPOSED RESIDENTIAL DEVELOPMENT AT LOT 3, 136 STATE HIGHWAY 26, HAMILTON

Prepared For:	Martin Cameron
Date:	29th March 2016
Project No:	16-0220
Revision No:	Final

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1 INTRODUCTION

BCD Group Limited (BCD) has been engaged by Martin Cameron to undertake a geotechnical site investigation and reporting for the proposed residential development at Lot 3, 136 State Highway 26, Hamilton (Figure 1: Location Plan).

This report collates and presents the field investigation data to provide foundation recommendations in relation to the 'good ground' requirements of NZS3604:2011 *Timber Framed Buildings*, slope stability analysis assessed in accordance with NZS1170.0:2001, NZS1170.5:2004 and amendments to the New Zealand Building Code of August 2011, stormwater disposal recommendations in accordance with Section E1-Surface water of the Building Code (E1) and wastewater disposal recommendations in accordance with NZS1547:2012 *On-site Domestic Wastewater Management.*

1.1 Site Description

The locality is an established rural-residential area in the outskirts of Hamilton. The greenfield site consists of unmaintained grass and is situated adjacent to a well vegetated gully system to the south of the lot. A (south eastern aspect) slope of approximately 20m vertical displacement is situated on the eastern half of the site.

1.2 Geology

Published geological map (Edbrook, S. W., 2005, Geology of the Waikato Area, 1:250,000 Geological Map 4) show that the site is underlain by the HINUERA FORMATION.

HINUERA FORMATION is described as pumice alluvium, comprised of cross-bedded pumice sand, silt and gravel with interbedded peat. The HINUERA FORMATION is found throughout the Waikato alluvial plain, and is typically deposited in a series of levees and swales of differing material composition representing the various depositional environments of the ancient braided Waikato river system. The HINUERA FORMATION can be as thick as 60m in areas, but is estimated to be approximately 24m thick at the proposed site (Lowe, D. J., 2010, Introduction to the Landscapes and Soils of the Hamilton Basin).

1.3 Field Investigation

Fieldwork was carried out by BCD on the 18th March 2016 with testing location(s) set out by BCD in relation to the proposed building platform, as indicated by our client.

The subsurface conditions within the site were investigated through three hand augers with dynamic penetration resistance testing (Scalas) up to 3m deep, conducted to assess the strength and consistency of the subsoil. Two CPT tests were conducted onsite to provide information for a slope stability assessment and to correlate soil layers.

Subsoil permeability was investigated through falling head permeability tests conducted in two 100mm diameter hand augered boreholes. Two additional hand auger boreholes were conducted to assess the material in the upper 1m of the soil profile to determine the soil category for waste water design.

The test locations are shown on the attached Site Plan (Figure 02), with hand auger logs (HA01-HA05) presented in Appendix A, CPT Logs present in Appendix B and soakage logs (SH01-SH02) presented in Appendix C.

1.4 Subsoil Profile

The investigation revealed 100mm-200mm TOPSOIL, underlain by predominantly SILT/SAND of varying thickness, composition and density to the depth of the hand augers (target depth 3m below present ground level).

A groundwater level of approximately 14m below present ground level was found during the investigation (as indicated on the supplied CPT logs).

2 FOUNDATION ASSESSMENT

The following recommendations and opinions are based upon data from observations made on site, the conducted hand augers and in-situ soil strength testing. Inferences about the nature and continuity of subsoil away from the exploration holes are made but cannot be guaranteed.

2.1 Proposed Development

No architectural plans are currently available for the proposed development, however we understand that a dwelling designed to NZS3604:2011 (requiring an Ultimate Geotechnical Bearing Capacity of 300kPa) is proposed in the location shown on the attached Site Plan (Figure 02). Should the position or extent of the house significantly change the following comments will require review.

2.2 Assessment Criteria

In order to use the standard foundation designs provided within NZS3604:2011: *Timber Framed Buildings* the requirements of 'good ground' as laid out within the standard need to be meet.

'Good ground' is defined in NZS3604:2011 as a subsoil capable of permanently withstanding an Ultimate Geotechnical Bearing Capacity of 300kPa (Structural Ultimate Limit State of 150kPa). In addition to these strength requirements subsoil must not contain:

- Potentially compressible ground – such as organic material (PEAT/TOPSOIL), FILL material (unless appropriately certified), soft cohesive material or loose granular material.
- Expansive soils – cohesive material (typically CLAYs) swelling and contracting due to variation in water content.
- Potential for movement – such as slope instability, settlement, erosion or effects from tree roots.

To confirm soils achieve the required strengths testing of the soils must confirm either:

- Scala penetrometer results greater than 5 blows per 100mm for two times the width of the proposed foundation and 3 blows per 100mm thereafter (considered to be more appropriate in determining soil strength in granular soils), or
- Undrained shear vane (considered to be more appropriate in determining soil strength in cohesive soils) results greater than 60kPa (Peak) achieve this strength criteria.

2.3 'Good Ground' Assessment

The conducted investigation indicates a soil profile predominantly made up of granular material with testing indicating the upper 1.2m (HA01) to 2.0m (HA02) cannot provide suitable founding material for any standard foundation designs as outlined in NZS3604:2011.

The conducted in-situ strength testing indicates an Ultimate Geotechnical Bearing Capacity of 300kPa (peak shear vane results greater than 60kPa) can be achieved below these loose layers at a depth of approximately 1.2m – 2.0m below present ground level.

2.4 Foundation Recommendations

The subsoil (generally) does not meet the 'good ground' requirements of NZS3604:2011 due to the assessed loose layers in the upper 1.2m – 2.0m below present ground level. Therefore, specifically designed foundations **or** specified ground remediation works (in order to comply with the 'good ground requirements of NZS3604:2011) are required for any proposed light weight timber framed residential development on this site.

The following foundation systems are considered suitable for any lightweight timber framed development for this site.

Option 1: Timber Pile Foundations

Specifically designed, driven tanalised timber pile foundations may be utilised to support the proposed development. The pile diameter, design driving set and pile layout will be subject to specific structural engineering design based on the design load of the structure and the strengths available within the soils at the site. Specific pile design is outside the scope of our engagement.

Test piles could be undertaken in order to reduce construction risk by confirming the required pile depth onsite once the pile diameter and design driving set has been confirmed by specific engineering design. Test piling would involving a minimum of two test piles driven one at either end of the building envelope and monitored by an appropriate qualified geotechnical engineer. Data obtained from the driving of these test piles would enable the lengths of the remaining piles to be determined. Subject to approval from the supervising engineer test piles may be used as production piles for the proposed structure.

Pile driving can cause significant vibrations that can potentially adversely affect nearby buildings, services and slopes. Where such risks are considered likely a pre-construction survey of the surrounding site may prove beneficial.

Bored pile foundations – Either bored reinforced concrete or concrete encased tanalised timber piles may be utilised at the site for the support of the proposed dwelling. The pile diameter, design depth and pile layout will be subject to specific structural engineering design based on the design load of the structure and the strengths available within the soils at the site, such design is outside the scope of this report.

Option 2 – Dig Out and Replacement

Dig Out and Replacement - The foundation area would require excavation to between 1.2m – 1.8m below present ground level (although this depth could vary), extending at minimum grade of 1 vertical: 1 horizontal (45° from base of foundations) beyond the building footprint. The bottom of the excavation will require inspection by a suitably qualified geotechnical professional and proof rolling with 6 passes of a 2 tonne (minimum) roller with the vibratory setting turned off. Any soft spots identified during inspection or proof rolling would require a localised excavation.

Thereafter the excavation can be backfilled with compacted imported granular fill back to foundation level and compacted in 200mm layers (uncompacted thickness) by a 2 tonne roller (minimum) to achieve a minimum of 5 blows per 100mm with a Scala penetrometer. The construction contractor is to complete compaction testing on a grid basis, with a suitably qualified geotechnical professional conducting confirmatory testing once sand pad is complete. Where a PS4 is required, a PS3 from the contractor accompanied by his compaction testing results will be required.

Following this ground remediation, NZS3604:2011 standard foundation designs may be used for any lightweight timber framed residential development on this site should the development achieve the assessed setback from the crest of the slope (refer to the slope stability section for details on the proposed setback).

2.5 Other Factors to Consider

Building Setback from the top edge of the slope

We recommend building setback from the crest of south east facing slope as detailed in Section 3 below.

Slope Battering/Retaining Walls

Any future excavations (into the adjacent slope) may cause slope destabilisation, which may result in an inaccurate slope stability assessment. We recommend our client contact BCD for advice regarding potential slope batters and/or retaining walls should they wish to carry out any excavation along the slope face.

3 SLOPE STABILITY

3.1 Analysis Parameters

The following outlines the modelled slope (Cross Section A-A') under Static, SLS and ULS seismic loading conditions to assess the likelihood of any possible slope failures over the design life of the proposed dwelling.

The seismic design criteria for the proposed development has been assessed in accordance with NZS1170.0:2001, NZS1170.5:2004 and amendments to the New Zealand Building Code of August 2011.

NZS1170.0:2002 requires that structures are designed to seismic "limit states" known as Ultimate Limit State (ULS), where the structure must remain sound enough to allow for evacuation and the preservation of life (though possibly irreparably damaged for the design event) and Serviceability Limit State (SLS) where the structure remains functional following the SLS design event.

Based upon the results of the conducted geotechnical investigation, published geology and our knowledge of the area the site is categorised as a "Shallow Soil" site (Subsoil Class C).

The advised Design Life and Importance Level for the proposed dwelling are 50 years and Level 2 respectively. The peak ground accelerations (PGAs) calculated and adopted for this geotechnical assessment in accordance with NZ1170.5:2004 are summarised in Table 1 Below, these values will be adopted for the slope stability analysis under seismic conditions.

Table 1: Geotechnical PGA Design Values

Importance Level	Design Life (years)	Limit State	Annual Probability of Exceedance	R Value	Peak Ground Accelerations (g)
2	50	SLS	1/25	0.25	0.08
		ULS	1/500	1	0.29

3.2 Results of Slope Stability Analysis Under Static and Seismic Conditions

A summary of the seismic conditions analysis results are presented in Table 2 below. Typical slope stability analysis results are presented in Appendix C.

Table 2: Slope Stability Analysis Results-Seismic Conditions

Case	Cross-Section	Seismic Loading Adopted	Minimum House Setback Distance (m)	Factor of safety
1	A-A'	Static (No Seismic)	6.5	1.5
2	A-A'	SLS	6.0	1.2
3	A-A'	ULS	7.5	1.0

Based upon the analysis, for critical Cross Section A-A' (abney survey conducted by BCD), a factor of safety of 1.2 can be achieved under SLS seismic loading with a 6.0m setback from the crest of the slope and a factor of safety of 1.0 can be achieved under ULS seismic loading with a 7.5m setback from the crest of the slope.

Our assessment under ULS seismic conditions indicates a setback distance of 7.5m from the crest of the slope should be adopted for any proposed development on-site.

Building development within the required 7.5m setback zone is possible but the foundations supporting any part of the building closer than 7.5m to the top of the slope would need to be designed by an engineer.

4 STORMWATER ASSESSMENT

The following comments and recommendations are based upon the conducted testing carried out in accordance with national and local authority requirements and guidelines.

4.1 Permeability Testing

Investigation comprised of two 100mm diameter hand augers, drilled to investigate the permeability (using falling head permeability testing) of the underlying materials. The test locations are shown on the attached Site Plan (Figure 2), with soakage test logs (SH01-SH02) and testing results presented in Appendix C.

Permeability testing and calculation of the corresponding soakage rate(s) were conducted in general accordance with the NZ Building Code E1 – Surface water.

A summary of the conducted permeability tests along with the soakage rates has been included as Table 3.

Table 3: Soakhole Test Summary

Hole I.D.	Depth	Soakage Rate
SH01	1.1m	11,500mm/hr
SH02	1.4m	24,000mm/hr

Based on the calculated soakage rates, we have adopted a soakage rate of 6000mm/hr (to allow for silting up and possible loss of soakage capacity). This soakage rate is significantly greater than the 300mm/hr limit for soakage to ground generally recommended by councils.

4.2 Stormwater Run-off

Our assessment of stormwater and its disposal is based upon the following assumptions with input from the Building Code (E1 Surface Water) and Hamilton City Council specifications (ITS). Should any of the inputs change from those below, the recommendations within this report will require review.

- Contributing catchment areas as per Table 4 below.
- Run-off factor of:
  - 0.95 for roof areas
  - 0.85 for hardstand areas
- A developed storm return period of 10 years (10% AEP) with a 60 minute duration (E1).
- An allowance of 2.1°C to compensate for climate change over the design period.

- Developed rainfall intensity of 44.7mm/hr (ITS).
- Pipework, tank installation and soakage systems undertaken by suitably qualified plumber and drain layer.
- The following catchment areas are preliminary areas provided by the client. We have added an additional 20% for each catchment area to allow for some area changes during the detailed design stage.

Table 4: Preliminary Catchment Areas (For Preliminary Design Purposes)

Roof Area	Hardstand Area
186m^2	80m^2

If the catchment areas change (through the design stage prior to construction or due to additions to the property in the future) stormwater volumes will require recalculation together with a review of the following comments and recommendations.

4.3 Preliminary Stormwater Recommendations

The soakage system requires a capacity to store the design storm event, minus the volume soaked over the storm duration (60min). Typically this would be achieved utilising a soakage trench, disposing of the stormwater initially by storage and then soakage.

From the calculated results, a preliminary soakage trench with a total base area of **2m^2** (minimum 1.0m deep), constructed as per '*Figure 13 (a) rock soak pit*' of the NZ Building Code E1: Surface Water (Appendix C) using 100mm - 150mm rock (void ratio 38%), and lined by an approved geotextile similar to Bidim A24 would adequately dispose of stormwater post development at this site.

The soakage trench should be preceded by a manhole/catch pit including an Enviropod or similar filter to catch leaves and other debris to avoid clogging of the soakage system. Such materials will otherwise fill the drainage aggregate voids with a resulting loss of soakage capacity.

The below ground system would require a minimum setback of 2.5m from the development foundations, 15m from the crest of the slope and 1.5m from the property boundary.

Should rain events of greater intensity or duration than the design event occur, the secondary flow from the soakage system should discharge to the ground level via a bubble-up chamber with overland flow or piped down the gully (subject to council approval).

5 WASTEWATER ASSESSMENT

The assessment of the site and soil conditions together with wastewater system design recommendations are in general accordance with AS/NZS 1547:2012, the Australian/New Zealand Standard for On-Site Domestic Wastewater Management.

5.1 Proposed development

Due to the preliminary nature of the development, we have designed a preliminary wastewater disposal system and land application area based on a standard a three bedroom dwelling with no connection to reticulated wastewater. Therefore, design of an on-site wastewater treatment and land application system is required. We have produced a preliminary design criteria for this assessment that has been outlined below:

- Reticulated water supply.
- 3 bedroom house with 5 person occupancy (maximum resident).

- Standard water fixings. Eg:
  - No garbage grinder.
  - No dual baths or modern multi jet showers.
  - No wastage of water through leaking taps or cistern overflows.

Should any of these inputs change before or after construction, then the recommendations within this report will be subject to review.

5.2 Assessment of Soil

HA04-HA05 were conducted to investigate the characteristics of the near surface subsoil for the purpose of land effluent disposal, the results have been outlined in Table 4 below.

Table 4: Soil Category and Land Application Summary

Hole I.D.	Depth (m)	Soil Category	Design Loading Rate (DLR) (mm/day) (bed/trench)			Design Irrigation Rate (DIR) (mm/day)	
			Conservative Rate	*Maximum Rate*	*Secondary Treatment*	*Spray/Drip*	*LPED*
HA04	0.9m	2	20	30	50	5	5
HA05	1.0m	2	20	30	50	5	5

DLR and DIR from AS/NZS 1547:2012 based on K_{sat} and soil category. N/A = Not Applicable for the corresponding K_{sat}.

Due to the design Soil Category, we recommend land application via standard trenches or beds to service the wastewater produced as a result of this development.

Preliminary design has been based on a Loading Rate of 25mm/day.

5.3 Preliminary On-site Wastewater Disposal

Based upon the investigation results and the requirements of AS/NZS1547:2012, disposal via ground loading systems such as conventional trenches or beds is recommended at this site.

Prior to disposal, wastewater requires treatment depending on the disposal method. For ground loading methods, primary treatment (septic tank) is required prior to land application.

Note: Primary, secondary and disinfectant systems are designed by wastewater specialist, with individual maintenance requirements which are needed to keep each system running effectively.

Primary Treatment
Primary treatment, generally in the form of a septic tank is required for treatment of all on-site wastewater. In relation to AS/NZS 1547:2012, occupancy of five persons (three bedrooms) requires an all-waste septic tank with a minimum capacity of 3,000litres. It is recommended the septic tank include an outlet filter to reduce maintenance on the disposal field.

Secondary Treatment
Secondary treatment can be completed in a number of ways utilising specialist treatment units to treat wastewater and reduce the BOD_5 (Biochemical Oxygen Demand), TSS (Total Suspended Solids), and E.coli content to below the required limits outlined in section M2 of AS/NZS1547:2012.

Secondary treatment is generally not required for standard trenches on beds but can be installed to decrease the size of the loading systems.

5.4 Effluent Disposal

All domestic wastewater produced by the proposed development should utilise ground loading methods such as conventional trenches or beds. These systems should be constructed in accordance with AS/NZS 1547:2012 with the required sizes, outlined below.

-Conventional Trenches
Based upon AS/NZS 1547:2012, 20m^2 (base area) of trenches could be utilised to dispose of the effluent (effluent to be of primary treatment level) from the proposed dwelling. Trenches should be installed in accordance with AS/NZS1547:2012 (Table L2 and Figure L1) with the base of the trenches to be on the SAND, found in the upper part of the soil profile.

If secondary treatment is utilised, trenches may be decreased to 10m^2 (base area).

-Conventional Beds
Based upon AS/NZS 1547:2012, 20m^2 (base area) of bed(s) could be utilised to dispose of the effluent (effluent to be of primary treatment level) from the proposed dwelling. Bed(s) should installed in accordance with AS/NZS1547:2012 (Table L2 and Figure L1) with the base of the bed(s) to be on the SAND, found in the upper part of the soil profile.

If secondary treatment is utilised, bed(s) may be decreased to 10m^2 (base area).

A secondary disposal area of the same size should be set aside for effluent disposal once the designed system has exceeded its design life, or if the effluent disposal system backs up and fails.

5.5 Wastewater System Design Conclusion

The recommendations of AS/NZS 1547:2012, show for a standard three bedroom dwelling on reticulated water supply with standard water fixings, 1,000litres of wastewater will be generated per day.

The results of the conducted investigation indicate a soil category of 2 (sandy loams) giving a DLR of 25mm/day.

Based upon the investigation results and the requirements of AS/NZS1547:2012, disposal via ground loading systems such as conventional trenches or beds is recommended for this site. Prior to disposal wastewater requires treatment depending on the disposal method. For loading systems wastewater must be treated to a minimum primary treatment level (septic tank). However, secondary treatment will decrease the land application area by half, to 10m^2.

For ground loading a land application area of 20m^2 is required to cater for the domestic wastewater produced by the proposed development. All aspects of the system should be installed in accordance with AS/NZS1547:2012.

Other factors which need to be considered in the context of the effluent disposal system are:

- Surface water should be diverted (bund) around the perimeter and up-slope of the land application area.
- The minimum total septic tank size shall be no less than 3,000litres.
- There shall be a zone of unsaturated soil of not less than 600mm from the bottom of the disposal trenches (based upon the winter groundwater level).
- The discharge shall not result in any objectionable odour beyond the boundary of the subject property.
- The disposal system shall not be sited within 20m of a Natural State Water Body or Fisheries Class Water Body and 10m from any other surface water body.
- The disposal system shall not be sited within 30m of any potable water supply well.
- The effluent disposal fields should be located at least 15m from the crest of the gully slope.
- The septic tank shall be fitted with an effluent outlet filter.
- A secondary disposal area of the same size should be set aside.
- The wastewater system shall be designed and installed such that there will be no adverse change in groundwater quality as a result of the discharge, or in combination with other discharges.
- Primary treatment tank(s) pump-out every 3-5 years.

- Wastewater appliances installed by suitably qualified plumber, and wastewater tanks and disposal systems constructed by a suitably qualified drain layer.

Non-compliance with any of the above aspects may trigger a regional consent for discharge.

Primary, secondary and disinfectant systems are designed by wastewater specialist, with individual maintenance requirements which are needed to keep each system running effectively.

5.6 Summarised Recommendations

Foundation Recommendations

- Pile foundations are recommended for the proposed dwelling due to the loose near surface soils.
- Alternatively, an excavated sand pad can be used. Excavation of all unsuitable material to approximately 1.2m to 1.8m below present ground level would be required. Backfill with imported SAND to comply with the requirements of NZS3604:2011. Standard NZS3604:2011 foundation designs may be utilised for any proposed residential development at this site with a building setback of 7.5m from the crest of the slope.

Slope Stability Assessment

- The conducted slope stability assessment indicates a development building setback of at least 7.5m from the crest of the slope. Building within the setback zone is feasible but specifically designed foundations (such as piles) will be required.

Preliminary Stormwater Management

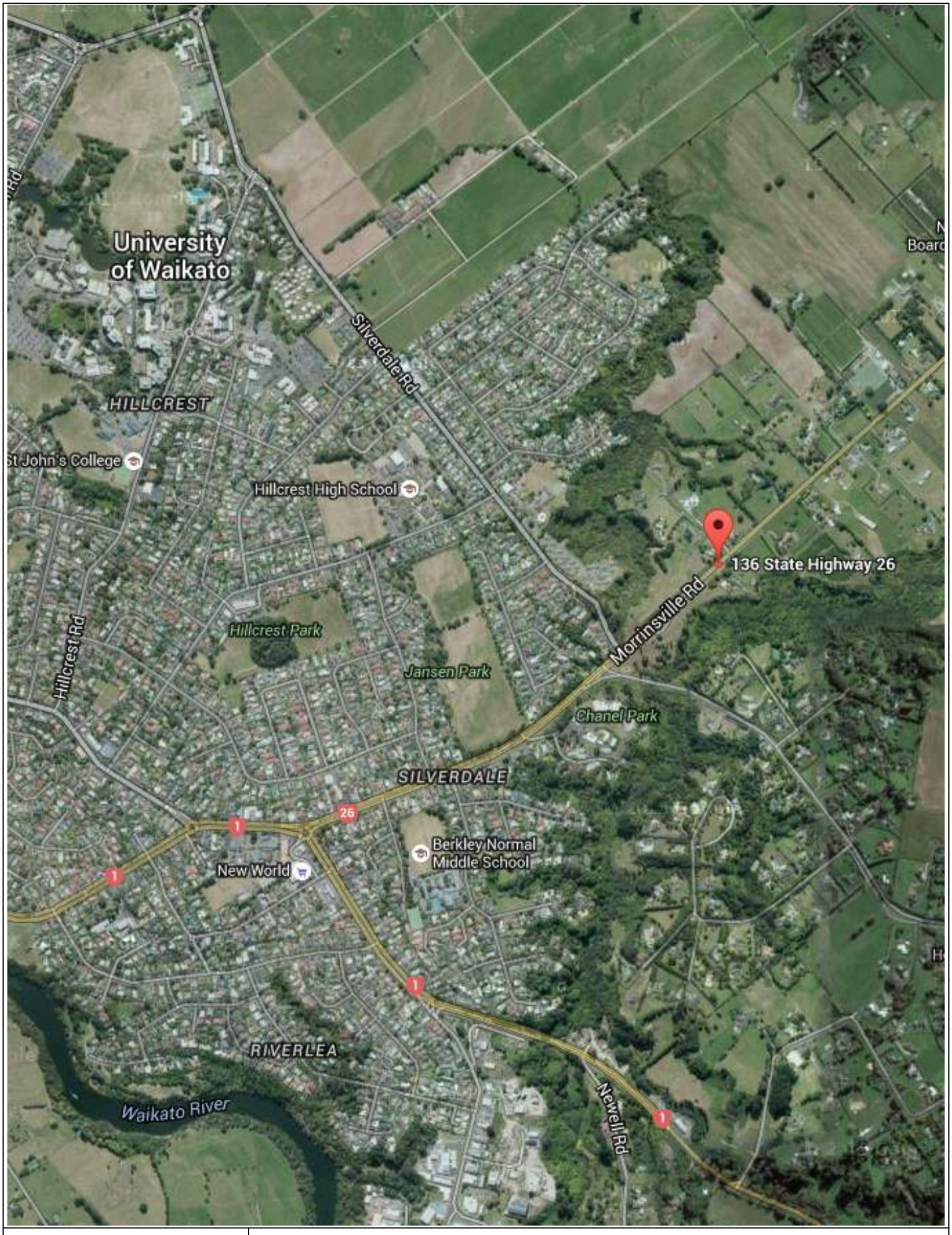
- Standard soakage trench with a minimum base area of $2m^2$ will be sufficient to account for stormwater discharge based on preliminary catchment areas.

Preliminary Wastewater Management

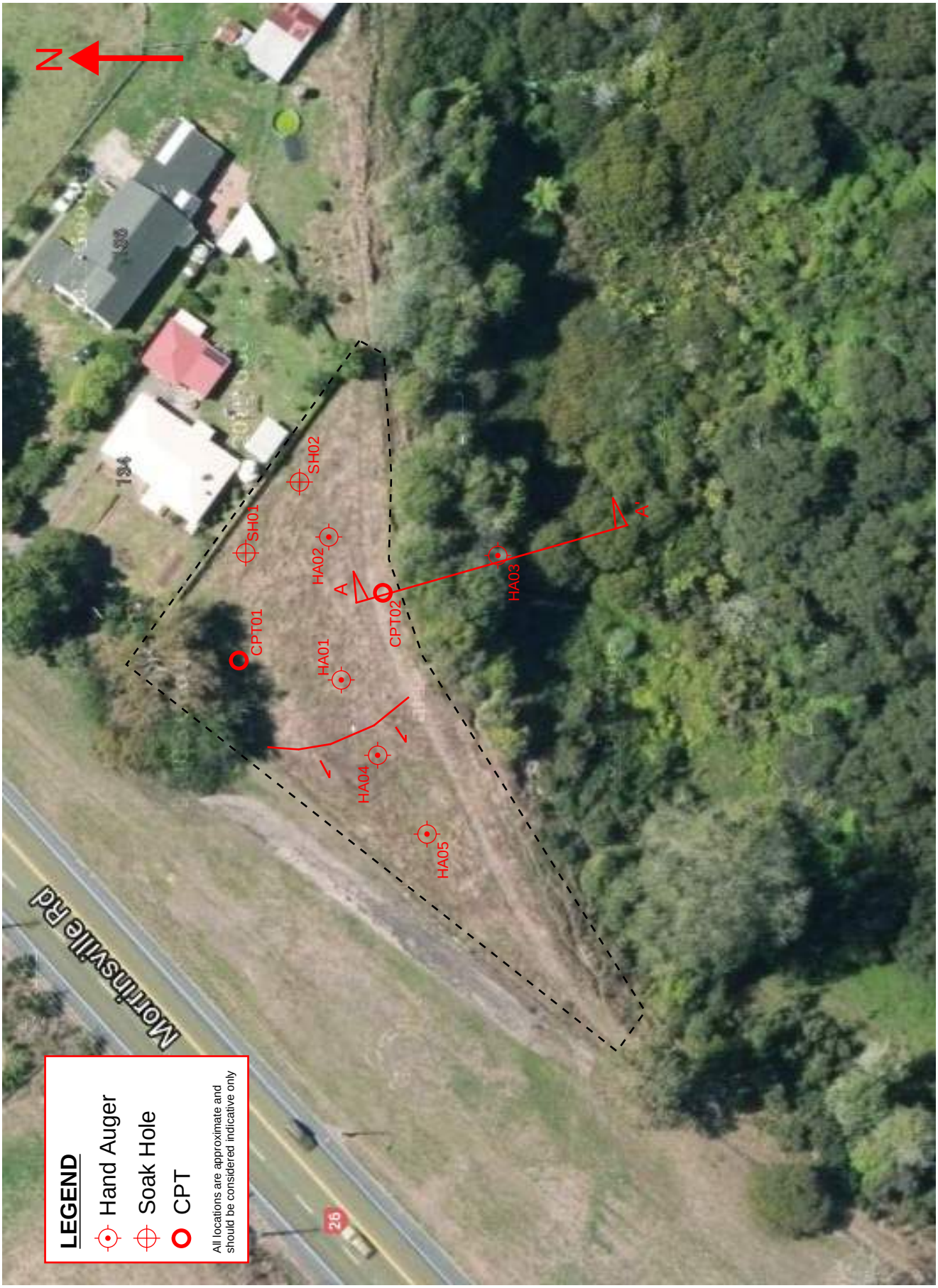
- 3,000litre septic tank to pump primary treated effluent to a conventional trench or bed with a minimum base area of $20m^2$.
- Bund or cut off drain to be installed on the eastern side of the field to divert surface run off (from the slope) around the effluent field.

6 REPORT LIMITATIONS

The recommendations given in this report are based upon limited site data from discrete tests. Variations in ground conditions can exist across the site. This report has been prepared for our client for their purposes. It is not to be relied upon or used out of context by any other person without reference to BCD Group Ltd. The reliance by other parties on the information or opinions contained in this report shall, without prior review and agreement in writing, be at such parties' sole risk.



BCD GROUP STRUCTURAL AND CIVIL ENGINEERING | PLANNING | GEOTECHNICAL	Project Title: Lot 3, 136 State Highway 26, Hamilton				
	Sheet Title: Location Plan				
	Drawn: C.D.	Date: 21-03-16	Scale: NTS	Job No: 16-0220	Figure: 01



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Project Title: Lot 3, 136 State Highway 26, Hamilton				
Sheet Title: Site Plan				
Drawn: C.D.	Date: 21-03-16	Scale: NTS	Job No: 16-0220	Figure: 02

APPENDIX A – Soil Logs

Soil Description

Log Identification: HA01

Investigation method	Geological Unit	Field Description	Depth (meters)	Undrained Shear Strength (kPa) Peak / Residual	Field Test Data: Scala Penetrometer (blows per 100mm drop) — Blow count	Plot of Scala results (Very loose / Loose / Medium Dense / Dense; 0 1 2 3 4 5 6 7 8 9 10)	Groundwater Level
HAND AUGER	T/S	TOPSOIL. Dark brownish black, dry-moist.	0.0		1		NOT ENCOUNTERED DURING DRILLING
	HINUERA FORMATION	Sandy SILT. Brown, very loose-loose, dry.			2 2 1 2		
			0.5		2 1 2 2 2		
		Silty SAND. Brown, very loose-loose, dry.	1.0		1 2 8 7 7		
		Below 1.2m, some gravel, medium dense-dense, moist.	1.5		8 5 5 5 6		
		Gravelly SAND. Light greyish brown, loose-dense, moist.	2.0		4 3 4 3 3		
		Below 1.7m, brown.	2.5		4 4 2 4		
			3.0				
		End of borehole at 3.0m - Target depth.	3.5				
			4.0				
			4.5				
			5.0				
			5.5				

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 136 State Highway 26, Hamilton
Site location: Lot 3 - 136 State Highway 26, Hamilton
Date of investigation: 18-03-2016

Job Number: 16-0220
Shear Vane ID: -
Logged By: C.D.
Checked By: J.H.

Soil Description

Log Identification: HA02

Investigation method	Geological Unit	Field Description	Depth (meters)
HAND AUGER	T/S	TOPSOIL. Dark brwonish black, dry-moist.	0.0
	HINUERA FORMATION	Sandy SILT. Brown, very loose-loose, dry.	0.5
		Below 0.7m, light brown.	1.0
		Silty SAND. Light brown, very loose-medium dense, dry-moist.	1.5
		Below 2.0m, reddish brown.	2.0
		Gravelly SAND. Light greyish brown, medium dense, moist.	
		End of borehole at 2.2m - Continual collapse (gravels).	2.5
			3.0
			3.5
			4.0
			4.5
			5.0
			5.5

Field Test Data

Undrained Shear Strength (kPa) Peak / Residual	Scala Penetrometer (blows per 100mm drop) Blow count	Plot of Scala results (Very loose 0 1 | Loose 2 3 | Medium Dense 4 5 6 | Dense 7 8 9 10)	Groundwater Level
	2 1 1 2 1		NOT ENCOUNTERED DURING DRILLING
	1 1 2 3 2		
	1 1 0.3 0.3 0.3		
	1 1 1 1 3		
	4 4 5 4 5		
	3 4 4 5		

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
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4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 136 State Highway 26, Hamilton
Site location: Lot 3 - 136 State Highway 26, Hamilton
Date of investigation: 18-03-2016

Job Number: 16-0220
Shear Vane ID: -
Logged By: C.D.
Checked By: J.H.

Soil Description

Log Identification: HA03

Investigation method	Geological Unit	Field Description	Depth (meters)	Undrained Shear Strength (kPa) Peak / Residual	Field Test Data: Scala Penetrometer (blows per 100mm drop) — Blow count	Plot of Scala results (Very loose / Loose / Medium Dense / Dense)	Groundwater Level
HAND AUGER	T/S	TOPSOIL. Dark brownish black, dry-moist.	0.0		3		NOT ENCOUNTERED DURING DRILLING
	HINUERA FORMATION	Gravelly SAND. Light brownish grey, very loose, dry.			1, 0.14, 0.14, 0.14		
			0.5		0.14, 0.14, 0.14, 0.14, 0.14		
			1.0		0.14, 0.14, 0.14, 0.14, 0.14		
			1.5		0.14, 1, 1, 2, 2		
		End of borehole at 1.8m - Continual collapse.	2.0		2, 2, 3, 4, 3		
			2.5		5, 4, 5, 6		
			3.0				
			3.5				
			4.0				
			4.5				
			5.0				
			5.5				

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 136 State Highway 26, Hamilton
Site location: Lot 3 - 136 State Highway 26, Hamilton
Date of investigation: 18-03-2016

Job Number: 16-0220
Shear Vane ID: -
Checked By: C.D.
Checked By: J.H.

Soil Description

Log Identification: HA04

Investigation method	Geological Unit	Field Description	Depth (meters)	Undrained Shear Strength (kPa) Peak / Residual	Field Test Data: Scala Penetrometer (blows per 100mm drop) — Blow count	Plot of Scala results (Very loose 0 1 / Loose 2 3 / Medium Dense 4 5 6 / Dense 7 8 9 10)	Groundwater Level
HAND AUGER	T/S	TOPSOIL. Dark brownish black, dry-moist.					N.E.D.D.
	H. FMN.	SAND. Light brown, dry. Below 0.5m, some silt and gravel, reddish brown.	0.5				
		End of borehole at 0.9m - Target depth. N.E.D.D. (not encountered during drilling) H. FMN. (Hinuera Formation)	1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5				

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 136 State Highway 26, Hamilton
Site location: Lot 3 - 136 State Highway 26, Hamilton
Date of investigation: 18-03-2016

Job Number: 16-0220
Shear Vane ID: -
Logged By: B.M.
Checked By: J.H.

Soil Description

Log Identification: HA05

Investigation method	Geological Unit	Field Description	Depth (meters)
HAND AUGER	T/S	TOPSOIL. Dark brownish black, dry-moist.	
	H. FMN.	Gravelly SAND. Light greyish brown, dry.	
		Below 0.4m, some silt.	0.5
		Below 0.8m, SAND, whitish grey.	1.0
		End of borehole at 1.0m - Target depth.	
		N.E.D.D. (not encountered during drilling)	1.5
		H. FMN. (Hinuera Formation)	2.0
			2.5
			3.0
			3.5
			4.0
			4.5
			5.0
			5.5

Field Test Data

Undrained Shear Strength (kPa) Peak / Residual	Scala Penetrometer (blows per 100mm drop)											Groundwater Level
	Blow count	Plot of Scala results										
		Very loose		Loose		Medium Dense			Dense			
		0	1	2	3	4	5	6	7	8	9	10
												N.E.D.D.

Notes:

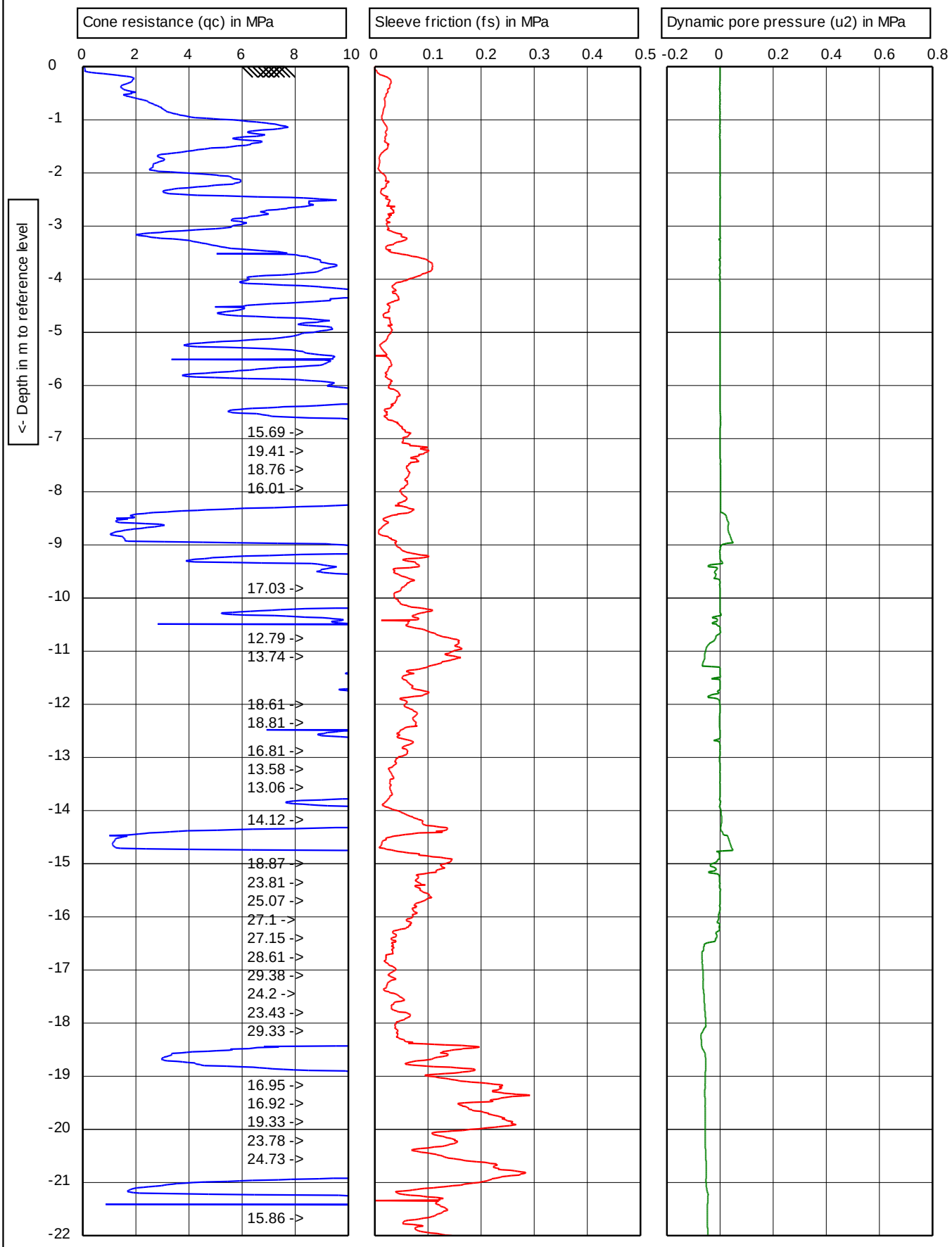
1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

BCD GROUP

Job name: 136 State Highway 26, Hamilton
Site location: Lot 3 - 136 State Highway 26, Hamilton
Date of investigation: 18-03-2016

Job Number: 16-0220
Shear Vane ID: -
Logged By: B.M.
Checked By: J.H.

APPENDIX B – CPT Logs



OPUS

IANZ ACCREDITED LABORATORY

Graphs indicated as not accredited are outside the scope of the laboratory's accreditation

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-12.90 m**

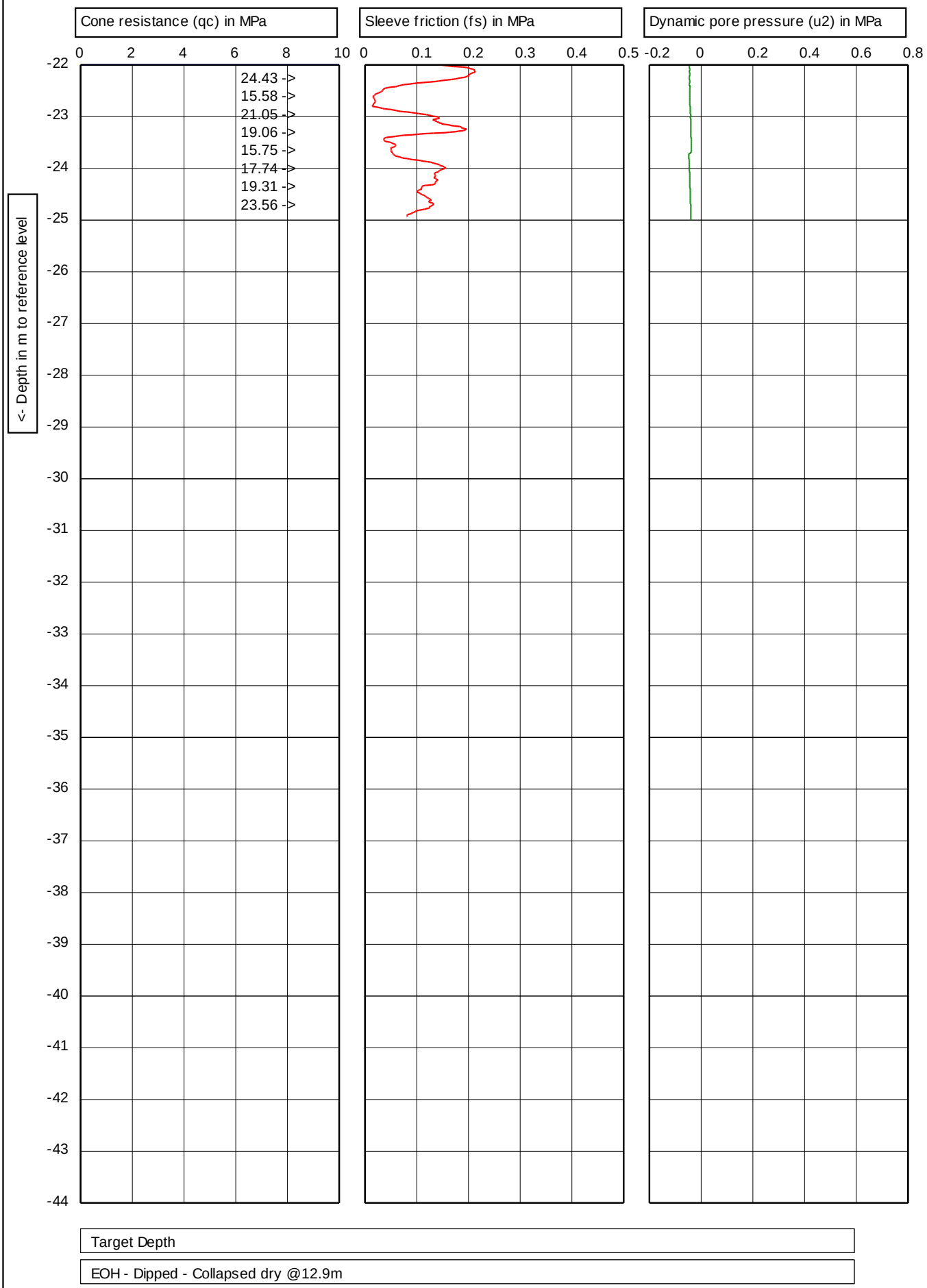
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01** **1/12**

1.45



Target Depth

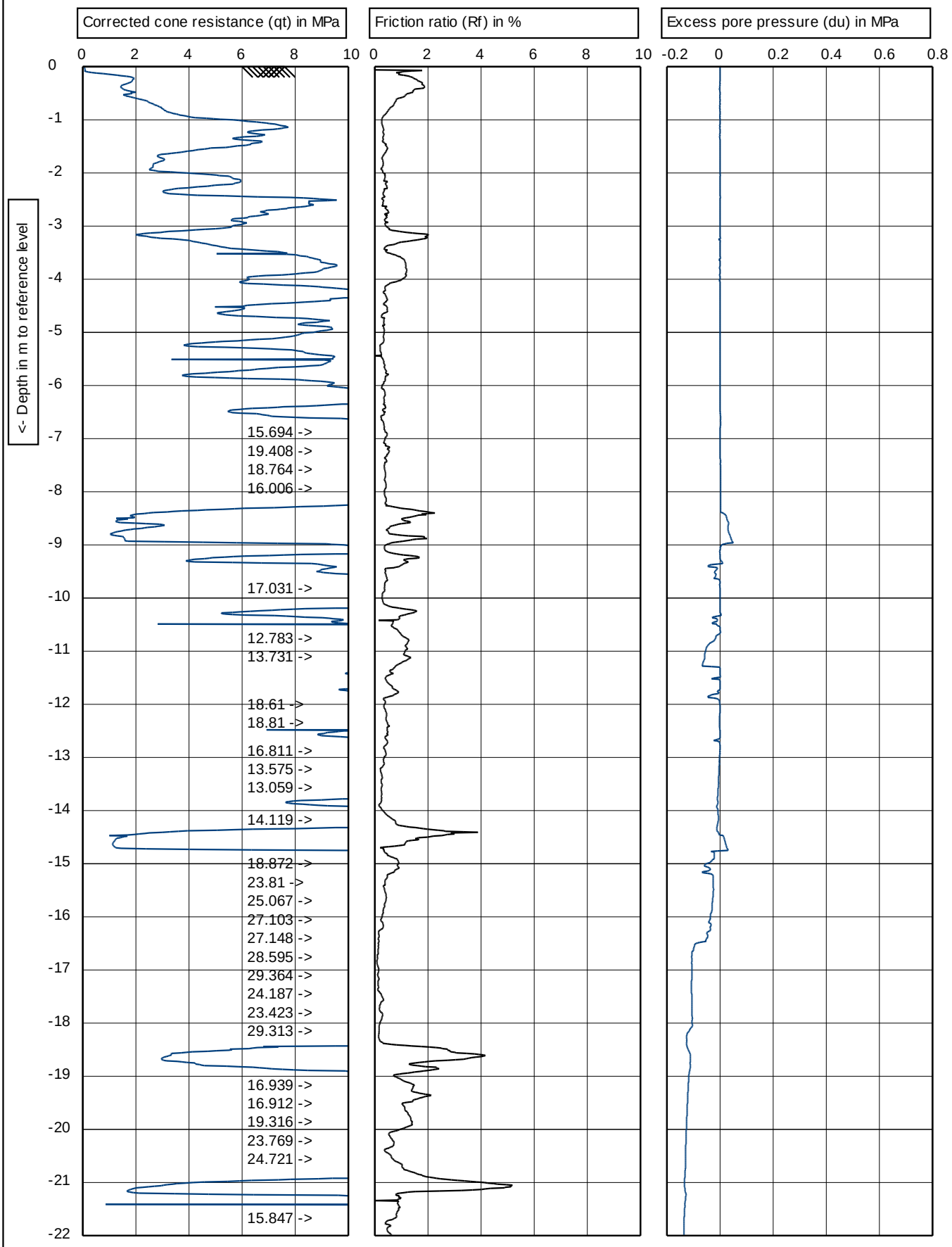
EOH - Dipped - Collapsed dry @12.9m

OPUS IANZ ACCREDITED LABORATORY

Graphs indicated as not accredited are outside the scope of the laboratory's accreditation

1.45

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill: **0.00 m Predrilled**
	G.L.: **0.00 m MSL**	W.L.: **-12.90 m**	Date: **17/03/2016**
Project:	**Lot 3 - SH26**		Cone no.: **C10CFIIP.C15211**
Location:	**136 SH26 - Hamilton**		Project no.: **2-68206.16_008**
Position:	**1805630, 5814358 NZTM**		CPT no.: **01** **2/12**



OPUS

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-12.90 m**

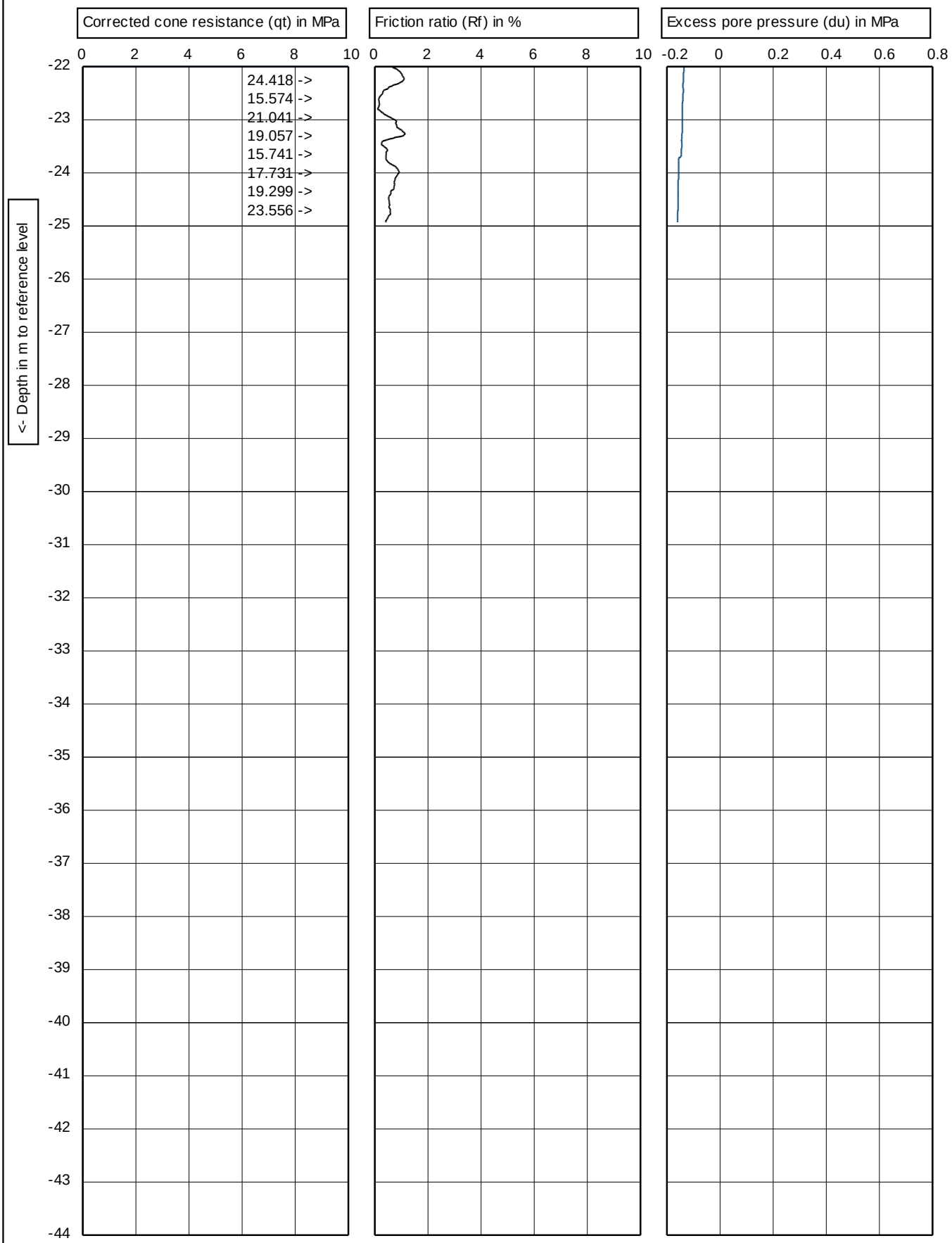
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01**

1.45



OPUS

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

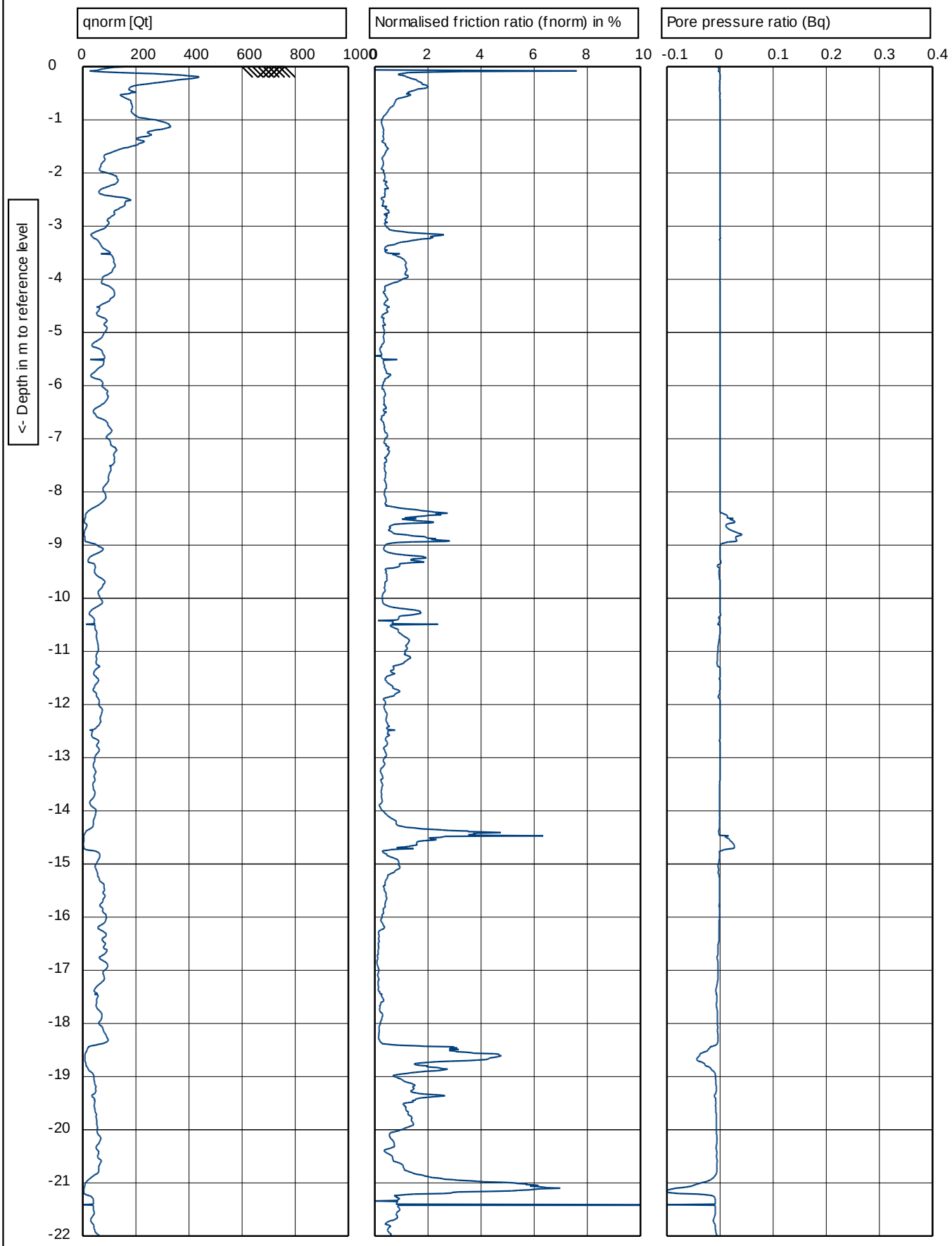
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-12.90 m**

Project: **Lot 3 - SH26**
Location: **136 SH26 - Hamilton**
Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01** **4/12**

1.45



OPUS

Graphs on this page are not IANZ accredited

1.45

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

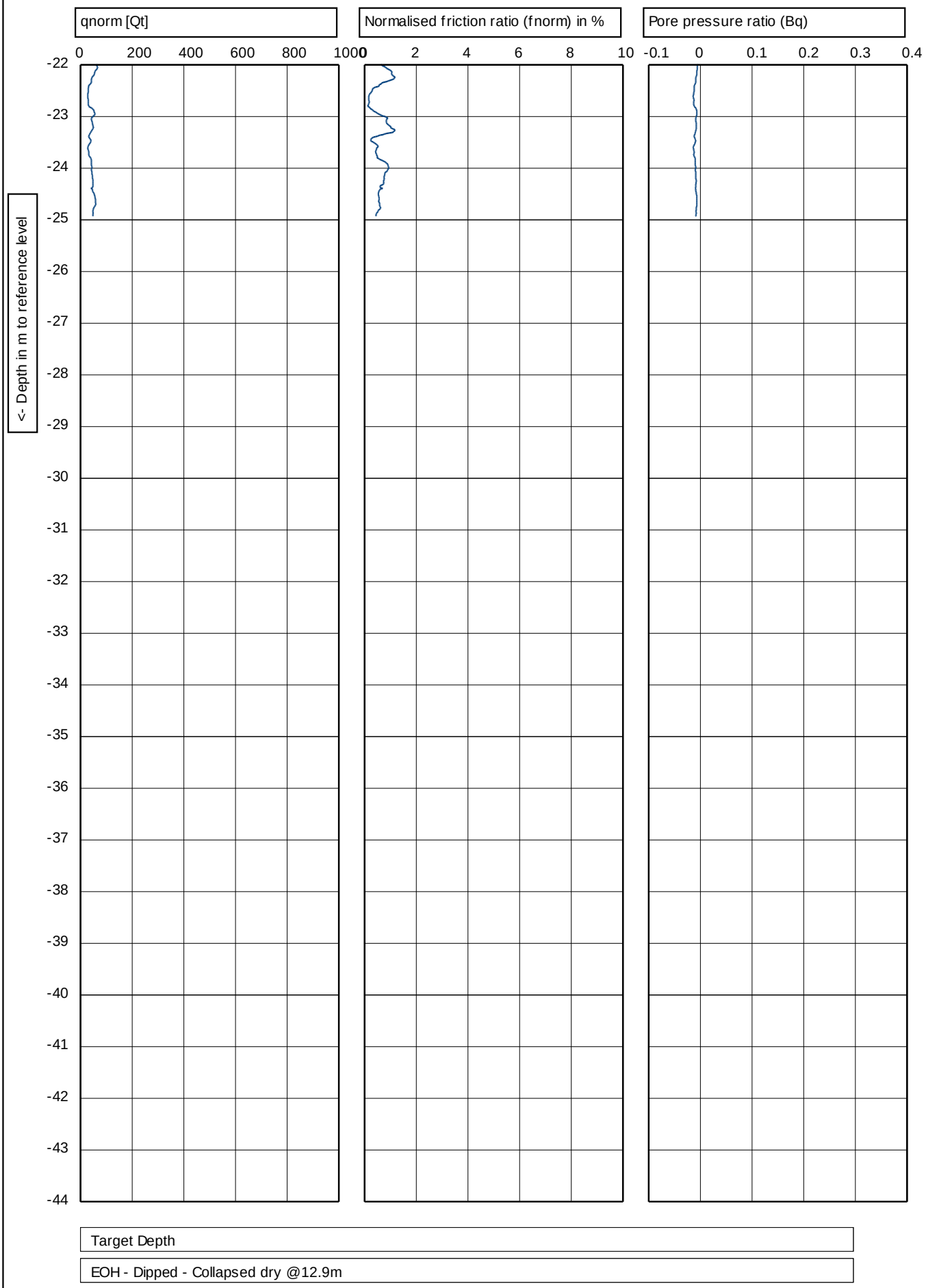
G.L.: **0.00 m MSL** W.L.: **-12.90 m**

Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01** **5/12**



Target Depth

EOH - Dipped - Collapsed dry @12.9m

OPUS

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-12.90 m**

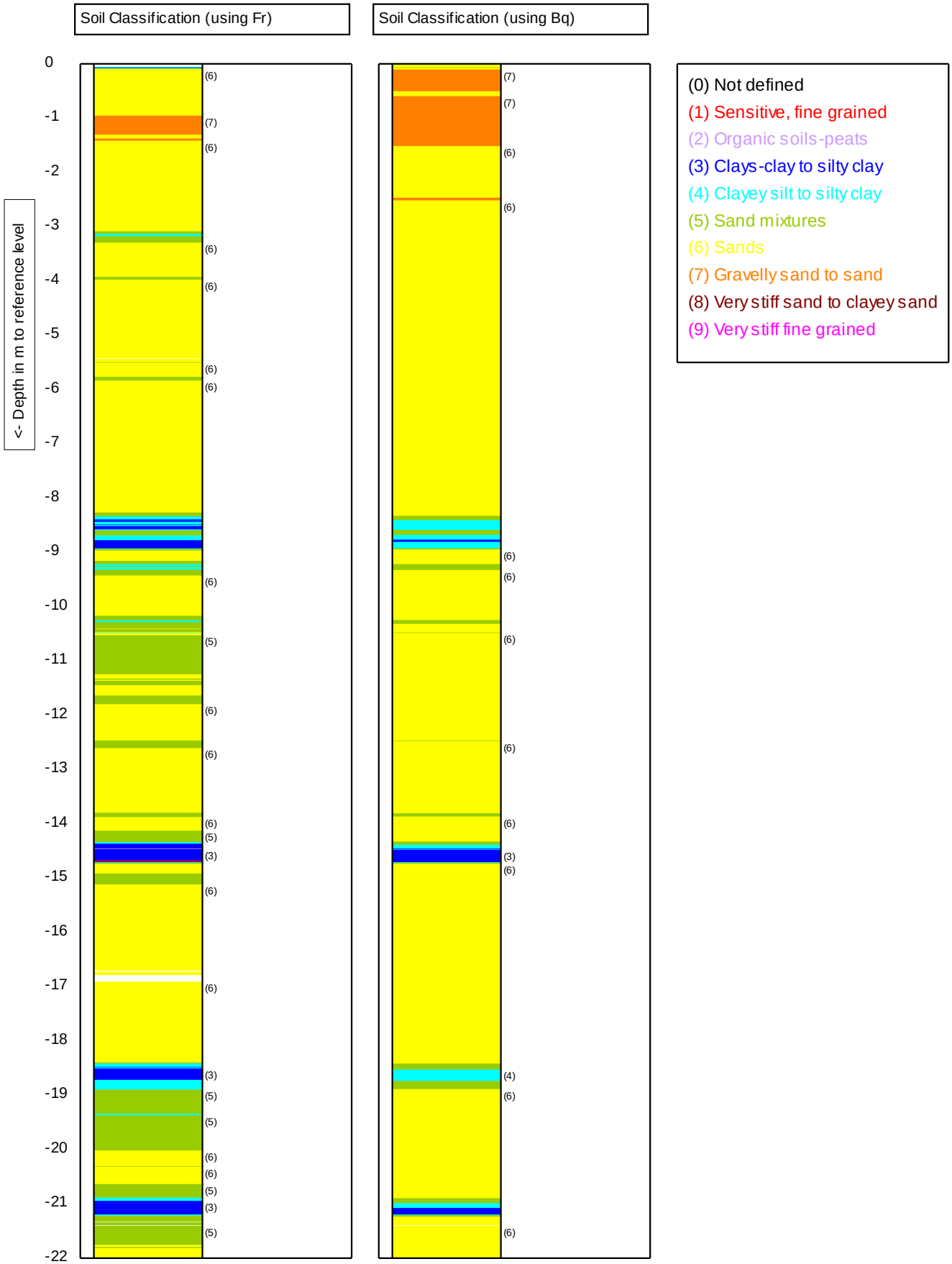
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01** **6/12**

1.45



OPUS

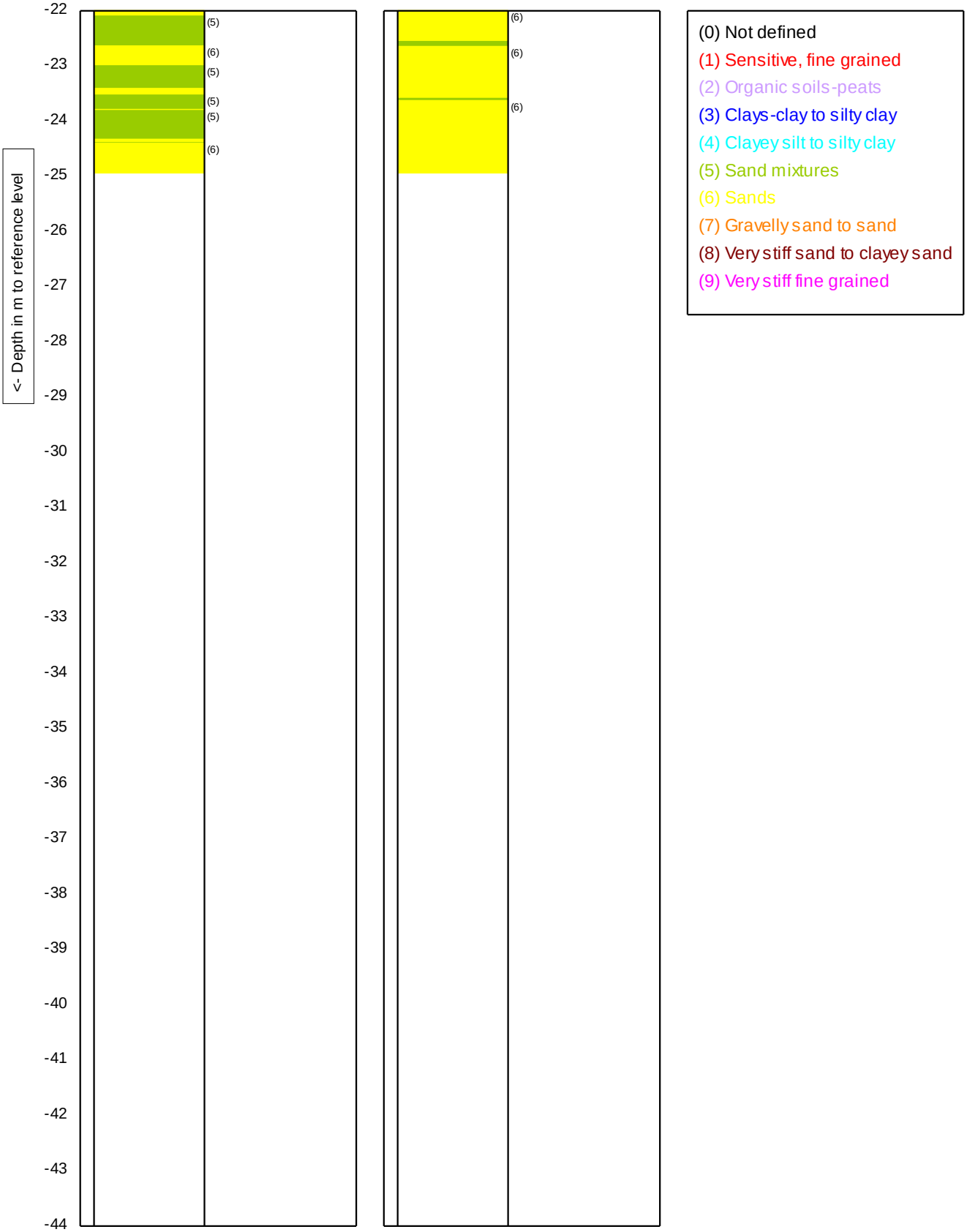
Graphs on this page are not IANZ accredited

1.45

r u2 / 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill:	**0.00 m Predrilled**
	G.L.: **0.00 m MSL** — W.L.: **-12.90 m**	Date:	**17/03/2016**
Project:	**Lot 3 - SH26**	Cone no.:	**C10CFIIP.C15211**
Location:	**136 SH26 - Hamilton**	Project no.:	**2-68206.16_008**
Position:	**1805630, 5814358 NZTM**	CPT no.:	**01** — **7/12**

Soil Classification (using Fr)

Soil Classification (using Bq)



(0) Not defined
(1) Sensitive, fine grained
(2) Organic soils-peats
(3) Clays-clay to silty clay
(4) Clayey silt to silty clay
(5) Sand mixtures
(6) Sands
(7) Gravelly sand to sand
(8) Very stiff sand to clayey sand
(9) Very stiff fine grained

OPUS

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

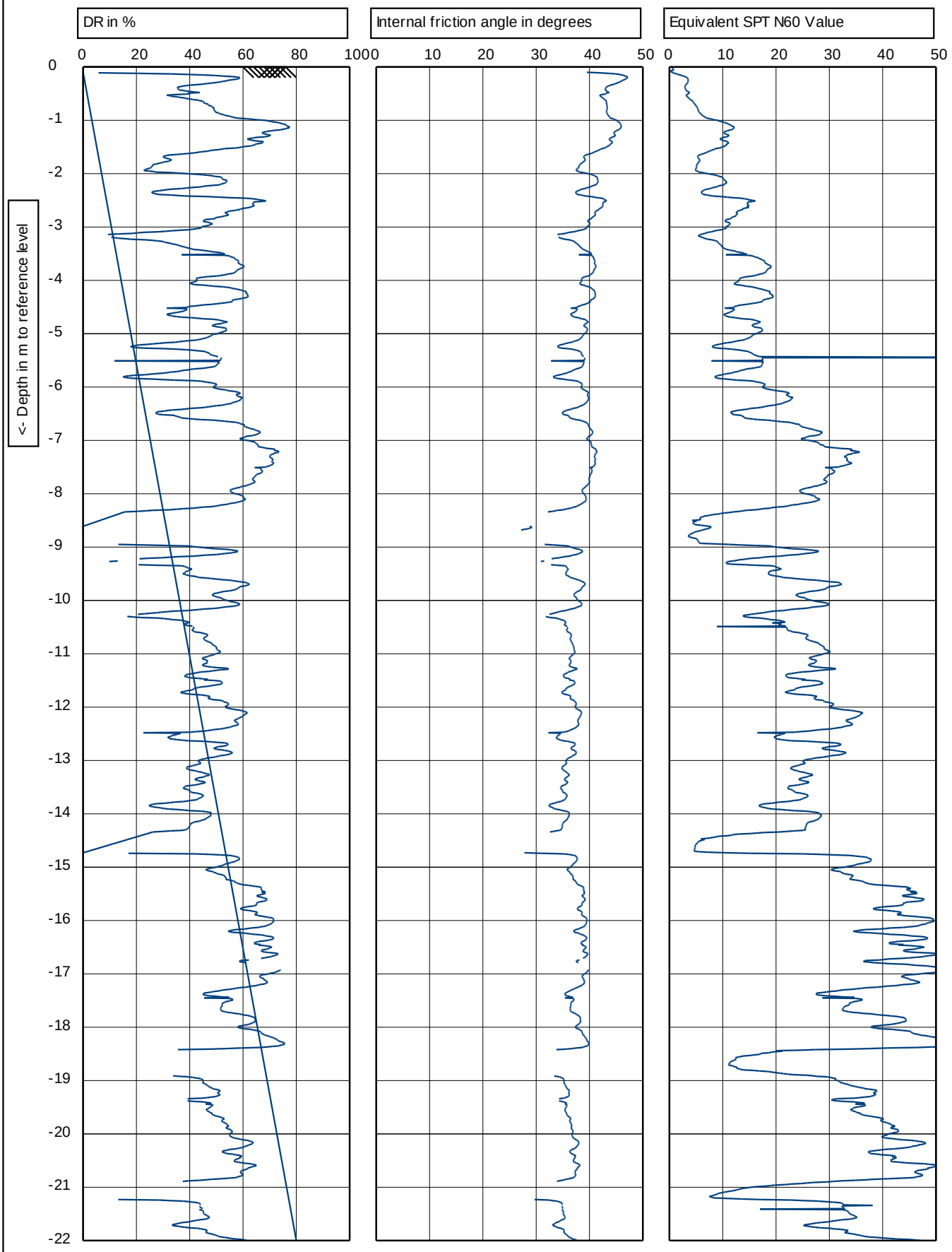
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-12.90 m**

Project: **Lot 3 - SH26**
Location: **136 SH26 - Hamilton**
Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01**

1.45

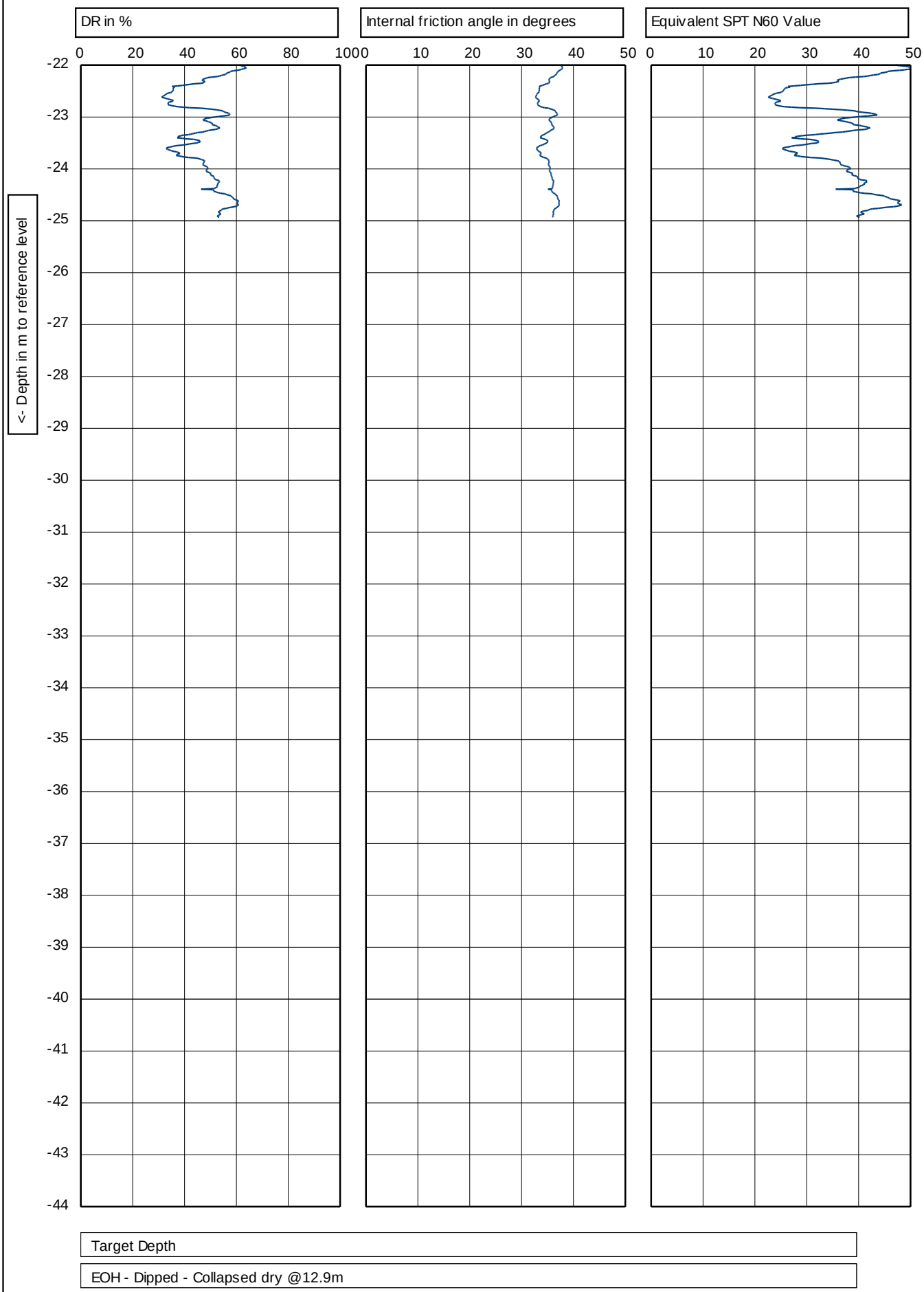


OPUS

Graphs on this page are not IANZ accredited

1.45

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill: **0.00 m Predrilled**
	G.L.: **0.00 m MSL**	W.L.: **-12.90 m**	Date: **17/03/2016**
Project:	**Lot 3 - SH26**		Cone no.: **C10CFIIP.C15211**
Location:	**136 SH26 - Hamilton**		Project no.: **2-68206.16_008**
Position:	**1805630, 5814358 NZTM**		CPT no.: **01** **9/12**



Target Depth

EOH - Dipped - Collapsed dry @12.9m

OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-12.90 m**

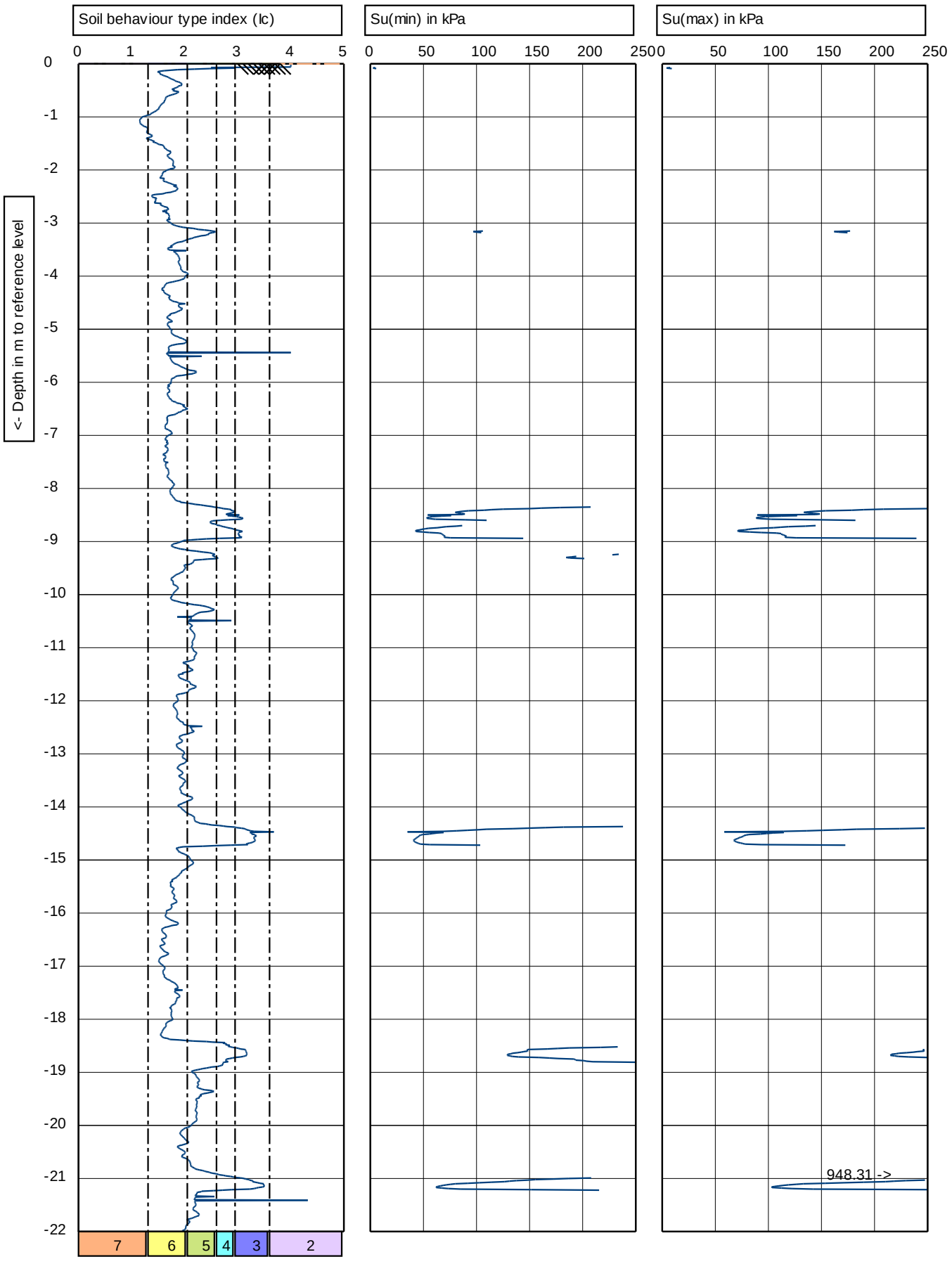
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01** **10/12**

1.45



OPUS

Graphs on this page are not IANZ accredited

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-12.90 m**

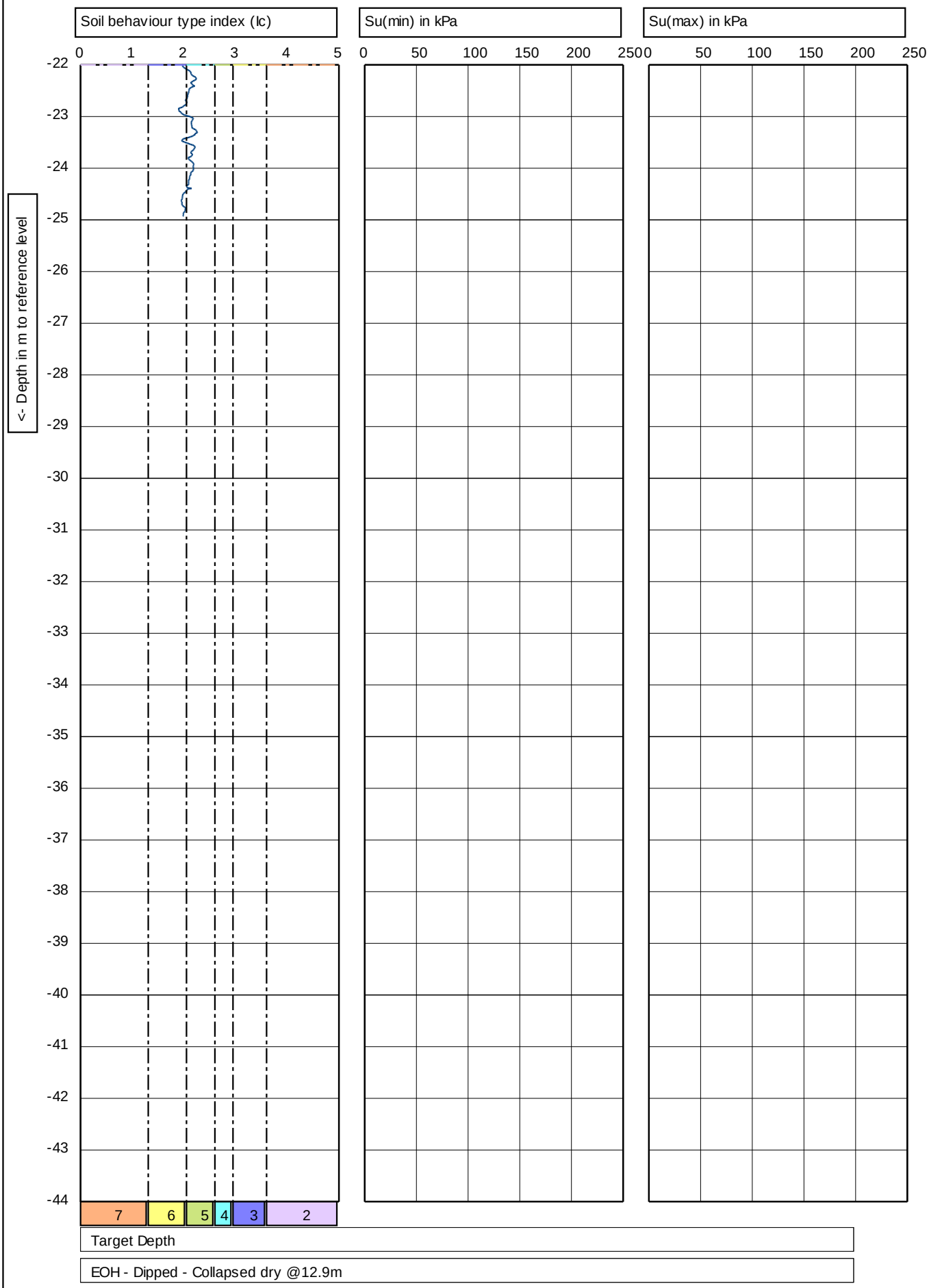
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01**

1.45



OPUS

Graphs on this page are not IANZ accredited

1.45

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

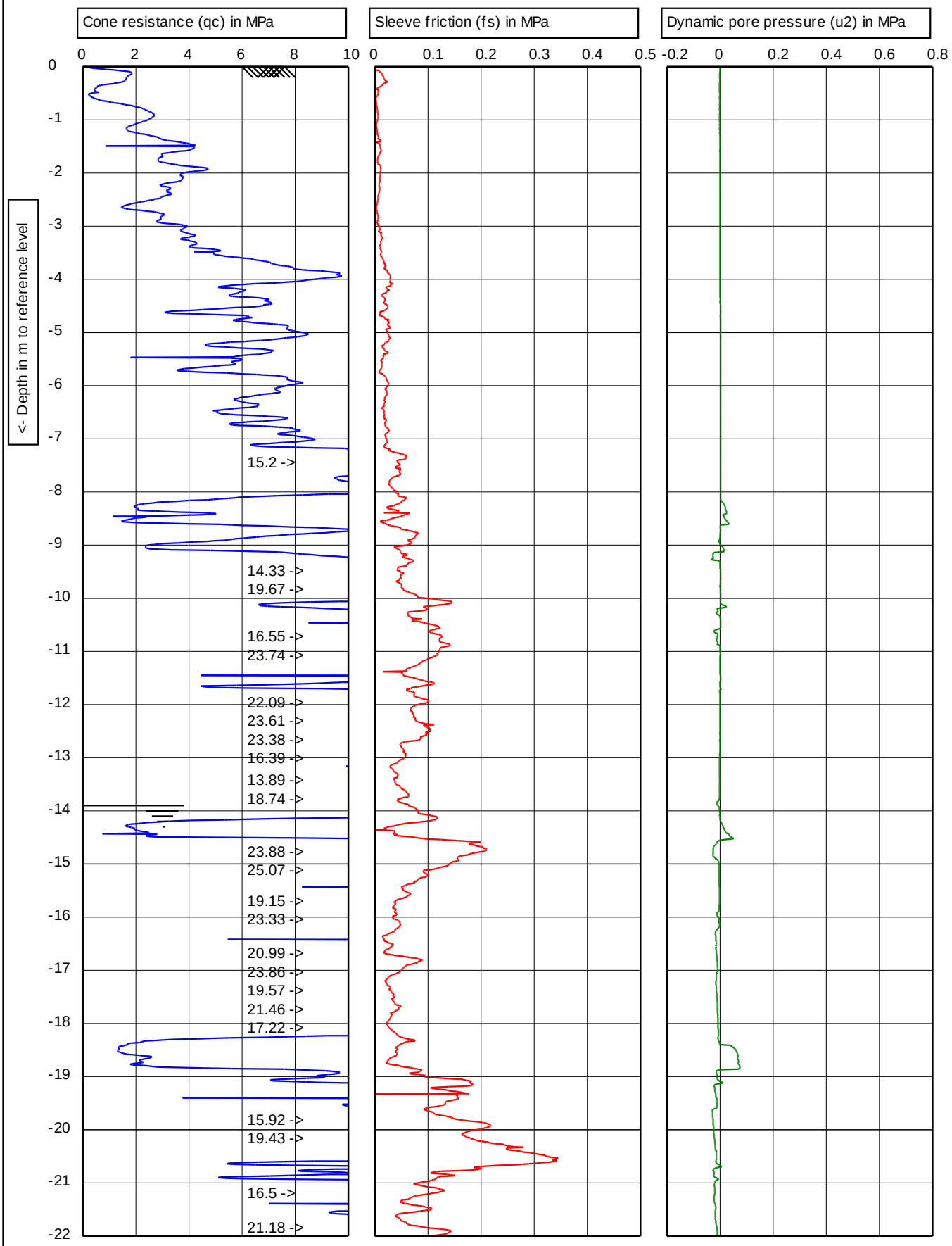
G.L.: **0.00 m MSL** W.L.: **-12.90 m**

Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805630, 5814358 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**01** **12/12**



OPUS IANZ ACCREDITED LABORATORY

Graphs indicated as not accredited are outside the scope of the laboratory's accreditation

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-13.90 m**

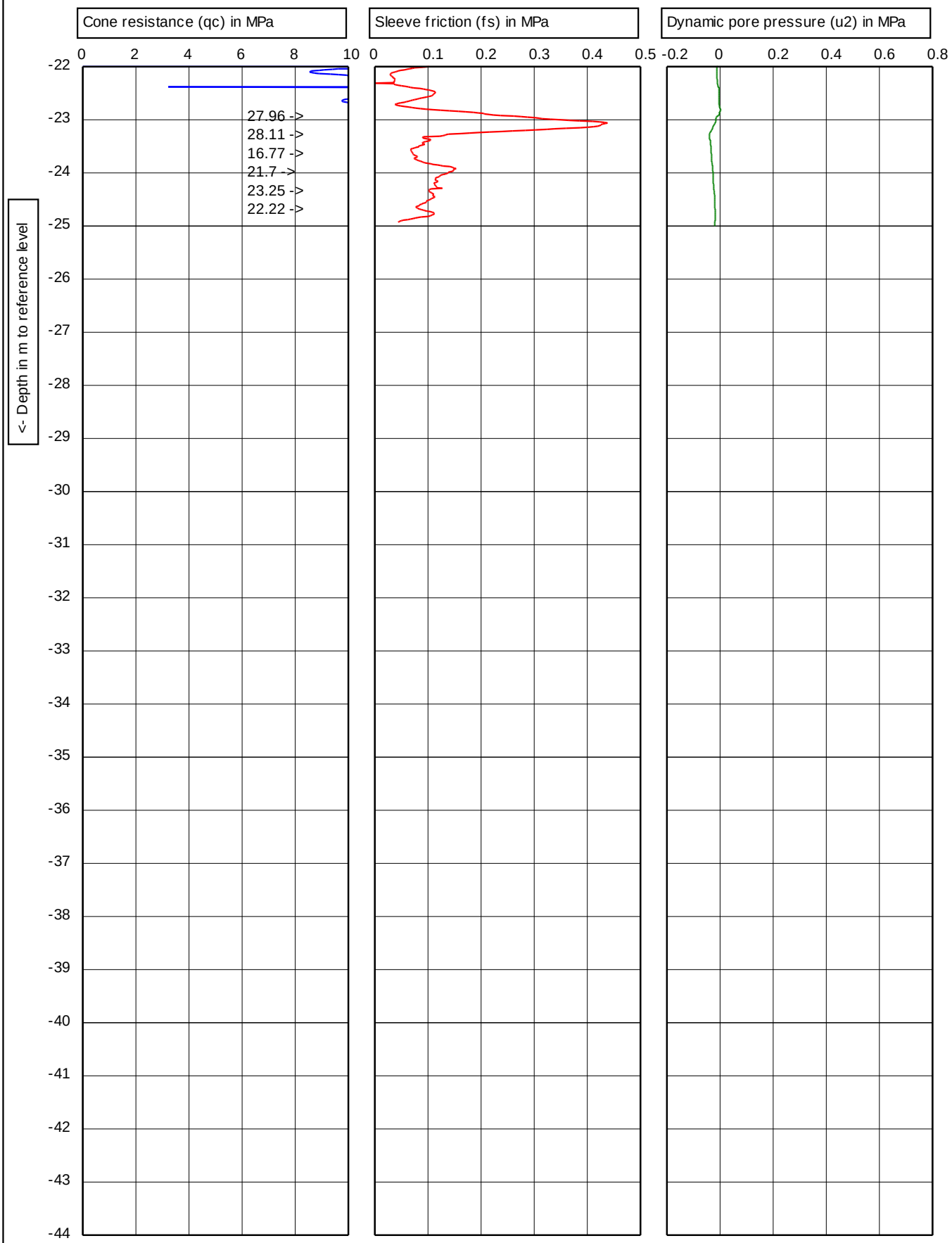
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02** **1/12**

1.45



OPUS IANZ ACCREDITED LABORATORY

Graphs indicated as not accredited are outside the scope of the laboratory's accreditation

r u2
L 150 cm²
10 cm²

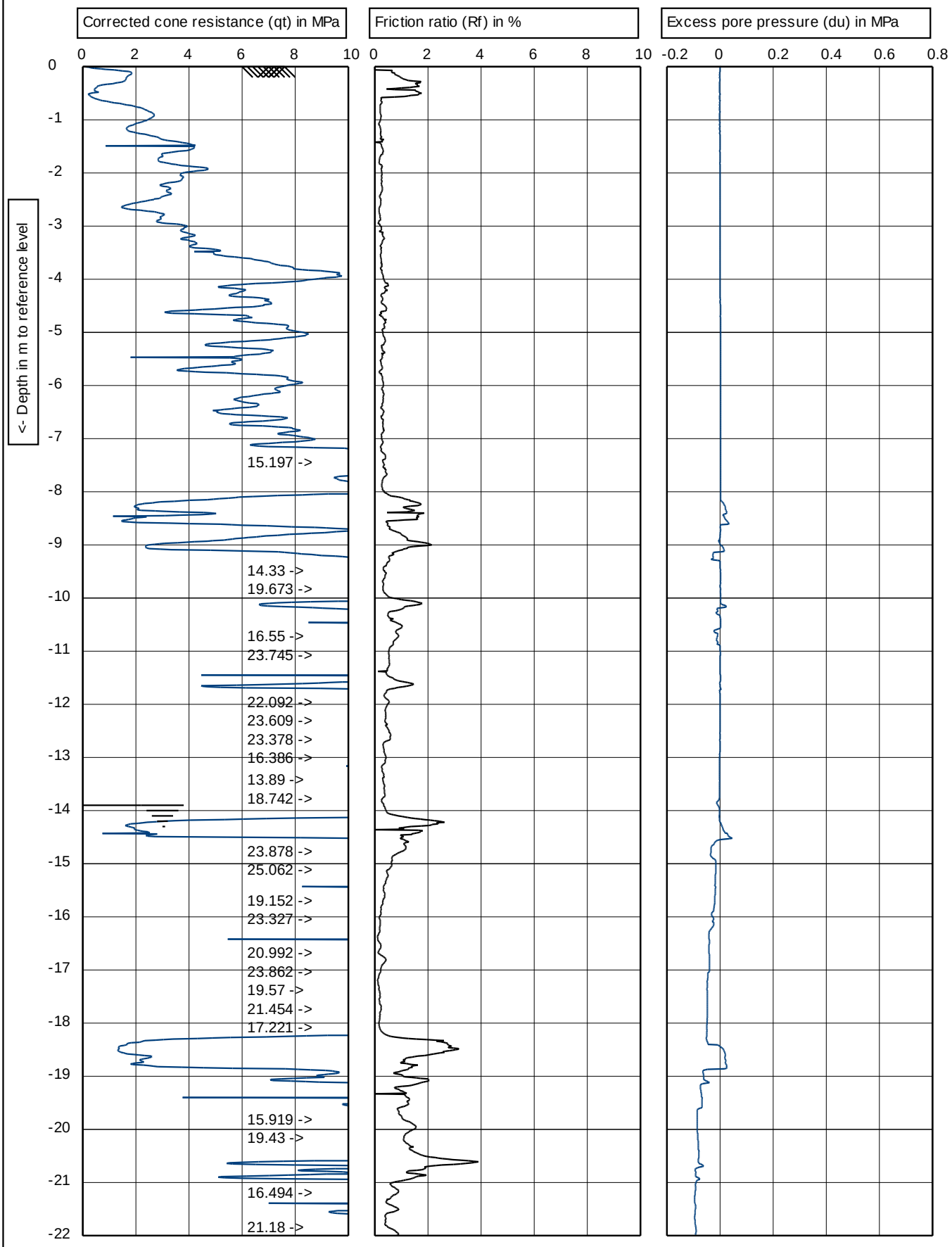
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

Project: **Lot 3 - SH26**
Location: **136 SH26 - Hamilton**
Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02** **2/12**

1.45



OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

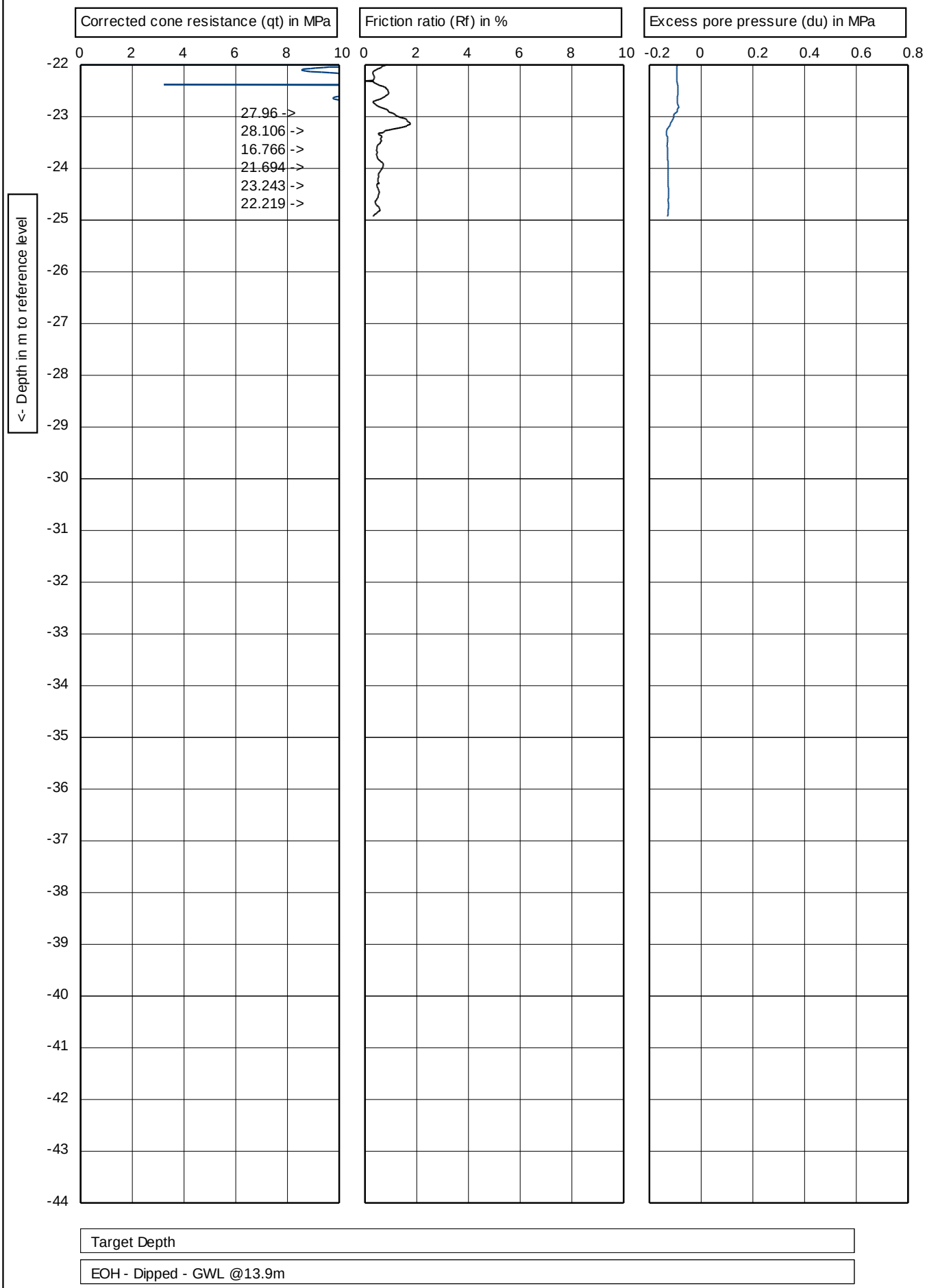
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02**

1.45



OPUS

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

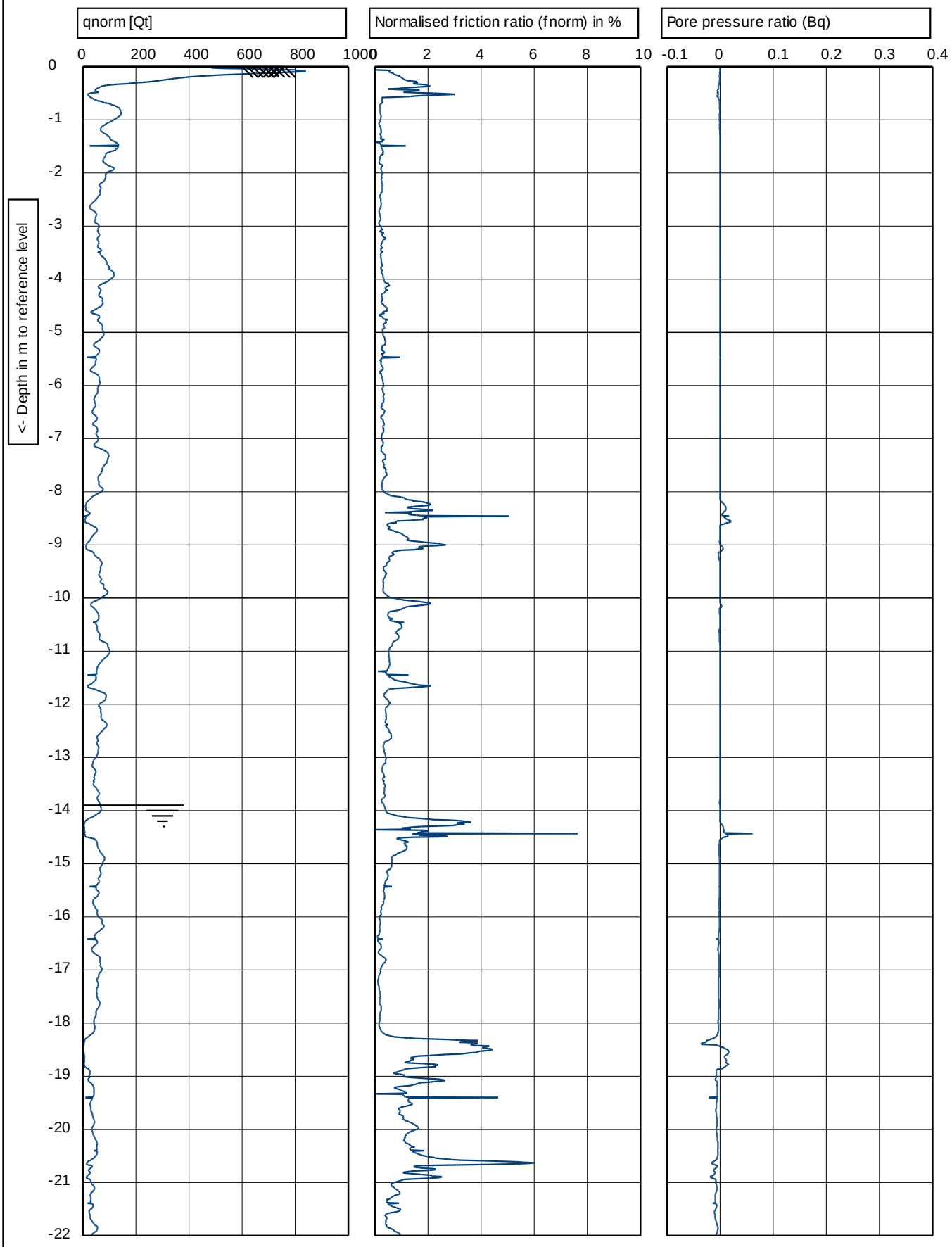
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

Project: **Lot 3 - SH26**
Location: **136 SH26 - Hamilton**
Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02** **4/12**

1.45



OPUS

Graphs on this page are not IANZ accredited

1.45

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

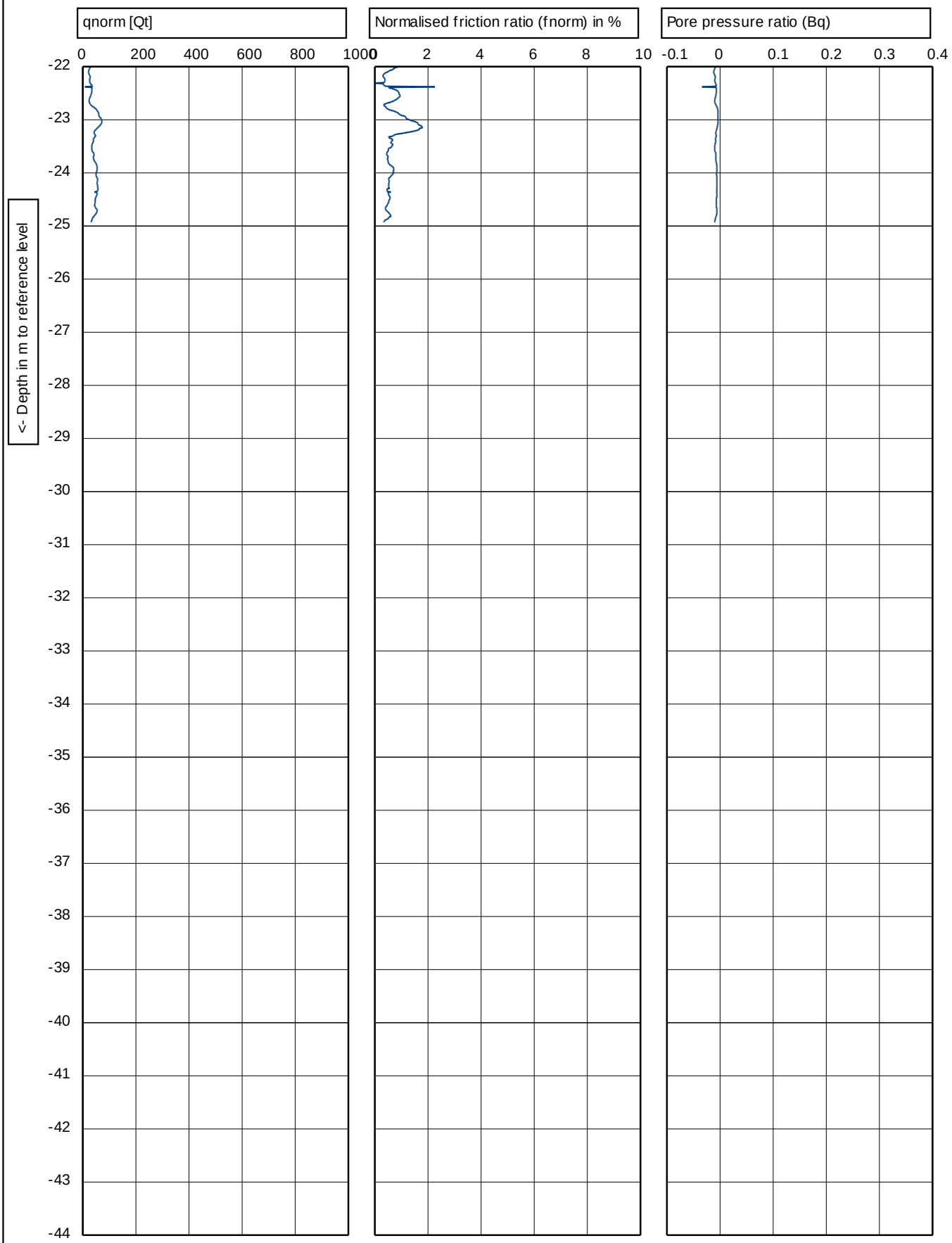
G.L.: **0.00 m MSL** W.L.: **-13.90 m**

Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02** **5/12**



Target Depth

EOH - Dipped - GWL @13.9m

OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

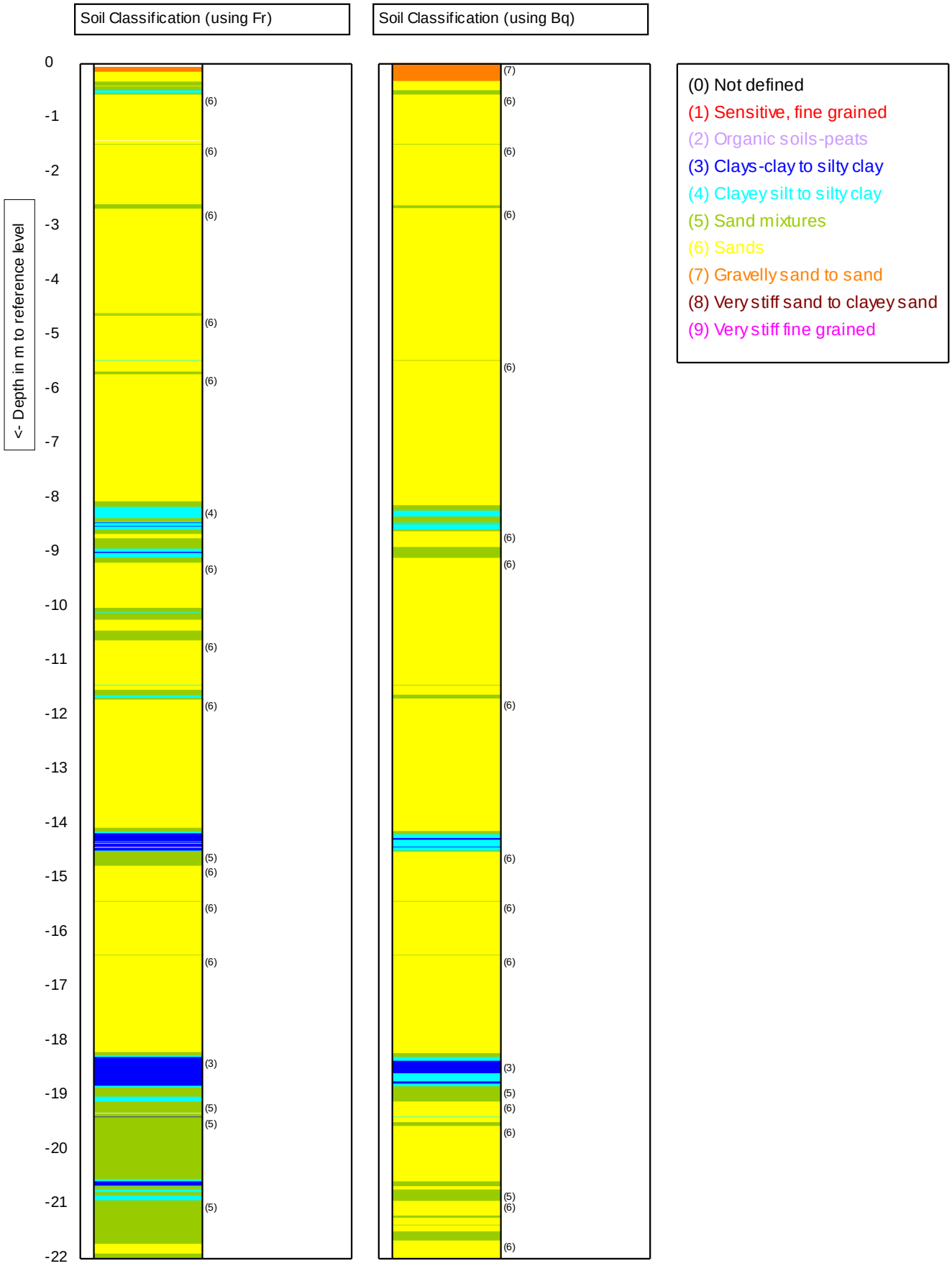
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

Project: **Lot 3 - SH26**
Location: **136 SH26 - Hamilton**
Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02**

1.45



OPUS

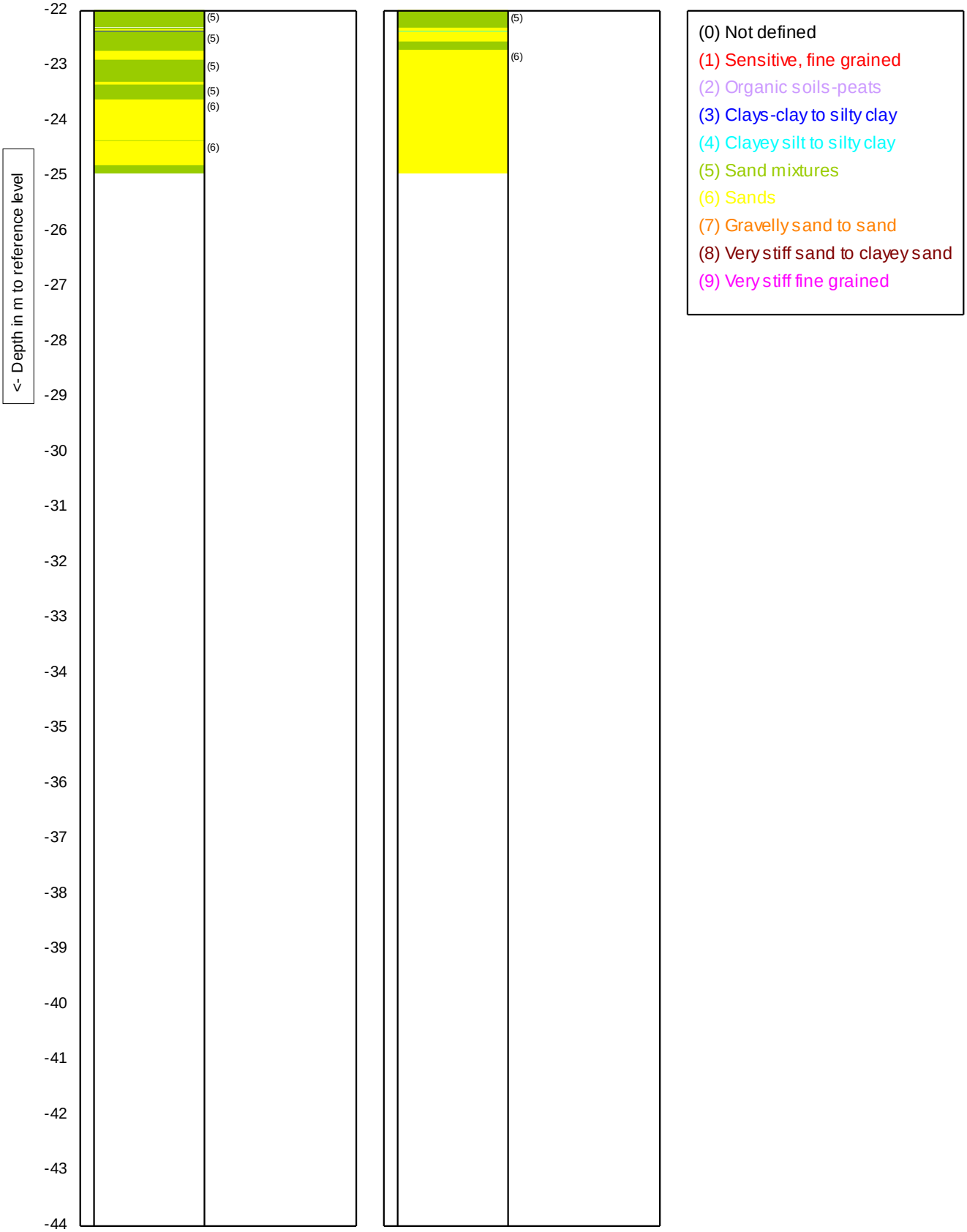
Graphs on this page are not IANZ accredited

r u2 / 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012	Predrill:	**0.00 m Predrilled**
	G.L.: **0.00 m MSL** W.L.: **-13.90 m**	Date:	**17/03/2016**
Project:	**Lot 3 - SH26**	Cone no.:	**C10CFIIP.C15211**
Location:	**136 SH26 - Hamilton**	Project no.:	**2-68206.16_008**
Position:	**1805634, 5814343 NZTM**	CPT no.:	**02** **7/12**

1.45

Soil Classification (using Fr)

Soil Classification (using Bq)



(0) Not defined
(1) Sensitive, fine grained
(2) Organic soils-peats
(3) Clays-clay to silty clay
(4) Clayey silt to silty clay
(5) Sand mixtures
(6) Sands
(7) Gravelly sand to sand
(8) Very stiff sand to clayey sand
(9) Very stiff fine grained

OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

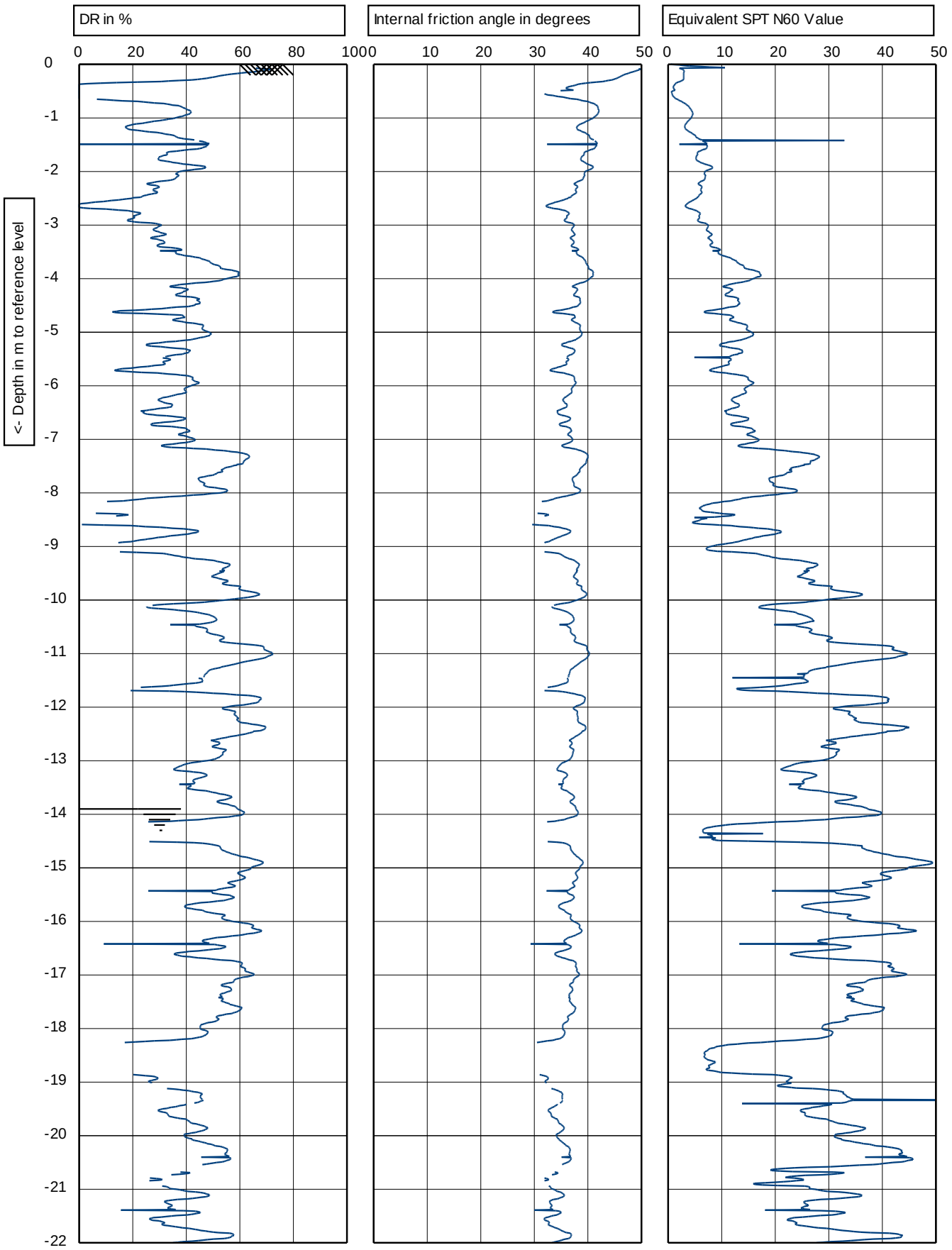
Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

Project: **Lot 3 - SH26**
Location: **136 SH26 - Hamilton**
Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02**

1.45

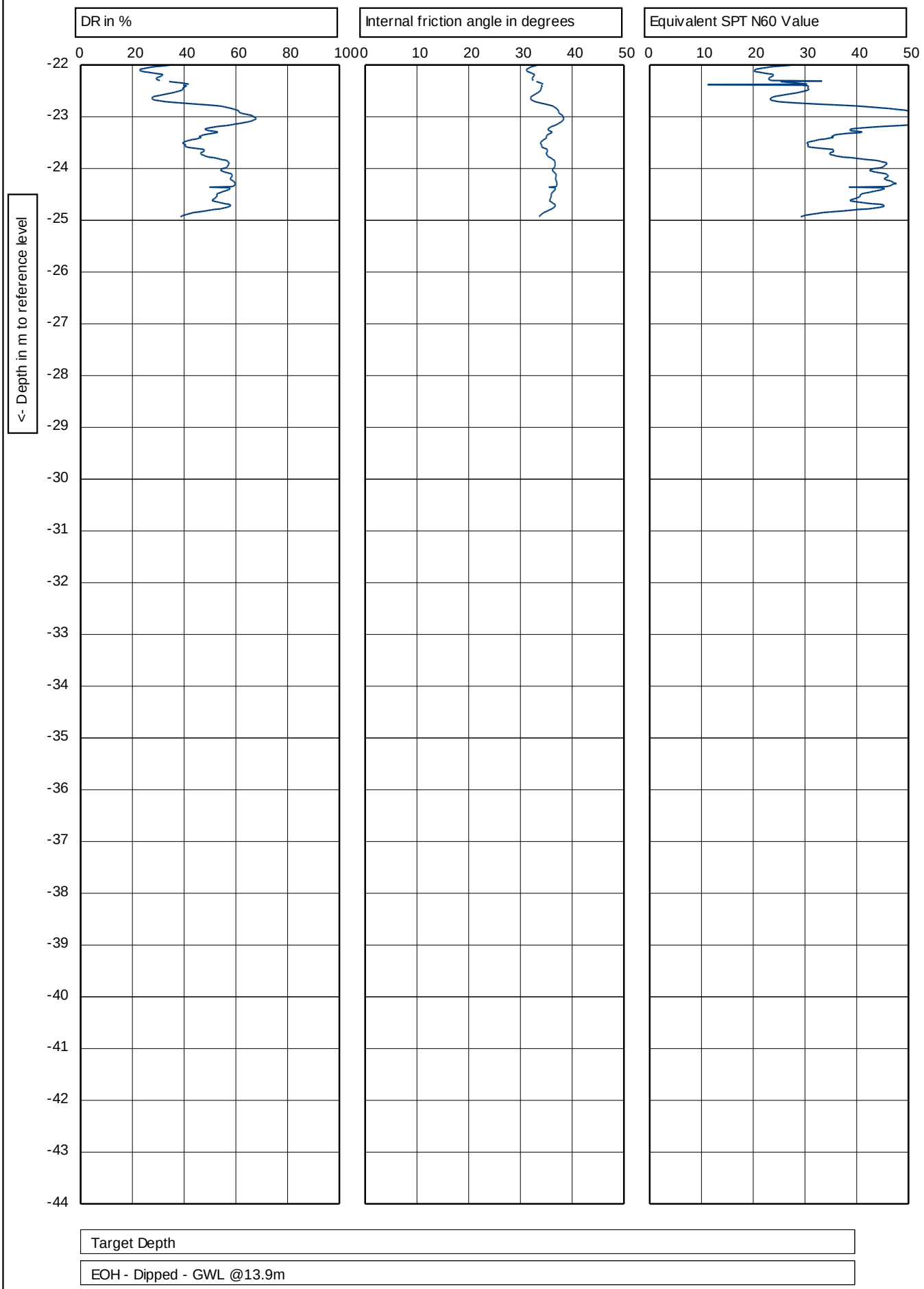


OPUS

Graphs on this page are not IANZ accredited

1.45

r u2 / L 150 cm² / 10 cm²	Test according ASTM D5778-12 & ISO 22476-1:2012		Predrill: **0.00 m Predrilled**
	G.L.: **0.00 m MSL**	W.L.: **-13.90 m**	Date: **17/03/2016**
Project:	**Lot 3 - SH26**		Cone no.: **C10CFIIP.C15211**
Location:	**136 SH26 - Hamilton**		Project no.: **2-68206.16_008**
Position:	**1805634, 5814343 NZTM**		CPT no.: **02** **9/12**



Target Depth

EOH - Dipped - GWL @13.9m

OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

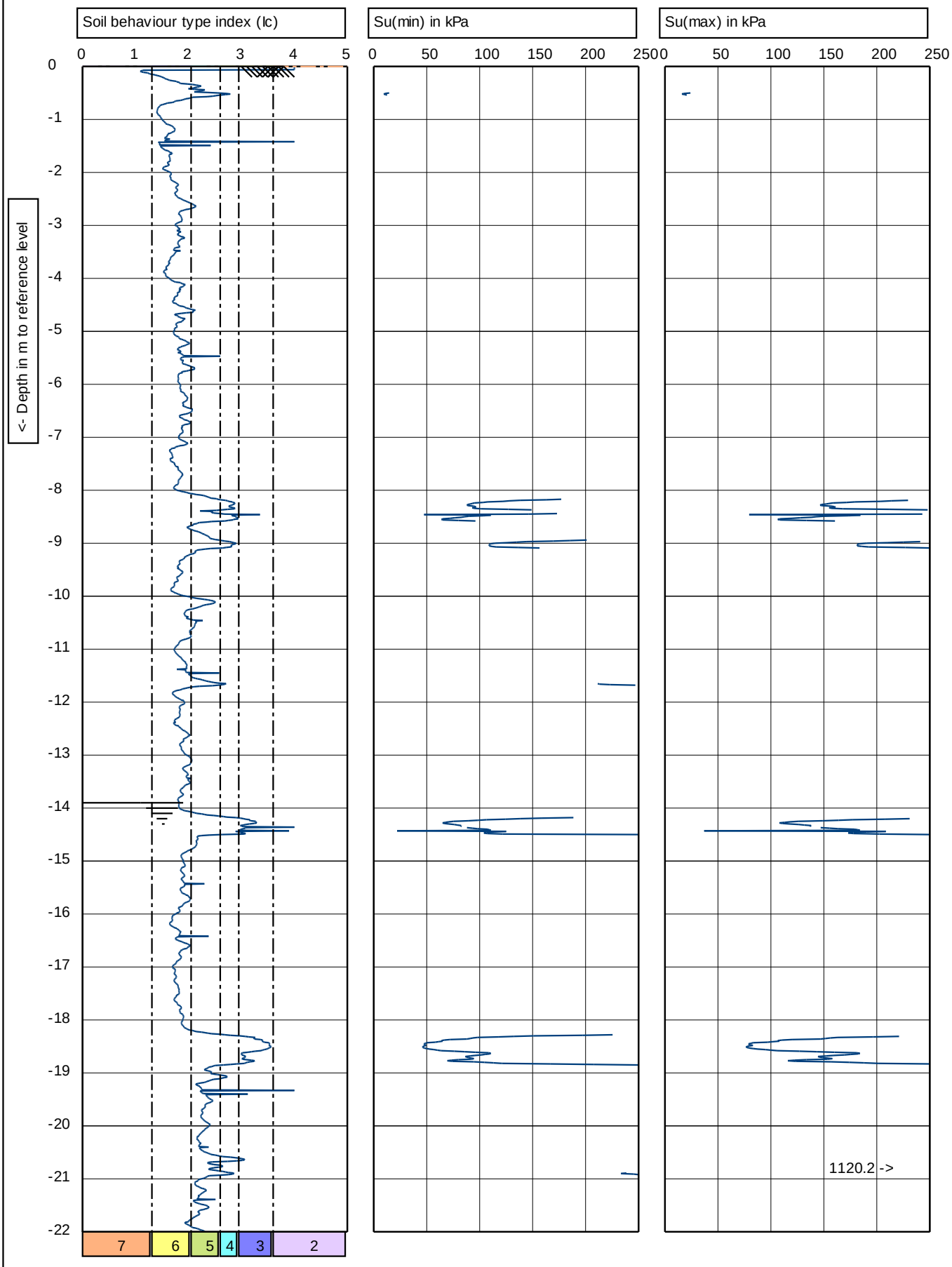
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02** **10/12**

1.45



OPUS

Graphs on this page are not IANZ accredited

r u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** W.L.: **-13.90 m**

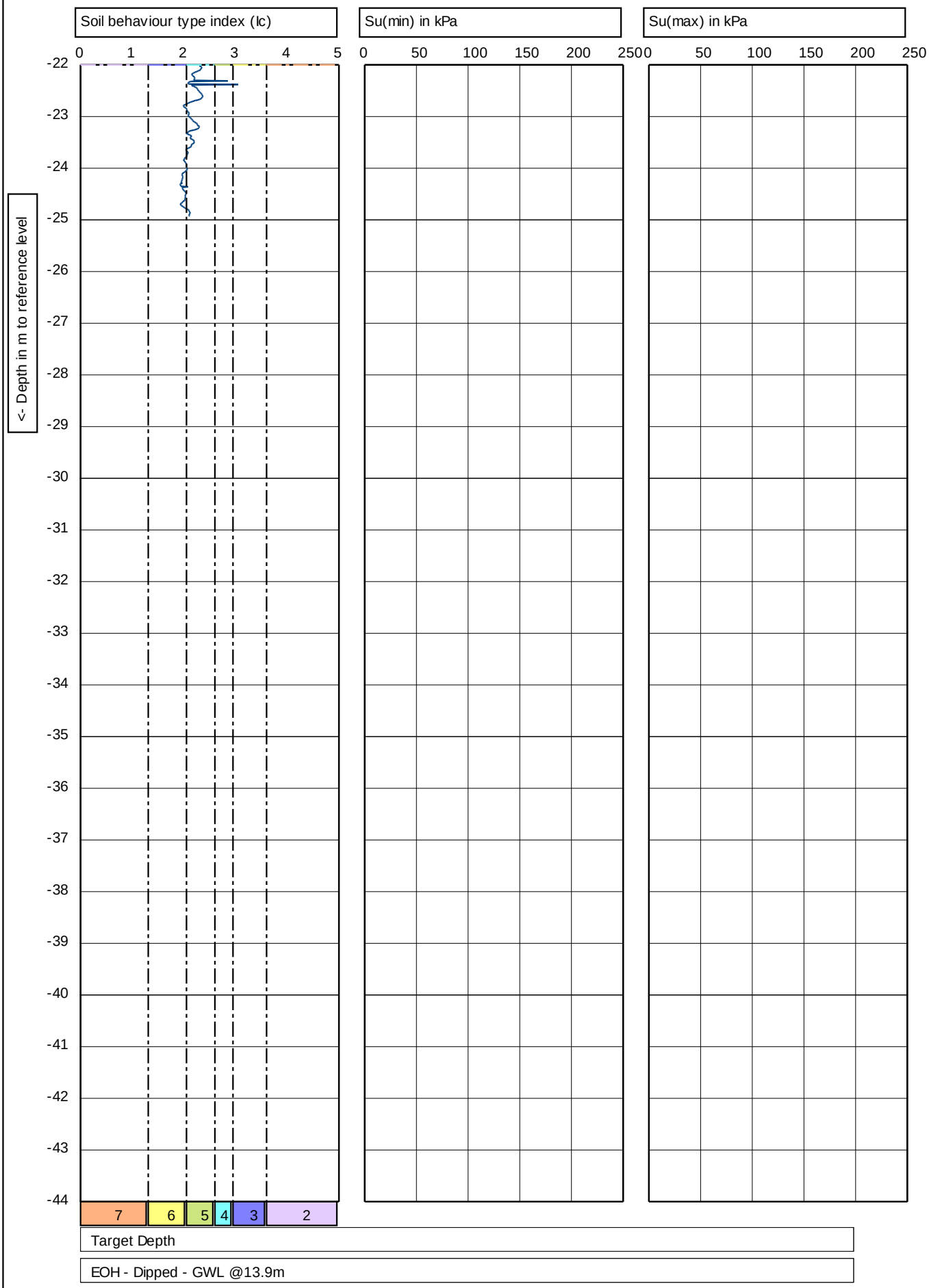
Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02** **11/12**

1.45



OPUS

Graphs on this page are not IANZ accredited

u2
150 cm²
10 cm²

Test according ASTM D5778-12 & ISO 22476-1:2012

G.L.: **0.00 m MSL** | W.L.: **-13.90 m**

Project: **Lot 3 - SH26**

Location: **136 SH26 - Hamilton**

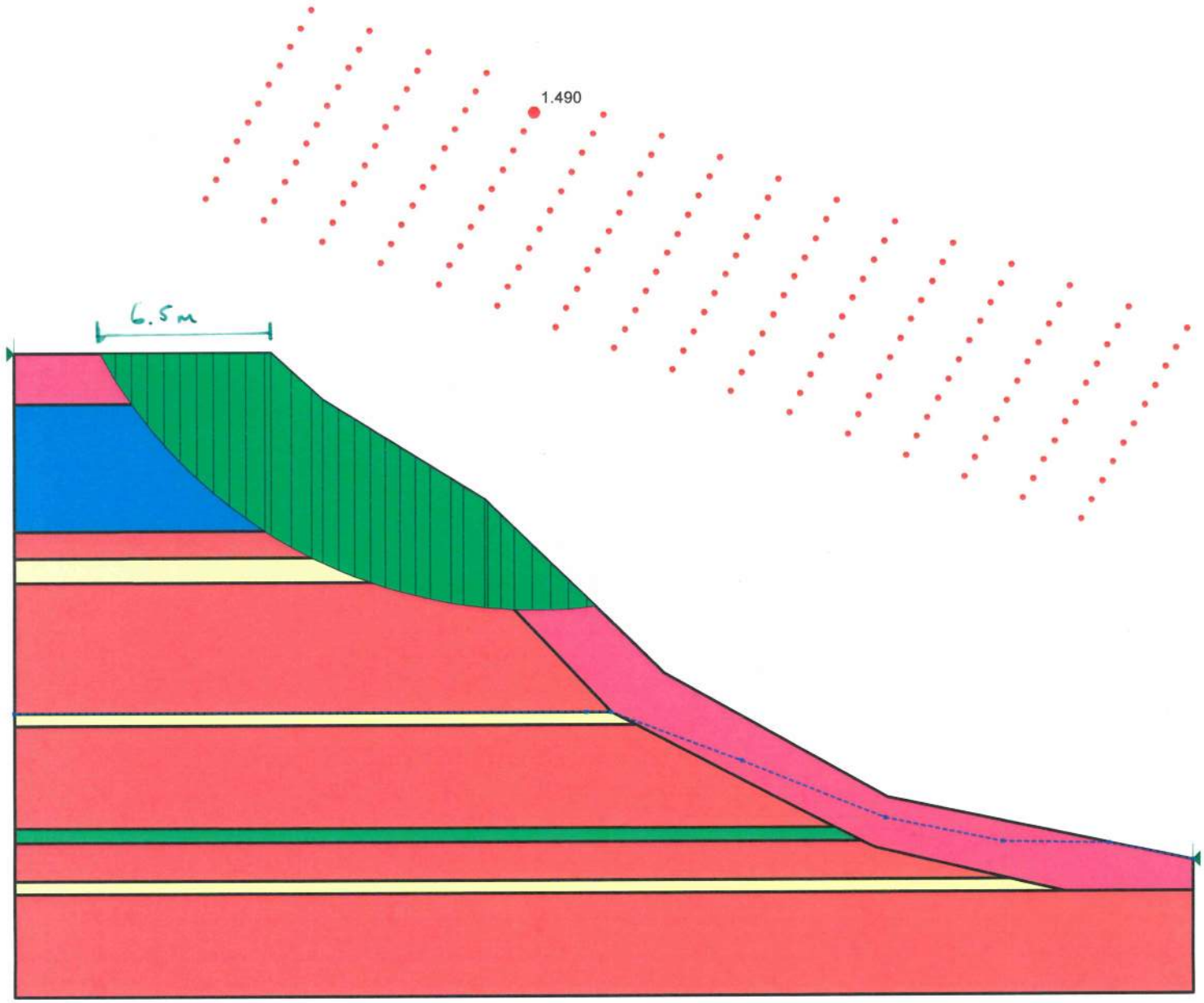
Position: **1805634, 5814343 NZTM**

Predrill:	**0.00 m Predrilled**
Date:	**17/03/2016**
Cone no.:	**C10CFIIP.C15211**
Project no.:	**2-68206.16_008**
CPT no.:	**02**

1.45

APPENDIX C – Slope Stability Plots

Slope Stability Analysis Results - Static Conditions



Name: Stiff SILT/CLAY
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion': 2 kPa
Phi': 32 °

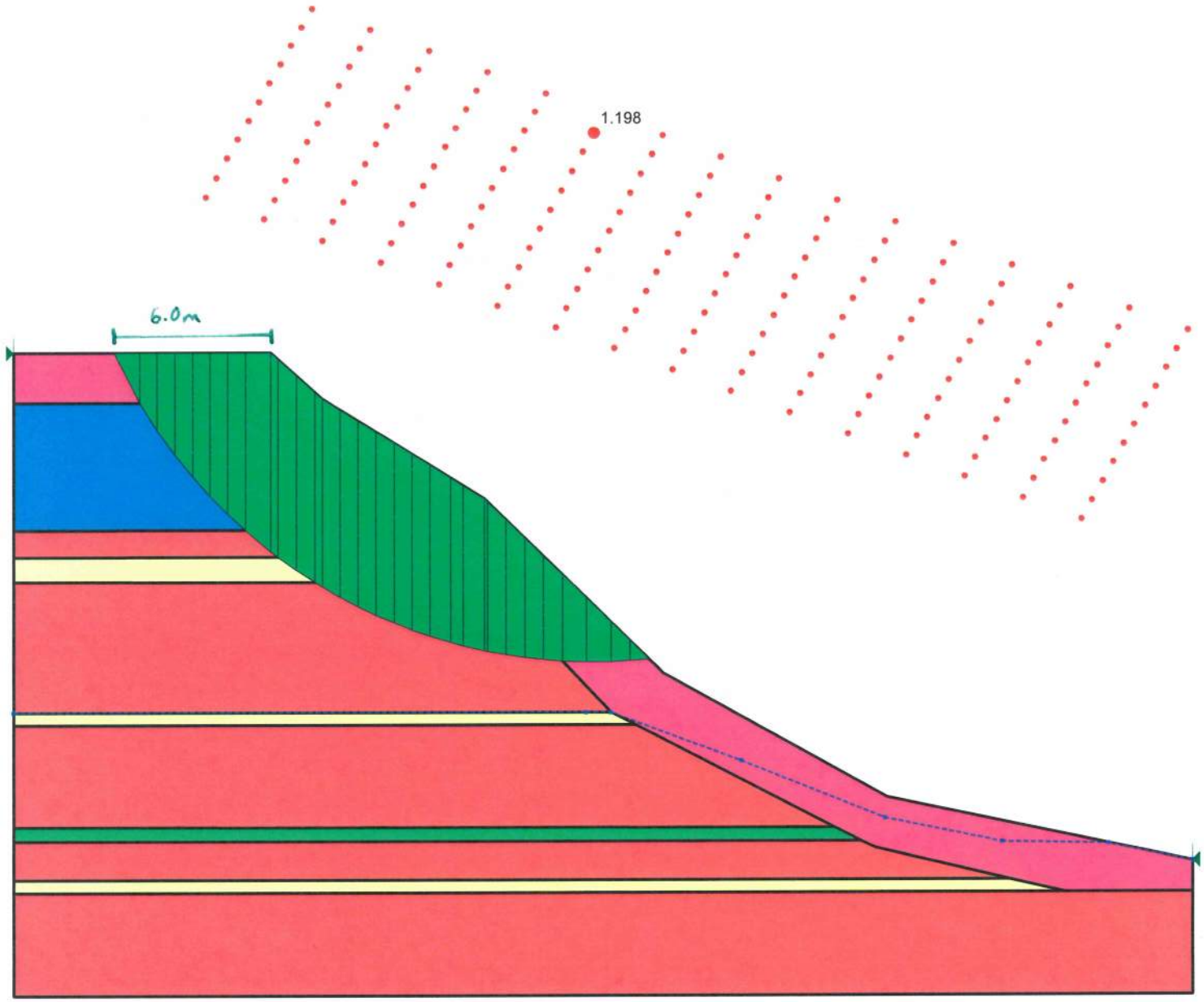
Name: Firm SILT/CLAY
Model: Mohr-Coulomb
Unit Weight: 16 kN/m³
Cohesion': 1 kPa
Phi': 30 °

Name: Medium dense SAND
Model: Mohr-Coulomb
Unit Weight: 16 kN/m³
Cohesion': 0 kPa
Phi': 32 °

Name: Dense SAND
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion': 0 kPa
Phi': 34 °

Name: Loose SAND
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion': 0 kPa
Phi': 28 °

Slope Stability Analysis Results - SLS Seismic Conditions



Name: Stiff SILT/CLAY
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion': 2 kPa
Phi': 32 °

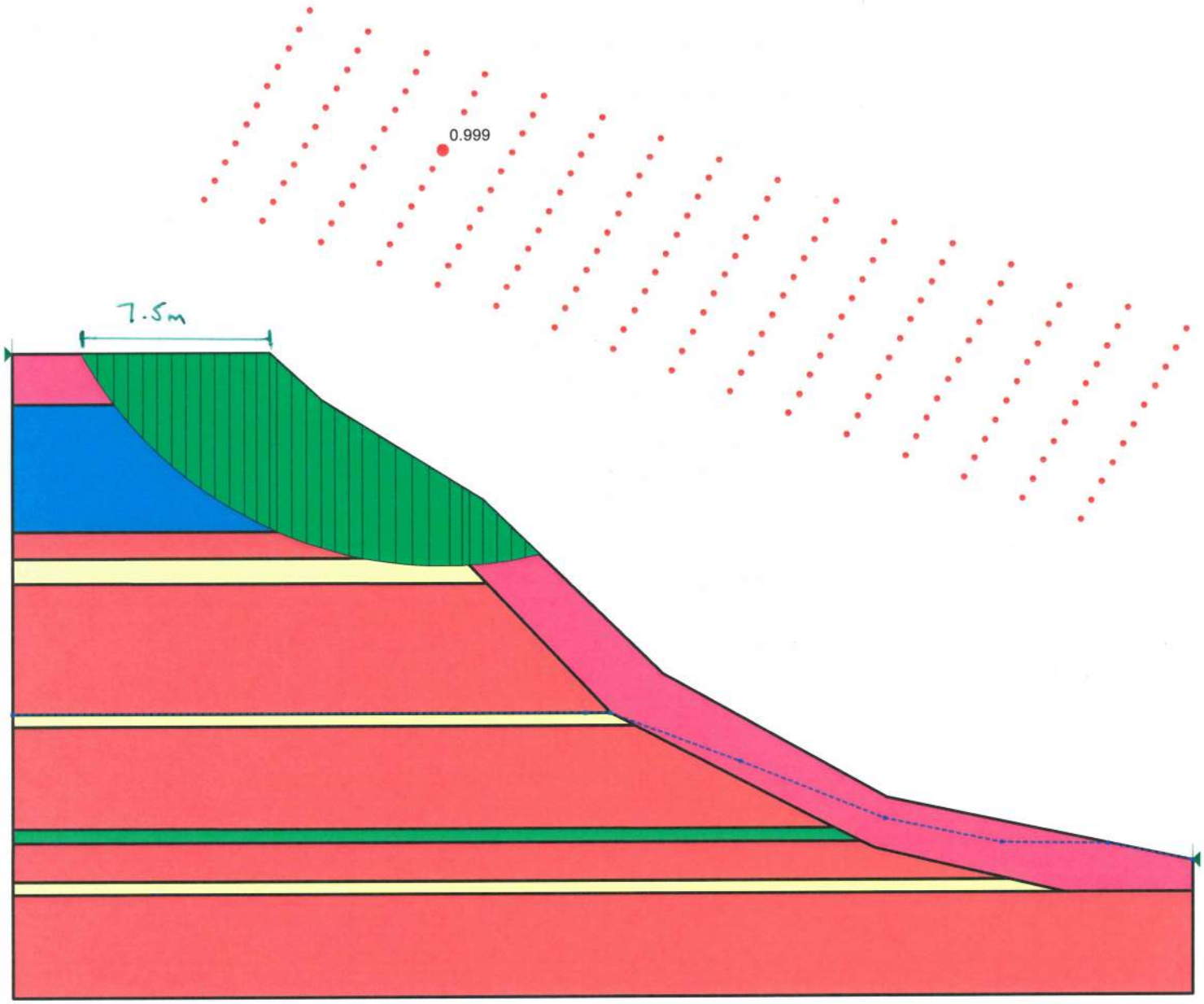
Name: Firm SILT/CLAY
Model: Mohr-Coulomb
Unit Weight: 16 kN/m³
Cohesion': 1 kPa
Phi': 30 °

Name: Medium dense SAND
Model: Mohr-Coulomb
Unit Weight: 16 kN/m³
Cohesion': 0 kPa
Phi': 32 °

Name: Dense SAND
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion': 0 kPa
Phi': 34 °

Name: Loose SAND
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion': 0 kPa
Phi': 28 °

Slope Stability Analysis Results - ULS Seismic Conditions



Name: Stiff SILT/CLAY
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion': 2 kPa
Phi': 32 °

Name: Firm SILT/CLAY
Model: Mohr-Coulomb
Unit Weight: 16 kN/m³
Cohesion': 1 kPa
Phi': 30 °

Name: Medium dense SAND
Model: Mohr-Coulomb
Unit Weight: 16 kN/m³
Cohesion': 0 kPa
Phi': 32 °

Name: Dense SAND
Model: Mohr-Coulomb
Unit Weight: 17 kN/m³
Cohesion': 0 kPa
Phi': 34 °

Name: Loose SAND
Model: Mohr-Coulomb
Unit Weight: 14 kN/m³
Cohesion': 0 kPa
Phi': 28 °

APPENDIX D - Soakage Logs

Soil Description

Investigation method	Geological Unit	Field Description	Depth (m)	End Depth (m)	Field Test Data: Time (min)	Depth Below GL (mm)	Change in Depth (mm)	Depth to bottom of hole (mm)
Log No: SH01		Pre-soak method: Fast draining	Litres used: 350		Liner used: No			
HAND AUGER	T/S	TOPSOIL. Dark brownish black, moist.		200mm COLLAPSE	0	0	0	1000
	HINUERA FORMATION	SILT. Light brown, dry-moist.			0.25	260	260	740
					0.5	510	250	490
					0.75	640	130	360
		Silty SAND. Light brown, dry.	0.5		1	710	70	290
					1.5	830	120	170
					2	880	50	120
		Below 0.9m, some gravel.	1.0					
		End of borehole at 1.1m - Target depth.	1.5					
			2.0					
			2.5					
Log No: SH02		Pre-soak method: Fast draining	Litres used: 350		Liner used: No			
HAND AUGER	T/S	TOPSOIL. Dark brownish black, moist.		NO COLLAPSE	0	390	0	1400
	HINUERA FORMATION	SILT. Light brown, dry-moist.			0.25	1100	710	690
					0.5	1270	170	520
					0.75	1370	100	420
		Below 0.5m, sandy SILT.	0.5		1	1400	30	390
		Silty SAND. Light brown, dry-moist.						
		Below 0.8m, SAND.	1.0					
		Below 1.1m, minor gravel.						
		End of borehole at 1.4m - Target depth.	1.5					
			2.0					
			2.5					

Notes:

1. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2. Soils have been described in general accordance with NZ Geomechanics Society "*Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*", December 2005
3. Undrained shear strengths (where reported) have been corrected in general accordance with NZ Geotech Society Inc. "*Guideline for Hand Held Shear Vane Test*", August 2001.
4. Scala Penetrometer testing (where reported) has been carried out in general accordance with NZS 4402 Test 6.5.2.

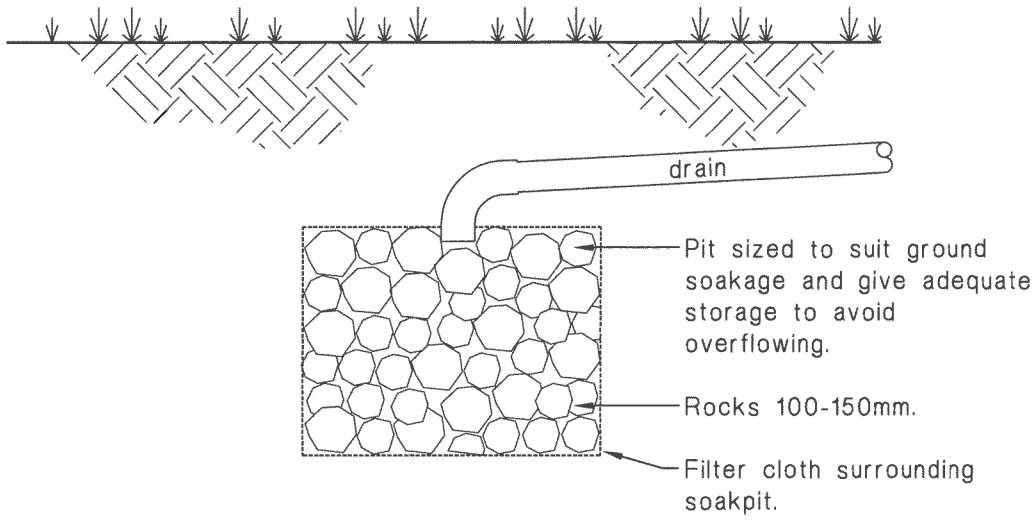
BCD GROUP

Job name: Lot 3, 136 State Highway 26
Site location: Lot 3, 136 State Highway 26, Hamilton
Date of investigation: 18-03-2016

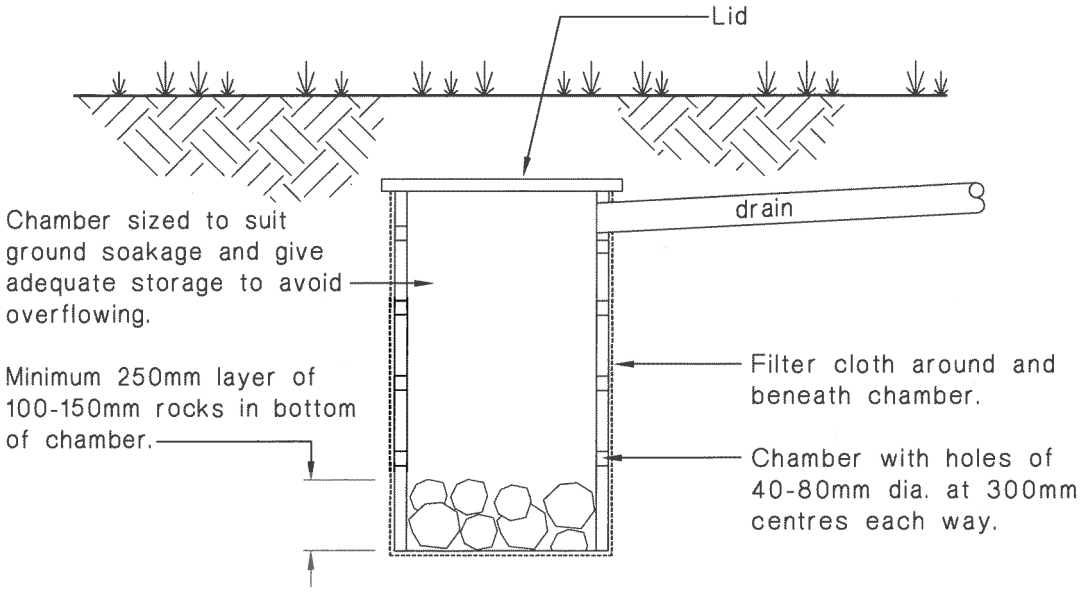
Job Number: 16-0220
Auger Size: 100mm
Logged By: B.M.
Checked By: J.H.

APPENDIX E – Soakage System Schematic

Figure 13: Soak Pit for Surface Water Disposal
Paragraph 9.0.4

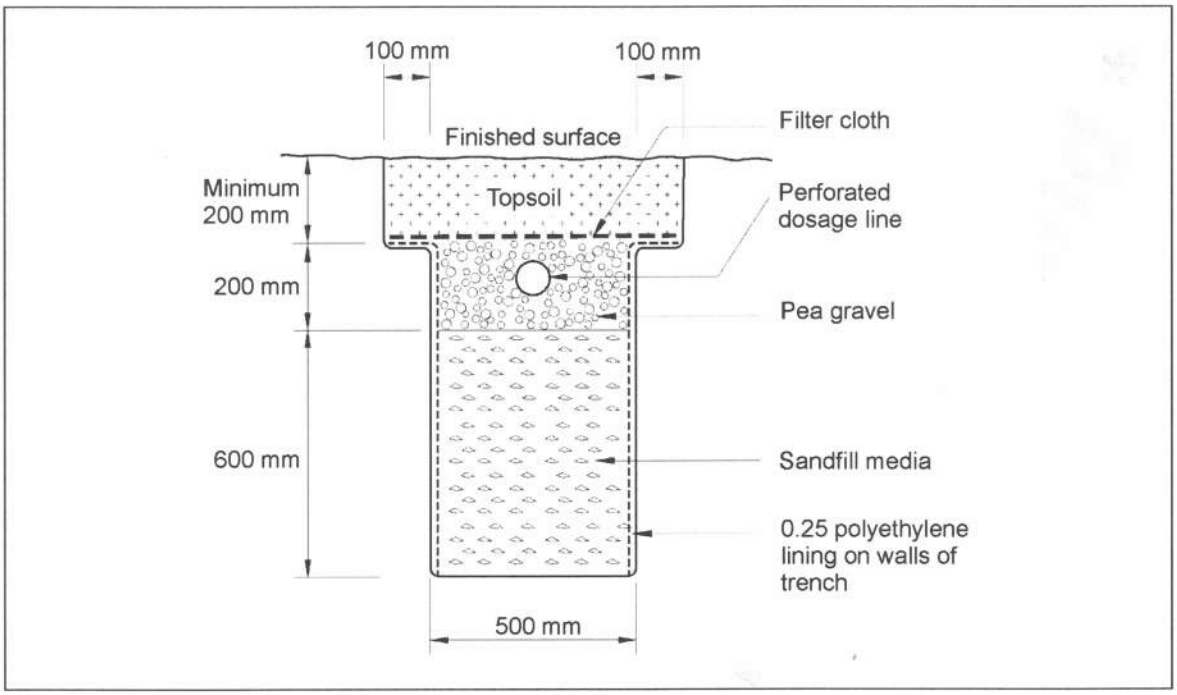


(a) Rock soak pit



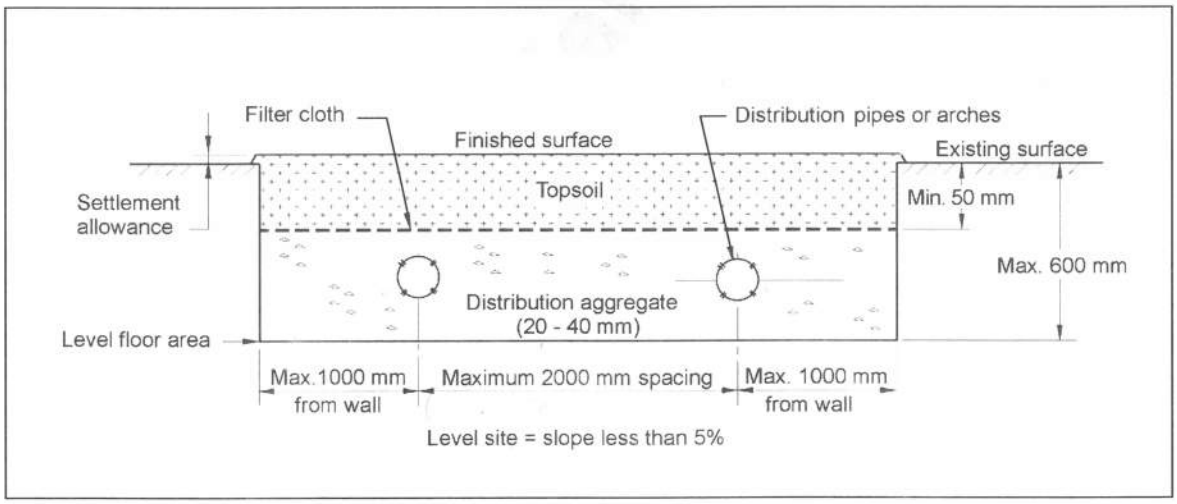
(b) Chamber soak pit

APPENDIX F – Wastewater Schematic



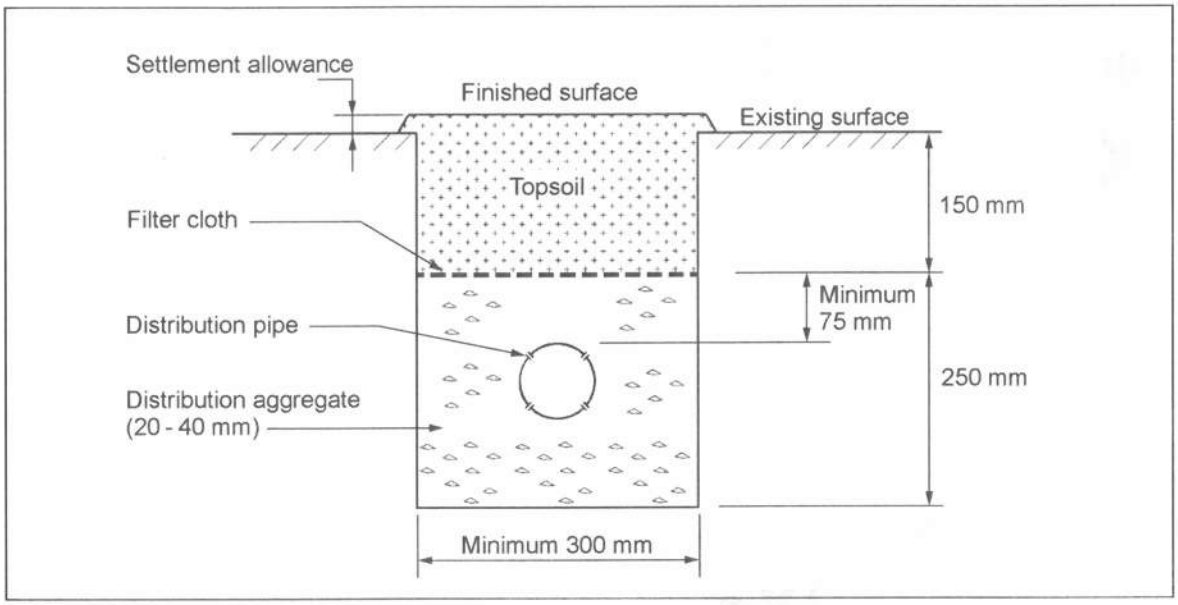
NOTE: An LPED line can be used for dose loading instead of the perforated line.

FIGURE L4 DISCHARGE CONTROL TRENCH



NOTE: LPED lines can be used instead of distribution pipes when dose loading effluent into beds.

FIGURE L5 CONVENTIONAL BED



NOTE: LPED lines can be used to replace distribution pipes when dose loading effluent into trenches.

FIGURE L1 CONVENTIONAL PIPED TRENCH

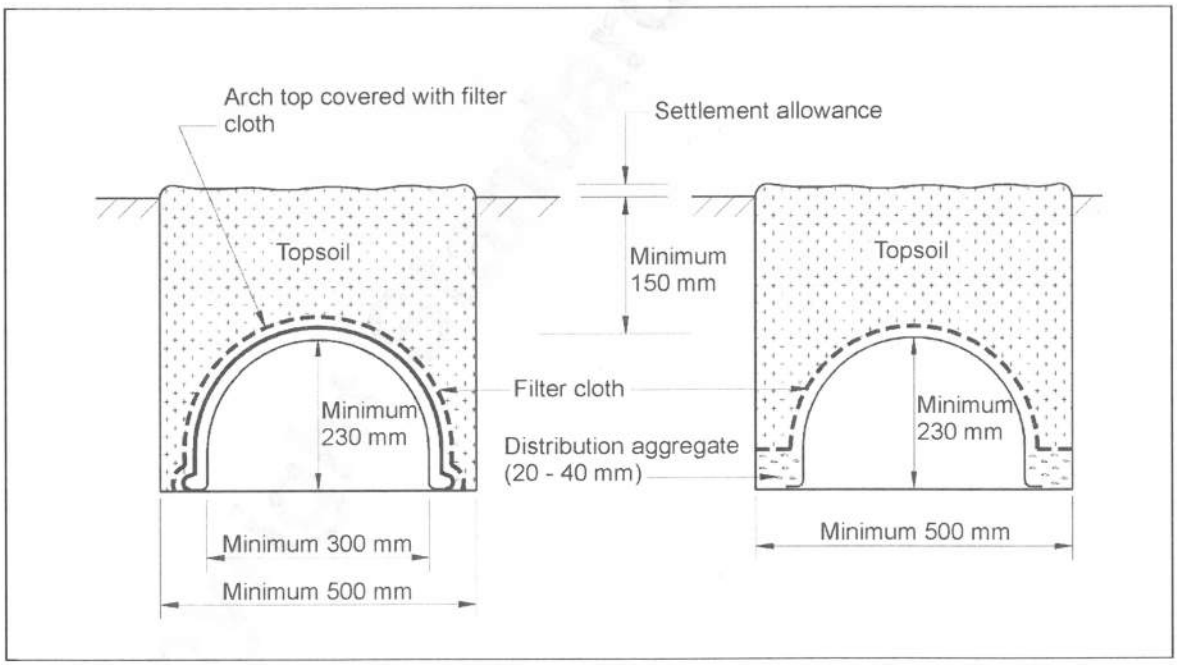


FIGURE L2 SELF-SUPPORTING ARCH TRENCH